



Digital Applications for Large Buildings & Critical Facilities

IEC Design Guide
06/2021

se.com/ww/ecostruxure-power

Life Is On

Schneider
Electric

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 and configuration of power projects.

Objective

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, 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.

It also 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

INTRODUCTIONp. 4

SECTION 1 | Defining the System Designp. 9
Considerations

SECTION 2 | Selecting and Implementingp. 27
the Digital Applications

APPENDIX | Product Informationp. 229

BIBLIOGRAPHY.....p. 245

EcoXpert.....p. 252

Green Premium.....p. 253

Legal Informationp. 254

1

2

3

4

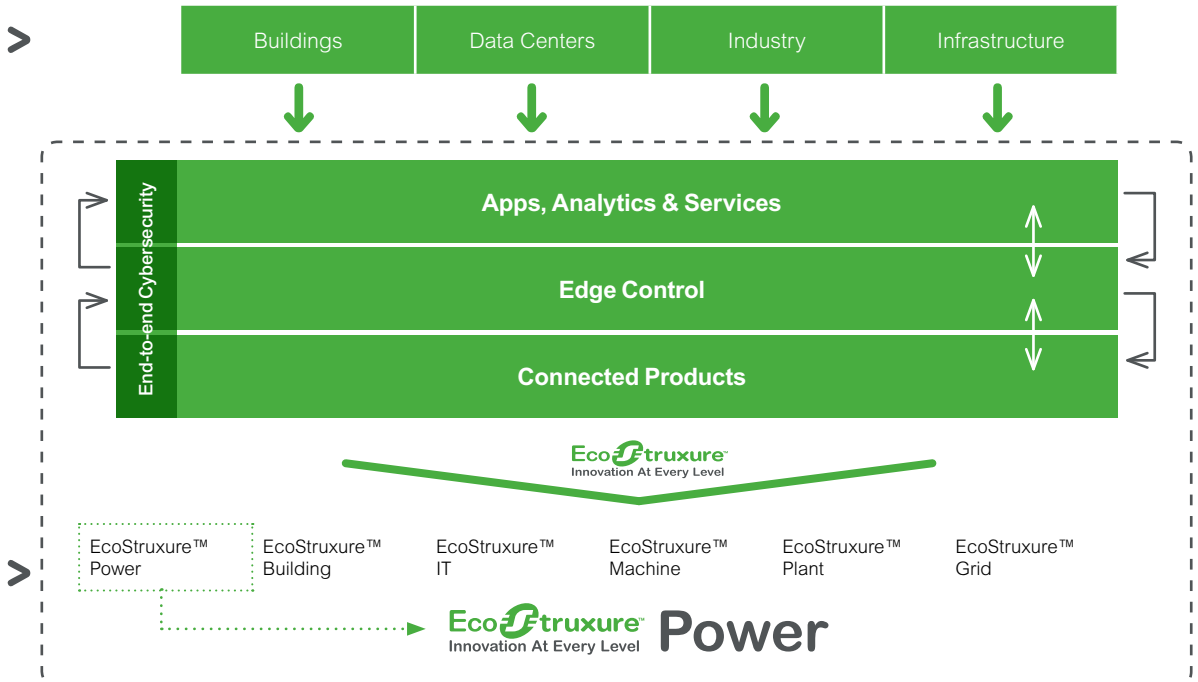
Overview of EcoStruxure™ Power (1/2)

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 (Building, Data Center, Industry and Infrastructure). This involves bringing the world of electrical distribution to those End-Markets.

4 End-Markets addressed



6 EcoStruxure™ domains of expertise

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 growth opportunities.

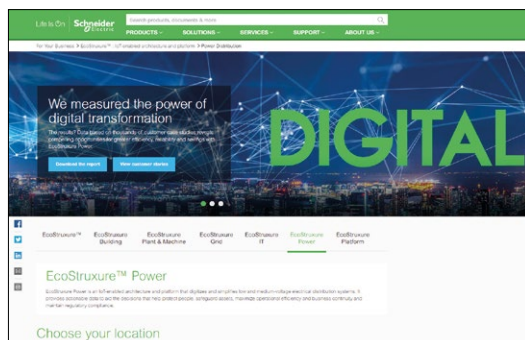
Overview of EcoStruxure™ Power (2/2)

EcoStruxure™ Power

- **EcoStruxure™ Power digitizes 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 distributions systems future ready. The added benefit of a holistic Schneider Electric system is 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 oil and gas. 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 Ethernet IP network is at the heart of our digitization story. With EcoStruxure™ Power, facility managers can use the data they collect to make realtime decisions to maximize business continuity and optimize operations.

More about EcoStruxure™ Power

se.com/ww/ecostruxure-power



About the Guide (1/2)

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:

1

Understanding the desired outcomes of the end user



2

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

[> See Electrical Installation Wiki \(page 251\)](#)



3

Defining the system design considerations for your installation

[> See design considerations overview \(page 11\)](#)

4

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

[> See digital applications overview \(page 29\)](#)

Selecting the correct:

[> Connected Products \(page 230\)](#)

[> Edge Control Software & Configuration Tools \(page 241\)](#)

[> Apps, Analytics and Services \(page 243\)](#)

Do you need help?
Find an EcoXpert Partner

[> See EcoXpert](#)

About the Guide (2/2)

Structure of the Document

Section 1 addresses the design considerations for the electrical installation in the context of system communications, data recording and timestamping, time-synchronization, data processing, data quality management, and cybersecurity.

Section 2 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 the 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** provides a brief description of all key connected products, Edge Control software and cloud-based Services.

The **Bibliography** provides links to useful documentation.

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

1

2

3

4

1

2

3

4

SECTION 1

Defining the System Design Considerations

Introduction.....	p. 10
Overview of System Design Considerations.....	p. 11
Communications	p. 12
Data Recording and Timestamping	p. 13
Data Processing	p. 16
Data Integration and Interoperability Between Systems	p. 17
Data Quality Management	p. 21
Cybersecurity	p. 23

Introduction

Why Read This Section

The purpose of Section 1 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.

1

Contents of This Section

This section discusses the following system design considerations and their relevancy to the implementation of EcoStruxure™ Power applications in Section 2:

- Communications
- Data recording and timestamping
- Data processing
- Data integration and interoperability between systems
- Data quality management
- Cybersecurity

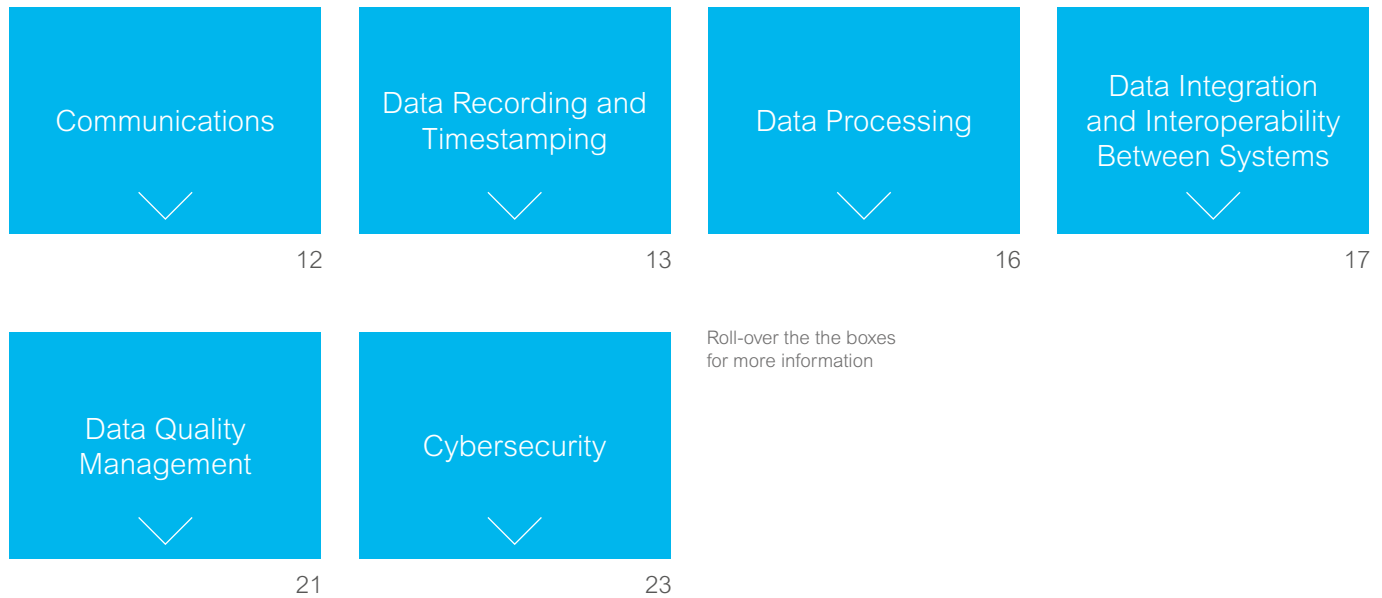
2

3

4

Overview of System Design Considerations

When designing a digital electrical installation, the following system design considerations must be studied:



Communications

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

The preferred method of system and device communications is direct Ethernet.

Indeed, modern sophisticated power system devices 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 devices with serial communication only, the connection is made via gateways through small serial daisy-chains with, typically, no more than eight devices.

EcoStruxure™ Communication Drivers

EcoStruxure™ Power supports two types of communication drivers:

- Native drivers for Schneider Electric devices, including legacy device drivers allowing modernization of systems with a step-by-step approach based on the life cycle of the assets
- Third-party device drivers using open protocols, such as Modbus, DNP3, IEC61850, BACnet, OPC DA, AE and UA can be easily created to capture realtime data using purpose-built productivity tools in EcoStruxure™ Power Monitoring Expert and Power Operation

Data Recording and Timestamping (1/3)

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 on board logging; realtime data only. Data recording and timestamping are performed by a data logger or Edge Control software.

Recommended Level of Data Recording

The time criticality of an application is defined by the recommended 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 device timestamp and by the synchronization of all devices to a single, reliable and accurate time reference.

Applications	Time Criticality	Recommended Time Accuracy [±]	Minimum Required Time Accuracy [±]
Continuous Thermal Monitoring	Low	1 min*	5 min*
Arc Flash Protection	High	1 ms	10 ms
Insulation Monitoring	Low	1 s	10 s
Electrical Asset Life Cycle management	Low	1 min	5 min
Asset Performance	Low	1 s	10 s
Electrical Distribution Monitoring & Alarming	Medium	10 ms	1 s
Capacity Management	Low	1 s	10 s
Backup Power Testing	Medium	10 ms	100 ms
Power Events Analysis	High	1 ms	10 ms
Breaker Settings Monitoring	Low	1 s	10 s
Power Quality Monitoring	Medium	10 ms	100 ms
Power Quality Correction	Low	1 s	10 s
Power Source & Load Control	Medium	10 ms	100 ms
Advanced Protection & Automation	High	1 ms	10 ms
Microgrid	Medium	10 ms	100 ms
Utility Bill Verification	Low	1 s	10 s
Cost Allocation	Low	1 s	10 s
Energy Monitoring	Low	1 s	10 s
Energy Benchmarking	Low	1 s	10 s
Energy Performance	Low	1 s	10 s
Energy Modeling & Verification	Low	1 s	10 s
Power Factor Correction	Low	1 s	10 s
Energy Efficiency Compliance	Low	1 s	10 s
Greenhouse Gas Reporting	Low	1 s	10 s
Power Quality Compliance	Low	1 s	10 s

* For 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.

Chart 2.1 – Minimum required and recommended time accuracy by digital power system.

Data Recording and Timestamping (2/3)

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.

1

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.

2

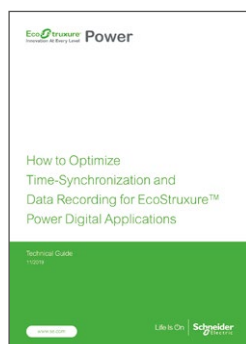
Ethernet-based protocols provide more economical solutions. The most cost-effective one but less accurate approach is achieved with **Modbus-based (or ION-based) time-synchronization** over an Ethernet or serial communications network.

3

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.

4



[How to Optimize Time-Synchronization and Data Recording for EcoStruxure™ Power Digital Applications](#)

Technical Guide
Ref: ESXP2TG001EN
11/2019

Data Recording and Timestamping (3/3)

Time-Synchronization Capabilities of EcoStruxure™ Power Connected Products

The table below highlights the supported time-synchronization methods.

Connected Product	Product Category	Logging capabilities ⁽¹⁾		Maximum reachable time-synchronization accuracy / Compatible time-synchronization protocols ^{(1) (2)}							
		Event log	Measurement log	1 ms		10 / 100 ms		100 ms	1 s		
				PTP	IRIG-B	NTP	DCF 77	SNTP	1per10	Over Modbus	Over ION
MasterPacT MTZ (with IFE/ eIFE)	Advanced Limited	•				•		•		•	
MasterPacT NT / NW (with IFE)	Advanced Limited	•				•		•		•	
ComPacT NS (with IFE)	Advanced Limited	•				•		•		•	
ComPacT NSX (with IFE)	Advanced Limited	•				•		•		•	
Acti9 Powertag Link	Advanced Limited	•						•		•	
PowerLogic PowerTag	Basic										
Vigilohm IM20H	Standard	•									
Vigilohm IFL12H	Standard	•									
Easergy P3	Advanced High	•			•			•		•	
Easergy P5	Advanced High	•		•	•			•		•	
Easergy C5	Advanced High	•		•				•			
Easergy Sepam 80 Series	Advanced Limited	•						•	•	•	
PowerLogic Vamp 321	Advanced High	•			•			•		•	
PowerLogic Vamp 121	Standard										
PowerLogic Vamp 125	Standard										
Easergy T300	Advanced High	•		•				•		•	
SMD (Modicon M251)	Advanced Limited	•						•		•	
Easergy TH110 / CL110	Basic										
Modicon M580	Advanced Limited	•				•		•		•	
Modicon M580 with ERT module	Advanced High	•			•	•	•	•		•	
Modicon M340	Advanced Limited	•				•		•		•	
PowerLogic ION9000	Advanced High	•	•	•	•	•		•		•	•
PowerLogic PM8000	Advanced High	•	•	•	•	•		•		•	•
PowerLogic PM5000	Standard		•					•		•	
PowerLogic HDPM6000	Standard										
Acti9 iEM3000	Standard										
Accusine PCS+	Standard										
Accusine PCSn	Standard										
Accusine PFV+	Standard										
VarPlus Logic	Standard										
Galaxy VX	Standard	•						•		•	
Galaxy VM	Standard	•						•		•	
Galaxy VS	Standard	•						•		•	
Connexium Managed Switches	Advanced Limited					•		•			
Harmony Sologate ZBRN32	Standard										

⁽¹⁾ Product can acquire new capabilities. Capabilities to be confirmed when ordering

⁽²⁾ These are typical accuracies. Refer to product technical documentation to get information regarding the maximum reachable accuracy

Chart 2.2 – Time-Synchronization Capabilities of EcoStruxure™ Power Connected Products.

For more information on time-synchronization and how to implement such a feature in a digital architecture, please refer to the dedicated [Time-synchronization Technical Document](#)

Data Processing

Data Processing Levels

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

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

1

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

Onboard Device Data Processing

Some EcoStruxure™ Connected Devices (e.g., ION9000, PM8000, MasterPacT MTZ, 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 device 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. It evaluates data using predictive asset maintenance algorithms and converts data into easy to understand information.

Data Integration and Interoperability Between Systems (1/4)

Why Integrate Operational Systems

With the considerable evolutions in IoT, capabilities of Power Management Systems (PMS) 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 EcoStruxure™ 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 PMS and some other systems like Building Management Systems (BMS; e.g., EcoStruxure™ Building Operation) or Industrial Automation platforms (IA; e.g., AVEVATM System Platform or Citect SCADA).

For example:

- Environmental conditions provided by the BMS can be used in the PMS to make correlations with the energy consumption
- Electrical data from the PMS can be used in the BMS for consolidation of global building information
- Information about process conditions, provided to the PMS by the IA 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 (e.g., 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 (e.g., 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 or to the automation controllers/enterprise server.

How to Integrate EcoStruxure Power with Other Operational Systems

This guide presents several applications where EcoStruxure™ Power Monitoring Expert (PME) or Power Operation (PO) can be integrated with other EcoStruxure™ or third-party systems:

INTEGRATION WITH OTHER ECOSTRUXURE™ SYSTEMS

Example of Integration with EcoStruxure™ Building Operation (EBO)

The goal of integrating EcoStruxure™ Power Monitoring Expert (PME) with EcoStruxure™ Building Operation (EBO) 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.

Data Integration and Interoperability Between Systems (2/4)

How to Integrate EcoStruxure Power with Other Operational Systems (cont.)

INTEGRATION WITH OTHER ECOSTRUXURE™ SYSTEMS (CONT.)

Example of Integration with EcoStruxure™ Building Operation (EBO) (cont.)

Data acquisition

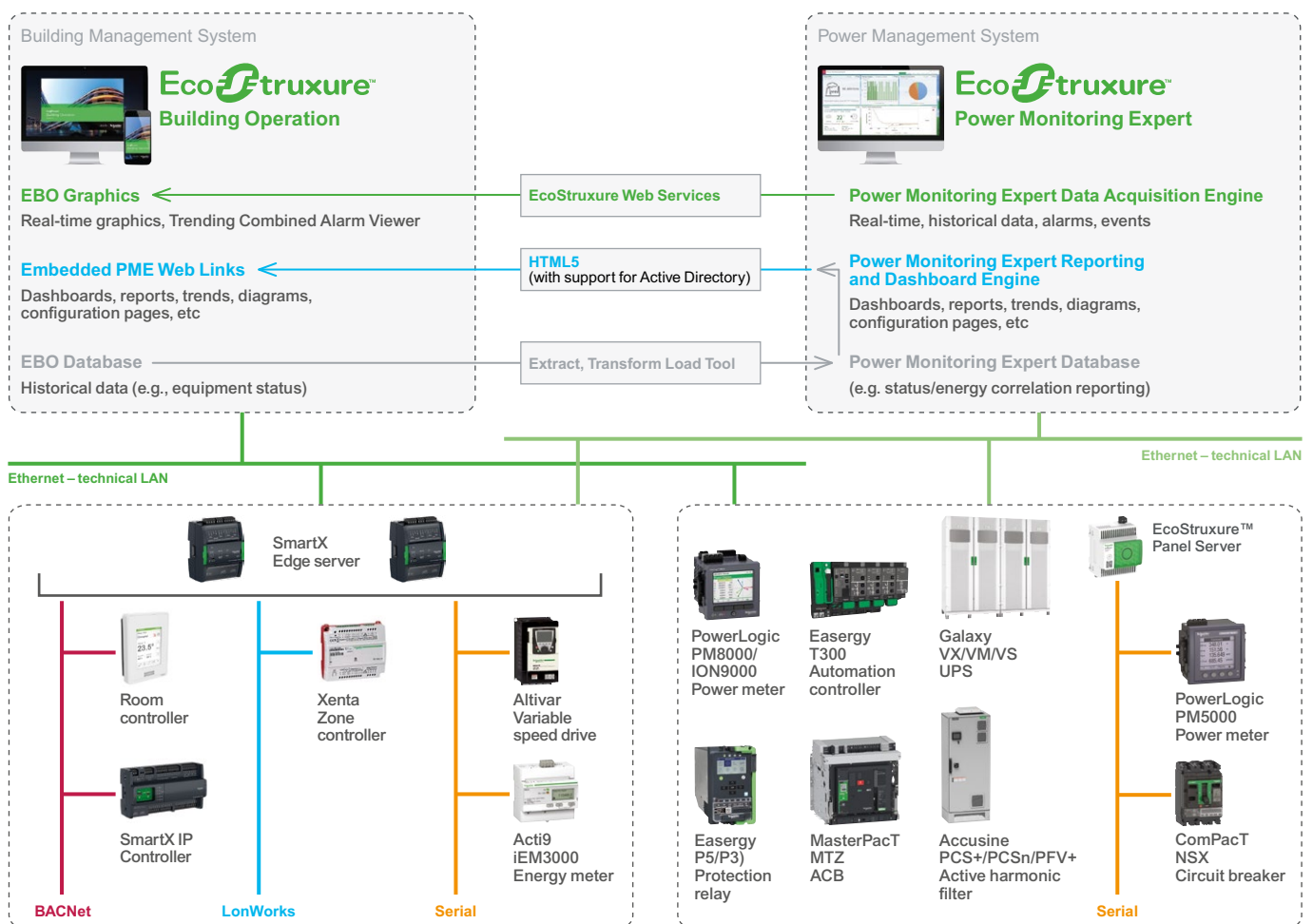
- Electrical and energy data (including real-time, historical data and events) from metering devices, circuit breaker trip units and other intelligent electrical devices (Schneider Electric or 3rd party) is acquired by PME (or PO – not shown in the diagram below)
- Mechanical data from Automation Servers and other mechanical field devices is acquired by EBO.

Integration of EcoStruxure™ Power Monitoring Expert data into EcoStruxure™ Building Operation

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

Integration of EcoStruxure™ Building Operation data into EcoStruxure™ Power Monitoring Expert

- Historical data (e.g., equipment status) can be exchanged from EBO to PME using an ETL* to enable normalization of energy data with operational data from the BMS.



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

* 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.

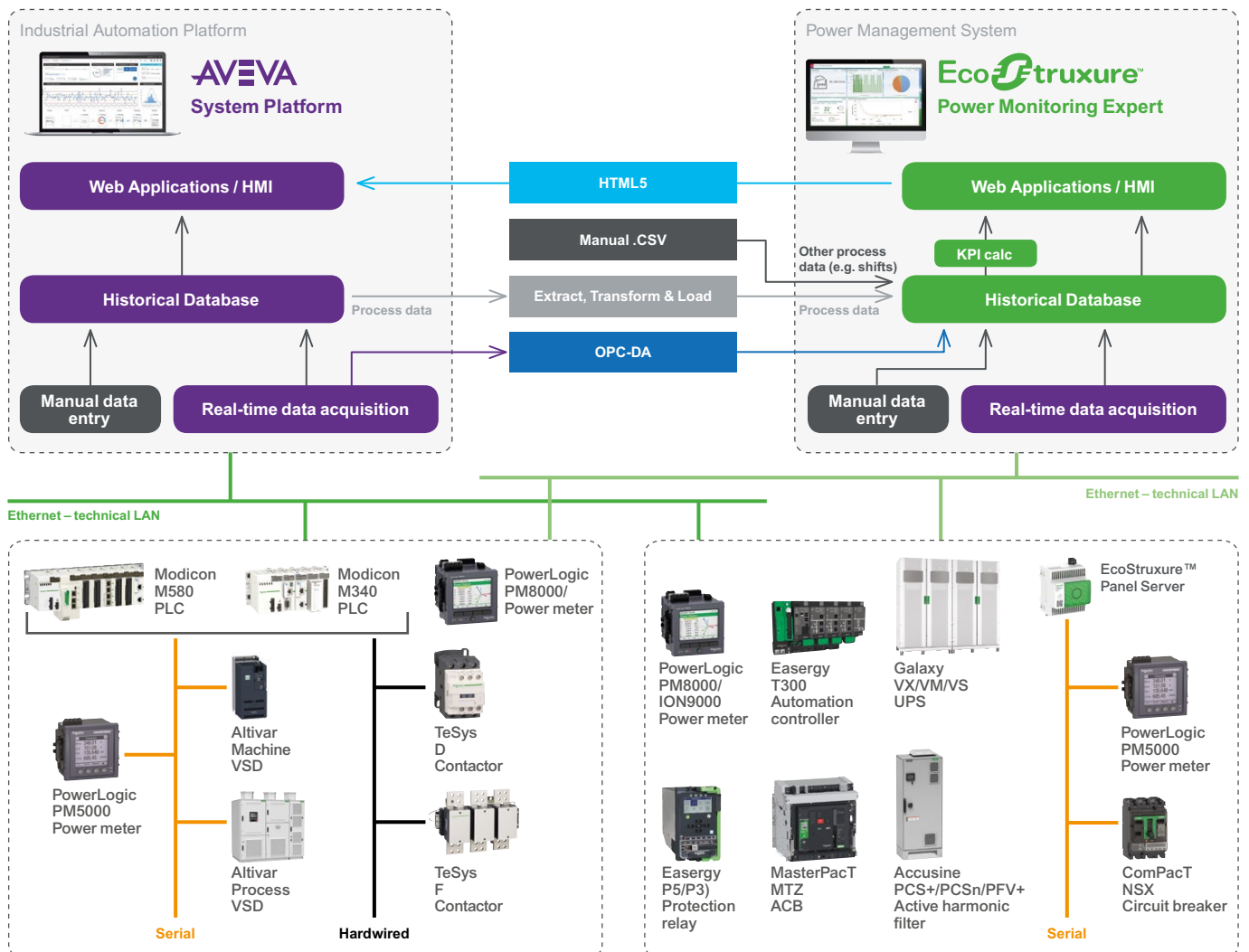
Data Integration and Interoperability Between Systems (3/4)

How to Integrate EcoStruxure Power with Other Operational Systems (cont.)

INTEGRATION WITH OTHER ECOSTRUXURE™ SYSTEMS (CONT.)

Example of Integration with EcoStruxure™ Plant (AVEVA System Platform)

The goal of integrating EcoStruxure™ Power Monitoring Expert (PME) 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 Integration and Interoperability Between Systems (4/4)

How to Integrate EcoStruxure Power with Other Operational Systems (cont.)

INTEGRATION WITH OTHER ECOSTRUXURE™ SYSTEMS (CONT.)

Example of Integration with EcoStruxure™ Plant (AVEVA System Platform) (cont.)

Data acquisition

- Electrical and energy data (including real-time, historical data and events) from metering devices, circuit breaker trip units and other intelligent electrical devices (Schneider Electric or 3rd party) is acquired by PME (or PO – not shown in the diagram above)
- Process data from PLCs, drives or other process field devices is acquired by the SCADA software (e.g., AVEVA System Platform).

Integration of AVEVA System Platform data into EcoStruxure™ Power Monitoring Expert

Capture in PME/PO of the most significant factors in the customer process is done through the standard integration capabilities provided with PME/PO. This includes using:

- OPC* DA* standard (EcoStruxure™ Power Operation also supports OPC AE* Server and UA* Client)
- Or an ETL (Extract, Transform and Load) utility, or 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* DA* 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* server and OPC UA* client functionality.

* OPC: Open Platform Communications
DA: Data Access
AE: Alarms & Events
UA: Unified Architecture

Data Quality Management (1/2)

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, Energy Managers, and Operators need to be able to rely on 100% accurate electrical distribution monitoring data to make sound decisions about safety, reliability and energy efficiency. In addition, they often need to provide accurate data to external stakeholders or applications.

EcoStruxure™ Power Advisor is available to address these issues.

EcoStruxure™ Power Advisor

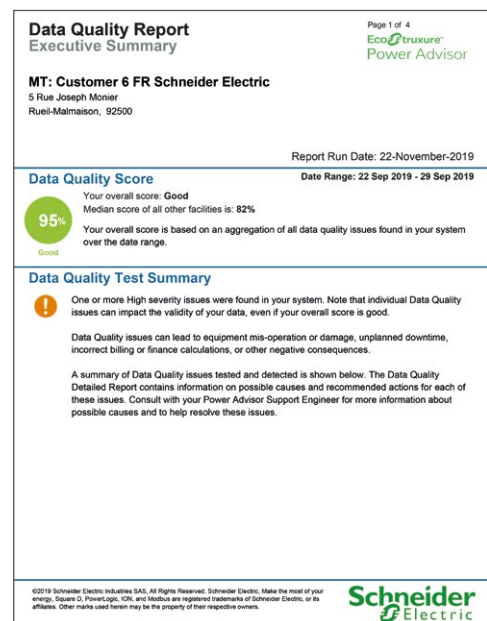
THIS CLOUD-BASED ANALYTICS AND SERVICES OFFER PROVIDES:

Regular System Health Checks to:

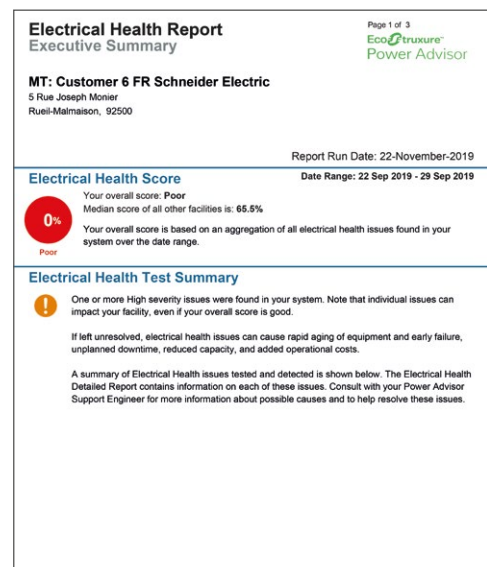
- Help ensure the power system is configured correctly
- Identify system wiring or installations issues
- Identify communications problems, data issues and gaps
- Detect Electrical System Health issues ([refer to Power Quality Monitoring application](#))

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



Ecostruxure™ Power Advisor Diagnostic Report



Ecostruxure™ Power Advisor Electrical Health Report



Data Quality Management (2/2)

Data Quality Management in More Detail

Data Quality Management is delivered through EcoStruxure™ Power Advisor system health checks shared as a consultative service by a qualified service engineer.

EcoStruxure™ Power Advisor is available as part of a Connected Service Plan with EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards.

SYSTEM HEALTH CHECKS

EcoStruxure™ Power Advisor system health checks are performed periodically using expert analytics based on electrical measurements and device diagnostics data from any metering device, embedded metering in circuit breakers and third-party devices.

The data quality system health 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 device logging periods
- Mismatched logging intervals
- Frequent logging (<1 minute intervals)
- Significant Unmetered Load (>20%)

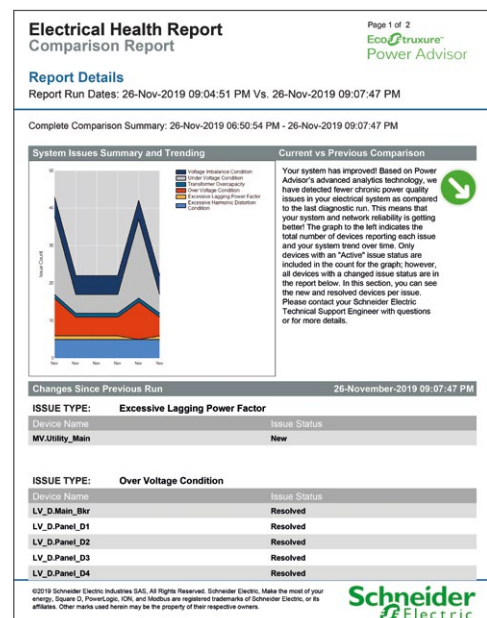
RECOMMENDATIONS

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 system health check:

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

PROGRESS MADE

A Data Quality Comparison Report indicates the progress made, as well as whether data quality is improving or deteriorating over time.



Ecostruxure™ Power Advisor Data Quality Comparison Report

Cybersecurity (1/3)

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 devices and growing numbers of attack surfaces. Because of this, operational technology security has 3 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 background 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.

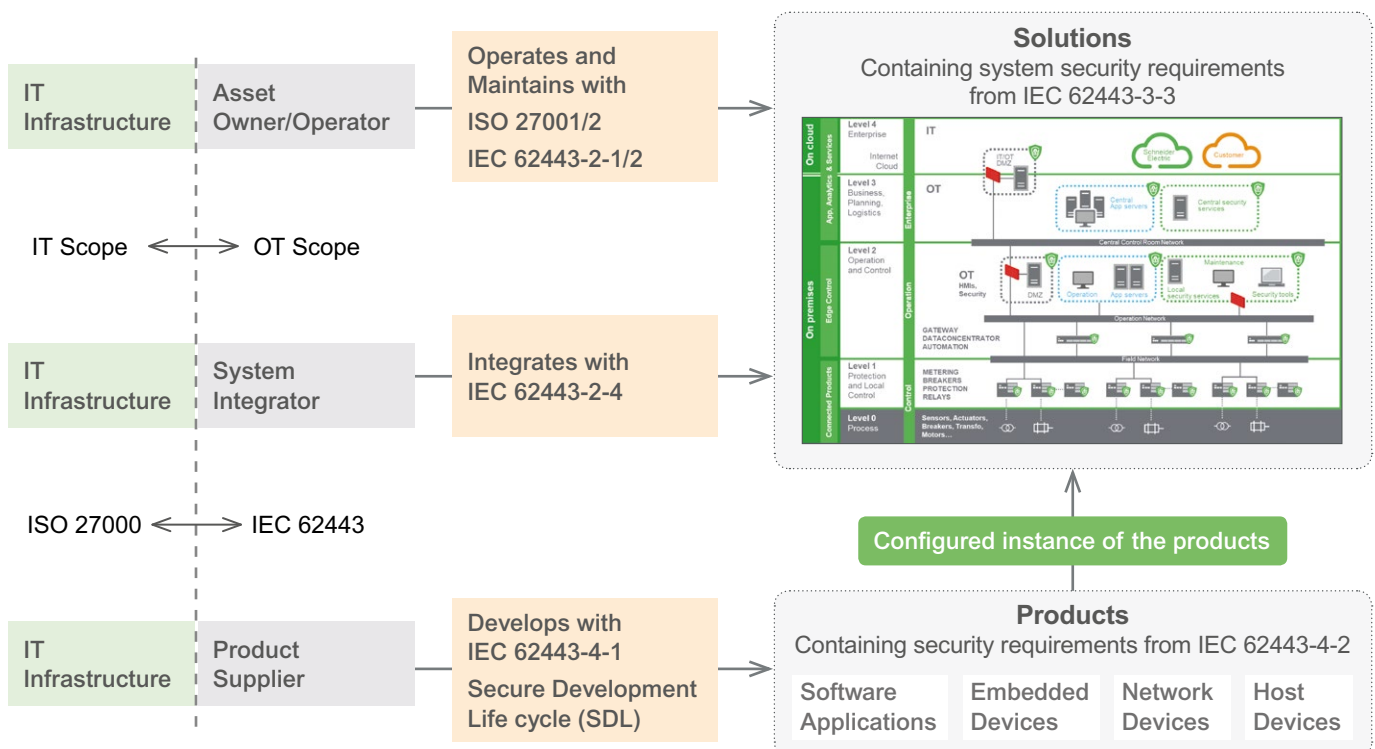


Chart 2.3 – Section of IEC 62443.

Cybersecurity (2/3)

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 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	Hackivist, Terrorist	ICS Specific	Moderate	Sophisticated (Attack)	Moderate (Hacker Group)
SL4	Nation State	ICS Specific	High	Sophisticated (Campaign)	Extended (Multi-disciplinary Teams)

Chart 2.4 – Security Levels of IEC 62443.

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:

		LIKELIHOOD				
		Remote	Unlikely	Possible	Likely	Certain
IMPACT	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

Chart 2.5 – Example of Risk Matrix.

EcoStruxure™ Power Commitment to IEC 62443

With EcoStruxure™ Power, we are fully committed to IEC 62443. This is a commitment as well as a journey, since cybersecurity requires ongoing operational activity to maintain a high level of security.

At the Connected Products level of EcoStruxure™ Power's architecture, products are developed in accordance with IEC 62443-4-2. See below 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
- Easergy P5 IEC 62443-4-1 and 4-2 certification

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. Check out the cybersecurity for EcoStruxure™ Power webpage: <https://www.se.com/ww/en/work/solutions/cybersecurity/power-cybersecurity.jsp>

Cybersecurity (3/3)

EcoStruxure™ Power Commitment to IEC 62443 (cont.)

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.

For more information on Cybersecurity Admin Expert, visit our website:

<https://www.se.com/ww/en/product-range-presentation/63515>



EcoStruxure™
Cybersecurity Admin Expert

Schneider Electric offers unique expertise in cybersecurity for operational technology systems with consulting, design, implementation, monitoring and response services to support all life cycles of a connected system. Schneider Electric's Cybersecurity Services can provide support on new systems, existing or legacy systems, 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.

Learn more about Cybersecurity Services on our website:

<https://www.se.com/ww/en/work/services/field-services/industrial-automation/industrial-cybersecurity/industrial-cybersecurity.jsp>

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

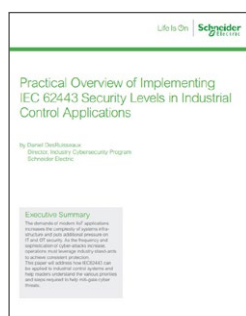
The following white paper provides details to learn more about the practical implementation of these security levels:

[Practical Overview of Implementing IEC62443 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.

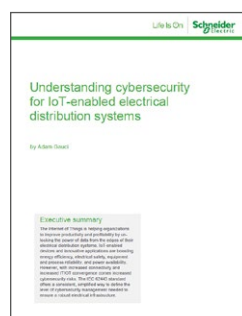
For more information on cybersecurity for EcoStruxure™ Power, visit the website:

<https://www.se.com/ww/en/work/solutions/cybersecurity/power-cybersecurity.jsp>



[Practical Overview of Implementing IEC 62443 Security Levels in Industrial](#)

White Paper
Ref: 998-20186845
10/2018



[Understanding cybersecurity for IoT-enabled electrical distribution systems](#)

White Paper
Ref: 998-20677347
10/2019

1

2

3

4

SECTION 2

Selecting and Implementing the Digital Applications

Introduction.....	p. 28
Overview of Digital Applications.....	p. 29
How to Use this Section	p. 30
Digital Applications	
Continuous Thermal Monitoring	p. 34
Arc Flash Protection.....	p. 46
Insulation Monitoring.....	p. 57
Electrical Asset Life Cycle Management.....	p. 65
Asset Performance	p. 71
Electrical Distribution Monitoring & Alarming.....	p. 81
Capacity Management	p. 91
Backup Power Testing	p. 97
Power Events Analysis	p. 107
Breaker Settings Monitoring.....	p. 114
Power Quality Monitoring	p. 120
Power Quality Correction	p. 130
Power Source & Load Control.....	p. 135
Advanced Protection & Automation	p. 141
Microgrid	p. 151
Utility Bill Verification	p. 160
Cost Allocation.....	p. 165
Energy Monitoring.....	p. 171
Energy Benchmarking	p. 181
Energy Performance	p. 188
Energy Modeling & Verification	p. 197
Power Factor Correction	p. 203
Energy Efficiency Compliance	p. 208
Greenhouse Gas Reporting	p. 216
Power Quality Compliance.....	p. 222

Introduction

Why Read This Section

In **Section 1**, the system design considerations were introduced to have all important information to hand when implementing the digital applications.

The objective of Section 2 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.

Contents of This Section

This section addresses the following areas for each EcoStruxure™ Power digital application:

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

Overview of Digital Applications

Below is a summary of all the applications available in this guide. In order to make them easier to select, they have been grouped according to their benefits.

VALUE PROPOSITION	END USER BENEFITS	RELATED APPLICATIONS				
ELECTRICAL SAFETY	Reduce the risk of electrical fires	Continuous Thermal Monitoring				1
	Protect staff and occupants	Arc Flash Protection	Insulation Monitoring			2
POWER AVAILABILITY	Enhance electrical asset management	Electrical Asset Life Cycle Management	Asset Performance			3
	Avoid unplanned downtime due to electrical failure	Electrical Distribution Monitoring & Alarming	Capacity Management	Backup Power Testing	Power Events Analysis	
		Breaker Settings Monitoring	Power Quality Monitoring	Power Quality Correction		4
		Power Source & Load Control	Advanced Protection & Automation			
	Gain resilience with distributed energy resources	Microgrid				
EFFICIENCY	Reduce energy, CO ₂ and costs	Utility Bill Verification	Cost Allocation	Energy Monitoring	Energy Benchmarking	
		Energy Performance	Energy Modeling & Verification	Power Factor Correction		
	Improve sustainability and compliance	Energy Efficiency Compliance	Greenhouse Gas Reporting	Power Quality Compliance		

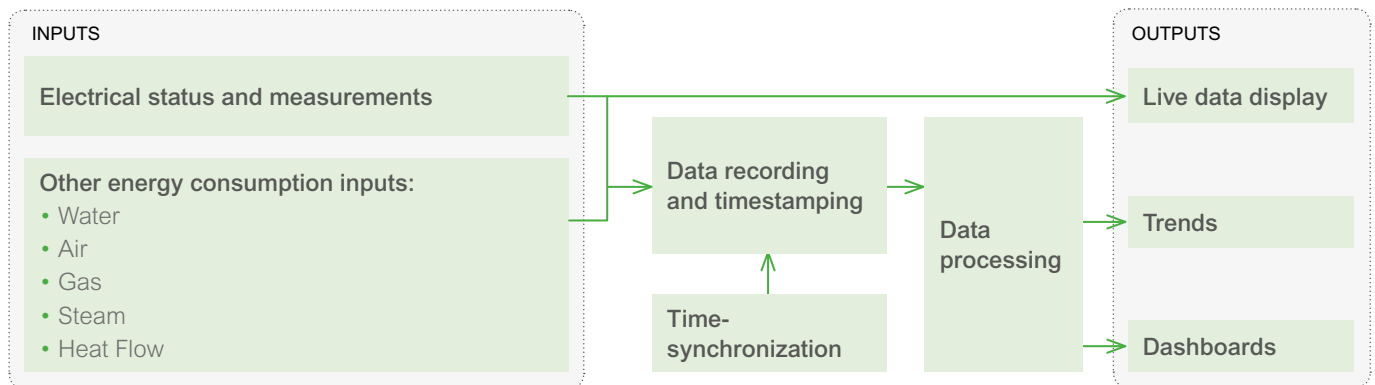
How to Use this Section (1/3)

Embedded Information for Each Application

Once the application context and outcomes are presented, a system description is provided for each application using the following elements:

1 • Data flow

A data flow diagram (example below)



2 • Data flow in detail

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

3 • Electrical architecture

Electrical distribution architectures (example on the following page) show the devices 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.

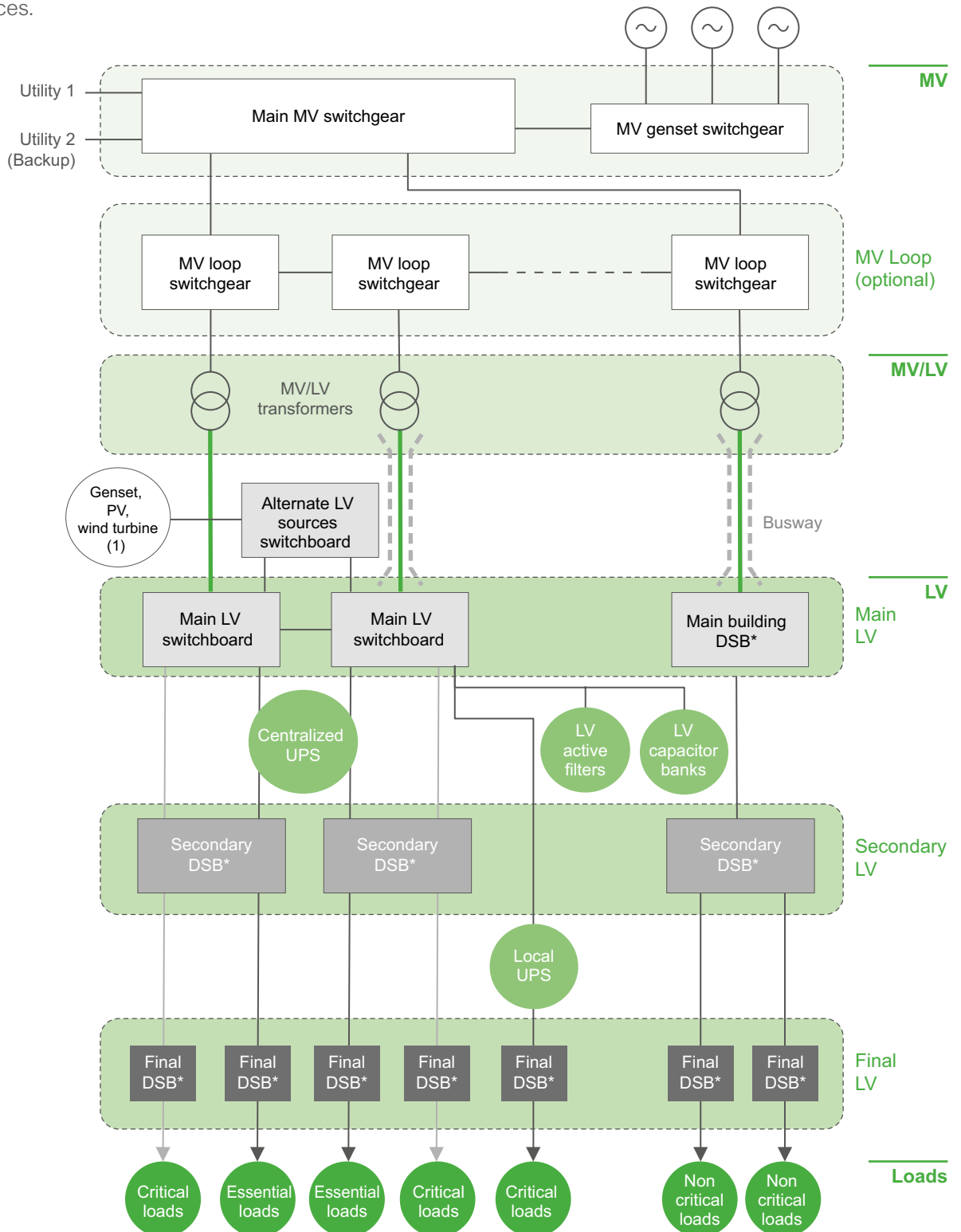
4 • Digital architecture

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

How to Use this Section (2/3)

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

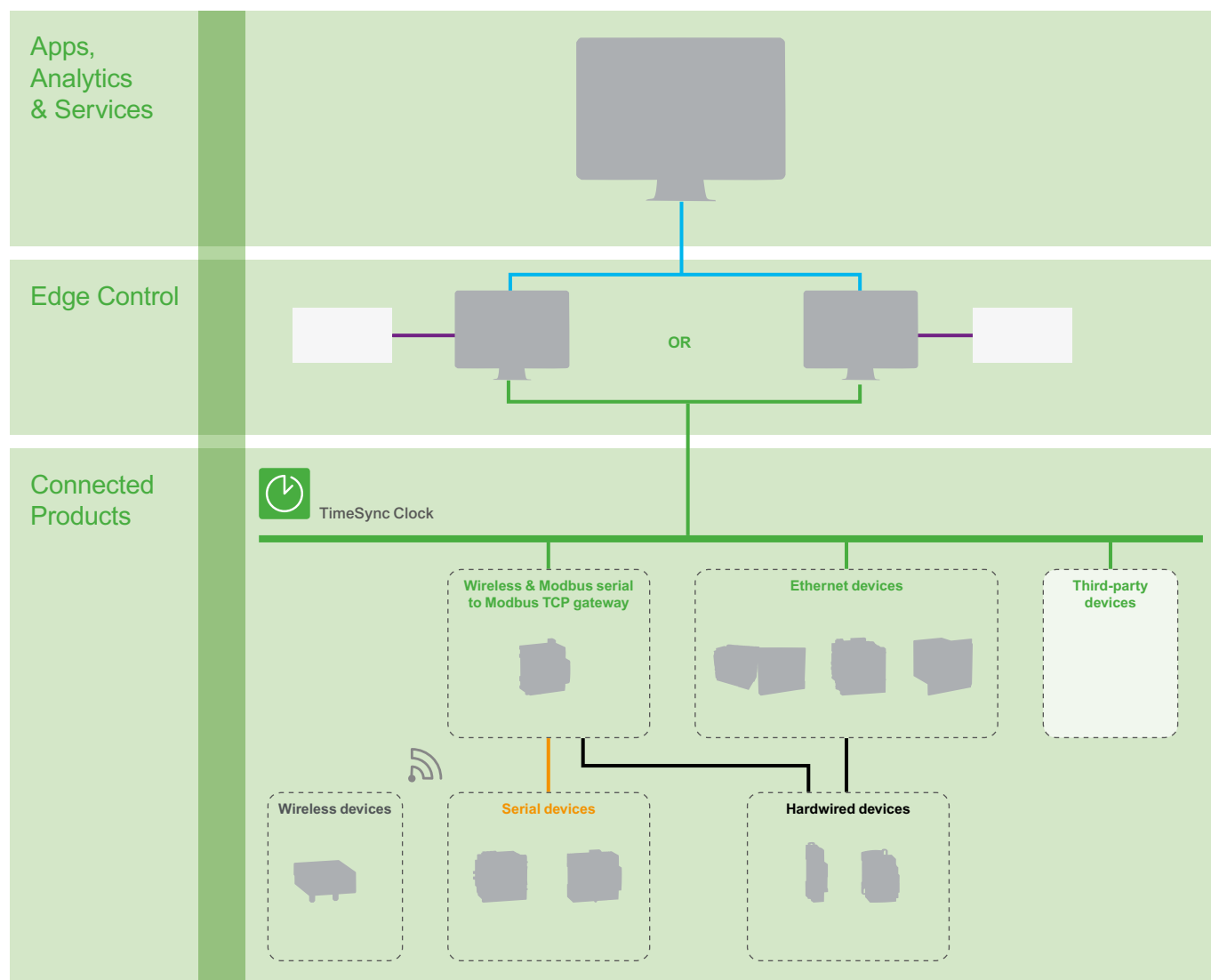
(1) Depending on source control policy (centralized or local), alternate sources may be connected either to the main LV switchboards or to secondary distribution switchboards



How to Use this Section (3/3)

Generic Digital Architecture Diagram

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



- Ethernet - public LAN/WAN
- Ethernet - technical LAN
- Serial
- Hardwired
- OPC / ETL
- ⬆️ Wireless - 2.4 GHz

1

2

3

4

> CONTINUOUS THERMAL MONITORING

Reduce Risk of Electrical Fires Due to Poor Connections in Critical Electrical Equipment (1/2)

Context of Application

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

A faulty power connection can lead to an increase in its electrical contact resistance, thus inducing a thermal runaway which, in the worst-case scenario, destroys switchgear and results in serious injury to the operator.

An increase in contact resistance can be caused by:

- loose connections due to improper installation or maintenance (improper tightening torque, loosening of a connection due to vibrations),
- damaged surface (due to corrosion, excessive pressure, 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 at regular intervals.

PROBLEM TO SOLVE

The Facility Manager needs to:

- Detect thermal runaways before they lead to electrical fires
- Take action on poor or faulty connections
- Reduce the costs of infrared inspections

PURPOSE OF CONTINUOUS THERMAL MONITORING 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 higher density applications, detect overheating of conductors using gas analysis of insulation deterioration

Provide Temperature Alarming and Reporting for a Rapid Response

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

Replace Infrared Inspections

- Continuous thermal monitoring is more cost-effective in the long run than infrared thermographic surveys



Connection Temperature Monitoring



Gas Analysis for High Density Applications

> CONTINUOUS THERMAL MONITORING

Reduce Risk of Electrical Fires Due to Poor Connections in Critical Electrical Equipment (2/2)

Application Outcomes

Live Data Display

For each electrical connection:

- Connection point temperature
- Phase to phase max. temperature deviation
- Status indication as regards alarm threshold (green/yellow/red)

Events & Alarms

Pre-alarms and alarms:

- When the absolute temperature threshold (defined by the user) is exceeded
- When an excessive deviation 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

This will help with early detection of faulty connections.

Comment: Users can define pre-alarm thresholds (e.g., 80% of absolute threshold) to detect a temperature deviation as soon as possible.

Trends

- Trending to analyse long-term temperature evolution

Reports

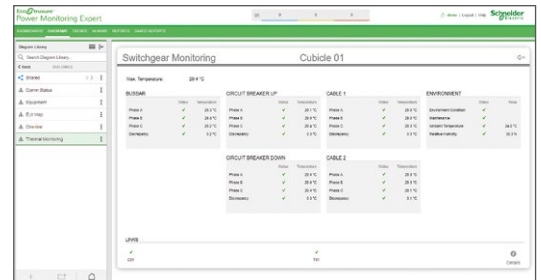
- Thermal status of the electrical installation and historical trending can be included in dedicated reports

Notifications

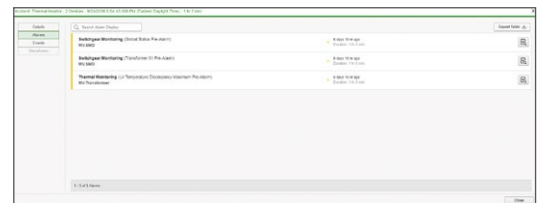
- SMS notifications and/or emails are sent under pre-alarming and alarming conditions to enable fast action

Cloud-based Analytics & Services

- Online customer portal
- Actionable proactive notification
- Expert maintenance advisory services



Live Data Display



Thermal Monitoring Alarms



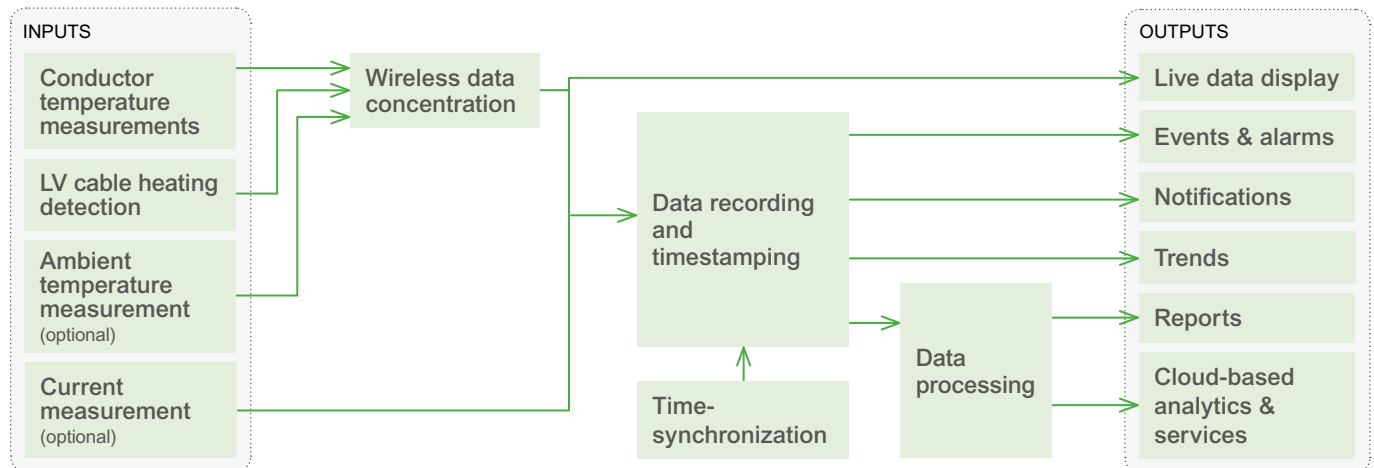
SMS Notification and/or
Email on Pre-alarm
and Alarm Conditions

> CONTINUOUS THERMAL MONITORING

System Description (1/5)

Data Flow

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



Data Flow in Detail

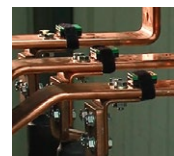
INPUTS

The following data is required:

Conductor Temperature Measurements

For MV switchgear, MV/LV transformers and LV switchboards, measurements are performed by Easergy 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.

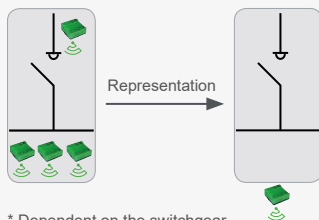
For the LV Busway Thermal Monitoring application, temperature measurement is performed by Easergy CL110 sensors mounted near busway junctions or connection points.



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

MV switchgear

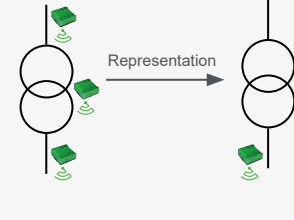
In MV switchgear*, up to 15 sensors can be installed in each cubicle, at each connection junction.



* Dependent on the switchgear

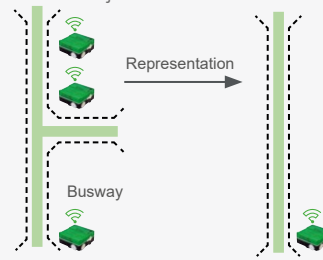
MV/LV Transformers

In dry transformers, sensors should be set on each phase connection, as well as on the transformer itself.



LV Busway

In busway applications, sensors should be located on each joint or connection.



Easergy TH110

Easergy CL110



Easergy TH110

Easergy CL110

Product, Software and Services: See page 229



> CONTINUOUS THERMAL MONITORING

System Description (2/5)

Data Flow in Detail (cont.)

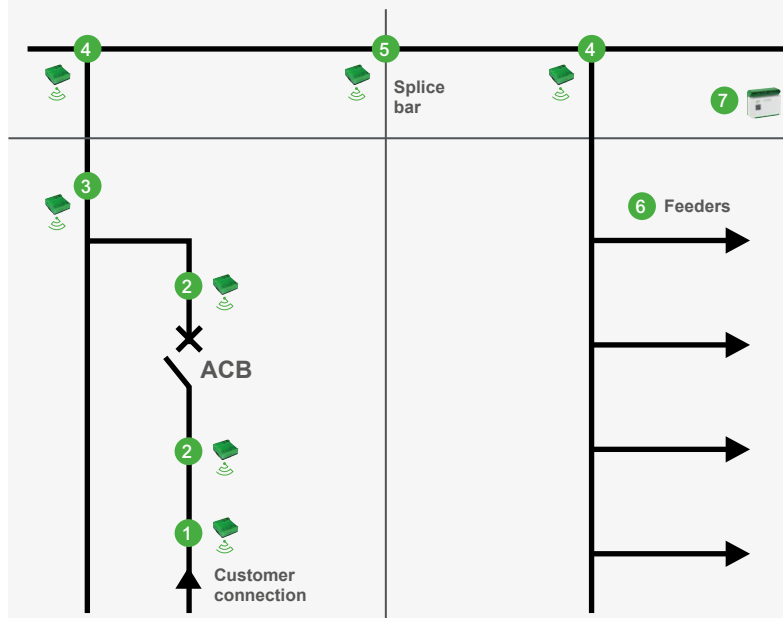
INPUTS (cont.)

Conductor Temperature Measurements (cont.)

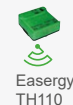
LV Switchboards

In LV switchboards*, up to 100 sensors can be installed to monitor each phase at the following locations:

- Incoming cable connections of Air Circuit Breaker (ACB) ①
- Fixed parts of plug-in contacts ②
- Junction between vertical busbar and ACB downstream bars ③
- Junctions between horizontal busbar and vertical busbar ④
- Splice bar junctions between sections of horizontal busbar ⑤
- Large feeders ⑥



* Dependent on the switchboard



LV Cable Heating Detection

For Moulded Case Circuit Breakers (MCCB) of LV switchboards*, due to the large number of feeder cable connections, a per-column overheating alarm synthesis is preferred.

It is achieved with an PowerLogic HeatTag ⑦ cable heating detector installed at the top of each MCCB column.

* Dependent on the switchboard

> CONTINUOUS THERMAL MONITORING

System Description (3/5)

Data Flow in Detail (cont.)

INPUTS (cont.)

Ambient Temperature Measurement (optional)

In MV applications (not applicable for LV), ambient temperature measurement is used to dynamically adapt the temperature threshold. Easergy CL110 ambient temperature sensors provide the internal ambient temperature of the equipment.

**Current Measurements (optional)**

Current measurement of monitored connection points is used to dynamically adapt temperature thresholds (not applicable for LV).

This is performed by a protection relay (e.g., Easergy P5 or P3) or a power meter (e.g., PowerLogic ION9000 or 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, the Sologate Harmony™ ZBRN32 is the data concentrator. Up to 60 sensors can be connected per Sologate.
- For LV busways, the EcoStruxure™ Panel Server is the data concentrator. Up to 100 sensors can be connected per Panel Server.
- For LV switchboards, the Acti9 PowerTag Link HD is the data concentrator. Up to 100 sensors can be connected per 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 the Edge Control software (EcoStruxure™ Power Monitoring Expert or Power Operation), by EcoStruxure™ Asset Advisor or, optionally, by a cloud gateway*.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)



* Enerlin'X Com'X or future model of the EcoStruxure™ Panel Server

> CONTINUOUS THERMAL MONITORING

System Description (4/5)

Data Flow in Detail (cont.)

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 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 SMD (Substation Monitoring Device).

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

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

Analog value outputs

- Temperature discrepancy between phases (not applicable for LV busways).

Status

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



Substation Monitoring Device (SMD)



EcoStruxure™ Power Monitoring Expert



EcoStruxure™ Power Operation with Advanced Reporting & Dashboards

OUTPUTS

Display of Live Data, Alarms, Events and Trends is performed locally on the SMD optional Human Machine Interface (HMI) (except trends), remotely by EcoStruxure™ Power Monitoring Expert, Power Operation or via the EcoStruxure™ Asset Advisor web interface.

Live Data Display

- The value of each measured point (temperature & current).
- The temperature discrepancy between phases (in MV applications only).
- The correlation between current and respective temperatures (in MV applications only).
- The status of each measured temperature relative to a predefined set point or calculated threshold (with color code).
- The overheating status of conductors based on insulation deterioration gas analysis, with color code (for high-density LV applications only).



Live Data Display

* Enerlin'X Com'X or future model of the EcoStruxure™ Panel Server



> CONTINUOUS THERMAL MONITORING

System Description (5/5)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Events & 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 busways).
- The overheating status of conductors based on insulation deterioration gas analysis (for high-density LV applications only).

Additionally, sensor diagnostic information is available.

Notifications

Notifications can be sent:

- By the SMD connected to a SR2mod03 GSM modem (alarms only through SMS).
- By EcoStruxure™ Power Monitoring Expert, Power Operation with the proper Event Notification Module (events, alarms via email and SMS).
- By EcoStruxure™ Asset Advisor.

Trends

- The evolution of each measured value over time.

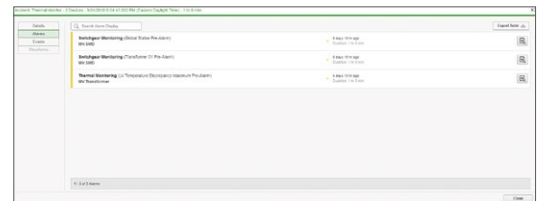
Reports

When EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards is installed, customized reports based on measured and processed data may be generated and sent automatically with email subscription.

Cloud-Based Analytics & Services

EcoStruxure™ Asset Advisor cloud-based analytics and services provide asset health analytics to interpret the status and history of critical assets with preventive notifications and 24/7 support.

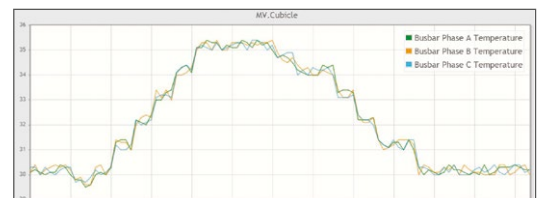
For Continuous Thermal Monitoring of assets, EcoStruxure™ Asset Advisor can provide analytics with condition-based, proactive recommendations through periodic reports and 24/7 expert support.



Thermal Monitoring Alarms



SR2mod03



Temperature Trends



EcoStruxure™ Asset Advisor

> CONTINUOUS THERMAL MONITORING

Electrical Architecture (1/2)

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⁽¹⁾ and Transformers

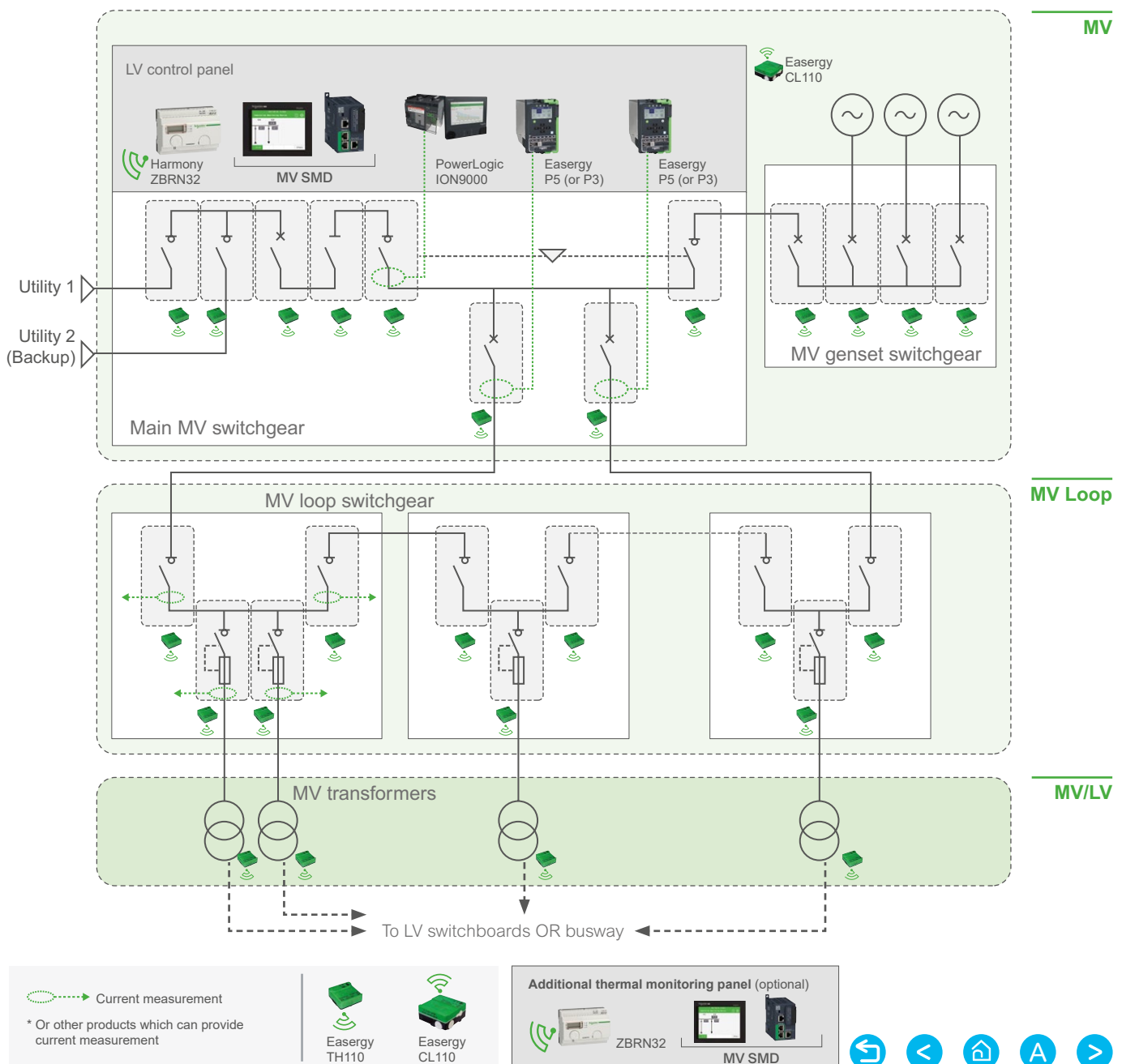
Depending on the switchgear configuration and transformers to monitor, the number of Easergy TH110 sensors, Sologate (Harmony ZBRN32) concentrators, current measurement devices and SMD will have to be adapted.

All devices except Easergy TH110 sensors are installed in LV control panels of the switchgear.

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

Comment about LV Control Panels

- Each MV switchgear is associated with a LV control panel. For legibility reasons, in the following diagram, 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.



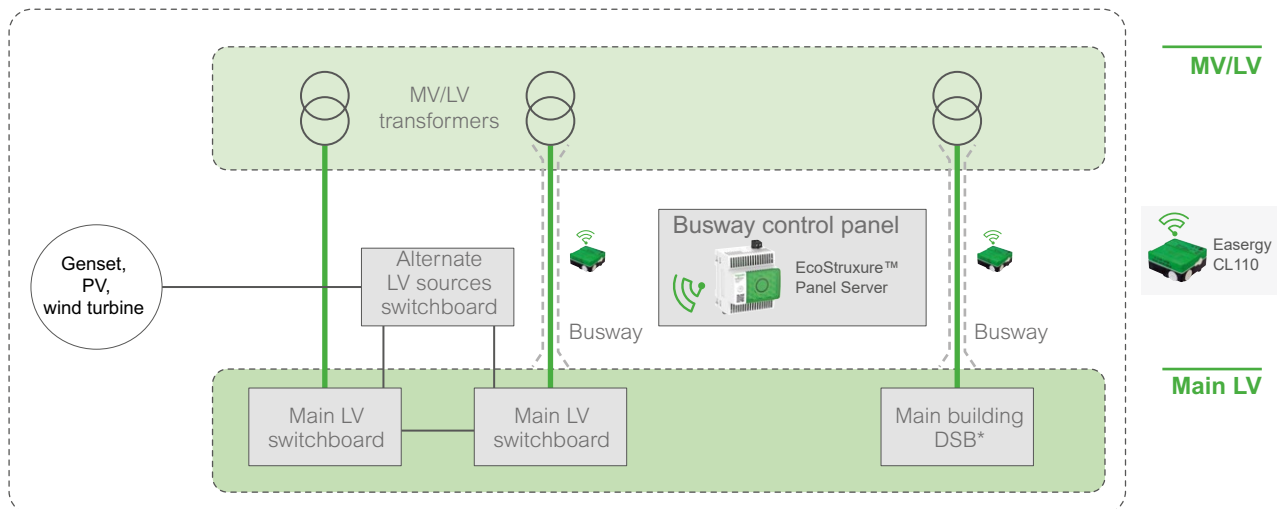
> CONTINUOUS THERMAL MONITORING

Electrical Architecture (2/2)

Implementation for Busway⁽¹⁾

For each busway joint or junction, such as tap-off points, corners, elbows or "joint packs", a single Easergy CL110 is installed; per-phase sensors are not required. Continuous Thermal Monitoring for busway only uses the EcoStruxure™ Panel Server to wirelessly collect data from Easergy CL110 sensors. An SMD is not required.

(1) The sensors in the busway must be installed by qualified Schneider Electric field services engineers.



* DSB = Distribution Switchboard

Implementation for LV Switchboards

For each horizontal and vertical busbar junction, as well as for ACBs upstream/downstream connections, Easergy TH110 sensors are installed on each phase.

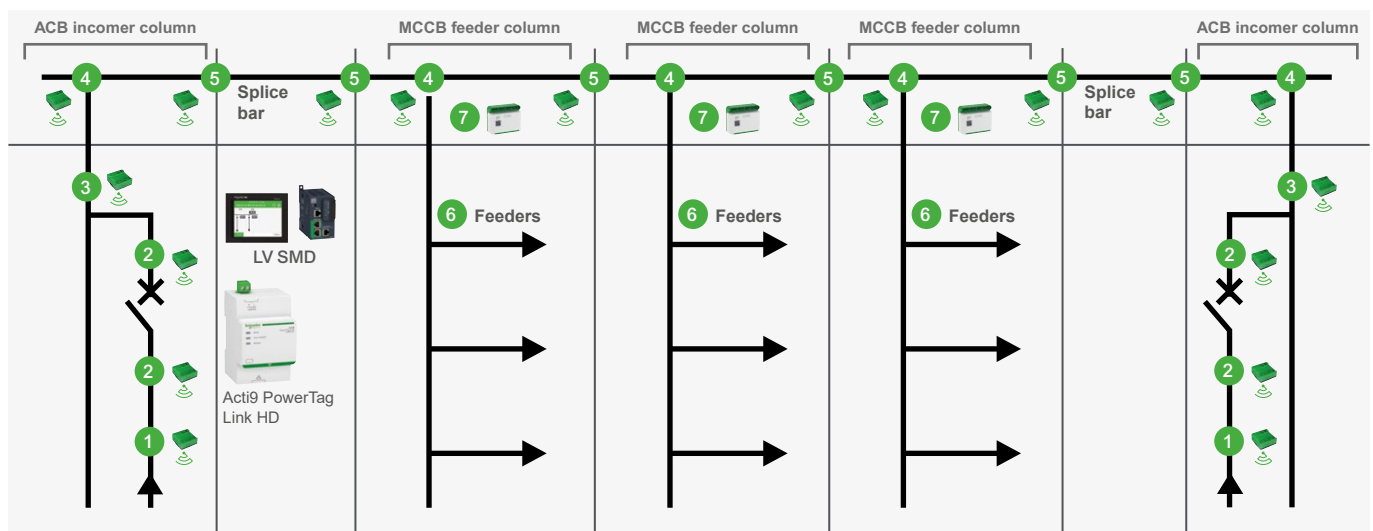
For MCCBs, one PowerLogic HeatTag sensor is installed on the top of each column.

Acti9 PowerTag Link HD and LV SMD are installed in dedicated compartments.

Depending on the switchboard configuration, the number of Easergy TH110 sensors, PowerTag Link HD and LV SMD will have to be adapted.

Example of a dual-ACB incomer switchboard with 3 MCCB columns: 60 wireless sensors

- 19 junctions are monitored with 1 Easergy TH110 sensor per phase: 57 Easergy TH110 sensors
- 1 PowerLogic HeatTag per MCCB column: 3 PowerLogic HeatTag sensors.



> CONTINUOUS THERMAL MONITORING

Digital Architecture (1/3)

Introduction

To define the digital architecture of the Continuous Thermal Monitoring application, the user's needs must be defined:

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

Different architectures are described in the following pages, as a 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, busways). 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.

Comment: 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:

	Tablet	Local HMI*	EcoStruxure™ Power Monitoring Expert	EcoStruxure™ Power Operation**	EcoStruxure™ Power Operation with Advanced Reporting & Dashboards	EcoStruxure™ Asset Advisor	EcoStruxure™ Power Monitoring Expert + Asset advisor	EcoStruxure™ Power Operation with Advanced Reporting & Dashboards + Asset Advisor
Features								
Tablet thermal scan								
Live data	●							
Local monitoring								
Live data		●						
Events & alarms		●						
On premise monitoring								
Live data			●	●	●		●	●
Events & alarms			●	●	●		●	●
Access to trends			●	●	●		●	●
Predesigned graphics for thermal monitoring			○	○	○		○	○
Access to reports			●		●		●	●
Remote notifications								
Events & alarms		○	●	●	●		●	●
Trends			●		●		●	●
Reports			●		●		●	●
Cloud remote monitoring & services								
Events & alarms						●	●	●
Trends						●	●	●
Reports						●	●	●
Expert maintenance recommendations						●	●	●

● Embedded

○ Available for all applications except LV busways

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

● Available if Events Notification Module is installed

* Except for LV busways, local monitoring is available with the SMD optional HMI

** Considerations on communication with sensors for busway

Comment: note that EcoStruxure™ Power Operation enables remote control of electrical installations, this may be an additional selection criteria to choose the most well-suited architecture.



> CONTINUOUS THERMAL MONITORING

Digital Architecture (2/3)

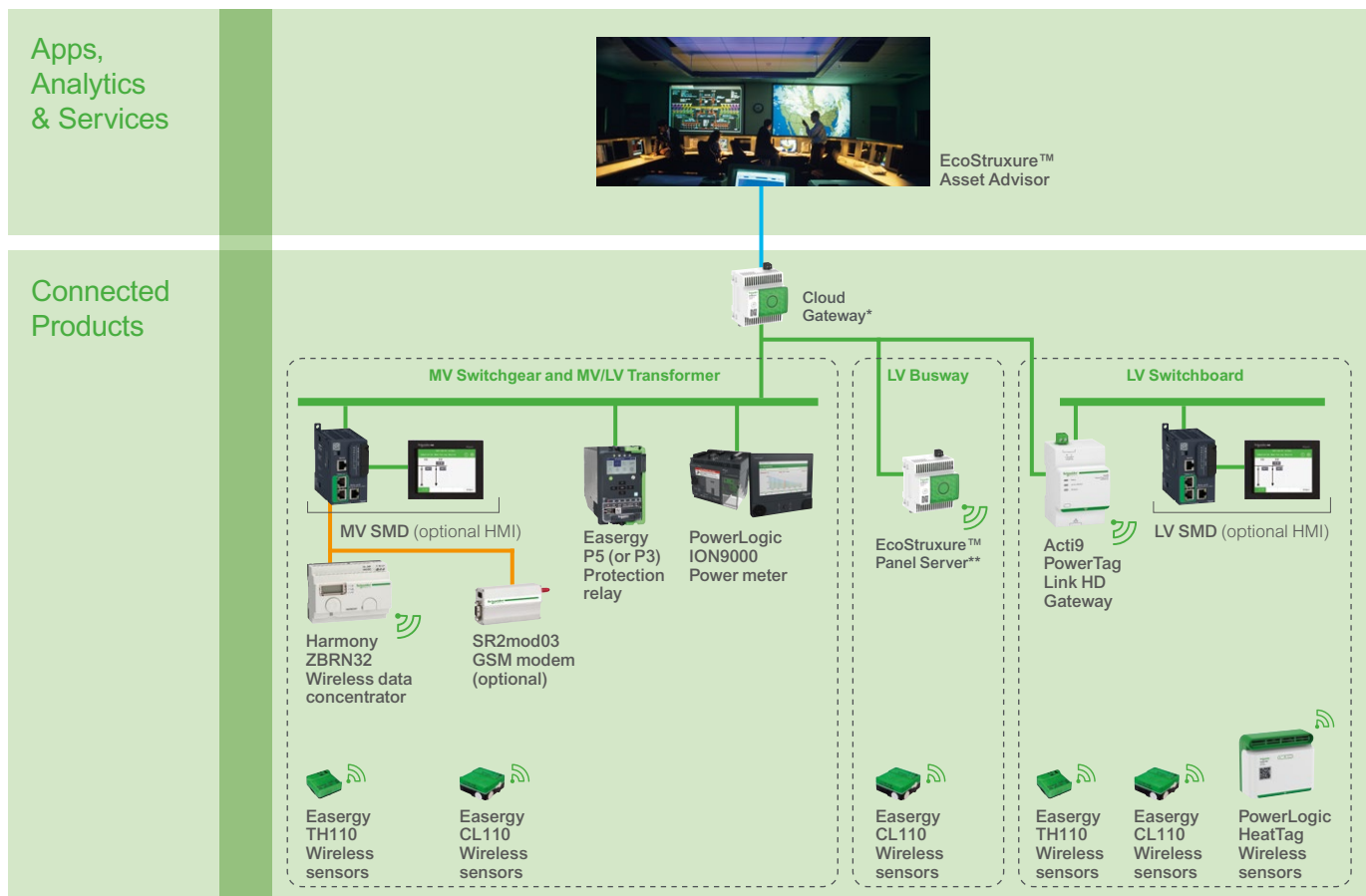
With Connected Products and Remote Services

In these architectures, data is collected from the wireless thermal sensors (Easergy CL110/TH110) and cable overheating sensors (PowerLogic HeatTag) using, depending on the application:

- the Sologate (Harmony ZBRN32) data concentrator and passed onto the MV SMD for local processing and display
- the EcoStruxure™ Panel Server
- the Acti9 PowerTag Link HD gateway and passed onto the LV SMD for local processing and display

Data is then recorded using a cloud gateway* before being passed onto EcoStruxure™ Asset Advisor. As part of a connected service, temperature and environmental data is processed, recorded and presented to the user for consultative reporting and advisory services with EcoStruxure™ Asset Advisor.

The recommended digital architectures for this solution are given below:



— Ethernet - public LAN/WAN

— Ethernet - technical LAN

— Serial

📶 Wireless - 2.4 GHz

* EnerlinX Com'X or future model of the EcoStruxure™ Panel Server

** When the EcoStruxure™ Panel Server will be available as a cloud gateway, it will be able to connect directly to EcoStruxure™ Asset Advisor



> CONTINUOUS THERMAL MONITORING

Digital Architecture (3/3)

With Connected Products, Edge Control Software and Optional Remote Services

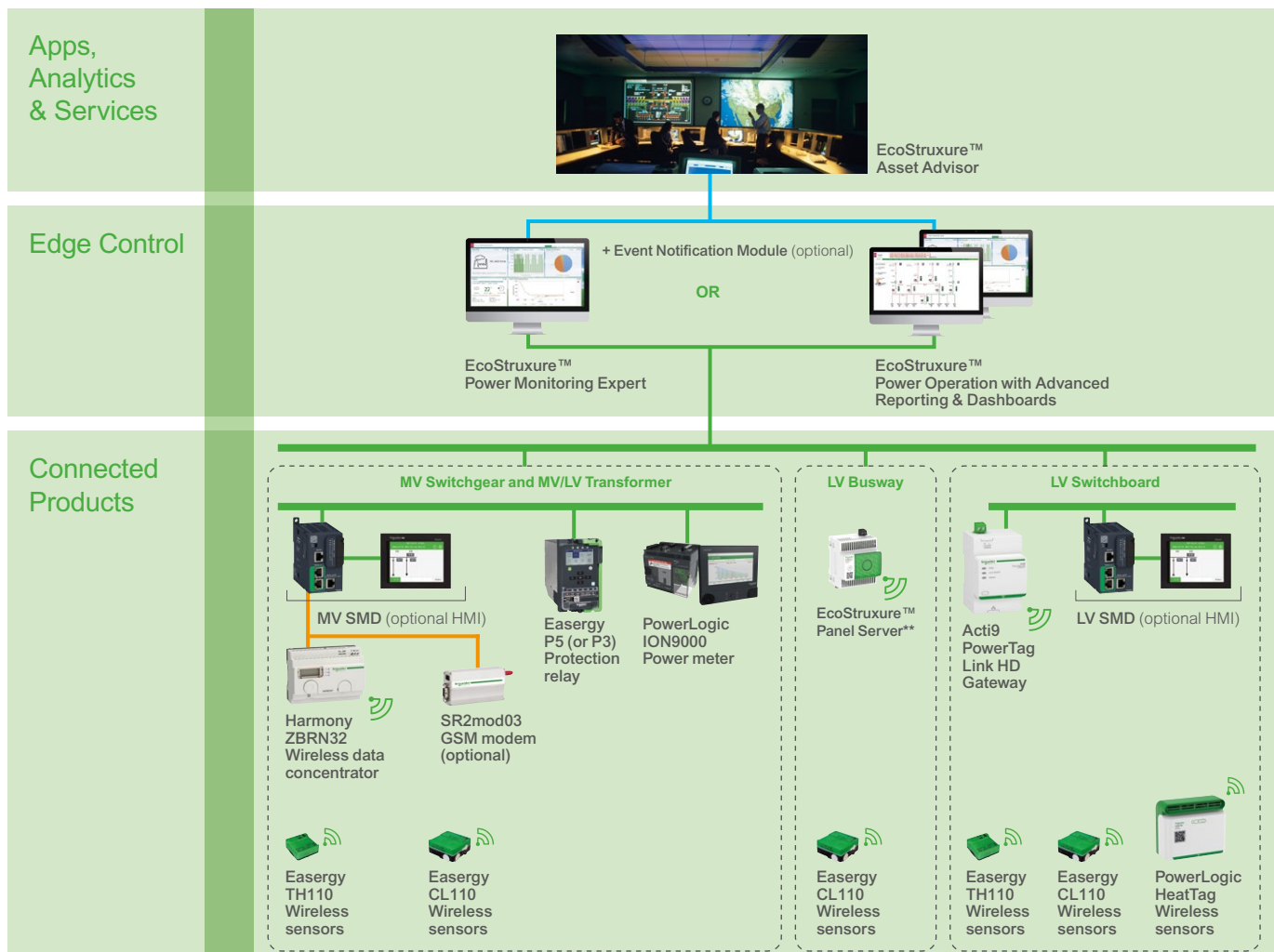
In these architectures, data is collected from the wireless thermal sensors (Easergy CL110/TH110) and cable overheating sensors (PowerLogic HeatTag) using, depending on the application:

- the Sologate (Harmony ZBRN32) data concentrator and passed onto the MV SMD for local processing and display
- the EcoStruxure™ Panel Server
- the Acti9 PowerTag Link HD gateway and passed onto the LV SMD for local processing and display

Data is then processed, recorded and presented to the user by the Edge Control Layer (EcoStruxure™ Power Monitoring Expert or Power Operation with the Advanced Reporting and Dashboards module).

Optionally, as part of a connected service, temperature and environmental data can be used for consultative reporting and advisory services with EcoStruxure™ Asset Advisor.

The recommended digital architectures for this solution are given below:



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.

Optionally, based on data collected in EcoStruxure™ Asset Advisor, the Schneider Electric Connected Service Hub can proactively notify the user of anomalies.

Specifically for MV applications, remote notifications on alarms can be sent directly from MV Switchgear with a SR2mod03 modem connected to the MV SMD.

> ARC FLASH PROTECTION

Help Protect Human Lives and Equipment from Arc Flash Damage (1/2)

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 limit the effects on equipment and persons.

1

Comment: 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, 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/>

2

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, interruption of processes and equipment
- Improve arc flash awareness for maintenance teams
- Provide post arc flash event analysis

3

PURPOSE OF THE ARC FLASH PROTECTION APPLICATION

4

Enhance Passive Arc Flash Mitigation Solutions

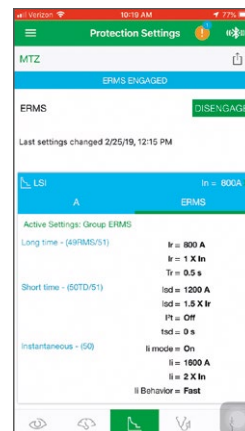
- By minimizing equipment damage, downtime and likelihood of personal injury or death by detecting light and/or current resulting from arc flash events and ultra-fast operation (less than 30 ms) of associated protective devices
- By reducing some of the risk during maintenance operation: Energy Reduction Maintenance Settings (ERMS) can be used to help protect staff, occupants and equipment by temporarily changing circuit breakers to instantaneous trip mode

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 shown within easy to interpret single-line diagrams and graphical incident timelines.

Enable Arc Flash Post Incident Analysis

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



ERMS Status Displayed on EcoStruxure™ Power Device

> ARC FLASH PROTECTION

Help Protect Human Lives and Equipment from Arc Flash Damage (2/2)

Application Outcomes

Live Data Display

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

Events & Alarms

- Circuit breaker operation statuses and alarms
- Arc flash protection device activation statuses and alarms
- Arc flash protection device diagnosis, smart trend, and power events analysis.

Trends

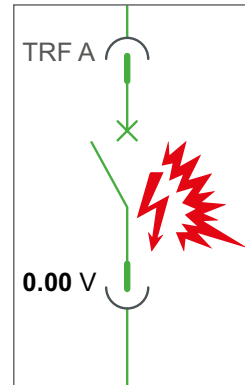
Long-term trends can be generated to understand if slow phenomena may have triggered an arc flash.

Notifications

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

Analysis Tools

Display of arc flash incidents on the Power Events Analysis incident timeline ([refer to Power Events Analysis application](#)).



Display of Arc Flash Related Trips on Single-Line Diagram

Timestamp	Event Name	Status
2018-01-01 10:00:00	Arc Flash Incident	Completed
2018-01-01 10:00:01	Arc Flash Protection Device Activation	Completed
2018-01-01 10:00:02	Arc Flash Protection Device Diagnosis	Completed
2018-01-01 10:00:03	Arc Flash Protection Device Activation	Completed
2018-01-01 10:00:04	Arc Flash Protection Device Diagnosis	Completed
2018-01-01 10:00:05	Arc Flash Protection Device Activation	Completed
2018-01-01 10:00:06	Arc Flash Protection Device Diagnosis	Completed
2018-01-01 10:00:07	Arc Flash Protection Device Activation	Completed
2018-01-01 10:00:08	Arc Flash Protection Device Diagnosis	Completed
2018-01-01 10:00:09	Arc Flash Protection Device Activation	Completed
2018-01-01 10:00:10	Arc Flash Protection Device Diagnosis	Completed

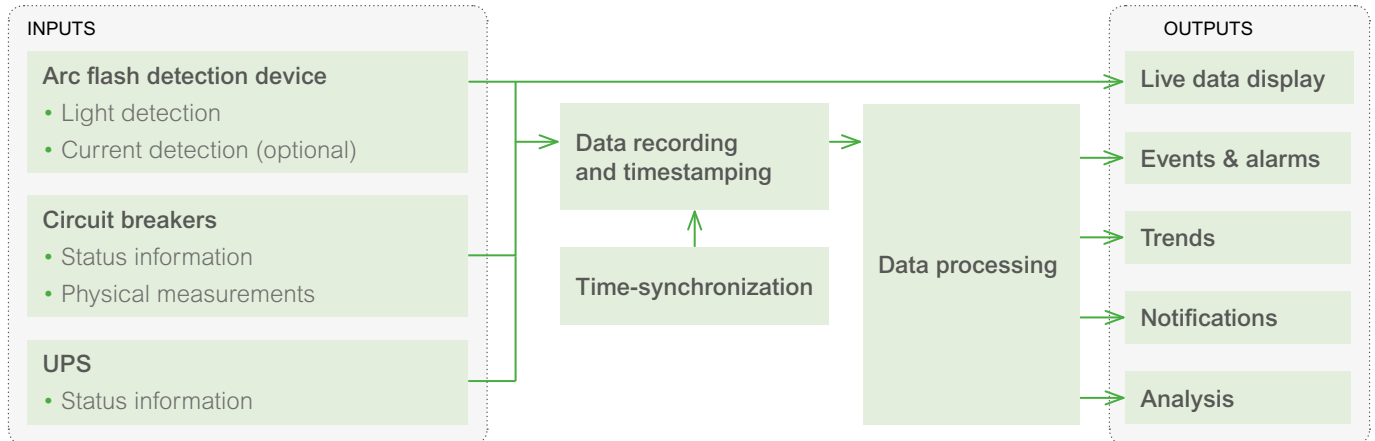
Incident Timeline with Arc Flash Events and Alarms

> ARC FLASH PROTECTION

System Description (1/6)

Data Flow

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



Data Flow in Detail

INPUTS

Arc flash protection can either be embedded in an electrical protection relay (Easergy P5 30 Series or Easergy P3 Advanced) or provided as an autonomous system when required (Easergy Arc V121 / V125).

Comment about Easergy P5 and P3: only the "30 Series" and "Advanced" protection relays of this range can offer arc flash detection/protection capabilities. Lower-end Easergy P5 and P3 - without arc flash features - may still be involved in some arc flash architectures, aside from autonomous arc flash protection systems. Variants of Easergy P5 will thus be distinguished in this document as Easergy P5 20 Series and 30 Series. For Easergy P3, the variants will be defined as "Standard" and "Advanced".

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. Easergy Arc VA1DA (or VA1EH) sensors offer a wide area arc flash detection with a typical detection time <1 ms.

These sensors can be connected to different arc flash protection devices like Easergy P5 30 Series or Easergy P3 Advanced, Easergy Arc V121 / V125.



> ARC FLASH PROTECTION

System Description (2/6)

Data Flow in Detail (cont.)

INPUTS (cont.)

Arc Flash Detection Device (cont.)

Current Detection (optional)

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

- Protection relays Easergy P5 30 Series or Easergy P3 Advanced directly acquire these measurements through their standard current transformers.
- Easergy Arc V125 requires an additional module with dedicated current transformers to detect high current values: Easergy Arc VAM4C.
- Easergy Arc V121 cannot be interfaced with a current metering system, it must only be used in switchboards that are not exposed to unintentional light sources.



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 (Easergy P5 or 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.



Comment: 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).

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, VM or VS).

It is therefore recommended to monitor the status of any UPS used for that purpose throughout the electrical distribution network.

> ARC FLASH PROTECTION

System Description (3/6)

Data Flow in Detail (cont.)

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 (Easergy P5 30 Series or Easergy P3 Advanced), analog and event data is recorded and timestamped onboard the protection relay itself.

Arc Flash Protection Installed as an Autonomous Feature

With Easergy Arc V121 / V125, 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 Easergy Arc V121 / V125. In this case, event data is recorded and timestamped onboard the communicating protection relay (Easergy P5 20 Series or Easergy 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 Easergy Arc V121 / V125. In this case, event data is recorded and timestamped onboard the communicating power meter (PowerLogic ION9000, 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 the chart 2.2 in Section 1, page 15.](#)



TIME-SYNCHRONIZATION

- For systemwide 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 may 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

> ARC FLASH PROTECTION

System Description (4/6)

Data Flow in Detail (cont.)

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 (Easergy P5 30 Series or Easergy P3 Advanced or Easergy Arc V121 / V125).

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.



1

2

3

4

> ARC FLASH PROTECTION

System Description (5/6)

Data Flow in Detail (cont.)

OUTPUTS

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

Live Data Display

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

Single-line Diagrams

- Digital single-line diagrams, with realtime animation in the event of arc flash detection.

Detailed Diagrams

- Device diagrams, pre-configured along with native device drivers (Easergy P5 30 Series or Easergy P3 Advanced) or customized to reflect Easergy Arc V121 / V125 (Easergy P5 20 Series or Easergy P3 Standard, MasterPacT MTZ, PowerLogic ION9000, PM8000)
- Realtime data in custom graphics (floor plans, elevation drawings).

Events & Alarms

Event Log Viewers

Alarms and events are uploaded from devices and displayed in native alarm and event viewers of the Edge Control software.

Chronological views include all alarms and events, 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.

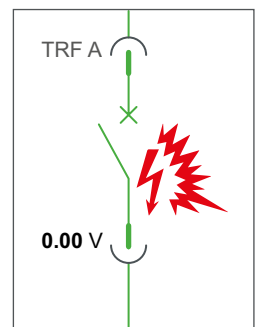
In addition, user remote control actions during the repair phase are traced with the operator name and timestamp.

Smart Alarming

Arc flash alarm or events are intelligently grouped to be displayed as comprehensive arc flash incidents and reduce the overall number of alarms in the viewer. Further analysis can be performed through drill down ([refer to the Power Events Analysis application](#)).

Notifications

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



Display of Arc Flash Related Trips on Single-Line Diagram

Incident Chronology with Arc Flash Events and Alarms

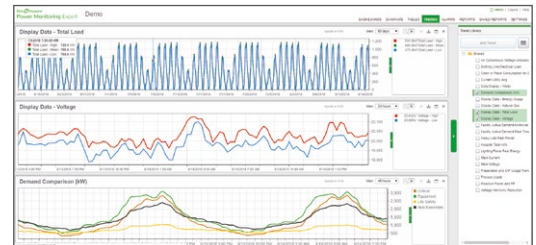
> ARC FLASH PROTECTION

System Description (6/6)

OUTPUTS (cont.)

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.

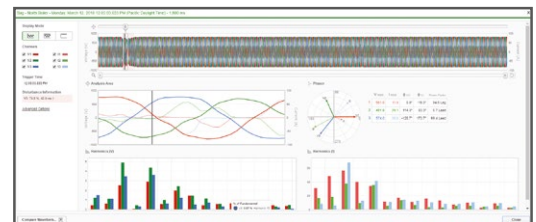


Realtime Trending

Analysis Tools

Waveform Viewer

To refine the understanding of an arc flash occurrence, electrical current waveforms captured by a circuit breaker or power meter can be displayed with a native waveform viewer.

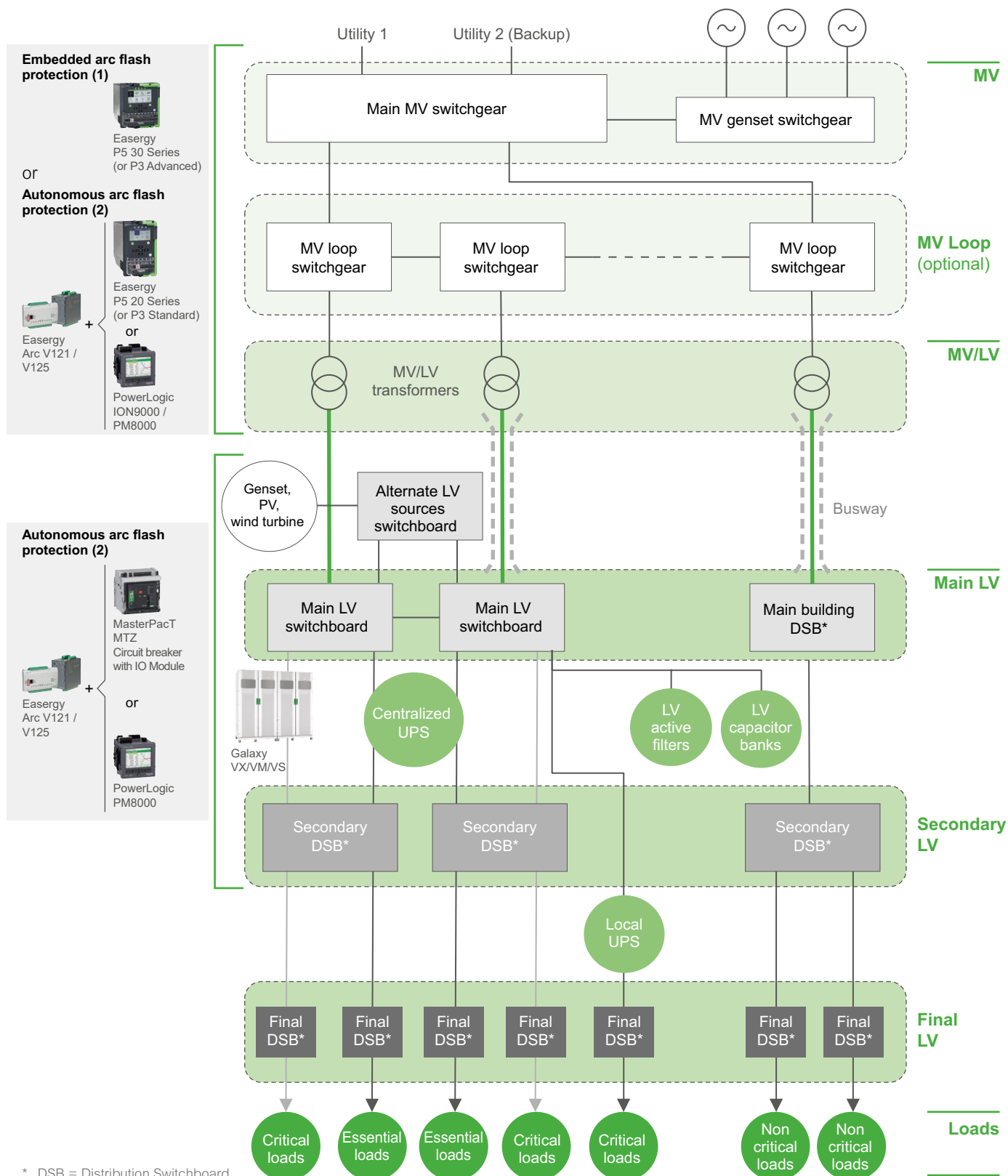


Waveform Viewer

> ARC FLASH PROTECTION

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:



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

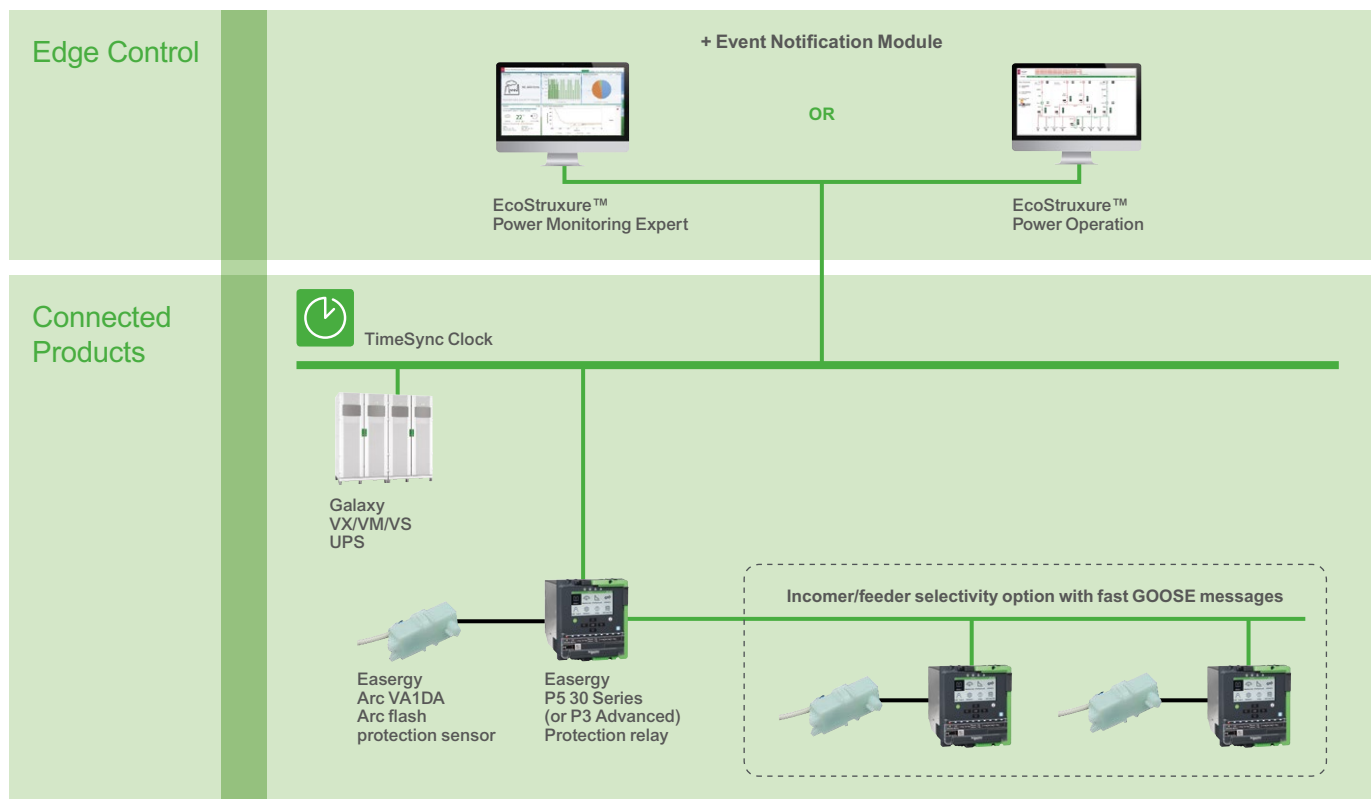


> ARC FLASH PROTECTION

Digital Architecture (1/2)

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:

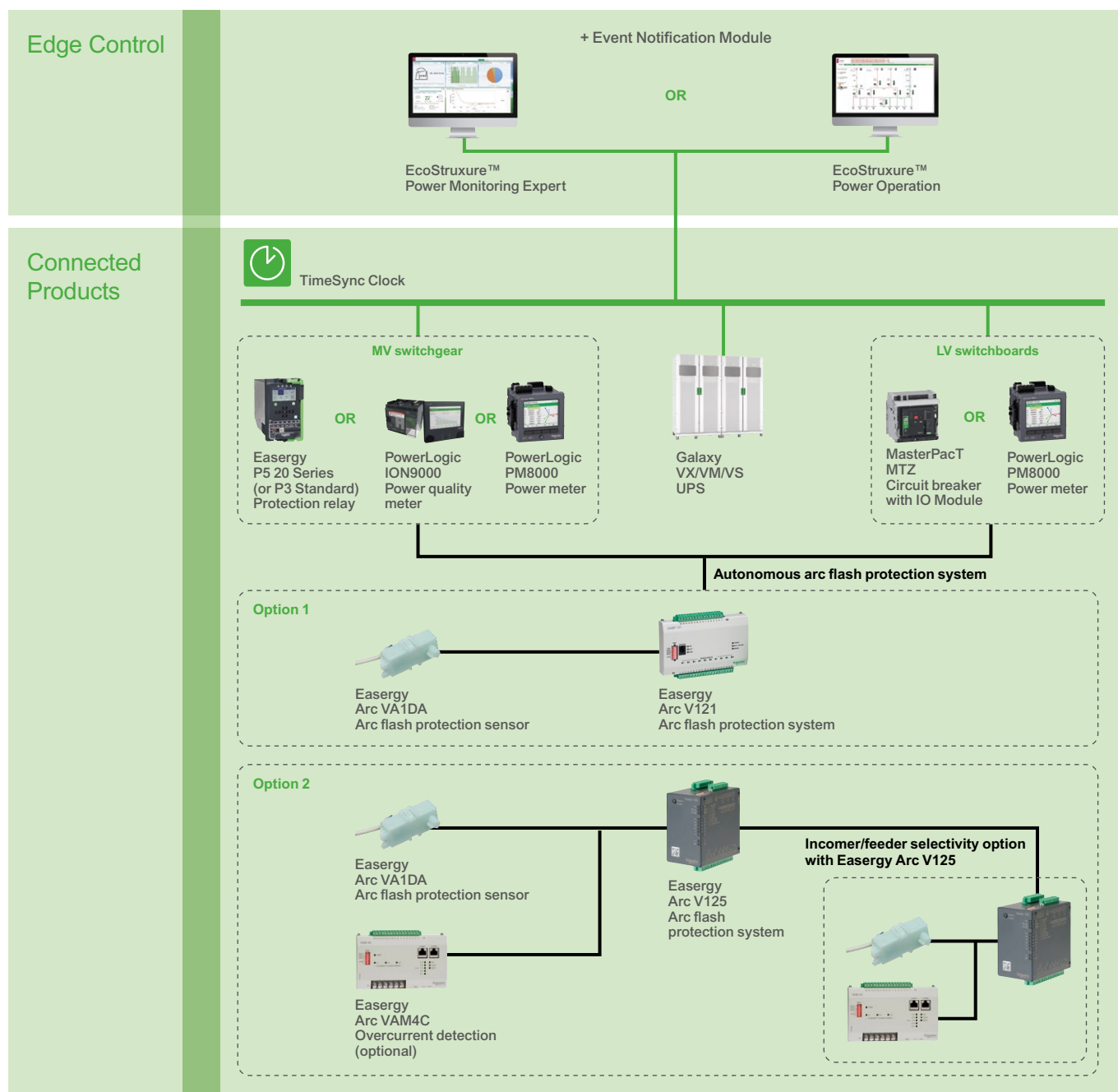


> ARC FLASH PROTECTION

Digital Architecture (2/2)

Architectures for Arc Flash Protection as an Autonomous Feature

Below is the recommended digital architecture for the Arc Flash Protection application when Easergy Arc V121 / V125 perform arc fault protection independently of the electrical protection relay.



— Ethernet - technical LAN
 — Hardwired

Product, Software and Services: See page 229



> INSULATION MONITORING

Monitor Insulation Status to Help Improve Safety and Operational Efficiency (1/2)

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 hospital, 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. Amongst others, this is typically the case in wet location applications (both MV and LV) such as wastewater treatment, mining, oil & gas, 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:

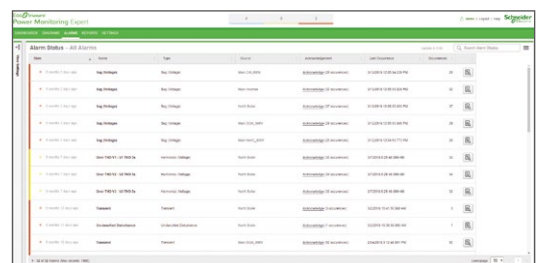
- Guarantee power availability and continuity of service for critical processes / equipment / areas
- Get real time information, notifications and alarms for overload / overheating issues and insulation status to ensure that installations are isolated from earth through sufficiently high impedance
-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

PURPOSE OF INSULATION MONITORING APPLICATION

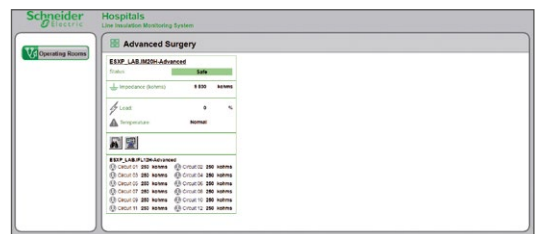
Help prevent disruption of critical processes due to insulation faults, overload, and over-temperature conditions by:

- Continuously monitoring (locally and/or remotely) insulation integrity
- Displaying the status of the installation
- Triggering and/or 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 (e.g., in operating rooms and intensive care units)



Insulation and Electrical Fault Alarm Viewer



Specific Diagram for Operating Rooms and ICUs

> INSULATION MONITORING

Monitor Insulation Status to Help Improve Safety and Operational Efficiency (2/2)

Application Outcomes

Live Data Display

- Insulation monitoring status
- Insulation monitoring absolute value (Ohm)

Events & Alarms

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

Trends

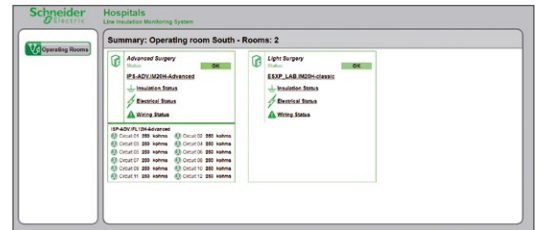
- Realtime and historical data can be viewed on a trend viewer

Reports

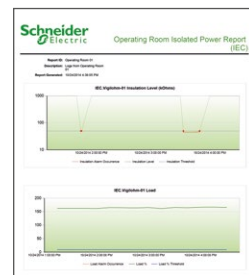
- Operating Room Isolated Power Report

Notifications

- SMS notifications can be sent for fast analysis and action
- Email notifications are also available to send reports and other noncritical information



Live Data Display



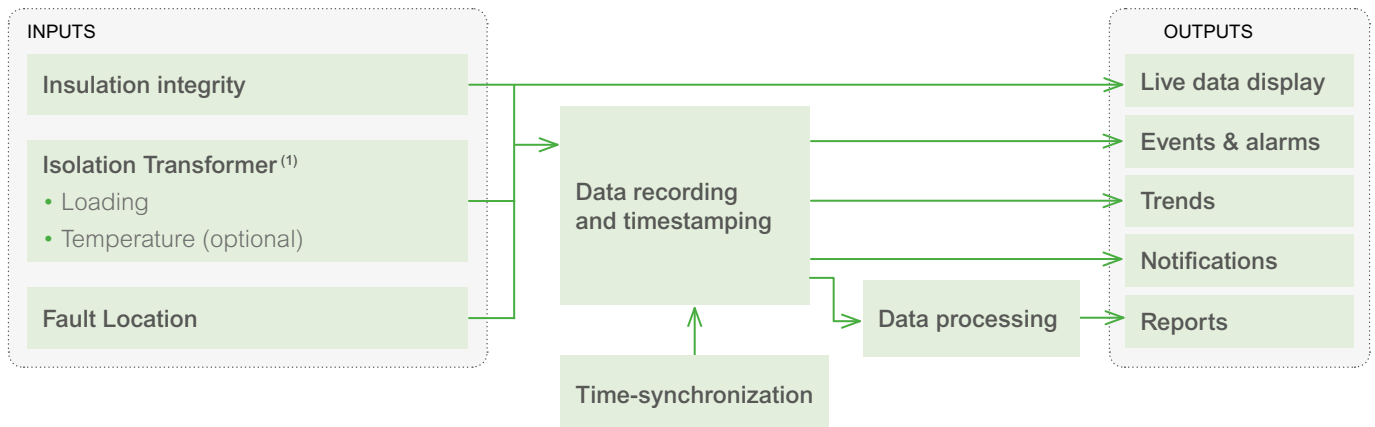
Operating Room Isolated Power Report

> INSULATION MONITORING

System Description (1/2)

Data Flow

The Insulation Monitoring application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data is required for the Insulation Monitoring application and is acquired from the Insulation Monitoring Device Vigilohm (IM400 or IM20-H⁽¹⁾):

Insulation Integrity

- Permanent measurement of insulation resistance to ground in IT systems

Isolation Transformer⁽¹⁾

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

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

Fault Location

Fault location information is provided by a dedicated device (Vigilohm IFL12), without any direct connection with the insulation monitoring device.

DATA PROCESSING

The insulation integrity (in kOhm and/or μF), transformer loading⁽¹⁾ and temperature⁽¹⁾ are sent to EcoStruxure™ Power Monitoring Expert and Power Operation with Advanced Reporting and Dashboards for data processing. Here, the data is analyzed and converted into alarms and events.

DATA RECORDING AND TIMESTAMPING

Realtime impedance, loading and temperature, as well as the generated alarm/event data is recorded as historical values in the Edge Control Software (EcoStruxure™ Power Monitoring Expert or EcoStruxure™ Power Operation with Advanced Reporting and Dashboards Module).

Time-synchronization is performed by the Edge Control Software using the network. Timestamping is done by the Vigilohm IM400 or IM20-H for the general insulation fault and independently by IFL12 series fault locators (MC and H) for the specific fault location.

(1) Specific to Healthcare application



> INSULATION MONITORING

System Description (2/2)

Data Flow in Detail (cont.)

OUTPUTS

Outputs are displayed remotely via the Edge Control software EcoStruxure™ Power Monitoring Expert and/or EcoStruxure™ Power Operation with Advanced Reporting and Dashboard except in specific cases.

1 Live Data Display

The following data is available natively:

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

The live data is displayed by EcoStruxure™ Power Monitoring Expert and Power Operation with Advanced Reporting and Dashboards.

Additionally, for use in healthcare, live data is displayed locally throughout the various HMIs (IMD LRDH⁽¹⁾ or Vigilohm HRP⁽¹⁾), and using the optional Insulation Monitoring Module⁽¹⁾⁽²⁾ of EcoStruxure™ Power Monitoring Expert and Power Operation with Advanced Reporting and Dashboards.



Vigilohm
HRP



Vigilohm
IMD LRDH

2 Events & Alarms

The following alarms can be raised by the Vigilohm IM400, IM20-H, IFL12 series (MC & H):

- Insulation fault pre-alarm (on IMD)
- Insulation fault alarm through communications and dry contact relay, plus visual & acoustic in operating rooms⁽¹⁾
- Insulation fault location (per feeder)
- Transformer fault⁽¹⁾



EcoStruxure™
Power Monitoring Expert

Alarms can be raised by the various HMIs (Operating Theater Display⁽¹⁾, Vigilohm HRP⁽¹⁾) and remotely by EcoStruxure™ Power Monitoring Expert and Power Operation with Advanced Reporting and Dashboards.

3 Trends

Any insulation monitoring parameter such as insulation integrity (kOhm / μF) can be displayed as a trend in EcoStruxure™ Power Monitoring Expert and Power Operation with Advanced Reporting and Dashboards.



EcoStruxure™
Power Operation
with Advanced Reports

4 Notifications

- SMS notifications can be sent for fast analysis and action.
- Email notifications are also available to send reports and other noncritical information

Reports⁽¹⁾⁽²⁾

The following report can be displayed or automatically sent via e-mail with 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

(1) Specific to Healthcare application

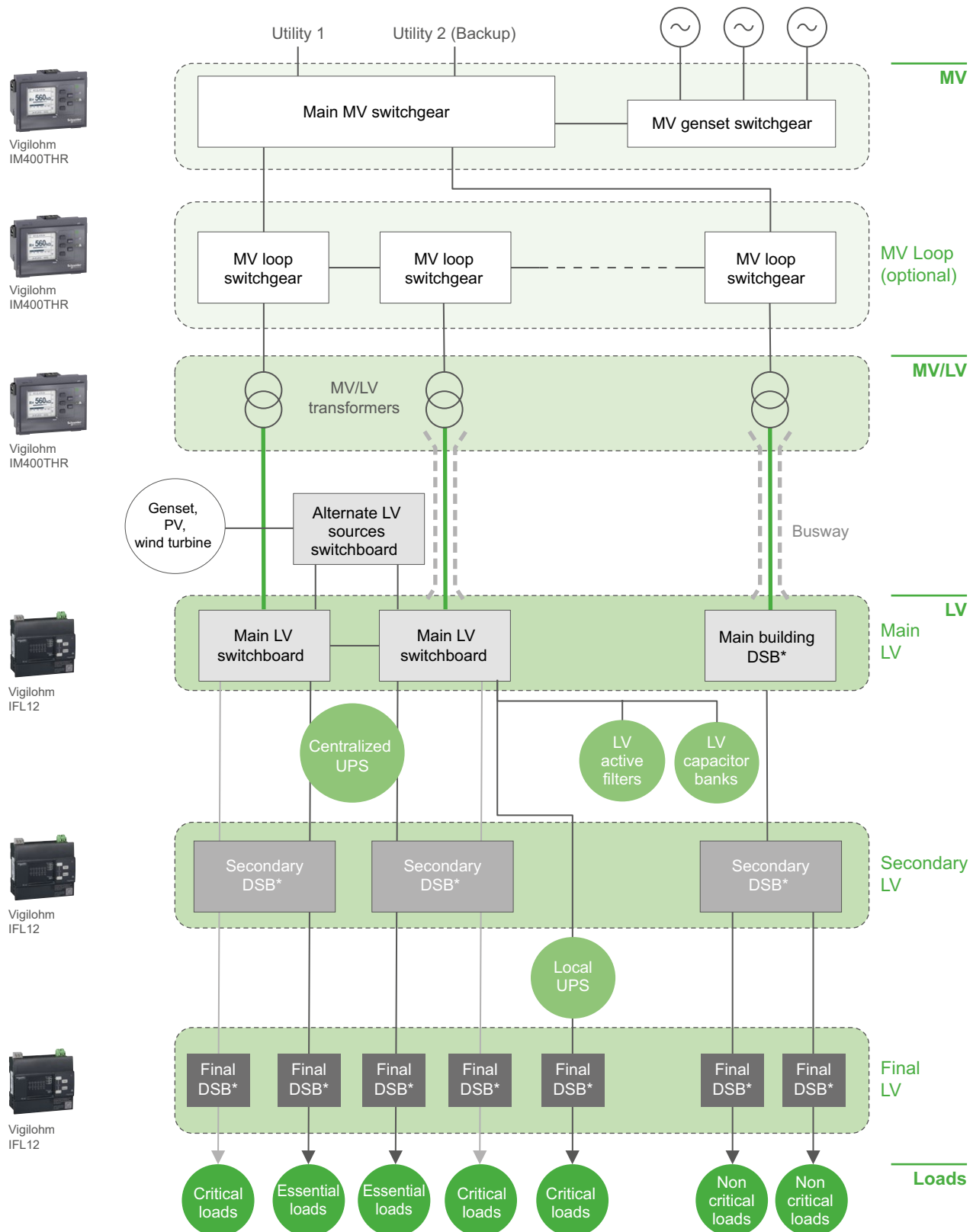
(2) The Insulation Monitoring module of EcoStruxure™ Power Monitoring Expert and Power Operation with Advanced Reporting and Dashboards must be deployed to benefit from these features



> INSULATION MONITORING

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

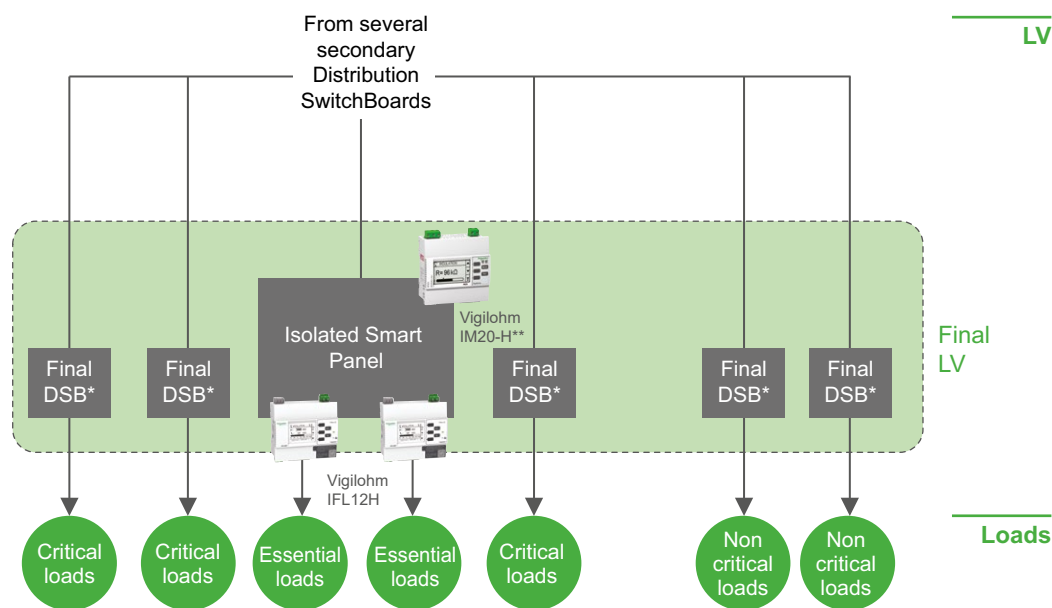
> INSULATION MONITORING

Electrical Architecture - Healthcare Applications

The following diagram details which area of the architecture the connected products should be added to, in order to implement the Insulation Monitoring Application.

Vigilohm IM20-H serves as the central Insulation Monitoring Device to monitor the network insulation.

Fault locators (IFL12H) are installed on each feeder to identify the circuit with compromised insulation integrity.



* DSB = Distribution Switchboard

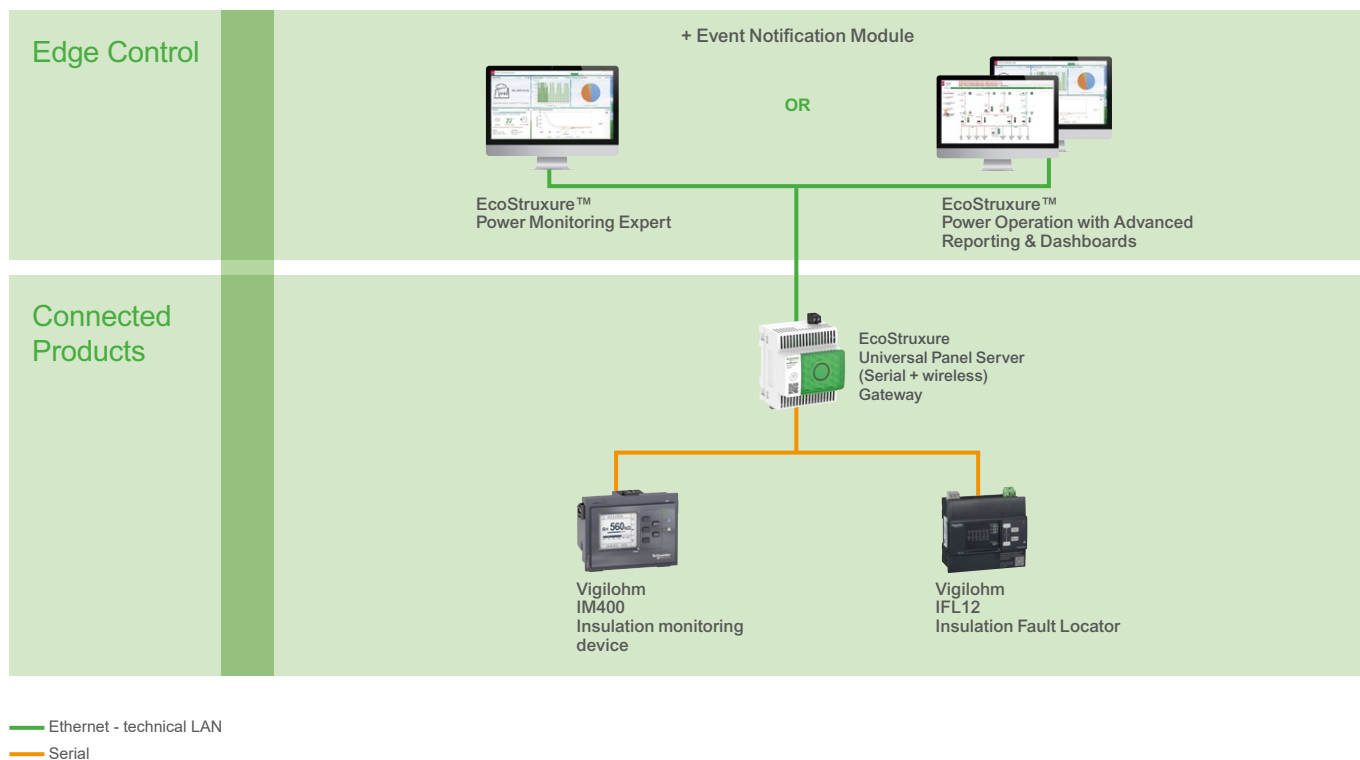
** In non-healthcare applications, the IM400 can be used (e.g., Marine, Industrial)

> INSULATION MONITORING

Digital Architecture - Industrial Applications

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

The recommended digital architecture for the Insulation Monitoring application is given below:

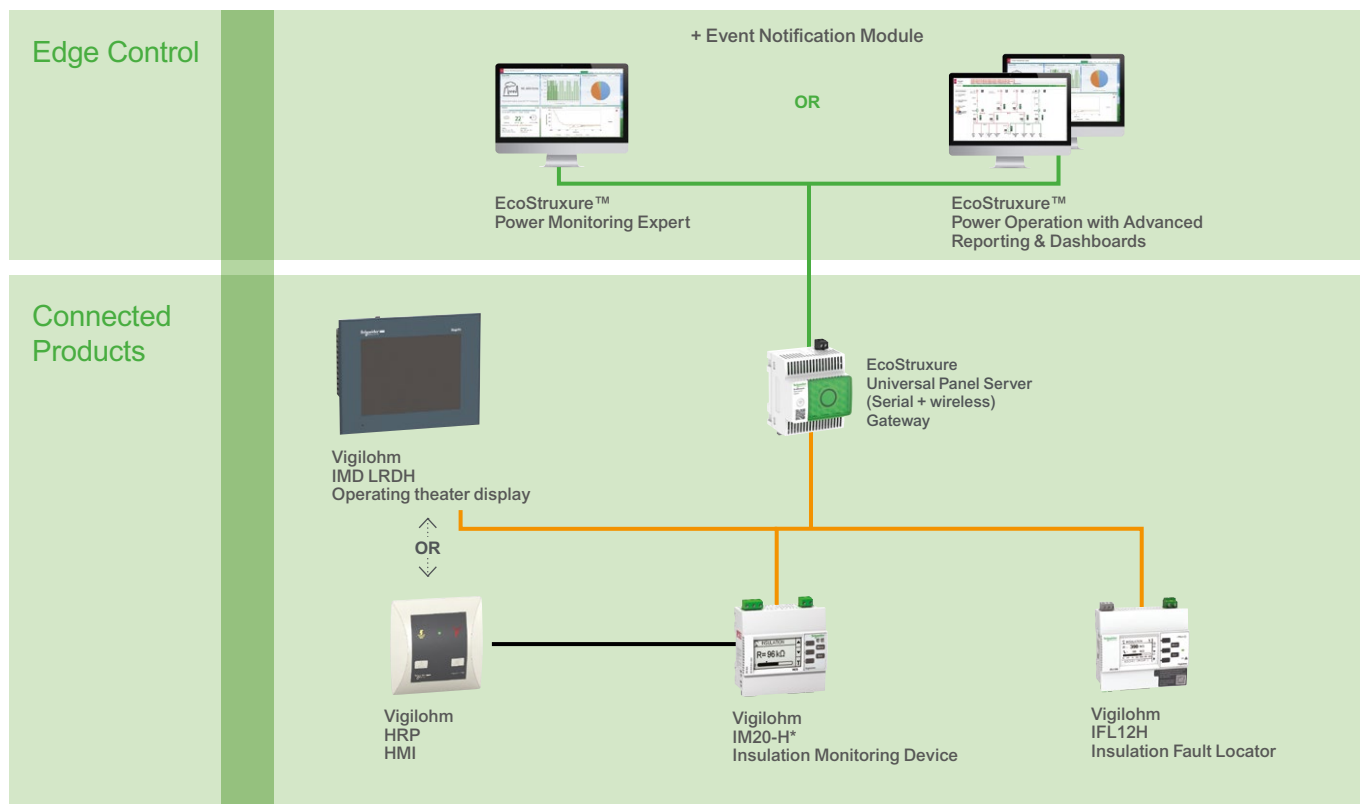


> INSULATION MONITORING

Digital Architecture - Healthcare Applications

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

The recommended digital architecture for the Insulation Monitoring application is given below:



> ELECTRICAL ASSET LIFE CYCLE MANAGEMENT

Streamline Electrical Asset Life Cycle Management to Improve Preventative Maintenance (1/2)

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 ELECTRICAL ASSET LIFE CYCLE MANAGEMENT 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

Plan Preventative Maintenance

- 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

Easily Manage Maintenance with 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



Switchboard with QR Code on Front Face



Maintenance Status and Location at a Glance

> ELECTRICAL ASSET LIFE CYCLE MANAGEMENT

Streamline Electrical Asset Life Cycle Management to Improve Preventative Maintenance (2/2)

Application Outcomes

Dashboards

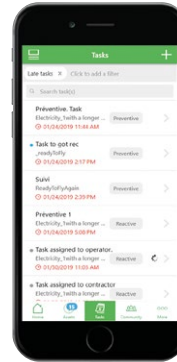
- Asset location map
- Overview of asset status
- Summary of team maintenance task status (late, upcoming)

Reports

- Editing and automatic storage of maintenance reports and asset information
- Log of maintenance tasks per asset with late/upcoming maintenance task due dates

Notifications

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



EcoStruxure™ Facility Expert Maintenance Task List

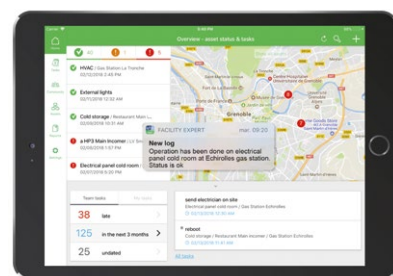
ASSETS SYNTHESIS
from 01/01/2018 to 12/31/2018

HP Site Eybens
Logs over the period

Asset	Log description	Date	Status	Duration
HP Site Eybens				
LV Smart Panel Main HP2	Tip Potential cause is overload	01/28/2018	🔴	-
Heat Pump feeder	Tip has been fixed	01/29/2018	🟢	01:00
	Check CB	03/09/2018	🟢	01:00
	Go on site to fix fault	09/12/2018	🟢	-
	Check load	11/12/2018	🟢	00:15
	Check amp rating	11/13/2018	🟢	-
	Check Heat Pump	11/13/2018	🟢	00:45
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	🟢	01:00
	Basic maintenance - Auxiliaries	01/28/2018	🟢	-
	Basic maintenance - Breaking unit	01/28/2018	🟢	00:30
	Basic maintenance - Chassis	01/28/2018	🟢	-
	Advanced maintenance - Breaking unit	01/28/2018	🟢	00:15
	Advanced maintenance - Control unit	01/28/2018	🟢	02:00
	Advanced maintenance - Power connection	01/28/2018	🟢	00:15

Summary report from 01/01/2018 to 12/31/2018
Generated by Schneider Electric on 02/02/2019 - Facility Expert

Asset Maintenance Report



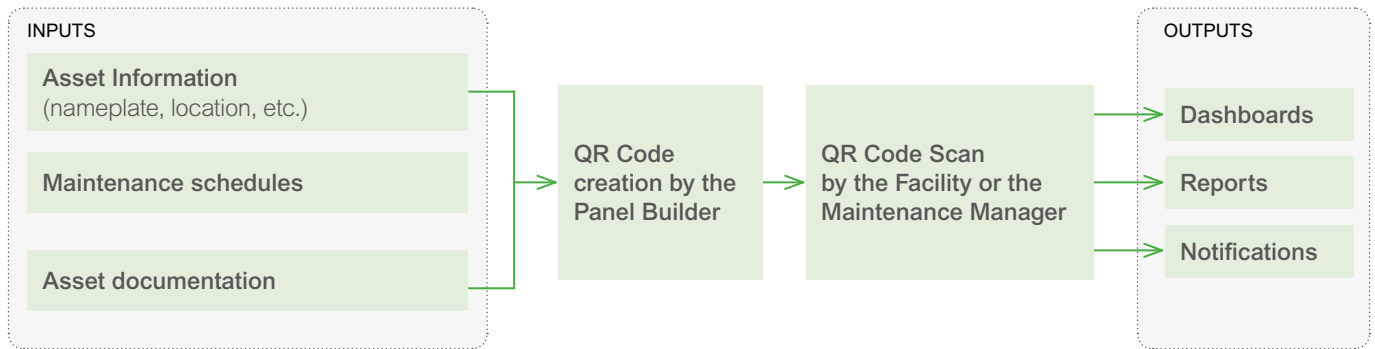
EcoStruxure™ Facility Expert Maintenance Notifications

> ELECTRICAL ASSET LIFE CYCLE MANAGEMENT

System Description (1/2)

Data Flow

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



Data Flow in Detail

INPUTS

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

Asset Information and Maintenance Schedules

- 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 switchgear (PremSet, SM6, PIX) and low voltage panels (PrismaSeT, Okken), motor control centers, circuit breakers such as MasterPacT MTZ, ComPacT NSX and Acti9 iC60, power factor correction devices such as VarSet Smart, harmonic filters like AccuSine, Trihal transformers, etc.
- For non-native equipment, templates can be created in EcoStruxure™ Facility Expert

Asset Documentation

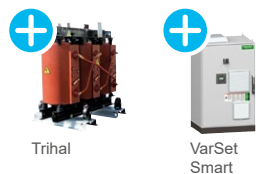
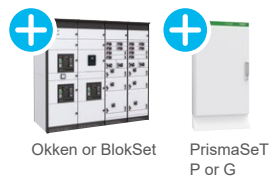
Asset documentation produced during panel construction can be attached to a defined electrical asset. This documentation may include wiring diagrams, single-line diagrams, user documentation, bill of materials, device serial numbers and more. Documentation is stored digitally, accessible through the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

QR CODE CREATION BY THE PANEL BUILDER

A QR code is produced through a process of installation and commissioning of electrical assets by the panel builder using EcoStruxure™ Power Commission.

QR CODE SCAN BY FACILITY OR MAINTENANCE MANAGER

The QR code link for a given asset gives access to its associated documentation and to the maintenance requirements and schedules. This simplifies utilisation and maintenance of the equipment throughout its operational life cycle.



EcoStruxure™ Power Commission



Equipment QR Code

ELECTRICAL ASSET LIFE CYCLE MANAGEMENT

System Description (2/2)

Data Flow in Detail (cont.)

OUTPUTS

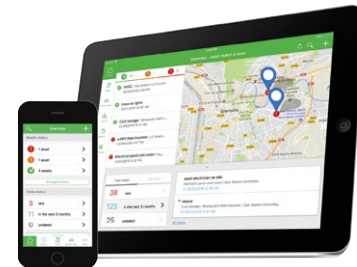
Outputs are displayed remotely via EcoStruxure™ Facility Expert software.

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...), 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, maintenance contributors
- visualization of all late or upcoming maintenance tasks

Asset	Log description	Date	Status	Duration
HP Site Eybens				
Logs over the period				
LV Busbar Panel M403	Trip Potential Close is overvoltage	01/28/2018	●	-
Heat Pump Heater	Trip has been fixed	01/29/2018	●	01000
	Check CB	03/09/2018	●	01000
	Go on site to fix issue	09/11/2018	●	-
	Check load	11/13/2018	●	00015
	Check amp rating	11/13/2018	●	-
	Check Heat Pump	11/13/2018	●	00045
Zone C feeder	Advanced maintenance - Auth-series	01/15/2018	●	-
	Basic maintenance - Breaking unit	01/15/2018	●	-
	Advanced maintenance - Chassis	01/26/2018	●	01000
	Basic maintenance - Auxiliaries	01/26/2018	●	-
	Basic maintenance - Breaking unit	01/26/2018	●	00030
	Basic maintenance - Chassis	01/26/2018	●	-
	Advanced maintenance - Breaking unit	01/26/2018	●	00015
	Advanced maintenance - Control unit	01/26/2018	●	02000
	Advanced maintenance - Power connection	01/26/2018	●	00015

EcoStruxure™ Facility Expert Maintenance Report

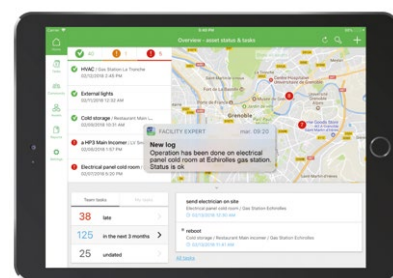
Maintenance Plan

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

Notifications

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

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

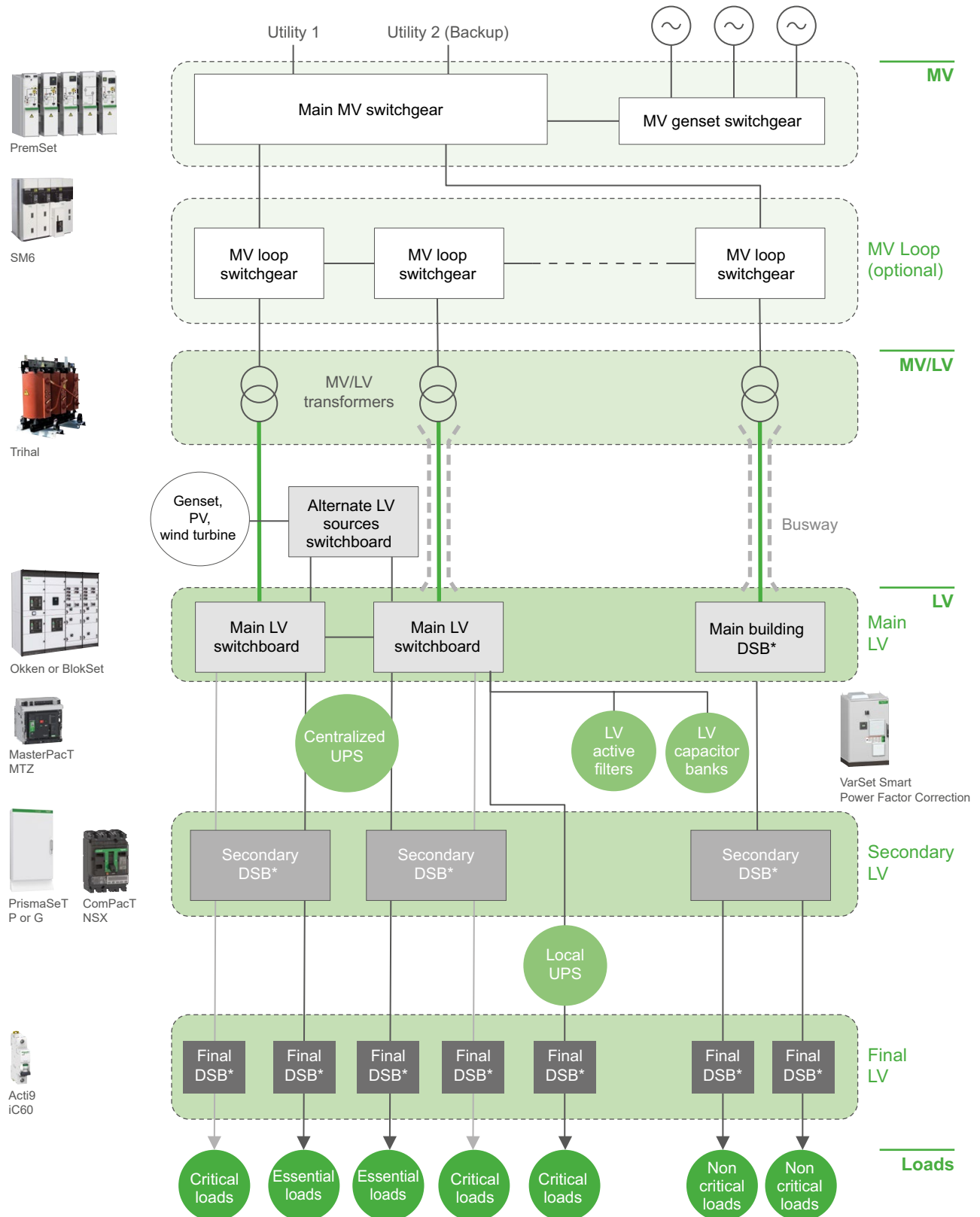


EcoStruxure™ Facility Expert Maintenance Notifications

ELECTRICAL ASSET LIFE CYCLE MANAGEMENT

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

The diagram illustrates the EcoStruxure™ Facility Expert workflow for commissioning Schneider Electric products. It is divided into two main sections: **Edge Control** and **Connected Products**.

Edge Control: This section includes a tablet displaying the EcoStruxure™ Facility Expert interface and a smartphone showing a QR code. A blue line connects the tablet to the smartphone, indicating data flow.

Connected Products: This section is divided into two main categories of products, each with a QR code for identification:

- Panels:**
 - PremSet SSIS medium voltage modular switchgear
 - SM6 Medium voltage modular switchgear
 - Trihal Medium voltage transformer
 - Okken or Blokset Power distribution switchboard
 - Prisma SeT P or G Low voltage system
 - VarSet Smart Capacitor bank
- Electrical Distribution Products:**
 - MasterPacT MTZ Circuit breaker
 - ComPacT NSX Circuit breaker
 - Acti9 iC60 Miniature circuit breaker
 - And many other Schneider Electric products with a QR code

The workflow process is as follows:

- QR Code Scan:** A smartphone scans the QR code on a product.
- QR Code Generation / Print:** The EcoStruxure™ Power Commissioning interface (a computer monitor) generates and prints a QR code.
- QR Code Scan:** The smartphone scans the QR code generated by the Power Commissioning interface.
- Edge Control:** The EcoStruxure™ Facility Expert interface (a tablet) receives data from the smartphone, completing the commissioning process.



> ASSET PERFORMANCE

Benefit from Strategic Maintenance Approach for Critical Assets (1/2)

Context of Application

In the past, equipment maintenance for circuit breakers, UPSs, motors, etc. was performed using a preventative approach. This means circuit breakers were serviced periodically, typically every 1 to 2 years.

By leveraging asset diagnostics data, preventive and condition-based maintenance models can help inform maintenance planning to reduce risk of early degradation, optimize maintenance activities and optimize maintenance related spending.

PROBLEM TO SOLVE

The Facility Manager Needs to:

- Move from reactive or preventative to condition-based (predictive) maintenance strategies for critical assets like circuit breakers, gensets, transformers, etc.
- Gain an insight 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 ASSET PERFORMANCE APPLICATION

Aggregate and Analyze Asset Health Data

- At Edge Control level: LV circuit breakers and UPSs, generator battery, Power Quality equipment
- Within Asset Advisor: MV/LV circuit breakers, MV/LV transformers (Dry/oil-immersed), Variable Speed Drives and connected motors

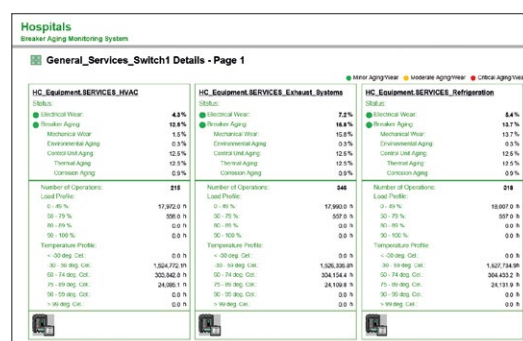
Using the connectivity of **EcoStruxure™ Power** and the wealth of data from connected assets, we are offering a condition-based, predictive approach, with real benefits for Facility Managers:

- Visibility of asset health across the entire system
- Continuous asset health monitoring streamlines inspections
- Analytics and expert advisory helps optimize maintenance planning

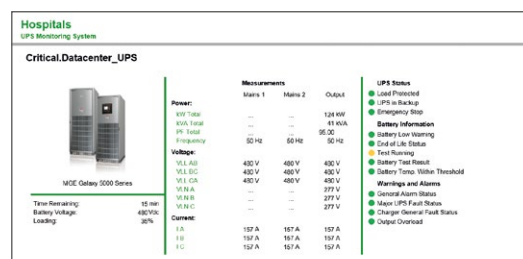
Application Outcomes

Live Data Display

- Circuit breaker asset monitoring diagram (% of electrical and mechanical wear, % of environmental and control unit aging, number of operations, load and temperature profiles)
- UPS monitoring diagrams (measurements, UPS status, battery information, pre-alarms and alarms)
- Power Quality mitigation equipment, generator status diagrams



Aging Diagram for Circuit Breakers



UPS Monitoring Diagram

> ASSET PERFORMANCE

Benefit from Strategic Maintenance Approach for Critical Assets (2/2)

Application Outcomes (cont.)

Reports

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

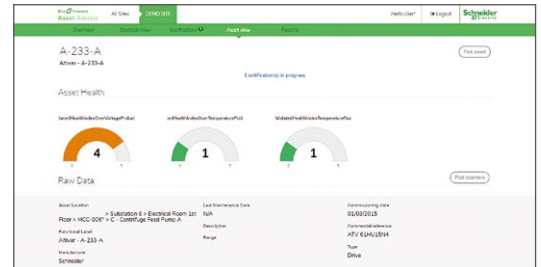
These reports provide the right information to help decide when to maintain circuit breakers, UPSs and generator start batteries.

Cloud-based Analytics Services

- Remote notifications in the event of electrical asset condition anomalies
- Predictive analytics to determine equipment remaining lifetime and other health indicators
- Asset matrix to visualize asset health risks
- Pro-active asset maintenance optimization support by Schneider Electric Service Bureau

Digital Logbook

For entry-level digital repository of asset documentation, preventative maintenance schedules, etc.



EcoStruxure™ Asset Advisor Asset Health Dashboard



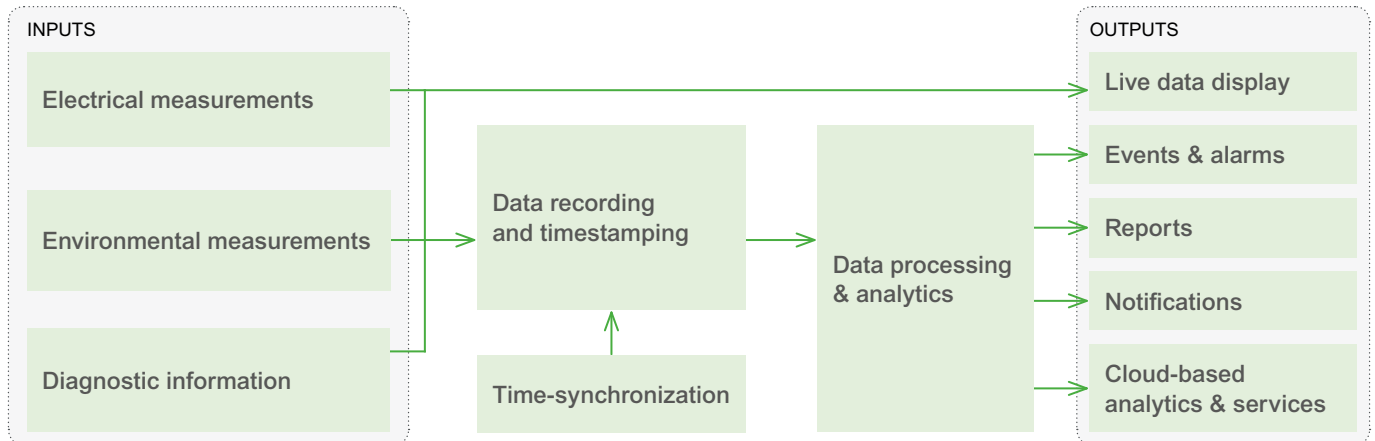
EcoStruxure™ Asset Advisor Risk Level Dashboard

> ASSET PERFORMANCE

System Description (1/4)

Data Flow

The Asset Performance application can be broken down as follows:



Data Flow in Detail

INPUTS

Asset Performance covers the following equipment types:

- 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

The following data is required:

Electrical Measurements

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

- Power meters (PowerLogic ION9000, PM8000)
- Protection devices such as Easergy P5 or P3, MasterPacT MTZ, ComPacT NSX
- UPS controller (Galaxy VX/VM/VS)
- Variable speed drive (Altivar ATV 61/71)

Examples of electrical measurements are as follows*:

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

Environmental Measurements

Environmental measurements are provided by the Easergy TH110 temperature and Easergy CL110 temperature & humidity sensors (associated with a Substation Monitoring Device - SMD - for MV switchgear and LV switchboards).

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

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



Product, Software and Services: See page 229

> ASSET PERFORMANCE

System Description (2/4)

Data Flow in Detail (cont.)

Diagnostic Information

Diagnostics data is provided by each of the connected products mentioned previously. It includes*:

- Contact wear
- Number of operations: trip, draw out
- Time for operation: tripping, charging...
- Output velocity and torque
- Drive thermal status

DATA RECORDING AND TIMESTAMPING

For advanced connected products such as the PowerLogic ION9000, PM8000, MasterPacT MTZ, Easergy P5/P3, the aforementioned data is recorded and timestamped on board.

For other connected products or third-party devices, data recording and timestamping is performed by the Edge Control software (EcoStruxure™ Power Monitoring Expert), by EcoStruxure™ Asset Advisor or by a cloud gateway** when directly associated with EcoStruxure™ Asset Advisor.

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

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)

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...). An external master clock may be required and connected to a GPS antenna to reach the expected time precision.

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 with Advanced Reporting & Dashboards for on-premise, self-serve reporting (e.g., low voltage circuit breakers, UPS, generator batteries).

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.



EcoStruxure™ Panel Server



TimeSync Clock



EcoStruxure™ Power Monitoring Expert



EcoStruxure™ Power Operation with Advanced Reporting & Dashboards

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

** Enerlin'X Com'X or future model of the EcoStruxure™ Panel Server

> ASSET PERFORMANCE

System Description (3/4)

Data Flow in Detail (cont.)

DATA PROCESSING (cont.)

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 & Alarming	Simple Asset Health Analytics	Advanced Asset Health Analytics & 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

Live Data Display

Live diagnostics data from monitored equipment can be displayed if Edge Control Software (EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards) is in the architecture.

Events & Alarms

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

Notifications*

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

- Simple diagnostics notifications based on data from supported connected products in 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
- Pro-active/Predictive analytics alerts and recommendations with EcoStruxure™ Asset Advisor Predictive for Schneider Electric MV/LV equipment and third-party equipment



EcoStruxure™
Power Monitoring Expert



EcoStruxure™
Power Operation with Advanced
Reporting & Dashboards

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

System Description (4/4)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Reports

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

It includes:

Low Voltage Circuit Breaker Aging Report*

The Circuit Breaker Aging Report shows the status of circuit breaker aging and wear in your electrical system.

The following IEC 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)

UPS and Generator Battery Health**

Reporting for assets such as generators, generator batteries and UPSs can be found in the [Backup Power Testing Application section \(page 97\)](#).

Cloud-Based Analytics & Services

EcoStruxure™ Asset Advisor cloud-based analytics and services provide asset health analytics to interpret the status and history of critical assets with preventive notifications and 24/7 support. EcoStruxure™ Asset Advisor can also provide complete predictive analytics with condition-based, pro-active recommendations.

Asset performance services include:

- Web portal and mobile app
- Customized reports on asset health condition
- 24/7 remote Connected Service Hub
- Pro-active expert Connected Service Hub recommendations
- Capital expense (Capex) vs. operating expense (Opex) recommendations to manage asset maintenance and end of life



Circuit Breaker Agency Summary

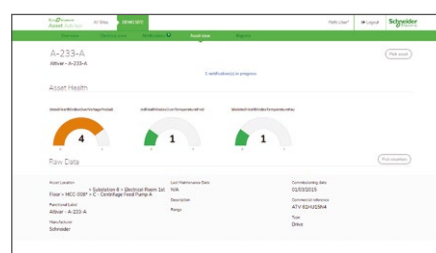
3/23/2018

Breaker Agency Summary					
Switchboard	Level	Breaker Name	Electrical Age (%)	Electrical Value (%)	
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	46.3	
		Breaker A9	42.5	66.8	
		Breaker A10	6.3	89.1	
		Breaker A11	2.3	79.3	
		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	92.1	93.9	
		Breaker A17	81.4	13.6	
		Breaker A18	19.7	53.5	
		Breaker A21	86.6	3.4	
		Breaker A22	55.9	41.0	
		Breaker A24	6.1	93.5	
		Breaker A25	47.0	81.1	
		Breaker A26	98.6	30.4	
		Breaker A27	11.9	72.4	
Switchboard A2	Critical	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	79.2	60.9	
		Breaker A34	31.4	59.6	
		Breaker A35	54.8	84.7	
		Breaker A36	28.4	99.5	
Switchboard A3	Critical	Breaker A37	36.0	59.1	
		Breaker A38	36.0	59.1	

Low Voltage Circuit Breaker Aging Report



EcoStruxure™ Asset Advisor Web Portal



EcoStruxure™ Asset Advisor Asset Health Dashboard

* Requires the Breaker Performance Module in EcoStruxure™ Power Monitoring Expert and Power Operation with Advanced Reporting & Dashboards

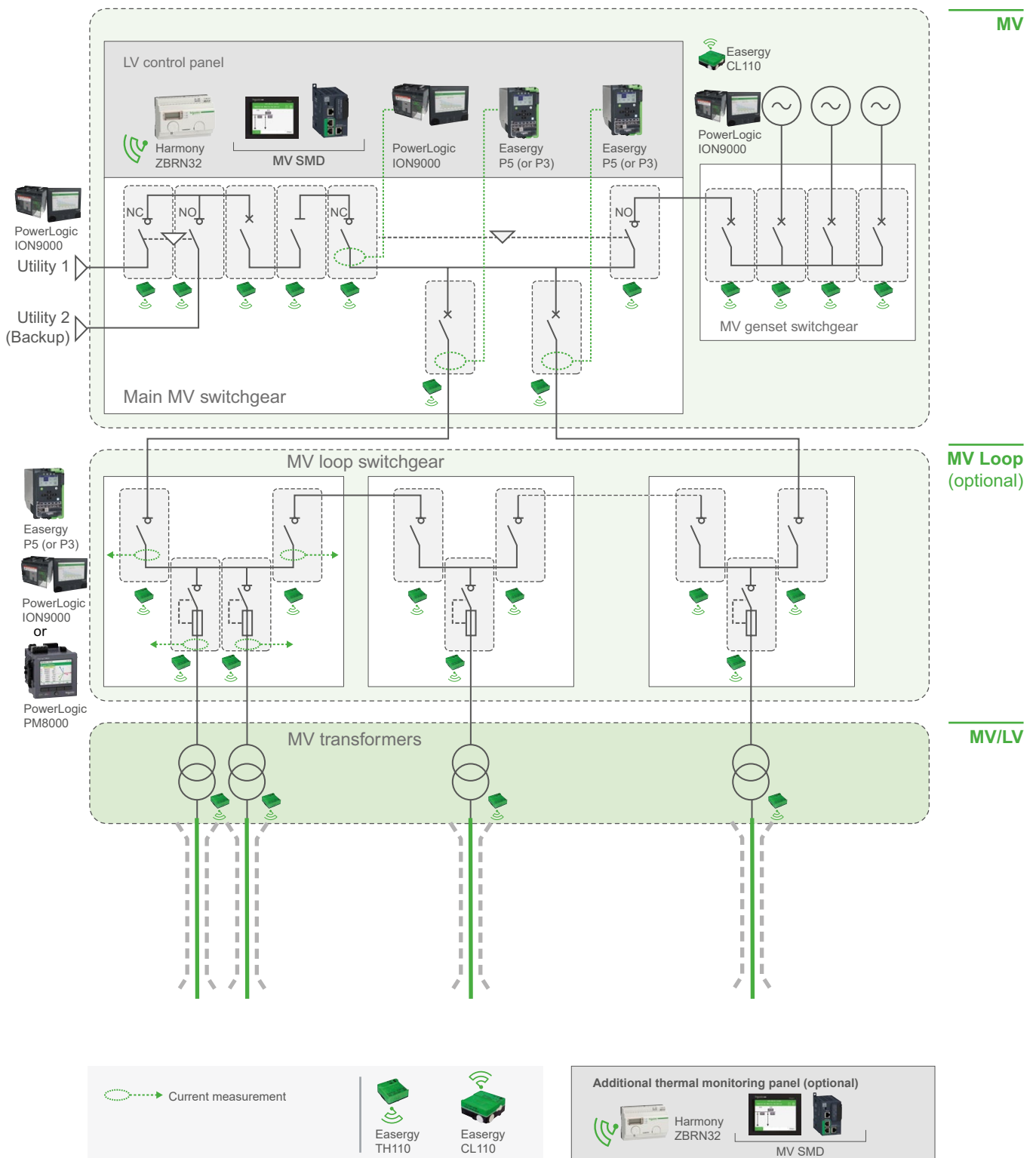
** Requires the Backup Power Module in EcoStruxure™ Power Monitoring Expert and Power Operation with Advanced Reporting & Dashboards

> ASSET PERFORMANCE

Electrical Architecture (1/2)

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.

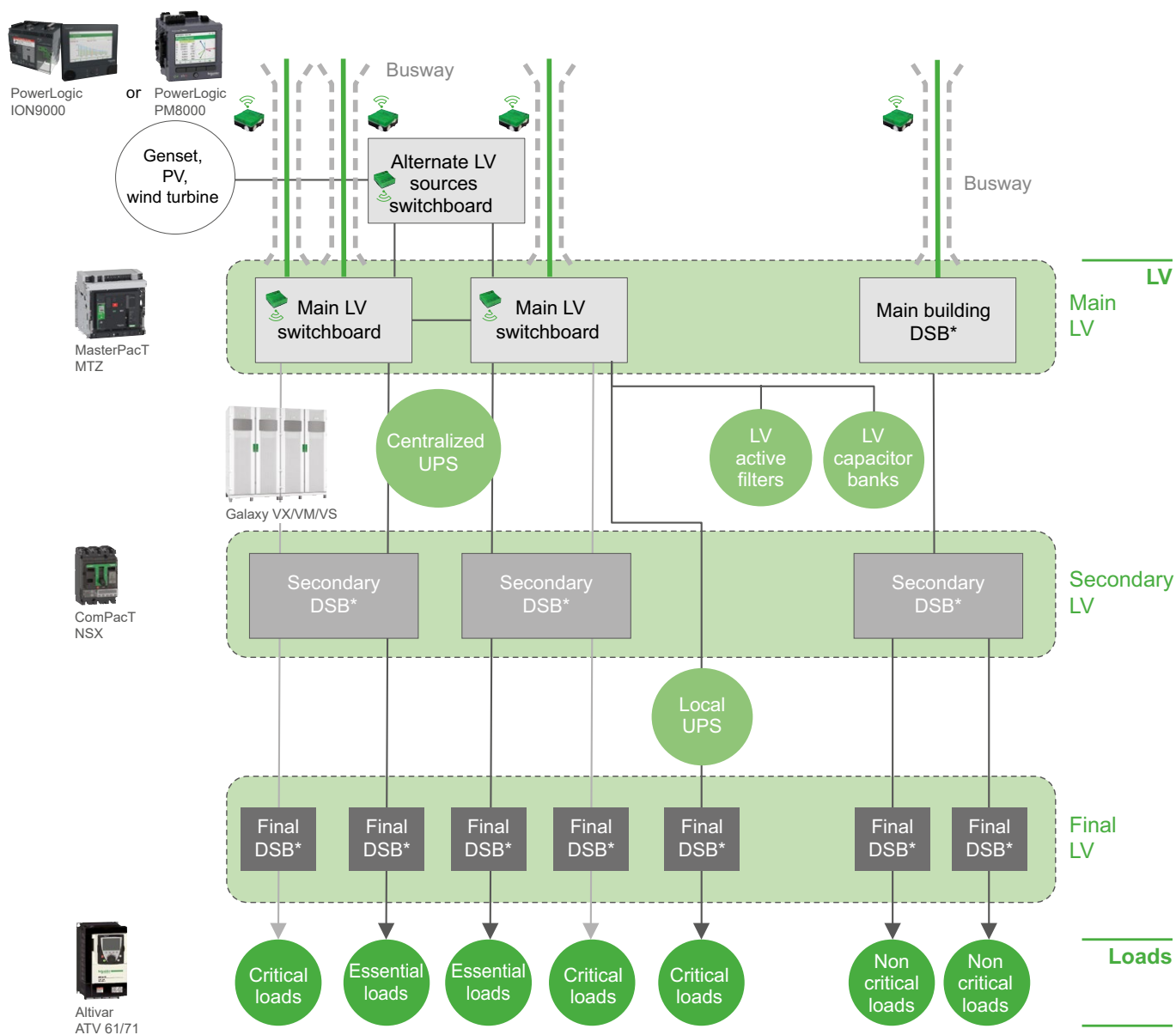
Upper Part (MV) of the Electrical Architecture



> ASSET PERFORMANCE

Electrical Architecture (2/2)

Lower Part (LV) of the Electrical Architecture



* DSB = Distribution Switchboard

Easergy
TH110Easergy
CL110

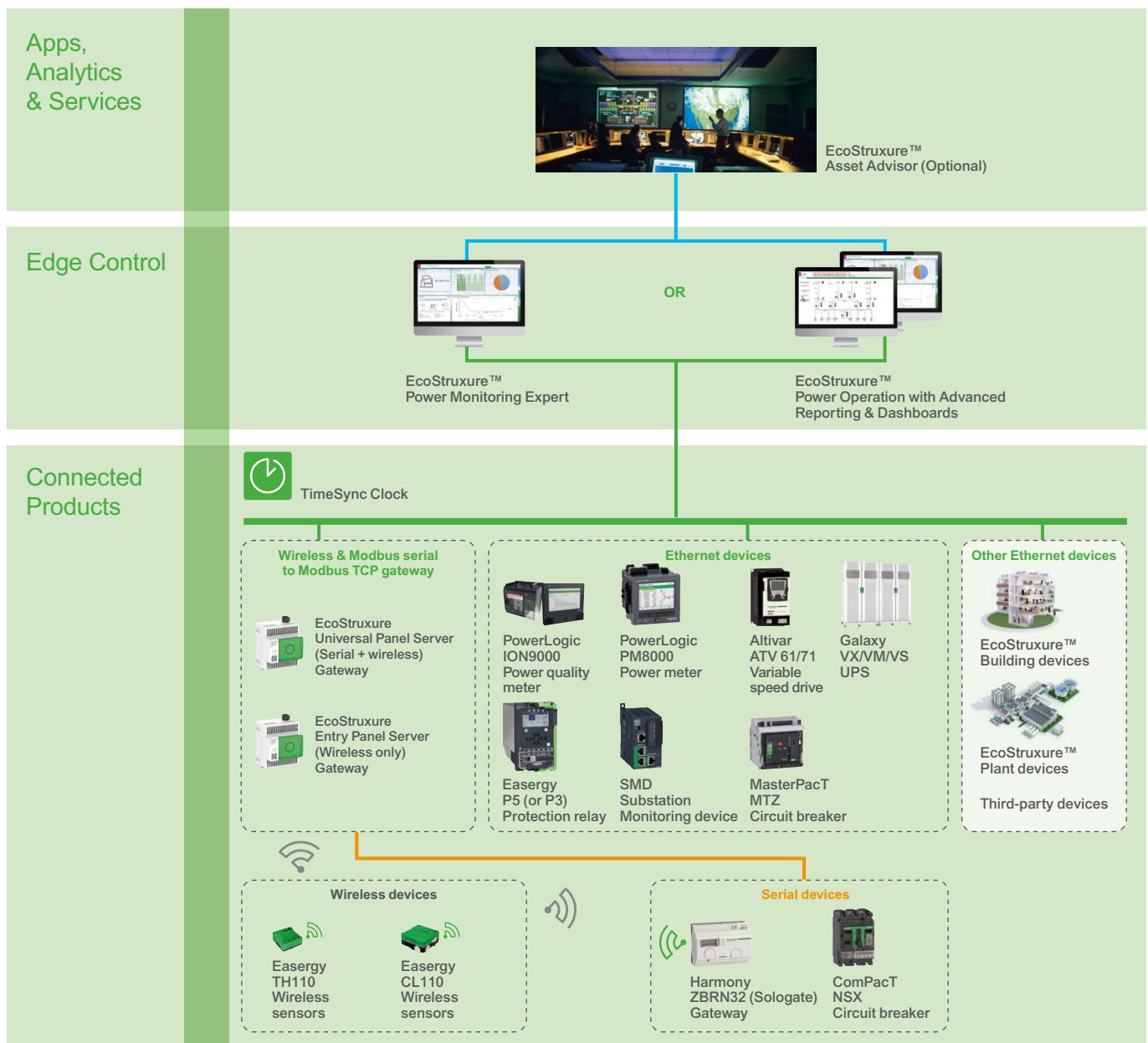
> ASSET PERFORMANCE

Digital Architecture (1/2)

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.

Optionally, as part of a connected service, data can be utilized with EcoStruxure™ Power Advisor for consultative reporting and advisory services from Schneider Electric service engineers.



Product, Software and Services: See page 229



> ASSET PERFORMANCE

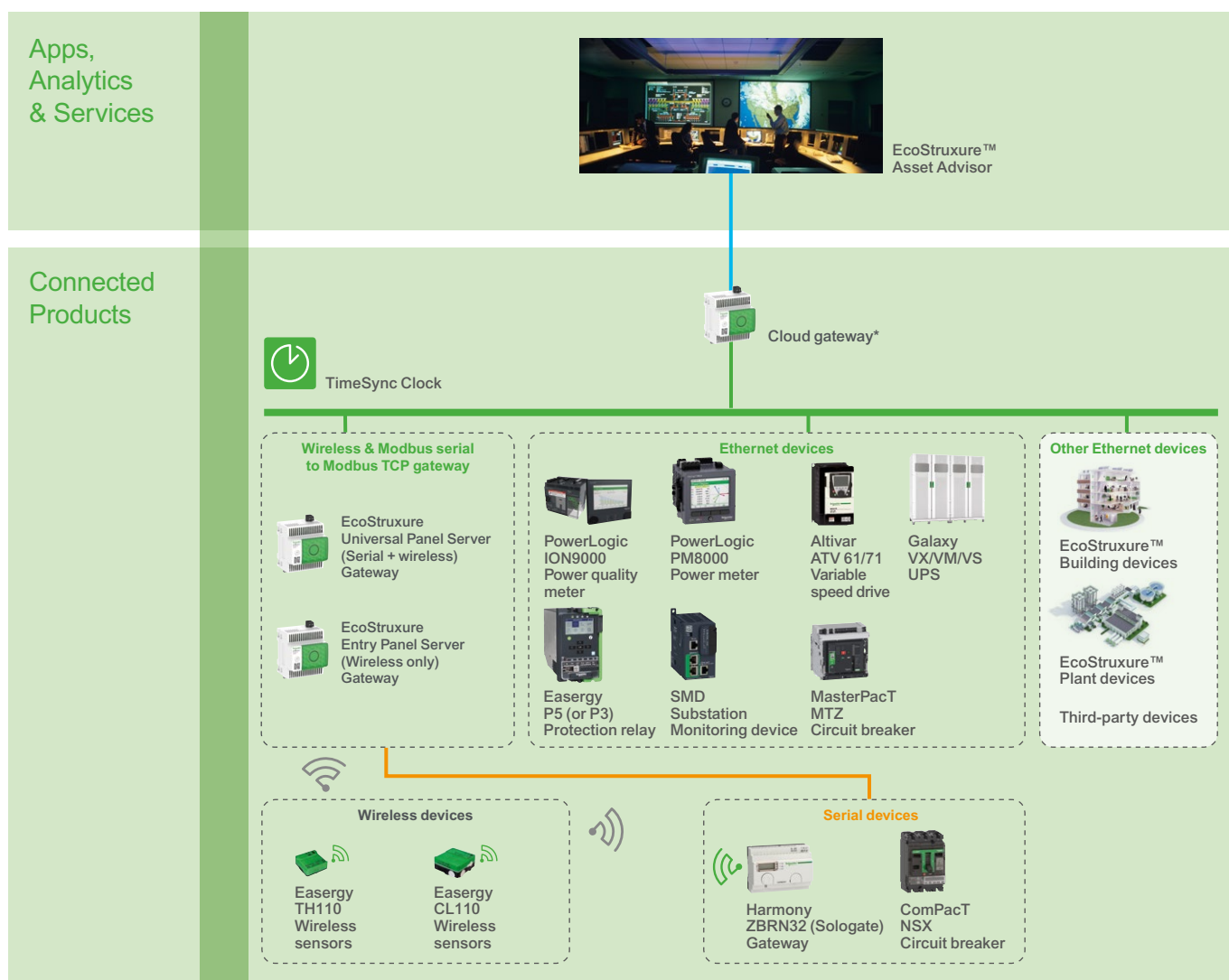
Digital Architecture (2/2)

With Connected Products and Remote Services

In this architecture, the data is collected from all connected products using a cloud gateway* and then passed on to EcoStruxure™ Asset Advisor.

As part of a connected service, data can be utilized with EcoStruxure™ Power Advisor for consultative reporting and advisory services from Schneider Electric service engineers.

The recommended digital architecture for this solution is given below:



* Enerlin'X Com'X or future model of the EcoStruxure™ Panel Server

> ELECTRICAL DISTRIBUTION MONITORING & ALARMING

Monitor Electrical Distribution Network and Be Alarmed in the Event of Failures (1/2)

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 failure has occurred, like we are used to with our 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 like breakers, UPSs, transformers, generators, etc.
- Know, analyze and understand where failures of the electrical distribution network come from

PURPOSE OF ELECTRICAL DISTRIBUTION MONITORING & ALARMING APPLICATION

Provide Realtime Status of the Electrical Distribution System

- Realtime 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 & 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 Intelligent Electrical Devices

For plug and play connectivity, and to provide rich contextual data that cannot be captured by BMS or generic SCADA applications.

1

2

3

4

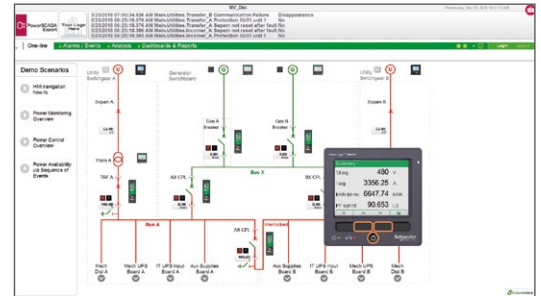
> ELECTRICAL DISTRIBUTION MONITORING & ALARMING

Monitor Electrical Distribution Network and Be Alarmed in the Event of Failures (2/2)

Application Outcomes

Live Data Display

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



Electrical Network Single-Line Diagram (with color animation)

Events & Alarms

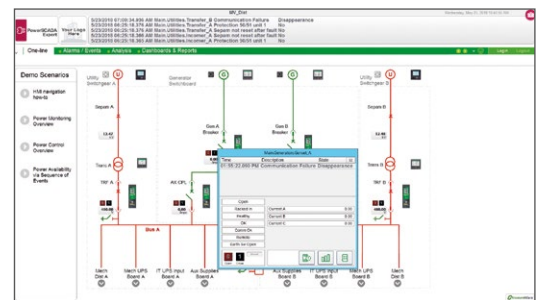
- Chronological display of events and alarms with sorting and filtering capabilities
- Intelligent alarm grouping into summary incidents

Trends

- Realtime and historical data can be viewed on a trend viewer

Dashboards

- Configurable dashboards for visualizing historical power system data



View of Device Data and Control

Reports

- Historical data reporting

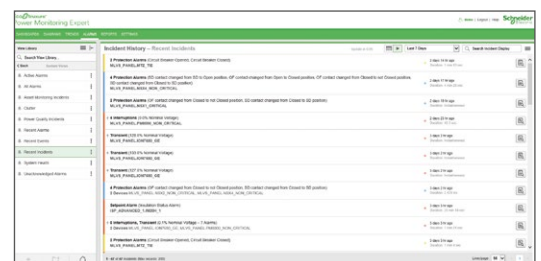
Notifications

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

Analysis Tools

Electrical Distribution Monitoring and Alarming provides an incident timeline with advanced functions:

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



Alarm Viewer - Recent Incidents



Power Events Incident Timeline

Cloud-Based Analytics & Services

As an option, EcoStruxure™ Power Advisor connected service can perform cloud-based analytics for electrical network health, with recommendations from expert service engineers.

BMS Integration

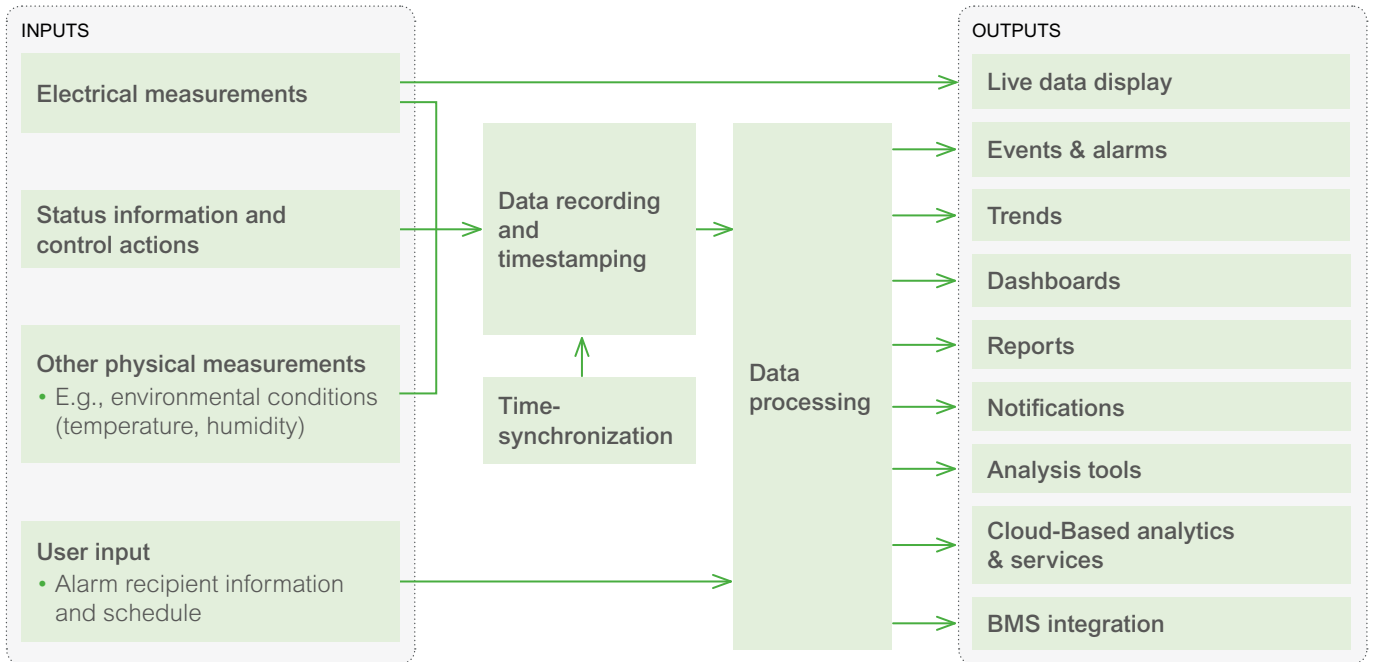
EcoStruxure Power enables integration of electrical data and alarms at the Edge Control layer with BMS software such as EcoStruxure Building Operation.

ELECTRICAL DISTRIBUTION MONITORING & ALARMING

System Description (1/6)

Data Flow

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



Data Flow in Detail

INPUTS

The Electrical Distribution Monitoring & 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:

- Power meters (PowerLogic ION9000, PM8000, PM5000, HDPM6000, PowerTag, Acti9 iEM3000, etc.)
- Protection devices such as Easergy P5 or P3, MasterPacT MTZ, ComPacT NSX (including its wireless auxiliary contact), Acti9 Active
- or other equipment such as UPS (Galaxy VX/VM/VS), ATS controller (Easergy T300), Power Correction equipment (AccuSine PCS+/PCSn/PFV+, VarSet Smart with VarPlus Logic controller)
- Other equipment (see comment below)

Comment: EcoStruxure™ Power Monitoring Expert and Power Operation offer native support for a wide range of connected products as well as support for open protocols for communication with third-party equipment.



Product, Software and Services: See page 229



> ELECTRICAL DISTRIBUTION MONITORING & ALARMING

System Description (2/6)

Data Flow in Detail (cont.)

INPUTS (cont.)

Electrical Measurements

The following electrical measurements are collected from connected products (realtime values, the minimum, maximum and average value):

- 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...) 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 relays include SMS and SMTP (Email).



EcoStruxure™
Power Monitoring Expert



EcoStruxure™
Power Operation with Advanced
Reporting & Dashboards

> ELECTRICAL DISTRIBUTION MONITORING & ALARMING

System Description (3/6)

Data Flow in Detail (cont.)

DATA RECORDING AND TIMESTAMPING

For the Electrical Distribution Monitoring & 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 onboard: PowerLogic ION9000, PM8000 and some PowerLogic PM5000 models (PM53xx and PM55xx)
- Event data recorded and timestamped on board: Easergy P5, Easergy P3, MasterPacT MTZ, ComPacT NSX
- No onboard recording, realtime data only. Recording and timestamping is done by a data logger (Cyber Sciences SER 3200/2408) or software (EcoStruxure™ Power Monitoring Expert or Power Operation): entry-level PowerLogic PM5000 models, Acti9 Active, Acti9 iEM3000, PowerTag, UPS, AccuSine PCS+/PCSn/PFV+, VarSet Smart with VarPlus Logic controller and other equipment (including third party)

For the Electrical Distribution Monitoring & Alarming application, a time accuracy of ± 10 ms 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 the chart 2.2 in Section 1, page 15.](#)

TIME-SYNCHRONIZATION

For systemwide electrical distribution monitoring & alarming, 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 through various technologies (PTP, NTP, SNTP etc.). An external master clock may be required and may be connected to a GPS antenna to reach the expected time precision.

DATA PROCESSING

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

Data processing is performed by EcoStruxure™ Power Monitoring Expert or Power Operation, or on board some sophisticated devices.



TimeSync Clock

ELECTRICAL DISTRIBUTION MONITORING & ALARMING

System Description (4/6)

Data Flow in Detail (cont.)

OUTPUTS

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) in various forms such as:

- Digital single-line diagrams, with realtime animation of the status of the electrical network
- Realtime electrical data and equipment status

Detailed Diagrams

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

Events & Alarms

Event Log Viewers

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

Chronological views include:

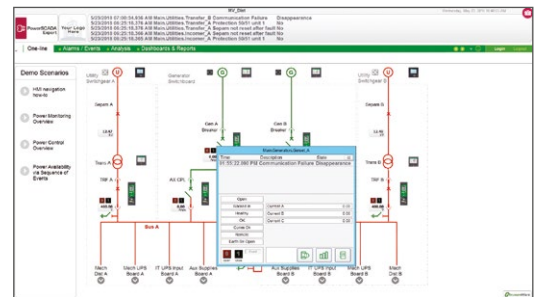
- All alarms and events, acknowledged or unacknowledged alarms, summary alarms or incidents
- High speed and high precision sequence of events to quickly locate the source of a power outage
- Traceability of user control actions with operator name and timestamp

Smart Alarming

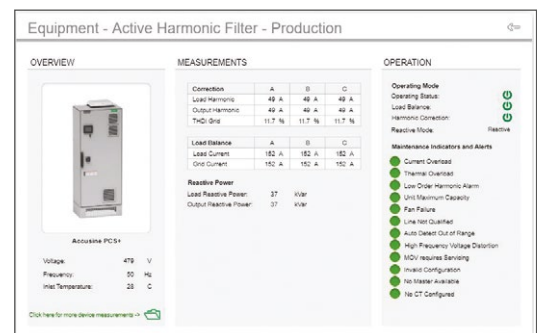
Alarm or events can be intelligently grouped to be displayed as incidents and reduce the overall number of alarms in the viewer. Further analysis can be done through drill down into specific events ([refer to Power Events Analysis Application page 107](#)).

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

- Asset Monitoring
- Power Quality
- System health (diagnostics)
- Etc.



Animated Single-Line Diagram with dynamic colorization in EcoStruxure™ Power Operation



Device Diagram in EcoStruxure™ Power Monitoring Expert

ID	Name	Type	Status	Acknowledgment	Date/Time
1	High Voltage	High Voltage	High Voltage	Acknowledgment	2023-10-27 10:00:00
2	Low Voltage	Low Voltage	Low Voltage	Acknowledgment	2023-10-27 10:00:00
3	High Temperature	High Temperature	High Temperature	Acknowledgment	2023-10-27 10:00:00
4	Low Temperature	Low Temperature	Low Temperature	Acknowledgment	2023-10-27 10:00:00
5	High Current	High Current	High Current	Acknowledgment	2023-10-27 10:00:00
6	Low Current	Low Current	Low Current	Acknowledgment	2023-10-27 10:00:00
7	High Frequency	High Frequency	High Frequency	Acknowledgment	2023-10-27 10:00:00
8	Low Frequency	Low Frequency	Low Frequency	Acknowledgment	2023-10-27 10:00:00
9	High Power	High Power	High Power	Acknowledgment	2023-10-27 10:00:00
10	Low Power	Low Power	Low Power	Acknowledgment	2023-10-27 10:00:00

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

ELECTRICAL DISTRIBUTION MONITORING & ALARMING

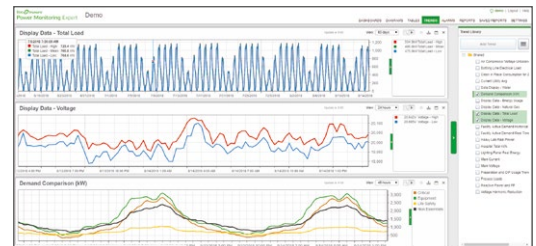
System Description (5/6)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Trends

Historical and realtime 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.



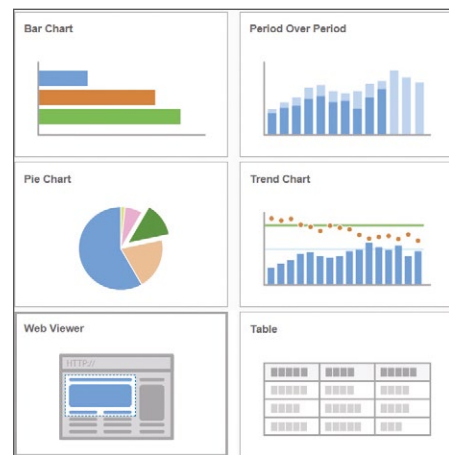
RealTime trending in EcoStruxure™ Power Monitoring Expert

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 with Advanced Reporting & Dashboards:

- Bar chart
- Trend chart
- Grid (table)
- Pie chart
- Period over period

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



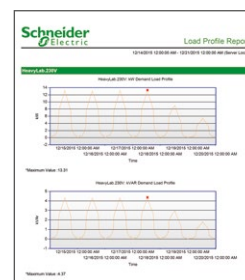
Dashboards

Reports

In addition to specialized reports, numerous general reports are available by default in Power Monitoring Expert or with the Advanced Reporting & Dashboards Module of Power Operation based on historical electrical values or event data. These reports can be generated on-demand or automatically, and sent via e-mail 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 ID	Event Name	Priority	Severity	Location	Timestamp	Message
1	Power Loss	High	Critical	Power House	2012-01-01 10:00:00	Power loss detected at Power House.
2	Power Loss	High	Critical	Power House	2012-01-01 10:00:00	Power loss detected at Power House.
3	Power Loss	High	Critical	Power House	2012-01-01 10:00:00	Power loss detected at Power House.
4	Power Loss	High	Critical	Power House	2012-01-01 10:00:00	Power loss detected at Power House.
5	Power Loss	High	Critical	Power House	2012-01-01 10:00:00	Power loss detected at Power House.
6	Power Loss	High	Critical	Power House	2012-01-01 10:00:00	Power loss detected at Power House.
7	Power Loss	High	Critical	Power House	2012-01-01 10:00:00	Power loss detected at Power House.
8	Power Loss	High	Critical	Power House	2012-01-01 10:00:00	Power loss detected at Power House.
9	Power Loss	High	Critical	Power House	2012-01-01 10:00:00	Power loss detected at Power House.
10	Power Loss	High	Critical	Power House	2012-01-01 10:00:00	Power loss detected at Power House.

Event History Report



Alarm Notifications

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 e-mail to configured recipients on user-defined schedules.

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

> ELECTRICAL DISTRIBUTION MONITORING & ALARMING

System Description (6/6)

Data Flow in Detail (cont.)

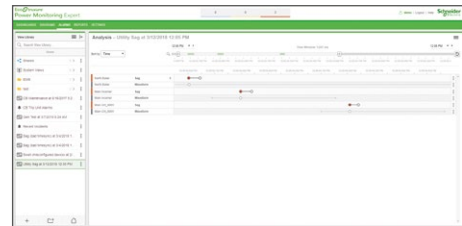
OUTPUTS (cont.)

Analysis Tools

Power Events Incident Timeline

This feature of EcoStruxure™ Power Monitoring Expert and Power Operation intelligently groups individual alarms and events 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 Events Analysis Application page 107](#)



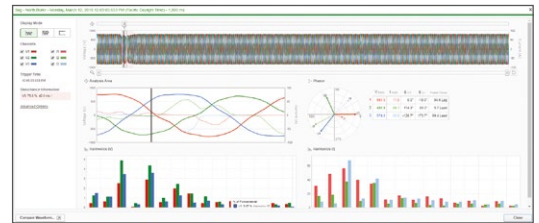
Power Events Incident Timeline

Waveform Viewer

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

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 & Services

As an option, EcoStruxure™ Power Advisor connected service can perform analytics based on historical data to provide insights and decision support. Issues and recommendations are shared with the user by a Schneider Electric service engineer on a periodic basis. Some of 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™ Power Advisor

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*) utility
- an HTML web page interface



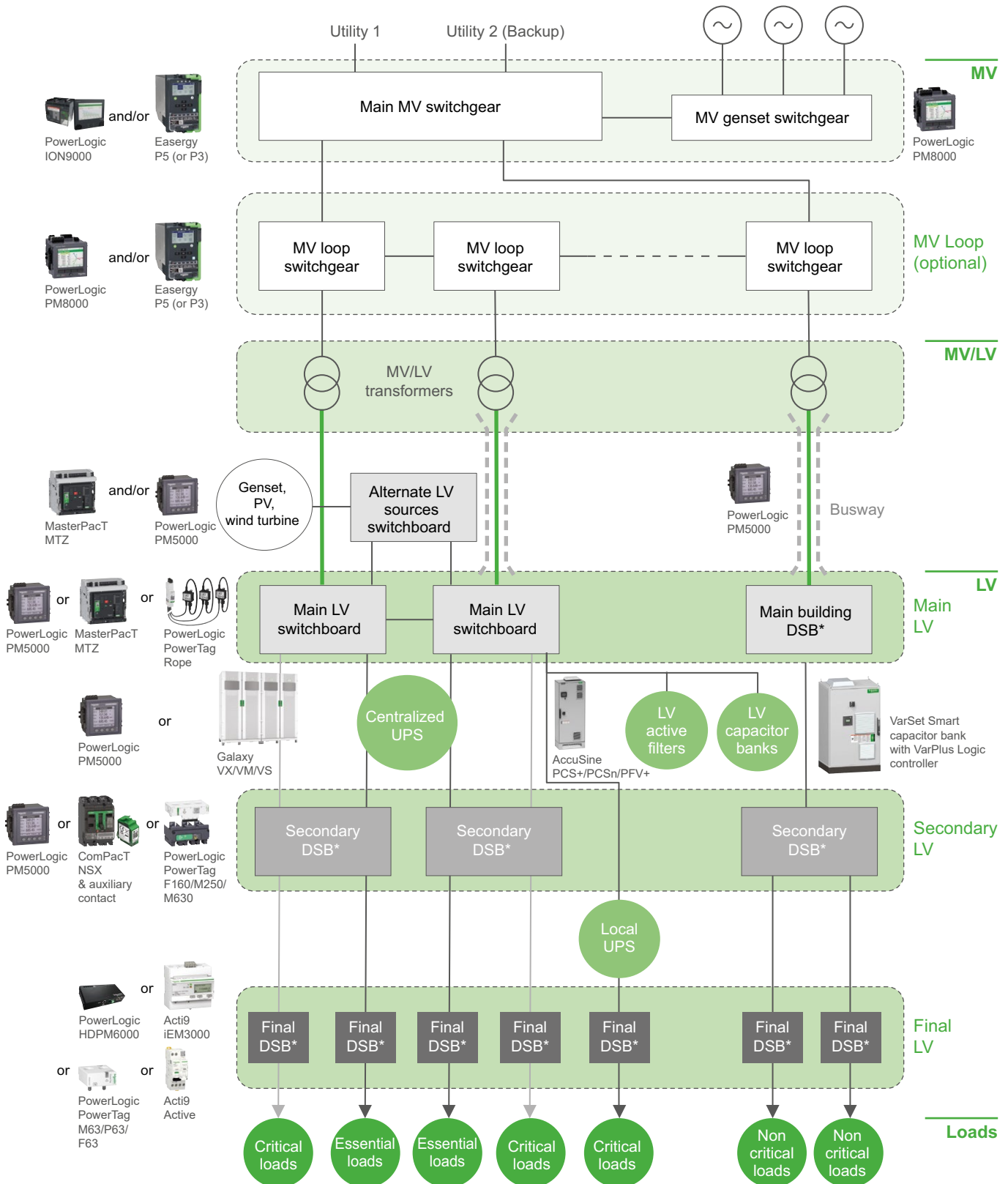
EcoStruxure™ Building Operation

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

ELECTRICAL DISTRIBUTION MONITORING & ALARMING

Electrical Architecture

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



> ELECTRICAL DISTRIBUTION MONITORING & ALARMING

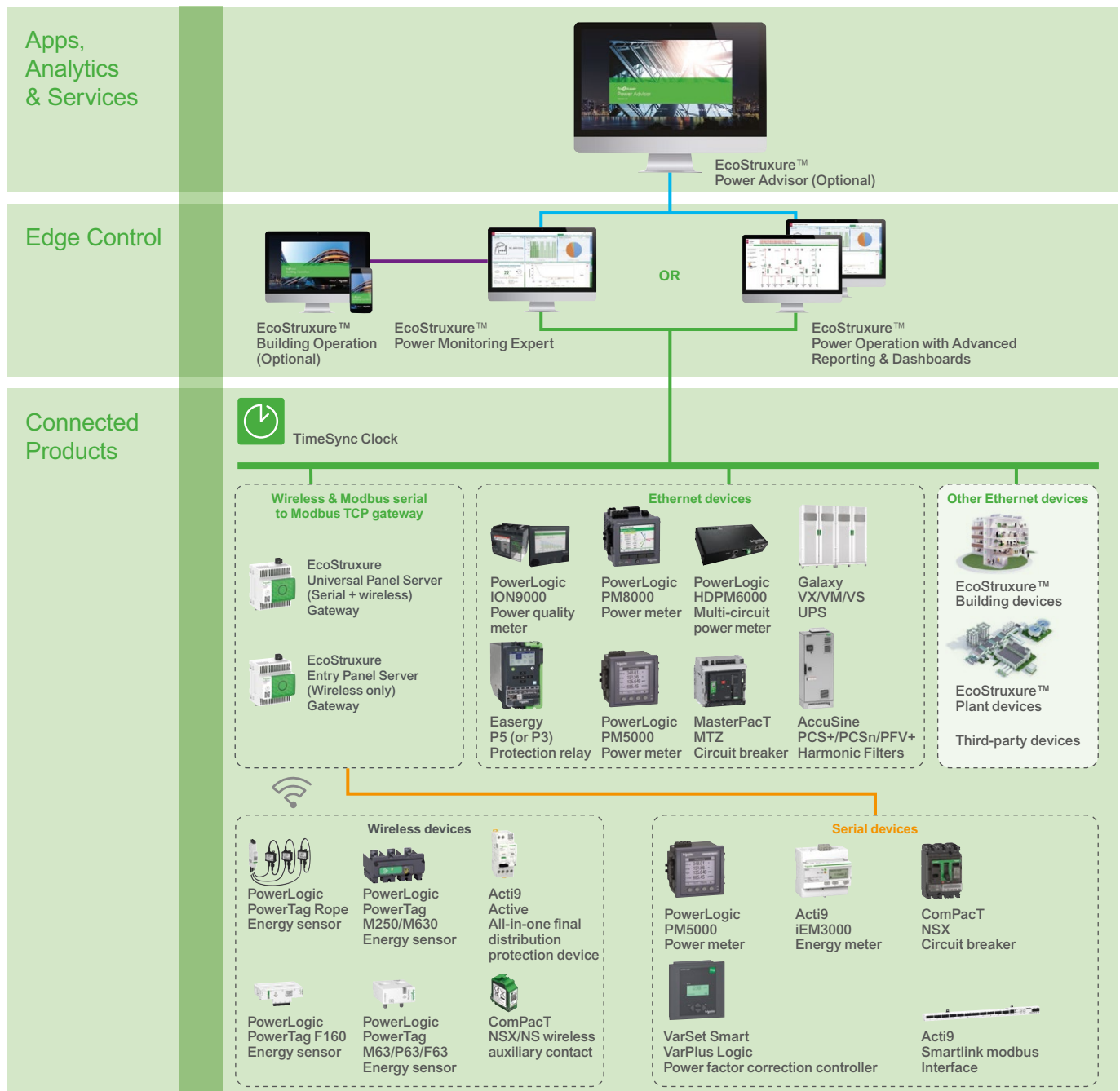
Digital Architecture

The digital architecture of the Electrical Distribution Monitoring & Alarming 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 (EcoStruxure™ Power Monitoring Expert or Power Operation) for on-premise 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™ Monitoring Expert or Power Operation.

Optionally, as part of a connected service, they can be utilized for analytics services with EcoStruxure™ Power Advisor for consultative recommendations from Schneider Electric service engineer.

The recommended digital architecture for the Electrical Distribution Monitoring & Alarming application is given below:



> CAPACITY MANAGEMENT

Help Prevent Business Disruption Due to Electrical Overload with Capacity Planning

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, old equipment is being upgraded...

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

This is a problem for circuit breakers, UPSs, generators, ATs, transformers, capacitor banks, bus bars, 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 Manager Needs to:

- Understand the capacity needs of the electrical distribution infrastructure supplying expansions or modifications of the facility environment
- Upgrade the facility while not exceeding the rated capacity of equipment, and mitigating potential risks to the electrical infrastructure (e.g., nuisance trips, overheating, fires)

PURPOSE OF CAPACITY MANAGEMENT APPLICATION

Visualize Realtime or Historical Power System Capacity

- Monitor realtime circuit loading
- Trend and report historical loading
- Pre-defined reporting for equipment capacity management (circuit breakers, UPSs, generators, ATs, transformers, capacitor banks, bus bars, 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

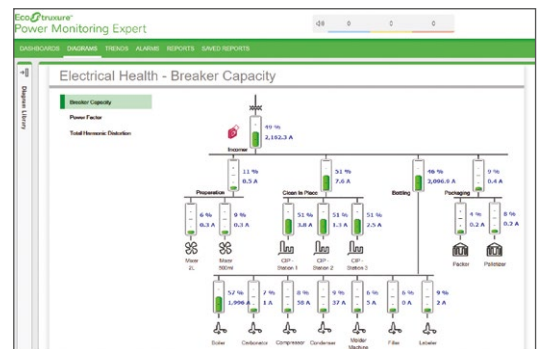
- Electrical Health diagram

Trends

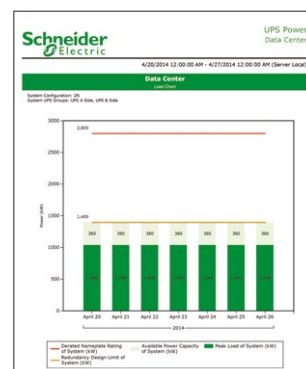
- Realtime and historical data can be viewed on a trend viewer

Reports

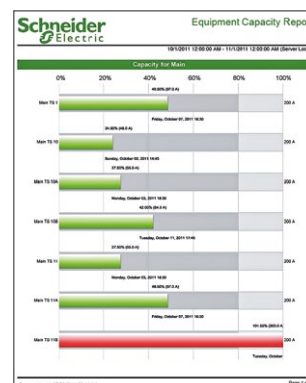
- Branch Circuit Capacity Report
- UPS Power Report
- Generator Capacity Report
- Generator Power Report
- Equipment Capacity Report
- Power Losses Report



Electrical Health Diagram



UPS Power Report



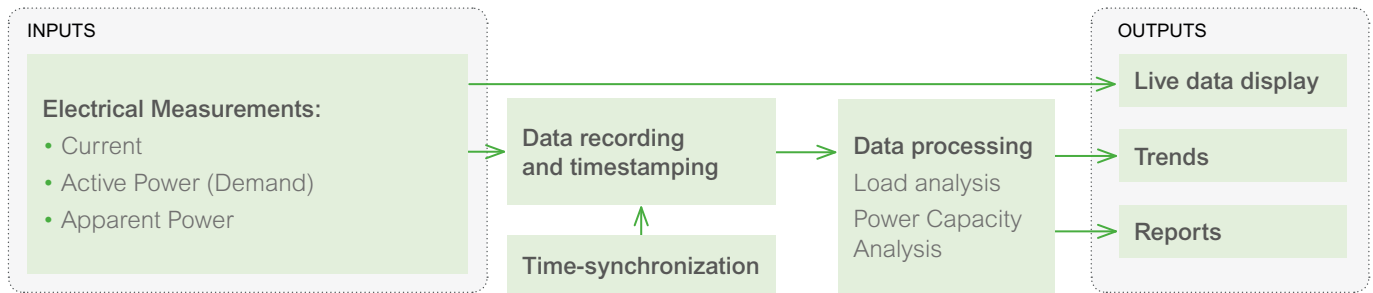
Equipment Capacity Report

> CAPACITY MANAGEMENT

System Description (1/3)

Data Flow

The Capacity Management Application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data is required:

Electrical Measurements

Capacity management requires the following electrical measurements to be recorded at strategic points in the electrical system (e.g., generators, UPS, ATS, feeders, etc.):

- Current (A)
- Active power (Demand) (kW)
- Apparent Power (kVA)

The measurements are recorded by electrical power meters such as the PowerLogic ION9000, PM8000, PM5000, HDPM6000, PowerTag, Acti9 iEM3000, etc.

Embedded metering in circuit breakers such as the MasterPacT MTZ, ComPacT NSX, MV protection relays such as Easergy P5/P3 or Galaxy VX/VM/VS are also suitable to provide the required electrical measurements.

DATA RECORDING AND TIMESTAMPING

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

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

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

For other devices (Easergy P5/P3, MasterPacT MTZ, entry-level PowerLogic PM5000 models, PowerTag range) measurements are performed by the devices and recorded by EcoStruxure™ Power Monitoring Expert or Power Operation.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)

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



Product, Software and Services: See page 229



> CAPACITY MANAGEMENT

System Description (2/3)

Data Flow in Detail (cont.)

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...). An external master clock may be required and 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 with Advanced Reporting & Dashboards.

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 design or alert about potential overloading.

For an Automatic Transfer Switch (ATS) 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.



EcoStruxure™
Power Monitoring Expert



EcoStruxure™
Power Operation with Advanced
Reporting & Dashboards

OUTPUTS

Outputs are displayed via EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards.

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

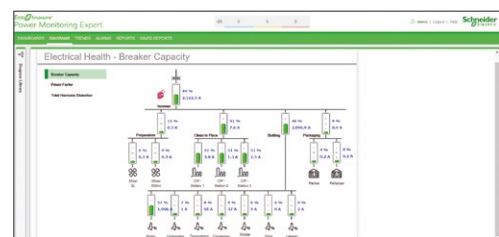
Trends

Historical and realtime 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.



Capacity Management Diagram

> CAPACITY MANAGEMENT

System Description (3/3)

Data Flow in Detail (cont.)

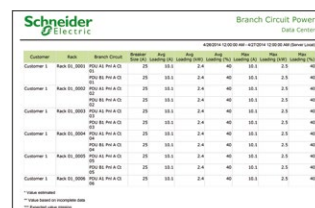
OUTPUTS (cont.)

Reports

The Capacity Management Module of EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards must be deployed to benefit from the following reports:

Branch Circuit Power Report

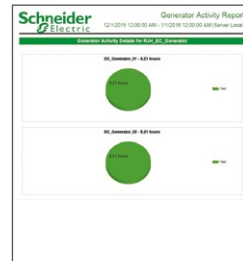
Monitor the capacity of branch circuits. Analyze IT branch circuit power loading. Understand remaining capacity at the branch circuit level – primarily for data center applications. Specific measurements required are Active Power (kW) and Current (A).



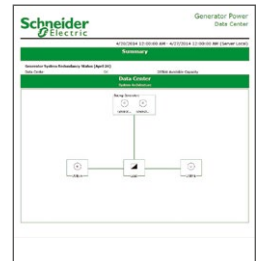
Branch Circuit Power Report

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).

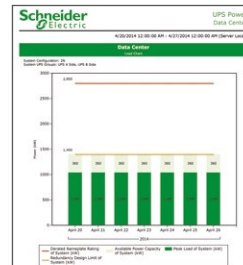


Generator Power Report

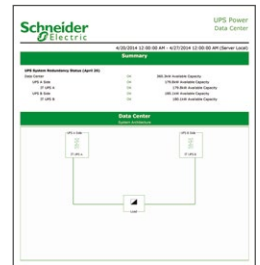


UPS Power Report

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).

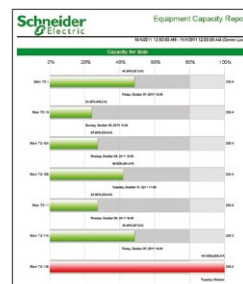


UPS Power Report

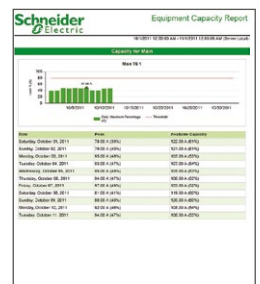


Equipment Capacity Report

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

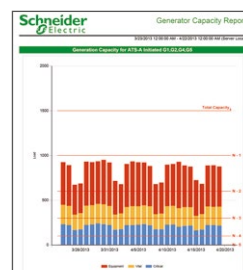


Equipment Capacity Report



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).



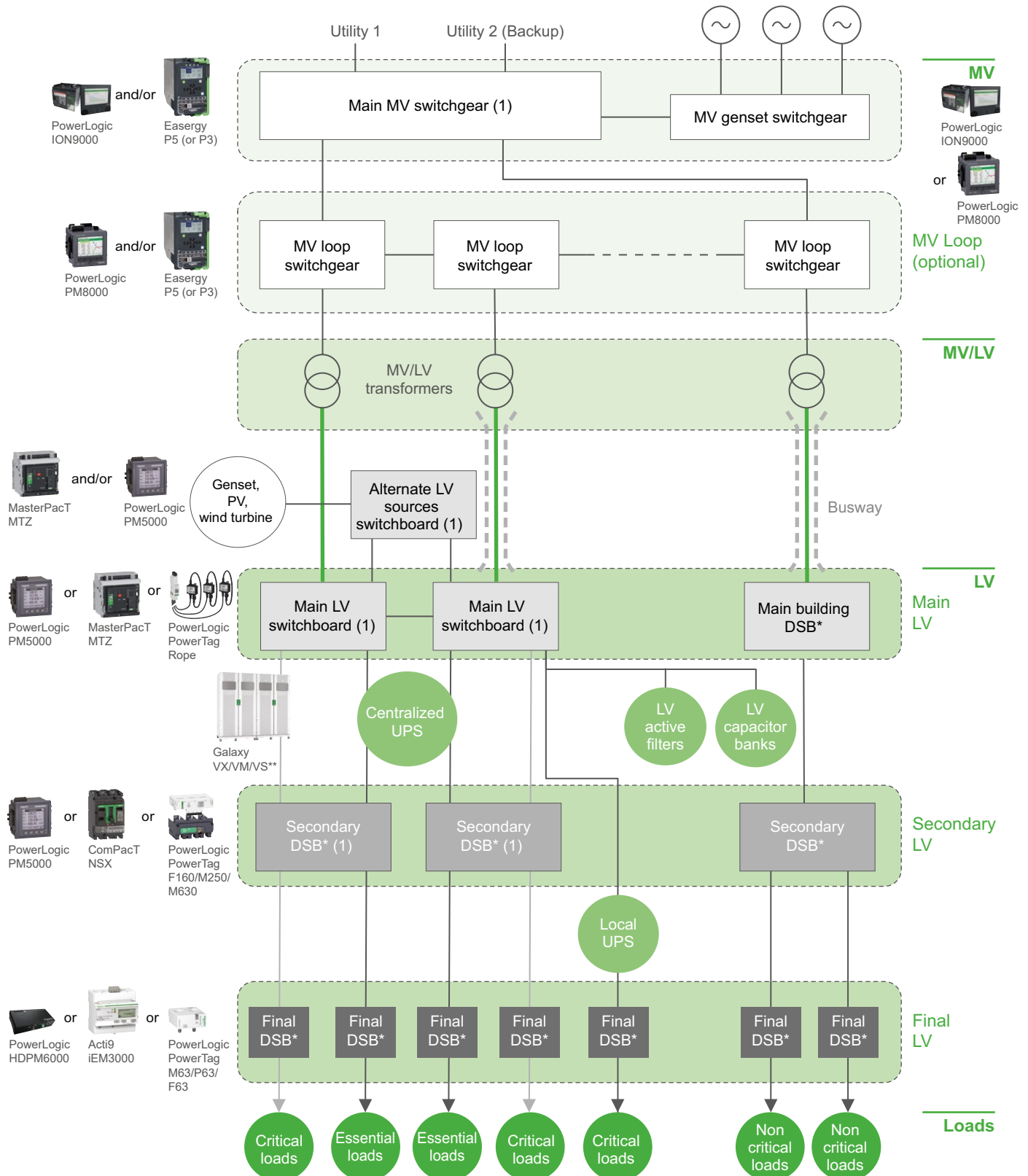
Generator Capacity Report

Product, Software and Services: See page 229

> CAPACITY MANAGEMENT

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/VM/VS is preferred, but Galaxy or Symmetra MW are also acceptable

(1) ATS is not represented but data can be acquired through inputs on the power meter

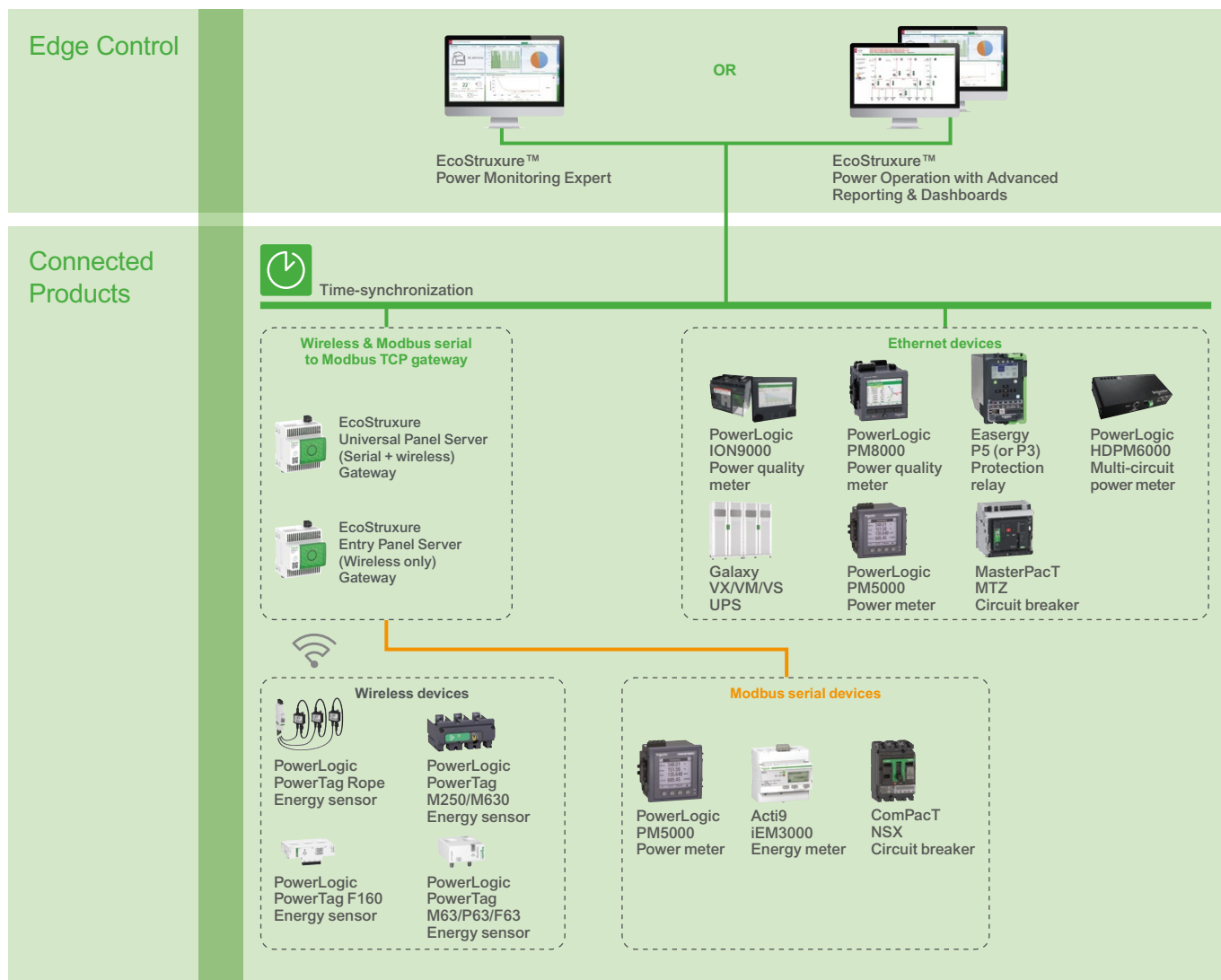
> CAPACITY MANAGEMENT

Digital Architecture

The digital architecture of the Capacity Management application recommends direct Ethernet connection to high-end energy measurement devices.

For other devices, depending on their communication protocols, some gateways may need to be installed in order to provide all information over Ethernet.

The recommended digital architecture for the Capacity Management application is given below:



BACKUP POWER TESTING

Help Ensure Reliability and Availability of Backup Power Systems with Proper Testing

Context of Application

Critical buildings such as hospitals and data centers rely on backup power systems* 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) (ATS). 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 being in the wrong mode, and so on.

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 & 110 (USA), AS_NZS 3009 (Australia / New Zealand), CSA Z32 and C282 (Canada).

PROBLEM TO SOLVE

The Facility 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 REGULATORY COMPLIANCE APPLICATION

Automatically detect Backup Power System* tests and generate reports:

- Automatic Transfer Switch (ATS)
- Backup generators
- Un-interruptible Power Supply (UPS)

Record key legislated parameters for compliance reports including:

- Transfer time for ATS and generators
- Generator run time, engine loading, exhaust and engine temperature
- Annual generator runtime for emission requirements reporting
- UPS's ability to sustain critical loads during power outage

Application Outcomes

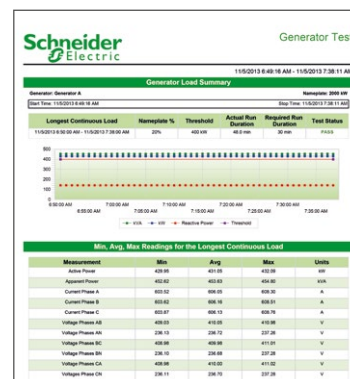
Live Data Display

- Device diagrams with status and analog values are available for ATS, generators and UPS

Reports

- Backup Power System* Test Report
- Generator Activity Report
- Generator Load Summary Report
- Generator Battery Health Report
- UPS Auto-Test Report
- UPS Battery Health Report

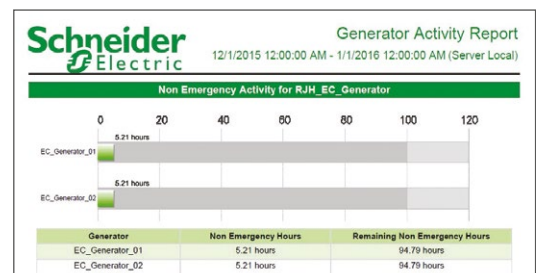
* Also sometimes referred to as Emergency Power Supply System (EPSS)



Backup Power System Test Report



UPS Auto-Test Report



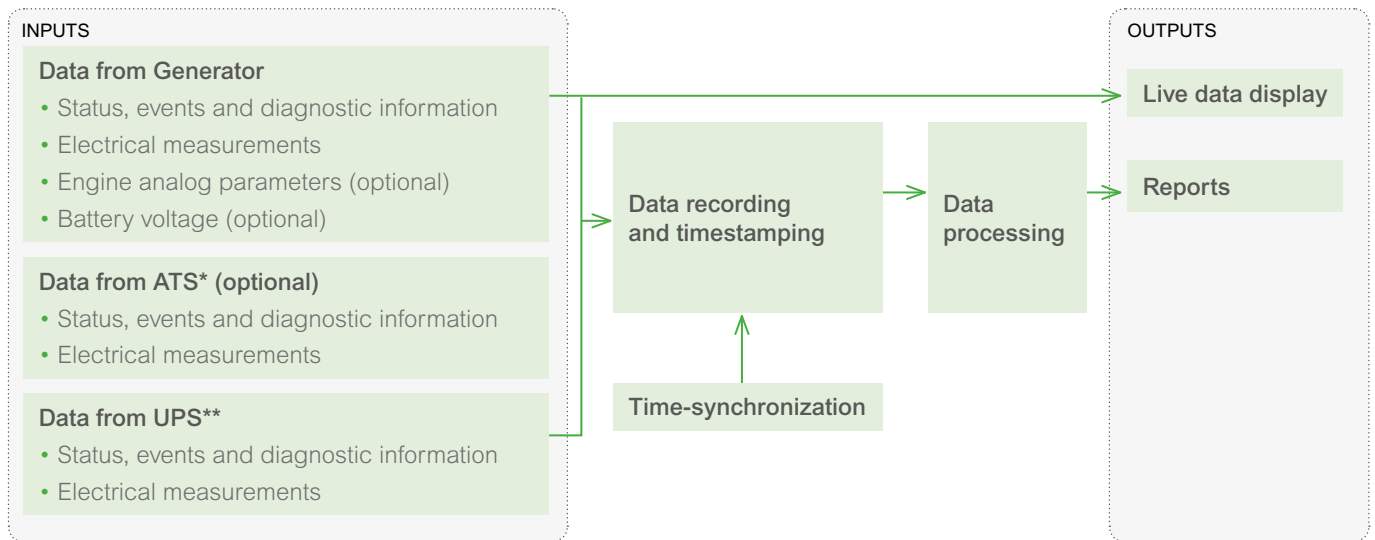
Generator Activity Report

> BACKUP POWER TESTING

System Description (1/5)

Data Flow

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



Data Flow in Detail

INPUTS

The following data is required:

Data from Generator

- **Status, Events and Diagnostic Information**
 - Stopped, running
 - Optional: Generator starting, generator power availability
 - Optional: Power Outage status
- **Electrical Measurements**
 - Voltage (line to neutral / line to line)
 - Current
 - Total power, total apparent power
 - PF sign total
 - Frequency
- **Optional: Engine Analog Measurements**
 - Engine Coolant Temp
 - Exhaust Gas Temp
 - Engine Oil Pressure
 - Engine start battery voltage

This input data may be provided by the generator controller and/or by power meters (PowerLogic ION9000, PM8000, PM5000) and/or data loggers (Cyber Sciences SER 3200/2408) and/or Easergy P5/Easergy P3/MasterPacT MTZ embedded metering.

* ATS: Automatic Transfer Switch

** UPS: Uninterruptible Power Supply



Product, Software and Services: See page 229



> BACKUP POWER TESTING

System Description (2/5)

Data Flow in Detail (cont.)

INPUTS (cont.)

Data from ATS*

• Status, Events and Diagnostic Information

Normal, Test, Emergency

• Electrical Measurements

Optional: ATS Load Data

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

Data from UPS**

The following measurements are performed:

• Status, Events and Diagnostic Information

• Electrical Measurements

- Voltage and current (line to neutral / line to line)
- Frequency

• Events

This input data is provided by the UPS (Galaxy VX/VM/VS).



DATA RECORDING AND TIMESTAMPING

Advanced meters such as the PowerLogic ION9000, PM8000 and some PowerLogic PM5000 models (PM53xx and PM55xx) can record onboard input data, energy measurements as well as connected equipment states.

For other connected products (Easergy P5, Easergy P3, MasterPacT MTZ, entry-level PowerLogic PM5000 models) measurements are performed by the connected products and recorded by EcoStruxure™ Power Monitoring Expert or Power Operation.

Timestamping Requirements for Backup Generator & ATS*

Due to the accuracy requirements of the Backup Power System Test Reports, 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*, 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.

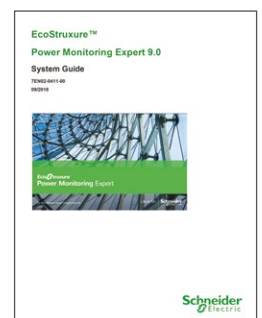
The following meters support this framework: PowerLogic ION9000 and PM8000.

Alternatively, this can be performed by the Cyber Sciences SER 3200/2408.

Timestamping Requirements for UPS**

For UPS Test Reports, time accuracy is not as critical, but should still be within ± 1 s.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)



EcoStruxure™ Power Monitoring Expert 9.0 System Guide
7EN02-0411-00 09/2018



* ATS: Automatic Transfer Switch

** UPS: Uninterruptible Power Supply

> BACKUP POWER TESTING

System Description (3/5)

Data Flow in Detail (cont.)

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.



TimeSync Clock

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

DATA PROCESSING

2 For the Backup Generator & ATS*

Data processing consists of:

- Analyzing the status information from the Generator(s) and ATsS* 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 Power System*** conformance tests, all success criteria are examined to provide a comprehensive fail/pass status.

3 For the UPS**

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

- If it has auto-test capabilities, (e.g., Galaxy VX, Galaxy VM, Galaxy 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.

These calculations are performed by the Backup Power Management Module of EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards.

EcoStruxure™
Power Monitoring ExpertEcoStruxure™
Power Operation with Advanced
Reporting & Dashboards

* ATS: Automatic Transfer Switch

** UPS: Uninterruptible Power Supply

*** Also sometimes referred to as Emergency Power Supply System (EPSS)

BACKUP POWER TESTING

System Description (4/5)

Data Flow in Detail (cont.)

OUTPUTS

Outputs are displayed remotely via the Edge Control software EcoStruxure™ Power Monitoring Expert or EcoStruxure™ Power Operation with Advanced Reporting & Dashboards.

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

Live Data Display

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

- Default Generator, UPS** and ATS* diagrams are available.
- Generator Performance operator interface helps monitor the following during tests in real time:
 - Electrical data: current, voltage, power, frequency, power factor
 - Generator and Automatic Transfer Switch run/stop status
- UPS** Auto-test diagrams

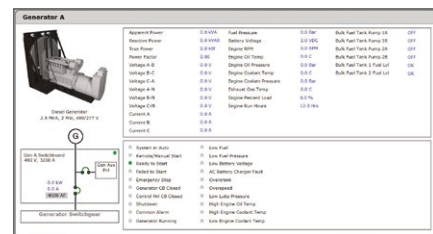
Reports

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

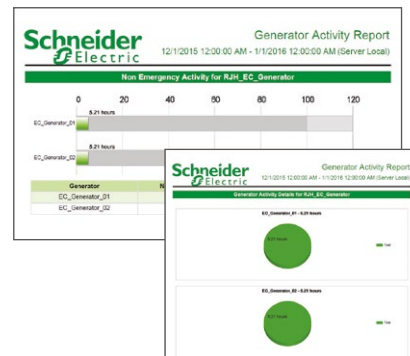
Backup Power Management Reports

Generator Activity Report

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



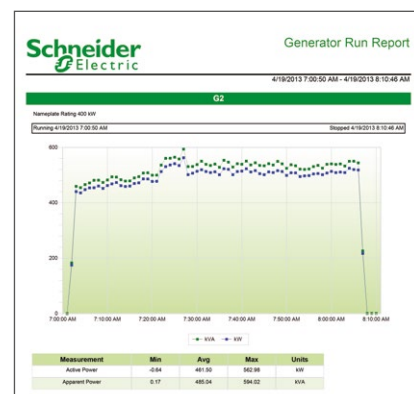
Operator Interface



Generator Activity Report

Generator Load Summary Report

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



Generator Load Summary Report

* ATS: Automatic Transfer Switch

** UPS: Uninterruptible Power Supply

BACKUP POWER TESTING

System Description (5/5)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Reports (cont.)

Backup Power Management Reports (cont.)

Backup Power System* Test Report

- 1 Provides a standard methodology for testing the generators and provides a detailed report of the generator operation during the test.
- 2 Can also be configured to conform to the requirements for an Backup Power System* test, including Automatic Transfer Switches (ATS). For example, the report shows the transfer time of the lead ATS and indicates whether the transfer time passes or does not pass the test requirements.

Generator Battery Health Report

It 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.

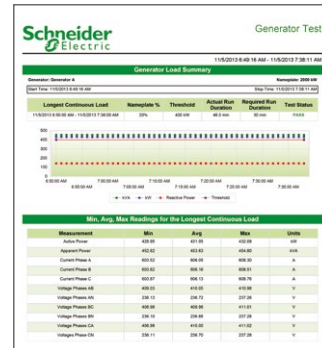
Uninterruptible Power Supply (UPS) Reports

UPS Auto-Test Report

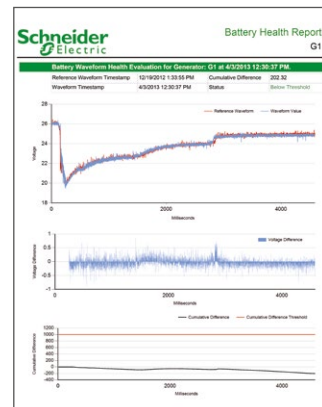
Provides information regarding the battery health of your Galaxy VX, Galaxy VM, and MGE 5500 UPS devices.

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

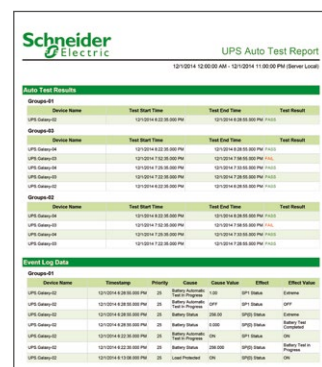
Displays information related to the health of the battery for a UPS device. The UPS devices intended for use with this report are UPS devices that do not have an auto-test capability. Available with PowerLogic ION9000 only.



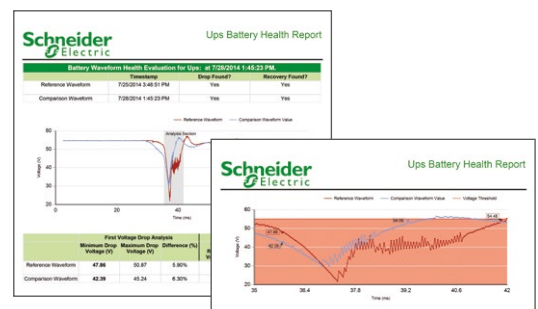
Backup Power System* Test Report



Generator Battery Health Report



UPS Auto-Test Report



UPS Battery Health Report (For third-party UPS)

* Also sometimes referred to as Emergency Power Supply System (EPSS)

> BACKUP POWER TESTING

Electrical Architecture (1/2)

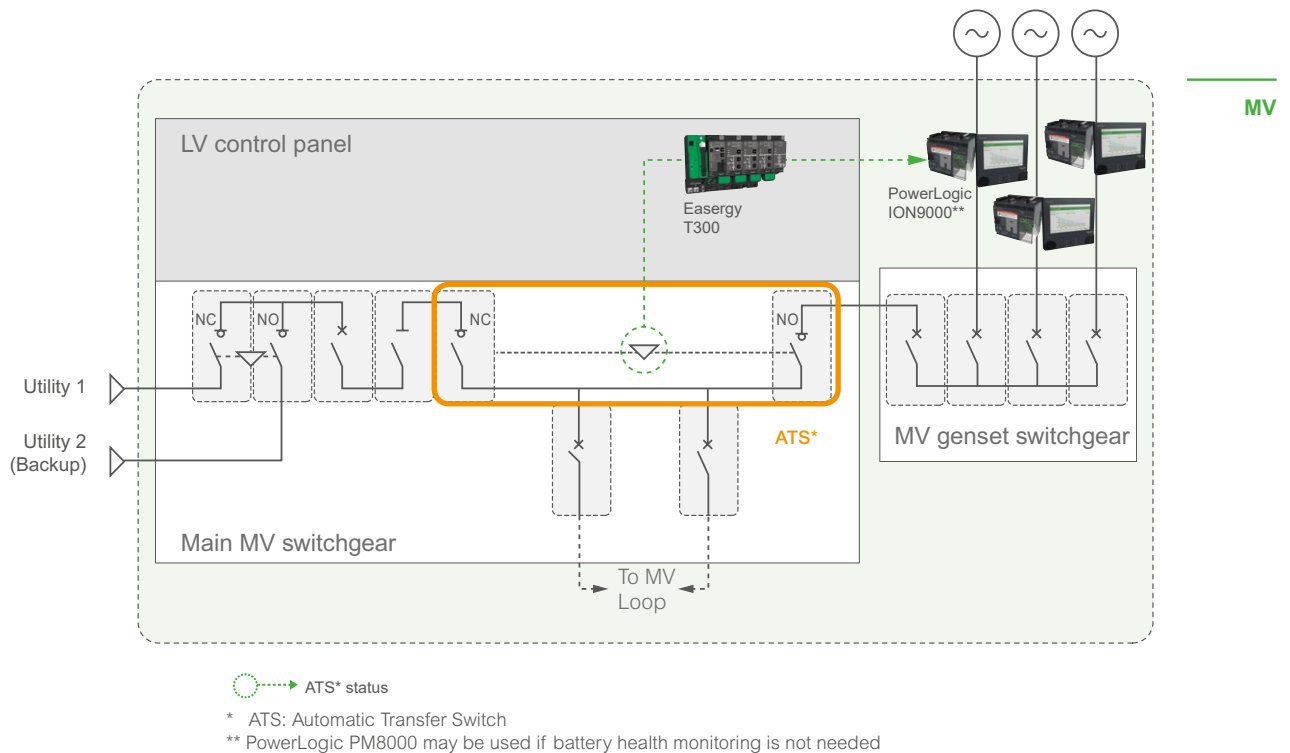
Introduction

The implementation of the Backup Power Testing application is different whether the generator is a MV or a LV system.

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:

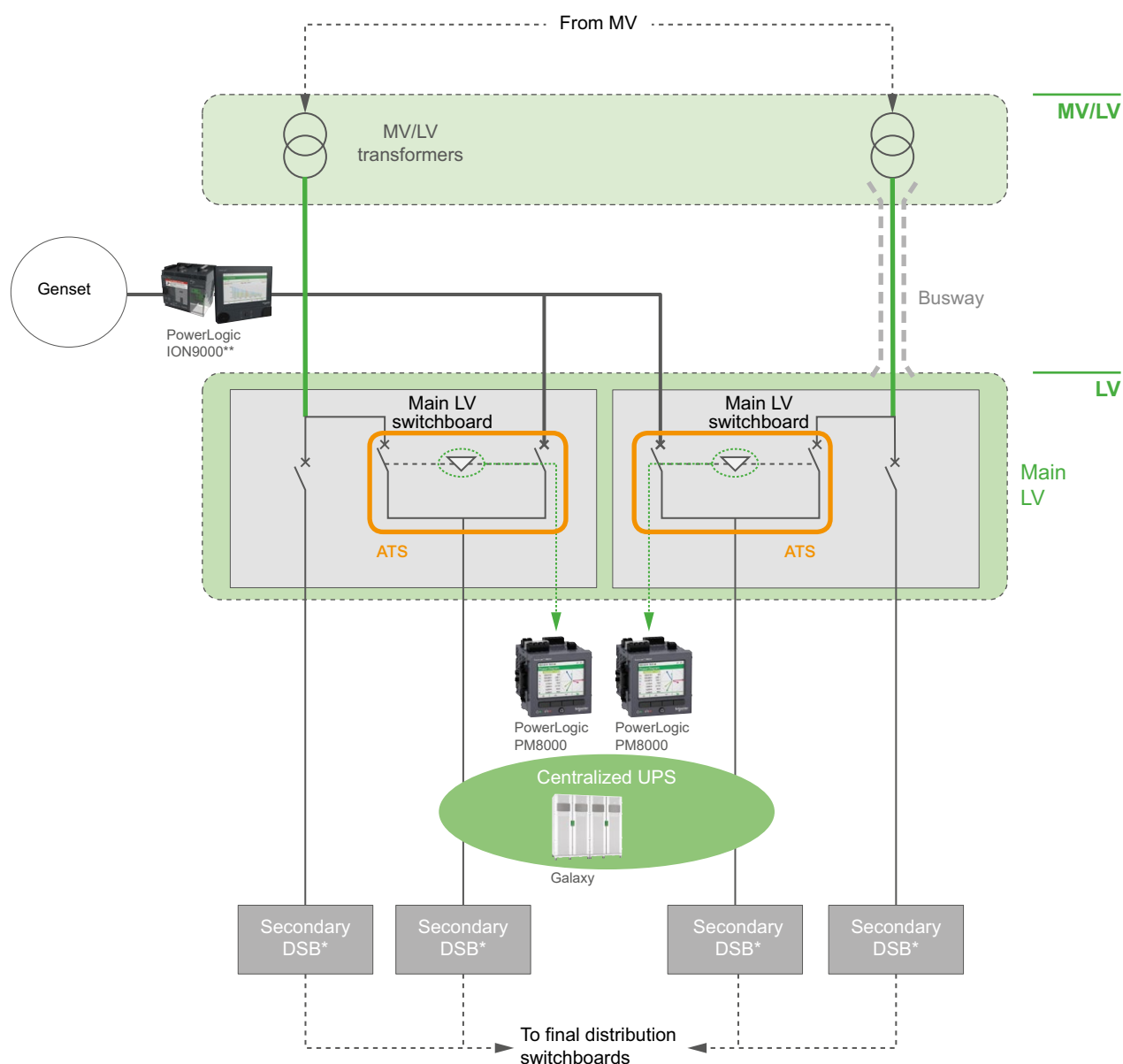


> BACKUP POWER TESTING

Electrical Architecture (2/2)

Low Voltage Generator Architecture

If the backup supply system operates on a low voltage section of the network, it will usually include several ATSs. As illustrated below, the ATS and the genset will be equipped with a power meter each, that will collect analog electrical data from their power outputs as well as status details via digital I/O ports.



○ → ATS status

* DSB = Distribution Switchboard

** PowerLogic PM8000 may be used if generator battery health monitoring is not needed

BACKUP POWER TESTING

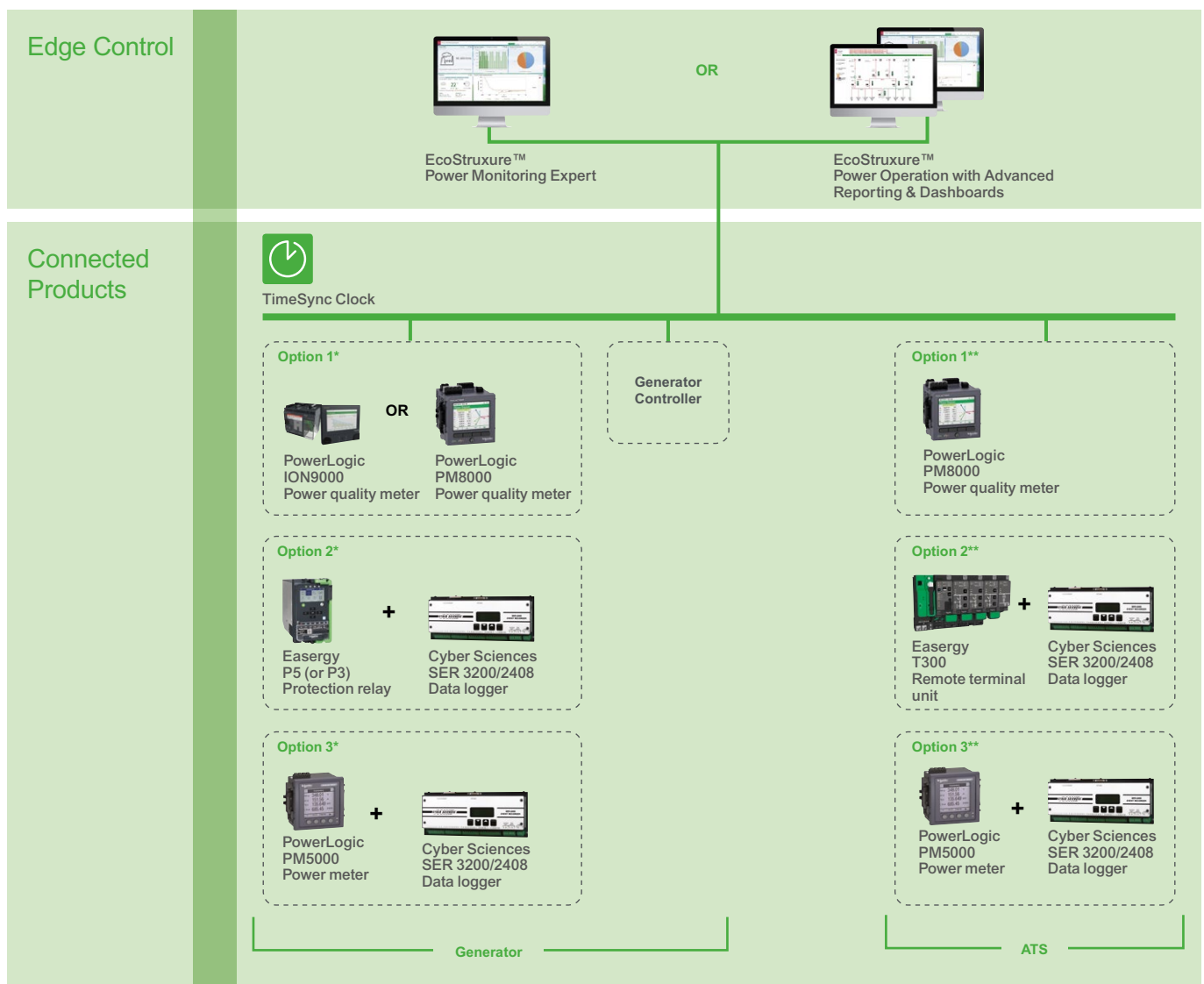
Digital Architecture (1/2)

Introduction

The digital architecture of the Backup Power Testing application is different if it relates to an MV or LV electrical architecture.

Medium Voltage Generator Architecture

Example of digital architecture to implement the Backup Power Testing application with a medium voltage generator:



— Ethernet - technical LAN

* Option 1 is the recommended architecture. Option 2 should be considered if Easergy P5/P3 with embedded metering is already present in the architecture. Option 3 can be considered if a lower cost meter such as PowerLogic PM5000 is specified.

** Option 1 is the recommended architecture. Option 2 should be considered if Easergy T300 is present in the architecture. Option 3 can be considered if a lower cost meter such as PowerLogic PM5000 is specified.

Product, Software and Services: See page 229

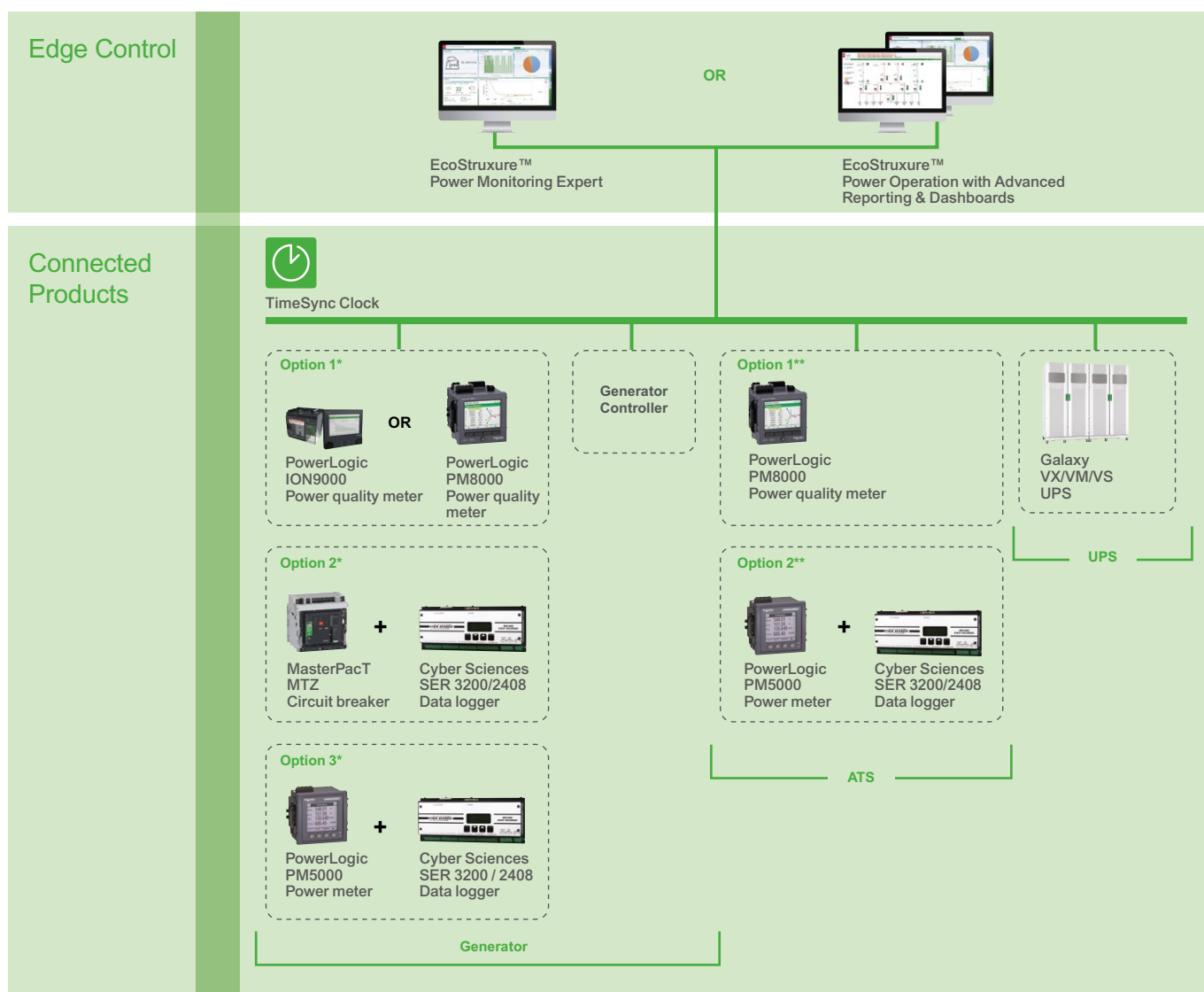


> BACKUP POWER TESTING

Digital Architecture (2/2)

Low Voltage Generator Architecture

Example of digital architecture to implement the Backup Power Testing application with a low voltage generator:



* 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 a lower cost meter such as PowerLogic PM5000 is specified.

** Option 1 is the recommended architecture. Option 2 can be considered if a lower cost meter such as PowerLogic PM5000 is specified.

> POWER EVENTS ANALYSIS

Analyze the Root Causes of Power Events (1/2)

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, surge impulses
- Unsuccessful power transfers caused by incorrect ATS operation
- And more...

These events may 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 be alarmed 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:

- Be able to analyze potentially damaging power events to identify root cause
- Have the right information to perform actions to avoid similar future events
- Be able to prioritize alarm resolution

PURPOSE OF POWER EVENTS ANALYSIS APPLICATION

Provide a User Friendly Graphical Tool to Simplify and Save Time in Event Analysis

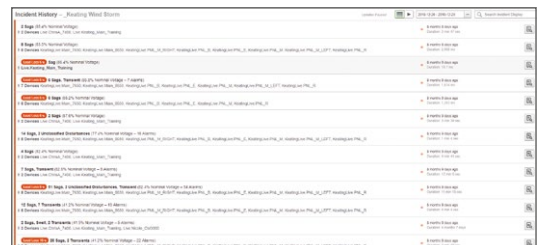
- Smart alarm context automatically brings any relevant information into view, including disturbance direction detection (DDD) and loss of load detection (LLD)
- Events and alarms can be viewed by category, severity, alarm type and status
- It allows visualization of events in the context of time across multiple devices with ability to annotate
- Analyses can be saved for later viewing

Provide an Aggregated View of Events in the Same Dashboard

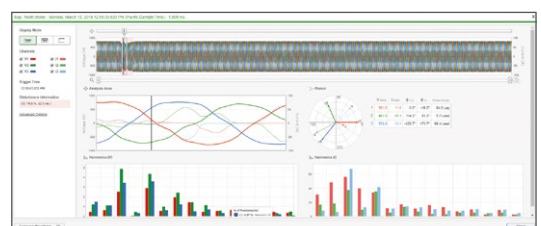
- Power quality, breaker trip and other power incidents across multiple devices intelligently grouped and displayed
- Simple visualization on a chronological timeline with contextual data such as RMS data and waveforms

Enable Root Cause Analysis

- Deep dive into contextual data from events such as visualizing waveforms, RMS data. This detailed data helps pinpoint the root cause of power-related incidents and enables appropriate actions to be identified.



Smart Alarm View with LLD and DDD



Waveform Viewer

> POWER EVENTS ANALYSIS

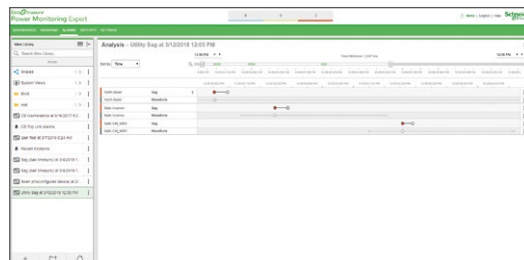
Analyze the Root Causes of Power Events (2/2)

Application Outcomes

Analysis Tools

The Power Events Analysis incident timeline provides advanced functions:

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



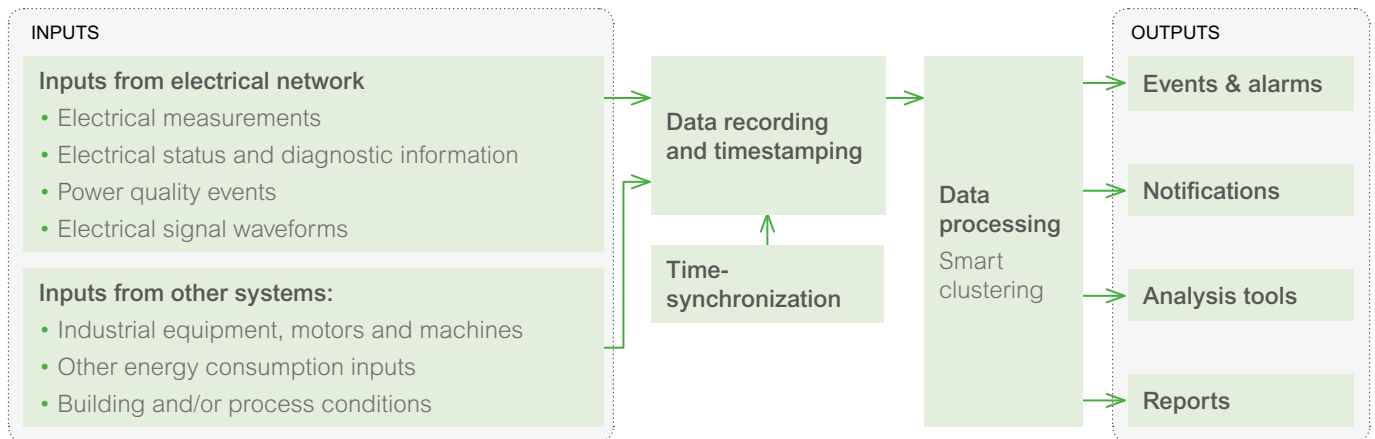
Timeline of Power Events

> POWER EVENTS ANALYSIS

System Description (1/3)

Data Flow

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



Data Flow in Detail

INPUTS

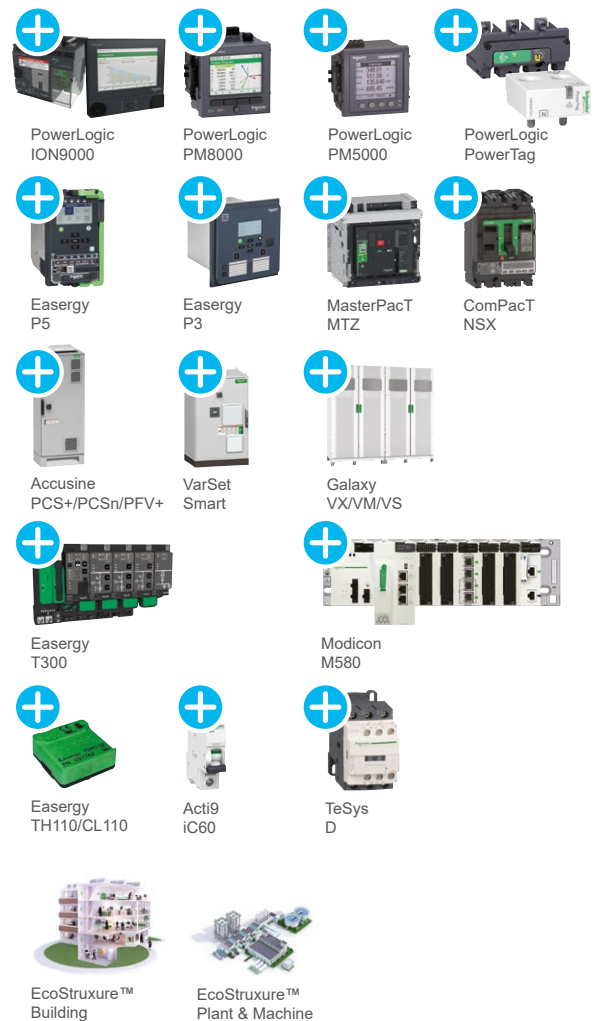
The following data is collected for the purpose of analyzing power system events:

Inputs from Electrical Network

- **Electrical measurements:** system loading and parameters such as voltage, current, power, temperature, etc. from sensors, relays, etc.
- **Electrical status and diagnostic information:** with associated status changes from contactors, switches, circuit breakers, etc.
- **Power quality events:** such as sags, swells, transients, harmonics, etc. from power meters, UPS, harmonic active filter, capacitor banks, etc.
- **Electrical Signal Waveforms:** high sample rate sinusoidal waveform data for all phases of voltage and current

Inputs from Other Systems

- Industrial process: motor, machine or equipment status
- Other energy consumption inputs (water, gas, steam, etc.)
- Building and/or process conditions in all user facilities: EcoStruxure™ Building Operation, EcoStruxure™ Plant & Machine or third-party systems



> POWER EVENTS ANALYSIS

System Description (2/3)

Data Flow in Detail (cont.)

DATA RECORDING AND TIMESTAMPING

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

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

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

For other connected products (Easergy P5, Easergy P3, MasterPacT MTZ, entry-level PowerLogic PM5000 models) steady state disturbances are measured by the connected products and recorded by EcoStruxure™ Power Monitoring Expert or Power Operation.

If data from these connected products requires more accurate timestamping, it should be relayed through another connected product with better accuracy (like PowerLogic ION9000 power quality meter or M580 PLC) through digital or analog I/Os.

When acquiring data from other systems, timestamps can also be imported through OPC or ETL*.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)



EcoStruxure™
Power Monitoring Expert



EcoStruxure™
Power Operation

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...). An external master clock is required and may be connected to a GPS antenna to reach the expected time precision.



TimeSync Clock

DATA PROCESSING

Smart Clustering

Data processing 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.

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

> POWER EVENTS ANALYSIS

System Description (3/3)

Data Flow in Detail (cont.)

OUTPUTS

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

Events & Alarms

Events/Alarms Log Viewers

They offer chronological display with sorting and filtering capabilities.

- Power Operation offers high speed Sequence of Events Recording to quickly locate the source of a fault. A time-quality flag indicates the accuracy of onboard clocks and the resulting accuracy of any events and alarms.
- Power Monitoring Expert and Power Operation can perform intelligent grouping of power system alarms and other metadata into time-based incidents, reducing clutter of the alarm view.

Comment: Smart alarms view includes 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 with Advanced Report is installed, reports can be generated, such as the Event History Report.

Notifications

Notifications (of alarms and events) 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 is accessed from the smart alarm viewer and plots events in an incident based on the time they were captured. Other metadata such as RMS data waveforms and other electrical values are also accessible in a drill-down workflow. The Incident Timeline enables the source of cascading power events to be quickly identified.

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:

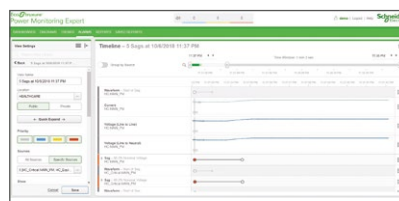
- Toggle on/off voltage/current channels
- RMS calculation, zoom, pan, export to CSV
- Interactive phasor and harmonic (voltage and current) diagrams
- Comparison of multiple waveforms with respect to each other

Time	Type	Description	Status
2019-01-01 10:00:00	Alarm	Power Quality Alarm	Active
2019-01-01 10:00:01	Event	Voltage Sag	Completed
2019-01-01 10:00:02	Event	Current Surge	Completed
2019-01-01 10:00:03	Event	Power Factor Low	Completed
2019-01-01 10:00:04	Event	Harmonic Distortion	Completed
2019-01-01 10:00:05	Event	Temperature High	Completed
2019-01-01 10:00:06	Event	Frequency Deviation	Completed
2019-01-01 10:00:07	Event	Power Loss	Completed
2019-01-01 10:00:08	Event	Power Restoration	Completed
2019-01-01 10:00:09	Event	Power Quality Alarm	Active
2019-01-01 10:00:10	Event	Voltage Sag	Completed
2019-01-01 10:00:11	Event	Current Surge	Completed
2019-01-01 10:00:12	Event	Power Factor Low	Completed
2019-01-01 10:00:13	Event	Harmonic Distortion	Completed
2019-01-01 10:00:14	Event	Temperature High	Completed
2019-01-01 10:00:15	Event	Frequency Deviation	Completed
2019-01-01 10:00:16	Event	Power Loss	Completed
2019-01-01 10:00:17	Event	Power Restoration	Completed
2019-01-01 10:00:18	Event	Power Quality Alarm	Active
2019-01-01 10:00:19	Event	Voltage Sag	Completed
2019-01-01 10:00:20	Event	Current Surge	Completed
2019-01-01 10:00:21	Event	Power Factor Low	Completed
2019-01-01 10:00:22	Event	Harmonic Distortion	Completed
2019-01-01 10:00:23	Event	Temperature High	Completed
2019-01-01 10:00:24	Event	Frequency Deviation	Completed
2019-01-01 10:00:25	Event	Power Loss	Completed
2019-01-01 10:00:26	Event	Power Restoration	Completed
2019-01-01 10:00:27	Event	Power Quality Alarm	Active
2019-01-01 10:00:28	Event	Voltage Sag	Completed
2019-01-01 10:00:29	Event	Current Surge	Completed
2019-01-01 10:00:30	Event	Power Factor Low	Completed
2019-01-01 10:00:31	Event	Harmonic Distortion	Completed
2019-01-01 10:00:32	Event	Temperature High	Completed
2019-01-01 10:00:33	Event	Frequency Deviation	Completed
2019-01-01 10:00:34	Event	Power Loss	Completed
2019-01-01 10:00:35	Event	Power Restoration	Completed
2019-01-01 10:00:36	Event	Power Quality Alarm	Active
2019-01-01 10:00:37	Event	Voltage Sag	Completed
2019-01-01 10:00:38	Event	Current Surge	Completed
2019-01-01 10:00:39	Event	Power Factor Low	Completed
2019-01-01 10:00:40	Event	Harmonic Distortion	Completed
2019-01-01 10:00:41	Event	Temperature High	Completed
2019-01-01 10:00:42	Event	Frequency Deviation	Completed
2019-01-01 10:00:43	Event	Power Loss	Completed
2019-01-01 10:00:44	Event	Power Restoration	Completed
2019-01-01 10:00:45	Event	Power Quality Alarm	Active
2019-01-01 10:00:46	Event	Voltage Sag	Completed
2019-01-01 10:00:47	Event	Current Surge	Completed
2019-01-01 10:00:48	Event	Power Factor Low	Completed
2019-01-01 10:00:49	Event	Harmonic Distortion	Completed
2019-01-01 10:00:50	Event	Temperature High	Completed
2019-01-01 10:00:51	Event	Frequency Deviation	Completed
2019-01-01 10:00:52	Event	Power Loss	Completed
2019-01-01 10:00:53	Event	Power Restoration	Completed
2019-01-01 10:00:54	Event	Power Quality Alarm	Active
2019-01-01 10:00:55	Event	Voltage Sag	Completed
2019-01-01 10:00:56	Event	Current Surge	Completed
2019-01-01 10:00:57	Event	Power Factor Low	Completed
2019-01-01 10:00:58	Event	Harmonic Distortion	Completed
2019-01-01 10:00:59	Event	Temperature High	Completed
2019-01-01 10:01:00	Event	Frequency Deviation	Completed

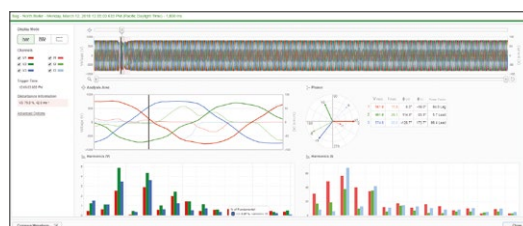
Alarm and Event Log Viewer in EcoStruxure™ Power Monitoring Expert and Power Operation

Time	Type	Description	Status
2019-01-01 10:00:00	Alarm	Power Quality Alarm	Active
2019-01-01 10:00:01	Event	Voltage Sag	Completed
2019-01-01 10:00:02	Event	Current Surge	Completed
2019-01-01 10:00:03	Event	Power Factor Low	Completed
2019-01-01 10:00:04	Event	Harmonic Distortion	Completed
2019-01-01 10:00:05	Event	Temperature High	Completed
2019-01-01 10:00:06	Event	Frequency Deviation	Completed
2019-01-01 10:00:07	Event	Power Loss	Completed
2019-01-01 10:00:08	Event	Power Restoration	Completed
2019-01-01 10:00:09	Event	Power Quality Alarm	Active
2019-01-01 10:00:10	Event	Voltage Sag	Completed
2019-01-01 10:00:11	Event	Current Surge	Completed
2019-01-01 10:00:12	Event	Power Factor Low	Completed
2019-01-01 10:00:13	Event	Harmonic Distortion	Completed
2019-01-01 10:00:14	Event	Temperature High	Completed
2019-01-01 10:00:15	Event	Frequency Deviation	Completed
2019-01-01 10:00:16	Event	Power Loss	Completed
2019-01-01 10:00:17	Event	Power Restoration	Completed
2019-01-01 10:00:18	Event	Power Quality Alarm	Active
2019-01-01 10:00:19	Event	Voltage Sag	Completed
2019-01-01 10:00:20	Event	Current Surge	Completed
2019-01-01 10:00:21	Event	Power Factor Low	Completed
2019-01-01 10:00:22	Event	Harmonic Distortion	Completed
2019-01-01 10:00:23	Event	Temperature High	Completed
2019-01-01 10:00:24	Event	Frequency Deviation	Completed
2019-01-01 10:00:25	Event	Power Loss	Completed
2019-01-01 10:00:26	Event	Power Restoration	Completed
2019-01-01 10:00:27	Event	Power Quality Alarm	Active
2019-01-01 10:00:28	Event	Voltage Sag	Completed
2019-01-01 10:00:29	Event	Current Surge	Completed
2019-01-01 10:00:30	Event	Power Factor Low	Completed
2019-01-01 10:00:31	Event	Harmonic Distortion	Completed
2019-01-01 10:00:32	Event	Temperature High	Completed
2019-01-01 10:00:33	Event	Frequency Deviation	Completed
2019-01-01 10:00:34	Event	Power Loss	Completed
2019-01-01 10:00:35	Event	Power Restoration	Completed
2019-01-01 10:00:36	Event	Power Quality Alarm	Active
2019-01-01 10:00:37	Event	Voltage Sag	Completed
2019-01-01 10:00:38	Event	Current Surge	Completed
2019-01-01 10:00:39	Event	Power Factor Low	Completed
2019-01-01 10:00:40	Event	Harmonic Distortion	Completed
2019-01-01 10:00:41	Event	Temperature High	Completed
2019-01-01 10:00:42	Event	Frequency Deviation	Completed
2019-01-01 10:00:43	Event	Power Loss	Completed
2019-01-01 10:00:44	Event	Power Restoration	Completed
2019-01-01 10:00:45	Event	Power Quality Alarm	Active
2019-01-01 10:00:46	Event	Voltage Sag	Completed
2019-01-01 10:00:47	Event	Current Surge	Completed
2019-01-01 10:00:48	Event	Power Factor Low	Completed
2019-01-01 10:00:49	Event	Harmonic Distortion	Completed
2019-01-01 10:00:50	Event	Temperature High	Completed
2019-01-01 10:00:51	Event	Frequency Deviation	Completed
2019-01-01 10:00:52	Event	Power Loss	Completed
2019-01-01 10:00:53	Event	Power Restoration	Completed
2019-01-01 10:00:54	Event	Power Quality Alarm	Active
2019-01-01 10:00:55	Event	Voltage Sag	Completed
2019-01-01 10:00:56	Event	Current Surge	Completed
2019-01-01 10:00:57	Event	Power Factor Low	Completed
2019-01-01 10:00:58	Event	Harmonic Distortion	Completed
2019-01-01 10:00:59	Event	Temperature High	Completed
2019-01-01 10:01:00	Event	Frequency Deviation	Completed

Event History Report



Power Events Incident Timeline

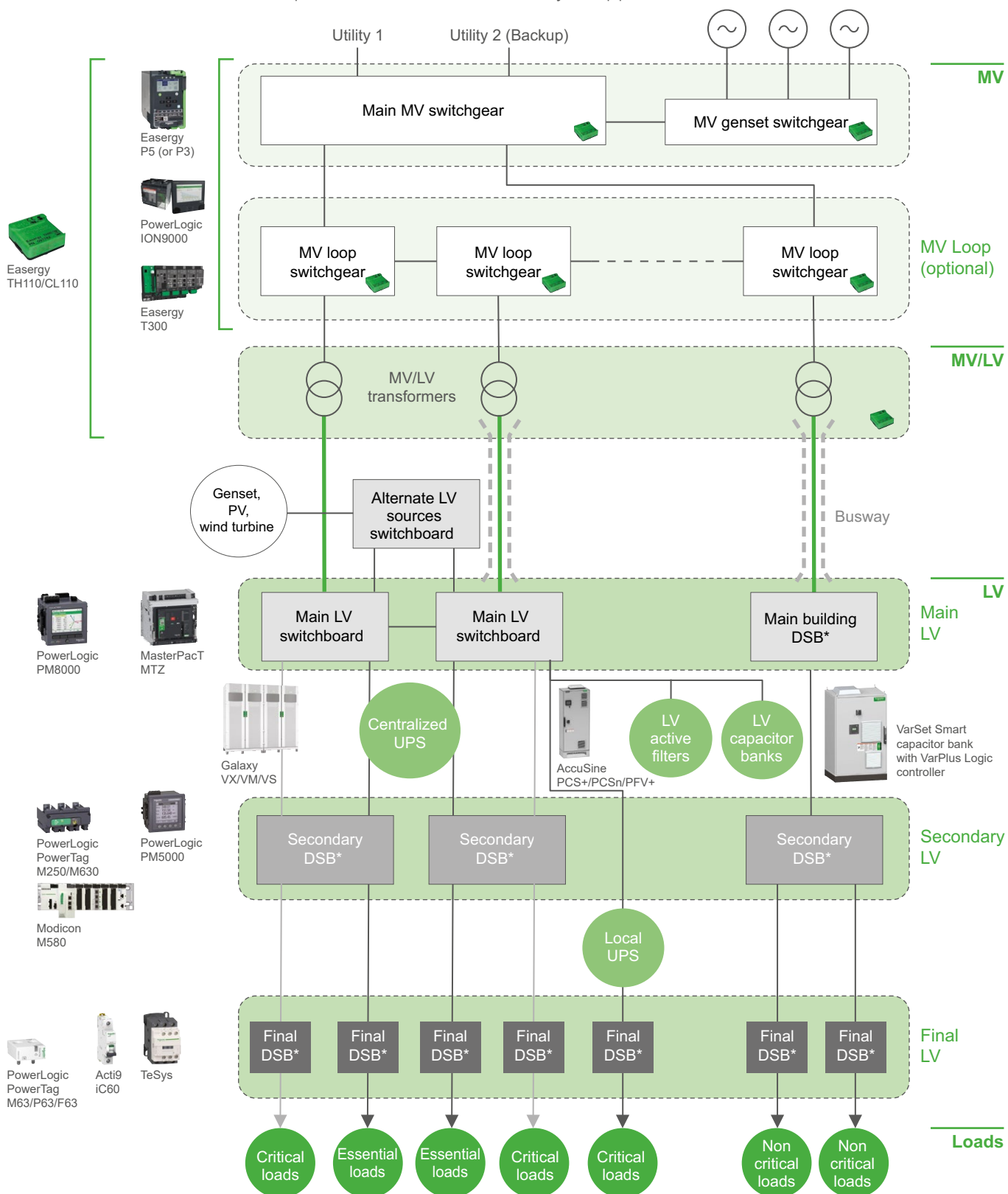


Waveform Viewer

POWER EVENTS ANALYSIS

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



POWER EVENTS ANALYSIS

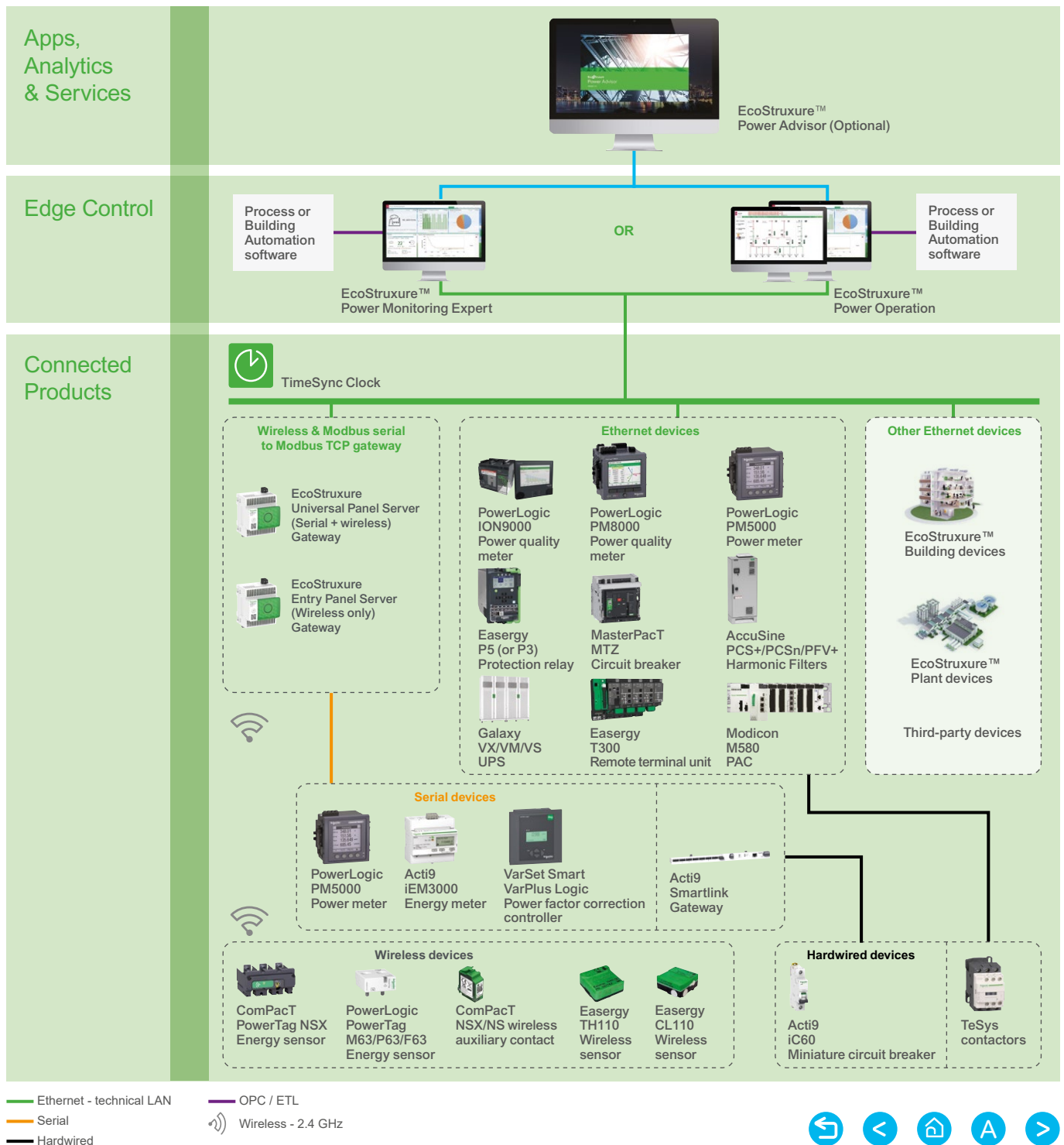
Digital Architecture

As the Power Events Analysis relies on data collection, the digital architecture must enable data collection from the connected products to the Edge Control. Depending on the communication protocols, some gateways may need to be embedded in order to provide all information over Ethernet.

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

Optionally, as part of a connected service, data can be used for analytics services with EcoStruxure™ Power Advisor. This data enables Schneider Electric service engineers to make recommendations.

The recommended architecture for the Power Events Analysis application is given below:



> BREAKER SETTINGS MONITORING

Monitor the Protection Settings of the Electrical Installation

Context of Application

An installation is designed with specific 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 a head circuit breaker instead of the local circuit breaker if the selectivity is ineffective
- Device destruction, fire outbreak and even harm to persons 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
- Prevent issues due to inappropriate or poorly coordinated circuit breaker settings

PURPOSE OF BREAKER SETTINGS MONITORING APPLICATION

Manually or Automatically Generate a Report Summarizing Settings of LV Circuit Breakers:

- After commissioning: to compare with specified settings
- Periodically: to detect inappropriate setting modifications

This report is used to help identify settings or co-ordination issues and to find the root cause.

Application Outcomes

Live Data Display

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

Events & Alarms

Alarms are generated on breaker trip settings changes.

Reports

For each protective device, the report displays the name, type of protection, and its thresholds.

It also detects any changes made to a baseline.

- Circuit Breaker Setting Report
- Circuit Breaker Inventory
- Summary of changes to trip settings
- Protection modes
- Maintenance status

Schneider Electric									
Circuit Breaker Setting Report									
Unassociated Breakers									
Breaker Name	Type	Protection Type	Serial Number	Protection Standard	Rated Voltage	Rated Current	Rated Frequency	Number of Poles	Date of Data Reading
MLVS_PANEL.MT.Z.TIE	Micrologic X	5.0 (LS)	N/A	IEC	400	1600	50Hz	4-Pole	6/7/2018 1:59:36 PM
MLVS_PANEL.MT.Z.TB	Micrologic X	5.0 (LS)	N/A	IEC	400	1600	50Hz	4-Pole	6/7/2018 2:29:33 PM
MLVS_PANEL.NS.X1_CRITICAL	CompactNSiSt	52	3N171830469	IEC	N/A	250	N/A	4-Pole	6/7/2018 1:44:38 PM
MLVS_PANEL.NS.X1_NON_CRITICAL	CompactNSiSt	52	P102250514	IEC	N/A	100	N/A	4-Pole	6/7/2018 2:39:35 PM
MLVS_PANEL.NS.X2_CRITICAL	CompactNSiSt	52	P102250502	IEC	N/A	100	N/A	4-Pole	6/7/2018 1:44:36 PM
MLVS_PANEL.NS.X2_NON_CRITICAL	CompactNSiSt	52	3N171830470	IEC	N/A	250	N/A	4-Pole	6/7/2018 1:44:33 PM
MLVS_PANEL.NS.X3_CRITICAL	CompactNSiSt	52	P102250505	IEC	N/A	100	N/A	4-Pole	6/7/2018 1:49:39 PM
MLVS_PANEL.NS.X3_NON_CRITICAL	CompactNSiSt	52	P102250505	IEC	N/A	100	N/A	4-Pole	6/7/2018 1:44:40 PM
MLVS_PANEL.NS.X4_CRITICAL	CompactNSiSt	52	P102250521	IEC	N/A	100	N/A	4-Pole	6/7/2018 1:49:39 PM
MLVS_PANEL.NS.X4_NON_CRITICAL	CompactNSiSt	52	P102250515	IEC	N/A	100	N/A	4-Pole	6/7/2018 1:44:29 PM
MLVS_PANEL.MTZ.TIE	Micrologic X	5.0 (LS)	N/A	IEC	400	1600	50Hz	4-Pole	6/7/2018 12:29:32 PM

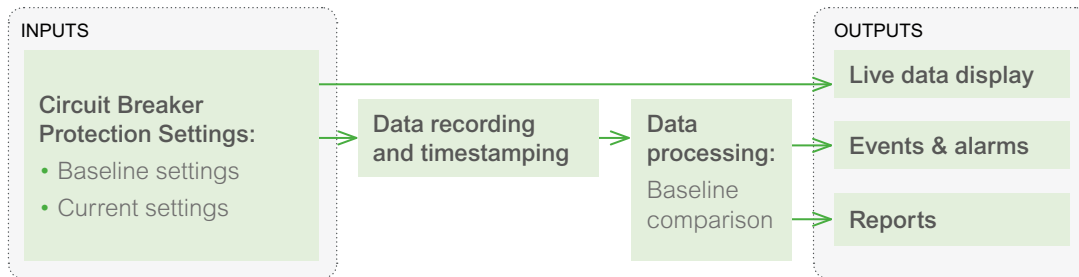
Circuit Breaker Setting Report

> BREAKER SETTINGS MONITORING

System Description (1/3)

Data Flow

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



Data Flow in Detail

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 co-ordination 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

PowerPacT (China) / ComPacT NSX:

- Micrologic 5.2/5.3 A/E
- Micrologic 6.2/6.3 A/E

MasterPacT MTZ:

- Micrologic 2 X, Xi
- Micrologic 3 X, Xi
- Micrologic 5 X, Xi
- Micrologic 6 X, Xi
- Micrologic 7 X, Xi

Baseline Settings

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

Current Settings

The baseline settings mentioned above are compared to the current settings of all included circuit breakers. Any differences are highlighted to help operators or facility managers understand any potential impact on the overall electrical system protection co-ordination.



> BREAKER SETTINGS MONITORING

System Description (2/3)

Data Flow in Detail (cont.)

DATA RECORDING AND TIMESTAMPING

Breaker protection settings data is recorded and timestamped by the Edge Control Software (EcoStruxure™ Power Monitoring Expert or the Advanced Reporting & Dashboards Module of Power Operation). Therefore, no specific device for time-synchronization is necessary.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)



EcoStruxure™
Power Monitoring Expert

DATA PROCESSING

Baseline Comparison

A circuit breaker protection setting baseline is used by the Edge Control (EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards Module) to compare the current 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.



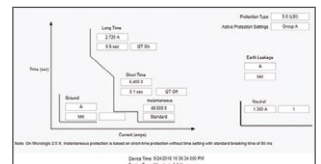
EcoStruxure™
Power Operation with Advanced
Reporting & Dashboards

OUTPUTS

Outputs are displayed remotely via the Edge Control software EcoStruxure™ Power Monitoring Expert and/or EcoStruxure™ Power Operation with Advanced Reporting & Dashboard.

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 & Alarms*

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

By default, alarms are generated in the event 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
- Ground Fault Overcurrent Curve
- Earth Leakage Protection Enabled
- Earth Leakage Protection Pickup Threshold / Time Delay

* The Breaker Performance Module of EcoStruxure™ Power Monitoring Expert must be deployed to benefit from these features.

> BREAKER SETTINGS MONITORING

System Description (3/3)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Reports*

Reports can be configured to be generated upon detection of breaker setting change.

Circuit Breaker Settings Report

It is used to monitor and report 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:

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

* The Breaker Performance Module of EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards must be deployed to benefit from these features.

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

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

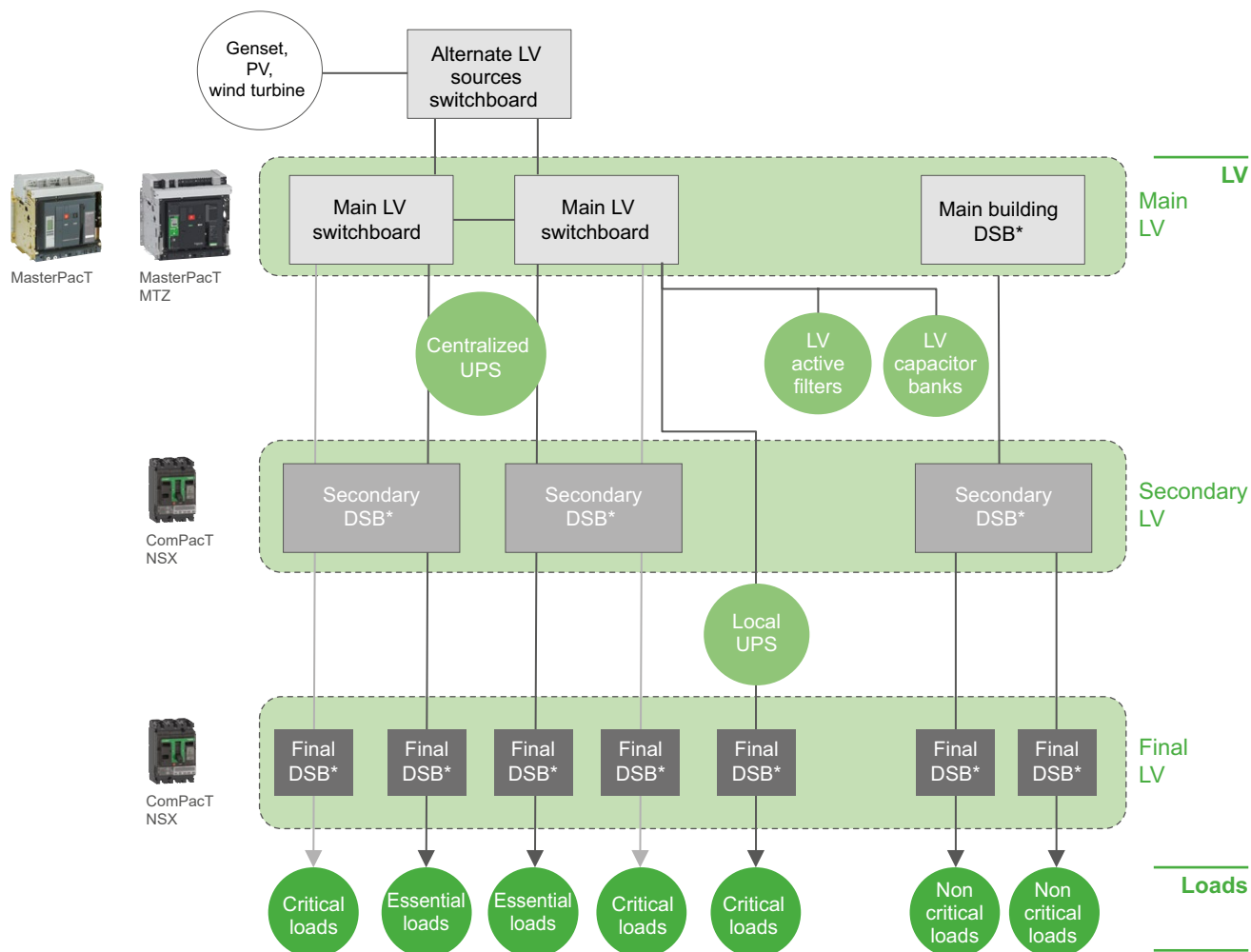
Value has changed since the baseline date of 7/26/2018 12:00:00 AM - (Server Local).

Circuit Breaker Settings Report

> BREAKER SETTINGS MONITORING

Electrical Architecture

The following diagram details in which areas of the electrical architecture the connected products should be located, in order to implement the Breaker Settings Monitoring application:



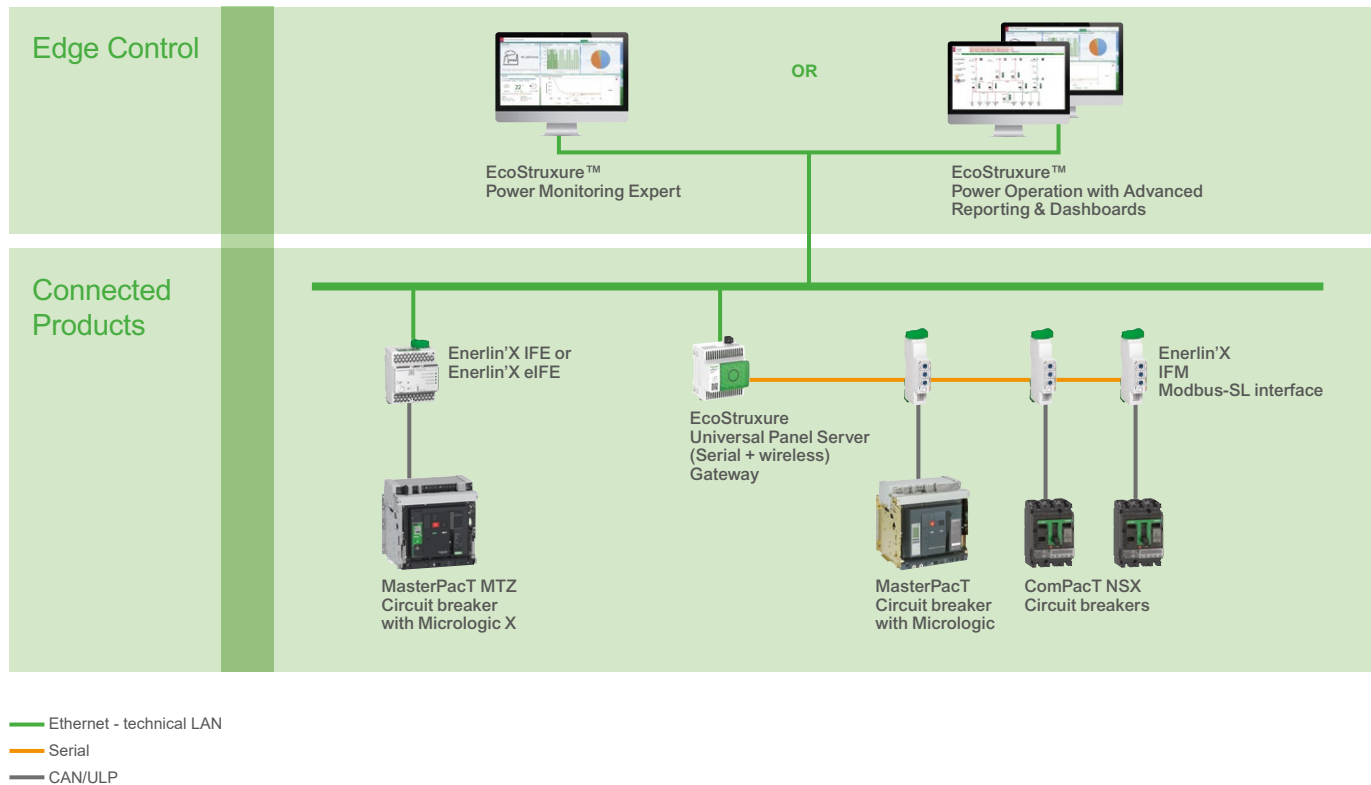
* DSB = Distribution Switchboard

> BREAKER SETTINGS MONITORING

Digital Architecture

The digital architecture of the Breaker Setting Monitoring application involves collecting the protection settings of the different circuit breakers either directly in Modbus TCP/IP or via a gateway.

The recommended digital architecture for the Circuit Breaker Setting Monitoring application is given below:



> POWER QUALITY MONITORING

Capture, Analyze and Understand Power Quality Disturbances (1/2)

Context of Application

There are many different power quality disturbances which can adversely affect critical or sensitive equipment, processes and buildings. To promote seamless and uninterrupted functioning of these assets, it is very important to continuously measure, understand and act on any power quality issues that could affect uninterrupted operation.

1

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

2

PURPOSE OF POWER QUALITY MONITORING APPLICATION

Monitor Persistent Steady State and Event-based Disturbances

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

3

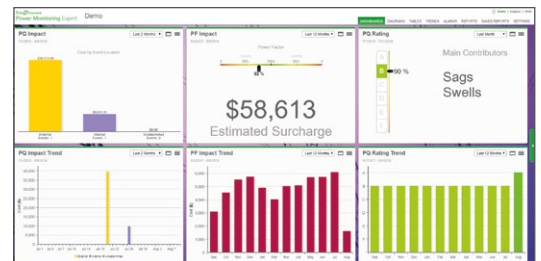
Better Understand Power Quality Disturbances

- 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

4

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

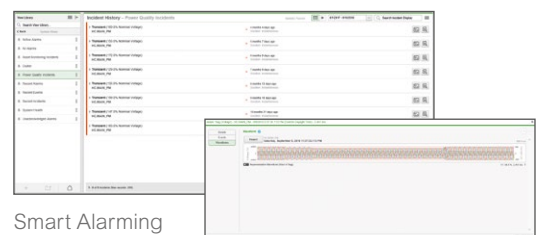
Steady state disturbances such as harmonics, unbalance, frequency can be visualized in real time.

Events & Alarms

Onboard events and alarms with timestamps.

Trends

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



Smart Alarming

> POWER QUALITY MONITORING

Capture, Analyze and Understand Power Quality Disturbances (2/2)

Application Outcomes (cont.)

Analysis Tools

- Power Events Incident Timeline
- Waveform viewer

Dashboards

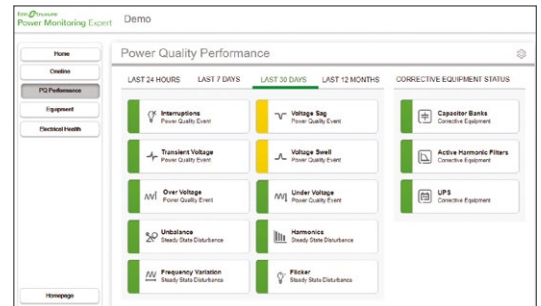
- Power Quality diagrams
- Power Quality dashboards

Reports

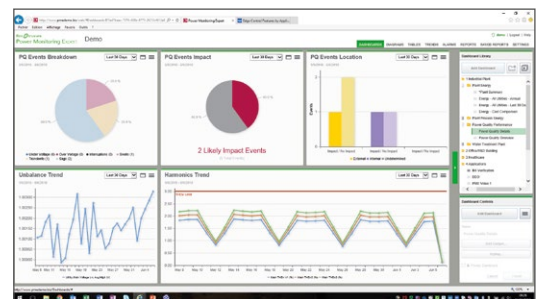
- Power Quality Report, Power Quality Analysis and Impact Reports
- Harmonics Compliance Report, IEC 61000-4-30 Report, EN 50160-2000 and EN 50160-2010 Reports

Cloud-based Analytics & Services

As an option, EcoStruxure™ Power Advisor connected service can perform cloud-based analytics on power quality data.



Power Quality Performance Status Panel



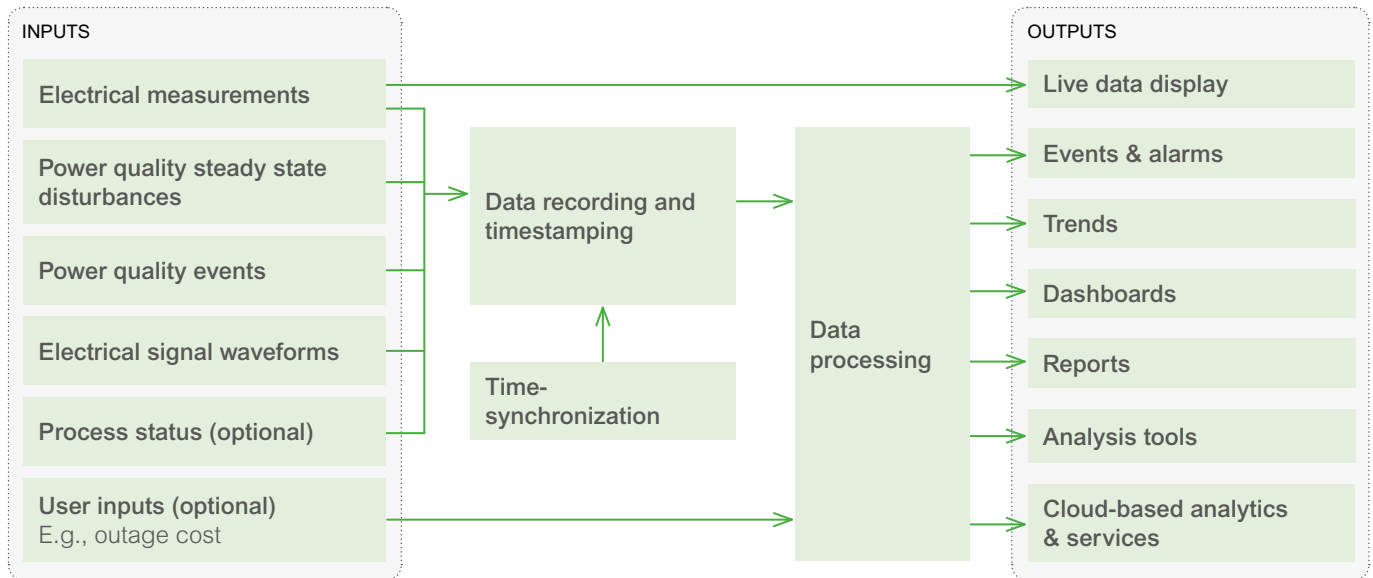
Power Quality Details Dashboard

> POWER QUALITY MONITORING

System Description (1/6)

Data Flow

Power Quality Monitoring application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data is required:

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

Power Quality Events

- Transients
- Interruptions
- Voltage sags & swells
- Overvoltage and undervoltage

Electrical Signal Waveforms

- High sample rate sinusoidal waveform data for all phases of voltage and current



For main incomers and critical feeders, power quality shall 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 & swells etc.). For less critical circuits, steady state disturbances can be acquired either by embedded metering in protection devices such as the Easergy P5/P3 relays, MasterPacT MTZ circuit breaker or by entry-level models of PM5000 power meters.

> POWER QUALITY MONITORING

System Description (2/6)

Data Flow in Detail (cont.)

INPUTS (cont.)

The following table outlines the limitations and capabilities with respect to power quality data capture:

	Flicker measurement	Transient detection	Disturbance direction	Sag/swell monitoring	Harmonic distortion: total/individual/interharmonics	Waveform capture
ION9000	Yes	Yes (20 μ s)	Yes	Yes	Yes (+TDD*) / Yes / No (1)	Yes
ION9000T	Yes	Yes (100 ns)	Yes	Yes	Yes (+TDD*) / Yes / No (1)	Yes
PM8000 series	No	No	Yes	Yes	Yes / Yes / No	Yes
PM5000 series	No	No	No	No	Yes (+TDD*) / Yes / No	No
MasterPacT MTZ	No	No	No	No	Yes / Yes / No (with additional digital module)	Yes, on trip event only
Easergy P5	No	No	No	Yes	Yes / Yes / No	Yes, on trip event only
Easergy P3	No	No	No	No	Yes / No / No	Yes, on trip event only

(1) Does provide interharmonic measurements, but not THD for interharmonics

* Total Demand Distortion

Process Status

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 (e.g., current or voltage drop)
- Hardwired signal from a process PLC or signal from a digital input (e.g., from a meter)
- An OPC tag served by an OPC server

User Inputs

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 ms (possible using PTP or GPS time-synchronization).

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

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

For other connected products (Easergy P5/P3, MasterPacT MTZ (2), entry-level PowerLogic PM5000 models) steady state disturbances are measured by the connected products and recorded by EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards.

When acquiring data from other systems, timestamps can also be imported through OPC or ETL (3).

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)



(2) For power quality measurements, MasterPacT MTZ has the option of adding the:

- Individual Harmonics Analysis Digital Module
- Under/Over voltage Digital Module

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

Product, Software and Services: See page 229



> POWER QUALITY MONITORING

System Description (3/6)

Data Flow in Detail (cont.)

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 ensure coordination among otherwise independent clocks.



TimeSync Clock

DATA PROCESSING

Power quality data is processed in some instances on board the device and others in the Edge Control software for visualization on the software interface.

Advanced power quality data processing is performed on board advanced power quality meters such as PowerLogic ION9000, PM8000:

- Determination of transients, sags, swells, and interruption
- Disturbance Direction Detection (DDD) for Transients and Voltage Sags/Swells (upstream, downstream)

EcoStruxure™
Power Monitoring Expert

Further data processing is performed in the Edge Control software (EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards):

- 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 Operation with Advanced
Reporting & Dashboards

With the addition of the Power Quality Performance Module in Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards, 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 (e.g., process interruption) with power quality event using an electrical input or physical signal from operations

PowerLogic
ION9000PowerLogic
PM8000

> POWER QUALITY MONITORING

System Description (4/6)

Data Flow in Detail (cont.)

OUTPUTS

Live data, trends, smart alarming and some dashboards and reporting are available by default in Edge Control software (EcoStruxure™ Power Monitoring Expert or EcoStruxure™ Power Operation with Advanced Reporting and Dashboards) for displaying power quality data.

The optional Power Quality Performance Module in EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting and Dashboards 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.

Live Data Display

At any time, all related electrical measurements and steady state disturbances such as harmonics, unbalance, frequency can be displayed in real time in EcoStruxure™ Power Monitoring Expert and Power Operation.

Events & Alarms

Power quality events captured and uploaded from connected products can be displayed as individual alarms in Edge Control 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, frequency can be displayed as trends to monitor their evolution over time.

Dashboards*

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 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 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.

* The Power Quality Performance Module of EcoStruxure™ Power Monitoring Expert must be deployed to benefit from these features.



EcoStruxure™
Power Monitoring Expert



EcoStruxure™
Power Operation with Advanced
Reporting & Dashboards



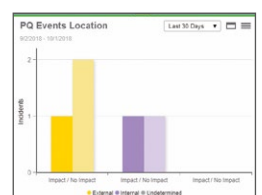
EcoStruxure™
Power Advisor



Power Quality Rating



Power Quality Incident Impact



Power Quality Incident Location



> POWER QUALITY MONITORING

System Description (5/6)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Dashboards* (cont.)

Power Quality Rating Trend

Shows the power quality rating, over a selected time period.



Power Quality Rating Trend

Power Quality Impact

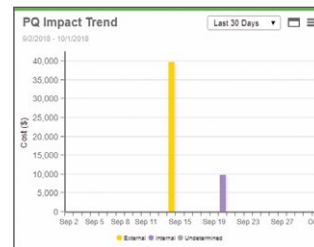
Shows the cost of power quality events with a process impact, over a selected time period. The information is shown in a column chart, grouped by location of power quality event origin (external, internal, undetermined).



Power Quality Impact

Power Quality Impact Trend

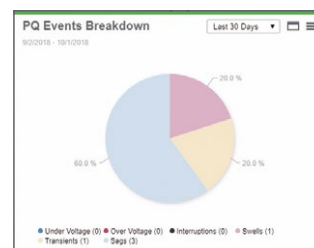
Shows the aggregated cost of power quality events with a process impact, over a selected time period.



Power Quality Impact Trend

Power Quality Incident Breakdown

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

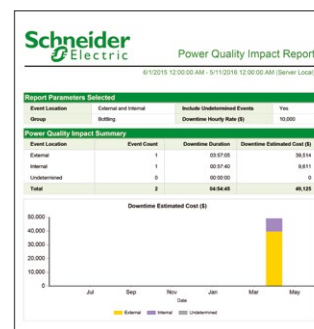
Reports*

The following reports can be generated on-demand or automatically, and sent via e-mail to configured recipients.

Power Quality Impact Report

Indicates impact from downtime that occurred for a power quality group and provides an estimated cost associated for a given period of time that is 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 are from an undetermined location.

* The Power Quality Performance Module of EcoStruxure™ Power Monitoring Expert must be deployed to benefit from these features.



Power Quality Impact Report

System Description (6/6)

OUTPUTS (cont.)

Power Quality Analysis Report

Power Quality Analysis Report
 8/1/2012 12:00:00 AM - 8/1/2012 12:00:00 AM (Device Load)

Power Quality Event Summary -- Total Events 52

Power Quality Events Breakdown:

Event Type	Count	Percentage
Interruptions (0)	0	0.0%
Line Voltage (0)	0	0.0%
Sag (0)	0	0.0%
200-250% (0)	0	0.0%
Transients (0)	0	0.0%
Lower Voltage (0)	0	0.0%

Power Quality Events Impact

Impact Type	Count	Percentage
Line Impact (0)	0	79.2%
Sag Impact (0)	0	20.8%

Power Quality Events Location

Location	Count
Distribution Transformer	2
Main Distribution Panel	8
Service Panel	1
Air Conditioning Panel	1
Air Handling Unit	0

Power Quality Analysis Report

The screenshot displays the iQoPower Power Monitoring & Control software interface. The top navigation bar includes the product name and a 'Demo' button. On the left, a sidebar contains navigation options: 'Home', 'Status', 'Performance' (highlighted), 'Report', and 'Historical Data'. The main content area is titled 'Power Quality Performance' and features a grid of status indicators for different power quality metrics. Each indicator consists of a colored bar (green for good, yellow for warning, red for critical) and a text label. The metrics shown are: Voltage Unbalance (green), Voltage Sag (yellow), Voltage Swell (green), Frequency Unbalance (green), Frequency Sag (green), Frequency Swell (green), Total Voltage (green), Under Voltage (green), Over Voltage (green), Undervoltage (green), Overvoltage (green), Frequency Variation (green), and Harmonics (green). A 'Corrective Equipment Status' section on the right shows the status of various equipment, including a Generator Breaker, a Motor, and a Transformer, with a 'Status' button at the bottom.

Power Quality Performance Diagrams

The screenshot shows the AWS IAM console 'Users' page. The 'Users' list is empty. The 'Groups' list shows 'AWS-ReadOnlyAccess' and 'AWS-ReadOnlyAccess-2'. The 'Groups' list is highlighted.

Power Events Incident Timeline

Waveform Viewer

These viewers allow for the following:

- [illegible]

Electrical Network Health Check Report

EcoStruxure™ Power Advisor

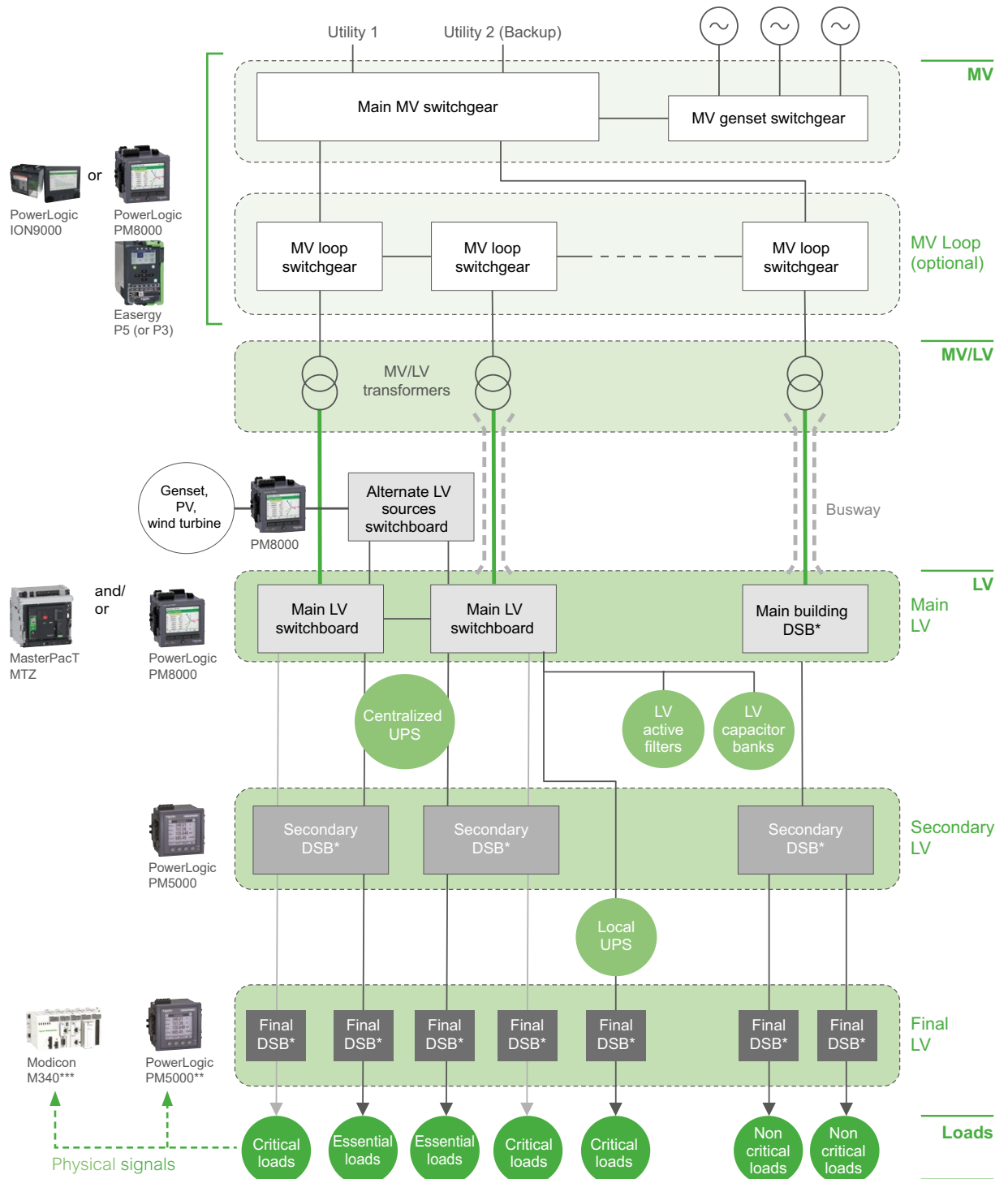


> POWER QUALITY MONITORING

Electrical Architecture

For sensitive loads or critical applications, standalone power quality meters are recommended in parallel with protection devices for sub-cycle power quality events 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 application:



* DSB = Distribution Switchboard

** PowerLogic PM5300 and PM5500 range meters and above support available digital IO for physical signal acquisition.

*** EcoStruxure™ Plant device

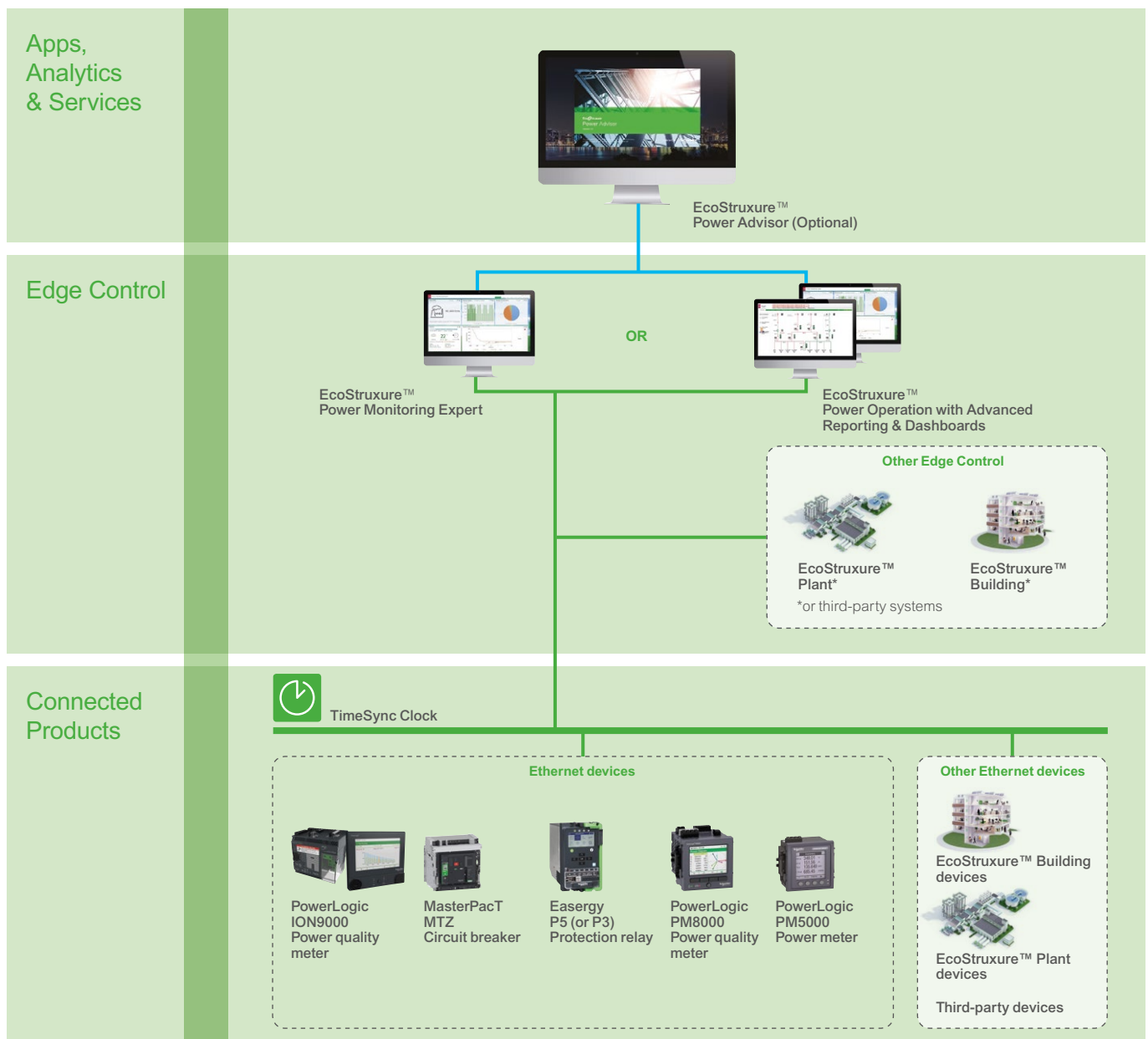
> POWER QUALITY MONITORING

Digital Architecture

The digital architecture of the Power Quality Monitoring 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.

For EcoStruxure™ Power Advisor, data from EcoStruxure™ Power Monitoring Expert or Power Operation are remotely collected and uploaded to the Schneider Electric cloud and analyzed by qualified service engineers.

The recommended digital architecture for the Power Quality Monitoring application is given below:



Product, Software and Services: See page 229



> POWER QUALITY CORRECTION

Help Protect Sensitive Equipment and Business Operations from Power Quality Issues

Context of Application

In order to ensure maximum 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:

- Protect sensitive equipment and processes against power quality issues
e.g., nuisance tripping, overheating, malfunction of sensitive equipment
- Ensure continuity of business operations
- Comply with standards
e.g., harmonics standards like IEEE 519.

PURPOSE OF POWER QUALITY CORRECTION APPLICATION

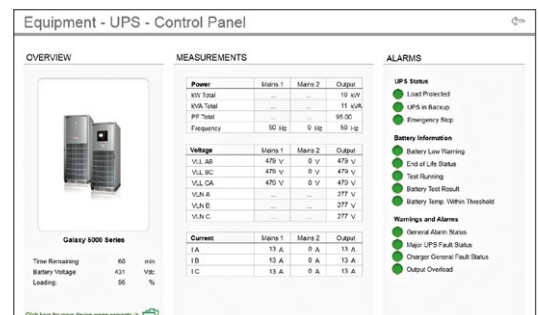
Power Quality Correction addresses common power quality issues such as harmonics, load unbalance and short interruptions.

Mitigate Harmonic Effects (with AccuSine PCS+/PCSn)

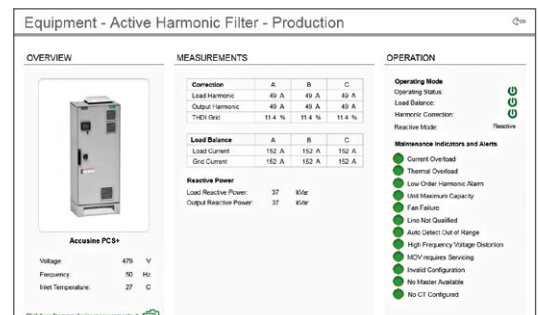
Harmonic disturbances typically occur in facilities with sizable non-linear loads such as variable speed drives (VSD), arc furnaces, electronic equipment with switch-mode power supplies, LED lighting, electronic ballasts, battery chargers and more...

Cure Power Quality Problems Due to Load Current Fluctuations (with UPS)

Typically needed to protect sensitive loads from interruptions, voltage sags and swells, flicker, etc.



UPS Equipment Control Panel Diagram



Active Harmonic Filtering Device Diagram

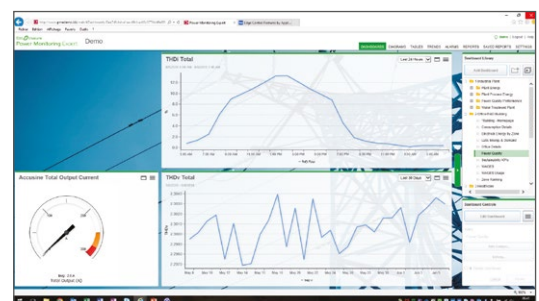
Application Outcomes

Live Data Display

- UPS equipment status panel diagram
- Active harmonic filtering device diagram.

Dashboards

- Power Quality dashboard: current, voltage, power factor, reactive power and energy, current and voltage harmonic distortions.



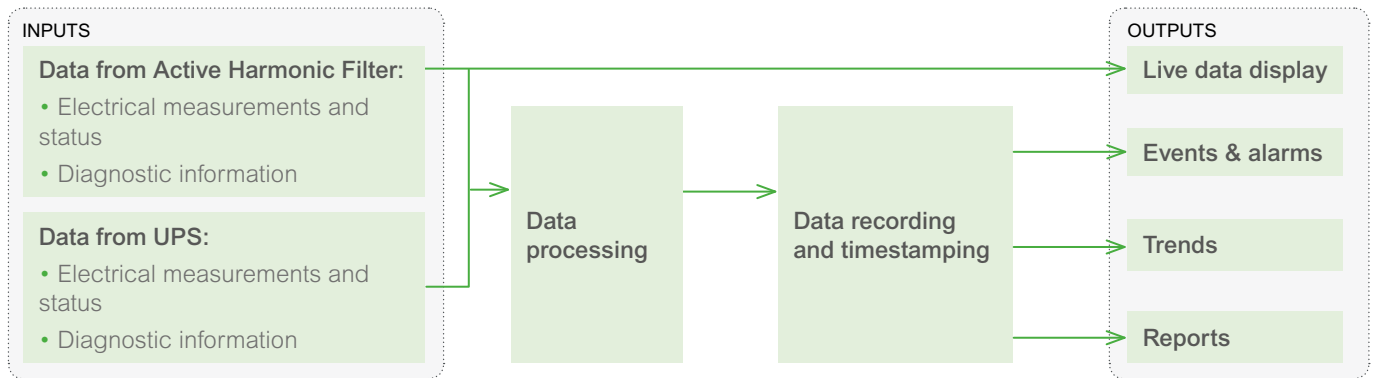
Standard Dashboard for Power Quality Correction

> POWER QUALITY CORRECTION

System Description (1/2)

Data Flow

The Power Quality Correction application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data is required:

Data from Active Harmonic Filters (AccuSine PCS+/PCSn/PFV+)

Electrical and Environmental

- Voltage, current, frequency
- Load harmonics, output harmonics
- Load reactive power, output reactive power
- Ambient temperature

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.

Data from UPS (Galaxy VX/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



POWER QUALITY CORRECTION

System Description (2/2)

Data Flow in Detail (cont.)

DATA PROCESSING

Data processing is done through the Edge Control's data acquisition engine to create alarms and events from status and diagnostic information (with EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards).



EcoStruxure™
Power Monitoring Expert

DATA RECORDING AND TIMESTAMPING

Data recording is done by EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards based on realtime 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.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)



EcoStruxure™
Power Operation with Advanced
Reporting & Dashboards

OUTPUTS

Live data, alarms, events, trends and dashboards are available by default in EcoStruxure™ Power Monitoring Expert and Power Operation with Advanced Dashboards & Reporting.

Live Data Display

Live data acquired by the software driver can be displayed through equipment diagrams in EcoStruxure™ Power Monitoring Expert or EcoStruxure™ Power Operation with Advanced Reporting & Dashboards.

One-page summary diagrams give quick access to the most useful realtime 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.

Events & Alarms

Alarms and events 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 diagnostics alarms.

Trends

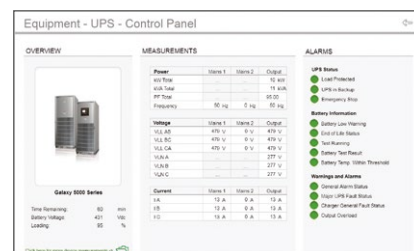
All analog values stored as historical data can be displayed as trends to monitor their evolution over time.

Dashboards

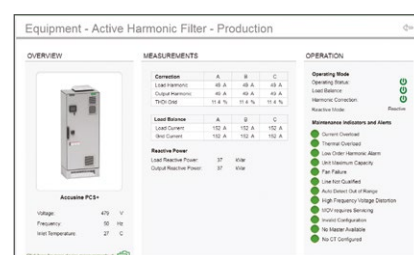
Electrical measurements acquired from correction equipment (AccuSine PCS+/PCSn/PFV+, Galaxy UPS) can be displayed as historical data in dashboards.

Some examples of these dashboards include:

- Active Harmonic Filter output
- Active Harmonic Filter THDi and THDv total (input or load)



UPS Live Data Display



Active Harmonic Filter Live Data Display



Active Harmonic Filter THDi and THDv Dashboards

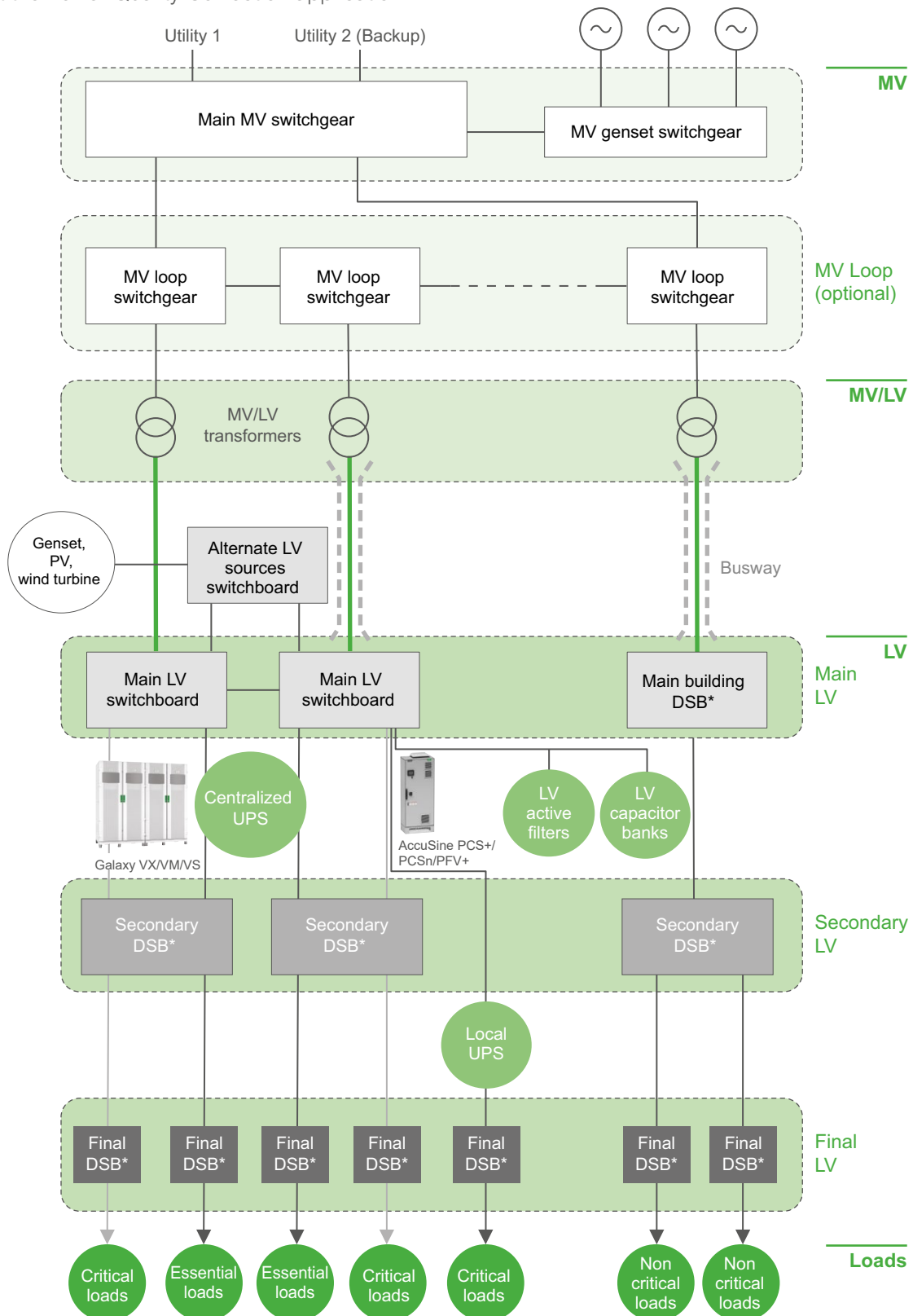
Product, Software and Services: See page 229



> POWER QUALITY CORRECTION

Electrical Architecture

The following diagrams detail which area of the architecture the devices should be installed in, in order to implement the Power Quality Correction application:



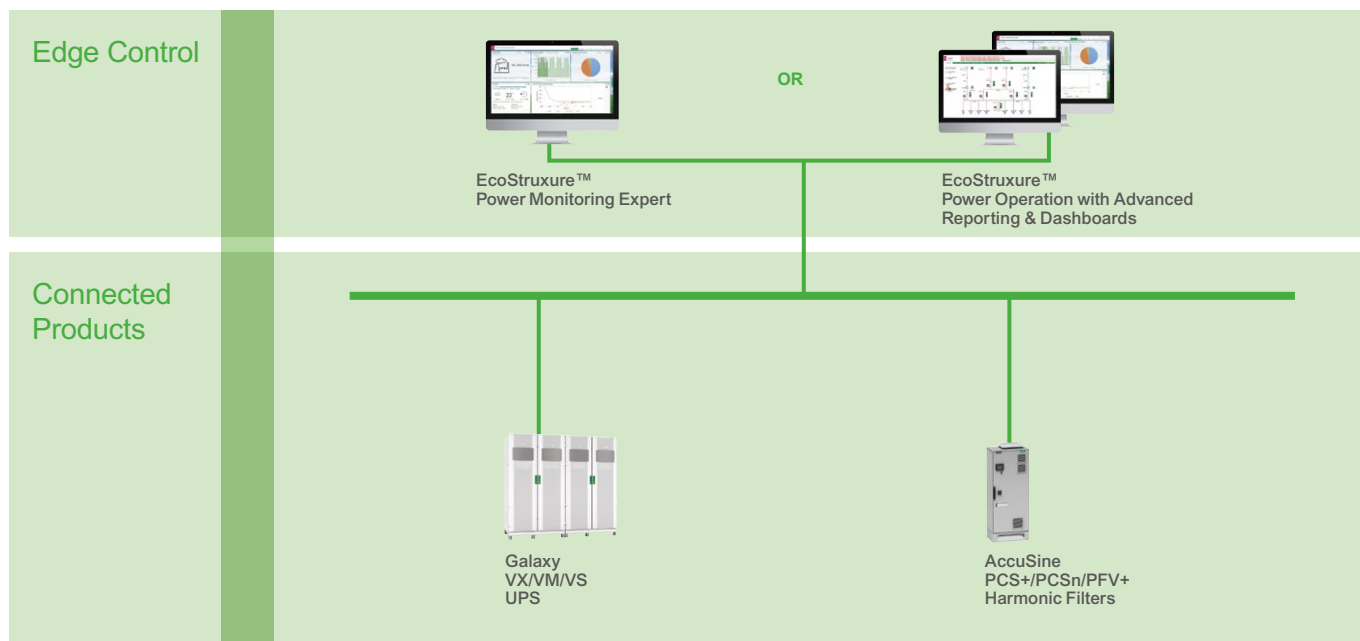
* DSB = Distribution Switchboard

> POWER QUALITY CORRECTION

Digital Architecture

Communications for both AccuSine PCS+/PCSn/PFV+ Active Harmonic Filters and Galaxy UPS (5xxx series and VX, VM, VS) are done through direct Ethernet connection.

The recommended digital architecture for the Power Quality Correction application is given below:



> POWER SOURCE & LOAD CONTROL

Remotely Control and Visualize Automated Electrical Control Schemes

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 the SCADA or mobile app
- Automate transfer schemes, load shifting or simple load shedding operations
- Visualize and audit sequences of operations

PURPOSE OF POWER SOURCE & LOAD CONTROL 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 controller-based electrical controls.

Application Outcomes

Live Data Display

- Animated Single-Line Diagrams (SLD) display the status of the system

Events & Alarms

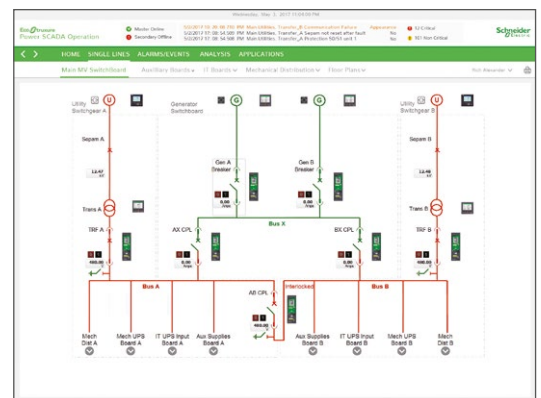
- All remote control actions performed in Ecostruxure™ Power Monitoring Expert or Power Operation are logged and available for auditing and tracking
- Operating status of automated systems (Loop configuration, Automatic Transfer Switch...) is permanently monitored. This enables preventive intervention through alarms and notification if any abnormal conditions arise in the electrical network reconfiguration system.

Notifications

- SMS 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 SCADA HMI or via the device mobile app
- 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



Animated Single-Line Diagram

The screenshot shows the 'Main MVS Switchboard' page in the Esri ArcGIS Enterprise Portal. The page features a top navigation bar with 'Esri ArcGIS Enterprise' and 'Power SCADA Operation' tabs. Below the navigation bar, there are several tabs: 'HOME', 'SINGLE LINES', 'ALARMS/EVENTS', 'ANALYSIS', and 'MAIN MVS SWITCHBOARD'. The 'MAIN MVS SWITCHBOARD' tab is active, displaying a table of system events. The table has columns for 'Date', 'Time', 'Time-Goal', 'Event', and 'Description'. The events listed include 'Main Utilities Transfer_A' and 'Main Utilities Transfer_B', which are marked as 'No Time Sync Information' and 'No Time Sync Information' respectively. The 'Description' column for these events indicates 'Requires reset after fault' and 'Protection 5051 unit 1'.

Date	Time	Time-Goal	Event	Description
12/20/2018	09:19:02:050 PM	No Time Sync Information	Main.Utilities.Transfer_A	Requires reset after fault
12/20/2018	09:19:02:020 PM	No Time Sync Information	Main.Utilities.Transfer_A	Protection 5051 unit 1
12/20/2018	09:19:02:010 PM	No Time Sync Information	Main.Utilities.Transfer_A	Requires reset after fault
12/20/2018	09:19:02:020 PM	No Time Sync Information	Main.Utilities.Income_A	Protection 5051 unit 1

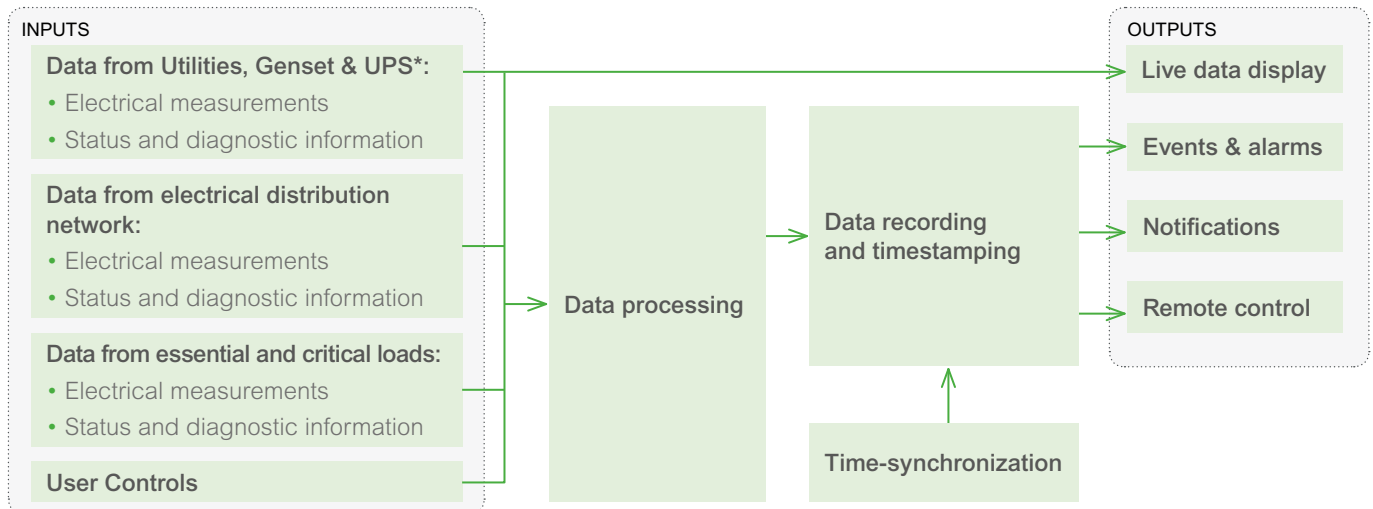
Alarms

> POWER SOURCE & LOAD CONTROL

System Description (1/3)

Data Flow

The Power Source & Load Control application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data is required:

Data from Utilities, Genset & UPS*

- **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 to diagnostic information to run proper automatic or manual reconfiguration sequences.

For the utility incomer and for the genset, these measurements are collected by protection relays such as the Easergy P5 or P3 or directly from the genset controller.

For UPS, the measurements can be performed by Galaxy VX/VM/VS.

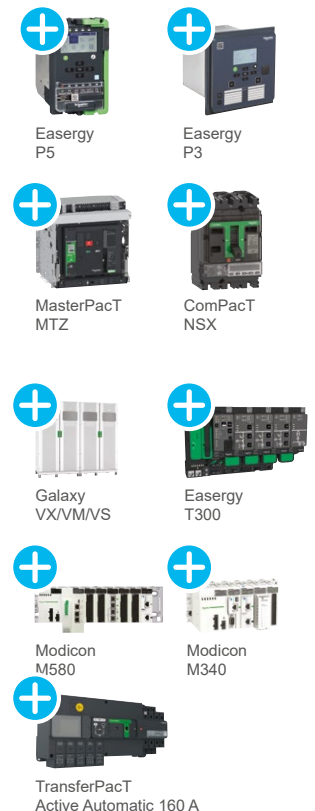
Data from Electrical Distribution System

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.
- **Status and diagnostic information:**
 - Status, diagnostics and associated status changes from contactors, switches, circuit breakers, Automatic Transfer Switch
 - Trip context from circuit breakers
 - Status of automatic reconfiguration devices

This information is gathered from protection relays with embedded metering (Easergy P5/P3, MasterPacT MTZ or ComPacT NSX), from automation controllers (Easergy T300, Modicon M340 or M580 PAC) and from the controller of the Automatic Transfer Switch (TransferPacT Active Automatic).

* UPS: Uninterruptible Power Supply



Product, Software and Services: See page 229



> POWER SOURCE & LOAD CONTROL

System Description (2/3)

Data Flow in Detail (cont.)

INPUTS (cont.)

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 (Acti9 or TeSys ranges) or through digital and analog inputs of controllers (Modicon M340 or M580 PAC).

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 device front panel), such as resetting of alarms or open/close orders.

DATA PROCESSING

For this Power Source & Load Control application, most data processing occurs before data recording and timestamping. This is because Power Source & Load Control relies on automation and mostly occurs without user intervention.

These automated actions are monitored and recorded with timestamps in Edge Control software (EcoStruxure™ Power Operation) for a better understanding of reconfiguration sequences and potential system issues due to improper operating conditions (e.g., device in local mode, tripped circuit breaker...).

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.

DATA RECORDING AND TIMESTAMPING

All Power Source & Load Control activities are recorded and timestamped for post mortem analysis, traceability and auditing.

For critical applications, a timestamp accuracy of ± 10 ms is recommended.

To achieve this, the measurements and events are recorded and timestamped onboard smart equipment such as Easergy P5/P3, Modicon M580 and M340, etc.

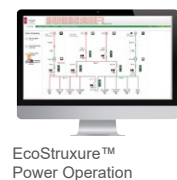
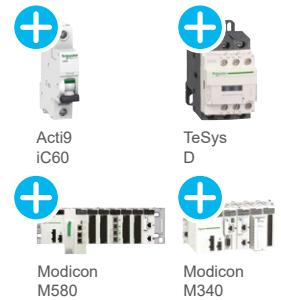
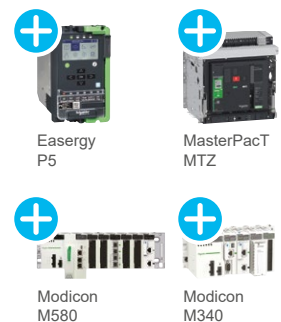
For less critical applications, ± 100 ms may be adequate.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)

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, SNTP...). An external master clock may be required and may be connected to a GPS antenna to reach the expected time precision.

EcoStruxure™
Power Operation

TimeSync Clock

Product, Software and Services: See page 229



> POWER SOURCE & LOAD CONTROL

System Description (3/3)

Data Flow in Detail (cont.)

OUTPUTS

Outputs are displayed remotely via EcoStruxure™ Power Operation or EcoStruxure™ Power Operation with Advanced Reporting & Dashboards.

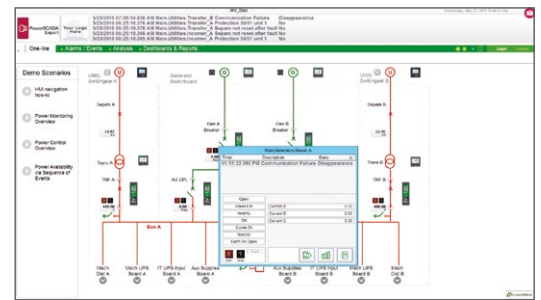


EcoStruxure™
Power Operation

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 understand the status of each piece of equipment.

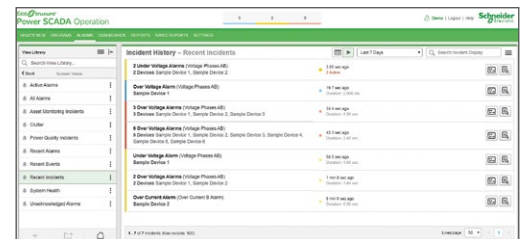


Live Data Display in EcoStruxure™ Power Operation

Events & Alarms

Events and alarms are uploaded from connected products or generated by the Edge Control software (EcoStruxure™ Power Operation or Power Operation with Advanced Reporting and Dashboards) and displayed in native alarm and event 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.



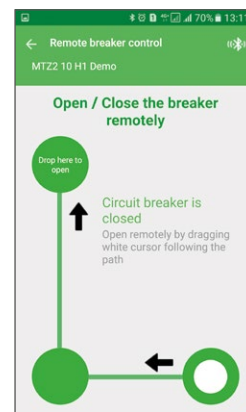
Events & Alarms Log viewer in EcoStruxure™ Power Operation

Notifications

Notifications can be sent by EcoStruxure™ Power Operation or Power Operation with Advanced Reporting and Dashboards with the optional Event Notification Module.

Remote Control

EcoStruxure™ Power Operation enables select-before-operate commands. Devices such as the MasterPacT MTZ, Easergy P5 or P3 can be manually controlled from the EcoStruxure™ Power Device App.

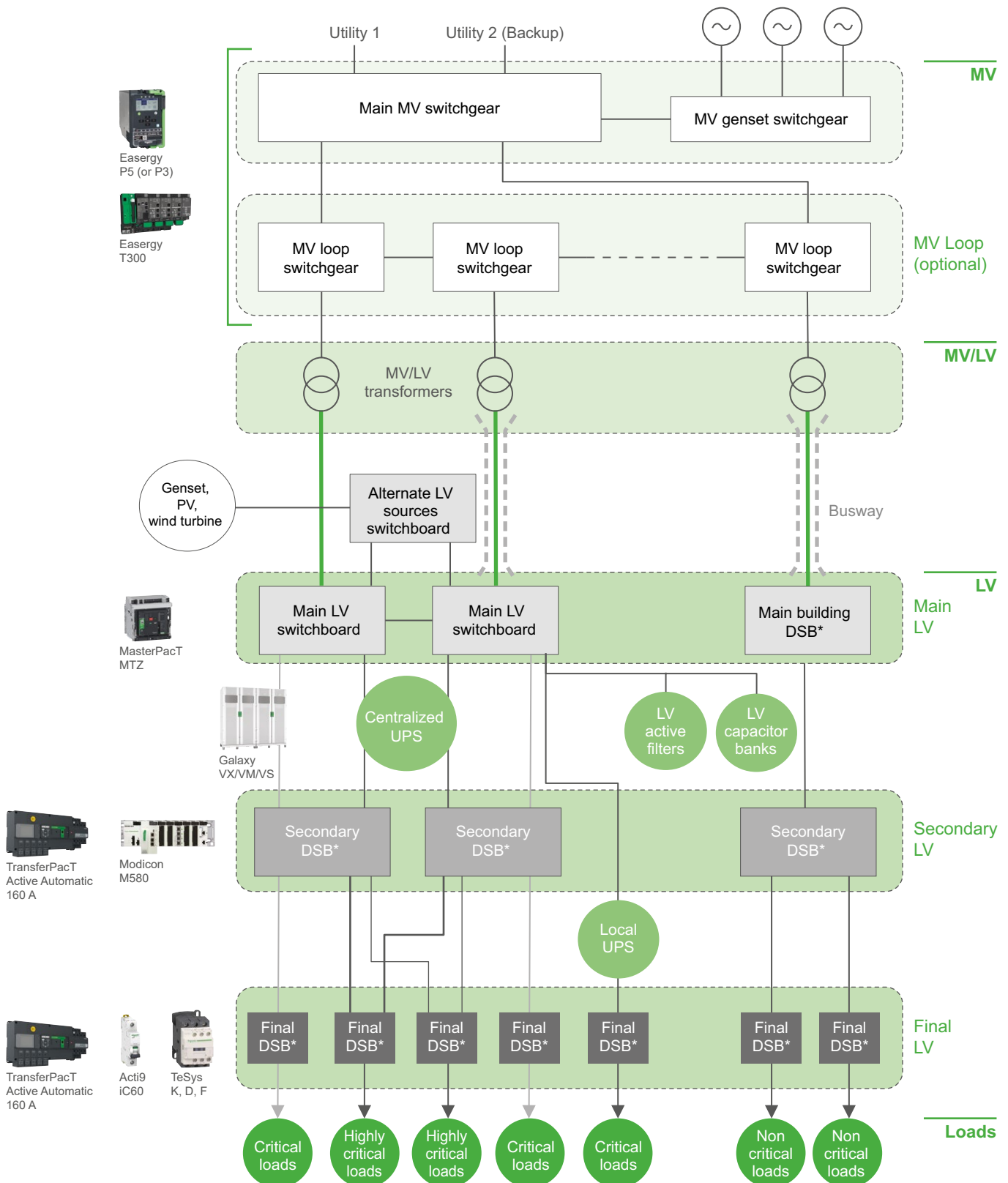


Remote Circuit Breaker Control Interface
in EcoStruxure™ Power Device

> POWER SOURCE & LOAD CONTROL

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 & Load Control application:



> POWER SOURCE & LOAD CONTROL

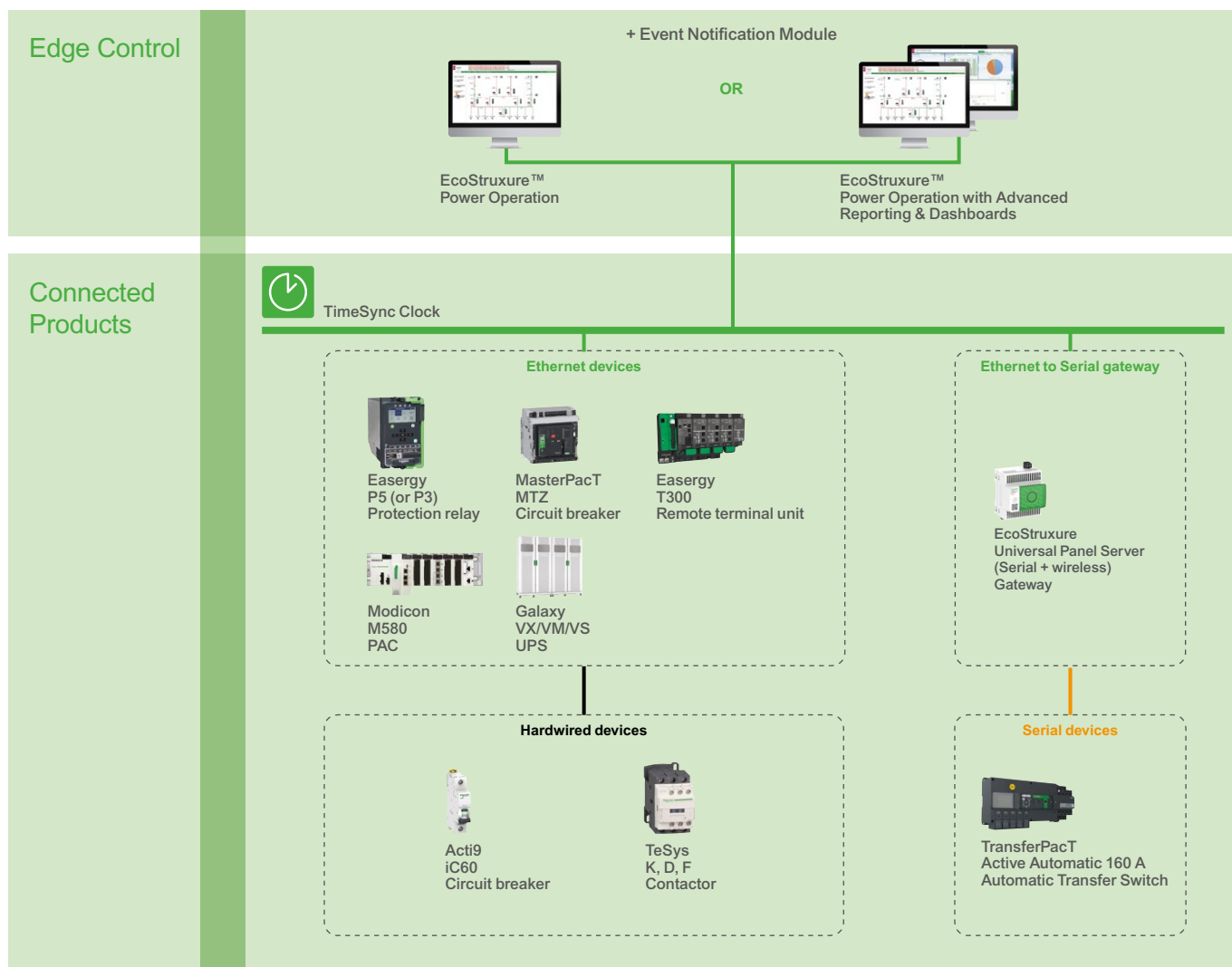
Digital Architecture

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 with slower performance.

The recommended digital architecture for the Power Source & Load Control application is given below:



> ADVANCED PROTECTION & AUTOMATION

Improve the Management of Large and Complex Electrical Distribution Networks Through Sophisticated Protection and Automation Schemes (1/2)

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 power distribution systems.

PROBLEM TO SOLVE

The Facility Manager Needs to:

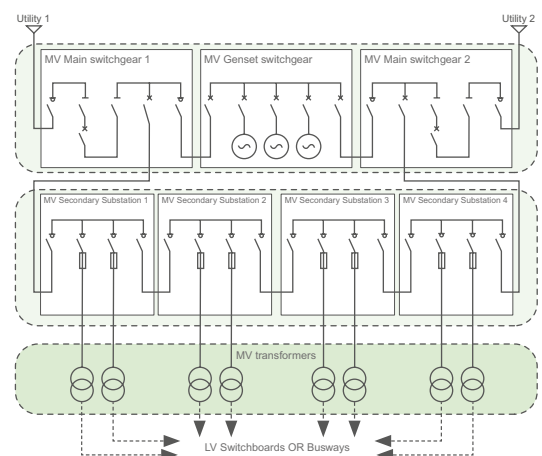
- Protect electrical networks from faults (e.g., short-circuit, overload)
- Maintain continuity of services in case of outages on primary source with an autonomous and fast response to events (e.g., fast self-healing, automatic transfer switch and load-shedding)
- Plan effective operation and maintenance programs

PURPOSE OF ADVANCED PROTECTION & AUTOMATION APPLICATION

Provide Protection and Fault Tolerant Automation Schemes

A combination of connected hardware, Edge Control software and advanced lifecycle management tools provides electrical network advanced automation and protection applications based upon IEC 61850 standard technologies.

Enable Remote Operation and Maintenance through Electrical System Graphical Displays



Application Outcomes

Cybersecurity

- Centralizes OT infrastructure user & password administration, Security Policies, Access Control, Security Logs and Intrusion Detection System

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: 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



> ADVANCED PROTECTION & AUTOMATION

Improve the Management of Large and Complex Electrical Distribution Networks Through Sophisticated Protection and Automation Schemes (2/2)

Application Outcomes (cont.)

Protection Schemes

Intelligent Electronic Devices (IED) monitor and protect electrical distribution systems with all required features, including:

- Thermal Overload protection
- Generator protection
- Transformer protection
- Arc flash protection

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

Events & Alarms

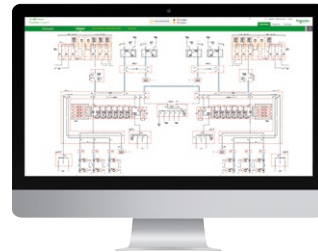
- Chronological display of events and alarms with sorting and filtering capabilities

Trends

- Realtime and historical data can be viewed on a trend viewer

Reports

- Select-before-operate commands are available from SCADA HMI



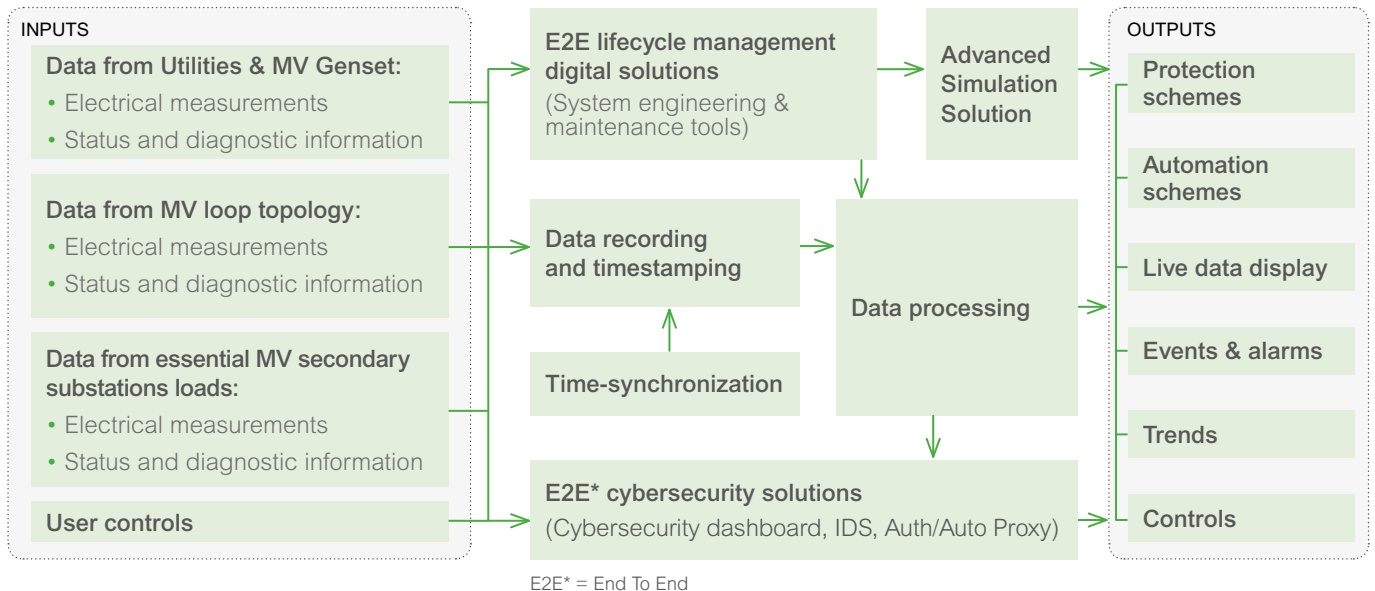
Single Line Diagram Live Display

> ADVANCED PROTECTION & AUTOMATION

System Description (1/6)

Data Flow

The Advanced Protection & Automation application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data is required:

Data from Utilities & MV Genset

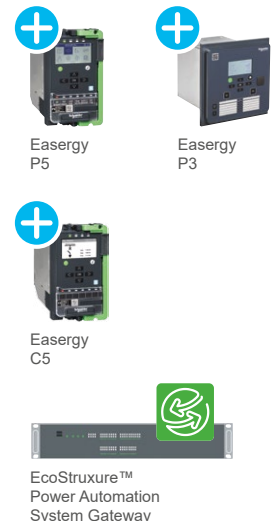
- **Electrical measurements:** power sources and outcome feeders are monitored to process real-time protection algorithms and automation schemes to automatically operate actuators in case of electrical fault
- **Status and diagnostic information:** if any source or network control operations involve the utility incomers, MV secondary substations or genset in the facility, it is essential to determine their status and to access to diagnostic information to run proper automatic reconfiguration sequences

For the utility incoomer and for the genset, these measurements are collected by protection relays such as the Easergy P3 or P5, automation controllers such as Easergy C5, or EcoStruxure Power Automation System Gateway in the case of Modbus device.

Data from MV Loop Topology

The following data is acquired from protection relays with embedded metering (Easergy P3 or P5) and from automation controllers (Easergy C5) for automatic systems and helps operators decide on the best supply path through the electrical distribution network:

- **Electrical measurements:** electrical system incoming and outgoing power and measurements such as voltage, current, power, etc. 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, 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 controller.



Product, Software and Services: See page 229



> ADVANCED PROTECTION & AUTOMATION

System Description (2/6)

Data Flow in Detail (cont.)

INPUTS (cont.)

Data from Essential 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:** incoming (from utilities), generated (from genset) and consumed power are collected in real-time and shared across IEC 61850 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 controller devices (Easergy C5), through digital and analog inputs connected to MV secondary circuits or through EcoStruxure™ Power Automation System Gateway in case of Modbus devices.



User Controls

In the event 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 (Easergy P5, P3 or C5).



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 ensure a correct sequence of events.

To achieve this, the measurements and events are recorded and timestamped onboard smart equipment such as Easergy P5, P3, C5 and EcoStruxure™ Power Automation System Gateway.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)

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 may be connected to a GPS antenna to obtain the expected time precision.



> ADVANCED PROTECTION & AUTOMATION

System Description (3/6)

Data Flow in Detail (cont.)

DATA PROCESSING

The protection, automation and control system processes real-time data to execute protection and automation schemes over IEC 61850 communication services.

These automated actions from these schemes are monitored and recorded with timestamps in Edge Control software (EcoStruxure™ Power Operation and EcoStruxure™ Power Automation System Gateway) to enable better understanding of protection and automation schemes sequence of operation and to analyse potential system issues due to improper operating conditions (e.g., device in local mode, tripped circuit breaker).

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.

END-TO-END (E2E) DIGITAL SOLUTIONS FOR LIFECYCLE MANAGEMENT

IEC 61850 standard offers digital solutions that help design, automate, configure, monitor, operate and maintain protection, automation and control systems.

EcoStruxure™ Power Automation System Engineering & Maintenance offers digital tools that add the necessary software intelligence for managing the electrical systems lifecycle.

EcoStruxure™ Power Automation System Engineering

This is a powerful tool that helps in configuring vendor-agnostic protection, automation and control systems with advanced techniques for information model and exchange based on IEC 61850 standard engineering capabilities such as:

- Vendor-agnostic system configuration support
- Applications standardization model to speed-up project deployment
- Intuitive interface to simplify the implementation of the standard
- Advanced templating techniques for future system evolutions/extensions
- Automating data flow configuration for protection relays, HMI and Gateways.

EcoStruxure™ Power Automation System Maintenance

It provides IEC 61850 vendor-agnostic inventory management software that helps maintain protection and control systems equipment:

- Storage and backup (configuration, setting files and documentation)
- System level version baselining
- Realtime monitoring of device firmware and configuration changes
- Automatic collection, storage and display of disturbance recorder files.



EcoStruxure™ Power Operation



EcoStruxure™ Power Automation System Gateway



EcoStruxure™ Power Automation System Engineering



EcoStruxure™ Power Automation System Maintenance

1

2

3

4

> ADVANCED PROTECTION & AUTOMATION

System Description (4/6)

Data Flow in Detail (cont.)

ADVANCED SIMULATION SOLUTION

The advanced simulation solution allows operators to efficiently run their commissioning or training activities by simulating any signal of protection, automation and control system applications and to assess how the electrical system responds to that stimulus.

The advanced simulation software is based on IEC 61850 and is capable of emulating the Intelligence Electronic Devices – IED. It supports simulation of the essential communication services such as MMS or GOOSE messages, provides information to live data displays (EcoStruxure™ Power Operation) and triggers events to test automation schemes.

Users can define their own scenarios based on the data available in the System Configuration Description (SCD) file and run them periodically. The software can also simulate an IEC 61850 client where users are able to issue and test control orders.



Advanced Simulation Software



EcoStruxure™ Power Operation

END-TO-END (E2E) CYBERSECURITY SOLUTIONS

Cybersecurity affects everyone. Therefore, ensuring an end-to-end cybersecurity solution for the protection, automation and control system infrastructure is essential.

The devices (e.g., Easergy P5, P3, C5, EcoStruxure™ Power Automation System Gateway, EcoStruxure™ Power Operation) are developed and manufactured supporting the security-by-design approach that incorporates security due diligence practices and common security level requirements, based on IEC 62443 standards, into its development lifecycle.

Digital tools with centralized applications are also necessary to maintain a better security posture of the industrial system.

EcoStruxure™ Cybersecurity Application Platform

It provides security management capabilities with real-time monitoring of cyberthreats to mitigate operational risks. This software application enables the protection, automation and control system to meet ISA-99/IEC 62443 standards as well as NIST/NERC-CIP requirements for central management functionalities:

- Security Dashboard (SNMP Trap and Syslog collection)
- Authentication and authorization proxy
- Intrusion detection system
- Virtualized and “containerized” environment to cope with future developments

EcoStruxure™ Cybersecurity Admin Expert

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.



Easergy P5



Easergy P3



Easergy C5



EcoStruxure™ Power Automation System Gateway



EcoStruxure™ Cybersecurity Application Platform



EcoStruxure™ Cybersecurity Admin Expert

The Security Patch Management services maintain the security level of the system throughout its lifecycle by providing tested and validated security updates that fix protection, automation and control system cyberthreats or vulnerabilities under the scope of the contract established by both parties.

[For a comprehensive overview of system cybersecurity capabilities, refer to Section 1, page 20.](#)

> ADVANCED PROTECTION & AUTOMATION

System Description (5/6)

Data Flow in Detail (cont.)

OUTPUTS

Outputs are delivered to the protection, automation and control system via EcoStruxure™ connected products and Edge Control software and services.

Protection Schemes

A wide range of protection functions are available via Easergy P3 and Easergy P5 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

Automation Schemes

Easergy C5 processes realtime, 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 systems applications:

- Fast Self-Healing (in less than 300 ms)
- Redundant Automatic Transfer Switch
- Load-shedding
- Load-restore
- Genset Capacity Management

Live Data Display

Data is displayed in animated single-line diagrams with embedded graphic objects including all relevant electrical measurements for sources, distribution network and loads.

Events & Alarms

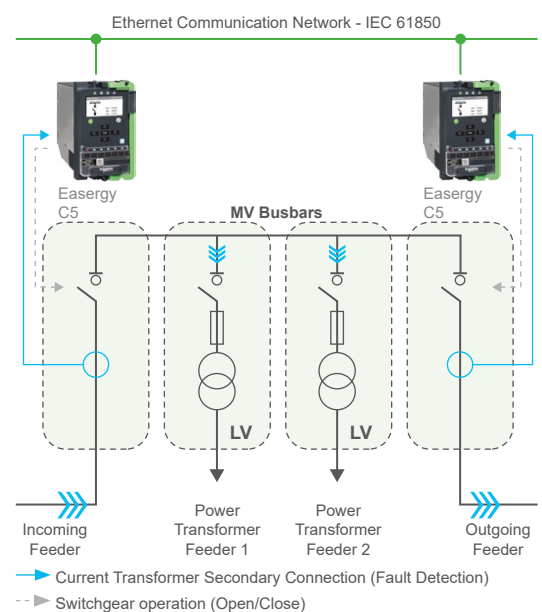
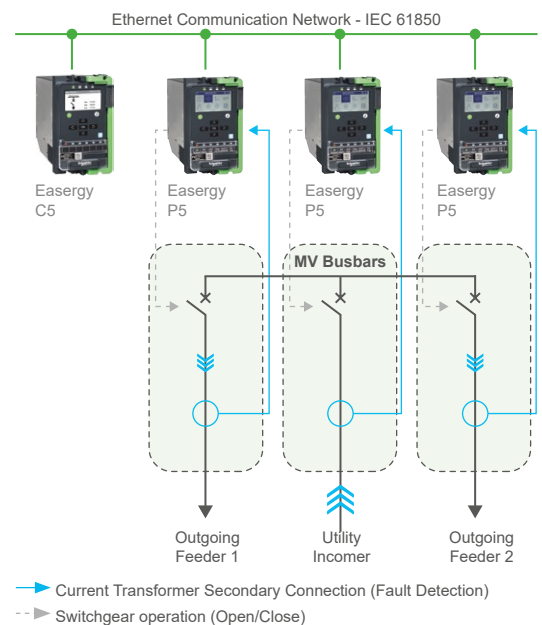
Events and alarms are uploaded from connected products or generated by the Edge Control software (EcoStruxure™ Power Operation or EcoStruxure™ Power Automation System Gateway). They are displayed in native event and alarm viewers with chronological display and sorting/filtering capabilities.

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



Live Data Display in EcoStruxure™ Power Operation



> ADVANCED PROTECTION & AUTOMATION

System Description (6/6)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Trends

1 Historical and realtime 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.

Controls

2 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.

3

4

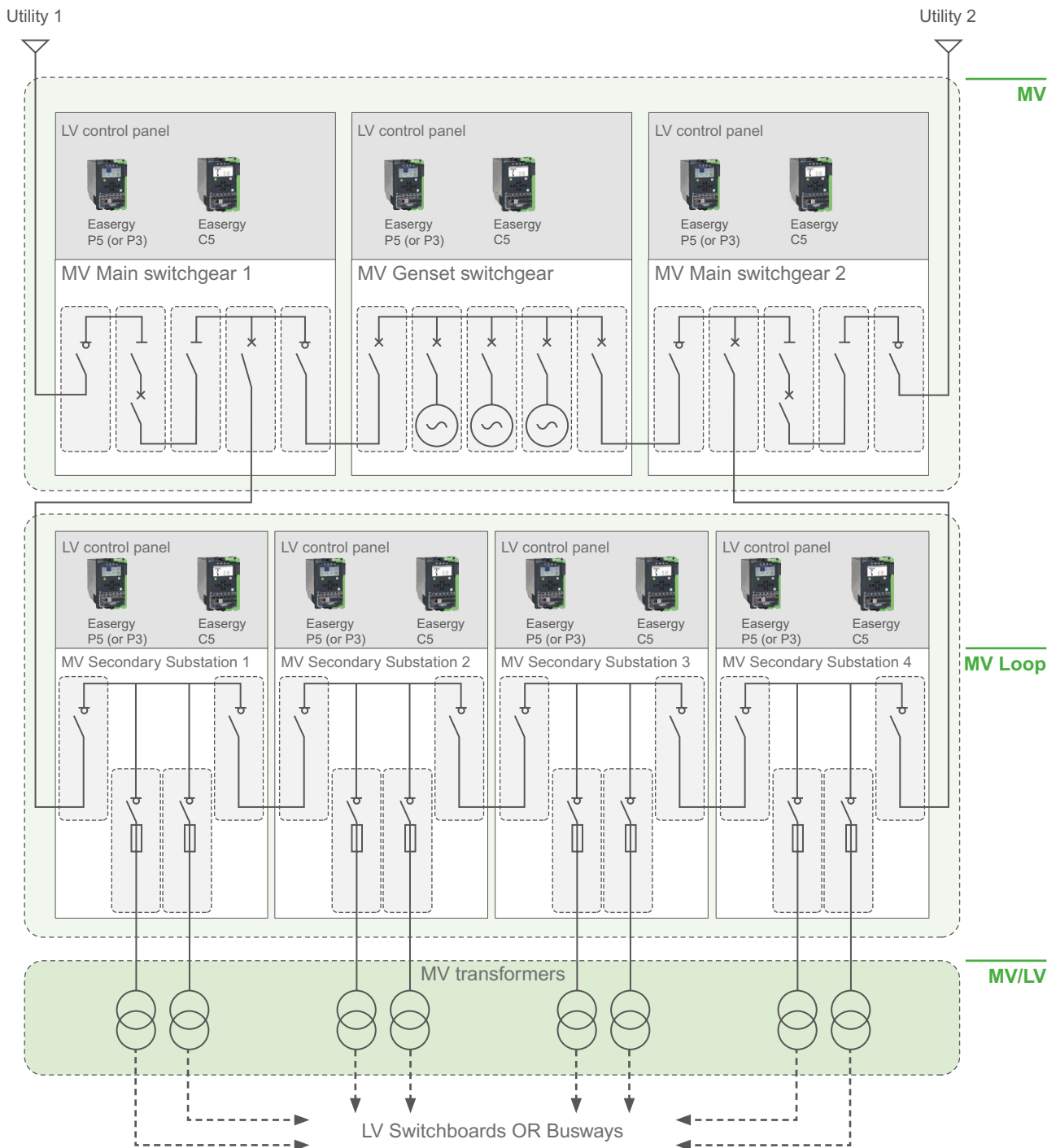
5

6

> ADVANCED PROTECTION & AUTOMATION

Electrical Architecture

The following diagram details which area of the electrical architecture the connected devices should be installed in order to implement the advanced automation and protection applications



> ADVANCED PROTECTION & AUTOMATION

Digital Architecture

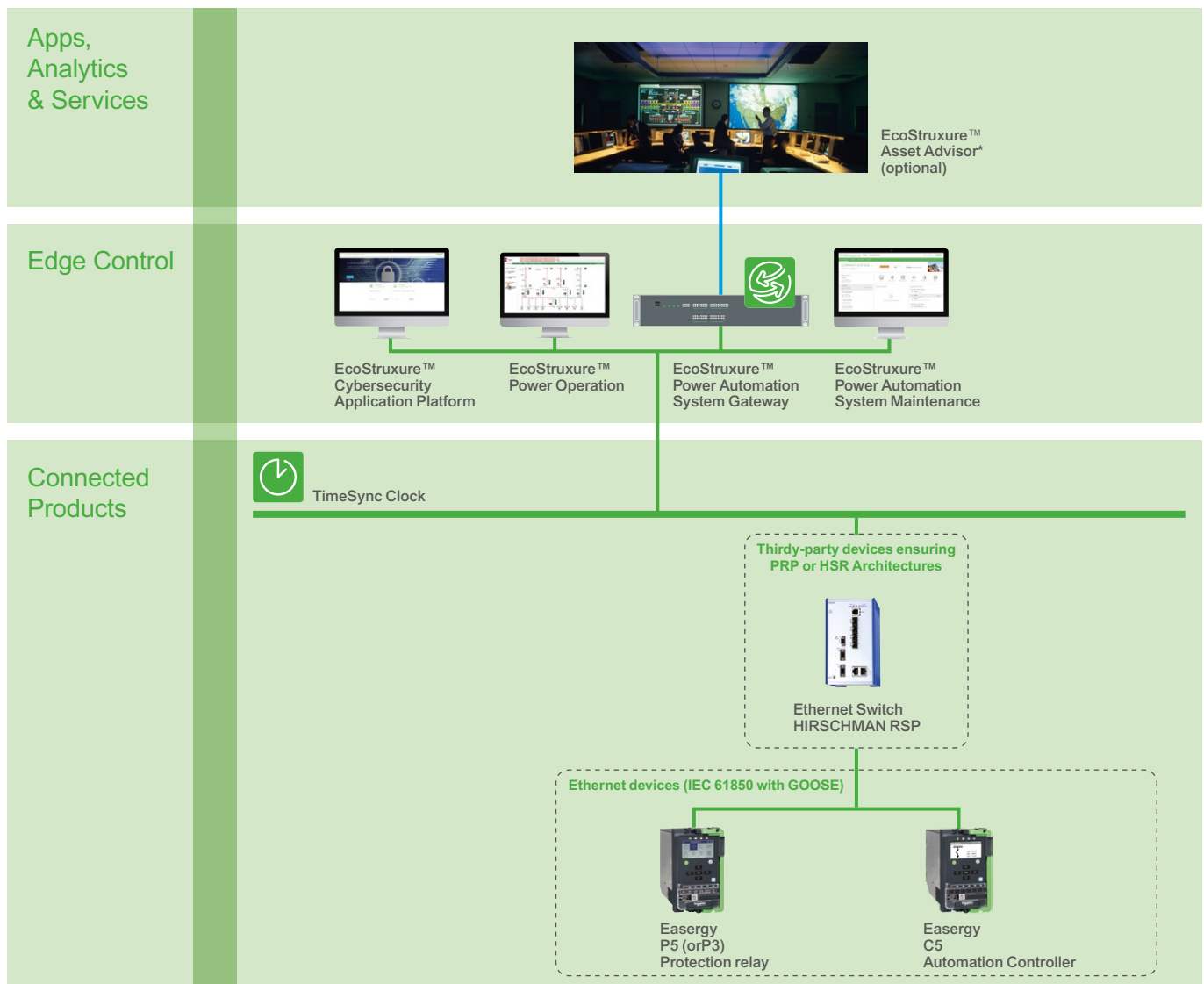
The digital architecture of the Advanced Protection & Automation application involves collecting the input data from the different products, either directly over Ethernet or via gateways. Ethernet-based communication is specifically required for fast acquisition of source and network reconfiguration conditions as well as fast action of automatic systems.

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 Power Automation System Gateway
- Cybersecurity: EcoStruxure™ Cybersecurity Application Platform and Cybersecurity Admin Expert
- Maintenance: EcoStruxure™ Power Automation System Engineering and Maintenance tools

Optionally, as part of a connected service, data can be used for analytics services with EcoStruxure™ Power Advisor. This data enables Schneider Electric service engineers to make recommendations.

The recommended digital architecture is given below:



* EcoStruxure™ Asset Advisor integrates asset performance data from EcoStruxure™ Power Automation System to enable more optimized electrical asset management. [See Asset Performance application for more details.](#)

> MICROGRID

Optimize Operations for Enhanced Energy Reduction and Resilience (1/2)

Context of Application

As grid electrical energy 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 to manage, 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 Operations Need to:

- Enhance power system reliability in the face of grid instability, as a result of an ever increasing occurrence of powerful storms and power availability due to grid constraints.
- 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 MICROGRID APPLICATION

Gain Resilience

Helps protect against extreme weather, cyberattacks, and grid instability to avoid costly downtime.

Reduce Risk

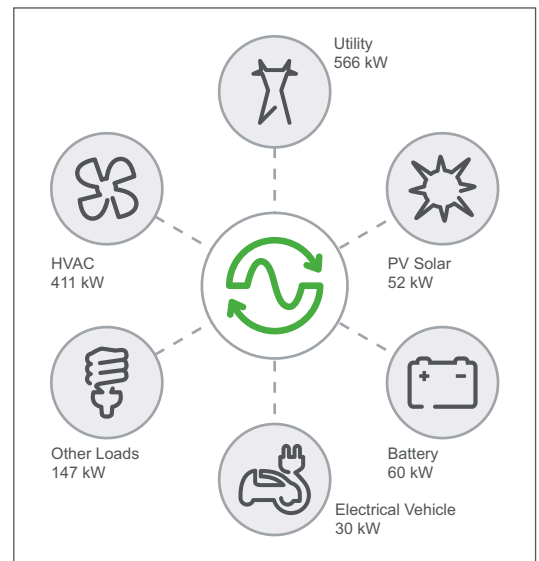
Best-in-class strategic partners provide Energy-as-a-Service (EaaS) with flexible governance models, enabling you to control your financial and operational risks.

Optimize Energy

Seamlessly integrate your Distributed Energy Resource (DER) 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

> MICROGRID

Optimize Operations for Enhanced Energy Reduction and Resilience (2/2)

Application Outcomes

Live Data Display

- High performance realtime 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 Microgrid controller including machine status, notifications, power flows, switch status, etc.

Events & Alarms

- Alarms and sequence of events related to management of distributed energy resources and the Microgrid's electrical distribution can be displayed in EcoStruxure™ Microgrid Operation's 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's HMI.

Notifications

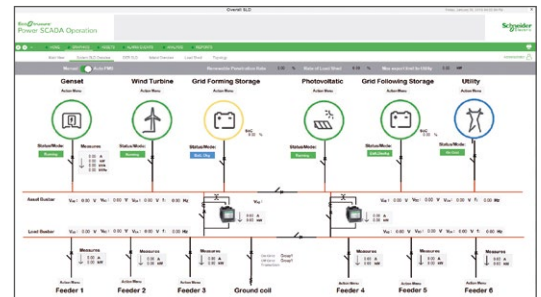
- Notifications of power system events can be automatically sent by SMS or e-mail to appropriate personnel.

Cloud-based Analytics & Services

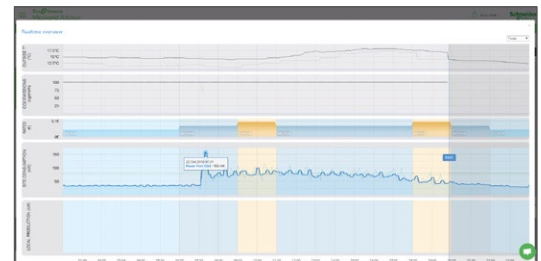
- Cloud-based EcoStruxure™ Microgrid Advisor aggregates data from EcoStruxure™ Microgrid Operation as well as other inputs including energy pricing and weather data to analyze the optimal times to consume or produce energy using distributed energy resources. Control commands can be relayed back to the on-premise controller to initiate actions automatically.



EcoStruxure™ Microgrid Operation Distributed Energy Resources Overview



EcoStruxure™ Microgrid Operation Live Data Display



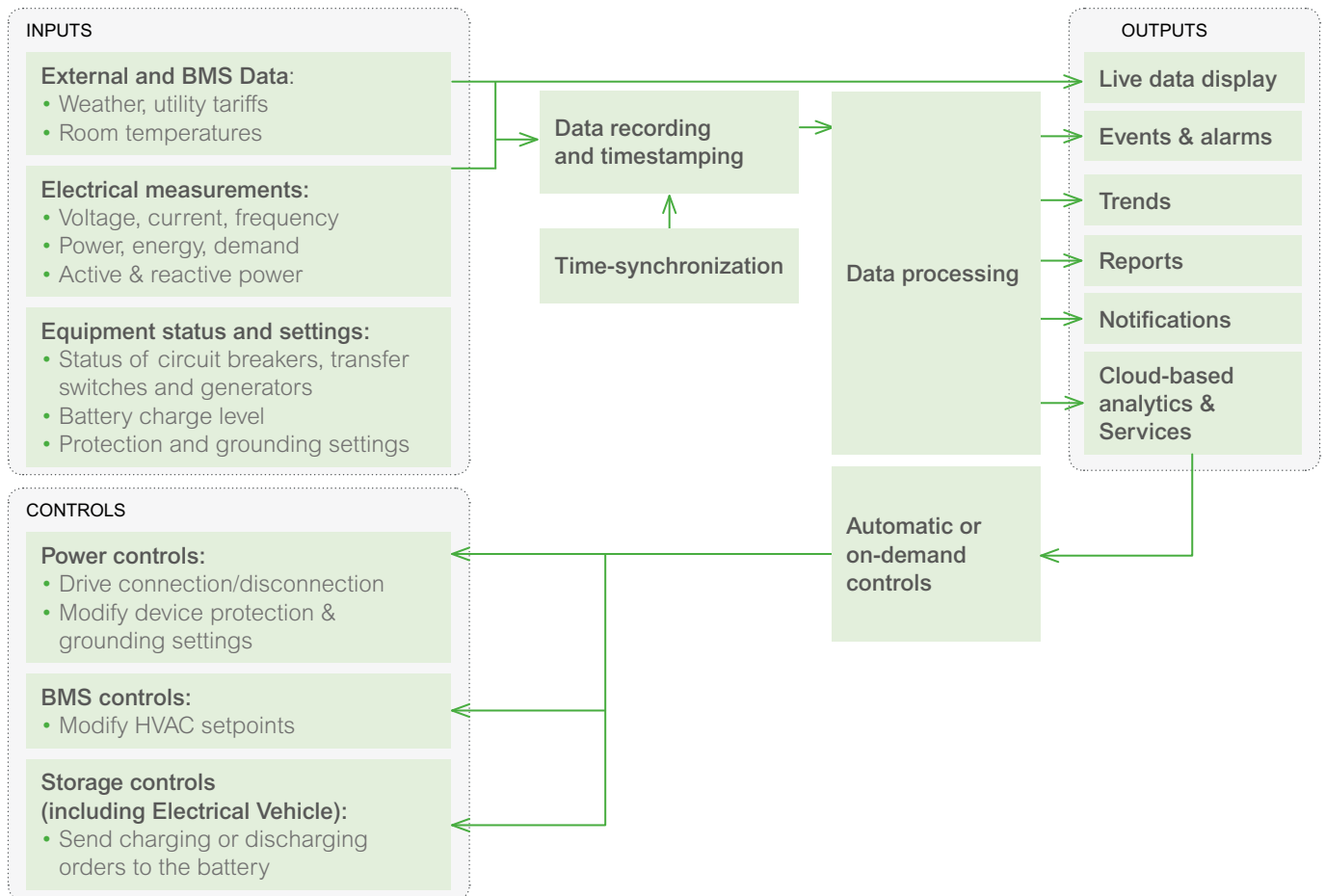
EcoStruxure™ Microgrid Advisor Realtime and Forecast Data

> MICROGRID

System Description (1/5)

Data Flow

The Microgrid application can be broken down as follows:



Data Flow in Detail

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

> MICROGRID

System Description (2/5)

Data Flow in Detail (cont.)

INPUTS (cont.)

Electrical Measurements

Connected products required to implement a microgrid solution can vary based on the project site, size, and types of Distributed Energy Resources (DER) utilized to achieve the application goals.

The following electrical measurements can be collected from connected products such as power meters (e.g., PowerLogic ION9000), protection relays (e.g., Easergy P5/P3), or circuit breakers (e.g., MasterPacT MTZ):

- Voltage, current, frequency
- Power, energy, demand
- Active & reactive power

Equipment Status and Settings

- Open/closed position of circuit breakers
- Operating mode of transfer switches
- Battery charge level
- Generator status
- Active protection and grounding settings

CONTROLS

To constantly optimize the power supply strategy, EcoStruxure™ Microgrid Operation Controller will control field devices dynamically.

The following controls can be sent:

Power Controls

- Open/close circuit breaker and transfer switch
- Adjust/curtail photovoltaic output
- Charge/discharge battery
- Start/stop generator
- Modify device protection & grounding settings

Building Management System (BMS) Controls

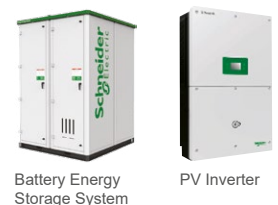
EcoStruxure™ Microgrid Operation Controller can also interact with the BMS to optimize the overall site energy consumption strategy:

- Modify HVAC setpoints

Battery Energy Storage System (BESS) Controls

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



> MICROGRID

System Description (3/5)

Data Flow in Detail (cont.)

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 allow complex microgrid power and energy events to be diagnosed 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 ms.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)

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 may be associated with a GPS antenna to achieve the required time accuracy.



TimeSync Clock

DATA PROCESSING AND CONTROL

In a Microgrid application, there are several embedded functions enabled by the processed input data in the Microgrid Controller of EcoStruxure™ Microgrid Operation to manage the operating conditions of Distributed Energy Resources (DER).

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 renewables' power production within the Microgrid.

DER Management & Control

- 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 from/to 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, provides the possibility for the microgrid to start its own electricity production and to reactivate itself sequentially as an island.

Protection Relays & Grounding/Earthing System Management

- Manages the protection relays and the grounding/earthing system during transition and operation in islanded mode.



EcoStruxure™ Microgrid Operation Controller

1

2

3

4

> MICROGRID

System Description (4/5)

Data Flow in Detail (cont.)

OUTPUTS

Live Data Display

High-performance realtime visualization of animated one-line diagrams in EcoStruxure™ Microgrid Operation's SCADA HMI allows you to gain situational awareness of the condition 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™ Operation Microgrid Controller: machine status, power flows, switch status, etc.

A Harmony Magelis ComPacT iPC can be used for local HMI/SCADA. It communicates with the Microgrid Controller as the monitoring and control access point.

It embeds the following features:

- It monitors and controls the microgrid electrical distribution topology.
- It monitors and controls Microgrid Controller functions.
- It monitors the system architecture and its communication network.
- It is the maintenance access point of the solution (access to technical documents and setting software).

Events & Alarms

Event Log Viewers

Alarms and events are uploaded from devices and visualized in native alarm and event viewers of the Edge Control software (EcoStruxure™ Power Monitoring Expert or Power Operation). Chronological views include all alarms and events, acknowledged or unacknowledged alarms, summary alarms or incidents related to Microgrid related events. High speed and high precision sequence of event 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.

Smart Alarming

Microgrid alarms or events 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 Events Analysis application](#)).

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 Distributed Energy Resources (DER). Trending in EcoStruxure™ Microgrid Advisor can additionally trend near realtime 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.

Reports

When EcoStruxure™ Power Monitoring Expert is installed and integrated with EcoStruxure™ Microgrid Operation, comprehensive reporting on the microgrid's electrical network is enabled. Refer to applications such as [Electrical Distribution Monitoring and Alarming](#), [Power Quality Monitoring](#), [Capacity Management](#), among other applications in this guide for details on reporting that can be embedded in a microgrid solution.

Notifications

Alarm notifications available with the optional Event Notification Module for EcoStruxure™ Microgrid Operation can be automatically sent via SMS or e-mail to configured recipients on user defined schedules.

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



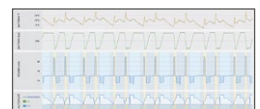
EcoStruxure™
Microgrid Operation



Harmony
Magelis Compact iPC



EcoStruxure™
Power Monitoring Expert



Battery Charge/Discharge Trend
in EcoStruxure™ Microgrid
Advisor



EcoStruxure™
Microgrid Advisor HMI



> MICROGRID

System Description (5/5)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Cloud-Based Analytics & Services

EcoStruxure™ Microgrid Advisor cloud-based analytics help optimize the energy production and consumption of on-site Distributed Energy Resources (DERs). 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.

Comment: 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* systems, cluster for Electrical Vehicle (EV) charging stations, etc.

EcoStruxure™ Microgrid Advisor manages and optimizes the DER following four control orders:

- Accumulation
- Normal
- Low
- Sleep

Those orders are sent to the DER itself (e.g., energy storage system) or to the existing DER management solutions:

- EcoStruxure™ Microgrid Operation
- Building Management System for HVAC* systems
- Cluster for Electrical Vehicle (EV) charging stations
- Etc.

Thanks to the web interface, the site facility manager can monitor near realtime 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.

Demand Response:

- Performing demand response events by connecting to a utility or a commercial aggregator platform which can monetize demand response orders.

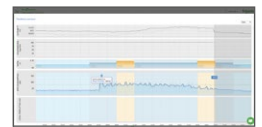
Off-grid mode preparation:

- 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 Microgrid Controller decides to go into off-grid (island) mode.

* HVAC : Heating, Ventilation, Air Conditioning



EcoStruxure™
Microgrid Advisor

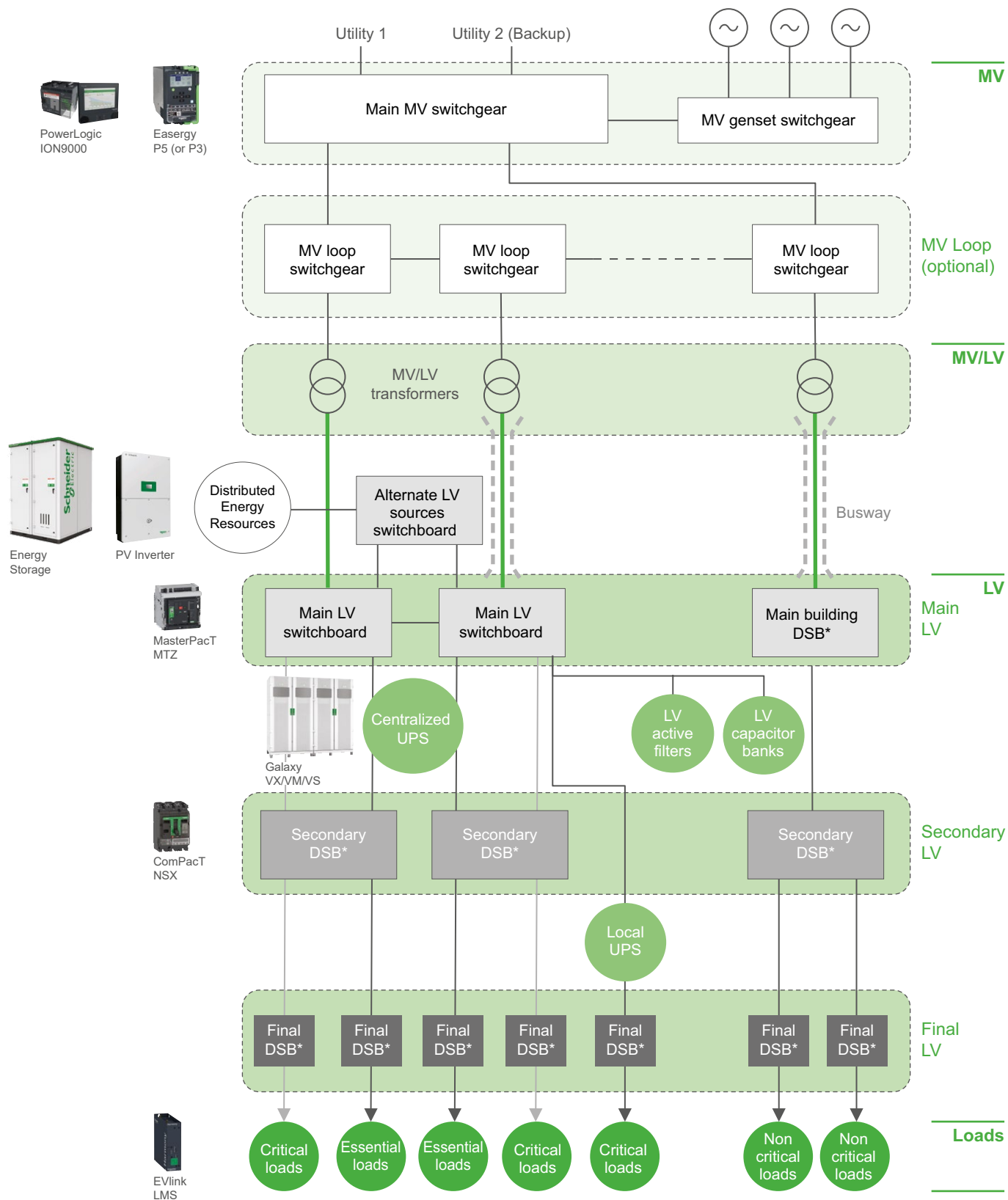


EcoStruxure™ Microgrid
Advisor Remote Monitoring
and Forecasting

> MICROGRID

Electrical Architecture

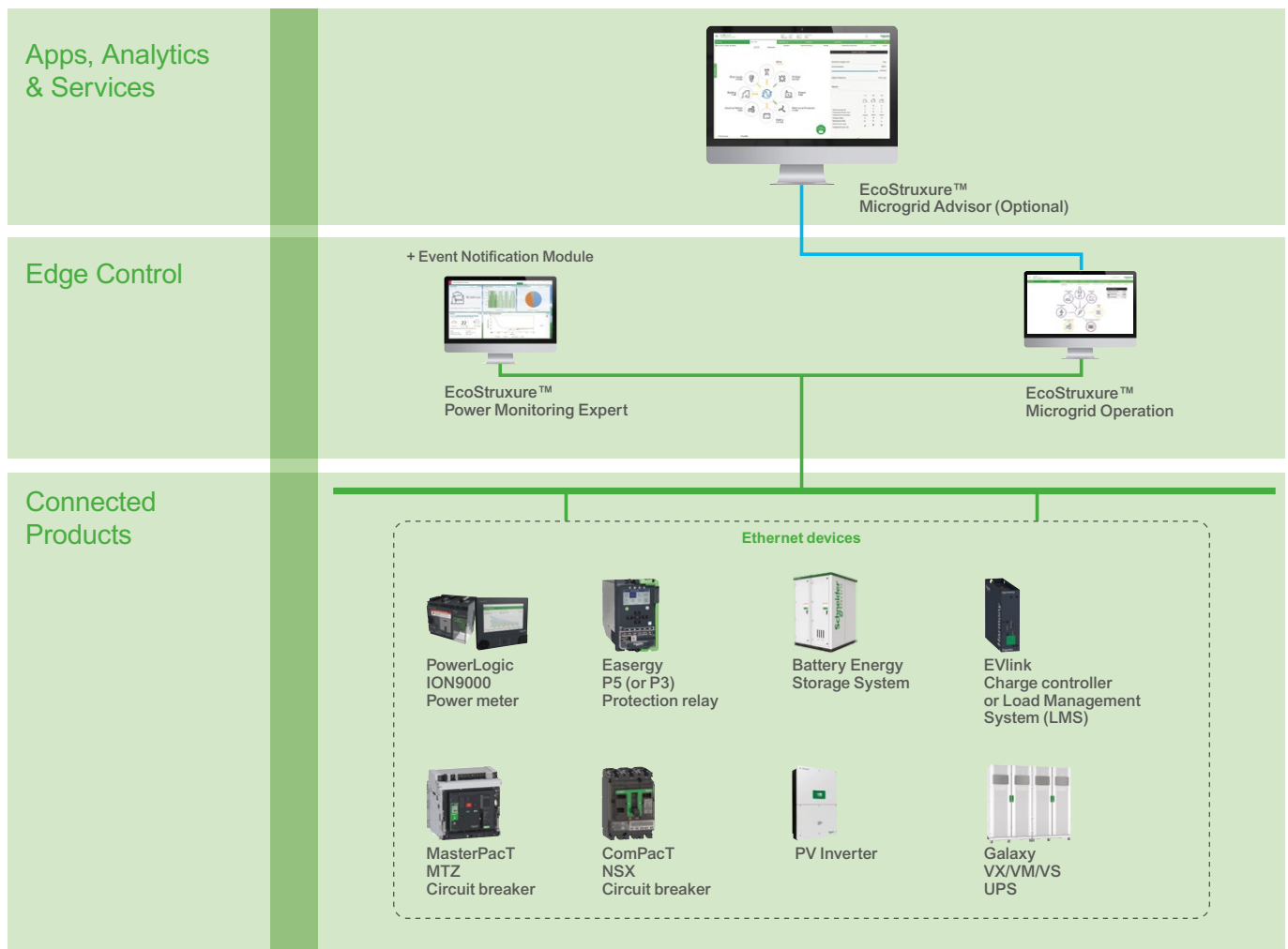
The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Microgrid application:



> MICROGRID

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 (EcoStruxure™ Power Monitoring Expert or EcoStruxure™ Microgrid Operation) for on-premise visualization analysis and reporting. Data can also be utilized by EcoStruxure™ Microgrid Advisor for advanced optimization and control. The recommended digital architecture for the Microgrid application is given below:

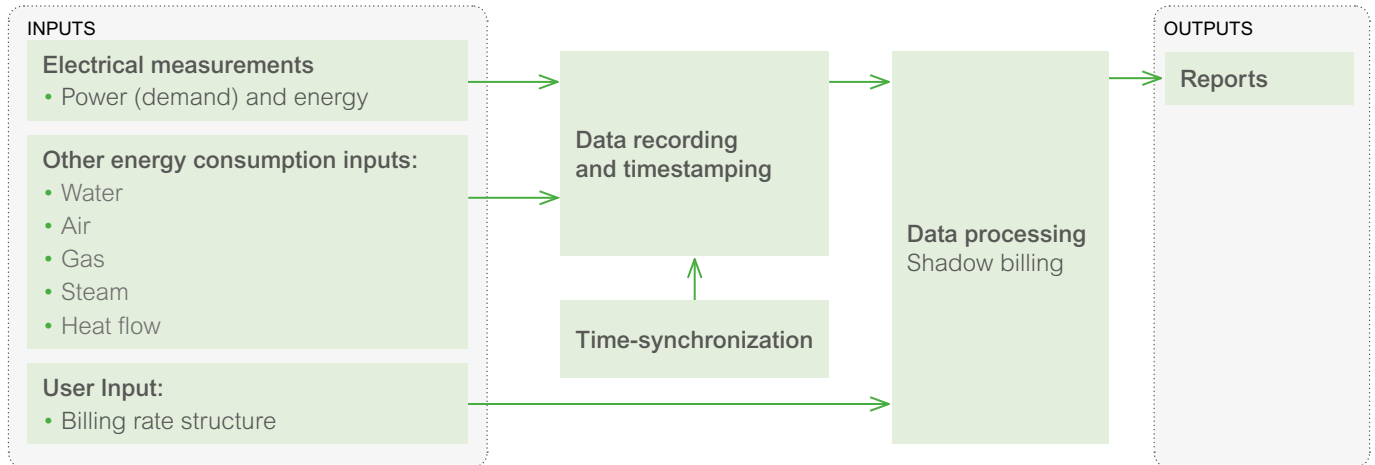


> UTILITY BILL VERIFICATION

System Description (1/2)

Data Flow

The Utility Bill Verification application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data is required:

Electrical Measurements**Power (Demand) and Energy**

All power (demand) 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.

Other Energy Consumption Inputs

- Water
- Air
- Gas
- Steam
- 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 Utility Bill Verification application, a timestamp accuracy of ± 1 s is sufficient. The above energy measurements are recorded and timestamped onboard smart equipment such as PowerLogic ION9000/PM8000.

For other WAGES* transducers, the signal can be recorded by EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards.

Comment: For devices without onboard logging, there is a risk of data loss in the event of a communication interruption.

* Water, Air, Gas, Electricity, Steam

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)



Product, Software and Services: See page 229



System Description (2/2)

TIME-SYNCHRONIZATION

Time-synchronization can be performed through various technologies (PTP, NTP, SNTP...). An external master clock is recommended and connects to a GPS antenna to reach the expected time precision.



TimeSync Clock

Shadow Billing

- Tiered rates
- Time of Use
- Power Factor rate
- Demand limits
- Reactive power



EcoStruxure™
Power Monitoring Expert

Outputs are displayed remotely via EcoStruxure™ Power Monitoring Expert or EcoStruxure™ Power Operation with Advanced Reporting & Dashboards. The Billing Module must be deployed to benefit from these features.



EcoStruxure™
Power Operation with Advanced
Reporting & Dashboards

Reports

The following report can be displayed or automatically sent by e-mail:

Billing Report

Based on certified energy measurements, the shadow bill will reflect the utility bill with all listed 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.

[illegible]

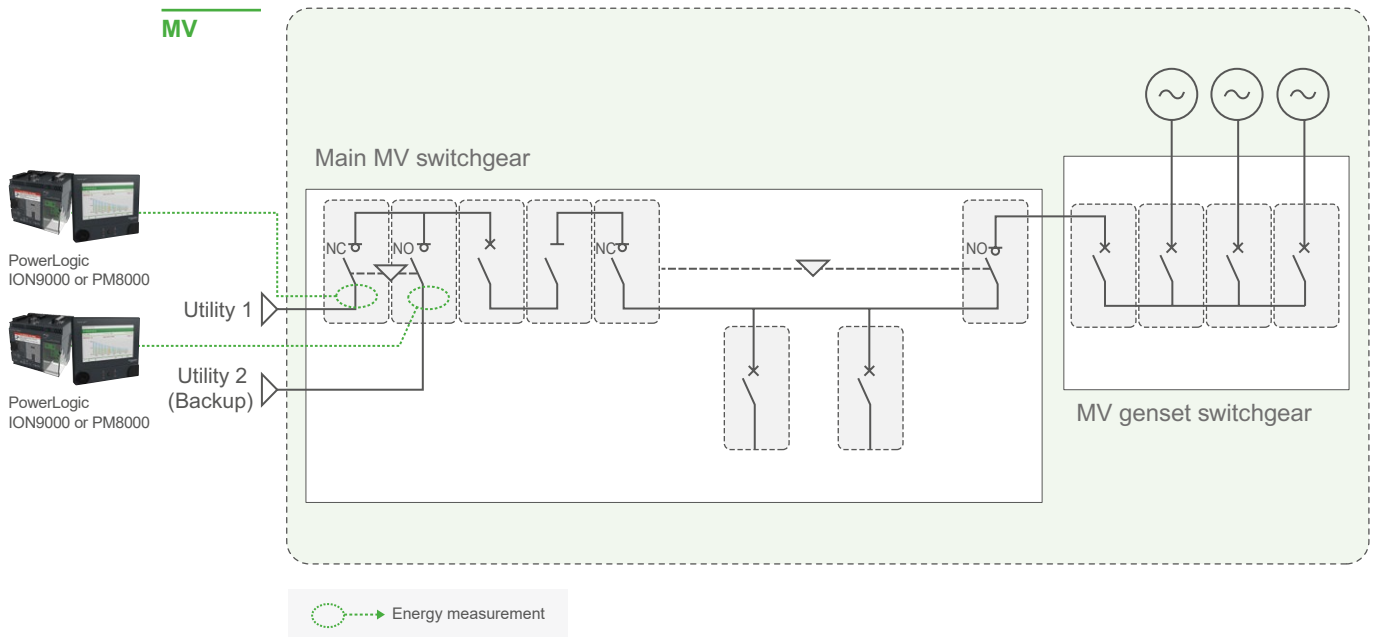
Billing Report

> UTILITY BILL VERIFICATION

Electrical Architecture

The diagram below 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.



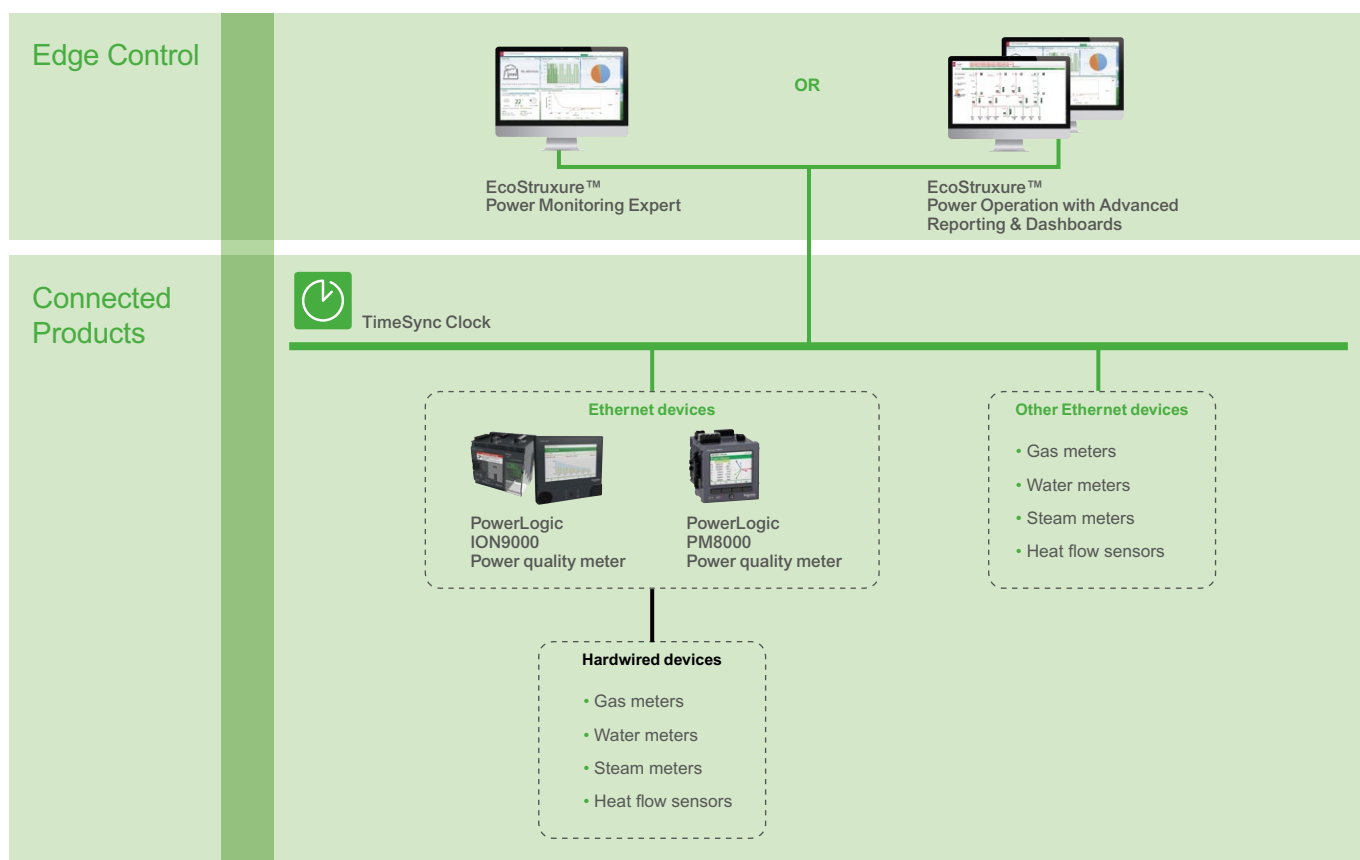
> UTILITY BILL VERIFICATION

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 (EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting and Dashboards) for reporting.

Power and energy values (kW, kVAR, kVA, kWh, kVARh, kVAh) must be measured by certified utility-grade energy meters (PowerLogic ION9000/PM8000).

The recommended digital architecture for the Utility Bill Verification application is given below:



— Ethernet - technical LAN
— Hardwired

> COST ALLOCATION

Gain Visibility to Improve Energy Cost Accountability

Context of Application

"You can't change what you don't measure!". 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 COST ALLOCATION APPLICATION

Encourage Energy Efficient Behaviour

By allocating energy cost by department, business unit, area, floor or building.

Find the Biggest Energy Savings Opportunities

Before initiating an energy savings project, it is necessary 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.
- **Billing Summary Report:**
Provides a summary view of the Multiple Billing 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.



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	Devices	Rate	Number of Units	Unit Cost	Cost (\$)
ABC Soft	Victoria_Keating_main_7650 (24 %)	Example Rate - Basic			
Energy Consumption Charge			44,929.32 kWh	\$0.05762	2,588.83
Peak Demand Charge (ABC Soft Peak @ 2015-03-21 2:00 PM)			81.17 kW	\$6.89	559.29
Victoria_Keating_main_7650 (24 %)					
Processing Fee					20.00
Total (\$)					3,168.12

Multiple Billing Report

Schneider Electric Billing Summary Report

Billing Period: 2015-03-01 12:00:00 AM - 2015-04-01 12:00:00 AM (Server Local)

Customer	Units	Unit Cost	Cost
ABC Soft	44,929.32 kWh	\$0.05762	2,588.83
ACME Technology	38,005.79 kWh	\$0.05762	2,188.57
Apple Co.	28,802.88 kWh	\$0.05762	1,659.82
Google Inc.	18,720.55 kWh	\$0.05762	1,078.86
Facebook Inc.	33.05 kWh	\$0.05762	1.90
Grand Total			\$15,623.99

Billing Summary Report

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	SC0001	5/28/2015 - 6/4/2015	11,559.2*	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

Circuit	Time Range	Energy (kWh)	Coincident Demand (kW)	Coincident Current (A)
PDU A1 P01 01 C1 01	5/28/2015 - 6/4/2015	100.8*	0.6	2.8
PDU B1 P01 01 C1 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

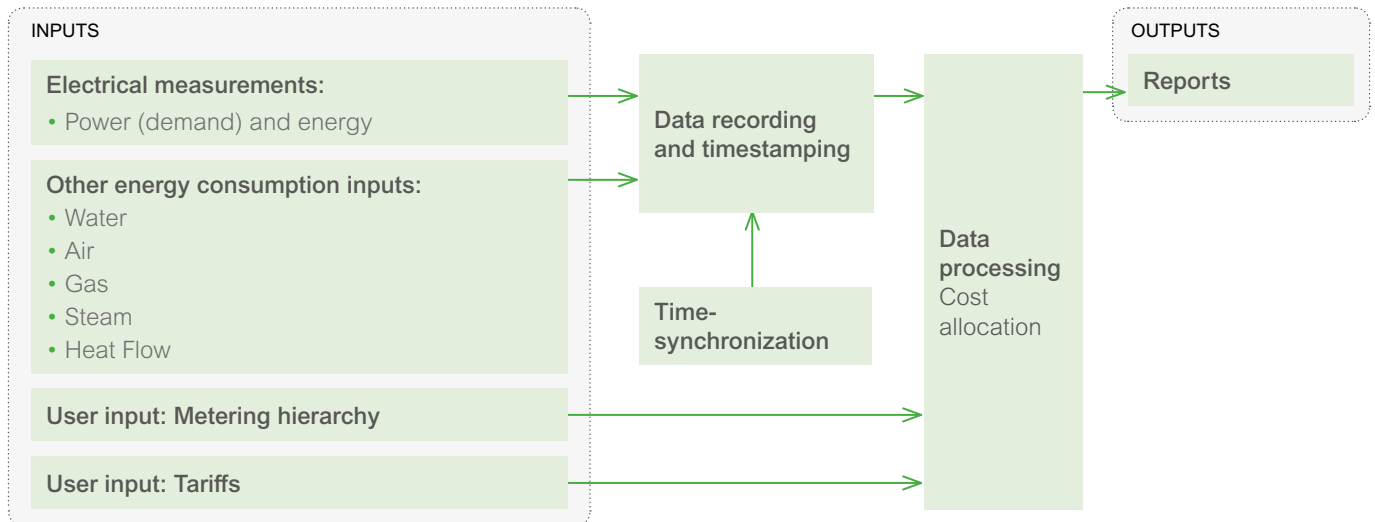
Energy Billing by IT Customer

> COST ALLOCATION

System Description (1/3)

Data Flow

The Cost Allocation application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data is required:

Electrical Measurements

- Power (demand) values (kW, kVAR, kVA)
- Energy values (kWh, kVARh, kVAh)

This data may be acquired from power/energy meters such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, PowerTag, Acti9 iEM3000, etc., at each point of interest in the electrical distribution, from medium voltage to low voltage to final distribution. Devices with embedded metering (e.g., Easergy P5, Easergy P3, MasterPacT MTZ, ComPacT NSX etc.) are also suitable for electrical power and energy monitoring.

These measurements can also be acquired via Modbus from third-party devices.

Other Energy Consumption Inputs

- Water
- Air
- Gas
- Steam
- Heat Flow

They can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

User Input: Metering Hierarchy

This correlates tenants, areas, departments or buildings with the appropriate metering devices.

User Input: Tariffs

To convert energy consumption into cost, it is necessary to configure the rate file for all relevant tariffs.



> COST ALLOCATION

System Description (2/3)

Data Flow in Detail (cont.)

DATA RECORDING AND TIMESTAMPING

For the Cost Allocation application, a timestamp accuracy of ± 1 s is sufficient. Advanced meters such as the PowerLogic ION9000, PM8000 and some PowerLogic PM5000 models (PM53xx and PM55xx) can timestamp and record onboard energy measurements as well as connected equipment states.

For other devices (e.g., Easergy P5, Easergy P3, MasterPacT MTZ, entry-level PowerLogic PM5000 models, PowerLogic PowerTag, Acti9 IEM3000, third-party equipment) energy measurements and equipment states are acquired by the devices and recorded by EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards.

Comment: For connected products without onboard logging, there is a risk of data loss in the event of a communication failure.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)



TIME-SYNCHRONIZATION

For 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...). An external master clock may be required and connected to a GPS antenna to reach the expected time precision.



DATA PROCESSING

Cost Allocation

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 with Advanced Reporting & Dashboards.



> COST ALLOCATION

System Description (3/3)

Data Flow in Detail (cont.)

OUTPUTS

The Billing Module of EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards 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 e-mail:

Billing Reports

• Multiple Billing Report

Provides an energy cost breakdown for each tenant, area, department or building.



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	44,829.32 kWh	\$0.00762	3,408.83
Peak Demand Charge	81.17 kW	\$0.00	889.29
Processing Fee			20.00
Total (\$)			3,168.12

Report
(Server Local)

Report
(Server Local)

Processing Fee		20.00	3,168.12
Total (\$)		3,217.66	
Processing Fee		20.00	2,118.76
Total (\$)			2,118.76

Total (\$)
3,168.12

Total (\$)
3,217.66

Multiple Billing Report

• Billing Summary Report

Provides a summary view of Multiple Billing Report.

Schneider Electric Billing Summary Report
Billing Period: 2015-03-01 12:00:00 AM - 2015-04-01 12:00:00 AM (Server Local)

Customer	Area	Units	Unit Cost	Cost
ABC Soft	Energy Consumption Charge	44,829.32 kWh	\$0.00762	3,408.83
ABC Soft	Peak Demand Charge	81.17 kW	\$0.00	889.29
ABC Soft	Processing Fee			20.00
Total				\$3,168.12
ACME Technology	Energy Consumption Charge	39,000.78 kWh	\$0.00762	2,969.37
ACME Technology	Peak Demand Charge	108.21 kW	\$0.00	748.72
ACME Technology	Processing Fee			20.00
Total				\$2,977.48
Alpha Co.	Energy Consumption Charge	28,000.00 kWh	\$0.00762	2,133.60
Alpha Co.	Peak Demand Charge	54.12 kW	\$0.00	372.00
Alpha Co.	Processing Fee			20.00
Total				\$2,185.60
Beta Financial	Energy Consumption Charge	20,000.00 kWh	\$0.00762	1,524.00
Beta Financial	Peak Demand Charge	50.73 kW	\$0.00	360.00
Beta Financial	Processing Fee			20.00
Total				\$1,904.00
Gamma Inc.	Energy Consumption Charge	16,720.00 kWh	\$0.00762	1,274.00
Gamma Inc.	Peak Demand Charge	33.82 kW	\$0.00	238.00
Gamma Inc.	Processing Fee			20.00
Total				\$1,532.00
Grand Total				\$13,623.40

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	SC001	5/28/2015 - 6/4/2015	11,659.21	69.4	238.9	5/28/2015 12:15:00	
	Rack	Time Range	Energy (kWh)	Consistent Demand (kW)	Consistent Current (A)		
	Rack 01_0001	5/28/2015 - 6/4/2015	201.6*	1.2	5.6		
		Circuit	Time Range	Energy (kWh)	Consistent Demand (kW)	Consistent Current (A)	
		PDU A1 Ph 03 C3 03	5/28/2015 - 6/4/2015	100.8*	0.6	2.8	
		PDU B1 Ph 03 C3 03	5/28/2015 - 6/4/2015	100.8*	0.6	2.8	
		Rack	Time Range	Energy (kWh)	Consistent Demand (kW)	Consistent Current (A)	
		Rack 03_0002	5/28/2015 - 6/4/2015	235.2*	1.4	6.6	

* Value estimated

* Value based on incomplete data

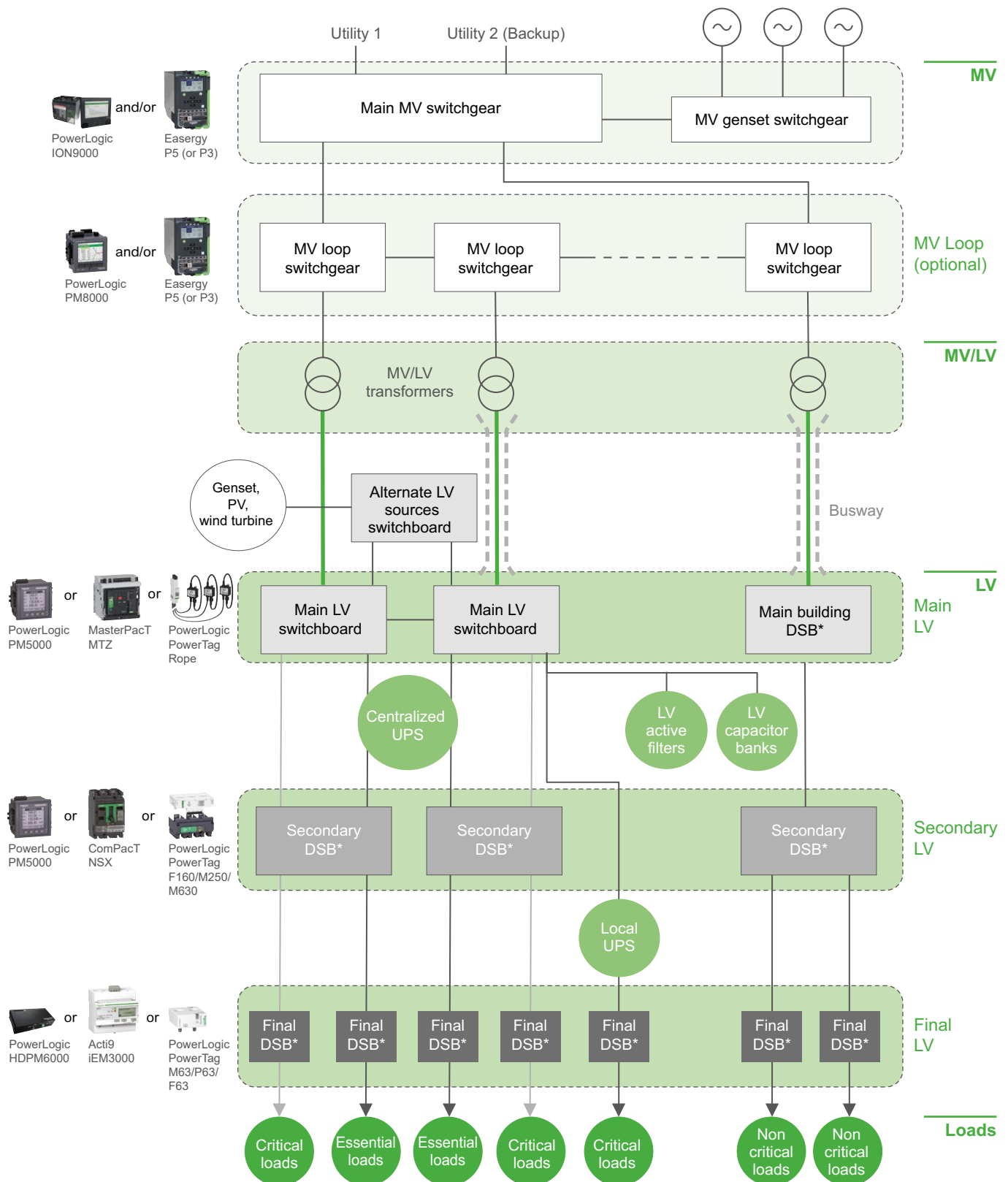
*** Expected value missing

Energy by IT Customer

> COST ALLOCATION

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:



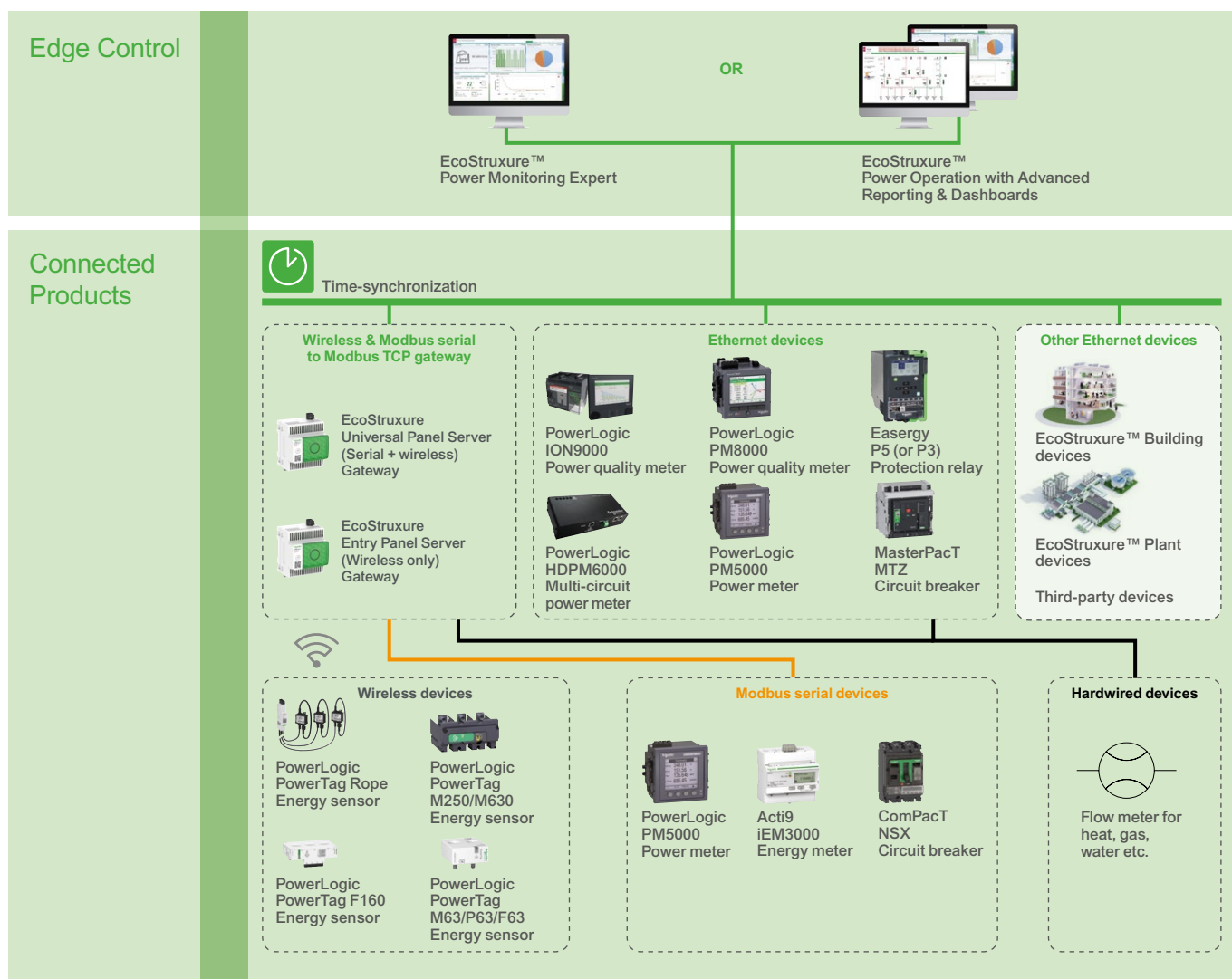
> COST ALLOCATION

Digital Architecture

The digital architecture of the Cost Allocation application uses a recommended direct Ethernet connection to energy meters. Data is captured on board devices and uploaded into the Edge Control software (EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards) for data processing, visualization and reporting.

Other energy consumption inputs can also be directly acquired via Ethernet or through hardwired signals from basic meters and sensors.

The recommended digital architecture for the Cost Allocation application is given below:



Product, Software and Services: See page 229



ENERGY MONITORING

Identify "Quick-Win" Opportunities for Energy Savings

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 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 ENERGY MONITORING 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 for a better return on investment for energy conservation initiatives.

Application Outcomes

Live Data Display

Realtime energy data displayed in configurable diagrams or realtime data tables.

Events & Alarms

Configure and visualize energy over consumption events to display in a historical event log.

Trends

Monitor consumption (WAGES*) for the whole facility, specific areas or loads in realtime charts.

Dashboards

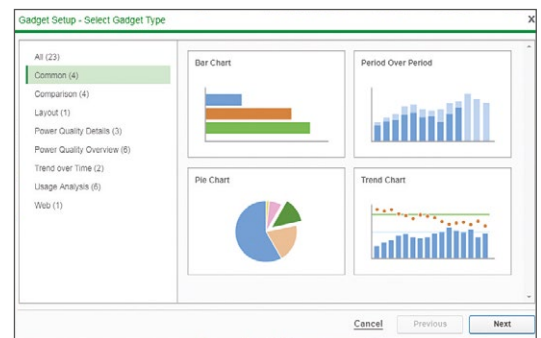
- Historical trends
- Energy consumption ranking
- Energy heat map
- Pareto charts
- Sankey diagram

Comment: Any of the dashboards shown can be included as part of a slideshow ("Energy Kiosk").

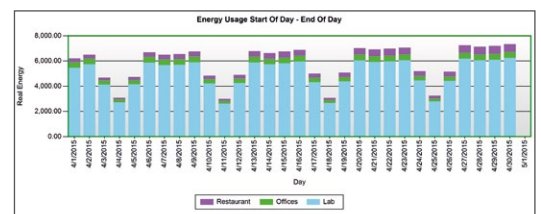
Reports

- Calendar Trend Report
- Energy Cost Report
- Energy Comparison Report
- Consumption Ranking Report
- Hourly Usage Report
- Load Profile Report
- Energy Usage Reports
- Energy Period over Period Report

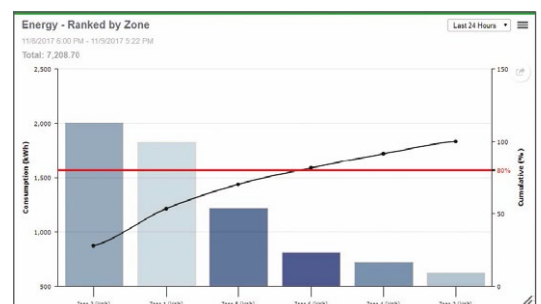
* Water, Air, Gas, Electricity, Steam



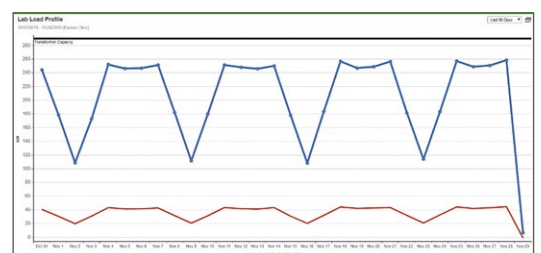
Configurable Dashboard Gadget Library for Analyzing Energy Usage



Energy Usage Reports



Pareto Chart



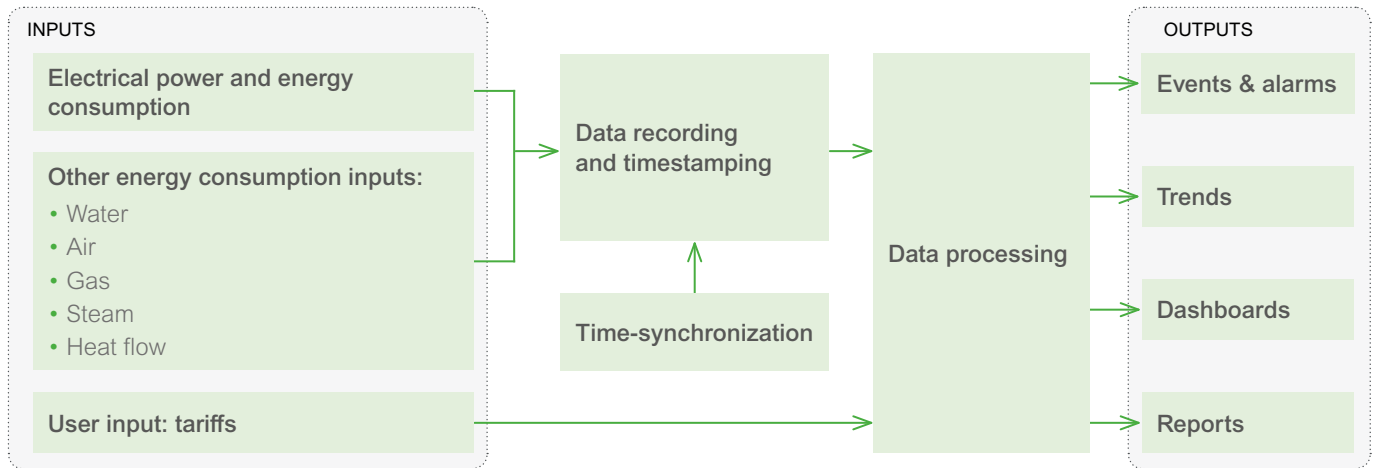
Simple Load Profile Chart

> ENERGY MONITORING

System Description (1/7)

Data Flow

The Energy Monitoring application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data is required:

Electrical Power and Energy Consumption

- Energy values (kWh, kVARh, kVAh)
- Power values (kW, kVAR, kVA)

This data may be acquired from power/energy meters such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, PowerTag, Acti9 iEM3000, etc., at each point of interest in the electrical distribution, from medium voltage to low voltage to final distribution.

Devices with embedded metering (e.g., Easergy P5, Easergy P3, MasterPacT MTZ, ComPacT NSX, Galaxy UPS, etc.) are also suitable for electrical power and energy monitoring.

These measurements can also be acquired via Modbus from third-party devices.

Other Energy Consumption Inputs

- Water
- Air
- Gas
- Steam
- Heat flow

They can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

User Input: Tariffs

To convert energy consumption into cost, it is necessary to apply the relevant tariffs to the power/energy consumption values.



> ENERGY MONITORING

System Description (2/7)

Data Flow in Detail (cont.)

DATA RECORDING AND TIMESTAMPING

For the Energy Monitoring application, a timestamp accuracy of ± 1 s is sufficient.

Advanced meters such as the ION9000, PM8000 and some PowerLogic PM5000 models (PM53xx and PM55xx) can timestamp and record onboard energy measurements as well as connected equipment states.

For other devices (Easergy P5, Easergy P3, MasterPacT MTZ, entry-level PowerLogic PM5000 models) energy measurements and equipment states are acquired by the devices and recorded by EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards.

When acquiring data from other customer systems, timestamps can also be imported through OPC or ETL*.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)

TIME-SYNCHRONIZATION

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

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

DATA PROCESSING

Specialized dashboards and a dedicated reporting engine analyze data to:

- Provide highlights on energy consumption according to the time of day, the day of the week, month, etc.
- "Convert Data to Information". This means showing consumption data in an easy to interpret format (e.g., heat map, calendar trend report, consumption ranking report, etc.)

Energy data processing is embedded in the Report Engine & Dashboard of EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards.



TimeSync Clock



EcoStruxure™ Power Monitoring Expert



EcoStruxure™ Power Operation with Advanced Reporting & Dashboards

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

> ENERGY MONITORING

System Description (3/7)

Data Flow in Detail (cont.)

OUTPUTS

Outputs are displayed remotely via EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting and Dashboard 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 with Advanced
Reporting & Dashboards

Events & Alarms

In EcoStruxure™ Power Monitoring Expert:

- Smart setpoints provide threshold-based alarming of historical energy usage.

Trends

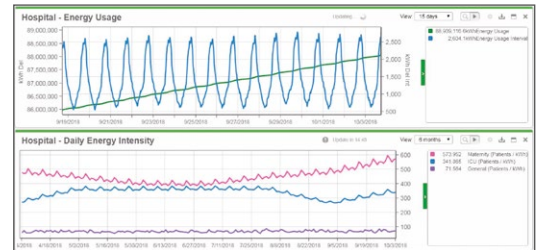
- Energy Usage trending

All input data detailed above can be displayed as trends.

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



Energy Usage Trending



Dashboard

> ENERGY MONITORING

System Description (4/7)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

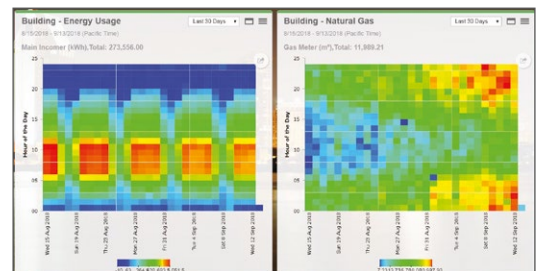
Dashboards (cont.)

Energy Usage Gadgets*

The following gadgets make it easier to display and interpret energy consumption data:

• Heat map gadget

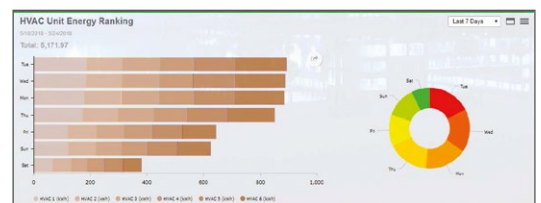
Creates a graphical representation of data where the individual values are represented as colors in a matrix format. This gadget can be used with consumption data to identify usage patterns and anomalies.



Heat Map Gadget

• Consumption/aggregated consumption ranking gadget

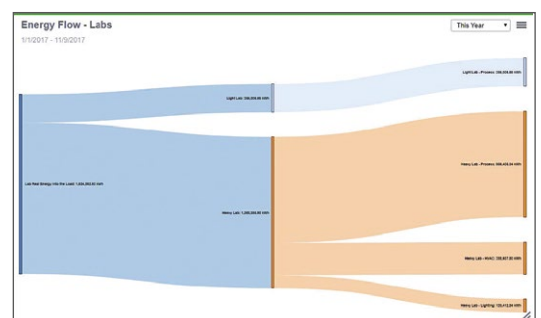
Compares the consumption of loads during specific time intervals, for example by hour, by day of week, or by day.



Consumption/Aggregated Consumption Ranking Gadget

• Sankey gadget

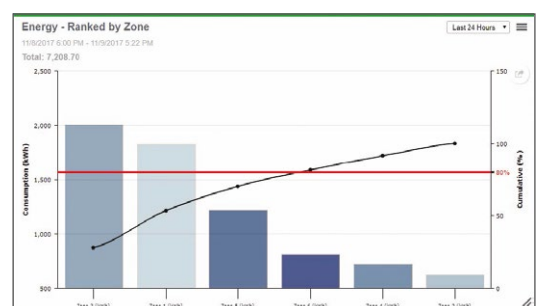
- Shows a flow diagram, in which the width of the arrows is proportional to the data values. The diagram starts as a combined flow for all the selected loads, and then breaks out into individual flows for each consumer.
- Used to show WAGES consumption broken down by load type, or to visualize consumption costs by load. You can also use it to show power losses.



Sankey Gadget

• Pareto/Aggregated pareto chart gadget

- Used to perform an 80/20 analysis, identifying those 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

* The Energy Analysis Dashboards Module of EcoStruxure™ Power Monitoring Expert must be deployed to benefit from these features.

ENERGY MONITORING

System Description (5/7)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

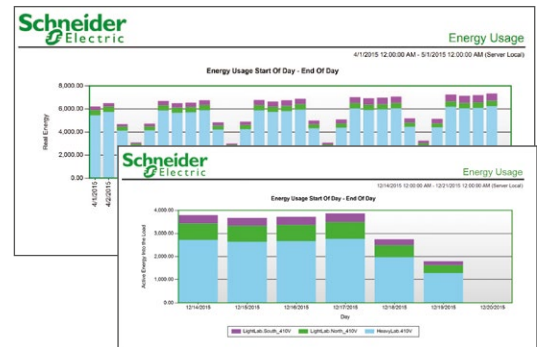
Reports

The following reports can be displayed or automatically sent by e-mail:

Energy Management Reports:

• Energy Usage Report

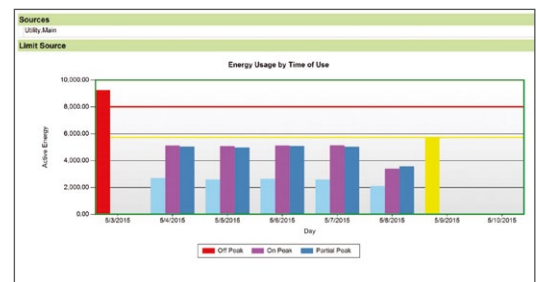
Highlights discrepancies and provides a visual interpretation of energy consumption data.



Energy Usage Report

• Energy Usage by Time of Use Report

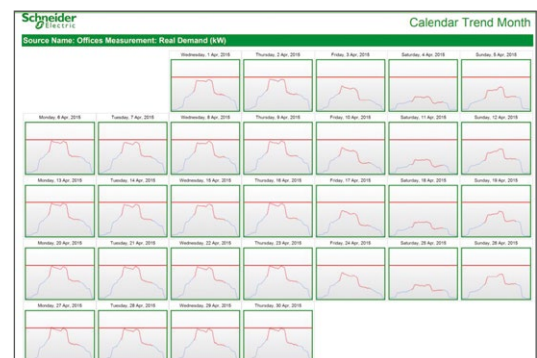
Compares consumption for different time of use periods (e.g., on-peak vs off-peak vs partial-peak).



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.

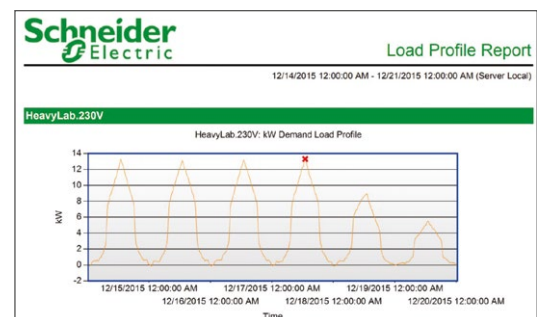


Calendar Trend Report

• 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 MONITORING

System Description (6/7)

Data Flow in Detail (cont.)

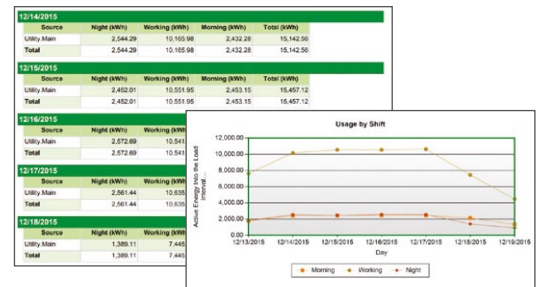
OUTPUTS (cont.)

Reports (cont.)

Energy Management Reports:

• Energy Usage by Shift Report

Compares a measurement from multiple devices for specified time periods (or shifts). This means energy consumption can be compared between shifts (for example, 6:00-1:00 vs. 1:00 to 8:00).



Energy Usage by Shift Report

• Consumption Ranking Report

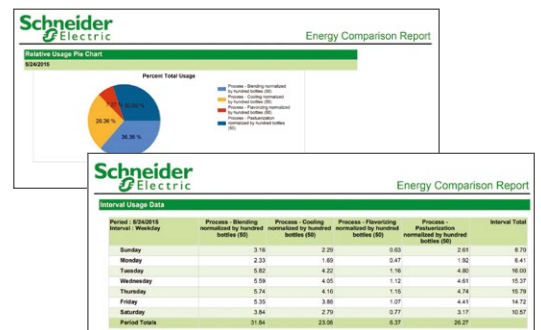
Highlights the relative ranking of energy consumption for several loads or areas. Consumption data can be normalized to facilitate the comparison. This report is intended to assist in building energy awareness through relative visualization.



Consumption Ranking Report

• Energy Comparison Report

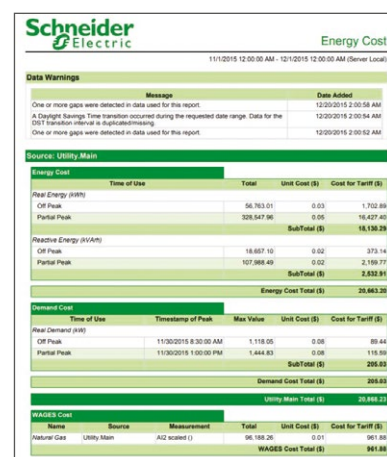
Compares energy consumption by process, equipment or area.



Energy Comparison Report

• Energy Cost Report

Converts energy consumption into cost by applying the relevant tariffs.



Energy Cost Report

> ENERGY MONITORING

System Description (7/7)

Data Flow in Detail (cont.)

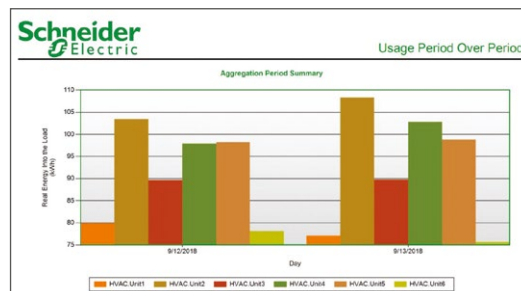
OUTPUTS (cont.)

Reports (cont.)

Energy Management Reports (cont.):

• Energy Period Over Period Report

Shows consumption data for the same measurement for two different viewing periods side-by-side.

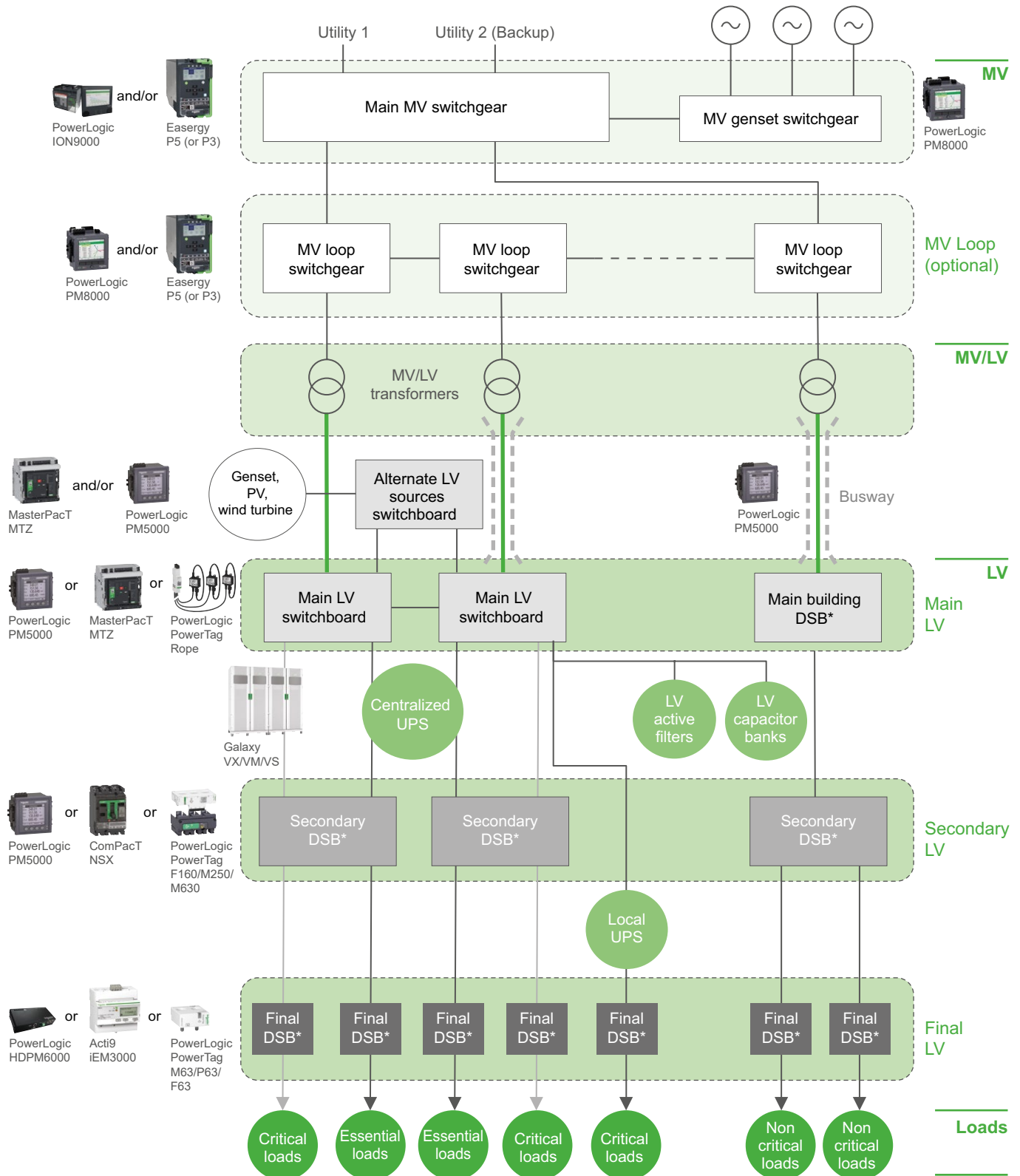


Energy Period Over Period Report

ENERGY MONITORING

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

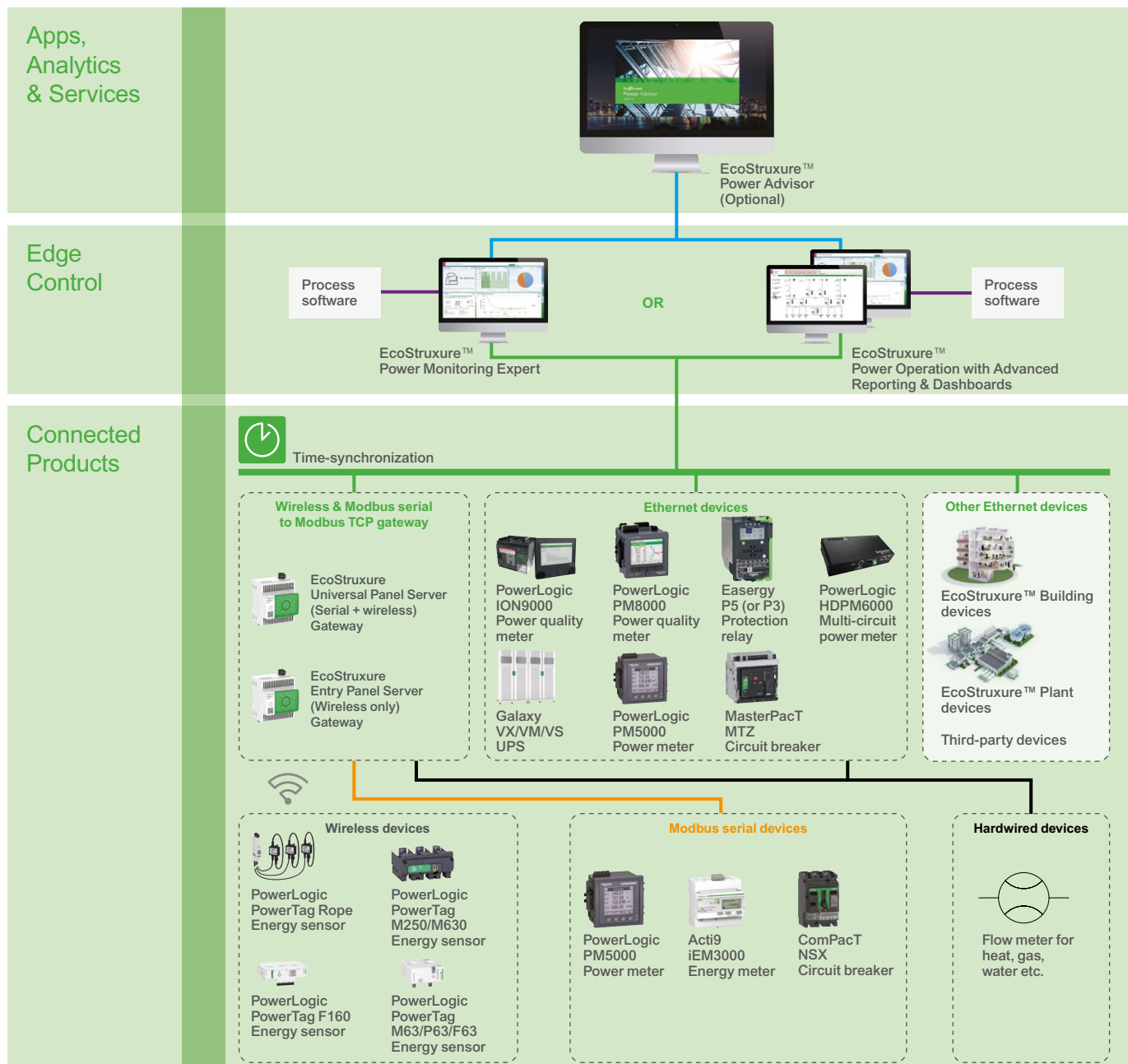
ENERGY MONITORING

Digital Architecture

The digital architecture of the Energy Monitoring application recommends direct Ethernet connection to energy measurement devices. Data is captured on board devices and uploaded into the Edge Control software (EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards) for data processing, visualization and reporting.

Other energy consumption inputs (WAGES) and equipment states can also be directly acquired via Ethernet or through hardwired signals from basic meters and sensors.

To capture the most significant factors in the customer process, OPC standard or ETL mechanism can be used to acquire data from external software. The recommended digital architecture is given below:



> ENERGY BENCHMARKING

Benchmark the Efficiency of Energy Use Across Devices, Processes, Facilities, or Organizations

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).*

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 ENERGY BENCHMARKING APPLICATION

Benchmark Multi-site Energy Usages

- Multi-site visualization enables 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 inefficient organization, facility, process or device use more energy than an efficient one.

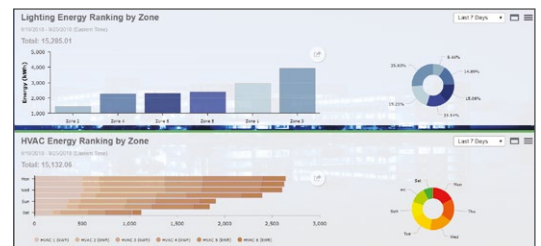
Application Outcomes

Dashboards

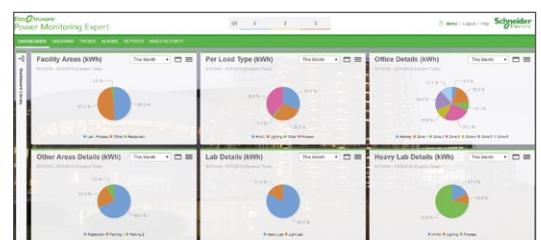
- Energy Comparison and Ranking dashboards
- Building Energy Rating gadget.

Reports

- Consumption Ranking Report
- Energy Comparison Report
- Calendar trend reports for benchmarking energy usage by load type and day of the week.



Energy Ranking by Zone



Building Area Benchmarking

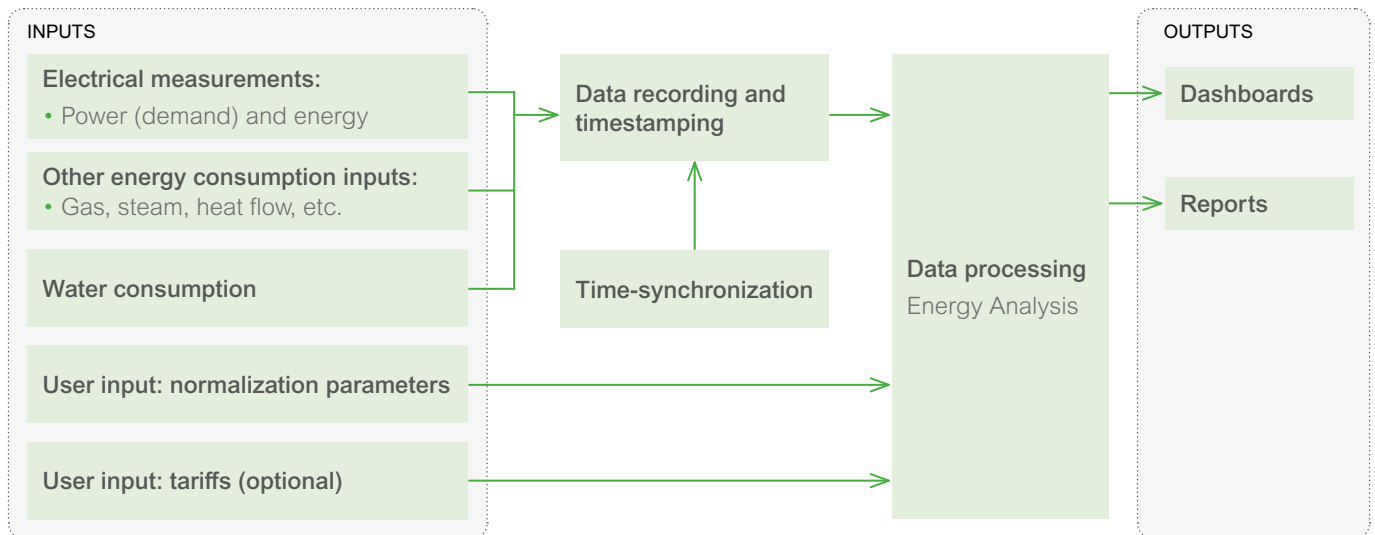
* Source: <https://www.energy.gov/eere/slsc/building-energy-use-benchmarking>

> ENERGY BENCHMARKING

System Description (1/4)

Data Flow

The Energy Benchmarking application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data is required:

Electrical Measurements

- Power (demand) values (kW, kVAR, kVA)
- Energy values (kWh, kVARh, kVAh)

This data may be acquired from power/energy meters such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, PowerTag, Acti9 iEM3000, etc., at each point of interest in the electrical distribution, from medium voltage to low voltage to final distribution.

Devices with embedded metering (e.g., Easergy P5, Easergy P3, MasterPacT MTZ, ComPacT NSX, Galaxy UPS, etc.) are also suitable for electrical power and energy monitoring.

These measurements can also be acquired via Modbus from third-party devices.

Other Energy Consumption Inputs

- Gas
- Steam
- Heat flow
- Water consumption (although not a form of energy, it is an important commodity to benchmark)

They can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.



> ENERGY BENCHMARKING

System Description (2/4)

Data Flow in Detail (cont.)

INPUTS (cont.)

User Input: Tariffs (optional)

Tariffs can be used to convert energy or water consumption into cost.

User Input: Normalization Parameters

Normalize consumption with respect to comparable devices, processes, facilities, departments or similar normalization parameters. These parameters are typically entered manually into the dashboards, reports or calculation engine of EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting and Dashboards.

DATA RECORDING AND TIMESTAMPING

For the Energy Benchmarking application, a timestamp accuracy of ± 1 s is sufficient for:

- Time-based historical data visualization,
- Energy and demand comparisons across comparable devices, processes, facilities or departments.

Advanced power meters such as the PowerLogic ION9000, PM8000 and some PowerLogic PM5000 models (PM53xx and PM55xx) can timestamp and record onboard energy measurements as well as connected equipment states.

For other devices (Easergy P5, Easergy P3, MasterPacT MTZ, entry-level PowerLogic PM5000 models), energy measurements and equipment states are acquired by the devices and recorded by EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards.

When acquiring data from other customer systems, timestamps can also be imported through OPC or ETL*.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)

TIME-SYNCHRONIZATION

For 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...). An external master clock may be required and connected to a GPS antenna to reach the expected time precision.

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 buildings energy ratings).

The calculation engine in EcoStruxure™ Power Monitoring Expert and Power Operation with Advanced Reporting and Dashboards provides the ability to normalize consumption data with respect to the normalization parameters described above.

This allows for comparing like for like to make benchmarking, as described above, meaningful.

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



TimeSync Clock



EcoStruxure™ Power Monitoring Expert



EcoStruxure™ Power Operation with Advanced Reporting & Dashboards

Product, Software and Services: See page 229



> ENERGY BENCHMARKING

System Description (3/4)

Data Flow in Detail (cont.)

OUTPUTS

Outputs are displayed via EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting and Dashboards.

Dashboards

The following gadgets ease visualization and interpretation of energy consumption data:

Energy Equivalency Gadget

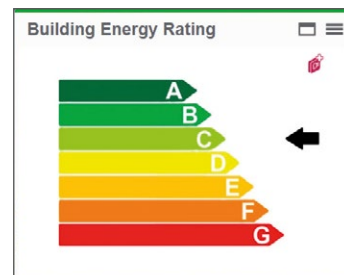
Shows a single value that is equivalent to the aggregated consumption input data, over a selected time period. The value can be scaled or normalized to represent a consumption equivalent measurement. The information is shown as a numeric value with unit, a custom text, and a custom graphic.



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*

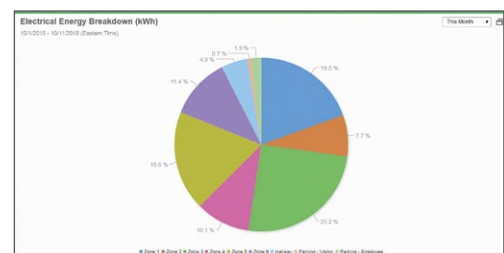
Compares the consumption of different loads, areas, processes or buildings over a period of time.



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.



Consumption Comparison

*The Energy Analysis Dashboards Module of EcoStruxure™ Power Monitoring Expert must be deployed to benefit from this gadget and other energy analysis visualizations.

> ENERGY BENCHMARKING

System Description (4/4)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Outputs are displayed via EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting and Dashboards.

Reports

The following Energy Management reports can be displayed or automatically sent by e-mail:

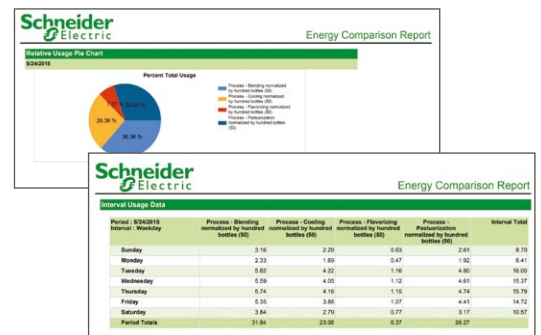
Consumption Ranking Report

- 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.

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.

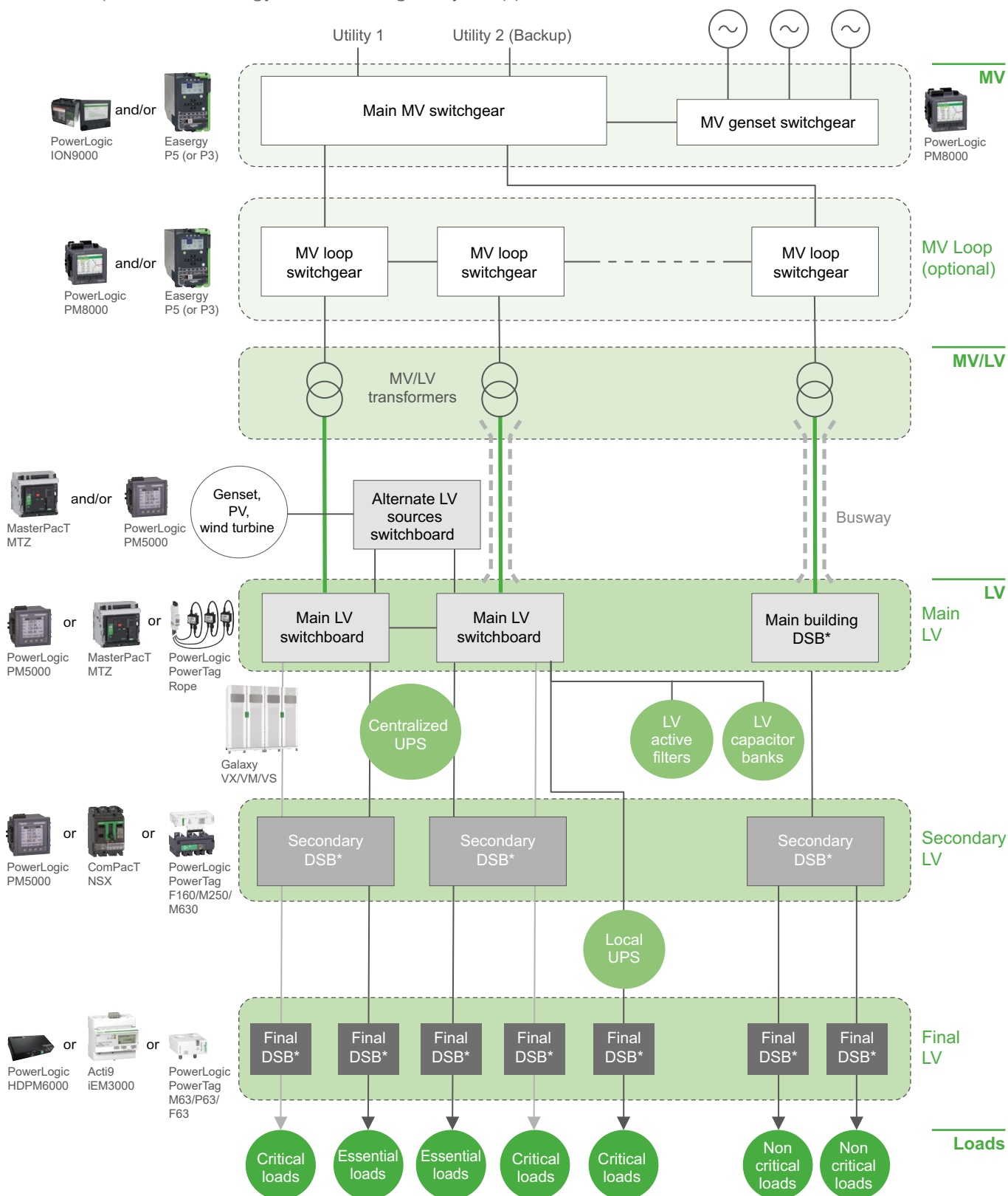
Both reports can be used to benchmark the energy consumption of areas, processes, devices or buildings with respect to each other.



ENERGY BENCHMARKING

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 Analysis application:



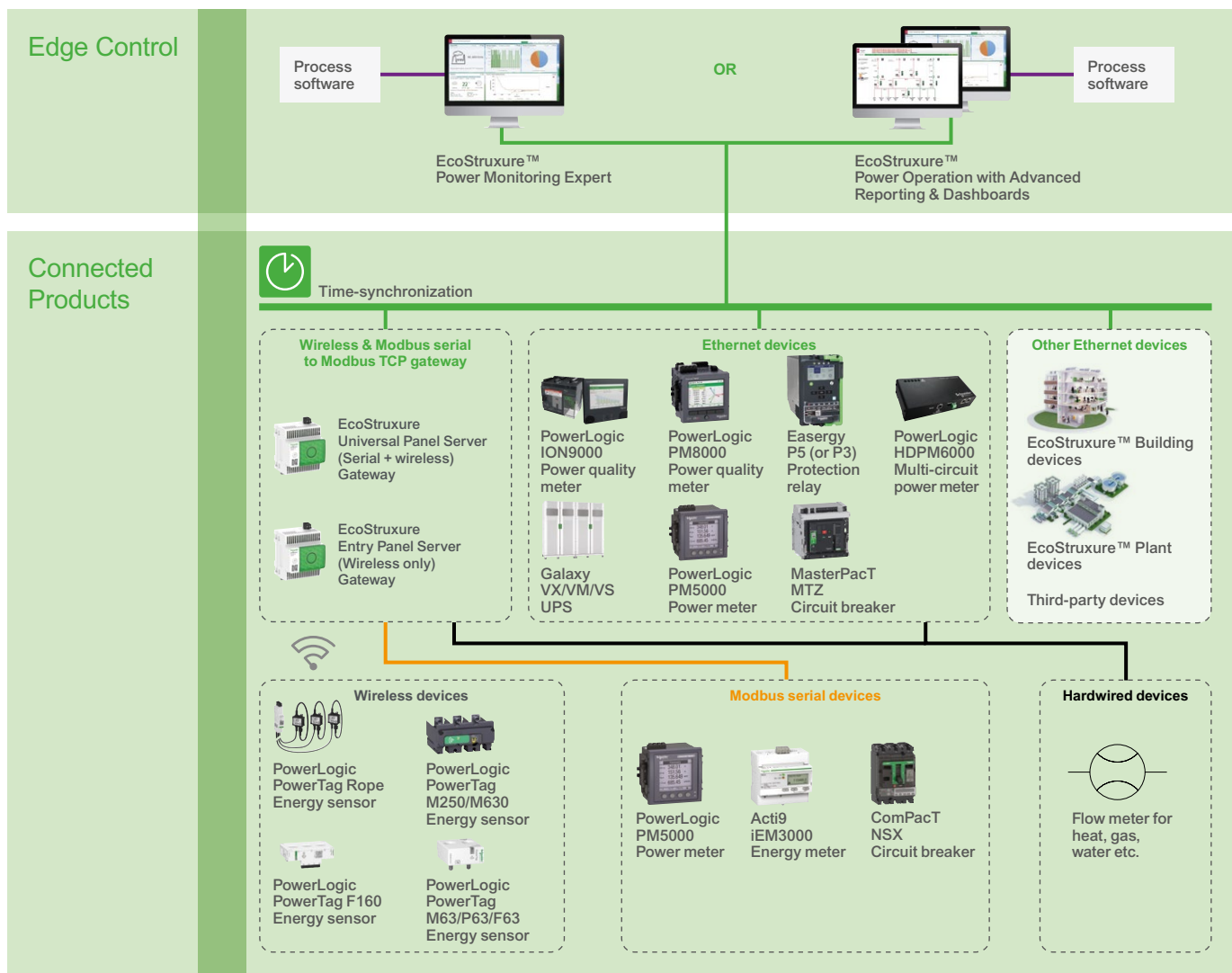
ENERGY BENCHMARKING

Digital Architecture

The digital architecture of the Energy Benchmarking application recommends direct Ethernet connection to energy meters. Data is captured on board connected products and uploaded into the Edge Control software (EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards) for data processing, visualization and reporting.

Other energy consumption inputs and equipment states can also be directly acquired via Ethernet or through hardwired signals from basic meters and sensors.

The recommended digital architecture for Energy Benchmarking is given below:



Product, Software and Services: See page 229



Analyze KPI Performance to Drive Behavioral Changes and Operational Efficiency

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 area, shifts, working hours or other contextual data to help identify areas to optimize through operational or behavioral changes.

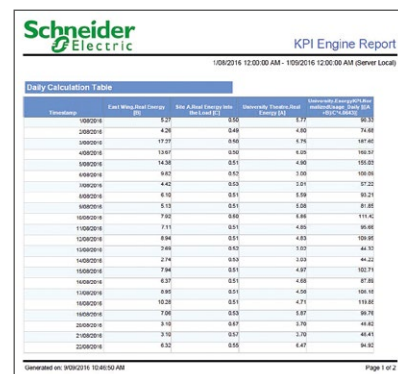
- Understand the energy intensity of the facility's operations
- Implement changes to process or building controls, energy production/consumption or operator behavior to continuously improve energy efficiency.

- By relating energy efficiency data with relevant operational context
- By establishing baselines of energy intensity for buildings, processes, areas, shifts or products.

- By comparing performance of a production line, building, area or shifts to find areas to optimize
- By implementing changes to operations, procedures or staff behaviors to continuously improve energy usage.



KPI Dashboard

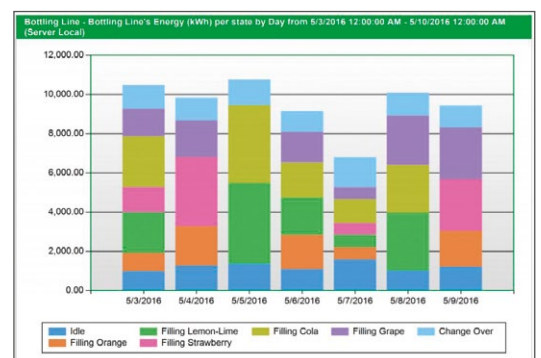


KPI Engine Report

- Key Performance Indicators (KPI): energy per unit of production, energy per shift, energy per process order, energy per production state
- Energy Intensity

- 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*
- Single Equipment Operation Report
- Multi-equipment Operation Report

* Uses static, pre-configured shift information



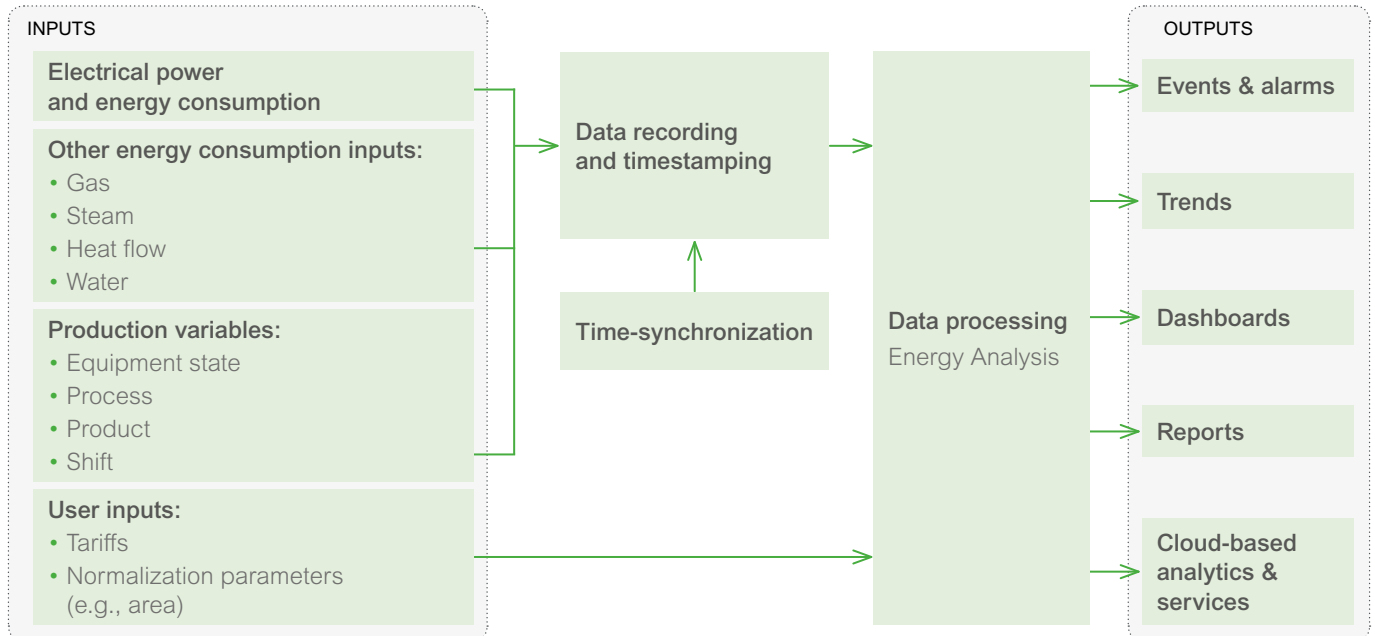
Energy Usage Report

> ENERGY PERFORMANCE

System Description (1/7)

Data Flow

The Energy Performance application can be broken down as follows:



Data Flow in Detail

INPUTS

The following measurements are performed:

Electrical Power and Energy Consumption

- Energy values (kWh, kVARh, kVAh)
- Power values (kW, kVAR, kVA)

This data may be acquired from power/energy meters such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, PowerTag, Acti9 iEM3000, etc., at each point of interest in the electrical distribution, from medium voltage to low voltage to final distribution.

Devices with embedded metering (e.g., Easergy P5, Easergy P3, MasterPacT MTZ, ComPacT NSX, Galaxy UPS, etc.) are also suitable for electrical power and energy monitoring.

These measurements can also be acquired via Modbus from third-party devices.

Other Energy Consumption Inputs

- Gas
- Steam
- Heat flow
- Water

They can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.



Product, Software and Services: See page 229



> ENERGY PERFORMANCE

System Description (2/7)

Data Flow in Detail (cont.)

INPUTS (cont.)

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
- Etc.

They can be imported in EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards from customer production systems through OPC or ETL*. Alternatively, they can also be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

User Input: Tariffs, Normalization Parameters

To convert energy consumption into cost, it is necessary to apply relevant tariffs to power/energy consumption values.

Also, 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 input.

DATA RECORDING AND TIMESTAMPING

For the Energy Performance application, a timestamp accuracy of ± 1 s is sufficient. Advanced meters such as the PowerLogic ION9000, PM8000 and some PowerLogic PM5000 models (PM53xx and PM55xx) can timestamp and record onboard energy measurements as well as connected equipment states.

For other devices (Easergy P5, Easergy P3, MasterPacT MTZ, entry-level PowerLogic PM5000 models) energy measurements and equipment states are acquired by the devices and recorded by EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards.

When acquiring data from other customer systems, timestamps can also be imported through OPC or ETL.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)



EcoStruxure™
Power Monitoring Expert



EcoStruxure™
Power Operation with Advanced
Reporting & Dashboards



PowerLogic
ION9000

PowerLogic
PM8000

PowerLogic
PM5000

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

> ENERGY PERFORMANCE

System Description (3/7)

Data Flow in Detail (cont.)

TIME-SYNCHRONIZATION

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

Time-synchronization can be performed through various technologies (PTP, NTP, SNTP, etc.). An external master clock may be required and may be linked to a GPS antenna to reach 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 with Advanced Reporting & Dashboards.

OUTPUTS

Display of outputs is performed by EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards except in specified cases.

The following outputs, when used as part of an energy conservation program, can help normalize energy data with respect to business operations (e.g., number of items produced) that drive energy usage.

Events & 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

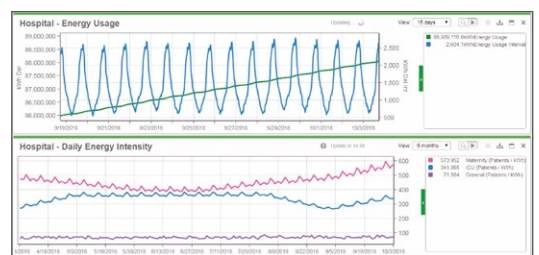
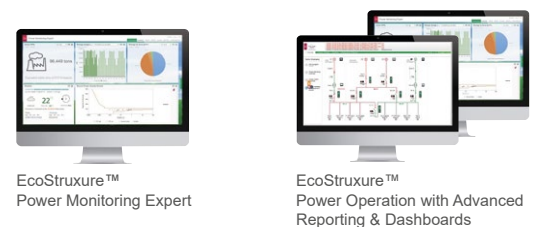
Dashboards

All dashboards can be configured to run automatically in slide show mode to perform the function of an "Energy Kiosk".

Key Performance Indicator Dashboards*

Dashboards to visualize, analyze and communicate information on an organization's energy performance KPIs continuous energy improvement.

* 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 with Advanced Reporting & Dashboards.



Energy Usage Trending



KPI Dashboard



ENERGY PERFORMANCE

System Description (5/7)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

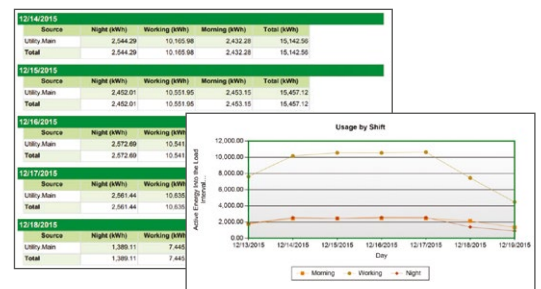
Reports

The following reports can be displayed or automatically sent by e-mail:

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, 6:00-1:00 vs. 1:00 to 8:00).

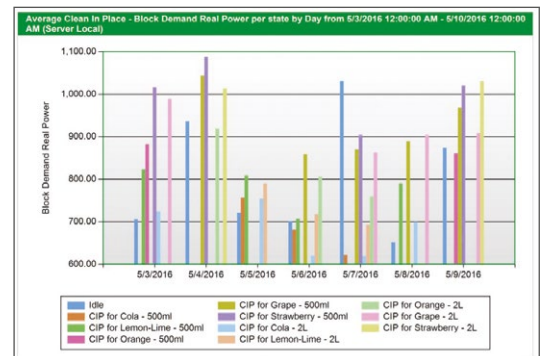


Energy Usage by Shift

Energy Analysis Reports*:

• Power Usage per State Report

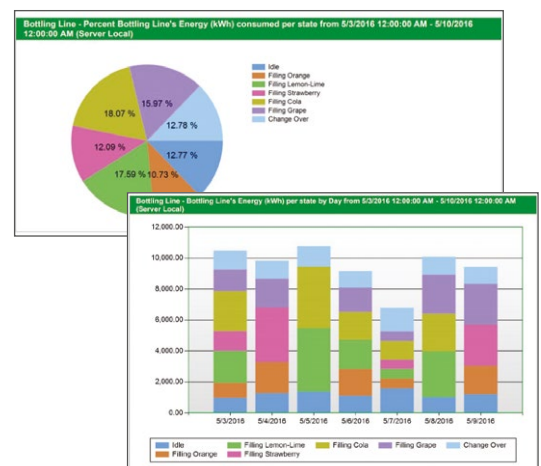
Details power usage per state of operation of a machine or process.



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

* The Energy Analysis Reports module of EcoStruxure™ Power Monitoring Expert must be deployed to benefit from these features

Product, Software and Services: See page 229



ENERGY PERFORMANCE

System Description (6/7)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Reports (cont.)

Energy Analysis Reports* (cont.):

• Duration Curve Report

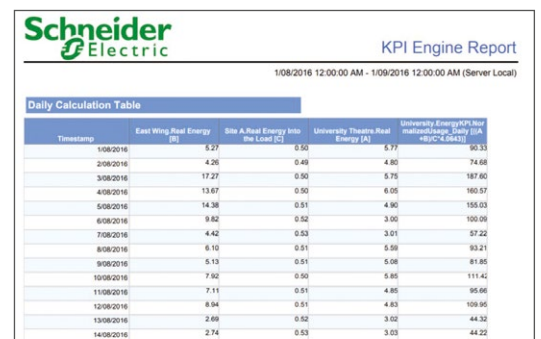
Shows distribution of power consumption versus duration to detect potential capacity or utilization issues.



Duration Curve Report

• KPI Engine

Calculates complex energy KPIs.

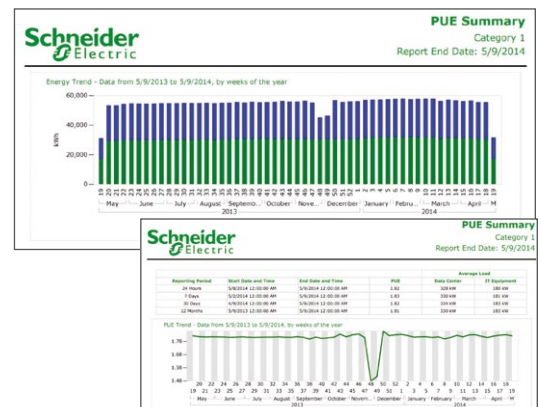


KPI Engine Report

• Power Usage Effectiveness (PUE) Report (data center)

Displays and analyzes Power Usage Effectiveness by day, week, month and year.

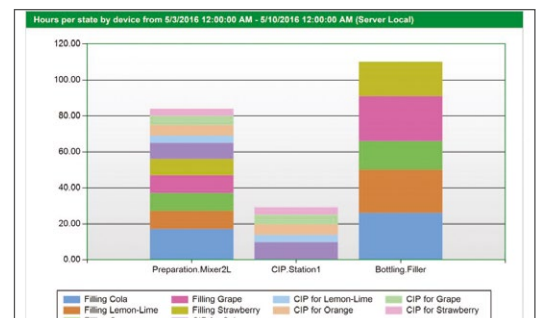
Compares the IT loads and support loads.



PUE Report (Data Center)

• Multi-Equipment Operation Report

Compares duration per state, per machine or process.



Multi-Equipment Operation Report

* The Energy Analysis Reports module of EcoStruxure™ Power Monitoring Expert must be deployed to benefit from these features

Product, Software and Services: See page 229



ENERGY PERFORMANCE

System Description (7/7)

Data Flow in Detail (cont.)

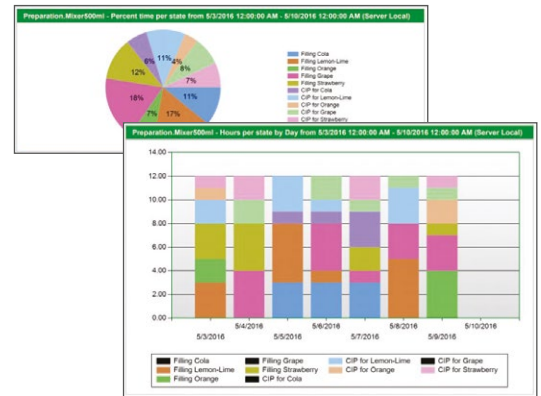
OUTPUTS (cont.)

Reports (cont.)

Energy Analysis Reports* (cont.):

• Single Equipment Operation Report

Compares duration per state for a single machine or process.



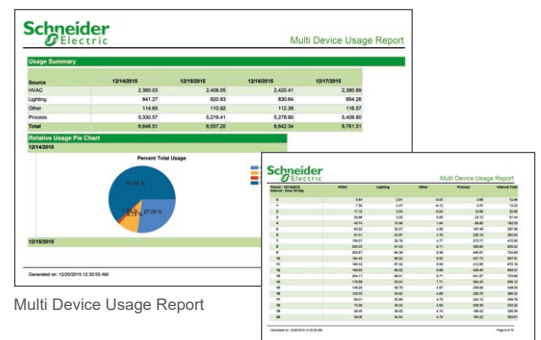
Single Equipment Operation Report

Usage Trending Reports:

• Multi Device Usage Report

Use the Multi Device Usage Report template to view consumption information for multiple devices.

View energy usage for a single period, or compare two periods, for example, this month versus last month.

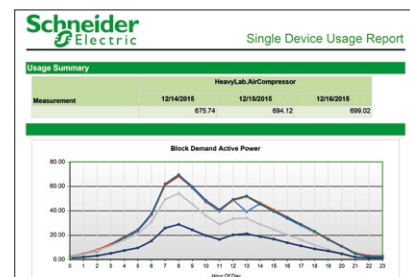


Multi Device Usage Report

• Single Device Usage Report

Use the Single Device Usage Report template to view 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 & Services

EcoStruxure™ Power Advisor System Health Checks can be used to help ensure data is accurate and reliable for Energy Performance.

For further details, [Refer to Section 1 on Data Quality Management](#).

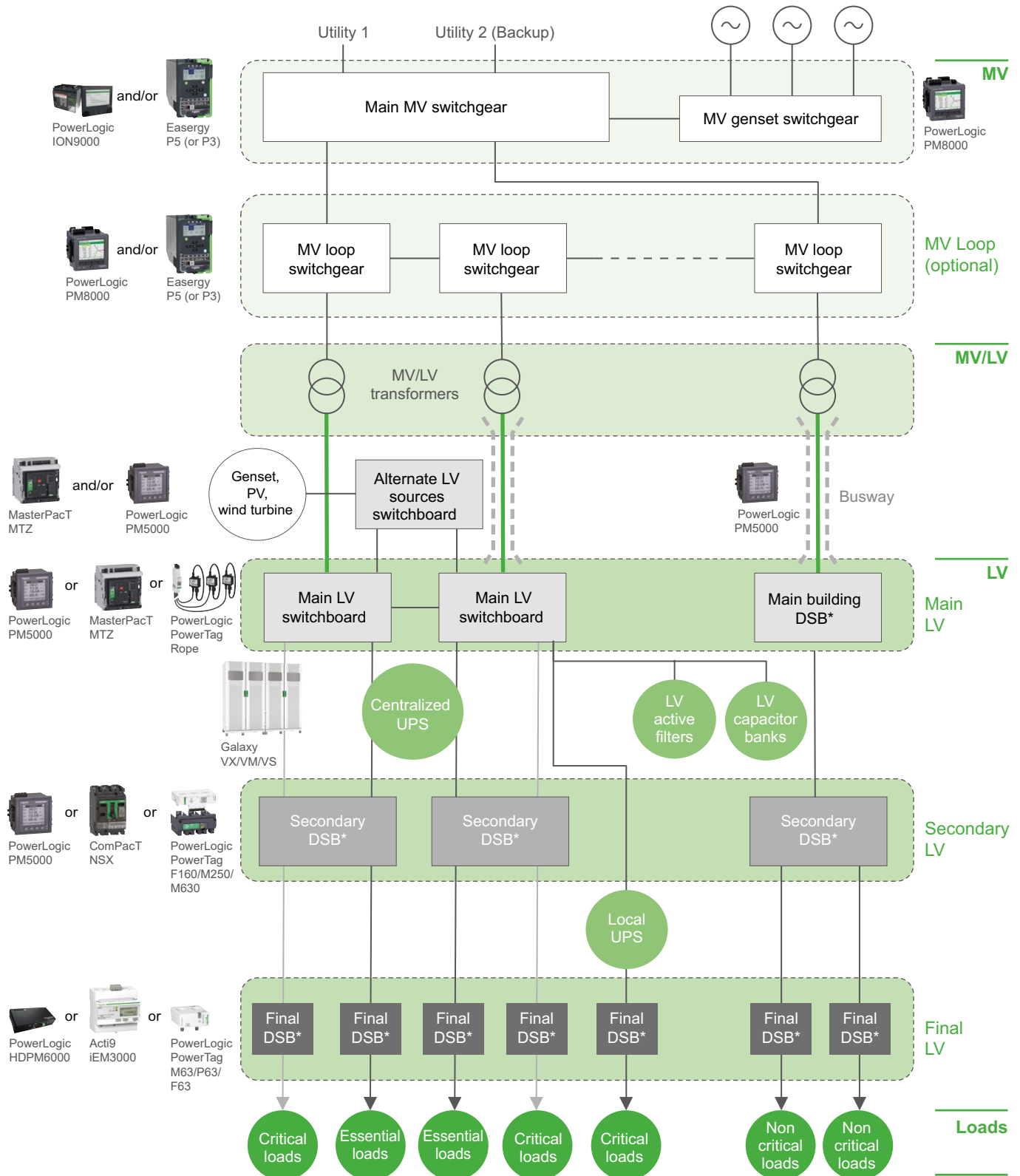


EcoStruxure™ Power Advisor

ENERGY PERFORMANCE

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

ENERGY PERFORMANCE

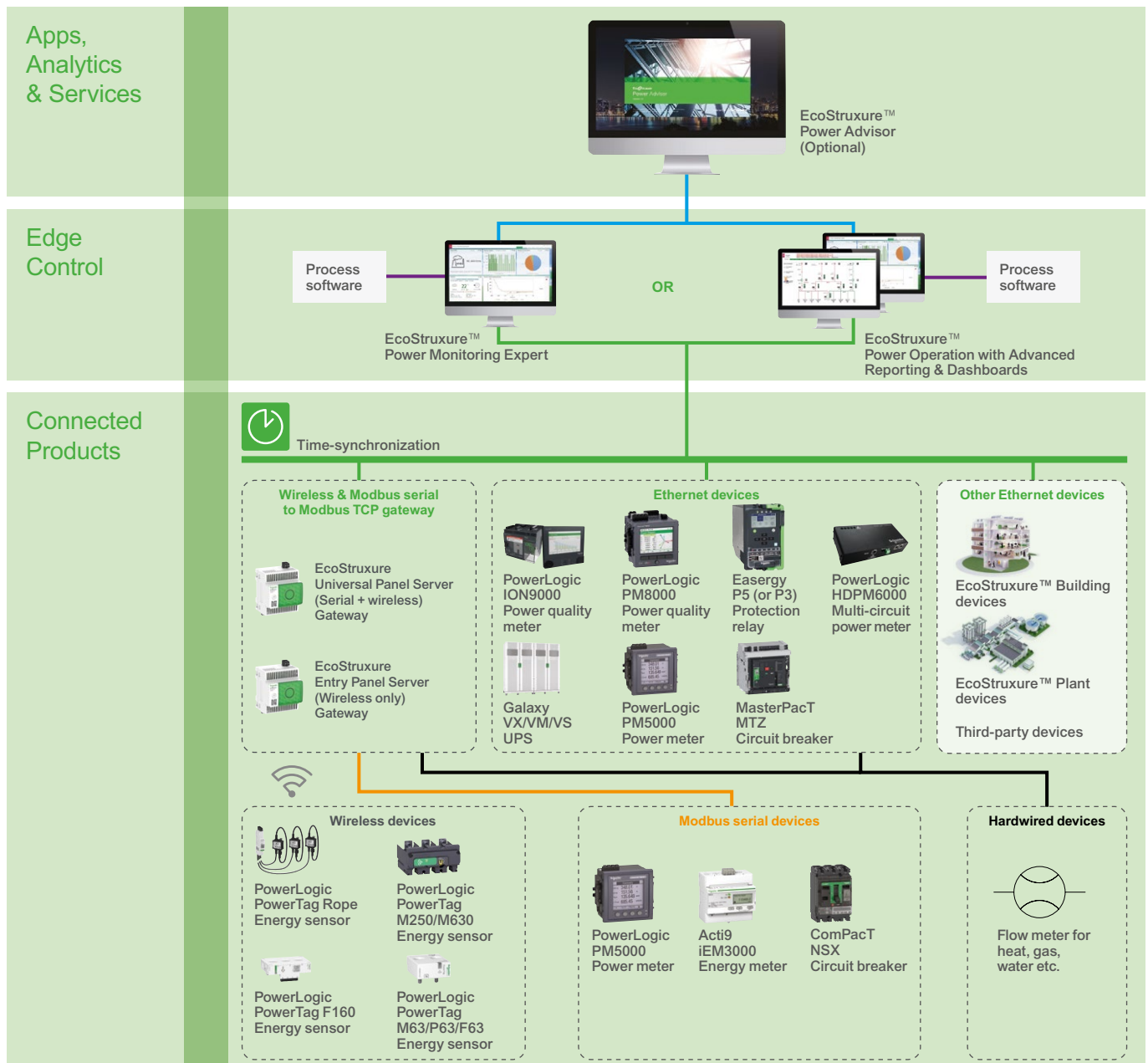
Digital Architecture

It is recommended to use a direct Ethernet connection to energy measurement devices for the Energy Performance application. Data is captured on board devices and uploaded into the Edge Control software (EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards) for data processing, visualization and reporting.

Other energy consumption inputs (WAGES) and equipment states can also be directly acquired over Ethernet or through hardwired signals from basic meters and sensors.

Alternatively, the most significant factors in customer processes can also be captured from other external process software using the OPC standard or ETL mechanism.

The recommended digital architecture for Energy Performance application is given below:



ENERGY MODELING & VERIFICATION

Track Performance, Fine-Tune Savings Programs by Modeling Energy Use and Verifying Savings

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 ENERGY MODELING & VERIFICATION 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 rate 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

Basic trends:

- Energy Usage
- Calendar

Modeled data can be displayed as trends.

Dashboards

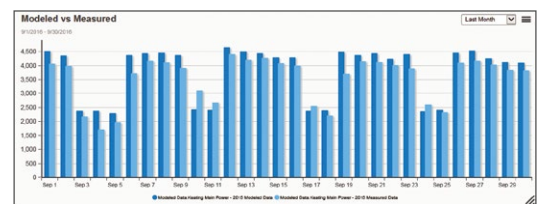
Energy Usage:

- Modeled values vs measured values

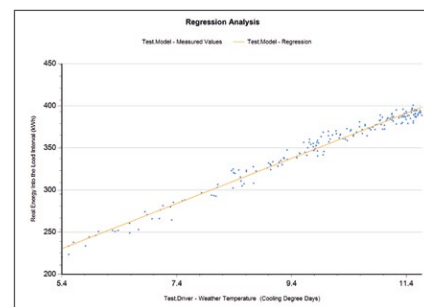
Comment: Modeled data can be displayed in most standard dashboards.

Reports

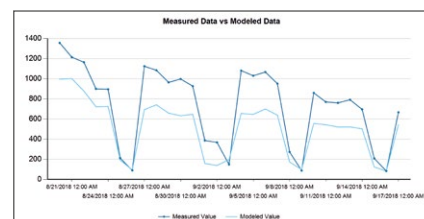
- Create Model Report
- Use Model Report



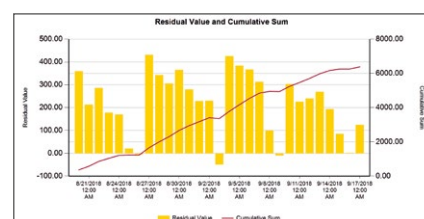
Modeled Values vs Measured Values Gadget



Energy Regression Analysis (Create Model Report)



Modeled Values vs Measured Values (Use Model Report)



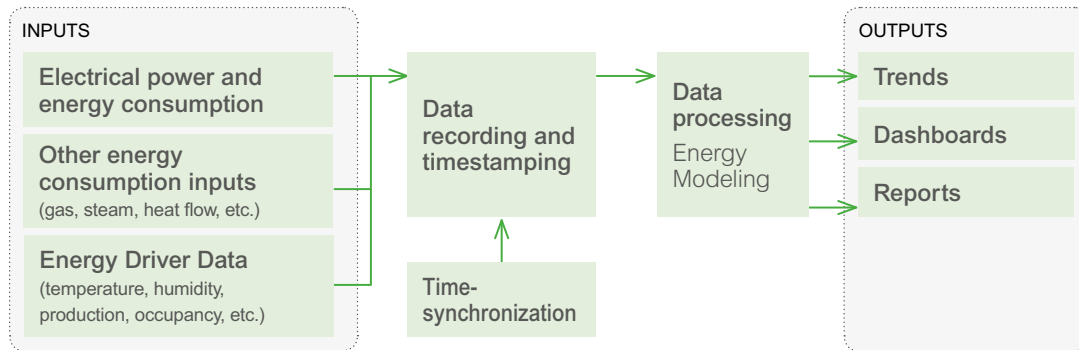
Cumulative Savings (Use Model Report)

> ENERGY MODELING & VERIFICATION

System Description (1/3)

Data Flow

The Energy Modeling & Verification application can be broken down as follows:



Data Flow in Detail

INPUTS

The following measurements are performed:

Electrical Power and Energy Consumption

- Energy values (kWh, kVARh, kVAh)
- Power values (kW, kVAR, kVA)

This data may be acquired from power/energy meters such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, PowerTag, Acti9 iEM3000, etc. at each point of interest in the electrical distribution, from medium voltage to low voltage to final distribution. Protection devices with embedded metering (e.g., Easergy P5, Easergy P3, MasterPacT MTZ, ComPacT NSX, etc.) are also suitable for electrical power and energy monitoring. These measurements can also be acquired via Modbus from third-party devices.

Other Energy Consumption Inputs

For a global model of energy consumption, other sources of energy shall be monitored:

- Gas
- Steam
- Heat flow

This energy data can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.

Energy Driver Data

Any data that may impact on energy consumption shall be monitored.

For example:

- Weather information (e.g., outside temperature)
- Production volumes (# of units, tons, etc.)
- Hours of operation and operation schedules (work hours, weekdays vs weekends, seasons, shifts, etc.)
- Base loads
- Building occupancy

They 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 or ETL.



> ENERGY MODELING & VERIFICATION

System Description (2/3)

Data Flow in Detail (cont.)

DATA RECORDING AND TIMESTAMPING

Advanced meters such as the ION9000, PM8000 and some PowerLogic PM5000 models (PM53xx and PM55xx) can timestamp and record onboard energy measurements as well as connected equipment states.

For other devices (Easergy P5, Easergy P3, MasterPacT MTZ, entry-level PowerLogic PM5000 models), energy measurements and equipment states are acquired by the devices and recorded by EcoStruxure™ Power Monitoring Expert and Power Operation with Advanced Reporting & Dashboards.

When acquiring data from other customer systems, timestamps can also be imported through OPC or ETL*.



TIME-SYNCHRONIZATION

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

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



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.

Comment: 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).

Energy modeling is embedded in the optional Energy Analysis Reports module of EcoStruxure™ Power Monitoring Expert and Power Operation with Advanced Reporting and Dashboards.



OUTPUTS

Outputs are displayed via EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting and Dashboard. The Energy Analysis Reports module of EcoStruxure™ Power Monitoring Expert must be deployed to benefit from these features.

Trends

Modeled data can be saved in the database and displayed as a trend.

Dashboards

Modeled data can be saved in the database and displayed as a dashboard.



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

ENERGY MODELING & VERIFICATION

System Description (3/3)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Reports

First the Energy Modeling & Verification application requires the energy model to be built (performed in the "Create Model Report") before using it for various analysis and verifications aims (performed in 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.

Prerequisites: To use this report, the data for the independent variables (driver data) and for the dependent variable (power/energy) must be available in the 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 actually 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.

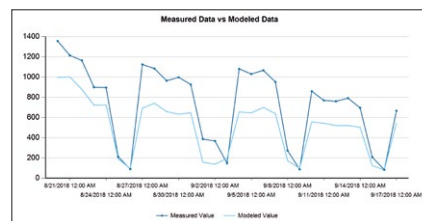
This report can be displayed or automatically sent by e-mail.

Comment: 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.

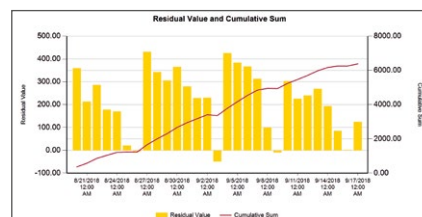
Prerequisites: To use this report, at least one model must have been defined for the facility or process. For forecasted energy/power consumption, the forecast of the independent variables (Driver Data) must be available in the Power Monitoring Expert database for the reporting period.



Create Model Report



Use Model Report: comparison between expected and actual energy consumption

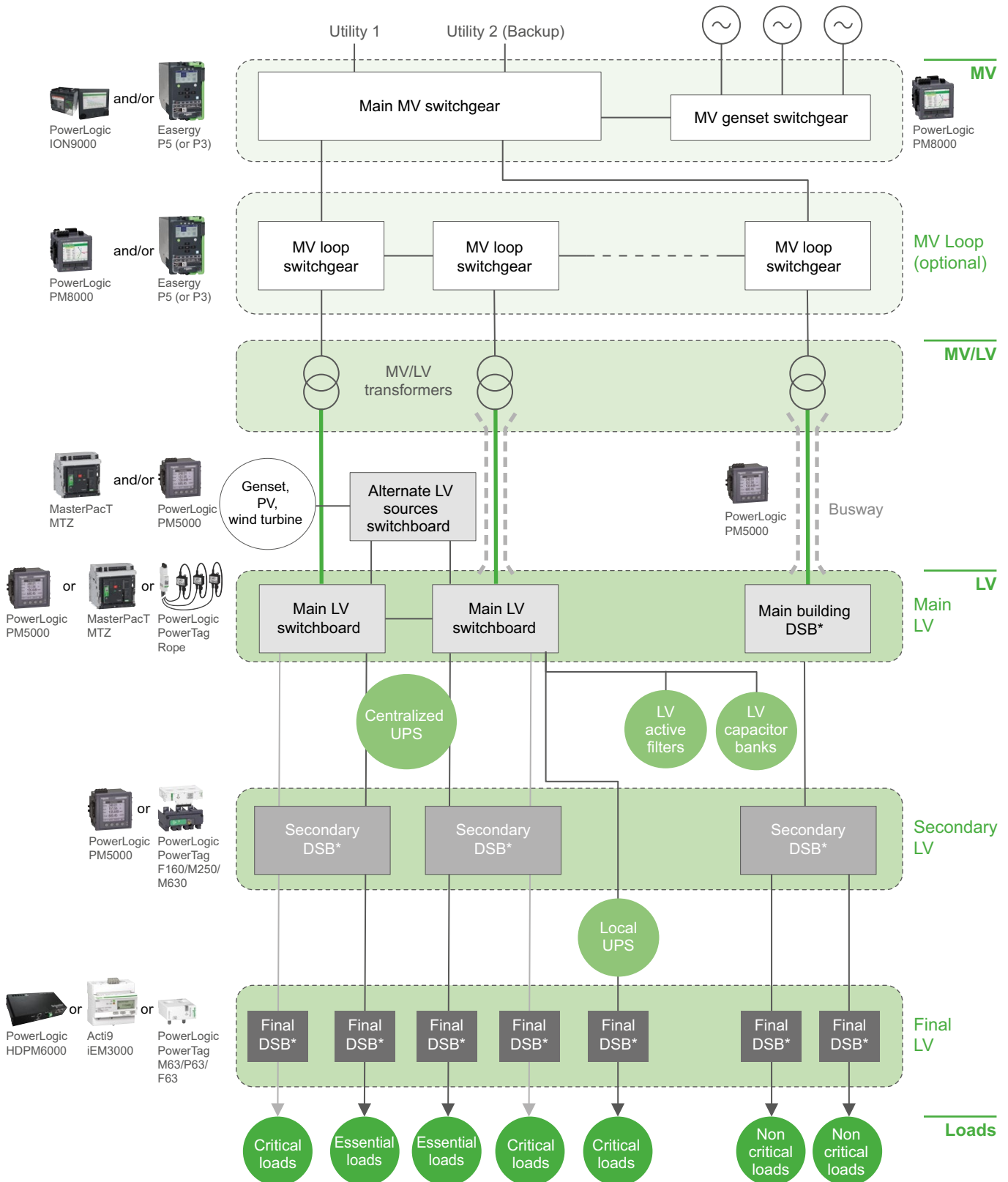


Use Model Report: residual value & cumulative sum of difference between expected and actual energy consumption

> ENERGY MODELING & VERIFICATION

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 & Verification application:



* DSB = Distribution Switchboard

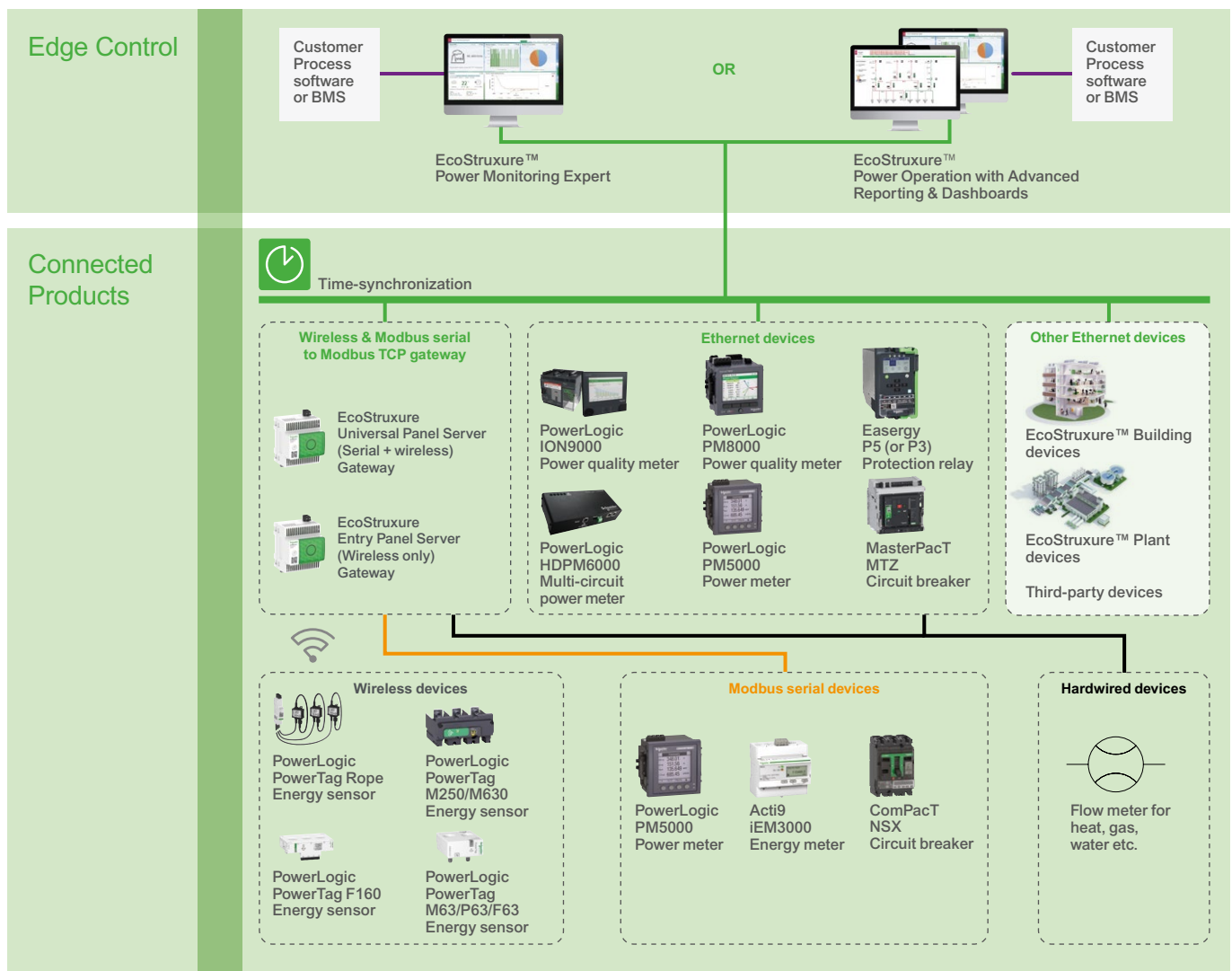
> ENERGY MODELING & VERIFICATION

Digital Architecture

The digital architecture of the Energy Modeling & Verification application recommends direct Ethernet connection to energy measurement devices or gateways. Data is captured on board devices and uploaded into the Edge Control software (EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reports & Dashboards) for data processing, visualization and reporting.

Other WAGES and equipment states can also be directly acquired via Ethernet or serial communication.

Example of digital architecture to implement the Energy Modeling & Verification application:



> POWER FACTOR CORRECTION

Reduce Utility Bill by Eliminating Power Factor Penalties

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 factors 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 eliminate power factor penalties on the energy bill

PURPOSE OF POWER FACTOR CORRECTION 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

- Realtime trending of power factor or reactive power

Events & Alarms

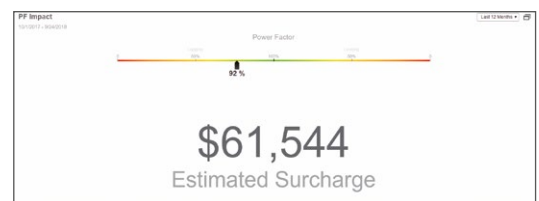
- Chronological display of events and alarms with sorting and filtering capabilities
- Intelligent alarm grouping into summary incidents

Trends

All analog values stored as historical data can be displayed as trends to monitor their evolution over time.

Dashboards

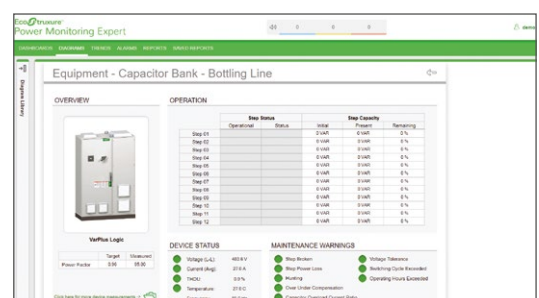
- Power Factor Estimated Cost gadgets
- Power Factor Impact gadgets
- Power Factor Correction Equipment diagrams



Power Factor Surcharges



Power Factor - Reactive Power Trending



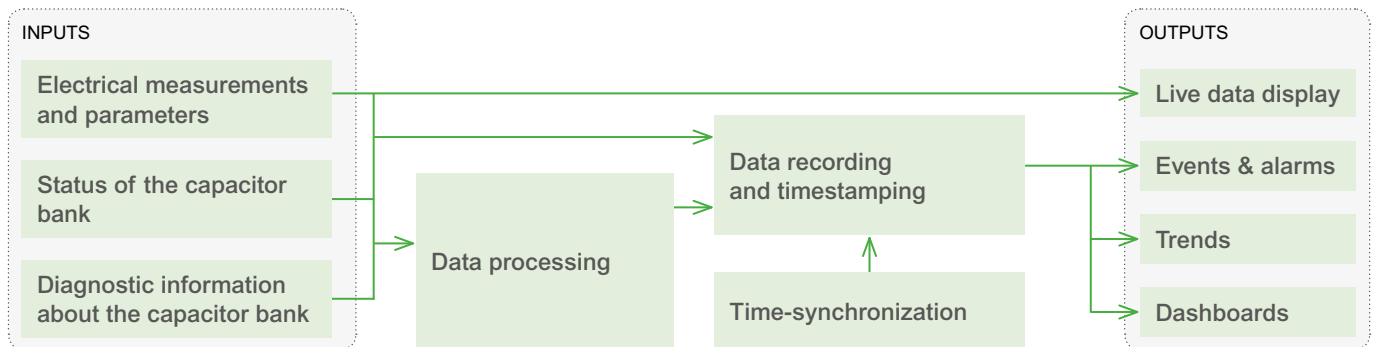
Power Factor Equipment Diagram

> POWER FACTOR CORRECTION

System Description (1/2)

Data Flow

The Power Factor Correction application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data is required:

Electrical Measurements and Parameters

- Power Factor (measured & targeted)
- Other electrical measurements: voltage, current, frequency, Power (kW, kVAR, kVA), harmonics

A power meter 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.

Status of the Capacitor Bank

- Active compensation steps

Diagnostic Information about the Capacitor Bank

- 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

These measurements are acquired from a power factor correction controller such as VarPlus Logic.

DATA PROCESSING

Data processing is done through the Edge Control's data acquisition engine to create alarms and events from status and diagnostic information (with EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards).



Product, Software and Services: See page 229



> POWER FACTOR CORRECTION

System Description (2/2)

Data Flow in Detail (cont.)

DATA RECORDING AND TIMESTAMPING

For Power Factor Correction equipment, data recording is performed by EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards, based on realtime 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), time-synchronization is required with a recommended accuracy of ± 100 ms or better.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)

TIME-SYNCHRONIZATION

For a consistent chronological view of all events which happen throughout the facility, the date and time should be accurately distributed to connected products and other management systems. For this application, this mainly concerns the PowerLogic ION9000 or PM8000 Power Quality Meters.

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

OUTPUTS

Live data, alarms, events and dashboards are available by default in EcoStruxure™ Power Monitoring Expert and Power Operation with Advanced Reporting & Dashboards.

Live Data Display

Live data acquired by the software driver can be displayed in Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards through equipment diagrams. The realtime data displayed include electrical measurements, operating modes, statuses and maintenance indicators.

Events & 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 diagnostics alarms.

Trends

All analog values stored as historical data can be displayed as trends to monitor their evolution over time.

Dashboards*

Electrical parameters acquired and recorded natively by power factor correction equipment (VarPlus Logic) can be displayed as historical data in dashboards. Some examples of these dashboards include:

- PF Impact
- PF Impact Trend

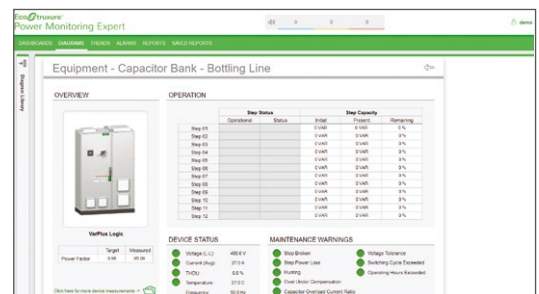
* The Power Quality Performance Module of EcoStruxure™ Power Monitoring Expert must be deployed to benefit from these features



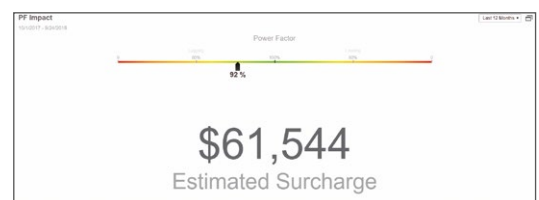
EcoStruxure™
Power Operation with Advanced
Reporting & Dashboards



TimeSync Clock



Default Diagram for Capacitor Banks



Power Factor Impact Dashboard



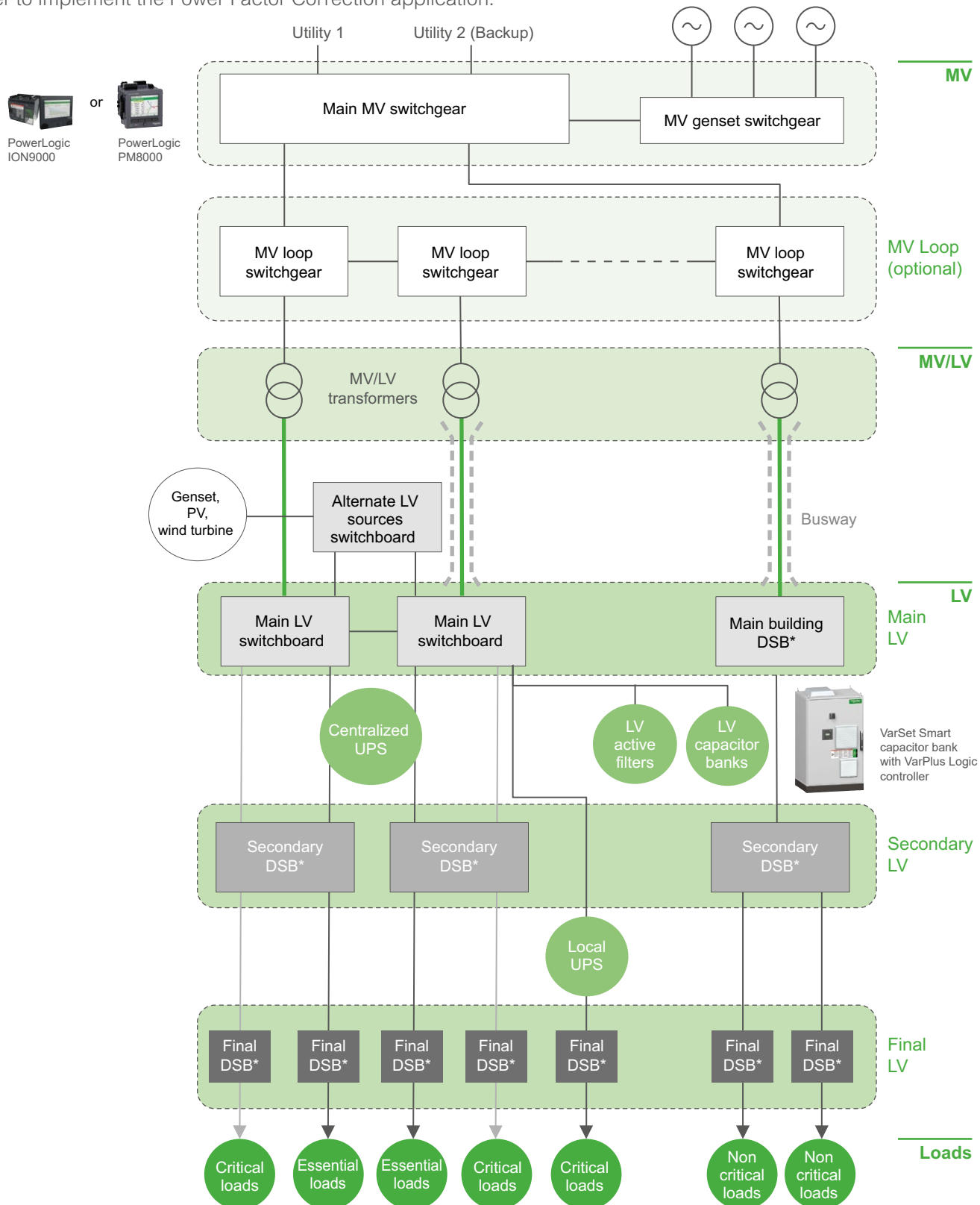
Power Factor Impact Trend Dashboard



> POWER FACTOR CORRECTION

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

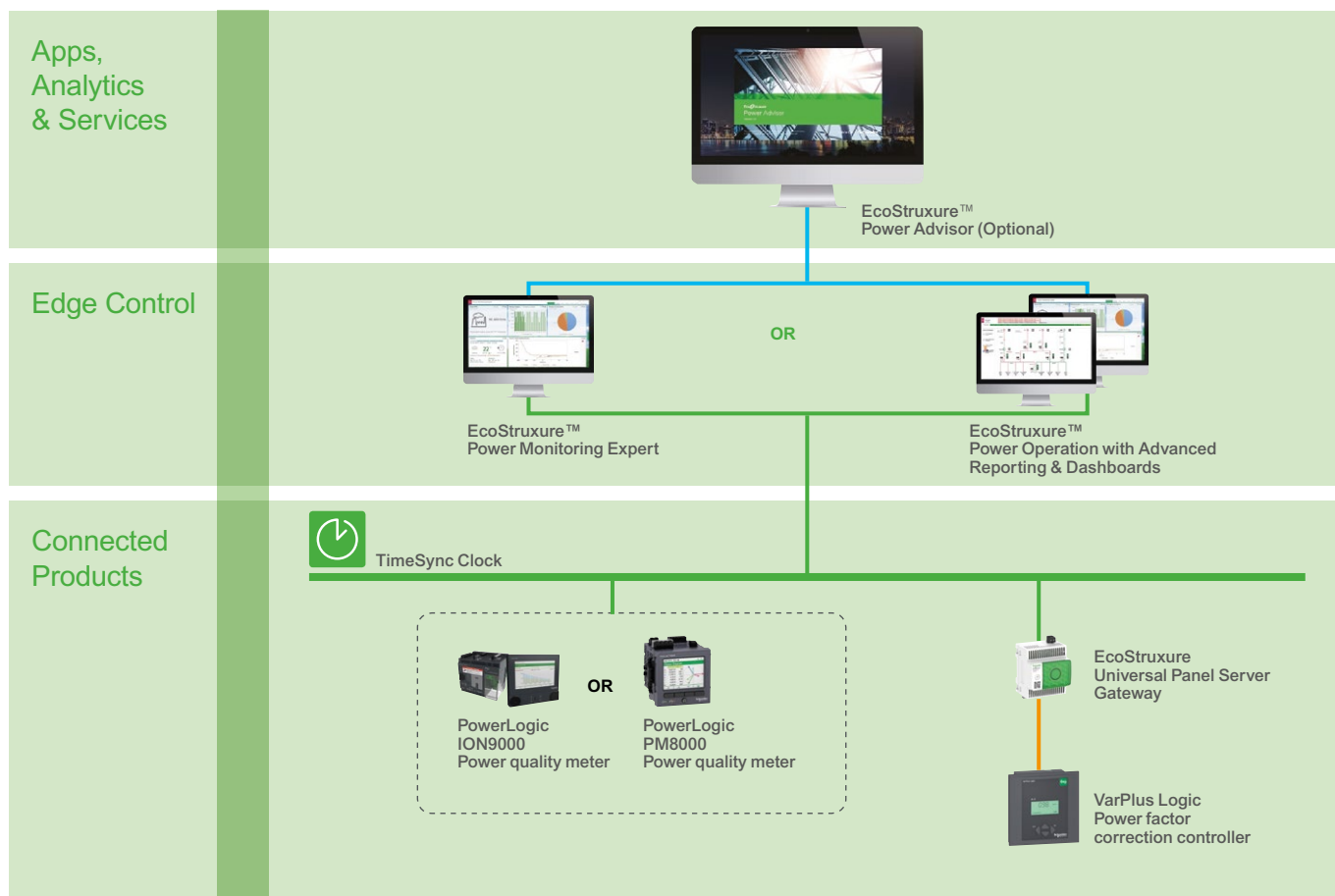


> POWER FACTOR CORRECTION

Digital Architecture

Communications for VarPlusLogic Power Factor Controller are done through a Modbus Serial connection. EcoStruxure™ Panel Server gateway converts the Modbus communications to Ethernet for realtime data acquisition by the Edge Control software, EcoStruxure™ Power Monitoring Expert and EcoStruxure™ Power Operation.

Optionally, as part of a connected service, data can be used for analytics services with EcoStruxure™ Power Advisor. This data enables Schneider Electric service engineers to make recommendations. The recommended digital architecture for the Power Factor Correction application is given below:



> ENERGY EFFICIENCY COMPLIANCE

Comply with Standards Related to Energy Management Systems (1/2)

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 (e.g., ISO 50001, 50002, 50006, Superior Energy Performance® and other local/regional energy efficiency standards)
- Communicate the energy efficiency program to stakeholders, and report on energy performance improvements.

PURPOSE OF ENERGY EFFICIENCY COMPLIANCE APPLICATION

Enable a Systematic Approach to Achieving Continuous Energy Performance Improvement

- By making energy usage visible at all stages of an energy management plan
- By providing transparency through reporting on energy performance indicators (EnPI) to regulators or shareholders, and demonstrating continuous improvement.



ISO 50001 Certificate

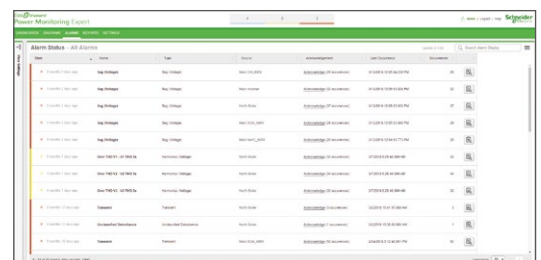
Application Outcomes

Events & Alarms

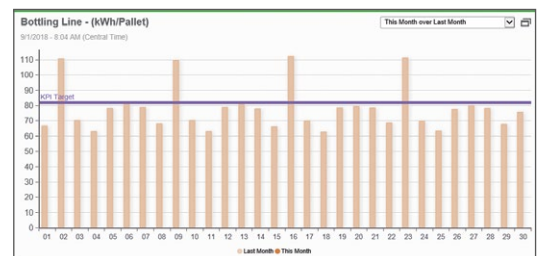
Smart alarms can be configured to alert energy managers or operations staff in the event of energy-related events requiring attention (e.g., imminent exceeding of peak demand threshold).

Trends

Measured energy values or ratios of measured values (or KPIs e.g., kWh/unit of production) can be trended.



Events and Alarms



Peak Demand Trend

ENERGY EFFICIENCY COMPLIANCE

Comply with Standards Related to Energy Management Systems (2/2)

Application Outcomes (cont.)

Dashboards

- Energy Cost Comparison
- Energy Consumption Ranking
- Energy Heat map
- Pareto charts
- Sankey diagram
- KPI (Key Performance Indicators) dashboards
- General line graphs, bar charts and pie charts.

Reports

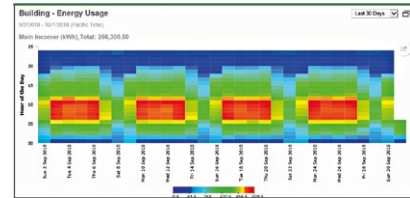
- Consumption Ranking Reports
- Energy Comparison Reports
- Energy Modeling Reports
- Energy Usage Reports
- Calendar Trend Reports
- KPI Engine Report.

Notifications

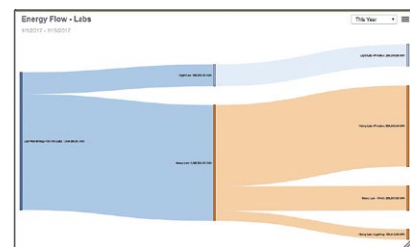
SMS or email notifications are sent on pre-alarm and alarming conditions described above to enable fast action.

Cloud-based Analytics & Services

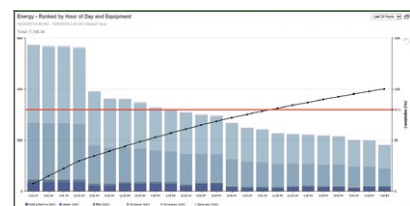
With Power Advisor, cloud-based data quality analytics check the system for errors and inconsistencies such as missing data, misconfigured metering, unmetered loads and more.



Energy Heat Map



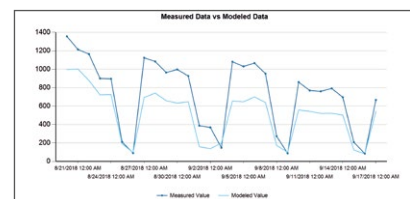
Sankey Diagram



Pareto Charts



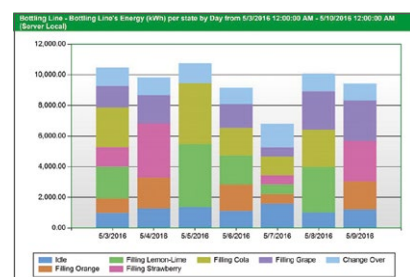
KPI Dashboard



Energy Use Model Report



Data Quality Analytics



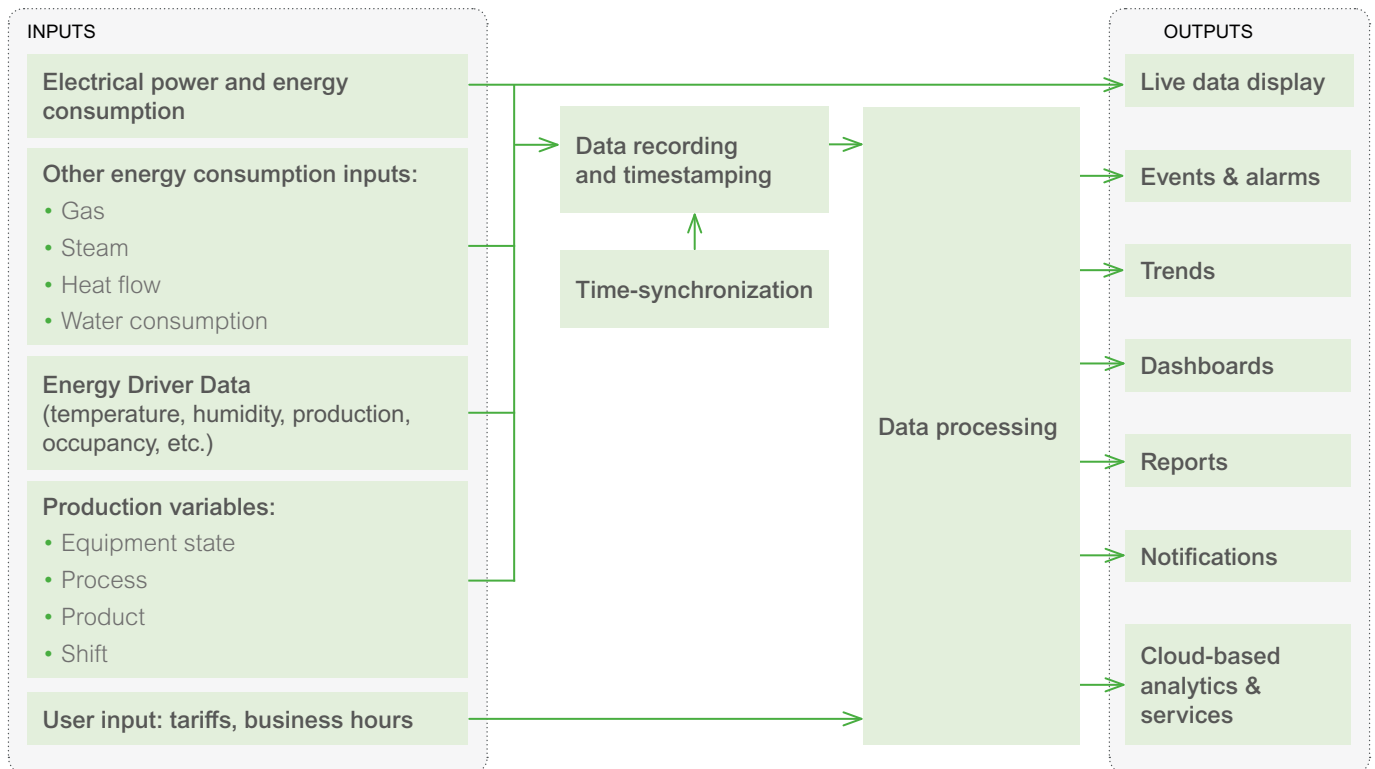
Energy Usage per Status Report

> ENERGY EFFICIENCY COMPLIANCE

System Description (1/4)

Data Flow

The Energy Efficiency Compliance application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data is required:

Electrical Power and Energy Consumption

The following devices can provide these values at all levels of the electrical distribution 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 PowerLogic PM8000 are recommended for high-accuracy energy applications.
- Class 0.5 or class 1 metering devices such as the embedded metering in the MasterPacT MTZ, PowerLogic PM5000 series, Acti9 iEM3000 series metering and Acti9 PowerTag are recommended for low voltage feeders and sub-distribution to measure power and energy.
- Metering devices with an accuracy below performance class 1 (e.g., the embedded Micrologic trip unit in the ComPacT NSX circuit breaker) are acceptable for sub-distribution and load circuits for cost optimization purposes.
- It is noteworthy that other electrical equipment such as MV protection relays (e.g., Easergy P5/P3), UPS, Power Factor controllers, etc., can provide energy measurements that can contribute to an overall energy efficiency compliance program



Product, Software and Services: See page 229



> ENERGY EFFICIENCY COMPLIANCE

System Description (2/4)

Data Flow in Detail (cont.)

INPUTS (cont.)

Other Energy Consumption Inputs

Other WAGES* data, indicated below, can be acquired via digital/analog inputs on metering devices with I/O or directly via Modbus.

- Gas
- Steam
- Air flow
- Water consumption

Energy Driver Data

Any data that might have an impact on energy consumption shall be monitored.

For example:

- Weather information (e.g., outside temperature)
- 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

They 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 or Power Operation with Advanced Reporting & Dashboards from customer systems through OPC** or ETL***.

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
- Etc.

They 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 or Power Operation with Advanced Reporting & Dashboards from customer systems through OPC** or ETL***.

User Input: Tariffs

To convert energy consumption into cost, it is necessary to apply the relevant tariffs to the power/energy consumption values.

* Water, Air, Gas, Electricity, Steam

** OLE (Object Linking and Embedding) for Process Control

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

ENERGY EFFICIENCY COMPLIANCE

System Description (3/4)

Data Flow in Detail (cont.)

DATA RECORDING AND TIMESTAMPING

For the Energy Efficiency Compliance application, a timestamp accuracy of ± 1 s is sufficient.

Advanced meters such as the ION9000, PM8000 and some PM5000 models (PM53xx and PM55xx) can timestamp and record onboard energy measurements as well as connected equipment states.

For other devices (Easergy P5, Easergy P3, MasterPacT MTZ, entry-level PM5000 models) energy measurements and equipment states are acquired by the devices and recorded by EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards.

When acquiring data from other customer systems, timestamps can also be imported through OPC* or ETL**.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)



PowerLogic ION9000



PowerLogic PM8000



PowerLogic PM5000

TIME-SYNCHRONIZATION

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

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



TimeSync Clock

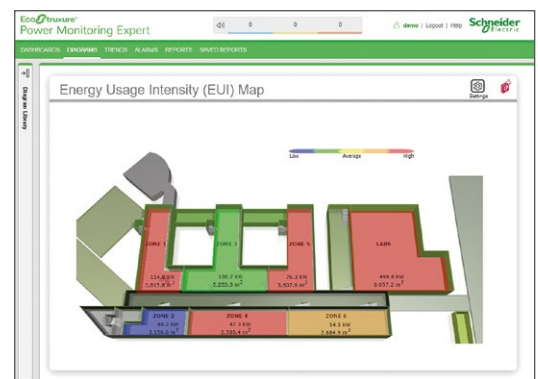
DATA PROCESSING

Energy data processing is embedded in the Report Engine & Dashboard of EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards.

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 with Advanced Reporting and Dashboards ([refer to Energy Monitoring application](#)).



Energy Usage Map

Events & Alarms

Smart alarms can be configured to alert energy managers or operations staff in the event of energy-related events which require attention. (e.g., imminent exceeding of peak demand threshold) ([refer to Energy Monitoring application](#)).

* OLE (Object Linking and Embedding) for Process Control

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

Events and Alarms

Product, Software and Services: See page 229



> ENERGY EFFICIENCY COMPLIANCE

System Description (4/4)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Trends

Measured energy values or ratios of measured values (or KPIs e.g., kWh/unit of production) can be trended in EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting and Dashboards.

Comment: 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 with Advanced Reporting & Dashboards ([refer to Energy Performance 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 (e.g., Energy Intensity)*

* 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 with Advanced Reporting & Dashboards

Reports

To help evaluate effectiveness of energy savings 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.

Energy Use Model Report

Analyze 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 & Verification application](#)).

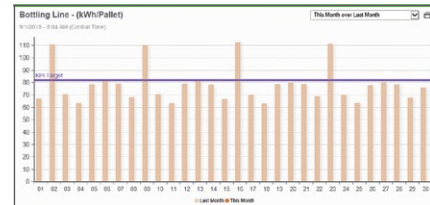
Notifications

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

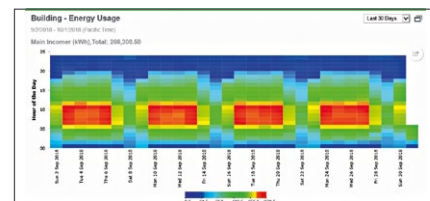
Cloud-based Analytics & Services

With an ISO 50001 energy management system, data quality is essential for proper planning, communication and decision-making on energy savings programs.

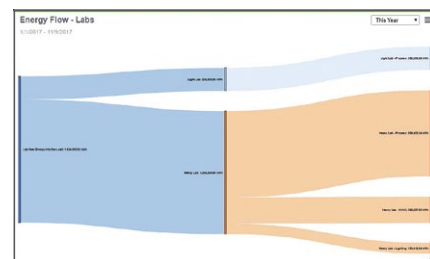
With Power Advisor, cloud-based data quality analytics check the system for errors and inconsistencies such as missing data, misconfigured metering, unmetered loads and more.



Peak Demand Trend



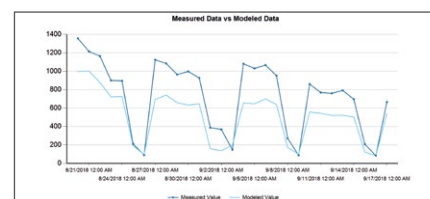
Energy Heat Map



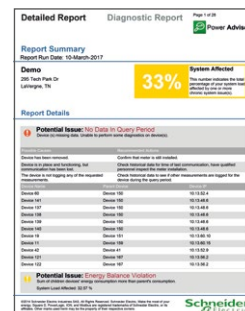
Sankey Diagram



KPI Dashboard



Energy Use Model Report



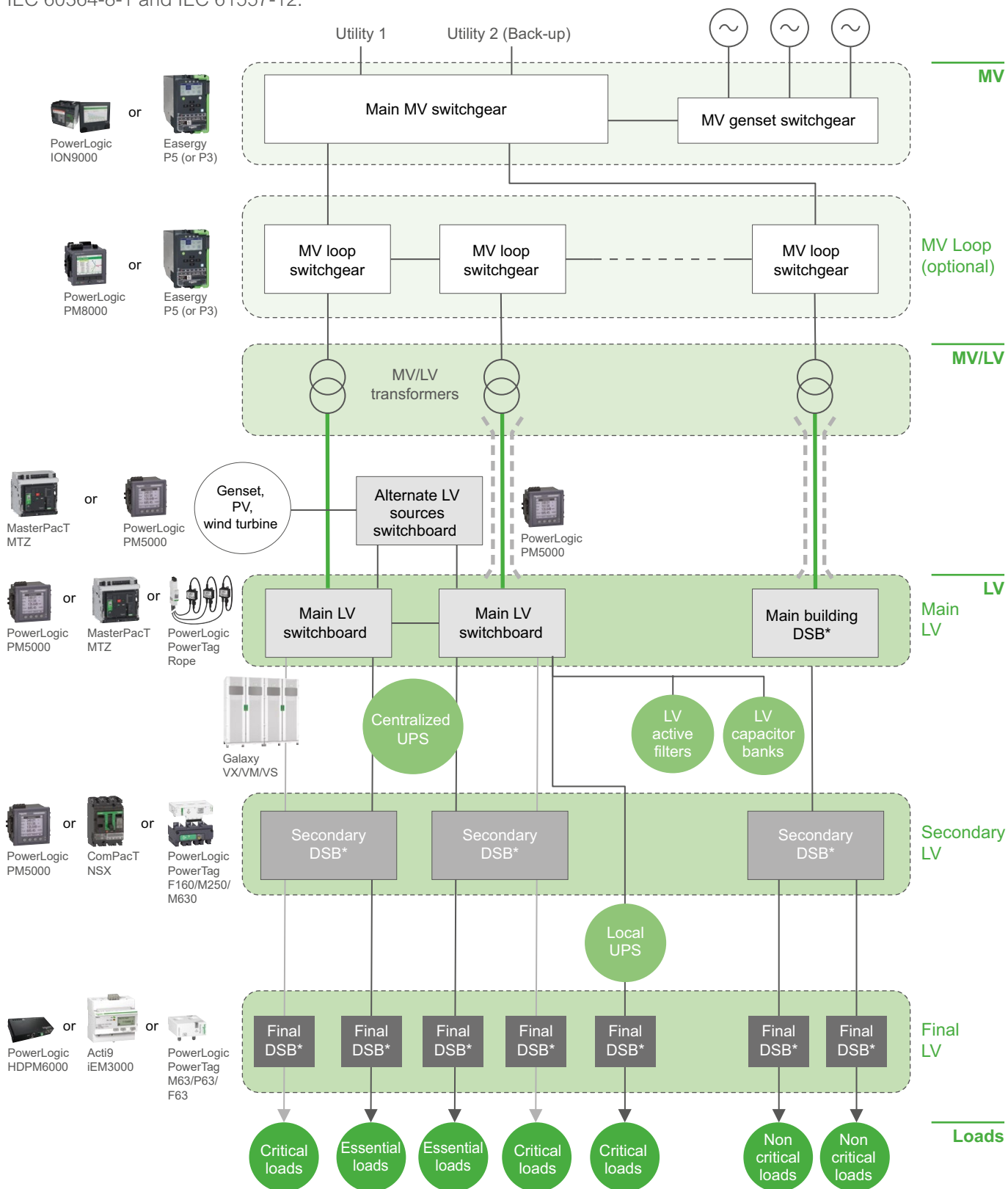
Data Quality Analytics

Product, Software and Services: See page 229

ENERGY EFFICIENCY COMPLIANCE

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, in accordance with the guidelines in IEC standards such as IEC 60364-8-1 and IEC 61557-12:



* DSB = Distribution Switchboard



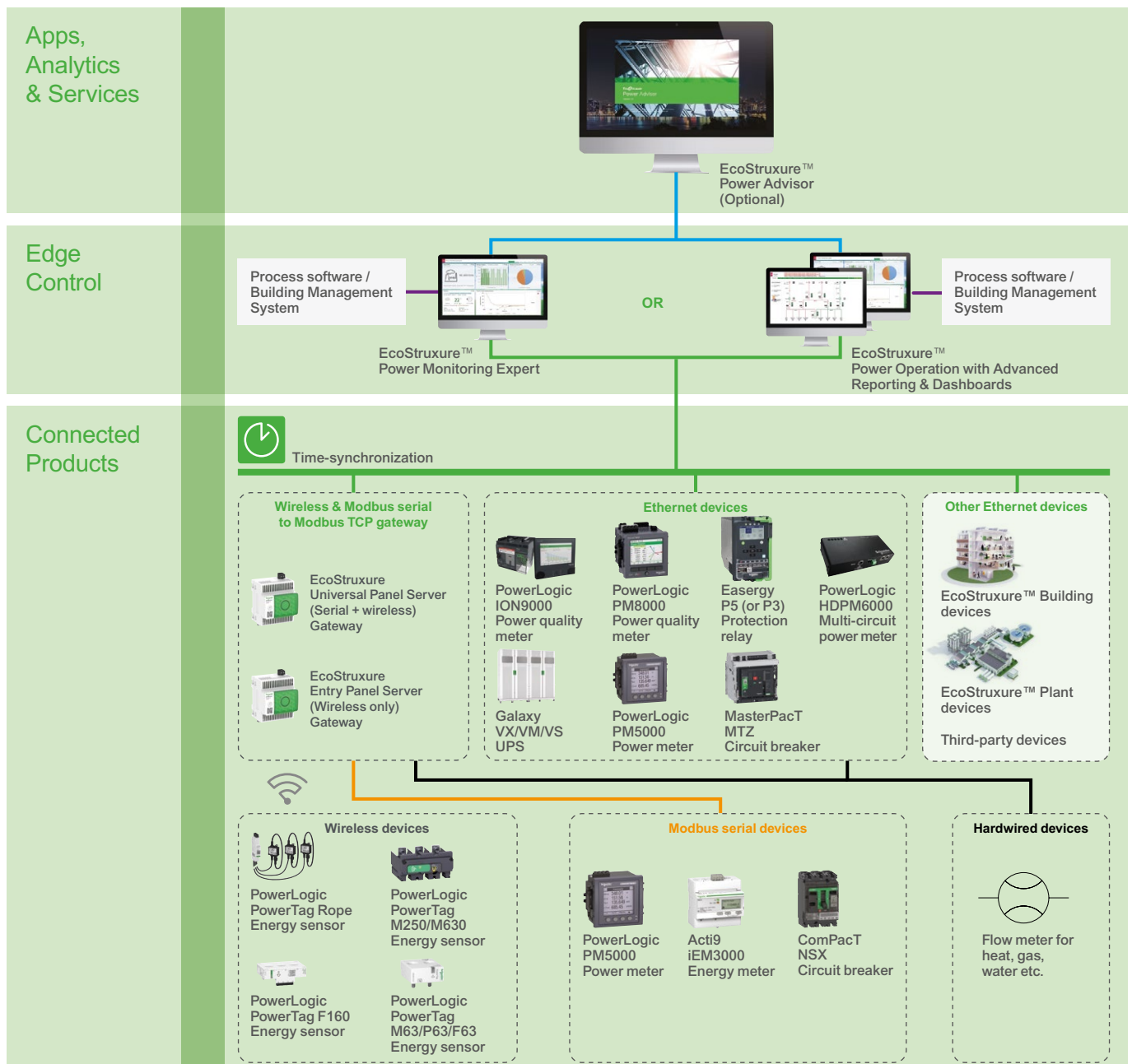
> ENERGY EFFICIENCY COMPLIANCE

Digital Architecture

The digital architecture of the Energy Efficiency Compliance application uses a recommended direct Ethernet connection to energy measurement devices as much as possible. Data is captured on board devices and uploaded into the Edge Control software (EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards) for data processing, visualization and reporting.

Other WAGES and equipment states can also be directly acquired via Ethernet or through hardwired signals from basic meters and sensors.

Alternatively, the most significant factors in customer processes can also be captured from other external process software using the OPC standard or ETL mechanism.



— Ethernet - public LAN/WAN

— Ethernet - technical LAN

— Serial

— Hardwired

— OPC / ETL

📶 Wireless - 2.4 GHz

> GREENHOUSE GAS REPORTING

Track and Report Carbon Emissions

Context of Application

Companies are faced with mounting global pressure to 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 into greenhouse gas equivalents to communicate the results of reduction efforts to stakeholders (shareholders, public, regulatory bodies)
- Promote a green image

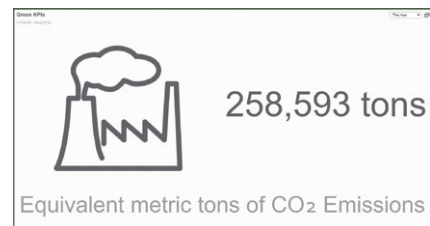
PURPOSE OF GREENHOUSE GAS REPORTING APPLICATION

Track and Report Carbon Emissions and Waste

Energy consumption and waste can be converted to carbon emissions and represented as:

- Equivalent tons of CO₂
- Saved trees
- Kilometers driven
- Etc.

In addition, Schneider Electric's modules can communicate water waste, and provide period over period usage comparison.

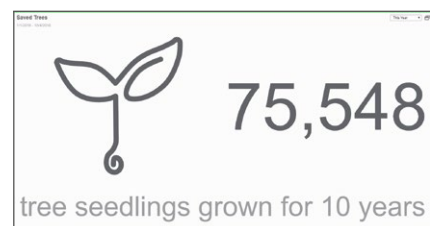


Application Outcomes

Dashboards

- Energy Equivalency Gadget

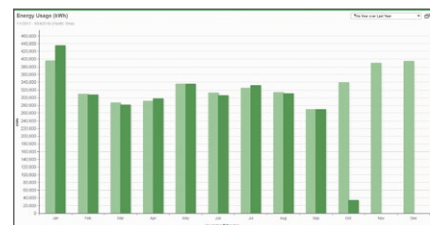
Carbon emissions are reported and segmented by source, scope and pollutant, and can be indexed to various specified metrics.



Energy Equivalency Gadget

- Period Over Period Gadget

The greenhouse gas emissions for one period are compared with those for a previous period.



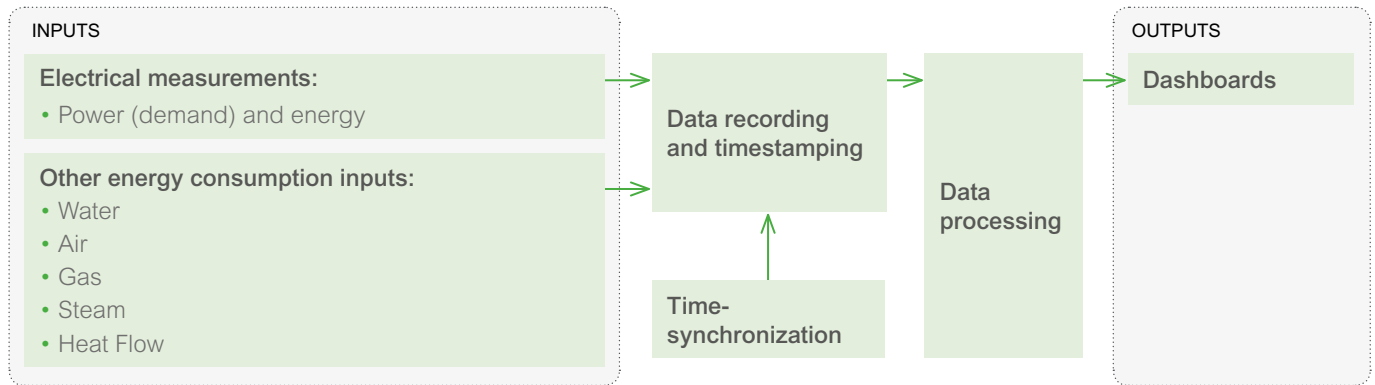
Period Over Period Gadget

> GREENHOUSE GAS REPORTING

System Description (1/3)

Data Flow

The Greenhouse Gas Reporting application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data is required:

Electrical Measurements

- Power (demand) values (kW, kVAR, kVA)
- Energy values (Joules, kWh, kVARh, kVAh)

This data may be acquired from power/energy meters such as PowerLogic ION9000, PM8000, PM5000, HDPM6000, PowerTag, Acti9 iEM3000, etc., at each point of interest in the electrical distribution hierarchy, from medium voltage to low voltage to final distribution.

Devices with embedded metering (e.g., Easergy P5, Easergy P3, MasterPacT MTZ, ComPacT NSX, Galaxy UPS etc.) are also suitable for electrical power and energy monitoring.

These measurements can also be acquired via Modbus from third-party devices.

Other Energy Consumption Inputs

- Water
- Air
- Gas
- Steam
- Heat Flow

They can be acquired via digital/analog inputs on meters or directly via Modbus from third-party devices.



Product, Software and Services: See page 229



> GREENHOUSE GAS REPORTING

System Description (2/3)

Data Flow in Detail (cont.)

DATA RECORDING AND TIMESTAMPING

For the Greenhouse Gas Reporting application, a timestamp accuracy of ± 1 s is sufficient for time-based historical data display of greenhouse gas emissions of devices, processes, facilities or departments.

Advanced power meters such as the PowerLogic ION9000, PM8000 and some PowerLogic PM5000 models (PM53xx and PM55xx) can timestamp and record onboard energy measurements as well as connected equipment states.

For other devices (Easergy P5, Easergy P3, MasterPacT MTZ, entry-level PowerLogic PM5000 models and other energy and power meters) energy measurements are acquired by the connected products and recorded by EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards.

When acquiring data from other customer systems, timestamps can also be imported through OPC or ETL*.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)

**TIME-SYNCHRONIZATION**

For 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 using various technologies (PTP, NTP, SNTP...). An external master clock may be required and linked to a GPS antenna to reach the expected time precision.

**DATA PROCESSING**

The calculation engine in EcoStruxure™ Power Monitoring Expert and Power Operation with Advanced Reporting & Dashboards provides the ability to convert energy consumption data into greenhouse gas equivalent measurements.



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

> GREENHOUSE GAS REPORTING

System Description (3/3)

Data Flow in Detail (cont.)

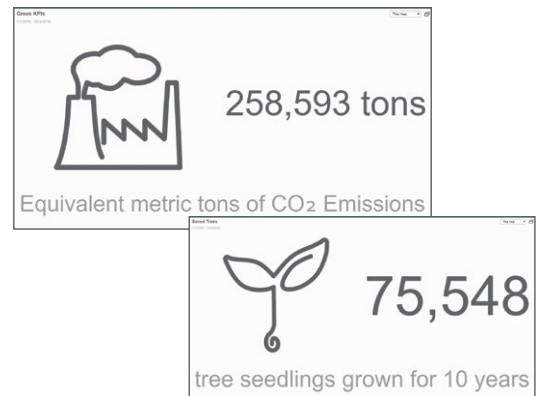
OUTPUTS

Outputs are displayed via EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards.

Dashboards

Energy Equivalency Gadget

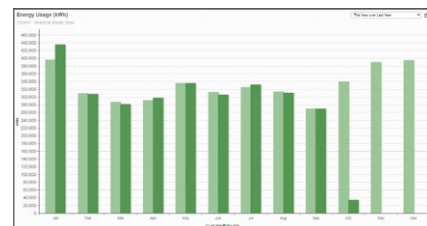
Shows a single value that is equivalent to the aggregated consumption input data, over a selected time period. The value can be scaled or normalized to represent an equivalent consumption measurement. The information is shown as a numeric value with unit, custom text, and a custom graphic.



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

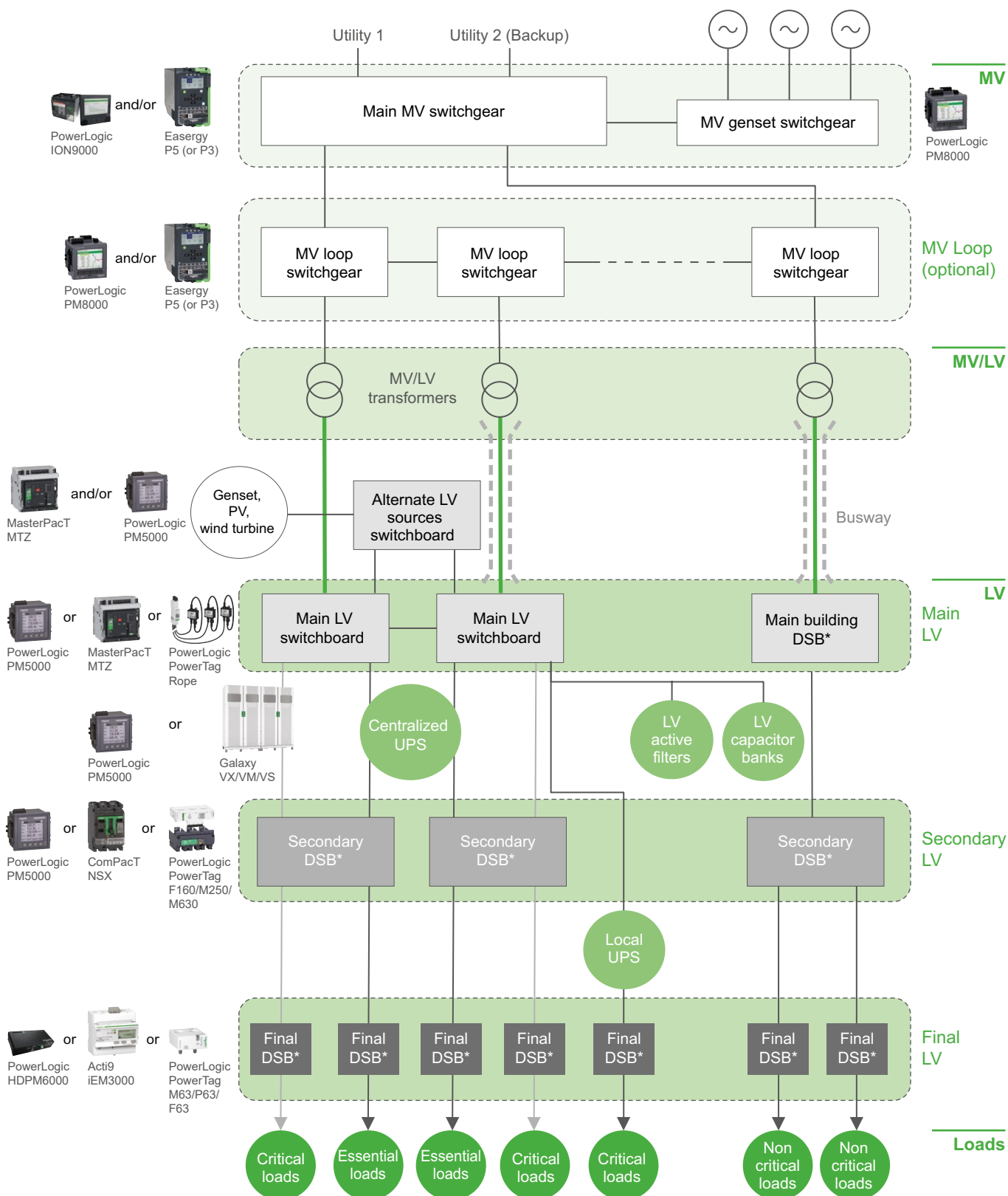
Other Gadgets and Trends

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.

> GREENHOUSE GAS REPORTING

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



> GREENHOUSE GAS REPORTING

Digital Architecture

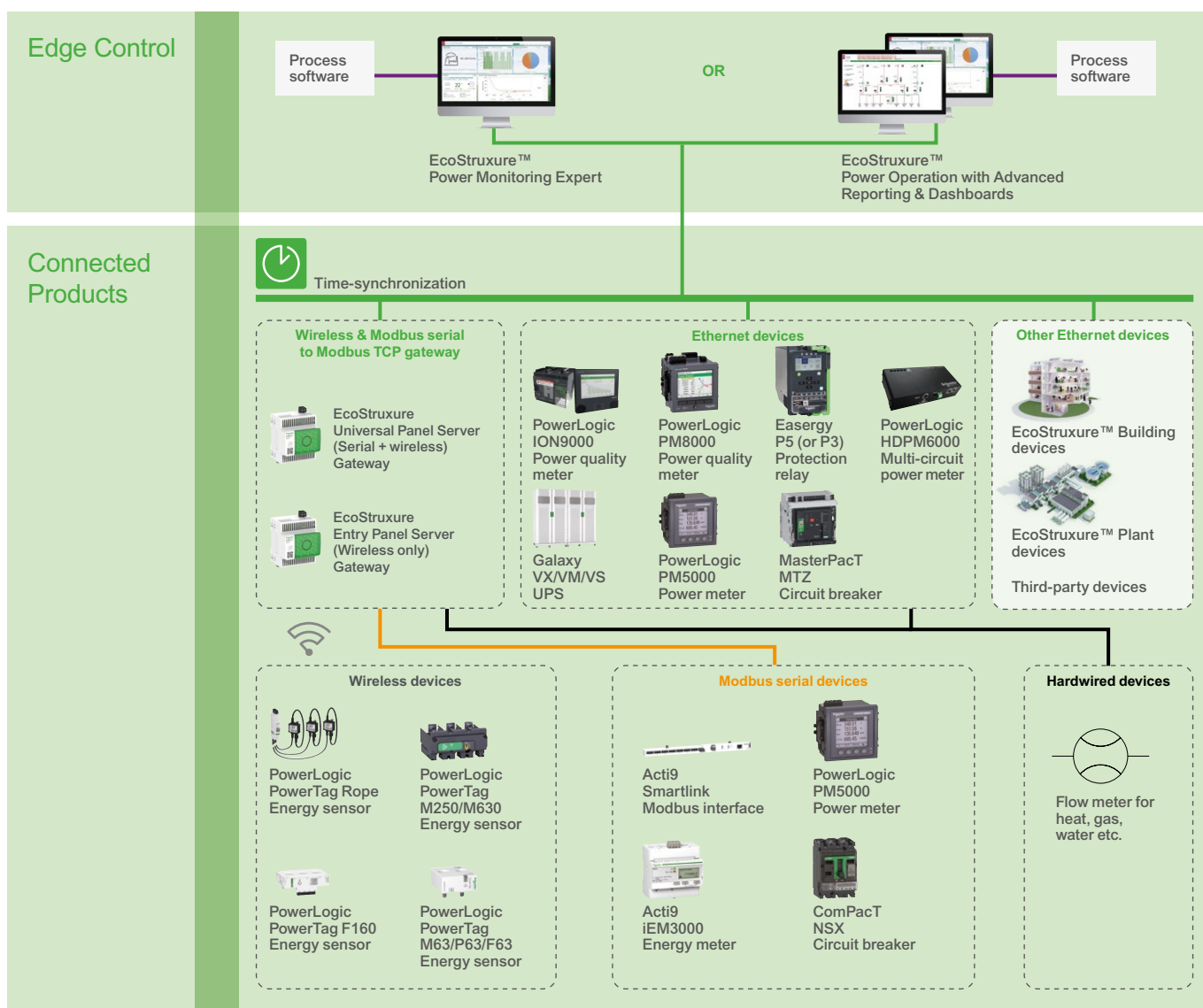
The digital architecture of the Greenhouse Gas Reporting application uses the recommended Ethernet connection or gateways to collect data from energy meters.

Data is captured on board connected products and uploaded into the Edge Control software (EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards) for data processing, visualization, analysis and reporting.

Other WAGES parameters can also be directly acquired via Ethernet 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 software.

The recommended digital architecture for the Greenhouse Gas Reporting application is given below:



— Ethernet - technical LAN

— Serial

— Hardwired

— OPC / ETL

— Wireless - 2.4 GHz

Product, Software and Services: See page 229



> POWER QUALITY COMPLIANCE

Comply with International and Local Power Quality Standards

Context of Application

There are many power quality standards and guidelines to help critical facilities avoid downtime or disruption of sensitive equipment. Understanding compliance with these standards can be challenging and time-consuming.

These standards include:

- 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

PROBLEM TO SOLVE

The Facility Manager Needs to:

- Comply with national and international standards which address allowable power quality limits and durations (as mentioned above)
- Use power quality standards as guidelines to provide an electrical utility power quality level of service

PURPOSE OF POWER QUALITY COMPLIANCE APPLICATION

Continuously Monitor Specific Power Quality Measurements

On the incoming service and key feeders throughout the facility.

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.

Application Outcomes

Reports

Power Quality Reports:

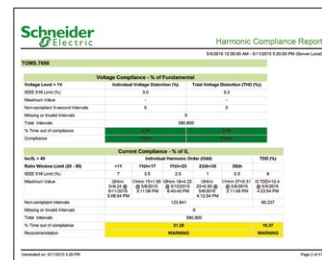
- Harmonics Compliance Report
- IEC 61000-4-30 Report
- EN 50160-2000 Report
- EN 50160-2010 Report
- CBEMA-ITIC Power Quality Report

In-depth Analysis of Power Quality Issues

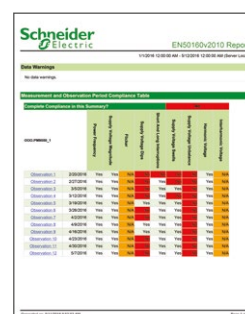
- Advanced dashboards and reports
- Analytics-based advisory services to improve performance across the system



Power Quality Report



Harmonic Compliance Report



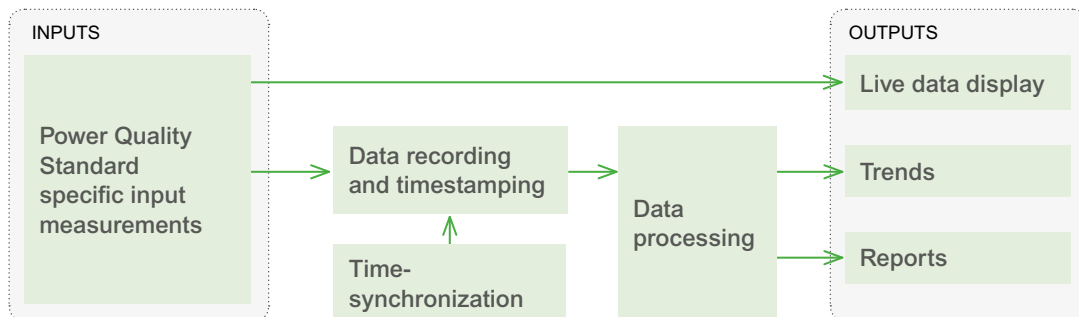
EN 50160-2010 Report

> POWER QUALITY COMPLIANCE

System Description (1/3)

Data Flow

The Power Quality Compliance application can be broken down as follows:



Data Flow in Detail

INPUTS

The required Power Quality Standard specific input measurements depend on the targeted standard.

The following table specifies how to select the right power meter depending on the chosen standard:

	EN 50160 compliance reporting	IEC 61000-4-30 Class A/S	IEEE 519	IEEE1159	CBEMA, ITIC, SEMI F47
ION9000	Yes (web, PME EN 50160 Report) ^{***}	Class A	Yes (web, PME Harmonic Compliance Report) ^{**}	No	Yes (web, PME PQ Report) [*]
PM8000 series	Yes (web, PME EN 50160 Report) ^{***}	Class S	Yes (web, PME Harmonic Compliance Report) ^{**}	No	Yes (web, PME PQ Report) [*]

* EcoStruxure™ Power Monitoring Expert: Power Quality Report

** EcoStruxure™ Power Monitoring Expert: Harmonic Compliance Report

*** EcoStruxure™ Power Monitoring Expert: EN 50160 Report



DATA RECORDING AND TIMESTAMPING

Advanced meters such as the PowerLogic ION9000, PM8000 can timestamp and record the necessary power quality data on board.

For the Power Quality Compliance application, a time accuracy of ± 1 s is sufficient.

[For a comprehensive overview of device recording and timestamping capabilities, refer to the chart 2.2 in Section 1, page 15.](#)



> POWER QUALITY COMPLIANCE

System Description (2/3)

Data Flow in Detail (cont.)

TIME-SYNCHRONIZATION

For a consistent chronological view of all power quality compliance data recorded throughout the facility, power quality meters must be accurately time-synchronized.

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



TimeSync Clock

DATA PROCESSING

Power Quality Compliance data processing consists of evaluation of power quality inputs against thresholds and definitions as per internationally recognized standards such as IEEE 519, EN 50160, IEC 61000-4-30, IEEE 1159, CBEMA, ITIC, SEMI F47.

Power quality data processing is performed on board advanced power quality meters such as PowerLogic ION9000 and PM8000 as well as in EcoStruxure™ Power Monitoring Expert or Power Operation with Advanced Reporting & Dashboards.

EcoStruxure™
Power Monitoring ExpertEcoStruxure™
Power Operation with Advanced
Reporting & Dashboards

OUTPUTS

Outputs are displayed via EcoStruxure™ Power Monitoring Expert or EcoStruxure™ Power Operation with Advanced Reporting & Dashboards.

Live Data Display

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 THD, current individual harmonics, current TDD

Trends

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 max. values)

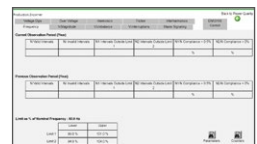
Reports

The following Power Quality Compliance reports can be generated and displayed on-demand or automatically generated and sent by e-mail:

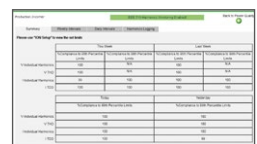
EN 50160:2000 and EN 50160:2010 Reports

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.

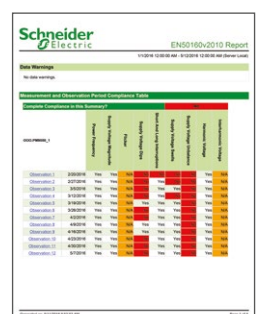
The compliance summary is based on the EN 50160-2000/2010 limits for each observation period: each default EN 50160 measurement indicates a pass or did not pass on the compliance test with a Y (yes) or N (no) respectively.



Live Data Display (EN 50160)



Live Data Display (IEEE 519)



EN 50160-2010 Report

> POWER QUALITY COMPLIANCE

System Description (3/3)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Reports (cont.)

Harmonic Compliance Report

Shows an analysis of the harmonic compliance of selected sources based on the IEEE 519 reference limits.

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.

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

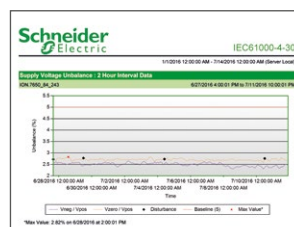
This report also displays waveform plots as well as RMS plots associated with a single incident, or all waveforms associated with their respective incidents.

Cloud-Based Analytics & Services

As an option, EcoStruxure™ Power Advisor connected service can perform cloud-based analytics on power quality data. System health checks can be run periodically and shared by a Schneider Electric service engineer to provide additional insights into persistent power quality issues, their potential impact or risk posed to the facility and improvement recommendations or mitigation solutions.



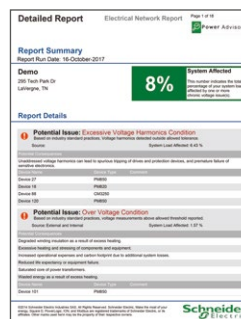
Harmonic Compliance Report



IEC 61000-4-30 Report



Power Quality Report



Electrical Network Health Check Report

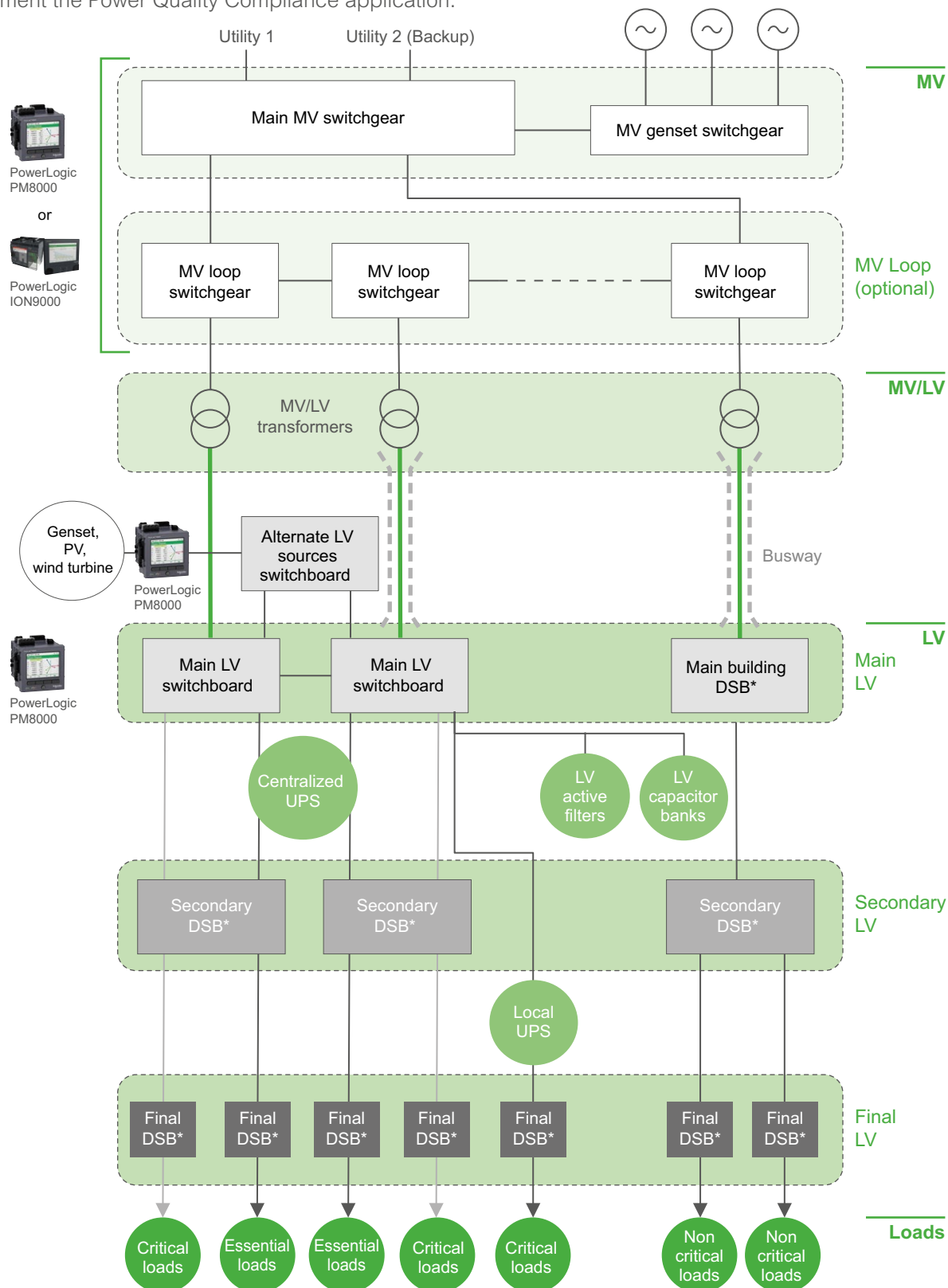


EcoStruxure™ Power Advisor

> POWER QUALITY COMPLIANCE

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 Compliance application:



* DSB = Distribution Switchboard

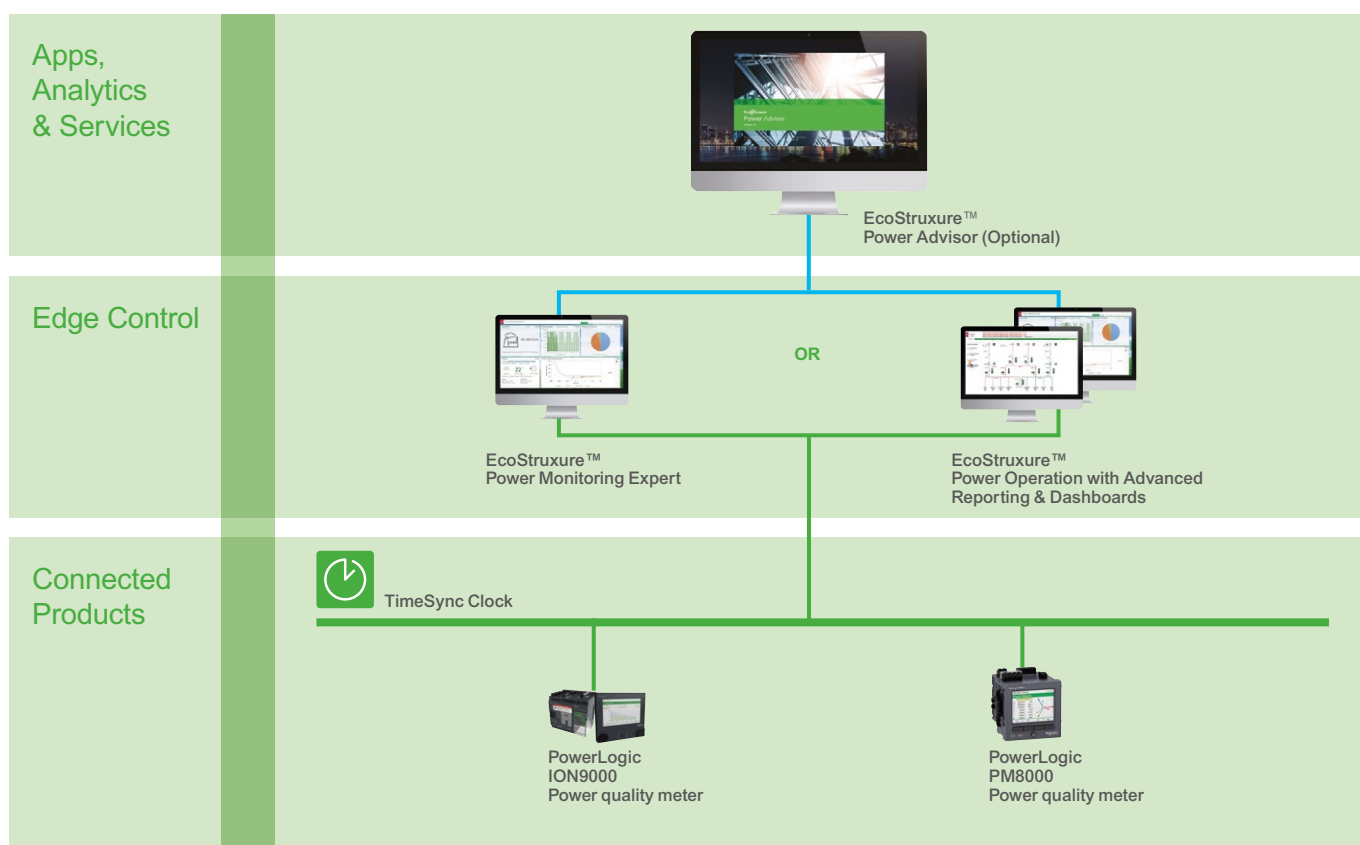
> POWER QUALITY COMPLIANCE

Digital Architecture

The digital architecture of the Power Quality 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.

Optionally, as part of a connected service, data can be used for analytics services with EcoStruxure™ Power Advisor. This data enables Schneider Electric service engineers to make recommendations.

The recommended digital architecture for the Power Quality Compliance application is given below:



— Ethernet - public LAN/WAN
— Ethernet - technical LAN

1

2

3

4

APPENDIX

Product Information

Connected Products..... p. 230

Edge Control & Configuration Tools p. 241

Apps, Analytics & Services..... p. 243

Connected Products (1/11)

PROTECTION, MONITORING & CONTROL DEVICES

1



Easergy P5

Medium voltage network protection relay



Easergy P5 is a protection relay for demanding medium-voltage applications. It offers users industry-leading dedicated protection relay functionality to reduce risks, improve reliability, all with advanced connectivity. Additionally, it can be used with a range of digital tools that make everyday operations simpler for users.

2



Easergy P3

Medium voltage network protection relay



Easergy 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. Easergy P3 has been designed to meet customer's needs including overcurrent and arc flash protection and latest connectivity.

3



Easergy C5

Medium voltage automation controller



Easergy 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.

4



Easergy T300

Distribution network management for MV and LV applications



Easergy 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 device 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 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.

Connected Products (2/11)

PROTECTION, MONITORING & CONTROL DEVICES (cont.)



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.



1



TransferPacT Active Automatic 160A

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.



2



ComPacT NSX/NS Auxiliary Contact

Wireless auxiliary contact

The wireless auxiliary contacts for ComPacT NSXm and ComPacT NSX offer the option to report the status of the breaker remotely (OPEN/CLOSED, TRIPPED, TRIPPED on electrical default). They are easily mounted in the same place as the wired ones.



3



TeSys K, D, F

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.



4



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.



Connected Products (3/11)

PROTECTION, MONITORING & CONTROL DEVICES

1



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 over-voltage protection. It helps protect people, appliances and circuits against fire risks - enabled by a compact all-in-one device. Through advanced notifications, diagnostics, analytics, it gives business owners and maintenance personnel greater control over their building's electrical health and, in-turn, enhances service continuity.

2



Easergy Arc

Arc flash protection system

Easergy Arc is a range of ultra-fast and flexible arc flash protection products which help eliminate or minimize costs resulting from arc flash damage - downtime, repair time, interruption of processes and equipment. Easergy Arc helps avoid personal injury due to arc flash events.

3

4

Connected Products (4/11)

INSULATION MONITORING & FAULT LOCATION DEVICES



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 IMD IFL12H

Insulation Fault Locator (IFL) for hospital applications

Vigilohm IMD IFL12H 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 IMD IFL12

Insulation Fault Locator (IFL)

Vigilohm IMD 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 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 IMD LRDH

Hospital remote HMI

In addition to the functionality of the HRP above, the IMD LRDH provides an insulation fault location indication on a graphical color display.



Vigilohm IM400

Insulation Monitoring Device (IMD) for hospital applications



The Vigilohm IM400 is an Insulation Monitoring Device (IMD) for low-voltage and medium-voltage ungrounded power systems, including marine environments. The device 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.

Connected Products (5/11)

POWER 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 meter

High-density, multi-circuit busway and panelboard power meters for cost and network management in large and critical power applications.



Acti9 iEM3000 Series

Energy meters (DIN rail-mounting)

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

PowerTag is a range of wireless energy sensors that provide precise, realtime 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.



Connected Products (6/11)

PLC & PAC



Substation Monitoring Device (SMD)

Local and/or remote monitoring for MV or LV applications

The Substation Monitoring Device performs analytics on temperature and environmental data for monitoring and alarming via a local HMI or SCADA system. The Substation Monitoring Device consists of an M251 PLC and optional Magelis HMI. It is configured in the factory and automatically integrates into Edge Control Software. The SMD can also send SMS messages in the event of alarms. The optional color display provides SLD representation with overlaid temperature values.



Modicon M580

Ethernet Programmable Automation Controller (ePAC) & safety PLC for process, availability & 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.

Connected Products (7/11)

POWER QUALITY MITIGATION, POWER FACTOR CORRECTION & UPS DEVICES

1



AccuSine PCS+

Active harmonic filter for industrial applications

AccuSine PCS+ is a high-performance, scalable active power correction solution for stabilizing electrical networks by providing harmonic mitigation, power factor correction and load balancing.



2



AccuSine PCSn

Active harmonic filter for commercial buildings, the lighting industry and other less harsh environments

AccuSine PCSn series is built on the AccuSine+ platform, providing a scalable and flexible, high-performance active harmonic filtering solution capable of mitigating neutral harmonic currents to bring reliability and efficiency to your electrical system, resulting in increased uptime, greater operational efficiency, prolonged equipment life, and improved energy efficiency.

3



AccuSine PFV+

Electronic reactive current compensation for specific and high-performance applications

AccuSine PFV+ addresses power quality issues by simple, effective elimination of leading or lagging power factors and reduction of voltage fluctuations. Its unique design helps extend equipment operating life and improves system power performance, and offers multiple features in one complete package. Power Factor correction with AccuSine PFV+ is worry-free and there is no risk of resonance.

4



VarSet Smart

LV capacitor bank

VarSet Smart 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 VarSet Smart, your power factor is maintained at an ideal level for optimal power system efficiency and cost reduction.



Varset Smart VarPlus Logic

Low voltage capacitor bank controller

VarPlus Logic is a controller for simple and efficient operation of your automatic power factor correction equipment to maintain power factor. It is a simple and intelligent relay which measures, monitors and controls the reactive energy.

Connected Products (8/11)

POWER QUALITY MITIGATION, POWER FACTOR CORRECTION & UPS DEVICES



Galaxy VX

3-phase uninterruptible power supply (UPS)

Galaxy VX is a scalable, high-performance extension of the Galaxy V-Series solutions. It is designed for large data centers and industrial applications.

1



Galaxy VM

3-phase uninterruptible power supply (UPS)

Galaxy VM is a 3-phase UPS power protection that seamlessly integrates into medium data centers, industrial or facilities applications.

2



Galaxy VS

3-phase uninterruptible power supply (UPS)

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 centres and other business-critical applications.



3

4

Connected Products (9/11)

COMMUNICATION DEVICES, GATEWAYS & DATA LOGGERS

1



EcoStruxure™ Panel Server

Wireless & Modbus serial to Modbus TCP gateway



EcoStruxure Panel Server is the next generation of gateway, providing seamless connection of wired or unwired smart IoT devices to your Edge Control software or advisor.

- The Universal Panel Server is an all-in-one gateway to retrieve data from both your wireless devices and Modbus devices.
- The Entry Panel Server is an optimized gateway to retrieve data from your wireless devices.

2



Acti9 Smartlink Modbus

Communication system

Acti9 Smartlink Modbus is a rapid-to-install, communication system modular interface that allows operators to remotely meter, monitor and control the essential functions of one or more distribution panels

3



PowerTag Link and PowerTag Link HD

Communication system

PowerTag Link 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 realtime.

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.

4



Enerlin'X IFE, IFE Gateway, EIFE and IFM

Communication interfaces for MasterPacT, PowerPacT, and ComPacT circuit breakers

IFE: Ethernet interface for MasterPacT, ComPacT and PowerPacT circuit breakers.

IFE gateway: Ethernet interface for MasterPacT, ComPacT and PowerPacT 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, ComPacT and PowerPacT circuit breakers.

Connected Products (10/11)

COMMUNICATION DEVICES, GATEWAYS & DATA LOGGERS (cont.)



Harmony Sologate ZBRN32

Data concentrator for wireless sensors & serial Modbus gateway

Each Zigbee concentrator has 60 inputs, numbered from I0 to I59. A sensor is paired with one of the Zigbee concentrator inputs, 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.

1



EcoStruxure™ Power Automation System Gateway

Protocol Converter, Data Concentrator, Automation & Microgrid Controller

EPAS-GTW 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.

2



Enerlin'X Com'X 200/210

Energy servers and data loggers

Enerlin'X Com'X collects and stores energy data from up to 64 field devices, connected to either Ethernet or Modbus serial networks. It also has embedded digital and analog inputs.

Data publisher

Batches of collected data periodically transmitted to an Internet server, as XML or CSV files.

Gateway

Makes all data from connected devices available in real time in Modbus TCP/IP format via Ethernet or Wi-Fi.

3



Cyber Sciences CyTime SER 2408 / 3200

Sequence of events recorder for high time accuracy applications

CyTime™ SER2409/3200 record 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 SER.

One CyTime SER serves as PTP master and all other CyTime SER devices sync automatically within 100 microseconds – without special Ethernet switches.

<https://www.cyber-sciences.com/product/sequence-of-events-recorder-ser/>

4

Connected Products (11/11)

SENSORS



Easergy TH110

Wireless thermal sensor for critical connections



The Easergy TH110 is a battery-free wireless temperature sensor used to perform the continuous thermal monitoring of critical connections made in the field, such as:

- MV cable connections
- MV busbar connections
- Withdrawable CB connections
- MV transformer input, windings, taps, LV output



Easergy CL110

Wireless thermal sensor for ambient temperature



The Easergy CL110 is a wireless temperature and humidity sensor with a battery for continuous ambient temperature monitoring:

- LV busway junctions and tap-offs
- Internal to electrical switchgear



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 prevent electrical fires due to overheating cables or cable connections. Thanks to the smart algorithm embedded in the sensor device, 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.

MICROGRID



Energy Control Center

Microgrid energy distribution

The ECC system is the "brains behind the operation". Information is constantly moving in and out of the ECC so it can make decisions based on current electrical availability. The ECC uses advanced algorithms to assess available power sources and their condition, as well as analyze load priority and energy requirements to determine which Distributed Energy Resources (DERs) to engage and when. The ECC has the ability to make critical decisions, and physically make adjustments to power sources and loads to help ensure energy reliability.

Unlike most installed PV systems, the ECC is even able to operate during a grid outage by using one of the other DERs as an anchor resource to be grid forming.

REMOTE DISPLAY



Magelis iPC

Industrial PC

Sleek all-in-one 10", 15" and 19" iPCs with an optimized industrial design.



Edge Control & Configuration Tools (1/2)



EcoStruxure™ Power Monitoring Expert

Power Management software

EcoStruxure™ Power Monitoring Expert helps maximize system reliability and optimize operational efficiency to increase your profitability.

1



EcoStruxure™ Power Operation

High-performance software system for electrical distribution monitoring and control

With its high availability, redundancy, high speed data acquisition and alarming, it 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.

2



EcoStruxure™ Power Operation with Advanced Reporting & Dashboards

High-performance software system for electrical distribution monitoring and control with historical dashboards and reporting applications

Advanced Power Monitoring Expert reporting and dashboards embedded in Power Operation.

3



EcoStruxure™ Building Operation

Integrated system for monitoring and optimization of building performance

This one-stop solution combines 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.

4



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 stable and optimized microgrids. EcoStruxure™ Microgrid Operator synchronizes load voltage and frequency to preserve customers' microgrid power supply, enabling grid continuity and stability when disconnecting and reconnecting to the grid.

Edge Control & Configuration Tools (2/2)

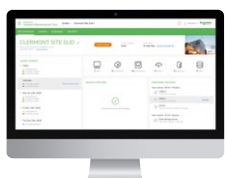
1



EcoStruxure™ Power Automation System Engineering **System Design, Specification & 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 & Control System compliant with IEC61850 standards enabling application standardization & engineering efficiency.

2



EcoStruxure™ Power Automation System Maintenance **System lifecycle management software**

Power Automation System Maintenance 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 cyber security.

3



EcoStruxure™ Cybersecurity Application Platform **Cybersecurity defense strategy software**

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, security dashboards with system logs.

4



EcoStruxure™ Cybersecurity Admin Expert **Centralized user, password and security policies management software**

EcoStruxure Cybersecurity Admin Expert is the first component of a solution for managing cybersecurity in your electrical network's operational technology (OT).

Apps, Analytics & Services



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 Connected Services Hub to act on your behalf.

1



EcoStruxure™ Power Advisor

Cloud-based data quality and power quality monitoring service

EcoStruxure™ Power Advisor raises metering diagnostics from device-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.

2

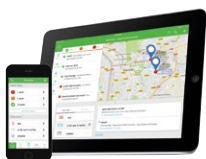


EcoStruxure™ Microgrid Advisor

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.

4



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.

3

1

2

3

4

BIBLIOGRAPHY

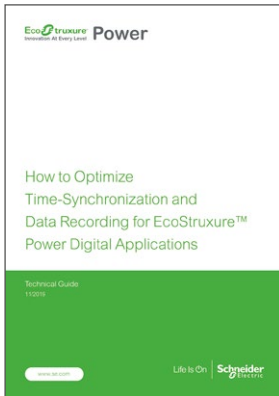
Useful Documentation..... p. 246

Useful Links p. 251

Useful Documentation (1/5)

Technical Guides

1



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.

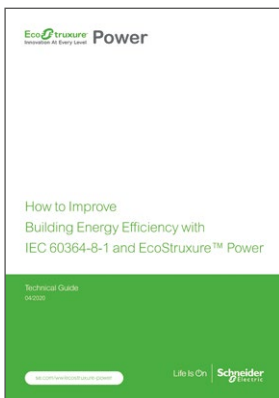


Technical Guide
Ref: ESXP2TG001EN
11/2019

<https://www.se.com/ww/en/download/document/ESXP2TG001EN/>

2

3



How to Improve Building Energy Efficiency with IEC 60364-8-1 and EcoStruxure™ Power

This document provides information and support with regards to the 2019 update of the IEC 60364-8-1 standard, and explains how EcoStruxure by Schneider Electric can help with compliance.



Technical Guide
Ref: ESXP2TG002EN
04/2020

<https://www.se.com/ww/en/download/document/ESXP2TG002EN/>

4

Useful Documentation (2/5)

Technical Guides (cont.)



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 covers what you need to know to make safer and more reliable switchboards using the latest IEC standards.



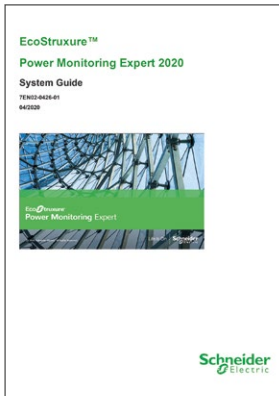
Technical Guide
Ref: AMTED300014EN
05/2018

<https://www.schneider-electric.com/en/work/products/product-launch/medium-voltage-technical-guide/>

Useful Documentation (3/5)

System Guides

1



EcoStruxure™ Power Monitoring Expert 2020

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.

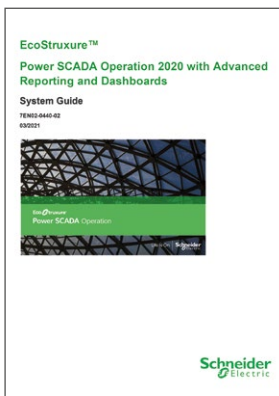


System Guide
Ref: 7EN02-0426
04/2020

<https://www.se.com/ww/en/download/document/7EN02-0426/>

2

3



EcoStruxure™ Power (SCADA) Operation 2020 with Advanced Reporting and Dashboards

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 (SCADA) Operation.



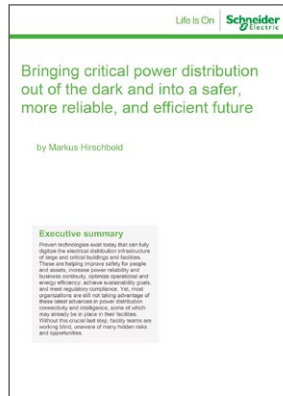
System Guide
Ref: 7EN02-0440
03/2021

<https://www.se.com/ww/en/download/document/7EN02-0440/>

4

Useful Documentation (4/5)

White Papers



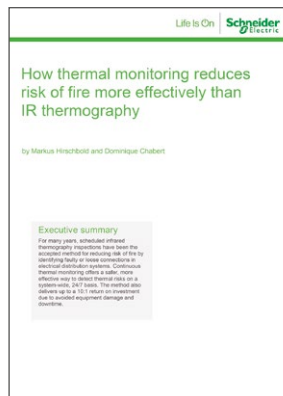
Bringing critical power distribution out of the dark and into a safer, more reliable, and efficient future

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.



White Paper
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

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 offers 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.



White Paper
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

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.



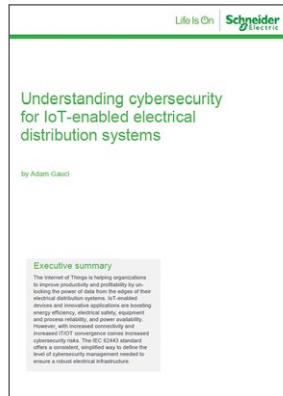
White Paper
Ref: 998-21143435_GMA
2021

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

Useful Documentation (5/5)

White Papers (cont.)

1



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.



White Paper
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

2

3



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.



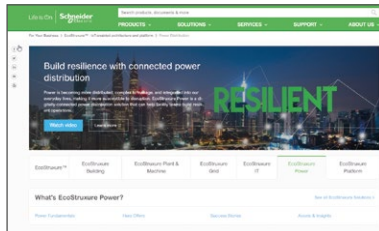
White Paper
Ref: 998-20186845
01/2018

<https://www.se.com/ww/en/download/document/998-20186845/>

4

Useful Links

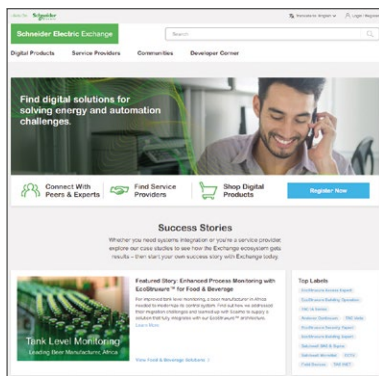
Web Portals



EcoStruxure™ Power Landing Page

Learn more about EcoStruxure Power, Schneider Electric's digital solution for electrical distribution to help improve electrical safety, power availability, efficiency 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

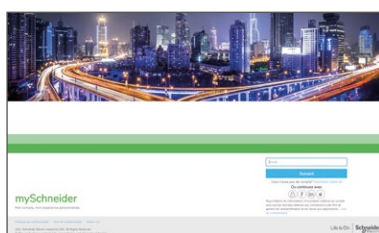
An open ecosystem for IoT energy management and automation solutions.

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.

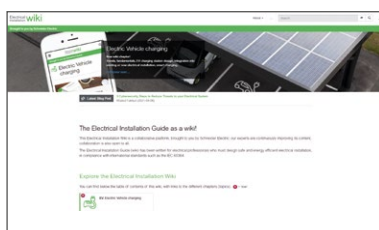
<https://exchange.se.com/>



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



5-star recognition
in CRN's 2020
Partner Program Guide

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 & Residential Automation (5 badges)
- Power Distribution & 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)

One Program. One Network. Endless Opportunities.



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*
- Circularity instructions



Discover what we mean by green
Check your products!

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.

CO₂ 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 CO₂ 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.

*PEP: Product Environmental Profile (i.e. Environmental Product Declaration)



Legal information

The Schneider Electric brand and any registered trademarks of Schneider Electric Industries SAS referred to in this guide are the sole property of Schneider Electric SA and its subsidiaries. They may not be used for any purpose without the owner's permission, given in writing. This guide and its content are protected, within the meaning of the French intellectual property code (Code de la propriété intellectuelle français, referred to hereafter as "the Code"), under the laws of copyright covering texts, drawings and models, as well as by trademark law. You agree not to reproduce, other than for your own personal, non-commercial use as defined in the Code, all or part of this guide on any medium whatsoever without Schneider Electric's permission, given in writing. You also agree not to establish any hypertext links to this guide or its content. Schneider Electric does not grant any right or license for the personal and non-commercial use of the guide or its content, except for a non-exclusive license to consult it on an "as is" basis, at your own risk. All other rights are reserved.

Electrical equipment should only be installed, operated, serviced and maintained by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material. As standards, specifications and designs change from time to time, please ask for confirmation of the information given in this publication.

Notes

Schneider Electric Industries SAS

35, rue Joseph Monier
CS 30323
92506 Rueil Malmaison Cedex
France
RCS Nanterre 954 503 439
Share capital €2,268,274,220
www.schneider-electric.com

As standards, specifications, and designs change from time to time,
please ask for confirmation of the information given in this publication.

06/2021
ESXP2G001EN

©2021 Schneider Electric. All Rights Reserved. Life Is On Schneider Electric is
a trademark and the property of Schneider Electric SE, its subsidiaries and affiliated
companies. All other trademarks are the property of their respective owners.

Life Is On

