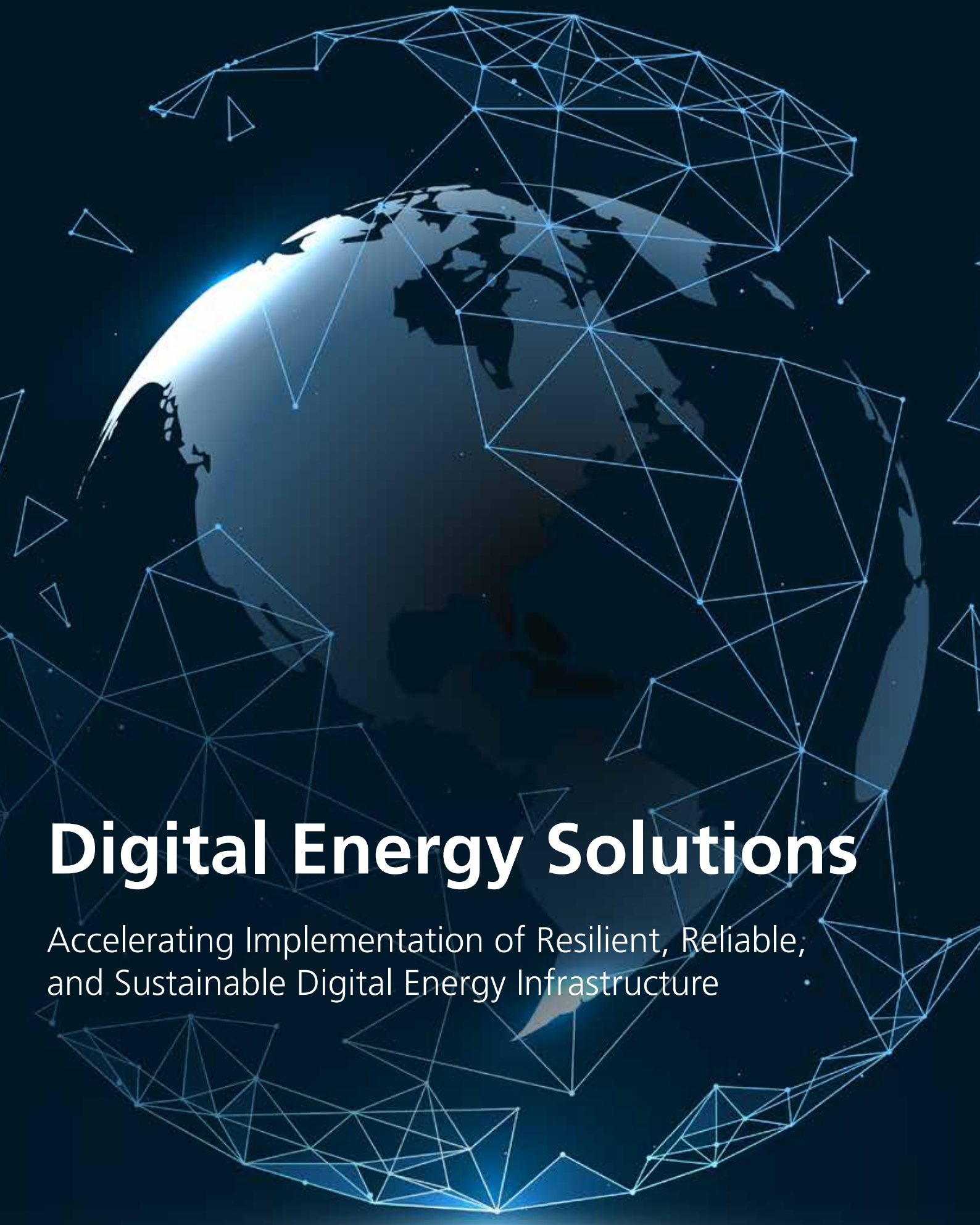
Digital Energy Solutions
Power Transmission & Distribution



Digital Energy Solutions

Accelerating Implementation of Resilient, Reliable, and Sustainable Digital Energy Infrastructure

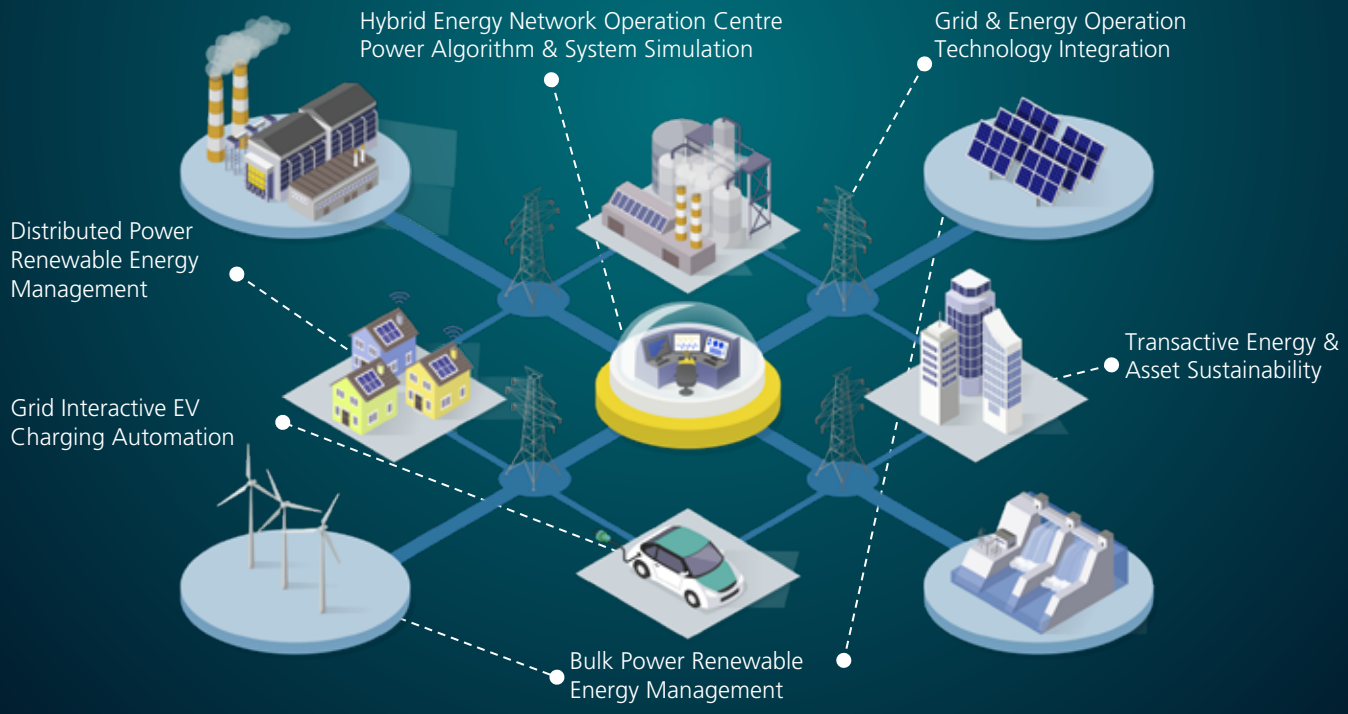
We are L&T PT&D Digital Energy Solutions

We are a part of Larsen & Toubro, a technology, engineering, construction, and financial services conglomerate engaged in executing EPC projects, high-tech manufacturing, and services. With a track record of having built some of the tallest, largest, longest, smartest, and most complex infrastructure, L&T has been recognized as builders of nations. We are the technology arm of L&T's Power Transmission & Distribution (PT&D) business, a leading EPC player possessing expertise in the design, manufacture, supply, installation, and commissioning of transmission lines, substations, underground cable networks, distribution networks, power quality improvement projects, infrastructure electrification, solar PV plants, battery energy storage systems, and mini/micro grid projects. Beyond being one of the most successful EPC players in the sector, our extensive experience in building complex power transmission and distribution systems has further helped us understand the importance of efficient operations of such systems; hence our entry into Digital Energy Solutions was a natural progression as we grow further in this space.

L&T PT&D Digital Energy Solutions is a unique integrated service provider residing in the PT&D business of the multibillion-dollar Indian conglomerate Larsen & Toubro. No matter how complex your power systems are, the effective exchange of information between your electrical installations and decision platforms ensures best results. With our all-round capabilities, we guarantee fast, reliable, secure, and smart solutions to operate your mission-critical power applications. Our EPC and digital solution capabilities put together will serve you with the best of solutions, satisfying all your power system execution and operation needs. With our solution-centric integration capabilities, we help you to successfully integrate cutting-edge technologies, thus delivering smarter, safer, and efficient energy systems.

DECODING ENERGY THROUGH 6 SEGMENTS

Introducing the **L&T Spark** platform – a platform that is specialized in serving the digitization needs of electrical and power systems. From power generation to transmission and distribution to end consumption, we are here to digitally transform every single touch point of electricity, thus making your power systems smarter, efficient, reliable, and secured.



Solutions under each segment

Hybrid Energy Network Operation Centre | Power Algorithm & System Simulation

Grid & Energy Operation Technology Integration	Transactive Energy & Asset Sustainability	Grid Interactive EV Charging Automation	Bulk Power Renewable Energy Management	Distributed Power Renewable Energy Management
• Grid Control Room Integration Solution • Data Acquisition & Federated Controller Solution • Common Digital Substation Solution	• Energy Efficiency Management Solution • Demand Response Management Solution • Energy Transaction Lifecycle Management Solution	• Charge Point Management Solution • Site Hybrid Energy Management Solution • EV Driver Mobile Application	• Power Plant Controller • Hybrid Energy Management System • Battery Energy Storage Control System	• Distributed Energy Resource Management System • Microgrid Energy Management System

Cybersecurity Services

HYBRID ENERGY NETWORK OPERATION CENTRE

Power outage disrupts businesses and comes at a steep price. Power generation, transmission, and distribution is a critical round-the-clock service – hence the paramount need to monitor and manage the operations and network elements of such vital systems to quickly deal with issues that can impact the performance. Through our Hybrid Energy Network Operation Centre solutions, we ensure behind-the-scenes operations to our end users who will have a seamless, continuously connected experience, thus eliminating the chances of occurrences such as prolonged downtime, malware infection, or poor functionality.

Our Offerings

Remote Monitoring & Diagnostics (RM&D) services for:

- Distributed energy resources (DERs) – solar, storage, distributed generation, and demand response
- Solar – storage integrated EV charging station

Bulk Power Balancing Authority (BA) services

PT&D device & assets data analytics and performance services

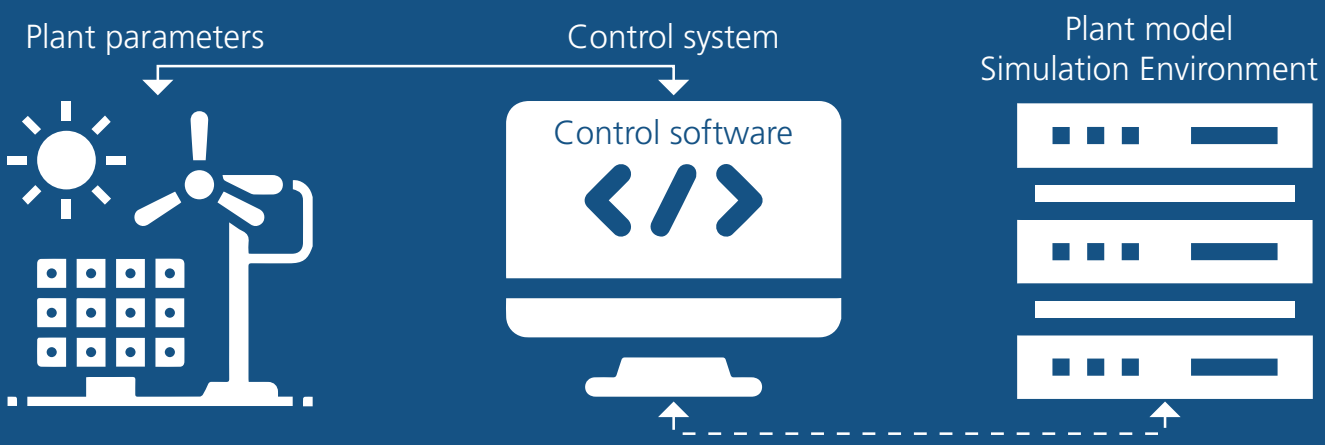
T&D control room application support services

Cybersecurity compliance monitoring services

Benefits

- **Centralized management** ability to manage large number of sites and complex operations
- **Automated operations** for reduced manual intervention
- **Real-time data availability**
- **Business intelligence** through smart analytics and machine learning

POWER ALGORITHM & SYSTEM SIMULATION



The power systems industry is consistently evolving from centralized generation of power to a grid that is expanding with considerable infusion of distributed energy resources integrated with smart technologies. While new technologies promise increased reliability and efficiency, they bring their own set of technological and integration challenges, which cannot be ignored. Traditionally, the grid was designed to absorb, transmit, and deliver power to end consumers from centralized power plants. With the increasing penetration of DERs, the direction of power flow is changing, posing challenges to system protection, operation, power quality, and more. This might result in damaging the mission-critical equipment and might be an expensive event to experience if the power plants are built before understanding the fundamental requirements. Our power algorithm and system simulation stand as the perfect solution to mitigate such challenges. Through our real-time simulation solutions, we help our clients optimize security, efficiency, and performance of micro grids, renewable energy sources, and large interconnected power grids while increasing return on investment, thus helping to build robust, resilient, and cost-effective power systems.

Our Offerings

Power system simulation for DER integrated grid operation

Utility interconnection simulation and study

Hardware in the loop (HIL) simulation services for:

- DER (solar – storage) controllers
- Microgrid controllers

Software in the loop (SIL) simulation services

Benefits

- **Understand the feasibility** of the project beforehand
- **Make informed decisions** regarding expansion and modernization of grids
- **Simulation cases** to verify controller behaviour under unusual operating conditions
- **Accurate field test scenarios** and faster testing time
- **Simulate real-world conditions,** thus facilitating parallel project development and faster time to market

GRID & ENERGY OPERATION AND TECHNOLOGY INTEGRATION

Traditional grids are under transition from a traditional static, centralized model for energy generation and distribution to a dynamic, bidirectional, decentralized model for energy generation, storage, and brokering towards the edge and closer to the consumer. After years of continuous operations, aging of the traditional power systems is inevitable. Further, with increasing integration of renewable energy and distributed resources, these aging electric infrastructures in many countries are being pushed to do more than what they were designed for. Modernizing the grid to suit current requirements has become a mandate, and this is what we are offering through our Grid & Energy Operation and Technology Integration (GETI) solutions. In our mission to make the grids smarter and more resilient, as system integrators, we work with best-of-the-breed technologies available and provide you with world-class solutions through cutting-edge technologies and control systems, ensuring seamless integration and communication between different systems to deliver more reliable and efficient electricity.

Our Offerings

Grid control room integration solution

Data acquisition and federated controller solution

Common digital substation solution – we Integrate substation assets of different OEMs and enable interoperability to effectively manage the operations of your substation and improve overall system reliability while reducing material and labour cost

Benefits

- **Optimize grid operations** and efficient management
- **Ensure high level of system reliability**
- **Make better decisions** with access to intelligence
- **Keep track** of the health of your power systems
- **Improve operational efficiency** and reduce operating cost
- **Improve asset life**
- **Improve transparency** in operation
- **Enable interoperability** and future security

TRANSACTIVE ENERGY & ASSET SUSTAINABILITY

Globally, the distribution network is getting smarter every day and is continuously evolving to support the increasing penetration of renewable and distributed energy resources. The evolving smart distribution network raises new challenges in the power system where it demands a transformational change that includes demand response, energy storage services, and a secure and transparent information system. It further demands substantial efficiency enhancements through market-based transactive exchanges amongst energy producers and energy consumers. Our Transactive Energy & Asset Sustainability solutions help our customers in meeting the requirements of a modernized network, with new economic tools and processes to enable these sorts of exchanges.

Through our solutions, we enable the systems involved to communicate and share energy data with ease. We help our customers optimize energy consumption, improve energy performance, increase resource efficiency, and reduce operating cost and carbon emissions including compliance with legislation. Further, we ensure ease of transferring and sharing economic and control mechanisms that assure the equilibrium between demand and supply among trading partners in the power system infrastructure, thereby delivering better utilization of grid assets, increased consumer satisfaction, and reduced energy cost.

Our Offerings

- Energy efficiency management solutions
- Demand response management solutions
- Energy transaction lifecycle management solutions

Benefits

- **Reduce energy spending**
- **Minimize carbon emission**
- **Predict consumption & spending** and plan accordingly
- **Reduction in outages and accidents**
- **Cut operational expenses**
- **Better utilization** of electrical assets
- **Greater network resilience** and reliability
- **Increase overall system efficiency**
- Meet **renewable energy integration** goals
- **Monetize flexible energy purchase** and usage

GRID INTERACTIVE EV CHARGING AUTOMATION

Electric mobility is the future. Globally, as a part of their climate action plan, nations, in addition to their grid-level green initiatives, are aggressively accelerating the adoption of electric vehicles (EVs). Consequential to the accelerated adoption of EVs, global power systems are witnessing increasing development of grid-connected and DER-integrated charging infrastructure, which is consistently increasing the pressure on the grid. This trend is only set to grow, and it is important for an EV charging service provider to have a robust platform interface that enables seamless EV charging and ensures efficient management of the grid.

L&T EV Spark CPMS solution makes your life simple when it comes to managing your EV charging networks. The solution is designed to cater to the EV charging needs of both the charge point operator and the end user through its web and mobile applications. Our solution will help you with all the aspects of charging management, starting from managing your charge point operations to handling the smart energy management for your charging networks. To put it shortly, you handle the business of charging, and we will enable it for you.

Our Offerings

- Charge point management solution
- Site hybrid energy management solution
- EV Driver mobile application

Benefits

- **Hardware agnostic**
- **Security and scalability through cloud technology**
- Utilize and manage the distributed energy resources and the grid through **smart energy management**
- Automatically distribute the available power dynamically through **dynamic load management**
- **White labelling** possibilities
- Integrate existing systems through **API Integration**

BULK POWER RENEWABLE ENERGY MANAGEMENT

Climate action has become the order of the day, and global economies are accelerating the adoption of renewable energy to fulfil their climate targets. An increasing amount of renewable energy along with energy storage is getting deployed every day and is constantly injected into a grid that is fundamentally designed to handle firm power generated from conventional sources. The primary challenge here is to inject intermittent generation units into the main grid while maintaining stability. It is important that the power generated from these renewable sources are efficiently injected into the grid every day, conforming to the grid codes and dynamics. Our Bulk Power Renewable Energy Management solutions help in this regard, starting with hardware-in-the-loop and software-in-the-loop simulations of the controllers being offered.

Our Offerings

- Power plant controller
- Hybrid energy management system
- Battery energy storage control system
- Hardware in the loop (HIL) simulation services
- Software in the loop (SIL) simulation services

Benefits

- **Monitor and control** the equipment in solar and wind plants
- **Measure power parameters** from energy meters/transducers
- **Ensure active power control, reactive power control, volt/var control** as well as frequency control for power plants
- **IPC-based PPC & BESS control system lowers complexity** as opposed to PLC-based solutions – no need for special programming knowledge for configuration
- **Compliant with cybersecurity requirements**
- **Ensure reliable, resilient, and seamless plant operation** through browser-based HMI

DISTRIBUTED POWER RENEWABLE ENERGY MANAGEMENT

In an era of fast adoption of new technologies, energy organizations and communities are increasingly opting for microgrids, powered by distributed energy resources such as solar, wind, and different forms of energy storage systems. Given the fundamental nature and the age of most of the grids around the world, DERs and microgrids are always viewed from a critical lens, attributed specifically to its challenges relating to infirm power injection and bidirectional flow of power, resulting in grid congestion and several other grid anomalies. While these new-age systems are welcomed by grid players at large, they also expect a well-managed power supply from the DERs to avoid any grid instability. Hence, it is imperative to ensure efficient management of these systems to deliver assured performance, and this is what we address through our Distributed Power Renewable Energy Management solutions, ensuring a reliable and resilient power system that caters efficiently to everyday power needs.

Our Offerings

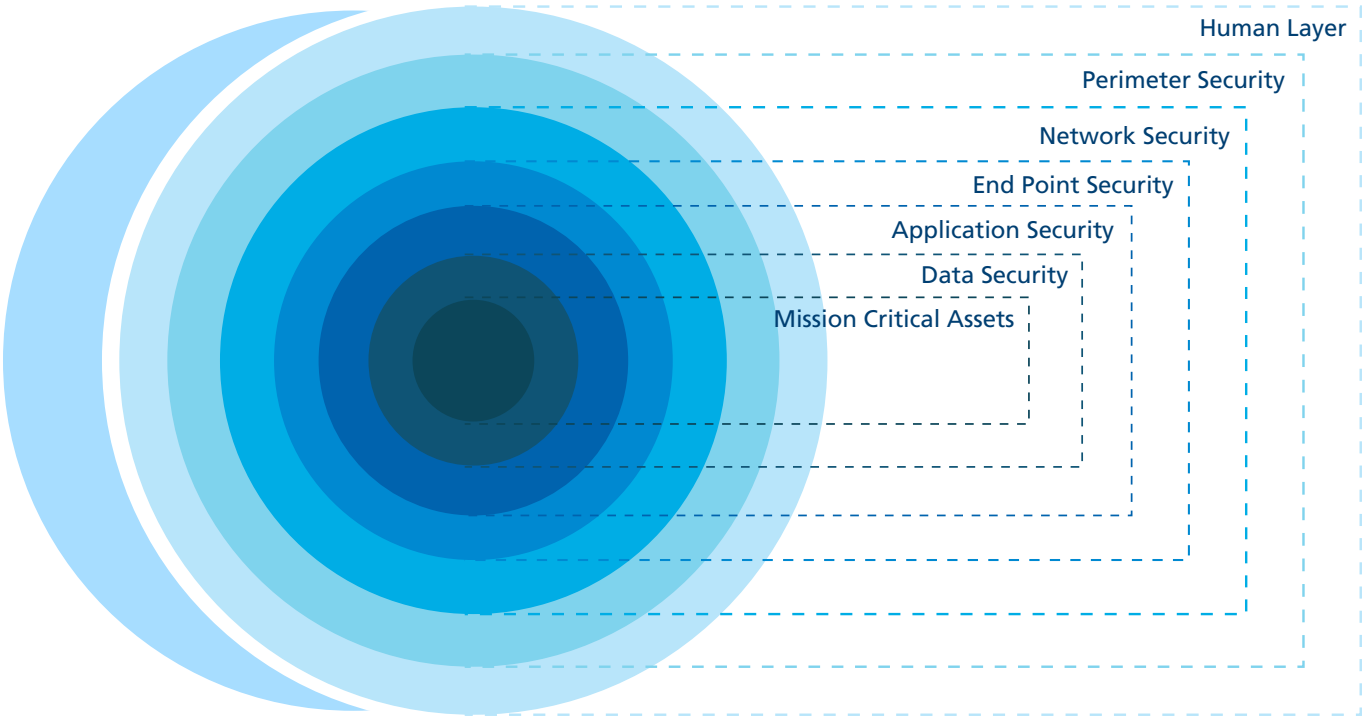
- Distributed energy resource management system
- Microgrid energy management system

Benefits

- **Manage various categories** of distributed energy assets
- **Effectively monitor and control DERs** and gain better insights
- **Ensure better network stability**
- **Lower operational costs** offered by distributed generation
- **Control the output of DERs, ESS, and other energy exchanges**
- **Ensure system efficiency** and economic performance of the microgrid
- Perform **real and reactive monitoring** of power

ICS CYBERSECURITY SERVICES FOR RELIABLE POWER SYSTEM OPERATIONS

7 layers of cybersecurity solutions



With Industrial Control Systems (ICSs) deployed at the heart of controlling and managing the power infrastructures, ICS Cybersecurity has become an important piece in the puzzle to ensure the integrity and reliability of the grid. This is primarily because of the conversion of grid operations from analog devices operated by switches, levers, and dials to a digital system run by programmable intelligent electronic devices on computerized networks. While increasing use of such digital technologies ensures efficient systems, it also exposes such critical infrastructures to the internet, which potentially increases the risks of cybersecurity threats that can arise from several sources ranging from industrial spies to ransom attacks.

Conforming to the best cybersecurity practices is key to safeguard from such risks; this is where we step in, to ensure secured and well-protected power systems for you. Through our services, we bring OT & IT technologies together, delivering an integrated ICS security solution built on the latest security standards and protocols such as IEC 62443. With this, we enable robust and more reliable power infrastructure for you to manage efficiently.

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