Digital Applications for Large Buildings & Critical Facilities

IEC Design Guide

ESXP2G001EN-05
11/2023

EcoStruxure™ Power

Schneider Electric™

Legal Information

Purpose of this Document

Target Audience

This design guide is intended for certified EcoXpert partners, System Integrators, Specifiers, electrical distribution designers, and other qualified personnel who are responsible for the design of projects.

Objective

The objective of EcoStruxure Power is to offer a range of digital applications to fulfill customers’ needs in large buildings and critical facilities such as data centers, large hotels, healthcare, industrial facilities, etc.

This document details the system design considerations for the electrical installation that must be taken into account when designing a digital architecture.

Also, it explains how to select the most appropriate digital applications according to the end users' needs, and how to implement these applications to meet the system design considerations.

This technical guide provides a special focus on all the necessary building blocks required at each level, for each application.

Table of Contents

Introduction

What’s in This Part

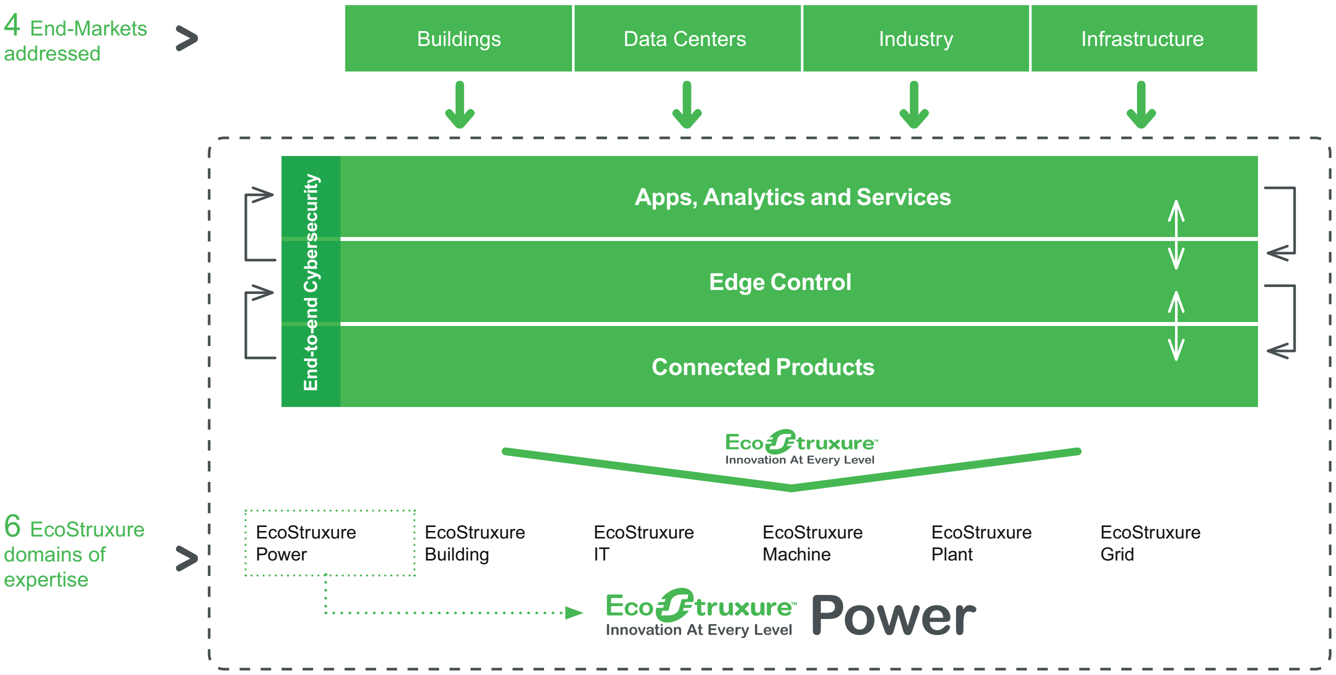
Overview of EcoStruxure Power

What's in This Chapter

Introduction

As shown in the diagram below, and indicated by the green arrows, EcoStruxure Power is one of the six domains of EcoStruxure, our IoT-enabled architecture and platform.

EcoStruxure Power plays a key role in all four End-Markets (Buildings, Data Centers, Industry, and Infrastructure). This involves bringing the world of digitalized electrical distribution to those End-Markets.

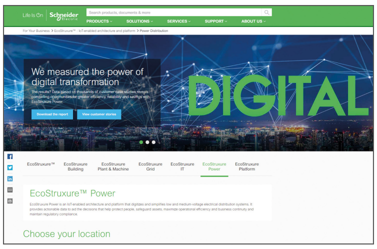


EcoStruxure's integrated architecture serves four End-Markets with its six domains of expertise.

OUR VISION OF A NEW ELECTRIC WORLD	The world is becoming more electric and digital, and power is becoming more distributed, more complex to manage, and more integrated into our everyday lives. We envision a New Electric World where building staff and occupants are safer, with zero electrical safety incidents. Where power is 100% available, with zero unplanned downtime. Where energy and operations are more efficient, with zero energy waste. And where operational systems are resilient, with zero cyber intrusions. We strive to make this vision a reality with our IoT-enabled EcoStruxure architecture and platform, which we deliver through our connected energy management ecosystem – a collective of partners and industry experts who are openly collaborating with us to push innovation, enhance productivity, reduce risk, and unlock new opportunities for sustainable growth.

EcoStruxure Power Value Proposition

- **EcoStruxure Power digitalizes and simplifies low and medium voltage electrical distribution systems**. It provides essential data to aid the decisions that help protect people, safeguard assets, maximize operational efficiency and business continuity, and maintain regulatory compliance.
- **EcoStruxure Power is an open architecture and platform** designed with the intention of making it easy to add, upgrade, and swap components. The world is full of electrical distribution systems in various stages of maturity, produced by a variety of manufacturers. Interoperability with EcoStruxure Power is essential to making these power distribution systems future ready. The added benefit of a holistic Schneider Electric system is the plug-and-play connectivity to achieve faster and lower risk integration and commissioning.
- **EcoStruxure Power architectures are cost-optimized** to deploy, using only the right technology to deliver the desired business outcomes for our customers – no more, no less. However, customer needs or demands change over time.
- The **EcoStruxure Power system is scalable** from light commercial and industrial buildings to critical facilities such as hospitals, data centers, or infrastructure such as airports, rail, and energy and chemicals. The scalability of EcoStruxure Power means it also grows and evolves with changing needs or demands through its modular architecture.
- **EcoStruxure Power architectures are fully flexible power distribution systems** with the ability to adapt to dynamic and ever-changing conditions, such as balancing supply and demand by the hour or minute or adding and then scaling on-site renewable generation capabilities over time. Connecting IT and OT systems into a single, easy-to-manage IP network is at the heart of our digitalization story. With EcoStruxure Power, facility managers can use the data they collect to make real-time decisions to maximize business continuity and optimize operations.
- **EcoStruxure Power architectures enable remote and on-site consultancy** to help maximize uptime, optimize maintenance costs, and improve operator efficiency while extending asset and system life expectancy.



EcoStruxure Power Landing Page

Learn more about EcoStruxure Power, Schneider Electric’s digital solution for electrical distribution to help improve electrical safety, power availability, sustainability, and cybersecurity. Get access to customer testimonials, useful resources, and more!

https://www.se.com/ww/en/work/campaign/innovation/power-distribution.jsp

About the Guide

What's in This Chapter

General Methodology for Designing Digital Applications for Large Buildings and Critical Facilities

Building a digital electrical installation is much easier if you follow the steps below:

Understand the desired outcomes of the end user.

Define the electrical installation, depending on the building's type and constraints.

See:

- Electrical Installation Wiki
- Medium Voltage Technical Guide, Ref. AMTED300014EN

Define the system design considerations for your installation.

See Defining the System Design Considerations, page 12

Select the required digital applications and learn how to implement them in the installation.

See Overview of Digital Applications, page 35

Select the correct:

- Connected Products, page 364
- Edge Control Software and Configuration Tools, page 372
- Apps, Analytics, and Services , page 374

Do you need help?

Find an EcoXpert Partner

See EcoXpert, page 382

Structure of the Guide

Part Defining the System Design Considerations, page 12 addresses design considerations of the electrical installation in the context of system communications, data recording and timestamping, time synchronization, data processing, data quality management, and cybersecurity.

Part Selecting and Implementing the Digital Applications, page 33 outlines the values provided by all EcoStruxure Power applications and provides information on how to select the most appropriate applications according to the end user's needs. It also explains how to implement these applications in a defined electrical architecture to be compliant with the system design considerations. It identifies all necessary building blocks required at each level, for each application, and how to connect those building blocks to Edge Control software and/or to cloud-based Analytics and Services.

The **Appendix**, page 363 provides a brief description of all key connected products, Edge Control software, and cloud-based Services.

The **Bibliography**, page 376 provides links to useful documentation.

Information about our **EcoXpert**, page 382 and **Green Premium**, page 383 programs is available at the end of the guide.

Defining the System Design Considerations

What's in This Part

Introduction

Why Read This Part

The purpose of this part is to highlight elements to take into account when designing a digital power distribution system, that impact product and solution choices.

These considerations are important because they can help reduce the overall integration risk, improve compatibility, simplify installation and commissioning, and optimize system cybersecurity.

Contents of This Part

This part discusses the following system design considerations and their relevancy to the implementation of EcoStruxure Power applications in Selecting and Implementing the Digital Applications, page 33:

Communications

What's in This Chapter

EcoStruxure Communication Protocols

EcoStruxure Power digital platform uses open communication protocols to aggregate data from connected products installed in MV/LV equipment, metering, and other sensors. These include:

- Modbus over serial communication
- Modbus TCP
- Industry standard wireless communication
- Other standard protocols used in the electrical distribution domain such as IEC61850

The preferred method of system and connected product communications is direct Ethernet.

Modern sophisticated power system connected products have rich data types that can generate large amounts of data, such as power quality data, which requires a high bandwidth connection to the monitoring software.

For connected products with serial communication only, the connection is made via gateways through serial daisy-chains with, typically recommended, not more than eight connected products.

EcoStruxure Communication Drivers

EcoStruxure Power supports two types of communication drivers:

- Native drivers for Schneider Electric connected products, including drivers for legacy connected products allowing modernization of systems with a step-by-step approach based on the life cycle of the assets
- Drivers for third-party connected products using open protocols, such as Modbus, DNP3, IEC61850, BACnet, and OPC can be easily created to capture real-time data using purpose-built productivity tools in EcoStruxure Power Monitoring Expert and Power Operation.

Data Recording and Timestamping

What's in This Chapter

Data Recording Options

In the EcoStruxure Power digital platform, data recording can occur at various levels of the architecture. Connected products, depending on their level of sophistication, can record data as follows:

- All data recorded and timestamped on board
- Only event and alarm data recorded and timestamped on board
- No onboard logging; real-time data only. Data recording and timestamping are performed by a data logger or Edge Control software.

Recommended Time Accuracy

The time criticality of an application defines the recommended time accuracy of data logged for the application to achieve its intended output.

The overall time accuracy level of a digital system will be derived both from the individual performance of the connected product timestamp and by the synchronization of system components to a single, reliable, and accurate time reference.

Applications	Time Criticality	Recommended Time Accuracy [+/-]	Minimum Required Time Accuracy [+/-]
Advanced Protection and Automation	High	1 ms	10 ms
Arc Flash Protection	High	1 ms	10 ms
Asset Performance	Low	1 s	10 s
Backup Power Testing	Medium	10 ms	100 ms
Circuit Breaker Settings Monitoring	Low	1 s	10 s
Capacity Management	Low	1 s	10 s
Continuous Thermal Monitoring	Low	1 min[1]	5 min[1]
Cost Allocation	Low	1 s	10 s
Electrical Asset Life Cycle Management	Low	1 min	5 min
Electrical Distribution Monitoring and Alarming	Medium	10 ms	1 s
Energy Benchmarking	Low	1 s	10 s
Energy Efficiency Compliance	Low	1 s	10 s
Energy Modeling and Verification	Low	1 s	10 s
Energy Monitoring	Low	1 s	10 s
Energy Performance	Low	1 s	10 s
Greenhouse Gas Reporting	Low	1 s	10 s

1. For continuous thermal monitoring application, considering the time constant of the physical phenomonena observed (temperature rise of electrical conductors), time accuracy in the range of a minute is acceptable.

Applications	Time Criticality	Recommended Time Accuracy [+/-]	Minimum Required Time Accuracy [+/-]
Guided Procedures Through Extended Reality	Low	1 s	10 s
Insulation Monitoring	Low	1 s	10 s
Microgrid	Medium	10 ms	100 ms
Operator Training Simulation[2]	High	1 ms	10 ms
Power Event Analysis	High	1 ms	10 ms
Power Factor Correction	Low	1 s	10 s
Power Quality Correction	Low	1 s	10 s
Power Quality Monitoring and Compliance	Medium	10 ms	100 ms
Power Source and Load Control	Medium	10 ms	100 ms
Simulate Before Operate[2]	High	1 ms	10 ms
Utility Bill Verification	Low	1 s	10 s

Time Synchronization

Purpose of Time Synchronization

When data is recorded and timestamped on board field devices, it is important to ensure that their internal clocks are accurate with respect to other devices and local time. The setting of devices to a single time reference is called time synchronization.

Time Synchronization Protocols

Various protocols and methodologies may be used to implement time synchronization.

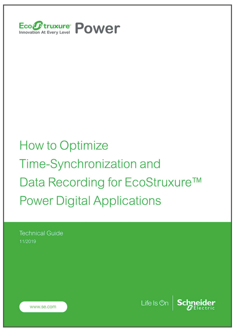
Some of the most expensive, but most accurate time synchronization technologies rely on **non-Ethernet protocols** (for example **IRIG-B, DCF77**) linked to a GPS antenna, GPS receiver, and clock.

Ethernet-based protocols provide more economical solutions. The most cost-effective but less accurate approach is achieved with **Modbus-based (or ION-based) time synchronization** over an Ethernet or serial communications network.

Protocols such as **NTP/SNTP** are now commonly supported by a wide range of connected devices and can provide sufficient performances for non-critical applications, typically in the range of 1 s down to 10 ms, at an affordable cost.

A recent Ethernet-based protocol called **PTP (Precision Time Protocol)**, defined in IEEE 1588 and IEC 61588, can achieve even more accurate time synchronization, in the range of 1 ms or better, offering a strong alternative to serial line based protocols.

2. For these applications, the time accuracy requirements only concern time synchronization between computers. Connected products are not concerned by the time accuracy requirement.



How to Optimize Time-Synchronization and Data Recording for EcoStruxure Power Digital Applications

Technical Guide
Ref: ESXP2TG001EN
11/2019

Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products

The table below highlights the data recording capabilities and supported time synchronization methods.

Connected Product	Product Category	Data Recording Capabilities[3]		Maximum Achievable Time Synchronization Accuracy / Compatible Time Synchronization Protocols[3 4]							
		Event Log	Measure-ment Log	1 ms		10/100 ms	100 ms	1 s			
				PTP	IRIG-B	NTP	DCF 77	SNTP	1per10	Over Mod-bus	Over ION
PROTECTION, MONITORING, and CONTROL DEVICES											
PowerLogic P5	Advanced High	●		●	●			●		●	
PowerLogic P3	Advanced High	●			●			●		●	
PowerLogic C5	Advanced High	●		●				●			
PowerLogic T300	Advanced High	●		●				●		●	
MasterPacT MTZ (with IFE/eIFE)	Advanced Limited	●				●		●		●	
ComPacT NSX (with IFE)	Advanced Limited	●				●		●		●	
TransferPacT Active	Advanced Limited	●								●	
ASCO 7000 Series PTS - Group 5 Controller	Advanced Limited	●								●	
Acti9 Active[5]	Basic										
Arc V121 / PowerLogic A125[5]	Basic										
ASCO 7000 Series PCS - Modicon M580	Advanced High	●	●			●				●	
ASCO SPD with ASM	Standard	●									
ASCO CPMA	Advanced Limited	●									
INSULATION MONITORING and FAULT LOCATION DEVICES											
Vigilohm IM20-H	Advanced Limited	●	●							●	
Vigilohm IFL12-H/IFL12	Advanced Limited	●	●							●	
Vigilohm IM400	Advanced Limited	●	●							●	
POWER METERS											
PowerLogic ION9000	Advanced High	●	●	●	●	●		●		●	●
PowerLogic PM8000	Advanced High	●	●	●	●	●		●		●	●
PowerLogic PM5000	Advanced Limited	●	●					●		●	
PowerLogic HDPM6000	Advanced Limited	●	●			●					
Acti9 iEM3000	Advanced Limited									●	
PowerLogic PowerTag	Standard										
ASCO 5200	Advanced Limited	●									
PLC and PAC											
Modicon M251 (SMD)	Advanced Limited	●						●		●	
Modicon M580	Advanced Limited	●				●		●		●	
Modicon M580 with ERT module	Advanced High	●			●	●	●	●		●	
Modicon M340	Advanced Limited	●				●		●		●	
POWER QUALITY MITIGATION, POWER FACTOR CORRECTION, and UPS DEVICES											
PowerLogic AccuSine PCS+[5]	Standard										
PowerLogic AccuSine PCSn[5]	Standard										
PowerLogic AccuSine EVC+[5]	Standard										
PowerLogic AccuSine PFV+[5]	Standard										
PowerLogic PFC[5]	Basic										
Galaxy VX	Advanced Limited	●						●		●	
Galaxy VL	Advanced Limited	●						●		●	
Galaxy VM	Advanced Limited	●						●		●	
Galaxy VS	Advanced Limited	●						●		●	
COMMUNICATION DEVICES, GATEWAYS, and DATA LOGGERS											
EcoStruxure Panel Server PaS400	Advanced Limited							●			
EcoStruxure Panel Server PaS600	Advanced Limited							●			
EcoStruxure Panel Server PaS800	Advanced Limited	●	●					●			
Acti9 Smartlink Modbus	Advanced Limited							●		●	
PowerTag Link	Advanced Limited							●		●	
Harmony Sologate ZBRN32[5]	Standard										
EcoStruxure Power Automation System Gateway[6]	Advanced High	●	●					●			
Cyber Sciences SER 3200/2408	Advanced High	●	●	●	●	●	●			●	
Connexium Managed Switches	Advanced Limited					●		●			
SENSORS											
PowerLogic TH110/CL110[5]	Basic										
PowerLogic HeatTag[5]	Basic										

For a definition of "product categories" and for more information on time synchronization and how to implement such a feature in a digital architecture, please refer to the dedicated How to Optimize Time-Synchronization and Data Recording for EcoStruxure Power Digital Applications

3. Product can acquire new capabilities. Capabilities to be confirmed when ordering.
4. These are typical accuracies. Refer to product technical documentation for information on the maximum reachable accuracy.
5. Time synchronization is performed by an upstream host.
6. This product also supports time synchronization through DNP3 and IEC101/1.

Data Processing

Data Processing Levels

Data processing in EcoStruxure Power is carried out at three possible levels:

- Onboard connected products
- In Edge Control software
- In cloud-based applications

Typically, all connected products perform some level of onboard processing. The remaining processing is done either in Edge Control or in cloud-based applications. More sophisticated connected products typically perform more of the data processing on board versus in Edge Control.

Onboard Device Data Processing

Some EcoStruxure connected products (PowerLogic ION9000, PM8000, etc.) provide significant onboard processing for sophisticated functionalities such as power quality event detection and recording and Disturbance Direction Detection (DDD). These features require high speed detection and processing which otherwise would not be possible over software to connected product communications.

Edge Control Software Data Processing

Secondary data processing is found in EcoStruxure Power Monitoring Expert and Power Operation. For features such as the reporting module, data processing is performed at the Edge Control level. It provides post processing of data for evaluation against regulatory standards or for converting data into easy to understand information.

Cloud-Based Applications Data Processing

Cloud-based data processing provides similar benefits to those found in Edge Control and it can additionally benefit from Machine Learning and Artificial Intelligence. It evaluates data using predictive asset maintenance algorithms and converts data into easy to understand information.

Data Integration and Interoperability Between Systems

What's in This Chapter

Why Integrate Operational Systems

With the considerable evolutions in IoT, capabilities of Power Management Systems (PMSs) have evolved to enable greater levels of analysis of power systems' operations and maintenance. Thus, Power Management Systems such as EcoStruxure Power Monitoring Expert and Power Operation monitor, analyze, and report all types of data from the connected electrical distribution products.

Sometimes, to enhance operational intelligence and the efficiency of facility and maintenance teams, data can be exchanged between the Power Management System and some other systems like Building Management Systems (BMS; such as EcoStruxure Building Operation) or Industrial Automation platforms (IA; such as AVEVA System Platform or Citect SCADA).

For example:

- Environmental conditions provided by the Building Management System can be used in the Power Management System to make correlations with the energy consumption.
- Electrical data from the Power Management System can be used in the Building Management Systems for consolidation of global building information.
- Information about process conditions, provided to the Power Management System by the Industrial Automation platform, can help identify the origin of a power event that affects the industrial process.

Traditionally, Power Management Systems, Building Management Systems, and Industrial Automation platforms are specified, designed, and commissioned separately, sometimes by specialized design consultants and through dedicated trade contractors (mechanical and electrical contractors). Each project stakeholder should consider the best way to deliver the end users' outcomes with the most optimal technical solution.

Integration of such systems with the user's outcomes in mind provides multiple advantages:

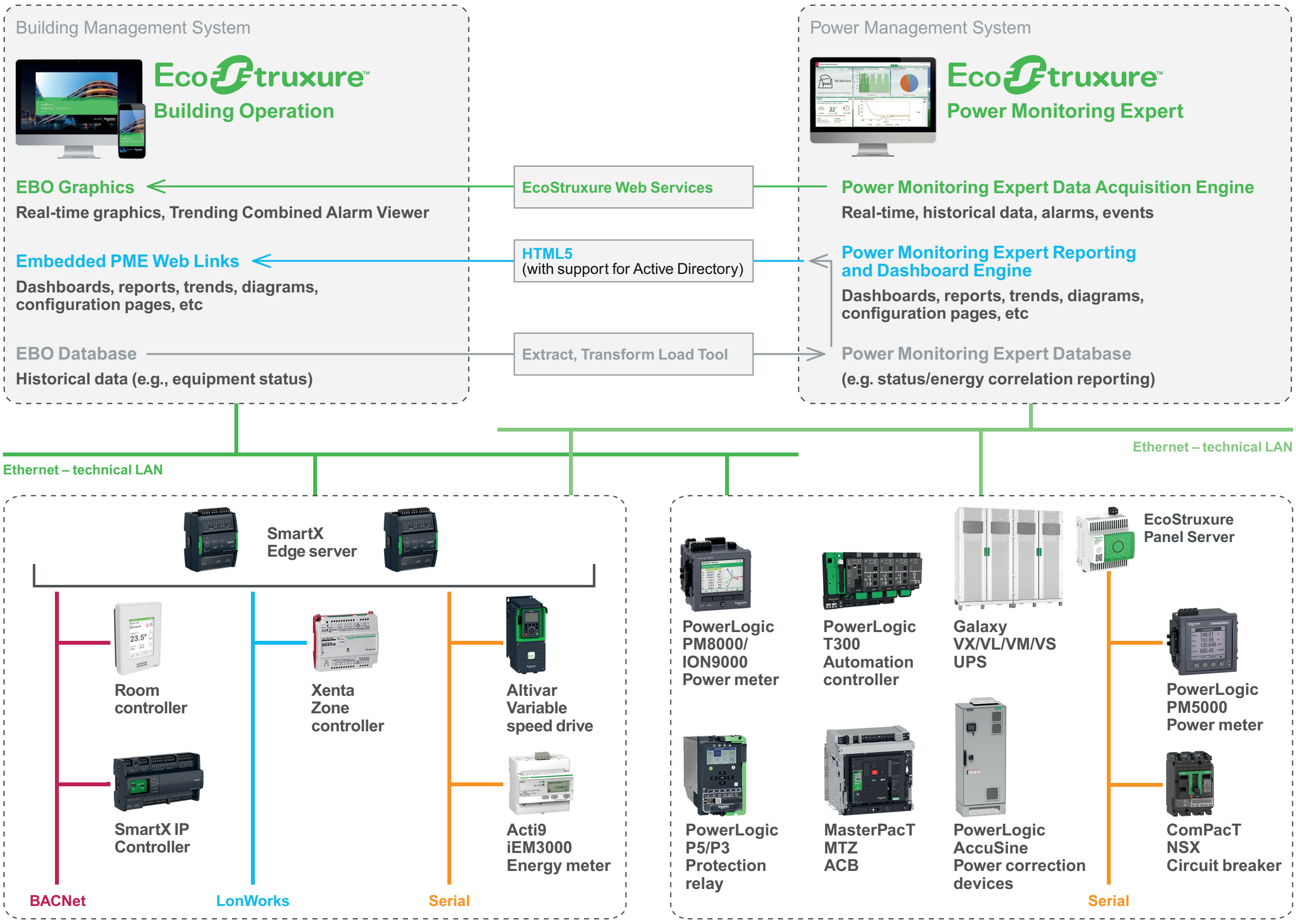
- Take advantage of the specialized capabilities of each platform such as acquisition of specialized data types like electrical waveforms.
- Improve user experience
- Help the project phase stakeholders deliver high quality systems at an optimized cost
- Take advantage of IP communications to optimize wiring between products and/or wiring from products to the automation controllers or enterprise server.

Integration with Other EcoStruxure Systems

This guide presents several applications where EcoStruxure Power Monitoring Expert or Power Operation can be integrated with other EcoStruxure or third-party systems.

Example of Integration with EcoStruxure Building Operation (EBO)

The goal of integrating EcoStruxure Power Monitoring Expert with EcoStruxure Building Operation is to provide a single pane of glass for these two operational systems. This allows integrated mechanical and electrical facility management/ maintenance teams to monitor both operational systems in a common interface.



Example of Combined Solution with EcoStruxure Building Operation and EcoStruxure Power Monitoring Expert

Data acquisition

- Electrical and energy data (including real-time, historical data, and events) from power and energy meters, circuit breaker trip units, and other intelligent electrical connected products (Schneider Electric or 3rd party) is acquired by EcoStruxure Power Monitoring Expert (or EcoStruxure Power Operation– not shown in the diagram below).
- Mechanical data from Automation Servers and other mechanical field connected products is acquired by EcoStruxure Building Operation.

Integration of EcoStruxure Power Monitoring Expert data into EcoStruxure Building Operation

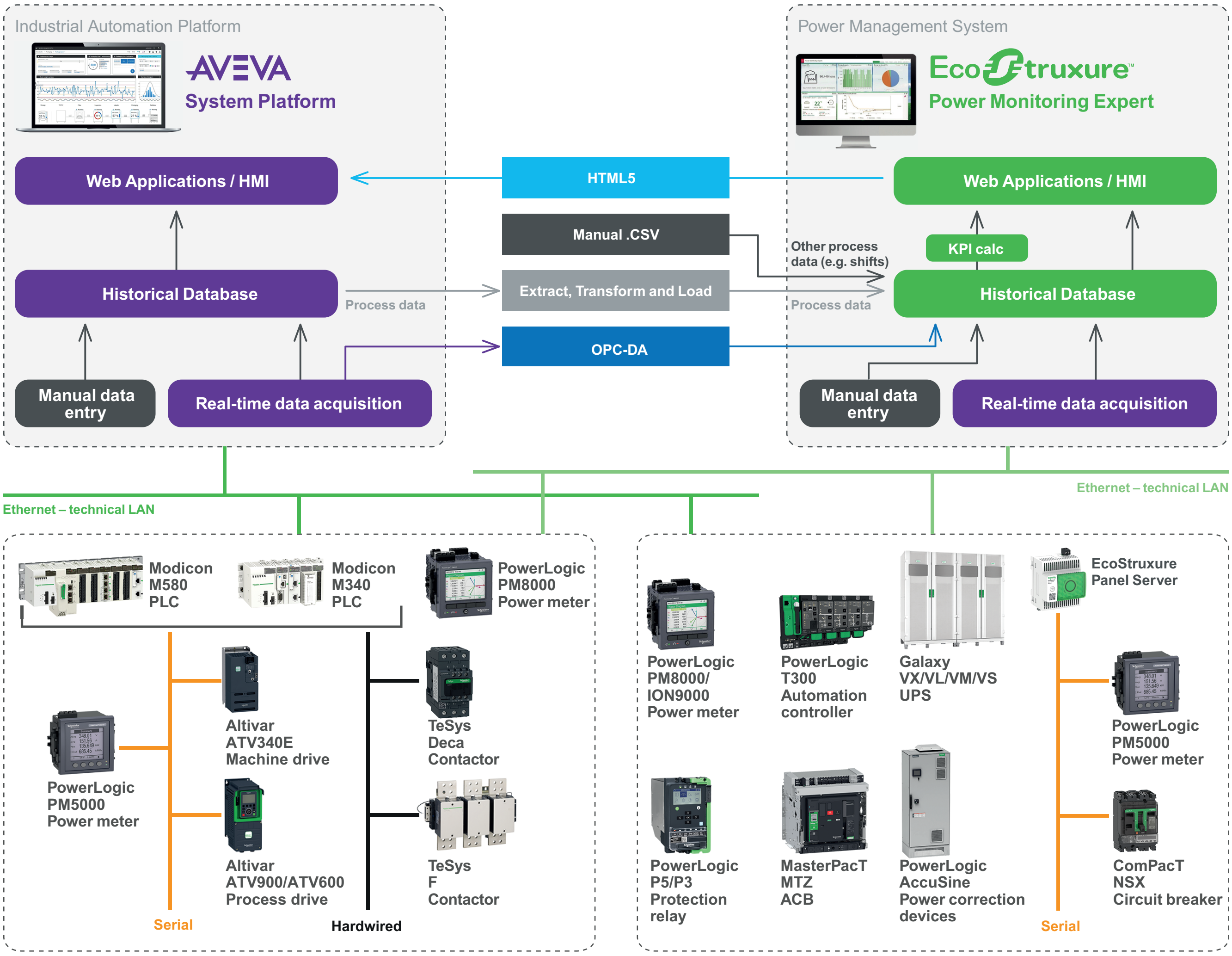
- Electrical and energy data from EcoStruxure Power Monitoring Expert is transferred to EcoStruxure Building Operation using EcoStruxure Web Services to be visualized in the EcoStruxure Building Operation Web interface.
- HTML5 web applications from EcoStruxure Power Monitoring Expert can also be integrated into the EcoStruxure Building Operation web interface (diagrams, dashboards, reports, etc.).

Integration of EcoStruxure Building Operation data into EcoStruxure Power Monitoring Expert

- Historical data (such as equipment status) can be exchanged from EcoStruxure Building Operation to EcoStruxure Power Monitoring Expert using an ETL[7] engine to enable normalization of energy data with operational data from the Building Management System.

Example of Integration with EcoStruxure Plant (AVEVA System Platform)

The goal of integrating EcoStruxure Power Monitoring Expert with EcoStruxure Plant is to improve plant operation. For example, to help identify the origin of a power event that affects the industrial process, or to analyze the energy usage correlation with production processes to help continuously improve energy efficiency of plant operations.



Example of Combined Solution with EcoStruxure Plant (AVEVA System Platform) and EcoStruxure Power Monitoring Expert

Data acquisition

- Electrical and energy data (including real-time, historical data, and events) from power and energy meters, circuit breaker trip units, and other intelligent electrical connected products (Schneider Electric or third party) is acquired by EcoStruxure Power Monitoring Expert (or EcoStruxure Power Operation– not shown in the diagram above).
- Process data from PLCs, drives, or other process field devices is acquired by the SCADA software such as AVEVA System Platform.

7. The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert and Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then convert that data so it can be loaded into another application.

Integration of AVEVA System Platform data into EcoStruxure Power Monitoring Expert

Capture in EcoStruxure Power Monitoring Expert or Power Operation of the most significant factors in the customer process is done through the standard integration capabilities provided with EcoStruxure Power Monitoring Expert or Power Operation. This includes using:

- OPC[8] DA[9] standard (EcoStruxure Power Operation also supports OPC AE[10] Server and UA[11] Client)
- ETL (Extract, Transform and Load) utility
- Other simple data exchange formats such as .CSV, which can be imported into the database of the process SCADA system

Integration of EcoStruxure Power Monitoring Expert data into AVEVA System Platform

HMI integration can be done by integrating the HTML web pages of EcoStruxure Power Monitoring Expert inside EcoStruxure Plant's SCADA HMI to visualize normalized energy and process KPIs.

Interoperability with Third-Party Systems

For interoperability with third-party systems, EcoStruxure Power Monitoring Expert and Power Operation support OPC[8] DA[9] client and server functionality.

OPC is a set of open standards for connectivity and interoperability of industrial automation and the enterprise system. OPC provides a bridge between Windows-based applications and process control hardware, thereby eliminating the need for proprietary or custom interfaces and drivers for the various data types and sources residing in the corporate information network.

Additionally, EcoStruxure Power Operation provides extended OPC AE[10] server and OPC UA[11] client functionality.

8. Open Platform Communications
9. Data Access
10. Alarms and Events
11. Unified Architecture

Data Quality Management

What's in This Chapter

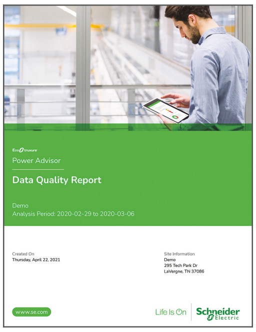
Purpose of Data Quality Management

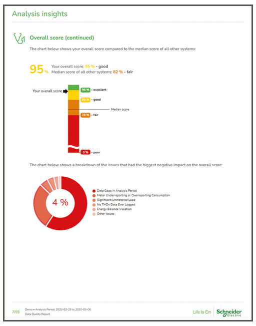
Data quality is the basis for reliable digital power systems. It is the foundation for operational decision making. Studies have shown that 80% of digital electrical distribution systems have outdated configurations or data quality issues. The source of this bad data can originate from wiring mistakes in the panel shop, installation mistakes when the panel is connected on site, and commissioning mistakes when the panel is tied into the Edge Control software. Other sources of data quality errors result from maintenance activities, system expansions, or retrofits.

Poor data quality can result in organizations being unable to demonstrate appropriate actions and decision making for energy saving programs associated with the ISO 50001 certification program. It can also result in general ill-informed decision making related to the electrical distribution operation, and root cause analysis of events that occur.

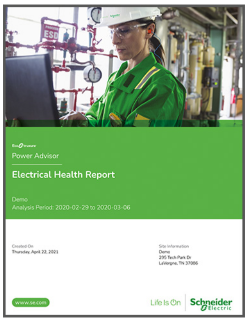
Facility Managers, Plant Managers, and Operators need to be able to rely on 100% accurate electrical distribution monitoring data to make sound decisions about electrical safety, power availability, and sustainability. In addition, they often need to provide accurate data to external stakeholders or applications.

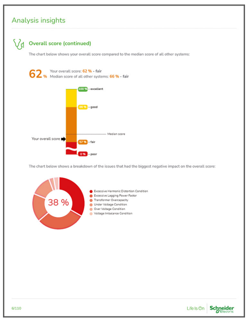
EcoStruxure Power Advisor and Service Plan are available to help address these issues.





EcoStruxure Power Advisor Data Quality Report - Overall Score





EcoStruxure Power Advisor Electrical Health Report - Overall Score

EcoStruxure Power Advisor and Service Plan

This cloud based analytics and services offer provides:

Regular system health checks to:

- Help ensure the power system is configured correctly
- Identify system wiring or installation issues
- Identify communication problems, data issues, and gaps
- Detect electrical system health issues (refer to Power Quality Monitoring and Compliance application)

Proactive expert guidance and decision support to:

- Find all system issues and performance problems using statistical interpretation
- List potential causes and recommended actions
- Understand the impact of leaving these issues unresolved

Data Quality Management in More Detail

EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts or our EcoXperts.

EcoStruxure Power Advisor is available with EcoStruxure Power Monitoring Expert or Power Operation.

Data Quality Checks

EcoStruxure Power Advisor data quality checks are performed periodically using expert analytics based on electrical measurements and connected product diagnostic data from any power and energy meter, embedded metering in circuit breakers, and third-party connected products.

The data quality check includes the following analytics on the system:

- No data in the query period
- All zero values
- An energy balance violation (based on parent and submeter energy measurements)
- Some negative values
- Consistently negative values
- Unchanging values
- Irregular energy consumption (underreporting or overreporting)
- Irregular connected product logging periods
- Mismatched logging intervals
- Frequent logging (<1 minute intervals)
- Significant unmetered Load (>20%)

Recommendations

Expert service engineers provide consultations and recommendations based on these analytics through direct and regular engagement with the end user on the following results of the data quality check:

- Overall system performance
- List of relevant issues
- System statistics per issue identified
- Description of issues
- List of potential causes and recommended actions

Cybersecurity

What's in This Chapter

Why Consider Cybersecurity when Designing an Electrical Architecture

The demands of modern IoT applications increase the complexity of systems' infrastructure and put additional pressure on IT and OT security. As the frequency and sophistication of cyberattacks increase, operations must leverage industry standards to achieve consistent protection.

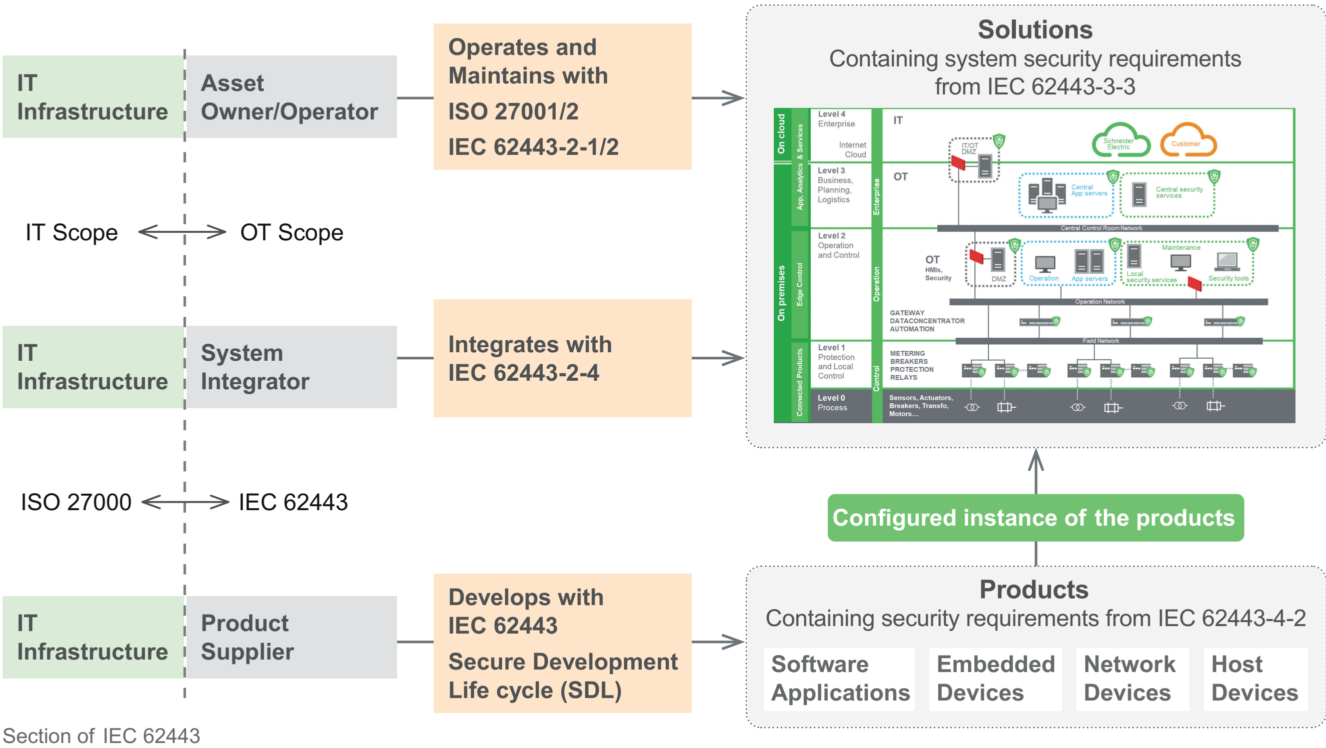
The challenges posed by operational technology are burgeoning regulations for cybersecurity, common protocols being increasingly exploited, the explosion of connected products and growing numbers of attack surfaces. Because of this, operational technology security has three main priorities – availability, integrity, and confidentiality.

Firstly, operational systems in large buildings and critical facilities in particular require high availability of the applications or processes they support as a top priority. While availability of power is of utmost importance, ensuring high data integrity upon which decisions are made is also essential in the digital age. Finally, confidentiality of data that could be used to determine trade secrets based on operational data is the third leg of the OT security triad.

See our white paper for more backgroud information: Understanding cybersecurity for IoT-enabled electrical distribution systems

IEC 62443 Standard

The IEC 62443 standard provides a comprehensive ecosystem of cybersecurity requirements for different actors involved in the life cycle of an electrical distribution or industrial control system. This involves a specific focus on the people, processes, and technology required by these systems.



Section of IEC 62443

IEC 62443 Security Levels

This includes the concept of security assurance levels. The specification defines a series of requirements designed to bring system security to one of the four defined levels. A summary of each level coupled with a characterization of the type of attacker the security level is designed to address is presented in the table below:

Security Levels of IEC 62443

Security Level	Target	Skills	Motivation	Means	Resources
SL1	Casual or coincidental violations	No Attack Skills	Mistakes	Non-intentional	Individual
SL2	Cybercrime, Hacker	Generic	Low	Simple	Low (Isolated Individual)
SL3	Hacktivist, Terrorist	ICS Specific	Moderate	Sophisticated (Attack)	Moderate (Hacker Group)
SL4	Nation State	ICS Specific	High	Sophisticated (Campaign)	Extended (Multi-disciplinary Teams)

Risk-Based Approach

IEC 62443 follows a risk-based approach and can be aligned with the methodology used for functional safety based on IEC 61508. Security assurance levels should be selected based on a risk assessment of the infrastructure and operations, as seen in the example risk matrix below:

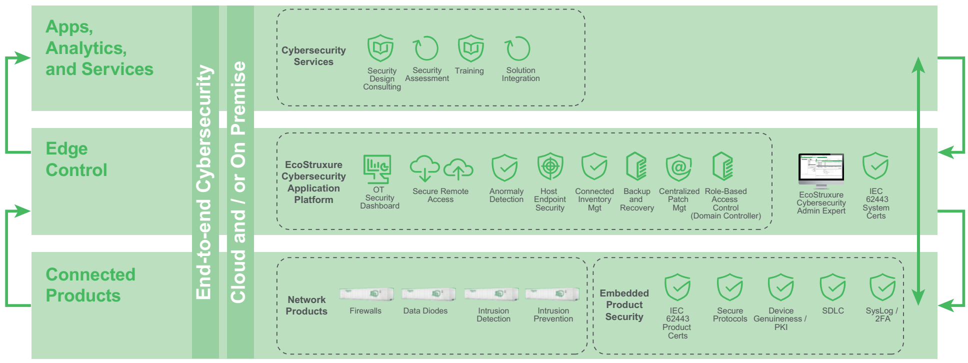
Example of Risk Matrix

IMPACT	LIKELIHOOD				
	Remote	Unlikely	Possible	Likely	Certain
Trivial	SL-0	SL-1	SL-1	SL-1	SL-1
Minor	SL-1	SL-1	SL-2	SL-2	SL-2
Moderate	SL-1	SL-2	SL-2	SL-3	SL-3
Major	SL-1	SL-2	SL-3	SL-4	SL-4
Critical	SL-1	SL-2	SL-3	SL-4	SL-4

EcoStruxure Cybersecurity Commitment to IEC 62443

EcoStruxure Cybersecurity provides end-to-end cybersecurity solutions across all layers from Connected Products and Edge Control to the Apps, Analytics, and Services layer, which includes guidance from expert service advisors.

EcoStruxure Power embeds this concept into all of its system architectures.



Connected Products and Edge Control Software

Connected products and Edge Control software are developed in accordance with IEC 62443-4-2. See the following product certifications.

- EcoStruxure Power Monitoring Expert IEC 62443-4-1 and 4–2 certification
- EcoStruxure Power Operation IEC 62443-4-1 and 4–2 certification
- PowerLogic P5 IEC 62443-4-1 and 4–2 certification

System Level

Schneider Electric also integrates and validates the cybersecurity requirements for the communicating system including connected products and Edge Control software. This system architecture is validated and certified by a third party according to the requirements of IEC 62443-3–3. For more information, visit the cybersecurity for EcoStruxure Power webpage: https://www.se.com/ww/en/work/solutions/cybersecurity/power-cybersecurity.jsp.

EcoStruxure Cybersecurity Admin Expert

In order to help secure the system in a consistent and efficient manner, Schneider Electric also offers free EcoStruxure Cybersecurity Admin Expert software for configuring and deploying the cybersecurity policy to EcoStruxure Power Connected Products and Edge Control Software.

It provides a comprehensive and intuitive cybersecurity policy configuration tool for centralized user and password administration:

- Security policies definition
- Security parameters configuration
- Security logs retrieval and display
- Centralized administration of user accounts and roles

EcoStruxure
Cybersecurity Admin Expert

For more information on Cybersecurity Admin Expert, visit our website: https://www.se.com/ww/en/product-range/63515-ecostruxure-cybersecurity-admin-expert/#overview.

EcoStruxure Cybersecurity Application Platform

EcoStruxure Power provides a system cybersecurity management layer offering visibility and management of cybersecurity controls, allowing operations teams to manage and maintain their cybersecurity control points.

It helps to provide security management capabilities with real-time monitoring of cyberthreats to help mitigate operational risks. This enables the system to meet IEC 62443 standards as well as NIST/NERC-CIP requirements for central management functionalities.

The security platform offers modules that can be added as required, as shown below:

EcoStruxure Cybersecurity Application Platform

Cybersecurity OT Dashboard (COTD)	Enables centralized cybersecurity monitoring of OT assets, offering visibility of the current system security status via dashboards..
Anomaly Detection	Continuously and passively monitors the system network for anomalous behavior against a known system baseline helping users to detect, characterize, and report security breaches in a timely manner. The module records all activity for future playback and diagnosis as required for incident detection and response.
Secure Remote Access	Single interface that helps provide secure remote connectivity to external users for testing, maintenance, and support of the system. Security administrators have full visibility and control over third party and employee access.
Backup and Restore	Helps to minimize data loss and reduce downtime due to a component failure or cyber-attack (such as ransomware) through automated backups and provides disaster recovery through rapid restoration.

Schneider Electric Cybersecurity Services

Schneider Electric offers unique expertise in cybersecurity for operational technology systems with consulting, design, implementation, monitoring, and response services to support the entire life cycle of a connected system.

Schneider Electric’s Cybersecurity Services provide support for new systems, existing or legacy systems, and integration of IT and OT networks. Cybersecurity service engineers are experienced and skilled in adapting the consultative approach to the end user’s existing IT policies, risk tolerance, and budget.

These services are based on the four categories below:

Permit	Manage access to operations systems and information through network and physical controls.
Protect	Implement specific controls as part of the operations systems to help provide ongoing protection.
Detect	Monitor the operating environment to detect and communicate threats.
Respond	Develop procedures and systems to help ensure a rapid response to cyber incidents to contain and mitigate attacks.

Learn more about Cybersecurity Services on our website: https://www.se.com/us/en/work/solutions/cybersecurity/.

Alignment with IEC 2700x

With IEC 62443, EcoStruxure Power is also aligned with IEC 2700x for specifying an Information Security Management System (ISMS) used in most organizations for securing their IT infrastructure.

Learn more about Cybersecurity Considerations

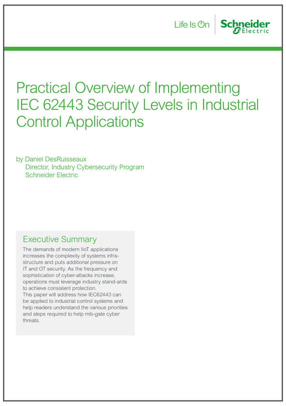
The following white paper provides details to learn more about the practical implementation of the security levels: Practical Overview of Implementing IEC 62443 Security Levels in Industrial Control Applications.

EcoStruxure Power recommends a "Defense in Depth" approach to system security. Defense in Depth is the coordinated use of security countermeasures to protect the integrity of information assets in a network. This ensures that if one layer of security is compromised, other layers of security are still capable of protecting our most critical operations and infrastructure.

Find out more about how "Defense in Depth" and IEC 62443 can be used to improve the cybersecurity of systems in the following documents:

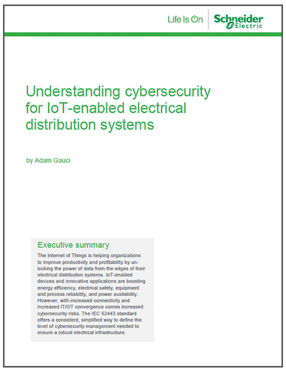
- Understanding cybersecurity for IoT-enabled electrical distribution systems
- EcoStruxure Power Guide for Designing and Implementing a Cyber Secure Digital Power System

For more information on cybersecurity for EcoStruxure Power, visit the website: https://www.se.com/ww/en/work/solutions/cybersecurity/power-cybersecurity.jsp.



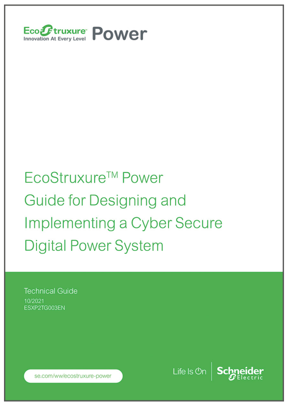
Practical Overview of Implementing IEC 62443 Security Levels in Industrial Control Applications

Technical Guide
Ref: 998-20186845
01/2018



Understanding cybersecurity for IoT-enabled electrical distribution systems

Technical Guide
Ref: 998-20677347
2019



EcoStruxure Power Guide for Designing and Implementing a Cyber Secure Digital Power System

Technical Guide
Ref: ESXP2TG003EN
10/2021

Selecting and Implementing the Digital Applications

What's in This Part

Introduction

Why Read This Part

In Part **Defining the System Design Considerations**, the system design considerations were introduced to have important information at hand when implementing the digital applications.

The objective of Part **Selecting and Implementing the Digital Applications** is to present all EcoStruxure Power digital applications, their key values, and implementation features to help you select and implement the appropriate applications according to the end user's needs. The part then describes how to implement the selected EcoStruxure Power digital applications within an electrical and digital architecture.

Contents of This Part

This part provides the following framework to understand and implement each EcoStruxure Power digital application:

- Context of the application
- Application outcomes
- Electrical architecture
- Digital architecture
- System description (data flow with inputs, outputs, and operating steps)

Overview of Digital Applications

Below is a summary of all the applications available in this guide. To ease selection, they have been grouped according to their end user benefits.

Click on any application below to navigate to it:

VALUE PROPOSITION	END USER BENEFITS	RELATED APPLICATIONS			
ELECTRICAL SAFETY[12]	Help reduce the risk of electrical fires	Continuous Thermal Monitoring			
	Help protect staff and occupants	Arc Flash Protection	Insulation Monitoring	Guided Procedures Through Extended Reality	
POWER AVAILABILITY	Enhance electrical asset management	Electrical Asset Life Cycle Management	Asset Performance		
	Reduce unplanned downtime due to electrical failure	Electrical Distribution Monitoring and Alarming	Capacity Management	Backup Power Testing	Power Event Analysis
		Circuit Breaker Settings Monitoring	Power Quality Monitoring and Compliance	Power Quality Correction	
		Power Source and Load Control	Advanced Protection and Automation		
	Avoid unplanned downtime due to misinformed operation	Operator Training Simulation new	Simulate Before Operate new		
	Gain resilience with distributed energy resources	Microgrid			
SUSTAINABILITY	Reduce energy, CO_2, and costs	Utility Bill Verification	Cost Allocation	Energy Monitoring	Energy Benchmarking
		Energy Performance	Energy Modeling and Verification	Power Factor Correction	
	Improve sustainability and compliance	Energy Efficiency Compliance	Greenhouse Gas Reporting		

12. This document presents general, non-binding information regarding the potential value that digitized power distribution products and solutions can bring to the user. Due to varying user situations and goals, Schneider Electric does not warranty or guarantee that the same or similar results represented in this document can be achieved. Please refer to Schneider Electric product and solution catalogs for actual specifications and performance.

What You Will Find in Each Application

Embedded Information for Each Application

The context and the purpose of the application are described, and the main outcomes are listed.

Then, a system description is provided using the following elements:

- Electrical architecture

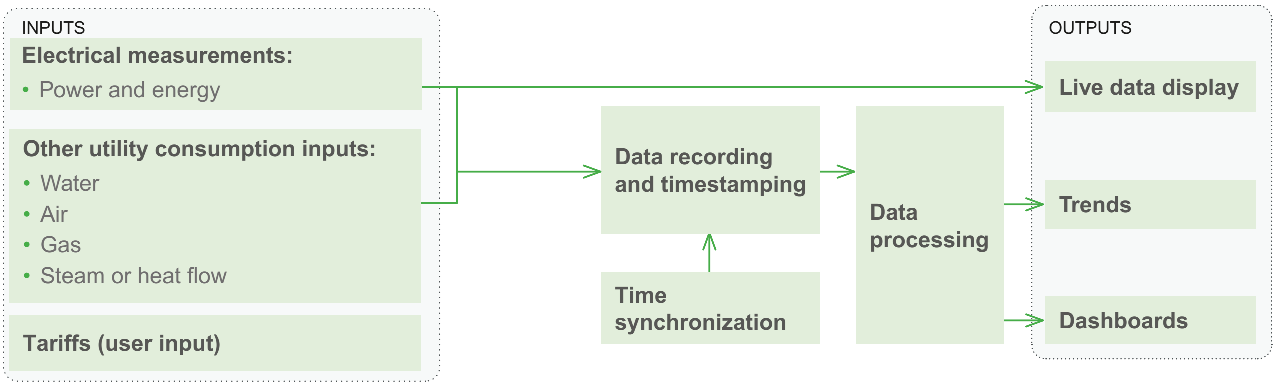
  Electrical distribution architectures (example on the following page) show the connected products required at each level of the electrical distribution hierarchy (from medium voltage to final low voltage distribution) to perform the appropriate function required for the application.

- Digital architecture

  Digital architectures show how connected products are connected to each other, to the Edge Control, and to the cloud-based Apps, Analytics, and Services. This is broken down by Ethernet, serial, wireless, and hardwired interfaces.

- Data flow

  A data flow diagram (example below)

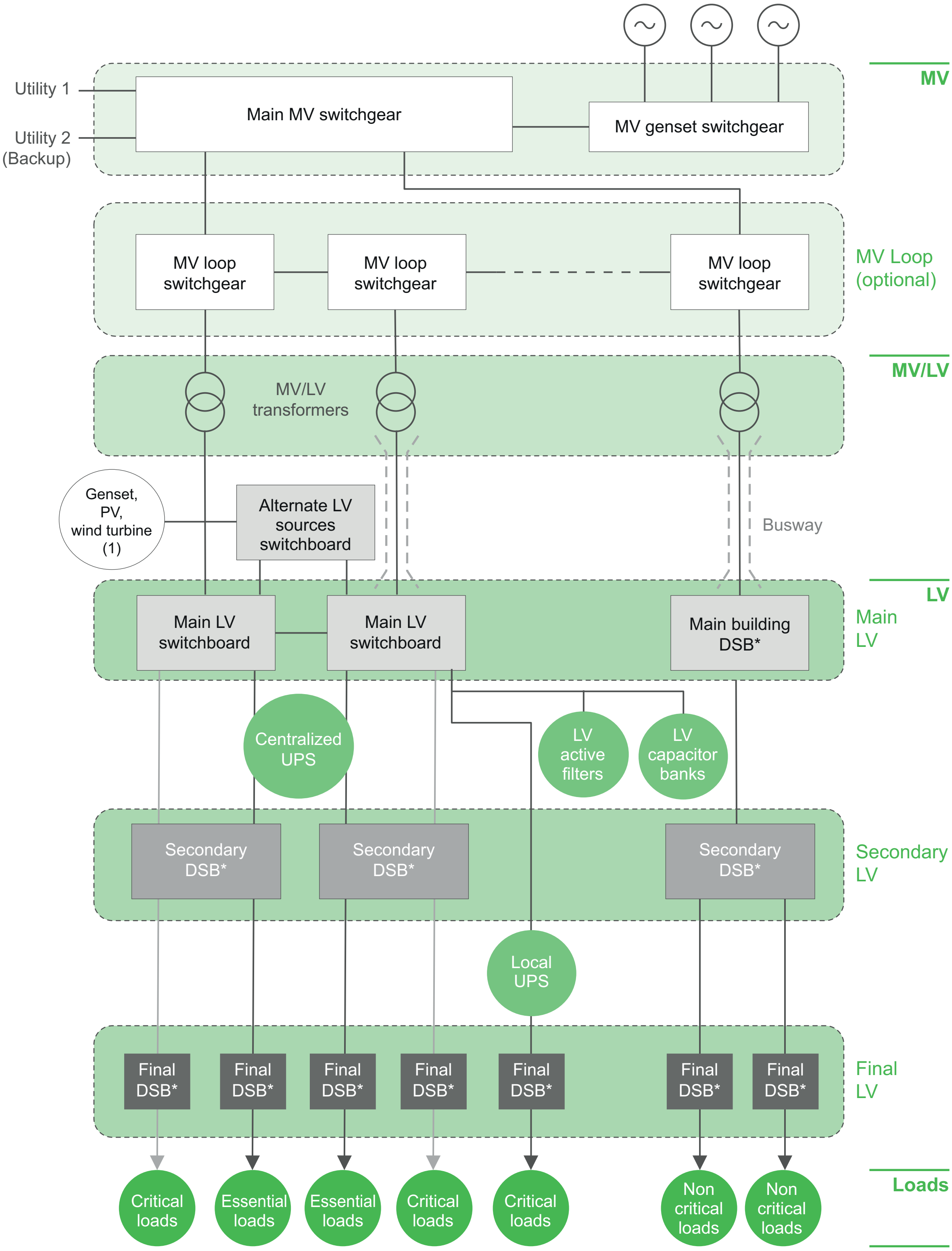


- Data flow in detail

  A description of the sub-functions (typically, data recording and timestamping, data processing, etc.), as well as their inputs and outputs, is provided with all related connected products, software, and services which contribute to the sub-applications.

Generic Electrical Architecture Diagram

Below is a generic electrical architecture (for illustration purposes). For each application, the positioning of all connected products contributing to the application is shown. Where necessary, detailed views further explain relevant nuances.

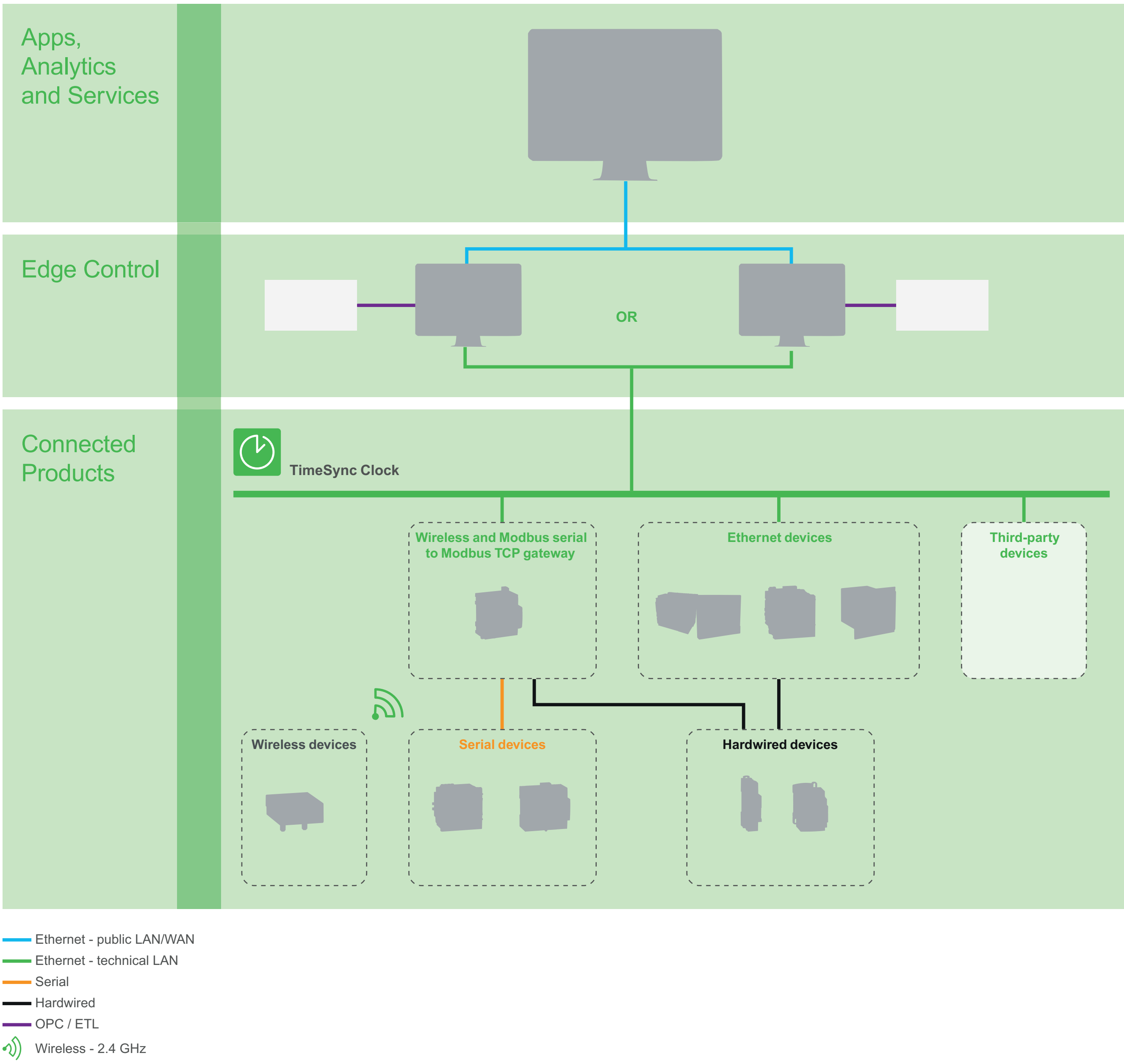


* DSB = Distribution Switchboard

(1) Depending on source control policy (centralized or local), alternate sources may be connected either to the main LV switchboards or to secondary distribution switchboards

Generic Digital Architecture Diagram

Below is a generic digital architecture diagram (for illustration purposes). The purpose of this diagram is to illustrate all connected products found in the electrical hierarchy with appropriate communication links.



Digital Applications for Electrical Safety

What's in This Part

Continuous Thermal Monitoring

What's in This Chapter

Overview

Context of Application

One of the leading causes of electrical fires in low and medium voltage installations is faulty power connections of cables, busbars, and withdrawable circuit breakers, in particular when the connections are made on site.

A faulty power connection can lead to an increase in electrical contact resistance, inducing a thermal runaway that can lead, in the worst case, to destruction of switchgear and severe injury to the operator..

An increase in contact resistance can be caused by:

- Loose connections due to improper installation or maintenance (improper tightening torque or loosening of a connection due to vibrations or thermal cycling)
- Damaged surface (due to corrosion, excessive pressure, or excessive friction)

Infrared inspections are a common solution to detect faulty power connections, but these must be performed manually, are tedious, and only identify issues on a periodic basis.

Problem to Solve

The facility manager needs to:

- Detect thermal runaways before they lead to electrical fires.
- Take action to resolve any faulty connections.
- Reduce the costs of infrared inspections.
- Monitor connections that may not be visible during inspections.

Purpose of Application

Early detection of faulty connections

- Monitor the temperature of busbar, cable, transformer, and withdrawable circuit breaker connections.
- Detect temperature deviations from normal operating conditions before they result in equipment downtime.
- For some switchboards, with a higher density of smaller conductors, overheating can be detected using gas analysis with Insulation Decomposition Detection (IDD) technology.

Provide temperature alarming and reporting for fast response

- Send pre-alarms and alarms in case of abnormal temperature rise.
- Enable easy reporting of the thermal status of the electrical installation.

Complement/replace infrared inspections

- Continuously monitor critical connection points to replace or augment periodic infrared surveys.


Connection Temperature Monitoring


Connection Temperature Monitoring


Gas Analysis with Insulation Decomposition Detection (IDD) Technology

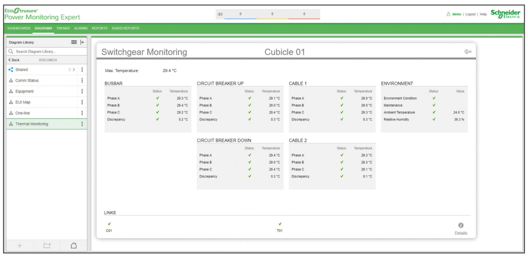
Application Outcomes

A properly designed Continuous Thermal Monitoring application provides the following outputs.

Live Data Display

For each electrical connection:

- Connection point absolute temperature
- Maximum phase-to-phase temperature discrepancy
- Status indication with respect to alarm thresholds (green/yellow/red)



Live Data Display

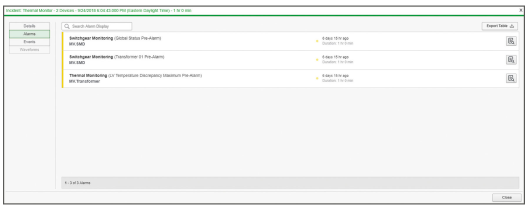
Events and Alarms

Alarms and pre-alarms can be defined for the following cases:

- When the absolute temperature threshold (defined by the user) is exceeded
- When an excessive discrepancy is detected between phase temperatures
- When the predictive threshold (which takes into account the conducted current) is exceeded
- When gas is detected due to overheating of the conductor insulation for some switchboards with a high density of smaller conductors

Pre-alarms and alarms help with early detection of faulty connections.

NOTE: Pre-alarm thresholds can be defined (for example, 80% of absolute threshold) to detect a temperature deviation as soon as possible.



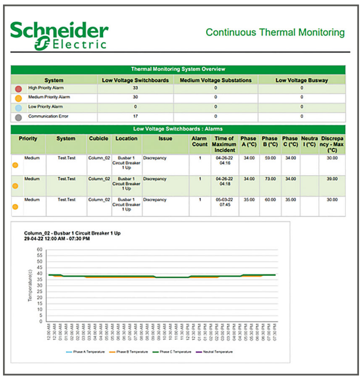
Thermal Monitoring Alarms

Trends

The Continuous Thermal Monitoring application provides trends to analyze long-term temperature evolution.

Reports

Thermal status of the electrical installation and historical trending can be included in dedicated reports.



Continuous Thermal Monitoring Report

Notifications

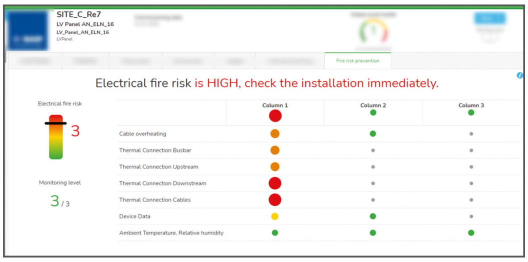
SMS and/or email notifications are sent for each pre-alarm and alarm condition to enable fast action.

Cloud-Based Analytics and Services

The EcoStruxure Service Plan powered by EcoStruxure Asset Advisor provides remote monitoring, asset management consulting, and on-site maintenance activities with recommendations from our Schneider Electric service experts.

Cloud-based analytics and services include:

- Continuous thermal monitoring
- Computation of an Electrical Fire Risk index
- Actionable recommendations 24/7 based on the live data and the value of this index



Electrical Fire Risk Prevention Indexes Computed in EcoStruxure Asset Advisor

Electrical Architecture

Introduction

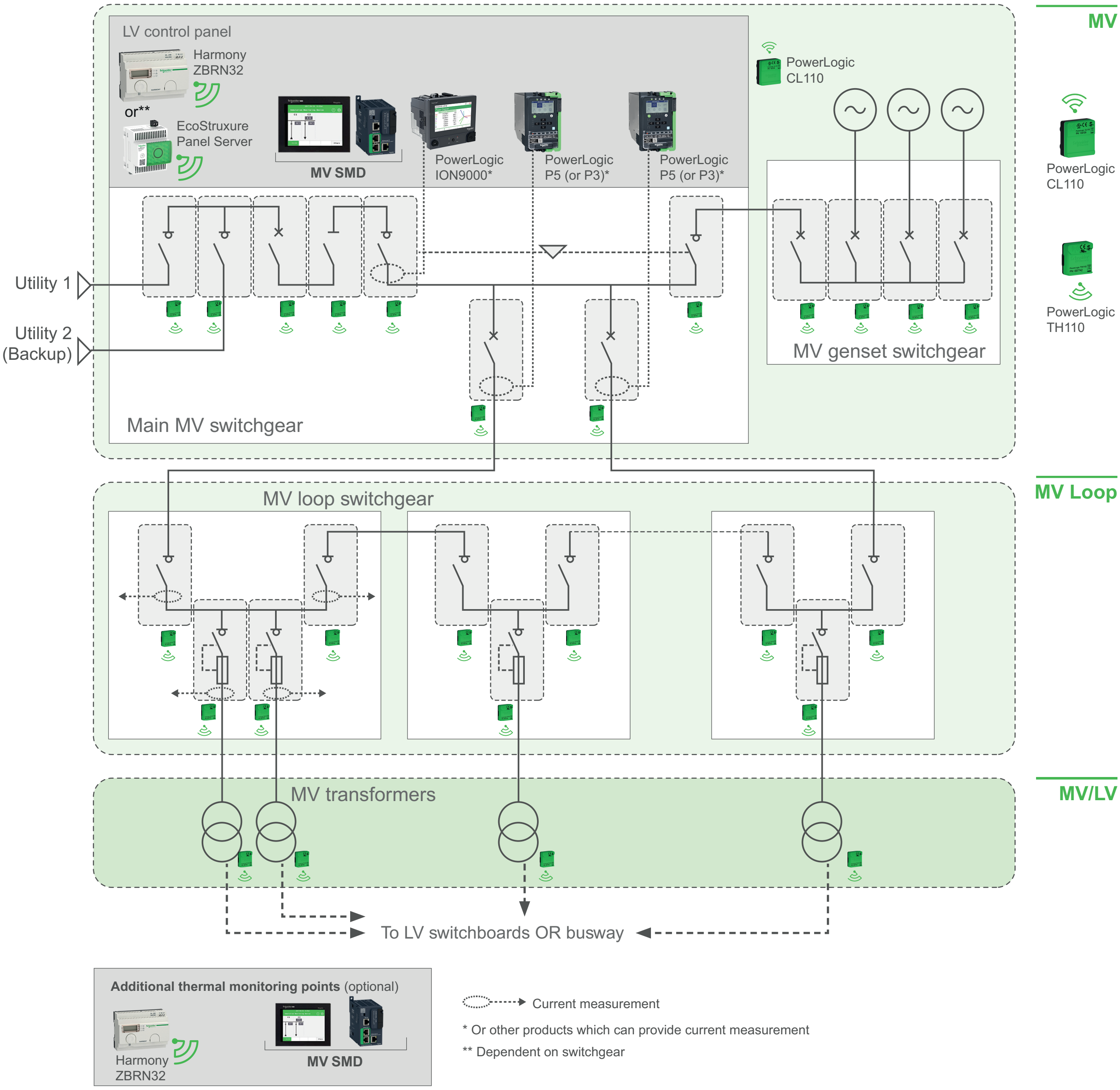
The following diagrams detail the areas of the architecture where the connected products should be installed in order to implement the Continuous Thermal Monitoring application:

Implementation for MV Switchgear and Transformers

Depending on the switchgear configuration and transformers to monitor, the number of connected products [PowerLogic TH110 sensor, Harmony ZBRN32 concentrator or EcoStruxure Panel Server, current measurement device, and Substation Monitoring Device (SMD)] has to be adapted.[13]

All devices except the PowerLogic TH110/CL110 sensors are installed in LV control panels of the switchgear.

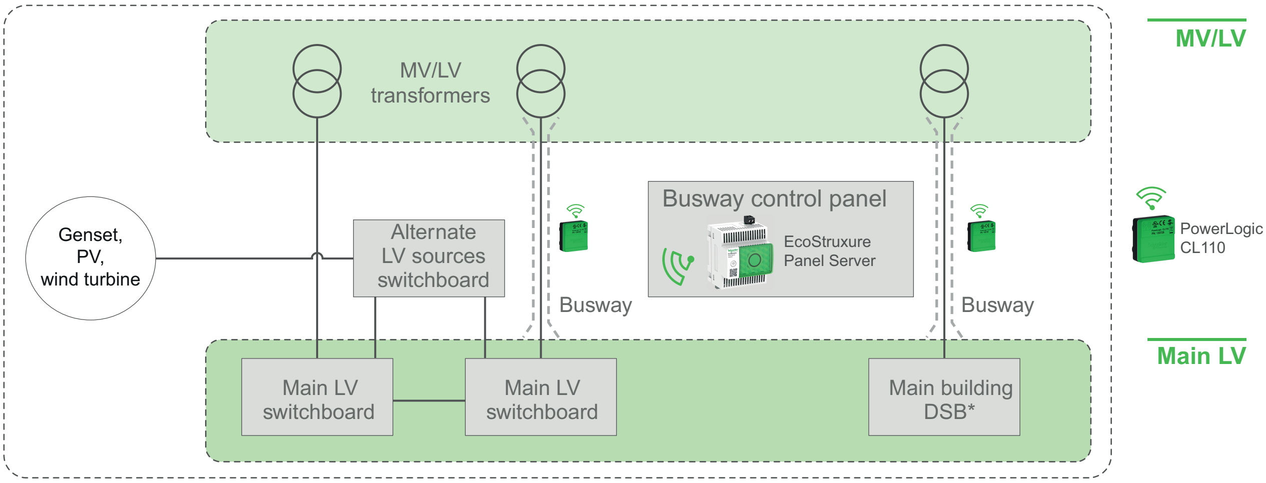
NOTE: Each MV switchgear is associated with an LV control panel. For legibility reasons, in the following diagram, the LV control panel has only been illustrated for the main MV switchgear. An additional Thermal Monitoring Panel may be needed, depending on distance constraints and user needs.



13. In new MV switchgear, the sensors are factory installed. For retrofit, the sensors must be installed by qualified Schneider Electric Services personnel.

Implementation for Busway

For each busway joint or junction, such as tap-off points, corners, elbows, or joint packs, a single PowerLogic CL110 is installed[14]. Per-phase sensors are not required. Continuous Thermal Monitoring for busway only uses the EcoStruxure Panel Server to wirelessly collect data from PowerLogic CL110 Environment Tag. A Substation Monitoring Device (SMD) is not required.



* DSB = Distribution Switchboard

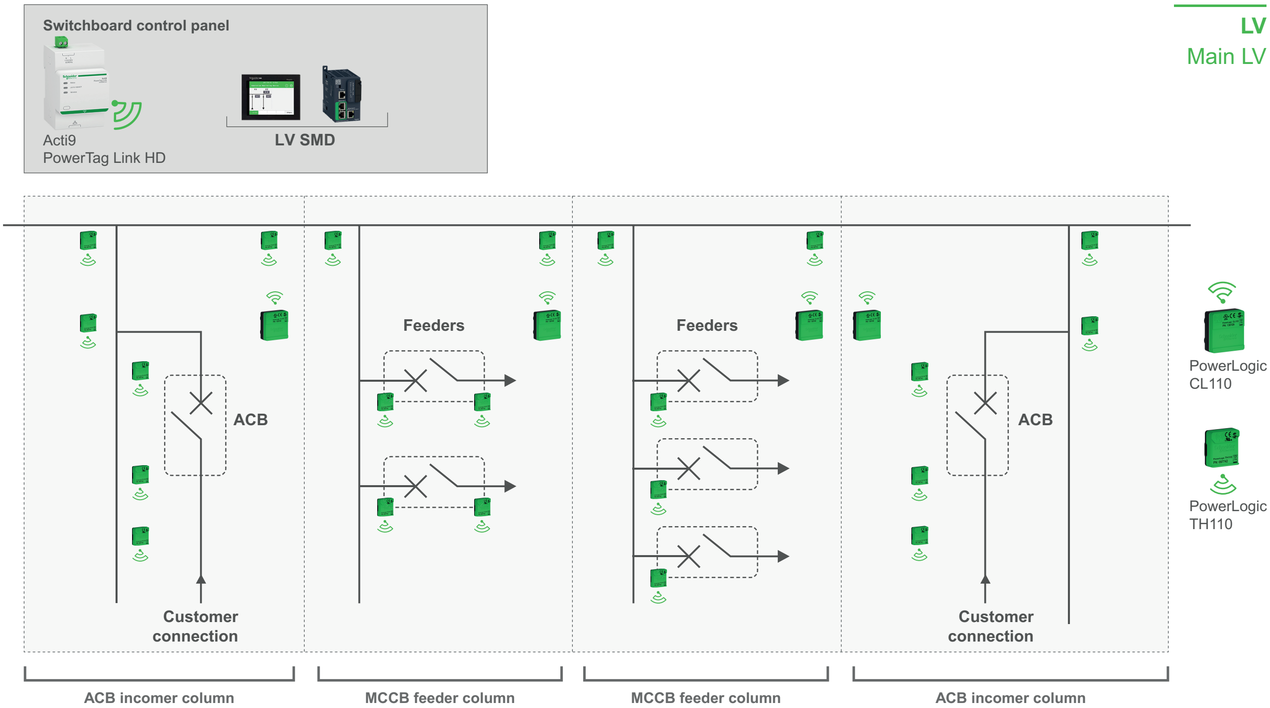
14. The sensors in the busway must be installed by qualified Schneider Electric field services personnel.

Implementation for LV Switchboards

Implementation of the Continuous Thermal Monitoring application depends on the type of switchboard:

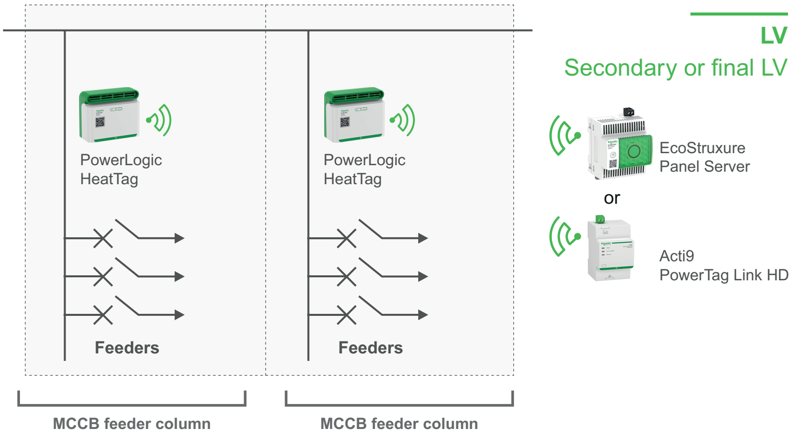
- **For LV Switchboards (Except PrismaSeT)**

  PowerLogic TH110 temperature sensors are installed on each phase of horizontal-vertical busbar junctions, as well as on ACB upstream/downstream connections. As an option, one PowerLogic CL110 per column can be added for ambient temperature measurement.



- **For PrismaSeT LV Switchboards**

  One PowerLogic HeatTag Insulation Decomposition Detector is installed at the top of each column.



Digital Architecture

Introduction

To define the digital architecture of the Continuous Thermal Monitoring application, you have to define the user’s needs:

- What data is needed?
- Where should they be available (local, on premise, cloud, and/or remote)?
- Is there a need for notifications?
- Is there a need for advanced diagnostic services?

In the following pages, several architectures are described in response to different feature choices.

In addition to the Continuous Thermal Monitoring solutions, a basic solution is available to replace/complement the yearly infrared inspection campaigns.

This tablet thermal scan solution consists only of the wireless sensors without wireless data concentrator. The operator will have to go to each and every area where sensors are installed (switchboards, transformers, busway). Data will be collected with a direct connection to the tablet equipped with a wireless dongle.

This solution only offers access to instantaneous sensor data.

> **NOTE:** Wireless sensors cannot be paired simultaneously with several wireless receivers. This tablet-based solution cannot be used simultaneously with advanced thermal monitoring solutions.

Digital architecture feature comparison table

The features of each architecture are detailed in the following table:

Feature	Tablet	Local HMI (1)	EcoStruxure Power Monitoring Expert	EcoStruxure Power Operation (2)	EcoStrux-ure Asset Advisor	EcoStruxure Power Monitoring Expert + Asset Advisor	EcoStruxure Power Operation + Asset Advisor
Tablet thermal scan							
Live data	●						
Local monitoring							
Live data		●					
Events and alarms		●					
Edge Control monitoring							
Live data			●	●		●	●
Events and alarms			●	●		●	●
Trends			●	●		●	●
Predesigned graphics for thermal monitoring			○	○		○	○
Reports			●	●		●	●
Remote notifications		○	●	●		●	●
Remote monitoring and services							
Events and alarms					●	●	●
Trends					●	●	●
Reports					●	●	●
Electrical fire risk index					●	●	●
Expert maintenance recommendations recommendations (3)					●	●	●

● Embedded

○ Available for all applications except LV busway

○ Available only for MV applications and if optional GSM modem is installed

● Available if Events Notification Module is installed

(1) Except for LV busway, local monitoring is available with the Substation Monitoring Device (SMD) optional HMI.

(2) Except for LV busway.

(3) Available with EcoStruxure Service Plan.

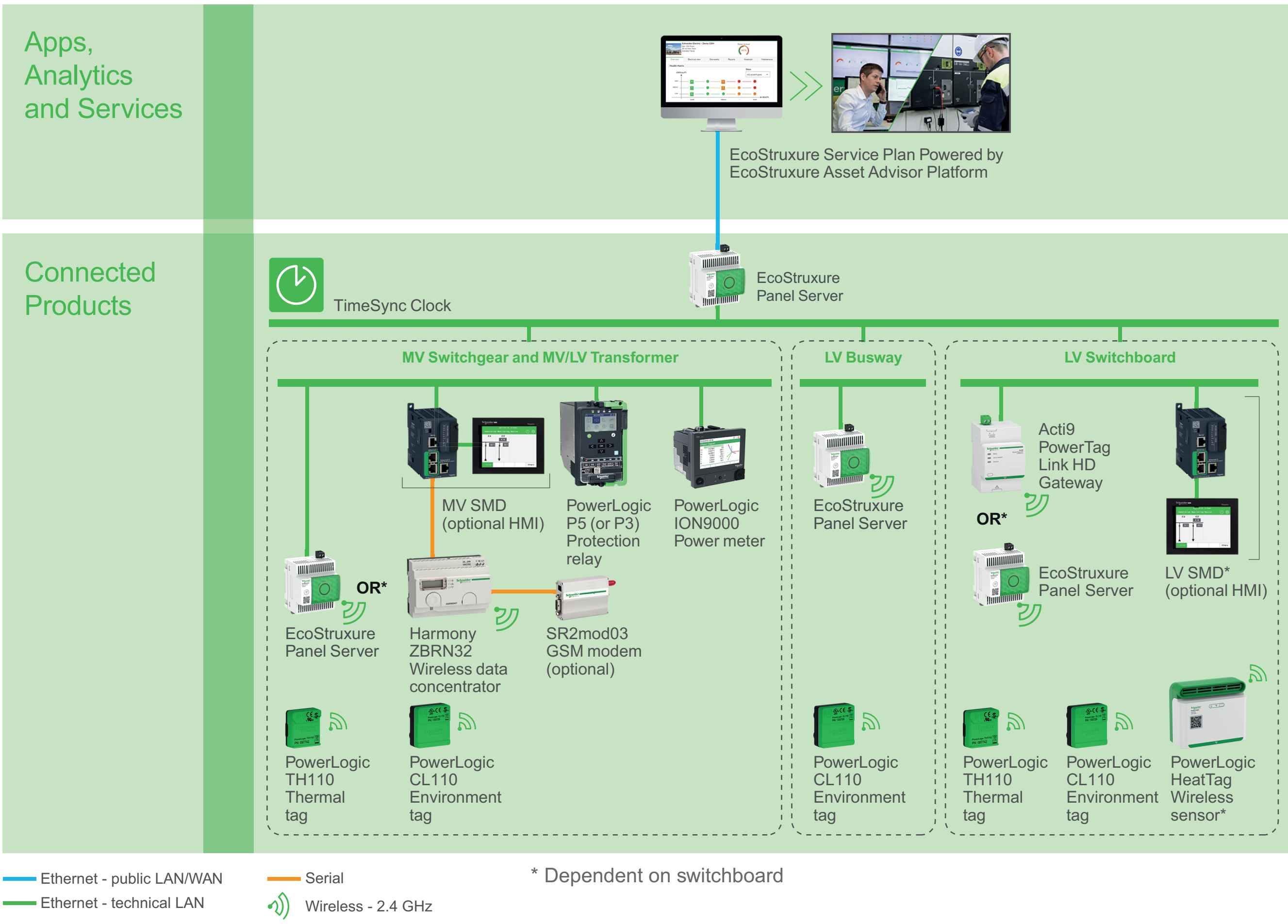
With Connected Products and Remote Services

In this architecture, data is collected from the wireless thermal sensors (PowerLogic CL110/TH110) and insulation decomposition detectors (PowerLogic HeatTag) using the EcoStruxure Panel Server, the Harmony ZBRN32 data concentrator or the Acti9 PowerTag Link HD gateway, depending on the switchgear.

In MV equipment, MV/LV transformer, and LV equipment applications, the data can then be passed on to the MV or LV Substation Monitoring Device (SMD) for local processing and display.

Data is then recorded using a cloud gateway (EcoStruxure Panel Server), passed on to the EcoStruxure Asset Advisor platform, and interpreted by experts as a part of EcoStruxure Service Plan.

Below is the recommended digital architecture for this solution:



How do you receive remote notifications?

Based on data collected in the EcoStruxure Asset Advisor platform, the Schneider Electric service experts proactively notify the user of critical anomalies.

Specifically for MV applications, remote notifications on alarms can be sent directly from MV Switchgear with an SR2mod03 modem connected to the MV Substation Monitoring Device (SMD).

With Connected Products, Edge Control Software, and Optional Remote Services

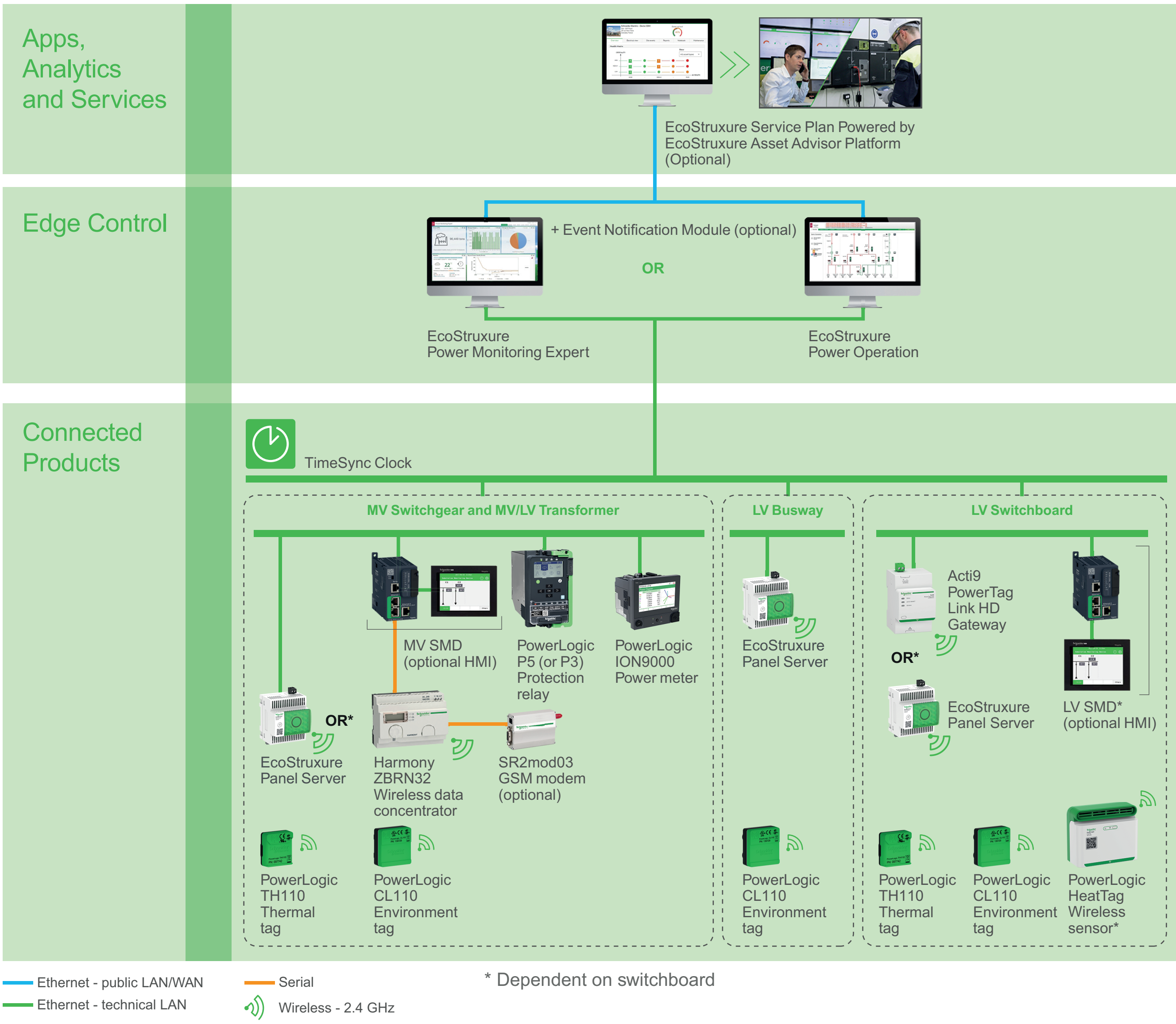
In this architecture, data is collected from the wireless thermal sensors (PowerLogic CL110/TH110) and insulation decomposition detectors (PowerLogic HeatTag) using the EcoStruxure Panel Server, the Harmony ZBRN32 data concentrator, or the Acti9 PowerTag Link HD gateway, depending on the switchgear.

In MV equipment, MV/LV transformer, and LV equipment applications, the data can then be passed on to the MV or LV Substation Monitoring Device (SMD) for local processing and display.

Data is then processed, recorded, and displayed to the user by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation).

As an option, data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Asset Advisor platform and interpreted by experts as a part of EcoStruxure Service Plan.

Below is the recommended digital architecture for this solution:



How do you receive remote notifications?

For both Edge Control solutions, remote notifications on alarms can be sent with the optional Event Notification Module of EcoStruxure Power Monitoring Expert and Power Operation.

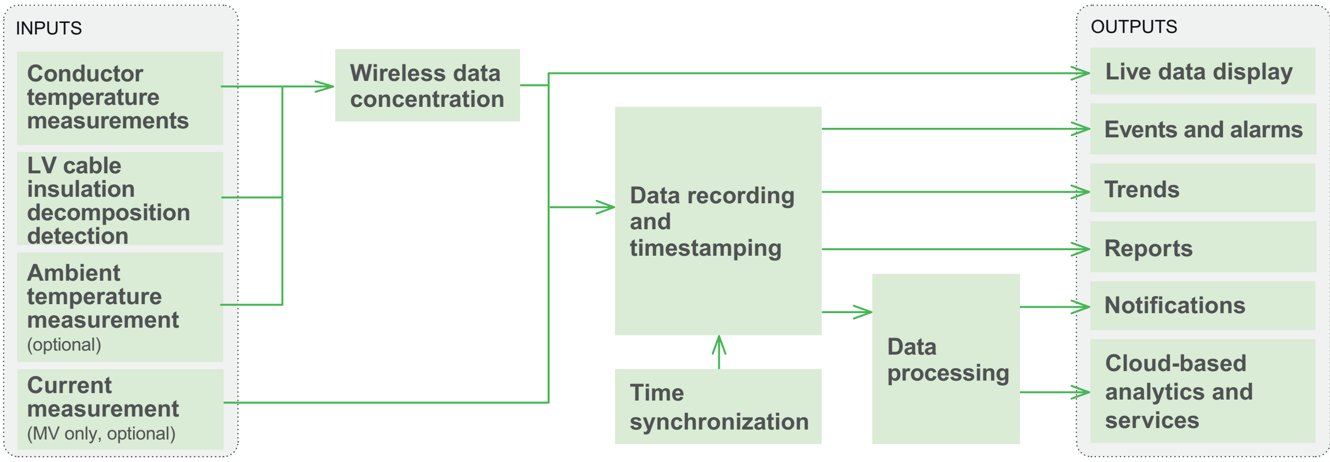
Based on data collected in the optional EcoStruxure Asset Advisor platform, the Schneider Electric service experts can proactively notify the user of critical anomalies.

Specifically for MV applications, remote notifications on alarms can be sent directly from MV Switchgear with an SR2mod03 modem connected to the MV Substation Monitoring Device (SMD).

System Description

Data Flow

The Continuous Thermal Monitoring application can be broken down as follows:



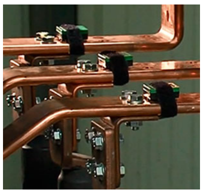
Inputs

The following data is required to enable the Continuous Thermal Monitoring application.

Conductor Temperature Measurements

For MV switchgear, MV/LV transformers, and certain LV switchboards, measurements are performed by factory-installed PowerLogic TH110 temperature sensors. They are installed on each phase in the critical areas of the gear, particularly at cable, busbar, transformer, and withdrawable circuit breaker connections to measure corresponding temperatures.

PowerLogic TH110



Set of PowerLogic TH110 Sensors Fixed on the Three Phases of an Electrical Connection

For the LV Busway Thermal Monitoring application, temperature measurement is performed by PowerLogic CL110 sensors mounted near busway junctions or connection points.

PowerLogic CL110

LV Cable Insulation Decomposition Detection

For some switchboards with a high density of smaller conductors, overheating can be detected using one PowerLogic HeatTag per column with gas analysis Insulation Decomposition Detection (IDD) technology.

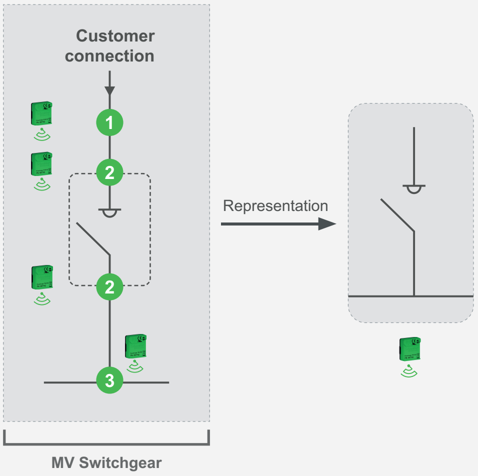
PowerLogic HeatTag

Illustration of Conductor Temperature Measurements and LV Insulation Decomposition Detection

MV Switchgear

In MV switchgear*, up to 15 sensors can be installed in each cubicle at the following locations:

1. Customer connections
2. Fixed parts of plug-in contacts upstream and downstream of switches and circuit breakers
3. Busbar junctions

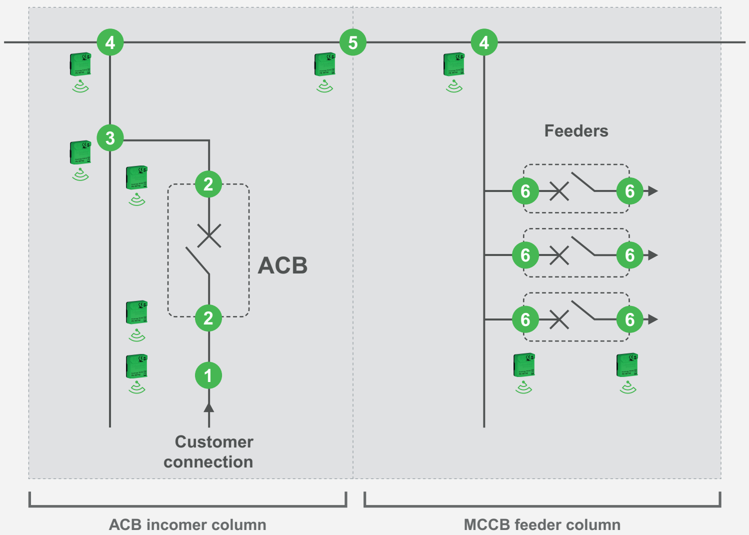


* Dependent on the switchboard

LV Switchboards (Except Prisma)

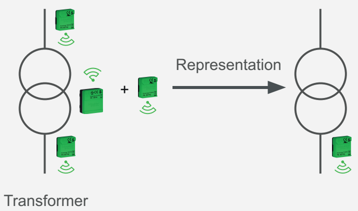
In LV switchboards (except Prisma), up to 100 PowerLogic TH110 temperature sensors per data concentrator can typically be installed to monitor each phase at the following locations:

1. Incoming customer connections of air circuit breakers (ACBs)
2. Fixed parts of plug-in contacts upstream and downstream of ACBs
3. Junctions between vertical busbars and ACB downstream bars
4. Junctions between horizontal busbars and vertical busbars
5. Splice bar junctions between sections of horizontal busbars
6. Upstream and downstream connections of large feeders



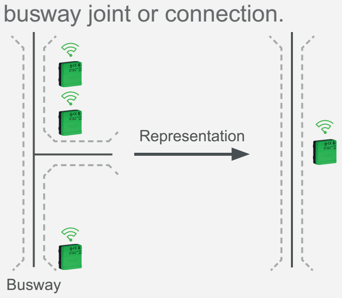
MV/LV Transformers

For dry transformer applications, PowerLogic TH110 sensors are installed on each phase connection, with a CL110 on the outside of the transformer enclosure.



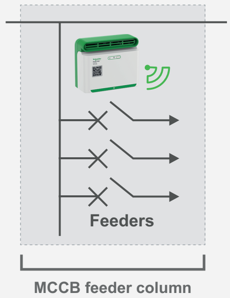
LV Busway

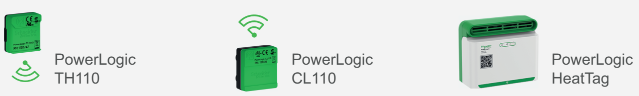
In busway applications, PowerLogic CL110 sensors should be deployed on each busway joint or connection.



LV Switchboards – Prisma

In Prisma switchboards, one PowerLogic HeatTag Insulation Decomposition Detector is installed at the top of each column.





Ambient Temperature Measurement (Optional)

PowerLogic CL110 ambient temperature sensors provide the internal ambient temperature of MV and LV equipment. In MV applications, ambient temperature measurement is used to dynamically adapt the temperature threshold.

PowerLogic
CL110

Current Measurements (MV Only, Optional)

Current measurement of monitored connection points is used to dynamically adapt temperature thresholds.

This is performed by a protection relay (for example, PowerLogic P5/P3) or a power meter (for example, PowerLogic ION9000 or PM8000).

PowerLogic
P5

PowerLogic
P3

PowerLogic
ION9000

PowerLogic
PM8000

Wireless Data Concentration

In the Continuous Thermal Monitoring application, the wireless signals from the temperature sensors are collected by a wireless data concentrator:

- **For MV switchgear and MV/LV transformers,** depending on the offer, the Harmony ZBRN32 or the EcoStruxure Panel Server is used as the data concentrator. Up to 60 sensors can be connected per ZBRN32 or 85 per Panel Server.
- **For LV busway,** the EcoStruxure Panel Server is used as the data concentrator. Up to 65 sensors can be connected per Panel Server.
- **For LV switchboards,** depending on the offer, the Acti9 PowerTag Link HD or the EcoStruxure Panel Server is used as the data concentrator. Up to 100 sensors can be connected per Acti9 PowerTag Link HD or 85 sensors for EcoStruxure Panel Server.

Harmony
ZBRN32

EcoStruxure
Panel Server

Acti9
PowerTag Link
HD

Data Recording and Timestamping

For the Continuous Thermal Monitoring application, considering the time constant of the physical phenomena observed (temperature rise of electrical conductors), time accuracy in the range of a minute is acceptable.

Measured and processed data is recorded with a timestamp for future analysis and reporting.

- Analog values are recorded for future trending analysis
- Status changes are recorded as events or alarms

Data recording is performed by EcoStruxure Power Monitoring Expert, Power Operation, or, optionally, by a local EcoStruxure Panel Server data logger when directly associated with EcoStruxure Asset Advisor.

EcoStruxure Power Monitoring Expert

EcoStruxure Power Operation

EcoStruxure Panel Server

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

Time Synchronization

When data recording is performed by a PC (as is the case for EcoStruxure Power Monitoring Expert or Power Operation), time synchronization is typically taken care of by the operating system of the PC.

For the EcoStruxure Panel Server cloud gateway, time synchronization can be performed via NTP/SNTP.

TimeSync Clock

Data Processing

For MV switchgear, MV/LV transformers, and LV switchboards, data processing is performed by a local Substation Monitoring Device (SMD). The SMD consists of data concentration, data processing, and Human Machine Interface (HMI).

Substation Monitoring Device (SMD)

For busway applications, data processing is performed directly by EcoStruxure Power Monitoring Expert, Power Operation, or Asset Advisor.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

EcoStruxure
Asset Advisor

Current and temperature measurements are processed to provide the following outputs:

Analog value outputs

- Temperature discrepancy between phases (not applicable for LV busway)

Status

- Status indication of each measured point relative to the set thresholds
- Status indication of temperature discrepancies between phases (not applicable for LV busway)

Outputs

Display of the following outputs is performed locally on the optional Substation Monitoring Device (SMD) Human Machine Interface (HMI) (except trends) and/or remotely by EcoStruxure Power Monitoring Expert, Power Operation, or via the Asset Advisor web platform.

Substation Monitoring Device (SMD)

EcoStruxure Power Monitoring Expert

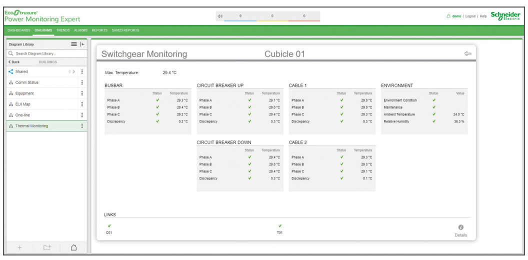
EcoStruxure Power Operation

EcoStruxure Asset Advisor

Live Data Display

The following live data is displayed:

- The value of each measured point (temperature and current)
- The temperature discrepancy between phases (not applicable for LV busway)
- The correlation between current and respective temperatures (in MV applications only)
- The status of each measured temperature relative to a set point or calculated threshold (with color code)
- The overheating status of conductors based on insulation deterioration gas analysis (with color code for some LV switchboards with a high density of smaller conductors)



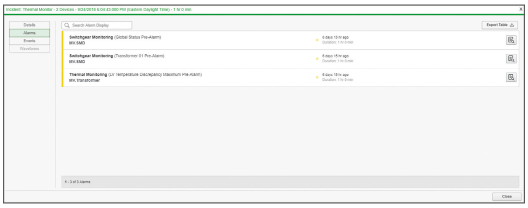
Live Data Display

Events and Alarms

Pre-alarms and alarms are generated when the following measurements exceed predefined set point or calculated thresholds:

- Individual phase temperature measurement
- Temperature discrepancy between phases (not applicable for LV busway)
- The overheating status of conductors based on insulation deterioration gas analysis (for some LV switchboards with a high density of smaller conductors)

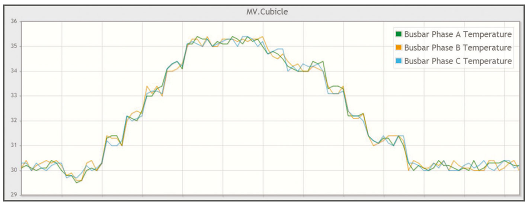
Additionally, sensor diagnostic information is available.



Thermal Monitoring Alarms

Trends

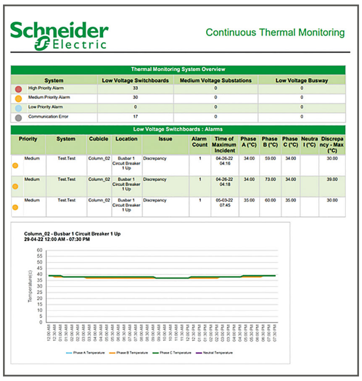
The Continuous Thermal Monitoring application provides the evolution of each measured value over time.



Temperature Trends

Reports

When EcoStruxure Power Monitoring Expert or Power Operation is installed, customized reports based on measured and processed data can be generated and sent automatically with email subscription.



Continuous Thermal Monitoring Report

Notifications

Notifications can be sent:

- By the Substation Monitoring Device (SMD) connected to an SR2mod03 GSM modem (alarms only through SMS)

SR2mod03

- By EcoStruxure Power Monitoring Expert or Power Operation with the Event Notification Module (events and alarms via email and/or SMS)
- By EcoStruxure Asset Advisor

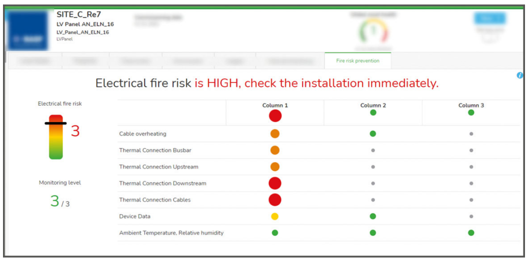
Cloud-Based Analytics and Services

The EcoStruxure Service Plan powered by EcoStruxure Asset Advisor provides remote monitoring, asset management consulting, and on-site maintenance activities with recommendations from our Schneider Electric service experts.

EcoStruxure Service Plan Powered by EcoStruxure Asset Advisor Platform

Cloud-based analytics and services include:

- Continuous thermal monitoring
- Computation of an electrical fire risk index
- Actionable recommendations 24/7 based on the live data and the value of this index



Electrical Fire Risk Prevention Indexes Computed in EcoStruxure Asset Advisor

Arc Flash Protection

What's in This Chapter

Overview

Context of Application

Arc flash incidents can occur as a result of maintenance activities, human error, or equipment failure. Often, this results in costly downtime, interruption of processes and equipment, and injury to persons. Most standard protective devices do not have the ability to respond quickly to arc flash incidents and to limit their effects on equipment and people.

NOTE: Arc flash is not to be confused with arc fault, which is another common cause of failure often related to human error or equipment/installations which are too old or damaged. This can also include loose terminals and crushed or damaged cables. Read the following article to learn more about the difference between arc flash and arc fault: https://blog.se.com/electrical-safety/2018/08/25/stopping-electrical-fires-using-arc-flash-and-arc-fault-protection/

When not stopped or detected in time, these small arcs, at the final distribution level, can result in fires, putting lives and installations at risk. To learn more about Active Arc Fault Detection Devices, check out these links:
https://www.se.com/ww/en/download/document/CA9SS100E/
https://www.se.com/ww/en/download/document/CA9SS099E/

Problem to Solve

The facility manager needs to:

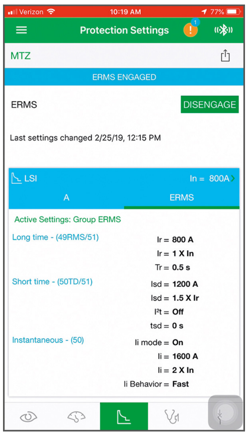
- Avoid personal injury due to arc flash events.
- Eliminate or minimize costs resulting from arc flash damage: downtime, repair time, and interruption of processes and equipment.
- Improve arc flash awareness, enabling fast response of maintenance teams.
- Provide post arc flash event analysis.

Purpose of the Application

Enhance passive arc flash mitigation solutions

- By minimizing equipment damage, downtime, and likelihood of personal injury or death through the detection of light and/or current resulting from arc flash events and ultra-fast operation (less than 40 ms) of associated protective devices.

- By reducing some of the risk during maintenance operation. Energy Reduction Maintenance Settings (ERMS) can be used to help protect staff, occupants, and equipment by temporarily changing circuit breakers to instantaneous trip mode.



ERMS Status Displayed on Power Device

Improve maintenance team awareness

By providing the appropriate information to help troubleshoot and identify the root cause of arc flash events. Arc flash incidents are displayed within easy-to-interpret single-line diagrams and graphical incident timelines.

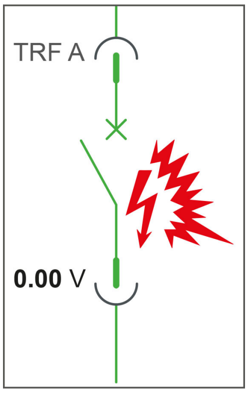
Enable arc flash post incident analysis

By leveraging relevant data. Reported events and alarms are collected from arc flash protective relays.

Application Outcomes

Live Data Display

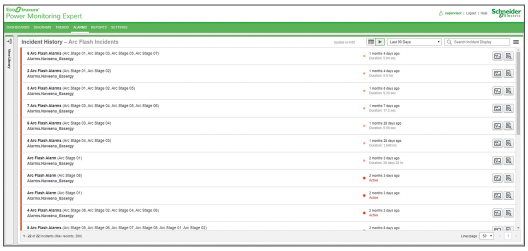
Arc flash incidents are displayed within easy-to-interpret graphical single-line diagrams that highlight which breaker operated as a result of an arc flash.



Display of Arc Flash Related Trips on Single-Line Diagram

Events and Alarms

- Circuit breaker operation statuses and alarms
- Arc flash protection device activation statuses and alarms
- Arc flash protection device diagnosis



Arc Flash Events and Alarms in Log Viewers of EcoStruxure Power Monitoring Expert and Power Operation

Trends

Long-term trends can be generated to determine if a slowly changing variable may have triggered an arc flash event.

Typically, observing temperature deviations can help you detect loose connections or insulation decomposition that could lead to an arc flash. For more information, refer to the Continuous Thermal Monitoring application.

Notifications

Immediate SMS and email notifications are sent to enable expedient response.

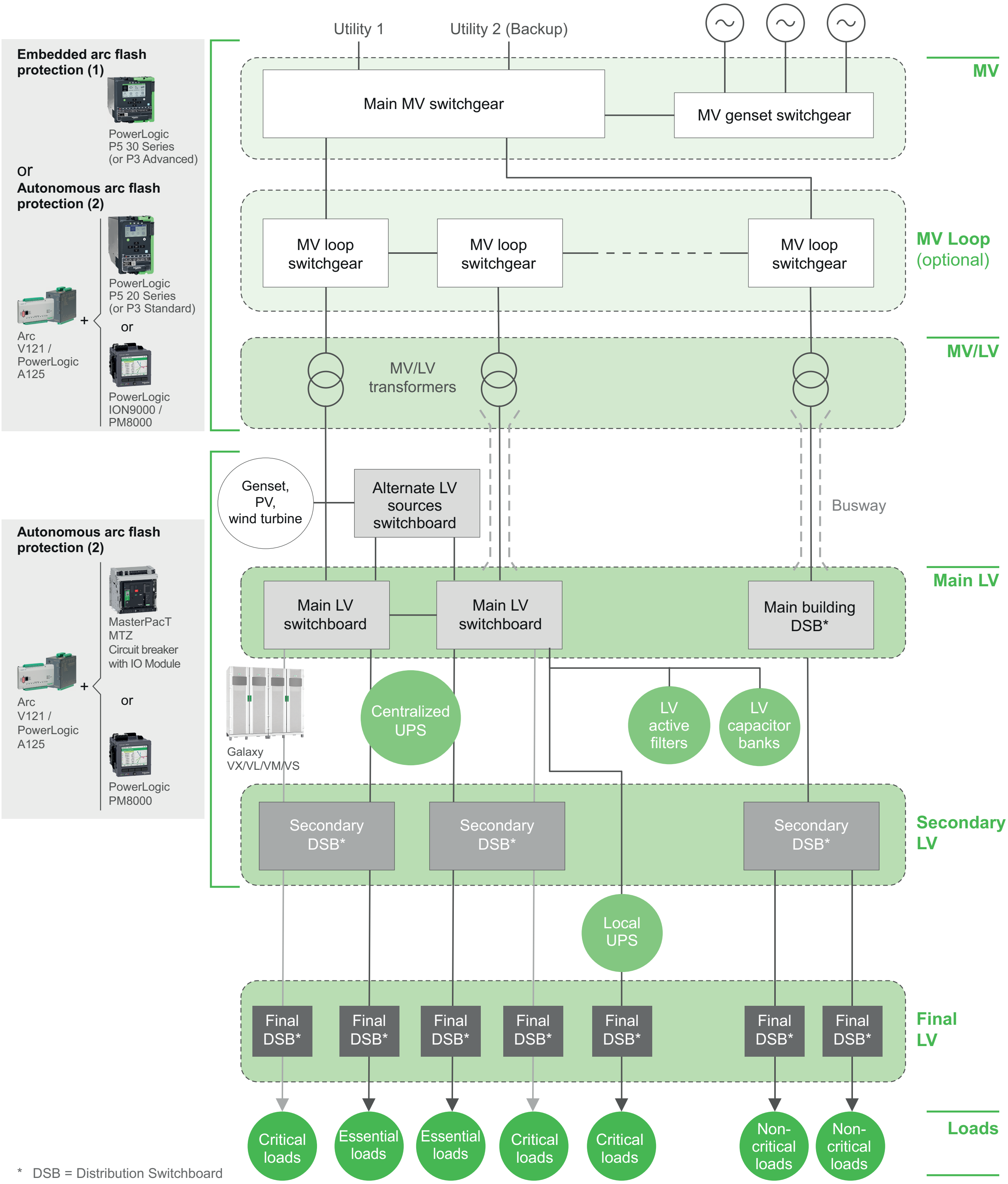
Analysis Tools

Display of arc flash incidents on the Power Event Analysis incident timeline (refer to the Power Event Analysis application).

Electrical current waveforms captured during an arc flash event can be displayed with a native waveform viewer in the Edge Control software.

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Arc Flash Protection application:



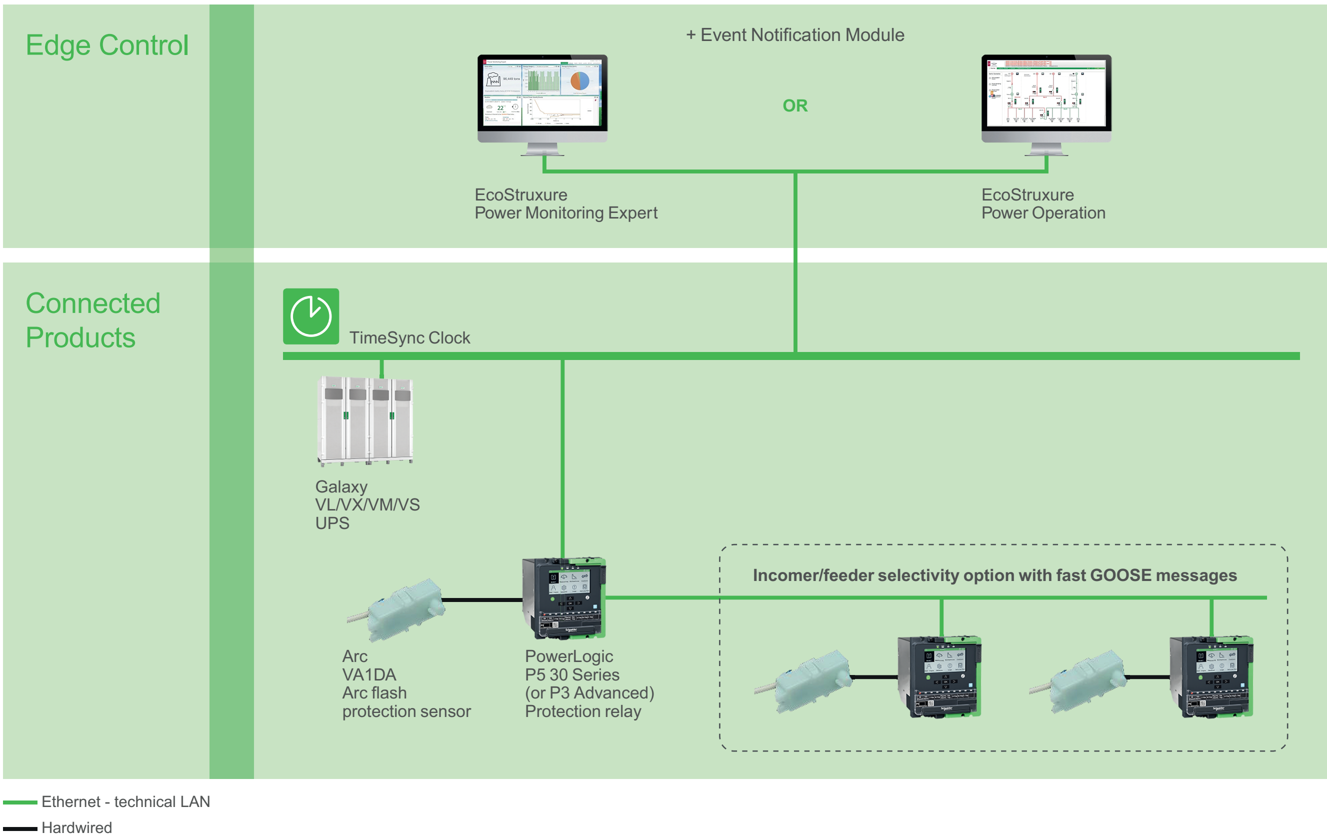
* DSB = Distribution Switchboard

(1) see digital architecture for arc flash protection embedded in protection relay
(2) see digital architecture for arc flash protection as an autonomous feature

Digital Architecture

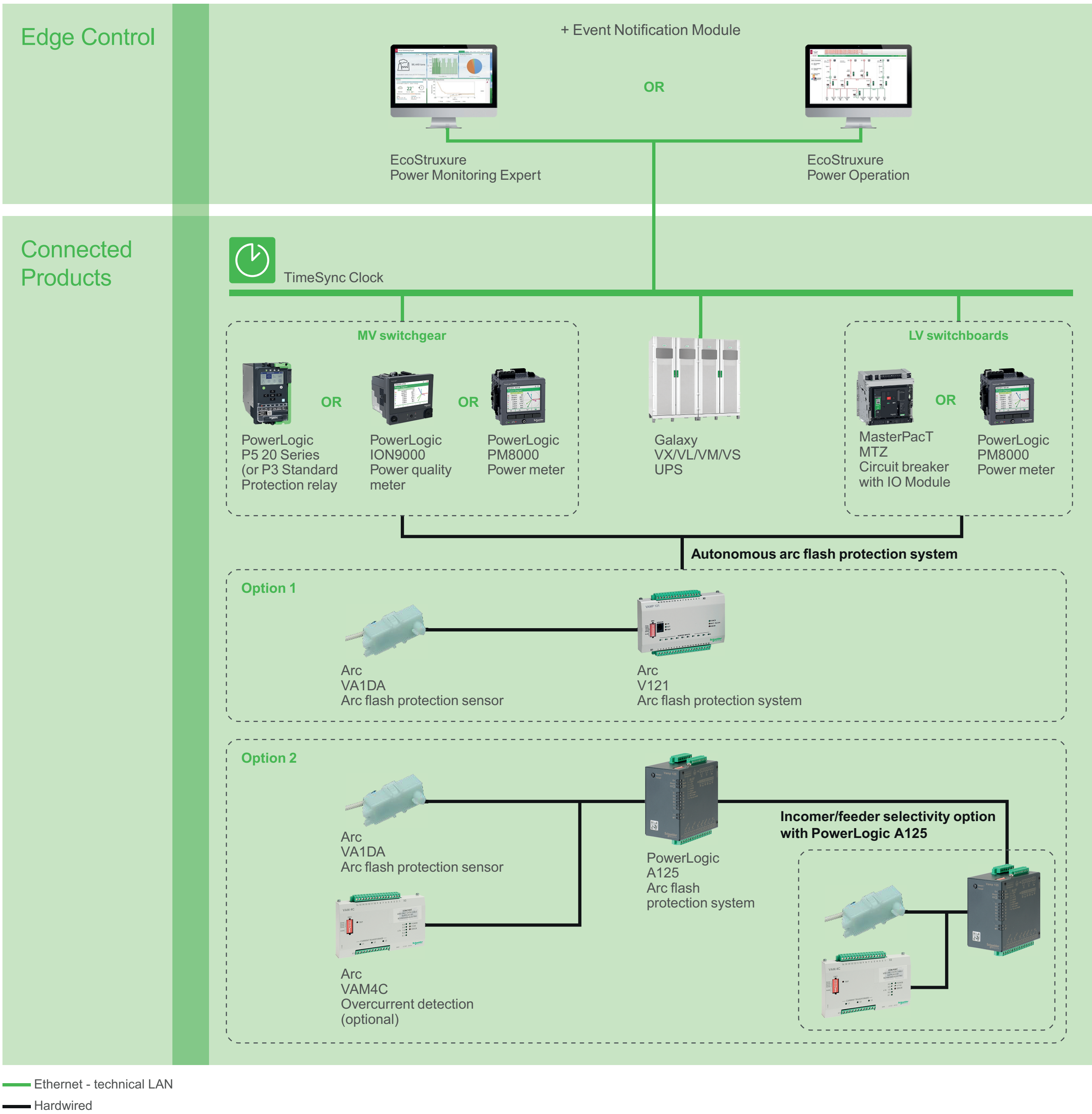
Architecture for Arc Flash Protection Embedded in Protection Relay

Below is the recommended digital architecture for the Arc Flash Protection application embedded in protection relay(s). This architecture is only applicable for MV switchgear:



Architectures for Arc Flash Protection as an Autonomous Feature

Below is the recommended digital architecture for the Arc Flash Protection application when PowerLogic A125 / Arc V121 performs arc fault protection autonomously from the electrical protection relay.

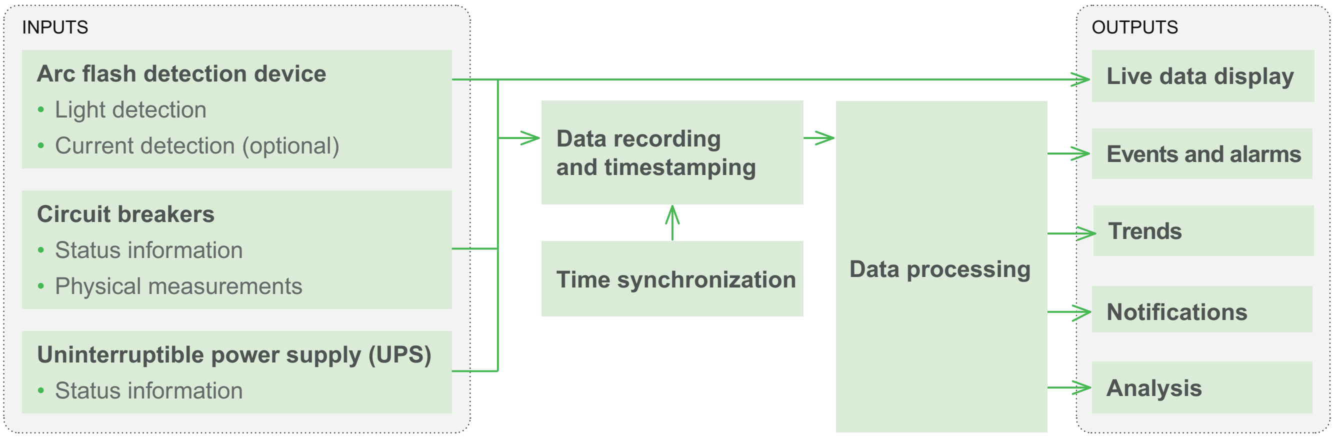


NOTE: For more information about options for Arc Flash Protection in LV switchboards, refer to Arc Flash Protection System in iPMCC by OKKEN Design guide (document number AFPDG0120EN).

System Description

Data Flow

The Arc Flash Protection application can be broken down as follows:



Inputs

Arc flash protection can either be embedded in an electrical protection relay (PowerLogic P5 30 series or P3 Advanced) or provided as an autonomous system when required (PowerLogic A125 / Arc V121).

NOTE: Embedded arc flash detection and protection capabilities are available in the PowerLogic P3 Advanced and P5 30 series. The PowerLogic P3 Standard and P5 20 series can also provide the arc flash protection capabilities when accompanied by standalone detection devices such as the PowerLogic A125 and Arc V121. The distinction between the embedded and standalone arc flash capabilities will be made throughout this application.

In all cases, the following data is required:

Arc Flash Detection Device

Light detection

To detect an arc flash, light sensors are installed in the critical areas of the switchboards. Arc VA1DA (or VA1EH) sensors offer a wide area arc flash detection with a typical detection time <1 ms.

Arc
VA1DA

These sensors can be connected to different arc flash protection devices like PowerLogic P5 30 series, P3 Advanced, PowerLogic A125, or Arc V121.


PowerLogic
P5 30 series


PowerLogic
P3 Advanced


PowerLogic
P5 20 series


PowerLogic
P3 Standard


PowerLogic
A125


Arc
V121

Current detection (optional)

In switchboards that could be exposed to unintentional light, the occurrence of an arc flash must be confirmed with the simultaneous detection of inrush current.

- Protection relays PowerLogic P5 30 series or P3 Advanced directly acquire these measurements through their standard current transformers.
- PowerLogic A125 requires an additional module (Arc VAM4C) with dedicated current transformers to detect high current values.
- Arc V121 cannot interface with a current metering system, it must only be used in switchboards that are not exposed to unintentional light sources.


Arc
VAM4C

Circuit Breakers

When an arc flash is detected, the main supply of the affected area must be disconnected to stop the effects of the arc. Due to high currents resulting from an arc flash, only a circuit breaker can perform this operation. For root cause analysis, circuit breakers must thus be monitored to get a comprehensive view of the arc flash event.

Status information

The arc flash protection system (embedded in protection relay or autonomous) must be able to control the circuit breaker. The following status information is monitored:

- Position (open, closed, racked-in, racked-out, etc.)
- Trip status, protection status
- Operating mode (local/remote when applicable)

Physical measurements

As the arc flash will generate high currents, the overcurrent protection of a protection relay is mandatory in parallel with the arc flash protection system. Therefore the circuit breaker must measure current values.

In addition, protection relays or trip units (PowerLogic P5/P3, MicroLogic X trip unit of MasterPacT MTZ with WFC Digital Module) will be able to capture current waveforms that can be leveraged to analyze the arc flash occurrence.

NOTE: In case the circuit breakers installed in the switchboard cannot communicate, the above information can be provided by a power meter equipped with digital inputs for status information and current measurements for waveform captures (PowerLogic ION9000, PM8000).


PowerLogic
P5 30 series


PowerLogic
P3 Advanced


PowerLogic
P5 20 series


PowerLogic
P3 Standard


MasterPacT
MTZ


PowerLogic
ION9000


PowerLogic
PM8000

Uninterruptible Power Supply (UPS)

Arc flash incidents can happen during the initial power up of the switchboards or during power restoration after maintenance activities.

To help ensure proper protection at switchboard power-up, the auxiliaries of all products involved in arc flash protection should be powered before the switchboard. To achieve this, auxiliaries should be powered from an external source through UPS, such as Galaxy VX/VL/VM/VS.

Therefore, it is recommended to monitor the status of any UPS used for that purpose throughout the electrical distribution network.


Galaxy
VX/VL/VM/VS

Data Recording and Timestamping

Depending on the solution selected for arc flash protection, data recording can occur at various levels.

Arc Flash Protection Embedded in Electrical Protection Relay

When the arc flash protection is embedded in the electrical protection relay (PowerLogic P5 30 series or P3 Advanced), analog and event data are recorded and timestamped onboard the protection relay itself.


PowerLogic
P5 30 series


PowerLogic
P3 Advanced

Arc Flash Protection Installed as an Autonomous Feature

With PowerLogic A125 / Arc V121, data must be relayed through another communicating device of the switchboard.

- This device should preferably be a communicating protection relay involved in the arc flash protection. This device should offer digital inputs for connection with PowerLogic A125 / Arc V121. In this case, event data is recorded and timestamped onboard the communicating protection relay (PowerLogic P5 20 series, P3 Standard, or MasterPacT MTZ).


PowerLogic P5 20 series


PowerLogic P3 Standard


MasterPacT MTZ

- In case the protection relays installed in the switchboard cannot communicate, a communicating power meter equipped with digital inputs can be used to relay information from PowerLogic A125 / Arc V121. In this case, event data is recorded and timestamped onboard the communicating power meter (PowerLogic ION9000 or PM8000).


PowerLogic ION9000


PowerLogic PM8000

For the Arc Flash Protection application, time accuracy of ±1 ms is recommended to be able to analyze the phenomena, in particular for highly critical applications.

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

Time Synchronization

- For system-wide understanding of arc flash phenomena in highly critical applications, it is important to have consistent timestamping. The date and time should be accurately distributed to connected products and other systems. Time synchronization can be performed using various technologies (PTP, NTP, SNTP, etc.). An external master clock is required and can be connected to a GPS antenna to reach the expected time precision.
- For less critical applications, a simple time synchronization over Modbus can be sufficient.


TimeSync Clock

Data Processing

Arc Flash Protection

To help ensure fast reaction to arc flash, data processing of light and current sensors is performed locally by the arc flash protection system that will trigger the circuit breaker opening (PowerLogic P5 30 series, P3 Advanced, or PowerLogic A125 / Arc V121).


PowerLogic
P5 30 series


PowerLogic
P3 Advanced


PowerLogic
A125


Arc
V121

Smart Clustering

To obtain a contextualized capture of the arc flash incident, data processing in Edge Control software consists of:

- Consolidation of alarms, events, waveforms, status changes, and other corresponding data from all connected products in chronological views
- Smart grouping of related data to help identify the root cause of incidents

Smart clustering is performed by EcoStruxure Power Monitoring Expert or Power Operation.


EcoStruxure
Power Monitoring Expert


EcoStruxure
Power Operation

Outputs

Outputs are displayed via the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation).


EcoStruxure
Power Monitoring Expert

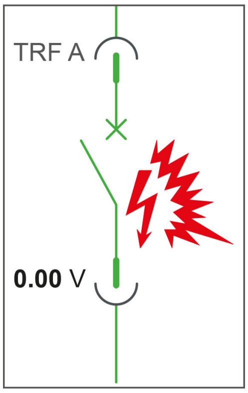

EcoStruxure
Power Operation

Live Data Display

The live status of arc flash detection in the electrical distribution system can be represented in the Edge Control software in various forms such as:

Single-line diagrams

- Digital single-line diagrams, with real-time animation in case of arc flash detection



Display of Arc Flash Related Trips on Single-Line Diagram

Detailed diagrams

- Device diagrams, pre-configured along with native device drivers (PowerLogic P5 30 series or P3 Advanced) or customized to reflect PowerLogic A125 / Arc V121 (PowerLogic P5 20 series, P3 Standard, MasterPacT MTZ, PowerLogic ION9000, or PM8000)
- Real-time data in custom graphics (floor plans, elevation drawings)

Events and Alarms

Event log viewers

Events and alarms are uploaded from devices and visualized in native event and alarm viewers of the Edge Control software.

Chronological views include all events and alarms, acknowledged or unacknowledged alarms, summary alarms, or incidents related with arc flash:

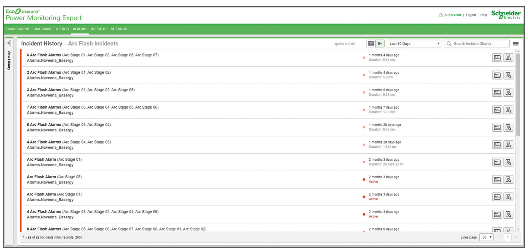
- Arc flash detection (light detection and optional current detection)
- Arc flash protection activation
- Circuit breaker status changes (opening, trip status, etc.)
- Arc flash protection system diagnostic status (UPS status, self-monitoring of sensors, self-diagnostics of connected products, and status of their interconnections).

High-speed and high-precision sequence of events helps locate the source of the fault.

In addition, user remote control actions during the repair phase are traced with operator name and timestamp.

Smart alarming

Arc flash events or alarms are intelligently grouped to be displayed as comprehensive arc flash incidents and to reduce the overall number of alarms in the viewer.



Incident Chronology with Arc Flash Events and Alarms

Notifications

- SMS and/or email notifications can be sent for fast analysis and action.
- Email notifications are also available to send reports and non-critical information.

Trends

In addition to high-resolution waveforms captured during the arc flash event, long-term trends can also be observed to understand if slow phenomena could trigger the arc flash.

Real-Time Trending in EcoStruxure Power Monitoring Expert

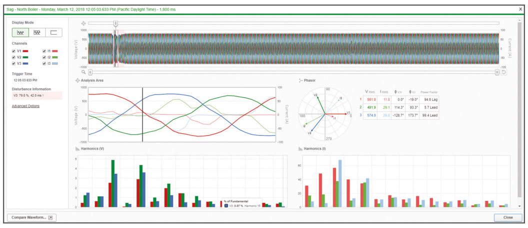
Analysis Tools

Power Event Analysis

The Power Event Analysis incident timeline provides advanced functions to enable further root cause investigation with detailed breakdown and sequence of alarms, waveforms, and power events involved in the incident (refer to the Power Event Analysis application).

Waveform viewer

To refine the understanding of an arc flash occurrence, electrical current waveforms captured by a protection relay, a trip unit, or a power meter can be displayed with a native waveform viewer in Edge Control software.



Waveform Viewer

Insulation Monitoring

What's in This Chapter

Overview

Context of Application

Any unexpected downtime or interruptions of critical processes and operations typically result in significant financial losses or danger to human lives. In hospitals, for example, ground faults in medical equipment can be lethal for the patient. Therefore, some of these critical processes require the use of IT (isolated from earth) earthing systems, also called ungrounded earthing systems, to allow for continuity of service of the installation in the event of an insulation fault. Among others, this is typically the case in wet location applications (both MV and LV) such as wastewater treatment, mining, energy and chemicals, marine, hospital operating rooms (OR), or intensive care units (ICU), etc. Facility and operations staff need to be made aware of insulation faults to quickly clear faults and reduce the risk of safety incidents.

Problem to Solve

Medical staff and facility operations and maintenance teams need to:

- Guarantee power availability and continuity of service for critical processes, equipment, or areas.
- Get real-time information, notifications, and alarms for overload, overheating, and insulation status to help ensure that installations are isolated from earth through sufficiently high impedance.
- Comply with insulation monitoring standards such as IEC 60364 and IEC 61557.

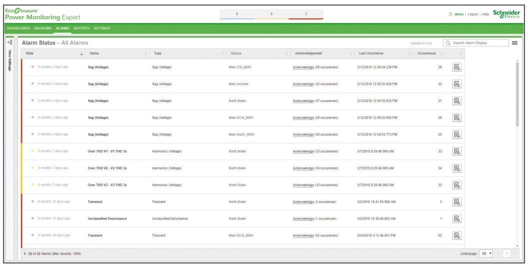
Purpose of the Application

Help prevent disruption of critical processes due to insulation faults, overload, and over-temperature conditions by:

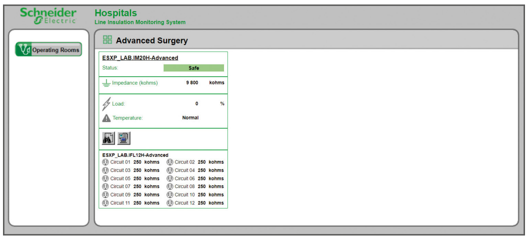
- Continuously monitoring insulation integrity locally and/or remotely
- Displaying the status of the installation
- Triggering and sending alarms in the event of an initial fault, to quickly clear it, since a second fault would cause a circuit breaker to trip

Provide first level troubleshooting support for staff

- For example, in operating rooms and intensive care units



Insulation and Electrical Fault Alarm Viewer



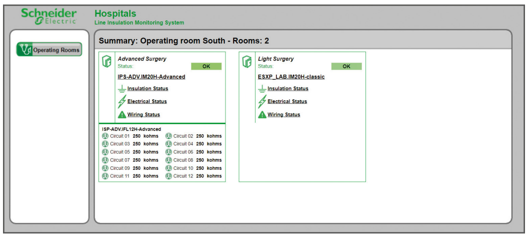
Specific Diagram for Operating Rooms and ICUs

Application Outcomes

The Insulation Monitoring application can provide the following suggested outputs.

Live Data Display

- Insulation monitoring status
- Insulation integrity absolute value (Ω)



Live Data Display

Events and Alarms

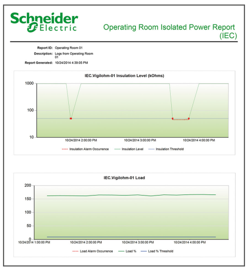
- Insulation fault (visual and acoustic in operating rooms and ICUs)
- Insulation fault location (per feeder / group of sockets)
- Isolation transformer fault (overload/overheating)

Trends

Real-time and historical data can be viewed on a trend viewer.

Reports

Operating Room Isolated Power Report



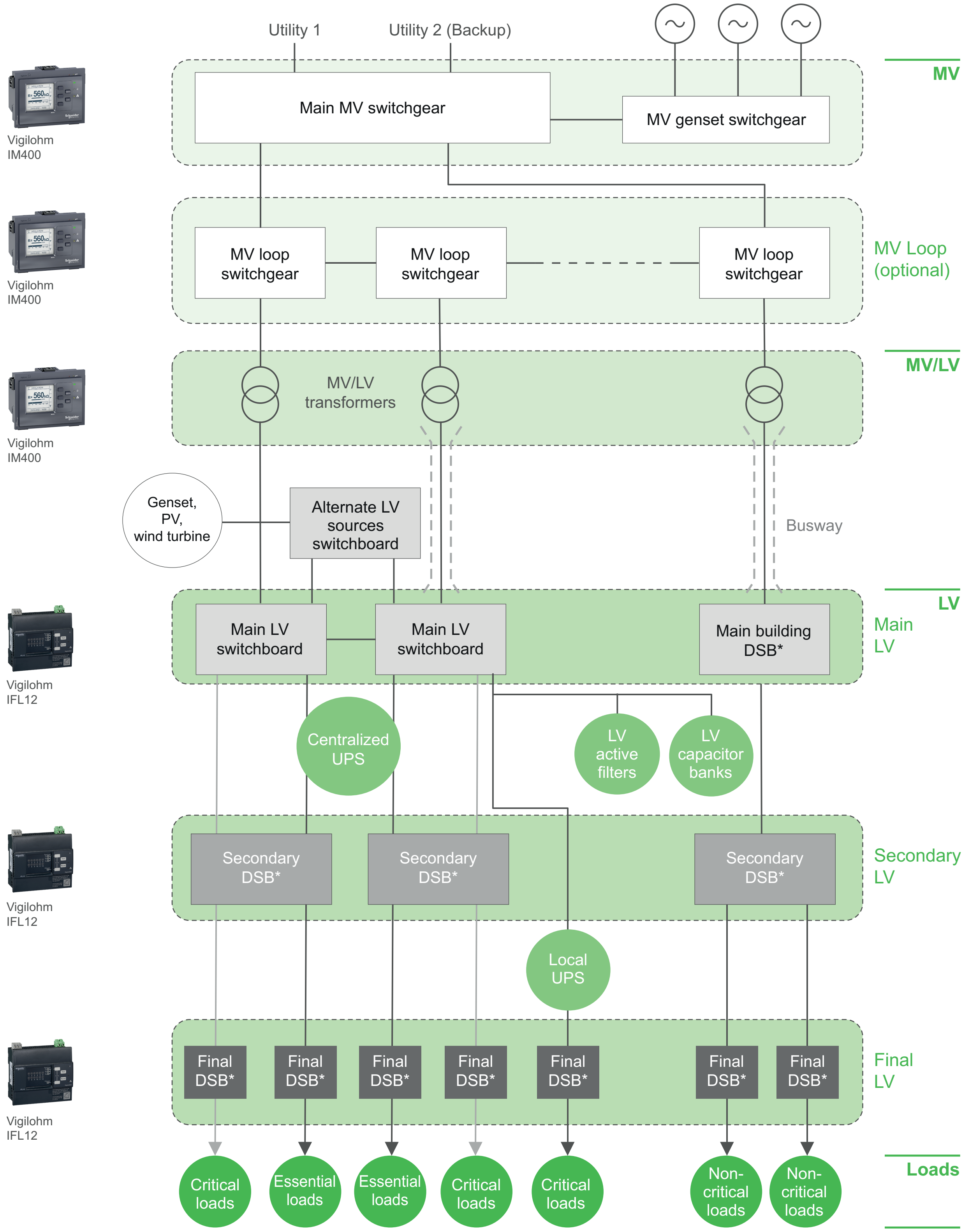
Operating Room Isolated Power Report

Notifications

- SMS and/or email notifications can be sent for fast analysis and action.
- Additional email notifications are available to send reports and other noncritical information.

Electrical Architecture - Industrial Applications

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Insulation Monitoring application for industrial applications:

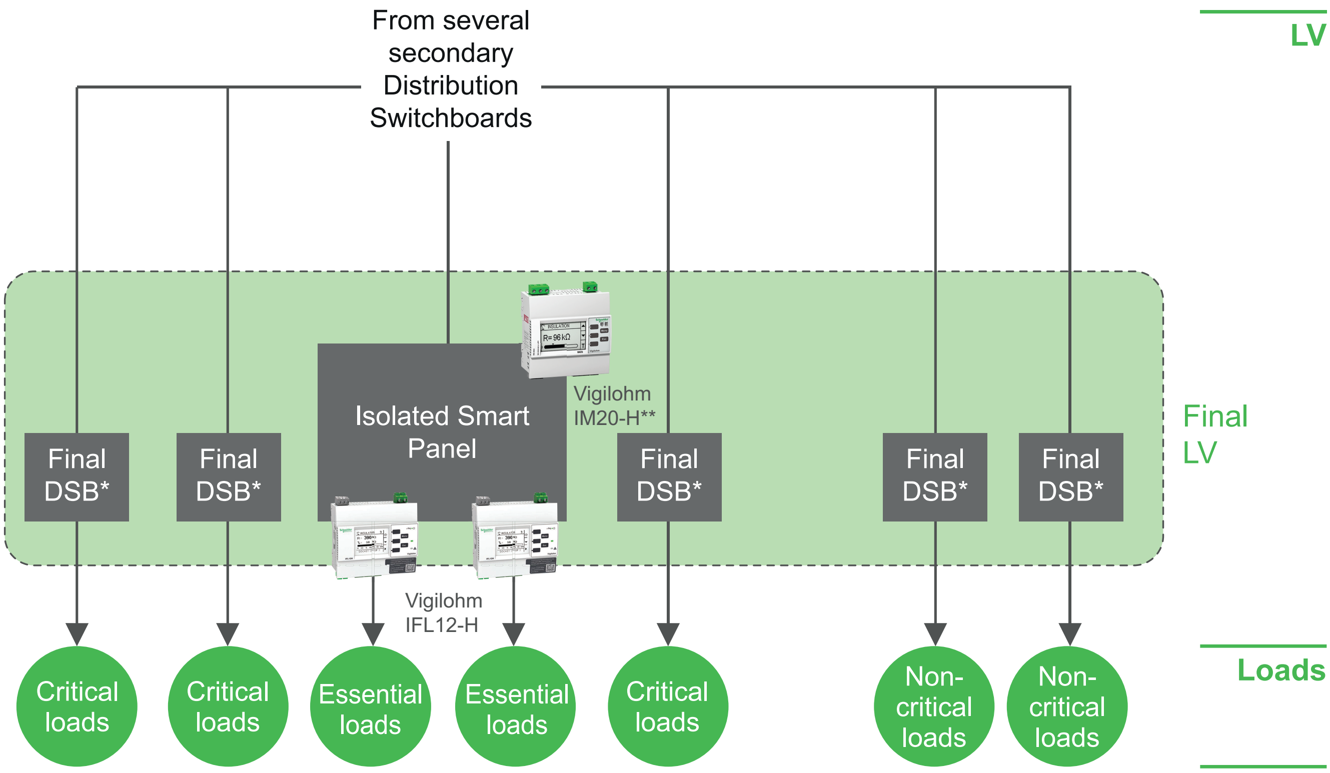


* DSB = Distribution Switchboard

Electrical Architecture - Healthcare Applications

The Vigilohm IM20-H serves as the central insulation monitoring device to monitor the network insulation. Fault Location Devices (Vigilohm IFL12-H) can be installed as an option on each feeder to identify the problem circuit.

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Insulation Monitoring application.



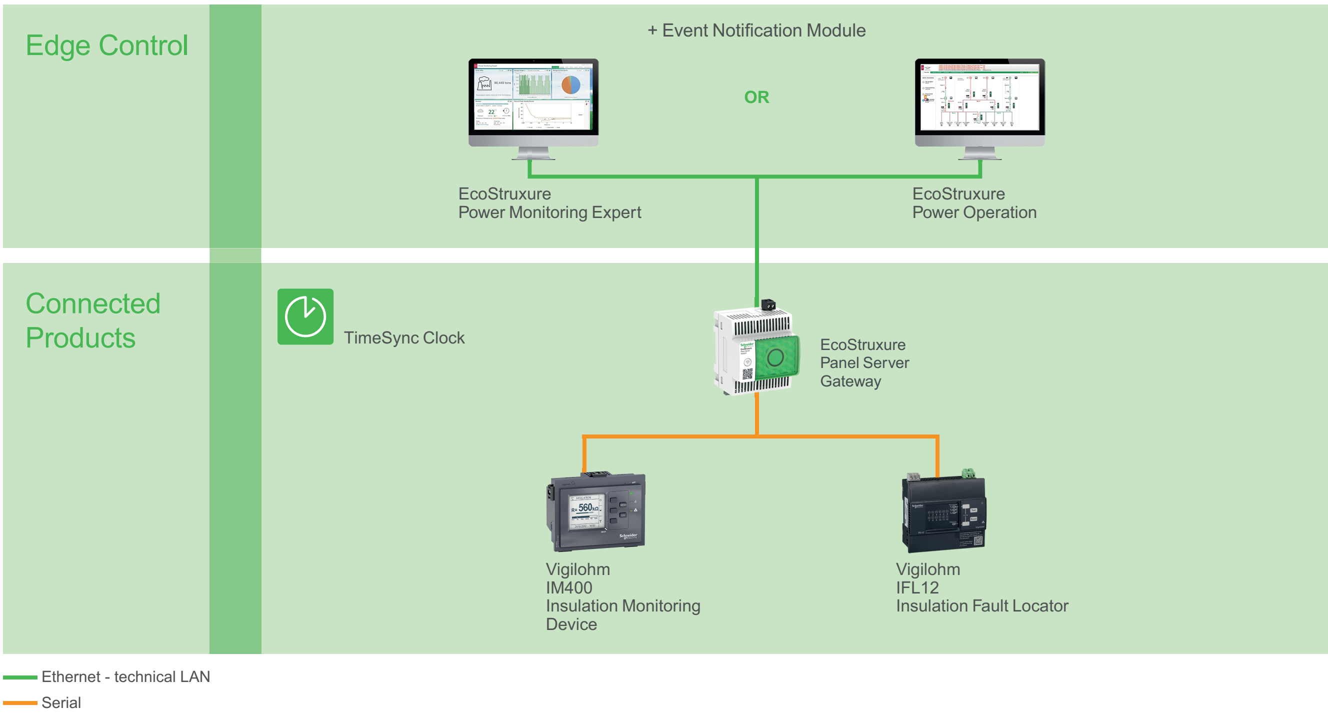
* DSB = Distribution Switchboard

** In non-healthcare applications, the IM400 can be used (e.g., Marine, Industrial)

Digital Architecture - Industrial Applications

Insulation Monitoring data is transferred to the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) via a gateway for on-premise visualization, analysis and reporting.

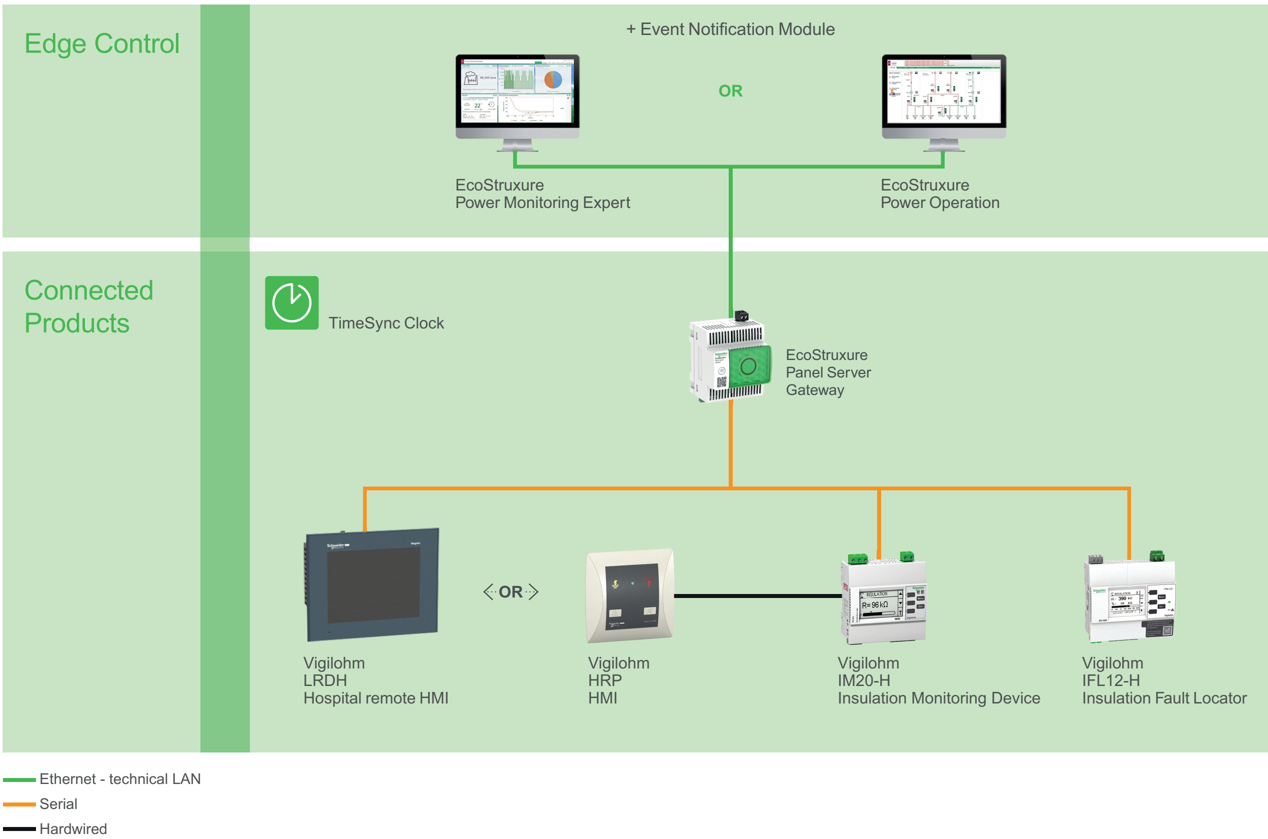
The recommended digital architecture for the application is shown below:



Digital Architecture - Healthcare Applications

Insulation Monitoring data is transferred to the Edge Control software (EcoStruxure Power Monitoring Expert and Power Operation) via a gateway for on-premise visualization, analysis, and reporting.

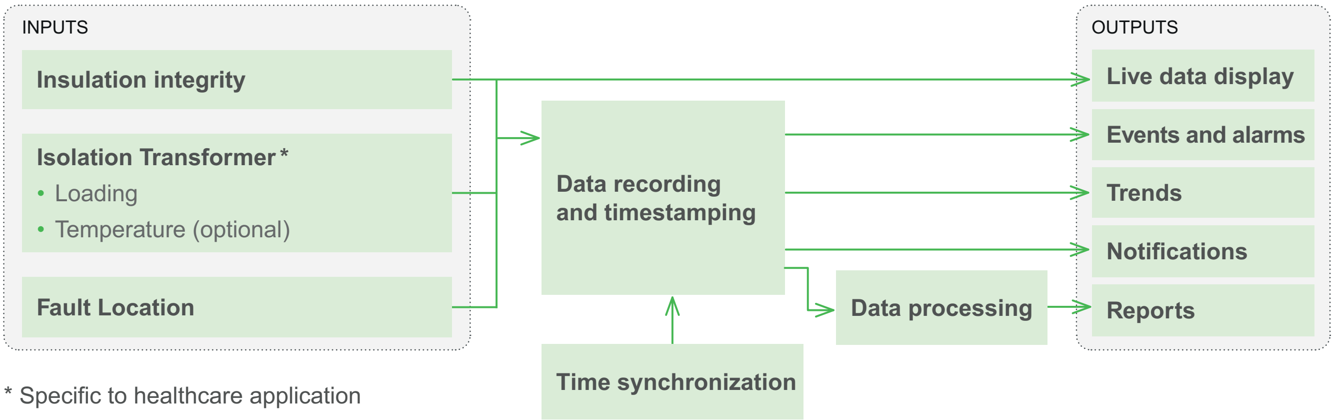
The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Insulation Monitoring application can be broken down as follows:



* Specific to healthcare application

Inputs

The following data is required for the Insulation Monitoring application and is acquired from the Insulation Monitoring Device Vigilohm (IM400 or IM20-H[15]) .

Vigilohm IM400

Vigilohm IM20-H

Insulation Integrity

- Permanent measurement of insulation resistance to ground in IT systems

Isolation Transformer[15]

- Isolation transformer loading (A)
- Isolation transformer temperature (optional)

The transformer loading calculation requires the transformer name plate rating and impedance threshold.

15. Specific to healthcare application

Fault Location

In case of an insulation fault, the location of the fault is indicated by the fault location device (Vigilohm IFL12).


Vigilohm
IFL12


Vigilohm
IFL12-H

Data Processing

The insulation integrity (in kΩ and/or μF), transformer loading[16], and temperature[16] are sent to EcoStruxure Power Monitoring Expert and/or Power Operation for data processing. Here, the data is analyzed and converted into events and alarms.


EcoStruxure
Power Monitoring Expert


EcoStruxure
Power Operation

Data Recording and Timestamping

Real-time impedance, loading, temperature, as well as the generated event and alarm data, are recorded as historical values in the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation).


EcoStruxure
Power Monitoring Expert


EcoStruxure
Power Operation

Timestamping is done by the Vigilohm IM400 or IM20-H for the general insulation fault and independently by Vigilohm IFL12 series fault locators (MC and H) for the specific fault location.


Vigilohm
IM400


Vigilohm
IM20-H

Timestamping of digital data, while not critical for Insulation Monitoring performance, should be accurate to ±1 s for consistency and data integrity.

16. Specific to healthcare application

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

Time Synchronization

For consistent timestamping of all the power and energy data, the date and time should be accurately distributed to connected products and data loggers.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be connected to a GPS antenna to reach the expected time precision.

TimeSync Clock

Outputs

Outputs are displayed remotely via EcoStruxure Power Monitoring Expert or Power Operation.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

For healthcare, additional data is available with the optional healthcare Insulation Monitoring Module of EcoStruxure Power Monitoring Expert or Power Operation. In addition, the live data events and alarms can be displayed locally by Vigilohm HRP or LRDH (Operating Theater Display) for instant access by staff.

Vigilohm
LRDH

Vigilohm
HRP

Live Data Display

The following data is available natively:

- Insulation monitoring status
- Insulation integrity absolute value (kΩ) and/or leakage capacitance value (µF)

Events and Alarms

The following alarms can be raised:

- Insulation fault pre-alarm

- Insulation fault alarm through communications and dry contact relay, plus visual and acoustic in operating rooms[17]
- Insulation fault location (per feeder / group of sockets)
- Transformer fault[17]

Trends

Any Insulation Monitoring parameter such as insulation integrity (kΩ/μF) can be displayed as a trend in the Edge Control software.

Notifications

- SMS and/or email notifications can be sent for fast analysis and action.
- Additional email notifications are available to send reports and other non-critical information.

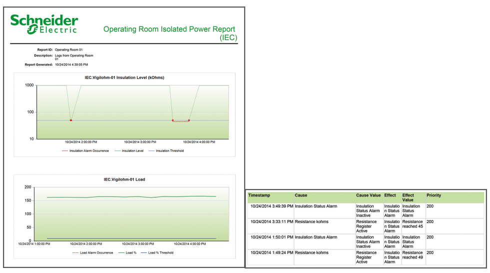
Reports[18, 19]

The following report can be displayed or automatically sent via email with the optional Insulation Monitoring module:

Isolated power report

For each Vigilohm IM20-H in the room, the report shows:

- Impedance graph: displays a comparison of impedance measurements to the impedance threshold .The impedance threshold is a blue line and actual measurements are shown as a green line. A red line shows the time when the impedance dropped below the threshold.
- Transformer load graph: displays a comparison of transformer load measurements to the load threshold. The threshold is a blue line and actual measurements are shown with a green line. A red line shows the time when the load rose above the threshold.
- Events table: shows information for each event that occurred in the date range.
- Data log table (optional): contains measurements for impedance, load, and temperature in the selected date range. Red values indicate measurements over the limit.



Isolated Power Report

17. Specific to healthcare application
18. Specific to healthcare application
19. The Insulation Monitoring module of EcoStruxure Power Monitoring Expert and Power Operation must be deployed to benefit from these features.

Guided Procedures Through Extended Reality

What's in This Chapter

Overview

Context of Application

In the past, as electrical distribution systems and associated operation and maintenance (O&M) procedures evolved slowly, and as employees benefitted from decades of experience, O&M challenges were substantial, but manageable.

Nowadays, facility personnel encounter a rapidly changing technical environment, whose underlying structure is becoming increasingly automated and uses increasingly complex digital technology. It is significantly more challenging for them to master all operational, maintenance, and safety practices specified in manufacturers' technical manuals and procedures.

Consequently, they must regularly perform stressful O&M tasks they are not intimately familiar with, where human error could have serious adverse safety or uptime consequences.

Problem to Solve

The facility manager, maintenance manager, and technician need to:

- Operate and maintain the electrical distribution installation while mitigating downtime and reducing risks resulting from human error.
- Quickly resolve technical issues with complicated procedures they are not intimately familiar with.
- Easily access and comply with asset maintenance schedules, safety information, and associated documentation.
- Participate in training without impacting the live equipment.

EcoStruxure XR Operator Advisor Client App

Purpose of the Application

Provide supporting information to help analyze the status of equipment:

- Virtual single line diagrams overlaid on top of equipment

- "Points of interest" which can display electrical data (V, A, kW, etc.) or equipment/environmental conditions (temperatures, humidity, etc.)
- Easy access to related documentation

Provide extended reality step-by-step "Guided Procedures" for operations and maintenance, available on:

- Smartphones
- Tablets
- Mixed reality glasses

Enable remote collaboration with experts in other locations

Mixed Reality Glasses

Application Outcomes

Contextual Asset and Site Information

Points of interest can be configured and virtually displayed in front of equipment and devices to communicate site-specific safety and maintenance information and to access drawings, user guides, and multimedia.

Contextual Asset or Site Information overlaid on top of equipment

Overlaid Live Data

Device and equipment data can be virtually overlaid on equipment and viewed in the EcoStruxure XR Operator Advisor Client Mobile App and/or Desktop App, or through mixed reality glasses.

Overlaid Events and Alarms

Abnormal conditions are virtually overlaid on top of equipment and are highlighted to alert and guide users.

"X-Ray" Vision

Users can virtually look inside enclosures without the risks involved with opening doors or removing panels.

"X-Ray" Vision

Step-by-Step Guidance

Users have access to generic or site-specific procedures with step-by-step instructions.

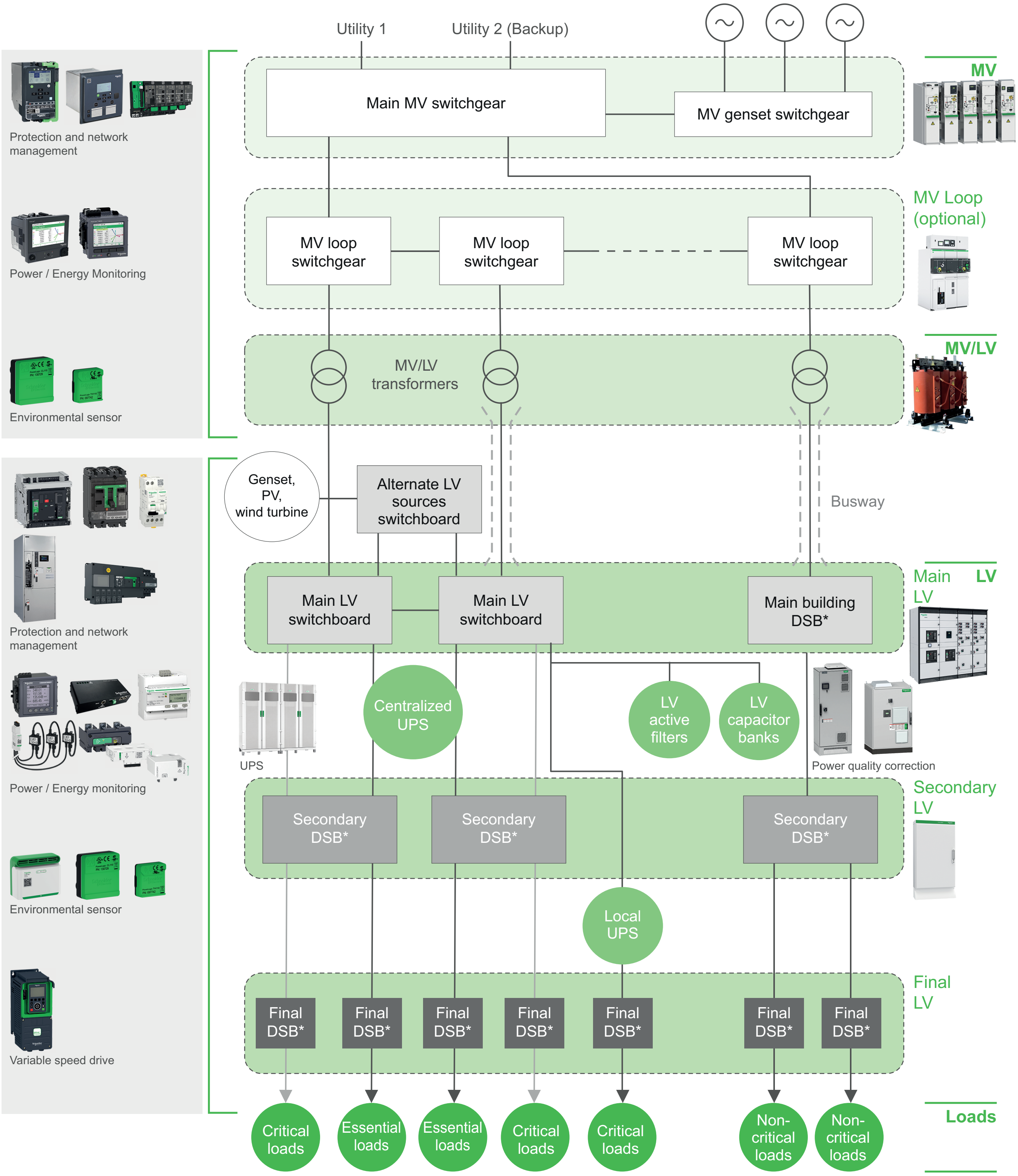
Data-driven step prerequisites can be configured to help ensure conditions are met before the next step can be started. Prerequisites can be status feedback from connected devices and/or pictures taken to document that actions were taken.

Remote Collaboration

A remote expert can support on-site personnel using the extended reality environment.

Electrical Architecture

The following diagram illustrates the types of products that can be connected to enable the Guided Procedures Through Extended Reality application:

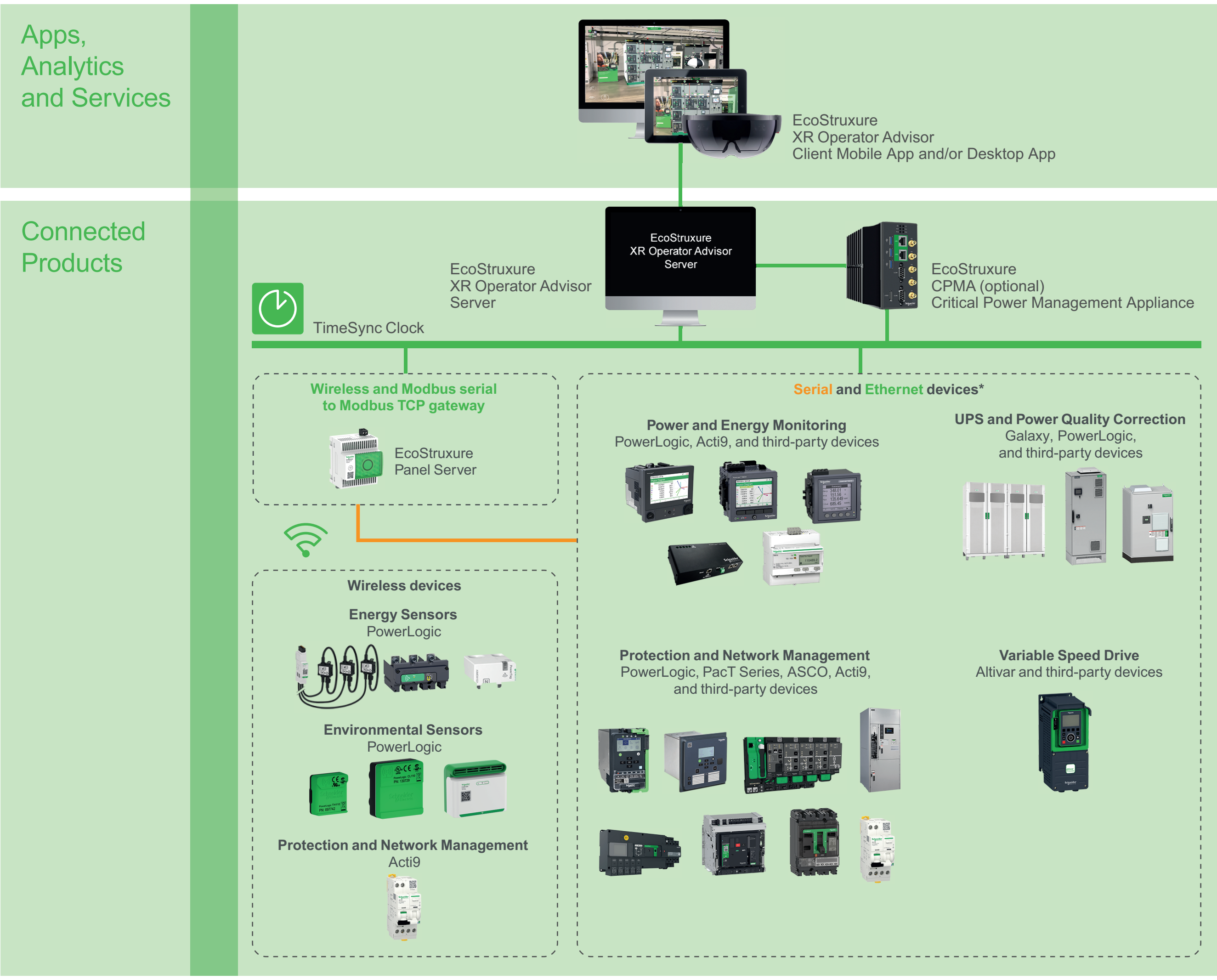


* DSB = Distribution Switchboard

Digital Architecture

The digital architecture of the Guided Procedures Through Extended Reality application involves collecting the input data from the different products (including third-party), either directly over Ethernet, via gateways (such as EcoStruxure Panel Server), or through the EcoStruxure CPMA (Critical Power Management Appliance). This data is then passed to the EcoStruxure XR Operator Advisor Server for data processing. Data can then be viewed on different EcoStruxure XR Operator Advisor Client Apps.

The recommended digital architecture for the application is shown below:



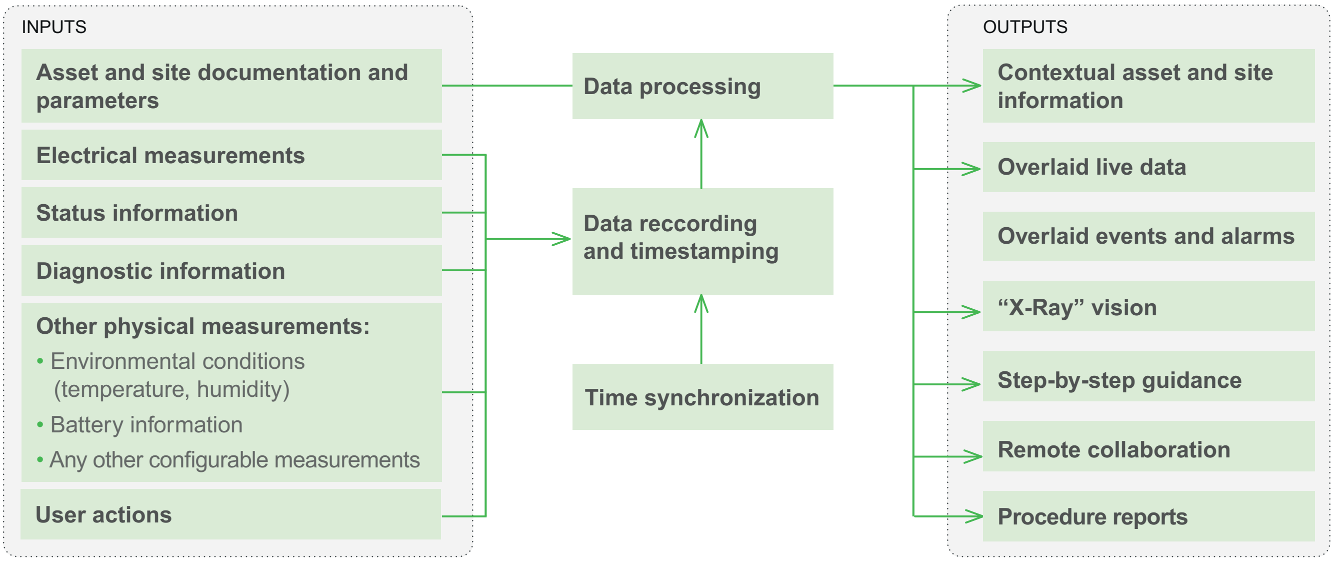
- Ethernet - technical LAN
- Ethernet - public LAN/WAN
- Serial
- Wireless - 2.4 GHz

* Depending on the connected product chosen, communication protocols can be Ethernet or Serial.

System Description

Data Flow

The Guided Procedures Through Extended Reality application can be broken down as follows:



Inputs

The following data is required to enable the Guided Procedures Through Extended Reality application:

Asset and Site Documentation and Parameters

These data are configured during the commissioning of the Extended Reality environment. They may include:

- Site map
- Size and relative spatial position of assets
- Standard manufacturer-recommended maintenance procedures
- User-requested procedures for a given electrical asset
- User guides
- Drawings
- Maintenance schedules
- Procedures for operation and maintenance that involve more than one related electrical asset in a given system

Electrical Measurements

Real-time values can be read from connected devices such as power and energy monitoring devices, energy sensors, protection and network management devices. Typical values include:

- Current and voltage
- Power (Active, Reactive, Apparent)
- Frequency
- Power factor
- Energy

Power and Energy Monitoring

PowerLogic, Acti9, and third-party devices

Energy Sensors

PowerLogic and third-party devices

Status Information

Status information can be retrieved from connected products:

- Circuit breaker position (open, closed, racked-in, racked-out, etc.)
- Circuit breaker trip status and protection status
- ATS/PTS status, UPS status, and motor status
- Other statuses, operating modes, or conditions

The above information can come from circuit breakers, protection relays, UPSs, ATSs/PTSs, power quality correction equipment, variable speed drives, and other electrical distribution equipment, including third-party devices.

Protection and Network Management

PowerLogic, PacT Series, ASCO, Acti9, and third-party devices

UPS and Power Quality Correction

Galaxy, PowerLogic, and third-party devices

Variable Speed Drive

Altivar and third-party devices

Diagnostic Information

Connected products can also provide diagnostic data. This can include:

- Operating mode (normal/degraded/fault)
- Self-diagnostic data of electronic devices
- Specific data depending on equipment (opening time of a circuit-breaker, transfer time of a transfer switch, etc.)

Other Physical Measurements

Non-electrical measurements like environmental conditions (temperature, humidity, etc.) can also be integrated into the system.

Environmental Sensors

PowerLogic and third-party devices

User Actions

User actions are captured during all operational or maintenance activities.

Data Processing

Data processing is performed by the EcoStruxure XR Operator Advisor Server. Data collected can be compared between communicating devices and/or to configured thresholds.

Trigger conditions calculated by the server use these data comparisons to determine if an operator can move to the next step of a procedure.

Additionally, the relative location of operators is calculated and can enable spatial trigger conditions that help prevent an operator from proceeding unless he or she is in the correct position.

EcoStruxure
XR Operator Advisor
Server

Outputs

Outputs are displayed in EcoStruxure XR Operator Advisor Client which can be accessed both locally, with a smart device or mixed reality glasses, and remotely using the PC based application.

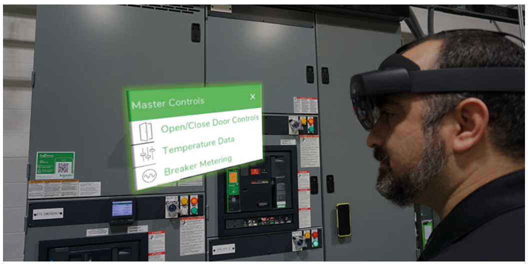
EcoStruxure
XR Operator Advisor
Client Mobile App and/or Desktop App

Contextual Asset and Site Information

The following information can be embedded in points of interest and virtually displayed in front of equipment and connected products:

- Safety information

- Maintenance information
- Drawings
- User guides
- Multimedia, etc.



Contextual Asset and Site Information

Overlaid Live Data

The following equipment and device data collected by the server can be displayed in EcoStruxure XR Operator Advisor Client :

- Electrical measurements
- Equipment status information
- Diagnostic information
- Other physical measurements

When viewed through a smart device or mixed reality glasses, the data is virtually overlaid on top of equipment and connected products.

Overlaid Live Data

Overlaid Events and Alarms

Alarms can be configured to alert energy managers or operations staff in case of events that require attention, such as:

- Exceeded threshold
- Electrical tripping
- Risk of arc flash
- Change in relative user position

Pop-up messages or visual changes can be configured to communicate the alarm or event conditions described above.

Overlaid Events and Alarms

"X-Ray" Vision

Operations staff can virtually look inside equipment without the risks associated with opening doors and removing panels. This is done by toggling the visibility of interior images overlaid on top of the equipment.

"X-Ray" Vision

Step-by-Step Guidance

- Operations staff can access generic or site-specific procedures configured using a decision tree interface that provides step-by-step instructions to complete relevant tasks.
- Procedures can be specific to a single equipment or span a sub-system of equipment in a user's installation.
- Step prerequisites, based on connected product data or relative user position, can be configured to help ensure conditions are met before the next step can be started.

Step-by-Step Guided Procedures

Remote Collaboration

- Users in multiple locations can access the extended reality environment to collaborate and coach others in real time with on-site situational awareness.

- The spatial position of collaborators is made viewable using virtual avatars.

Procedure Reports

- After a procedure is performed by an operator, a report can be viewed to attest to its completion or if the procedure was not completed.
- In case a procedure is interrupted, the report can help initiate the review and improvement of either of the procedure, tooling, or operator training.

Digital Applications for Power Availability

What's in This Part

Electrical Asset Life Cycle Management

What's in This Chapter

Overview

Context of Application

Traditional methods for managing maintenance of electrical assets such as medium and low voltage switchboards, circuit breakers, busway, and transformers can be cumbersome, complex, and time-consuming. Large amounts of documentation to store and manage as well as asset maintenance schedules (especially in large electrical networks) can lead to unexpected failures and costly unplanned downtime if not properly managed. Digital asset tracking can help facility maintenance teams improve maintenance effectiveness and efficiency.

Problem to Solve

The facility and maintenance manager needs to:

- Have electrical asset documentation readily available.
- Improve the effectiveness of maintenance teams to manage and assign tasks for electrical asset maintenance routines.
- Increase the mean-time-between-failures (MTBF), reduce the mean-time-to-repair (MTTR), reduce the total cost of ownership (TCO), and optimize overall asset life cycle.

Purpose of the Application

Simplify asset tracking with a digital representation of your equipment:

- Digital repository of asset location and documentation
- Easy access to documentation, drawings, warranty information, etc. using a mobile or desktop application

Switchboard with QR Code®[20] on Front Face

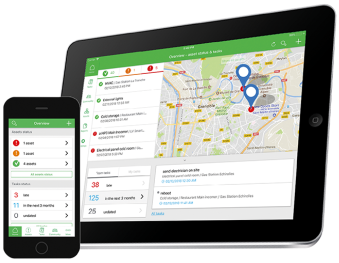
Plan preventative maintenance

20. QR Code is a registered trademark of DENSO WAVE INCORPORATED in Japan and other countries.

- Standard maintenance plan template per asset

Receive maintenance notifications

- Receive proactive notifications on mobile phone or desktop application
- Simplify maintenance planning
- Avoid missed maintenance tasks that could lead to failures
- Track maintenance history



Maintenance Status and Location at a Glance

Easily manage maintenance tasks within facility teams

- Easily and quickly share tasks with teams
- Provide instructions and guidance to designated service engineer
- Generate event log and report on asset maintenance

Keep asset information up-to-date

- Once maintenance has been performed, update documentation, future maintenance tasks, and schedules

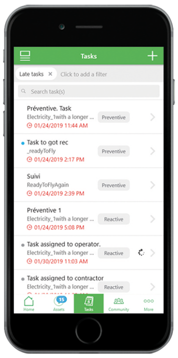
Share projects and collaborate online

- Collaborate with professional partners to achieve a common goal
- Easily identify the key stakeholders in charge of the different stages of the project to reduce contradictory or missing information

Application Outcomes

Dashboards

- Asset location map
- Overview of asset status
- Summary of team maintenance task status (late, upcoming)

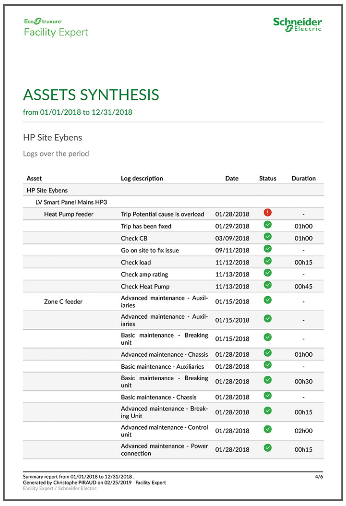


EcoStruxure Facility Expert Maintenance Task List

Reports

- Editing and automatic storage of maintenance reports and asset information

- Log of maintenance tasks per asset with late/upcoming maintenance task due dates


EcoStruxure
Facility Expert

ASSETS SYNTHESIS

from 01/01/2018 to 12/31/2018

HP Site Eybens

Logs over the period

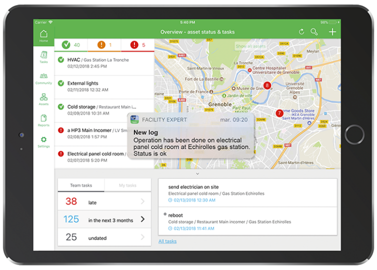
Asset	Log description	Date	Status	Duration
HP Site Eybens				
LV Smart Panel Mains HP3				
Heat Pump feeder	Trip Potential cause is overload	01/28/2018		-
	Trip has been fixed	01/29/2018		01h00
	Check CB	03/09/2018		01h00
	Go on site to fix issue	09/11/2018		-
	Check load	11/12/2018		00h15
	Check amp rating	11/13/2018		-
	Check Heat Pump	11/13/2018		00h45
Zone C feeder	Advanced maintenance - Auxiliaries	01/15/2018		-
	Advanced maintenance - Auxiliaries	01/15/2018		-
	Basic maintenance - Breaking unit	01/15/2018		-
	Advanced maintenance - Chassis	01/28/2018		01h00
	Basic maintenance - Auxiliaries	01/28/2018		-
	Basic maintenance - Breaking unit	01/28/2018		00h30
	Basic maintenance - Chassis	01/28/2018		-
	Advanced maintenance - Breaking Unit	01/28/2018		00h15
	Advanced maintenance - Control unit	01/28/2018		02h00
	Advanced maintenance - Power connection	01/28/2018		00h15

Summary report from 01/01/2018 to 12/31/2018 . 4/6
Generated by Christophe PIRAUD on 02/25/2019 Facility Expert
Facility Expert / Schneider Electric

Asset Maintenance Report

Notifications

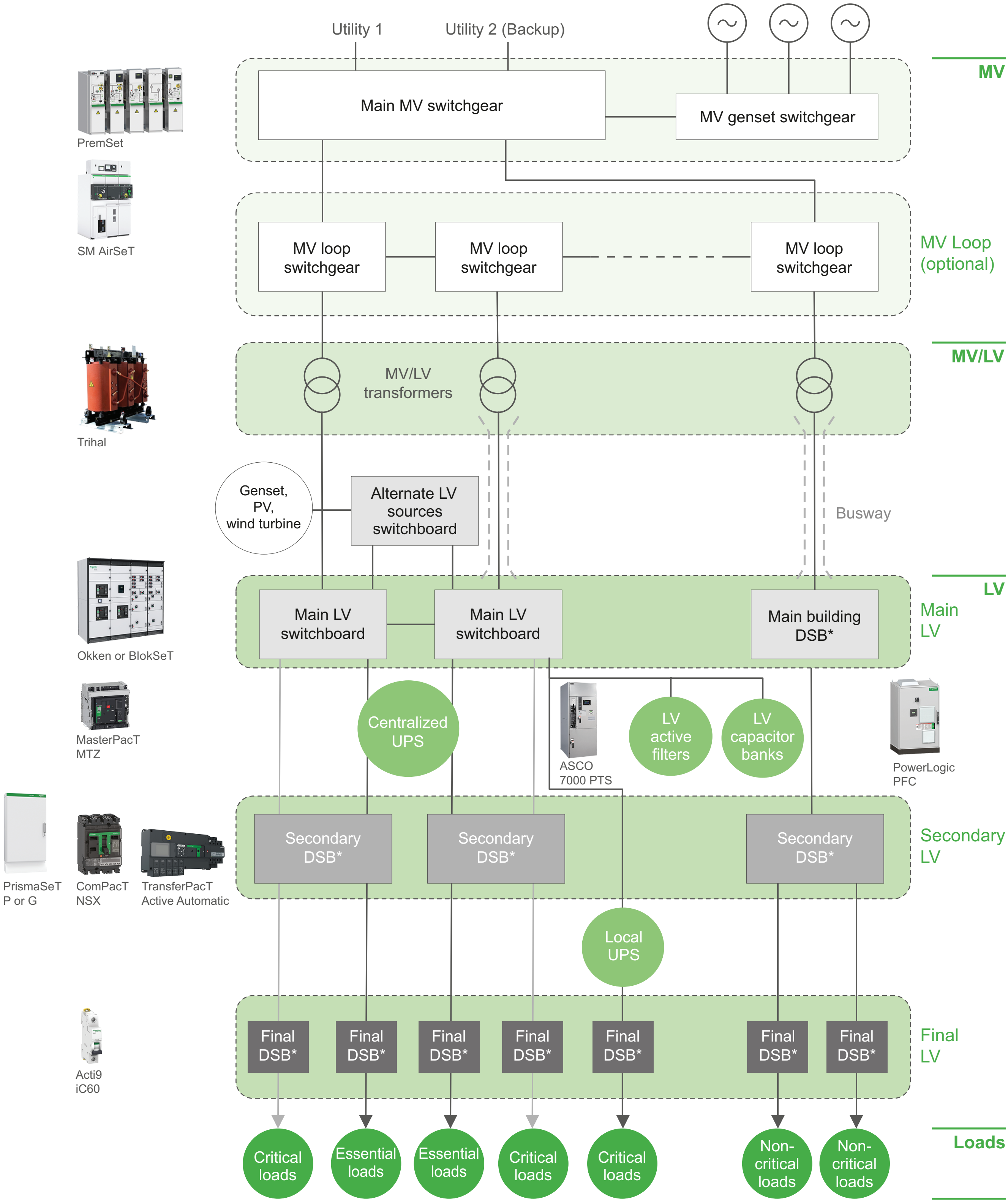
- Notification through mobile or desktop application of assigned, scheduled, or late maintenance tasks



EcoStruxure Facility Expert Maintenance Notifications

Electrical Architecture

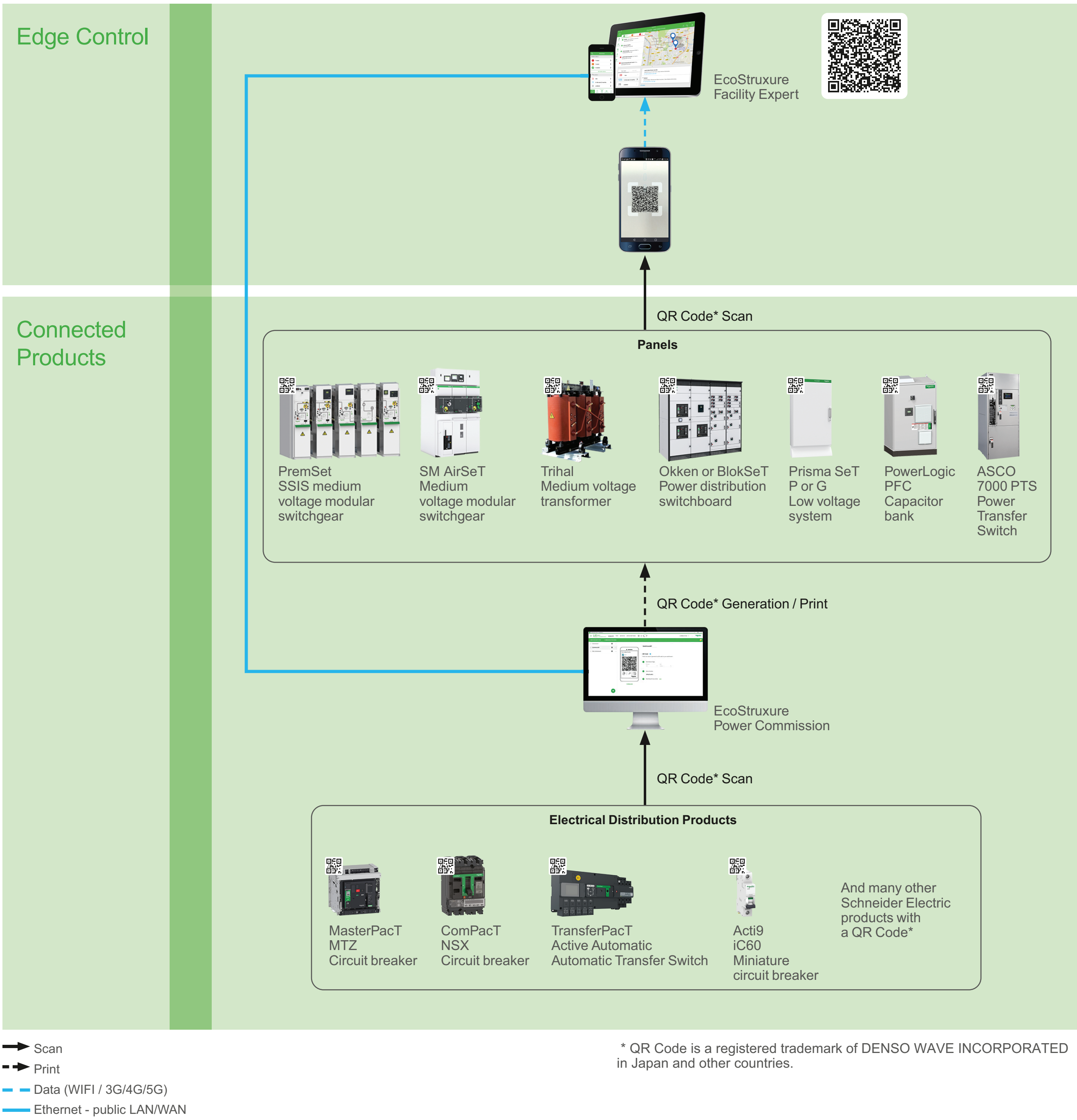
The following diagram details the areas of the architecture where the Electrical Asset Life Cycle Management application can be deployed.



* DSB = Distribution Switchboard

Digital Architecture

The recommended digital architecture for the application is shown below:

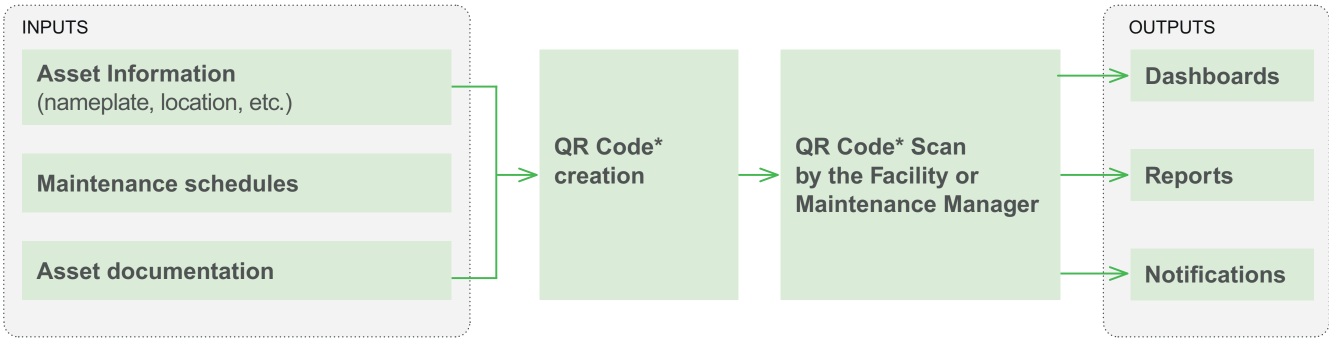


* QR Code is a registered trademark of DENSO WAVE INCORPORATED in Japan and other countries.

System Description

Data Flow

The Electrical Asset Life Cycle Management application can be broken down as follows:



* QR Code is a registered trademark of DENSO WAVE INCORPORATED in Japan and other countries.

Inputs

The following data are acquired during the manufacturing and commissioning of electrical assets:

Asset Information and Maintenance Schedules

- Electrical characteristics and serial number are captured as per nameplate, as well as context information that will help locate the Asset (customer, country, town, facility, building, floor, etc.).
- Maintenance templates and schedules include the standard manufacturer recommended maintenance procedures and schedules for a given electrical asset.
- Standard templates exist for a number of electrical assets such as:.
  - Medium voltage equipment (PremSet, SM AirSeT, PIX)
  - Low voltage equipment (PrismaSeT, Okken)
  - Power transfer switches (ASCO 7000 Series PTS)
  - Motor control centers
  - Circuit breakers such as MasterPacT MTZ, ComPacT NSX, and Acti9 iC60
  - Power correction devices such as PowerLogic PFC and AccuSine
  - Trihal transformers
- For non-native equipment, templates can be created in EcoStruxure Facility Expert.


PremSet


SM AirSeT


Okken or
BlokSeT


PrismaSeT
P or G


ASCO
7000 Series
PTS


TransferPacT
Active
Automatic


MasterPacT
MTZ


ComPacT
NSX

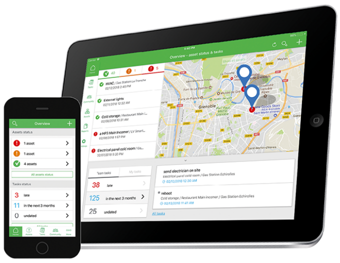

Trihal


PowerLogic
PFC


PowerLogic
AccuSine

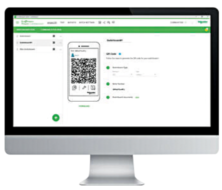
Asset Documentation

Asset documentation produced during panel construction can be attached to a defined electrical asset. This documentation may include wiring diagrams, single-line diagrams, user documentation, bill of materials, device serial numbers, and more. Documentation is stored digitally, accessible through the EcoStruxure Facility Expert app, and maintained as necessary during the operational life cycle.


EcoStruxure
Facility Expert

QR Code Creation

A QR Code[21] is produced through a process of installation and commissioning of electrical assets by Schneider Electric or the licensed panel builder using EcoStruxure Power Commission.


EcoStruxure
Power Commission

21. QR Code is a registered trademark of DENSO WAVE INCORPORATED in Japan and other countries.

QR Code Scan by the Facility or Maintenance Manager

The QR Code[22] for a given asset gives access to its associated documentation, maintenance requirements, and schedules. This simplifies utilization and maintenance of the equipment throughout its operational life cycle.

Equipment QR Code[22] (Nonfunctional Example Code)

Outputs

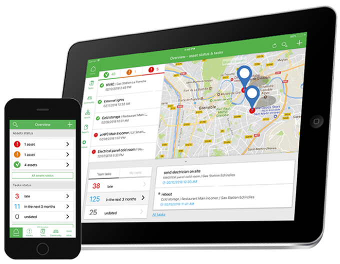
Outputs are displayed remotely via EcoStruxure Facility Expert software.

Dashboards

Map View

EcoStruxure Facility Expert provides a map view of where electrical assets are located.

- By clicking on a particular site, the list of the electrical assets can be viewed.
- Selecting an electrical asset provides access to its preventive maintenance status, procedures, and documentation.
- The available documentation consists of test reports (electrical, communication, etc.), electrical drawings, bill of material (BOM), etc.
- Users can also identify the required maintenance tasks and assign them to the appropriate person or team.



EcoStruxure Facility Expert Map View

Reports

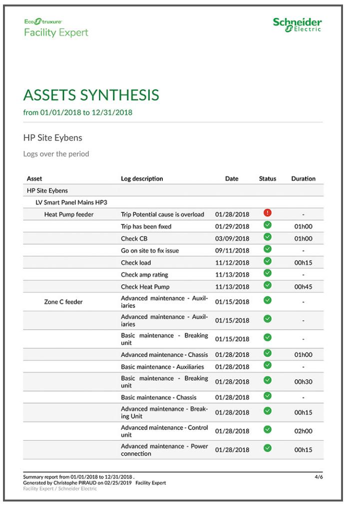
Facility Expert Maintenance Report

Maintenance reports can be generated to easily identify a summary of the status of maintenance tasks for electrical assets.

For a given asset, it provides:

- nameplate information
- key information including maintenance logs over the selected period, list of performed tasks, duration of inspections, and maintenance contributors
- visualization of all late or upcoming maintenance tasks

22. QR Code is a registered trademark of DENSO WAVE INCORPORATED in Japan and other countries.



EcoStruxure
Facility Expert

Schneider Electric

ASSETS SYNTHESIS

from 01/01/2018 to 12/31/2018

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Heat Pump feeder	Trip Potential cause is overload	01/28/2018	!	-
	Trip has been fixed	01/29/2018	✓	01h00
	Check CB	03/09/2018	✓	01h00
	Go on site to fix issue	09/11/2018	✓	-
	Check load	11/12/2018	✓	00h15
	Check amp rating	11/13/2018	✓	-
	Check Heat Pump	11/13/2018	✓	00h45
Zone C feeder	Advanced maintenance - Auxiliaries	01/15/2018	✓	-
	Advanced maintenance - Auxiliaries	01/15/2018	✓	-
	Basic maintenance - Breaking unit	01/15/2018	✓	-
	Advanced maintenance - Chassis	01/28/2018	✓	01h00
	Basic maintenance - Auxiliaries	01/28/2018	✓	-
	Basic maintenance - Breaking unit	01/28/2018	✓	00h30
	Basic maintenance - Chassis	01/28/2018	✓	-
	Advanced maintenance - Breaking Unit	01/28/2018	✓	00h15
	Advanced maintenance - Control unit	01/28/2018	✓	02h00
	Advanced maintenance - Power connection	01/28/2018	✓	00h15

Summary report from 01/01/2018 to 12/31/2018 . 4/6
Generated by Christophe PIRAUD on 02/25/2019 Facility Expert
Facility Expert / Schneider Electric

EcoStruxure Facility Expert Maintenance Report

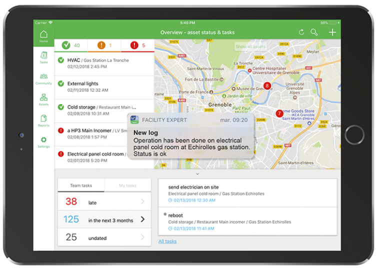
Maintenance Plan

Maintenance plans with auto-generated templates for Schneider Electric assets can be generated.

Notifications

The EcoStruxure Facility Expert application provides alerts and notifications when preventative maintenance tasks are due.

Alarm details and relevant associated actions such as acknowledgement, planning, and assignment of tasks are instantly accessible from the notification.



EcoStruxure Facility Expert Maintenance Notifications

Asset Performance

What's in This Chapter

Overview

Context of Application

In the past, equipment maintenance for circuit breakers, Uninterruptible Power Supplies (UPSs), motors, etc. was performed using a preventative or reactive approach. This means that devices were serviced periodically (typically every 1 to 2 years), upon failure, or upon the occurrence of a problem. Therefore, some equipment was maintained more often than necessary, whereas other equipment could have benefited from more frequent maintenance. Preventive and condition based maintenance on the other hand optimizes maintenance, and performs the right maintenance at the right time.

Problem to Solve

The facility/energy manager needs to:

- Move from reactive or preventative to condition-based (predictive) maintenance strategies for critical assets like circuit breakers, gensets, transformers, etc.
- Gain visibility into the health of critical assets and maintain them when necessary.
- Enhance their maintenance strategy with expert services to determine the optimal time to maintain critical assets.
- Streamline and optimize maintenance spending.

Purpose of the Application

Aggregate and analyze asset health data

- At Edge Control level: LV circuit breakers, UPSs, generator batteries, and power quality equipment
- Within Asset Advisor: MV/LV circuit breakers, MV/LV transformers (dry/oil-immersed), variable speed drives, and connected motors

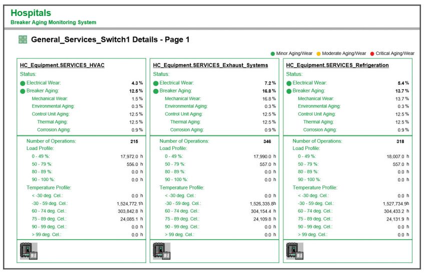
Offer a condition-based predictive approach, with tangible benefits for facility managers:

- Increase visibility of asset health across the entire system
- Streamline inspections using continuous asset health monitoring
- Optimize maintenance planning with analytics and expert advice

Application Outcomes

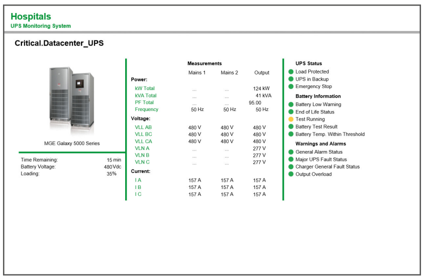
Live Data Display

- Circuit breaker asset monitoring diagram (% of electrical and mechanical wear, % of environmental and control unit aging, number of operations, and load and temperature profiles)



Aging Diagram for Circuit Breakers

- UPS monitoring diagram (measurements, UPS status, battery information, pre-alarms, and alarms)



UPS Monitoring Diagram

- Power quality mitigation equipment diagrams
- Generator status diagrams

Reports

- Circuit Breaker Aging Report
- UPS Health Report
- Generator Battery Health Report

These reports provide the right information to help decide when to maintain circuit breakers, UPSs, and generator start batteries.

Notifications

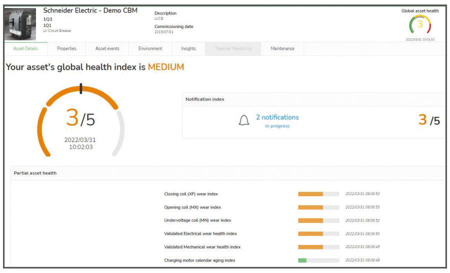
- SMS and/or email notifications can be sent for fast analysis and action.
- Email notifications are also available to send reports and non-critical information.

Cloud-Based Analytics and Services

EcoStruxure Service Plan powered by EcoStruxure Asset Advisor provides remote monitoring, asset management consulting, and on-site maintenance activities with recommendations from our Schneider Electric service experts.

It includes:

- Monitoring and alarms with remote notifications in the event of electrical asset condition anomalies
- Predictive analytics to help determine remaining equipment lifetime and other health indicators
- Condition-based asset maintenance triggered by a maintenance index



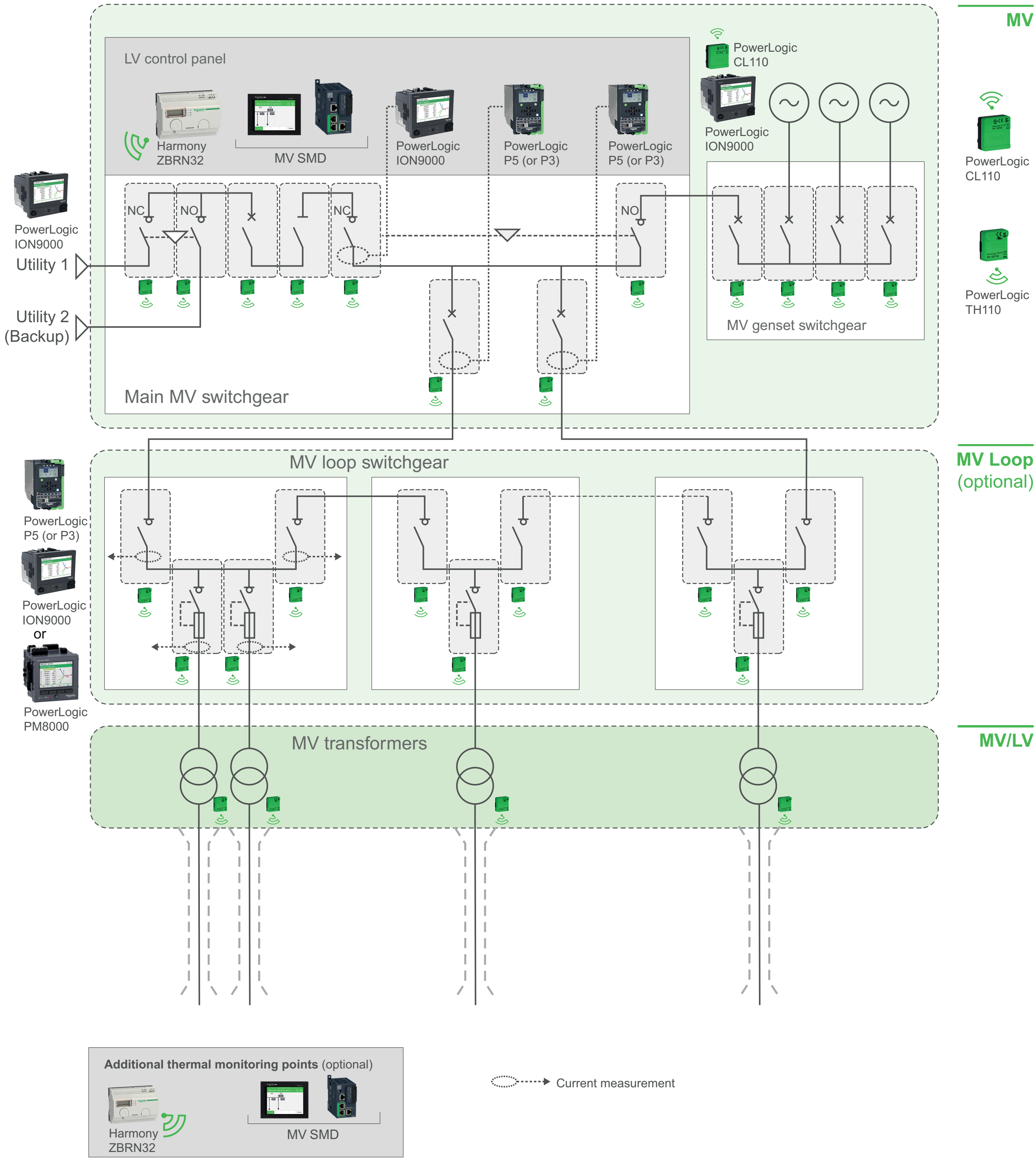
EcoStruxure Asset Advisor Asset Health Dashboard

EcoStruxure Asset Advisor Risk Level Dashboard

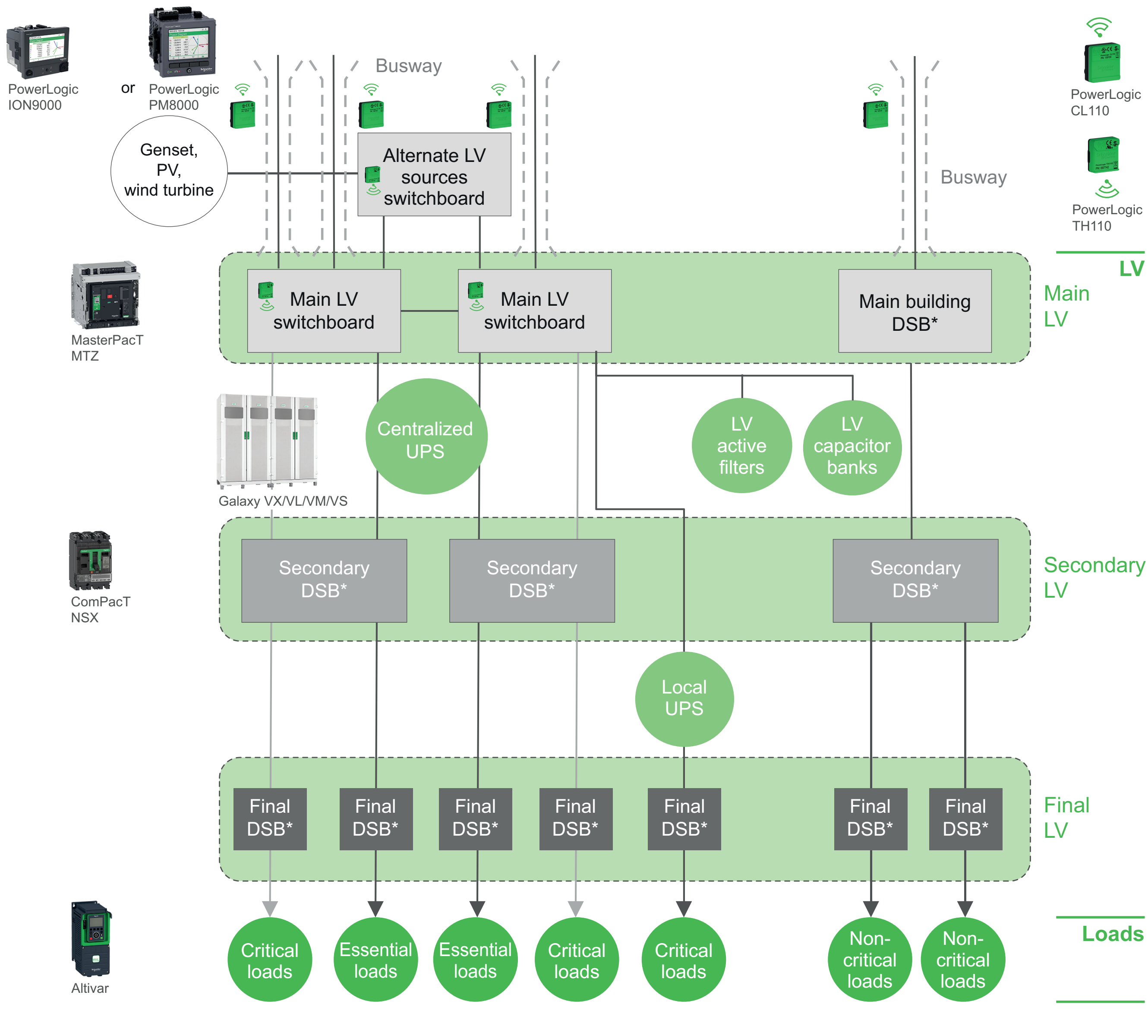
Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Asset Performance application. For more simplicity, the diagram has been split in two.

Upper Part (MV) of the Electrical Architecture



Lower Part (LV) of the Electrical Architecture



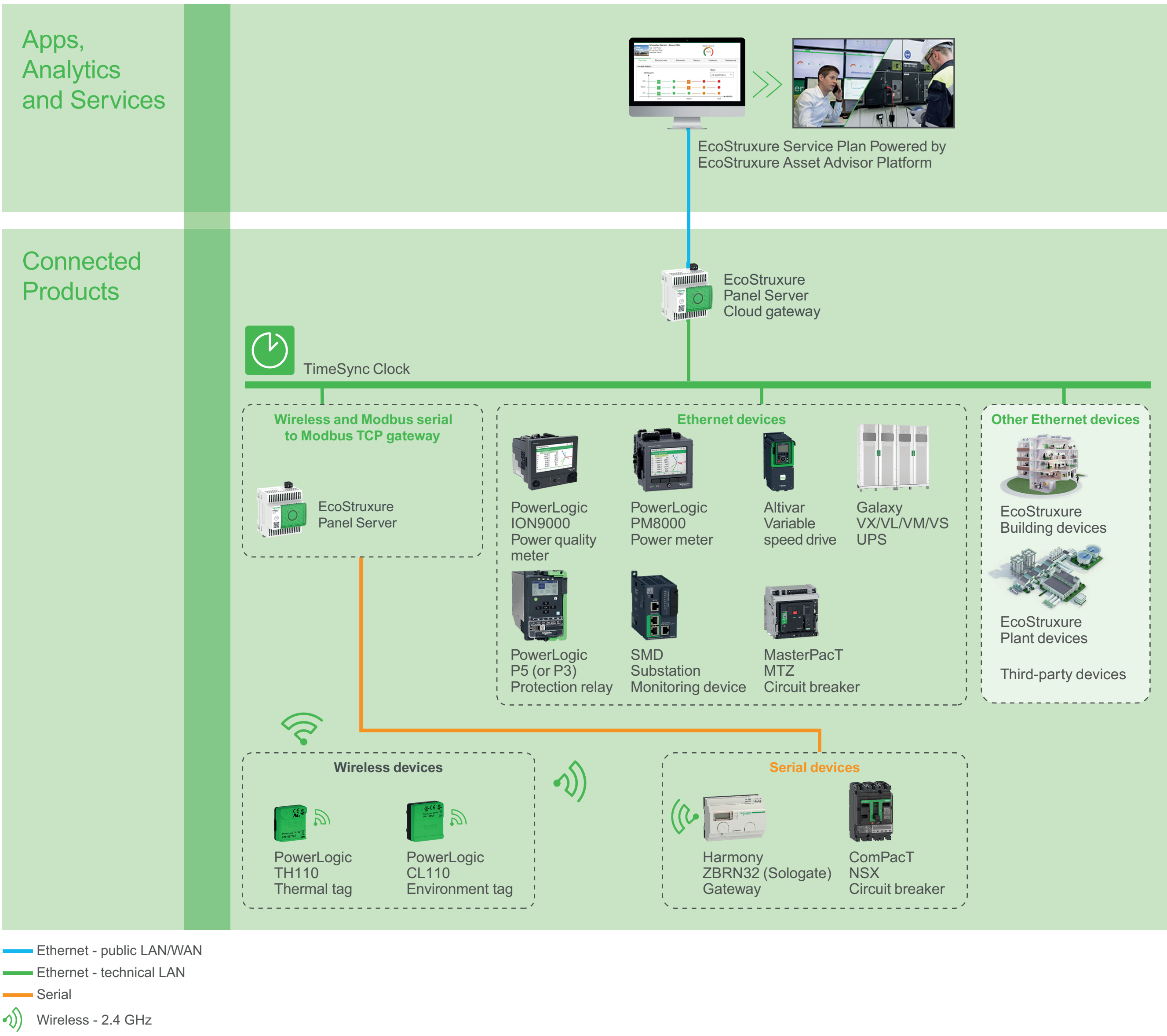
* DSB = Distribution Switchboard

Digital Architecture

With Connected Products and Remote Services

In this architecture, the data is collected and recorded from all connected products using a cloud gateway (EcoStruxure Panel Server). It is then passed on to the EcoStruxure Asset Advisor platform and interpreted by experts as part of the EcoStruxure Service Plan.

The recommended digital architecture for the application is shown below:

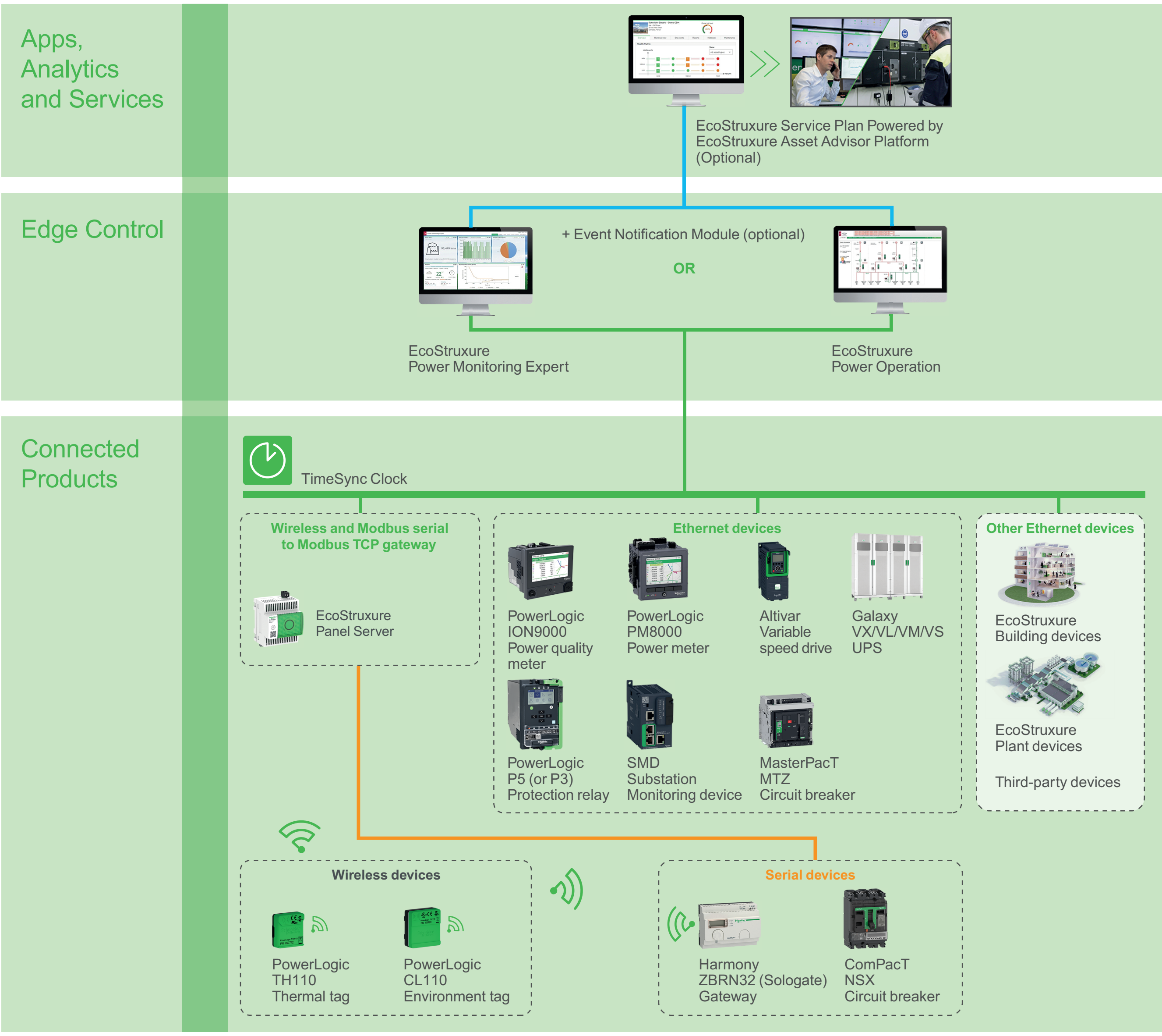


With Connected Products, Edge Control Software, and Optional Remote Services

In this architecture, the data is collected from all connected products either directly over Ethernet or via gateways. This data is then recorded and processed by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for on-premise visualization, analysis, and reporting.

As an option, data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Asset Advisor platform and interpreted by experts as a part of the EcoStruxure Service Plan.

The recommended digital architecture for the application is shown below:

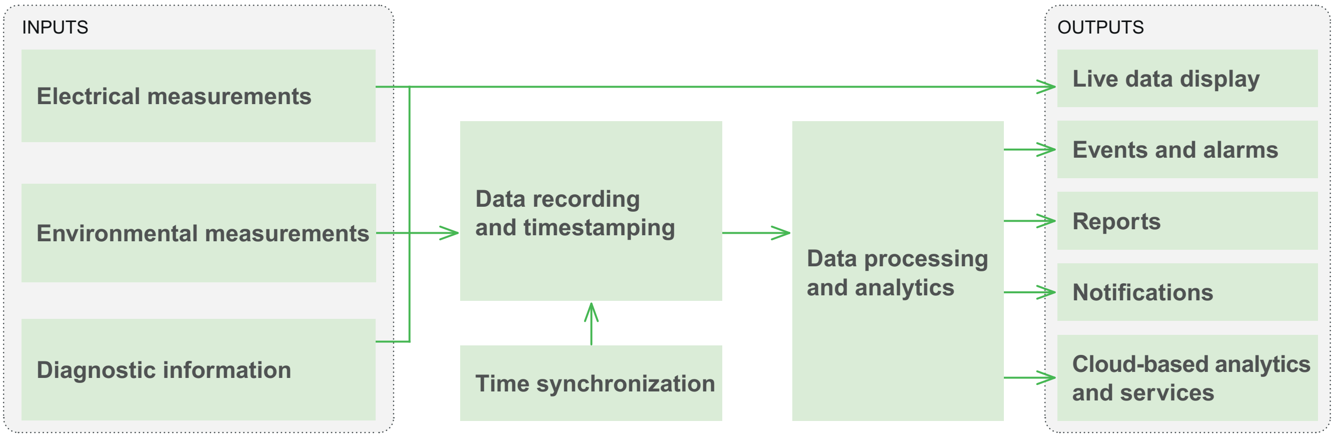


Ethernet - public LAN/WAN
Ethernet - technical LAN
Serial
Wireless - 2.4 GHz

System Description

Data Flow

The Asset Performance application can be broken down as follows:



Inputs

Data is collected from the following equipment types to implement the Asset Performance application:

- MV switchgear
- MV circuit breakers
- MV/LV oil transformer
- MV/LV dry-type transformer
- Generator
- Generator batteries
- LV switchboards
- LV circuit breakers
- LV busway
- UPS
- Variable speed drives
- MV/LV motors

Electrical Measurements

Depending on the asset, electrical measurements and status information can be provided by:

- **Power meters** such as PowerLogic ION9000, PM8000

PowerLogic ION9000

PowerLogic PM8000

- **Protection devices** such as PowerLogic P5/P3, MasterPacT MTZ, ComPacT NSX


PowerLogic P5


PowerLogic P3


MasterPacT MTZ


ComPacT NSX

- **UPS controller** such as Galaxy VX/VL/VM/VS


Galaxy VX/VL/VM/VS

- **Variable speed drive** (VSD) such as Altivar


Altivar VSD

Examples of electrical measurements are as follows[23]:

- 3-phase currents and voltage
- Active, reactive power
- Cumulative breaking current (kA²)
- Trip circuit, auxiliary voltages

Environmental Measurements

Environmental measurements are provided by the PowerLogic TH110 and PowerLogic CL110 thermal and environment tags that can be connected to a Substation Monitoring Device (SMD).

- Temperatures from cables, busbar, and windings
- Ambient temperature and humidity


PowerLogic TH110


PowerLogic CL110


Substation Monitoring Device (SMD)

Diagnostic Information

Diagnostic data is provided by each of the connected products mentioned previously. It includes[23]:

- Contact wear

23. This is not a comprehensive list. Other data may be available and contribute to asset health analytics.

- Number of operations (open/close, trip, draw out)
- Time for operation (trip, charge)
- Output velocity and torque
- Drive thermal status

Data Recording and Timestamping

For advanced connected products such as the PowerLogic ION9000, PM8000, MasterPacT MTZ, PowerLogic P5, and PowerLogic P3, the previously mentioned data is recorded and timestamped onboard.


PowerLogic ION9000


PowerLogic PM8000


MasterPacT MTZ


PowerLogic P5


PowerLogic P3

For other connected products or third-party devices, depending on the chosen digital architecture, data recording and timestamping is performed by the Edge Control software (EcoStruxure Power Monitoring Expert), by EcoStruxure Asset Advisor, or by EcoStruxure Panel Server when directly associated with EcoStruxure Asset Advisor.


EcoStruxure Power Monitoring Expert


EcoStruxure Asset Advisor


EcoStruxure Panel Server

Timestamping of digital data, while not critical for asset performance, should be accurate to ±1 second for consistency and data integrity.

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

Time Synchronization

To have a consistent chronological view of all events that take place throughout the facility, the date and time should be accurately distributed to connected products and other management systems.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and connected to a GPS antenna to reach the expected time precision.


TimeSync Clock

Data Processing

In the Asset Performance application, data processing consists of evaluating data from critical connected assets and applying advanced analytics to identify potential risks.

A first level of asset diagnostics, monitoring, and alarming, as well as some simple analytics are computed in EcoStruxure Power Monitoring Expert and Power Operation for on-premise, self-serve reporting (for example, low voltage circuit breakers, UPSs, generator batteries).


EcoStruxure
Power Monitoring Expert


EcoStruxure
Power Operation

More advanced analytics, such as predictive analysis and recommendations for maintenance optimization, are available with EcoStruxure Asset Advisor. They are typically recommended for highly critical, capital intensive assets.

For a summary breakdown, see the table of available asset health analytics below:

Location	On-Premise		Cloud-Based
	Edge Control		Preventive/Predictive Advisor Services
Equipment	Monitoring and Alarming	Simple Asset Health Analytics	Advanced Asset Health Analytics and Recommendations
MV switchgear	●		●
MV circuit breakers	●		●
MV/LV oil transformer	●		●
MV/LV dry-type transformer	●		●
Generator	●		●
Generator batteries	●	●	●
LV switchboard	●		●
LV circuit breakers	●	●	●
LV busway	●		●
UPS	●	●	
Variable speed drives	●		●
MV/LV motors	●		●

Outputs

Display of the following outputs is performed by EcoStruxure Power Monitoring Expert, Power Operation, or via the Asset Advisor web platform.


EcoStruxure
Power Monitoring Expert


EcoStruxure
Power Operation


EcoStruxure
Asset Advisor

Live Data Display

Live diagnostics data from monitored equipment can be visualized if the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) is in the architecture.

Events and Alarms

Asset related events and alarms can be raised in EcoStruxure Power Monitoring Expert and/or Power Operation in real time, or near real time, depending on the system configuration. These include MV switchgear and transformer environmental conditions (temperature and humidity), busway junction temperatures, breaker health (aging) and other simple diagnostics (communications, status, etc.).

Reports

Reporting is available for asset health analysis with Edge Control Software (EcoStruxure Power Monitoring Expert and Power Operation).

It includes:

Low Voltage Circuit Breaker Aging Report [24]

The circuit breaker aging report shows the status of circuit breaker aging and wear in your electrical system. The following LV circuit breaker ranges are supported:

- MasterPacT MTZ 1/2/3
- MasterPacT NT
- MasterPacT NW
- ComPacT NS630b-3200
- PowerPacT H-, J-, and D-Frame (China)

Schneider Electric

Circuit Breaker Aging Report

3/23/2015

Breaker Aging and Wear Summary

Switchboard	Level	Breaker Name	Electrical Aging (%)	Electrical Wear (%)
Switchboard A1	Critical	Breaker A2	84.8	53.7
		Breaker A3	87.8	85.7
		Breaker A4	96.7	71.9
		Breaker A5	30.8	90.3
		Breaker A7	73.2	74.5
		Breaker A8	38.2	66.3
		Breaker A9	42.5	66.8
		Breaker A10	6.3	89.1
		Breaker A11	2.3	78.3
		Breaker A12	47.4	53.2
		Breaker A13	67.3	71.7
		Breaker A14	57.2	69.5
		Breaker A15	80.7	50.8
		Breaker A16	12.1	93.9
		Breaker A17	81.4	13.6
		Breaker A18	19.7	53.5
		Breaker A21	56.6	3.4
		Breaker A22	55.9	61.0
		Breaker A24	6.1	93.5
		Breaker A25	47.0	81.1
		Breaker A26	98.6	35.4
		Breaker A27	11.9	72.4
		Breaker A28	14.0	62.3
		Breaker A29	96.5	31.6
		Breaker A30	86.4	16.2
		Breaker A32	91.1	80.0
		Breaker A33	78.2	50.9
		Breaker A34	31.4	59.6
		Breaker A35	54.8	84.7
		Breaker A36	28.6	99.5
		Breaker A37	36.0	59.1

Low Voltage Circuit Breaker Aging Report

UPS and Generator Battery Health [25]

Reporting for assets such as generators, generator batteries, and UPSs can be found in the Backup Power Testing Application section.

24. Requires the Breaker Performance Module in EcoStruxure Power Monitoring Expert and Power Operation.
25. Requires the Backup Power Module in EcoStruxure Power Monitoring Expert and Power Operation.

Notifications [26]

There are various options for remote notifications depending on the selected architecture:

- Simple diagnostic notifications based on data from supported connected products in the Edge Control software (Schneider Electric circuit breakers, protection relays, UPS, etc.)
- Preventive maintenance notifications based on EcoStruxure Asset Advisor Preventive analytics for Schneider Electric MV/LV equipment
- Proactive/Predictive analytics alerts and recommendations with EcoStruxure Asset Advisor Predictive for Schneider Electric MV/LV equipment and third-party equipment

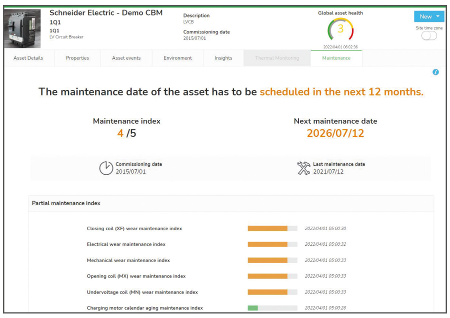
Cloud-Based Analytics and Services

EcoStruxure Service Plan powered by EcoStruxure Asset Advisor provides remote monitoring, asset management consulting, and on-site maintenance activities with recommendations from our Schneider Electric service experts.

It includes:

- Continuous asset monitoring and alarms
- Web portal and mobile app consultation with 24/7 remote support
- Remote notifications in the event of electrical asset condition anomalies
- Predictive analytics to help determine remaining equipment lifetime and other health indicators
- Customized reports with recommendations on asset health condition and optimized maintenance plan
- Condition-based asset maintenance triggered by Maintenance Index
- Optimized maintenance plan and proactive recommendations from Schneider Electric experts

EcoStruxure Service Plan powered by EcoStruxure Asset Advisor platform



EcoStruxure Asset Advisor Maintenance Index

26. For notifications in EcoStruxure Power Monitoring Expert and Power Operation, the Event Notification Module is required.

Electrical Distribution Monitoring and Alarming

What's in This Chapter

Overview

Context of Application

Just like any other process in a facility, electrical distribution systems are complex with many devices, and potential failures can occur at different locations. Considering the critical nature of the continuity of an electrical power supply, having the capacity to quickly view, analyze, and understand where the detected failure has occurred, like a car dashboard, is key for facility managers.

Problem to Solve

The facility manager needs to:

- Gain visibility of the status and relevant information of the entire electrical system.
- Receive alarms on abnormal conditions or events.
- Monitor and report on peak demand, loading of equipment such as breakers, UPSs, transformers, generators, etc.
- Know, analyze, and understand where issues of the electrical distribution network come from.

Purpose of Application

Provide real-time information about the electrical distribution system

- Real-time status
- Power availability
- Detailed information about each connected device: breakers, UPSs, transformers, generators, etc.

Identify anomalies and notify the right personnel

The Electrical Distribution Monitoring and Alarming application provides alarming in the event of any abnormal conditions and notifications based on alarm priority and shift schedule.

Aggregate onboard alarm data in an easy-to-understand way

To avoid alarm flooding and help with alarm interpretation, incidents are intelligently aggregated based on event type and time.

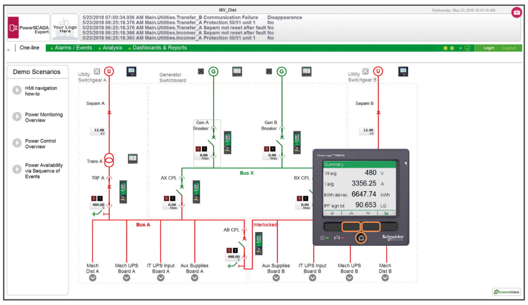
Native integration of connected products

Plug and play connectivity of devices provides rich contextual data that cannot be captured by BMS or generic SCADA applications.

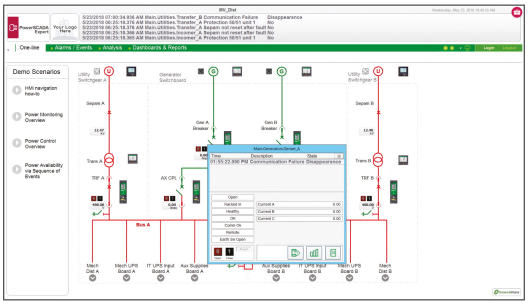
Application Outcomes

Live Data Display

- Native support for a wide range of devices and communication protocols
- Electrical network Single-Line Diagrams (SLDs)
- SLD color animation to distinguish energized/de-energized sections
- Elevation drawings
- Real-time data values of each connected device, such as electrical parameters, device settings, and status information



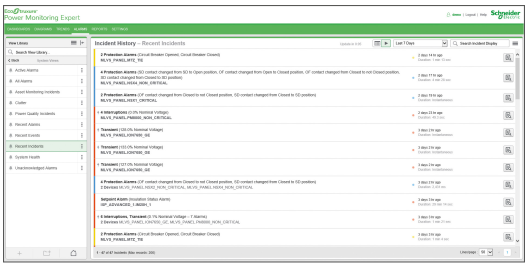
Electrical Network Single-Line Diagram (with color animation)



View of Device Data and Control

Events and Alarms

- Chronological display of events and alarms with sorting and filtering capabilities
- Intelligent alarm grouping into summary incidents



Alarm Viewer - Recent Incidents

Trends

- Real-time and historical data can be viewed on a trend viewer.

Dashboards

- Configurable dashboards for visualizing historical power system data

Reports

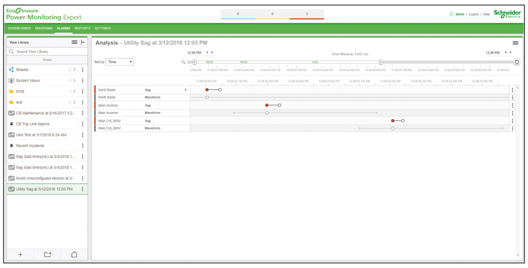
- Historical data reporting

Notifications

- SMS and/or email notifications can be sent for fast analysis and action.
- Email notifications are also available to send reports and non-critical information.

Analysis Tools

Display of incidents on the Power Event Analysis incident timeline (for more information, refer to the Power Event Analysis application).

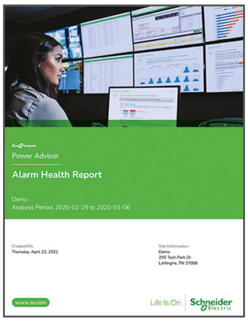


Power Events Incident Timeline

Display of electrical waveforms captured during arc flash event with a native waveform viewer in Edge Control software.

Cloud-Based Analytics and Services

As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides electrical network and alarm health analytics with recommendations from our Schneider Electric service experts.



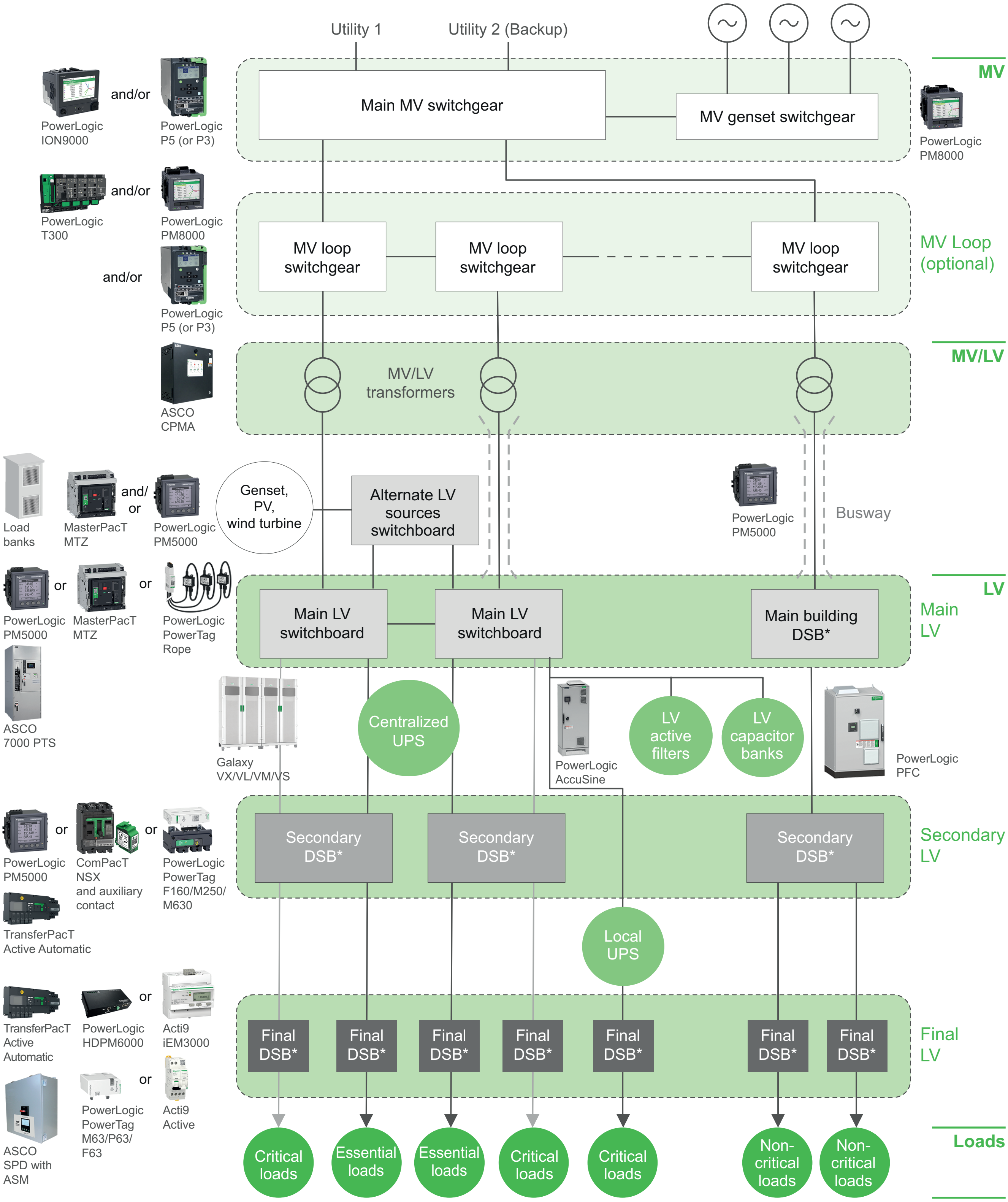
EcoStruxure Power Advisor Alarm Health Report

BMS Integration

EcoStruxure Power enables integration of electrical data and alarms at the Edge Control layer with BMS software such as EcoStruxure Building Operation.

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Electrical Distribution Monitoring and Alarming application:



* DSB = Distribution Switchboard

Digital Architecture

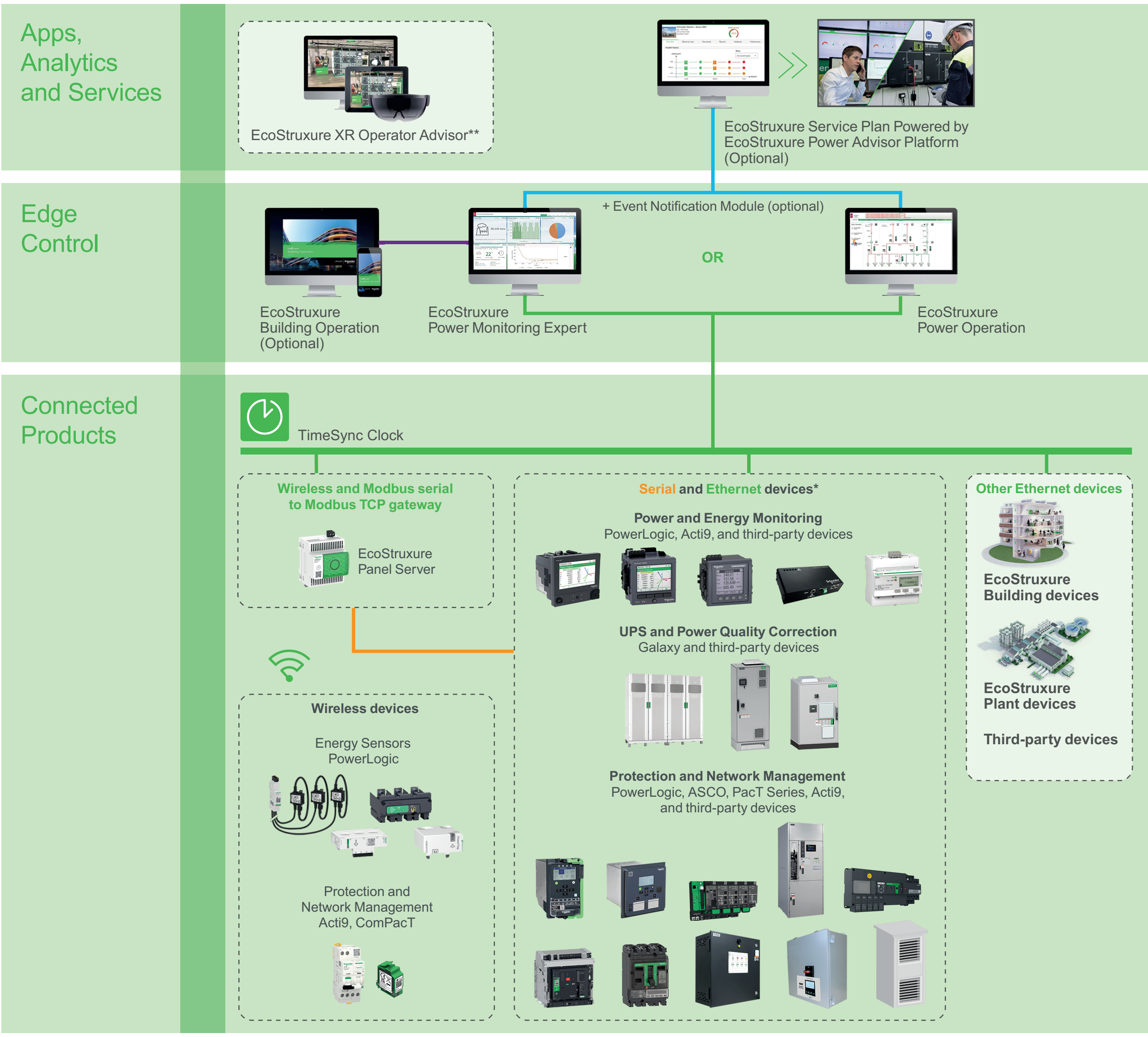
The digital architecture of the Electrical Distribution Monitoring and Alarming application involves collecting the input data from the different products, either directly over Ethernet or via gateways (such as EcoStruxure Panel Server). These data are then used by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for on-premises visualization, analysis, and reporting.

The most important data from the electrical distribution can also be monitored with a Building Management System (BMS) such as EcoStruxure Building Operation, thanks to seamless integration with EcoStruxure Power Monitoring Expert or Power Operation.

As an option, EcoStruxure XR Operator Advisor Client can be used to enhance Electrical Distribution Monitoring and Alarming with virtually overlaid data on top of equipment and devices.

Data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Power Advisor platform and interpreted by experts as a part of the EcoStruxure Service Plan.

The recommended digital architecture for the application is shown below:



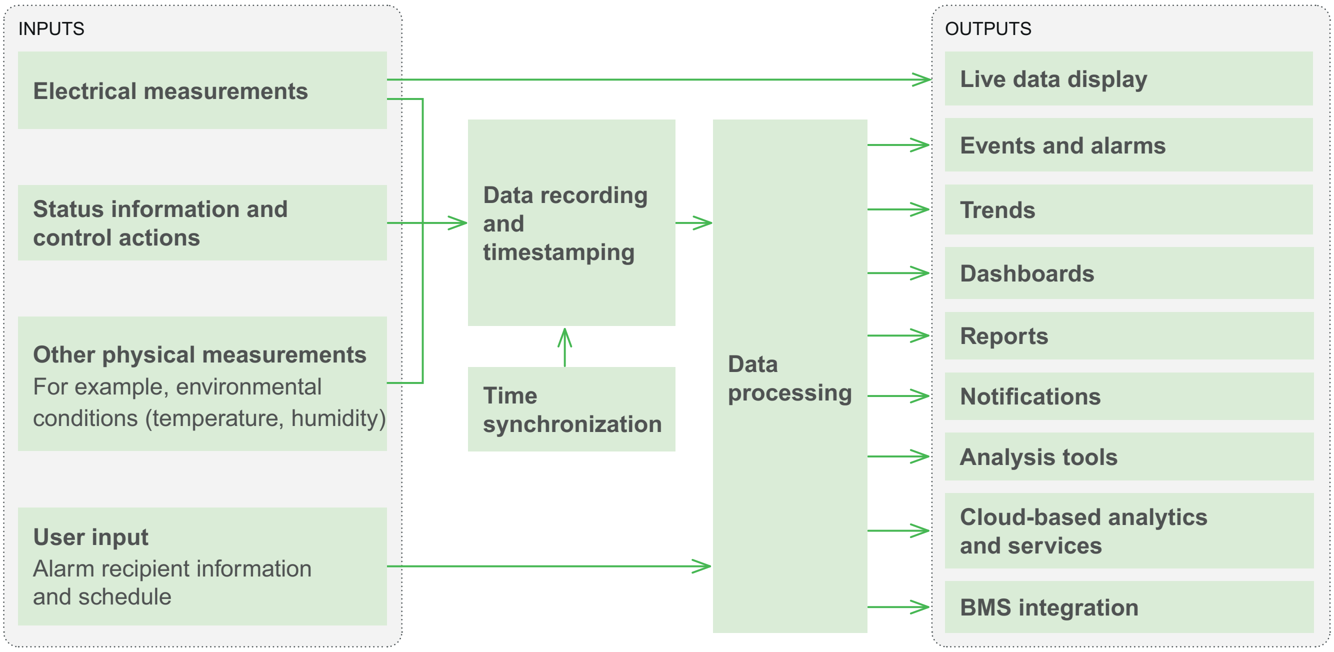
* Depending on the connected device chosen, communication protocols can be Ethernet or Serial / ** See digital architecture of Guided Procedures through Extended Reality to understand how you can leverage EcoStruxure XR Operator Advisor for this application

Ethernet - public LAN/WAN
Ethernet - technical LAN
EWS / ETL / HTML
Serial
Wireless - 2.4 GHz

System Description

Data Flow

The Electrical Distribution Monitoring and Alarming application can be broken down as follows:



Inputs

The Electrical Distribution Monitoring and Alarming application collects data from connected products to provide access to consolidated views of electrical measurements, status information, and individual device details. It also monitors remote control actions.

Electrical measurements and status information can be acquired from a wide range of connected products as well as third-party equipment through open communication protocols. Typical connected products include:

- **Energy/Power meters**, such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, Acti9 iEM3000, PowerTag


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


PowerLogic HDPM6000


Acti9 iEM3000


PowerLogic PowerTag

- **Protection devices**, such as PowerLogic P5/P3, MasterPacT MTZ, ComPacT NSX (including its wireless auxiliary contact), Acti9 Active


PowerLogic P5


PowerLogic P3


MasterPacT MTZ


ComPacT NSX and Auxiliary Contact

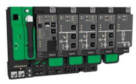

Acti9 Active

- **Other equipment**, such as UPS (Galaxy VX/VL/VM/VS), ATS/PTS (ASCO 7000 Series PTS, TransferPacT Active Automatic), ATS controller (PowerLogic T300), protective devices (ASCO SPD with ASM), power correction devices (PowerLogic PFC and AccuSine PCS+/PCSn/EVC/PFV+), Load Banks


Galaxy VX/VL/VM/VS


ASCO 7000 Series PTS


TransferPacT Active Automatic


PowerLogic T300


ASCO SPD with ASM


PowerLogic PFC


PowerLogic AccuSine PCS+/PCSn/EVC/PFV+


Load Banks

Electrical Measurements

The following electrical measurements are collected from connected products (real-time values, the minimum, maximum, and average values):

- Current and voltage
- Power (Active, Reactive, Apparent)
- Frequency
- Power factor
- Energy
- Harmonic distortion
- Voltage and current unbalance

Status Information and Control Actions

From intelligent electrical devices such as circuit breakers, power quality correction equipment, ATSs, and other electrical distribution equipment:

- Circuit breaker position (open, closed, racked-in, racked-out, etc.)
- Circuit breaker trip status, protection status
- UPS status, motor status
- Other statuses, operating modes or conditions
- Control actions (operator or automatic)

Other Physical Measurements

Non-electrical measurements, such as environmental conditions (temperature, humidity, etc.), can also be integrated into the system.

User Input: Alarm Recipient Information and Schedule

For alarm/event notification and distribution, recipient delivery schedules need to be configured.

These schedules are configured to send notifications to the appropriate operators, taking into account shift schedules, holidays, and weekends.

Delivery mechanisms include SMS and SMTP (email).

Data Recording and Timestamping

For the Electrical Distribution Monitoring and Alarming application, data recording can occur at various levels. Connected products, depending on the level of sophistication, can record data as follows:

- **Analog and event data recorded and timestamped on board:** PowerLogic ION9000, PM8000, and some PowerLogic PM5000 models (PM53xx and PM55xx)


PowerLogic ION9000

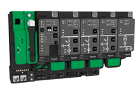

PowerLogic PM8000


PowerLogic PM5000

- **Event data recorded and timestamped on board:** PowerLogic P5/P3, T300, MasterPacT MTZ, ComPacT NSX


PowerLogic P5


PowerLogic P3


PowerLogic T300


MasterPacT MTZ


ComPacT NSX

- **No onboard recording; real-time data only. Recording and timestamping is done by a data logger** (Cyber Sciences SER 3200/2408), **server** (ASCO CPMA) **or software** (EcoStruxure Power Monitoring Expert or Power Operation): entry-level PowerLogic PM5000 models, Acti9 Active, Acti9 iEM3000, PowerLogic PowerTag, TransferPacT Active Automatic, Galaxy UPS, PowerLogic AccuSine PCS+/ PCSn/EVC+/PFV+, PowerLogic PFC, and other equipment (including third-party)

PowerLogic
PM5000

Cyber Sciences
SER 3200/2408

ASCO
CPMA

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

For the Electrical Distribution Monitoring and Alarming application, a time accuracy of ±10 milliseconds is recommended, in particular for highly critical applications. For less critical applications, 1 s is acceptable.

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

Time Synchronization

For consistent timestamping of all the data, the date and time should be accurately distributed to connected products and data loggers.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be connected to a GPS antenna to reach the expected time precision.

TimeSync Clock

Data Processing

For the Electrical Distribution Monitoring and Alarming application, data processing is multi-faceted: it includes alarm evaluation, mathematical manipulation, converting status data from devices without onboard logging to events and alarms, etc.

Data processing is performed by EcoStruxure Power Monitoring Expert, Power Operation or onboard advanced devices.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Outputs

The Electrical Distribution Monitoring and Alarming application can provide the following suggested outputs in EcoStruxure Power Monitoring Expert and/or Power Operation.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Live Data Display

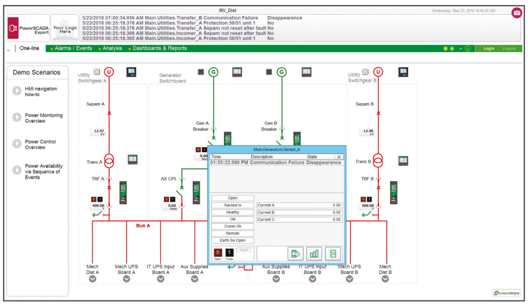
Single-Line Diagrams

The live status of the electrical distribution can be represented in the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) or in extended reality (EcoStruxure XR Operator Advisor Client) in various forms such as:

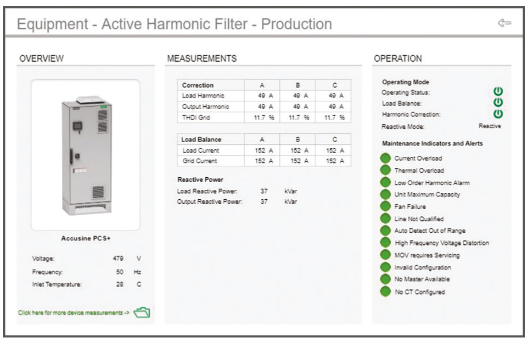
- Digital single-line diagrams, with real-time animation of the status of the electrical network
- Real-time electrical data and equipment status

Detailed Diagrams

- Custom data tables
- Default device diagrams (pre-configured along with native device drivers)
- Or real-time data in custom graphics (floor plans, elevation drawings)



Animated Single-Line Diagram with Dynamic Colorization in EcoStruxure Power Operation



Device Diagram in EcoStruxure Power Monitoring Expert

Events and Alarms

Event Log Viewers

Events and alarms are uploaded from devices or generated by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) and displayed in native event and alarm viewers.

Chronological views include:

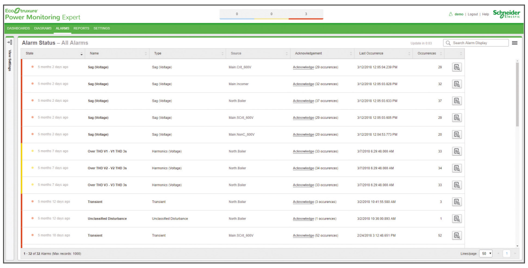
- All events and alarms, acknowledged or unacknowledged alarms, summary alarms or incidents
- High speed and high precision sequence of events to quickly locate the source of a power outage

Smart Alarming

Events or alarms can be intelligently grouped to be displayed as incidents and reduce the overall number of alarms in the viewer. Further analysis can be done through drill down into specific events (refer to Power Event Analysis Application).

In EcoStruxure Power Monitoring Expert and Power Operation, Smart Alarm categories include, among others:

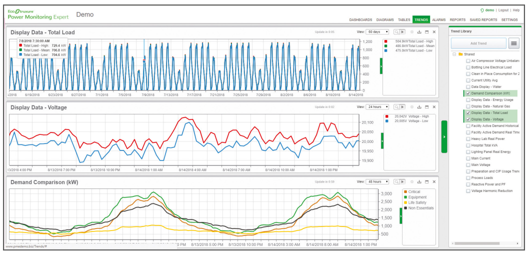
- Asset Monitoring
- Power Quality
- System Health (diagnostics)



Alarm and Event Log Viewer in EcoStruxure Power Monitoring Expert and Power Operation

Trends

Historical and real-time electrical and other measured data can be displayed as trends in Edge Control software. Multiple measurements from selected devices can be viewed with dynamic scaling on a configurable time range. Additionally, target lines can be applied to trended data. Trended data can also be exported in . CSV format.



Real-Time Trending in EcoStruxure Power Monitoring Expert

Dashboards

In addition to specialized dashboards, any historical data from the system can be displayed in graphical dashboard gadgets in EcoStruxure Power Monitoring Expert or Power Operation:

- Bar chart
- Trend chart
- Grid (table)
- Pie chart

- Period over period

Additionally, information from the web (for example, weather feed) can be viewed as a dashboard.

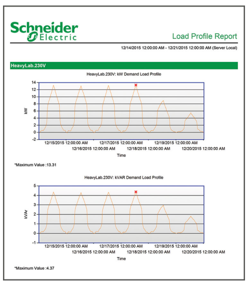
Dashboards

Reports

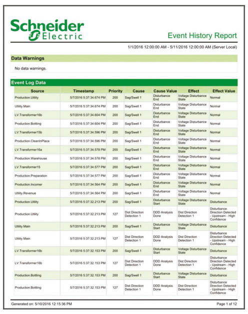
In addition to specialized reports, numerous general reports are available by default in EcoStruxure Power Monitoring Expert or with Power Operation based on historical electrical values or event data. These reports can be generated on-demand or automatically, and sent via email to configured recipients. General Reports include, among others:

- Trend/Multiple Trend Report
- Single/Multiple Equipment Operation Report
- Tabular Report
- Load Profile Report
- Event History Report

Data can also be exported into common file formats such as .CSV to import into other enterprise systems.



Load Profile Report



Event History Report

Notifications

Alarm notifications available with the optional Event Notification Module for EcoStruxure Power Monitoring Expert and Power Operation can be automatically sent via SMS or email to configured recipients on user-defined schedules.

Alarm notifications can be configured to delay sending notifications during a user-defined amount of time and to send a single notification for multiple events. This prevents flooding of notifications.

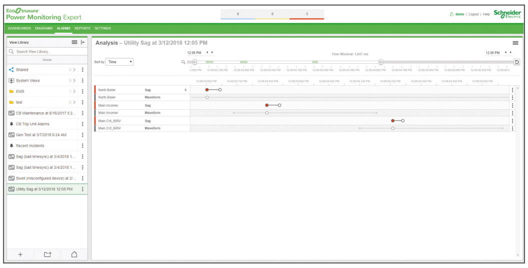
Alarm Notifications

Analysis Tools

Power Events Incident Timeline

This feature of EcoStruxure Power Monitoring Expert and Power Operation intelligently groups individual events and alarms as single comprehensive incidents during a given time period. It helps highlight the root cause and the consequences of an incident.

For more information, refer to the Power Event Analysis Application.



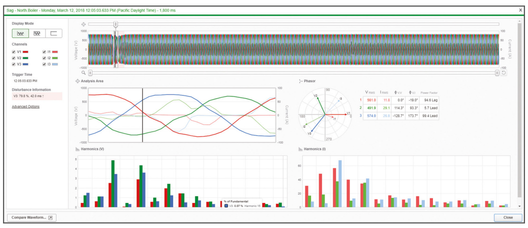
Power Events Incident Timeline

Waveform Viewer

Electrical signal waveforms can be visualized with a native waveform viewer in both EcoStruxure Power Monitoring Expert and Power Operation.

These viewers allow for the following:

- Toggle on/off voltage/current channels
- RMS calculation, zoom, pan, export to CSV
- Interactive phasor and harmonic (voltage and current) diagrams
- Multiple waveforms to be compared to each other



Waveform Viewer

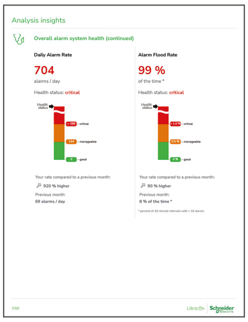
Cloud-Based Analytics and Services

As an option, EcoStruxure Service Plan, powered by EcoStruxure Power Advisor, provides electrical network and alarm health analytics with recommendations from our Schneider Electric service experts. Issues and recommendations are shared with the user on a periodic basis. These analytics and recommendations include:

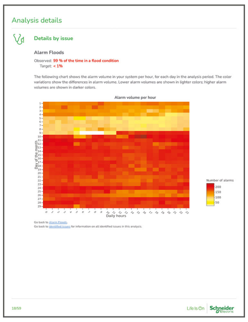
- Analyze Edge Control historical alarms according to guidelines in ISA 18.2 / IEC 62682
- Identify patterns and recommend actions to remove, repair or resolve alarms
- Analyze and recommend actions for transformer overcapacity

- Identify excessive voltage and current harmonics and recommend mitigation
- Measure and recommend improvements of poor power factor

EcoStruxure
Service Plan Powered by EcoStruxure Power Advisor Platform



EcoStruxure
Power Advisor Alarm Health Report - Overall Alarm System Health



EcoStruxure
Power Advisor Alarm Health Report - Alarm Floods

BMS Integration

EcoStruxure Power Monitoring Expert and Power Operation can seamlessly integrate with EcoStruxure Building Operation to enable real-time monitoring, alarms, dashboards, and reporting on electrical data in the BMS.

This integration is done through use of:

- an EcoStruxure Web Services (EWS) interface
- an Extract, Transform and Load (ETL[27]) utility
- an HMTL web page interface

EcoStruxure Building Operation

27. The EcoStruxure Extract Transform Load (ETL) Engine is a companion application for EcoStruxure Power Monitoring Expert and Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.

Capacity Management

What's in This Chapter

Overview

Context of Application

Many facilities are in a constant state of flux. Areas are being renovated, equipment is being moved, new production lines are brought online, and old equipment is being upgraded.

Capacity of the electrical distribution infrastructure has to evolve per these changing environments while not exceeding the rating of electrical distribution equipment.

This is a problem for circuit breakers, Uninterruptible Power Supplies (UPSs), generators, Automatic Transfer Switches / Power Transfer Switches (ATSs/PTSs), transformers, capacitor banks, busbars, conductors, fuses, etc. Often, exceeding the rated capacity means nuisance trips, but it can also result in overheating or fires.

Problem to Solve

The facility/energy manager needs to:

- Understand the capacity needs of the electrical distribution infrastructure to comply with energy standards and/or to plan for expansions or modifications of the facility.
- Upgrade the facility while not exceeding the rated capacity of equipment and while mitigating potential risks to the electrical infrastructure (for example, nuisance trips, overheating, fires).

Purpose of the Application

Visualize real-time or historical power system capacity

- Monitor real-time circuit loading
- Trend and report historical loading
- Pre-defined reporting for equipment Capacity Management (circuit breakers, UPSs, generators, ATSs/PTSs, transformers, capacitor banks, busbars, conductors, fuses, etc.)

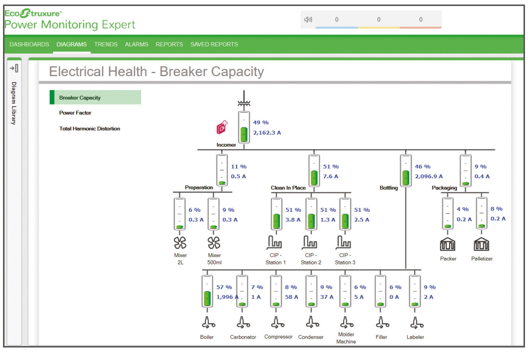
Provide information for capacity planning

- Simplify capacity planning for operations, expansion, or modifications
- Avoid oversubscribing critical equipment

Application Outcomes

Live Data Display

Capacity of electrical circuits can be visualized in an Electrical Health Diagram.



Electrical Health Diagram

Events and Alarms

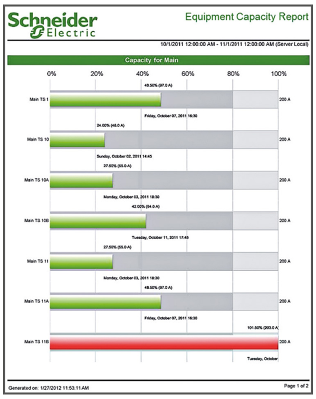
Smart alarms can be configured to alert energy managers or operations staff in case equipment capacity thresholds are exceeded.

Trends

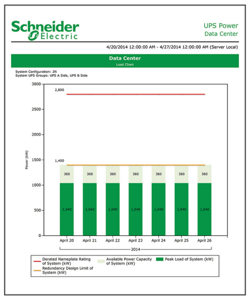
Real-time and historical data can be viewed on a trend viewer.

Reports

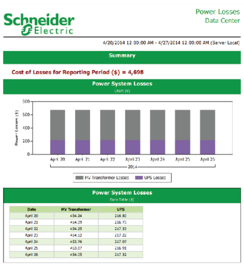
- Branch Circuit Power Report
- UPS Power Report
- Generator Capacity Report
- Generator Power Report
- Equipment Capacity Report
- Power Losses Report



Equipment Capacity Report



UPS Power Report



Power Losses Report

Notifications

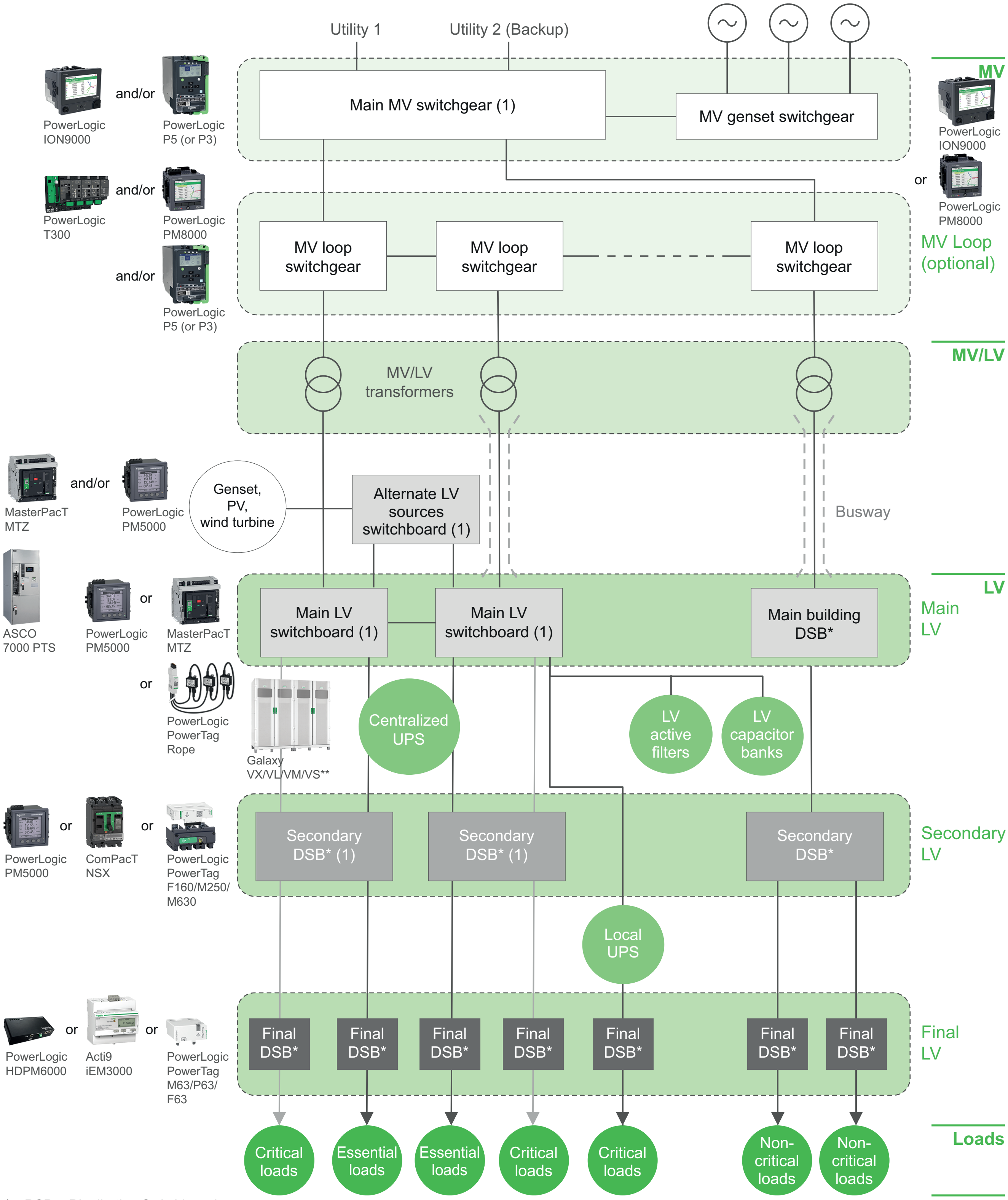
SMS or email notifications are sent on pre-alarm and alarm conditions to enable fast action.

Cloud-Based Analytics and Services

As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor can perform analytics based on historical data to provide insights and decision support. Issues related to electrical capacity of critical equipment, such as transformers, are shared with the user by our Schneider Electric service experts on a periodic basis with recommended actions to resolve them.

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Capacity Management application:



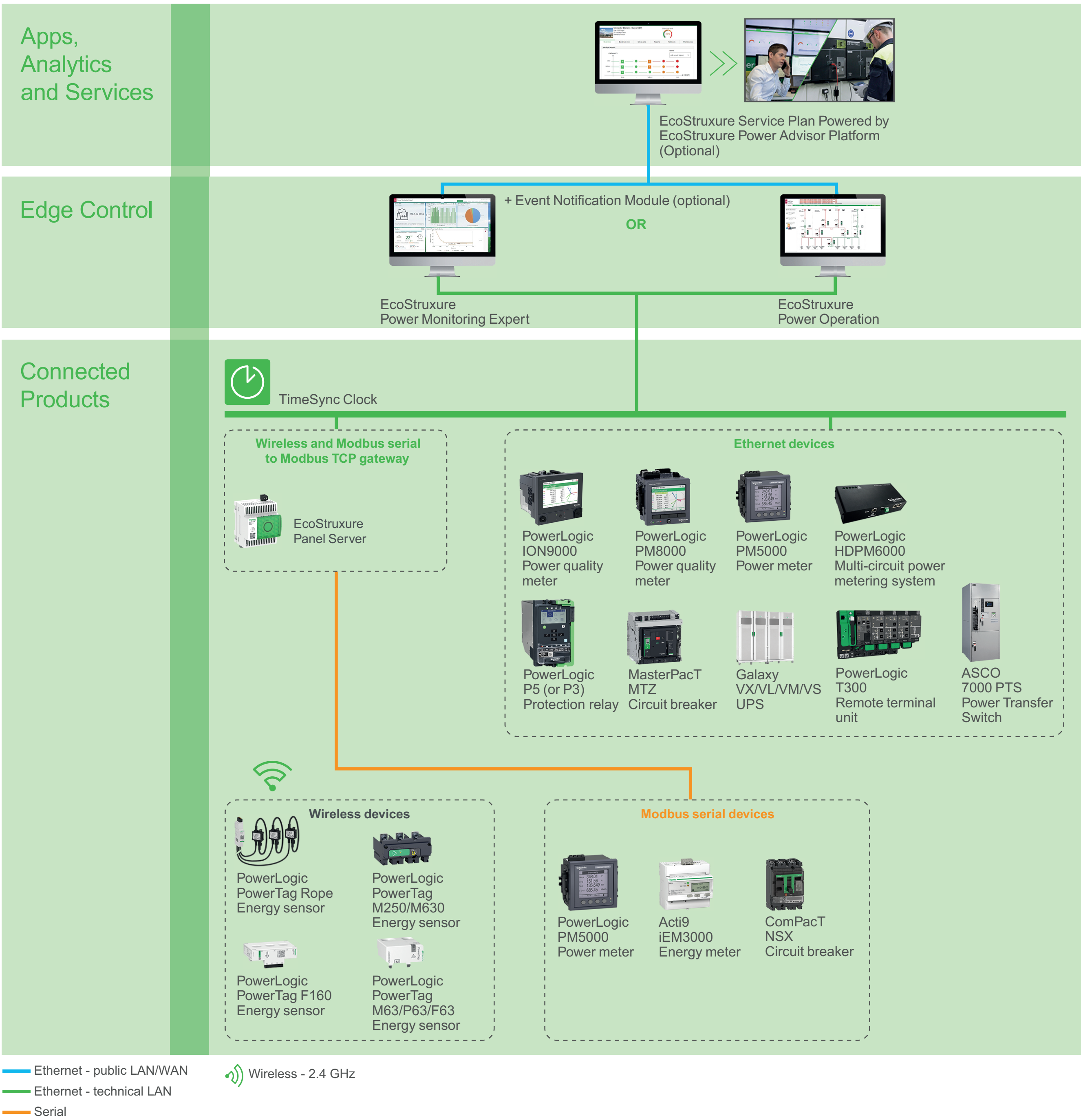
* DSB = Distribution Switchboard
** Galaxy VX/VL/VM/VS is preferred, but Galaxy or Symmetra MW are also acceptable.
(1) Automatic Transfer Switch (ATS) is not represented but data can be acquired through inputs on the power meter.

Digital Architecture

In this architecture, the data is collected from connected products either directly over Ethernet or via gateways (such as the EcoStruxure Panel Server). These data are then recorded and processed by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for on-premise visualization, analysis, and reporting.

As an option, data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Power Advisor platform and interpreted by experts as part of the EcoStruxure Service Plan.

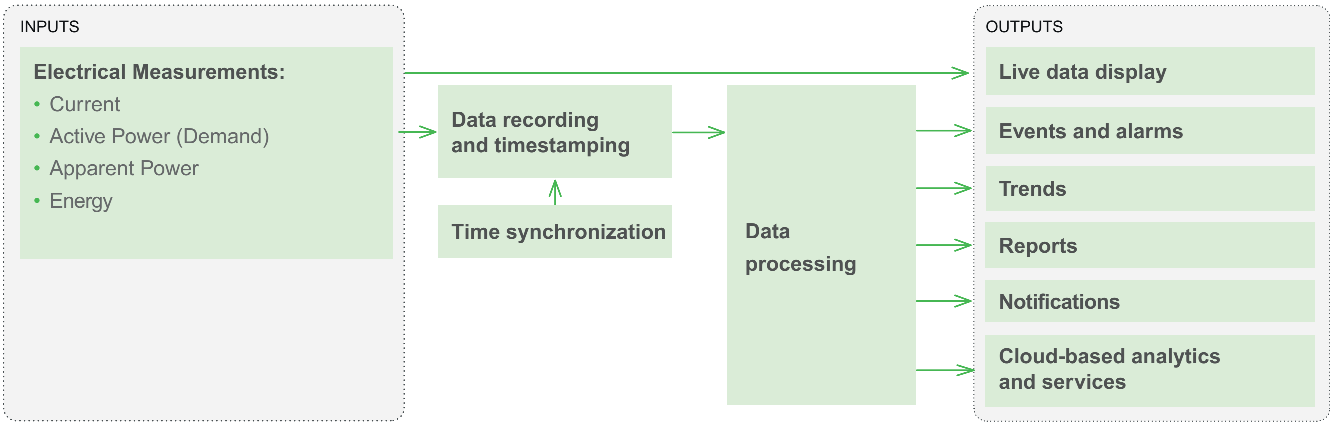
The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Capacity Management application can be broken down as follows:



Inputs

The following data is required:

Electrical Measurements

The following electrical measurements are collected at strategic points of interest in the electrical distribution such as generators, Uninterruptible Power Supplies (UPSs), Automatic/Power Transfer Switches (ATSs/PTSs), feeders:

- Current (A)
- Active power (demand) (kW)
- Apparent power (kVA)
- Energy (kWh)

These data may be acquired from:

- **Power/energy meters** such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, PowerTag, Acti9 iEM3000


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


PowerLogic HDPM6000


Acti9 iEM3000


PowerLogic PowerTag

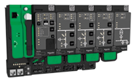
- **Devices with embedded metering** such as protection devices (PowerLogic P5/P3, MasterPacT MTZ, ComPacT NSX), automation controllers (PowerLogic T300, ASCO 7000 Series PTS), and UPSs (Galaxy VX/VL/VM/VS)

PowerLogic P5

PowerLogic P3

MasterPacT MTZ

ComPacT NSX



PowerLogic T300

ASCO 7000 Series PTS

Galaxy VX/VL/VM/VS

Data Recording and Timestamping

For the Capacity Management application, a timestamp accuracy of ±1 second is sufficient for:

- Time-based historical data visualization
- Capturing peak power demand
- Comparing peaks between different circuits for proper capacity planning

Advanced power meters such as the PowerLogic ION9000, PM8000, HDPM6000 and some PowerLogic PM5000 models (PM53xx and PM55xx) can timestamp and record onboard energy measurements. EcoStruxure Power Monitoring Expert or Power Operation can then retrieve the records with their original timestamp.

PowerLogic ION9000

PowerLogic PM8000

PowerLogic HDPM6000

PowerLogic PM5000

For other devices (PowerLogic P5/P3, MasterPacT MTZ, ComPacT NSX, Galaxy VX/VL/VM/VS, PowerLogic T300, ASCO 7000 Series PTS, entry level PowerLogic PM5000 models, Acti9 iEM3000, PowerLogic PowerTag, etc.) measurements are acquired by the connected products and then recorded and timestamped by EcoStruxure Power Monitoring Expert or Power Operation.

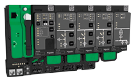

PowerLogic
P5


PowerLogic
P3


MasterPacT
MTZ


ComPacT
NSX


Galaxy
VX/VL/VM/VS


PowerLogic
T300


ASCO
7000 Series
PTS


PowerLogic
PM5000


Acti9
iEM3000


PowerLogic
PowerTag


EcoStruxure
Power Monitoring Expert


EcoStruxure
Power Operation

NOTE: For devices without onboard logging, there is a possibility of data loss in the event of a communication failure.

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

Time Synchronization

For consistent timestamping of all the data, the date and time should be accurately distributed to connected products and data loggers.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be connected to a GPS antenna to reach the expected time precision.


TimeSync Clock

Data Processing

Capacity Management data processing is embedded in the optional Capacity Management module of EcoStruxure Power Monitoring Expert or Power Operation.


EcoStruxure
Power Monitoring Expert


EcoStruxure
Power Operation

Load Analysis

For branch circuits within a data center facility, average and maximum loading are tracked and compared to the circuit breaker size (A) to validate the design or to alert about potential overloading.

For an Automatic/Power Transfer Switch (ATS/PTS) or other equipment, peak load is compared with the rated capacity of the equipment to alert about potential overloading.

Power Capacity Analysis

For generators or UPSs, all related loads are compared with the remaining capacity to validate that a utility power outage could be handled while still complying with the intended redundancy design.

Power Loss Calculation

For transformers or UPSs, measurements performed at primary and secondary connections (in and out) are compared to establish power loss and associated cost.

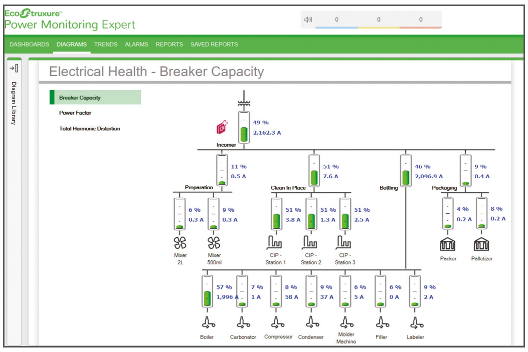
Outputs

Outputs are displayed by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation).

Live Data Display

The following visualizations can be configured:

- Live graphic pages to show actual loading compared to nameplate rating or designed capacity (Capacity Management diagram)
- Live data tables with current and demand power values for selected devices



Capacity Management Diagram

Events and Alarms

Smart alarms can be configured to alert energy managers or operations staff in case of exceeded equipment capacity thresholds.

Trends

Historical and real-time electrical and other measured data can be displayed as trends in Edge Control software.

Multiple measurements from selected devices can be viewed with dynamic scaling on a configurable time range.

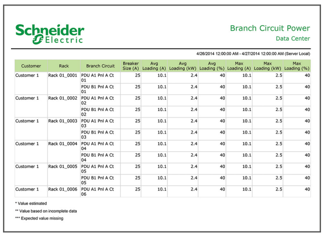
Additionally, target lines can be applied to trended data. Trended data can also be exported in .CSV format.

Reports

The Capacity Management module of EcoStruxure Power Monitoring Expert or Power Operation must be deployed to benefit from the following reports:

Branch Circuit Power Report

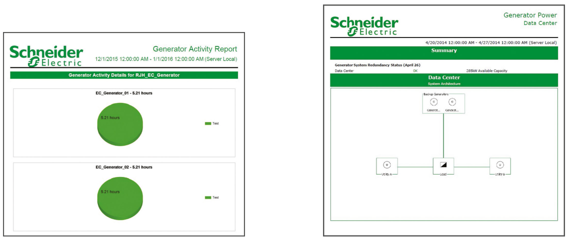
Monitors the capacity of branch circuits. Use this report to analyze IT branch circuit power loading and to understand remaining capacity at the branch circuit level (primarily for data center applications). Specific measurements required are Active Power (kW) and Current (A).



Branch Circuit Power Report

Generator Power Report

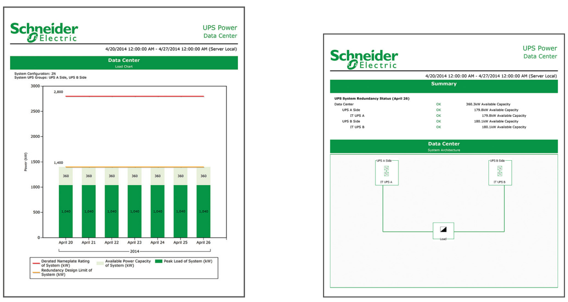
Provides information regarding the generator backup power system and its ability to handle a utility power outage while still complying with the intended redundancy design. Specific measurements required are Active Power (kW).



Generator Power Report

UPS Power Report

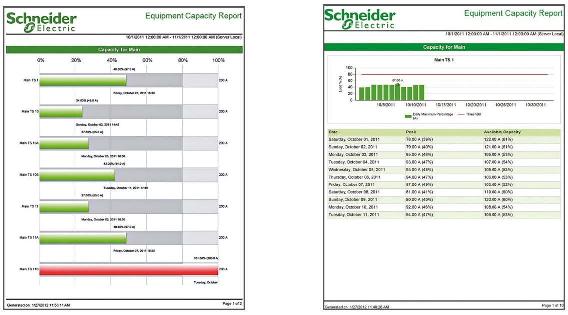
Provides information regarding the UPS backup power system and its ability to handle a utility power outage while still complying with the intended redundancy design. Specific measurements required are Active Power (kW).



UPS Power Report

Equipment Capacity Report

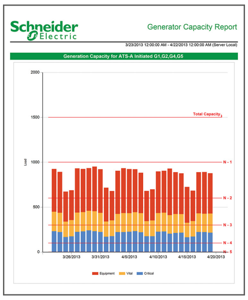
Shows the peak load of any circuit breaker, cable, busbar, ATS/PTS, etc. with respect to its rated capacity. Specific measurements required are Active Power (kW), Apparent Power (kVA), or Current (A).



Equipment Capacity Report

Generator Capacity Report

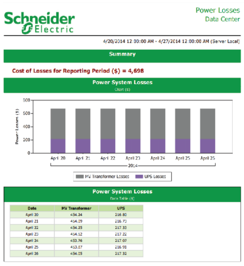
Helps verify that the generators can adequately support the loads required during a utility outage. Specific measurements required are Active Power (kW) or Apparent Power (kVA).



Generator Capacity Report

Power Losses Report

The Power Losses Report shows losses (kW and cost) in transformers and UPS systems. The cost calculations are based on a configurable flat-rate energy cost. Use this report to analyze and quantify the power losses in your transformer and UPS networks.



Power Losses Report

Notifications[28]

SMS or email notifications are sent on pre-alarm and alarm conditions to enable fast action.

28. For notifications in EcoStruxure Power Monitoring Expert and Power Operation, the Event Notification Module is required.

Cloud-Based Analytics and Services

As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides electrical network and alarm health analytics with recommendations from our Schneider Electric service experts.

Issues and recommendations are shared with the user on a periodic basis. These analytics and recommendations:

- Identify patterns and recommend actions to remove, repair, or resolve alarms.
- Analyze and recommend actions to mitigate transformer overloading.
- Identify excessive voltage and current harmonics and recommend mitigation.
- Measure and recommend improvements of poor power factor.

EcoStruxure Service Plan Powered by EcoStruxure Power Advisor

Backup Power Testing

What's in This Chapter

Overview

Context of Application

Critical buildings such as hospitals and data centers rely on backup power systems, also sometimes referred to as Emergency Power Supply Systems (EPSS), to supply the facility with power during an interruption of the utility incomer(s). During such an event, power is transferred from the utility supply to the alternate power source using Automatic Transfer Switch(es) / Power Transfer Switch(es) (ATS/PTS). According to the Electric Power Research Institute (EPRI), backup power systems fail to start 20% to 30% of the time. Common causes include starter battery failure, low fuel levels, wet stacking, controls in the wrong state, etc.

In some critical facilities such as hospitals, regulatory requirements specify how and how often the backup/emergency power systems need to be maintained and tested. They also prescribe how these test and maintenance activities are to be recorded. Doing this manually is error-prone and cumbersome. Examples of such regulatory requirements are: IEC 60364-7-710 (Europe), HTM-06-01 (UK), NFPA 99 and 110 (USA), AS_NZS 3009 (Australia / New Zealand), CSA Z32 and C282 (Canada).

Problem to Solve

The facility/energy manager needs to:

- Ensure the reliability and availability of backup power supply systems in the event of unexpected power outages.
- Save time, improve productivity, and ensure accuracy of testing process and documentation per standards or manufacturer recommendations.
- Comply with local and international standards and satisfy reporting requirements of regulatory bodies in critical buildings.

Purpose of the Application

Provide automated backup power test reporting including:

- Automatic/Power Transfer Switch (ATS/PTS)
- Backup generators
- Uninterruptable Power Supply (UPS)

Record key legislated parameters for compliance reports including:

- Transfer time for ATS/PTS and generators
- Generator run time, engine loading, exhaust and engine temperature
- Annual generator runtime for emission requirements reporting
- Ability of UPSs to sustain critical loads during power outage

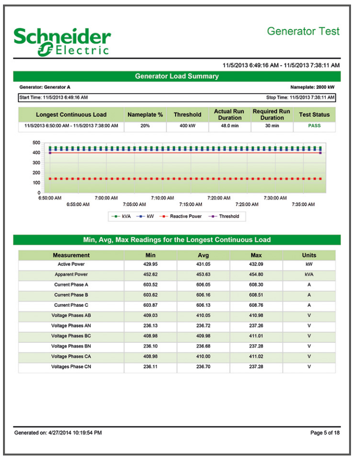
Application Outcomes

Live Data Display

Device diagrams with status and analog values are available for ATS/PTS, generators, and UPS.

Reports

- Generator Test (EPSS) Report



Generator Test

11/5/2013 6:49:16 AM - 11/5/2013 7:38:11 AM

Generator Load Summary

Generator: Generator A Nameplate: 2000 kW

Start Time: 11/5/2013 6:49:16 AM Stop Time: 11/5/2013 7:38:11 AM

Longest Continuous Load	Nameplate %	Threshold	Actual Run Duration	Required Run Duration	Test Status
11/5/2013 6:50:00 AM - 11/5/2013 7:38:00 AM	20%	400 kW	48.0 min	30 min	PASS

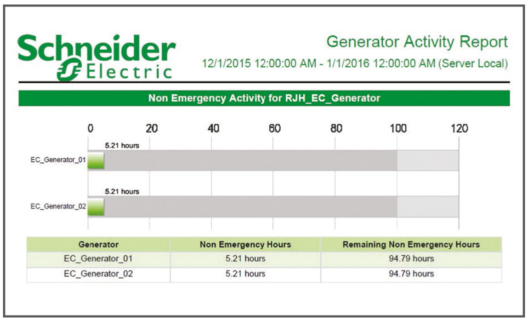
Min, Avg, Max Readings for the Longest Continuous Load

Measurement	Min	Avg	Max	Units
Active Power	429.95	431.05	432.09	kW
Apparent Power	452.62	453.63	454.80	kVA
Current Phase A	603.52	606.05	608.30	A
Current Phase B	603.62	606.16	608.51	A
Current Phase C	603.87	606.13	608.76	A
Voltage Phases AB	409.03	410.05	410.98	V
Voltage Phases AN	236.13	236.72	237.26	V
Voltage Phases BC	408.98	409.98	411.01	V
Voltage Phases BN	236.10	236.68	237.28	V
Voltage Phases CA	408.98	410.00	411.02	V
Voltages Phase CN	236.11	236.70	237.28	V

Generated on: 4/27/2014 10:19:54 PM Page 5 of 18

Backup Power System Test Report

- Generator Activity Report



Generator Activity Report

12/1/2015 12:00:00 AM - 1/1/2016 12:00:00 AM (Server Local)

Non Emergency Activity for RJH_EC_Generator

Generator	Non Emergency Hours	Remaining Non Emergency Hours
EC_Generator_01	5.21 hours	94.79 hours
EC_Generator_02	5.21 hours	94.79 hours

Generator Activity Report

- Generator Load Summary Report
- Generator Battery Health Report

- UPS Auto-Test Report

UPS Auto Test Report

12/1/2014 12:00:00 AM - 12/1/2014 11:00:00 PM (Server Local)

Groups-03

Device Name	Timestamp	Priority	Cause	Cause Value	Effect	Effect Value
UPS.Galaxy-02	12/1/2014 6:28:55.000 PM	25	Battery Automatic Test In Progress	1.00	SP1 Status	Extreme
UPS.Galaxy-02	12/1/2014 6:28:55.000 PM	25	Battery Automatic Test In Progress	OFF	SP1 Status	OFF
UPS.Galaxy-02	12/1/2014 6:28:55.000 PM	25	Battery Status	256.00	SP(0) Status	Extreme
UPS.Galaxy-02	12/1/2014 6:28:55.000 PM	25	Battery Status	0.000	SP(0) Status	Battery Test Completed
UPS.Galaxy-02	12/1/2014 6:22:35.000 PM	25	Battery Automatic Test In Progress	ON	SP1 Status	ON
UPS.Galaxy-02	12/1/2014 6:22:35.000 PM	25	Battery Status	256.000	SP(0) Status	Battery Test in Progress
UPS.Galaxy-02	12/1/2014 6:13:08.000 PM	25	Load Protected	ON	SP(0) Status	ON

Groups-02

Device Name	Timestamp	Priority	Cause	Cause Value	Effect	Effect Value
UPS.Galaxy-04	12/1/2014 8:28:55.000 PM	25	Battery Automatic Test In Progress	1.00	SP1 Status	Extreme
UPS.Galaxy-04	12/1/2014 8:28:55.000 PM	25	Battery Automatic Test In Progress	OFF	SP1 Status	OFF
UPS.Galaxy-04	12/1/2014 8:28:55.000 PM	25	Battery Status	256.00	SP(0) Status	Extreme
UPS.Galaxy-04	12/1/2014 8:28:55.000 PM	25	Battery Status	0.000	SP(0) Status	Battery Test Completed
UPS.Galaxy-04	12/1/2014 8:22:35.000 PM	25	Battery Automatic Test In Progress	ON	SP1 Status	ON
UPS.Galaxy-04	12/1/2014 8:22:35.000 PM	25	Battery Status	256.000	SP(0) Status	Battery Test in Progress
UPS.Galaxy-04	12/1/2014 8:13:08.000 PM	25	Load Protected	ON	SP(0) Status	ON
UPS.Galaxy-03	12/1/2014 7:58:55.000 PM	25	Battery Automatic Test In Progress	1.00	SP1 Status	Extreme
UPS.Galaxy-03	12/1/2014 7:58:55.000 PM	25	Battery Automatic Test In Progress	OFF	SP1 Status	OFF
UPS.Galaxy-03	12/1/2014 7:58:55.000 PM	25	Battery Status	256.00	SP(0) Status	Extreme
UPS.Galaxy-03	12/1/2014 7:58:55.000 PM	25	Battery Status	6.000	SP(0) Status	Battery Test Completed
UPS.Galaxy-03	12/1/2014 7:52:35.000 PM	25	Battery Automatic Test In Progress	ON	SP1 Status	ON
UPS.Galaxy-03	12/1/2014 7:52:35.000 PM	25	Battery Status	256.000	SP(0) Status	Battery Test in Progress
UPS.Galaxy-03	12/1/2014 7:43:08.000 PM	25	Load Protected	ON	SP(0) Status	ON
UPS.Galaxy-04	12/1/2014 7:33:55.000 PM	25	Battery Automatic Test In Progress	1.00	SP1 Status	Extreme
UPS.Galaxy-04	12/1/2014 7:33:55.000 PM	25	Battery Automatic Test In Progress	OFF	SP1 Status	OFF
UPS.Galaxy-04	12/1/2014 7:33:55.000 PM	25	Battery Status	256.00	SP(0) Status	Extreme
UPS.Galaxy-04	12/1/2014 7:33:55.000 PM	25	Battery Status	0.000	SP(0) Status	Battery Test Completed
UPS.Galaxy-03	12/1/2014 7:28:55.000 PM	25	Battery Automatic Test In Progress	1.00	SP1 Status	Extreme

Generated on: 3/3/2015 1:17:08 PM Page 3 of 4

UPS Auto-Test Report

- UPS Battery Health Report

Electrical Architecture

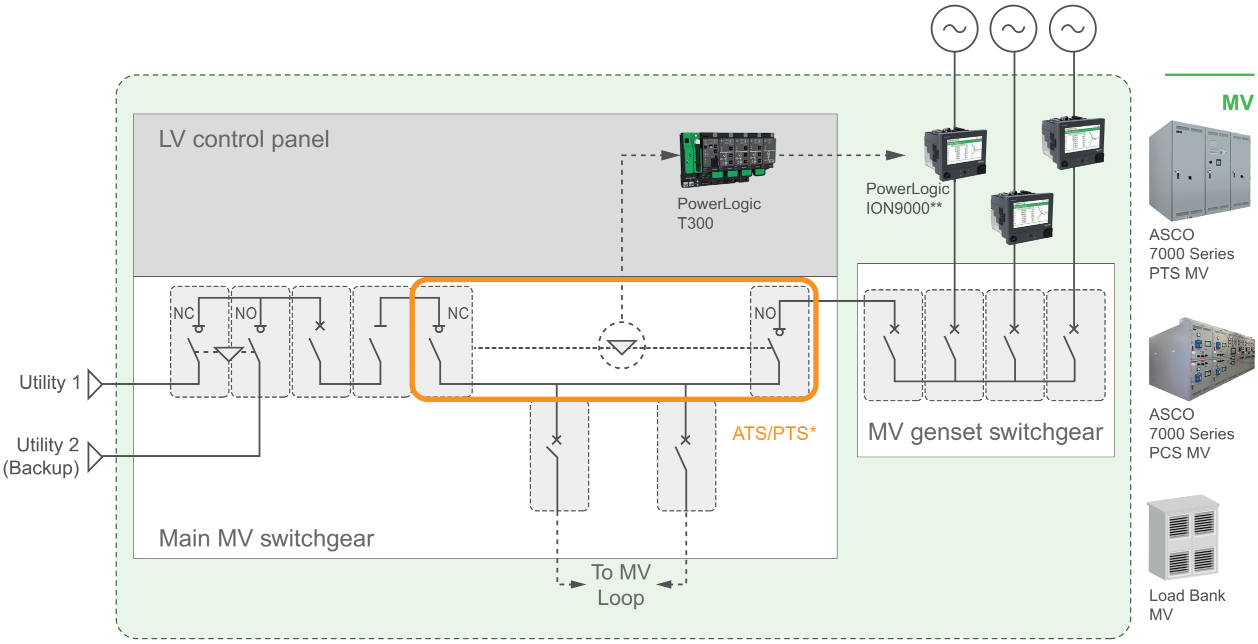
Introduction

The implementation of the Backup Power Testing application is different in the case of an MV or LV generator architecture.

The following diagrams detail the areas of the architecture where the connected products should be installed for both configurations.

Medium Voltage Generator Architecture

When generators are connected to medium voltage distribution, the following typical architecture can be implemented:



ATS/PTS* status

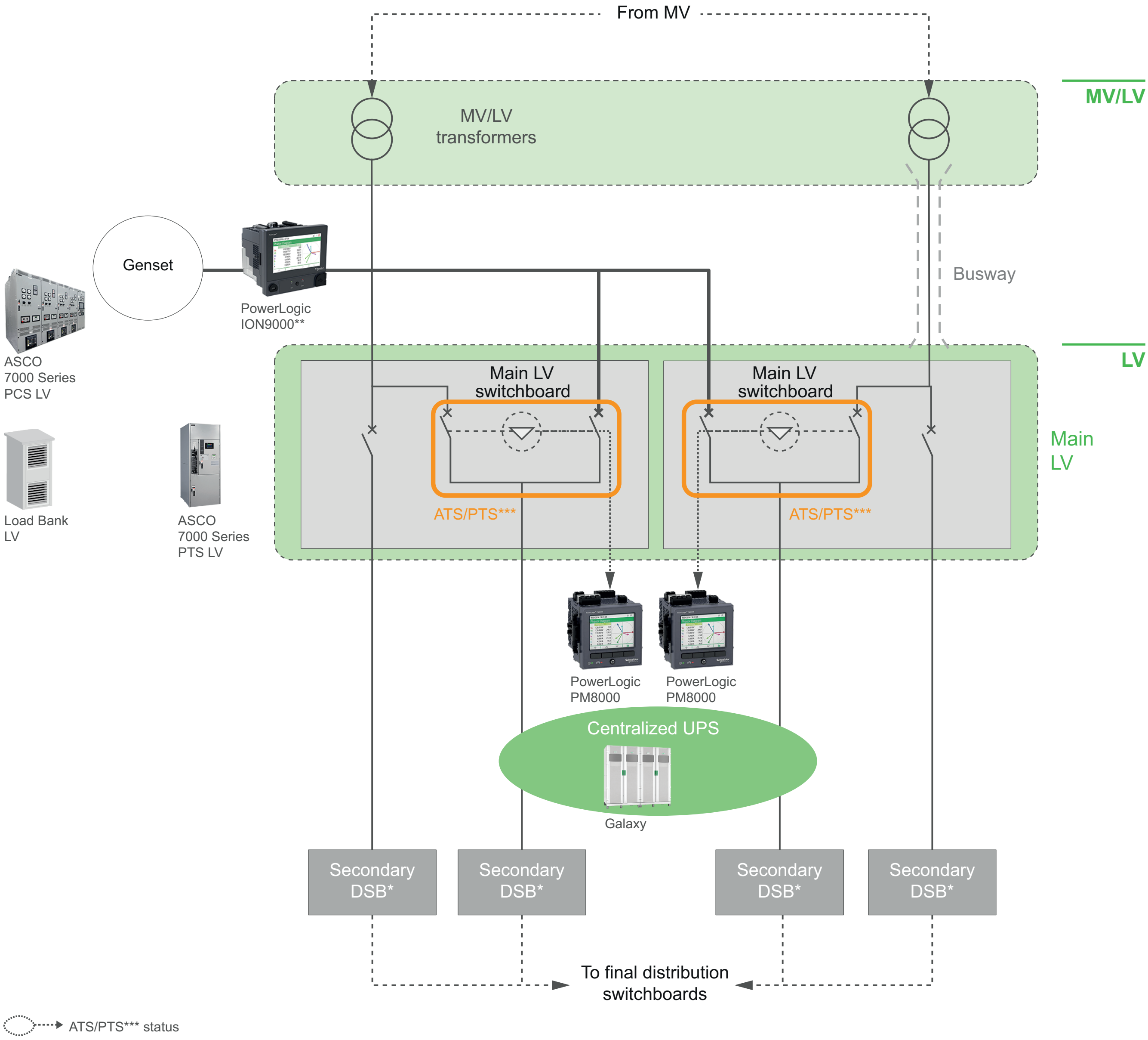
* ATS/PTS: Automatic Transfer Switch / Power Transfer Switch
** PowerLogic PM8000 may be used if battery health monitoring is not needed

Low Voltage Generator Architecture

If the backup/emergency power system operates on a low voltage section of the network, it will usually include several ATS/PTSs[29].

As illustrated below, the ATS/PTS[29] and the genset will each be equipped with a power meter that will collect analog electrical data from its power outputs as well as status details via digital I/O ports.

29. ATS/PTS: Automatic Transfer Switch / Power Transfer Switch



*   DSB = Distribution Switchboard
** PowerLogic PM8000 may be used if generator battery health monitoring is not needed
*** ATS/PTS: Automatic Transfer Switch / Power Transfer Switch

Digital Architecture

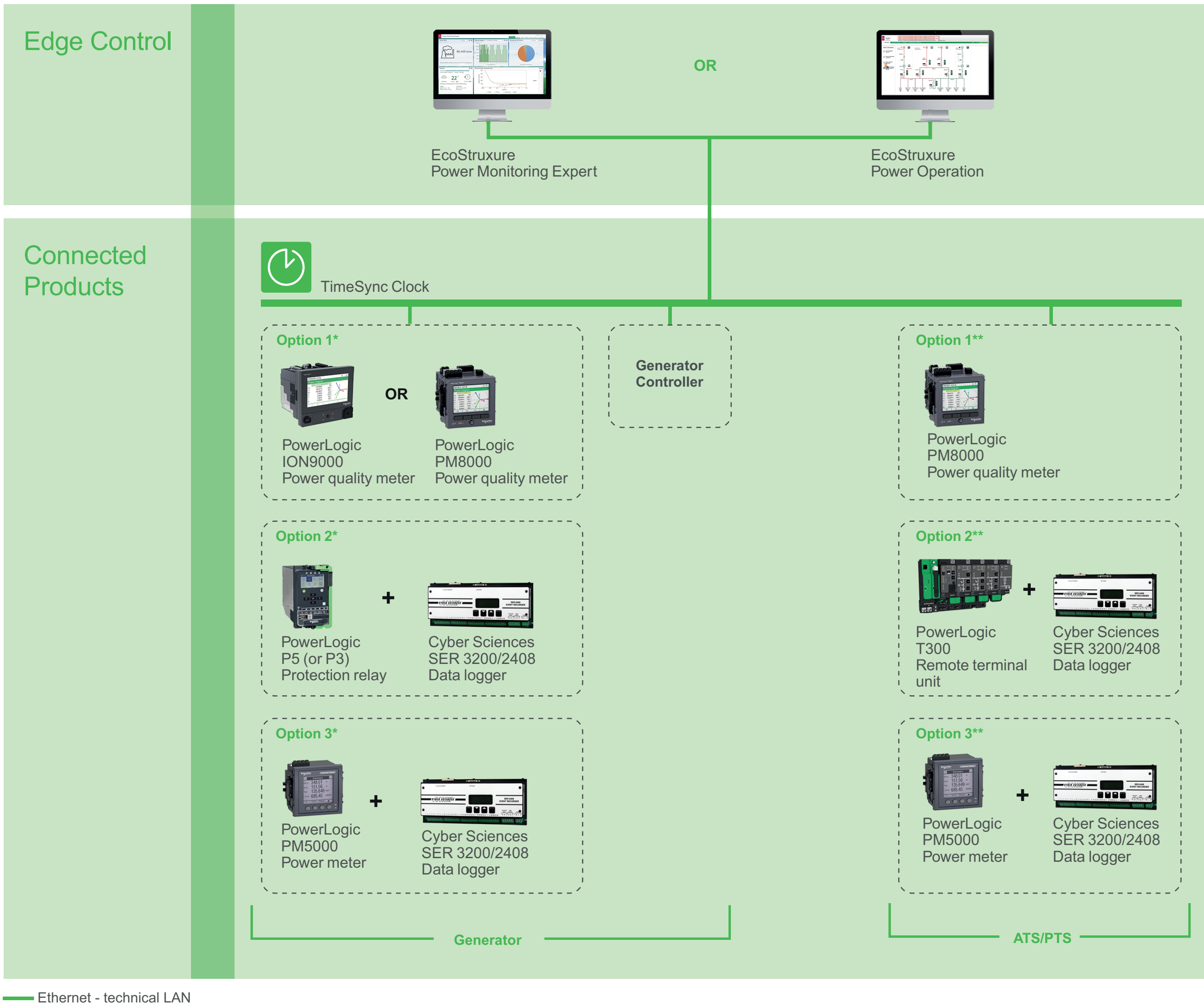
There are three possible digital architectures for the Backup Power Testing application:

- Medium Voltage Generator Architecture
- Low Voltage Generator Architecture
- ASCO Medium and Low Voltage Architecture

Medium Voltage Generator Architecture

The digital architecture of the Backup Power Testing application recommends direct Ethernet connections to the connected products. Data is captured on board connected products and uploaded into the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for data processing, visualization and reporting

The recommended digital architecture to implement the Backup Power Testing application with a medium voltage generator is shown below:



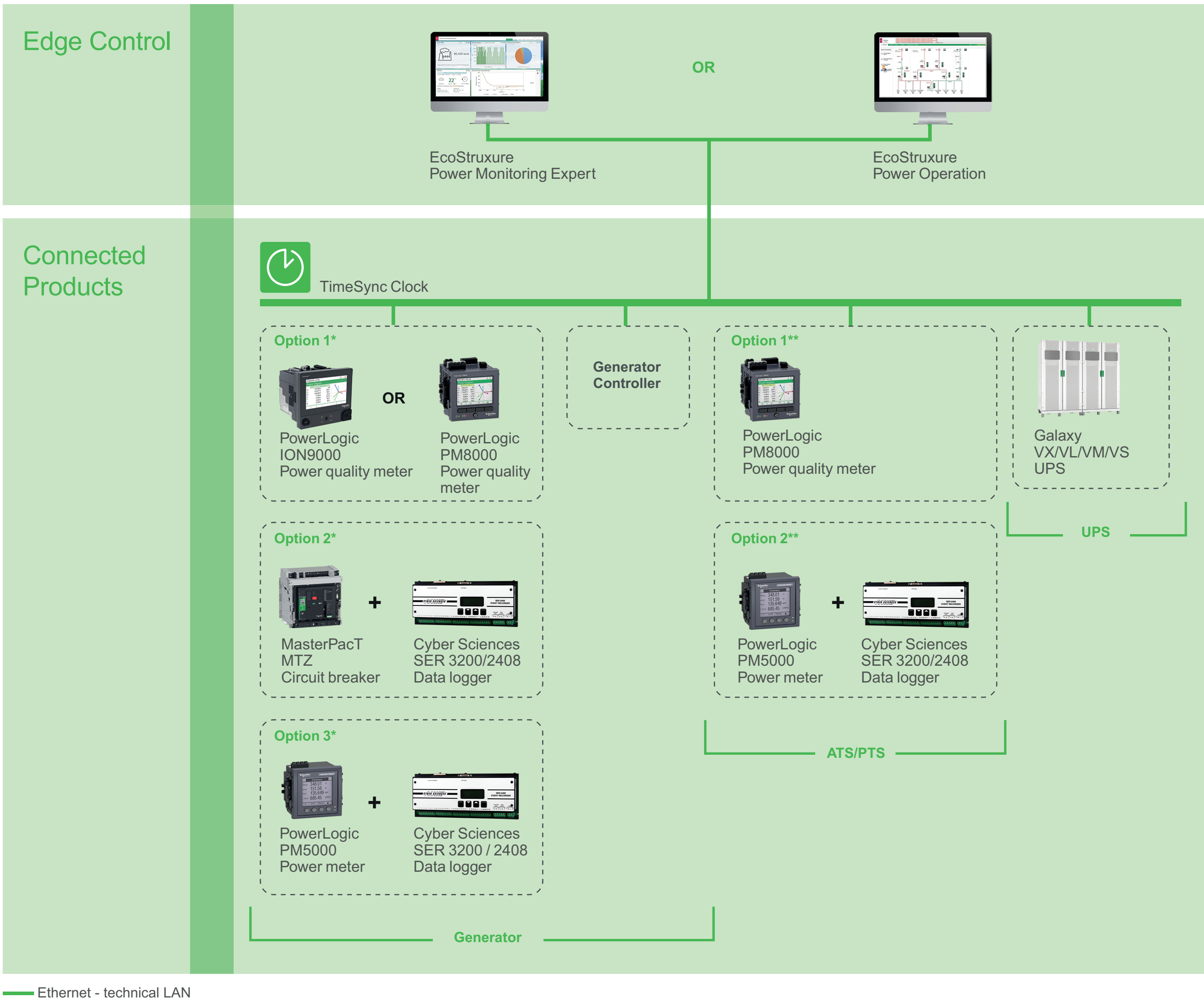
* Option 1 is the recommended architecture. Option 2 should be considered if PowerLogic P5/P3 with embedded metering is already present in the architecture. Option 3 can be considered if an entry-level meter such as PowerLogic PM5000 is specified.

** Option 1 is the recommended architecture. Option 2 should be considered if PowerLogic T300 is present in the architecture. Option 3 can be considered if an entry-level meter such as PowerLogic PM5000 is specified.

Low Voltage Generator Architecture

The digital architecture of the Backup Power Testing application recommends direct Ethernet connections to the connected products. Data is captured on board connected products and uploaded into the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for data processing, visualization and reporting.

The recommended digital architecture to implement the Backup Power Testing application with a low voltage generator is shown below:



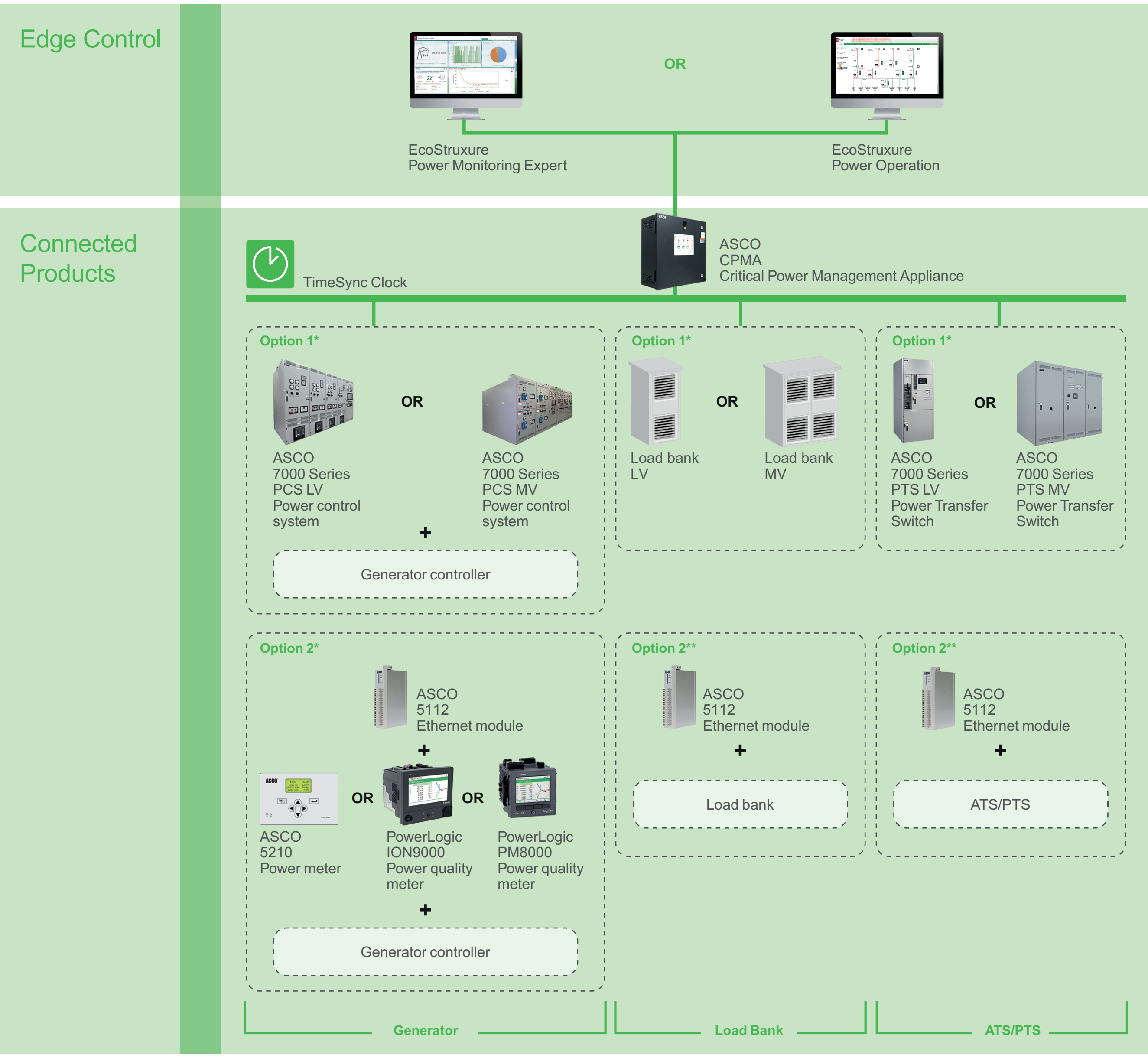
* Option 1 is the recommended architecture. Option 2 should be considered if MasterPacT MTZ with embedded metering is already present in the architecture. Option 3 can be considered if an entry-level meter such as PowerLogic PM5000 is specified.

** Option 1 is the recommended architecture. Option 2 can be considered if an entry-level meter such as PowerLogic PM5000 is specified.

ASCO Medium and Low Voltage Architecture

In this architecture, data from the ASCO PTS (Power Transfer Switch), PCS (Power Control System), and from Load Banks and Generator Controllers are acquired by the ASCO CPMA (Critical Power Management Appliance) which can perform data processing and visualization. The processed data can also be displayed in the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for data visualization and reporting.

The recommended digital architecture to implement the Backup Power Testing application with the ASCO system is shown below:



Ethernet - technical LAN

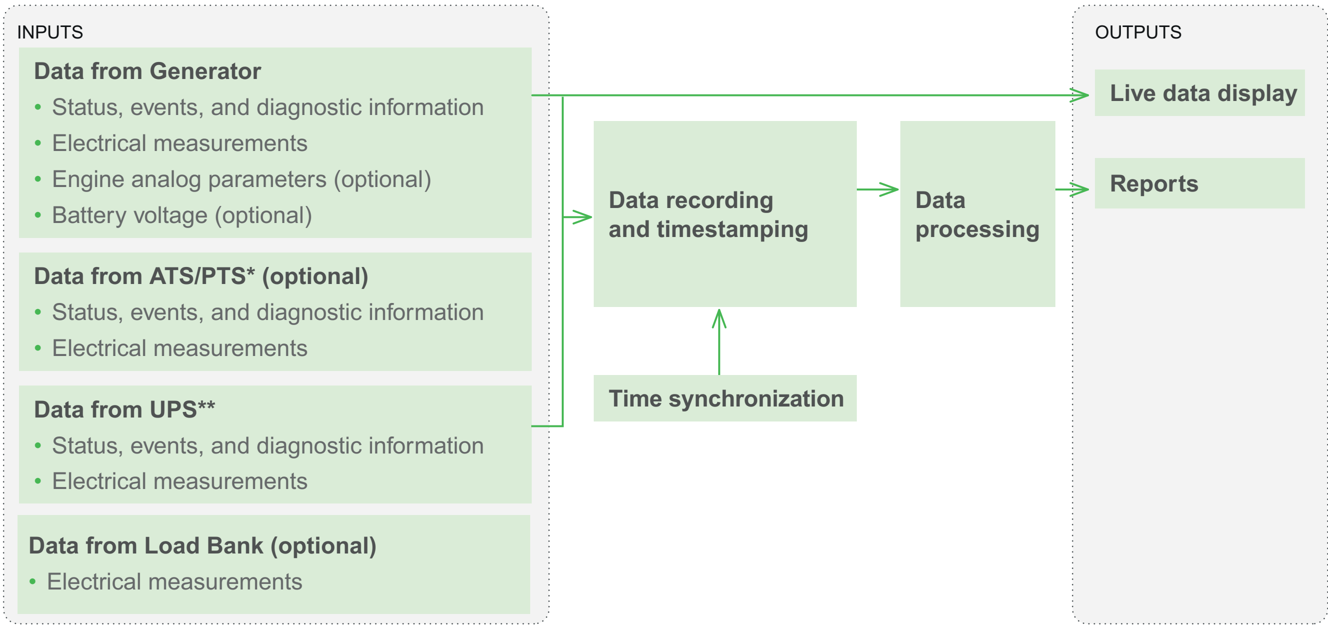
* Option 1 is the recommended architecture for Greenfield and/or Digital based solutions

** Option 2 is the recommended architecture for Brownfield / Retrofit or hardwired solutions.

System Description

Data Flow

The Backup Power Testing application can be broken down as follows:



* ATS/PTS: Automatic Transfer Switch / Power Transfer Switch
** UPS: Uninterruptible Power Suppy

Inputs

Data from Generator

The following data are required:

Status, events, and diagnostic information:

- Stopped, running
- Generator starting, generator power availability (optional)
- Power outage status (optional)

Electrical measurements:

- Voltage (line to neutral / line to line)
- Current
- Total power, total apparent power
- Power factor
- Frequency

Engine analog measurements (optional):

- Engine coolant temperature
- Exhaust gas temperature
- Engine oil pressure
- Engine start battery voltage

This input data may be provided by the generator controller, the power control system (ASCO 7000 Series PCS), power meters (PowerLogic ION9000, PM8000, PM5000, ASCO 5210), data loggers (Cyber Sciences SER 3200/2408, ASCO 5112), and/or embedded metering (PowerLogic P5/P3, MasterPacT MTZ).


ASCO
7000 Series
PCS


PowerLogic
ION9000


PowerLogic
PM8000


PowerLogic
PM5000


ASCO
5210


Cyber
Sciences
SER 3200/
2408


ASCO
5112


PowerLogic
P5


PowerLogic
P3


MasterPacT
MTZ

Data from Automatic Transfer Switch / Power Transfer Switch (ATS/PTS)

The following data are collected:

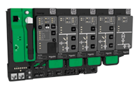
Status, events, and diagnostic information:

- Normal, Test, Emergency

Electrical measurements:

- ATS/PTS load data (optional)

This input data may be provided by the ATS/PTS controller (PowerLogic T300, ASCO 7000 Series PTS), power meters (PowerLogic ION9000, PM8000, PM5000), and/or data loggers (Cyber Sciences SER 3200/2408).


PowerLogic
T300


ASCO
7000 Series
PTS MV


ASCO
7000 Series
PTS LV


PowerLogic
ION9000


PowerLogic
PM8000


PowerLogic
PM5000


Cyber Sciences
SER 3200/2408

Data from Uninterruptible Power Supply (UPS)

The following data are collected:

Status, events, and diagnostic information:

- Operating mode
- UPS fault
- Charger fault
- Output overload

Electrical measurements:

- Voltage and current (line to neutral / line to line)
- Frequency
- Battery voltage signature

These input data are provided by the UPS (Galaxy VX/VL/VM/VS).

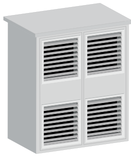

Galaxy VX/VL/VM/VS

Data from Load Bank (optional)

The following data are collected:

Electrical measurements:

- Voltage (line to neutral / line to line)
- Current
- Total power, total apparent power
- Power factor
- Frequency


Load Bank MV


Load Bank LV

Data Recording and Timestamping

To help ensure the validity of the test reports and avoid repetition of the test due to data loss, data must be recorded and timestamped at the connected product level. This will allow producing a valid report even if there was a temporary communication loss between the Edge Control software and the connected products during the test.

Advanced meters such as the PowerLogic ION9000, PM8000, and some PowerLogic PM5000 models (PM53xx and PM55xx) can timestamp and record onboard input data, energy measurements, and connected equipment states. EcoStruxure Power Monitoring Expert or Power Operation can then retrieve the records with their original timestamp.


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000

For other connected products (PowerLogic P5/P3, MasterPacT MTZ, entry-level PowerLogic PM5000 models) measurements are acquired by the connected products and then recorded and timestamped by associated Cyber Sciences SER 3200/2408 or by the ASCO CPMA (Critical Power Management Appliance).

PowerLogic
P5

PowerLogic
P3

MasterPacT
MTZ

PowerLogic
PM5000

ASCO
CPMA

Cyber Sciences
SER 3200/2408

Timestamping Requirements for Backup Generator and ATS/PTS

Due to the accuracy requirements of the Generator Test (EPSS) Report, it is necessary to have all status data recorded with high time precision. Depending on the jurisdiction, this is typically greater than ±100 ms.

When using power meters to monitor generator and ATS/PTS, a custom framework is required to record all required data. This framework is described in detail in the Backup Power module in the EcoStruxure Power Monitoring Expert System Guide.

Advanced power meters (PowerLogic ION9000 and PM8000) support this framework.

Timestamping Requirements for UPS

For UPS test reports, time accuracy is not as critical, but should still be within ±1second.

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

Time Synchronization

For a consistent chronological view of all events that take place throughout the facility, date and time should be accurately distributed to connected products and other management systems.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be connected to a GPS antenna to reach the expected time precision.

TimeSync Clock

Data Processing

The following calculations are performed by the Backup Power Module of EcoStruxure Power Monitoring Expert or Power Operation.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

In the case of an ASCO architecture, these calculations can be performed by the ASCO CPMA.

ASCO
CPMA

For the Backup Generator and ATS/PTS[30]

Data processing consists of:

- Analyzing the status information from the generator(s) and ATS/PTSs[30] and compiling the run history table which details each and every backup power run, including start, stop, and transfer time.
- Among others, the following indicators are extracted from available data:
  - Split of emergency / non-emergency running hours as an annual total.
  - Running hours broken out into categories for Test, Power Outage, Load Shedding.
- For the backup/emergency system[31] conformance tests, all success criteria are examined to provide a comprehensive fail/pass status.

For the UPS[32]

Data processing depends on whether the UPS equipment has auto-test capabilities:

- If it has auto-test capabilities, (for example, Galaxy VX/VL/VM/VS), the module will gather all data relevant for the auto-test (final status of the test and status for each step).
- If not, the module compares the battery voltage waveform during a transfer to a reference signature waveform.

Outputs

Outputs are displayed remotely via the Edge Control software EcoStruxure Power Monitoring Expert or Power Operation.

The Backup Power module of EcoStruxure Power Monitoring Expert must be deployed to benefit from the following features.

30. ATS/PTS: Automatic Transfer Switch / Power Transfer Switch
31. Also sometimes referred to as Emergency Power Supply System (EPSS)
32. UPS: Uninterruptible Power Supply

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

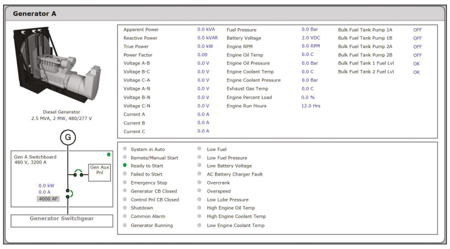
In the case of an ASCO architecture, outputs are displayed by the ASCO CPMA.

ASCO
CPMA

Live Data Display

The following outputs can be configured to represent an operator interface for Backup Power Testing:

- Default Generator, UPS[33], and ATS/PTS[34] diagrams
- Generator Performance (EPSS) operator interface. Helps monitor the following during tests in real time:
    - Electrical data: current, voltage, power, frequency, power factor
    - Generator and ATS/PTS run/stop status
- UPS[33] Auto-test diagrams



Generator Equipment Diagram

Reports

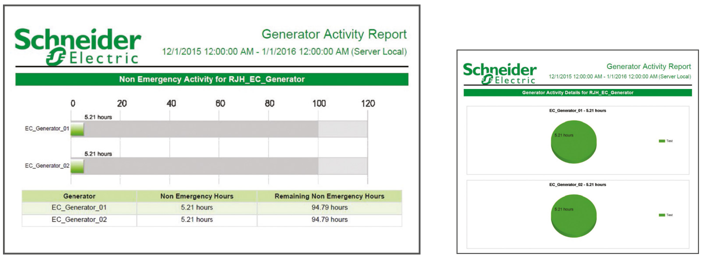
The following reports can be generated on-demand or automatically generated and sent by email:

33. UPS: Uninterruptible Power Supply
34. ATS/PTS: Automatic Transfer Switch / Power Transfer Switch

Backup/Emergency Power Reports

- **Generator Activity Report**

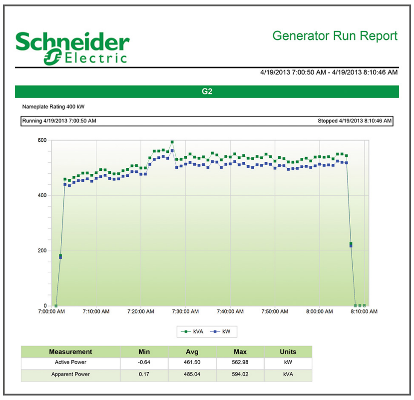
  Shows the test run hours and other test run data for each generator in the selected group.



Generator Activity Report

- **Generator Load Summary Report**

  Provides a summary graph of electrical data during a generator run.

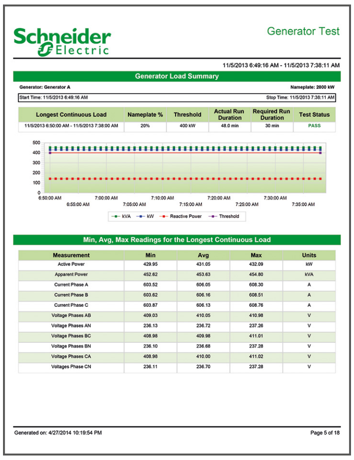


Generator Load Summary Report

- **Generator Test (EPSS) Report**

  Provides a standard methodology for testing the generators and provides a detailed report of the generator operation during the test.

  Can also be configured to conform to the requirements for a Backup/ Emergency Power Supply System (EPSS)[35] test, including ATS/PTS[36]. For example, the report shows the transfer time of the lead ATS/PTS[36] and indicates whether the transfer time passes or does not pass the test requirements.



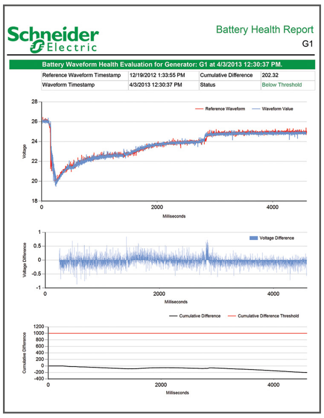
Backup Power System[35] Test Report

35. Also sometimes referred to as Emergency Power Supply System (EPSS)
36. ATS/PTS: Automatic Transfer Switch / Power Transfer Switch

- **Generator Battery Health Report**

  Shows the captured waveform image of the generator voltage when the generator starts, compares it to a reference signature, and uses it to monitor battery performance over time and plan preventative maintenance actions when necessary.

  Available with PowerLogic ION9000 only.



Generator Battery Health Report

Uninterruptible Power Supply (UPS) Reports

- **UPS Auto-Test Report**

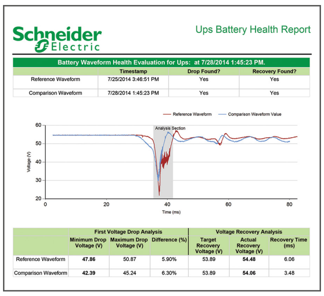
  Provides information regarding the battery health of your Galaxy VX/VL/VM/VS UPS devices.

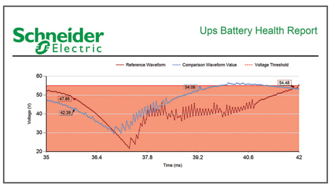
UPS Auto-Test Report

- **UPS Battery Health Report (For third-party UPS)**

  Displays information related to the health of the battery for a UPS device. The UPS devices intended for use with this report are UPS devices that do not have an auto-test capability.

  Available with PowerLogic ION9000 only.





UPS Battery Health Report (For third-party UPS)

Power Event Analysis

What's in This Chapter

Overview

Context of Application

Various power events can affect your electrical installation:

- Motor startup sequences leading to voltage sags and current overloads
- Transient events such as capacitor switching and surge impulses
- Unsuccessful power transfers caused by incorrect Automatic Transfer Switch / Power Transfer Switch (ATS/PTS) operation, etc.

These events can cause damage to sensitive equipment and processes, and result in unexpected downtime.

Thanks to connectivity and embedded sensors on critical equipment, it is easy to receive alarms when such power events occur. However, it can be much more difficult to find the root cause of power events without the proper context and tools.

Problem to Solve

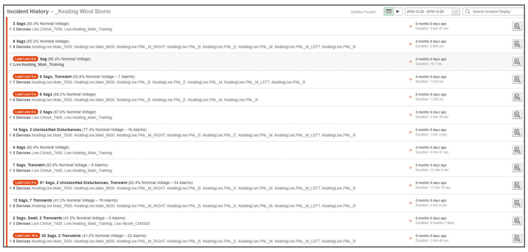
The facility manager needs to:

- Analyze potentially damaging power events to identify the root cause.
- Perform actions to avoid similar future events.
- Prioritize operator actions based on alarm priority.

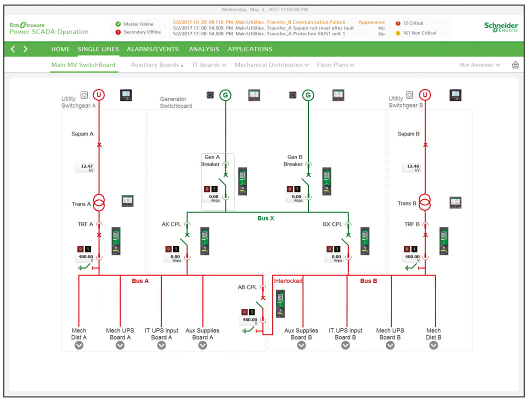
Purpose of the Application

Provide a user-friendly graphical tool to simplify and save time in event analysis

- Smart alarm context automatically brings any relevant information into view, including disturbance direction detection (DDD) and loss of load detection (LLD).
- Events and alarms can be viewed by category, severity, alarm type, and status.
- Events can be visualized in the context of time across multiple devices.
- Analyses can be saved for later viewing.
- Power system events can be visually replayed using an animated electrical single line diagram, floor plan, or facility riser.



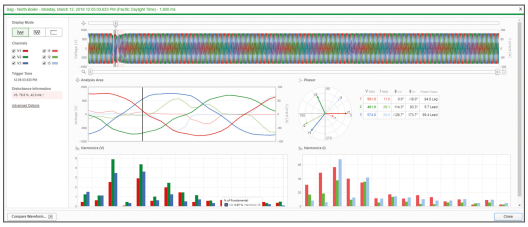
Smart Alarm View with LLD and DDD



Animated Single Line Diagram

Provide an aggregated view of events in the same dashboard

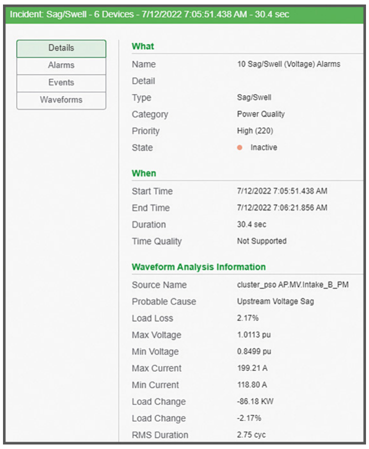
- Power quality, circuit breaker trip, and other power incidents across multiple devices can be intelligently grouped and displayed.
- Events can be visualized on a chronological timeline with contextual data such as RMS data and waveforms.



Waveform Viewer

Enable root cause analysis

- High probability causes of selected Power Quality events can be displayed to operators.



Automated Root Cause Analysis

Application Outcomes

Events and Alarms

- Chronological display of events and alarms with sorting and filtering capabilities
- Intelligent alarm grouping into summary incidents

Reports

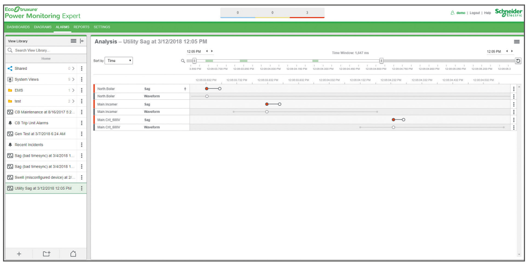
- Historical data reporting

Notifications

- SMS and/or email notifications can be sent for fast analysis and action.
- Email notifications are also available to send reports and non-critical information.

Analysis Tools

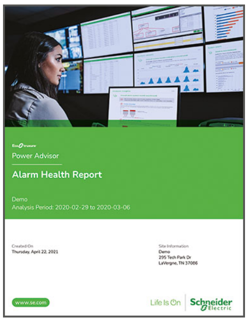
- **Power Event Incident Timeline:** helps identify the root cause and the consequences of an incident. This feature intelligently groups individual events and alarms as a single comprehensive incident during a given time period. Other data such as RMS waveforms and other electrical values are also accessible in a drill-down workflow.
- **Waveform Viewer:** power events can be visualized using the native waveform viewer in the Edge Control software.
- **Root Cause Analysis:** automated analytics built into the Edge Control software provide probable root cause of certain power events.
- **Power Event Playback:** if ASCO CPMA (Critical Power Management Appliance) is used to collect data in the system, power events can be recorded and replayed in dynamic one line diagrams.



Timeline of Power Events

Cloud-Based Analytics and Services

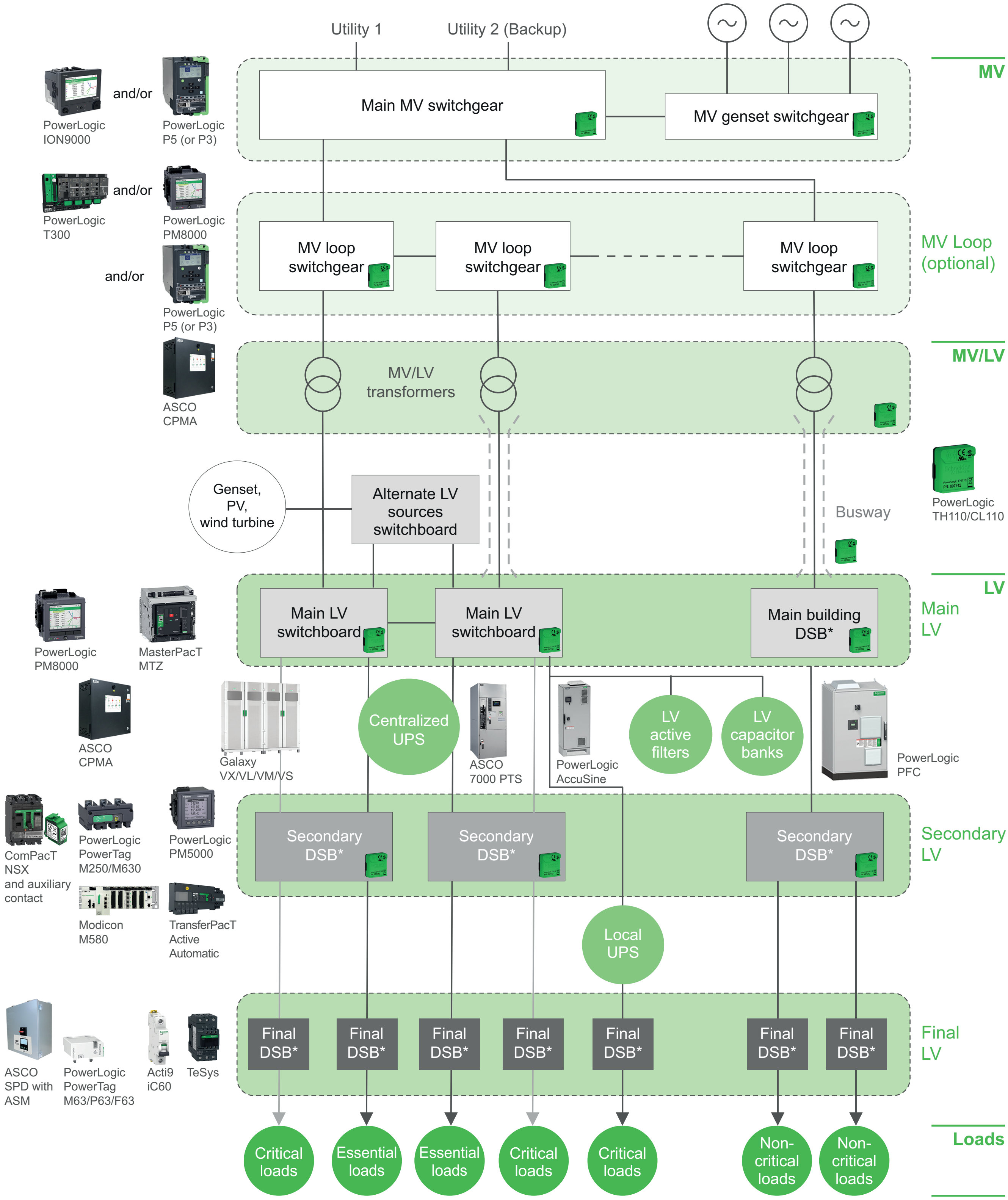
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides electrical network and alarm health analytics with recommendations from our Schneider Electric service experts.



EcoStruxure Power Advisor Alarm Health Report

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Power Event Analysis application:



* DSB = Distribution Switchboard

Digital Architecture

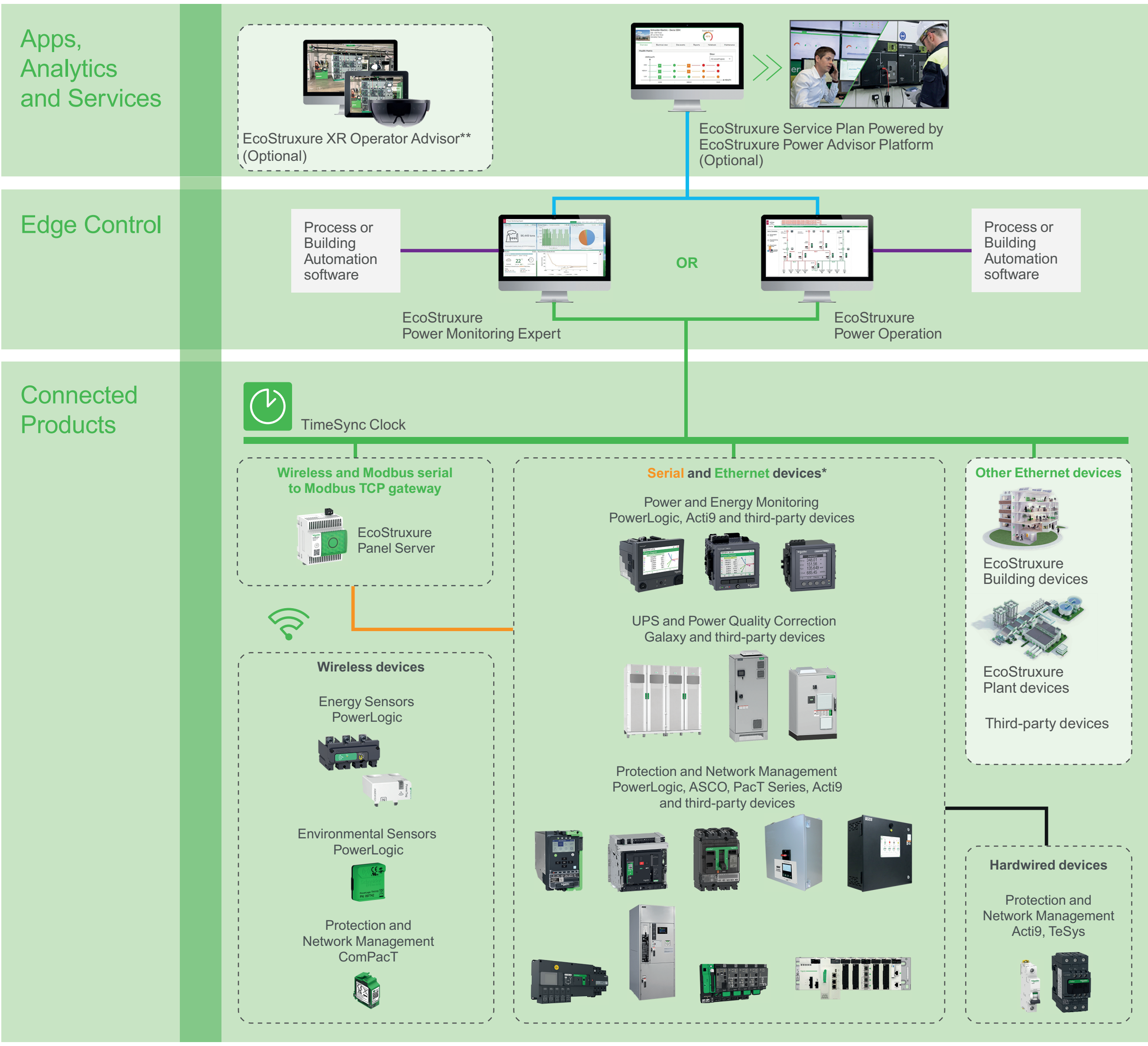
The digital architecture of the Power Event Analysis application involves collecting the input data from the different products, either directly over Ethernet or via gateways. This data is then used by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for on-premise visualization analysis and reporting.

The most significant factors in the customer process can also be captured from external process software using the OPC standard or ETL tool.

As an option, EcoStruxure XR Operator Advisor Client can be used to enhance the Power Event Analysis application with virtually overlaid data on top of equipment and devices.

Data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Power Advisor platform and interpreted by experts as a part of the EcoStruxure Service Plan.

The recommended digital architecture for the application is shown below:

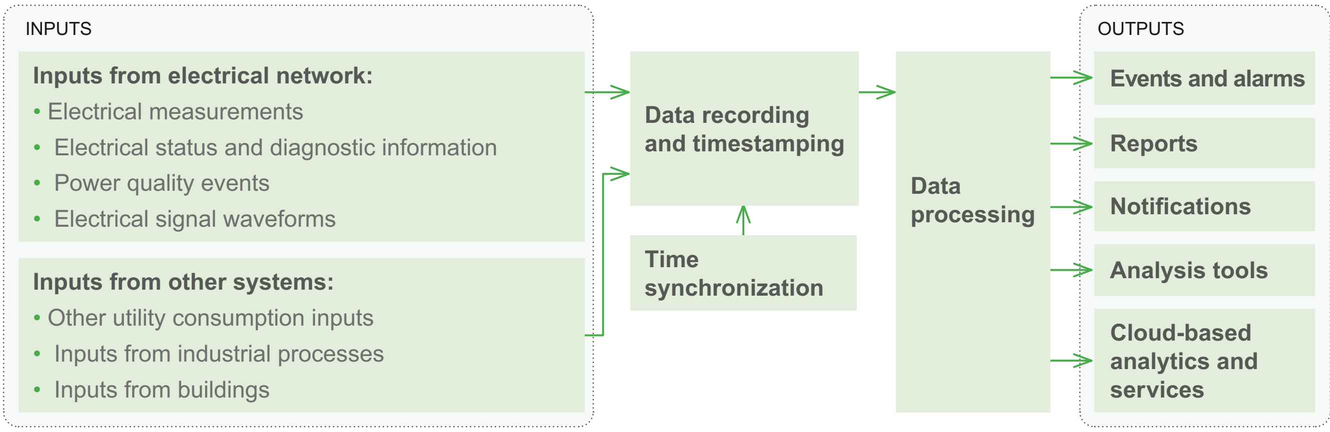


* Depending on the connected device chosen, communication protocols can be Ethernet or Serial
** See digital architecture of Guided Procedures through Extended Reality to understand how you can leverage EcoStruxure XR Operator Advisor for this application

System Description

Data Flow

The Power Event Analysis application can be broken down as follows:



Inputs

Data is collected from diverse electrical devices for the purpose of analyzing power system events:

Inputs from Electrical Network

Electrical measurements: system loading and parameters such as voltage, current, power, and temperature from sensors, relays, etc.

- **Electrical status and diagnostic information:** status changes from contactors, switches, circuit breakers, ATS/PTS, etc.
- **Power quality events:** such as sags, swells, transients, harmonics from power meters, UPSs, active harmonic filters, capacitor banks, surge protective devices, etc.
- **Electrical signal waveforms:** high sample rate sinusoidal waveform data for all phases of voltage and current.

Data can be acquired from a wide range of connected products as well as third-party equipment through open communication protocols. Typical connected products include:

- **Energy/Power meters**, such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, Acti9 iEM3000, PowerLogic PowerTag


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


PowerLogic HDPM6000


Acti9 iEM3000


PowerLogic PowerTag

- **Protection devices**, such as PowerLogic P5/P3, MasterPacT MTZ, ComPacT NSX (including its wireless auxiliary contact), Acti9 Active

PowerLogic P5

PowerLogic P3

MasterPacT MTZ

ComPacT NSX and Auxiliary Contact

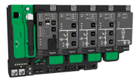
Acti9 Active

- **Other equipment**, such as UPS (Galaxy VX/VL/VM/VS), ATS/PTS (ASCO 7000 Series PTS, TransferPacT Active Automatic), ATS controller (PowerLogic T300), protective devices (ASCO SPD with ASM), power correction devices (PowerLogic PFC and AccuSine PCS+/PCSn/EVC/PFV+), Load Banks, PLCs (Modicon M580), motor control (TeSys), environmental sensors (PowerLogic CL110/TH110),

Galaxy VX/VL/VM/VS

ASCO 7000 Series PTS

TransferPacT Active Automatic



PowerLogic T300

ASCO SPD with ASM

PowerLogic PFC

PowerLogic AccuSine PCS+/PCSn/ EVC/PFV+

Load Banks

Modicon M580

TeSys

PowerLogic TH110

PowerLogic CL110

Inputs from Other Systems

Other kinds of inputs can be used by the Power Event Analysis application:

- **Other utility consumption inputs:** water, gas, steam, etc.
- **Inputs from industrial processes:** motor, machine, or equipment status can be acquired from EcoStruxure Plant and Machine or third-party systems.
- **Inputs from buildings:** conditions in all facilities can be acquired from EcoStruxure Building Operation or third party systems.

EcoStruxure Building

EcoStruxure Plant and Machine

Data Recording and Timestamping

For highly critical applications, optimal chronological correlation is achieved with a time accuracy of ±1 millisecond (possible using PTP or GPS time synchronization).

For less critical applications, a time accuracy of ±100 milliseconds is adequate (with NTP and SNTP).

Time stamping and recording depends on the connected product type:

- **Advanced meters** such as the PowerLogic ION9000, PM8000, and some PowerLogic PM5000 models (PM53xx and PM55xx) can timestamp and record onboard input data.


PowerLogic ION9000

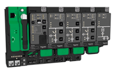

PowerLogic PM8000


PowerLogic PM5000

- **For other connected products** (PowerLogic P5/P3, T300, MasterPacT MTZ, and entry-level PowerLogic PM5000 models) steady state disturbances and other data are measured by the connected products and recorded by software (EcoStruxure Power Monitoring Expert or Power Operation) or by a server (ASCO CPMA).


PowerLogic P5


PowerLogic P3


PowerLogic T300


Master-PacT MTZ


PowerLogic PM5000


EcoStruxure Power Monitoring Expert


EcoStruxure Power Operation


ASCO CPMA

- **If data from these connected products require more accurate timestamping**, it should be relayed through another connected product or data recorder with better accuracy (like PowerLogic ION9000 power quality meter, Modicon M580 PLC, or Cyber Sciences SER 3200/2408).


PowerLogic ION9000


Modicon M580


Cyber Sciences SER 3200/ 2408

When acquiring data from other systems, timestamps are imported through OPC[37] or ETL[38].

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

37. OPC: Open Platform Communications;
38. The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert and Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.

Time Synchronization

For a consistent chronological view of all events that take place throughout the facility, the date and time should be accurately distributed to connected products and other management systems.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). Time synchronization precision is essential to derive value from Power Event Analysis. An external master clock is required and can be connected to a GPS antenna to reach the expected time precision.

TimeSync Clock

Data Processing

Smart Clustering

Data processing consists of:

- Consolidation of events, alarms, waveforms, status changes, and other corresponding data from all connected products in chronological views
- Smart grouping of related data to help identify the root cause of incidents

Smart clustering is performed by EcoStruxure Power Monitoring Expert or Power Operation.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Outputs

Outputs are displayed by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation).

EcoStruxure
Power Monitoring Expert

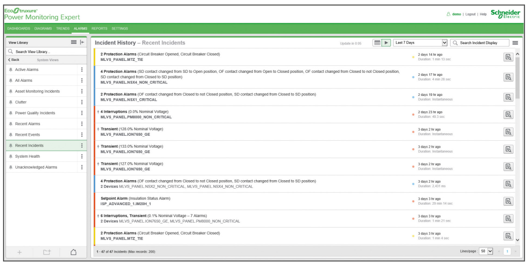
EcoStruxure
Power Operation

Events and Alarms

Event/Alarm Log Viewers

These offer chronological display with sorting and filtering capabilities.

- EcoStruxure Power Operation offers high speed Sequence of Events Recording to quickly locate the source of any abnormal conditions. A time-quality flag indicates the accuracy of onboard clocks and the resulting accuracy of any events and alarms.
- EcoStruxure Power Monitoring Expert and Power Operation intelligently group related alarms, events, waveforms, and other associated data in an incident view to simplify the root cause analysis of an incident.

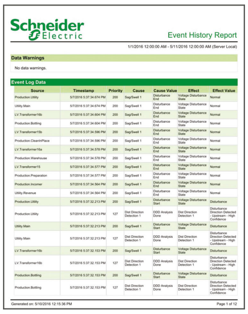


Alarm and Event Log Viewer in EcoStruxure Power Monitoring Expert and Power Operation.

NOTE: Smart alarm views include relevant context acquired from smart power quality metering to indicate direction of a disturbance (upstream or downstream of the device capturing an event) and a percentage of nominal load lost as a result of an event such as a sag, transient, or interruption.

Reports

When EcoStruxure Power Monitoring Expert or Power Operation is installed, reports can be generated, such as the Event History Report.



Event History Report

Notifications

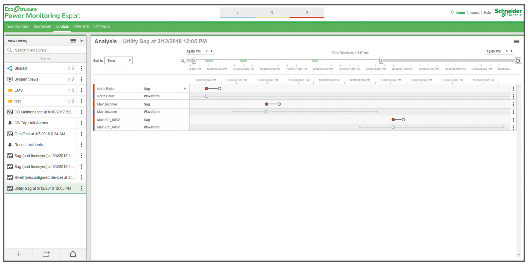
Notifications of events and alarms can be sent by EcoStruxure Power Monitoring Expert or Power Operation using the Event Notification Module.

Analysis Tools

Power Events Incident Timeline

The Power Events Incident Timeline helps identify the root cause and the consequences of an incident using the following advanced functions:

- Sorting of event and alarm data according to their date and time
- Detailed breakdown and sequence of alarms, waveforms, and trends involved in the incident
- Disturbance direction detection to locate upstream/downstream root cause of an incident



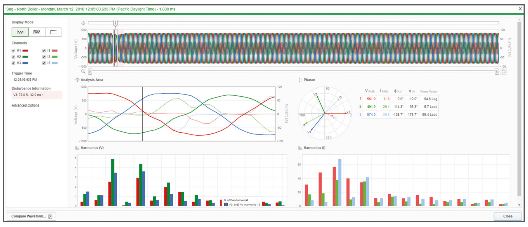
Power Events Incident Timeline

Waveform Viewer

Electrical signal waveforms can be displayed with a native waveform viewer in both EcoStruxure Power Monitoring Expert and Power Operation.

These viewers allow for the following:

- Toggle on/off voltage and current channels
- RMS calculation, zoom, pan, export to CSV
- Interactive phasor and harmonic (voltage and current) diagrams
- Comparison of multiple waveforms with respect to each other



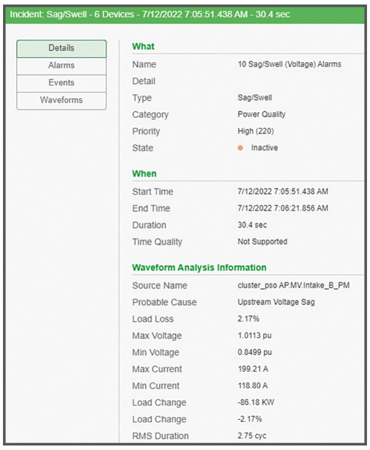
Waveform Viewer

Root Cause Analysis

Automated waveform analytics provide the probable root cause of certain power quality events including:

- Voltage sag
- Inrush event
- Load start
- Single-phase fault
- Subcycle fault
- Three-phase fault
- Two-phase fault

This detailed data enables appropriate actions to be identified.



Root Cause Analysis

Power Event Playback

If ASCO CPMA (Critical Power Management Appliance) is used to collect data in the system, power events can be recorded and replayed in dynamic one line diagrams

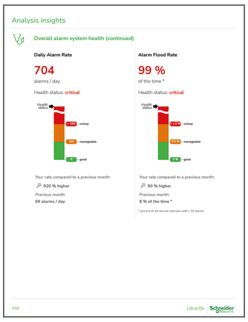
The playback tool offers comprehensive, easy-to-use capabilities:

- Continuously record all dynamic one line and floor plan control animations, sequence of events, and analog power data.
- Replay animated one line view of selected power events for better understanding of power event interdependency.
- Archive and share replayed animated one line events to improve collaboration and root cause analysis.

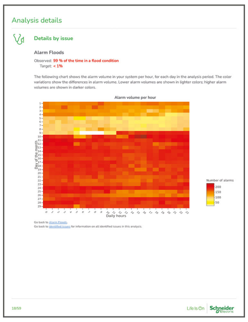
Cloud-Based Analytics and Services

As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides electrical network and alarm health analytics with recommendations from our Schneider Electric service experts. It helps categorize and reduce alarms.

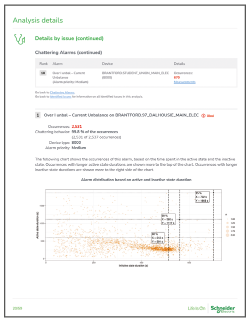
EcoStruxure Service PlanPowered by EcoStruxure Power Advisor Platform



EcoStruxure Power Advisor Alarm Health Report - Overall Alarm System Health



EcoStruxure Power Advisor Alarm Health Report - Alarm Floods



EcoStruxure Power Advisor Alarm Health Report - Details by Issue

Circuit Breaker Settings Monitoring

What's in This Chapter

Overview

Context of Application

An installation is designed with specific circuit breaker settings, calculated to optimize the protection of the installation. However, throughout the life cycle of the installation, these settings may not be applied correctly or may be modified (for example during maintenance, product replacement, or due to nuisance tripping).

An incorrect setting may lead to:

- Nuisance tripping if the threshold is too low
- The tripping of an upstream circuit breaker instead of the local circuit breaker if the selectivity is ineffective
- Device destruction, fire outbreak, and/or personal injury if the coordination between products is not correct

Problem to Solve

The facility manager needs to:

- Be confident that electrical protection devices are able to fulfill their function.
- Help prevent issues due to inappropriate or poorly coordinated circuit breaker settings.

Purpose of the Application

Manually or automatically generate a report summarizing settings of LV circuit breakers:

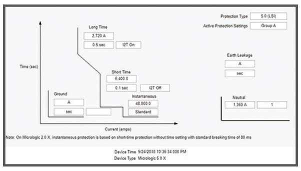
- Easily compare commissioned settings with designed settings to establish a validated baseline
- Compare actual circuit breaker settings with commissioned settings
- Periodically detect inappropriate setting modifications
- Provide information for capacity planning

This report helps to identify settings or coordination issues and to find the root cause of any settings or coordination problems.

Application Outcomes

Live Data Display

At any time, circuit breaker protection settings can be viewed in device diagrams.



Default trip curve diagram for MasterPacT MTZ In EcoStruxure Power Monitoring Expert.

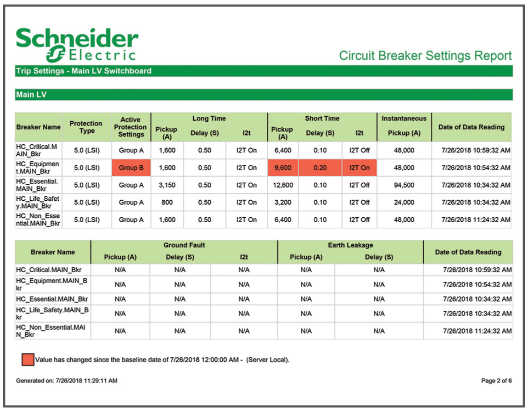
Events and Alarms

Alarms are generated when circuit breaker trip settings change.

Reports

For each protective device, the Circuit Breaker Settings report displays the name, type of protection, and related thresholds.

It also detects any changes made with respect to a baseline.



Circuit Breaker Settings Report

Trip Settings - Main LV Switchboard

Main LV

Breaker Name	Protection Type	Active Protection Settings	Long Time Pickup (A)	Long Time Delay (S)	Long Time I2t	Short Time Pickup (A)	Short Time Delay (S)	Short Time I2t	Instantaneous Pickup (A)	Date of Data Reading
HC_Critical.MAIN_Bkr	5.0 (LSI)	Group A	1,600	0.50	I2T On	6,400	0.10	I2T Off	48,000	7/26/2018 10:59:32 AM
HC_Equipment.MAIN_Bkr	5.0 (LSI)	Group B	1,600	0.50	I2T On	9,600	0.20	I2T On	48,000	7/26/2018 10:54:32 AM
HC_Essential.MAIN_Bkr	5.0 (LSI)	Group A	3,150	0.50	I2T On	12,600	0.10	I2T Off	94,500	7/26/2018 10:34:32 AM
HC_Life_Safety.MAIN_Bkr	5.0 (LSI)	Group A	800	0.50	I2T On	3,200	0.10	I2T Off	24,000	7/26/2018 10:34:32 AM
HC_Non_Essential.MAIN_Bkr	5.0 (LSI)	Group A	1,600	0.50	I2T On	6,400	0.10	I2T Off	48,000	7/26/2018 11:24:32 AM

Breaker Name	Ground Fault Pickup (A)	Ground Fault Delay (S)	Ground Fault I2t	Earth Leakage Pickup (A)	Earth Leakage Delay (S)	Date of Data Reading
HC_Critical.MAIN_Bkr	N/A	N/A	N/A	N/A	N/A	7/26/2018 10:59:32 AM
HC_Equipment.MAIN_Bkr	N/A	N/A	N/A	N/A	N/A	7/26/2018 10:54:32 AM
HC_Essential.MAIN_Bkr	N/A	N/A	N/A	N/A	N/A	7/26/2018 10:34:32 AM
HC_Life_Safety.MAIN_Bkr	N/A	N/A	N/A	N/A	N/A	7/26/2018 10:34:32 AM
HC_Non_Essential.MAIN_Bkr	N/A	N/A	N/A	N/A	N/A	7/26/2018 11:24:32 AM

Value has changed since the baseline date of 7/26/2018 12:00:00 AM - (Server Local).

Generated on: 7/26/2018 11:29:11 AM

Page 2 of 6

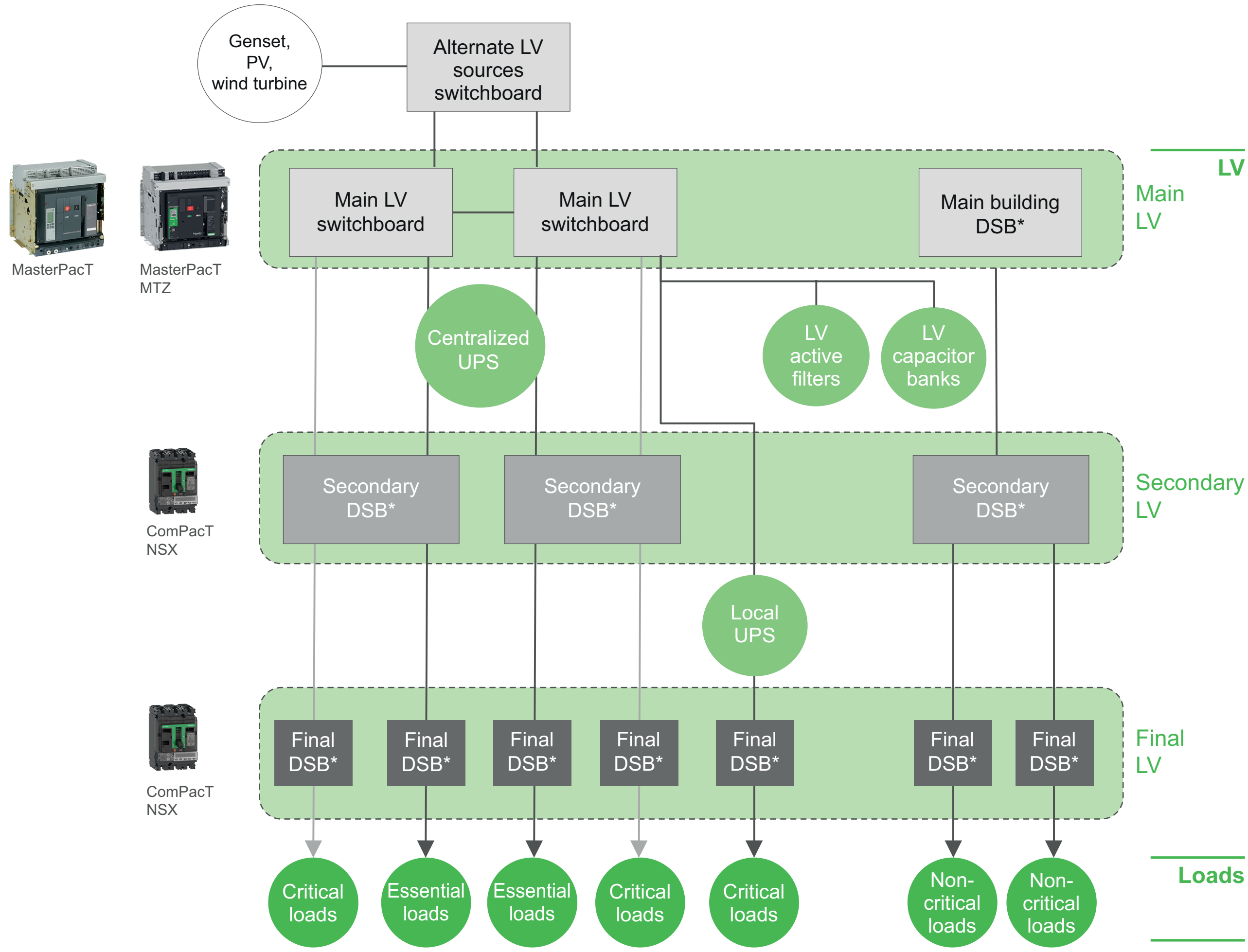
Circuit Breaker Settings Report

Notifications

SMS and/or email notifications can be sent upon settings changes to help detect potential loss of selectivity.

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Circuit Breaker Settings Monitoring application:

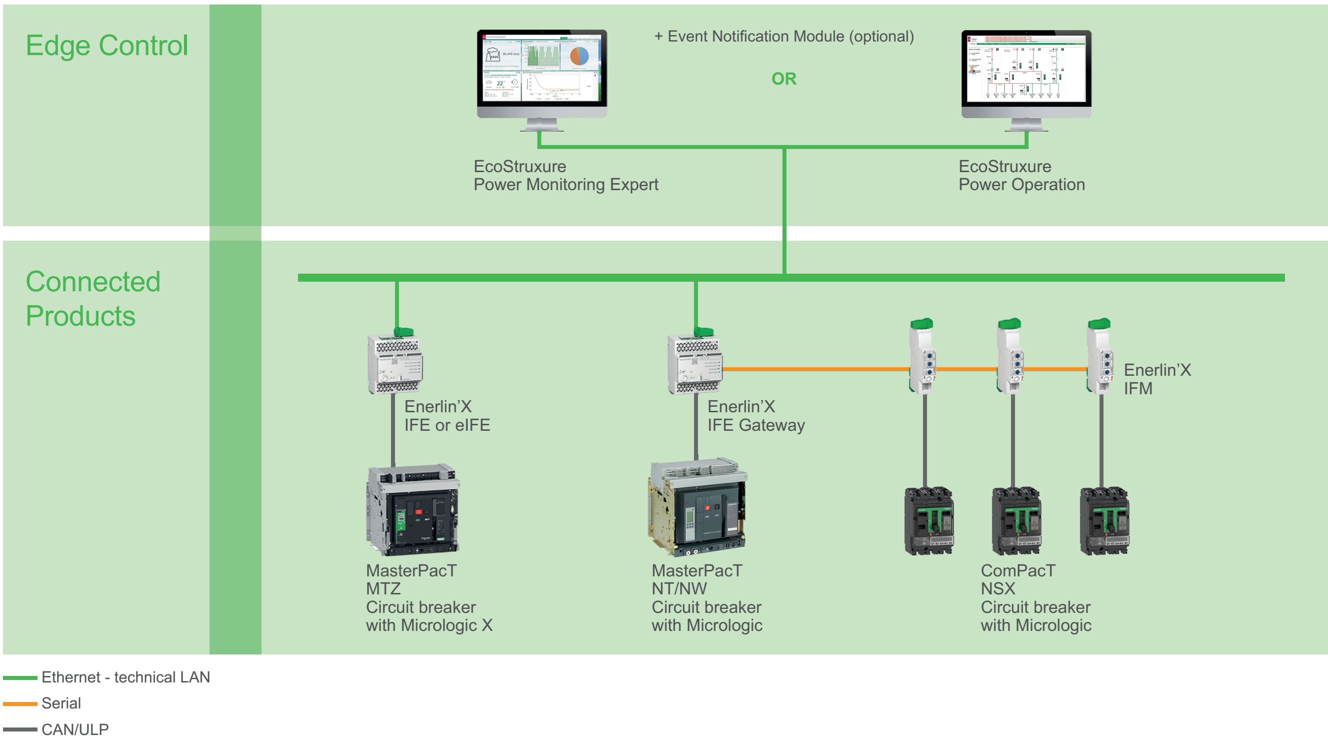


* DSB = Distribution Switchboard

Digital Architecture

The digital architecture of the Circuit Breaker Settings Monitoring application depicts the collection of the protection settings of different circuit breakers via gateways (Enerlin'X IFE, eIFE, or IFM). These data are then recorded and processed by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for on-premise visualization, analysis, and reporting.

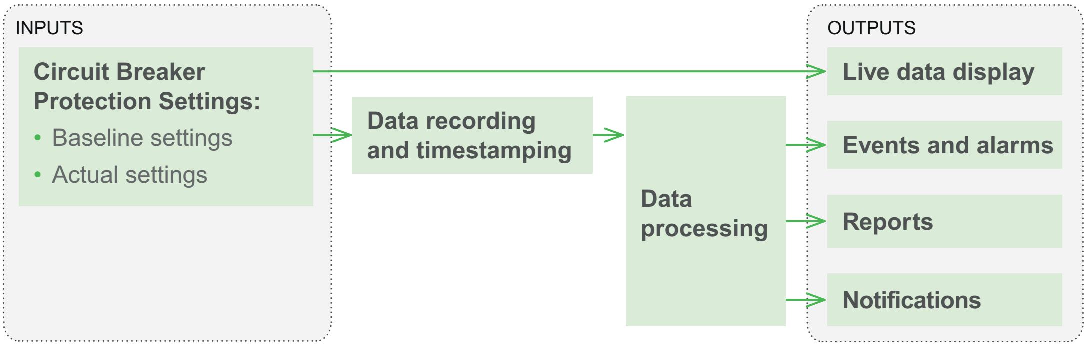
The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Circuit Breaker Settings Monitoring application can be broken down as follows:



Inputs

The following data is required:

Circuit Breaker Protection Settings

Circuit breaker protection settings are obtained from communicating circuit breaker trip units. These protection settings are typically based on an electrical system coordination study performed by an expert. These settings are designed to minimize the impact of disturbances. Any changes in protection settings must consider the overall system coordination of the facility.

The following LV circuit breakers can be monitored by this application:

- **MasterPacT:**
  - MicroLogic 2 A/E
  - MicroLogic 5 A/E/P/H
  - MicroLogic 6 A/E/P/H
  - MicroLogic 7 A/P/H

MicroLogic for MasterPacT

- **PowerPacT (China) / ComPacT NSX:**
  - MicroLogic 5.2/5.3 A/E
  - MicroLogic 6.2/6.3 A/E

MicroLogic for ComPacT NSX

- **MasterPacT MTZ:**
  - MicroLogic 2 X, Xi
  - MicroLogic 5 X, Xi
  - MicroLogic 6 X, Xi
  - MicroLogic 7 X, Xi

MicroLogic X for MasterPacT MTZ

Baseline settings

To capture the original coordination settings, a snapshot is recorded for future reference as a baseline. This baseline is referred to in the Circuit Breaker Protection Settings Report.

Actual settings

Actual protection settings are monitored and recorded either periodically or on value-change notification from connected products.

Data Recording and Timestamping

Circuit breaker protection settings data is recorded and timestamped by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation). Therefore, no specific device for time synchronization is necessary.

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Data Processing

Baseline Comparison[39]

A circuit breaker protection setting baseline is used by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation Module) to compare the actual state of the circuit breaker settings to a baseline point in time.

If a change is detected between the state of the settings today and the state of the settings on the baseline date, the change will be timestamped, an event will be generated, and the change will be noted in the reporting.

39. The Breaker Performance module of EcoStruxure Power Monitoring Expert or Power Operation must be deployed to benefit from these features.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Outputs

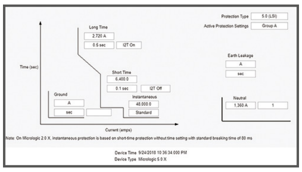
Outputs are displayed by the Edge Control software (EcoStruxure Power Monitoring Expert or EcoStruxure Power Operation).

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Live Data Display

The protection settings (default trip curve) for a supported circuit breaker can be displayed in the default device diagrams of the Edge Control software.



Default trip curve diagram for MasterPacT MTZ In EcoStruxure Power Monitoring Expert.

Events and Alarms[40]

Any potential changes to the designed protection settings for a circuit breaker can be raised as an event or alarm in the Edge Control software’s native alarm interface.

By default, alarms are generated in case of any changes to the following settings:

- Type of Protection
- Long Time Overcurrent Protection Enabled
- Long Time Overcurrent Pickup Threshold / Time Delay
- Long Time Overcurrent Curve
- Short Time Overcurrent Protection Enabled
- Short Time Overcurrent Pickup Threshold / Time Delay
- Short Time Overcurrent Curve
- Instantaneous Overcurrent Protection Enabled
- Instantaneous Overcurrent Pickup Threshold
- Ground Fault Overcurrent Protection Enabled
- Ground Fault Overcurrent Pickup Threshold / Time Delay

40. The Breaker Performance module of EcoStruxure Power Monitoring Expert or Power Operation must be deployed to benefit from these features.

- Ground Fault Overcurrent Curve
- Earth Leakage Protection Enabled
- Earth Leakage Protection Pickup Threshold / Time Delay

Reports[41]

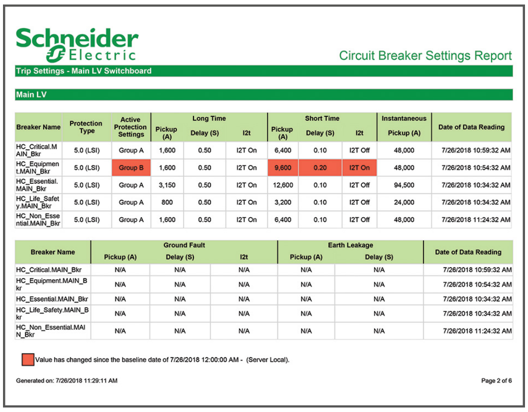
Reports can be configured to be generated upon detection of a circuit breaker settings change.

Circuit Breaker Settings Report

Monitors and reports on the configuration settings of the circuit breakers in your electrical system. The report highlights changes between the baseline and the last known values.

The contents of the report can be summarized as follows:

- Circuit breaker name
- Protection settings, protection modes, maintenance status
- Value (actual and baseline)
- Date/time of change detection
- Date/time of last settings verification



Circuit Breaker Settings Report

Trip Settings - Main LV Switchboard

Main LV

Breaker Name	Protection Type	Active Protection Settings	Long Time			Short Time			Instantaneous	Date of Data Reading
			Pickup (A)	Delay (S)	I2t	Pickup (A)	Delay (S)	I2t	Pickup (A)	
HC_Critical.MAIN_Bkr	5.0 (LSI)	Group A	1,600	0.50	I2T On	6,400	0.10	I2T Off	48,000	7/26/2018 10:59:32 AM
HC_Equipment.MAIN_Bkr	5.0 (LSI)	Group B	1,600	0.50	I2T On	9,600	0.20	I2T On	48,000	7/26/2018 10:54:32 AM
HC_Essential.MAIN_Bkr	5.0 (LSI)	Group A	3,150	0.50	I2T On	12,600	0.10	I2T Off	94,500	7/26/2018 10:34:32 AM
HC_Life_Safety.MAIN_Bkr	5.0 (LSI)	Group A	800	0.50	I2T On	3,200	0.10	I2T Off	24,000	7/26/2018 10:34:32 AM
HC_Non_Essential.MAIN_Bkr	5.0 (LSI)	Group A	1,600	0.50	I2T On	6,400	0.10	I2T Off	48,000	7/26/2018 11:24:32 AM

Breaker Name	Ground Fault			Earth Leakage		Date of Data Reading
	Pickup (A)	Delay (S)	I2t	Pickup (A)	Delay (S)	
HC_Critical.MAIN_Bkr	N/A	N/A	N/A	N/A	N/A	7/26/2018 10:59:32 AM
HC_Equipment.MAIN_Bkr	N/A	N/A	N/A	N/A	N/A	7/26/2018 10:54:32 AM
HC_Essential.MAIN_Bkr	N/A	N/A	N/A	N/A	N/A	7/26/2018 10:34:32 AM
HC_Life_Safety.MAIN_Bkr	N/A	N/A	N/A	N/A	N/A	7/26/2018 10:34:32 AM
HC_Non_Essential.MAIN_Bkr	N/A	N/A	N/A	N/A	N/A	7/26/2018 11:24:32 AM

Value has changed since the baseline date of 7/26/2018 12:00:00 AM - (Server Local).

Generated on: 7/26/2018 11:29:11 AM

Page 2 of 6

Circuit Breaker Settings Report

Notifications

Notifications of events and alarms can be sent by EcoStruxure Power Monitoring Expert or Power Operation using the Event Notification Module.

41. The Breaker Performance module of EcoStruxure Power Monitoring Expert or Power Operation must be deployed to benefit from these features.

Power Quality Monitoring and Compliance

What's in This Chapter

Overview

Context of Application

There are many different power quality disturbances which can adversely affect critical or sensitive equipment, processes, and buildings. Continuously measuring, understanding, and acting on these disturbances is key to limiting equipment damage and reducing process and building interruptions.

Several national and international power quality standards exist to help facilities avoid downtime or disruption of sensitive equipment:

- EN 50160 – European standard for industrial and commercial networks
- IEEE 519 – Global standard for voltage and current harmonics
- IEEE 1159 – US power quality standard
- IEC 61000-4-30 – International power quality measurement techniques standard

Though helpful, understanding compliance with these standards can be challenging and time-consuming.

Problem to Solve

The facility manager needs to:

- Understand which power quality events could adversely affect their processes or operations.
- Be able to monitor persistent power quality disturbances.
- Analyze and determine actions needed to correct issues.
- Comply with national and international standards which address allowable power quality limits and durations (as mentioned above).
- Use power quality standards as guidelines to help ensure the appropriate level of power quality provided by the electric utility.

Purpose of the Application

Monitor persistent steady state and event-based disturbances and power quality measurements

- Harmonics, current unbalance, flicker, and over/undervoltage conditions, transients, interruptions, etc.

Visualize and report on power quality data

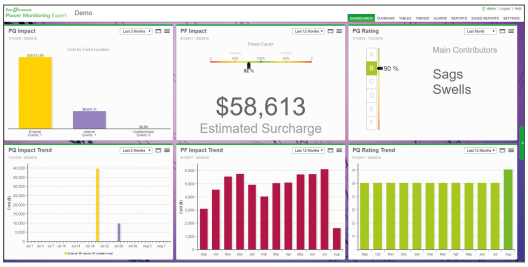
- To adhere to any power quality industry standards such as CBEMA, ITIC, SEMI F47, EN 50160, IEC 61000-4-30, IEEE 519 and 1159.

Better understand power quality disturbances

- Trends and reports to understand potential issues that could affect operations
- Event details, such as waveforms, captured and studied
- Patented Disturbance Direction Detection to locate the directionality of events

Enable in-depth analysis of power quality issues

- Advanced dashboards and reports
- Analytics-based advisory services to improve performance across the system



Power Quality Overview Dashboard

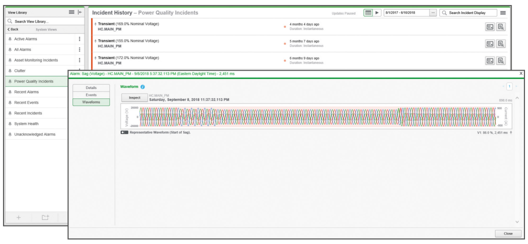
Application Outcomes

Live Data Display

Steady state disturbances such as harmonics, unbalance, and frequency can be visualized in real time.

Events and Alarms

Onboard events and alarms with timestamps.



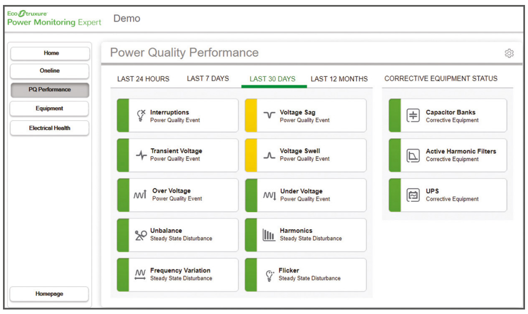
Smart Alarming

Trends

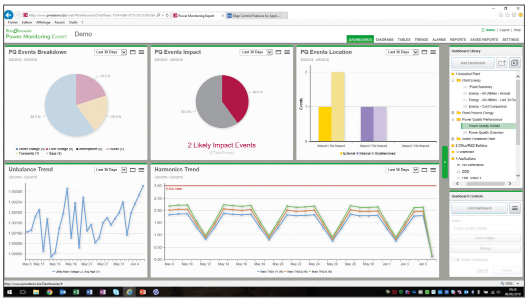
Steady state disturbances such as harmonics, unbalance, and frequency can be visualized as trends to monitor their evolution over time.

Dashboards

- Power quality performance diagrams
- Power quality dashboards

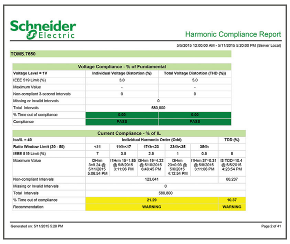


Power Quality Performance Status Panel

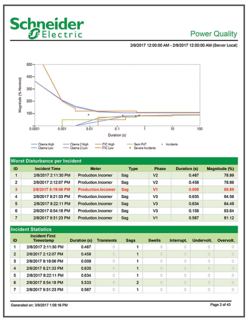

Power Quality Details Dashboard

Reports

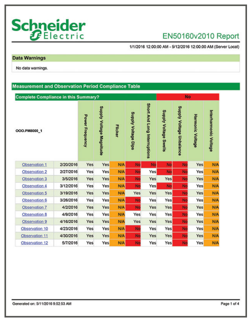
- Power Quality Report
- Power Quality Analysis Report
- Power Quality Impact Report
- Harmonics Compliance Report
- IEC 61000-4-30 Report
- EN 50160-2000 Report
- EN 50160-2010 Report



Harmonic Compliance Report



Power Quality Report



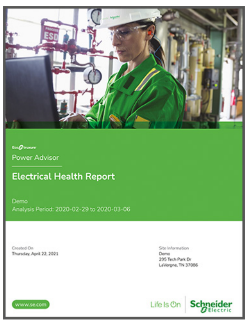
EN 50160-2010 Report

Analysis Tools

- Power events incident timeline
- Waveform viewer

Cloud-Based Analytics and Services

As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides power quality analytics with recommendations from our Schneider Electric service experts.



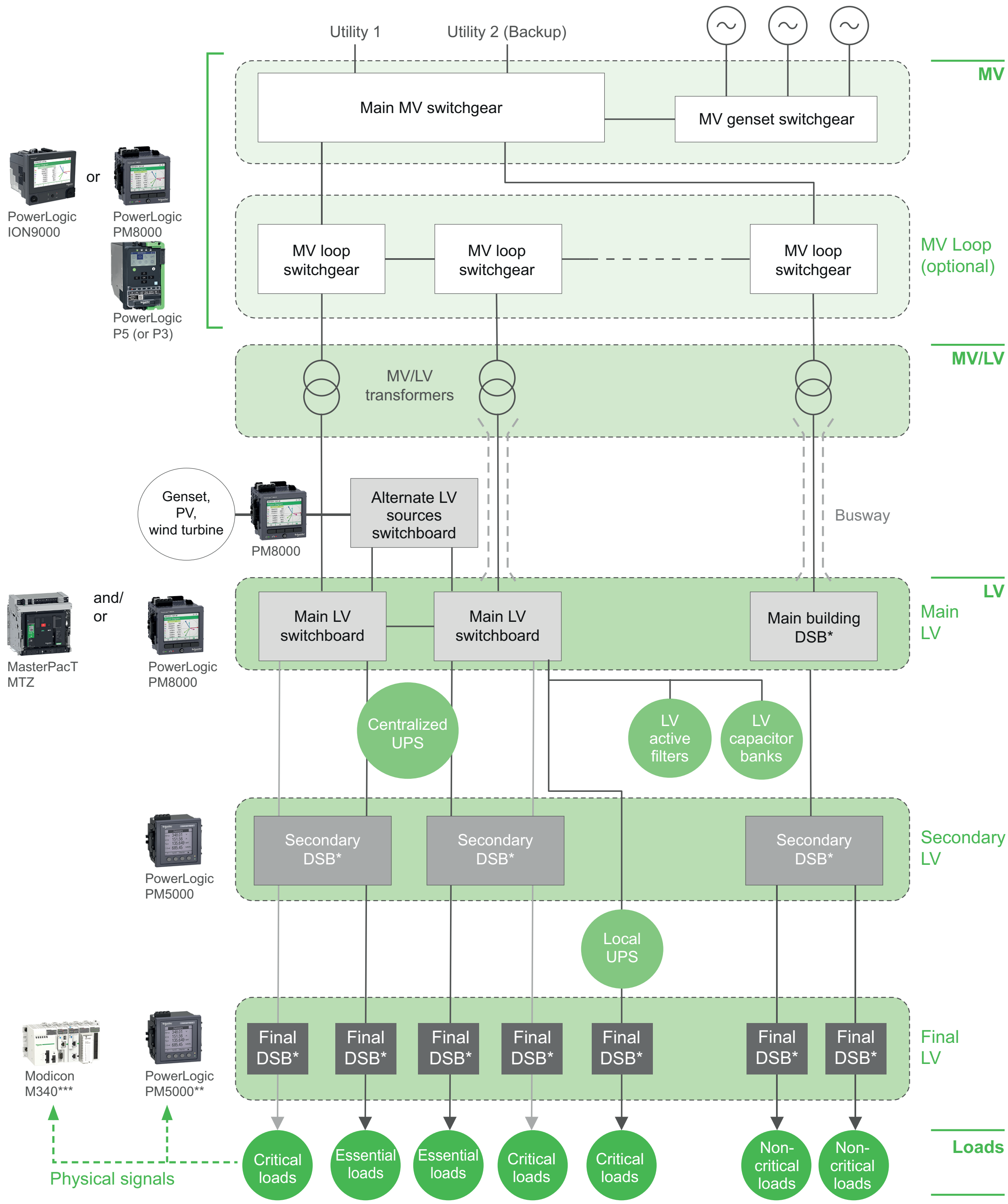
EcoStruxure Power Advisor Electrical Health Report

Electrical Architecture

For sensitive loads or critical applications, standalone power quality meters are recommended in parallel with protection devices for sub-cycle power quality event capture and Disturbance Direction Detection.

For non-sensitive loads or for measuring chronic steady-state disturbances, embedded metering in protection devices is sufficient.

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Power Quality Monitoring and Compliance application:



* DSB = Distribution Switchboard

** PowerLogic PM5300 and PM5500 range meters and above support available digital IO for physical signal acquisition.

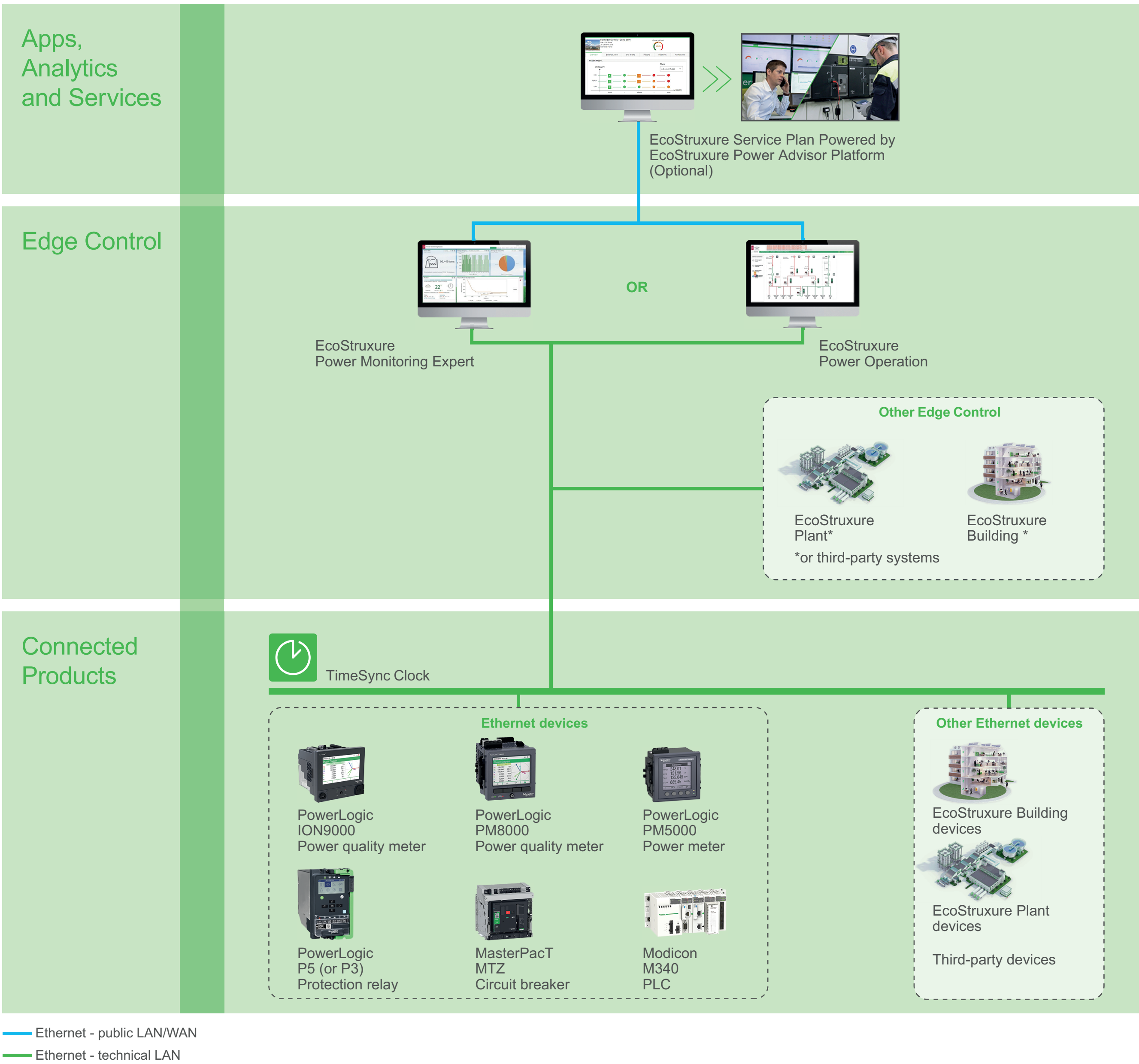
*** EcoStruxure Plant device

Digital Architecture

The digital architecture of the Power Quality Monitoring and Compliance application recommends direct Ethernet connections to power quality measurement connected products. Data is captured on board connected products and uploaded into the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for data processing, visualization, and reporting.

As an option, data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Power Advisor platform and interpreted by experts as part of the EcoStruxure Service Plan.

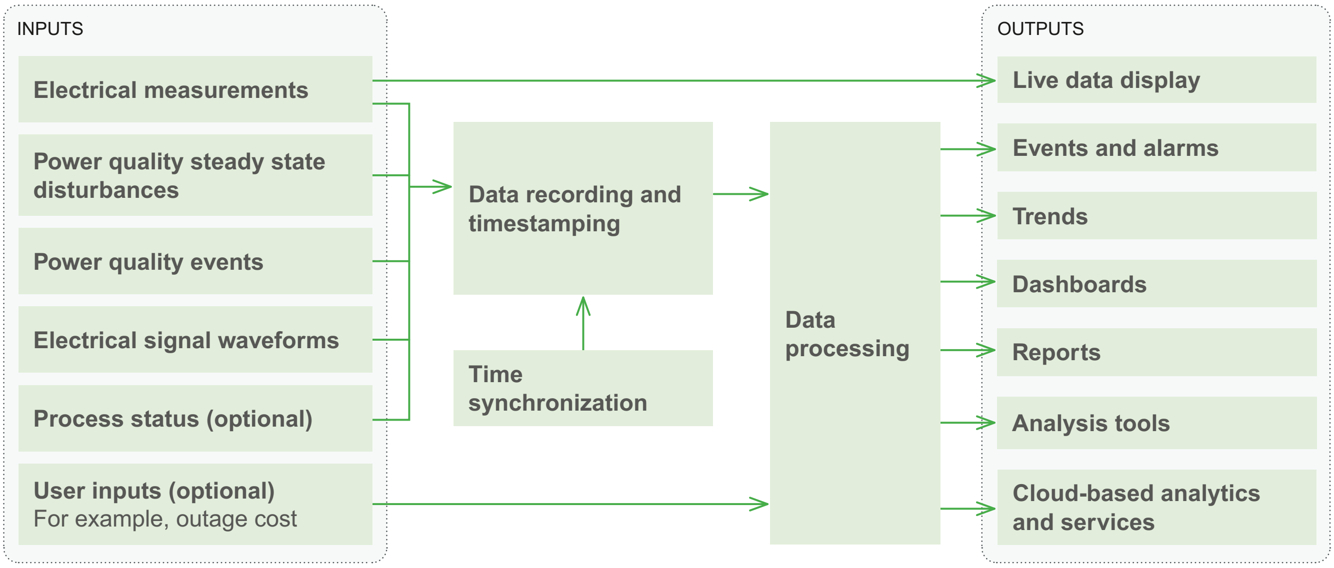
The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Power Quality Monitoring and Compliance application can be broken down as follows:



Inputs

The Power Quality Monitoring and Compliance application collects data from the connected products of the electrical installation to monitor and report on the power quality situation.

- **For main incomers and critical feeders**, power quality can be monitored on a continuous basis by power quality meters such as the PowerLogic ION9000, PM8000, and high-end models of the PM5000 series. These meters are capable of capturing sub-cycle power quality events (transients, voltage sags and swells, etc.).


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000

- **For less critical circuits**, steady state disturbances can be acquired either by embedded metering in protection devices such as the PowerLogic P5/P3 relays, MasterPacT MTZ circuit breaker, or by entry-level models of PM5000 power meters.


PowerLogic P5


PowerLogic P3


MasterPacT MTZ


PowerLogic PM5000

The following table outlines the limitations and capabilities of the connected products with respect to power quality data capture:

Product	Flicker measurement	Transient detection	Disturb-ance direction	Sag/swell monitoring	Harmonic distortion: total/individual/ interharmonics	Waveform capture
PowerLogic ION9000	Yes	Yes (20 µs)	Yes	Yes	Yes (+TDD[42]) / Yes / No[43]	Yes
PowerLogic ION9000T	Yes	Yes (100 ns)	Yes	Yes	Yes (+TDD[42]) / Yes / No[43]	Yes
PowerLogic PM8000	No	No	Yes	Yes	Yes / Yes / No	Yes
PowerLogic PM5000	No	No	No	No	Yes (+TDD[42]) / Yes / No	No
PowerLogic P5	No	No	No	Yes	Yes / Yes / No	Yes, on trip event only
PowerLogic P3	No	No	No	No	Yes / No / No	Yes, on trip event only
MasterPacT MTZ	No	No	No	No	Yes / Yes / No (with additional digital module)	Yes, on trip event only

The following table specifies how to select the right power meter depending on the chosen standard:

Product	EN 50160 compliance reporting	IEC 61000-4-30 Class A/S	IEEE 519	IEEE1159	CBEMA, ITIC, SEMI F47
 PowerLogic ION9000	Yes (web, PME EN 50160 Report)[44]	Class A	Yes (web, PME Harmonic Compliance Report)[45]	No	Yes (web, PME PQ Report)[46]
 PowerLogic PM8000 series	Yes (web, PME EN 50160 Report)[44]	Class S	Yes (web, PME Harmonic Compliance Report)[45]	No	Yes (web, PME PQ Report)[46]

The following data are required to enable Power Quality Monitoring and Compliance:

Electrical Measurements

- Voltage, current, and power measurements need to be captured accurately and with a high sample rate.

Power Quality Steady State Disturbances

- Voltage and current harmonics
- Voltage and current imbalance
- Voltage fluctuations (flicker)
- Frequency variations

42. Total Demand Distortion
43. Does provide interharmonic measurements, but not Total Harmonic Distortion (THD) for interharmonics.
44. EcoStruxure Power Monitoring Expert: EN 50160 Report
45. EcoStruxure Power Monitoring Expert: Harmonic Compliance Report
46. EcoStruxure Power Monitoring Expert: Power Quality Report

Power Quality Events

- Transients
- Interruptions
- Voltage sags and swells
- Overvoltage and undervoltage

Electrical Signal Waveforms

- High sample rate sinusoidal waveform data for all phases of voltage and current

Process Status (Optional)

For some additional and optional analytics, such as the impact of processes or operations resulting from power quality events, an impact signal is required. This signal can originate from several sources such as:

- Electrical signal (for example, current or voltage drop)
- Hardwired signal from a process PLC (such as Modicon M340) or signal from a digital input (for example, from a meter)

Modicon M340

- An OPC tag served by an OPC server

User Inputs (Optional)

Additional optional user inputs such as outage cost can be input into the software analysis configuration to provide an estimate of the financial impact of power quality.

Data Recording and Timestamping

For highly critical applications, optimal chronological correlation is achieved with a time accuracy of ±1 millisecond (possible using PTP or GPS time synchronization).

For less critical applications, a time accuracy of ±100 milliseconds is adequate (with NTP and SNTP).

Advanced meters such as the PowerLogic ION9000, PM8000, and some PM5000 models (PM53xx and PM55xx) can timestamp and record onboard input data.

PowerLogic ION9000

PowerLogic PM8000

PowerLogic PM5000

For other connected products (PowerLogic P5/P3, MasterPacT MTZ[47], and entry-level PowerLogic PM5000 models) steady state disturbances are measured

47. For power quality measurements, MasterPacT MTZ has the option of adding the:
 * Individual Harmonics Analysis Digital module
 * Under/Overvoltage Digital module

by the connected products and recorded by EcoStruxure Power Monitoring Expert or Power Operation.

PowerLogic
P5

PowerLogic
P3

MasterPacT
MTZ

PowerLogic
PM5000

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

When acquiring data from other systems, timestamps can also be imported through OPC[48] or ETL [49].

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

Time Synchronization

To reconstruct an accurate chronological view of events that take place during an electrical incident, all connected products must have on-board clocks that are designed to receive a time synchronization signal from an external master reference clock.

The purpose of time synchronization is to help ensure coordination among otherwise independent clocks.

TimeSync Clock

Data Processing

Power quality data is processed on board the device or in the Edge Control software for visualization.

Advanced power quality data processing is performed on board advanced power quality meters such as PowerLogic ION9000 or PM8000:

- Determination of transients, sags, swells, and interruptions
- Disturbance Direction Detection (DDD) for transients and voltage sags/swells (upstream, downstream)

48. OPC: Open Platform Communications
49. The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert and Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.


PowerLogic
ION9000


PowerLogic
PM8000

Further data processing is performed in the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation):

- Evaluation of power quality inputs with thresholds and definitions as per internationally recognized standards such as IEEE 519, EN 50160, IEC 61000-4-30, IEEE 1159, CBEMA, ITIC, SEMI F47.


EcoStruxure
Power Monitoring Expert


EcoStruxure
Power Operation

With the addition of the Power Quality Performance module in Power Monitoring Expert or Power Operation, the following data processing is done to provide analytic views of power quality data:

- Calculation of Power Quality Rating (A/B/C/D/E/F) based on aforementioned standards
- Evaluation of Power Quality Impact based on the thresholds defined by ITIC standard
- Correlation of operations impact (for example, process interruption) with power quality events using an electrical input or physical signal from operations

Outputs

Live data, trends, smart alarming, and some dashboards and reporting are available by default in Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for displaying power quality data.


EcoStruxure
Power Monitoring Expert


EcoStruxure
Power Operation

The optional Power Quality Performance module in EcoStruxure Power Monitoring Expert or Power Operation can provide further analytics, visualization, and reporting.

Lastly, EcoStruxure Power Advisor provides optional analytics-based support services to analyze power system data and provide actionable recommendations.


EcoStruxure
Power Advisor

Live Data Display

At any time, all related electrical measurements and steady state disturbances such as harmonics, unbalance, and frequency can be displayed in real time in EcoStruxure Power Monitoring Expert or Power Operation.

Predefined diagrams exist for the following power quality standards:

- **Analytic Views for EN 50160**

  Supply voltage dips, temporary overvoltages, flicker, harmonic and inter-harmonic voltage, frequency, voltage magnitude, supply voltage unbalance, short and long-term interruptions, and mains signaling
- **Analytic Views for IEEE 519**

  Voltage individual harmonics, voltage Total Harmonic Distortion (THD), current individual harmonics, and current Total Demand Distortion (TDD)

Events and Alarms

Power quality events captured and uploaded from connected products can be displayed as individual alarms in the Edge Control software and intelligently grouped as incidents during a given time period.

Related data such as waveforms can be accessed from the alarm interface for insight into the event details and root cause.

Trends

Steady state disturbances such as harmonics, unbalance, and frequency can be displayed as trends to monitor their evolution over time.

The following trends can be created:

- **For EN 50160**

  Trends of parameters and counters
- **For IEEE 519**

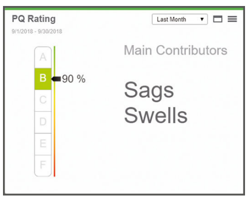
  Trends of voltage THD and current TDD (both mean and maximum values)

Dashboards[50]

Historical power quality events are displayed in dashboards with the following gadgets:

Power Quality Rating

Shows a power quality rating in the form of a letter grade (A to F). The rating is a summary of multiple types of power quality disturbances. The information is shown as a graphic display of the letter grade, with a % power quality rating and a list of the main contributing disturbances.

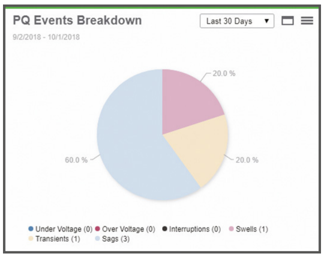


Power Quality Rating

Power Quality Incident Breakdown

50. The Power Quality Performance module of EcoStruxure Power Monitoring Expert must be deployed to benefit from these features.

Shows a breakdown of the power quality events, by type, over a selected time period. The information is shown in a pie chart, as a percentage distribution of the events.



Power Quality Incident Breakdown

Power Quality Incident Impact

Shows the number of power quality events, over a period of time, that might have had a process impact, compared to those that most likely did not have an impact. It is a simplified representation of the CBEMA/ITIC curve in a pie chart format. Events that are inside the curve are shown as "no impact events" and those outside the curve are shown as "likely impact events."

Power Quality Incident Impact

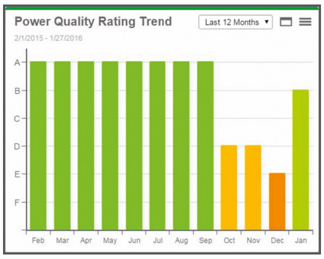
Power Quality Incident Location

Shows the number of power quality events, over a selected time period, grouped by location of origin (external, internal, undetermined). In addition, it indicates whether the events had a likely process impact or not. The information is shown in a column chart, grouped by impact assessment.

Power Quality Incident Location

Power Quality Rating Trend

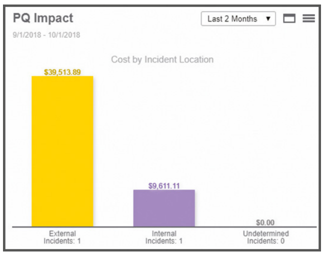
Shows the power quality rating, over a selected time period.



Power Quality Rating Trend

Power Quality Impact

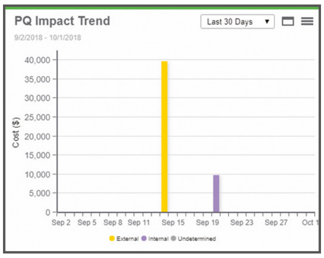
Shows the cost of power quality events with a process impact, over a selected time period. The information is shown in a column chart, grouped by location of power quality event origin (external, internal, undetermined).



Power Quality Impact

Power Quality Impact Trend

Shows the aggregated cost of power quality events with a process impact, over a selected time period.



Power Quality Impact Trend

Reports[51]

The following reports can be generated on demand or automatically, and sent via email to configured recipients.

Power Quality Report

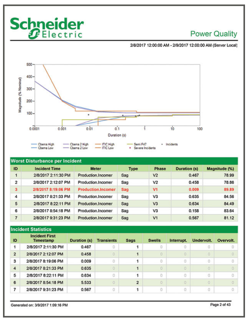
Summarizes the number and severity of voltage sags, swells, and transients over a period of time. The generated report includes a graphical representation of these power quality events plotted against one or more power quality curves, such as CBEMA (1996), CBEMA (Updated), ITIC, or SEMI F47 curves.

The Power Quality Report aggregates historical power quality data into power quality incidents:

- An incident is a summary, or aggregated event, which represents a number of individual power quality events (sags, swells, or transients) that occurred across an electrical network in a short period of time.
- A power quality event refers to a sag, swell, or transient event in the Event Log.

This report also displays waveform plots as well as RMS plots associated with a single incident, or all waveforms associated with their respective incidents.

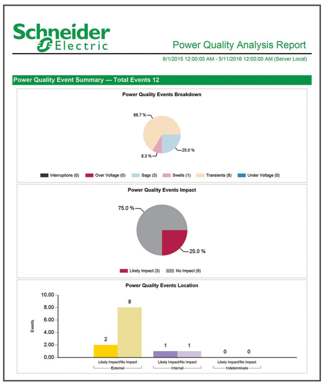
51. The Power Quality Performance module of EcoStruxure Power Monitoring Expert must be deployed to benefit from these features.



Power Quality Report

Power Quality Analysis Report

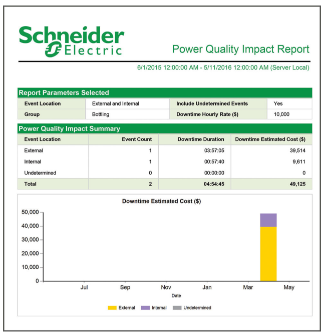
Summarizes power quality events and disturbances occurring in a production environment. Events include voltage transients, sags, swells, interruptions, and overvoltage and undervoltage events. Disturbances are related to harmonics, unbalances, flicker, and frequency variation. An understanding of these events and disturbances can help determine actions to reduce production downtime and to increase equipment lifetime and reliability.



Power Quality Analysis Report

Power Quality Impact Report

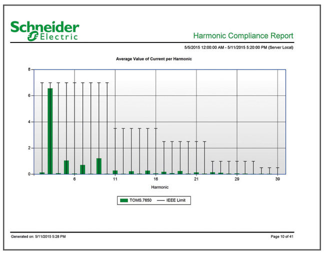
Indicates the impact from downtime that occurred for a power quality group and provides an estimated cost associated with a given period of time calculated using the rate defined in the Power Quality Group configuration file. It also provides information on power quality events that might be the cause of the downtime and indicates whether they occurred internally, externally, or from an undetermined location.



Power Quality Impact Report

Harmonics Compliance Report

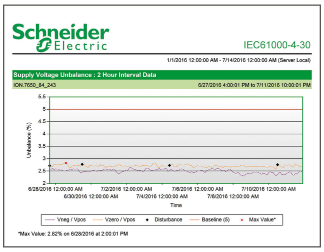
Shows an analysis of the harmonic compliance of selected sources based on the IEEE 519 reference limits.



Harmonics Compliance Report

IEC 61000-4-30 Report

Provides IEC 61000-4-30 compliance information by observation period (3 second, 10 minute, or 2 hour measurement interval) for one or more sources (voltage profile, THD profile, unbalance profile, flicker profile, frequency profile, and summary table).



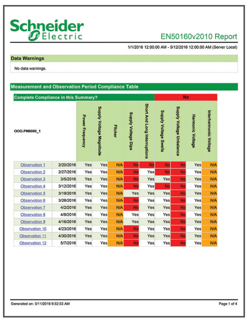
IEC 61000-4-30 Report

EN 50160-2000 and EN 50160-2010 Reports

Provides a comprehensive analysis of all EN 50160-2000/2010 compliance data logged by multiple meters (supply voltage dips, temporary overvoltages, supply voltage unbalance, harmonic voltage, interharmonic voltage, frequency and voltage magnitude, flicker, and short and long-term interruptions).

The compliance summary is based on the EN 50160-2000/2010 limits for each observation period. Each default EN 50160 measurement indicates a pass or fail on the compliance test with a Y (yes) or N (no) respectively.

> **NOTE:** EN 50160:2000 and 2010, published in 2000 and 2010 respectively, is a set of power quality standards used by certain energy suppliers and energy consumers.

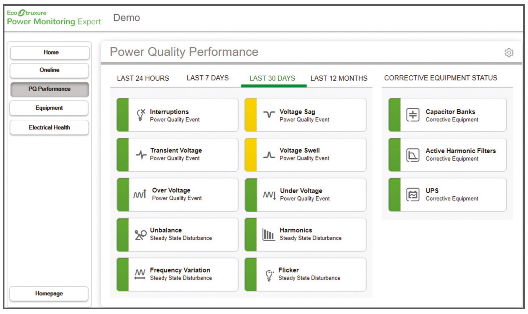


EN 50160-2010 Report

Analysis Tools

Power Quality Performance Diagrams[52]

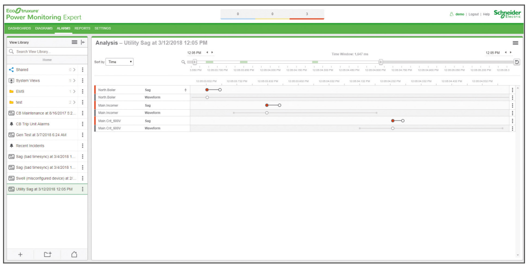
Green, yellow, and red status indicators are used for each event or disturbance type to represent the severity during various timeframes (24 hours, one week, last 30 days, etc.), based on power quality standards and recommended thresholds described in the Data Processing, page 19 section.



Power Quality Performance Diagrams

Power Events Incident Timeline

This feature of EcoStruxure Power Monitoring Expert intelligently groups related events and alarms as single comprehensive incidents during a given time period. It helps highlight the root cause and the consequences of an incident.

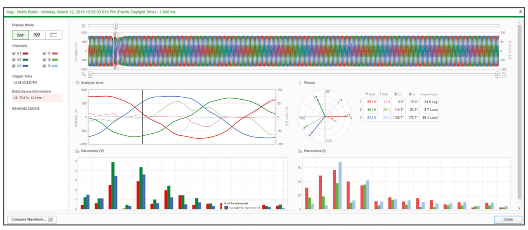

Power Events Incident Timeline

Waveform Viewer

Electrical signal waveforms can be displayed with a native waveform viewer in both EcoStruxure Power Monitoring Expert and Power Operation

These viewers allow for the following:

- Toggle on/off voltage/current channels
- RMS calculation, zoom, pan, export to CSV
- Interactive phasor and harmonic (voltage and current) diagrams
- Multiple waveform comparison


Waveform Viewer

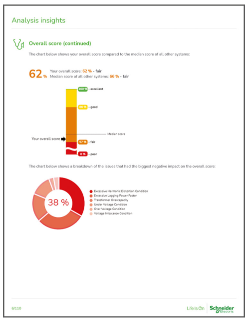
52. The Power Quality Performance module of EcoStruxure Power Monitoring Expert must be deployed to benefit from these features.

Cloud-Based Analytics and Services

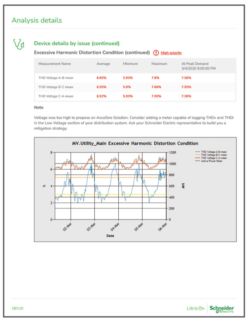
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides power quality analytics with recommendations from our Schneider Electric service experts.

System health checks can be run periodically and shared by a Schneider Electric service expert to help provide additional insights into persistent power quality issues, their potential impact or risk posed to the facility, and improvement recommendations or mitigation solutions.

EcoStruxure Service Plan Powered by EcoStruxure Power Advisor Platform



EcoStruxure Power Advisor
Electrical Health Report - Overall Score



EcoStruxure Power Advisor
Electrical Health Report - Device Details by Issue

Power Quality Correction

What's in This Chapter

Overview

Context of Application

In order to optimize business continuity, critical facilities such as hospitals, data centers, industrial plants, and other infrastructure must avoid damage to sensitive equipment and unexpected disruptions. In these facilities, non-linear loads such as variable speed drives and other electronic equipment with switching power supplies can cause power quality issues. In addition, utilities can feed poor power quality to the facility. As a result, during the design or operations phase of a building, the proper compensation must be implemented to mitigate these effects and deliver clean power to sensitive processes.

Problem to Solve

The facility manager needs to:

- Help protect sensitive equipment and processes against power quality issues such as nuisance tripping, overheating, and malfunction of sensitive equipment.
- Help ensure continuity of business operations.
- Comply with power quality standards such as IEEE 519 for harmonics.

Purpose of the Application

Power Quality Correction addresses common power quality issues such as harmonics, load unbalance, and short interruptions.

Mitigate harmonic effects

Harmonic disturbances typically occur in facilities with sizable non-linear loads such as variable speed drives (VSD), arc furnaces, electronic equipment with switch-mode power supplies, LED lighting, electronic ballasts, battery chargers, etc.

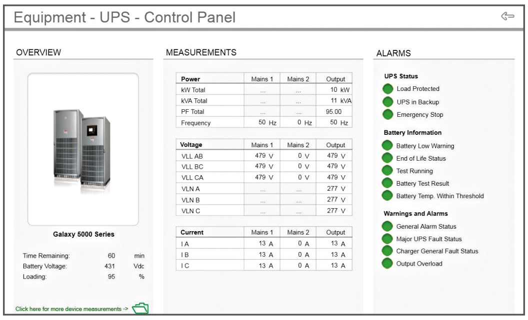
Cure power quality problems due to load current fluctuations

Typically needed to help protect sensitive loads from interruptions, voltage sags and swells, flicker, etc.

Application Outcomes

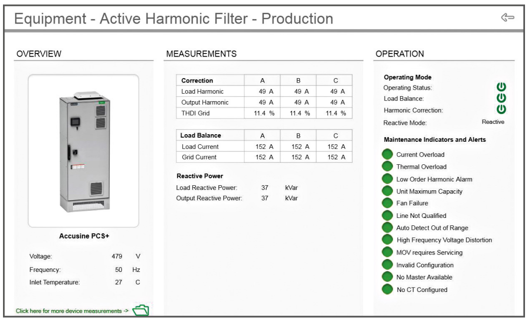
Live Data Display

- UPS equipment status panel diagram



UPS Equipment Status Panel Diagram

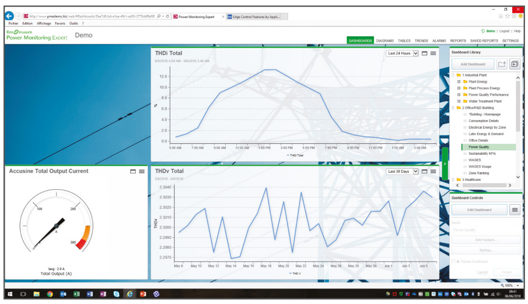
- Active harmonic filtering device diagram



Active Harmonic Filtering Device Diagram

Dashboards

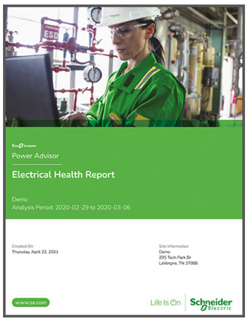
- Power quality dashboard including current, voltage, power factor, reactive power and energy, and current and voltage harmonic distortions



Standard Dashboard for Power Quality Correction

Cloud-Based Analytics and Services

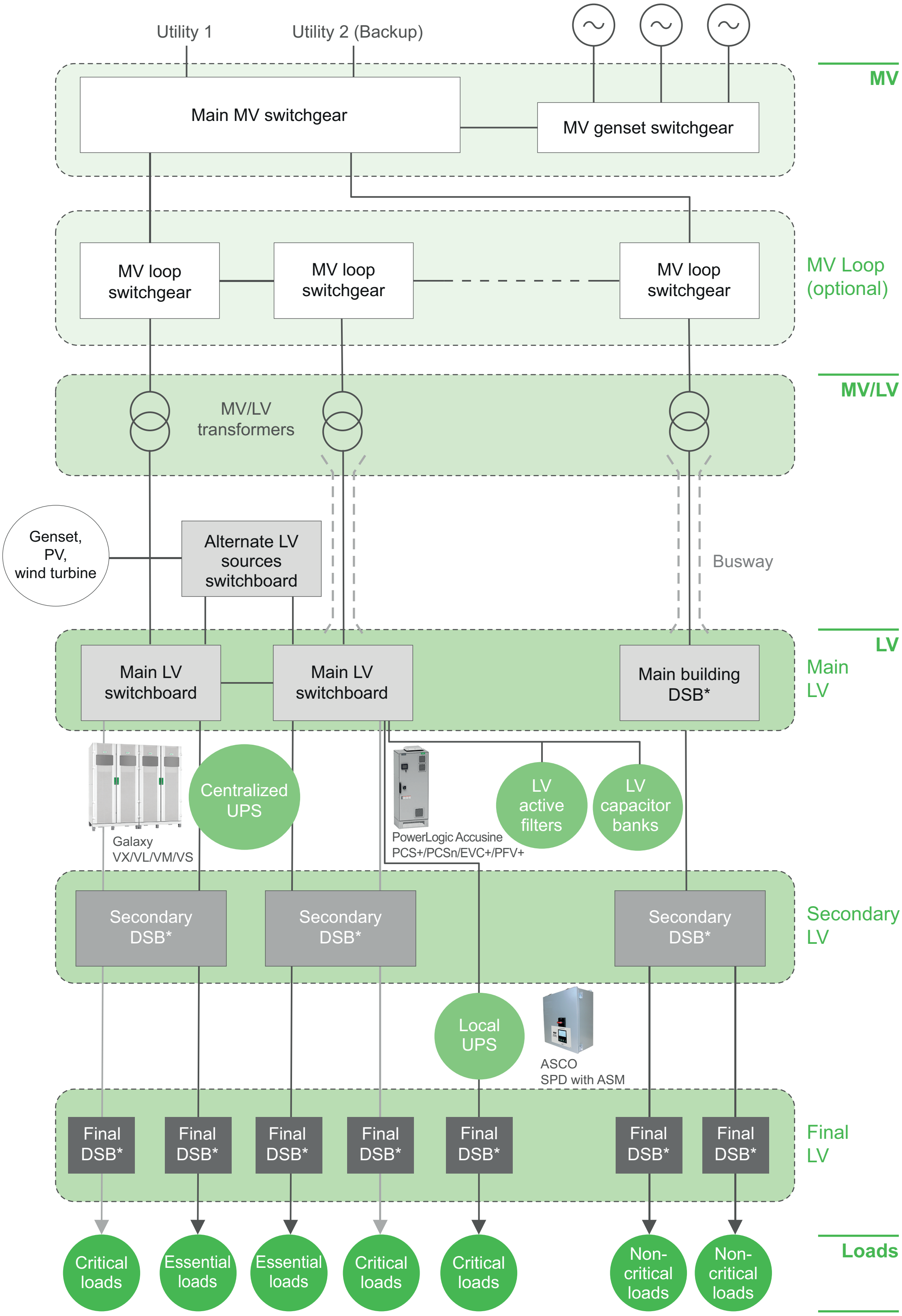
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides power quality analytics with recommendations from our Schneider Electric service experts.



EcoStruxure Power Advisor Electrical Health Report

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Power Quality Correction application:



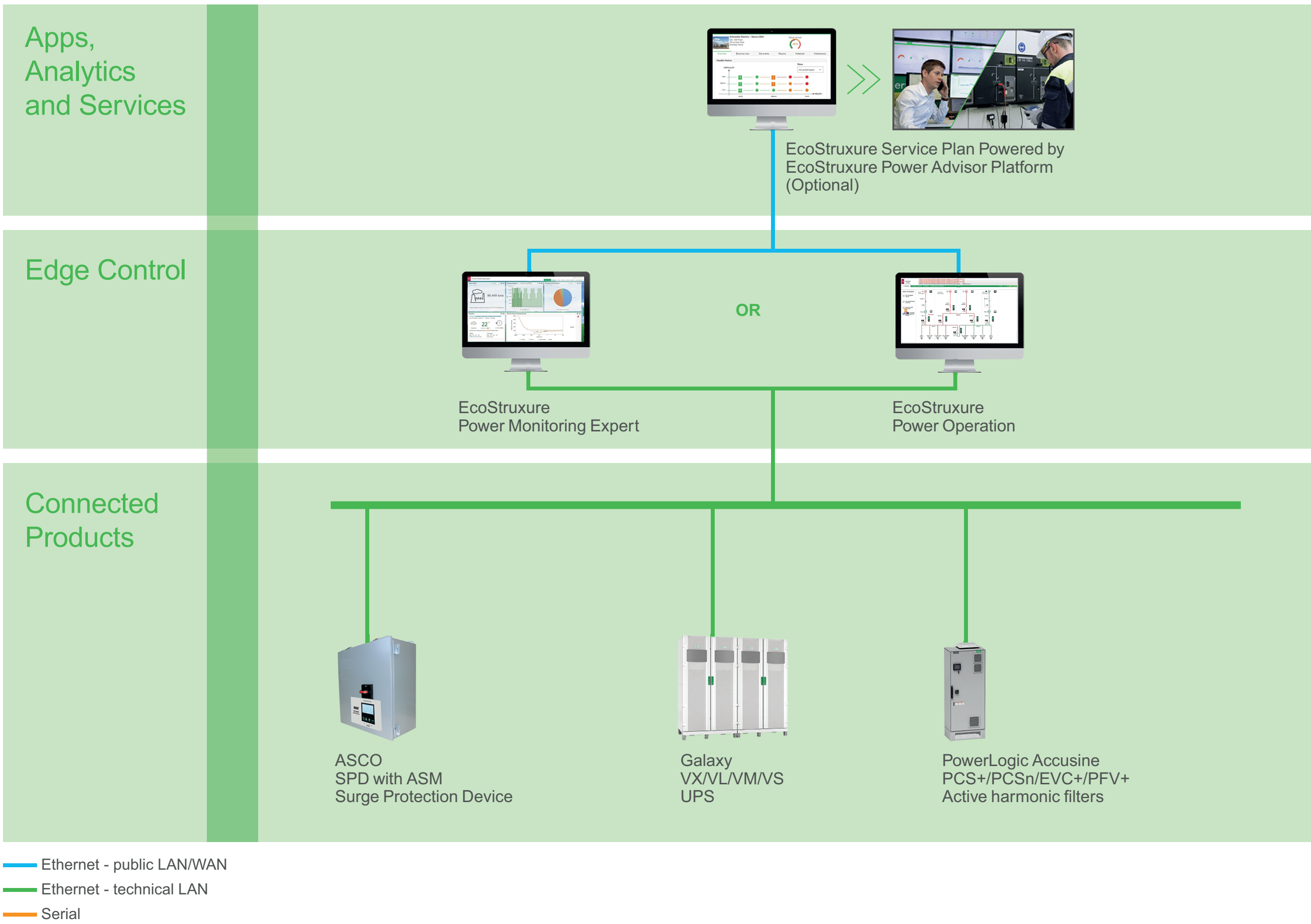
* DSB = Distribution Switchboard

Digital Architecture

Data collected by both PowerLogic AccuSine PCS+/PCSn/EVC+/PFV+ power correction devices and Galaxy VX/VL/VM/VS UPSs is passed on to the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) using a direct Ethernet connection.

As an option, data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Power Advisor platform and interpreted by experts as part of the EcoStruxure Service Plan.

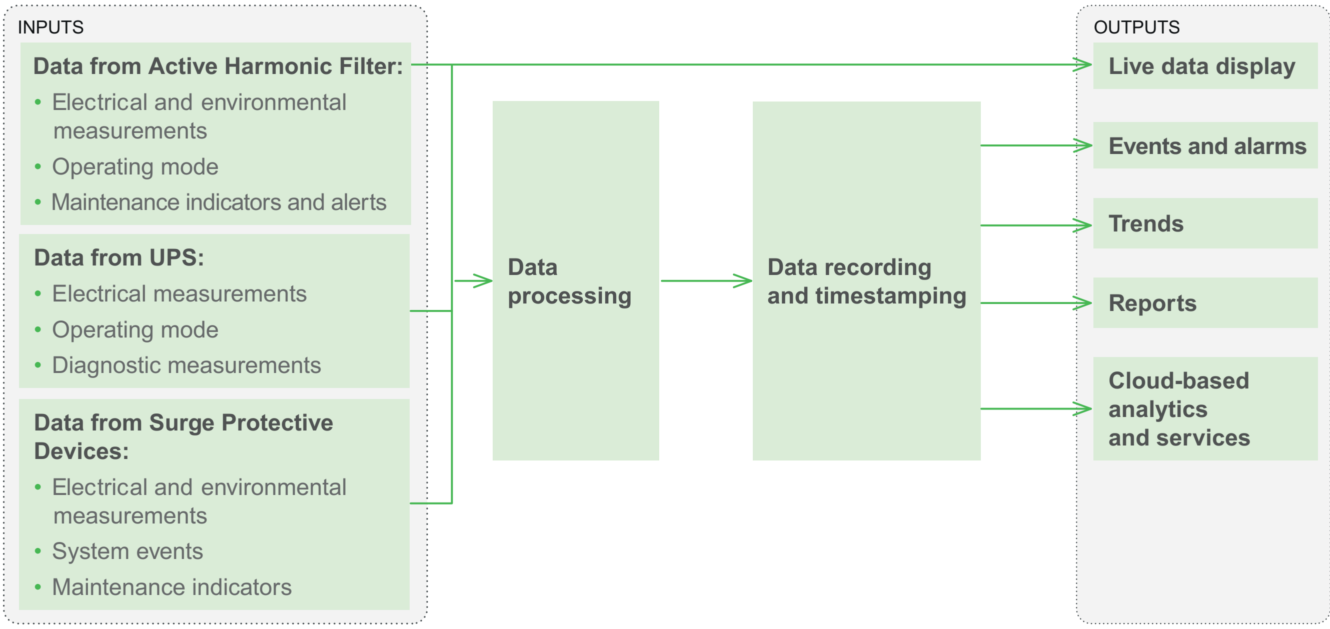
The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Power Quality Correction application can be broken down as follows:



Inputs

The following data is required:

Data from Active Harmonic Filters (PowerLogic AccuSine PCS+/PCSn/EVC+/PFV+)

Electrical and environmental measurements

- Voltage, current, frequency
- Load harmonics, output harmonics
- Load reactive power, output reactive power
- Ambient temperature
- Total harmonic distortion (THD), individual harmonics

Operating mode

- Operating status, load balance, harmonic correction
- Reactive, auto start, auto detect modes

Maintenance indicators and alerts

For example: overloads, capacity alarms, required servicing alarm, etc.

PowerLogic AccuSine PCS+/PCSn/EVC+/PFV+

Data from UPS (Galaxy VX/VL/VM/VS)

Electrical measurements

- Input and output voltages, currents, and frequencies
- UPS active and apparent power

Operating mode

- Load protected mode
- Bypass enabled mode
- Charging mode
- Test mode
- UPS in backup mode

Diagnostics measurements

- Load capacity percentage, output overload
- Remaining backup time (minutes)
- Battery temperature, charge level, low battery status, end of life

Galaxy
VX/VL/VM/VS

Data from Surge Protective Devices (ASCO SPD with ASM)[53]

Electrical and environmental measurements

- Voltage
- Frequency
- Harmonics

System events

- Surge count
- Voltage sag/swell count

Maintenance indicators

- MOV (Metal Oxide Varistor) health
- SPD health

ASCO
SPD with ASM

Data Processing

Data processing is done through the Edge Control's data acquisition engine to create events and alarms from status and diagnostic information (with EcoStruxure Power Monitoring Expert or Power Operation).

53. Surge protective device with active surge monitor

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Data Recording and Timestamping

Data recording is done by EcoStruxure Power Monitoring Expert or Power Operation based on real-time values acquired by the driver.

Timestamping is performed by the PC and recorded in the database, available to the HMI. Therefore, no specific device for time synchronization is necessary.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Outputs

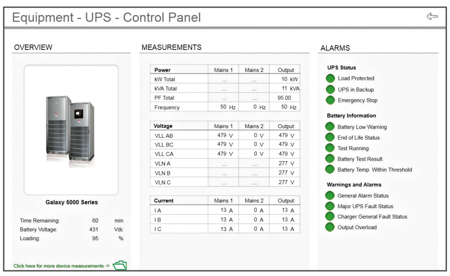
Live data, events, alarms, trends, and dashboards are available by default in EcoStruxure Power Monitoring Expert and Power Operation.

Live Data Display

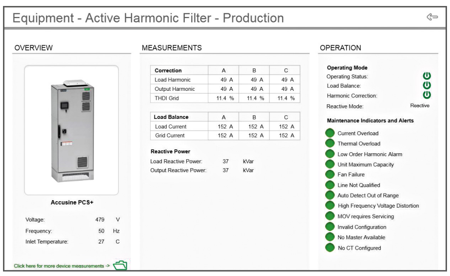
Live data acquired by the software driver can be displayed through equipment diagrams and animated single-line diagrams in EcoStruxure Power Monitoring Expert or Power Operation.

One-page summary diagrams give quick access to the most useful real-time data including electrical measurements, operating modes and statuses, and maintenance indicators.

When required, other measurements and status information can be investigated through more detailed diagrams.



UPS Equipment Diagram



Active Harmonic Filter Equipment Diagram

Events and Alarms

Events and alarms are generated by the Edge Control software upon change of the statuses. The events are timestamped by the PC then recorded and displayed in the software’s default alarm interface as diagnostic alarms.

Trends

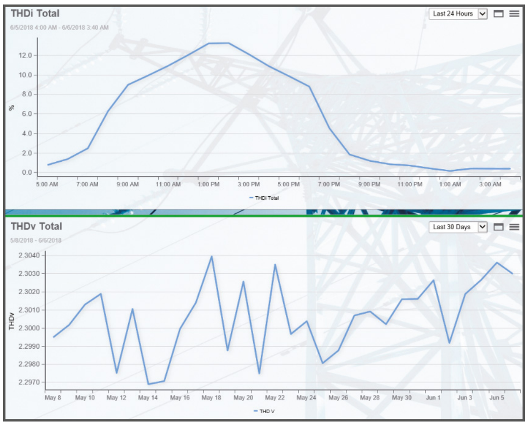
All analog values stored as historical data can be displayed as trends to monitor their evolution over time.

Dashboards

Electrical measurements acquired from correction equipment (PowerLogic AccuSine PCS+/PCSn/EVC+/PFV+, Galaxy VX/VL/VM/VS) can be displayed as historical data in dashboards.

Some examples of these dashboards include:

- Active Harmonic Filter output
- Active Harmonic Filter THDi and THDv total (input or load)

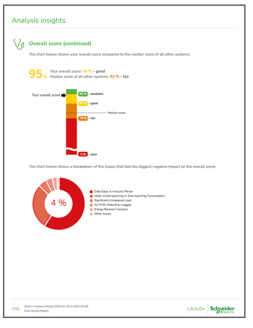


Active Harmonic Filter THDi and THDv Dashboards

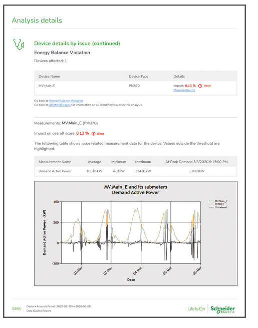
Cloud-Based Analytics and Services

As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides power quality analytics with recommendations from our Schneider Electric service experts.

EcoStruxure
Service Plan powered by EcoStruxure Power Advisor Platform



EcoStruxure
Power Advisor Electrical Health Report - Overall Score



EcoStruxure
Power Advisor Electrical Health Report - Device Details by Issue

Power Source and Load Control

What's in This Chapter

Overview

Context of Application

Facility managers of large and critical buildings expect a reliable power network to maximize uptime for their business. However, a number of factors make this more complex. Growing grid instability due to increasing power demand and unpredictable, powerful storms are impacting continuous power availability.

To maximize availability and reliability of their power networks, they require smart and cost-effective remote control, automatic transfer systems, and load management.

Problem to Solve

The facility manager needs to:

- Remotely control electrical loads from a SCADA system.
- Automate transfer schemes, load shifting, or simple load shedding operations.
- Visualize and audit sequences of operations.

Purpose of the Application

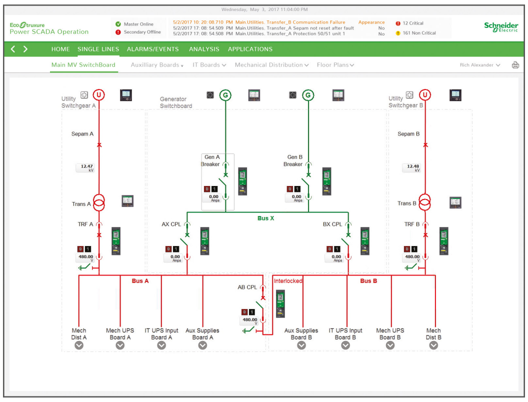
Remotely control, visualize, and supervise automatic transfer schemes

A combination of connected hardware and Edge Control software allows for remote controls or monitoring of automated controls.

Application Outcomes

Live Data Display

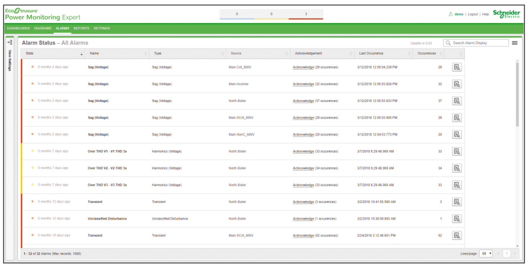
- Animated Single-Line Diagrams (SLDs) display the status of the system.
- If ASCO CPMA (Critical Power Management Appliance) is deployed, animated electrical single-line diagrams, floor plans, or facility risers can visually replay power control events.



Animated Single-Line Diagram

Events and Alarms

- All remote control actions performed are logged and available for auditing and tracking.
- Alarms on operating status of automated systems (Loop configuration, Automatic Transfer Switch, etc.) enable preventive intervention if any abnormal conditions arise in the electrical network reconfiguration system.



Alarm and Event Log Viewer in EcoStruxure Power Operation

If ASCO CPMA (Critical Power Management Appliance) is deployed, events and alarms can be displayed locally for associated backup power devices.

Notifications

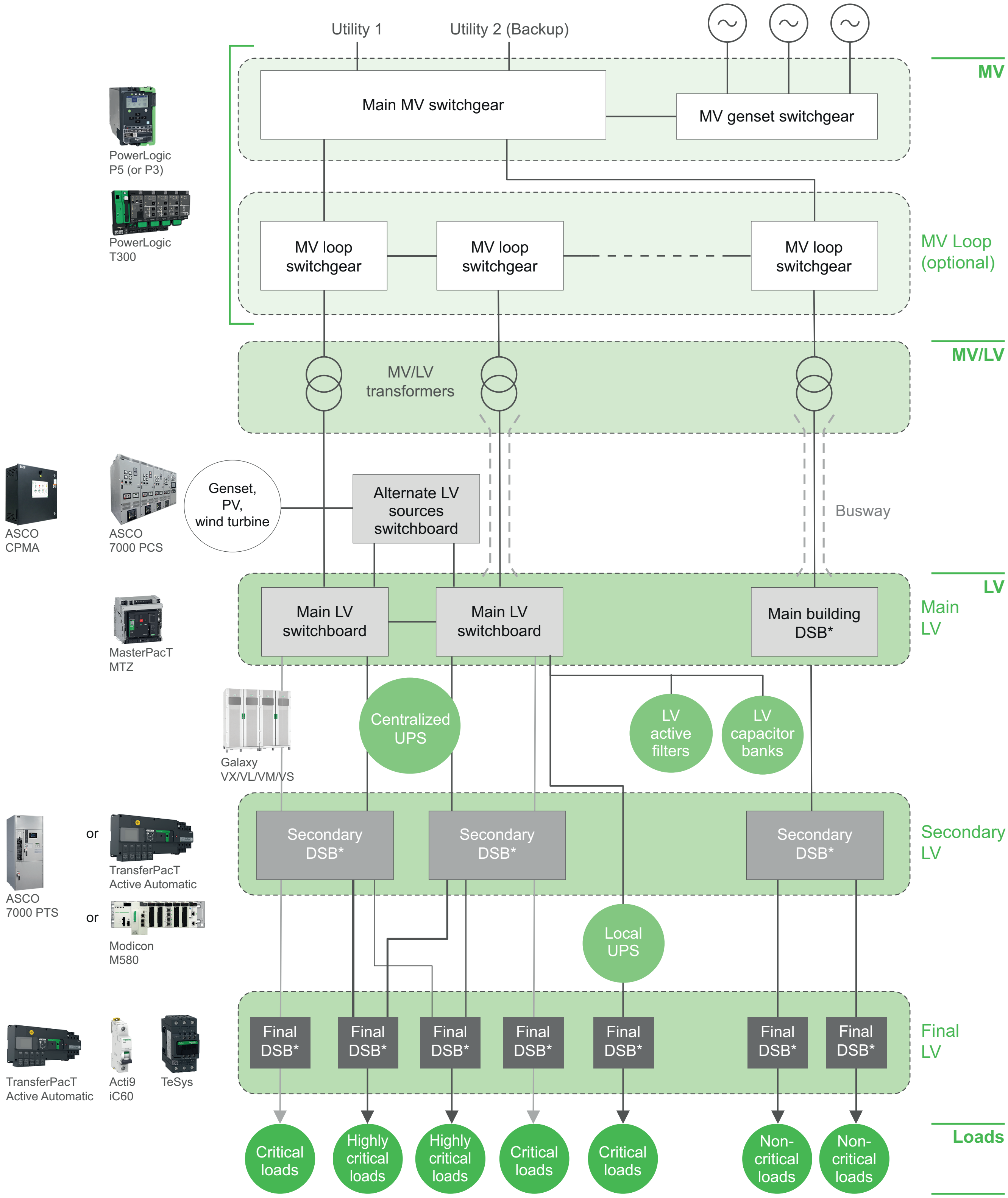
- SMS and/or email notifications can be sent for fast analysis and action.
- Email notifications are also available to send reports and non-critical information.

Remote Control

- Select-before-operate commands are available from EcoStruxure Power Operation or via circuit breaker mobile apps.
- Automatic transfer schemes help ensure seamless transition from utility sources to backup systems.
- Simple load control is available to manage demand, helping prevent overloads or utility surcharges.
- If ASCO CPMA (Critical Power Management Appliance) is deployed, remote controls are available for associated ATS.

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Power Source and Load Control application:



* DSB = Distribution Switchboard

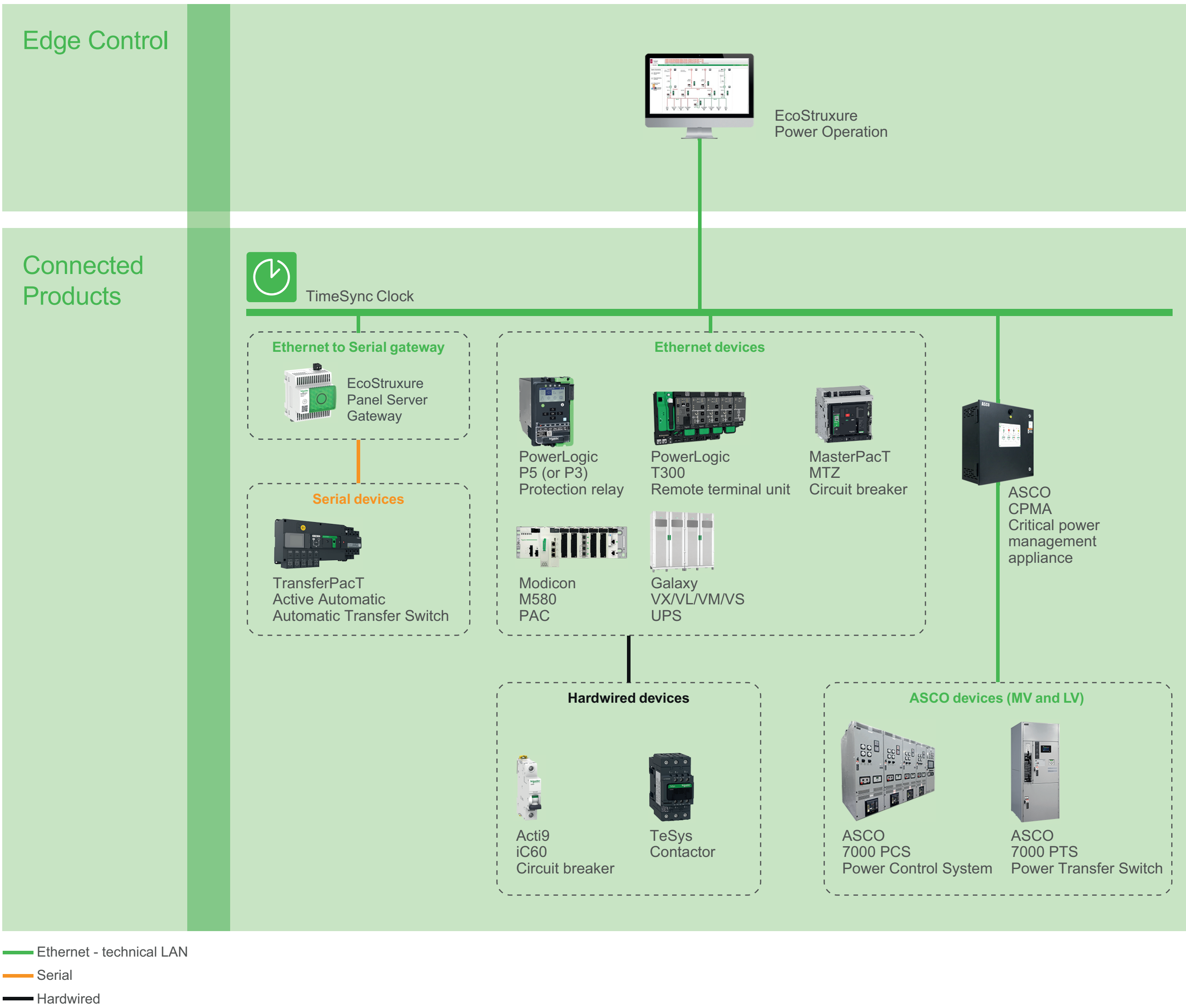
Digital Architecture

In this architecture, the data is collected from connected products either directly over Ethernet, via gateways (such as the EcoStruxure Panel Server), or by the ASCO CPMA. This data is then recorded and processed by the Edge Control software (EcoStruxure Power Operation) for on-premise visualization, analysis, and reporting.

Ethernet-based communication is preferred for fast acquisition of source and network reconfiguration conditions as well as fast action of automatic systems.

In addition, Ethernet-based communication architectures offer a faster response time for user controls. Legacy connected products can be accessed through protocols such as Serial Modbus but will exhibit slower performance.

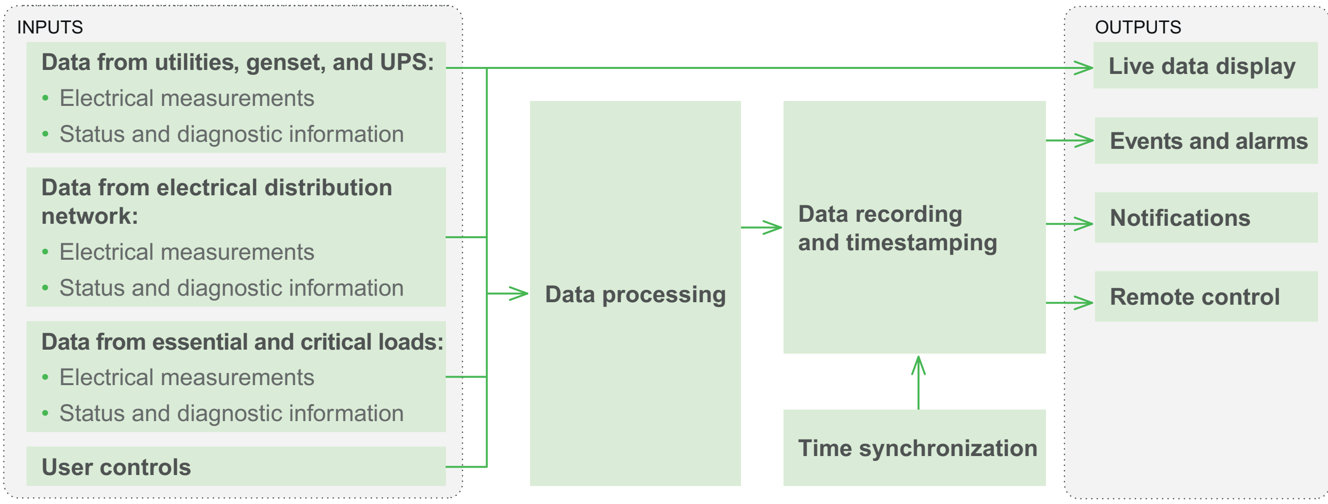
The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Power Source and Load Control application can be broken down as follows:



Inputs

Data from Utilities, Genset, and UPS[54]

The following data is required:

- **Electrical measurements**: power sources are monitored to launch automatic reconfigurations or to help operators decide on relevant actions to restore power.
- **Status and diagnostic information**: if any source or load control operations involve the utility incomers, the genset(s), or UPS(s) in the facility, it is key to understand their status and access diagnostic information to run proper automatic or manual reconfiguration sequences.

For the utility incomer and genset, these measurements are collected by protection relays such as the PowerLogic P5/P3 or directly from the genset controller. For UPSs, the measurements can be performed by Galaxy VX/VL/VM/VS.


PowerLogic P5


PowerLogic P3


Galaxy VX/VL/VM/VS

Data from Electrical Distribution Network

The following data is acquired to help automatic systems or operators decide on the best supply path through the electrical distribution network:

- **Electrical measurements:** electrical system loading and parameters such as voltage, current, power, etc.

54. UPS: Uninterruptible Power Supply

- **Status and diagnostic information:**
  - Status, diagnostics, and associated status changes from contactors, switches, circuit.breakers, Automatic Transfer Switches / Power Transfer Switches (ATS/PTS), etc.
  - Trip context from circuit breakers.
  - Status of automatic reconfiguration devices.

This information can be gathered from:

- Protection relays with embedded metering (PowerLogic P5/P3, MasterPacT MTZ, or ComPacT NSX)

PowerLogic P5

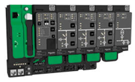
PowerLogic P3

MasterPacT MTZ

ComPacT NSX

- Automation controllers (ASCO 7000 Series PCS, PowerLogic T300, Modicon M340 or M580 PAC)

ASCO 7000 Series PCS



PowerLogic T300

Modicon M340

Modicon M580

- The controllers of the ATS/PTS (ASCO 7000 Series PTS, TransferPacT Active Automatic)

ASCO 7000 Series PTS

TransferPacT Active Automatic

Data from Essential and Critical Loads

In critical facilities, the preservation of essential loads such as motors, machines, or other equipment is of utmost importance. Therefore, the following data is key:

- Electrical measurements.
- Status and diagnostic information: it is necessary to understand the status and diagnostic information of these essential loads prior to stopping or re-starting them.

This data can be collected from final distribution devices (for example, Acti9 or TeSys ranges) or through digital and analog inputs of controllers (Modicon M340 or M580 PAC).

TeSys

Modicon M340

Modicon M580

Acti9 iC60

User Controls

In the event the automation system halts (due to improper operating conditions) or for the purpose of maintenance, the user is able to issue external control actions (both from EcoStruxure Power Operation or on the device front panel), such as resetting of alarms or open/close orders.

EcoStruxure
Power Operation

Data Processing

For the Power Source and Load Control application, most data processing occurs before data recording and timestamping since power control relies on automation and mostly occurs without user intervention.

These automated actions are monitored and recorded with timestamps in the Edge Control software (EcoStruxure Power Operation or ASCO CPMA in the case of ASCO architectures) for a better understanding of reconfiguration sequences and potential system issues due to improper operating conditions (for example, device in local mode, tripped circuit breaker, etc.).

User intervention (user controls) may be necessary in the event of halted automation, manual load control, or maintenance activities. In this case, data processing consists of logging all user actions with the date and time as well as their user ID for traceability purposes.

EcoStruxure
Power Operation

ASCO
CPMA

Data Recording and Timestamping

All Power Source and Load Control activities are recorded and timestamped for postmortem analysis, traceability, and auditing.

For critical applications, a timestamp accuracy of ±10 milliseconds is recommended.

To achieve this, the measurements and events are recorded and timestamped onboard smart equipment such as PowerLogic P5/P3, Modicon M580 and M340, etc.

For less critical applications, ±100 milliseconds may be adequate.

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.


PowerLogic
P5


PowerLogic
P3


Modicon
M580


Modicon
M340

Time Synchronization

For a consistent chronological view of all events that take place throughout the facility, the date and time should be accurately distributed to connected products and other management systems.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be connected to a GPS antenna to reach the expected time precision.


TimeSync Clock

Outputs

Outputs are displayed remotely by EcoStruxure Power Operation or by ASCO CPMA (Critical Power Management Appliance).


EcoStruxure
Power Operation

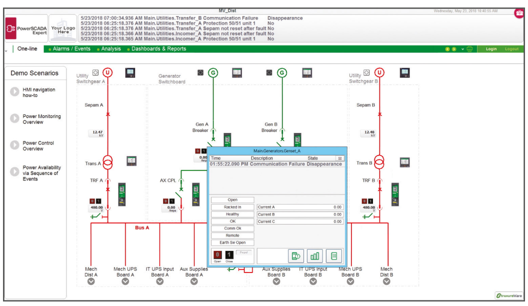

ASCO
CPMA

Live Data Display

Data is displayed in animated single-line diagrams with embedded graphic objects with relevant electrical measurements for sources, distribution network, and loads.

Detailed equipment views with diagnostic information help users to understand the status of each piece of equipment.

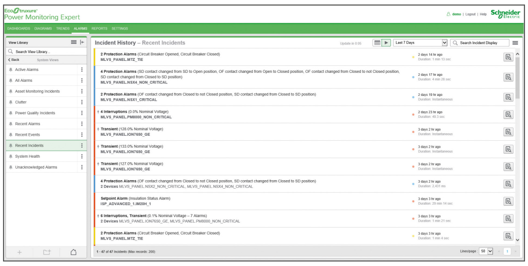
If ASCO CPMA is deployed, animated electrical single-line diagrams, floor plans, or facility risers can visually replay power control events.


Live Data Display in EcoStruxure Power Operation.

Events and Alarms

Events and alarms are uploaded from connected products or generated by the Edge Control software (EcoStruxure Power Operation) and displayed in native event and alarm viewers. Chronological views include:

- All alarms and events, acknowledged or unacknowledged alarms, summary alarms, or incidents
- High speed and high precision sequence of events to quickly locate the source of a power outage
- Traceability of user control actions with operator name and timestamp



Events and Alarms Log viewer in EcoStruxure Power Operation.

If ASCO CPMA (Critical Power Management Appliance) is deployed, events and alarms can be displayed locally for associated backup power devices such as ATS or genset.

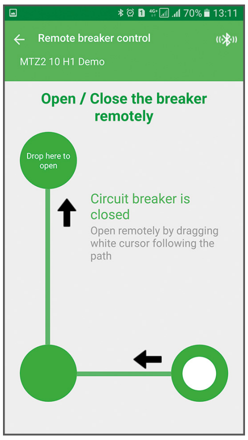
Notifications

Notifications can be sent by EcoStruxure Power Operation with the optional Event Notification module.

Remote Control

EcoStruxure Power Operation enables select-before-operate commands.

Devices such as the MasterPacT MTZ or PowerLogic P5/P3 can be manually controlled from theEcoStruxure Power Device App.



Remote Circuit Breaker Control Interface in EcoStruxure Power Device .

If ASCO CPMA (Critical Power Management Appliance) is deployed, remote controls are available for associated ATS.

Advanced Protection and Automation

What's in This Chapter

Context of Application

Facility managers of large sites and critical buildings expect a reliable power network to maximize uptime and meet their business goals. However, growing grid instability due to increasing power demand and shortfalls in sequence of operation procedures are leading to unpredictable events and unplanned outages that ultimately jeopardize continuity of service and long-term performance objectives.

To maximize electrical infrastructure investment, they require solutions that bring operational sustainability and resiliency through fault tolerant automation schemes such as fast self-healing, automatic transfer systems, load-shedding, and load-restore to help bring more autonomous responses to the Medium Voltage power distribution systems.

Problem to Solve

The facility manager needs to:

- Help protect electrical networks from faults (short-circuit, overload, etc.).
- Maintain continuity of service in case of outages with an autonomous and fast response to events (fast self-healing, automatic transfer switch, load-shedding, etc.).
- Plan effective operation and maintenance programs.

Purpose of the Application

Provide protection and fault tolerant automation schemes

A combination of connected hardware, Edge Control software, and advanced lifecycle management tools provides the electrical network with advanced automation and protection applications based on IEC 61850 standard.

Application Outcomes

Protection Schemes

Intelligent Electronic Devices (IED) monitor and help protect electrical distribution systems with all required features, including:

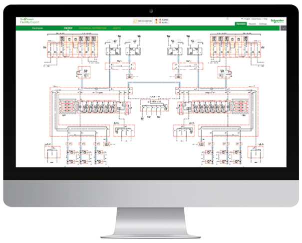
- Thermal overload protection
- Generator protection
- Transformer protection
- Arc flash protection

Automation Schemes

- Fast Self-Healing: detects, isolates and restores the power in MV open loop electrical topologies in less than 300 ms.
- Automatic Transfer Switch / Power Transfer Switch: automatically switches to backup power in the event of a fault on the primary source.
- Load-shedding: keeps critical loads connected while shedding non-critical ones to balance generation and consumption.
- Load-restore: limits the inrush current while reconnecting the loads by sequentially reclosing power transformers.
- Emergency Genset Capacity Management: balances the emergency genset's capacity with the energy consumption according to the available power.

Live Data Display

- Animated Single-Line Diagrams (SLD) display the status of the system with color animation to distinguish sections with and without a power supply.



Single Line Diagram Live Display

Events and Alarms

- System events and alarms are displayed in chronological order with sorting and filtering capabilities.

Trends

- Real-time and historical data can be viewed on a trend viewer.

Remote Control

- Select-before-operate commands are available from SCADA HMI.

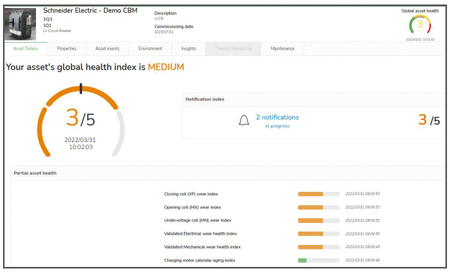
Cloud-Based Analytics and Service

EcoStruxure Service Plan powered by EcoStruxure Asset Advisor provides remote monitoring, asset management consulting and on-site maintenance activities with recommendations from our Schneider Electric service experts.

It includes:

- Continuous asset monitoring and alarms with remote notifications in the event of electrical asset condition anomalies
- Predictive analytics to help determine remaining equipment lifetime and other health indicators

- Condition-based asset maintenance triggered by a Maintenance Index

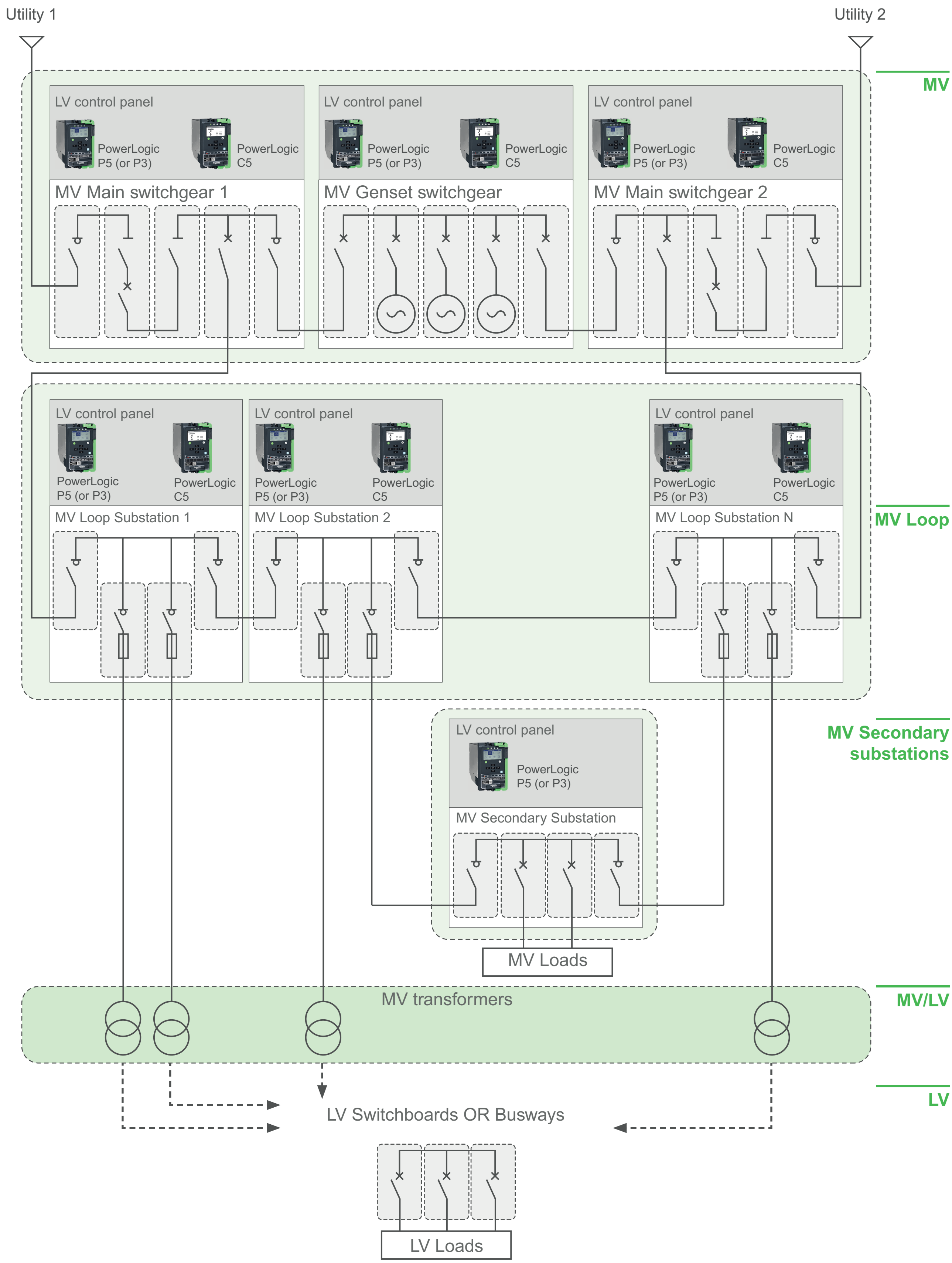


EcoStruxure Asset Advisor Asset Health Dashboard

EcoStruxure Asset Advisor Risk Level Dashboard

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Advanced Protection and Automation application.



Digital Architecture

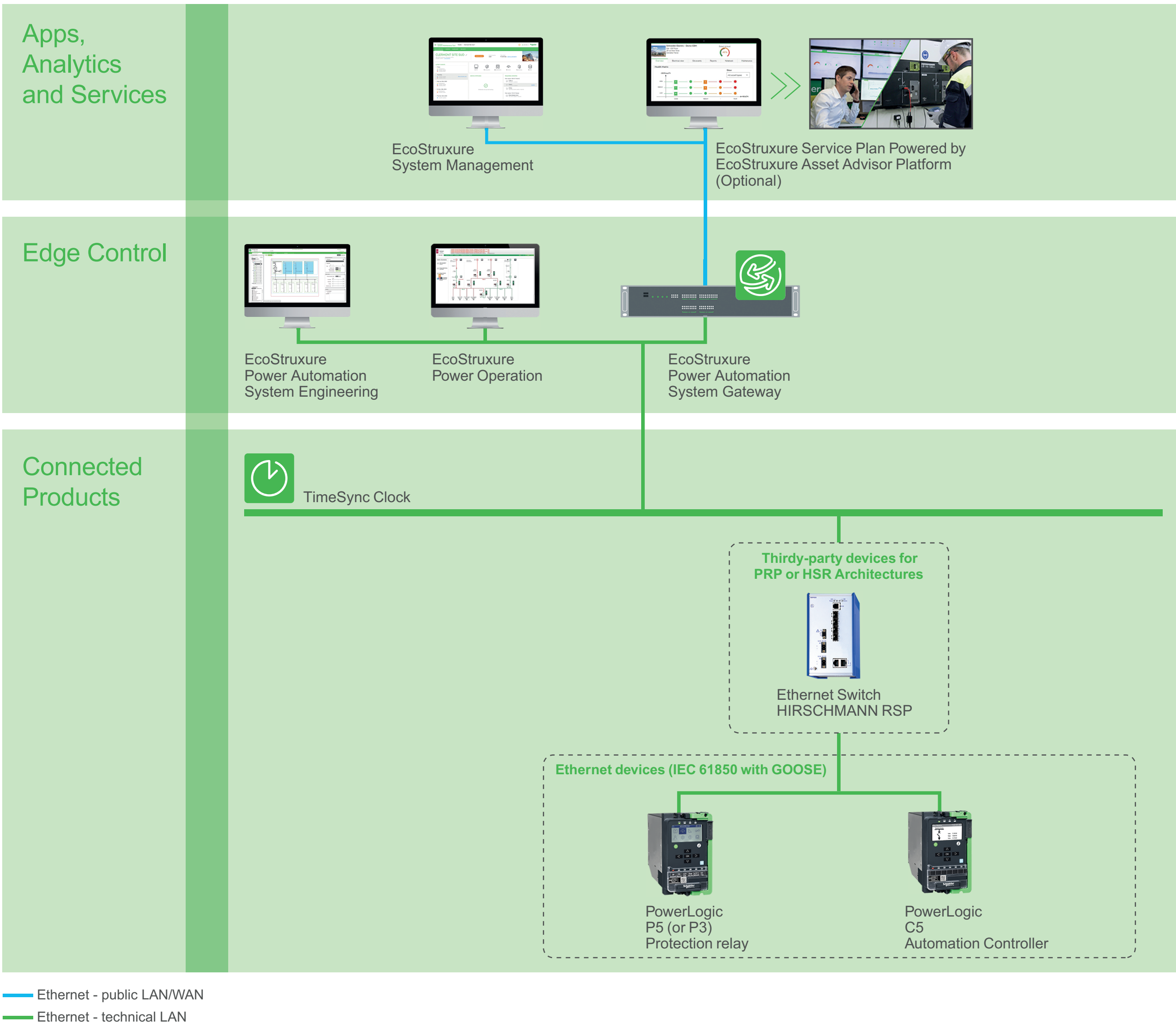
The digital architecture of the Advanced Protection and Automation application involves collecting the input data from the different products, either directly over Ethernet or via gateways. Ethernet-based communication is required for high-performance network reconfiguration response time.

This data is then used by the Edge Control layer which consists of a set of software-defined applications across the following levels:

- Operations: EcoStruxure Power Operation (HMI) and EcoStruxure Power Automation System Gateway
- Maintenance: EcoStruxure Power Automation System Engineering and System Management.

As an option, data from EcoStruxure Power Operation or EcoStruxure Power Automation System Gateway can be passed on to the EcoStruxure Asset Advisor[55] platform and interpreted by experts as part of the EcoStruxure Service Plan.

The recommended digital architecture for the application is shown below:

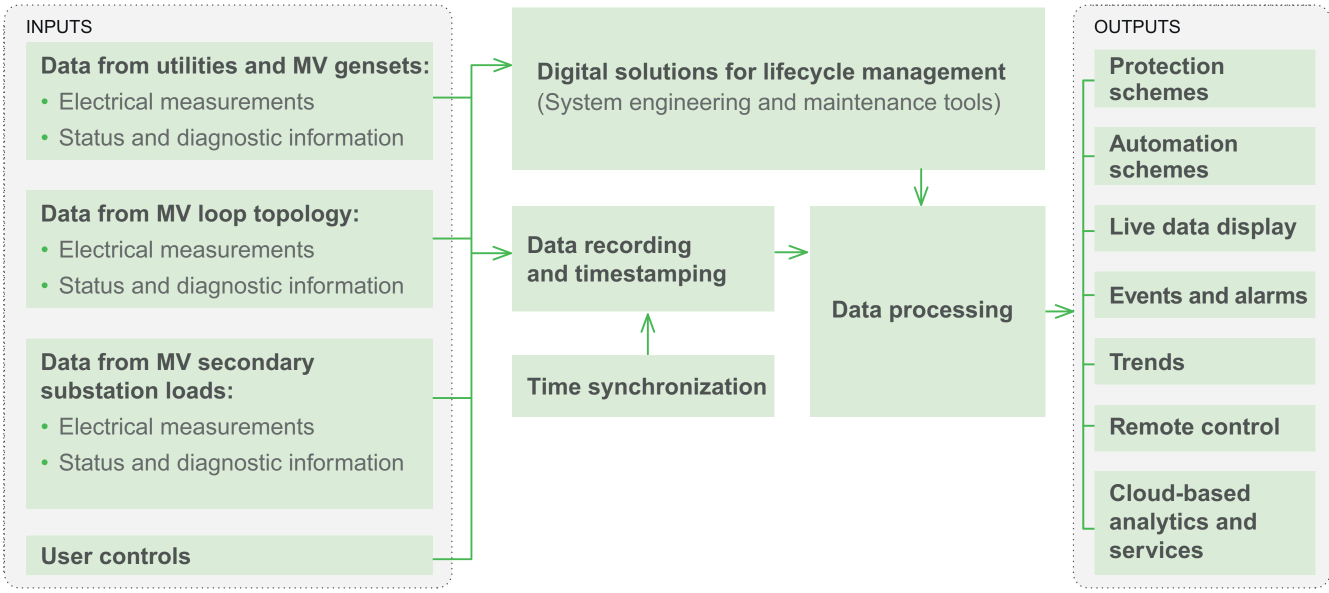


55. EcoStruxure Asset Advisor integrates asset performance data from EcoStruxure Power Automation System Gateway to enable more optimized electrical asset management. See Asset Performance application for more details.

System Description

Data Flow

The Advanced Protection and Automation application can be broken down as follows:



Inputs

Data from Utilities and MV Gensets

The following data is required:

- **Electrical measurements**: power sources and feeders are monitored to process real-time protection algorithms and automation schemes to automatically operate actuators in case of electrical fault. Incoming (from utilities) and generated (from genset) power data is collected in real time and shared across an IEC 61850 network to execute load-shedding and load-restore automation schemes.
- **Status and diagnostic information**: if any source or network control operations involve the utility incomers, MV secondary substations, or gensets in the facility, it is essential to determine their status and to access diagnostic information to run proper automatic reconfiguration sequences.

For the utility incomer and for the genset(s), these measurements are collected by protection relays (such as the PowerLogic P5/P3), automation controllers (such as PowerLogic C5), or EcoStruxure Power Automation System Gateway (EPAS-GTW) in the case of Modbus devices.


PowerLogic P5


PowerLogic P3


PowerLogic C5


EcoStruxure Power Automation System Gateway

Data from MV Loop Topology

The following data is acquired from protection relays with embedded metering (PowerLogic P5/P3) and from automation controllers (PowerLogic C5) for automatic systems and helps operators decide on the best supply path through the electrical distribution network:


PowerLogic P5


PowerLogic P3


PowerLogic C5

- **Electrical measurements:** measurements such as voltage, current, and power are collected to process real-time protection algorithms and automation schemes for power restoration, load shedding, etc.
- **Status and diagnostic information:**
  - Status and diagnostics from contactors, switches, and circuit breakers
  - Trip signals from protection relays
  - Operation mode of automation schemes (local/remote, manual/auto, test)
  - Status and diagnostics from protection relays and/or automation controllers

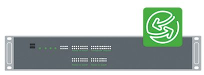
Data from MV Secondary Substation Loads

In critical facilities, the preservation of essential loads such as motors, machines, or other equipment is of utmost importance. Therefore, the following data is key:

- **Electrical measurements**: consumed power data is collected in real-time and shared across the IEC 61850 high-performance Ethernet network to execute load-shedding and load-restore automation schemes.
- **Status and diagnostic information** are necessary to understand the conditions of these essential loads prior to shedding or restoring them.

This data can be collected from automation controllers (PowerLogic C5), through digital and analog inputs connected to MV secondary circuits, or through EcoStruxure Power Automation System Gateway in case of Modbus devices.


PowerLogic C5


EcoStruxure Power Automation System Gateway

User Controls

In the event the protection or automation system halts due to improper operating conditions or for the purpose of maintenance, the user is able to issue external control actions such as resetting of controls or open/close orders either:

- from a Central HMI (EcoStruxure Power Operation) or
- from the front panel of local devices (PowerLogic P5/P3 or C5).


PowerLogic C5


PowerLogic P5


PowerLogic P3


EcoStruxure Power Operation

Data Recording and Timestamping

All protection, automation, and control system activities are recorded and timestamped for postmortem analysis, traceability, and auditing.

For critical applications, a timestamp accuracy of ±1 ms is required to help ensure a correct sequence of events.

To achieve this, the measurements and events are recorded and timestamped onboard smart equipment such as PowerLogic P5/P3 and C5 and EcoStruxure Power Automation System Gateway.

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

EcoStruxure
Power Automation System
Gateway

PowerLogic
P5

PowerLogic
C5

PowerLogic
P3

Time Synchronization

For a consistent chronological overview of all events that take place throughout the facility, the date and time should be accurately distributed to connected products and other management systems.

Time synchronization can be performed through various technologies (PTP, NTP). An external master clock may be required and can be connected to a GPS antenna to obtain the expected time precision.

TimeSync Clock

Data Processing

Real-time data is processed to execute protection and automation schemes and control functions over the IEC 61850 high-performance Ethernet network.

The results are monitored and recorded in Edge Control software (EcoStruxure Power Operation and EcoStruxure Power Automation System Gateway) for a better understanding of protection and automation schemes, sequence of operation, and potential system issues due to abnormal conditions (device in local mode, tripped circuit breaker, etc.).

User intervention may be necessary in the event of halted automation, manual load control, or maintenance activities. In this case, data processing consists of logging all user actions with the date and time as well as user ID for traceability purposes.

EcoStruxure
Power Operation

EcoStruxure
Power Automation System Gateway

Digital Solutions For Lifecycle Management

The IEC 61850 standard offers digital solutions that help specify, design, automate, configure, monitor, operate, and maintain protection, automation and control systems. EcoStruxure Power Automation System offers digital tools that add the necessary software intelligence for managing the electrical system's lifecycle.

EcoStruxure Power Automation System Engineering (EPAS-E)

This tool complies with IEC 61850 standards for specification and configuration of vendor-agnostic protection, automation, and control systems:

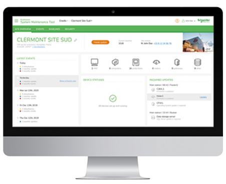
- Vendor-agnostic system configuration
- Application standardization to optimize project deployment
- Intuitive interface to simplify implementation
- Advanced template management for future system evolutions/extensions
- Automated data flow configuration for protection relays, HMIs, and gateways

EcoStruxure
Power Automation System Engineering

EcoStruxure System Management

This tool provides IEC 61850 vendor-agnostic inventory management that helps maintain protection, automation, and control systems:

- Storage and backup of configuration, setting files, and documentation
- System level version baselining
- Real-time monitoring of device firmware and configuration changes
- Automatic collection, storage, and display of disturbance recorder files
- Mass firmware upgrade (PowerLogic T300 only)



EcoStruxure
System Management

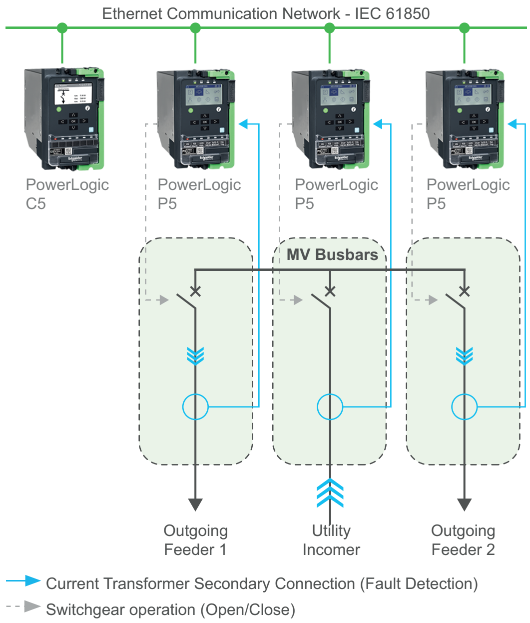
Outputs

Outputs are delivered to the advanced protection and automation system via connected products, Edge Control software, and services.

Protection Schemes

A wide range of protection functions are available via PowerLogic P5 and P3 relays to meet the requirements of electrical utilities point of connection and MV electrical systems:

- Feeder Protection
- Generator Protection
- Transformer Protection
- Motor Protection
- Arc Flash Protection

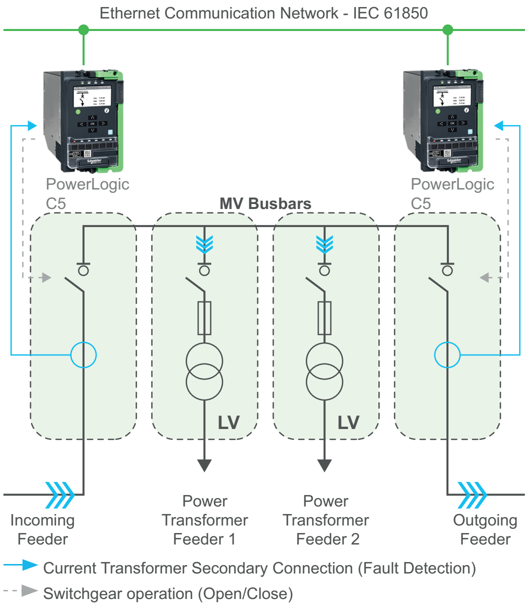


Protection and Automation in MV Incomer Substation

Automation Schemes

PowerLogic C5 processes real-time and fault-tolerant automation schemes based on the IEC 61131-3 standard over interoperable IEC 61850 Ethernet network communication services for a more autonomous response of MV electrical system applications:

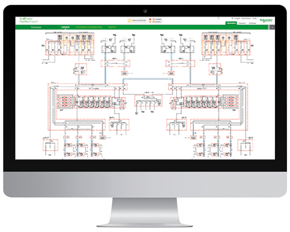
- Fast Self-Healing (in less than 300 ms)
- Redundant Automatic Transfer Switch / Power Transfer Switch (ATS/PTS)
- Load-shedding
- Load-restore
- Genset Capacity Management



Protection and Automation in MV Secondary Substation

Live Data Display

Data is displayed in animated single-line diagrams with embedded graphic objects including all relevant electrical measurements for sources, distribution networks, and loads.



Live Data Display in
EcoStruxure Power Operation

Events and Alarms

Events and alarms are uploaded from connected products or generated by the Edge Control software (EcoStruxure Power Operation or EcoStruxure Power Automation System Gateway). They are displayed in native event and alarm viewers with chronological display and sorting/filtering capabilities.

Chronological views include:

- All alarms and events, acknowledged or unacknowledged alarms, summary alarms or incidents.
- High-speed and high-precision sequence of events to quickly locate the source of a power outage.
- Traceability of user control actions with operator name and timestamp.

EcoStruxure
Power Operation

EcoStruxure
Power Automation System Gateway

Trends

Historical and real-time electrical and other measured data can be displayed as trends in Edge Control software. Multiple measurements from selected devices can be viewed with dynamic scaling on a configurable time range. Additionally, target lines can be applied to trended data.

Remote Control

In the event of a halt in the automation system (due to improper operating conditions) or for maintenance, the user is able to issue external control actions (both from EcoStruxure Power Operation or the front panel of the device), such as open/close orders or resetting of alarms.

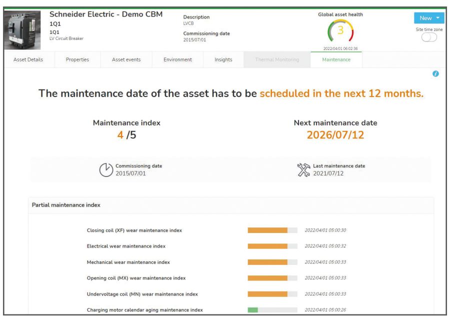
Cloud-Based Analytics and Services

EcoStruxure Service Plan powered by EcoStruxure Asset Advisor provides remote monitoring, asset management consulting, and on-site maintenance activities with recommendations from our Schneider Electric service experts.

It includes:

- Continuous asset monitoring and alarms
- Web portal and mobile app consultation with 24/7 remote support
- Remote notifications in the event of electrical asset condition anomalies
- Predictive analytics to help determine remaining equipment lifetime and other health indicators
- Customized reports with recommendations on asset health condition and optimized maintenance plan
- Condition-based asset maintenance triggered by Maintenance Index
- Optimized maintenance plan and proactive recommendations from Schneider Electric experts

EcoStruxure Service Plan Powered by EcoStruxure Asset Advisor Platform



EcoStruxure Asset Advisor Maintenance Index

Operator Training Simulation

What's in This Chapter

Overview

Context of Application

Modern electrical systems are increasingly complex to operate in particular with the advent of renewable power sources. For operation and maintenance personnel, it is significantly more challenging to master all operational and maintenance tasks, especially when performed in stressful situations. Insufficient knowledge to perform certain operations or procedures can result in delayed restoration following an unintended event, or lead to safety consequences.

Problem to Solve

The facility, operations, and maintenance managers need to:

- Avoid unplanned outages and reduce safety risks due to operator missteps.
- Overcome skill shortages in operations and maintenance teams.
- Strengthen operator confidence and efficiency to perform complex operations (such as startup and shutdown).
- Enable operators to practice safely without affecting the live system.

Purpose of the Application

Provide an efficient and cost-effective training tool for operations and maintenance staff to help reduce safety risks

Use a highly-realistic model-driven power system simulator (Digital Twin) to:

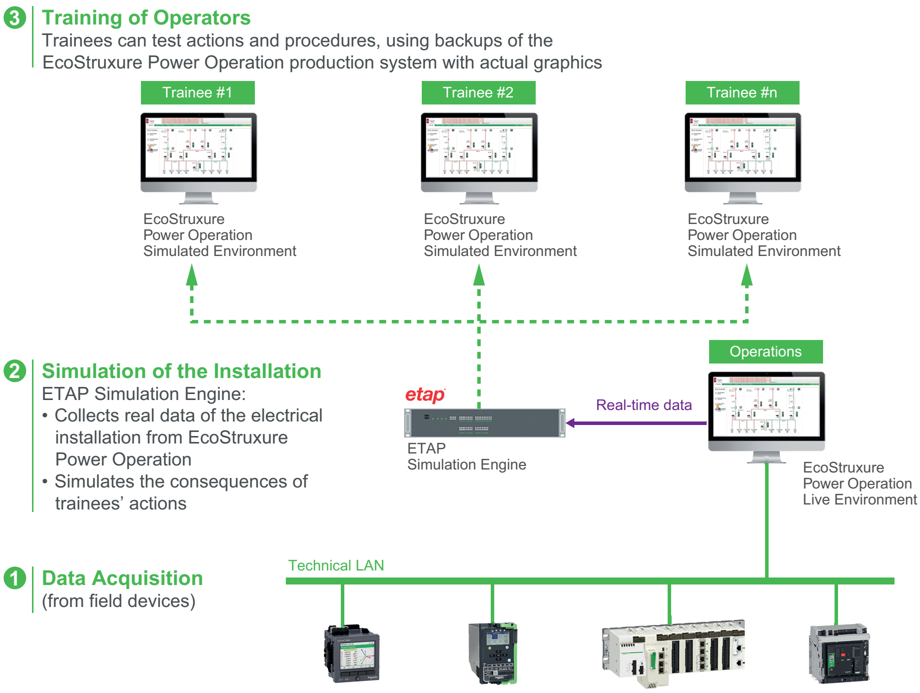
- Improve familiarity with day-to-day and/or complex operations in offline system (predefined scenarios).
- Track and review trainee actions and identify potential areas for staff skills improvement.
- Improve response time to critical events.

Operator Training Simulator

Application Outcomes

Real-Time Dynamic Simulation

Model-driven real-time simulator using a complete set of actual data of the entire electrical network to mimic a multitude of user-defined real-case scenarios and to train operators.



Schematic Diagram for Operator Training Simulation Application

Live Data Display

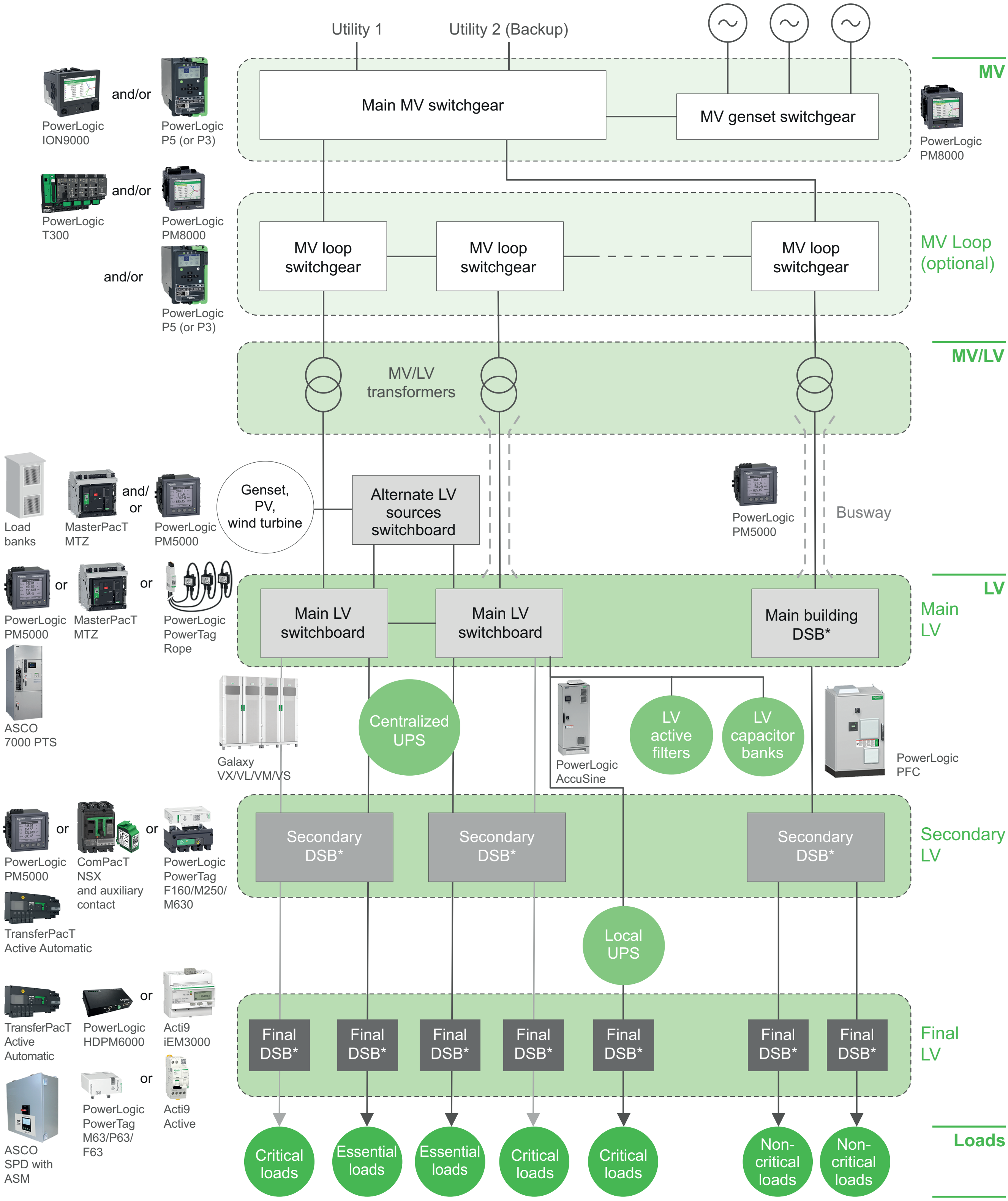
- Digital single-line diagrams with real-time animation of the status of the electrical network
- Real-time electrical data and equipment status

Reports

- Trainee reports: track and review trainee actions to identify potential areas for improvement.

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Operator Training Simulation application:

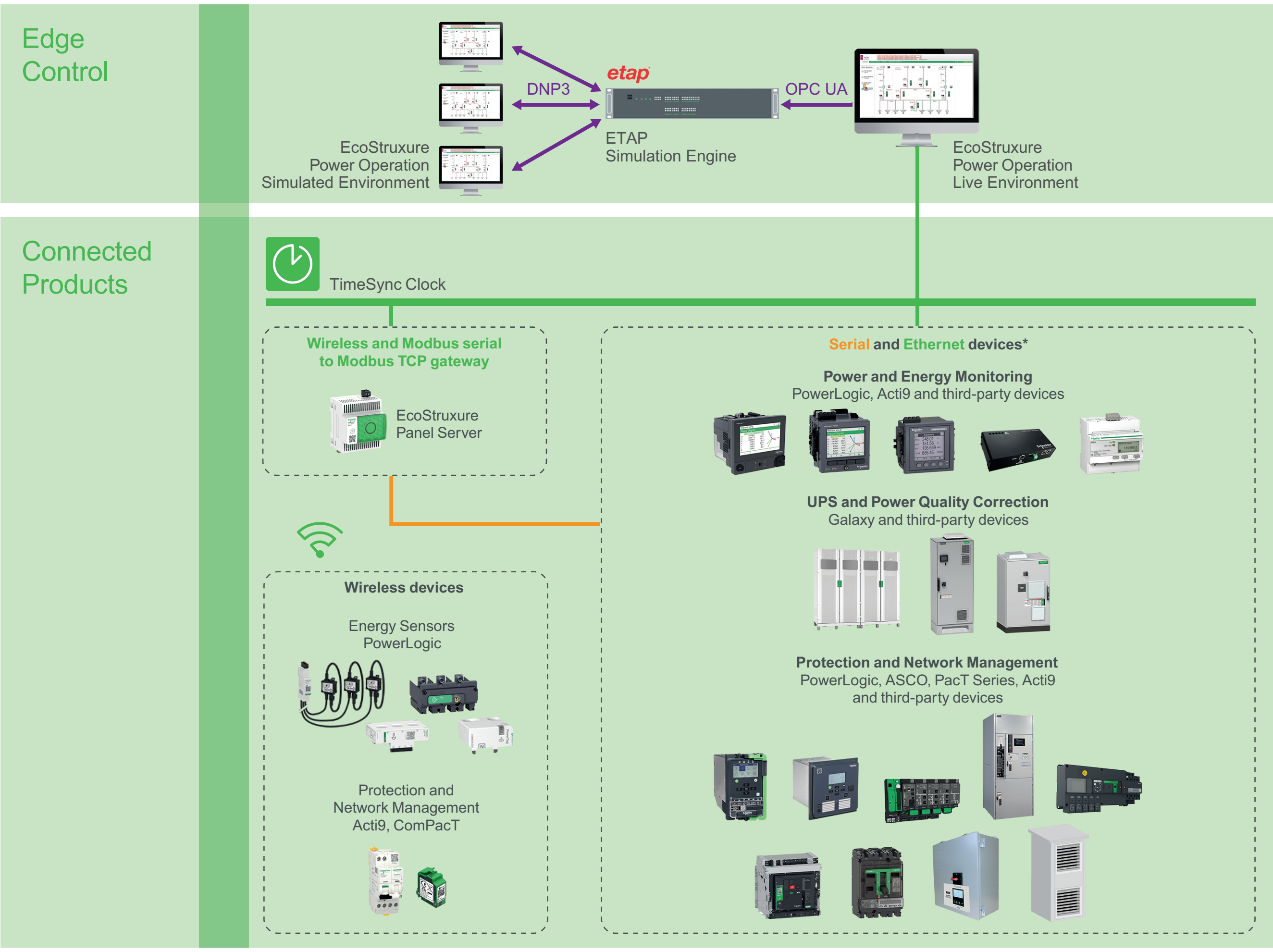


* DSB = Distribution Switchboard

Digital Architecture

The digital architecture of the Operator Training Simulation application involves collecting the input data from the different products, either directly over Ethernet or via gateways. This data is then processed by the Edge Control (EcoStruxure Power Operation) live environment and passed on to the ETAP Simulation Engine (using the OPC UA communication protocol) for training or simulations in simulated Edge Control environments.

The recommended digital architecture for the application is shown below:

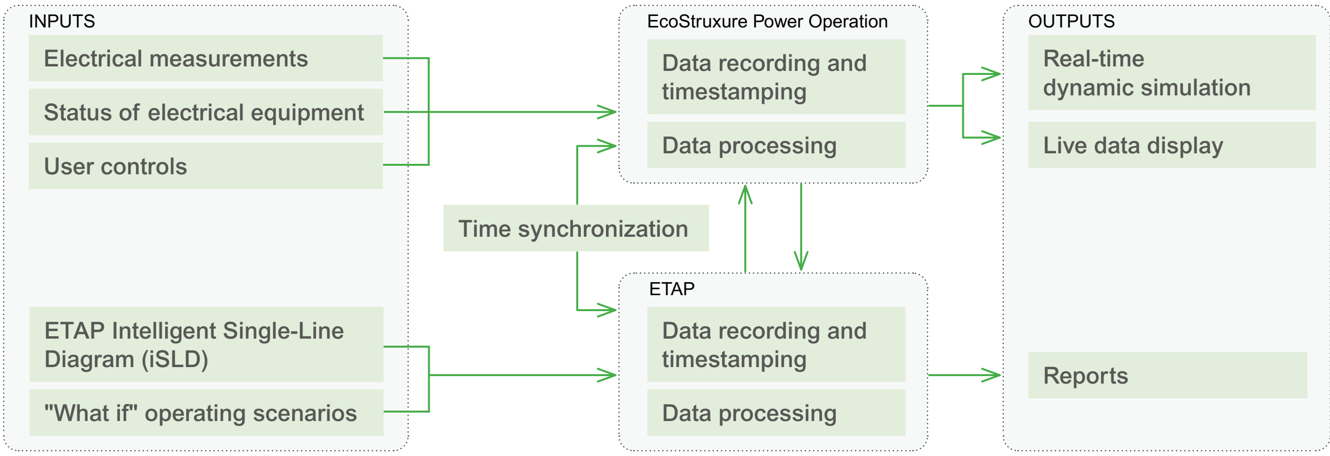


* Depending on the connected device chosen, communication protocols can be Ethernet or Serial

System Description

Data Flow

The Operator Training Simulation application can be broken down as follows:



Inputs

The Operator Training Simulation application collects data in real time from the connected products of the electrical installation to generate a highly realistic model of the electrical system and enable operators to be trained on a digital twin of a site.

The Electrical Distribution Monitoring and Alarming application collects data from connected products to provide access to consolidated views of electrical measurements, status information, and individual device details. It also monitors remote control actions.

Electrical measurements and status information can be acquired from a wide range of connected products as well as third-party equipment through open communication protocols. Typical connected products include:

- **Energy/Power meters**, such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, Acti9 iEM3000, PowerTag


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


PowerLogic HDPM6000


Acti9 iEM3000


PowerLogic PowerTag

- **Protection devices**, such as PowerLogic P5/P3, MasterPacT MTZ, ComPacT NSX (including its wireless auxiliary contact), Acti9 Active


PowerLogic P5


PowerLogic P3


MasterPacT MTZ


ComPacT NSX and Auxiliary Contact

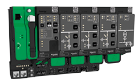

Acti9 Active

- **Other equipment**, such as UPS (Galaxy VX/VL/VM/VS), ATS/PTS (ASCO 7000 Series PTS, TransferPacT Active Automatic), ATS controller (PowerLogic T300), protective devices (ASCO SPD with ASM), power correction devices (PowerLogic PFC and AccuSine PCS+/PCSn/EVC/PFV+), Load Banks


Galaxy VX/VL/VM/VS


ASCO 7000 Series PTS


TransferPacT Active Automatic


PowerLogic T300


ASCO SPD with ASM


PowerLogic PFC


PowerLogic AccuSine PCS +/PCSn/ EVC/PFV+


Load Banks

Electrical Measurements

The following electrical measurements are collected from connected products (real-time values, the minimum, maximum and average value):

- Current and voltage
- Power (Active, Reactive, Apparent)
- Frequency
- Energy
- Harmonic distortion
- Voltage and current unbalance

Status of Electrical Equipment

Information is collected from intelligent electrical devices such as circuit breakers, power quality correction equipment, ATSs and other electrical distribution equipment:

- Circuit breaker position (open, closed, racked-in, racked-out, etc.)
- Circuit breaker trip status, protection status
- UPS status, motor status
- Other statuses, operating modes or conditions

User Controls

Trainees can interact with the digital twin and follow operational procedures by evaluating control strategies and emulate controls such as:

- Sequence of operations
- Load transfer switching
- Contingency plans

ETAP Intelligent Single-Line Diagram (iSLD)

ETAP’s iSLD is a digital representation of the electrical system including all equipment characteristics and system behavior. It is designed to be the model of AC & DC networks based on real-time and estimated data.

“What If” Operating Scenarios

Some sequences of events must be predefined to train operators on sequences following critical operational situations such as:

- Utility outage
- Generator testing
- Motor starting
- Faults
- Contingency plans
- Sequence of operations to restore the power

Data Recording and Timestamping

For the Operator Training Simulation application:

- User actions are recorded and timestamped by EcoStruxure Power Operation.
- Status changes generated in response by the ETAP Simulation Engine are recorded and timestamped by the ETAP server.

This timestamped data is used to provide accurate sequence of events in the action summary report that can be produced after training sessions or after simulated actions.

To reach an optimal chronological correlation, a time accuracy of ±1 millisecond is recommended for both the trainee workstation (EcoStruxure Power Operation) and the ETAP Simulation Engine.

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

ETAP
Simulation Engine

EcoStruxure
Power Operation

Time Synchronization

To be able to replay or analyze sequence of operations, time synchronization is required between the EcoStruxure Power Operation computers (server and user HMI) and the ETAP Simulation Engine.

This can be achieved by setting NTP or SNTP synchronization between computers.

TimeSync Clock

Data Processing

Real-time data from the electrical installation is provided by EcoStruxure Power Operation Edge Control using OPC UA communication protocol.

ETAP Simulation Engine additionally analyzes power system dynamics and transient disturbances, estimates the magnitudes and phase angles of bus voltages, currents, and performs analysis on arc flash hazards and incident energy.

This data is used by the ETAP Simulation Engine to generate highly-realistic equipment responses to a series of control actions by a user.

All user actions (user controls) are logged for traceability purposes.

ETAP
Simulation Engine

EcoStruxure
Power Operation

Outputs

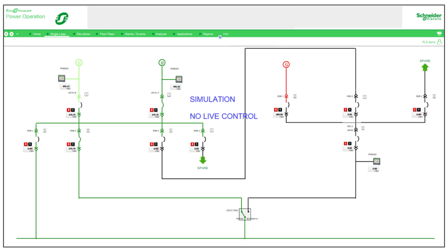
The outputs of the ETAP Simulation Engine are displayed in EcoStruxure Power Operation.

ETAP
Simulation Engine

EcoStruxure
Power Operation

Real-time Dynamic Simulation

Electrical SCADA utilizes data generated by ETAP Simulation Engine to mimic a multitude of user-defined real-case scenarios. It helps to provide an advanced and cost-effective training environment, that prepares operators to quickly respond to various power systems events and emergency situations.



Simulated Operator Training Environment

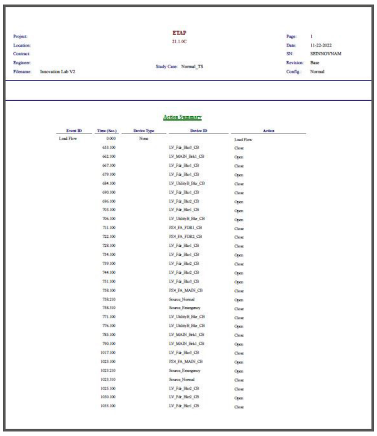
Live Data Display

The live status of the electrical distribution can be represented in the Edge Control software (EcoStruxure Power Operation) in various forms such as:

- Digital single-line diagrams, with real-time animation of the status of the electrical network
- Real-time electrical data and equipment status

Reports

In addition to specialized reports, action summary reports are generated to evaluate the steps taken by operators, and to assess and/or validate their competence level.



ETAP Action Summary Report

Simulate Before Operate

What’s in This Chapter

Overview

Context of Application

Modern electrical systems are increasingly complex to operate in particular with the advent of renewable power sources.

Facility teams often cannot predict the outcome of switching or maintenance actions, sometimes required following an unintended event. Inexperienced operators’ lack of confidence to perform certain operations or procedures, especially when performed in a crisis situation, can result in severe consequences to the system, accounting for a high financial impact to the business.

Problem to Solve

The facility, operations, and maintenance managers need to:

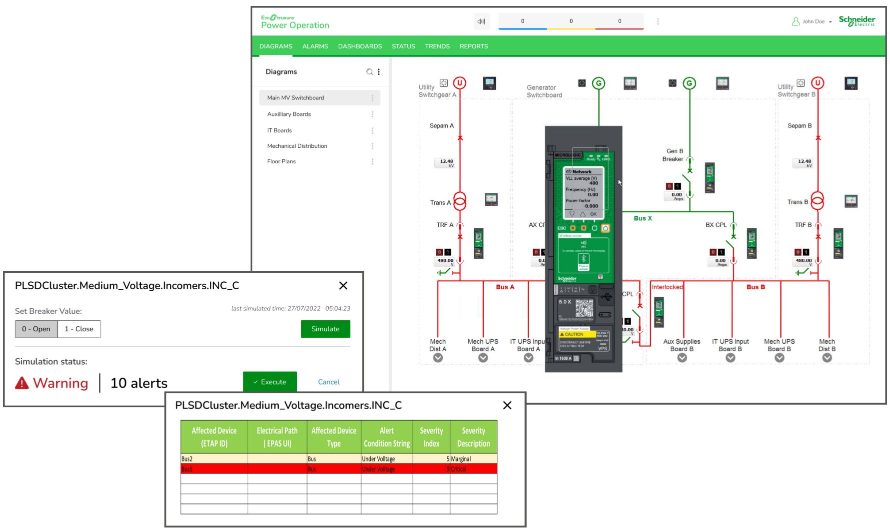
- Help operators avoid missteps that can lead to unplanned outages, equipment overloads, or people safety risk.
- Strengthen operator confidence and efficiency for complex operations (such as breaker operation and motor starting).

Purpose of the Application

Help facility managers and/or operators understand the consequences of an action prior to executing it.

Use a highly-realistic model-driven power system simulator (Digital Twin) to:

- Simulate the consequences of an action and list the potential risks or side effects.
- Enhance familiarity with unusual/new operations.

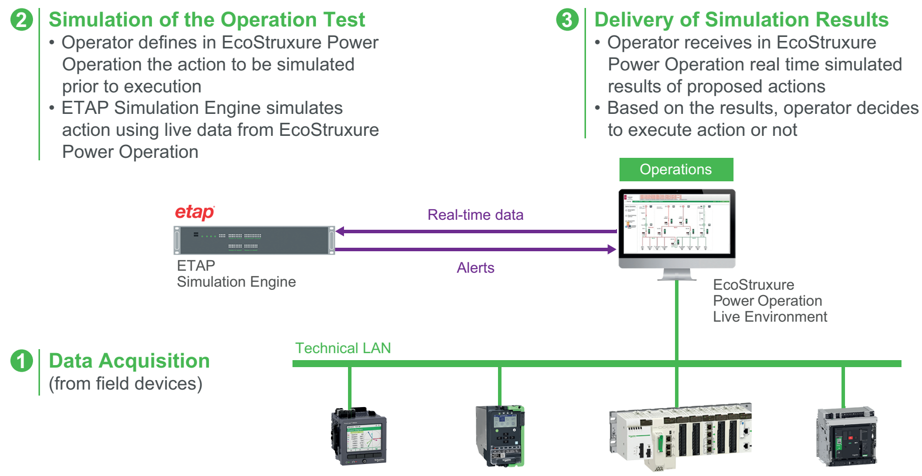


Simulate Before Operate Environment

Application Outcomes

Real-Time Dynamic Simulation

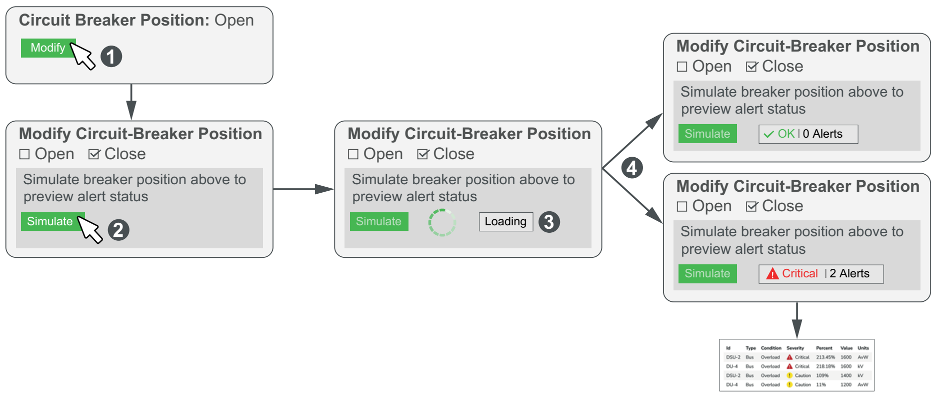
Model-driven real-time simulator using a complete set of actual data of the entire electrical network to simulate the consequences of an action prior to execution



Schematic Diagram for Simulate Before Operate Application

Alerts

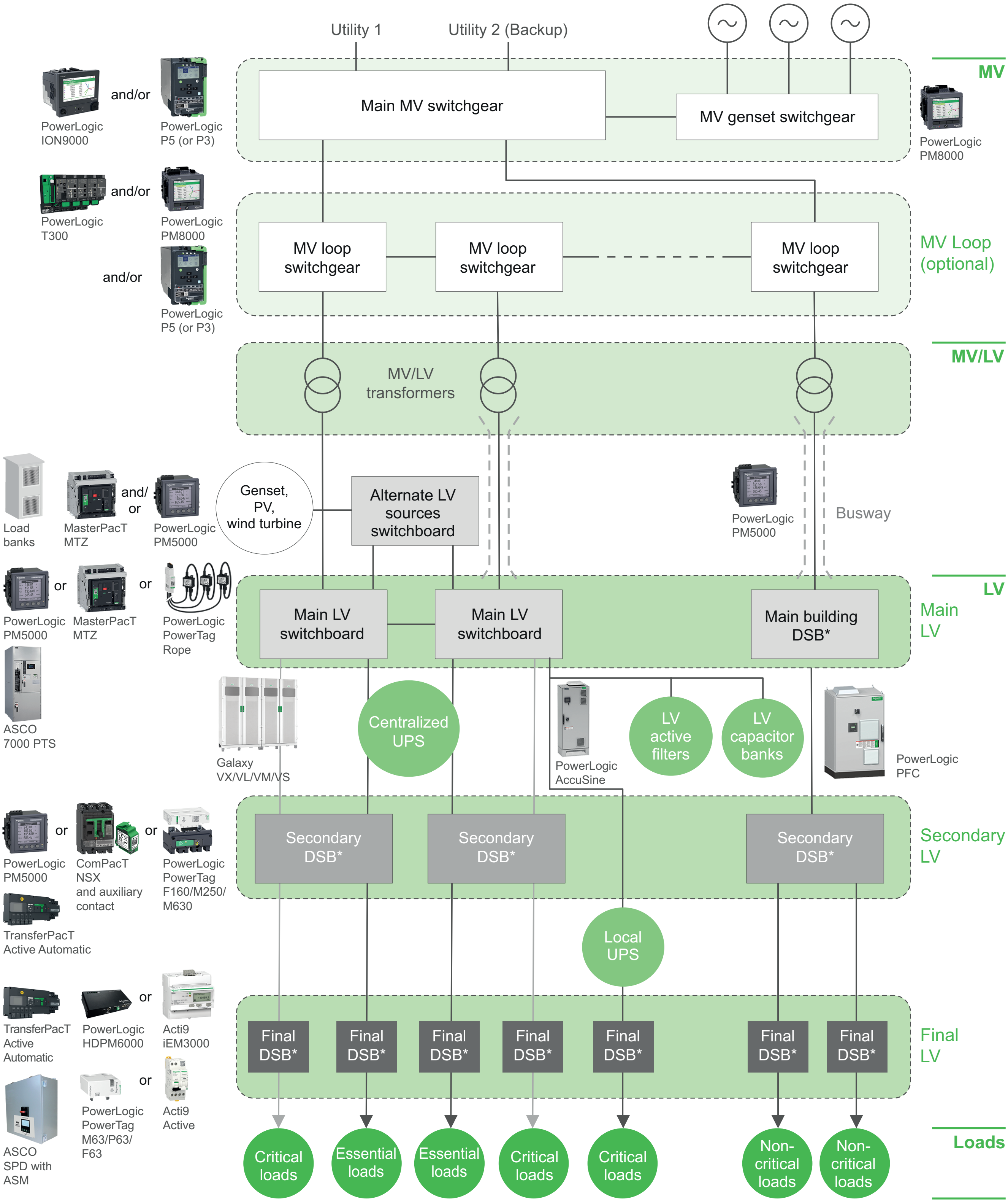
Alerts regarding potential consequences (overloads, over/undervoltage, overexcitation, etc.) if an action is performed



Simulate Before Operate Process Flow to Generate Alerts

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Simulate Before Operate application:

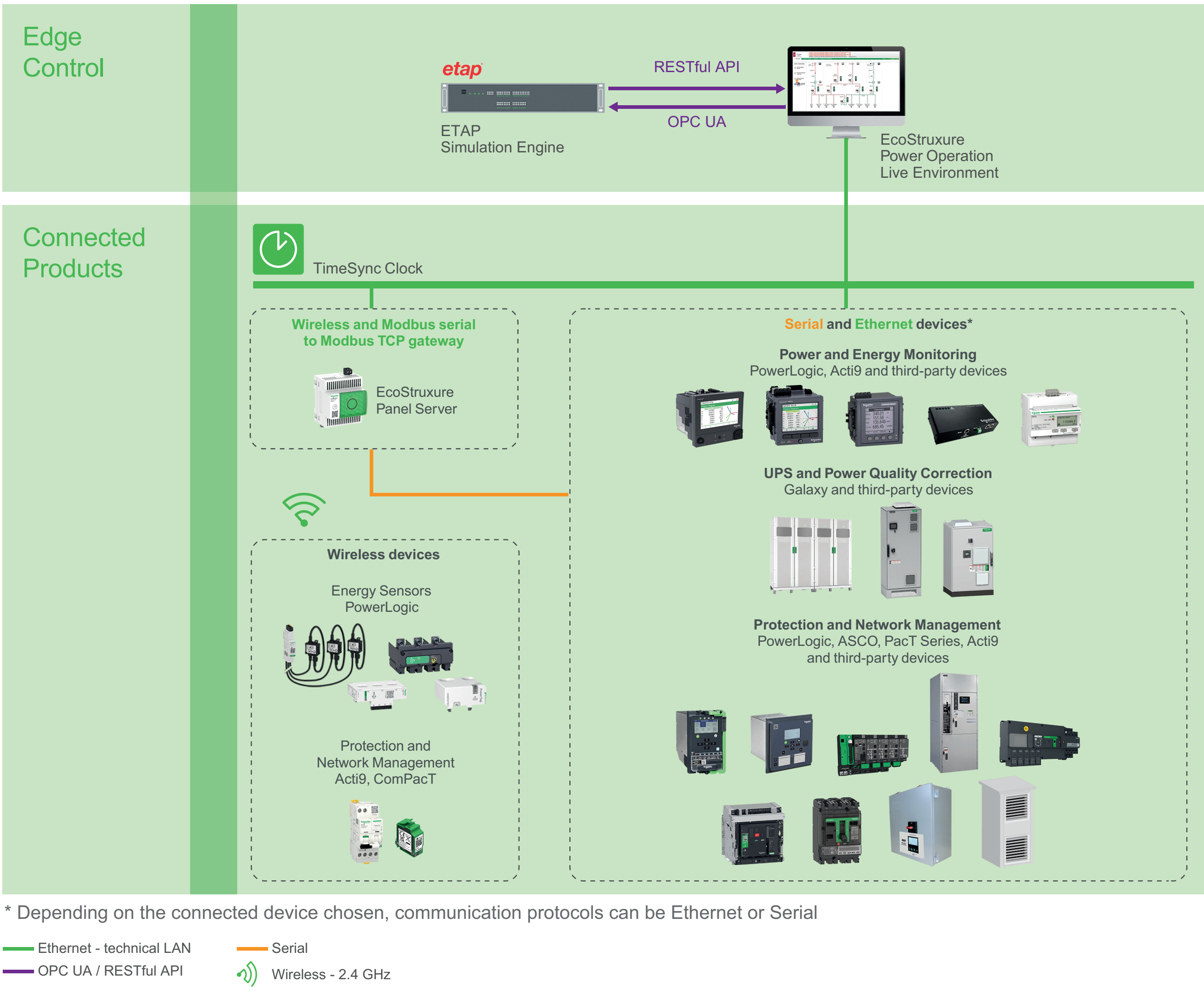


* DSB = Distribution Switchboard

Digital Architecture

The digital architecture of the Simulate Before Operate application involves collecting the input data from the different products, either directly over Ethernet or via gateways. This data is then processed by the Edge Control (EcoStruxure Power Operation) and passed on to the ETAP Simulation Engine (using the OPC UA communication protocol) for simulations. The alerts are then displayed in EcoStruxure Power Operation (using the ETAP RESTful API).

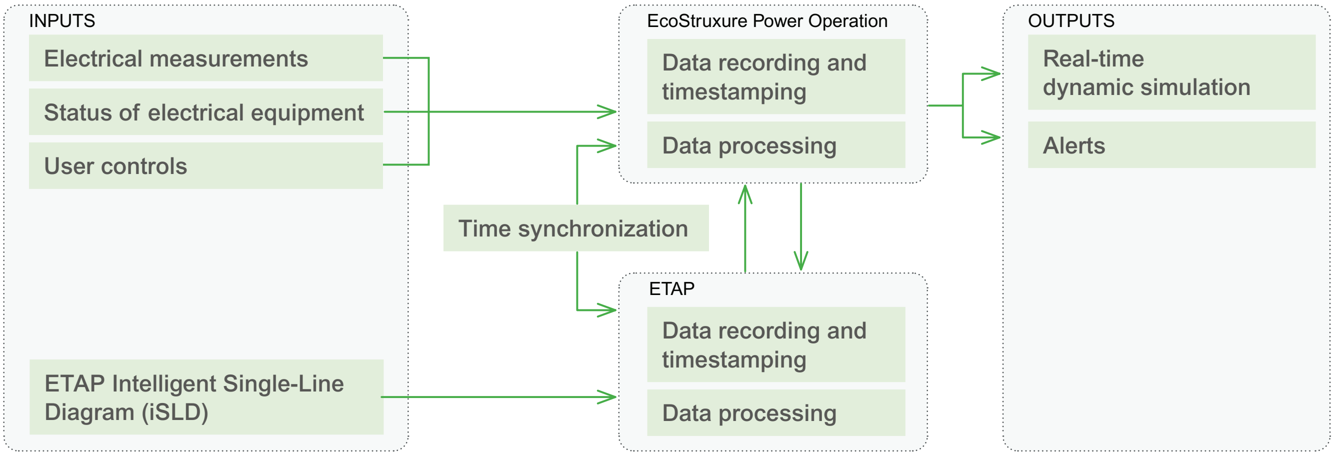
The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Simulate Before Operate application can be broken down as follows:



Inputs

The Simulate Before Operate application collects data in real time from the connected products of the electrical installation to generate a highly realistic model of the electrical system and enable operators to simulate the outcome of an action before executing it.

Electrical measurements and status information can be acquired from a wide range of connected products as well as third-party equipment through open communication protocols. Typical connected products include:

- **Energy/Power meters**, such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, Acti9 iEM3000, PowerTag


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


PowerLogic HDPM6000


Acti9 iEM3000


PowerLogic PowerTag

- **Protection devices**, such as PowerLogic P5/P3, MasterPacT MTZ, ComPacT NSX (including its wireless auxiliary contact), Acti9 Active


PowerLogic P5


PowerLogic P3


MasterPacT MTZ


ComPacT NSX and Auxiliary Contact

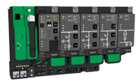

Acti9 Active

- **Other equipment**, such as UPS (Galaxy VX/VL/VM/VS), ATS/PTS (ASCO 7000 Series PTS, TransferPacT Active Automatic), ATS controller (PowerLogic T300), protective devices (ASCO SPD with ASM), power correction devices (PowerLogic PFC and AccuSine PCS+/PCSn/EVC/PFV+), Load Banks


Galaxy VX/VL/VM/VS


ASCO 7000 Series PTS


TransferPacT Active Automatic


PowerLogic T300


ASCO SPD with ASM


PowerLogic PFC


PowerLogic AccuSine PCS+/PCSn/ EVC/PFV+


Load Banks

Electrical Measurements

The following electrical measurements are collected from connected products (real-time values, the minimum, maximum, and average values):

- Current and voltage
- Power (Active, Reactive, Apparent)
- Frequency
- Energy
- Harmonic distortion
- Voltage and current unbalance

Status of Electrical Equipment

Information is collected from intelligent electrical devices such as circuit breakers, power quality correction equipment, ATSs, and other electrical distribution equipment:

- Circuit breaker position (open, closed, racked-in, racked-out, etc.)
- Circuit breaker trip status, protection status
- UPS status, motor status
- Other statuses, operating modes, or conditions

User Controls

Control actions are used to determine the response to changes in equipment status, loading, and generation levels such as:

- Breaker operation
- Motor starting
- Load changes

ETAP Intelligent Single-Line Diagram (iSLD)

ETAP's iSLD is a digital representation of the electrical system including all equipment characteristics and system behavior. It is designed to be the model of AC & DC networks based on real-time and estimated data.

Data Recording and Timestamping

For the Simulate Before Operate application:

- User actions are recorded and timestamped by EcoStruxure Power Operation.
- ETAP Simulation Engine predicts system behavior using real-time data.

To reach an optimal chronological correlation, a time accuracy of ±1 millisecond is recommended for both the trainee workstation (EcoStruxure Power Operation) and the ETAP Simulation Engine.

ETAP
Simulation Engine


EcoStruxure
Power Operation

Time Synchronization

To be able to replay or analyze a sequence of operations, time synchronization is required between the EcoStruxure Power Operation computers (server and user HMI) and the ETAP Simulation Engine.

This can be achieved by setting NTP or SNTP synchronization between computers.


TimeSync Clock

Data Processing

Real-time data from the electrical installation is provided by EcoStruxure Power Operation Edge Control using the OPC UA communication protocol.

This data is used by the ETAP Simulation Engine to generate highly-realistic equipment responses to a series of control actions by a user.

ETAP leverages its load flow engine to perform analysis to determine if there are actions that will result in non-desired situations.

Additionally, all user actions (user controls) are logged for traceability purposes within EcoStruxure Power Operation.

Outputs

The outputs of the ETAP Simulation Engine are displayed in EcoStruxure Power Operation.

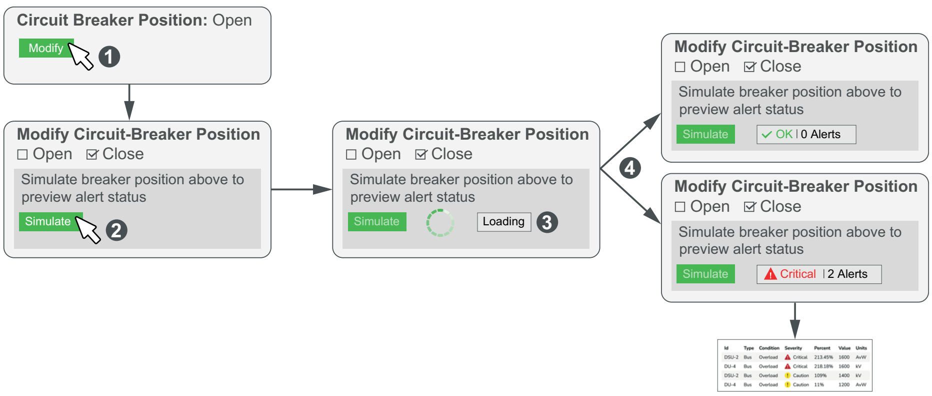
Real-Time Dynamic Simulation

EcoStruxure Power Operation leverages an integrated simulation engine that enables operators to be aware of potential risks of performing various operations prior to execution. It helps to provide a model-driven real-time simulator for early detection and indication of potential power system risks using a complete and consistent set of actual data of the entire electrical network.

Alerts

ETAP Simulation Engine generates and communicates alerts to EcoStruxure Power Operation to display potential incidents prior to any action being executed. Alert notifications can be configured to include, among others:

- Overloads
- Overvoltage/undervoltage
- Overexcitation



Simulate Before Operate Process Flow to Generate Alerts

Microgrid

What's in This Chapter

Overview

Context of Application

As electrical grid ages in many parts of the world, and environmental factors such as natural disasters and storms threaten grid reliability, distributed energy resources are growing in popularity. Managing multiple sources of energy production can be complex, especially when it comes to making optimal decisions to produce locally generated energy compared to consuming grid energy in the event that grid stability is at risk. Distributed energy resources also offer an opportunity to reduce energy costs and improve the sustainability of an organization.

Problem to Solve

Microgrid facility operators need to:

- Enhance electrical system reliability in the face of grid instability and constraints, partially due to an increasing occurrence of powerful storms.
- Enable optimal energy usage and cost efficiency, leveraging distributed energy resources to reduce, reuse, and optimize energy consumption.
- Enable the optimized use of renewable resources including solar photovoltaics, fuel cells, natural gas generators, and combined heat and power systems.

Purpose of the Application

Improve resilience

Helps protect against extreme weather, cyberattacks, and grid instability to avoid costly downtime.

Help reduce risk

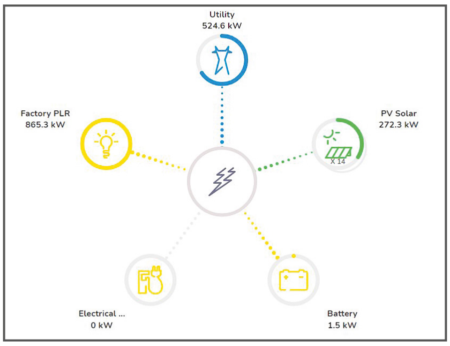
Enables control of financial and operational risks thanks to best-in-class strategic partners which provide Energy-as-a-Service (EaaS) with flexible governance models.

Optimize energy

Seamlessly integrate your Distributed Energy Resources (DERs) and be empowered with actionable insights on when to consume, store, and sell energy for the greatest financial advantage.

Increase sustainability

Easily quantify your carbon reduction efforts, meet your sustainability goals, and become a leader in the new energy landscape.

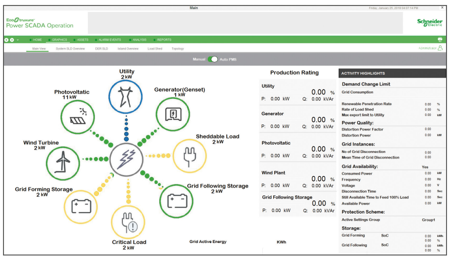


Microgrid System

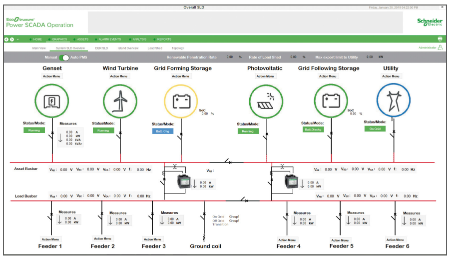
Application Outcomes

Live Data Display

High-performance, real-time visualization of animated single-line diagrams provides situational awareness of the state of the power system from anywhere, and allows operators - with the proper credentials - to control it remotely. It displays information coming from the EcoStruxure Microgrid Operation controller including machine status, notifications, power flows, switch status, etc.



EcoStruxure Microgrid Operation Distributed Energy Resources Overview



EcoStruxure Microgrid Operation Live Data Display

Events and Alarms

Alarms and sequences of events related to management of distributed energy resources and the microgrid’s electrical distribution can be displayed in EcoStruxure Microgrid Operation Human Machine Interface (HMI).

Trends

Historical and live electrical data can be displayed as trends in EcoStruxure Microgrid Operation and Microgrid Advisor. With Microgrid Advisor, trended data can also be forecasted to support decision making on when to use or produce energy.

Reports

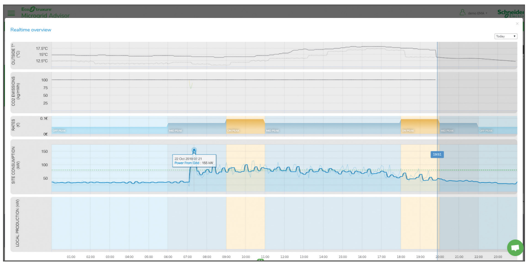
Comprehensive microgrid power system reporting is available with EcoStruxure Power Monitoring Expert integrated with EcoStruxure Microgrid Operation HMI.

Notifications

Notifications of power system events can be automatically sent by SMS or email to appropriate personnel.

Cloud-based Analytics and Services

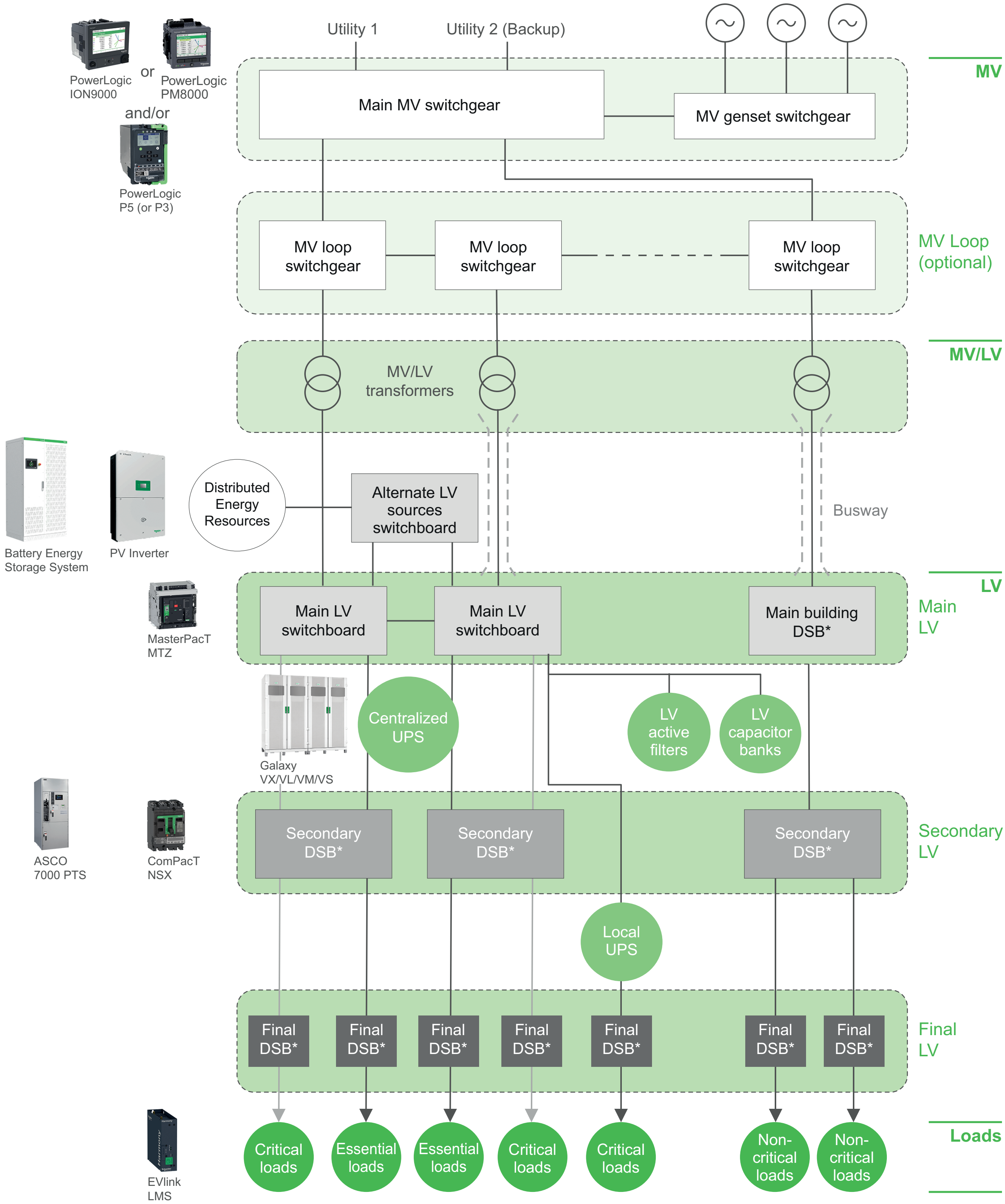
Cloud-based EcoStruxure Microgrid Advisor aggregates data from EcoStruxure Microgrid Operation as well as other inputs, including energy pricing and weather data, to define the optimal time to consume or produce energy from DERs. Control commands can be relayed back to the on-site controller to initiate actions automatically.



EcoStruxure Microgrid Advisor Real-time and Forecast Data

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Microgrid application:

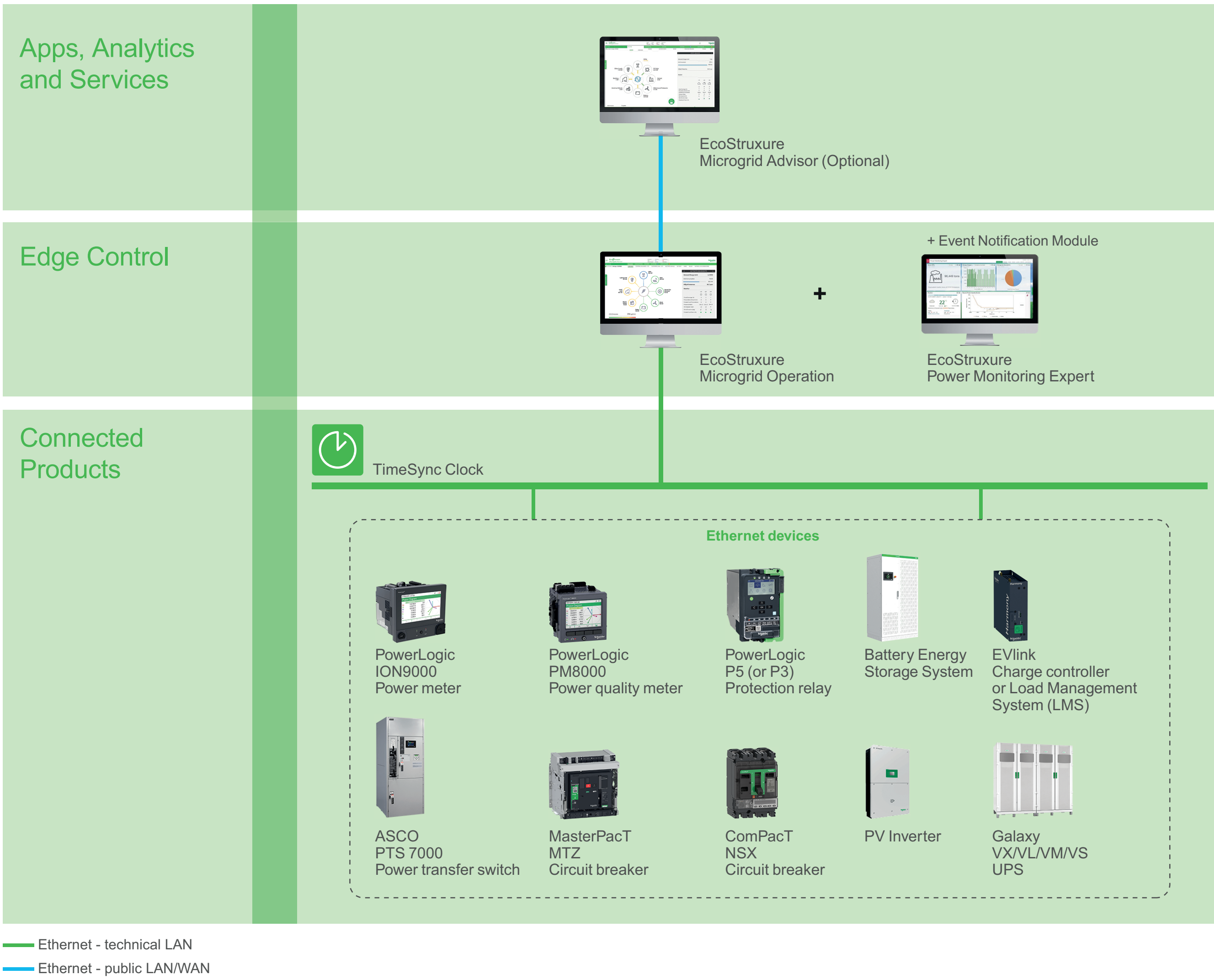


* DSB = Distribution Switchboard

Digital Architecture

The digital architecture of the Microgrid application involves collecting the input data from the different products, either directly over Ethernet or via gateways. This data is then used by the Edge Control software (EcoStruxure Microgrid Operation with optional integration of EcoStruxure Power Monitoring Expert) for on-premise visualization, analysis, reporting, and control. Data can also be utilized by EcoStruxure Microgrid Advisor for advanced optimization and control.

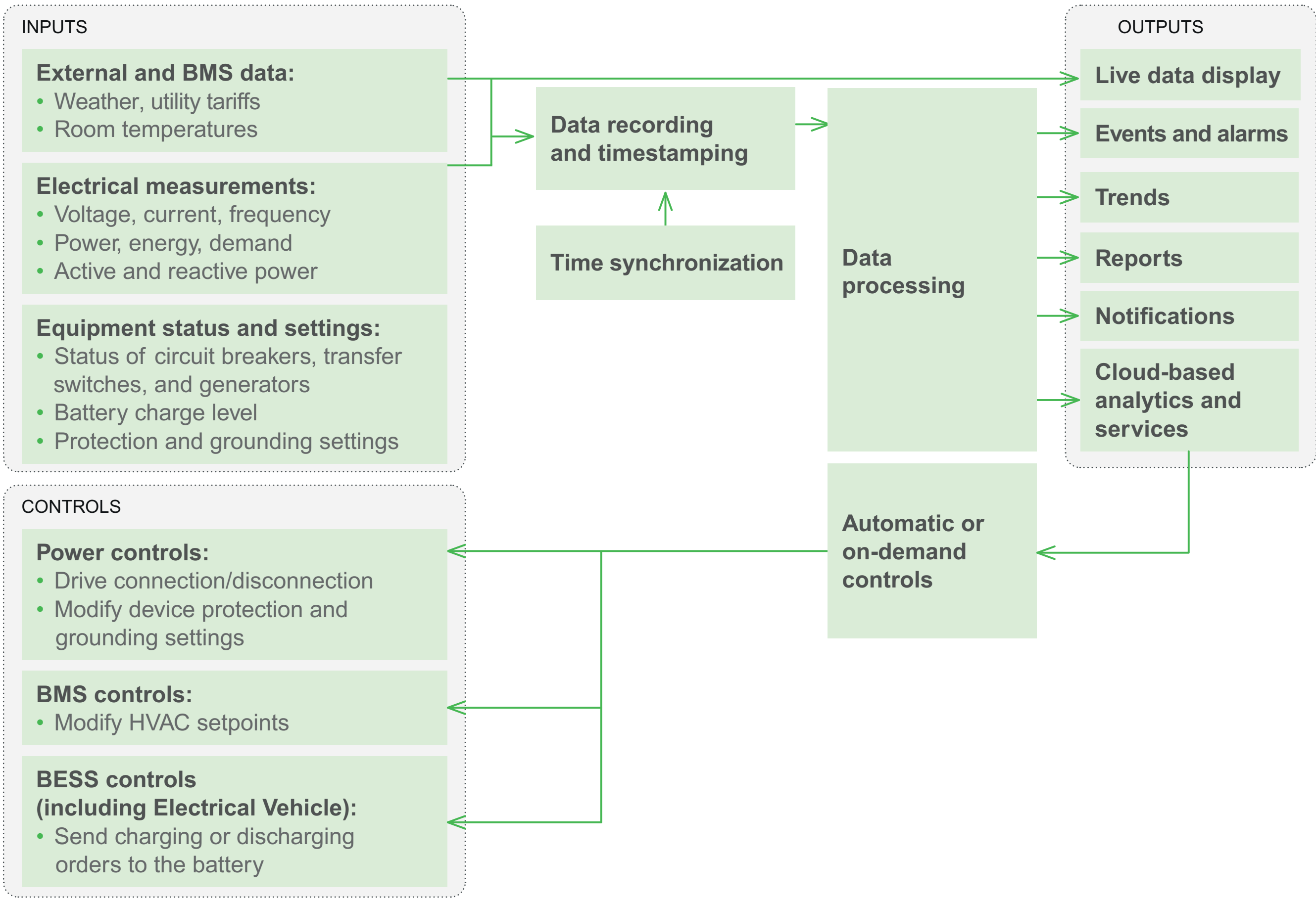
A microgrid can integrate one of those two control solutions or both depending on the customer requirements. The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Microgrid application can be broken down as follows:



Inputs

The following data is required:

External and Building Management System (BMS) Data

External data inputs can be supplied to the system to guide energy production and the consumption strategy:

- Weather forecasts
- Utility pricing rules

BMS-related data can also influence the microgrid management strategy:

- HVAC status
- Acceptable room temperature

Electrical Measurements

Connected products required to implement a microgrid solution can vary based on the project site, size, and types of Distributed Energy Resources (DERs) utilized to achieve the application goals.

Typical connected products include:

- **Energy/power meters**, such as PowerLogic ION9000

PowerLogic ION9000

- **Protection relays**, such as PowerLogic P5/P3

PowerLogic P5

PowerLogic P3

- **Circuit breakers**, such as MasterPacT MTZ, ComPacT NSX

MasterPacT MTZ

ComPacT NSX

The following electrical measurements can be collected:

- Voltage, current, frequency
- Power, energy, demand
- Active and reactive power

Equipment Status and Settings

- Open/closed position of circuit breakers
- Operating mode of transfer switches such as ASCO 7000 Series PTS
- Battery charge level
- Generator status
- Active protection and grounding settings

ASCO 7000 Series PTS

Battery Energy Storage System

PV Inverter

Controls

To constantly optimize the power supply strategy, EcoStruxure Microgrid Operation Controller will control field devices dynamically.

EcoStruxure Microgrid Operation Controller

Power Controls

The following power controls can be sent:

- Open/close circuit breakers and transfer switches
- Adjust/curtail photovoltaic output
- Charge/discharge batteries
- Start/stop generator(s)
- Modify device protection and grounding settings

Building Management System (BMS) controls

EcoStruxure Microgrid Operation Controller can also interact with the BMS to optimize the overall site energy consumption strategy:

- Modify HVAC setpoints

Battery Energy Storage System (BESS) controls (including electrical vehicle)

EcoStruxure Microgrid Operation Controller can send commands to the storage system to optimize its control strategy:

- When to charge
- When to discharge
- Stop charging according to maximum State of Charge

EVlink LMS

Data Recording and Timestamping

For a microgrid operator to make informed decisions and take corrective action, accurate timestamped data is needed to determine when, where, and in what order events have occurred for root cause analysis.

To enable diagnosis of complex microgrid power and energy events in EcoStruxure Microgrid Operation, it is recommended to utilize connected products (meters, protection relays, etc.) with onboard data logging capability and with a time precision of +/- 10 milliseconds.

EcoStruxure
Microgrid Operation

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

Time Synchronization

For a consistent chronological view of all microgrid events, the date and time should be accurately distributed to connected products and other management systems.

Time synchronization can be performed using various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be associated with a GPS antenna to achieve the required time accuracy.

TimeSync Clock

Data Processing

In a microgrid application, there are several embedded functions enabled by the processed input data in the controller of EcoStruxure Microgrid Operation to manage the operating conditions of Distributed Energy Resources (DERs).

EcoStruxure Microgrid
Operation Controller

These are described as follows:

Topological engine:

Computes and analyzes the electrical network topology in real time.

Load sharing:

Provides voltage and frequency stability by balancing production and consumption in real time, aiming to maximize renewable power production within the microgrid.

DER management:

Function in charge of driving and interacting with each of the DERs in the microgrid, taking into account the type of DER, the type of DER inverter, and the different operating conditions.

Grid management:

Monitors and analyzes the grid status in real time to detect when it is not available or when the electrical conditions require the microgrid to be disconnected from the grid. During grid-connected mode, the Microgrid Controller manages the import/export of energy to/from the grid.

Load shedding:

Turns off non-critical loads when consumption exceeds local production capacity.

Black start sequence feature:

In the absence of grid connection or self-generation, this feature provides the possibility for the microgrid to start its own electricity production and to reactivate itself sequentially as an island.

Protection relays and grounding/earthing system management:

Manages the protection relays and the grounding/earthing system during transition and operation in islanded mode.

Outputs

Live Data Display

High-performance real-time visualization of animated one-line diagrams in EcoStruxure Microgrid Operation's SCADA HMI allows you to gain situational awareness of the state of your power system from anywhere, and it allows operators, with the proper credentials, to perform remote control. It displays information coming from the EcoStruxure Microgrid Operation Controller: machine status, power flows, switch status, etc.

A Harmony Magelis Compact iPC can be used for local HMI/SCADA. It communicates with the controller as the monitoring and control access point.

It embeds the following features:

- Monitors and controls the microgrid electrical distribution topology
- Monitors and controls the EcoStruxure Microgrid Operation Controller functions
- Monitors the system architecture and its communication network
- Acts as the maintenance access point of the solution (access to technical documents and configuration software)

EcoStruxure Microgrid Operation

Harmony Magelis Compact iPC

Events and Alarms

Event log viewers:

Events and alarms are uploaded from devices and visualized in native event and alarm viewers of the Edge Control software (EcoStruxure Microgrid Operation). Chronological views include all events and alarms, acknowledged or unacknowledged alarms, and summary alarms or incidents related to microgrid events. High speed and high precision sequence of events analysis helps locate the source of any switching sequence issues or other related faults. In addition, user remote control actions are traced with operator name and timestamp.

EcoStruxure
Microgrid Operation

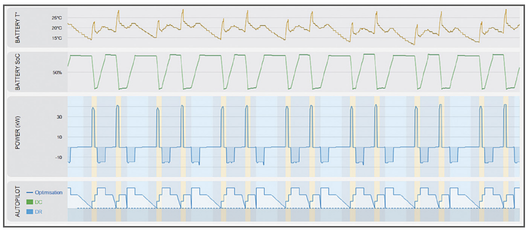
Smart alarming:

With the optional integration of EcoStruxure Power Monitoring Expert, microgrid events or alarms are intelligently grouped to be displayed as comprehensive microgrid incidents and reduce the overall number of alarms in the viewer. Further analysis can be performed through drill-down (refer to the Power Event Analysis application).

EcoStruxure
Power Monitoring Expert

Trends

Historical energy data from the microgrid power system can be displayed as trends in EcoStruxure Microgrid Operation for on-site facility teams to monitor and manage the electrical system and DERs. Trending in EcoStruxure Microgrid Advisor can additionally show near-real-time and forecasted energy production and consumption data within the context of other parameters such as energy rate schedules, temperature, and other factors that drive decision-making for optimal microgrid energy usage and production modes.



Battery Charge/Discharge Trend in EcoStruxure Microgrid Advisor

Reports

When EcoStruxure Power Monitoring Expert is installed and integrated with EcoStruxure Microgrid Operation, comprehensive reporting on the microgrid electrical network is enabled. Refer to applications such as Electrical Distribution Monitoring and Alarming, Power Quality Monitoring and Compliance, Capacity Management, among other applications for details on reporting that can be embedded in a microgrid solution.

Notifications

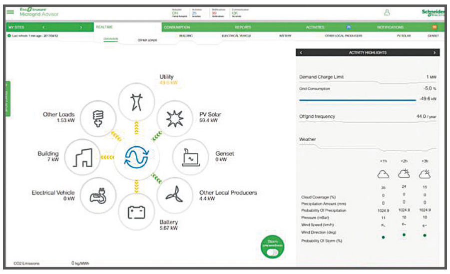
Alarm notifications available with the optional Event Notification Module for EcoStruxure Power Monitoring Expert can be automatically sent via SMS or email to configured recipients on user defined schedules.

Alarm notifications can be configured to delay sending notifications during a user-defined amount of time and to send a single notification for multiple events. This prevents flooding of notifications.

Cloud-Based Analytics and Services

EcoStruxure Microgrid Advisor cloud-based analytics help optimize the energy production and consumption of on-site Distributed Energy Resources (DERs).

EcoStruxure Microgrid Advisor



EcoStruxure Microgrid Advisor HMI

They forecast and optimize when to produce, consume, and store energy on a customer site, based on electricity tariff rate, site constraints, weather forecast information, and demand response requests.

> **NOTE:** EcoStruxure Microgrid Advisor does not replace existing control solutions which may already be installed at a site such as a Building Management System (BMS) for HVAC[56] systems, cluster for Electrical Vehicle (EV) charging stations, etc.

EcoStruxure Microgrid Advisor manages and optimizes the following four DER control orders:

- Accumulation
- Normal
- Low
- Sleep

These orders are sent to the DER itself (energy storage system) or to the existing DER management solutions, such as:

- EcoStruxure Microgrid Operation
- Building Management System for HVAC[56] systems
- Cluster for Electrical Vehicle (EV) charging stations

Thanks to the web interface, the site facility manager can monitor near-real-time energy data as well as the potential savings and earnings achieved. Such data can also be exported in an Excel file for deeper analysis.

Some optimization use cases include:

Tariff management:

- Controlling DERs according to the variable electricity tariff rate. EcoStruxure Microgrid Advisor can modify the energy consumption / energy production ratio of the site to adapt it to the tariff periods (peak/off-peak periods) while maintaining the same level of comfort for occupants.

Demand control:

- Reducing the demand charge of a site by leveraging the DER's flexibility to reduce the consumption peak of the facility (peak shaving) and thereby reducing the demand charge for the customer

Self-consumption:

- Maximizing energy consumption of local energy sources including energy storage systems

56. HVAC: Heating, Ventilation, Air Conditioning

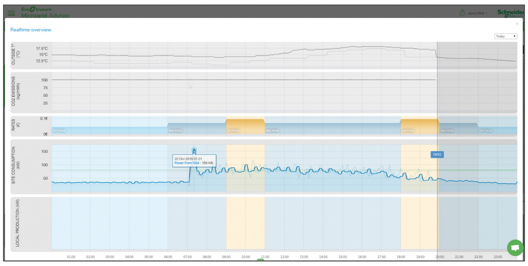
Demand response:

- Performing demand response orders by connecting to a utility or a commercial aggregator platform which can monetize demand response orders

Off-grid mode preparation:

- Preparing a customer site to enter island mode using the forecasting capabilities of EcoStruxure Microgrid Advisor in association with the EcoStruxure Microgrid Operation Controller. EcoStruxure Microgrid Operation, by collecting weather forecast information, is able to calculate the probability of a storm arriving in the next three hours. If the probability of a storm is high, the facility manager can activate the off-grid preparation mode.

  EcoStruxure Microgrid Operation will switch the priority from energy saving / cost optimization to reliability, in order to store and accumulate as much energy as possible, before the EcoStruxure Microgrid Operation Controller goes into off-grid (island) mode.



EcoStruxure Microgrid Advisor Remote Monitoring and Forecasting

Digital Applications for Sustainability

What's in This Part

Utility Bill Verification

What's in This Chapter

Overview

Context of Application

Electrical energy has some unique characteristics such as time-of-use or peak demand charges that can contribute to complicated billing. Mistakes do happen in energy billing and are surprisingly common.

Discrepancies can include:

- Invoicing errors
- Incorrect rates applied
- Incorrect meter readings
- Duplicate line items

Problem to Solve

The facility manager needs to:

- Be able to provide energy billing data to financial organizations.
- Get a reliable basis for comparison to dispute the utility bill with the energy provider.
- Understand the billing composition and details.

Purpose of the Application

Provide an accurate reference for bill validation and analysis

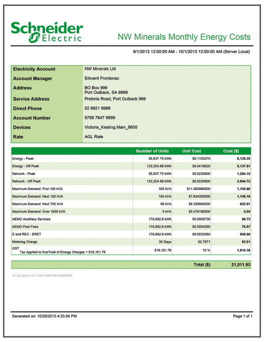
- Automatic generation of a shadow bill using power monitoring software
- Measurement taken at the same location as the utility meter
- Energy consumption data collected with the same frequency (typically 15 minutes) and equal (or better) accuracy as the utility bill

Application Outcomes

Reports

The shadow bill includes the same information as the original utility bill to compare key measurements:

- Energy usage (kWh, kVARh, kVAh)
- Demand (kW, kVAR)
- Power factor
- Time of use (TOU) and seasonal usage
- Other fees and miscellaneous charges



Schneider Electric

NW Minerals Monthly Energy Costs

9/1/2013 12:00:00 AM - 10/1/2013 12:00:00 AM (Server Local)

Electricity Account	NW Minerals Ltd
Account Manager	Edward Frontenac
Address	BO Box 999 Port Outback, SA 9999
Service Address	Pretoria Road, Port Outback 999
Direct Phone	02 9921 9999
Account Number	9788 7647 9999
Devices	Victoria_Keating.Main_8600
Rate	AGL Rate

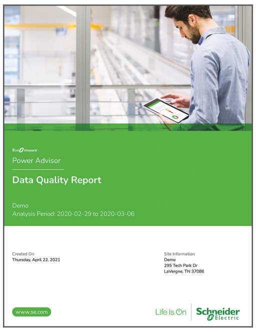
	Number of Units	Unit Cost	Cost ($)
Energy - Peak	55,637.75 kWh	$0.1103270	6,138.35
Energy - Off Peak	123,254.88 kWh	$0.0416820	5,137.51
Network - Peak	55,637.75 kWh	$0.0230800	1,284.12
Network - Off Peak	123,254.88 kWh	$0.0230800	2,844.72
Maximum Demand: First 100 kVA	100 kVA	$11.085980000	1,108.60
Maximum Demand: Next 150 kVA	150 kVA	$7.634350000	1,145.15
Maximum Demand: Next 750 kVA	98 kVA	$6.339860000	622.01
Maximum Demand: Over 1000 kVA	0 kVA	$5.476180000	0.00
AEMO Ancilliary Services	178,892.6 kWh	$0.0003730	66.73
AEMO Pool Fees	178,892.6 kWh	$0.0004280	76.57
E and REC - ERET	178,892.6 kWh	$0.0033260	595.00
Metering Charge	30 Days	$2.7671	83.01
GST Tax Applied to SubTotal of Energy Charges = $19,101.76	$19,101.76	10 %	1,910.18
		Total ($)	21,011.93

Generated on: 10/29/2013 4:33:54 PM Page 1 of 1

Shadow Bill Generated by Schneider Electric

Cloud-Based Analytics and Services

As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.

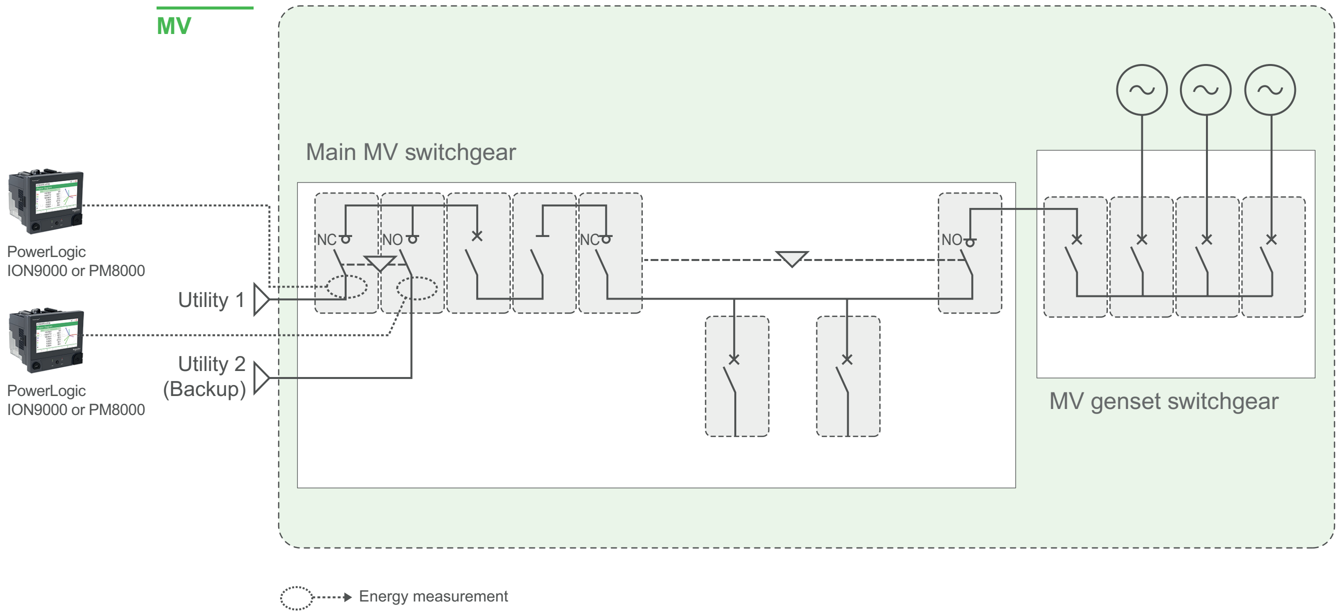


EcoStruxure Power Advisor Data Quality Report

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Utility Bill Verification application.

Certified utility grade meters must be installed (on each utility incomer) to perform accurate measurements which can help with utility bill verification.



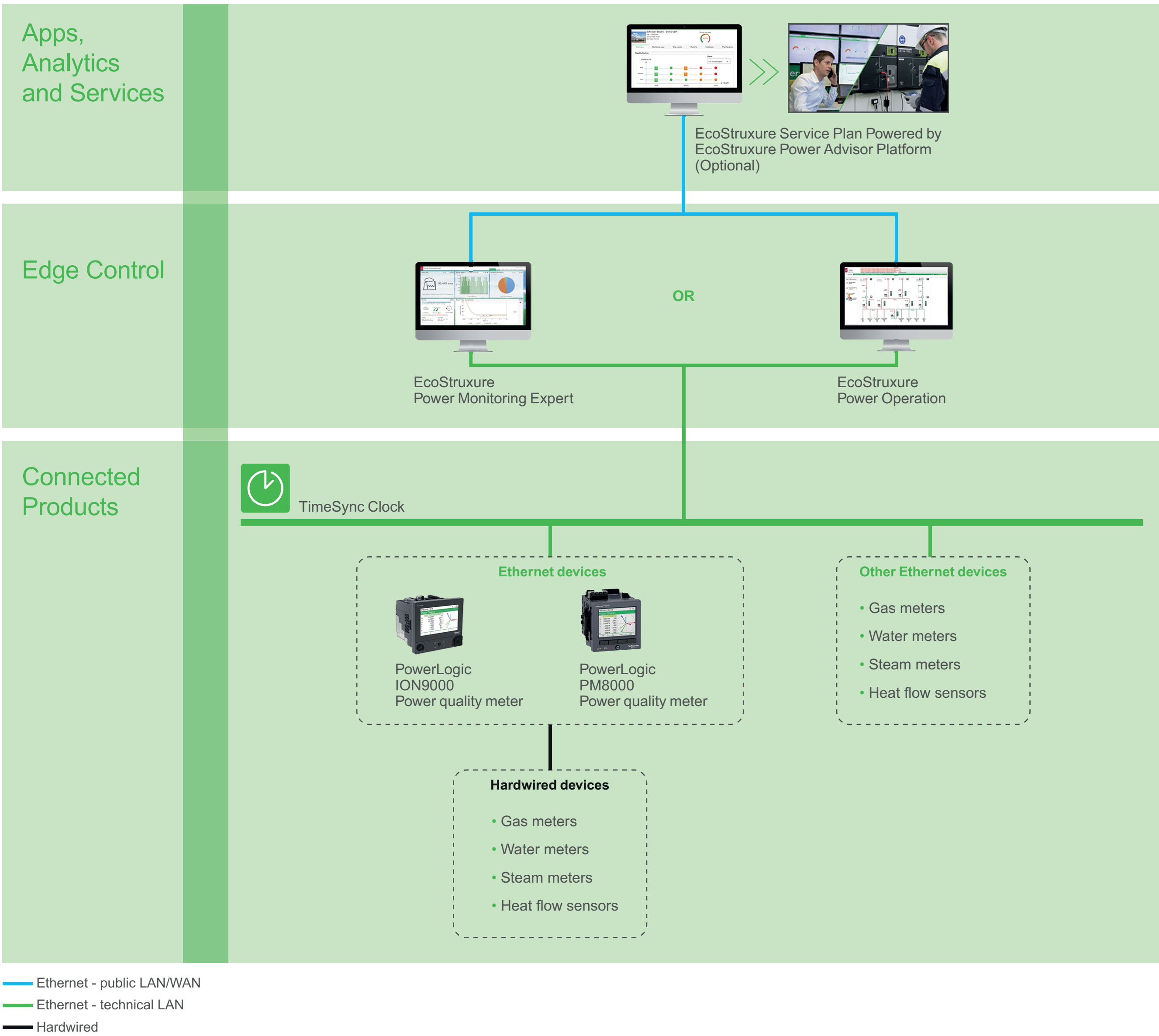
Digital Architecture

The digital architecture of the Utility Bill Verification application consists of utility-grade energy meters collecting accurate energy and demand (power) data. This data is then transferred by IP communication to the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for reporting.

Power and energy values (kW, kVAR, kVA, kWh, kVARh, kVAh) must be measured by certified utility-grade energy meters (PowerLogic ION9000/PM8000).

As an option, data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Power Advisor platform and interpreted by experts as part of the EcoStruxure Service Plan.

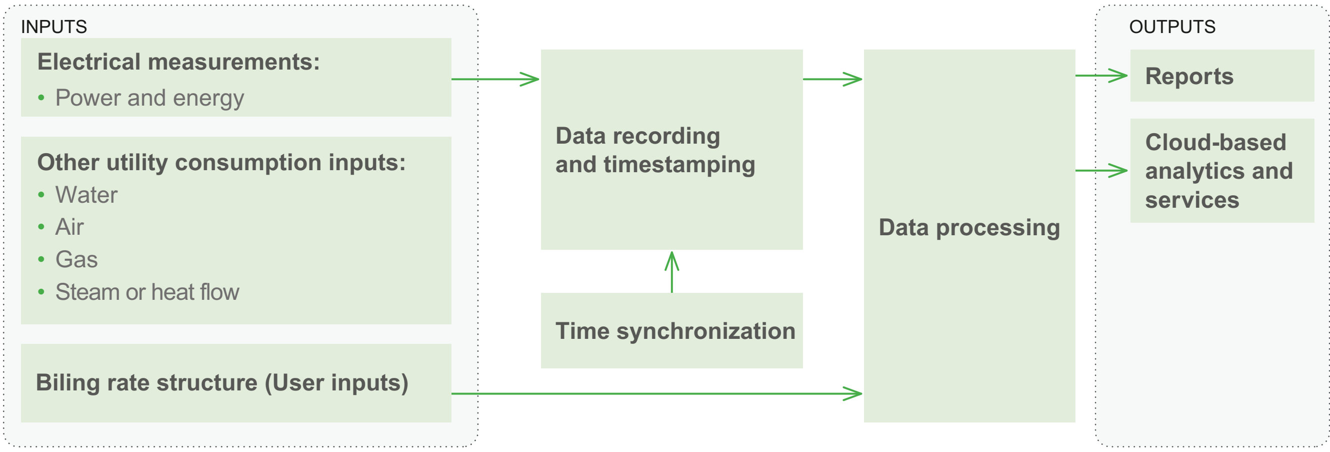
The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Utility Bill Verification application can be broken down as follows:



Inputs

The following data is required:

Electrical Measurements

Power and energy

All power values (kW, kVAR, kVA) and energy values (kWh, kVARh, kVAh) must be measured by certified utility-grade energy meters (PowerLogic ION9000/ PM8000). These meters have an equal or better accuracy than the utility meter to achieve appropriate shadow billing accuracy.


PowerLogic ION9000


PowerLogic PM8000

Other Utility Consumption Inputs

- Water
- Air
- Gas
- Steam or heat flow

These can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

Billing Rate Structure (User Inputs)

The rate structure imposed by the utility is configured in the system so that the shadow bill reflects all aspects of the actual utility bill.

Data Recording and Timestamping

For the Utility Bill Verification application, a timestamp accuracy of ±1 second is sufficient.

The above energy measurements are recorded and timestamped by onboard smart meters such as PowerLogic ION9000/PM8000.

PowerLogic
ION9000

PowerLogic
PM8000

For other WAGES[57] transducers, the signal can be recorded by EcoStruxure Power Monitoring Expert or Power Operation.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

> **NOTE:** For devices without onboard logging, there is a risk of data loss in the event of a communication interruption.

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

Time Synchronization

To achieve accurate timestamping of all power and energy data, the date and time should be accurately distributed to connected products and data loggers.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock is recommended and connects to a GPS antenna to reach the expected time precision.

TimeSync Clock

Data Processing

Shadow Billing

A comparison bill is established based on demand (power) and energy measurements.

The rate engine supports many different rate structures to take into account all contractual aspects of the utility billing:

- Tiered rates

57. Water, Air, Gas, Electricity, Steam

- Time of use
- Power factor rate
- Demand limits
- Reactive power

Outputs

Display of outputs is performed by EcoStruxure Power Monitoring Expert or Power Operation.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

The optional Billing module of EcoStruxure Power Monitoring Expert and Power Operation must be deployed to benefit from these features.

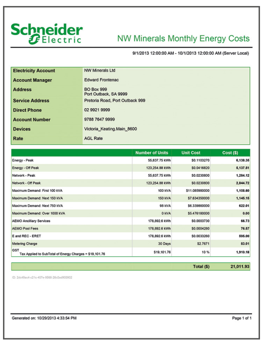
Reports

The following report can be displayed or automatically sent by email:

Billing Report

Based on certified energy measurements, the shadow bill will reflect the utility bill with the following line items:

- Energy registers reading (start/end of billing period)
- Energy consumption charge
- Transmission charge
- Line maintenance charge
- On peak and off peak usage charge
- Peak demand charge
- State tax
- Daily charge
- Processing fee
- Recycling fee
- Etc.



Schneider Electric

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9/1/2013 12:00:00 AM - 10/1/2013 12:00:00 AM (Server Local)

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Rate	AGL Rate

	Number of Units	Unit Cost	Cost ($)
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Maximum Demand: Over 1000 kVA	0 kVA	$5.476180000	0.00
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Metering Charge	30 Days	$2.7671	83.01
GST Tax Applied to SubTotal of Energy Charges = $19,101.76	$19,101.76	10 %	1,910.18
		Total ($)	21,011.93

Generated on: 10/29/2013 4:33:54 PM Page 1 of 1

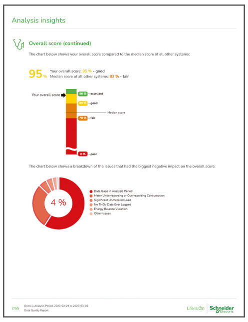
Billing Report

Cloud-Based Analytics and Services

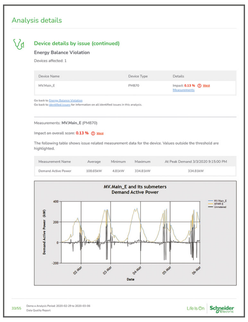
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts. Data quality means data accuracy; it helps ensure the reliability of shadow bills.

For further information, refer to Data Quality Management, page 24.

EcoStruxure Service Plan Powered by EcoStruxure Power Advisor Platform



EcoStruxure Power Advisor Electrical Health Report - Overall Score



EcoStruxure Power Advisor Electrical Health Report - Device Details by Issue

Cost Allocation

What's in This Chapter

Overview

Context of Application

"If you can't measure it, you can't improve it." Studies show that buildings or facilities with sub-metering and cost allocation use less energy than those that allocate energy cost by area (ft² or m²) or other non-metered allocation methods. Typically, a 10 to 20% reduction in usage can be achieved due to behavior change and conservation. This in turn requires that occupants or cost centers are provided with the right information to make the right decisions.

Problem to Solve

The facility manager needs to:

- Gain insight into which departments, processes, buildings, or floors are contributing to energy costs.
- Improve energy accountability by allocating costs to departments or tenants.
- Identify key areas for energy savings opportunities.

Purpose of Application

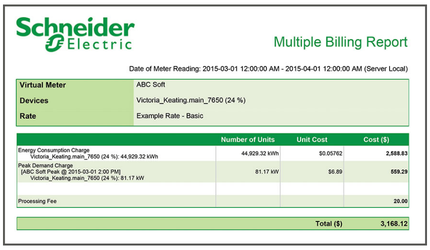
Encourage energy efficient behavior: you can encourage energy efficient behavior by allocating energy cost by department, business unit, area, floor, or building.

Find the biggest energy savings opportunities: before initiating an energy savings project, you need to understand which load type, business unit, area, floor, or building provides the biggest savings opportunities.

Application Outcomes

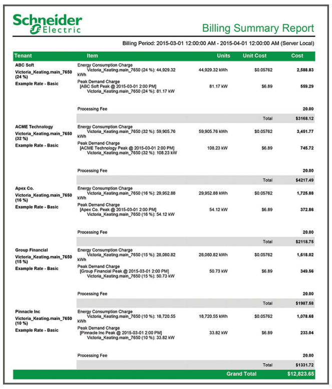
Reports

Multiple Billing Report: provides an energy cost breakdown for each tenant, area, department, or building.



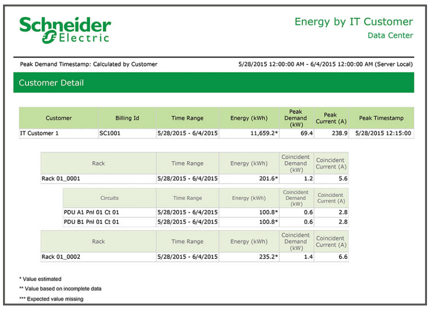
Multiple Billing Report

Billing Summary Report: provides a summary view of the Multiple Billing Report.



Billing Summary Report

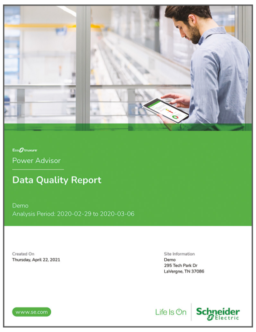
Energy Billing by IT Customer: provides information regarding energy usage for customers within a colocation data center facility. This report template also allows you to export billing information (for CSV export) and troubleshoot the billing system.



Energy Billing by IT Customer

Cloud-Based Analytics and Services

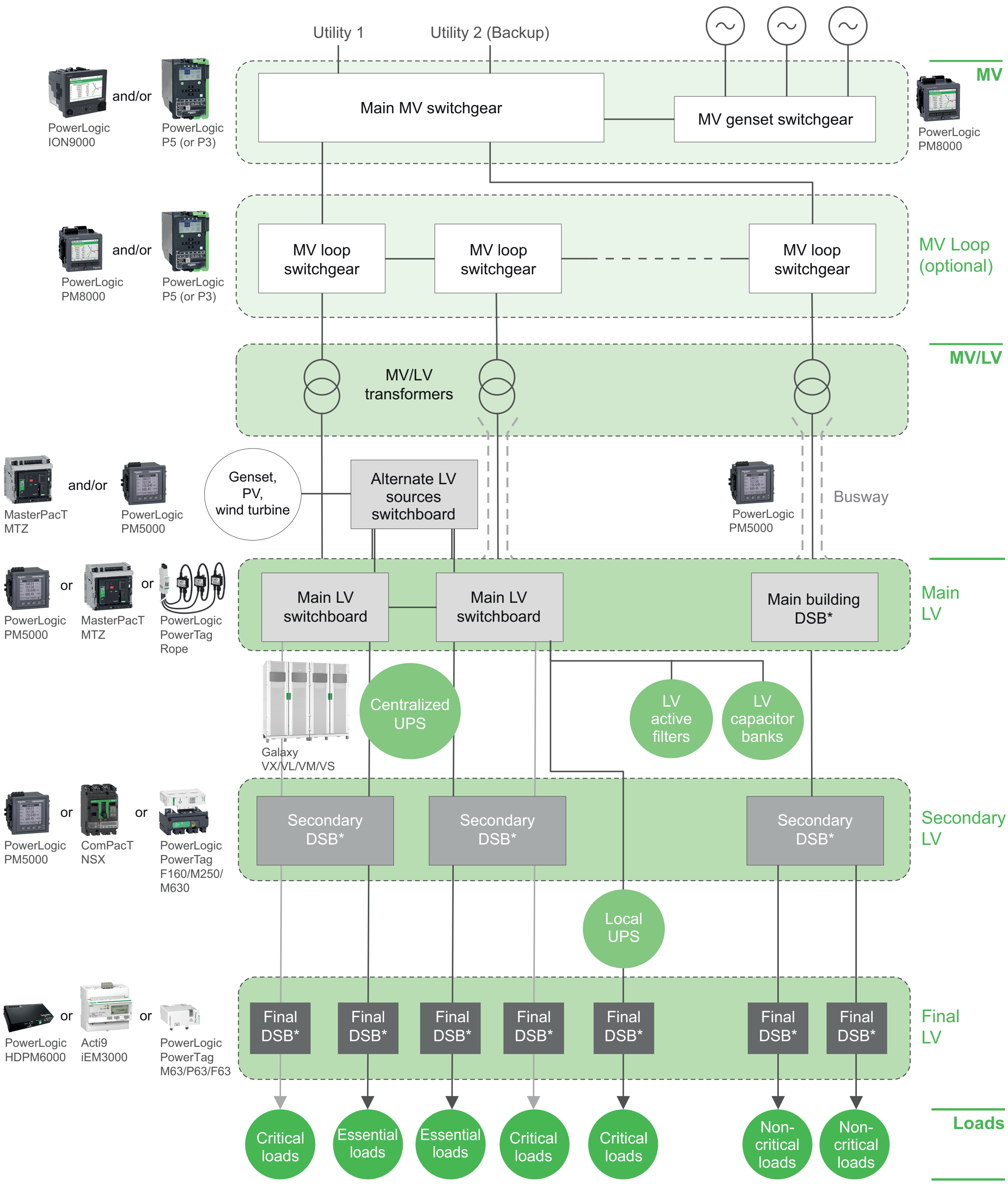
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.



EcoStruxure Power Advisor Data Quality Report

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Cost Allocation application:



* DSB = Distribution Switchboard

Digital Architecture

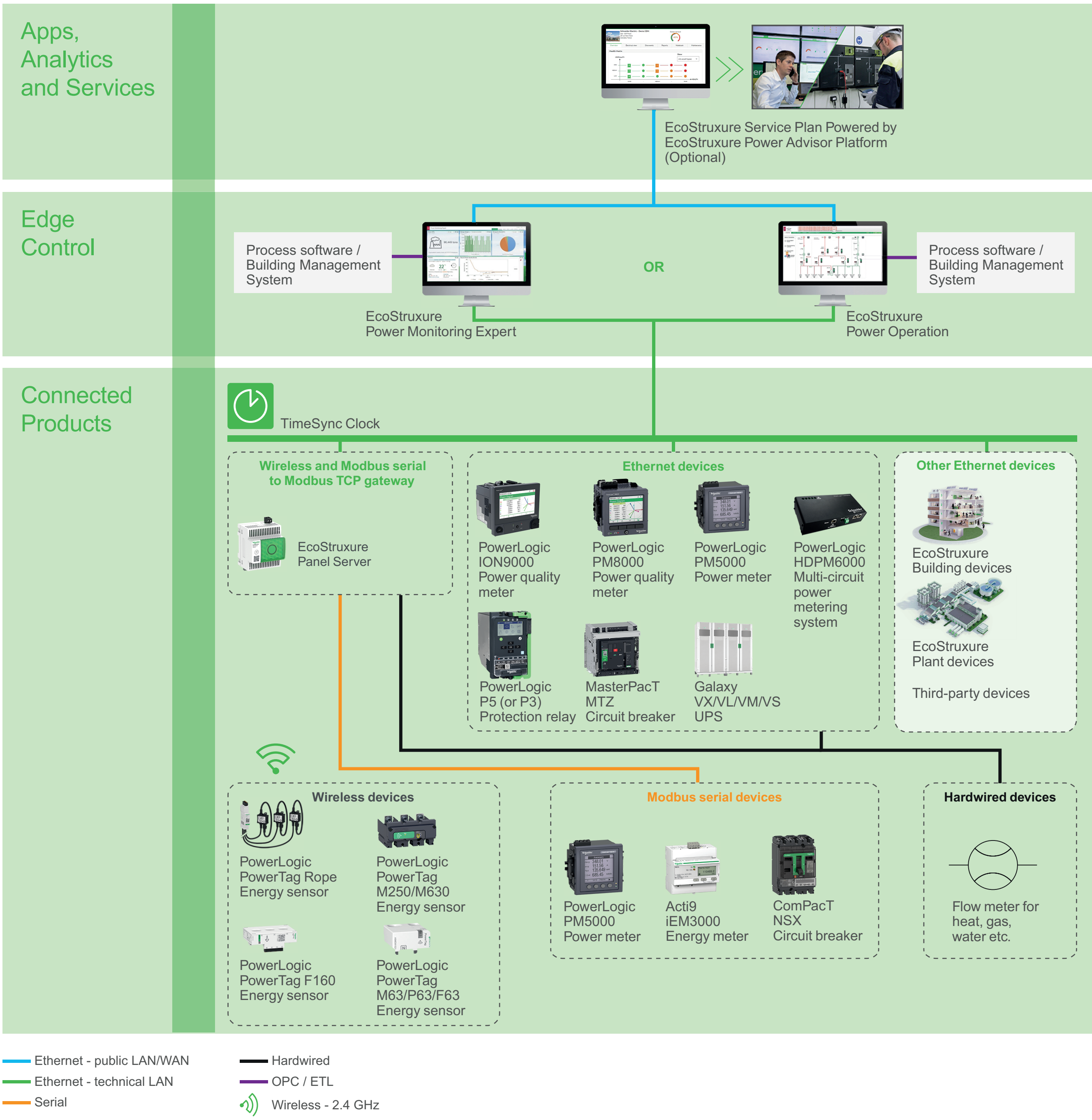
In this architecture, the data is collected from connected products either directly over Ethernet or via gateways (such as the EcoStruxure Panel Server). This data is then recorded and processed by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for on-premise visualization, analysis, and reporting.

Other utility consumption inputs (WAGES) can also be directly acquired via Ethernet, via serial communication, or through hardwired signals from basic meters and sensors.

To include other process or equipment related data in the analyses, OPC or ETL can be used to acquire data from external process or building management software.

As an option, data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Power Advisor platform and analyzed by experts as part of the EcoStruxure Service Plan.

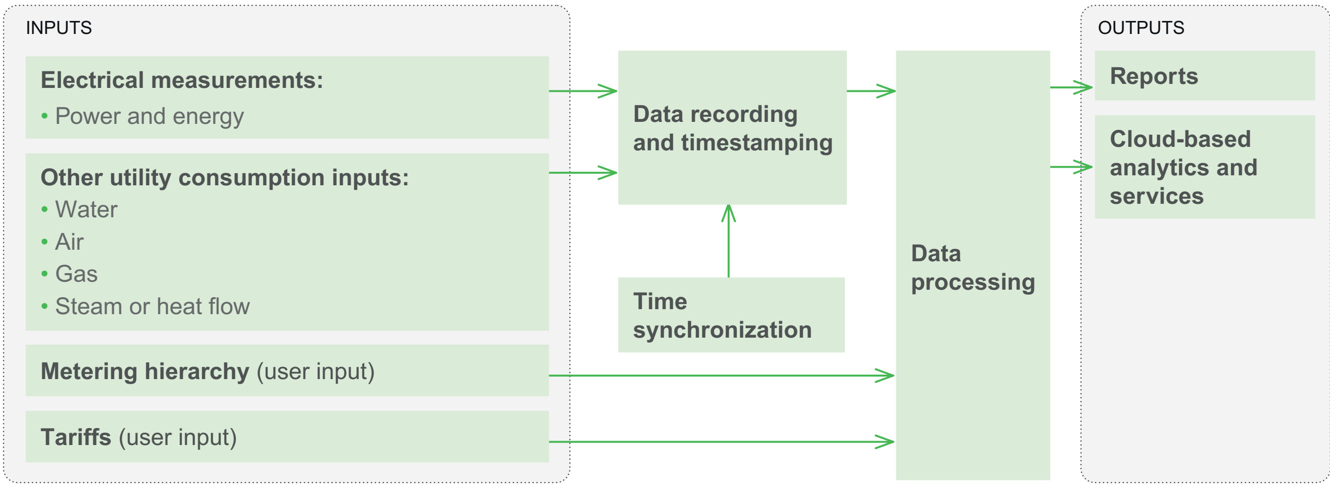
The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Cost Allocation application can be broken down as follows:



Inputs

The following data are required to implement the Cost Allocation application.

Electrical Measurements

The following electrical measurements are collected at each point of interest in the electrical distribution, from Medium Voltage, to Low Voltage, down to Final Distribution.

- Power values (kW, kVAR, kVA)
- Energy values (kWh, kVARh, kVAh)

These data may be acquired from:

- **Power/energy meters** such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, PowerTag, Acti9 iEM3000


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


PowerLogic HDPM6000


Acti9 iEM3000


PowerLogic PowerTag

- **Devices with embedded metering** such as PowerLogic P5/P3, MasterPacT MTZ, and ComPacT NSX protection devices, or Galaxy VX/VL/VM/VS UPS

PowerLogic P5

PowerLogic P3

MasterPacT MTZ

ComPacT NSX

Galaxy VX/VL/VM/VS

- **Third-party devices (via Modbus)**

Other Utility Consumption Inputs

The following utilities can be monitored:

- Water
- Air
- Gas
- Steam or heat flow

They can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

Metering Hierarchy (User Input)

Metering hierarchy correlates tenants, areas, departments, or buildings with the appropriate metering devices.

Tariffs (User Input)

To convert energy consumption into cost, you need to configure the rate file for all relevant tariffs.

Data Recording and Timestamping

For the Cost Allocation application, a timestamp accuracy of ±1 second is sufficient.

Advanced power meters such as the PowerLogic ION9000, PM8000, HDPM6000, and some PowerLogic PM5000 models (PM53xx and PM55xx) can timestamp and record onboard energy measurements. EcoStruxure Power Monitoring Expert or Power Operation can then retrieve the records with their original timestamp.


PowerLogic ION9000


PowerLogic PM8000


PowerLogic HDPM6000


PowerLogic PM5000

For other devices (PowerLogic P5/P3, MasterPacT MTZ, Galaxy VX/VL/VM/VS, entry-level PowerLogic PM5000 models, Acti9 iEM3000, PowerLogic PowerTag, etc.) energy measurements are acquired by the connected products and then recorded and timestamped by EcoStruxure Power Monitoring Expert or Power Operation.


PowerLogic P5


PowerLogic P3


MasterPacT MTZ


Galaxy VX/VL/VM/VS


PowerLogic PM5000


Acti9 iEM3000


PowerLogic PowerTag


EcoStruxure Power Monitoring Expert


EcoStruxure Power Operation

When acquiring data from other customer systems, timestamps can also be imported through OPC[58] or ETL[59].

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

Time Synchronization

For consistent timestamping of all the data, the date and time should be accurately distributed to connected products and data loggers.

58. OPC = Open Platform Communications
59. ETL = The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert and Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be connected to a GPS antenna to reach the expected time precision.

TimeSync Clock

Data Processing

The recorded energy data is converted to energy cost using the information in the rate file. It is then allocated to tenants, areas, departments, or buildings based on the metering hierarchy.

Cost allocation data processing is embedded in the optional Billing Module of EcoStruxure Power Monitoring Expert or Power Operation.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Outputs

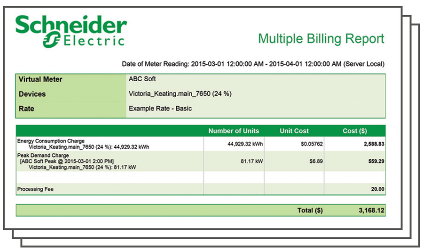
The Billing Module of EcoStruxure Power Monitoring Expert or Power Operation must be deployed to benefit from the following reports.

Reports

The following reports can be generated and displayed on-demand or automatically generated and sent by email:

Billing Reports

- **Multiple Billing Report** Provides an energy cost breakdown for each tenant, area, department, or building.



Schneider Electric

Multiple Billing Report

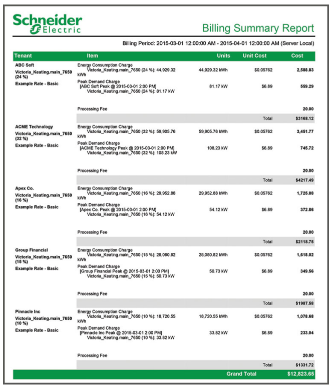
Date of Meter Reading: 2015-03-01 12:00:00 AM - 2015-04-01 12:00:00 AM (Server Local)

Virtual Meter	ABC Soft
Devices	Victoria_Keating.main_7650 (24 %)
Rate	Example Rate - Basic

	Number of Units	Unit Cost	Cost ($)
Energy Consumption Charge Victoria_Keating.main_7650 (24 %): 44,929.32 kWh	44,929.32 kWh	$0.05762	2,588.83
Peak Demand Charge [ABC Soft Peak @ 2015-03-01 2:00 PM] Victoria_Keating.main_7650 (24 %): 81.17 kW	81.17 kW	$6.89	559.29
Processing Fee			20.00
		Total ($)	3,168.12

Multiple Billing Report

- **Billing Summary Report** Provides a summary view of Multiple Billing Report.



Billing Summary Report

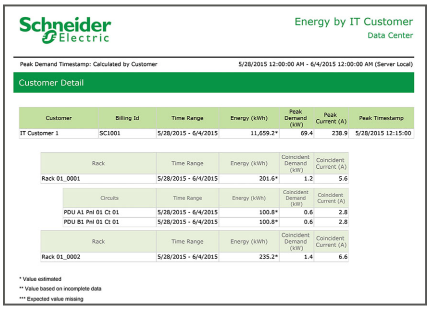
Billing Period: 2015-03-01 12:00:00 AM - 2015-04-01 12:00:00 AM (Server Local)

Tenant	Item	Units	Unit Cost	Cost
ABC Soft Victoria_Keating.main_7650 (24 %) Example Rate - Basic	Energy Consumption Charge Victoria_Keating.main_7650 (24 %): 44,929.32 kWh	44,929.32 kWh	$0.05762	2,588.83
	Peak Demand Charge [ABC Soft Peak @ 2015-03-01 2:00 PM] Victoria_Keating.main_7650 (24 %): 81.17 kW	81.17 kW	$6.89	559.29
	Processing Fee			20.00
			Total	$3168.12
ACME Technology Victoria_Keating.main_7650 (32 %) Example Rate - Basic	Energy Consumption Charge Victoria_Keating.main_7650 (32 %): 59,905.76 kWh	59,905.76 kWh	$0.05762	3,451.77
	Peak Demand Charge [ACME Technology Peak @ 2015-03-01 2:00 PM] Victoria_Keating.main_7650 (32 %): 108.23 kW	108.23 kW	$6.89	745.72
	Processing Fee			20.00
			Total	$4217.49
Apex Co. Victoria_Keating.main_7650 (16 %) Example Rate - Basic	Energy Consumption Charge Victoria_Keating.main_7650 (16 %): 29,952.88 kWh	29,952.88 kWh	$0.05762	1,725.88
	Peak Demand Charge [Apex Co. Peak @ 2015-03-01 2:00 PM] Victoria_Keating.main_7650 (16 %): 54.12 kW	54.12 kW	$6.89	372.86
	Processing Fee			20.00
			Total	$2118.75
Group Financial Victoria_Keating.main_7650 (15 %) Example Rate - Basic	Energy Consumption Charge Victoria_Keating.main_7650 (15 %): 28,080.82 kWh	28,080.82 kWh	$0.05762	1,618.02
	Peak Demand Charge [Group Financial Peak @ 2015-03-01 2:00 PM] Victoria_Keating.main_7650 (15 %): 50.73 kW	50.73 kW	$6.89	349.56
	Processing Fee			20.00
			Total	$1987.58
Pinnacle Inc Victoria_Keating.main_7650 (10 %) Example Rate - Basic	Energy Consumption Charge Victoria_Keating.main_7650 (10 %): 18,720.55 kWh	18,720.55 kWh	$0.05762	1,078.68
	Peak Demand Charge [Pinnacle Inc Peak @ 2015-03-01 2:00 PM] Victoria_Keating.main_7650 (10 %): 33.82 kW	33.82 kW	$6.89	233.04
	Processing Fee			20.00
			Total	$1331.72
			Grand Total	$12,823.65

Billing Summary Report

IT Billing Reports

- **Energy by IT Customer** Provides information regarding energy usage for users within the data center facility to allocate branch circuit consumption to users and IT racks. It also provides exporting of billing system information (for CSV export) and troubleshooting of the billing system.



Energy by IT Customer
Data Center

Peak Demand Timestamp: Calculated by Customer 5/28/2015 12:00:00 AM - 6/4/2015 12:00:00 AM (Server Local)

Customer Detail

Customer	Billing Id	Time Range	Energy (kWh)	Peak Demand (kW)	Peak Current (A)	Peak Timestamp
IT Customer 1	SC1001	5/28/2015 - 6/4/2015	11,659.2*	69.4	238.9	5/28/2015 12:15:00

Rack	Time Range	Energy (kWh)	Coincident Demand (kW)	Coincident Current (A)
Rack 01_0001	5/28/2015 - 6/4/2015	201.6*	1.2	5.6

Circuits	Time Range	Energy (kWh)	Coincident Demand (kW)	Coincident Current (A)
PDU A1 Pnl 01 Ct 01	5/28/2015 - 6/4/2015	100.8*	0.6	2.8
PDU B1 Pnl 01 Ct 01	5/28/2015 - 6/4/2015	100.8*	0.6	2.8

Rack	Time Range	Energy (kWh)	Coincident Demand (kW)	Coincident Current (A)
Rack 01_0002	5/28/2015 - 6/4/2015	235.2*	1.4	6.6

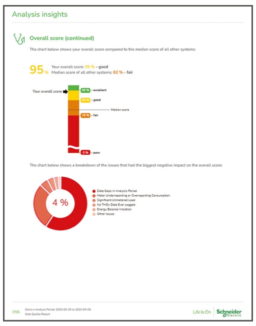
* Value estimated
** Value based on incomplete data
*** Expected value missing

Energy by IT Customer

Cloud-Based Analytics and Services

As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.

EcoStruxure Service Plan Powered by EcoStruxure Power Advisor



EcoStruxure Power Advisor Data Quality Report - Overall Score

For further information, refer to Data Quality Management, page 24.

Energy Monitoring

What's in This Chapter

Overview

Context of Application

There are numerous opportunities for saving energy in a building or critical facility. However, not all lead to profitable return on investment. In order to choose quick-win conservation measures, energy in the facility must be monitored to understand where and how it is consumed, and to understand which factors contribute the most to energy consumption and cost.

Problem to Solve

The facility/energy manager needs to:

- Raise awareness of where, when, and how energy is used.
- Find and prioritize opportunities for energy conservation.

Purpose of the Application

Become aware of energy usage

- By turning data into information and representing energy usage and consumption within easy-to-interpret graphical dashboards and reports to raise awareness of key stakeholders.

Identify quick-win opportunities for energy savings

- By comparing and visualizing hourly, daily, weekly, monthly, and yearly energy usage, and associated costs for different utilities.
- By identifying and prioritizing which load types, equipment, processes, areas, or buildings lend themselves to a better return on investment for energy conservation initiatives.

Application Outcomes

Live Data Display

Real-time energy data displayed in configurable diagrams or real-time data tables

Events and Alarms

Configure and visualize energy overconsumption events to display in a historical event log.

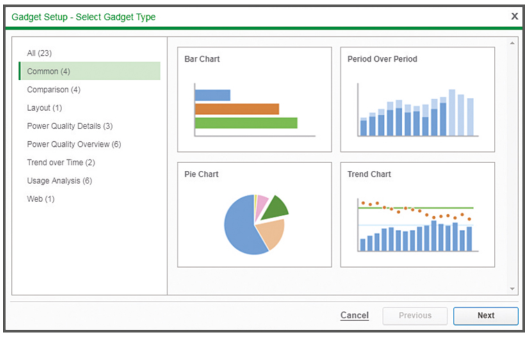
Trends

Monitor consumption (WAGES)[60] for the whole facility, specific areas, or loads in real-time charts.

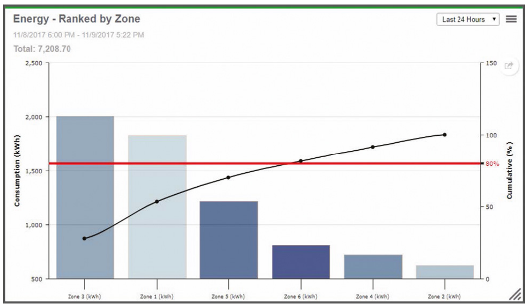
Dashboards

- Historical trends
- Energy consumption ranking
- Energy heat map
- Pareto charts
- Sankey diagram

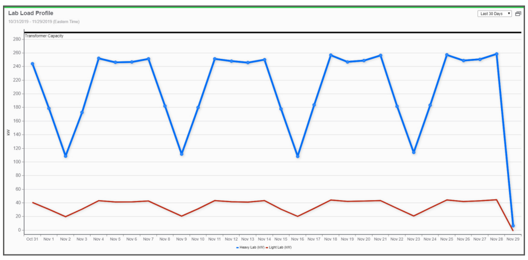
NOTE: Any of the dashboards shown can be included as part of a slideshow ("Energy Kiosk").



Configurable Dashboard Gadget Library for Analyzing Energy Usage



Pareto Chart



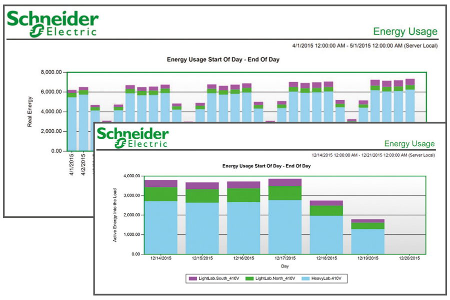
Simple Load Profile Chart

Reports

- Calendar Trend Report
- Energy Cost Report
- Energy Comparison Report
- Consumption Ranking Report

60. Water, Air, Gas, Electricity, Steam

- Hourly Usage Report
- Load Profile Report
- Energy Usage Report
- Energy Period Overperiod Report



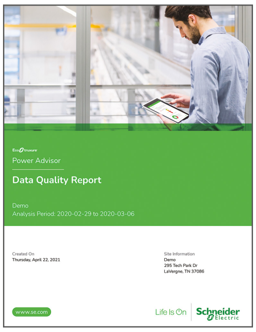
Energy Usage Report

Notifications

SMS or email notifications are sent on pre-alarm and alarm conditions described above to enable fast action.

Cloud-Based Analytics and Services

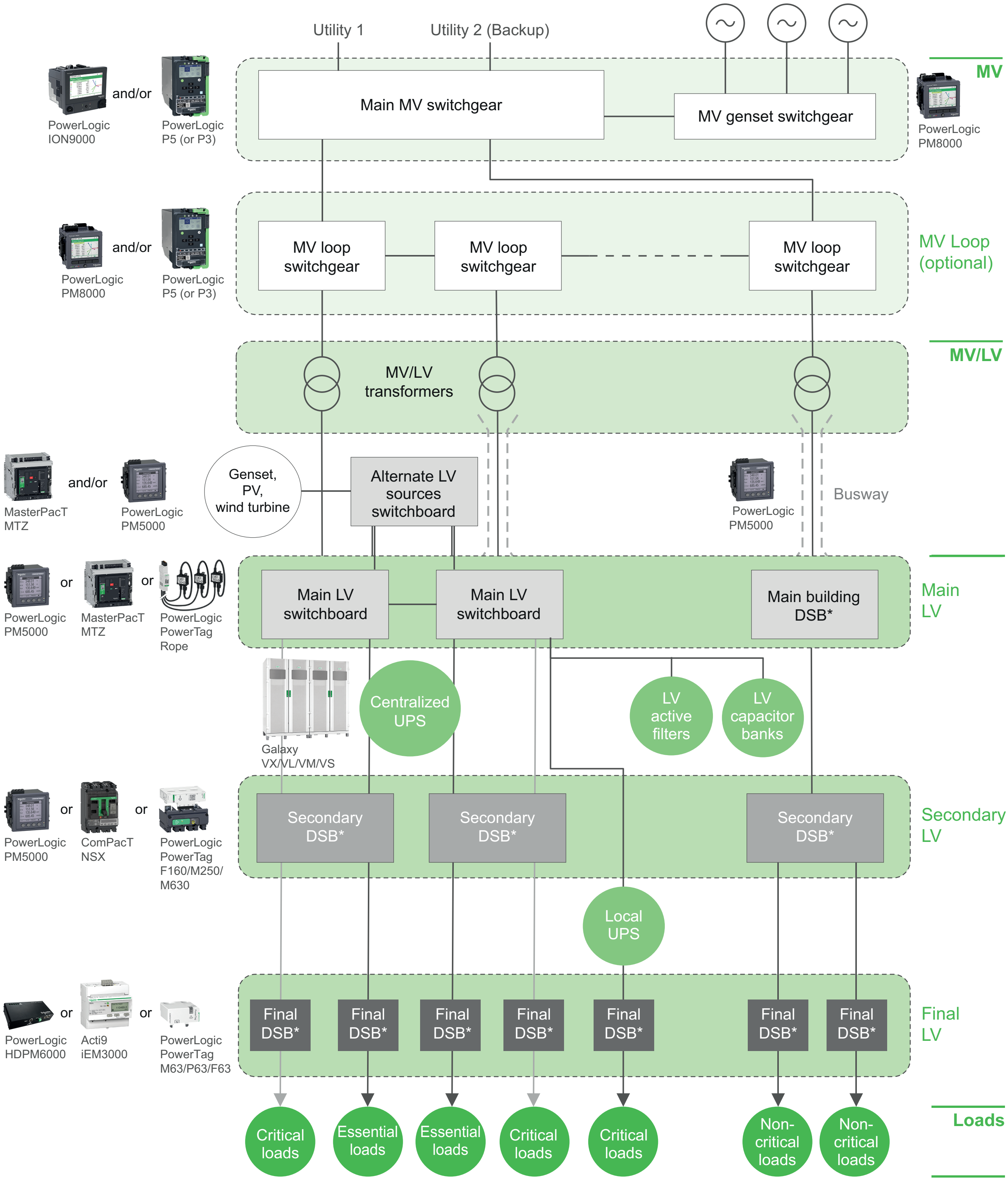
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.



EcoStruxure Power Advisor Data Quality Report

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Energy Monitoring application:



* DSB = Distribution Switchboard

Digital Architecture

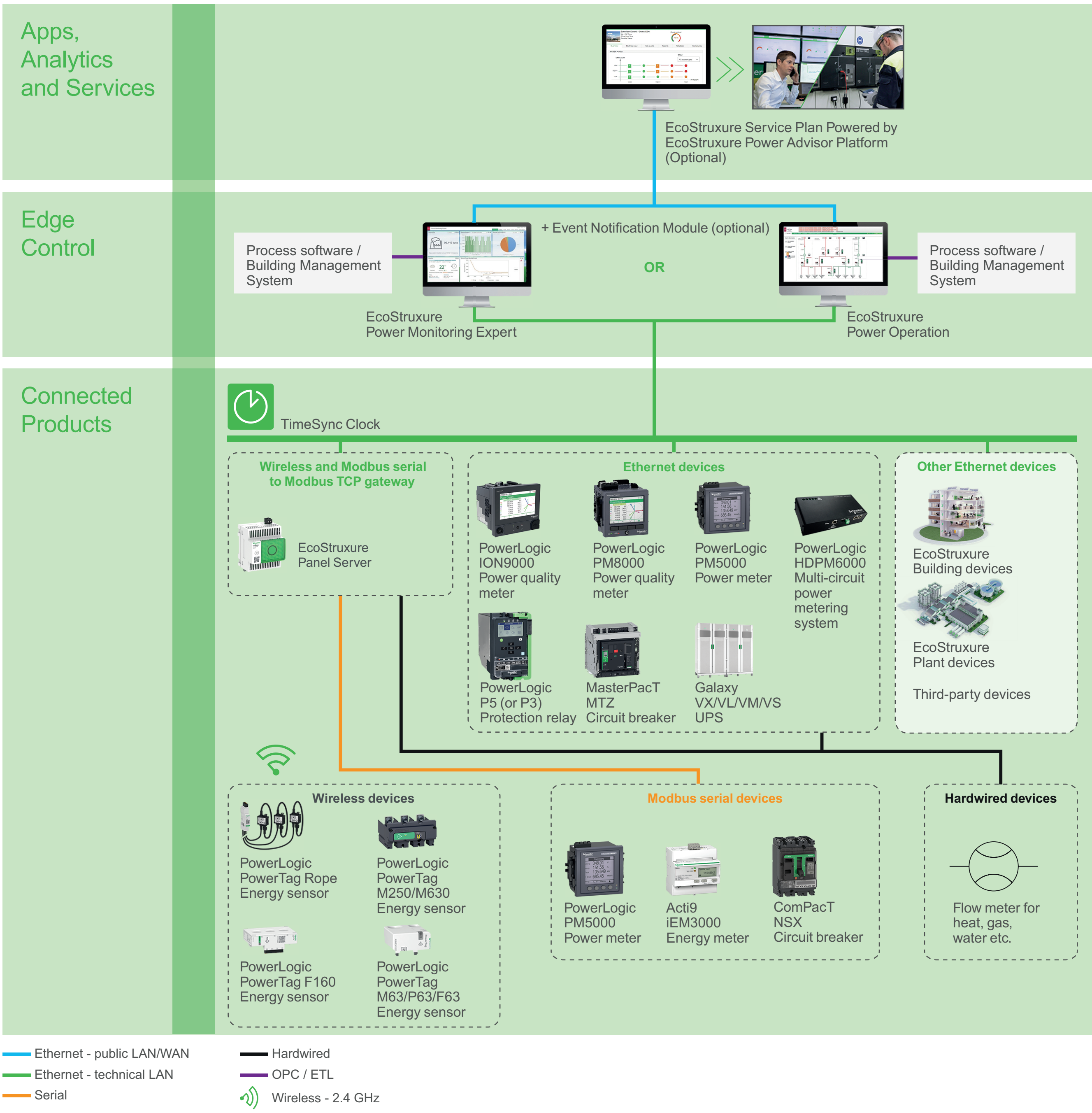
In this architecture, the data is collected from connected products either directly over Ethernet or via gateways (such as the EcoStruxure Panel Server). This data is then recorded and processed by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for on-premise visualization, analysis, and reporting.

Other utility consumption inputs (WAGES) and equipment states can also be directly acquired via Ethernet, via serial communication, or through hardwired signals from basic meters and sensors.

To include other process or equipment related data in the analyses, OPC or ETL can be used to acquire data from external process or building management software.

As an option, data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Power Advisor platform and analyzed by experts as part of the EcoStruxure Service Plan.

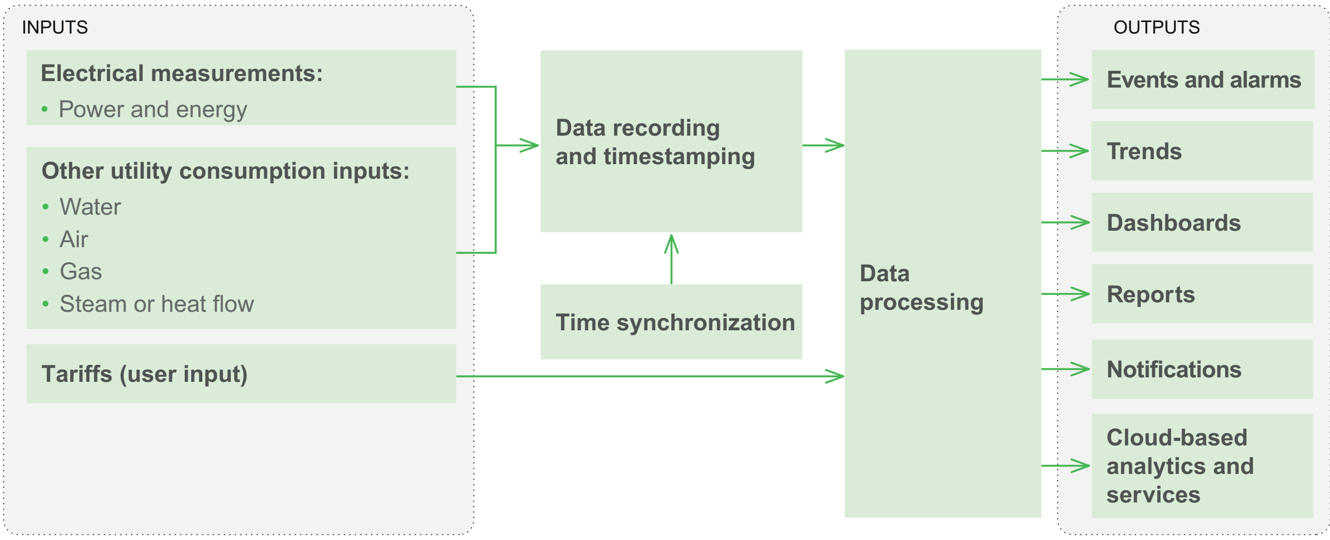
The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Energy Monitoring application can be broken down as follows:



Inputs

The following data are required to implement the Energy Monitoring application.

Electrical Measurements

The following electrical measurements are collected at each point of interest in the electrical distribution, from Medium Voltage, to Low Voltage, down to Final Distribution.

- Power values (kW, kVAR, kVA)
- Energy values (kWh, kVARh, kVAh)

These data may be acquired from:

- **Power/energy meters** such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, PowerTag, Acti9 iEM3000


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


PowerLogic HDPM6000


Acti9 iEM3000


PowerLogic PowerTag

- **Devices with embedded metering** such as PowerLogic P5/P3, MasterPacT MTZ, and ComPacT NSX protection devices, or Galaxy VX/VL/VM/VS UPS


PowerLogic P5


PowerLogic P3


MasterPacT MTZ


ComPacT NSX


Galaxy VX/VL/VM/VS

- **Third-party devices (via Modbus)**

Other Utility Consumption Inputs

The following utilities can be monitored:

- Water
- Air
- Gas
- Steam or heat flow

They can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

Tarrifs (User Input)

To convert energy consumption into cost, it is necessary to apply the relevant tariffs to the power/energy consumption values.

Data Recording and Timestamping

For the Energy Monitoring application, a timestamp accuracy of ±1 second is sufficient.

Advanced power meters such as the PowerLogic ION9000, PM8000, HDPM6000, and some PowerLogic PM5000 models (PM53xx and PM55xx) can timestamp and record onboard energy measurements. EcoStruxure Power Monitoring Expert or Power Operation can then retrieve the records with their original timestamp.


PowerLogic ION9000


PowerLogic PM8000


PowerLogic HDPM6000


PowerLogic PM5000

For other devices (PowerLogic P5/P3, MasterPacT MTZ, Galaxy VX/VL/VM/VS, entry-level PowerLogic PM5000 models, Acti9 iEM3000, PowerLogic PowerTag, etc.) energy measurements are acquired by the connected products and then recorded and timestamped by EcoStruxure Power Monitoring Expert or Power Operation.


PowerLogic P5


PowerLogic P3


MasterPacT MTZ


Galaxy VX/VL/VM/VS


PowerLogic PM5000


Acti9 iEM3000


PowerLogic PowerTag


EcoStruxure Power Monitoring Expert


EcoStruxure Power Operation

When acquiring data from other customer systems, timestamps can also be imported through OPC[61] or ETL[62].

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

Time Synchronization

For consistent timestamping of all the data, the date and time should be accurately distributed to connected products and data loggers.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be connected to a GPS antenna to reach the expected time precision.


TimeSync Clock

Data Processing

Specialized dashboards and a dedicated reporting engine analyze data to:

- Provide highlights on energy consumption according to the most relevant criteria (time of day, day of week, month, etc.).
- Visualize consumption data in an easy to interpret format (heat map, calendar trend report, consumption ranking report, etc.).

Energy data processing is embedded in the reporting engine and in the dashboards.EcoStruxure Power Monitoring Expert or Power Operation.

61. OPC = Open Platform Communications
62. ETL = The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert and Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Outputs

Outputs are displayed remotely via EcoStruxure Power Monitoring Expert or Power Operation except in specific cases.

The following outputs, when used as part of an energy management plan, can help meet relevant requirements for energy efficiency compliance standards such as ISO 50001, ISO 50002 and ISO 50006.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

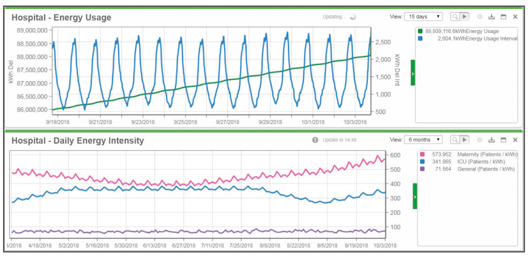
See the Energy Efficiency Compliance application for detailed information.

Events and Alarms

In EcoStruxure Power Monitoring Expert, smart setpoints provide threshold-based alarming of historical energy usage.

Trends

- Energy Usage trending
- All input data detailed above can be displayed as trends.



Energy Usage Trending

Dashboards

All dashboards can be configured to run automatically in slide show mode to perform the function of an Energy Kiosk.

Generic data display dashboards can be used:

- To analyze energy consumption parameters by day of the week, hour of the day, season, etc
- To compare different energy consumption parameters between buildings, areas or departments, and load types
- To detect increasing energy consumption caused by deteriorating equipment

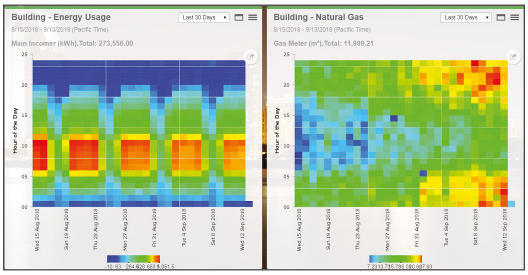
Dashboard

Energy usage gadgets [63]

The following gadgets make it easier to display and interpret energy consumption data:

- Heat map gadget

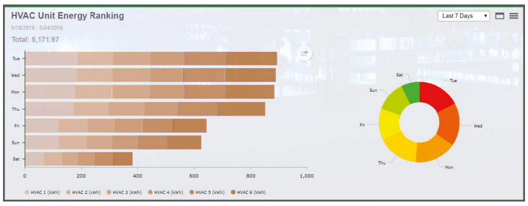
  Creates a graphical representation of data where the individual values are represented as colors in a matrix format. This gadget can be used with consumption data to identify usage patterns and anomalies.



Heat Map Gadget

- Consumption / aggregated consumption ranking gadget

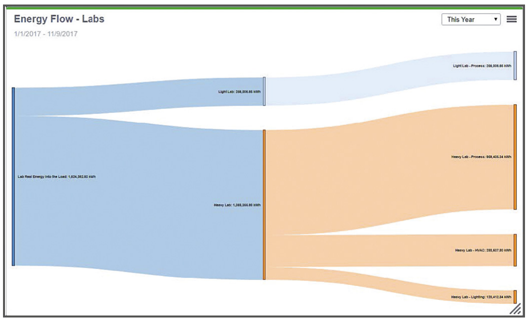
  Compares the consumption of loads during specific time intervals, for example by hour, by day of week, or by day.



Consumption/Aggregated Consumption Ranking Gadget

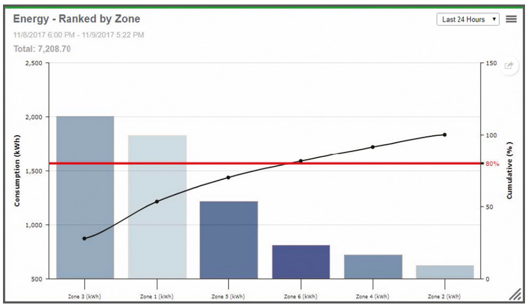
63. The Energy Analysis Dashboards Module of EcoStruxure Power Monitoring Expert must be deployed to benefit from these features.

- Sankey gadget
  - Shows a flow diagram in which the width of the arrows is proportional to the data values. The diagram starts as a combined flow for all the selected loads and then breaks out into individual flows for each consumer.
  - Used to show WAGES consumption broken down by load type or to visualize consumption costs by load. It can also be used to show power losses.



Sankey Gadget

- Pareto / aggregated pareto chart gadget
  - Used to perform an 80/20 analysis, identifying the loads that together make up the largest portion, or 80% of the overall consumption
  - Shows consumption data by load for multiple loads, over a selected time period. The information is shown in a combined column and line chart, grouped by aggregation period. The columns are arranged from highest consumption to lowest consumption with a target threshold.
  - Includes a cumulative curve based on the aggregation period consumption values.



Pareto / Aggregated Pareto Chart Gadget

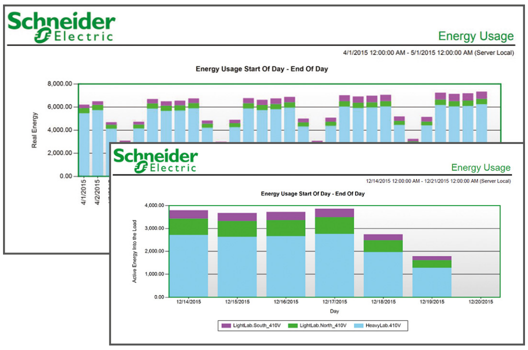
Reports

The following reports can be displayed or automatically sent by email:

Energy Management Reports:

- Energy Usage Report

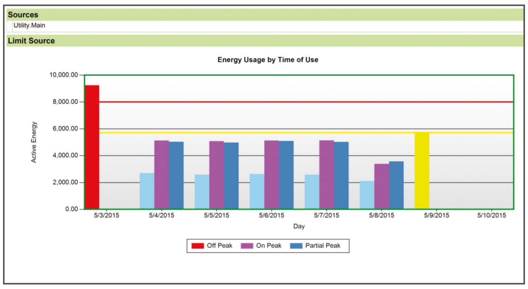
  Highlights discrepancies and provides a visual interpretation of energy consumption data.



Energy Usage Report

- Energy Usage by Time of Use Report

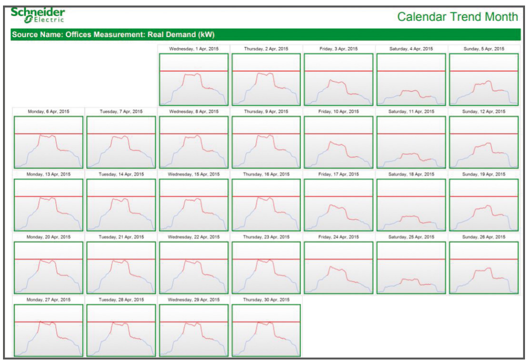
  Compares consumption for different time of use periods (on-peak vs off-peak vs partial-peak).



Energy Usage by Time of Use Report

- Calendar Trend Report

  Provides a monthly or weekly interpretation of hourly usage data, benchmarks performance targets, and identifies peak and off-peak usage patterns

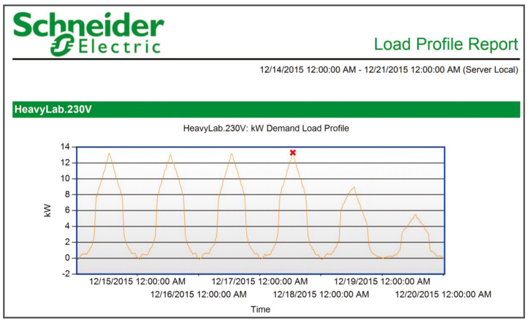


Calendar Trend Report

- Load Profile Report

  Creates a graphical representation of demand or load levels over a period of time. The profile shows peak loads as points on the graph where peak electricity demand is high. A load trend report can be used to analyze the electrical loads at the time of maximum demand.

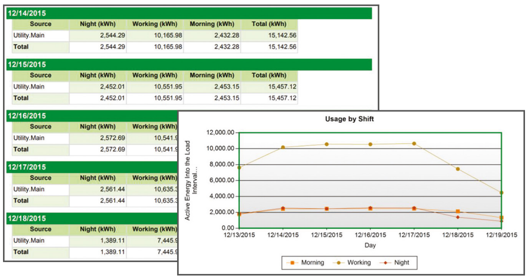
  This information can show opportunities for developing strategies to improve energy management.



Load Profile Report

- Energy Usage by Shift Report

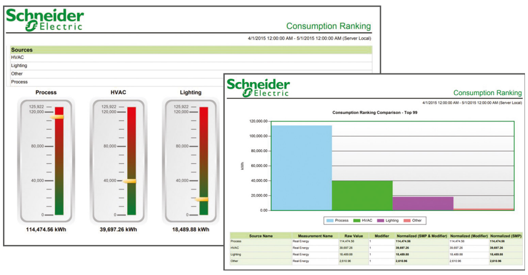
  Compares a measurement from multiple devices for specified time periods (or shifts). This enables energy consumption comparison between shifts (for example, 6:00-1:00 vs. 1:00 to 8:00).



Energy Usage by Shift Report

- Consumption Ranking Report

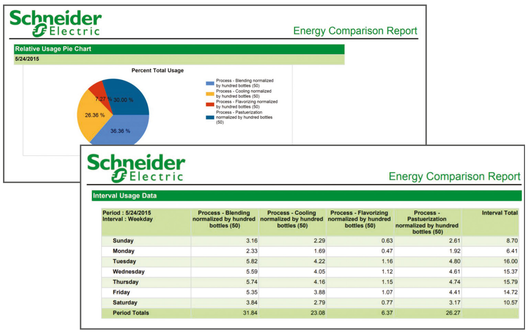
  Highlights the relative ranking of energy consumption for several loads or areas. Consumption data can be normalized to facilitate the comparison. This report is intended to assist in building energy awareness through relative visualization.



Consumption Ranking Report

- Energy Comparison Report

  Compares energy consumption by process, equipment, or area.

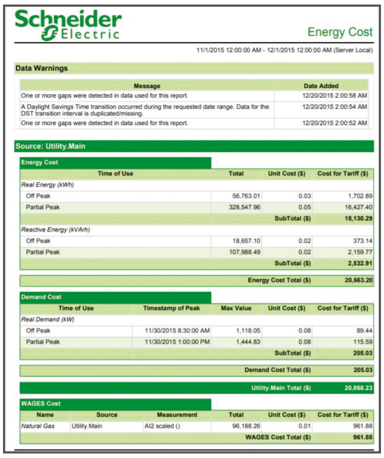


Period : 5/24/2015 Interval : Weekday	Process - Blending normalized by hundred bottles (50)	Process - Cooling normalized by hundred bottles (50)	Process - Flavorizing normalized by hundred bottles (50)	Process - Pastuerization normalized by hundred bottles (50)	Interval Total
Sunday	3.16	2.29	0.63	2.61	8.70
Monday	2.33	1.69	0.47	1.92	6.41
Tuesday	5.82	4.22	1.16	4.80	16.00
Wednesday	5.59	4.05	1.12	4.61	15.37
Thursday	5.74	4.16	1.15	4.74	15.79
Friday	5.35	3.88	1.07	4.41	14.72
Saturday	3.84	2.79	0.77	3.17	10.57
Period Totals	31.84	23.08	6.37	26.27	

Energy Comparison Report

- Energy Cost Report

  Converts energy consumption into cost by applying the relevant tariffs.



Data Warnings

Message	Date Added
One or more gaps were detected in data used for this report.	12/20/2015 2:00:58 AM
A Daylight Savings Time transition occurred during the requested date range. Data for the DST transition interval is duplicated/missing.	12/20/2015 2:00:54 AM
One or more gaps were detected in data used for this report.	12/20/2015 2:00:52 AM

Source: Utility.Main

Energy Cost

Time of Use	Total	Unit Cost ($)	Cost for Tariff ($)
Real Energy (kWh)			
Off Peak	56,763.01	0.03	1,702.89
Partial Peak	328,547.96	0.05	16,427.40
		SubTotal ($)	18,130.29
Reactive Energy (kVArh)			
Off Peak	18,657.10	0.02	373.14
Partial Peak	107,988.49	0.02	2,159.77
		SubTotal ($)	2,532.91
		Energy Cost Total ($)	20,663.20

Demand Cost

Time of Use	Timestamp of Peak	Max Value	Unit Cost ($)	Cost for Tariff ($)
Real Demand (kW)				
Off Peak	11/30/2015 8:30:00 AM	1,118.05	0.08	89.44
Partial Peak	11/30/2015 1:00:00 PM	1,444.83	0.08	115.59
			SubTotal ($)	205.03
			Demand Cost Total ($)	205.03
			Utility.Main Total ($)	20,868.23

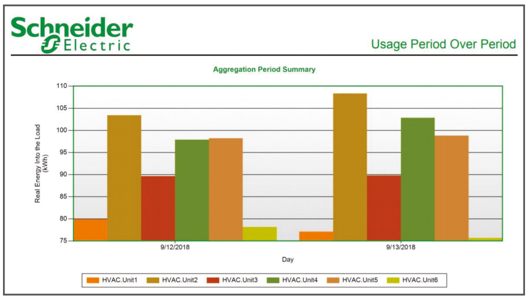
WAGES Cost

Name	Source	Measurement	Total	Unit Cost ($)	Cost for Tariff ($)
Natural Gas	Utility.Main	AI2 scaled ()	96,188.26	0.01	961.88
				WAGES Cost Total ($)	961.88

Energy Cost Report

- Energy Period Over Period Report

  Shows consumption data for the same measurement for two different viewing periods side-by-side.



Energy Period Over Period Report

Notifications[64]

SMS or email notifications are sent on pre-alarm and alarm conditions described above to enable fast action.

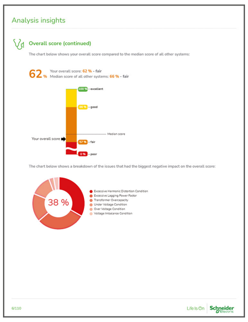
64. For notifications in EcoStruxure Power Monitoring Expert and Power Operation, the Event Notification Module is required.

Cloud-Based Analytics and Services

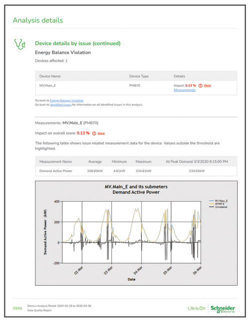
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.

For further information, refer to Data Quality Management, page 24.

EcoStruxure Service Plan powered by EcoStruxure Power Advisor Platform



EcoStruxure Power Advisor Data Quality Report - Overall Score



EcoStruxure Power Advisor Data Quality Report - Device Details by Issue

Energy Benchmarking

What's in This Chapter

Overview

Context of Application

Benchmarking is the practice of comparing the measured performance of a device, process, facility, or organization to itself, its peers, or established norms, with the goal of informing and motivating performance improvement. When applied to building energy use, benchmarking serves as a mechanism to measure energy performance of a single building over time, relative to other similar buildings, or to modeled simulations of a reference building built to a specific standard (such as an energy code)[65]

Problem to Solve

The facility manager needs to:

- Benchmark energy usage with respect to other comparable devices, processes, facilities, or departments managed from a single location (identify efficient facility vs inefficient facility).
- Identify outliers and other levers to target energy savings programs.

Purpose of the Application

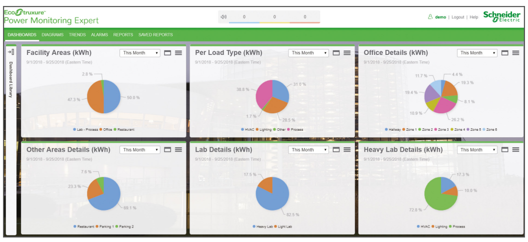
Benchmark multi-site energy usages

- Multi-site visualization to enable benchmarking across multiple organizations, facilities, processes, or devices from a centralized location
- Comparison of energy usage by normalizing consumption with respect to area, production volume, or other drivers

The good performers could be used as a model to improve the poor performers.

Improve understanding

It improves understanding of what makes an efficient organization, facility, process, or device use less energy than an inefficient one.



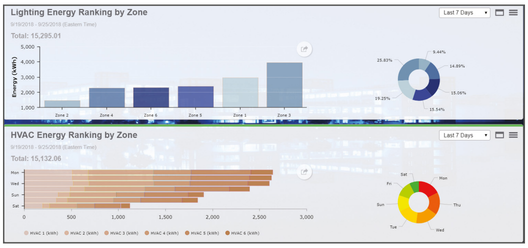
Building Area Benchmarking

65. Source: https://www.energy.gov/eere/slsc/building-energy-use-benchmarking

Application Outcomes

Dashboards

- Energy comparison and ranking dashboards
- Building energy rating gadget



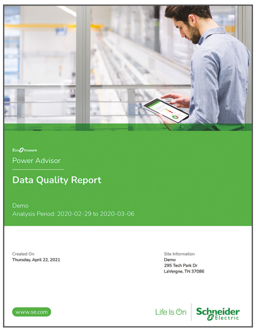
Energy Ranking by Zone

Reports

- Consumption Ranking Report
- Energy Comparison Report
- Calendar Trend Reports for benchmarking energy usage by load type and day of the week

Cloud-Based Analytics and Services

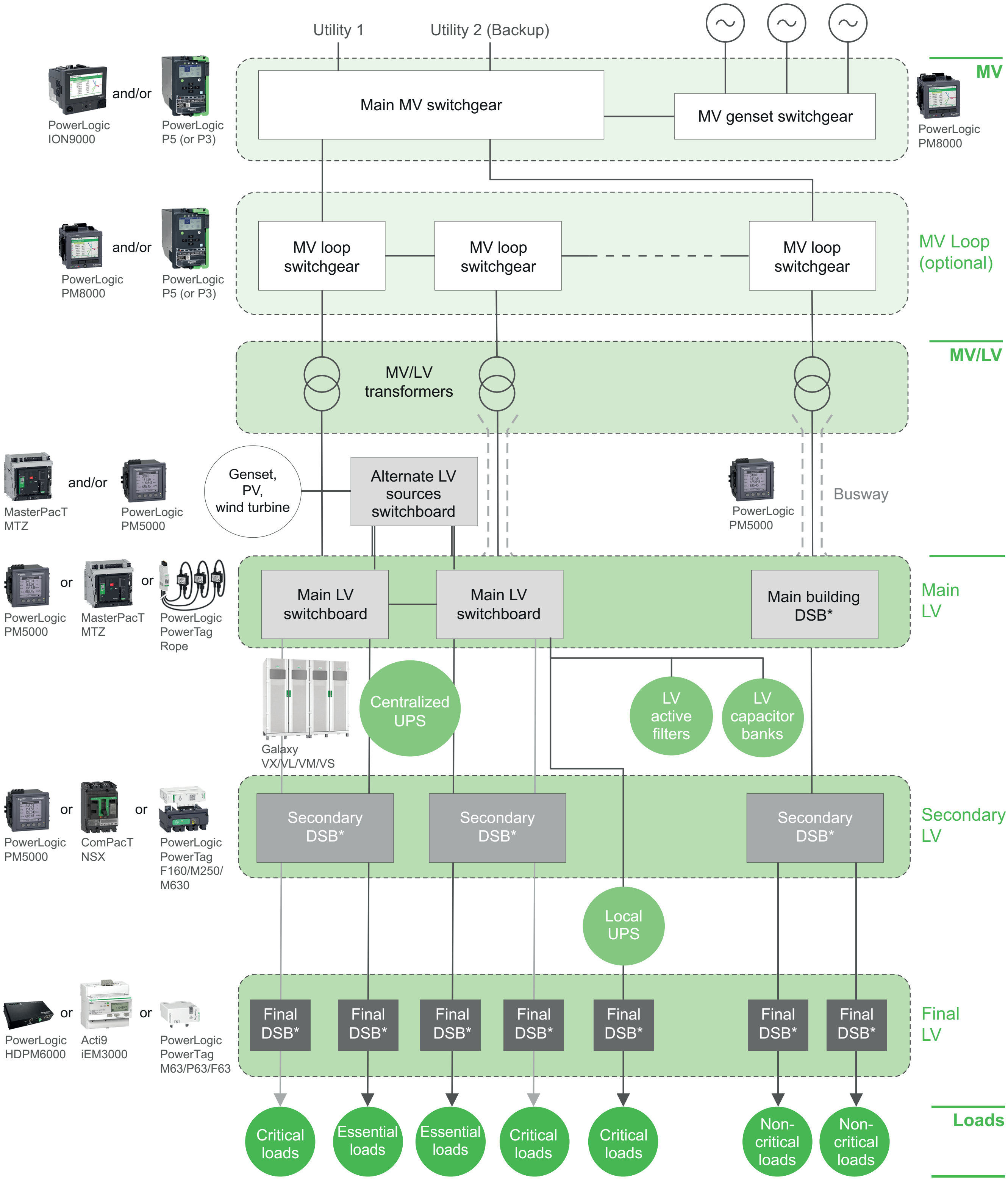
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.



EcoStruxure Power Advisor Data Quality Report

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Energy Benchmarking application:



* DSB = Distribution Switchboard

Digital Architecture

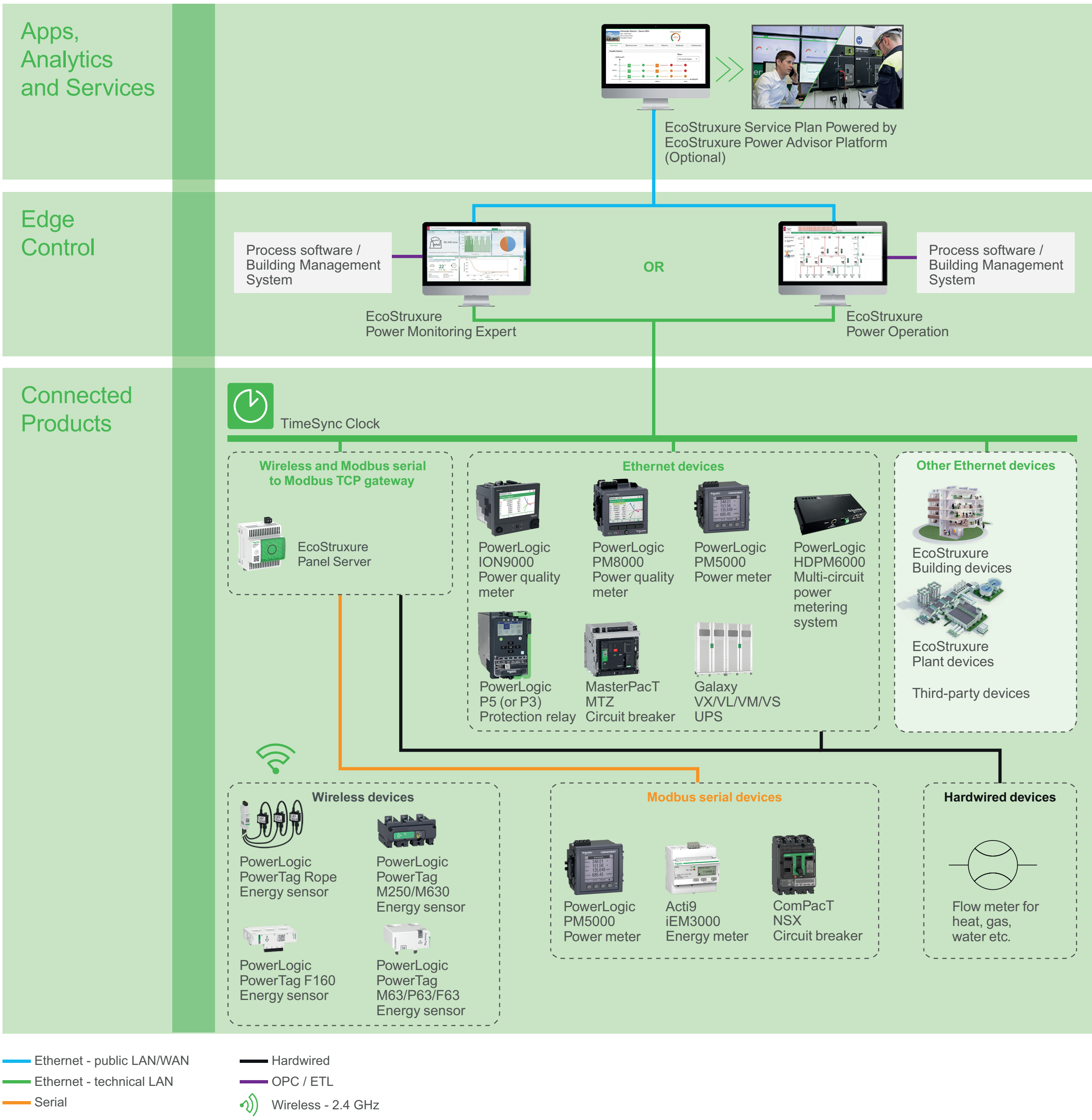
In this architecture, the data is collected from connected products either directly over Ethernet or via gateways (such as the EcoStruxure Panel Server). This data is then recorded and processed by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for on-premise visualization, analysis, and reporting.

Other utility consumption inputs (WAGES) and equipment states can also be directly acquired via Ethernet, via serial communication, or through hardwired signals from basic meters and sensors.

To include other process or equipment related data in the analyses, OPC or ETL can be used to acquire data from external process or building management software.

As an option, data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Power Advisor platform and analyzed by experts as part of the EcoStruxure Service Plan.

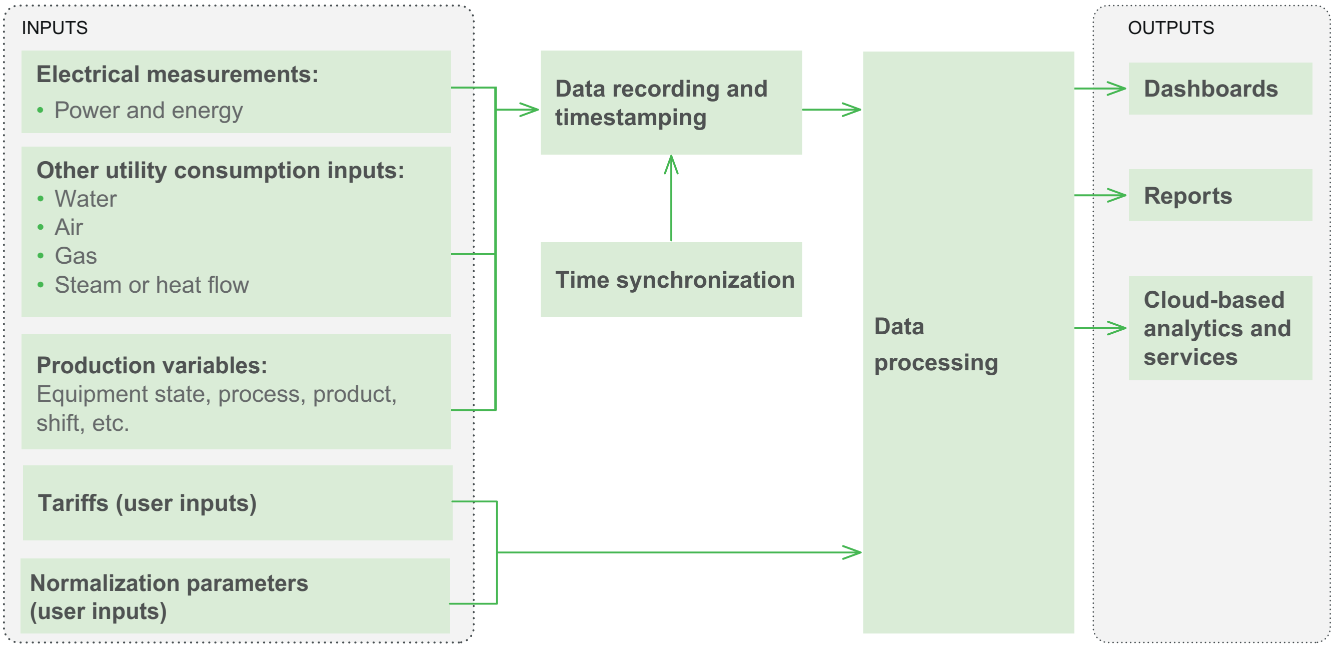
The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Energy Benchmarking application can be broken down as follows:



Inputs

The following data are required to implement the Energy Benchmarking application.

Electrical Measurements

The following electrical measurements are collected at each point of interest in the electrical distribution, from Medium Voltage, to Low Voltage, down to Final Distribution.

- Power values (kW, kVAR, kVA)
- Energy values (kWh, kVARh, kVAh)

These data may be acquired from:

- **Power/energy meters** such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, PowerTag, Acti9 iEM3000


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


PowerLogic HDPM6000


Acti9 iEM3000


PowerLogic PowerTag

- **Devices with embedded metering** such as PowerLogic P5/P3, MasterPacT MTZ, and ComPacT NSX protection devices, or Galaxy VX/VL/VM/VS UPS


PowerLogic P5


PowerLogic P3


MasterPacT MTZ


ComPacT NSX


Galaxy VX/VL/VM/VS

- **Third-party devices (via Modbus)**

Other Utility Consumption Inputs

The following utilities can be monitored:

- Water
- Air
- Gas
- Steam or heat flow

They can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

Production Variables

To correlate energy consumption with the different production variables such as equipment states, processes, production lines, products produced, shifts, etc., these production variables must be monitored, recorded, and used to normalize the respective energy consumption.

Examples:

- Process batch A/B/C/
- Product X/Y/Z produced on which machine during which shift
- Equipment in normal/maintenance mode
- Motor low/medium/high speed

These can be imported in EcoStruxure Power Monitoring Expert or Power Operation from customer production systems through OPC[66] or ETL[67]


EcoStruxure Power Monitoring Expert


EcoStruxure Power Operation

Alternatively, these can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

Normalization Parameters (User Input)

Normalize consumption with respect to comparable devices, processes, facilities, departments, or similar normalization parameters. These parameters are typically

66. OPC: Open Platform Communications
67. The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert or Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.

entered manually into the dashboards, reports, or calculation engine of EcoStruxure Power Monitoring Expert or Power Operation.


EcoStruxure
Power Monitoring Expert


EcoStruxure
Power Operation

Tariffs (User Input, Optional)

Tariffs can be used to convert energy or water consumption into cost.

Data Recording and Timestamping

For the Energy Benchmarking application, a timestamp accuracy of ±1 second is sufficient.

Advanced power meters such as the PowerLogic ION9000, PM8000, HDPM6000, and some PowerLogic PM5000 models (PM53xx and PM55xx) can timestamp and record onboard energy measurements as well as connected equipment states. EcoStruxure Power Monitoring Expert or Power Operation can then retrieve the records with their original timestamp.


PowerLogic
ION9000


PowerLogic
PM8000


PowerLogic
HDPM6000


PowerLogic
PM5000

For other devices (PowerLogic P5/P3, MasterPacT MTZ, Galaxy VX/VL/VM/VS, entry-level PowerLogic PM5000 models, Acti9 iEM3000, PowerLogic PowerTag, etc.) energy measurements and equipment states are acquired by the connected products and then recorded and timestamped by EcoStruxure Power Monitoring Expert or Power Operation.


PowerLogic
P5


PowerLogic
P3


MasterPacT
MTZ


Galaxy
VX/VL/VM/VS


PowerLogic
PM5000


Acti9
iEM3000


PowerLogic
PowerTag


EcoStruxure
Power Monitoring Expert


EcoStruxure
Power Operation

When acquiring data from other customer systems, timestamps can also be imported through OPC[68] or ETL[69].

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

Time Synchronization

For consistent timestamping of all the data, the date and time should be accurately distributed to connected products and data loggers.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be connected to a GPS antenna to reach the expected time precision.

TimeSync Clock

Data Processing

This application focuses on comparing the measured performance of a device, process, facility, or organization with respect to its peers, but also with respect to some standards (such as building energy ratings).

The calculation engine in EcoStruxure Power Monitoring Expert andPower Operation provides the ability to normalize consumption data with respect to the normalization parameters described above.

This allows for meaningful benchmarking by comparing like to like.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Outputs

Outputs are displayed by EcoStruxure Power Monitoring Expert or Power Operation.

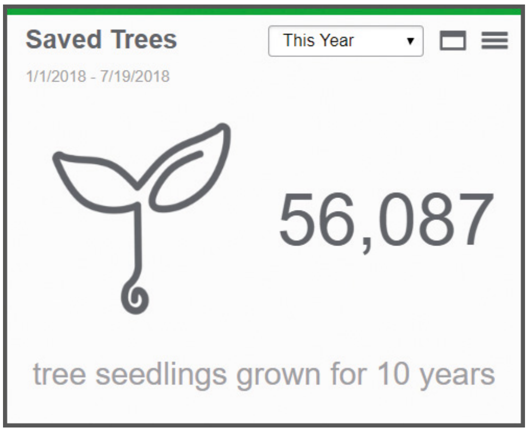
Dashboards

The following gadgets ease visualization and interpretation of energy consumption data:

Energy Equivalency Gadget

68. OPC = Open Platform Communications
69. ETL = The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert and Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.

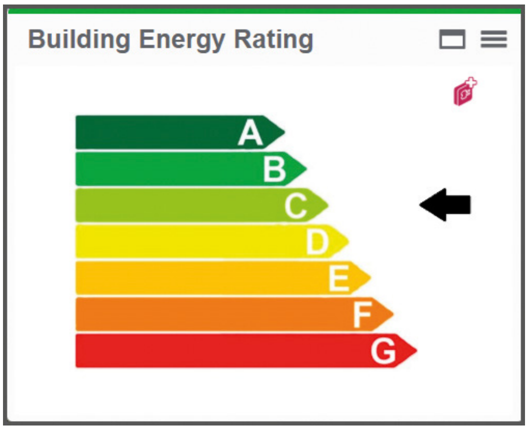
Shows a single value that is equivalent to the aggregated consumption input data, over a selected time period. The value can be scaled or normalized to represent an equivalent consumption measurement. The information is shown as a numeric value with unit, a custom text, and a custom graphic.



Energy Equivalency Gadget

Building Energy Rating (BER) Gadget

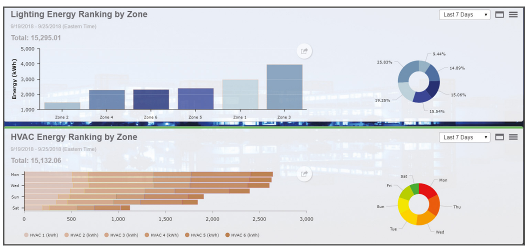
Displays a graphical representation of the energy performance of a building. It is similar to energy ratings commonly displayed on consumer products.



Building Energy Rating Gadget

Consumption Ranking Gadget [70]

Compares the consumption of different loads, areas, processes, or buildings over a period of time.

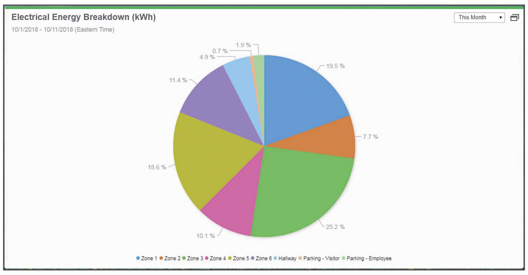


Consumption Ranking Gadget

Consumption Comparison

By creating several gadgets for each area, process, or building of interest, with normalized consumption details, it is possible to benchmark their consumption with respect to each other

70. The Energy Analysis Dashboards Module of EcoStruxure Power Monitoring Expert must be deployed to benefit from this gadget and other energy analysis visualizations.



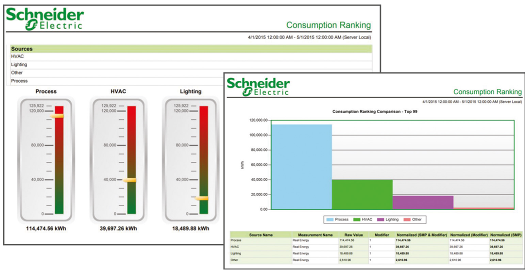
Consumption Comparison

Reports

The following Energy Management reports can be displayed or automatically sent by email:

Consumption Ranking Report

- Displays the relative ranking of energy consumption for one or more source/ measurement pairs. Consumption data can be normalized to facilitate comparison.
- Intended to assist in building energy awareness through relative visualization.

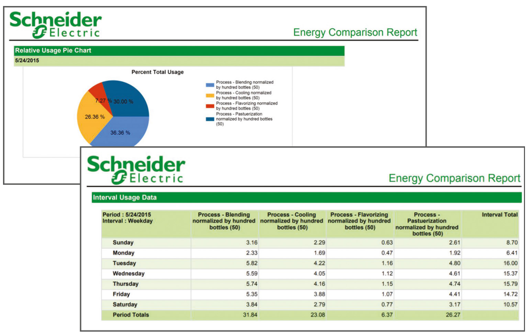


Consumption Ranking Report

Energy Comparison Report

- Compares different load types on a particular source to perform building benchmarking.
- Converts energy to a common energy unit and can normalize energy by criteria, such as area. Results are shown with either bar or pie charts.

Both reports can be used to benchmark the energy consumption of areas, processes, devices, or buildings with respect to each other.



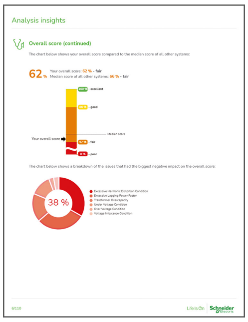
Energy Comparison Report

Cloud-Based Analytics and Services

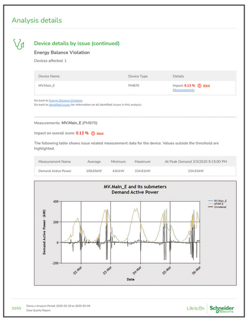
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.

For further information, refer to Data Quality Management, page 24.

EcoStruxure Service Plan Powered by EcoStruxure Power Advisor Platform



EcoStruxure Power Advisor Data Quality Report - Overall Score



EcoStruxure Power Advisor Data Quality Report - Device Details by Issue

Energy Performance

What's in This Chapter

Overview

Context of Application

Once the basic energy conservation measures have been identified, the next step in the energy management journey is to continuously optimize energy usage efficiency. Understanding the true energy efficiency is best achieved by normalizing energy usage within the context of production processes, building areas, shifts, working hours, or other contextual data to help identify areas to optimize through operational or behavioral changes.

Problem to Solve

The facility/energy manager needs to:

- Understand the energy intensity of the facility's operations.
- Implement changes to process or building controls, energy production/ consumption, or operator behavior to continuously improve energy efficiency.

Purpose of the Application

Normalize energy data to give it context

- Relate energy efficiency data with relevant operational context.
- Establish baselines of energy intensity for buildings, processes, areas, shifts, or products.

Establish normalized baselines for comparison against best performing processes, operations, buildings, or shifts

- Compare performance of a production line, building, area, or shift to find areas to optimize.
- Implement changes to operations, procedures, or staff behaviors to continuously improve energy usage.

Application Outcomes

Events and Alarms

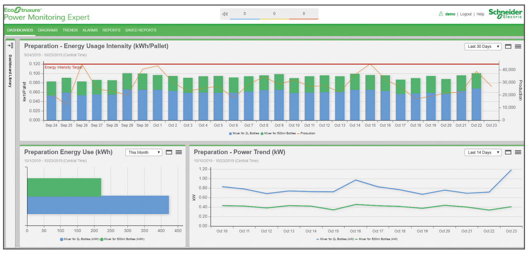
System events and alarms are displayed in chronological order with sorting and filtering capabilities.

Trends

Real-time and historical data can be viewed on a trend viewer.

Dashboards

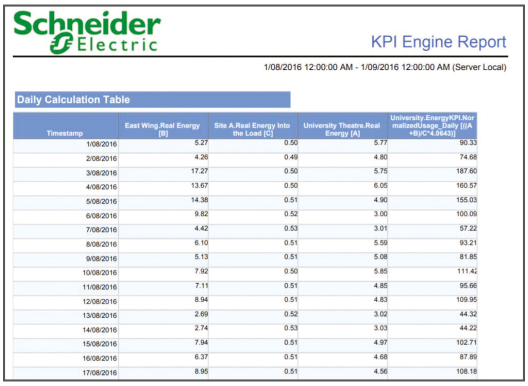
- Key Performance Indicators (KPI): energy per unit of production, energy per shift, energy per process order, energy per production state
- Energy Intensity



KPI Dashboard

Reports

- Duration Curve Report
- Energy Usage per State Report
- Power Usage per State Report
- Power Usages Summary Report
- KPI Engine Report
- Energy Usage by Shift Report[71]
- Single Equipment Operation Report
- Multi-equipment Operation Report



Schneider Electric

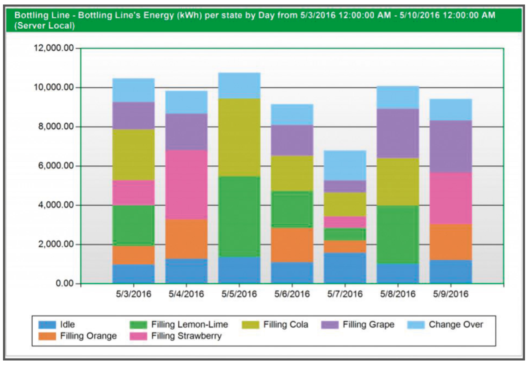
KPI Engine Report

1/08/2016 12:00:00 AM - 1/09/2016 12:00:00 AM (Server Local)

Daily Calculation Table

Timestamp	East Wing.Real Energy [B]	Site A.Real Energy Into the Load [C]	University Theatre.Real Energy [A]	University.EnergyKPI.NormalizedUsage_Daily [((A+B)/C*4.0643)]
1/08/2016	5.27	0.50	5.77	90.33
2/08/2016	4.26	0.49	4.80	74.68
3/08/2016	17.27	0.50	5.75	187.60
4/08/2016	13.67	0.50	6.05	160.57
5/08/2016	14.38	0.51	4.90	155.03
6/08/2016	9.82	0.52	3.00	100.09
7/08/2016	4.42	0.53	3.01	57.22
8/08/2016	6.10	0.51	5.59	93.21
9/08/2016	5.13	0.51	5.08	81.85
10/08/2016	7.92	0.50	5.85	111.42
11/08/2016	7.11	0.51	4.85	95.66
12/08/2016	8.94	0.51	4.83	109.95
13/08/2016	2.69	0.52	3.02	44.32
14/08/2016	2.74	0.53	3.03	44.22
15/08/2016	7.94	0.51	4.97	102.71
16/08/2016	6.37	0.51	4.68	87.89
17/08/2016	8.95	0.51	4.56	108.18

KPI Engine Report

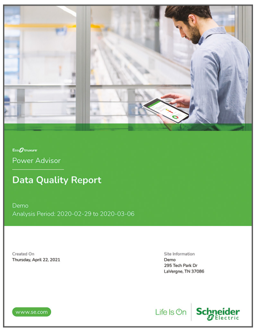


Energy Usage Report

71. Uses static, pre-configured shift information.

Cloud-Based Analytics and Services

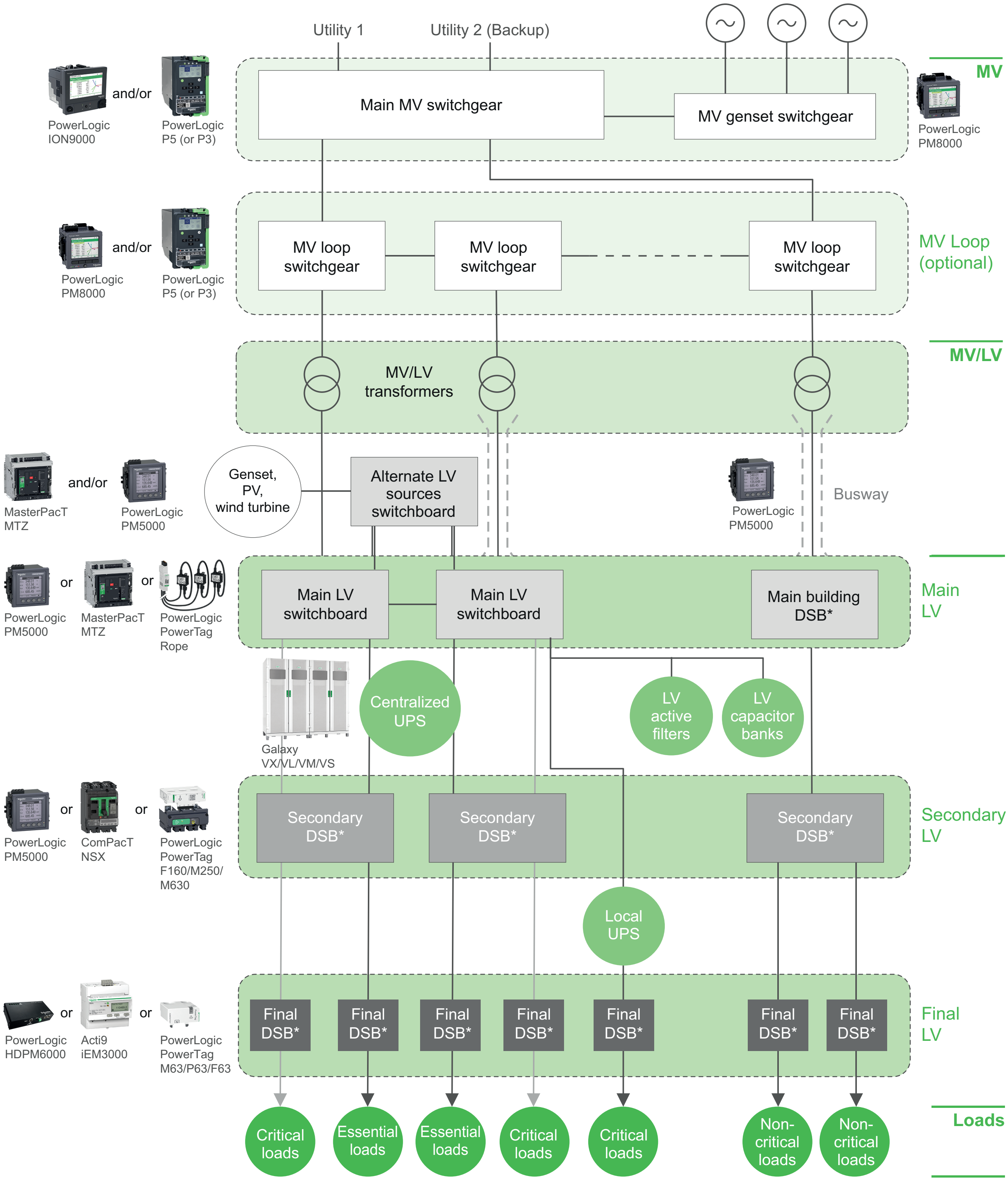
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.



EcoStruxure Power Advisor Data Quality Report

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Energy Performance application:



* DSB = Distribution Switchboard

Digital Architecture

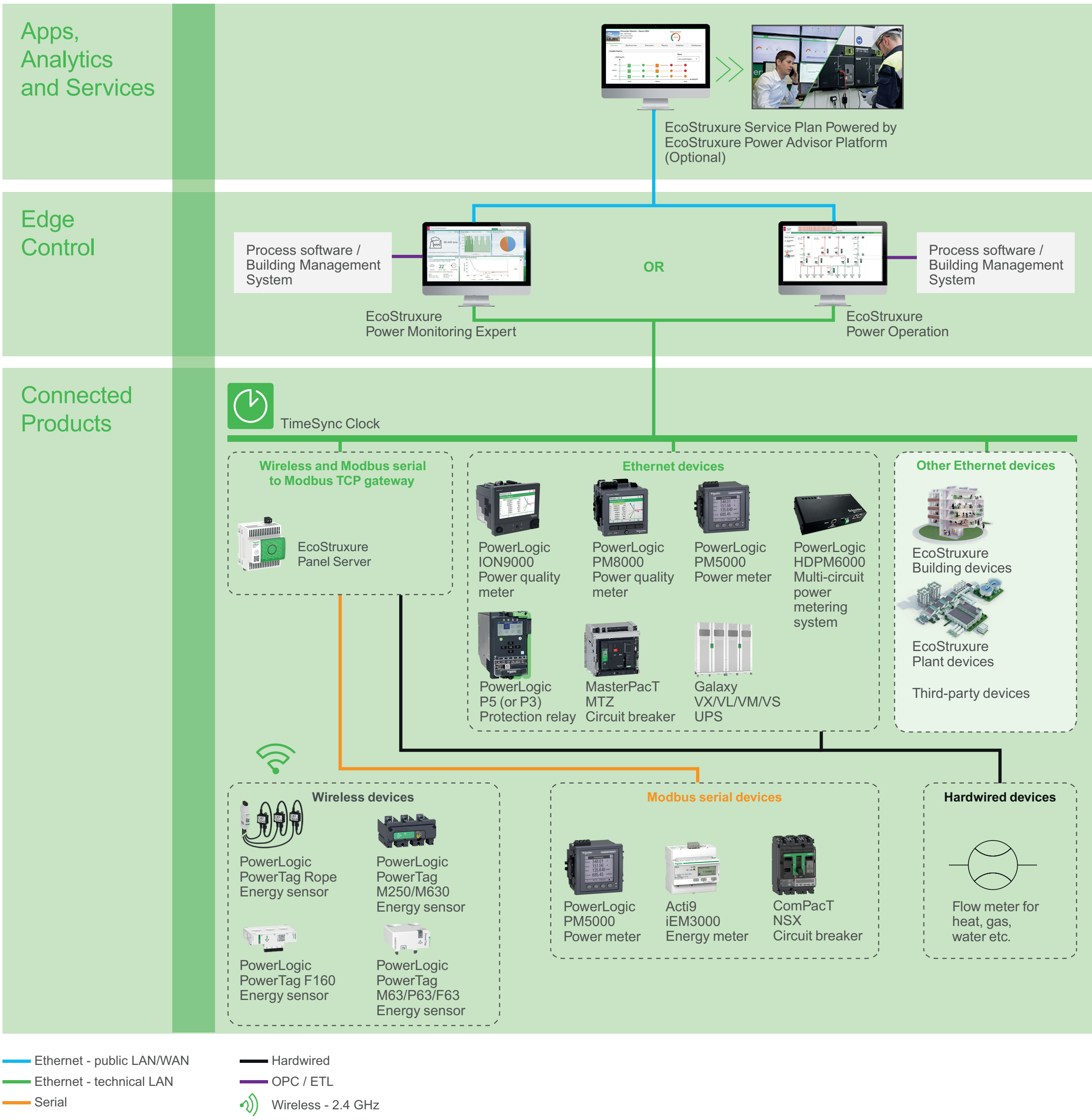
In this architecture, the data is collected from connected products either directly over Ethernet or via gateways (such as the EcoStruxure Panel Server). This data is then recorded and processed by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for on-premise visualization, analysis, and reporting.

Other utility consumption inputs (WAGES) and equipment states can also be directly acquired via Ethernet, via serial communication, or through hardwired signals from basic meters and sensors.

To include other process or equipment related data in the analyses, OPC or ETL can be used to acquire data from external process or building management software.

As an option, data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Power Advisor platform and analyzed by experts as part of the EcoStruxure Service Plan.

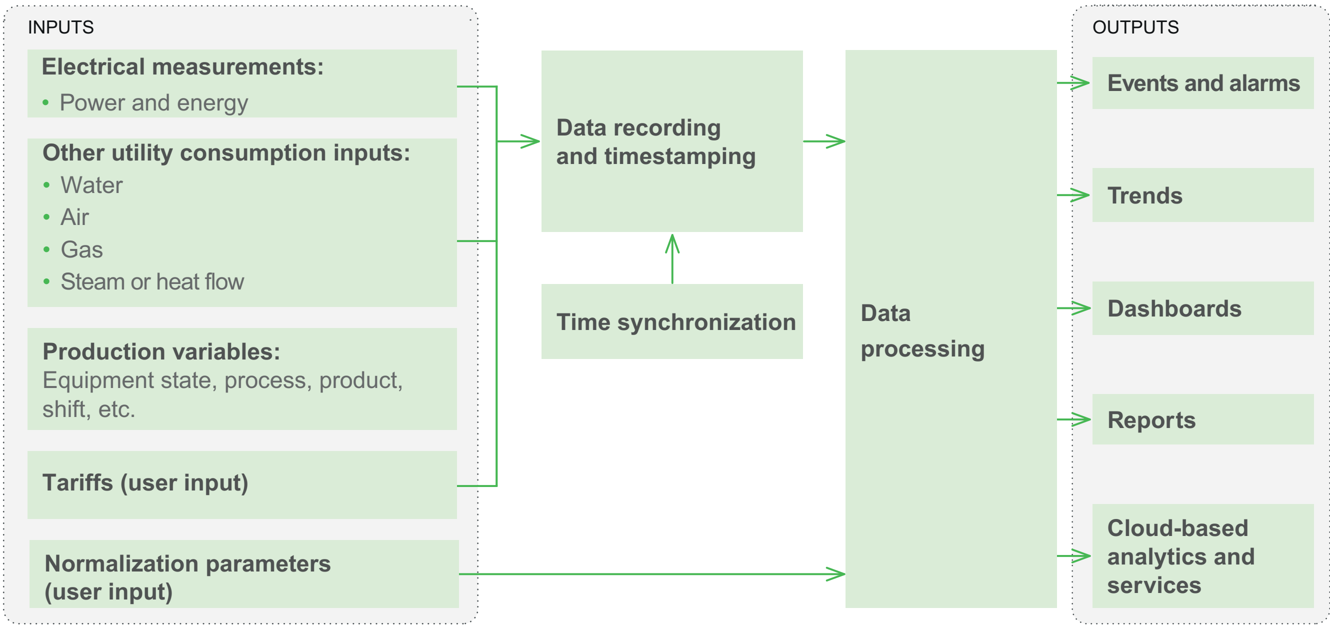
The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Energy Performance application can be broken down as follows:



Inputs

The following data are required to implement the Energy Performance application.

Electrical Measurements

The following electrical measurements are collected at each point of interest in the electrical distribution, from Medium Voltage, to Low Voltage, down to Final Distribution.

- Power values (kW, kVAR, kVA)
- Energy values (kWh, kVARh, kVAh)

These data may be acquired from:

- **Power/energy meters** such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, PowerTag, Acti9 iEM3000


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


PowerLogic HDPM6000


Acti9 iEM3000


PowerLogic PowerTag

- **Devices with embedded metering** such as PowerLogic P5/P3, MasterPacT MTZ, and ComPacT NSX protection devices, or Galaxy VX/VL/VM/VS UPS

PowerLogic P5

PowerLogic P3

MasterPacT MTZ

ComPacT NSX

Galaxy VX/VL/VM/VS

- **Third-party devices (via Modbus)**

Other Utility Consumption Inputs

The following utilities can be monitored:

- Water
- Air
- Gas
- Steam or heat flow

They can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

Production Variables

To correlate energy consumption with the different production variables such as equipment states, processes, production lines, products produced, shifts, etc., these production variables must be monitored, recorded, and used to normalize the respective energy consumption.

Examples:

- Process batch A/B/C/
- Product X/Y/Z produced on which machine during which shift
- Equipment in normal/maintenance mode
- Motor low/medium/high speed

These can be imported in EcoStruxure Power Monitoring Expert or Power Operation from customer production systems through OPC[72] or ETL[73]

EcoStruxure Power Monitoring Expert

EcoStruxure Power Operation

Alternatively, these can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

Tariffs (User Input)

To convert energy consumption into cost, it is necessary to apply relevant tariffs to power/energy consumption values.

72. OPC: Open Platform Communications
73. The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert or Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.

Normalization Parameters (User Input)

For certain KPIs to be relevant, it is necessary to normalize their respective data.

For example, to be able to compare energy consumption between buildings, it is necessary to normalize the consumption with respect to building area.

These normalization parameters need to be provided as user inputs.

Data Recording and Timestamping

For the Energy Performance application, a timestamp accuracy of ±1 second is sufficient.

Advanced power meters such as the PowerLogic ION9000, PM8000, HDPM6000, and some PowerLogic PM5000 models (PM53xx and PM55xx) can timestamp and record onboard energy measurements as well as connected equipment states. EcoStruxure Power Monitoring Expert or Power Operation can then retrieve the records with their original timestamp.


PowerLogic ION9000


PowerLogic PM8000


PowerLogic HDPM6000


PowerLogic PM5000

For other devices (PowerLogic P5/P3, MasterPacT MTZ, Galaxy VX/VL/VM/VS, entry-level PowerLogic PM5000 models, Acti9 iEM3000, PowerLogic PowerTag, etc.) energy measurements and equipment states are acquired by the connected products and then recorded and timestamped by EcoStruxure Power Monitoring Expert or Power Operation.


PowerLogic P5


PowerLogic P3


MasterPacT MTZ


Galaxy VX/VL/VM/VS


PowerLogic PM5000


Acti9 iEM3000


PowerLogic PowerTag


EcoStruxure Power Monitoring Expert


EcoStruxure Power Operation

When acquiring data from other customer systems, timestamps can also be imported through OPC[74] or ETL[75].

74. OPC = Open Platform Communications
75. ETL = The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert and Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

Time Synchronization

For consistent timestamping of all the data, the date and time should be accurately distributed to connected products and data loggers.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be connected to a GPS antenna to reach the expected time precision.

TimeSync Clock

Data Processing

Specialized dashboards and dedicated reporting engine analyze data to:

- Provide highlights on energy consumption according to the most relevant criteria.(per load type, per process line, per area, etc.)
- Assess energy usage by process area or by product output
- Highlight what factors (process state, external conditions, etc.) contribute most to energy usage

Energy data processing is embedded in EcoStruxure Power Monitoring Expert or Power Operation.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Outputs

Display of outputs is performed by EcoStruxure Power Monitoring Expert or Power Operation except in specified cases.

The following outputs, when used as part of an energy management program, can help normalize energy data with respect to business operations (number of items produced, etc.) that drive energy usage.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

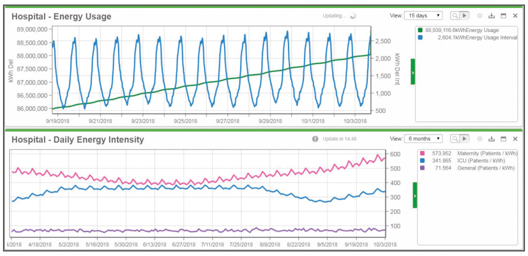
Events and Alarms

In EcoStruxure Power Monitoring Expert smart setpoints offer threshold-based alarming on energy usage.

Trends

Energy Usage Trending

All input data detailed above can be displayed as trends.



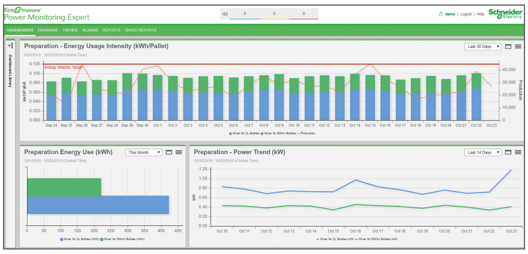
Energy Usage Trending

Dashboards

All dashboards can be configured to run automatically in slide show mode to perform the function of an Energy Kiosk.

Key Performance Indicator Dashboards[76]

Dashboards to visualize, analyze, and communicate information about an organization's energy performance KPIs for continuous energy improvement



KPI Dashboard

76. KPI dashboards require contextual data and configuration of the KPI Report available with the Energy Analysis module in EcoStruxure Power Monitoring Expert or Power Operation.

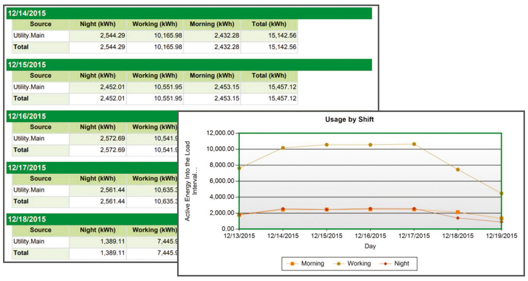
Reports

The following reports can be displayed or automatically sent by email:

Energy Management Reports:

- **Energy Usage by Shift**

  Compares a measurement from multiple devices for specified time periods (or shifts). This means energy usage can be compared between shifts (for example, 6:00 to 1:00 vs. 1:00 to 8:00).

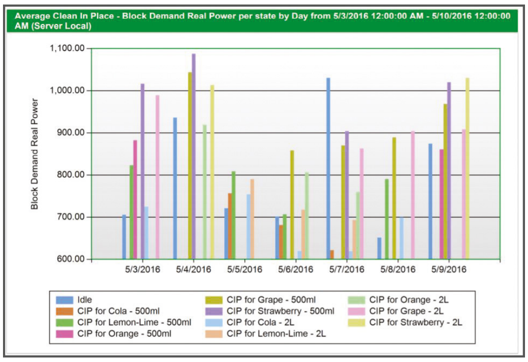


Energy Usage by Shift

Energy Analysis Reports:[77]

- **Power Usage per State Report**

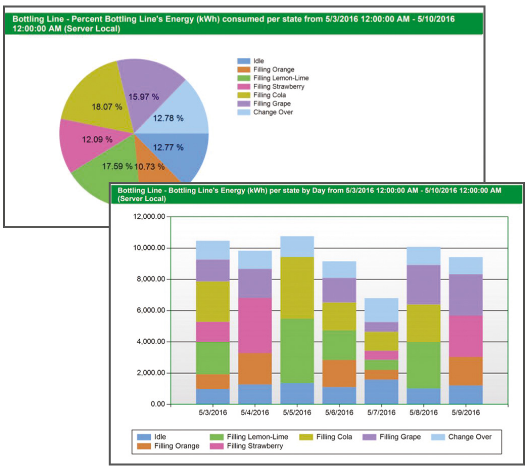
  Details power usage per state of operation of a machine or process.



Power Usage per State Report

- **Energy Consumption per State Report**

  Details energy consumption per state of operation of a machine or process.

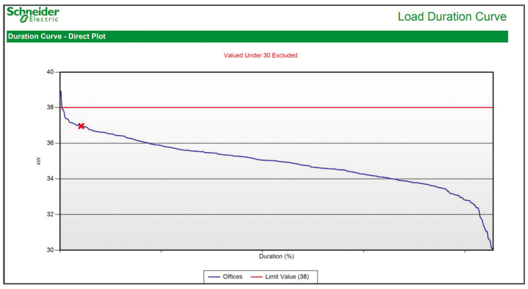


Energy Consumption per State Report

77. The Energy Analysis Reports module of EcoStruxure Power Monitoring Expert must be deployed to benefit from these features.

- **Duration Curve Report**

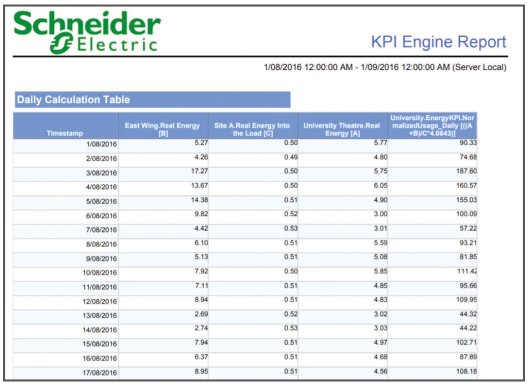
  Shows distribution of power consumption versus duration to detect potential capacity or utilization issues.



Duration Curve Report

- **KPI Engine Report**

  Calculates complex energy KPIs.



Schneider Electric

KPI Engine Report

1/08/2016 12:00:00 AM - 1/09/2016 12:00:00 AM (Server Local)

Daily Calculation Table

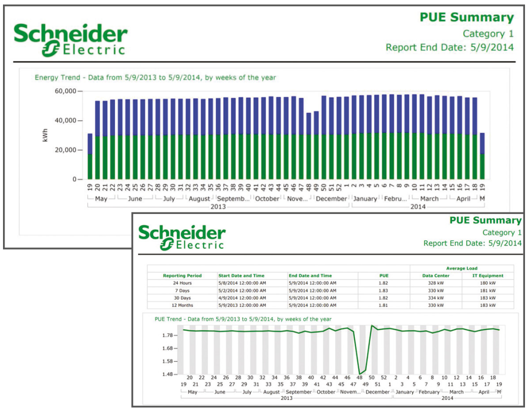
Timestamp	East Wing.Real Energy [B]	Site A.Real Energy Into the Load [C]	University Theatre.Real Energy [A]	University.EnergyKPI.NormalizedUsage_Daily [((A +B)/C*4.0643)]
1/08/2016	5.27	0.50	5.77	90.33
2/08/2016	4.26	0.49	4.80	74.68
3/08/2016	17.27	0.50	5.75	187.60
4/08/2016	13.67	0.50	6.05	160.57
5/08/2016	14.38	0.51	4.90	155.03
6/08/2016	9.82	0.52	3.00	100.09
7/08/2016	4.42	0.53	3.01	57.22
8/08/2016	6.10	0.51	5.59	93.21
9/08/2016	5.13	0.51	5.08	81.85
10/08/2016	7.92	0.50	5.85	111.42
11/08/2016	7.11	0.51	4.85	95.66
12/08/2016	8.94	0.51	4.83	109.95
13/08/2016	2.69	0.52	3.02	44.32
14/08/2016	2.74	0.53	3.03	44.22
15/08/2016	7.94	0.51	4.97	102.71
16/08/2016	6.37	0.51	4.68	87.89
17/08/2016	8.95	0.51	4.56	108.18

KPI Engine Report

- **Power Usage Effectiveness (PUE) Report (for data centers)**

  Displays and analyzes Power Usage Effectiveness by day, week, month and year.

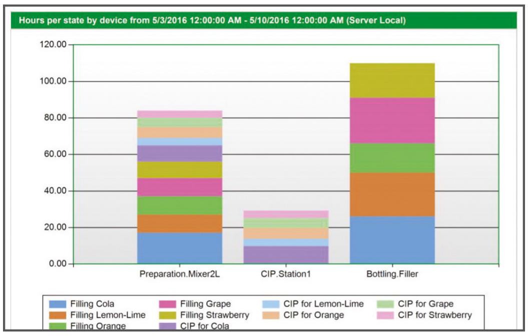
  Compares the IT loads and support loads.



PUE Report (Data Center)

- **Multi-equipment Operation Report**

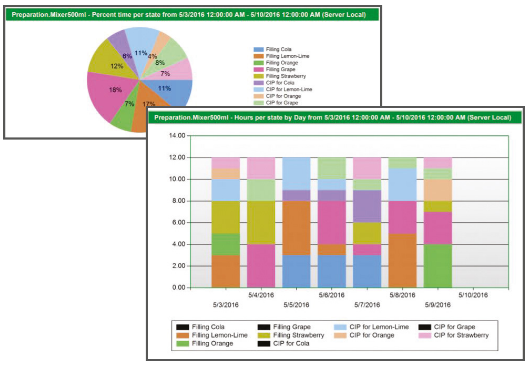
  Compares duration per state, per machine or process.



Multi-equipment Operation Report

- **Single Equipment Operation Report**

  Compares duration per state for a single machine or process.



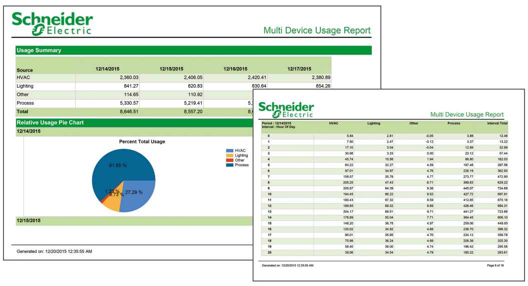
Single Equipment Operation Report

Usage Trending Reports:

- **Multi Device Usage Report**

  Displays consumption information for multiple devices.

  View energy usage for a single period, or compare two periods, for example, this month versus last month.

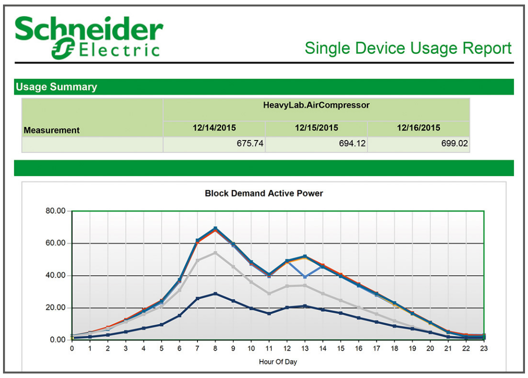


Multi Device Usage Report

- **Single Device Usage Report**

  Displays energy information for one device.

  View energy usage for a single period, or compare two periods, for example, this month versus last month.



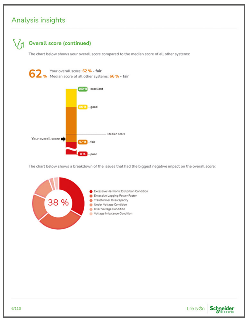
Single Device Usage Report

Cloud-Based Analytics and Services

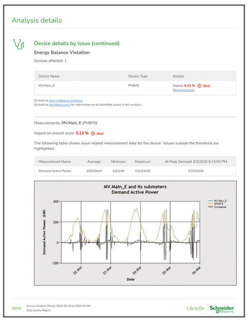
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.

For further information, refer to Data Quality Management, page 24.

EcoStruxure Service Plan Powered by EcoStruxure Power Advisor Platform



EcoStruxure Power Advisor Data Quality Report - Overall Score



EcoStruxure Power Advisor Data Quality Report - Device Details by Issue

Energy Modeling and Verification

What's in This Chapter

Overview

Context of Application

In order to detect abnormal equipment behavior, which is detrimental for energy consumption, or to gain a true understanding of the return on investment of an energy management program, it is important to understand the relationship of how your facility should be performing compared to the actual energy performance. Energy modeling is one way of tracking energy efficient operation and assessing the effectiveness of energy saving investments.

Problem to Solve

The facility/energy manager needs to:

- Develop strategies and action plans to reduce energy consumption or improve energy usage.
- Maximize energy efficiency of equipment and processes, and reduce operating costs of the facility.
- Determine the relative difference between pre-retrofit and post-retrofit energy consumption.

Purpose of the Application

Define modeled data of energy consumption related to energy drivers

Provide feedback loop between energy managers and operations

By analyzing the energy performance of the facility or building against a modeled baseline which takes into account all relevant energy drivers such as outside temperature, occupancy, or productivity

Use modeled data to detect abnormal consumption values

Track the improved performance, verify and report savings

By determining the difference between pre-retrofit and post-retrofit energy consumption

Application Outcomes

Trends

Comparison trends:

- Energy Usage Trends
- Calendar Trends

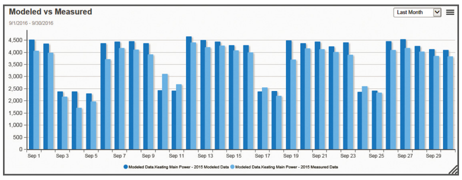
Modeled data can be displayed as trends and compared to actual data.

Dashboards

Energy Usage:

- Modeled values vs measured values

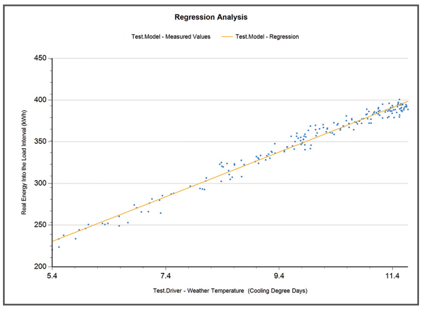
  NOTE: Modeled data can be displayed in most standard dashboards.



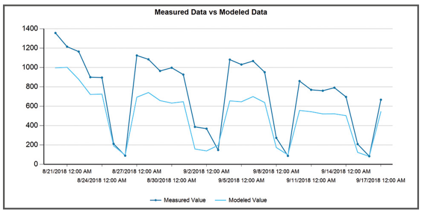
Modeled Values vs Measured Values Gadget

Reports

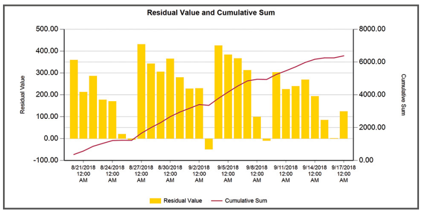
- Create Model Report
- Use Model Report



Energy Regression Analysis (Create Model Report)



Modeled Values vs Measured Values (Use Model Report)



Cumulative Savings (Use Model Report)

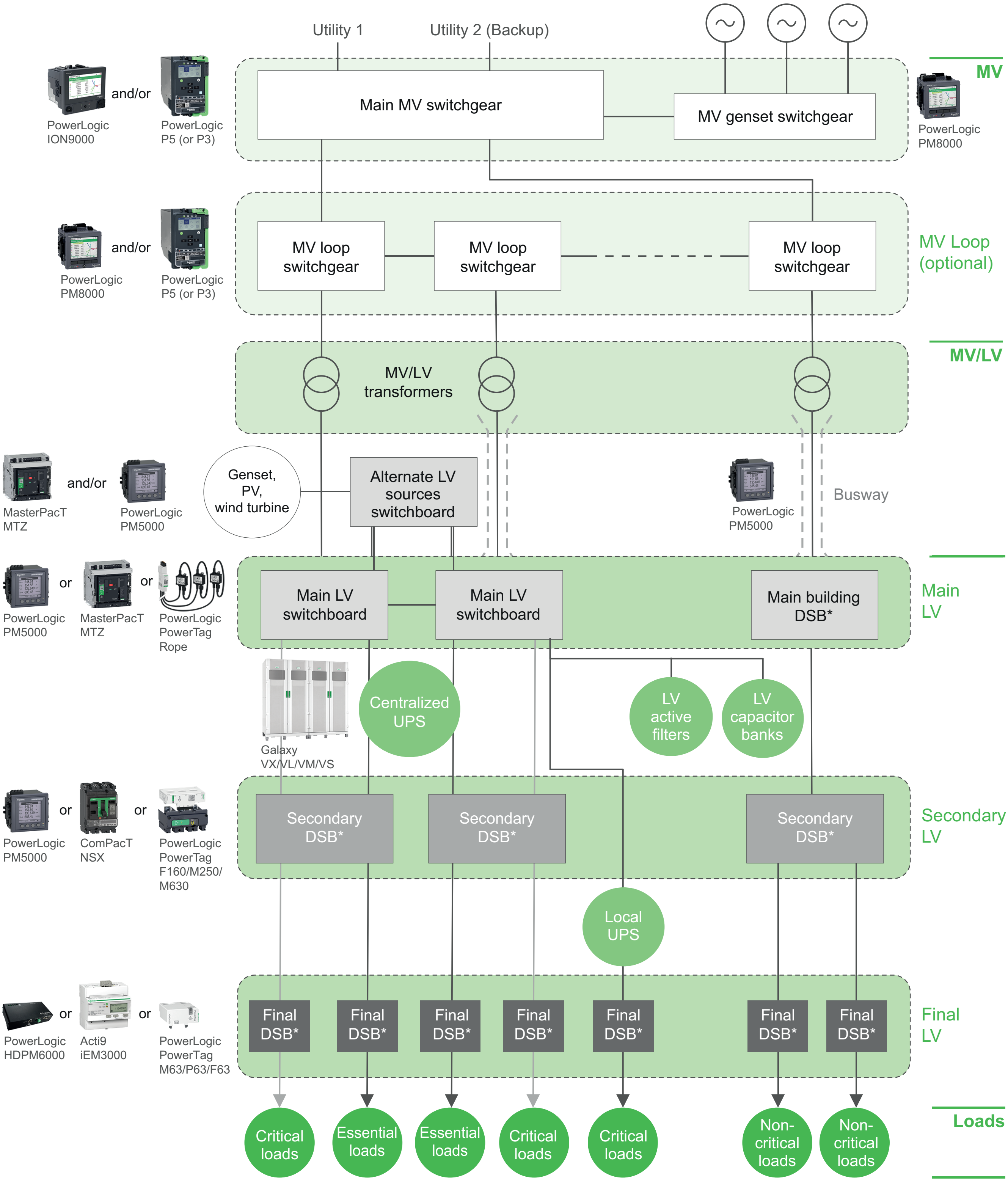
Cloud-Based Analytics and Services

As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.

EcoStruxure Power Advisor Data Quality Report

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Energy Modeling and Verification application:



* DSB = Distribution Switchboard

Digital Architecture

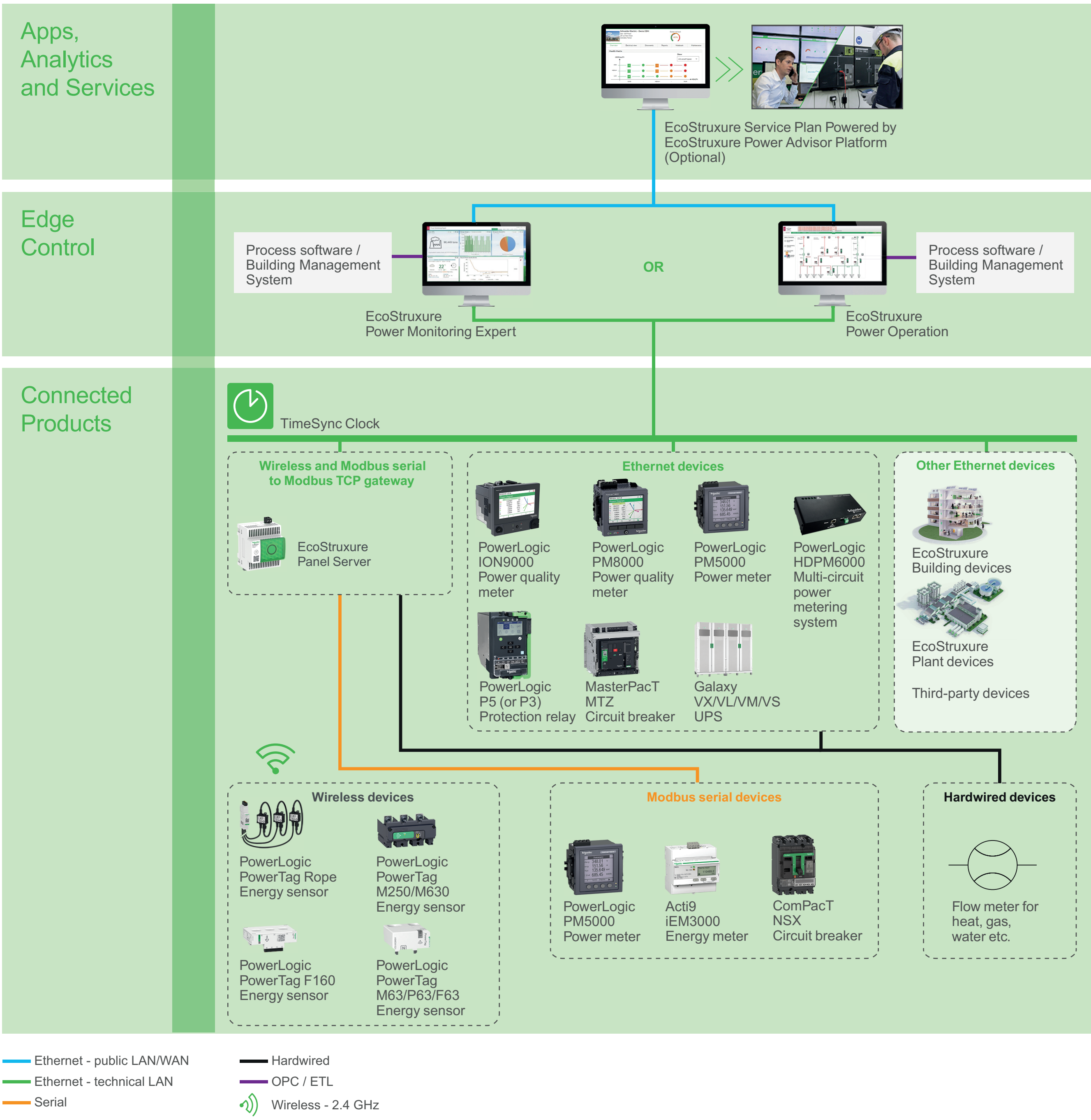
In this architecture, the data is collected from connected products either directly over Ethernet or via gateways (such as the EcoStruxure Panel Server). This data is then recorded and processed by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for on-premise visualization, analysis, and reporting.

Other utility consumption inputs (WAGES) can also be directly acquired via Ethernet, via serial communication, or through hardwired signals from basic meters and sensors.

To include other process or equipment related data in the analyses, OPC or ETL can be used to acquire data from external process or building management software.

As an option, data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Power Advisor platform and analyzed by experts as part of the EcoStruxure Service Plan.

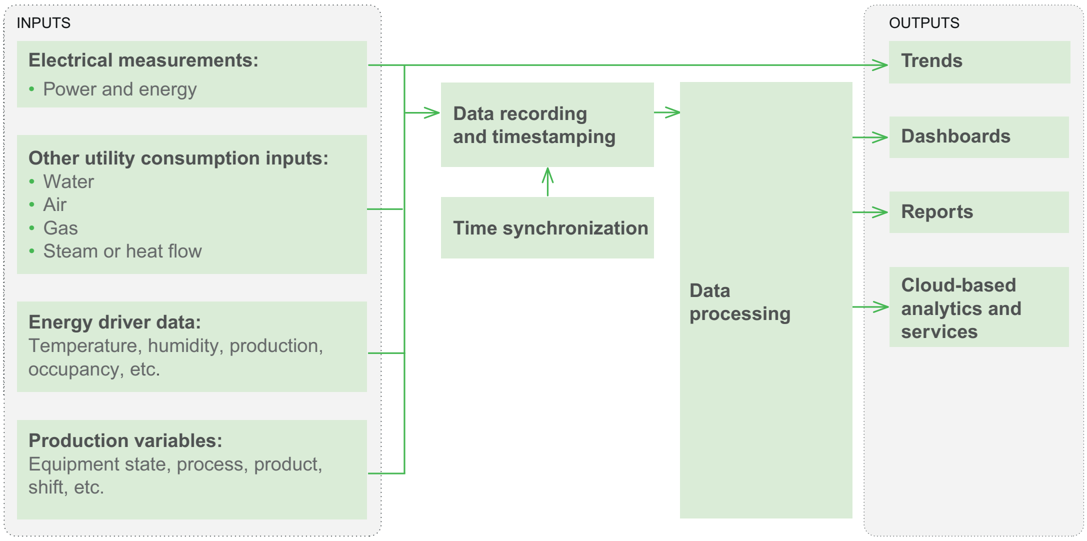
The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Energy Modeling and Verification application can be broken down as follows:



Inputs

The following data are required to implement the Energy Modeling and Verification application:

Electrical Measurements

The following electrical measurements are collected at each point of interest in the electrical distribution, from Medium Voltage, to Low Voltage, down to Final Distribution.

- Power values (kW, kVAR, kVA)
- Energy values (kWh, kVARh, kVAh)

These data may be acquired from:

- **Power/energy meters** such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, PowerTag, Acti9 iEM3000


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


PowerLogic HDPM6000


Acti9 iEM3000


PowerLogic PowerTag

- **Devices with embedded metering** such as PowerLogic P5/P3, MasterPacT MTZ, and ComPacT NSX protection devices, or Galaxy VX/VL/VM/VS UPS


PowerLogic P5


PowerLogic P3


MasterPacT MTZ


ComPacT NSX


Galaxy VX/VL/VM/VS

- **Third-party devices (via Modbus)**

Other Utility Consumption Inputs

The following utilities can be monitored:

- Water
- Air
- Gas
- Steam or heat flow

They can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

Energy Driver Data

Any data which might have an impact on energy consumption should be leveraged.

For example:

- Weather information (outside temperature, humidity, etc.)
- Production volumes (number of units, tons, etc.)
- Hours of operation and operation schedules (work hours, weekdays vs weekends, seasons, shifts, etc.)
- Base loads
- Building occupancy

These can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices. They can also be imported in EcoStruxure Power Monitoring Expert from customer systems through OPC [78] or ETL[79].


EcoStruxure Power Monitoring Expert


EcoStruxure Power Operation

Production Variables

To correlate energy consumption with the different production variables such as equipment states, processes, production lines, products produced, shifts, etc., these production variables must be monitored, recorded, and used to normalize the respective energy consumption.

78. OPC: Open Platform Communications
79. The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert or Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.

Examples:

- Process batch A/B/C/
- Product X/Y/Z produced on which machine during which shift
- Equipment in normal/maintenance mode
- Motor low/medium/high speed

These can be imported in EcoStruxure Power Monitoring Expert or Power Operation from customer production systems through OPC[80] or ETL[81]

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Alternatively, these can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

Data Recording and Timestamping

For the Energy Modeling and Verification application, a timestamp accuracy of ±1 second is sufficient.

Advanced power meters such as the PowerLogic ION9000, PM8000, HDPM6000, and some PowerLogic PM5000 models (PM53xx and PM55xx) can timestamp and record onboard energy measurements as well as connected equipment states. EcoStruxure Power Monitoring Expert or Power Operation can then retrieve the records with their original timestamp.

PowerLogic
ION9000

PowerLogic
PM8000

PowerLogic
HDPM6000

PowerLogic
PM5000

For other devices (PowerLogic P5/P3, MasterPacT MTZ, Galaxy VX/VL/VM/VS, entry-level PowerLogic PM5000 models, Acti9 iEM3000, PowerLogic PowerTag, etc.) energy measurements and equipment states are acquired by the connected products and then recorded and timestamped by EcoStruxure Power Monitoring Expert or Power Operation.

80. OPC: Open Platform Communications
81. The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert or Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.


PowerLogic P5


PowerLogic P3


MasterPacT MTZ


Galaxy VX/VL/VM/VS


PowerLogic PM5000


Acti9 iEM3000


PowerLogic PowerTag


EcoStruxure Power Monitoring Expert


EcoStruxure Power Operation

When acquiring data from other customer systems, timestamps can also be imported through OPC[82] or ETL[83].

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

Time Synchronization

For consistent timestamping of all the data, the date and time should be accurately distributed to connected products and data loggers.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be connected to a GPS antenna to reach the expected time precision.


TimeSync Clock

Data Processing

Energy Modeling

Based on acquired input data, a regression analysis is performed to define a model of energy/power in relation to different energy drivers. The application uses this model to forecast consumption, highlight unexpected changes in consumption, or verify savings resulting from energy conservation measures.

NOTE: Typically a minimum of 6 months of historical data is required to create accurate energy models (especially when seasonal temperature data is used in the model).

82. OPC = Open Platform Communications
83. ETL = The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert and Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.

Energy modeling is embedded in the optional Energy Analysis Reports module of EcoStruxure Power Monitoring Expert and Power Operation.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Outputs

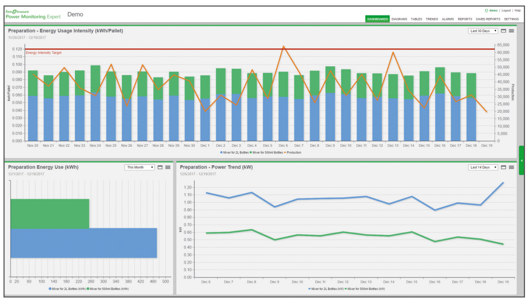
Outputs are displayed via EcoStruxure Power Monitoring Expert or Power Operation. The Energy Analysis Reports module of EcoStruxure Power Monitoring Expert or Power Operation must be deployed to benefit from these features.

Trends

Modeled data can be saved in the database and displayed as a trend for comparison with actual field data.

Dashboards

Modeled data can be saved in the database and displayed as a dashboard.



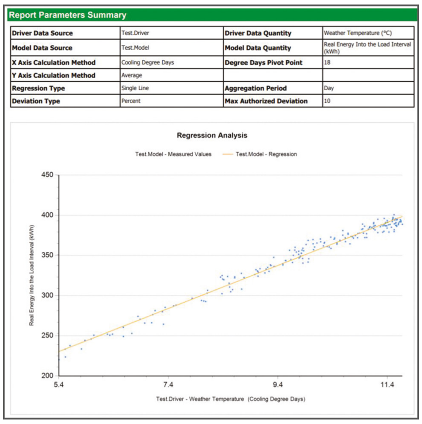
Dashboard

Reports

The first step in the use of the Energy Modeling and Verification application is to build an energy model (performed in the Create Model Report). This energy model is then used for the various analyses and verifications (with the Use Model Report).

Create Model Report

This report is used to create a model of a facility or process compared to various energy drivers such as outside temperature, production volumes, etc. After the model has been created, this report will not need to be run unless a new model needs to be created.



Report Parameters Summary

Driver Data Source	Test.Driver	**Driver Data Quantity**	Weather Temperature (°C)
Model Data Source	Test.Model	**Model Data Quantity**	Real Energy Into the Load Interval (kWh)
X Axis Calculation Method	Cooling Degree Days	**Degree Days Pivot Point**	18
Y Axis Calculation Method	Average		
Regression Type	Single Line	**Aggregation Period**	Day
Deviation Type	Percent	**Max Authorized Deviation**	10

Create Model Report

NOTE: To use this report, the data for the independent variables (driver data) and for the dependent variable (power/energy) must be available in the EcoStruxure Power Monitoring Expert database for the reporting period.

Use Model Report

The Use Model Report shows the expected consumption of a facility or process, based on a model created with the Create Model Report. The report shows a graphical representation of the modeled data, the measured data, and the delta between the two. It also includes tables with numeric data.

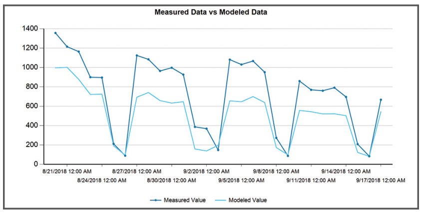
The objective is to compare expected consumption to actual consumption in order to:

- Identify unexpected changes in consumption related to abnormal load use or load dysfunction
- Identify actual savings as a result of energy conservation measures

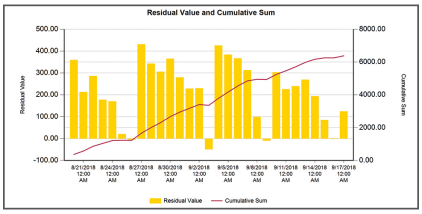
This report can be displayed or automatically sent by email.

NOTE: The report is not limited to energy consumption modeling. It can be used to model any quantity that is dependent on drivers, for example power factor based on power demand.

NOTE: To use this report, at least one model must have been defined for the facility or process. For forecasted energy/power consumption, the forecast of the independent variables (driver data) must be available in the Power Monitoring Expert database for the reporting period.



Use Model Report: comparison between expected and actual energy consumption



Use Model Report: residual value and cumulative sum of difference between expected and actual energy consumption

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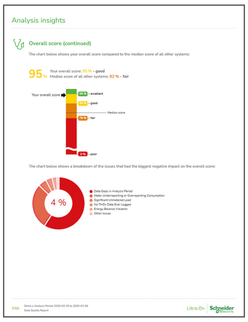
Cloud-Based Analytics and Services

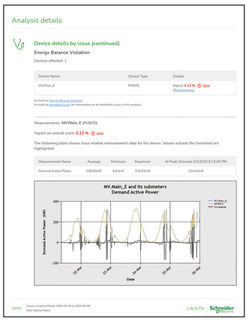
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.

For further information, refer to Data Quality Management, page 24.

EcoStruxure Service Plan Powered by EcoStruxure Power Advisor Platform



EcoStruxure Power Advisor Electrical Health Report - Overall Score



EcoStruxure Power Advisor Electrical Health Report - Device Details by Issue

Power Factor Correction

What's in This Chapter

Overview

Context of Application

For large electricity consumers, utilities often charge penalties on the energy bill for reactive power consumption or lagging power factor. Reactive power and lagging power factor are primarily caused by inductive motor loads, and can be compensated using power factor correction equipment. Power Factor Correction is a common way of achieving fast return on investment.

Problem to Solve

The facility manager needs to:

- Gain visibility into the facility's reactive power and power factor.
- Reduce or avoid power factor penalties on the energy bill.

Purpose of the Application

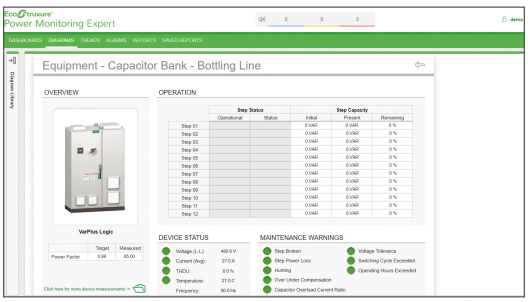
Reduce financial impact of power factor on energy bill by:

- Improving power factor to lower utility bills
- Reducing total process power consumption
- Optimizing capacitor bank maintenance with useful alarming and diagnostics data

Application Outcomes

Live Data Display

- Real-time values of power factor or reactive power
- Real-time monitoring and diagnostics of power factor correction equipment
- Power Factor Correction Equipment diagrams



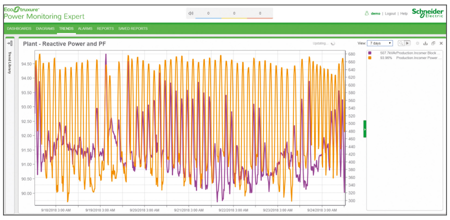
Power Factor Equipment Diagram

Events and Alarms

- Chronological display of events and alarms with sorting and filtering capabilities
- Intelligent alarm grouping into summary incidents

Trends

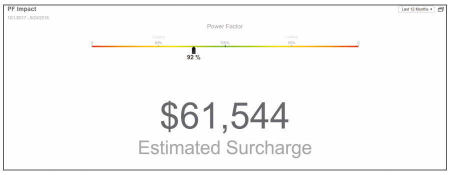
All analog values stored as historical data can be displayed as trends to monitor their evolution over time.



Power Factor - Reactive Power Trending

Dashboards

- Power Factor Estimated Cost gadgets
- Power Factor Impact gadgets



Power Factor Surcharges

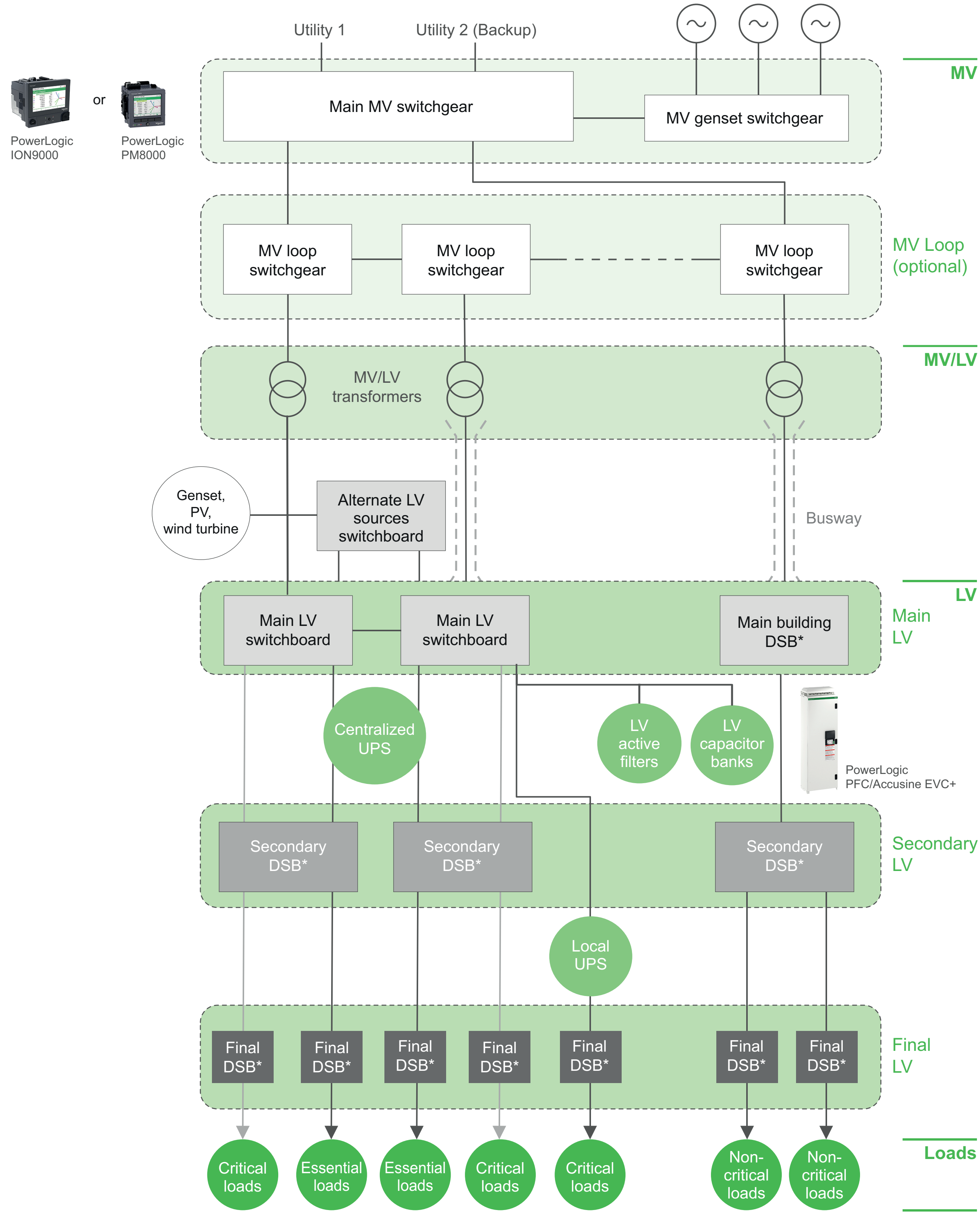
Cloud-Based Analytics and Services

As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.

EcoStruxure Power Advisor Data Quality Report

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Power Factor Correction application:



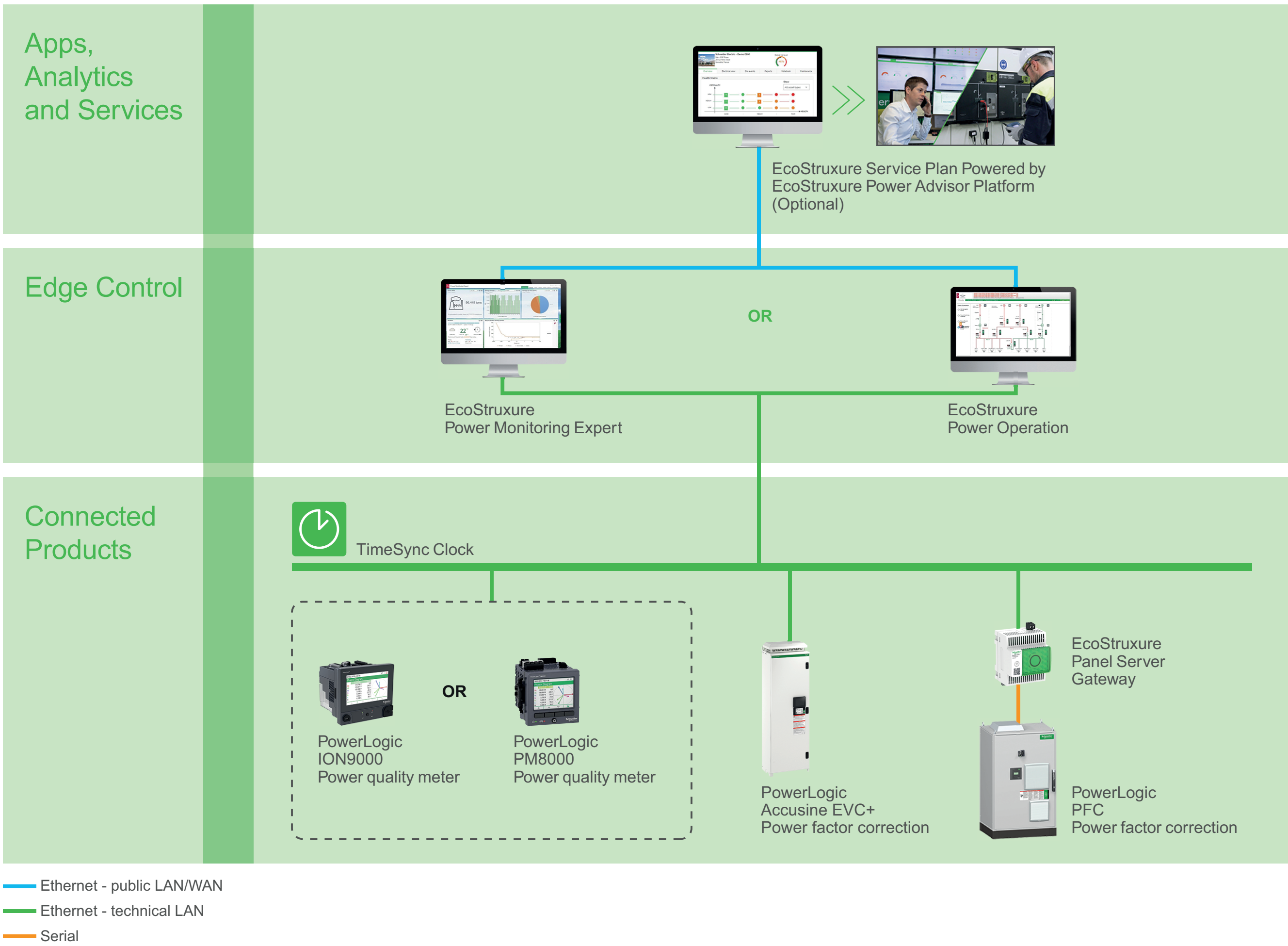
* DSB = Distribution Switchboard

Digital Architecture

In this architecture, the combined power factor measured at utility entrance is collected from connected products (PowerLogic ION9000 or PM8000) directly over Ethernet and then recorded and processed by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for on-premise visualization, analysis, and reporting. Communications are performed directly over Ethernet for PowerLogic AccuSine EVC+ and through a Modbus Serial connection for PowerLogic PFC. EcoStruxure Panel Server gateway converts the Modbus communications to Ethernet for real-time data acquisition by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation).

As an option, data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Power Advisor platform and analyzed by experts as part of the EcoStruxure Service Plan.

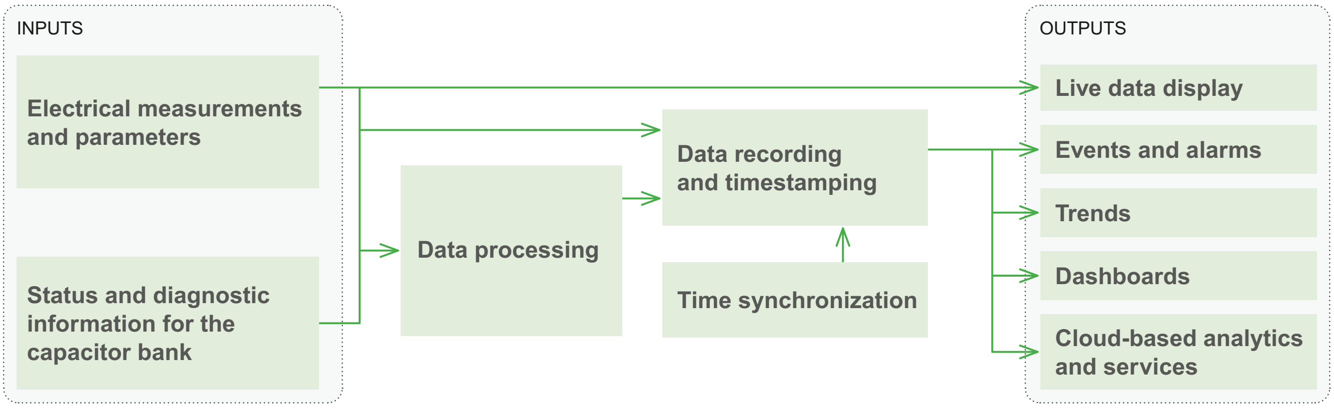
The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Power Factor Correction application can be broken down as follows:



Inputs

The following data is required:

Electrical Measurements and Parameters

- Power Factor (measured and targeted)
- Other electrical measurements: voltage, current, frequency, power (kW, kVAR, kVA), harmonics

A power meter (PowerLogic ION9000 or PM8000) at the utility entrance is used to check that the combined power factor, as seen by the utility, is within allowable thresholds to avoid power factor penalties.

PowerLogic ION9000

PowerLogic PM8000

Status and Diagnostic Information for the Capacitor Bank

- Active compensation steps
- Broken steps
- Step power loss
- Hunting
- Over/under compensation
- Temperature
- THD voltage, voltage tolerance, overcurrent
- Switching cycles
- Operating hours
- Ambient and max temperature
- Capacitor overload
- Fan status

This information is acquired by Power Factor Correction equipment such as PowerLogic PFC/AccuSine EVC+.


PowerLogic
PFC


PowerLogic
AccuSine EVC+

Data Processing

Data processing is done through the Edge Control's data acquisition engine to create events and alarms from status and diagnostic information (with EcoStruxure Power Monitoring Expert or Power Operation).


EcoStruxure
Power Monitoring Expert


EcoStruxure
Power Operation

Data Recording and Timestamping

For power factor correction equipment, data recording is performed by EcoStruxure Power Monitoring Expert or Power Operation, based on real-time values acquired by the driver. For the power quality meters located at the service entrance, data recording is performed on board the device(s). For these device(s), a time accuracy of 1 second or better is recommended.

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.


EcoStruxure
Power Monitoring Expert


EcoStruxure
Power Operation

Time Synchronization

For consistent timestamping of all the data, the date and time should be accurately distributed to connected products and data loggers.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be connected to a GPS antenna to reach the expected time precision.

TimeSync Clock

Outputs

Live data, alarms, events, and dashboards are available by default in EcoStruxure Power Monitoring Expert and Power Operation.

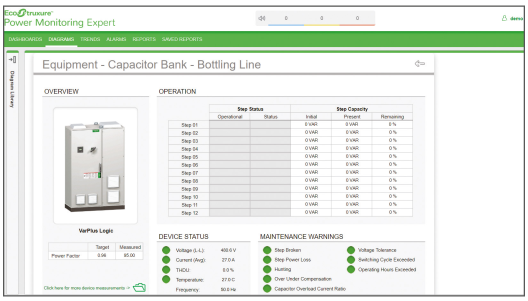
EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Live Data Display

Live data acquired by the software driver can be displayed in Power Monitoring Expert or Power Operation through equipment diagrams.

The real-time data displayed include electrical measurements, operating modes, statuses, and maintenance indicators.



Default Diagram for Capacitor Banks

Events and Alarms

Events and alarms are generated by the Edge Control software upon change of the statuses. The events are timestamped by the PC, recorded, and displayed in the software’s default alarms interface as diagnostic alarms.

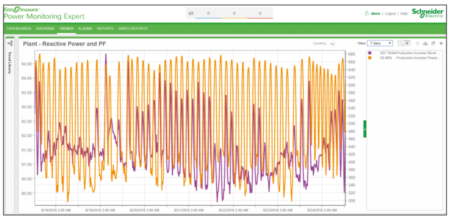
Trends

All analog values stored as historical data can be displayed as trends to monitor their evolution over time.

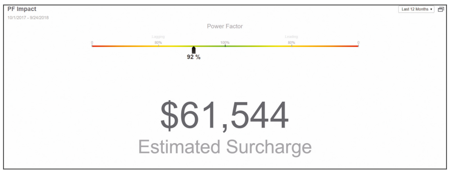
Dashboards [84]

Electrical parameters acquired and recorded natively by power factor correction equipment (PowerLogic PFC and PowerLogic AccuSine EVC+) can be displayed as historical data in dashboards. Some examples of these dashboards include:

- PF Impact
- PF Impact Trend



Power Factor Impact Trend Dashboard



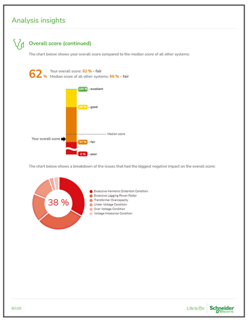
Power Factor Impact Dashboard

Cloud-Based Analytics and Services

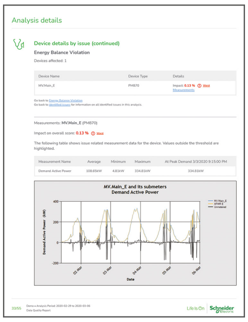
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.

For further information, refer to Data Quality Management, page 24.

EcoStruxure Service Plan Powered by EcoStruxure Power Advisor Platform



EcoStruxure Power Advisor Data Quality Report - Overall Score



EcoStruxure Power Advisor Data Quality Report - Device Details by Issue

84. The Power Quality Performance Module of EcoStruxure Power Monitoring Expert must be deployed to benefit from these features.

Energy Efficiency Compliance

What's in This Chapter

Overview

Context of Application

Today's building owners are facing increasing pressure to make their facilities operate more efficiently on multiple fronts. Energy prices certainly remain high in many regions and are the primary driver for businesses seeking to lower their ongoing operating costs. More recently, energy efficiency regulations also have been pushing owners to understand and begin reducing their energy use.

Problem to Solve

The facility/energy manager needs to:

- Demonstrate compliance with standards related to energy efficiency (ISO 50001, 50002, 50006, Superior Energy Performance®, IECC, LEED, and other local/regional energy efficiency standards).
- Communicate the energy efficiency program to stakeholders, and report on energy performance improvements.

ISO 50001 Certificate

Purpose of the Application

Enable a systematic approach to achieving continuous energy performance improvement

- By making energy usage visible at all stages of an energy management and improvement plan.
- By providing transparency through reporting on energy performance indicators (EnPI) to regulators or shareholders, and demonstrating continuous improvement.

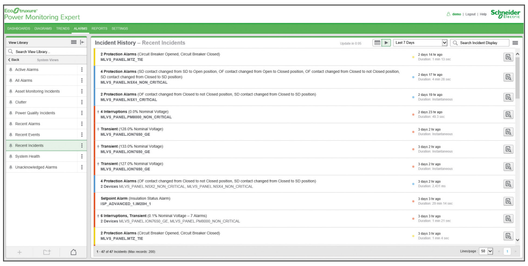
Application Outcomes

Live Data Display

Measured energy values such as kWh and peak demand (kW) can be visualized in custom graphical diagrams and live data tables in the Edge Control software.

Events and Alarms

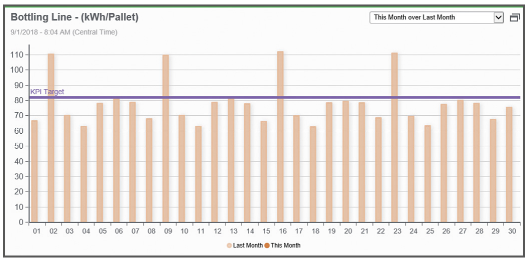
Smart alarms can be configured to alert energy managers or operations staff in case of energy-related events which require attention (imminent exceeding of peak demand threshold, etc.).



Events and Alarms

Trends

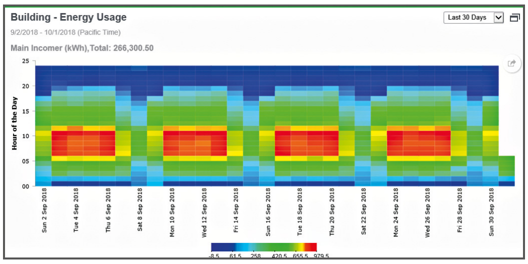
Measured energy values, ratios of measured values, or KPIs (kWh/unit of production, etc.) can be trended in the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation).



Peak Demand Trend

Dashboards

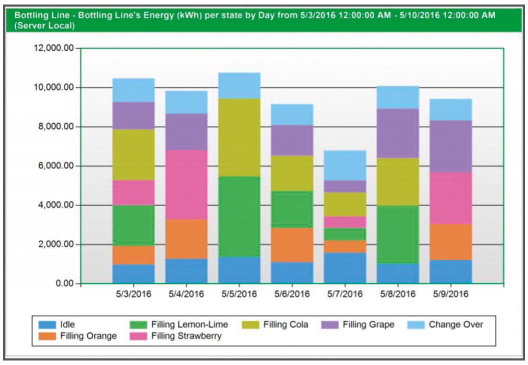
- Energy cost comparison
- Energy consumption ranking
- Energy heat map
- Pareto charts
- Sankey diagram
- KPI (Key Performance Indicator) dashboards
- General line graphs, bar charts, and pie charts



Energy Heat Map

Reports

- Consumption Ranking Reports
- Energy Comparison Reports
- Energy Modeling Reports
- Energy Usage Reports
- Calendar Trend Reports
- KPI Engine Reports
- Load Profile Reports
- Energy Cost Reports



Energy Usage per Status Report

Notifications[85]

SMS or email notifications are sent on pre-alarm and alarm conditions described above to enable fast action.

Cloud-based Analytics and Services

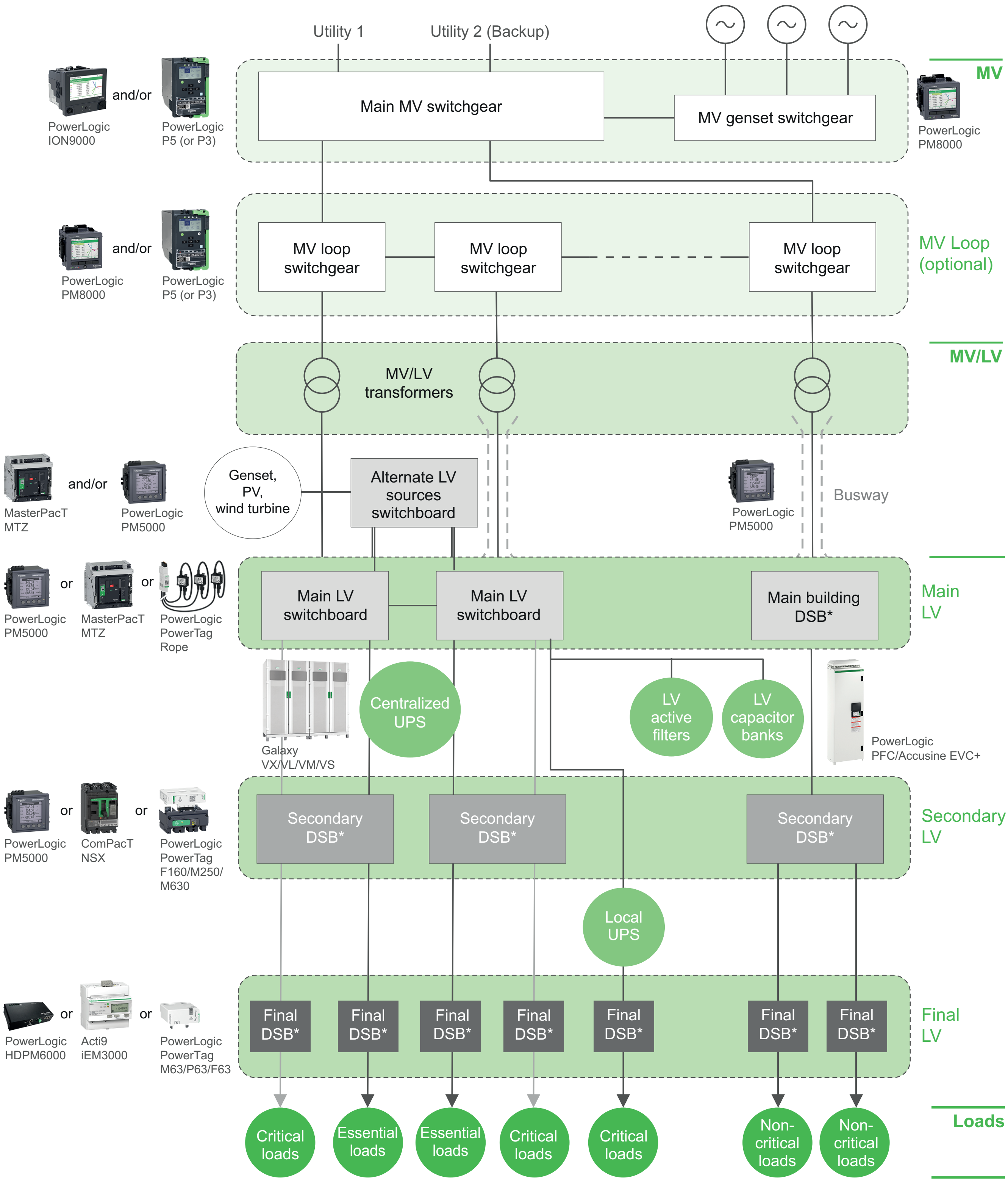
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.

85. For notifications in EcoStruxure Power Monitoring Expert and Power Operation, the Event Notification Module is required.

EcoStruxure Power Advisor Data Quality Report

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Energy Efficiency Compliance application, in accordance with the guidelines in standards such as ISO 50001, 50002, 50006, IEC 60364-8-1, and IEC 61557-12:



* DSB = Distribution Switchboard

Digital Architecture

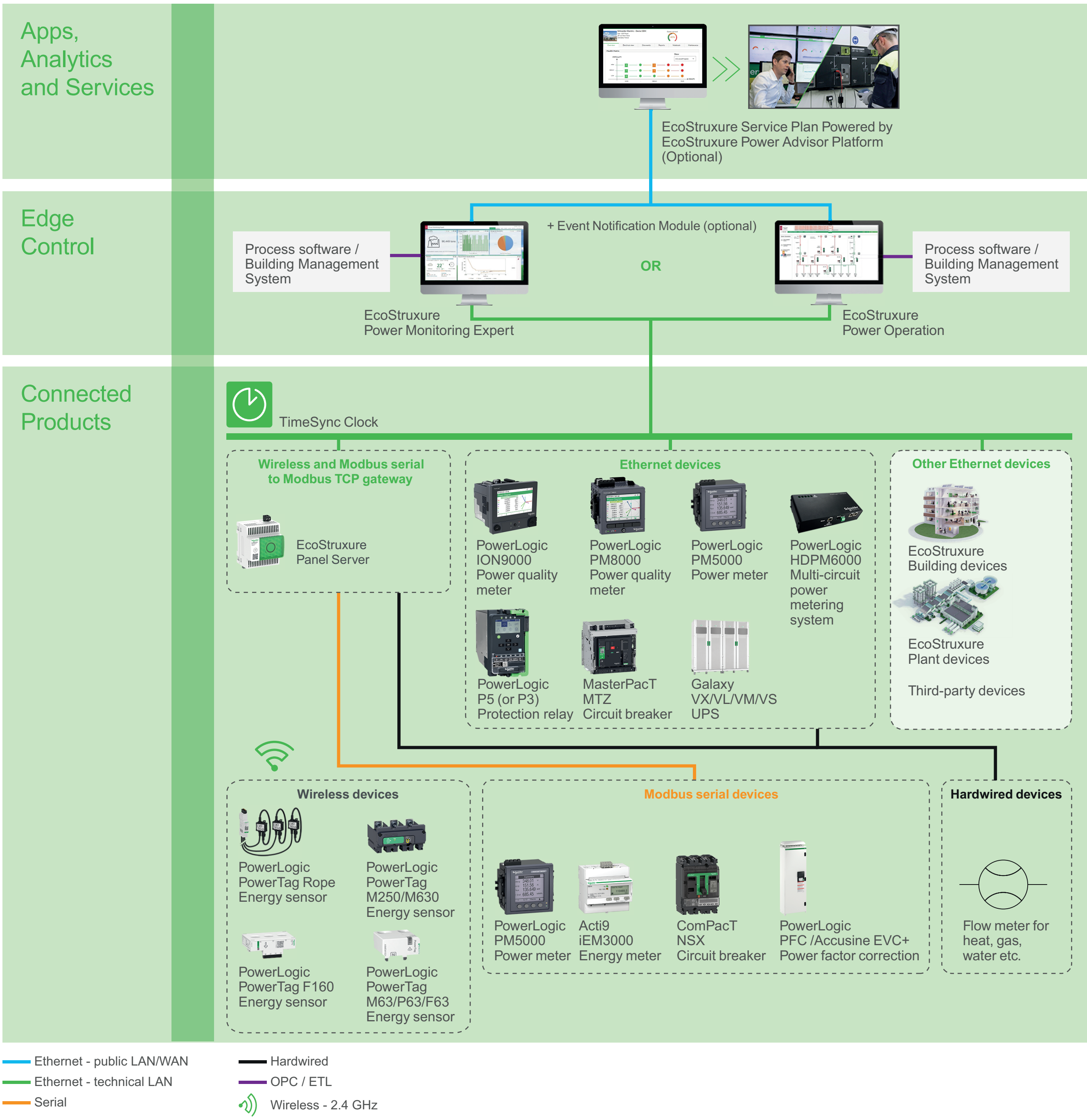
In this architecture, the data is collected from connected products either directly over Ethernet or via gateways (such as the EcoStruxure Panel Server). This data is then recorded and processed by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for on-premise visualization, analysis, and reporting.

Other utility consumption inputs (WAGES) and equipment states can also be directly acquired via Ethernet, via serial communication, or through hardwired signals from basic meters and sensors.

To include other process or equipment related data in the analyses, OPC or ETL can be used to acquire data from external process or building management software.

As an option, data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Power Advisor platform and analyzed by experts as part of the EcoStruxure Service Plan.

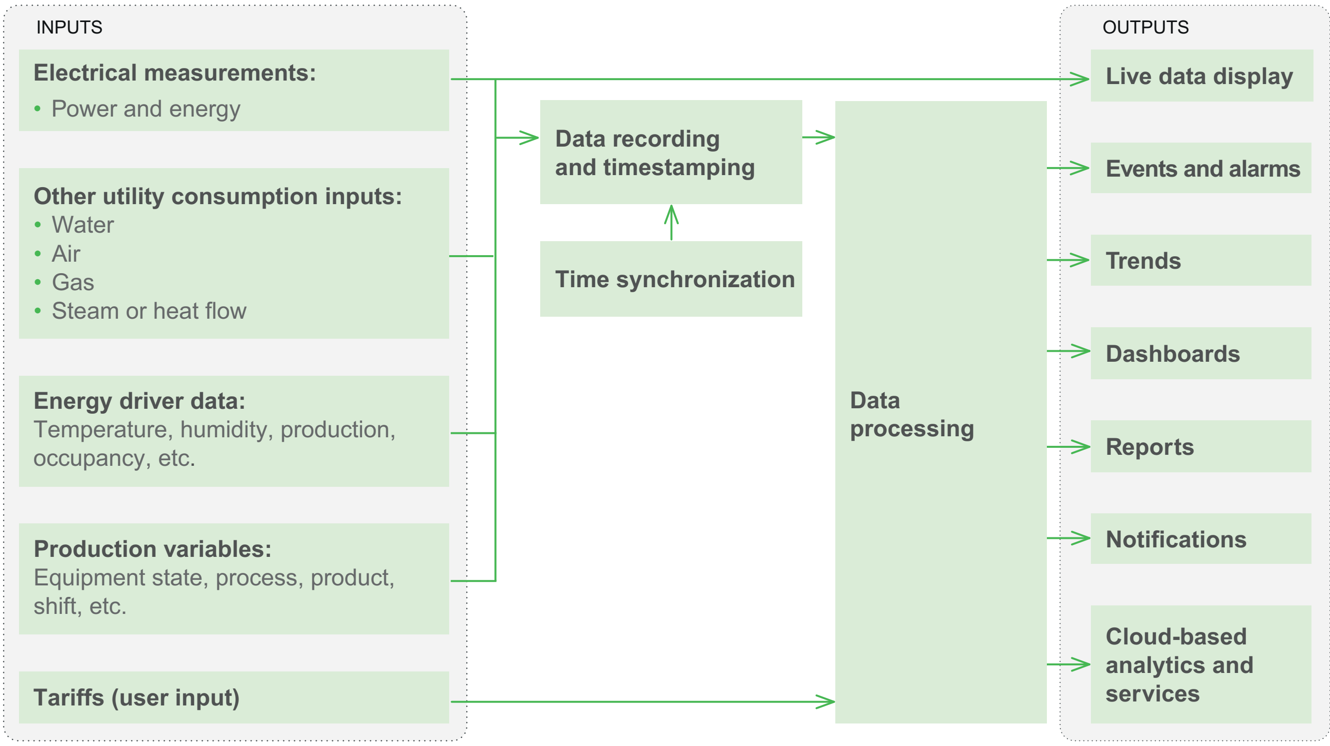
The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Energy Efficiency Compliance application can be broken down as follows:



Inputs

The following data are required to implement the Energy Efficiency Compliance application.

Electrical Measurements

The following electrical measurements are collected at each point of interest in the electrical distribution, from Medium Voltage, to Low Voltage, down to Final Distribution.

- Power values (kW, kVAR, kVA)
- Energy values (kWh, kVARh, kVAh)

The following devices can provide these data in line with IEC 61557-12 and IEC 60364-8-1, as well as a measurement plan according to ISO 50001.

- **Class 0.1 or class 0.2 devices** (as per IEC 61557-12) such as PowerLogic ION9000 or PM8000 are recommended for high-accuracy applications.

PowerLogic ION9000

PowerLogic PM8000

- **Class 0.5 or class 1 metering devices** such as the embedded metering in the MasterPacT MTZ, PowerLogic PM5000, HDPM6000, PowerTag, and Acti9 iEM3000 are recommended for low voltage feeders and sub-distribution to measure power and energy.


MasterPacT MTZ


PowerLogic PM5000


PowerLogic HDPM6000


Acti9 iEM3000


PowerLogic PowerTag

- **Metering devices with an accuracy below performance class 1** (the embedded MicroLogic trip unit in the ComPacT NSX circuit breaker, etc.) are acceptable for sub-distribution and load circuits for cost optimization purposes.


ComPacT NSX

- **Other electrical equipment** such as MV protection relays (PowerLogic P5/ P3, etc.), UPSs (Galaxy VX/VL/VM/VS, etc.), Power Factor controllers (PowerLogic PFC, AccuSine EVC+, etc.), can provide energy measurements that can contribute to an overall energy efficiency compliance program.


PowerLogic P5


PowerLogic P3


Galaxy VX/VL/VM/VS


PowerLogic PFC


PowerLogic AccuSine EVC +

Other Utility Consumption Inputs

The following utilities can be monitored:

- Water
- Air
- Gas
- Steam or heat flow

They can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

Energy Driver Data

Any data which might have an impact on energy consumption should be leveraged.

For example:

- Weather information (outside temperature, humidity, etc.)
- Production volumes (number of units, tons, etc.)
- Hours of operation and operation schedules (work hours, weekdays vs weekends, seasons, shifts, etc.)
- Base loads

- Building occupancy

These can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices. They can also be imported in EcoStruxure Power Monitoring Expert from customer systems through OPC [86] or ETL[87].

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Production Variables

To correlate energy consumption with the different production variables such as equipment states, processes, production lines, products produced, shifts, etc., these production variables must be monitored, recorded, and used to normalize the respective energy consumption.

Examples:

- Process batch A/B/C/
- Product X/Y/Z produced on which machine during which shift
- Equipment in normal/maintenance mode
- Motor low/medium/high speed
- Generator starting/running/stopped
- ATS in normal/test/emergency mode

These can be imported in EcoStruxure Power Monitoring Expert or Power Operation from customer production systems through OPC[86] or ETL[87]

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Alternatively, these can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

Tariffs (User Inputs)

To convert energy consumption into cost, it is necessary to apply the relevant tariffs to the power/energy consumption values.

Data Recording and Timestamping

For the Energy Efficiency Compliance application, a timestamp accuracy of ±1 second is sufficient.

Advanced power meters such as the PowerLogic ION9000, PM8000, HDPM6000, and some PowerLogic PM5000 models (PM53xx and PM55xx) can

86. OPC: Open Platform Communications
87. The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert or Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.

timestamp and record onboard energy measurements as well as connected equipment states. EcoStruxure Power Monitoring Expert or Power Operation can then retrieve the records with their original timestamp.


PowerLogic ION9000


PowerLogic PM8000


PowerLogic HDPM6000


PowerLogic PM5000

For other devices (PowerLogic P5/P3, MasterPacT MTZ, Galaxy VX/VL/VM/VS, entry-level PowerLogic PM5000 models, Acti9 iEM3000, PowerLogic PowerTag, PowerLogic PFC, AccuSine EVC+, etc.) energy measurements and equipment states are acquired by the connected products and then recorded and timestamped by EcoStruxure Power Monitoring Expert or Power Operation.


PowerLogic P5


PowerLogic P3


MasterPacT MTZ


Galaxy VX/VL/VM/VS


PowerLogic PM5000


Acti9 iEM3000


PowerLogic PowerTag


PowerLogic PFC


PowerLogic AccuSine EVC+


EcoStruxure Power Monitoring Expert


EcoStruxure Power Operation

When acquiring data from other customer systems, timestamps can also be imported through OPC[88] or ETL[89].

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

88. OPC = Open Platform Communications
89. ETL = The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert and Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.

Time Synchronization

For consistent timestamping of all the data, the date and time should be accurately distributed to connected products and data loggers.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be connected to a GPS antenna to reach the expected time precision.

TimeSync Clock

Data Processing

Energy data processing is embedded in the reporting engine and in the dashboards of EcoStruxure Power Monitoring Expert or Power Operation.

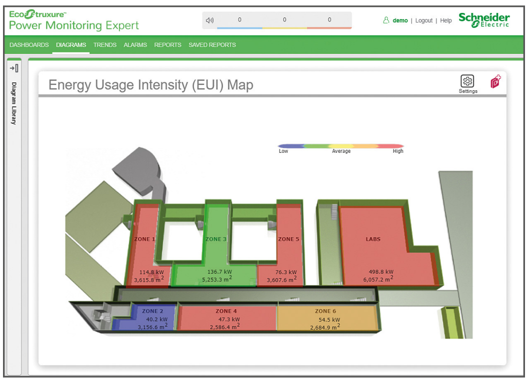
EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Outputs

Live Data Display

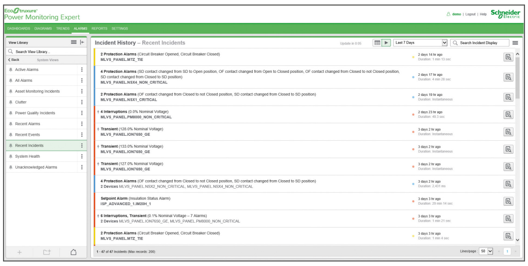
Measured energy values such as kWh and peak demand (kW) highlighted in ISO 50006 sub-standard of ISO 50001 can be displayed in dashboards, custom graphical diagrams, and live data tables in EcoStruxure Power Monitoring Expert or Power Operation (refer to Energy Monitoring application).



Live Data Display Example: Energy Usage Map

Events and Alarms

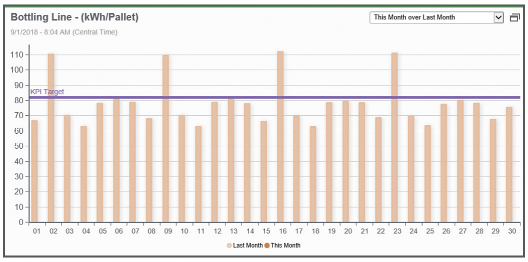
Smart alarms can be configured to alert energy managers or operations staff in case of energy-related events which require attention (imminent exceeding of peak demand threshold, etc.) (refer to Energy Monitoring application).



Events and Alarms

Trends

Measured energy values, ratios of measured values, or KPIs (kWh/unit of production, etc.) can be trended in the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation).



Peak Demand Trend

NOTE: To monitor ratios of measured values in trends, normalization data such as production, temperature, square meters, etc. must be integrated using ETL, OPC or .csv file export. In addition, the KPI Report must be configured to write KPI data into the database in EcoStruxure Power Monitoring Expert or Power Operation (refer to Energy Monitoring application).

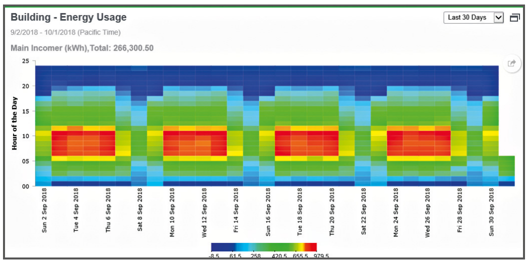
Dashboards

Dashboards to visualize, analyze, and communicate energy performance in accordance with an ISO 50001 management program can be configured (refer to Energy Monitoring application).

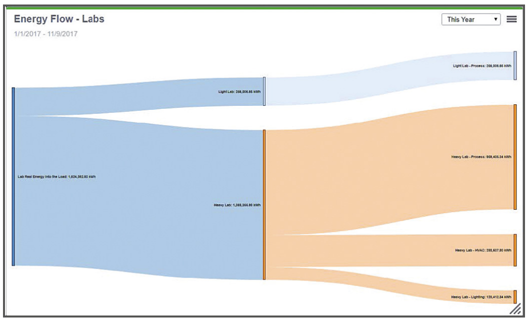
Some examples of dashboards include:

- Sankey diagram
- Energy heatmap
- Pareto chart
- Period over period
- Historical trends, bar chart, line chart with target line, pie chart
- KPI dashboards (Energy Intensity[90], etc.)

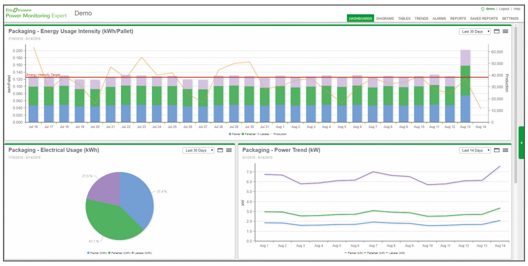
90. KPI dashboards require contextual data and configuration of the KPI Report available with the Energy Analysis module in EcoStruxure Power Monitoring Expert or Power Operation, etc.



Energy Heat Map Dashboard



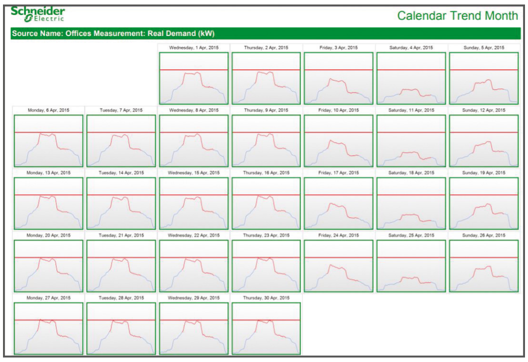
Sankey Diagram


KPI Dashboard

Reports

Several reports are available to support Energy Efficiency Compliance:

- Consumption Ranking Reports
- Energy Comparison Reports
- Energy Modeling Reports
- Energy Usage Reports
- Calendar Trend Reports
- KPI Engine Reports
- Load Profile Reports
- Energy Cost Reports



Calendar Trend Report

These reports are described in detail in the Energy Monitoring application.

To help evaluate the effectiveness of energy saving initiatives, an energy model can be created to simulate the facility's energy baseline. This baseline can then be compared to energy drivers such as production, heating, or cooling degree days. It analyzes actual energy use compared to the model to track and forecast energy savings as a result of organizational or operational changes (refer to Energy Modeling and Verification application).

Notifications[91]

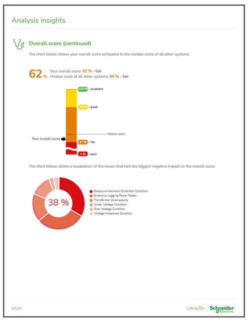
SMS or email notifications are sent on pre-alarm and alarm conditions described above to enable fast action.

Cloud-Based Analytics and Services

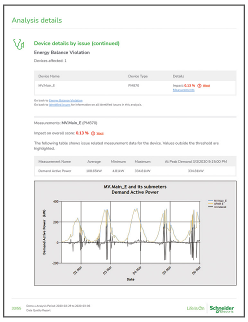
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.

For further information, refer to Data Quality Management, page 24.

EcoStruxure Service Plan Powered by EcoStruxure Power Advisor Platform



EcoStruxure Power Advisor Data Quality Report - Overall Score



EcoStruxure Power Advisor Data Quality Report - Device Details by Issue

91. For notifications in EcoStruxure Power Monitoring Expert and Power Operation, the Event Notification Module is required.

Greenhouse Gas Reporting

What's in This Chapter

Overview

Context of Application

Companies are faced with mounting global pressure to help cut carbon emissions and become more efficient by reducing energy and water consumption and waste. To do this they require accurate and timely environmental reporting.

Problem to Solve

The facility manager needs to:

- Convert energy consumption to greenhouse gas equivalents to communicate the results of reduction efforts to stakeholders (shareholders, public, regulatory bodies).
- Promote a green image.

Purpose of the Application

Track and report carbon emissions and waste

Energy consumption and waste can be converted to carbon emissions and represented, for example, as:

- Equivalent tons of CO_2
- Saved trees
- Kilometers driven

In addition, Schneider Electric's modules can communicate water waste and provide period-over-period usage comparison.

Application Outcomes

Dashboards

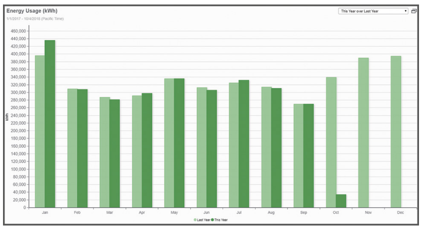
- Energy Equivalency Gadget

  Carbon emissions are reported and segmented by source, scope, and pollutant, and can be indexed to various specified metrics.

Energy Equivalency Gadget

- Period Over Period Gadget

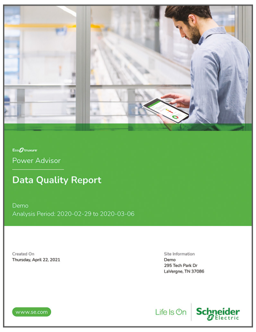
  The greenhouse gas emissions for one period are compared with those for a previous period.



Period Over Period Gadget

Cloud-Based Analytics and Services

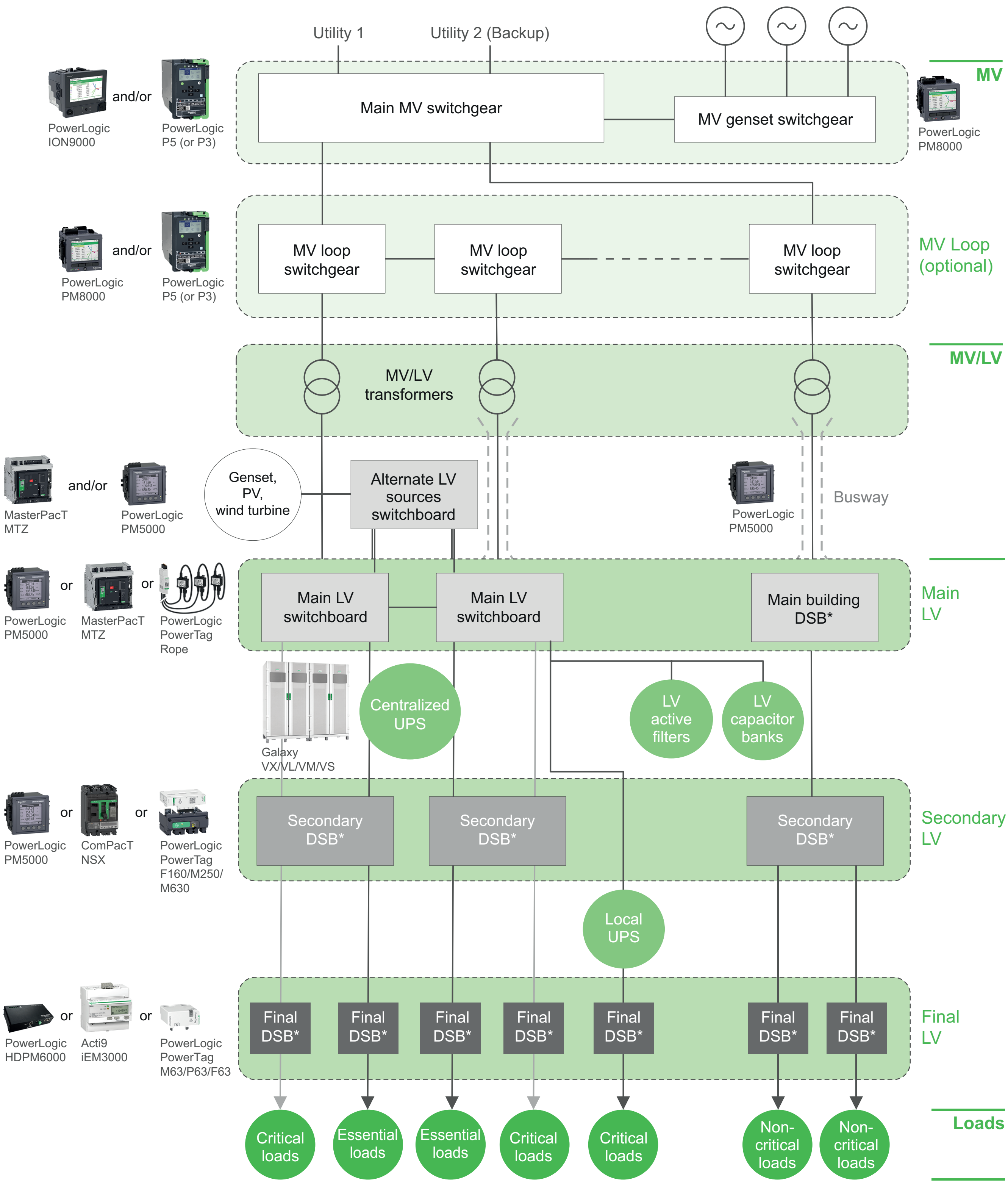
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.



EcoStruxure Power Advisor Data Quality Report

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Greenhouse Gas Reporting application:



* DSB = Distribution Switchboard

Digital Architecture

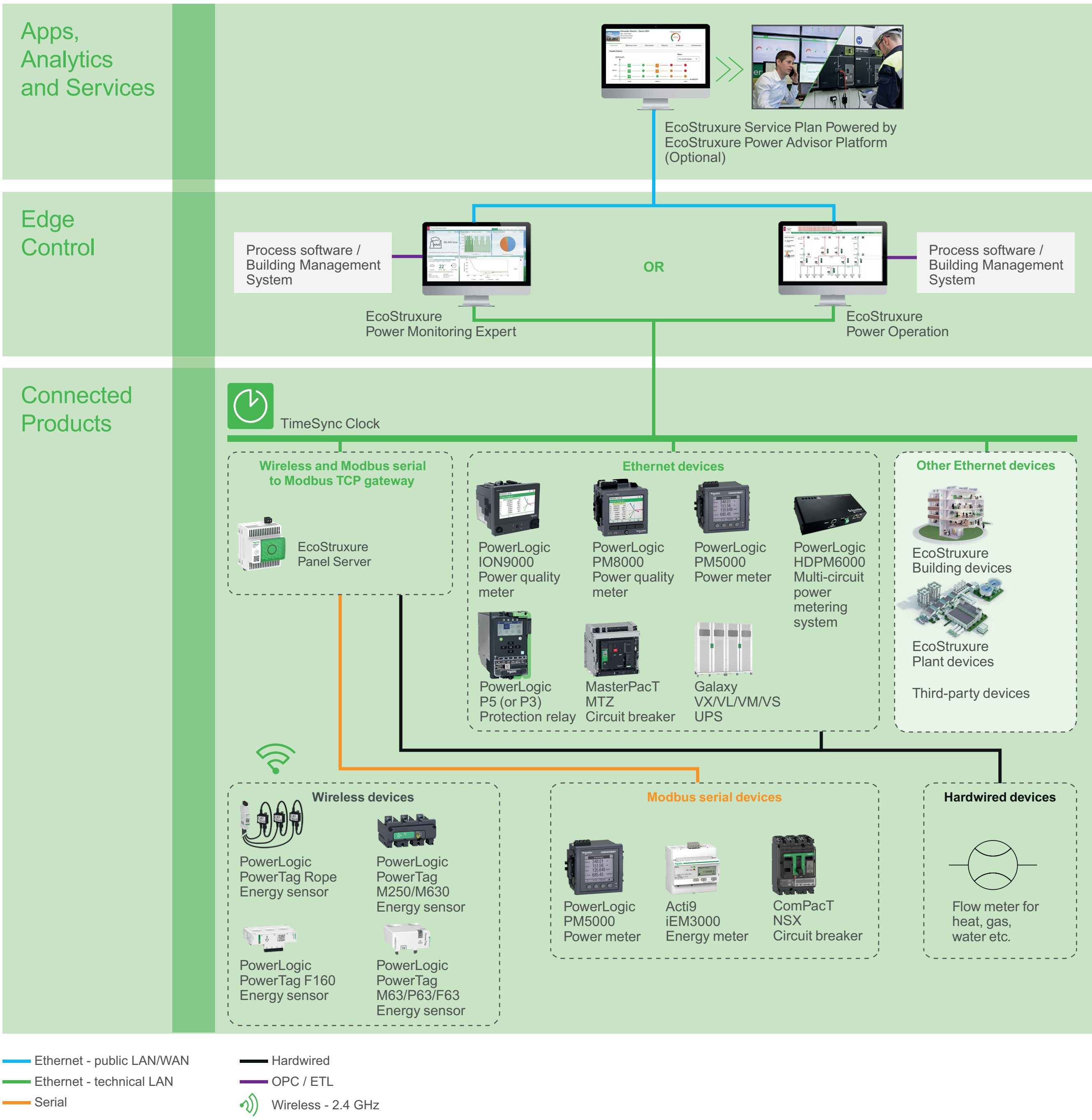
In this architecture, the data is collected from connected products either directly over Ethernet or via gateways (such as the EcoStruxure Panel Server). This data is then recorded and processed by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation) for on-premise visualization, analysis, and reporting.

Other utility consumption inputs (WAGES) can also be directly acquired via Ethernet, via serial communication, or through hardwired signals from basic meters and sensors.

To include other process or equipment related data in the analyses, OPC or ETL can be used to acquire data from external process or building management software.

As an option, data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Power Advisor platform and analyzed by experts as part of the EcoStruxure Service Plan.

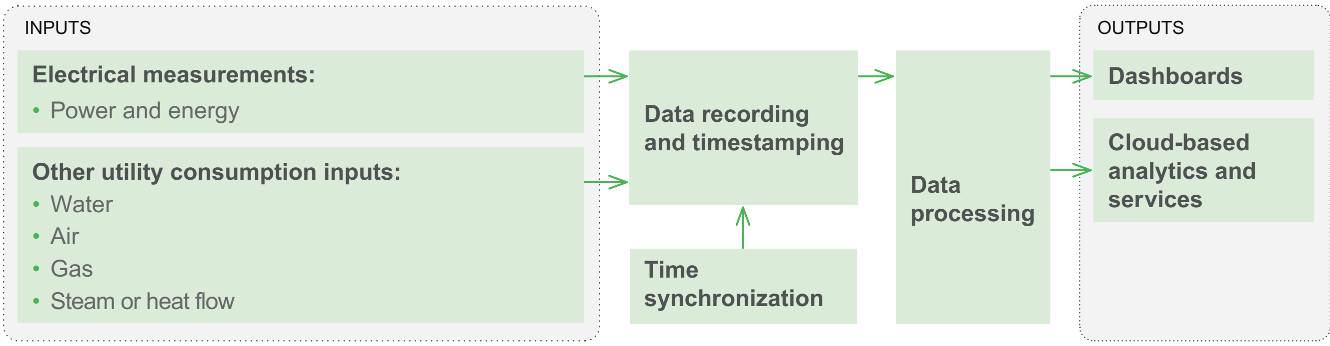
The recommended digital architecture for the application is shown below:



System Description

Data Flow

The Greenhouse Gas Reporting application can be broken down as follows:



Inputs

The following data are required to implement the Greenhouse Gas Reporting application:

Electrical Measurements

The following electrical measurements are collected at each point of interest in the electrical distribution, from Medium Voltage, to Low Voltage, down to Final Distribution.

- Power values (kW, kVAR, kVA)
- Energy values (kWh, kVARh, kVAh)

These data may be acquired from:

- **Power/energy meters** such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, PowerTag, Acti9 iEM3000


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


PowerLogic HDPM6000


Acti9 iEM3000


PowerLogic PowerTag

- **Devices with embedded metering** such as PowerLogic P5/P3, MasterPacT MTZ, and ComPacT NSX protection devices, or Galaxy VX/VL/VM/VS UPS


PowerLogic P5


PowerLogic P3


MasterPacT MTZ


ComPacT NSX


Galaxy VX/VL/VM/VS

- **Third-party devices (via Modbus)**

Other Utility Consumption Inputs

The following utilities can be monitored:

- Water
- Air
- Gas
- Steam or heat flow

They can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

Data Recording and Timestamping

For the Greenhouse Gas Reporting application, a timestamp accuracy of ±1 second is sufficient.

Advanced power meters such as the PowerLogic ION9000, PM8000, HDPM6000, and some PowerLogic PM5000 models (PM53xx and PM55xx) can timestamp and record onboard energy measurements. EcoStruxure Power Monitoring Expert or Power Operation can then retrieve the records with their original timestamp.

PowerLogic ION9000

PowerLogic PM8000

PowerLogic HDPM6000

PowerLogic PM5000

For other devices (PowerLogic P5/P3, MasterPacT MTZ, Galaxy VX/VL/VM/VS, entry-level PowerLogic PM5000 models, Acti9 iEM3000, PowerLogic PowerTag, etc.) energy measurements are acquired by the connected products and then recorded and timestamped by EcoStruxure Power Monitoring Expert or Power Operation.

PowerLogic P5

PowerLogic P3

MasterPacT MTZ

Galaxy VX/VL/VM/VS

PowerLogic PM5000

Acti9 iEM3000

PowerLogic PowerTag

EcoStruxure Power Monitoring Expert

EcoStruxure Power Operation

When acquiring data from other customer systems, timestamps can also be imported through OPC[92] or ETL[93].

For a comprehensive overview of device recording and timestamping capabilities, refer to Data Recording and Time Synchronization Capabilities of EcoStruxure Power Connected Products, page 17.

Time Synchronization

For consistent timestamping of all the data, the date and time should be accurately distributed to connected products and data loggers.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and can be connected to a GPS antenna to reach the expected time precision.

TimeSync Clock

Data Processing

The calculation engine in EcoStruxure Power Monitoring Expert and Power Operation provides the ability to convert energy consumption data into greenhouse gas equivalent measurements.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

Outputs

Outputs are displayed by EcoStruxure Power Monitoring Expert or Power Operation.

EcoStruxure
Power Monitoring Expert

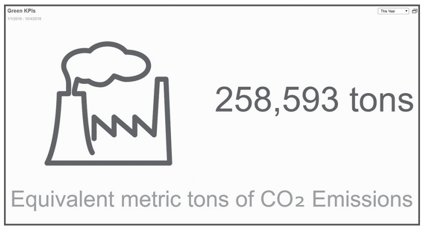
EcoStruxure
Power Operation

Dashboards

Energy Equivalency Gadget

92. OPC = Open Platform Communications
93. ETL = The EcoStruxure Extract Transform Load (ETL) engine is a companion application for EcoStruxure Power Monitoring Expert and Power Operation. It is used to extract historical data from one application (Schneider Electric or third-party), then transform that data so it can be loaded into another application.

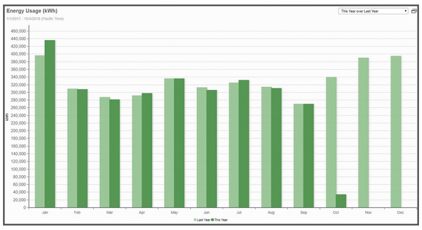
Shows a single value that is equivalent to the aggregated consumption input data, over a selected time period. The value can be scaled or normalized to represent an equivalent consumption measurement. The information is shown as a numeric value with unit, custom text, and a custom graphic.



Energy Equivalency Gadget

Period Over Period Gadget

Can be used to compare the greenhouse gas emissions of one period with respect to a previous period.



Period over Period Gadget

Other Gadgets and Trends

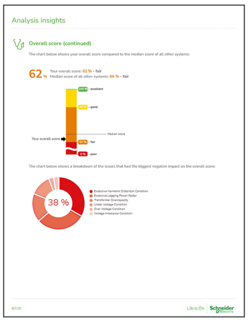
Many other gadgets or trends (such as those discussed in the Energy Monitoring application) can be used to display and analyze greenhouse gas equivalent measurements.

Cloud-Based Analytics and Services

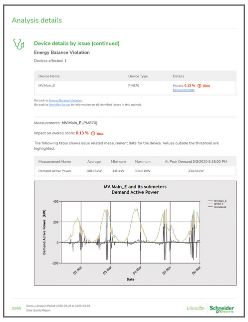
As an option, EcoStruxure Service Plan powered by EcoStruxure Power Advisor provides data quality analytics with recommendations from our Schneider Electric service experts.

For further information, refer to Data Quality Management, page 24.

EcoStruxure Service Plan Powered by EcoStruxure Power Advisor Platform



EcoStruxure Power Advisor
Data Quality Report - Overall Score



EcoStruxure Power Advisor
Data Quality Report - Device Details by Issue

Appendix

What's in This Part

Product Information

What's in This Chapter

Connected Products

Protection, Monitoring, and Control

PowerLogic P5

Medium voltage network protection relay

PowerLogic P5 is a protection relay for demanding medium-voltage applications. It offers users industry-leading dedicated protection relay functionality to reduce risk and improve reliability, all with advanced connectivity. Additionally, it can be used with a range of digital tools that make everyday operations simpler for users.

PowerLogic P3

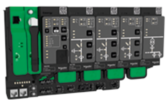
Medium voltage network protection relay

PowerLogic P3 is a range of easy-to-use protection relays for medium voltage applications. With fast delivery, it is an ideal way for panel builders, contractors, and partners to save time. PowerLogic P3 has been designed to meet customer's needs including overcurrent and arc flash protection and latest connectivity.

PowerLogic C5

Medium voltage automation controller

PowerLogic C5 is a scalable and interoperable solution for large buildings and critical facilities that brings software intelligence to automation schemes to help operate electrical distribution systems automatically and promote energy efficiency, power reliability, and continuity of services across a multitude of applications.



PowerLogic T300

Distribution network management for MV and LV applications

PowerLogic T300 is a modular platform for hardware and firmware, and an application building block for medium voltage and low voltage distribution network management. It offers a single solution for control and monitoring, from a simple pole-top equipment to a large MV/LV substation. It is a powerful Remote Terminal Unit for feeder automation.

MasterPacT MTZ

High current air circuit breakers up to 6300 A embedding advanced digital technologies for LV applications

Future Ready MasterPacT MTZ is a comprehensive range of air circuit breakers designed to help protect electrical systems from damage caused by overloads, short circuits, and equipment ground faults. MasterPacT MTZ embeds advanced digital technologies and MicroLogic X control units help contribute to safety and energy efficiency.

ComPacT NSX

Molded case circuit breakers up to 630 A for LV applications

ComPacT NSX is a full range of high-performance molded case circuit breakers in 2 frame sizes designed to meet your needs from thermal-magnetic to advanced MicroLogic trip units. MicroLogic allows for wired communication, whereas PowerTag NSX is designed for wireless communication.

Auxiliary Contact for ComPacT NSX/NS

Wireless auxiliary contact (OF/SD/SDE status)

The wireless Auxiliary Contact for ComPacT NSX/NS offers the option to report the status of the circuit breaker remotely (OPEN/CLOSED, TRIPPED, TRIPPED on electrical default). It is easily mounted in the same place as the wired auxiliary contacts.

TransferPacT Active Automatic

Automatic Transfer Switch

TransferPacT Active Automatic is a range of transfer switches for source changeover. It can transfer the power from one source to another for power continuity. This offer is driven by a solenoid with fast transfer speed (<500 ms) which is suitable for applications in hospitals, commercial buildings, and data centers. The product has a modular controller, and the interactive functions can be extended anywhere depending on the customer’s requirements.

ASCO 7000 Series PTS

Power transfer switch and controls for LV and MV applications

ASCO 7000 Series PTS are the industry standard for power switching and control. They are offered in single transfer switch or redundant bypass configurations. Automatic controls are available in open, delayed, closed, and soft load transfer transition modes.

TeSys

Contactors for LV applications

As the largest selling line of contactors in the world, the TeSys range offers high reliability with long mechanical and electric life across the entire range of accessories for motor and load control. TeSys contactors are available for both IEC and NEMA applications and are certified by major standards around the world.

Acti9 iC60

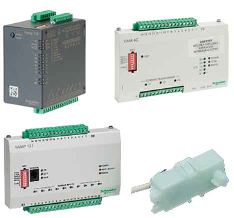
Miniature circuit breakers for final LV applications

Acti9 iC60 is a range of DIN rail miniature circuit breakers that provides circuit protection and continuity of service up to 63 A. It is especially ideal for polluted environments and networks.

Acti9 Active

All-in-one final distribution protection device

Acti9 Active devices come with integrated earth leakage protection, miniature circuit breaker, Arc fault detection device, and overvoltage protection. It helps protect people, appliances, and circuits against fire risks, enabled by a compact all-in-one device. Through advanced notifications, diagnostics, and analytics, it gives business owners and maintenance personnel greater control over their building's electrical health and, in-turn, enhances service continuity.



Arc V121, PowerLogic A125, and Accessories (VA1DA, VAM4C)

Arc flash mitigation by optical detection

Arc flash protection devices which help eliminate or minimize costs resulting from arc flash damage - downtime, repair time, interruption of processes and equipment. Arc flash protection devices help avoid personal injury due to arc flash events.

ASCO 7000 Series PCS

Advanced power control system (PCS) for LV and MV applications

ASCO 7000 Series PCS is the electrical industry's most advanced power control automation systems for facility power sources, load, and electrical distribution. They provide configured and engineered-to-order autonomous control sequences for maximum value and flexibility.

ASCO SPD with ASM

Surge protective device with active surge monitor

ASCO SPD with ASM offers industry-leading surge protection with intelligent surge monitoring, detection, and logging technologies.

ASCO CPMA

Critical power management appliance

ASCO CPMA solutions help monitor and control everything from single-generator backup power systems to critical power across multi-building and multi-site applications. Sophisticated event logging features and automated compliance reporting provide advanced forensic insight and streamline compliance testing.

Insulation Monitoring and Fault Location

Vigilohm IM400

Insulation Monitoring Device (IMD) for industrial applications

Vigilohm IM400 is an Insulation Monitoring Device (IMD) for low-voltage and medium-voltage ungrounded power systems, including marine environments. The connected product monitors the insulation of a power system and notifies any insulation faults as soon as they occur. The IM400 is used for all power system types - AC, DC, combined, rectified, with a variable speed drive, etc. It can be combined with an IFL12 for insulation fault location. The communication protocol is Modbus RTU.

Vigilohm IFL12

Insulation Fault Locator (IFL) for industrial applications

Vigilohm IFL12 is a digital Insulation Fault Locator (IFL) for low-voltage ungrounded power systems. When installed in conjunction with an IM20-H, this Insulation Fault Locator individually monitors each of the feeders. It reports fault locations, either locally, through a light and a contact, or remotely, through the Modbus communication port.

Vigilohm IM20-H

Insulation Monitoring Device (IMD) for hospital applications

Vigilohm IM20-H is a specific Insulation Monitoring Device (IMD) that complies with IEC 61557-8 and provides insulation integrity alarming, isolation transformer overload, and temperature monitoring. The communication protocol is Modbus RTU.

Vigilohm IFL12-H

Insulation Fault Locator (IFL) for hospital applications

Vigilohm IFL12-H is a digital Insulation Fault Locator (IFL) for low-voltage ungrounded power systems. When installed in conjunction with an IM20-H, this Insulation Fault Locator individually monitors each of the feeders. It reports fault locations, either locally, through a light and a contact, or remotely, through the Modbus communication port.

Vigilohm HRP

Hospital Remote Panel (HRP)

When installed in conjunction with an IM20-H, the Vigilohm HRP provides a local alarm in the operating theatre.

Vigilohm LRDH

Hospital remote HMI

In addition to the functionality of the HRP above, the Vigilohm LRDH provides an insulation fault location indication on a graphical color display.

Power and Energy Meters

PowerLogic ION9000 Series

Power quality meters for utility incomers or highly critical applications

PowerLogic ION9000 series is a range of advanced power quality meters, designed for high accuracy, energy cost, network management, and power quality requirements.

PowerLogic PM8000 Series

Power quality meters for critical applications

PowerLogic PM8000 series is a range of high-performance power meters for cost and network management applications on feeders and critical loads. It simplifies power quality and maximizes versatility.

PowerLogic PM5000 Series

Power meters with basic power quality functionality

PowerLogic PM5000 series is a range of high-end, cost-effective, and compact power meters which enable energy cost and basic network management applications.

PowerLogic HDPM6000

Multi-circuit power metering system

PowerLogic HDPM6000 are high-density, multi-circuit busway and panelboard power meters for cost and network management in large and critical power applications.

Acti9 iEM3000

DIN rail mounted energy meters

Acti9 iEM3000 series is a range of cost-effective energy meters which can easily be integrated into an Energy Management System or a Building Management System thanks to native Modbus, BACnet, M-bus, and LON protocols. It provides a full view of energy consumption and multiple tariffs give customers the flexibility to match the billing structure of their utility.

PowerLogic PowerTag

Wireless energy sensors

PowerLogic PowerTag is a range of wireless energy sensors that provide precise, real-time data on energy, currents, power, voltage, and power factor. These sensors accurately monitor energy consumption and wirelessly communicate this data in real time via a gateway.

ASCO 5210

Power manager transducer

The ASCO 5210 Power Manager collects real-time power system information from ASCO Power Control Systems and 7000 Series Power Transfer Switch products (which utilize the Group 5 Controller). It transmits data serially to a remote network management product for collection and analysis.

PLC and PAC

Substation Monitoring Device (SMD)

Local and/or remote monitoring for MV or LV applications

The Substation Monitoring Device (SMD) performs analytics on temperature and environmental data for monitoring and alarming via a local HMI or SCADA system. The Substation Monitoring Device (SMD) consists of an M251 PLC and optional Magelis HMI. It is factory-configured and automatically integrates into the Edge Control software. The Substation Monitoring Device (SMD) can also send SMS messages in case of alarms. The optional color display provides SLD representation with overlaid temperature values.

Modicon M580

Ethernet Programmable Automation Controller (ePAC) and safety PLC for process, availability and safety solutions

Modicon M580 high-end ePAC features redundant controllers, new stand-alone safety controllers (safety PLC) with native Ethernet and cybersecurity embedded in its core.

Modicon M340

Mid-range PLC for industrial process and infrastructure

Modicon M340 Programmable Automation Controller (PAC) is built to suit the needs of the process industry and a wide range of demanding automation applications such as a multitasking system for optimal reflex time.

Power Quality Correction, Power Factor Correction, and UPS

PowerLogic AccuSine PCSn

Active Harmonic Mitigation for commercial buildings

PowerLogic AccuSine PCSn provides a scalable and flexible, high-performance active harmonic filtering solution capable of mitigating harmonics in neutral circuits for improved electrical system reliability and efficiency resulting in less downtime and a longer equipment life.

PowerLogic AccuSine PCS+

Active Harmonic Mitigation for industrial applications

PowerLogic AccuSine PCS+ is a high-performance, scalable active power correction solution for stabilizing electrical networks by providing harmonic mitigation, as well as providing power factor correction and load balancing.

PowerLogic AccuSine EVC+

Electronic VAR Compensation for commercial and light industrial applications

PowerLogic AccuSine EVC+ is a high-speed, stepless reactive power compensation system that helps keep power networks efficient, reliable, and healthy. It is designed to help you keep your power factor stable and voltage balanced even with fast changing loads, unlike capacitor banks that tend to over- or under-compensate in dynamic environments. Built on the award-winning PowerLogic AccuSine active correction platform, the AccuSine EVC+ offers superior performance for power factor correction, phase balancing, and harmonic mitigation and is well suited to modern electrical networks with a lot of digital loads and distributed power sources.

PowerLogic AccuSine PFV+

Electronic VAR Compensation for specific and high-performance applications

PowerLogic AccuSine PFV+ addresses power quality issues via simple, effective correction of leading or lagging power factors and reduction of voltage fluctuations. Its unique design helps extend equipment operating life and improve system power performance, and offers multiple features in one complete package.

PowerLogic PFC

LV capacitor bank for power factor correction

PowerLogic PFC is a complete range of high-quality power factor correction solutions engineered to compensate reactive power and harmonic distortion. These are easy and flexible solutions that can immediately boost a facility's energy efficiency and productivity. Thanks to PowerLogic PFC, your power factor is maintained at an ideal level for optimal power system efficiency and cost reduction.

Galaxy VX/VL/VM/VS

3-phase uninterruptible power supply (UPS)

Galaxy VX/VL/VM/VS range is composed of the following products:

Galaxy VX is a scalable, high-performance extension of the Galaxy V-Series solutions. It is designed for large data centers and industrial applications.

Galaxy VL is a 3-phase UPS for 200 to 500 kVA/kW. Its modular, redundant design and low total cost of ownership serve medium to large data centers and other mission critical facility applications.

Galaxy VM is a 3-phase UPS power protection that seamlessly integrates into medium data center, industrial, or facilities applications.

Galaxy VS is a highly efficient 3-phase UPS from 20 to 100 kVA (400 V/480 V) and 10 to 50 kVA (208 V) for edge, small, and medium data centers and other business-critical applications.

Gateways and Data Loggers

EcoStruxure Panel Server

IoT gateway for an intelligent power network

EcoStruxure Panel Server is a high performance, modular gateway with enhanced cybersecurity that offers quick and easy connection to multiple concurrent edge control or cloud applications. It is able to collect and store data from wireless and wired devices using a variety of protocols including Zigbee, Modbus TCP, and Modbus RTU.

Acti9 PowerTag Link HD

Communication system

Acti9 PowerTag Link HD is an Ethernet connection concentrator (Modbus TCP/IP) for wireless devices with data display web pages. The associated PowerTag energy sensors allow alarms to be managed via email for terminal loads, and energy, power, current, and voltage to be measured accurately in real time. The associated PowerTag control modules are designed to monitor a circuit and wirelessly notify the concentrator of the information status of a contact (OF, SD, CT or TL position indication). The entire system can easily be installed in existing LV equipment using Multi9 / Acti9 / ComPacT NSX type circuit breakers.

Enerlin'X IFE, EIFE, and IFM

Communication interfaces for MasterPacT and ComPacT circuit breakers

IFE: Ethernet interface for MasterPacT and ComPacT circuit breakers. Also includes Modbus serial to TCP functionality.

EIFE: Ethernet interface for drawout MasterPacT MTZ air circuit breakers.

IFM: Modbus Serial interface for MasterPacT and ComPacT circuit breakers.

Harmony ZBRN32

Data concentrator for wireless sensors and serial Modbus gateway

Each Zigbee concentrator has 60 inputs. A sensor is paired with one input of the Zigbee concentrator, meaning the sensor's ID is associated with the concentrator input and all information concerning the sensor can be read in a Modbus table using the input index.

EcoStruxure Power Automation System Gateway

Protocol converter, data concentrator, automation and microgrid controller

EcoStruxure Power Automation System Gateway is a scalable and interoperable rugged communication gateway that helps to remotely monitor and operate electrical processes, contributing to a more connected and efficient digital power system. The gateway application software also supports automation and microgrid controller capabilities. Extra functions to reconcile the main drivers of power grid transformation: energy transition, distributed generation, and renewables.

Cyber Sciences SER 3200/2408

Sequence of events recorder (SER) for high time accuracy applications

Cyber Sciences SER 3200/2408 records status changes of 32 channels, timestamped to 1 ms. Time synchronization is achieved via PTP (IEEE 1588), IRIG-B, DCF77, NTP, Modbus TCP, or an RS-485 signal from another sequence of events recorder (SER). One SER serves as a PTP server and all other SER devices sync automatically within 100 microseconds – without special Ethernet switches. https://www.cyber-sciences.com/product/sequence-of-events-recorder-ser/

ASCO 5112

Quad-ethernet module for ASCO applications

The ASCO 5112 Quad-Ethernet Modules (QEM) are a line of protocol gateways that provide users with communication interfaces to ASCO transfer switches, meters, and input/output devices.

Sensors

PowerLogic TH110

Wireless thermal sensor for critical connections

The PowerLogic TH110 is a battery-free wireless temperature sensor used to perform the continuous thermal monitoring of critical connections made in the field.

PowerLogic CL110

Wireless thermal sensor for ambient temperature

The PowerLogic CL110 is a wireless temperature and humidity sensor with a battery for continuous ambient temperature monitoring.

PowerLogic HeatTag

Wireless sensor for early detection of overheating cables

PowerLogic HeatTag, connected to edge or cloud software, helps building operators monitor LV switchboards 24/7 to help prevent electrical fires due to overheating cables or cable connections. Thanks to the smart algorithm embedded in the sensor, excessive cable temperatures are detected by analyzing the gases/molecules released from the insulation of overheating cables. In case of a detected issue, an alert is sent to the building operator to act before smoke appears or before an electrical fire starts. Due to the relatively large number of cable connections in most installations, one sensor at the top of each column is recommended to easily identify the origin of the overheating alarm.

MV/LV Equipment

PremSet

SSIS Modular MV Switchgear up to 24 kV

PremSet is a SF6-free Medium Voltage (MV) switchgear up to 17.5 kV (1250 A) which features Shielded Solid Insulation System (SSIS), with all live parts encapsulated, shielded, and earthed. PremSet uses vacuum technology for breaking.

SM AirSeT

SF6-free Modular MV Switchboard

SM AirSeT is a natively connected SF6-free Medium Voltage (MV) switchgear up to 24 kV (1250 A) for secondary distribution networks and installations, for commercial and industrial building sectors and utilities. It uses Pure Air technology and vacuum technology for breaking.

Trihal

MV/LV Dry Type Transformer from 160 kVA to up to 15 MVA

Trihal is a three-phase transformer for MV/LV secondary distribution networks up to 15 MVA (36 kV). It uses epoxy resin insulation (oil free) making it suitable for indoor installation in commercial and industrial buildings.

Okken/BlokSeT

LV Power Distribution Switchboard

Okken/BlokSeT are complete and customized low voltage switchboards for electrical distribution up to 7300 A and 7000 A respectively and for motor control up to 250 kW.

PrismaSeT (P or G)

LV Power Distribution Switchboard

PrismaSeT is a panel building system for power distribution switchboards up to 4000 A.

Edge Control and Configuration Tools

EcoStruxure Power Monitoring Expert

Power Management software

EcoStruxure Power Monitoring Expert helps maximize system reliability and optimize operational efficiency to increase your profitability.

EcoStruxure Power Operation

High-performance software system for electrical distribution monitoring and control

With its high availability, redundancy, high speed data acquisition, and alarming, EcoStruxure Power Operation is aimed at very large sites with many devices and high availability requirements. The software gives operators exceptional knowledge and control of their network through an intuitive, interactive, and customizable interface. With fast, consistent access to actionable information, Power Operation operators are more effective at protecting and optimizing their electrical distribution network, improving both its efficiency and productivity.

EcoStruxure Building Operation

Integrated system for monitoring and optimization of building performance

EcoStruxure Building Operation is a one-stop solution combining building operation software and field-level control devices and hardware with engineering, installation, services, and analytics to create seamlessly connected buildings. EcoStruxure Building Operation integrates any building management application and provides native support for open protocols including LON, BACnet, Modbus, and web services.

EcoStruxure Microgrid Operation

Microgrid Controller Solution

EcoStruxure Microgrid Operation is a complete microgrid controller solution associated with an ergonomic HMI. It provides network balancing features and protection adaptation for more stable and optimized microgrids. EcoStruxure Microgrid Operation synchronizes load voltage and frequency to preserve customers' microgrid power supply, enabling grid continuity and stability when disconnecting and reconnecting to the grid.

EcoStruxure Cybersecurity Application Platform

Cybersecurity defense strategy software

EcoStruxure Cybersecurity Application Platform provides OT infrastructure with a full package of essential security features to help protect assets against cyber-threats such as intrusion detection, system authentication and authorization proxy, and security dashboards with system logs.

EcoStruxure Cybersecurity Admin Expert

Centralized user, password and security policies management software

EcoStruxure Cybersecurity Admin Expert is a comprehensive and intuitive cybersecurity configuration and policy tool for your operational technology environment.

EcoStruxure Power Automation System Engineering

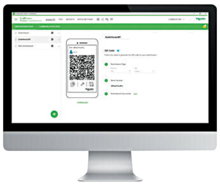
System Design, Specification and Configuration Tool

EcoStruxure Power Automation System Engineering is an easy to use, vendor independent engineering workbench, which can be used to design and configure a future-proof Protection Automation and Control System compliant with IEC 61850 standards enabling application standardization and engineering efficiency.

EcoStruxure System Management

System lifecycle management software

EcoStruxure System Management tool is a vendor agnostic inventory baseline management software, which can be used to perform maintenance on connected equipment in a heterogenous multi-vendor solution with a focus on cybersecurity.



EcoStruxure Power Commission

Digital-enabled switchboard commissioning software

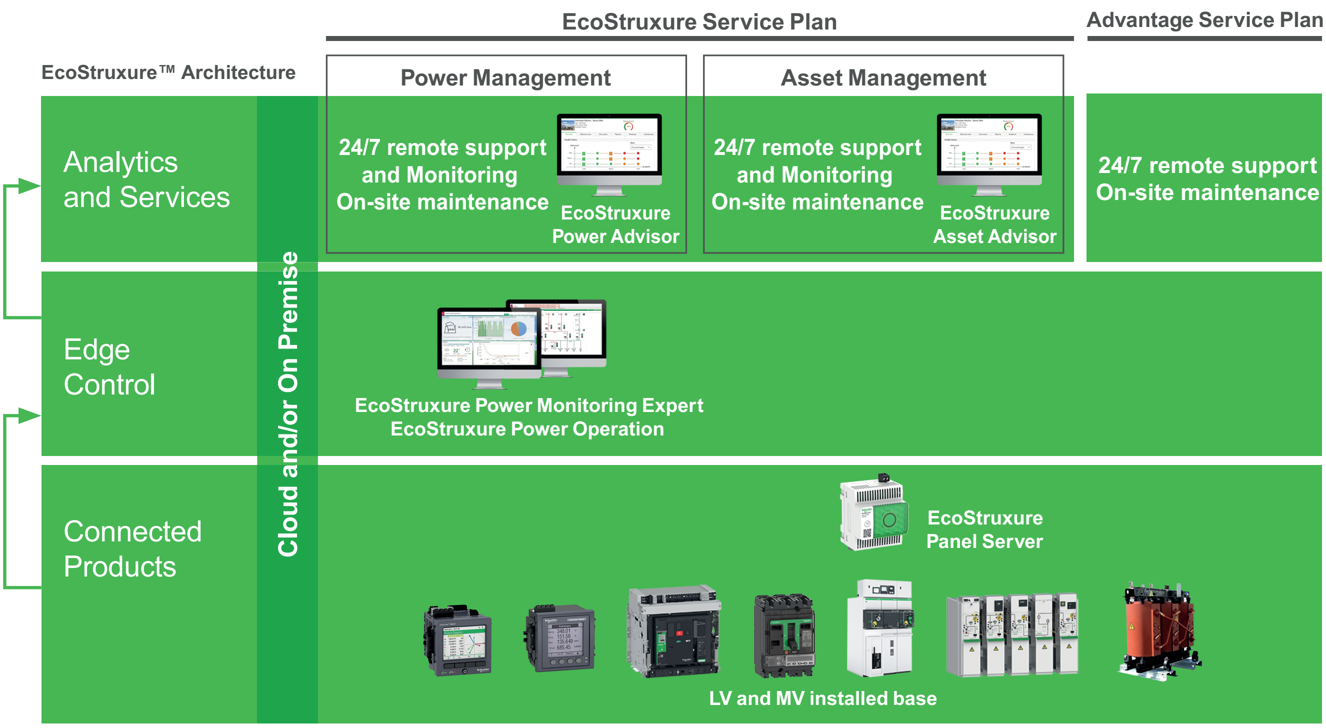
EcoStruxure Power Commission is an intuitive software tool that offers easy configuration, testing methodologies, and integrated reporting for all smart devices connected to your switchboard - all in one program. It's the simplest way to set up, test, commission, and manage the smart devices and systems within your switchboard.

Apps, Analytics, and Services

EcoStruxure Service Plan

Remote and on-site services

From essential support to advanced expertise, EcoStruxure Service Plan is a set of tailored service contracts that combine the power of EcoStruxure Power platform (EcoStruxure Asset Advisor and Power Advisor) with remote and on-site consultancy. It helps maximize uptime, optimize maintenance costs, improve operator efficiency while extending asset and system life expectancy.



Overview of EcoStruxure Service Plan

Functionality	Improve your electrical asset management				Optimize your power management	
	Prevent	Predict	Plus	Prime	Prime	Ultra
Asset monitoring and alarming	●	●	●	●		
24/7 technical support	●	●	●	●	●	●
On-site emergency support	●	●	●	●	●	●
Asset/System data analytics, reports, asset/power management consultancy		●		●	●	●
Preventive maintenance			●	●	●	●
Condition-based maintenance with Maintenance Index			●	●		
Labor repair				●		
Spare parts				Option		●

EcoStruxure Service Plan Packages

EcoStruxure Asset Advisor

Cloud-based asset monitoring service for predictive and preventive maintenance

EcoStruxure Asset Advisor brings a proactive approach to electrical distribution and critical data center assets, combining IoT and cloud-based technologies with Schneider Electric's experts and services for business continuity. EcoStruxure Asset Advisor evaluates live data from your critical connected assets and uses advanced analytics to identify potential threats. With this data, Asset Advisor gives you the power of choice for critical decisions, either to take action yourself or to leverage Schneider Electric's service experts to act on your behalf.

EcoStruxure Power Advisor

Cloud-based data quality and power quality monitoring service

EcoStruxure Power Advisor raises metering diagnostics from connected product-based troubleshooting to full system analysis. It combines expert advice with advanced algorithms (applying it to data from your Power Monitoring Expert system) to identify gaps or issues in your power management system, as well as power quality issues within your larger electrical distribution system.

EcoStruxure Microgrid Advisor

Microgrid Forecasting and Optimization

EcoStruxure Microgrid Advisor enables you to dynamically control on-site energy resources and loads to optimize your facility's performance. The software seamlessly connects to your distributed energy resources to automatically forecast and optimize how and when to consume, produce, and store energy. The web-based user interface makes it easy to understand your real-time savings, earnings, and CO2 emissions data.

EcoStruxure Facility Expert

Cloud-based software for asset maintenance and improved collaboration

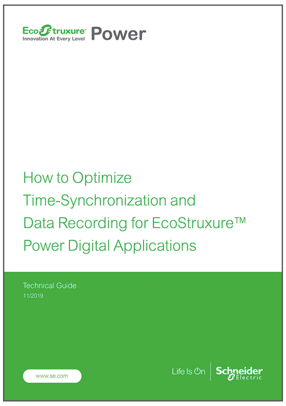
Based on the latest technology evolution of mobile App, Web platform, and IoT, EcoStruxure Facility Expert helps you optimize field operations, reduce energy consumption, and ensure business continuity.

Bibliography

What's in This Chapter

Useful Documentation

Technical Guides

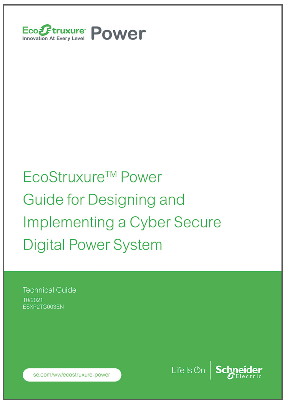


How to Optimize Time Synchronization and Data Recording for EcoStruxure Power Digital Applications

This technical guide details how to define the digital architecture to implement proper timestamping of the collected data depending on the selected digital applications. It provides a special focus on the various methods used to time synchronize the internal clocks of advanced devices such as power meters, trip units, protective relays, PLCs, UPS controllers, harmonic filters,etc.

Technical Guide
Ref: ESXP2TG001EN
11/2019

https://www.se.com/ww/en/download/document/ESXP2TG001EN/



EcoStruxure Power Guide for Designing and Implementing a Cyber Secure Digital Power System

This document is intended to give an understanding of cybersecurity for IoT-enabled electrical distribution systems. It discusses how increased connectivity and increased IT/OT convergence come with increased cybersecurity risks and how to effectively mitigate these risks. The IEC 62443 standard is used as a consistent, simplified way to define the level of cybersecurity management needed to help ensure a robust electrical infrastructure.
This document also supports and complements the EcoStruxure Power Design Guide (Digital Applications for Large Buildings and Critical Facilities).

Technical Guide
Ref: ESXP2TG003EN
10/2021

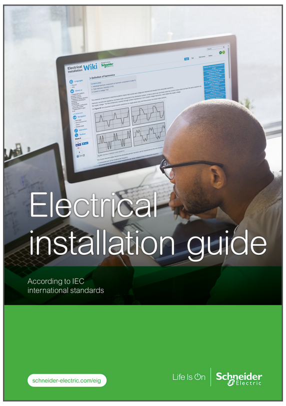
https://www.se.com/ww/en/download/document/ESXP2TG003EN/

Electrical Fire Prevention: Discover How to Mitigate Risk of Fire for New and Existing Commercial Buildings

Learn how to go above and beyond electrical installation standards. Our Electrical Fire Prevention Guide considers the risk of fire caused by electrical currents that fall below overcurrent protection thresholds. It focuses on the latest solutions to help mitigate such hazards in both new and existing installations in commercial buildings.

Technical Guide
Ref: 998-20623657_GMA
06/2019

https://go.schneider-electric.com/WW_201907_Electrical-Fire-Prevention-Guide-Content_EA-LP-EN.html?source=Content&sDetail=Electrical-Fire-Prevention-Guide_WW&_ga=2.268036299.430161284.1570454404-1169979586.1533734481

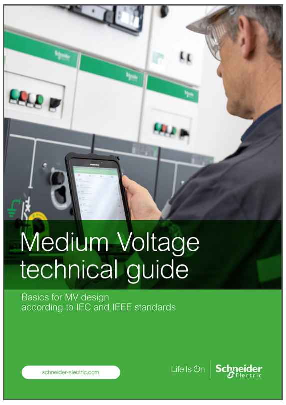


Electrical Installation Guide

The Electrical Installation Guide is written for professionals who design, install, inspect, and maintain low-voltage electrical installations in compliance with the standards published by the International Electrotechnical Commission (IEC), such as the IEC 60364 series.
Our experts share their industry-leading knowledge about new and updated electrical installation standards and technological evolutions so that you can have the most up-to-date and relevant information.
For the most up-to-date content, check the online version of this guide, the Electrical Installation Wiki.

Technical Guide
Ref: EIGED306001EN

https://www.se.com/ww/en/work/products/product-launch/electrical-installation-guide/

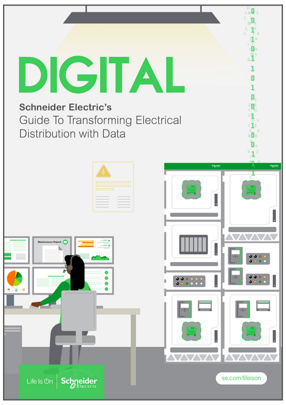


Medium Voltage Technical Guide

Whatever your involvement in medium voltage power - specifying, designing, operating, maintaining, or learning as a student - our guide provides useful information to help you make switchboards safer and more reliable.

Technical Guide
Ref: AMTED300014EN
03/2022

https://www.schneider-electric.com/en/work/products/product-launch/medium-voltage-technical-guide/



Guide To Transforming Electrical Distribution with Data

This guide explores the significant impact of utilizing a data-driven approach to enhance electrical systems in businesses. By leveraging sensors, analytics, and monitoring, companies can obtain valuable insights to improve various aspects of efficiency. From enhancing operational processes to streamlining maintenance activities, optimizing costs, and empowering the workforce, this strategy provides an effective means to help strengthen and protect businesses in the realm of electrical distribution.

Technical Guide
Ref: NRJWHP21050EN
09/2021

https://go.schneider-electric.com/WW_202112_Digital-Reference-Guide-Electrical-Distribution-Content_01-SF-LP-EN.html?source=Content&sDetail=Digital-Reference-Guide-Electrical-Distribution_WW

Selection Guide

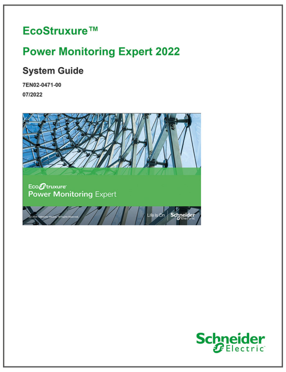
Digital Applications by Market Segment for Large Buildings and Critical Facilities

The objective of EcoStruxure Power is to offer a range of digital applications to fulfill customers' needs in large buildings & critical facilities such as data centers, large hotels, healthcare, and industrial facilities. Those applications are presented in the EcoStruxure Power Design Guide, sorted by value proposition. The current document is a supplementary guide to the EcoStruxure Power Design Guide. It proposes a selection of the most appropriate applications, depending on the targeted segment.

Technical Guide
Ref: ESXP2G002EN
09/2021

https://www.se.com/ww/en/download/document/ESXP2G002EN/

System Guides

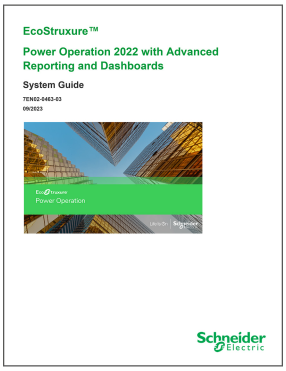


Power Monitoring Expert 2022 System Guide

This guide is intended for Application Engineers, System Integrators, or other qualified personnel who are responsible for designing, installing, configuring, maintaining, and using EcoStruxure Power Monitoring Expert software.
This document is not a tutorial; it was written with the assumption that you have been trained in the deployment and use of EcoStruxure Power Monitoring Expert.
Online help: https://digital-energy-help.se.com/pme/content/home.htm

Technical Guide
Ref: 7EN02-0471
07/2022

https://www.se.com/ww/en/download/document/7EN02-0471/



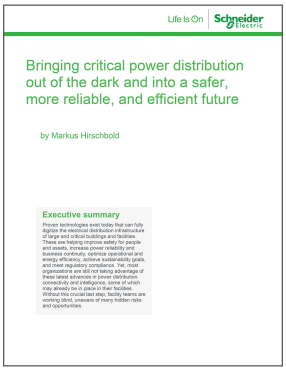
Power Operation 2022 System Guide

This guide is intended for Application Engineers, System Integrators, or other qualified personnel who are responsible for designing, installing, configuring, maintaining, and using EcoStruxure Power Operation software with Reporting and Dashboards.
This document is not a tutorial; it was written with the assumption that you have been trained in the deployment and use of EcoStruxure Power Operation.
Online help: https://digital-energy-help.se.com/po/content/home.htm

Technical Guide
Ref: 7EN02-0463
09/2023

https://www.se.com/ww/en/download/document/7EN02-0463/

White Papers



Bringing critical power distribution out of the dark and into a safer, more reliable, and efficient future

by Markus Hirschbold

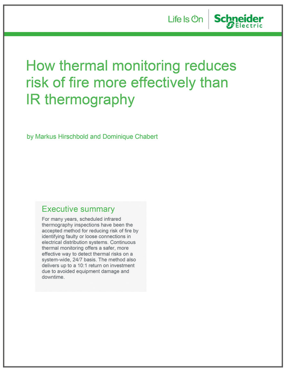
Executive summary

Bringing critical power distribution out of the dark and into a safer, more reliable, and efficient future

Proven technologies exist today that can fully digitize the electrical distribution infrastructure of large and critical buildings and facilities. These are helping improve safety for people and assets, increase power reliability and business continuity, optimize operational and energy efficiency, achieve sustainability goals, and meet regulatory compliance. Yet, most organizations are still not taking advantage of these latest advances in power distribution connectivity and intelligence, some of which may already be in place in their facilities. Without this crucial last step, facility teams are working blind, unaware of many hidden risks and opportunities.

Technical Guide
Ref: 998-20329038
2019

https://go.schneider-electric.com/WW_201904_Critical-power-distribution-WP_EA-LP-EN.html?source=Content&sDetail=Critical-power-distribution-WP_WW&



How thermal monitoring reduces risk of fire more effectively than IR thermography

by Markus Hirschbold and Dominique Chabert

Executive summary

How thermal monitoring reduces risk of fire more effectively than IR thermography

For many years, scheduled infrared thermography inspections have been the accepted method for reducing risk of fire by identifying faulty or loose connections in electrical distribution systems. Continuous thermal monitoring helps provide a safer, more effective way to detect thermal risks on a system-wide, 24/7 basis. The method also delivers up to a 10:1 return on investment due to the equipment damage and downtime avoided.

Technical Guide
Ref: 998-20425658
2018

https://go.schneider-electric.com/WW_201903_How-thermal-monitoring-reduces-risk-of-fire-more-effectively-than-IR-thermography-A09341_EA-LP-EN.html?source=Advertising-Online&sDetail=How-thermal-monitoring-reduces-risk-of-fire-A09341_WW&

Do more with less: Moving power and building management to the cloud

by Markus Hirschbold and Grant Reig

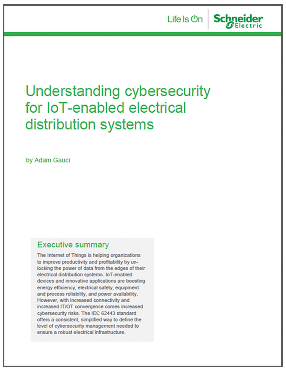
Executive summary

Do more with less: Moving power and building management to the cloud

Building owners and operators are facing growing demands for buildings that are more sustainable, resilient, efficient, and people-centric. New cloud-hosted power and building management applications can help meet these business, regulatory, and occupant requirements with a scalable solution that minimizes the costs of onsite IT services, computing hardware, and software. Additionally, cloud-hosting helps secure data storage, simplifies remote operations and cross-team collaboration, and enables facilities with limited resources to engage expert advisory services.

Technical Guide
Ref: 998-21143435_GMA
2021

https://go.schneider-electric.com/WW_202103_GMA-cloud-based-building-and-power-management_EA-LP.html?source=Content&sDetail=GMA-cloud-based-building-and-power-management_WW


Life Is On Schneider Electric

Understanding cybersecurity for IoT-enabled electrical distribution systems

by Adam Gauci

Executive summary

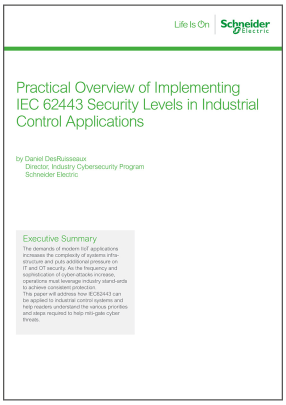
The Internet of Things is helping organizations to improve productivity and profitability by un-locking the power of data from the edges of their electrical distribution systems. IoT-enabled devices and innovative applications are boosting energy efficiency, electrical safety, equipment and process reliability, and power availability. However, with increased connectivity and increased IT/OT convergence comes increased cybersecurity risks. The IEC 62443 standard offers a consistent, simplified way to define the level of cybersecurity management needed to ensure a robust electrical infrastructure.

Understanding cybersecurity for IoT-enabled electrical distribution systems

The Internet of Things is helping organizations to improve productivity and profitability by unlocking the power of data from the edges of their electrical distribution systems. IoT-enabled devices and innovative applications are boosting energy efficiency, electrical safety, equipment and process reliability, and power availability. However, with increased connectivity and increased IT/OT convergence comes increased cybersecurity risks. The IEC 62443 standard offers a consistent, simplified way to define the level of cybersecurity management needed to ensure a robust electrical infrastructure.

Technical Guide
Ref: 998-20677347
2019

https://go.schneider-electric.com/WW_201909_Understanding-Cyber-security-for-IoT-White-Paper-Content_EA-LP-EN.html?source=Content&sDetail=Understanding-Cyber-security-for-IoT-White-Paper_WW


Life Is On Schneider Electric

Practical Overview of Implementing IEC 62443 Security Levels in Industrial Control Applications

by Daniel DesRuisseaux
Director, Industry Cybersecurity Program
Schneider Electric

Executive Summary

The demands of modern IIoT applications increases the complexity of systems infra-structure and puts additional pressure on IT and OT security. As the frequency and sophistication of cyber-attacks increase, operations must leverage industry stand-ards to achieve consistent protection.
This paper will address how IEC62443 can be applied to industrial control systems and help readers understand the various priorities and steps required to help miti-gate cyber threats.

Practical Overview of Implementing IEC 62443 Security Levels in Industrial Control Applications

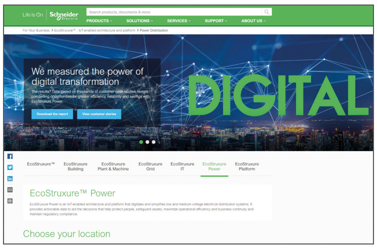
This paper will address how IEC 62443 can be applied to industrial control systems and help readers understand the various priorities and steps required to help mitigate cyberthreats.

Technical Guide
Ref: 998-20186845
01/2018

https://www.se.com/ww/en/download/document/998-20186845/

Useful Links

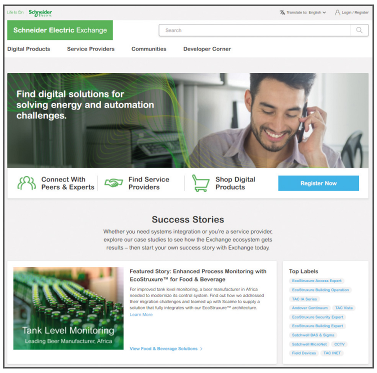
Web Portals



EcoStruxure Power Landing Page

Learn more about EcoStruxure Power, Schneider Electric's digital solution for electrical distribution to help improve electrical safety, power availability, sustainability, and cybersecurity. Get access to customer testimonials, useful resources, and more!

https://www.se.com/ww/en/work/campaign/innovation/power-distribution.jsp



Schneider Electric Exchange

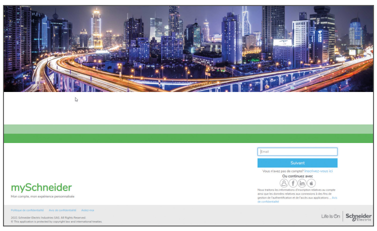
An open ecosystem for IoT energy management and automation solutions.

Create: With integrated efficiency solutions across all domains in energy management and automation, Schneider Electric Exchange is a space for innovation. Use Shop resources to develop new applications and APIs. Tackle challenges, promote your ideas, and gain global input on your work.

Collaborate: We celebrate the diversity of global communities where you can interact in your niche or with the industry at large. Network and find experts to co-create solutions, find answers to your toughest business challenges, and offer your insights as an industry leader.

Scale: Effectively and efficiently scale your business by promoting your expertise, publishing new products, and learning about the latest innovations.

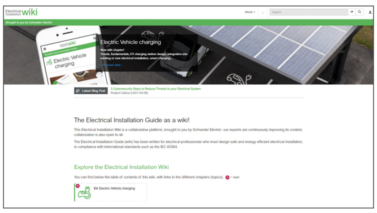
https://exchange.se.com/



mySE Partner Portal

Login or register for the mySE Partner to get a personalized portal with easy access.

https://www.se.com/myschneider/



Electrical Installation Wiki

This Electrical Installation Wiki is the live on-line version of the Electrical Installation Guide. It is the reference to check for the most up-to-date content. Recent updates include a new chapter on Electric Vehicle charging, updated content on photovoltaic self-consumption, and new content on the choice and coordination of RCDs in the presence of DC earth leakage currents
Since 2020, the Wiki also has a new responsive look and feel, making it easier to read and navigate, in particular on mobile phones.

https://www.electrical-installation.org/

EcoXpert Partner Program

The Implementation Arms of EcoStruxure all over the World

Who Are the EcoXperts?

An EcoXpert is a Schneider Electric **partner company** that is **trained and certified on EcoStruxure**, our open, interoperable, IoT-enabled system architecture and platform.

A worldwide certified network delivering local support

More than **4,000** EcoXpert partners in **74** countries

Cross-expertise knowledge

11 competency certifications (badges) available, distributed in:

- Building and Residential Automation (5 badges)
- Power Distribution and Management (5 badges)
- Services (1 badge)

Why Call On an EcoXpert Partner?

- **Reduce the risks and costs** of your projects thanks to segment specialized partners.
- **Receive lifetime support** for your products and projects (design, engineering, installation and maintenance phases).

Discover our EcoXpert program

Find the right partner to support your project

Green Premium

An industry leading portfolio of offers delivering sustainable value

More than 75% of our product sales offer superior transparency on the material content, regulatory information, and environmental impact of our products:

- RoHS compliance
- REACh substance information
- Industry leading # of PEP's[94]
- Circularity instructions

The Green Premium program stands for our commitment to deliver customer-valued sustainable performance. It has been upgraded with recognized environmental claims and extended to cover all offers including Products, Services, and Solutions.

CO_2 and P&L impact through… Resource Performance	Green Premium brings improved resource efficiency throughout an asset's lifecycle. This includes efficient use of energy and natural resources, along with the minimization of CO_2 emissions.
Cost of ownership optimization through… Circular Performance	We're helping our customers optimize the total cost of ownership of their assets. To do this, we provide IoT-enabled solutions, as well as upgrade, repair, retrofit, and remanufacture services.
Peace of mind through… Well-being Performance	Green Premium products are RoHS and REACh compliant. We're going beyond regulatory compliance with step-by-step substitution of certain materials and substances from our products.
Improved sales through… Differentiation	Green Premium delivers strong value propositions through third-party labels and services. By collaborating with third-party organizations we can support our customers in meeting their sustainability goals such as green building certifications.

Discover what we mean by green. **Check your products!**

94. Product Environmental Profile (for example, Environmental Product Declaration)

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As standards, specifications, and design change from time to time, please ask for confirmation of the information given in this publication.

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