smarter grid solutions

WHITEPAPER

DISTRIBUTED ENERGY RESOURCE MANAGEMENT SYSTEMS

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EXECUTIVE SUMMARY

The addition of Distributed Energy Resources (DER) at scale to existing distribution networks requires a significant shift in the way the power system is planned and operated. Distribution networks have traditionally played a largely passive role in the delivery of power to customers, with limited DER (including solar, wind, electric vehicles and batteries) penetration and limited data on the real-time operation of the system. The accelerating adoption of DER connected at the edge of the grid necessitates a move from this largely passive distribution grid toward a more active grid – with DER management and control – and is the underpinning of the transition of Distribution Utilities to Distribution System Operators (DSO). This decentralization of energy impacts directly on the entire supply chain, it takes a largely passive and predictable distribution system and makes it much more dynamic, through the addition of intermittent renewables, electric vehicles and other DER that create two-way power flows, can breach operational constraints on the grid and require a high degree of visibility and flexibility in grid operations.

The new DER coming on to the system need to be controlled and coordinated, while the distribution system they are connecting to needs to be observable and managed. Distributed Energy Resource Management Systems (DERMS) are emerging as the core solution to this complex set of interactions. Many distribution utilities are making the move toward Advanced Distribution Management Systems (ADMS); DERMS is a complementary solution to add to the toolkit for the modern DSO, addressing use cases not related to typical ADMS core capabilities.

DERMS are required to bridge the planning and operating timescales of the DSO, managing bidirectional power flows, voltage control and helping realize the value that DER brings to the system and the market. DERMS also has a role to play in helping DSOs handle and interact with the myriad options emerging in the market related to customer technologies and cloud infrastructure.

Turning these challenges into opportunities requires a new way of thinking about managing and planning the distribution grid. Adopting these new ways of thinking and new technologies will help reduce the cost of DER deployment at scale, supporting clean energy and de-carbonization objectives. In this white paper, Smarter Grid Solutions outlines some of the core capabilities and functions of DERMS.

SECTION 1

INTRODUCTION

INTRODUCTION

Electric power systems across the world are becoming increasingly decentralized. No group of technologies has proven to be as disruptive to the electric power sector as Distributed Energy Resources ("DERs", including solar, wind, batteries and electric vehicles). The growth of this new asset class has been driven by numerous factors including declining technology costs, evolving customer preferences, and clean energy policies. DERs impact multiple functional groups within the utility including customer service, planning, and operations. Left unmanaged, integrating these resources with the grid safely, reliably, and cost effectively, can be challenging - particularly as penetration levels increase. However, whereas initially the proliferation of DERs was perceived by some utilities as an existential threat, utilities are now beginning to recognize that customer and shareholder value can be created from integrating and coordinating these resources as part of a Distribution System Operator ("DSO") model which more closely aligns distribution planning, operations, and the market. Achieving this critical alignment requires both new approaches and technologies that can manage the complexities of DER adoption and operation.

In markets where DER deployments are gathering pace, there is a general acceptance of the need to bring power system planning and operations closer together to address the challenges of massive DER deployment. This is especially true in situations where numerous small-scale DER may be coming onto the system on a daily or weekly basis, where the individual impact is low but the collective impact is large. Distribution Utilities are under pressure to provide cheaper and more cost effective DER connections; this can only be delivered by making improvements to the processes, tools and methods used. This implies new technology, but also a new set of capabilities for distribution utilities. In the following sections, we highlight example developments in North America, the United Kingdom and Germany that cover the issues facing all countries and markets in the distributed energy transition. As DER deployments continue to grow, the impact on market operations will be significant and a more tightly coupled set of interactions around Integrated System Planning, Grid Operations and Market Operations will be required for the distribution system.

Figure 1. DERMS Interactions across planning, operations and the market

SECTION 2

MARKET CONTEXT FOR DERMS

To illustrate and demonstrate the market context for DERMS, we will explore three markets in which we have first-hand experience: the USA, United Kingdom and Germany. Each of these markets are tackling DER growth in different ways but align on the same path to DERMS.

UNITED STATES OF AMERICA

In the USA, several states have committed to legislation that will lead to a carbon-free electricity system. California, New York, Hawaii, and Washington D.C. have made this commitment as of the beginning of 2019, with other states expected to follow these first movers. These are significant developments as despite the growth in renewables in the USA, solar and wind still account for less than 9% of the energy supplied. The commitment to renewables is augmented by additional commitments to energy storage, with various states mandating activities and MW goals for battery storage implementation that are expected to make 2019 the first year in which the North American industry delivers more than 1 GWh of storage capacity. Many of these DER are connecting to the distribution grid and will need to be managed and orchestrated accordingly.

The United States Government Department of Energy's Office of Electricity Delivery and Energy Reliability (DOE-OE), in close collaboration with California, New York, District of Columbia, Hawaii, and Minnesota utility regulatory commissions formed a collaborative working group with industry participants, led by Pacific Northwest National Laboratory (PNNL) called the Modern Distribution Grid Project[1]. A key contribution of this work is the definition of a scope for the modern distribution grid that will accommodate and enable DER growth, which covers technical functions and capabilities, across three main areas: distribution system planning, distribution system operations, and distribution market operations. As can be seen in Figure 2, this represents a broad set of new capabilities for the industry not previously required.

An example of how a leading state is addressing this energy system transition to renewables and distributed energy is the Reforming the Energy Vision (REV) proceeding in New York State[2]. The New York REV proceeding requires the establishment of the Distribution System Platform (DSP) that will support DER markets that recognize and reward the value of DER based on time and location. Each of the distribution utilities in New York are required to detail their activities with respect to a five year implementation plan for the DSP (known as the DSIP – Distribution System Implementation Plan). One example of this is Con Edison's plan for its service territory in and around New York City[3]. The DSP is synonymous with DERMS, recognizing that a platform is required to on-board, monitor, group, control, and analyze DER.

These developments can be difficult to follow, they are complex and fast-moving. They also require significant time spent on working groups, engagement groups and in analysis of the details and implications on policy decisions. It is clear that no matter the detail, there are sets of new requirements that will become increasingly material to how distribution utilities do business in North America. A good reference of the views of multiple investor owned utilities on these requirements is the standardized requirements for DERMS issued by the Smart Electric Power Alliance[4].

Figure 2. DSP-x overview of new and existing DSO capabilities

Capabilities	Objectives: Reliability, Safety and Operational Efficiency	Objectives: DER Intergration	Objectives: DER Utilization
Market Operations	New	New	New
Grid Operations	Existing	New	New
Planning	Existing	New	New

UNITED KINGDOM

The requirement for DERMS in the UK has been largely driven by the incentive mechanisms established by the regulator, Ofgem, in the last decade. The most significant changes were the introduction of Total Expenditure (TOTEX), which involves valuing Operating Expenditure (OPEX) network solutions in a way that equalizes them with Capital Expenditure (CAPEX) options, and innovation funding[5]. While the former enables non-wires alternatives to load or generation growth, the latter was specifically targeted at addressing the energy trilemma – how to decarbonize the energy system at a reasonable cost without compromising energy security.

The market for DER over this period has been dominated by the growth in onshore renewables, displacing bulk energy from fossil fuel generation such as coal. Between 2009 and 2017 the installed capacity of onshore wind grew from 3.5 GW to 12.8 GW, offshore wind grew from 1.0 GW to 7.0 GW, and photovoltaics grew from 0 GW to 12.8 GW[6]. The rapid growth in demand for renewable connections created immense pressure for timely and cost effective connections to the grid. Combined with the clear regulatory steer to innovate, distribution utilities piloted and have since adopted into everyday operations the concept of flexible connections. With flexible connections customers can have a small portion of their maximum import/export capacity limited at times when the grid is congested. Minimizing curtailment volumes is therefore critical for customer service and real-time control and Active Network Management (ANM) became the initial use case for DERMS. A good practice guide was published by the Electricity Networks Association to establish a standard approach to requirements across the distribution utilities[7].

As a consequence of the increasing moves by distribution utilities to manage DER, and the effect of the increasing proportions of renewables on the Electricity System Operator's (ESO) ability to securely operate the system[8], the UK industry has embraced a requirement for greater flexibility and coordination across industry participants. This whole systems approach is being defined and implemented by cross-industry working groups through the Open Networks project[9].

The Open Networks project is coordinating the development of frameworks, codes and standards designed to allow DER to access networks and to access markets. Adding to the DERMS requirement for flexible connections is the introduction of flexibility services; highly localized demand response services for load relief, and planned or unplanned outages. The requirements of DERMS now encompasses the planning, contracting, forecasting, implementation and settlement of these services as well as dispatch, real-time and fail safe control. There is a wider expectation that Open Networks will ultimately facilitate complete customer choice for DER, including peer to peer and access arrangement trading.

Smarter Grid Solutions testing its Active Network Management system at the National Renewable Energy Laboratory in Boulder, CO in 2016 (Image ©NREL, Photographer Dennis Schroder)

Wind Turbines connected to the Orkney Active Network Management system in 2008. (Image ©Smarter Grid Solutions)

Smarter Grid Solutions Production Engineering Director, Euan Davidson, talks to customers in its new R&D laboratory in 2018. (Image ©Smarter Grid Solutions, Photographer Chris Watt)

GERMANY

The Federal Government of Germany has been aggressively pursuing policies which aim to decarbonize vast portions of the German economy. This, coupled with a policy to retire the country's nuclear fleet early, has led to what Germans term the Energiewende - the energy transition - from coal and gas to renewable sources. Federal policy is to meet 80% of electrical demand from renewables by 2050. As of 2016 around 30% of demand was met by renewables. If Germany is to reach federal targets, it has a lot more to connect, around 2.5 times the current renewable installation. The grid development plans assume that the vast majority if this, over 90%, will connect to the distribution system. Current grid investment plans sit at around 50B Euro to get to 2030. Most of this is at transmission with specific projects identified; however, this also includes assumptions about smart technologies and practices at distribution.

German distribution utilities have been actively managing the network since 2009 but in a different way to the way described previously for the UK market. They have a system called EisMan – infeed management – whereby renewable generators are curtailed by the Transmission Operator (TO) or Distribution System Operator (DSO). Renewable generators are then compensated for lost revenue. The law allows for generators to be compensated up to 3% per year before the regulator forces the DSO or TO to reinforce the grid. This has been shown to significantly reduce the amount of grid capacity required to facilitate DER growth by around 40% and provide a significant reduction in the total cost to society[10] .

One of the interesting developments in Germany is the move from "static" curtailment limits on DER applied ahead of time to a more "dynamic" allocation of curtailment in response to real-time grid conditions. There is a subtle distinction between these two approaches, but this becomes significant when preventive control measures include limiting DER access based on pre-fault loading limits. Adopting Active Network Management (ANM) significantly reduces the curtailment of DER due to constraints on the existing distribution system by only curtailing when limits are actually breached (in both pre-fault and post-fault conditions). This is one of the ley learnings from the DERMS activity in Germany: the preventive approach to curtailment (using forecasting, state estimation and security constrained optimal power flow) requires the operator to build in a reserve margin for safety and to address errors, which then makes the curtailment too punitive for the DER developer and more expensive for society at large by requiring more distribution system capacity through expensive grid upgrades.

Since 2009 anything at grid scale that has been connected to the German Grid is controlled by EisMan. Since 2012 that's been all new connections down to 100kW in size. The deployment requires a device at the grid edge to allow the DER to participate in the compensated curtailment regime. As a result, much of the infrastructure is already in place to allow the application of dynamic curtailment to the installed and growing fleet of DER.

In terms of reduction in curtailment costs, dynamic curtailment through ANM almost doubles capacity compared to export limiting, potentially halving curtailment costs and allowing more DER to connect whilst deferring or avoiding reinforcement. EWE Netz and RWTH Aachen estimate that dynamic curtailment can almost double capacity at 70% of rural/semi-rural feeders. Dynamic curtailment is only one of a suite of measures German DSOs are looking at to increase the participation of DER. Those measures are bundled into what has been called the traffic light concept (Green: no grid constraints and the market runs without DSO intervention; Amber: grid constraints forecast and flexible services traded/procured ahead of need e.g. demand response; Red: action to be taken, e.g. dynamic curtailment). This requires DERMS that can meet DSOs needs across these 3 operating states.

> Limited curtailment may be more cost effective than upgrading grid infrastructure. Curtailment of distributed generation (or "DG shedding") has the potential to considerably increase the connection capacity and therefore accelerate the deployment of wind and solar power. According to a study from the German distribution company, EWE Netz, the dynamic curtailment of 5% of the energy generated from solar PV increases the grid connection capacity by around 225% without new grid investment (EWE Netz, 2015). While this might sound surprising for project developers, curtailment can lower the overall cost and accelerate the deployment of wind and solar PV.
>
> *Source: IEA, 2016. Re-powering Markets: Market design and regulation during the transition to low-carbon power systems*

DERMS IN 2019 AND BEYOND

For many in the sector, it is not clear how and when to make DERMS investments and in some cases, what functionality to prioritize. It can also be difficult to identify what kind of investments to make at each stage, for example, should it be a large enterprise-wide deployment or a gradual and incremental adoption of new technologies and new ways of working?

This confluence of technology adoption, process development and new ways of working gets to the point of the PNNL-led work on the Modern Distribution Grid Project: the development of technologies and the capabilities of distribution utilities must go hand in hand. Distribution utilities are in the process of transitioning from managing a relatively fixed number of variables focused almost solely on reliability, toward the management and on-boarding of large-scale DER that will impact on all aspects of their business.

At low DER penetration levels, the grid has an inherent ability to interconnect distributed energy resources based on robust design criteria and existing planning standards. However, interconnection policies and tariff reform, particularly for smaller scale assets, has typically lagged behind advancements in technologies and the related cost reductions. For the most part, simple tariffs and incentive programs were used to facilitate early growth of the distributed renewable industry in the US resulting in rapid interconnection of several hundred MWs of electricity being allowed to export onto the grid, regardless of whether the location of that injection was valuable from a system perspective. This lack of locational value is often compounded by the fact the utilities lack visibility and control of these resources. This leads to a utility management quandary: should the DSO build the DERMS to manage these DER? If so, what should this DERMS do and how should it fit with ADMS and other enterprise systems? Our view is that the distribution utility must build these systems and own the underpinning data architecture.

Smarter Grid Solutions believes that the time is now to begin the DERMS implementation. This is not only driven by the need to manage DER during normal and contingency operations, but also by an important principle: the DSO is not the same as the TSO (Transmission System Operator) and the challenges at the distribution level are different to the wholesale and transmission level.

In the following sections, we identify some of the DERMS capabilities and functions that are desirable, before making a set of recommendations for the ideal characteristics of DERMS.

Resist the Urge to think DSO is TSO

The wholesale market and the TSO make use of a well-established and evolved set of principles and practices. There is an understandable temptation to take this approach and map it to the DSO model and the services markets that will be required on distribution grids. The problem with this is that distribution systems are different from transmission systems in ways that matter and the significance of this should not be ignored.

Transmission networks are observable; that is, there are enough measurements available to make the system observable from a mathematical perspective. The communications systems available to the TSO are usually extensive and high-performing. Models of the transmission system are well developed, accurate and do not change often. There is a high degree of system inertia, stability and redundancy at the bulk power transmission level together with accurate system loading forecasts. The TSO can operate the market around a common set of principles and price signals that enable pre-fault and post-fault limits to drive system access. Distribution networks are starting from a very different place. They are often significantly larger in size (in terms of "nodes and wires"), change often, are unbalanced and largely unobservable with very limited monitoring and communications systems. In addition, many issues at distribution voltage levels are local to a particular feeder, substation, or area and there is a limited set of local options and solutions available. In addition, DER tends to develop in clusters, meaning there are specific localized technology and power systems issues to address.

SECTION 3

DERMS CAPABILITIES AND FUNCTIONS

In this section, Smarter Grid Solutions takes our experience of implementing DERMS in multiple geographic markets to call out the core capabilities and functions required of DERMS. The use cases we identify in this section are those that represent the most common drivers on the deployment of DERMS for distribution utilities that are making the transition to becoming a DSO. The details of each vary across different markets, technologies and customers; however, the core set remains largely valid.

DYNAMIC DER HOSTING CAPACITY

Connecting DER to constrained parts of the distribution grid requires DERMS to apply Active Network Management (ANM) techniques. This involves the coordination and control of DER to autonomously manage thermal and voltage constraints through the control of DER active and reactive power. This can enable increases in hosting capacity of up to 100%, providing cheaper and quicker DER connections than traditional infrastructure upgrades. ANM works by allowing DER to access and use grid capacity normally reserved for use during outages. This differs from a more traditional DER dispatch approach in that ANM involves automated and dynamic pre-fault and post-fault actions on DER (and the distribution system) that results in a much higher penetration of DER and a more economic basis for DER interconnection to constrained parts of the grid.

NON-WIRES ALTERNATIVES

DER can perform a useful role in the deferral of planned infrastructure. This requires DERMS to coordinate all types of DER at specific times and locations in a manner that is similar to demand response. In North America, these are viewed as non-wires alternatives where regulators are requiring and incentivising the utility to examine and deploy alternatives to infrastructure upgrades.

DER OPTIMAL DISPATCH

More DER on the system means more ways that DER can support the efficient operation of the grid and realize the value they can provide the system. DERMS is useful to support traditional optimization techniques, such as optimal power flow and security constrained optimal power flow, but also has the ability to enable faster acting optimization routines that can address local or temporal aspects of operating the system with increased DER, particularly when energy storage is involved.

FLEXIBILITY SERVICES

New service markets are emerging at the distribution level, these represent new opportunities for DER operators to participate in the operation of the distribution grid and be paid for their services. This requires DERMS to interact with market platforms and enable the coordination and control (i.e. the physical) side of the market to be implemented on behalf of the DSO.

MICROGRIDS

Microgrids are still not commonplace on the distribution system, but there is an undeniable trend toward facility, campus, and community microgrids. DERMS must be able to integrate with microgrids and incorporate the control of the microgrid as an entity with the operation of other DER on the same feeder, or under the same substation.

T-D INTERFACE

In addition to flexibility service markets, the proliferation of DER that is visible and controllable will also require DERMS to be able to interface with and provide services to the TSO. This would be implemented in much the same way as other flexibility services, with the exception that the TSO would procure services through the DSO without necessarily specifying the DER units that would be responding, this will be determined and implemented by the DSO using DERMS.

ELECTRIFICATION OF HEAT AND TRANSPORT

The addition of large numbers of electric vehicles and the increasing shift away from gas and oil to electric heating will result in significant changes to load profiles on the distribution system. DERMS will need to support the distribution utility in forecasting and simulating these developments, but also in terms of optimizing and scheduling EVs, hot water tanks, storage heaters, and thermostats to complement other operational use cases, including demand response, load relief and DER hosting capacity optimization.

GETTING TO GRIPS WITH THE DATA

The increasing amount of data from customers and DER will need to be processed and managed. This data will come from utility-owned assets, customer assets and via third party cloud connections. It is the management of this data that presents the greatest challenge to the DSO transition and utilities will need to make investments in the technologies and capabilities required. A variety of technologies, open standards and security measures will need to be put in place.

DER VENDOR CLOUD INTERGRATION

As more customers adopt DER at the domestic level, the DSO will be able to "discover" new devices and new monitoring (e.g. voltage, real power, reactive power, etc.) available through technology vendor clouds. What this means for data, security, and interoperability will need to be carefully considered.

ON-BOARDING DER AT SCALE

The on-boarding of DER at scale requires new capabilities and new technologies to be employed by DERMS. Larger, grid-scale DER, with a utility managed communications and control interface can be self-provisioned through the use of container-based (e.g. Docker) grid edge logic running on a range of industrial computing platforms. This reduces the time and manual activity required to provision DER units and integrate them with DERMS. DERMS will also have to be able to provide DER vendor cloud integration and market platform integration to continuously discover and verify DER locations, capacities and capabilities (as defined by customers) that can be incorporated within system operations.

DER PLANNING

The remit of any DERMS begins at the point in time where a DER developer is considering making an application to connect to the distribution system. This means that the tools and methods used to operate the distribution system (e.g. optimization methods, contingency analysis, real-time ANM control for constraint management, etc.) need to be represented in the studies performed during planning. These studies need to be automated wherever possible to provide DER developers with fast feedback. The exchange of information between offline planning tools and online DERMS will become increasingly important.

DER GROUPING

One of the core functional capabilities of any DERMS platform is the ability to dynamically and effectively group DER for the purposes of management and control. This provides the DSO with the opportunity to aggregate DER, but also to simplify the management and control functions required at scale. Automatic grouping of DER by location, technology, price, or some other factor, will give the operator the chance to quickly incorporate DER into planned and unplanned outage work. This also gives the DSO the opportunity to access services from groups of DER, who will realize greater value from their assets.

In North America, a range of standards and working groups are emerging that explore the lifecycle of DER groups and identify the controls to be applied to DER groups that include smart inverter capabilities. SEP2.0 in California is a leading example of this and other approaches like this are being explored and adopted in other parts of the world.

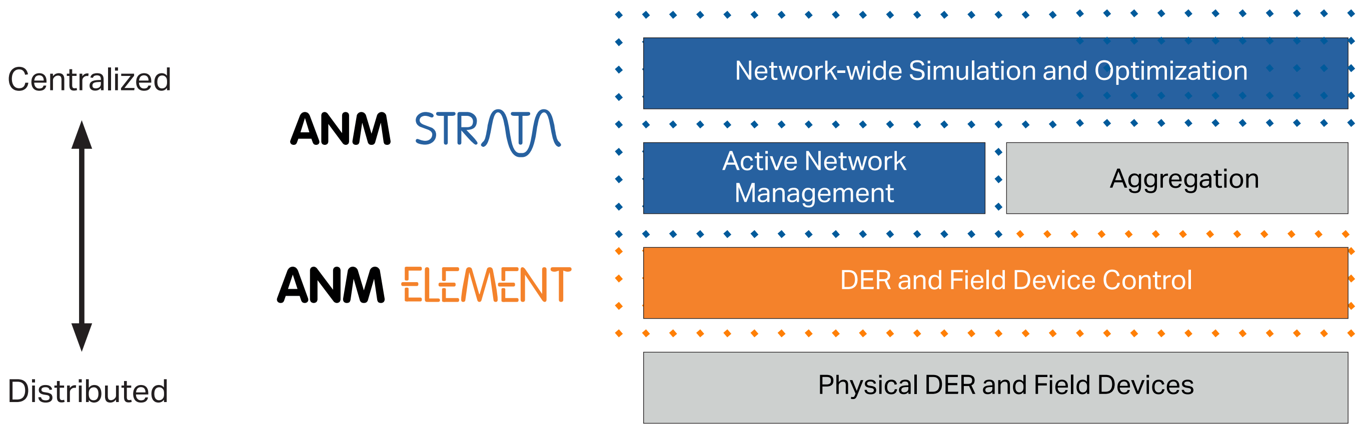
THE SMARTER GRID SOLUTIONS PERSPECTIVE ON DERMS

Smarter Grid Solutions has been deploying DERMS functionality for 10 years. We know that DERMS stretches from planning to operations, management to control, and from the utility systems to cloud systems and customer devices. DERMS is distinct from the SCADA or Advanced Distribution Management Systems (ADMS) being employed and deployed by many distribution utilities. The interaction with ADMS is an important aspect of any DERMS deployment, as is the ability to support various deployment architectures, including hybrid-cloud, hub-and-spoke and peer-to-peer. The ADMS is a centralized system, whereas DERMS can be deployed across centralized, distributed and grid-edge domains.

DERMS must integrate with the ADMS to receive network model updates and ensure DER are managed and controlled in-line with work associated with planned and unplanned outages. Importantly, DERMS also needs to be able to operate when the model is unavailable, erroneous, or out of date.

As a result, DERMS needs to be able to support a range of optimization and control algorithms and approaches, but also work with and implement outputs from ADMS or market systems when required. The core aspect of any DERMS implementation is the scalability of the platform; DER processing, provisioning, management and control must be automated and replicable across 10,000's of DER, growing to 100,000's and 1,000,000's in the coming decade.

As can be seen in the following diagram, SGS's ANM Strata is an example of a DERMS platform that has three distinct capabilities at the centralized or "hub" component of the platform: network-wide simulation and optimization, ANM and aggregation. Where required, ANM Element can be deployed to DER locations to perform local management and control functions and to ensure fail-safe response of DER to loss of communications or non-compliance events.



SECTION 4

RECOMMENDATIONS

The previous sections have introduced a range of market issues and the associated capabilities and functions required of a DERMS platform. Based on this, it is possible to identify some of the ideal characteristics of DERMS that will help the industry evaluate DERMS products, strategy and implementation plans. In this section we introduce a range of high-level features that should be explicitly addressed in any DERMS platform.

SCALABILITY

DERMS must demonstrate performance at 10,000's of DER up to 1,000,000's, with and without aggregation. DERMS should use automation to meet scalability objectives and deliver the architecture and bus-based technologies to underpin scalability objectives.

MODULARITY AND TARGETED SCHEMES

DERMS requires automated deployment and orchestration of a mix of schemes and functions at the centralized, distributed and grid-edge domains, based on common processes and algorithms. These schemes should be targeted at operational management of DER and the impacts on the system, including the coordination of microgrids with other DER.

NETWORK MODEL

DERMS should support exchange of network model data with the ADMS based on the Common Information Model (CIM). It is also crucial that DERMS can provide functionality that can maintain operation in the absence of network model availability and minimize the dependency on the model.

MARKET INTERFACES

DERMS should support integration with wholesale and distribution service market platforms. A key aspect of this is the ability of DERMS to arbitrate between market services and the needs of the local distribution system.

HIGH AVAILABILITY AND REDUNDANCY

These real-time algorithms can be used for sub-second response to manage pre-fault and post-fault constraints, and also to deliver remedial action schemes at distribution, i.e. direct transfer trip

FAIL-SAFE FEATURES

DERMS should be resilient to failures of any software, hardware or communications system. Graceful degradation of all DERMS functions in the event of any single or combined failure is required.

REAL-TIME CONTROL SCHEME CAPABILITY

Support and deliver fast-acting, deterministic and targeted constraint management algorithms that can interact with higher-level optimization algorithms, especially in DER hot spots.

3RD PARTY INTEGRATION

Demonstrate an Integration Framework capable of supporting open standards-based integration with devices, systems, clouds, and aggregators across a range of master/slave or client/server tele-control protocols, brokered and broker-less middleware, and web services.

SUPPORT MULTIPLE ARCHITECTURES

DERMS should be able to support various deployment architectures including federated, hierarchical, layered, hub-and-spoke, distributed, and peer-to-peer across on-premise, cloud, and field deployment models.

GROUPING AND AGGREGATION

DERMS should include native functions to enable automated and manual grouping of DER based on technical, economic and locational factors. It should also be possible for external and higher-level systems, e.g. ADMS, to request DER grouping via DERMS functions should be utilized.

SECURITY

Any DERMS security architecture should be designed from the ground up to preserve availability, integrity and confidentiality of data. It should enforce strong authentication methods; integrate with the existing enterprise security architecture to support directory services, intrusion detection and prevention systems. Any DERMS platform should support multiple roles, to enforce strict separation of duties and least privilege. DERMS should support the latest secure communication protocols while providing the facility to encapsulate legacy protocols in secure encrypted tunnels. All actions taken by DERMS and activity by users should be logged and externally validated.

PREDICTABLE AND QUANTIFABLE ALGORITHM PERFORMANCE

Demonstrate robust design and implementation of real-time systems technologies, ensuring methods scale without impacting performance.

TECHNICAL AND COMMERCIAL OPTIMIZATION

Support and host multiple kinds of DERMS optimization algorithms, ranging from system-wide SCOPF to fast hybrid linearized OPF to economic dispatch (e.g. unit commitment) using system, weather, market, load and DER forecasting data. Common scheduling and dispatch functions should be utilized.

MODULARITY AND TARGETED SCHEMES

DERMS requires automated deployment and orchestration of a mix of schemes and functions at the centralized, distributed, and grid-edge domains based on common processes and algorithms.

AI AND DATA ANALYTICS

Demonstrate the ability to process and handle large data sets and to perform a range of analytics on this data, including the application of artificial intelligence methods such as deep learning, to provide greater insight into DER activity, DERMS performance and situational awareness through predictive analytics.

ADMS AND UTILITY ENTERPRISE INTEGRATION

It is essential that DERMS is integrated into the broader set of tools being used to operate the distribution system. This means open standards for integration with the ADMS, including ICCP, MultiSpeak, DNP3.0, and CIM (including grouping instructions utilizing CIM). DERMS must also integrate with other systems and services available through the host utility, including weather and other forecasting engines, asset management databases and the utility data historian.

SECTION 5

CONCLUSIONS

CONCLUSIONS

In this white paper we have identified the main drivers for DERMS, outlined the core functions and capabilities of DERMS and described some ideal DERMS characteristics that will aid the industry in evaluating products, strategy and implementation plans. For utilities that are making the transition to DSO, the implementation of DERMS is a crucial step. The growth of DER is an undeniable trend and there is tremendous value to society in adopting these technologies in the fight against climate change. Distribution utilities require DSO capability to harness renewable resources and to store, regulate and dispatch storage (including batteries and electric vehicles) in concert with distribution and wholesale markets. The time is now to build the capabilities and technologies to deliver this value, for the benefit of all society.

This white paper is intended to provide a useful reference for those embarking on this journey, who are devising DERMS roadmaps and deployment plans. DERMS involves many complex interactions and a solid foundation of capabilities, functions and principles will ensure complexity is managed and the opportunities for DER to play a broader role in system operations and the market are realized.

The way customers are adopting DER needs to be reflected in the capabilities of the distribution utilities. It is no longer enough to continuously extend the existing centralized systems to meet DERMS requirements. The existing centralized systems have delivered the reliable electricity supply that we all enjoy, but the broad range of DER technologies, interfaces, standards and the rapid changes that impact distribution planning, operations and emerging markets require a more dynamic approach – the challenge in the coming years is prioritizing activity and ensuring that technology and capability go hand-in-hand.

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Bob is considered a leader in the deployment and development of DERMS and Active Network Management software, was named in the Top 50 Smart Grid Pioneers by SmartGrid Today in 2012, and named one of the Top 10 CleanTech Entrepreneurs in New York City. He serves on the NYSERSA Grid Modernization Committee, Industry Advisory Board of various US Department of Energy initiatives, and has been an invited participant in various government energy based forums.

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