White Paper

Distributed Energy Resource Management in the Modern Grid

Sponsored by: ABB

John Villali
November 2017

SITUATION OVERVIEW

In both regional and global markets, distributed and renewable energy sources are being connected to the grid at a rapid pace. The intermittent nature of these resources can create grid operational challenges related to system reliability, power quality, and power availability. Distributed energy resources (DERs) and renewable resources continue to make up the fastest-growing segment of power generation in many markets. In IDC FutureScape: Worldwide Utilities 2018 Predictions (IDC #EMEA41791517, October 2017), IDC predicts that “through 2020, solar – the fastest-growing form of distributed power globally – will drive up distributed energy management system implementations and expansions of existing advanced distribution management systems by as much as 50%.” In these situations, the task of synchronizing the bulk transmission system with the local distribution network, while ensuring the optimal use of power resources to meet supply and demand, is becoming more and more complex.

To address some of the core challenges posed by the high penetration of DERs on power grids, utilities are evaluating investments in distributed energy resource management systems (DERMSs). DERMSs are composed of hardware and software applications that enable utilities to reliably and safely operate the distribution system in the presence of high DER penetration. A DERMS analyzes historical and real-time data that can help integrate, manage, and control flexible and intermittent DERs and electric demand. The analysis and actionable intelligence derived from such systems are then applied in efforts to keep the transmission and distribution system in sync with an efficient and reliable supply and demand balance. In turn, this demand balance should ideally optimize power flows, electric demand, DERs, and traditional centralized generation.

DERMSs are a critical factor in both distribution and renewable resource management. Renewable resource management being a top investment priority for many utilities indicates that the industry is focused on integrating the management of renewables, which is key to the development and operation of an efficient grid, as well as improving customer service. While utilities adapt to the abundance of new intermittent supply being introduced to the grid (e.g., wind and solar power), new technology and processes will be needed to support the power system. In addition to ensuring reliability and efficiency, utilities will invest in DERMSs to create a new distribution system model that will provide electric consumers with more choices. In IDC FutureScape: Worldwide Utilities 2017 Predictions (IDC #EMEA40123816, November 2016), IDC predicted that “by 2019, utilities will need to learn how to integrate externally originated asset, market, and grid data and 30% will invest in distributed energy resource management systems. This emphasizes the sentiment that a DERMS, especially as an
integral component of an advanced distribution management system (ADMS), will be the investment focus for most utilities in the next few years.

**DERMS and Digital Transformation**

To accommodate future change, utilities must operate the grid in a significantly more agile manner. Agility is necessary to adapt to renewables and other DER sources. Adopting new digital technologies, analytics, and predictive systems, like DERMSs, in sync with existing distribution management systems will allow utilities to predict and proactively manage the impact of DERs on the overall grid, including intermittent DERs like solar and wind. Another aspect of digital transformation is to use a DERMS as a nonwire alternative solution to more quickly integrate DERs into the grid operation. This includes better and more efficient onboarding of DERs as well as leveraging DERs such as solar, wind, and microgrids as dynamic generation sources to maintain power quality and provide grid services to customers on the distribution network.

Many digital enhancements to a utilities power system are DER related and are the foundational capabilities for a transformed grid. It’s important to note that a significant component of successful digital transformation is having an ADMS that can integrate with a DERMS that includes a packaged set of capabilities to support DER needs. Figure 1 illustrates how a DERMS can effectively be an extension of an existing ADMS.

**FIGURE 1**

---

**DERMS as an Extension of ADMS**

---

Source: IDC, 2017
Digital transformation for distributed energy is illustrated in four use cases: distributed energy management, virtual power plants (VPPs), microgrids, and distribution-level trade automation (see Table 1).

TABLE 1

<table>
<thead>
<tr>
<th>Use Case</th>
<th>Current Situation</th>
<th>Goals and Objectives</th>
<th>Technology Deployed</th>
<th>Use Case Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributed energy management</td>
<td>DERs like solar and wind are intermittent sources, and the grid has to account for their performance in real time. It creates a situation where environmental issues can significantly impact the power available to the grid.</td>
<td>Have a system that can forecast, plan, and manage the DERs as a component of the overall grid; it would also accelerate the integration of DERs onto the grid as they are developed.</td>
<td>DMS, SCADA, smart inverters, grid analytics, cognitive, and cloud</td>
<td>Use DERMS to integrate DERs onto the grid as a reliable and quality energy source.</td>
</tr>
<tr>
<td>Virtual power plants (VPP)</td>
<td>Distributed energy sources are acted on as individual sources on the grid for planning, forecasting, and operation.</td>
<td>All DERs, including demand response, are consolidated as a single source through detailed real-time analysis of capability. The performance is based on real-time data such as weather and grid performance. The VPP is then used on the grid or presented as a single marketable source in a potential wholesale market.</td>
<td>DMS, DERMS, SCADA, grid analytics, and cloud</td>
<td>Consolidate DERs into a single virtual power plant for operations.</td>
</tr>
<tr>
<td>Microgrids</td>
<td>All generation assets at customer sites are either on the grid or off the grid. There is little availability to have campus-type generation automatically access or isolate from/to the grid.</td>
<td>Have microgrids that can be self-sustaining for power generation and distribution within a small area. These microgrids can be isolated from the grid or used to support the grid as a distributed energy resource.</td>
<td>Smart grid components, controllers, SCADA, grid analytics, and cloud</td>
<td>Manage microgrids as a local energy service and as a reliable resource to help operate the grid.</td>
</tr>
<tr>
<td>Distribution-level trade automation</td>
<td>Some automation exists for regulatory compliance and financial processing but is not tightly integrated.</td>
<td>Realize a reduction in declaration penalties, improved time through markets, accurate/timely settlement, lower transaction costs, and more efficient dispute resolution.</td>
<td>Blockchain, industry cloud, mobile, and IoT</td>
<td>Integrate distributed ledger–based settlement for energy commodities as industry cloud capabilities evolve to enable distribution-level energy trading “communities.”</td>
</tr>
</tbody>
</table>

Source: IDC Energy Insights, 2017
While utilities adapt to the new intermittent supply introduced to the grid via wind, solar power, and microgrids, new technologies and processes will be needed to ensure reliability and efficiency of the power system. In addition to ensuring reliability and efficiency, utilities are investing in DERMSs to create a new model of the distribution system. This new model aims to provide electric consumers with more choices regarding how they consume and produce energy. Many utilities are responding to the continued adoption of rooftop solar, the ability to sell power back to the grid (net metering), and electric consumers’ increased voluntary involvement in demand response (DR) programs by prioritizing new technology investments and upgrades for the distribution system. Solar is expected to continue its momentum as the fastest-growing form of power being connected to the grid for the near term. For long-term success, solar plus energy storage for behind-the-meter applications is expected to see lower capital costs over time while additionally making continuous efforts to improve the technology and life cycle of battery backup generation.

**DERMS Pilot Programs: Opportunities, Solutions, and Benefits**

The high penetration of DERs and renewables added to the grid requires utilities to invest in a DERMS. In turn, DERMSs can provide the tools needed to ensure system reliability and provide better visibility of DERs so that supply meets demand at any given time. DERMSs can optimize assets from both the centralized power system and power resources at the distribution level; this can help utilities provide the best service and quality of power to their electric consumers.

Some recent pilot programs that highlight the benefits of DERMSs are discussed in the sections that follow.

**DERMS Pilot #1**

**Opportunity:** A European utility experiencing an increase in the adoption of electric vehicles (EVs) wanted to establish a pilot program that would facilitate a balance between the demand for EV charging and the availability of surplus wind energy.

**Solution:** A real-time monitoring and management system was deployed to balance the charging of EVs with the availability of wind energy reserves. In addition, the solution enabled the utility to draw power back from the EVs onto the grid to stabilize energy availability. This solution also provides advanced modeling of supply, demand, and grid flows by collecting data and providing real-time analytics.

**Benefit:** The ability to monitor grid performance and energy availability in real time allows for the diversion to alternate energy resources automatically, which optimizes grid flow and performance. With this solution, the utility increased the number of EV charging stations without disrupting the energy use patterns of its customers.

**DERMS Pilot #2**

**Opportunity:** To create a cost-effective VPP, a large U.S. investor-owned utility (IOU) sought to aggregate power from hundreds of homes with solar power and battery storage. This VPP would provide home owners with a backup power system in the event of an outage and provide the utility with improved grid resiliency, reliability, and sustainability.

**Solution:** The establishment of a VPP that aggregates solar and storage systems creates a local generation source that can supply power during peak demand times. Supervisory control and data acquisition (SCADA) integration provides remote monitoring and control of the VPP. This solution allows the utility to forecast and optimize grid performance and reduce the need to rely on traditional fossil fuel power to meet peak demand.
**Benefits:** The VPP provides the ability to dispatch power that the utility can control and rely on in real time. This allows customers to save on their electric bills while providing the utility a means to ensure the delivery of renewable and reliable power to customers during peak electric demand periods.

**DERMS Pilot #3**

**Opportunity:** A large North American utility needed better ways to manage and control assets on its distribution system. With a high penetration of DERs, the utility had to adjust to quick and, in many cases, large shifts in demand and DER output.

**Solution:** The utility implemented real-time voltage management on its distribution system. This solution optimized volt/var control, which provided effective load flow analysis. Efforts to improve grid operations and fault location isolation and service restoration (FLISR) were also optimized.

**Benefit:** The solution provides real-time control of system voltage devices, including load tap changing transformers, line voltage regulators, and capacitor banks, thereby allowing the grid to adapt to changes in electric load and DER output. This voltage management provided a more efficient grid operation, which results in savings and improved power quality for customers.

**DERMS Pilot #4**

**Opportunity:** A U.S. utility with a high concentration of DERs sought to defer capital cost on its transmission and distribution system by implementing a demand response program. This DR program should ensure that power supply resources meet demand at peak times while incentivizing customers to participate in the program through cost savings.

**Solution:** The automated DR program curtails energy use and mitigates price spikes during peak events seamlessly. The program allows customers to predetermine customized load shedding strategies during peak periods and directly connects the utility with a customer's home or facility — automating the decrease of load.

**Benefits:** The intermittence of DERs can inhibit the utility's ability to balance load and stabilize the grid. The DR program offers the utility's grid operator demand-side resources in real time. This allows the utility to respond to immediate peaks and valleys in load caused by renewable resources. The automated DR program also provides cost savings to the utility's electric end users with minimal disruptions. The program gives the utility and its electric customers visibility into real-time energy use profiles, which enables the utility to shed load and reduce costs. In turn, customers realize energy savings.

**ABB DERM Solution**

ABB Enterprise Software’s Distributed Energy Resource Management (DERM) Solution is designed to equip distribution companies, generators, and aggregators with the tools needed to manage the grid in the presence of high DER penetration while maximizing the value of energy portfolios for market participants. The ABB DERM offering can help these entities overcome the challenges that come along with integrating large amounts of DERs onto the grid.

The ABB DERM Solution is geared toward segments in the power sector, as discussed in the sections that follow.
**Distribution Network Operators**

ABB's DERM Solution for distribution network operators (DNOs) enables operation of the network in the presence of high DER penetration to ensure grid stability and performance. It provides DNOs with real-time visibility into and control of DERs on the network, helping them maintain system reliability and power quality. The ABB DERM Solution is an extension of ABB's ADMS offering leveraging ABB's extensive advanced network applications and deep domain experience in distribution operations to manage DERs along with traditional network assets such as capacitor banks, voltage regulators, and tap changers.

**Market Participants**

The ABB DERM offering for energy market participants helps energy companies such as aggregators, generation companies, and retailers maximize the economic value of their DER asset portfolios. The solution leverages ABB's expertise in energy optimization and market operations to help these energy marketers maximize direct revenue generated from their DER assets or indirect revenue from growing their customer base. Market participants can aggregate DERs into virtual power plants by controlling, optimizing, and dispatching localized distributed power to meet economic objectives. Furthermore, the solution provides revenue incentives for market participants, enabling them to aggregate their DER portfolios to participate in wholesale energy and ancillary services markets through a host of market bidding, settlements, and communication tools.

**Benefits of ABB DERM Solution**

ABB's DERM Solution can offer immediate and long-term benefits in the four core areas discussed in the sections that follow.

**Dispatch and Control**

DNOs can manage the utility's distribution network efficiently, including volt/var control and quality management, grid balancing, and optimization. In addition, dispatch and control is a critical component of the offering that enables utilities and market participants to directly control utility-owned DERs or indirectly control nonutility-owned grid-edge assets, including solar, energy storage, and smart inverters. ABB DERM Solution for DNOs aims to provide various dispatch and control capabilities, including:

- Direct control
- Indirect control
- Volt/var optimization

**Hosting and Registration**

ABB DERM Solution also includes hosting and registration capabilities – essential when monitoring the availability, production, and condition of installed DERs. In addition to providing visibility into the metered DERs and connections to the network, this core component helps DNOs drive network hosting capacity for DERs and manage grid constraint conditions. Use cases within hosting and registration include:

- DER registration
- Active power management
- DER scheduling and tracking
- Dynamic DER aggregation
**DER Optimization**

ABB’s DERM Solution also provides the core function of DER and grid optimization. This component enables a grid-level growth incentive design as well as grid optimization and resources-level profitability optimization. Optimization of DERs maintains network stability in real time as well as in the midterm and long term, which produces scheduling functions based on DER generation, demand (load) forecasts, and market prices.

**Market Settlements and Transactions**

ABB’s DERM Solution also provides a means for measurement and verification as energy marketers participate in wholesale energy and ancillary services markets. This includes responding to price signals and dispatching DERs based on market conditions.

ABB’s DERMS offering has both distinct and shared modules for DNOs and energy market participants. DNOs can benefit from an integrated DERMS and ADMS solution with a single network model and geospatial control center for grid operators, real-time DER monitoring, optimization, active power management, and volt/var optimization for grid reliability. Market participants can rely on ABB’s economic DER optimization, control, and market settlement functions to increase profitability.

Both DNOs and market participants benefit from the following ABB DERM Solution capabilities and use cases:

- DER generation and demand forecasting
- DER registration and hosting
- DER monitoring
- DER direct control
- Market settlements

ABB has invested in Enbala Power Networks to strengthen its DERM Solution offering. The product is positioned to enable DNOs to manage the entire life cycle of their DERs while ensuring reliability and efficiency of the distribution network. With the Enbala partnership, the ABB DERM Solution combines the expertise of ABB in network control and distribution network operations with Enbala’s core strength of real-time load control, active power management of DERs, and volt/var optimization.

**Implementation Challenges**

When utilities are considering implementing a DERMS, common challenges are the pace and organizational commitment regarding the needed integration of information technology (IT) and operational technology (OT). As utilities are digitally transforming themselves, IT/OT convergence is a necessary but often slow and cumbersome transition.

A DERMS heavily relies on effective IT/OT integration within a utility for the efficient and optimal management of both the centralized power systems and the distributed power systems of the utility’s service territory. A modernized network that can communicate with grid-edge devices is essential in a quality DERMS. The ability to monitor, control, and dispatch distributed resources in a manner that ensures reliability and availability of resources to meet power demand is a critical obligation. This is also a challenge for all utilities in areas where there is high penetration of DERs and renewables.
Recommendations

Perform due diligence. To fully understand the capabilities of, and expenditures involved in implementing, a DERMS, utilities should examine the following core areas of an end-to-end DERMS: planning, forecasting, demand management, grid management, and energy markets.

Be fully aware of the regulatory environment and the pace of a DERMS implementation. There are many regional differences in the penetration of DERs and the regulations surrounding DERs that can impact investment decisions for both the electric consumer and the utility.

Evaluate current technologies, capabilities, and processes that are in place within your existing distribution management system or advanced distribution management system that can be compatible with a DERMS to reduce integration costs and redundancy.

Consider the entire vendor ecosystem when investing in a DERMS. The vendors offering DERMS solutions have a wide range of capabilities. Implementation can be done by a single vendor offering an end-to-end solution or by integrating several platforms from both technology vendors and systems integration firms. A strong understanding of the costs and capabilities of offerings in the DERMS space can save on time and expenses.

Conclusion

The main capability of DERMSs is to increase and improve network reliability and availability while offering revenue incentives to energy market players. DERMSs will help the owners and operators of DERs increase profitability by optimizing their renewable asset portfolio — thereby maximizing output and revenue on those assets. In a competitive market, DERMSs can provide innovative service offerings, increase differentiation to gain and retain customers, and help end users meet their sustainability goals. DERMSs can help meet regulatory compliance requirements around DERs and renewables in a regulated environment, helping utilities provide system reliability along with quality service and power in the process. As DERMSs mature with the continued growth of clean reliable DERs and renewables, the market will need to adjust to new and more efficient approaches to distribution system management. Utilities must adapt to customer-centric generation becoming a significant part of grid operations.

While the DERMS is emerging in the power market, utilities will need to make investments to manage the distribution system of the future. A DERMS provides a digital, nonwire alternative to large capital network investments. In many regions, this new challenging environment is already present. Utilities are playing catch-up to manage DERs and onboard them quickly. The increase in DER resources coming online will not slow down in the near term. A DERMS that is tightly aligned with an ADMS is a must for utilities to operate an effective grid and satisfy consumers as well as regulators.
About IDC

International Data Corporation (IDC) is the premier global provider of market intelligence, advisory services, and events for the information technology, telecommunications and consumer technology markets. IDC helps IT professionals, business executives, and the investment community make fact-based decisions on technology purchases and business strategy. More than 1,100 IDC analysts provide global, regional, and local expertise on technology and industry opportunities and trends in over 110 countries worldwide. For 50 years, IDC has provided strategic insights to help our clients achieve their key business objectives. IDC is a subsidiary of IDG, the world's leading technology media, research, and events company.

Global Headquarters

5 Speen Street
Framingham, MA 01701
USA
508.872.8200
Twitter: @IDC
idc-community.com
www.idc.com

Copyright Notice

External Publication of IDC Information and Data – Any IDC information that is to be used in advertising, press releases, or promotional materials requires prior written approval from the appropriate IDC Vice President or Country Manager. A draft of the proposed document should accompany any such request. IDC reserves the right to deny approval of external usage for any reason.

Copyright 2017 IDC. Reproduction without written permission is completely forbidden.