T&DWorld

EXECUTIVE SUMMARY

The Energy Transition: Gearing Up for Smarter Utility and Industrial Power Grids

IoT for Utility and Industrial Power Grids: Where Is the Value?

Robert Klaffus, Chief Executive Officer (CEO), Siemens Digital Grid
Arjan Vromans, Electrical Manager, Shell Netherlands Refinery
with Representatives from **CESC Limited, India**

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KEY TAKEAWAYS

- The rapidly changing energy system is driving a need for energy intelligent smart grids.
- Siemens brings intelligence to the distribution grid.
- CESC Limited is using IoT solutions to address its requirements.
- Shell Pernis is working toward fully automated operation, inspection, and maintenance.

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IoT for Utility and Industrial Power Grids: Where Is the Value?

OVERVIEW

The Internet of Things (IoT) is allowing utilities and industrial power grid owners alike to increase the efficiency of their power operations. Using historical and real-time data collected from devices on the distribution grid, organizations can quickly identify and resolve problems before they become major issues impacting consumers and costing the business.

Siemens Digital Grid is helping these organizations look to the future and implement intelligent smart grid to meet their business requirements and improve operational and cost efficiency.

CONTEXT

The speakers discussed the benefits of IoT for utility and industrial power grids and shared some of the solutions that have been implemented to improve efficiency.

KEY TAKEAWAYS

The rapidly changing energy system is driving a need for energy intelligent smart grids.

The energy system is changing rapidly, becoming more decentralized and increasingly complex as more energy is based on renewables. This is driving a need for energy-intelligent grids that bring transparency to operators regarding what is happening on the grid, such as potential overload situations and outages.

By the numbers: The energy system is changing rapidly

- **0.18% to 15.5%:** The annual growth rate of renewable power generation from 1965 to 2019.
- **0.02 million to 7.2 million:** The global electric car fleet from 2010 to 2019.
- **24%:** The CAGR of the energy storage market from 2014 to 2019.
- **7x:** The projected increase in distributed energy resources until 2030.
- **19%:** The estimated CAGR of the microgrid market from 2019 to 2028.

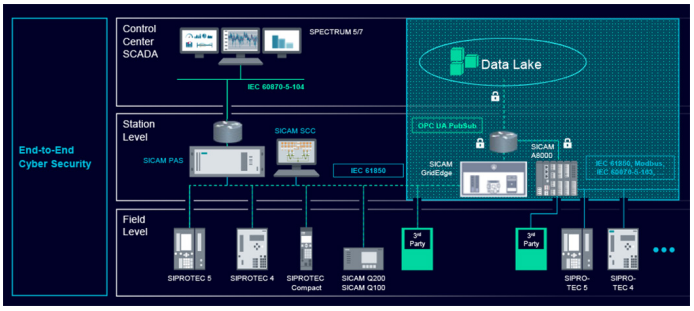
Today, nearly all transmission grids are intelligent, but approximately 90% of all distribution grids are not, making it difficult to support these more complex systems. As massive changes occur within the energy system, distribution grids need to become more intelligent and support the bi- and multi-directional power flows, including not just the high-voltage levels where intelligence is already high, but the medium- and low-voltage levels as well.

> The system today will not be capable of handling this more complex energy system moving forward. One of the reasons is that the distribution grids today are largely dumb.
>
> *Robert Klaffus, Chief Executive Officer (CEO), Siemens Digital Grid*

Siemens brings intelligence to the distribution grid.

Siemens recognizes that bringing intelligence to existing assets and intelligent electronic devices (IEDs) can be costly. With this in mind, the company offers "plug and play" IoT solutions at scale through its Grid Diagnostic Suite.

Figure 1: Architecture of Siemens Grid Diagnostic Suite, including SICAM Navigator and SIPROTEC Dashboard



Within the suite are two key applications, SICAM Navigator, which focuses on incident management, and SIPROTEC Dashboard, which is targeted at efficient maintenance.

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SICAM Navigator & SIPROTEC Dashboard address incident management and maintenance challenges

	SICAM Navigator	SIPROTEC Dashboard
Focus	Incident management	Efficient maintenance
Challenge	– Delayed fault notification – Missing location information – Longer shutdown period	– Missing transparency – Time-based preventive maintenance – Unplanned downtimes
Use Case	– Easy access to fault information – Fast and efficient fault localization – Efficient service notifications	– Continuous online monitoring of parameters – Predictive instead of preventive maintenance – Optimized maintenance planning
Customer Value	– Quick power supply restoration – OPEX savings and CAPEX deferment – Optimized resource planning	– Reduced unplanned outages – OPEX saving/CAPEX deferment – Optimized resource planning

Looking to the future, Siemens sees expanding offerings to include artificial intelligence (AI) for the active management of distribution networks, providing even more transparency. These offerings may include state estimation with machine learning (ML) models, deployment of ML models to edge devices, and distributed intelligence to detect and remedy network congestions.

CESC Limited is using IoT solutions to address its requirements.

The oldest power utility in India, with more than 120 years of experience, CESC Limited has a lengthy list of requirements necessary to improve power delivery to its 3.4 million customers. CESC is implementing several IoT solutions to help them meet these requirements.

> CESC wants to absorb, assimilate, and build on the OEM technology and move forward.
>
> *Udayan Gangula, General Manager Technical, CESC Limited*

Current CESC requirements focus on improving power delivery

Area	Requirements
Maintenance	CESC has already shifted from reactive to preventive; they now want to move on to predictive and prescriptive.
Progressive improvement of network performance	The three areas CESC is working on are: – Improve situational awareness – Add remote manageability – Automate low voltage level for 400 Volt and below
Analytics	The focus is on: – Rule-based and stochastic AI and ML-based insights – Routine decision making riding on objective evidence
Operational technology communication	The focus is on the last mile, as well as self-healing, multi-application and scalable networks.
Mobility	Field force automation, decision making on the go, and operating at the edge are key requirements for CESC.
New technology	CESC needs to be open to assess, adopt, assimilate, and absorb new technology, as well as build on the original equipment manufacturers' (OEMs) solutions.
IT infrastructure	With many OEM solutions offered in a software-as-a-service (SaaS) model, CESC is focused on a cybersecure interconnected, well-orchestrated, and reciprocated multi-vendor IT ecosystem.
Research and development (R&D)	CESC is prioritizing its R&D efforts by collaborating with OEMs and sharing best practices.

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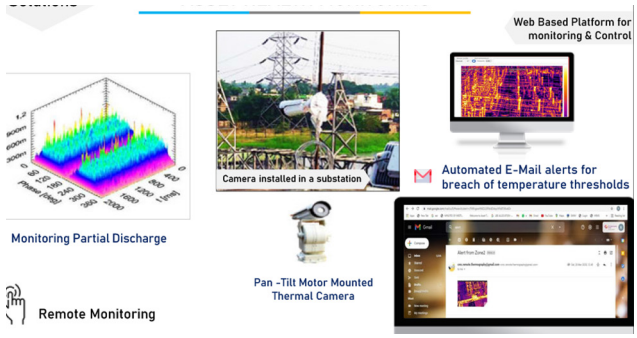
Some of the IoT solutions CESC is using to meet these requirements are:

- **Distribution transformer (DT) monitoring and allied analytics.** CESC has already seen a 50% reduction in annual DT failure and an 80% reduction in annual DT procurement, improving operational efficiency and optimizing CAPEX and OPEX.
- **Smart metering.** CESC is going beyond the common use cases to add value by identifying tariff mismatches and performing real-time micro-energy audits, remote electronic consumer indexation, and meter auto-reconciliation.
- **Asset health monitoring.** Proactive online monitoring allows CESC to avert breakdowns and plan CAPEX better.
- **Digital control and protection.** CESC uses real-time monitoring, mixed reality, and augmented reality to gain insights and act upon them remotely, enabling faster restoration.
- **Data democratization within the organization.** CESC takes decision making to the edge, with tab-based meter inspections and reading, and metering on the go.

Figure 2: Example of CESC's asset health monitoring, which helps avert breakdowns



> A self-healing grid at a substation is edge computing. This technology will be welcome in the future as the grid becomes more and more complicated and the tolerance of the consumer for outages reduces.
>
> *Sanjoy Mukherjee, Vice President Distribution Technical, CESC Limited*

Shell Pernis is working toward fully automated operation, inspection, and maintenance.

One of the largest petro-chemicals sites in Europe, Shell Pernis has an extensive but aging electrical infrastructure mixed with some modern equipment. As Shell builds new plants that support fully automated operation, inspection, and maintenance, Shell Pernis also seeks to take advantage of innovations that drive this level of efficiency across the site.

Working with Siemens when grounding the opportunity, Shell Pernis realized that only 5% of the thousands of data objects available—typically 1,000 data objects per IED—were available to staff. Instead, they wanted to ensure that all historical and real-time data would be easily available and usable by users across the engineering community.

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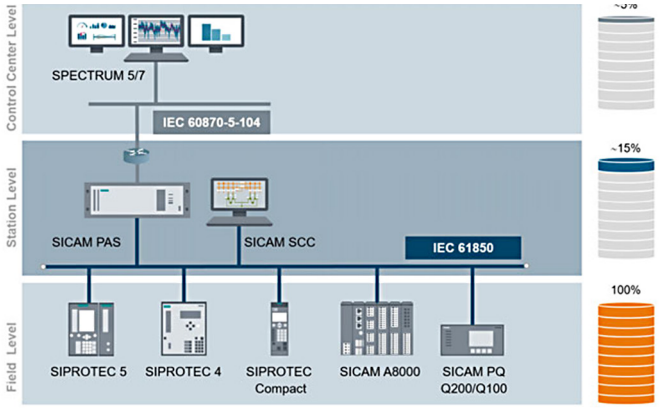
Figure 3: Siemens opportunity grounding shows only 5% of data is available for Shell Pernis users



Siemens and Shell Pernis focused on making more data available from the high-voltage electrical network by connecting IEDs to a data platform, enabling easy access to historical and real-time data for users in engineering, plant, and maintenance to analyze and combine with other data.

Riding on the success of the project, Shell Pernis is planning to work closely with Siemens to use data analytics to avoid equipment failures.

> Autonomous operation is the next step. I think we're closer to that than we think. We have a few challenges, but with Siemens we can realize a lot of things in the near future.
>
> *Arjan Vromans, Electrical Manager, Shell Netherlands Refinery*

BIOGRAPHIES

Sanjoy Mukherjee

Vice President Distribution Technical, CESC Limited

Sanjoy Mukherjee has some 30 years of experience in the area of power transmission and distribution network planning as well as in grid design, construction, asset creation, technology adoption, automation, and thermal power projects.

Robert Klaffus

Chief Executive Officer (CEO), Siemens Digital Grid

Since April 01, 2019, Robert Klaffus is responsible as Chief Executive Officer (CEO) for the global Digital Grid business at Siemens Smart Infrastructure. Robert holds a degree in Industrial Engineering and Operations Research and a master's degree in business administration from the Technische Universität Berlin and ESCP Europe. He also holds an Executive MBA with Corporate Finance specialization from IE Business School. Robert has collected lots of experiences over years in the whole energy sector with a focus on power distribution and energy automation.

Udayan Ganguly

General Manager Technical, CESC Limited

Udayan Ganguly has over three decades of power distribution utility experience—both for licensee and franchisee models of operation. His core areas: technology adoption, automation, and smart grid applications.

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Arjan Vromans
Electrical Manager, Shell Netherlands Refinery

After completing his studies in electrical engineering, Arjan Vromans started his career as a consultant power system analysis at KEMA, from where he made the switch to the petrochemical industry. Arjan has been working for Shell for over 20 years in different locations such as the Middle East, Siberia, and his current work location Pernis near Rotterdam. At Pernis, Arjan is currently both electrical manager and electrical installation manager. In these years he has formed a clear vision on how through innovation and digitalization the maintenance and management of electrical installations can be optimized and how these contribute to the reliability of the electrical network, which will become increasingly important due to electrification as a result of the energy transition. Together with Siemens, Arjan was able to take the first steps in implementing data-driven maintenance and management of electrical installations.