San Diego Gas & Electric Company

Grid Modernization Progress Report

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Introduction

Over the past decades, San Diego Gas & Electric Company ("SDG&E" or "the Company") has made investments in innovative, cutting-edge technologies and programs that have made it a leader in utility wildfire safety and grid resiliency. From integrating automation and control technologies, to implementing efficient work processes, to designing and building microgrids, our investments are already benefiting our customers and serve as a foundation for the grid of the future.

SDG&E and its customers are also no strangers when it comes to integrating distributed energy resource ("DER") technologies. To date, SDG&E has authorized over 317,000 DER interconnection requests, installed at a rate of over 2,000 each month. These DER installations represent approximately one in every five households in SDG&E's service territory, with over 2,185 megawatts ("MW") in aggregate nameplate capacity.

SDG&E believes that the future grid needs to be dynamic, robust, and resilient, and it must evolve to support continued DER proliferation and enhancements to safety and reliability through assimilation of other emerging technology. The future grid also needs to empower customers, increase renewable generation, integrate electric vehicles ("EV"), and reduce greenhouse gas ("GHG") emissions while simultaneously maintaining and improving system safety, reliability, operational efficiency, security, and customer privacy. Thus, SDG&E's grid modernization vision is to innovate and optimize a grid that is safe and reliable and accelerates decarbonization – all while delivering value and choice for all customers. This vision reinforces SDG&E as the operator, planner, and integrator for the distribution system, while being supportive of state goals regarding DER adoption, transportation electrification, and decarbonization.

The following report details SDG&E's advancements, challenges, and future outlooks in the grid modernization areas of grid management systems, communications and cybersecurity infrastructure, and engineering software and planning tools.

Grid Management Systems

Integrated Test Facility ("ITF") Expansion

The ITF provides a learning and testing space for SDG&E to develop its own institutional knowledge and intellectual capital that aligns with CPUC goals and objectives. It is a vital asset that provides internal engineers and experts opportunities to work side by side. This resource provides a true cross-functional effort, designed to help projects from different groups and departments at SDG&E to coordinate and integrate, thereby increasing SDG&E's knowledge of power system and advanced technologies. Each laboratory room compliments efforts to improve the electrical power systems' reliability and efficiency. By testing within a laboratory environment, it allows SDG&E to safely test and troubleshoot different technologies, techniques and scenarios without putting SDG&E's personnel and operational systems at risk. The ITF is an integral part of SDG&E's safety culture.

Recent Activity, Challenges, and Outlook
Since 2021, the ITF has installed a smart board and Audio and Visual upgrades to the conference rooms. In addition, the ITF Team purchased software licenses and support for Real Time Digital Simulators that help model and test the technologies of the future within a lab setting. The ITF is

being utilized for projects that are being tested for wildfire prevention, system protection, reliability, and renewable communications. There have been successful outcomes of ITF projects. To name a few, SDG&E engineers pioneered and patented a falling conductor protection scheme in the event the power line breaks. This system can de-energize the line before it lands on the ground. This project was designed, developed, and tested in the lab to tell the electric system to immediately shut off power on a line if sensors detect that it is broken. There is also the development of servers using IEEE 2030.5 Protocol in the lab to test inverter communications for renewable energy resources, to enhance operational flexibility. SDG&E has also designed and tested our own 4G LTE communications system, to replace legacy systems and enable technologies such as Falling Conductor Protection to work quickly and reliably. SDG&E is also using the ITF to test behind the meter isolation switches that could help customers stay energized during utility outages. The CPUC has requested this effort be done by the three IOUs in California and the ITF is where SDG&E performs its testing.

The current challenges are the ability to collaborate with academia and third-party entrepreneurs within the bounds of prudent utility business practices. While SDG&E sees a potential value with working with outside parties in the ITF, there are safety and regulatory accounting concerns that make it infeasible.

SDG&E plans to double the size of the ITF laboratory space in the near future. As the grid handles more complicated technologies, there is a growing need to test the communications and connections of tomorrow in the safe environment the ITF lab provides.

Advanced Distribution Management System ("ADMS")

SDG&E's initial ADMS included an Outage Management System ("OMS") integrated with a Distribution Management System ("DMS"). To achieve SDG&E's desired operational vision, the ADMS was tightly integrated with other ancillary operational systems including the Geographic Information System ("GIS"), SCADA, Customer Information System ("CIS"), and Advanced metering infrastructure (AMI) systems. This initial ADMS deployment included a fully as-switched model of the distribution system which provides granular system visibility and management capabilities for the operators. The OMS also enabled the full suite of digital switch plan management, including documentation, tagging, and authorization capabilities across emergency and planned work, with all SCADA switching executed remotely from the control center. The full ADMS platform also enables timely customer outage communications, integrated workflow management and real-time resource status management both integrating data from AMI and SCADA with the internal as-switched grid model. ADMS has been a core enabling factor when it comes to SDG&E's superior safety and reliability metrices.

Moreover, ADMS is a key foundational system that anchors SDG&E's ability to operate and manage the distribution system in a high DER future. Its DER-aware modeling, integrated network analysis and system reconfiguration applications paves the way for SDG&E to develop its growing capabilities around DER management and is a first step towards the fully integrated ADMS and DER Management System ("DERMS") platform.

In its TY 2024 General Rate Case ("GRC"), SDG&E proposes the Reliability and Operational Safety ("ROSE") project and Smart Grid Operation ("SGO") projects to ensure ADMS can be enhanced to address safety and reliability driven needs. These enhancements also provide a foundation for implementation of broader DER management capabilities, as proposed in the new Enterprise DERMS project. The scope of ROSE and SGO projects include enhanced customer communications during blue sky and Public Safety Power Shutoff ("PSPS") events, expanded visibility to DERs and advanced outage and reliability analytics. Additionally, SDG&E intends to

improve its electric modeling, which is the foundation for all optimization applications within the ADMS. Accurate modeling not only improves switching accuracy and operating efficiency, but also provides an accurate baseline for planning and operating with DERs in the distribution system. The projects will also build upon existing architecture and platforms and further implement and refine advanced applications such as Volt/Var Optimization ("VVO"), Fault Isolation and Service Restoration ("FLISR"), Fault Location ("FL") and day ahead forecasting. Both the ROSE project and the SGO project are driven primarily by safety and reliability, but also provide a meaningful foundation for supporting DER integration.

Recent Activity, Challenges, and Outlook
In the recent past, SDGE's ADMS teams have been focused on improving integrations with systems such as the new CIS system, providing better more timely outage notices and communications with individual customers. Many enhancements have been made to automate Distribution Operator functions, thus reducing workload, and improving Operator focus on safety. Other improvements to the IT infrastructure have created a more resilient and available ADMS system -- even during cybersecurity patching, planned system maintenance and disaster recovery -- thus also improving safety considerations.

Distribution model optimizations have been completed to enable more accurate prediction and management of circuits during planned and unplanned outages in preparation for DERMS. DER assets modeled in the ADMS were verified to improve power flow calculations and direction. To further increase the visibility of DERs, large scale DER assets (rated at 1MW and greater) require SCADA telemetry and the future roadmap includes leveraging this data to improve the ADMS model and forecasting accuracy. Currently this data is viewable to the operators, and SDG&E has a methodical approach to continue to add in real-time data to the ADMS model.

SDG&E regularly upgrades key systems including the Network Management Systems (NMS) and Oracle Utilities Analytics (OUA), to newer versions to enhance safety and reliability through improvements in both processes and technology. In conjunction with the system upgrades, SDG&E added enhancement tools including FLISR and Suggested Switching. These are under evaluation alongside day-ahead forecasting in 2024. Legacy applications were replaced by web-based IT supported solutions to quickly gather and report data needed. SDG&E has added indices to track customer experience to help improve identification of reliability improvements to prioritize.

A primary challenge to most ADMS systems is the rapid pace of change in smart grid device technology and incorporating those improvements into the SCADA and ADMS systems. In addition, the proliferation of DER devices, their emerging standards and the onboarding and integration of those devices onto the distribution grid have caused an influx of changing requirements that ADMS must support. While the ADMS distribution system model is updated with additional SCADA data and DER attributes, improving the accuracy of FLISR and FL solutions -- in addition to expanding these capabilities to other circuits --becomes more challenging. As a result, FLISR is currently set to manual mode to evaluate the potential solutions and make improvements to the algorithm and power flow. FL solutions are also closely monitored and evaluated to identify and correct model inaccuracies. Finally, as Distribution Operations responsibilities grow, the need to automate repetitive tasks and provide plans and actions that reduce Operator workload to manage the distribution grid more safely, will continue to challenge the ADMS.

SDG&E's ADMS will continue to include enhancements that incorporate new technologies that are focused on improving reliability, furthering automation, and setting the stage to add enhancements for DERMS. In 2023, the ADMS was updated to include capabilities that use the

Fire Potential Index (FPI) generated by the SDG&E Meteorology team to raise Distribution Operations and crew personnel awareness of the potential for wildfires and allow for greater controls to ensure safe operations in times of greater wildfire risk. Also, in areas of high FPI, a switch plan for minimizing customer outages will be automatically generated so that should a PSPS event be necessary, Distribution Operations personnel will be able to act more quickly. ADMS will also be reintroducing mobile application access to ADMS to provide field personnel and crews real-time access to ADMS data to increase field crew awareness during both planned and unplanned work, develop more accurate estimated restoration times during outages and provide quicker and more accurate damage assessments to be submitted from the field. SDG&E has been developing pilots and procedures for these applications since 2023. Finally, as part of modeling improvements, ADMS will also be expanding the use of FLISR to additional circuits to automate the detection and restoration of unplanned outages by enabling FLISR on additional circuits. To support the upcoming DERMS system, additional SCADA data will be acquired from the SCADA head-end system to more accurately identify the DER devices, ratings, and attributes so that SDG&E can accurately forecast and signal the need for dispatchable DER that we expect to interconnect in the future.

Local Area Distribution Controller ("LADC") – Microgrid Controller

To support the controls associated with microgrids, SDG&E is working on developing and deploying a new microgrid controller, known as the LADC. The LADC is designed as a fast local controller that can rapidly control inverter-based resources and distributed generation while leveraging synchro-phasor data as control input. This fast control was deemed necessary based on experiences dealing with transient microgrid operating conditions in a low inertia environment. This is especially true for uncontrolled customer DER with legacy inverters without strong ride through capabilities where voltage or frequency excursions associated with these transients can cause them to trip offline en masse. SDG&E expects to integrate all resources, including those operated by third parties within multi-premise microgrids, with the LADC in addition to utility assets. The LADC projects are primarily driven by DER Integration but are also necessary to ensure safe and reliable operation within microgrids connected to SDG&E's distribution system.

Utilizing the LADC and to increase visibility, management, and control of the distribution system, SDG&E has also been utilizing a combination of data, analytical method, engineering and operations knowledge, and various tools to build a data notification system and visualization dashboards. This enables timely and targeted response to data changes and system events. Some of the use cases implemented include voltage monitoring and notification, phase balancing, and overloading circuits watchlist. With more data available, including DER performance data, SDG&E expects to continue using analytics to further finetune its process to make more data-driven planning and operational decisions. In addition, SDG&E has ongoing grid technology deployment such as the Advanced Protection ("AP") technology to further extend branch circuit protection for improved reliability.

Recent Activity, Challenges, and Outlook

In the past 6 months SDG&E teams have been advancing LADCs at the Cameron Corners Wildfire Mitigation Plan (WMP) Microgrid, the Ramona Air Attack Base WMP Microgrid and the Borrego Springs Microgrid; overcoming technical issues inherent with mixed-maturity energy storage devices from different manufacturers. In December 2022, the teams completed two milestones, integrating both LADC and SCADA controls at the Ramona Air Attack Base WMP Microgrid. This milestone enabled SDG&E's Distribution Operations to have control of the Tesla Megapack Battery for use during Wildfire or PSPS events. In December 2023, Phase 1 LADC integration completed at the Borrego Springs Microgrid, but full automation was postponed until LADC Phase 2, due to mechanical failure of the two diesel generators. In the first quarter of 2024,

engineering teams have completed LADC Factory Acceptance Testing and User Acceptance Testing for Elliot Microgrid using SDG&E's ITF Power systems Lab. Currently the SDG&E teams are performing Elliot Energy Storage Microgrid Controls Acceptance Testing at SDG&E's ITF Lab, and configuring Paradise Energy Storage Servers for Factory Acceptance Testing. Concurrently, the teams are supporting priority operational work, supporting Cameron Corners WMP Microgrid Flow Battery installation, supporting installation of new Tesla Megapacks, and supporting the Deisel Generator replacement at the Borrego Springs Microgrid.

The project teams have faced significant challenges from many angles. Most significantly for Borrego Springs was aging assets and for delay of the Cameron Corners flow battery. Additional challenges have come because each piece of microgrid hardware is programmed with custom logic and, although subsets of hardware are being tested in lab environments prior to field installation, full system lab tests are not possible; the entire system is operated for the first time in production environments with customers on the circuits.

In the next two years, the project teams will leverage the lessons learned and operational techniques developed while integrating the LADC at the Ramona Air Attack Base WMP Microgrid and Borrego Springs Microgrids. In 2024, SDG&E is working towards LADC integration for Elliot, Paradise, Boulevard, and Clairemont Microgrid sites, which are all Phase 2 LADC sites. The 2024 roadmap for LADC integration will be more productive because these four microgrids use the same technology and vendors. The teams expect Shelter Valley WMP Microgrid, Butterfield Ranch WMP Microgrid, Cameron Corners and Borrego Springs New energy asset construction to complete and become operational in early 2025 so LADC integrations for these sites are on the roadmap for 2025. Although the architecture and integrations are complex, the LADC puts SDG&E's Distribution Operations, Distributed Energy Resources, and Generation Operations teams in control of microgrid assets with their respective native control systems.

Enterprise DERMS

SDG&E views DERMS as providing the overarching capabilities within the operational domain to monitor, manage, and optimize DERs. With the already solid foundation established by previous investments in SCADA Headend replacement, ADMS, and other network infrastructure, SDG&E believes it is important to carefully evaluate and design the capabilities needed to further enable DER integration in the operational domain and its existing systems portfolio. Instead of building out one enterprise application platform, SDG&E believes it can enhance its existing tools and build out scenario-driven capabilities as needed in a progressive manner.

Although SDG&E has not implemented an enterprise DERMS to date, it is one of the early adopters in expanding its grid management capabilities to embrace DER integration. SDG&E has a long history of working with national labs, vendors, research facilities, and universities via the avenue of state directed EPIC, Department of Energy Solar Energy and Technologies (SETO) Funding Opportunity Announcements, and other grant opportunities. However, additional capabilities and functionalities, along with consistent use cases, are needed to develop and implement DERMS at the production level. SDG&E envisions DERMS to perform functions in the following three categories:

Day Ahead: The DERMS will consider the day ahead load forecast and anticipated equipment configurations and settings on a circuit-by-circuit basis, which it will leverage from the ADMS. The ADMS forecast is sophisticated and leverages weather forecasts, static (non-dispatchable/controllable) nameplate solar, smart meter data, SCADA telemetry points, as well as the circuit and equipment impedance models to determine the projected load at various telemetry points on a 24-hour schedule. If a constraint is detected by the day ahead simulation,

the DERMS will signal the need for dispatchable DER to come online the next day. This signal will be based on an optimization routine that considers the number and capabilities of DERs, circuit constraints such as voltage/thermal capacity, economic constraints), repetitive-use constraints such as not overusing demand response resources, and any other constraints that may come up depending on the type of use. For specific types of DER, like battery storage, DERMS could signal day ahead charging limits based on far more up-to-date forecasts, rather than the conservative annual forecast used today for our distribution-connected battery storage customers who are participating in the wholesale market. In 2023, SDG&E focused on the Distribution Management System (DMS) model updates and developed procedures to improve model accuracy and convergence, resulting in the ability to run day-ahead forecasts and estimate peak loads for subsequent days. In 2024 we have begun accuracy comparisons in preparation for a DERMS to ingest this data.

Real Time: SDG&E also expects the DERMS, which will be connected and integrated with SDG&E's as- switched distribution system model on ADMS, to react in real time if set electrical constraint values are exceeded to prevent voltage and overload problems that could lead to outages on the distribution system if not mitigated. The goal is for these constraints to be dynamically captured such that the DERMS has the capability of recognizing the actual constraints on the as-switched electric system. As an operator performs switching to restore service to customers, the DERMS can then evaluate the large DERs on the system and adjust their output, either up or down, depending on the scenario. These output adjustments will provide grid performance that stays within the system constraints that are recalculated as the system is reconfigured through switching operations. Key to this is the integration SDGE has built with our Enterprise GIS system. System changes are digitized and uploaded to our NMS on a daily basis and this year SDG&E continues to identify solutions that clean up data discrepancies.

Record and learn: The DERMS will need the capability of verifying the expected output from dispatchable resources and validating the actual output by measuring what the distribution system received in response to the dispatch signals sent to the resource. Event reporting will be necessary for determining if contract obligations are met. Event reporting can also act as a data feedback loop to improve the accuracy of day ahead forecasts and to improve the optimization programming of the DERMS. To date, SDG&E receives telemetry from all WDATs greater than 1MW. This data is brought into the control center for operator visibility and to inform decision making in switching on this distribution system. Additionally, static charge limits are viewable in the control center which give conservative predictability to the devices on our system.

Recent Activity, Challenges, and Outlook

SDG&E met with additional potential DERMS vendors to have them introduce and provide demonstrations of their product, and to allow SDG&E to ask technical questions regarding the capabilities of their product. Additionally, SDG&E representatives have participated in industry conferences and sessions to knowledge share on DERMS roadmap and specifications pertinent to brining on a DERMs vendor. We are working to better define our use cases and refine our vendor list for a formal Request for Proposal. SDG&E also established a 2030.5 server in its Technology lab to start demonstrating the capability of communicating to inverters and controlling inverter outputs, a key capability the DERMS will need to monitor and manage DERs. In SDG&E's current system, large DER assets participating in the wholesale market are interconnected with SCADA switches at the point of interconnection which provides telemetry and control. However, the control is static, SCADA can either isolate the customer or DER from the grid, or it can connect the customer or DER to the grid. The development of the 2030.5 technology would allow SDG&E and its future DERMS to control the inverter output providing a more sophisticated solution that

is more friendly to both the customer and the electric system. Generation/load output values can be adjusted rather than completely isolating DER assets from the system.

As mentioned above, to have the DERMS SDG&E envisions, it will need to have the capability to control either directly or through real time request to customers at the inverter level vs at the SCADA level,[1] and SDG&E is still early in its development of the 2030.5 head end system. In addition, the DERMS system will rely heavily on day ahead forecasting to optimize dispatchable DER at scale, and SDG&E must work to refine its data inputs into the distribution system model to continue to improve the accuracy of its day ahead forecasts. The ADMS model enhancements continue to be SDG&E's focus before our DERMS implementation.

The LADC deployments detailed above alongside pilot projects, including vehicle to grid and virtual power plants, provide us with additional experience and use case understanding necessary capabilities as we move toward a DERMS solution.

SDG&E plans to submit a formal request for proposal to DERMS vendors in 2024 and is on track to purchase and integrate a DERMS system in 2025, with the goal of piloting the use cases described in future years consistent with SDG&E's current GRC application.

Supervisory Control and Data Acquisition ("SCADA") Headend Replacement

SDG&E has long been using the SCADA system to monitor, control, and protect distribution assets. As the cornerstone of its operational platform, the implementation of the distribution SCADA ("DSCADA") system more than two decades ago initiated SDG&E's roadmap establishing system management capabilities within the distribution control center. Over time, this legacy DSCADA system faced increasing challenges as more and more communication edge devices were deployed in the field.

In 2017, SDG&E engaged a consulting firm to perform a full evaluation of the DSCADA system. Upon evaluation, it was identified that the legacy DSCADA system did not meet SDG&E's technical roadmap requirements for grid modernization. Key issues included a lack of support for Internet Protocol ("IP") communications as well as a limited capacity to send/receive DSCADA points associated with newer devices and general system scalability concerns. Moreover, given the DSCADA system was deployed more than 20 years ago with antiquated user interfaces, the development of DSCADA screens were very inefficient and time consuming. The system did not have a reliable backup process and was heavily dependent on an aging hardware configuration, which created many challenges for operational support of the system.

Consistent with the final recommendation by the consulting firm, SDG&E decided to replace the legacy system with a new DSCADA Head-end system. In 2020 SDG&E completed a full upgrade of DSCADA. The upgrade enabled the DSCADA system to continue serving as the critical data aggregation system to integrate additional grid sensing, switching and protection equipment for the control center. In 2022 and 2023, SDG&E completed the Phase 2 of SCADA Head-end upgrade project to further enhance the DSCADA system to have full testing capabilities.

[1] For some Behind-The-Meter (BTM) applications such control will require the presence of a Power Control System (PCS) that monitors power flow at the customer's Point of Common Coupling (PCC) with the utility and uses this data to signal the inverter to increase or decrease output as necessary to manage grid imports or exports to specified levels. A PCS will be necessary because control of the inverter by itself has no effect on the customer's end-use load.

Recent Activity, Challenges, and Outlook

Upgrading the SCADA system to newer versions enhances safety and reliability through improvements in both processes and technology. In conjunction with the system upgrades, SDG&E teams have successfully converted serial SCADA communications to an IP based communication protocol improving SCADA reliability. In addition, Security Profiler software was implemented to establish baselines and monitor deviations of software on the SCADA equipment within the SCADA network which hardened the cyber security posture. The SCADA team has successfully integrated to LADC and Falling Conductor Protocol controllers. The team transitioned from quarterly system security patching to monthly with no interruptions to operations. Scheduled nightly server backups of all non-production and production environments which are stored for six weeks improving business continuity. The number of active RTUs in the SCADA has increased by 15% in the last two years. Additionally, in 2022 SDG&E added a physical multi- factor authentication to critical areas where SCADA equipment is located. The team implemented the use of a new change management software that will monitor and record system changes for auditing purposes. Necessary segmentation of server processes will increase stability for integrations with NMS and provide SCADA data to SDG&E's corporate historian.

A primary challenge to SCADA systems is maintaining cyber security of the network in the current threat landscape. This requires constant monitoring and improvements to enhance system security. The implementation of automated security patch software would allow for better efficiency and consistency across SCADA hardware. Consistent upgrades to the operating systems and hardware will be needed to maintain business continuity and system security. Additional challenges include the need for a more advanced reporting and analytics application to fully utilize historical data to improve situational awareness. As the Distribution SCADA system continues to grow, the need increases for additional licensing and the migration of SCADA communications to SDG&E private Long-Term Evolution (LTE) network to improve visibility and reliability of the system.

In 2023, Inter Control Center Protocol (ICCP) was implemented, non-production and will be implemented in production in 2024, allowing for improved situational awareness and data sharing with other business applications. The team will implement the use of a new change management software that will monitor and record system changes for auditing purposes. Fully operational SCADA simulators will provide a necessary training tool for Distribution System Operators that will be integrated with the Oracle Network Management System (NMS) System. A new SCADA test environment will be integrated with Oracle NMS to improve testing between the critical system applications. Necessary segmentation of server processes will increase stability for integrations with Oracle NMS and provide SCADA data to SDG&E's corporate historian. The addition of a redundant non-production development environment allows business continuity in the event of a system emergency where system updates can be performed in an isolated environment and validated before implementation to the production SCADA in line with SDG&E's Operational Technology Standards. SDG&E is preparing for additional hardware and software upgrades in 2025. Efforts will include improvements to the integrations with the company's corporate historian, modifications for more intuitive SCADA alarming for the distribution control center, and continually enhancing the cybersecurity footprint.

Demand Response Management System ("DRMS") Replacement

SDG&E has over two decades of experience in managing Demand Response ("DR") programs. The DRMS replacement project was targeted to implement a new DRMS system that meets the current and future needs of Demand Response ("DR") customers and the resulting DR programs. This platform allows SDG&E's internal DR team to track and manage the various DR Programs and Pilots via one single platform. The DRMS replacement system is designed to be able to grow and expand, allowing SDG&E to have the capacity to manage and signal smart devices. The new platform allows SDG&E's

DR team to provide a better customer experience as many more customers purchase smart devices and equipment that will be used to provide DR. The DRMS technology is primarily driven by DER integration, but the replacement project was primarily driven by aging IT infrastructure.

Recent Activity, Challenges, and Outlook
The new DRMS platform allowed SDG&E to retire these old legacy systems and look to the future. The new SDG&E DRMS system went live on March 28, 2023, and has been consistently updated to include more DR programs.

A significant benefit of the new DRMS platform is that all SDG&E DR programs and Pilots are now under one application. A single application provides scalability and adaptability that will accommodate new DR pathways and capacity, thereby enabling DR to grow for many years.

The role and types of DR programs are changing as we focus more on grid resiliency and reliability. The new DRMS system will allow the management of our existing DR programs and Pilots, our third-party programs and integration of these programs with the CAISO wholesale market. It will be expandable and therefore allow SDG&E to effectively manage future DR programs. These future DR programs will include commercial and residential devices, energy management systems along with battery storage, and electric vehicle to grid applications. The new DRMS system will also improve our third party and customer experience as we move to a more dynamic landscape of dynamic pricing, resiliency and demand flexibility.

Communications and Cybersecurity Infrastructure

Fiber Development

SDG&E's current backhaul fiber optic network is comprised of over 900 miles of fiber connecting over 75 transmission substations. SDG&E is approximately 60% complete with another 590 miles to build towards completing a diverse fiber optic infrastructure network to all remaining substations. The fiber optic network not only provides a direct connection to substation equipment, but it also serves as backhaul and redundant pathways for Long-Term Evolution ("LTE") field area network technology and Microwave links that enables distribution automation devices to be interconnected to back-end control systems. In the 2024 GRC, SDG&E is continuing with the building fiber network through the Fiber Optic for Relay Protection & Telecommunications project, and the HFTD Transmission Fiber Optics project. Both projects are primarily driven by safety and reliability but provide the network foundation for supporting DER integration.

Recent Activity, Challenges, and Outlook
By the end of 2023, SDG&E installed 303-miles which of fiber. In 2023, SDG&E installed 29.7-miles which connected 12 Transmission substations. In 2024, SDG&E is scheduled to construct an additional 26-miles which connects 8 Transmission substations.

The two main challenges that impact project delivery are Agency permitting delays and material lead times that vary widely.

SDG&E has increased support for the Fiber Build Infrastructure projects. With the construction of an estimated 30+ miles per year, the long-term goal is to build a complete and diverse fiber network infrastructure by 2032.

Private LTE

SDG&E is deploying a privately-owned LTE field area network using licensed radio frequency ("RF") spectrum by means of the Distribution Communications Reliability Improvements ("DCRI") program. The private LTE ("PLTE") network and associated upgraded communication infrastructure will enhance the overall reliability of SDG&E's communication network, which is critical for enabling fire prevention and public safety programs. In the meantime, SDG&E envisions this network will also serve as a foundational network for DER integration efforts. Similar to the Fiber development projects, the private LTE Project is also primarily driven by safety and reliability but provides the foundation for supporting DER integration. The project is an ongoing program and is expected to continue through 2030.

Recent Activity, Challenges, and Outlook
The PLTE deployment is underway with 58 sites built and more slated for 2024. The acquisition of the PLTE Spectrum has been completed for San Diego and Imperial counties. Migration of existing sites, end uses, and system protection technologies have begun with a target of approximately 800 being converted in 2024.

SDG&E expects to ramp up in the coming years the actual number of sites that are installed per year.

Most sites planned for base station installation have engineered steel foundation piles that will have telecommunication antennas at the top of the pole and electric (12 kV and below) attachments in the middle of the pole. Poles are currently undergoing standardization. Development of pole specification, including workspace, operational, and manufacturing requirements, has taken longer than expected. To complete the pole standardization, three pilot sites were selected and pole orders were placed at the end of 2023. In 2024, construction of these three pilot sites and standardization of pole designs is expected to be completed, which will accelerate the program in 2025 and beyond. In addition, process improvements with substation and transmission facility engineering and operations groups are being developed to ensure proper design and construction and streamline the activities to help accelerate the program.

SDG&E projects completion of the PLTE project with full coverage of our service territory by 2030.

Cyber Security

SDG&E has established holistic Operational Technology ("OT") and Information Technology ("IT") and cloud cyber security strategies to mitigate cyber risks and protect its systems and customers from cyber- attacks and potential catastrophic events. These integrated efforts are ongoing and continue to evolve as requirements, standards, policies, and threats change. Our OT cybersecurity program has quickly grown into a function utilizing technology and standards to enhance engagement across the business, expand asset visibility and enable enhanced vulnerability management capabilities. We have invested in measures to strengthen perimeter and internal defenses and have adopted use of modern technologies across various core cyber infrastructure capabilities. SDG&E will continuously assess associated cyber risks and evaluate new technology that can be adopted to mitigate these risks. SDG&E also plans to continue to actively engage in state initiatives working with broader stakeholders.

SDG&E will continue to support broader business objectives and adoption of modern grid, cloud, OT and IT systems and infrastructures by evolving security controls, utilizing, and conforming to NIST standards, and continuously assessing internal and external threats. In partnership with various business entities, SDG&E continues to develop a culture of cyber awareness and vigilance, ensuring our staff and contractors are informed on top security risks such as social engineering, phishing, and other related threat actor tactics.

SDG&E relies on Federal, State, and Local government partnerships for intelligence feeds along with peer utility industry relationships and private (subscription) based services for Industrial Control Systems (ICS) cybersecurity threat intelligence. We also obtain cybersecurity threat intelligence from a variety of entities and sources, including Information Sharing and Analysis Centers (ISACs), the Federal Bureau of Investigations (FBI), FERC, the DOE, the Department of Homeland Security (DHS), CISA, Transportation Security Administration (TSA) and a variety of US intelligence community agencies. Information from threat intelligence sources in the utility industry continues to reveal adversaries that are using advanced tradecraft in their attempts to access our nation's utility systems.

The Cybersecurity program utilizes risk management frameworks, including but not limited to the National Institute of Standards and Technology (NIST) Cybersecurity Framework, Center for Internet Security (CIS-20), NIST 800-53, and MITRE ATT&CK framework. Additionally, SDG&E complies with all applicable laws and regulations both at the State and Federal level.

Engineering Software and Planning Tools

Customer Facing Portals

To improve customer experience and support customers' energy transition interests, SDG&E has rolled out customer facing portals such as the Distribution Interconnection Information System ("DIIS") and Distribution Resource Planning("DRP") Data Portal, which have provided greater ease and flexibility to customers adopting DER technologies. A new Microgrid Portal was recently developed for local and tribal governments to support community resiliency planning. A description of the portals, recent updates and future lookout are included below.

DRP Data Portal
In Rulemaking 14-0808-13, issued on February 2015, the CPUC required SDG&E and other utilities to publish a DRP Data Portal. The portal is comprised of an Integration Capacity Analysis (ICA) map which includes information from SDG&E's annual Grids Needs Assessment (GNA) report, and Distribution Deferral Opportunity Report (DDOR), among other data types. The ICA maps published within the portal contain data from both the Generation ICA and the Load ICA. The data presented in the ICA map provides the estimated feeder level integration capacity results at a section level or node level. The Data Portal also hosts a data layer to allow registered customers to download SDG&E's GNA and DDOR reports.

Recent Activity, Challenges, and Outlook
Since 2021, in accordance with Administrative Law Judge's September 9, 2021, Ruling Ordering Refinements to the Load ICA, SDG&E has been working on implementation of several modeling changes to Load ICA. SDG&E made progress on the development of the modeling changes and intends to complete these changes by the first quarter of 2025. The data portal is also currently in the scope of the High DER Grid Planning OIR (R.21-06-017); additional changes may be identified and proposed as appropriate.

Interconnection Portal
In 2013, SDG&E launched an automated application process and online tool, DIIS for contractors and customers to manage interconnection projects. DIIS is a self-service portal which enables customers and contractors to fully manage the lifecycle of NEM projects. The tool allows users to create projects, receive real time status updates and notifications, and is available 24/7. As

mentioned in the overview, SDG&E's DIIS has greatly facilitated its customers embracing DER adoption quickly and easily. To date, SDG&E has authorized over 317,000 DER interconnection requests advancing over 2,185 MW of generation. Moreover, DIIS allows fast track applications to be processed in an average of 3 days for residential applications.

Recent Activity, Challenges, and Outlook
Since 2021, SDG&E has been working on further DIIS reporting functionality to support Rule 21 for CPUC reporting and auditing requirements. New features are being designed and deployed to intake Wholesale Distribution Access Tariff (WDAT) customer applications, provide new project management features to better track design, construction, and interconnection activities, in addition to dissemination of generation customer information to distribution operators to support distribution grid operations while supporting wholesale market participation. As of March 2024, SDG&E is nearing the first phase of releases for the DIIS upgrades related to the WDAT and tracking (scheduled for Q2 – Q3 of 2024).

Microgrid Portal (Tribal/Local Government Portal)
SDG&E completed development, in November 2023, of a separate, access-restricted data portal for local and tribal governments. The development and activation of the portal complies with requirements specified in the CPUC Decision 20-06-017.[2] This portal supports local and tribal efforts to promote community resiliency.
community resiliency.

The portal includes a map application that displays GIS data. The GIS data depicts (a) planned grid investments, (b) high fire threat districts, (c) electrical infrastructure and (d) weather-related factors that led to the decision to de-energize from each prior PSPS events and the resulting distribution and transmission line outages.

Planning Tools

In the past decade, SDG&E has implemented many updates to its planning tools to meet the deliverables identified in the multiple tracks of the Distribution Resources Plan (DRP) proceeding. These tracks required creation of new analyses such as ICA for both generation and load and DER Growth Scenario forecast processes. The scale of the data and analysis requires specific and customized tools to process and promote data quality and accuracy. As discussed earlier, the ICA tool is housed within the DRP data portal. Information in the DRP data portal is intended to provide information that informs customers' efforts to interconnect new generation and to add load. ICA takes input from GIS, SCADA and AMI and is intertwined with existing planning tools such as Synergi and LoadSEER.

In 2015, SDG&E adopted a third-party proprietary software forecast toolset, LoadSEER, from Integral Analytics, Inc., to disaggregate the CEC's system-level forecast of loads and Behind-The-Meter (BTM) DER additions to the circuit level. This tool provides SDG&E a geospatial load disaggregation methodology and allows integration of DER forecasts required through the DRP DER Growth Scenarios. The enhanced forecast capability helps determine the timing and duration of future forecast distribution capacity needs. In 2020, SDG&E created a tool that queries the coincident contribution of DER resource impacts during each circuit's/bus's forecast peak time to better inform the "indirect distribution cost" utilized in the IDER Avoided Cost Calculator (ACC) proceeding. SDG&E currently uses a variety of methodologies, tools, and software including Synergi and LoadSEER, to perform the analyses necessary to accurately identify the planned infrastructure improvements that will prepare the distribution system for high electrification.

Recent Activity, Challenges, and Outlook

As discussed above in the DRP Data Portal section, since 2021, SDG&E has been working on implementation of several modeling changes to Load ICA. SDG&E has also been working on continuous improvement of analytical accuracy for both Load ICA and Gen ICA. Further, the changes to Load ICA are driving and will continue to drive several changes to SDG&E's distribution system modeling and analysis software, Synergi, including but not limited to software updates.

Conclusion

The projects and programs that SDG&E has implemented under grid modernization support SDG&E's grid modernization vision and align with the state goals regarding DER adoption, transportation electrification, and decarbonization. As California continues to electrify, SDG&E understands the importance and value of DERs in meeting the significantly increased electric demand electrification will bring. At the same time, an increasing number of DERs add operational complexity. The tools and processes described in this Grid Modernization Report will allow SDG&E to continue to provide safe and reliable distribution service. The investments SDG&E is making today in its grid management tools, cybersecurity and communication, and engineering and planning tools will allow SDG&E to have fewer limits on distribution circuit hosting capacity, more dynamic charging limits for battery storage customers, and more nuanced DER management under abnormal configurations due to advancements in inverter control. All these enhancements allow for the safe and reliable integration of more DER of all varieties onto the electric system, supporting electrification and the high DER future.