EcoStruxure™
Innovation At Every Level

Power

Digital Applications
for Large Buildings & Critical Facilities

IEC Design Guide

schneider-electric.com/ecostruxure

Life Is On | Schneider Electric

Legal Information

As standards, specifications and designs change from time to time, please ask for confirmation of the information given in this publication.

Safety Messages

Important Instructions

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service or maintain it.

The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of either symbol to a "Danger" or "Warning" safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.
Failure to follow these instructions will result in death, serious injury, equipment damage, or permanent loss of data.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **can result in** death or serious injury.
Failure to follow these instructions can result in death, serious injury, equipment damage, or permanent loss of data.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **can result in** minor or moderate injury.
Failure to follow these instructions can result in injury or equipment damage.

NOTICE

NOTICE is used to address practices not related to physical injury. The safety alert symbol shall not be used with this signal word.

Please Note

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel.
No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction, operation and installation of electrical equipment, and has received safety training to recognize and avoid the hazards involved.

Before you Begin

Electrical monitoring and control equipment and related software are used in a variety of buildings and facilities. The type or model of electrical monitoring and control equipment suitable for each application will vary depending on factors such as the system dependability level, unusual conditions and government regulations etc.

Only the user can be aware of all the conditions and factors present during setup, operation and maintenance of the solution. Therefore, only the user can determine how the electrical monitoring and control equipment and associated safety and interlock features should be used properly. When selecting electrical monitoring and control equipment and related software for a particular application, the user should refer to the applicable local and national standards and regulations. The National Safety Council's Accident Prevention Manual also provides much useful information.

Ensure that appropriate safety and mechanical/electrical interlock protection have been installed and are operational before placing the equipment into service. All mechanical/electrical interlock and safety protection must be coordinated with the related equipment and software programming.

Safety Messages

Start up and Test

Before using electrical control and automation equipment for regular operation after installation, the system should be given a start-up test by qualified personnel to verify correct operation of the equipment. It is important that arrangements for such a check be made and that enough time is allowed to perform complete and satisfactory testing.

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and grounds, except those grounds installed according to local regulations (according to the National Electrical Code in the U.S.A., for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Perform all start-up tests recommended by the manufacturer.

Operation and Adjustments

The following precautions are from the NEMA Standards Publication ICS 7.1-195 (English version prevails):

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.
- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer's instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer's instructions and the machinery used with the electrical equipment.
- Only those operational adjustments actually required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

Safety Precautions

The following safety messages apply to installation, configuration and operation of Ecostruxure™ Power Monitoring Expert, Power SCADA Operation, Power SCADA Operation with Advanced Reporting & Dashboards, EcoStruxure™ Building Operation, and Energy Expert, and all connected product.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Do not use the software to control time-critical functions because communication delays can occur between the time a control is initiated and when that action is applied.
- Do not use the software to control remote equipment without securing it with an authorized access level, and without including a status object to provide feedback about the status of the control operation.

Failure to follow these instructions can result in death or serious injury.

⚠ WARNING

INACCURATE DATA RESULTS

- Do not incorrectly configure the software, as this can lead to inaccurate reports and/or data results.
- Do not base your maintenance or service actions solely on messages and information displayed by the software.
- Do not rely solely on software messages and reports to determine if the system is functioning correctly or meeting all applicable standards and requirements.
- Consider the implications of unanticipated transmission delays or failures of communications links.

Failure to follow these instructions can result in death, serious injury, equipment damage, or permanent loss of data.

NOTICE

LOSS OF DATA

- Be sure to activate product and component licenses prior to the expiry of the trial license.
- Ensure that you activate sufficient licenses for the servers and devices in your system.
- Backup or archive any Server database data before adjusting any database memory options.
- Only personnel with advanced knowledge of Server databases should make database parameter changes.

Failure to follow these instructions can result in loss of data.

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Safety Messages

NOTICE

UNAUTHORIZED OR UNINTENDED ACCESS TO CUSTOMER DATA

- Personnel setting up third-party authentication of the software must be aware that links to data are not secure.
- Do not setup access links to sensitive or secure data.

Failure to follow these instructions can result in unauthorized or unintended access to sensitive or secure customer data.

NOTICE

NETWORK INOPERABILITY

Do not make unauthorized changes in the network configuration.

Failure to follow these instructions can result in an unstable or unusable network.

This document is intended to describe how to select and configure the Ecostruxure™ Power Digital Applications for Large Buildings and Critical Facilities, including EcoStruxure™ Power Monitoring Expert, Power SCADA Operation, Power SCADA Operation with Advanced Reporting and Dashboards, and all associated connected products.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN OR EXPLOSION

- Only qualified personnel familiar with low and medium voltage equipment are to perform work described in this set of instructions. Workers should understand the hazards involved in working with or near low and medium voltage circuits.
- Perform such work only after reading and understanding all of the instructions contained in this bulletin.
- Turn off all power before working on or inside equipment.
- Use a properly rated voltage sensing device to confirm that the power is off.
- Before performing visual inspections, tests, or maintenance on the equipment, disconnect all sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, grounded, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of back feeding.
- Handle this equipment carefully and install, operate, and maintain it correctly in order for it to function properly. Neglecting fundamental installation and maintenance requirements may lead to personal injury, as well as damage to electrical equipment or other property.
- Beware of potential hazards, wear personal protective equipment and take adequate safety precautions.
- Do not make any modifications to the equipment or operate the system with the interlocks removed. Contact your local field sales representative for additional instruction if the equipment does not function as described in this manual.
- Carefully inspect your work area and remove any tools and objects left inside the equipment.
- Replace all devices, doors and covers before turning on power to this equipment.
- All instructions in this manual are written with the assumption that the customer has taken these measures before performing maintenance or testing.

Failure to follow these instructions will result in death or serious injury.

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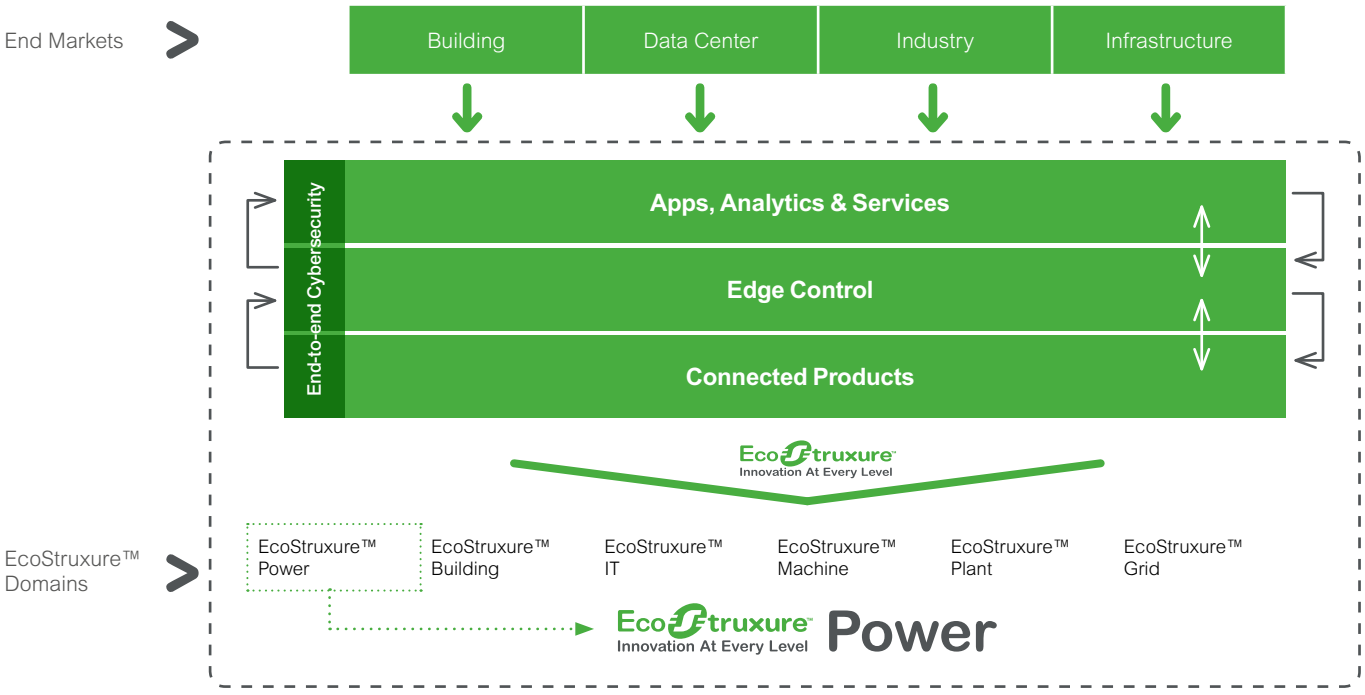
Introduction

Overview of EcoStruxure™ Power

This Digital Applications Design Guide describes the building blocks of EcoStruxure™ Power. As shown in the diagram below, and indicated by the green arrows, EcoStruxure™ Power is one of the six domains of EcoStruxure™ and plays a key role in all four end markets. This involves bringing the world of electrical distribution to those end markets.



EcoStruxure™'s integrated architecture serves four end markets with its six domains of expertise.

EcoStruxure™ Power Includes:

- The IoT enabled platform of connected products, edge control, and apps, analytics & services
- Expertise from design to system specification, deployment, operation and support
- A user community for sharing and exchange of information
- Lifecycle tools to help with system design, deployment and commissioning

EcoStruxure™ Power Leverages the Best of Both Worlds:

- On-site applications (i.e. Edge Control): for improved latency, safety and on-site control
- Cloud based applications and services: outsourced service expertise with cloud based data aggregation and machine learning

EcoStruxure™ Power Offers:

- Plug & play connectivity to achieve fast integration and commissioning for all Schneider Electric connected devices
- Open, flexible, scalable architectures to reach beyond Schneider Electric offers and include 3rd party products found in the electrical distribution
- Cybersecurity to achieve consistent protection of both on-site and cloud-based applications, against the increasing frequency and sophistication of cyber-attacks
- Design tools to make the design and specifications process of a project faster, simpler, and help ensure compliance with all relevant standards

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List of Applications

Introduction

Purpose of this Document

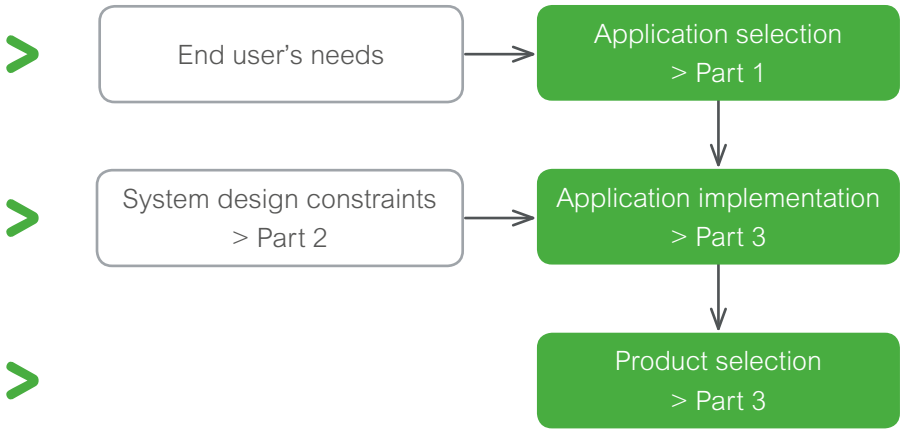
This document is geared towards specifiers, electrical distribution designers, system integrators and EcoXperts.

It proposes many digital applications to fulfill customers' needs in large buildings & critical facilities such as data centers, large hotels, healthcare and industrial facilities etc.

Proposed Methodology

This document proposes to:

- Select the most appropriate applications according to the end user's needs
- Understand how to implement these applications, depending on system design constraints
- Select the required products for system design and project specifications



Organization of the Document

Part 1 outlines the values provided by all EcoStruxure™ Power applications and how to select the most appropriate applications according to the end users' needs.

In part 2, design constraints of the electrical installation are discussed from the point of view of system communications, data recording and timestamping, time synchronization, data processing and Cyber Security.

Part 3 helps understand how to implement these applications depending on their electrical architecture's constraints. It identifies all necessary building blocks required at each level, for each application, and how to connect those building blocks to Edge Control and cloud based analytics and services.

The Appendix provides a brief description of all key connected devices, edge control software and cloud based services.

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PART 1

Select the Required Digital Applications

PART 1 | Select the Required Digital Applications

Introduction (1/2)

1

This part proposes to select the most appropriate applications according to the end user's needs.

Below is a summary of all applications available in this guide : in order to ease selection, the applications have been grouped depending on the benefit they offer.

SAFE & RELIABLE

2

BENEFITS

- Avoid Electrical Fires and Ensure Protection
- Avoid Downtime by Preventing Power Failures
- Increase Electrical System & Asset Reliability

3

RELATED APPLICATIONS

- Continuous Thermal Monitoring
- Electrical Distribution Monitoring & Alarming
- Power Quality Monitoring
- Insulation Monitoring
- Capacity Management
- Power Quality Correction

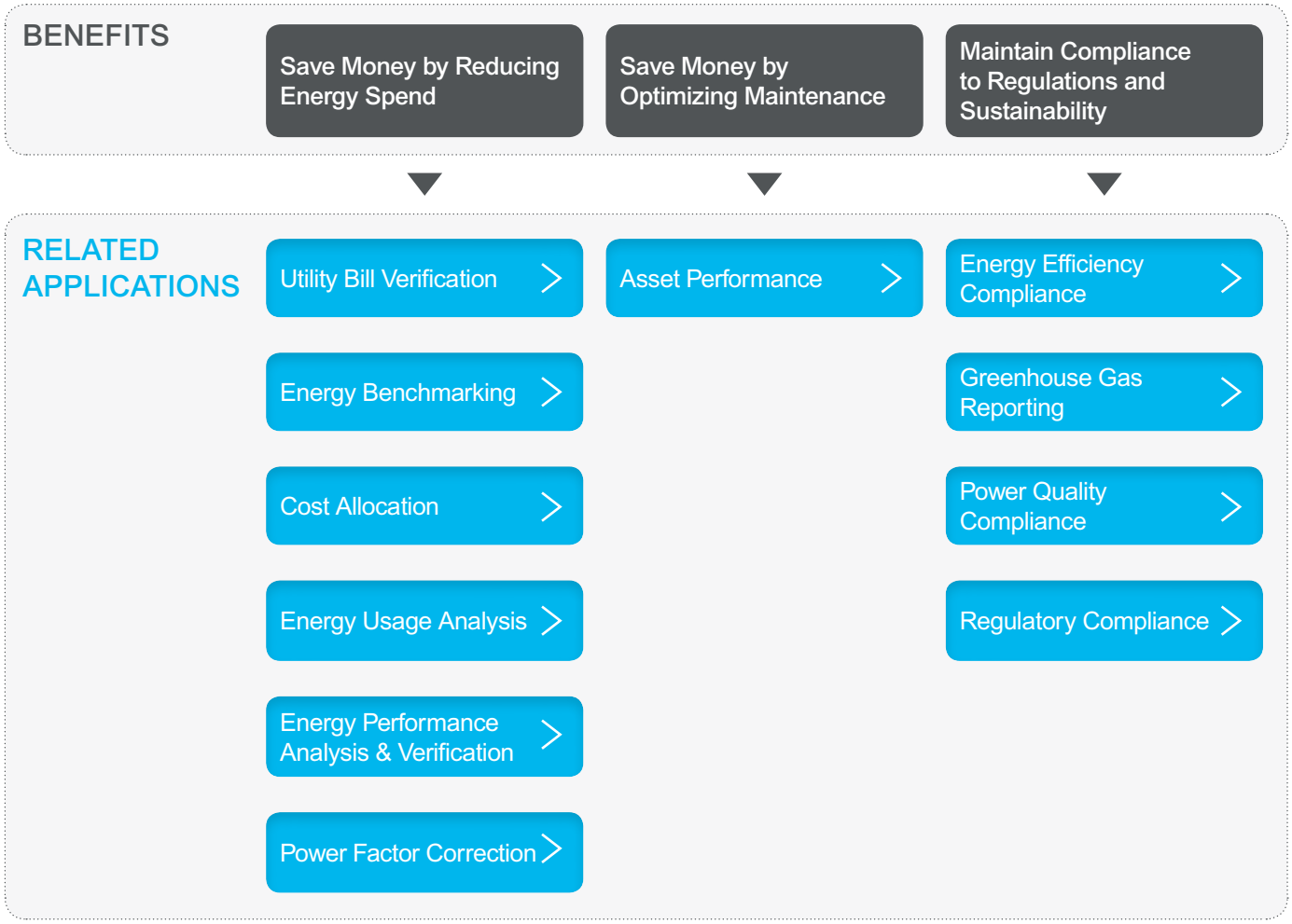
4

- Backup Power Testing
- Breaker Settings Monitoring
- Power Events Analysis
- Source and Network Control

Click on the applications above to navigate to the related page

Introduction (2/2)

EFFICIENT



Click on the applications above to navigate to the related page

CONTINUOUS THERMAL MONITORING

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

1

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 may lead to an increase of its electrical contact resistance which induces a thermal runaway leading, in the worst case, to destruction of switchgear and severe injury to the operator.

Increase of contact resistance can result from:

- loose connections due to improper installation or maintenance (improper tightening torque, connection loosening due to vibrations),
- damaged surface (due to corrosion, excessive pressure, excessive friction).

A common remedy is provided by periodic thermal surveys which are manual, onerous and only identify issues on a periodic basis.

2

3

Problem to Solve

The Facility Manager needs to:

- Detect thermal runaways before they lead to electrical fires
- Take action on faulty connections
- Cut down on periodic thermal survey costs

Connection temperature monitoring

4

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 failure

Provide temperature alarming and reporting for fast response

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

Replace periodic thermographic inspections

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

CONTINUOUS THERMAL MONITORING

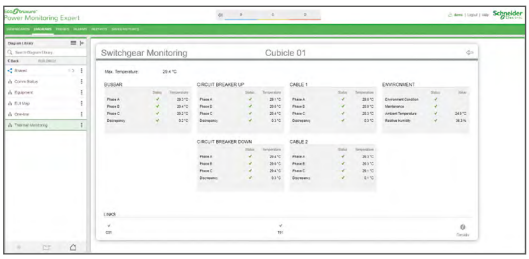
Reduce Risk of Electrical Fires Due to Poor Connections in Critical Electrical Equipment (2/2)

Outputs of the Application

Live data display

For each electrical connection:

- Connection point temperature
- Phase to phase max temperature deviation
- Status indication with respect to alarm threshold (green/yellow/red)



Live data display

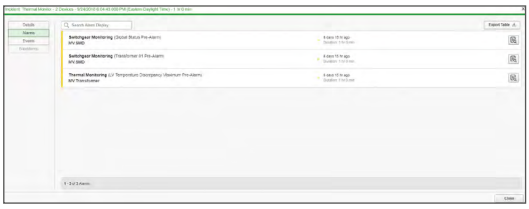
Events and alarms

Pre-alarms and alarms:

- When the absolute temperature threshold (defined by the user) is exceeded
- When an excessive deviation is detected between phase temperature
- When the predictive threshold (which takes into account the conducted current) is exceeded

This will help early detection of faulty connections

Note: User can define pre-alarm thresholds (eg.: 80% of absolute threshold) to detect a deviation of the temperature as soon as possible.



Thermal Monitoring Alarms

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 are sent on pre-alarming and alarming conditions to enable fast action

Cloud-based Analytics and Services

- Online customer portal
- Expert service advisors
- Actionable proactive notification

I want to implement this application: See details page 58

Monitor Insulation Status of Critical Locations (1/2)

1

CONTEXT OF APPLICATION

In hospitals, operating theatre and intensive care units require uninterrupted power availability. Ground faults in medical equipment can be lethal for the patient. In addition, many jurisdictions legislate isolated power to protect patients and staff from leakage currents. To achieve this, IT earthing or grounding systems with insulation supervision provide insulation degradation monitoring and alarming without tripping or power interruption.

Nurses are typically responsible for taking immediate actions when insulation faults occur and in many cases require assistance from electricians or electrical engineers to help with the troubleshooting.

2

Problem to Solve

The end-user (nurse) needs to:

- Be alarmed in case of insulation faults
- Have the means to identify and clear the insulation fault as soon as possible

The Facility Manager needs to:

- Guarantee the power availability and the continuity of activity in operating theatre (OT) and intensive care units (ICU)
- Get real-time information of insulation status
- Be alarmed / notified in case of insulation or overload issues

3

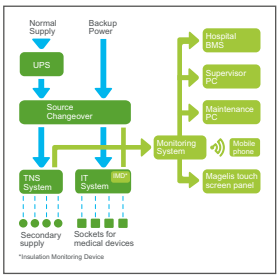
Purpose of Insulation Monitoring Application

Permanently monitor insulation integrity and display status in real-time

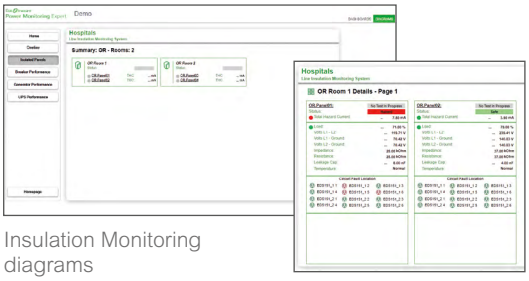
- To provide alarming in operating theaters and intensive care units in case of insulation faults
- To remotely monitor from the nurse's station and facility manager's office
- To monitor for overload and over-temperature conditions

Provide first level support of troubleshooting for staff in operating theaters and intensive care units

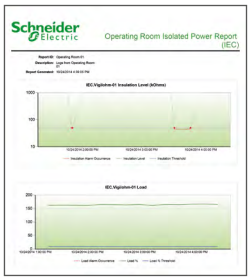
4



Functional diagram of operating theater switchboard



Insulation Monitoring diagrams



Operating Room Isolated Power report IEC

INSULATION MONITORING

Monitor Insulation Status of Critical Locations (2/2)

Outputs of the Application

Live data display
- Insulation monitoring status
- Insulation monitoring absolute value (Ohm)

Events and alarms
- Insulation fault (visual and acoustic in operating rooms)
- Insulation fault location (per feeder / group of sockets)
- Transformer electrical fault (overload, overtemperature)
- Custom I/O switching

Report
- Operating Room Isolated Power report

I want to implement this application: See details page 68

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

1

CONTEXT OF APPLICATION

Just like any other process in a facility, electrical distribution is a complex system with many devices, and failures can occur at different locations. This is why the electrical distribution network needs to be monitored.

Similar to the dashboard in a car, which provides detailed information about the speed, RPM, oil pressure, temperature, tire pressure, status of the lights, blinker, etc., the Energy and Power Monitoring System provides all relevant information about the electrical distribution system.

Considering how critical it can be to maintain the continuity of electrical supply, having the capacity to quickly view, analyze and understand where the failure comes from is a key concern for Facility Managers.

2

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

3

Purpose of Electrical Distribution Monitoring & Alarming Application

4

Provide real-time status of the electrical distribution system

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

Identify anomalies and notify the right personnel

- In case of conditions which could have adverse short term or long term effects
- Provide alarming and notification in case of any abnormal conditions or events

The Electrical Distribution Alarming application provides notification 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.

ELECTRICAL DISTRIBUTION MONITORING & ALARMING

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

Outputs of the Application

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
- Real-time data values of each connected device, such as electrical parameters, device settings and status information…

Events and alarms

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

Trends

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

Dashboards

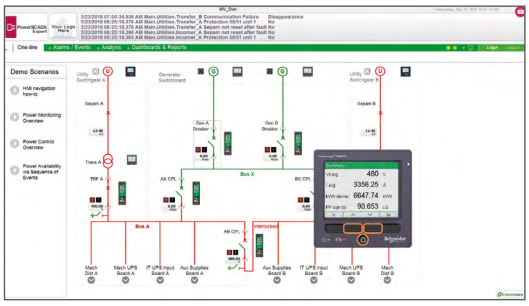
- Configurable dashboards for visualizing historical power system data

Reports

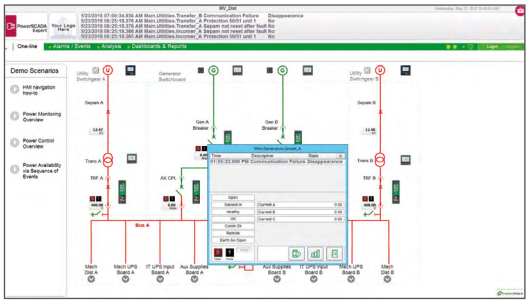
- Historical data reporting

Notifications

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



Electrical network single-line diagram (with color animation)



View of device data and control

Alarm viewer – Recent incidents

I want to implement this application: See details page 72

CAPACITY MANAGEMENT

Help Prevent Business Disruption from Electrical Overload with Capacity Planning

1

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 on line, 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, ATSs, transformers, capacitor banks, bus bars, conductors, fuses, etc. Often times, exceeding the rated capacity means nuisance trips, but it can also result in overheating or fires.

2

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)

3

Purpose of Capacity Management Application

Visualize real-time or historical power system capacity

- Monitor real-time circuit loading
- Trend and report historical loading
- Pre-defined reporting for equipment capacity management (circuit breakers, UPSs, generators, ATSs, transformers, capacitor banks, bus bars, conductors, fuses, etc.)

Provide information for capacity planning

- Simplify capacity planning for operations expansion or modifications
- Avoid over-subscribing critical equipment

4

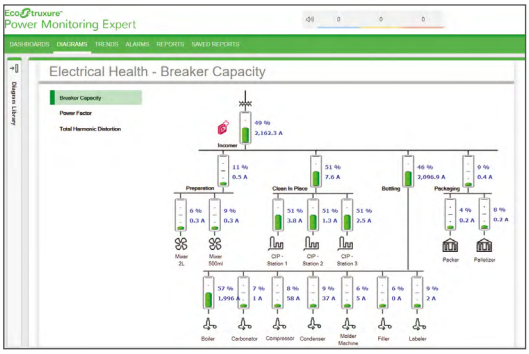
Outputs of the Application

Live data display

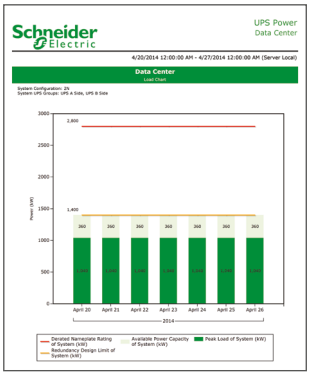
- Electrical Health diagram

Reports

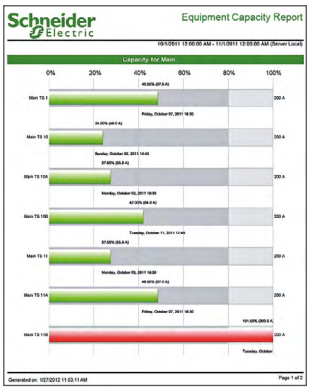
- Branch Circuit Capacity report
- UPS Power report
- Generator Capacity report
- Generator Power report
- Equipment Capacity report
- Power Losses report



Electrical Health diagram



UPS Power report



Equipment Capacity report

I want to implement this application: See details page 80

BACK-UP POWER TESTING

Help Ensure Reliability and Availability of Back-Up Power Systems with Proper Testing

CONTEXT OF APPLICATION

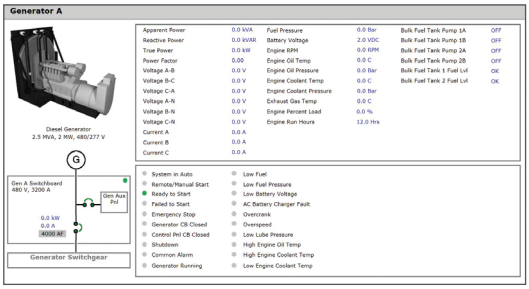
Critical buildings such as hospitals and data centers rely on emergency power systems to supply the facility with power during an interruption of the utility incomer(s). During an interruption, power is transferred from the utility supply to the alternate power source using automatic transfer switch(es) (ATS).

In fact, according to the Electric Power Research Institute (EPRI), back-up power systems fail to start 20% to 30% of the time. Common causes include starter battery failure, low fuel levels, wet-stacking, controls in wrong state, etc.

Problem to Solve

The Facility Manager needs to:

- Ensure the reliability and availability of back-up 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



Generator diagram

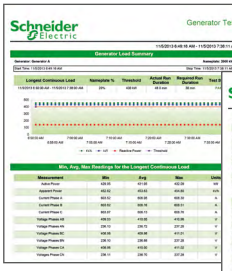
Purpose of Back-Up Power Testing Application

Monitor, automatically record and report back-up power tests

- Automatic transfer switches
- Back-up generators
- UPS

Record key legislated parameters for compliance reports including:

- Transfer time for Automatic Transfer Systems and generators
- Generator run time, engine loading, exhaust and engine temperature, fuel levels and battery health
- UPS's ability to sustain critical loads during power outage, and UPS battery health



Generator Test report

UPS Auto-test report

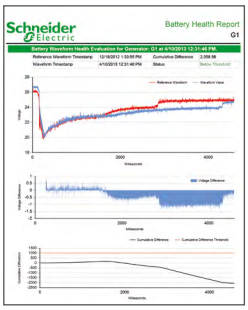
Outputs of the Application

Live data display

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

Reports

- Generator Test (EPSS) report
- Generator Battery Health report
- Generator Load Summary report
- UPS Auto-test report
- UPS Battery Health report



Battery Health report

I want to implement this application: See details page 85

BREAKER SETTINGS MONITORING

Control the Protection Settings of the Electrical Installation

1

CONTEXT OF APPLICATION

An installation is designed with specific breaker settings, calculated to optimize the protection of the installation. However, throughout the lifecycle of the installation, these settings may not be applied correctly or may be modified (for example during maintenance, product replacement, because of 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 people harm if the coordination between products is not correct.

2

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

3

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 of any settings or co-ordination problems.

4

Outputs of the Application

Live data display

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

Events and alarms

Alarms are generated on breaker trip settings changes.

Reports

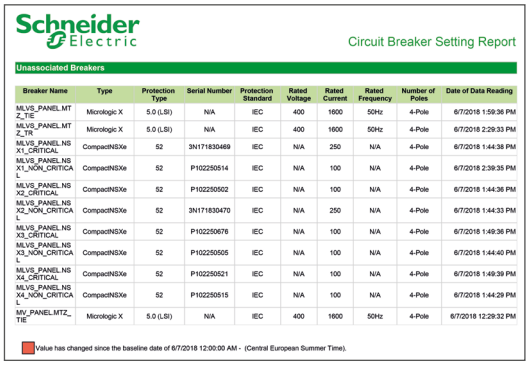
For each protective device, the report displays the name, type of protection, and its thresholds.

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

- Circuit Breaker Setting report
- Circuit Breakers Inventory
- Trip settings change summary
- Protection modes
- Maintenance status

Notifications

SMS notifications can be sent upon settings change to detect potential loss of selectivity.


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.MTZ_TIE	Micrologic X	5.0 (LSI)	N/A	IEC	400	1600	50Hz	4-Pole	6/7/2018 1:59:36 PM
MLVS_PANEL.MTZ_TR	Micrologic X	5.0 (LSI)	N/A	IEC	400	1600	50Hz	4-Pole	6/7/2018 2:29:33 PM
MLVS_PANEL.NSX1_CRITICAL	CompactNSXe	52	3N171830469	IEC	N/A	250	N/A	4-Pole	6/7/2018 1:44:38 PM
MLVS_PANEL.NSX1_NON_CRITICAL	CompactNSXe	52	P102250514	IEC	N/A	100	N/A	4-Pole	6/7/2018 2:39:35 PM
MLVS_PANEL.NSX2_CRITICAL	CompactNSXe	52	P102250502	IEC	N/A	100	N/A	4-Pole	6/7/2018 1:44:36 PM
MLVS_PANEL.NSX2_NON_CRITICAL	CompactNSXe	52	3N171830470	IEC	N/A	250	N/A	4-Pole	6/7/2018 1:44:33 PM
MLVS_PANEL.NSX3_CRITICAL	CompactNSXe	52	P102250676	IEC	N/A	100	N/A	4-Pole	6/7/2018 1:49:36 PM
MLVS_PANEL.NSX3_NON_CRITICAL	CompactNSXe	52	P102250505	IEC	N/A	100	N/A	4-Pole	6/7/2018 1:44:40 PM
MLVS_PANEL.NSX4_CRITICAL	CompactNSXe	52	P102250521	IEC	N/A	100	N/A	4-Pole	6/7/2018 1:49:39 PM
MLVS_PANEL.NSX4_NON_CRITICAL	CompactNSXe	52	P102250515	IEC	N/A	100	N/A	4-Pole	6/7/2018 1:44:29 PM
MV_PANEL.MTZ_TIE	Micrologic X	5.0 (LSI)	N/A	IEC	400	1600	50Hz	4-Pole	6/7/2018 12:29:32 PM

Value has changed since the baseline date of 6/7/2018 12:00:00 AM - (Central European Summer Time).

Circuit Breaker Setting report

I want to implement this application: See details page 94

POWER EVENT ANALYSIS

Analyse 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 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

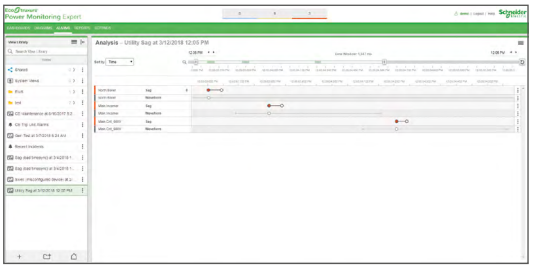
The Facility Manager needs to:

- Be able to analyze potentially damaging power events
- Enable actions to avoid future events
- Be able to prioritize alarm resolution

Purpose of Power Event Analysis Application

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

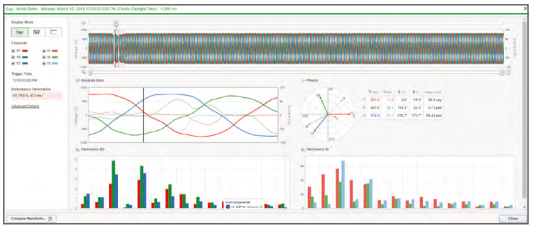
- Smart alarm context brings the right information into view automatically
- Events and alarms can be viewed by category, severity, alarm type and status
- Allow visualize events in context of time across multiple devices with ability to annotate
- Analyses can be saved for later viewing



Timeline of power events

Provide an aggregated view of events in the same dashboard

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



Waveform viewer

Enable root cause analysis

Focus on deep dive into contextual data from events such as visualizing waveforms, RMS data

This detailed data allows us to identify root cause and enables action.

POWER EVENT ANALYSIS

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

Outputs of the Application

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 location of an alarm

I want to implement this application: See details page 99

SOURCE AND NETWORK 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 are making 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 automated self-healing solutions.

Problem to Solve

The Facility Manager needs:

- Remote control of loads, or automatic control schemes for source transfer and load-shedding operations
- Self-healing network reconfiguration to quickly isolate a fault and restore power

Purpose of Source and Network Control Application

Remotely control, visualize and supervise automatic transfer and network reconfiguration schemes

A combination of connected hardware and edge control software allows for remote or distributed controller based, automated electrical network control through substation protocols like IEC 61850.

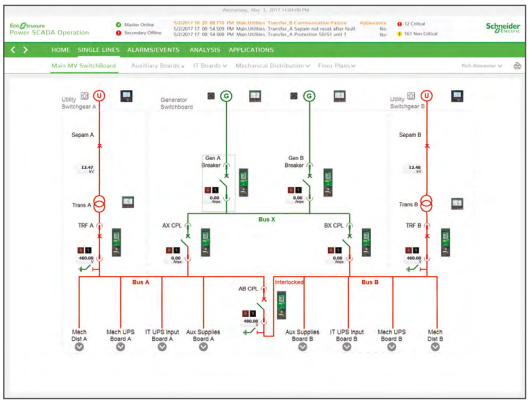
Outputs of the Application

Live data display

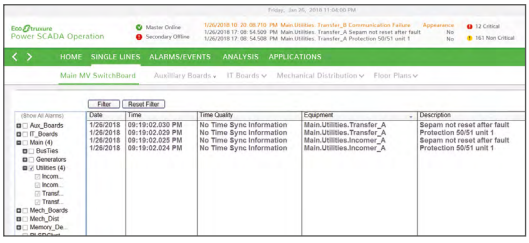
- Animated Single Line Diagrams (SLD) display the status of the system

Events and alarms

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



Animated Single Line Diagram



Alarms

I want to implement this application: See details page 104

Capture, Analyze and Understand Power Quality Disturbances

1

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.

2

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

Power Quality overview dashboard

3

Purpose of Power Quality Monitoring Application

Monitor persistent steady state and event based disturbances

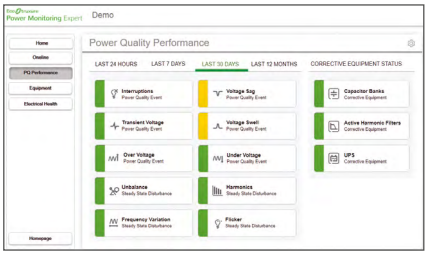
- Harmonics, current unbalance, flicker and over/under voltage conditions, transients, interruptions…

Better understand power quality disturbances

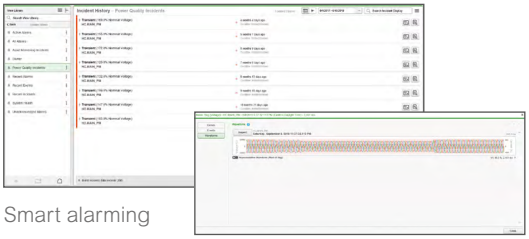
- Trends and reports to understand potential issues that could affect operations
- Capture and study event details such as waveforms
- Patented Disturbance Direction Detection to locate the directionality of events

Deep-dive analysis of power quality issues

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



Power Quality Performance Status Panel



Smart alarming

4

Outputs of the Application

Events and alarms

- Onboard events and alarms with timestamps

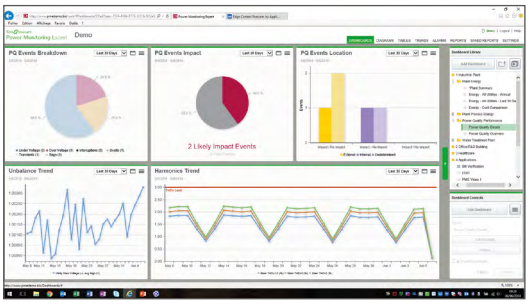
Waveform viewer

Dashboards

- Power Quality Status Panel 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



Power Quality details dashboard

I want to implement this application: See details page 109

POWER QUALITY CORRECTION

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, unbalance and short interruptions.

Mitigate harmonics effects (with AccuSine PCS+)

Harmonic conditions typically occur in facilities with sizable non-linear loads such as variable speed drives (VSD), arc furnaces, electronic equipment with switch-mode power supplies, 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.

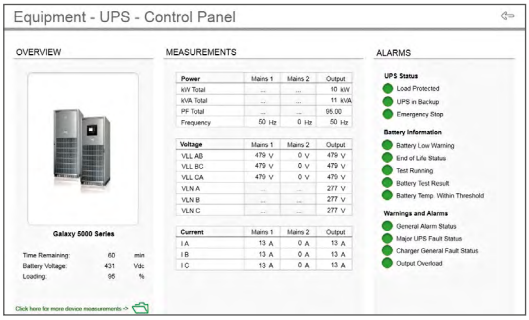
Outputs of the Application

Live data display

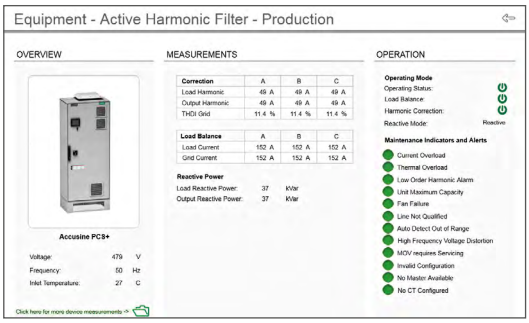
- UPS equipment status panel diagram
- Active harmonic filtering device diagram

Dashboard

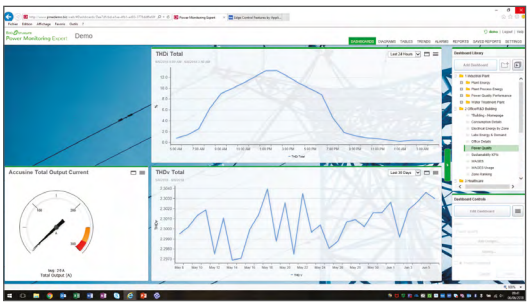
- Power Quality dashboard: current, voltage, power factor, reactive power and energy, current and voltage harmonic distortions



UPS equipment control panel diagram



Active harmonic filtering device diagram



Power Quality Correction typical dashboard

I want to implement this application: See details page 117

UTILITY BILL VERIFICATION

Check for Utility Bill Discrepancies

1

CONTEXT OF APPLICATION

Electrical energy has some unique characteristics such as time-of-use, demand peak charges, and more that can contribute to complicated billing. Mistakes do happen in energy billing and are surprisingly common.
Some discrepancies can include:

- Invoicing errors
- Wrong rates applied
- Incorrect meter readings
- Duplicate line items
- And more...

2

Problem to Solve

The Facility Manager needs to:

- Be able to provide energy billing data to financial organizations
- Get a reliable basis for comparison to dispute the utility bill with the energy provider
- Understand the billing composition and details

3

Purpose of Utility Bill Verification Application

Provide a similar and reliable basis for billing analysis

- Automatic generation of a "shadow bill" by power monitoring software
- Measurement performed at the same location as the utility meter
- Energy consumption data collected with same frequency (typically 15 min) and equal accuracy (at least) as for utility bill

4

Outputs of the Application

Reports

The "shadow bill" includes the same information as the utility original bill to compare key measurements:

- Energy usage (kWh, kVARh, kVAh)
- Demand (kW, kVAR)
- Power factor

"Shadow bill" generated by Schneider Electric

I want to implement this application: See details page 121

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

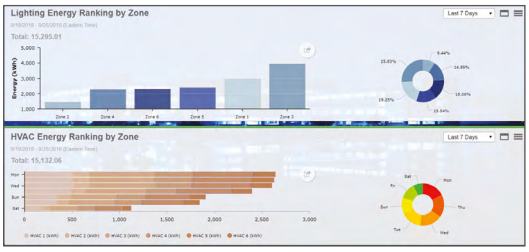
Benchmark multi-site energy usages

- 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

of what makes an inefficient organization, facility, process or device use more energy than an efficient one.



Energy Ranking by Zone

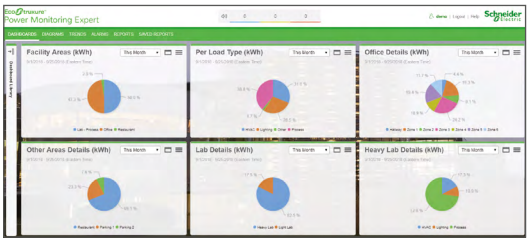
Outputs of the Application

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



Building Area Benchmarking

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

I want to implement this application: See details page 125

COST ALLOCATION

Gain Visibility to Improve Energy Cost Accountability

1

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.

2

Problem to Solve

The Facility Manager needs to:

- Gain visibility into which departments, processes, buildings or floors are contributing to energy cost
- Improve energy accountability by allocating costs to departments or tenants
- Identify key areas for energy savings opportunities

3

Purpose of Cost Allocation Application

Encourage energy efficient behaviour

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

4

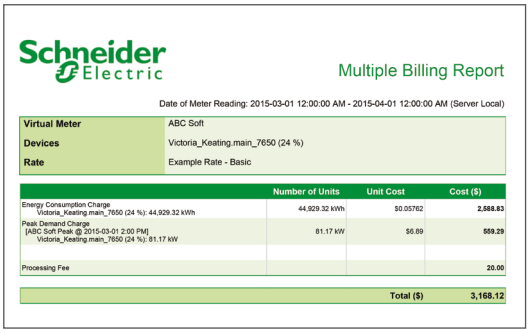
Find the biggest energy savings opportunities

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.

Outputs of the Application

Reports

- Multiple Billing report:
  Provides an energy cost breakdown for each tenant, area, department or building.
- Billing Summary report:
  Provides a summary view of 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.


Schneider Electric

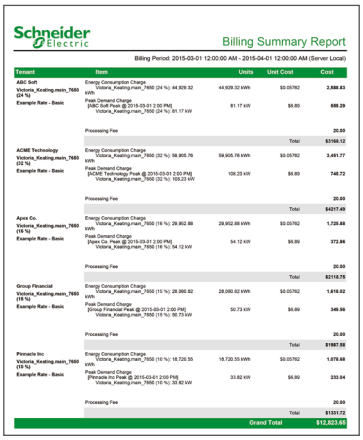
Multiple Billing Report

Date of Meter Reading: 2015-03-01 12:00:00 AM - 2015-04-01 12:00:00 AM (Server Local)

Virtual Meter	ABC Soft
Devices	Victoria_Keating.main_7650 (24 %)
Rate	Example Rate - Basic

	Number of Units	Unit Cost	Cost ($)
Energy Consumption Charge Victoria_Keating.main_7650 (24 %): 44,929.32 kWh	44,929.32 kWh	$0.05762	2,588.83
Peak Demand Charge [ABC Soft Peak @ 2015-03-01 2:00 PM] Victoria_Keating.main_7650 (24 %): 81.17 kW	81.17 kW	$6.89	559.29
Processing Fee			20.00
		Total ($)	3,168.12

Multiple Billing report

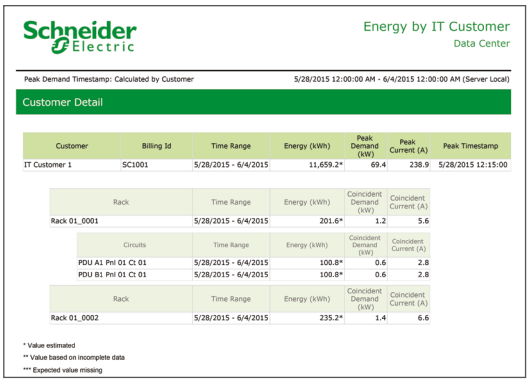

Schneider Electric

Billing Summary Report

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

Tenant	Item	Units	Unit Cost	Cost
ABC Soft Victoria_Keating.main_7650 (24 %) Example Rate - Basic	Energy Consumption Charge Victoria_Keating.main_7650 (24 %): 44,929.32 kWh	44,929.32 kWh	$0.05762	2,588.83
	Peak Demand Charge [ABC Soft Peak @ 2015-03-01 2:00 PM] Victoria_Keating.main_7650 (24 %): 81.17 kW	81.17 kW	$6.89	559.29
	Processing Fee			20.00
			Total	$3,168.12
ACME Technology Victoria_Keating.main_7650 (32 %) Example Rate - Basic	Energy Consumption Charge Victoria_Keating.main_7650 (32 %): 59,905.76 kWh	59,905.76 kWh	$0.05762	3,451.77
	Peak Demand Charge [ACME Technology Peak @ 2015-03-01 2:00 PM] Victoria_Keating.main_7650 (32 %): 109.23 kW	108.23 kW	$6.89	746.72
	Processing Fee			20.00
			Total	$4,217.49
Apex Co. Victoria_Keating.main_7650 (16 %) Example Rate - Basic	Energy Consumption Charge Victoria_Keating.main_7650 (16 %): 29,902.88 kWh	29,902.88 kWh	$0.05762	1,720.88
	Peak Demand Charge [Apex Co. Peak @ 2015-03-01 2:00 PM] Victoria_Keating.main_7650 (16 %): 54.12 kW	54.12 kW	$6.89	372.86
	Processing Fee			20.00
			Total	$2,113.75
Group Financial Victoria_Keating.main_7650 (15 %) Example Rate - Basic	Energy Consumption Charge Victoria_Keating.main_7650 (15 %): 28,090.82 kWh	28,090.82 kWh	$0.05762	1,618.02
	Peak Demand Charge [Group Financial Peak @ 2015-03-01 2:00 PM] Victoria_Keating.main_7650 (15 %): 50.73 kW	50.73 kW	$6.89	349.56
	Processing Fee			20.00
			Total	$1,987.58
Pinnacle Inc Victoria_Keating.main_7650 (10 %) Example Rate - Basic	Energy Consumption Charge Victoria_Keating.main_7650 (10 %): 18,720.55 kWh	18,720.55 kWh	$0.05762	1,078.88
	Peak Demand Charge [Pinnacle Inc Peak @ 2015-03-01 2:00 PM] Victoria_Keating.main_7650 (10 %): 33.82 kW	33.82 kW	$6.89	233.04
	Processing Fee			20.00
			Total	$1,331.72
			Grand Total	$12,823.65

Billing Summary report


Schneider Electric

Energy by IT Customer

Data Center

Peak Demand Timestamp: Calculated by Customer — 5/28/2015 12:00:00 AM - 6/4/2015 12:00:00 AM (Server Local)

Customer Detail

Customer	Billing Id	Time Range	Energy (kWh)	Peak Demand (kW)	Peak Current (A)	Peak Timestamp
IT Customer 1	SC1001	5/28/2015 - 6/4/2015	11,659.2*	69.4	238.9	5/28/2015 12:15:00

Rack	Time Range	Energy (kWh)	Coincident Demand (kW)	Coincident Current (A)
Rack 01_0001	5/28/2015 - 6/4/2015	201.6*	1.2	5.6

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

Rack	Time Range	Energy (kWh)	Coincident Demand (kW)	Coincident Current (A)
Rack 01_0002	5/28/2015 - 6/4/2015	235.2*	1.4	6.6

* Value estimated
** Value based on incomplete data
*** Expected value missing

Energy Billing by IT Customer

I want to implement this application: See details page 131

ENERGY USAGE ANALYSIS

Determine Where to Focus Energy Conservation Initiatives

CONTEXT OF APPLICATION

Energy Usage Analysis leverages energy consumption data to understand how much energy is consumed by the various load types, areas, processes or production outputs. It helps analyze usage patterns and understand which factors contribute most to energy usage and thereby lend themselves for the biggest return on investment for energy consumption measures.

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 initiatives

Purpose of Energy Usage Analysis 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

Optimize energy usage

- By comparing and visualizing hourly, daily, weekly, monthly and yearly energy usage, and cost for different utilities
- By identifying and prioritizing which load types, processes, areas or buildings lend themselves for the better return on investment for energy conservation initiatives

Outputs of the Application

Events and alarms

- Smart setpoints to generate alarms based on historical usage of energy

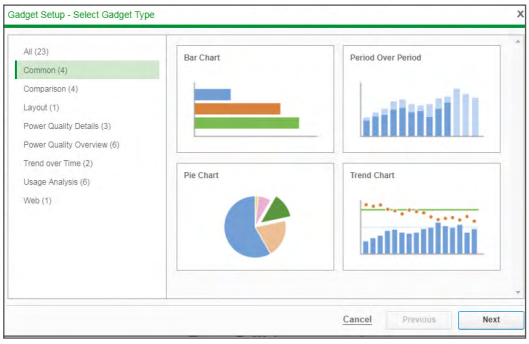
Dashboards

- Energy Cost Comparison
- Energy Consumption Ranking
- Energy Heat Map
- Pareto charts
- Sankey diagram

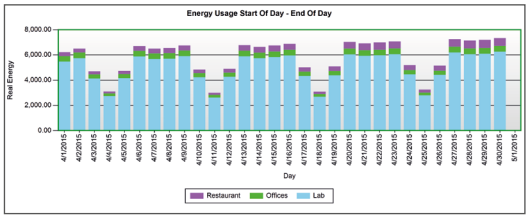
Reports

- Energy Usage reports
- Consumption Ranking reports
- Energy Comparison reports
- Calendar Trend report
- Simple load profile charts
- Load Duration curve

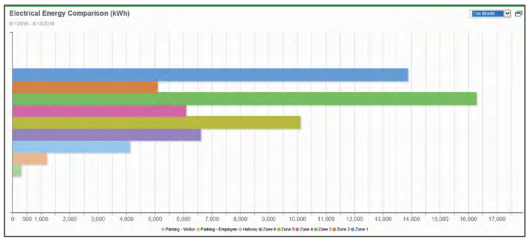
Note: Any of the dashboards shown in the Energy Kiosk section can be used in Energy Usage Analysis.



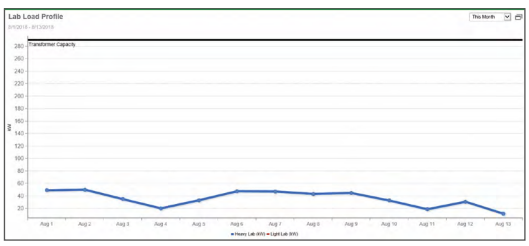
Configurable dashboard gadget library for analyzing energy usage



Energy Usage reports



Pareto charts



Simple load profile charts

I want to implement this application: See details page 136

ENERGY PERFORMANCE ANALYSIS AND VERIFICATION

Understand Energy Usage Patterns and Find Energy Waste in the Context of Operations

1

CONTEXT OF APPLICATION

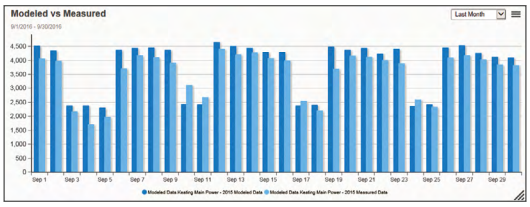
Energy drivers such as outside temperature, building occupancy and production volumes can be used to develop energy models which correlate these drivers with energy consumption. These models help identify energy savings opportunities or verify savings from energy conservation measures.

2

Problem to Solve

The Facility/Energy Manager needs to:

- Analyze the energy performance of the facility
- 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



Modeled values vs Measured values gadget

3

Purpose of Energy Performance Analysis and Verification Application

Define modeled data of energy consumption related to energy drivers

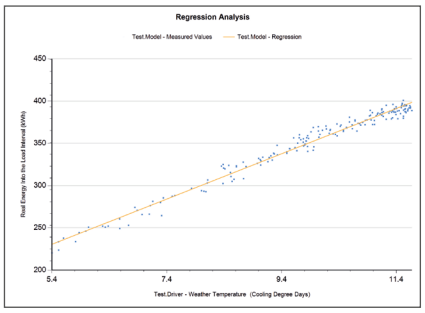
Provide feedback loop between energy managers and operations

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 or productivity

Use modeled data to detect abnormal consumption values

Track the improved performance, verify and report savings

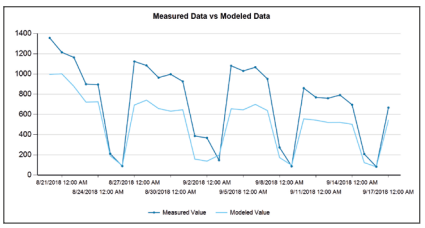
By determining the difference between pre-retrofit and post-retrofit energy consumption



Energy Regression Analysis (Create Model report)

4

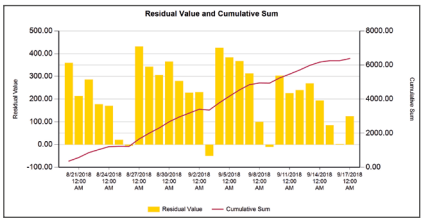
Outputs of the Application



Modeled values vs Measured values (Use Model report)

Trends

Modeled data can be visualized as trends and compared to actual data.



Cumulative Savings (Use Model report)

Dashboards

Energy Usage dashboards:

- Modeled values vs measured values

Note: Modeled data can be visualized in most standard dashboards.

Reports

- Create Model report
- Use Model report

I want to implement this application: See details page 148

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 factor are primarily caused by inductive motor loads, and can be compensated using power factor correction equipment. Power Factor Correction is a common way of achieving fast return on investment.

Problem to Solve

The Facility Manager needs to:

- Gain visibility into the facility's reactive power and power factor
- Lower 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

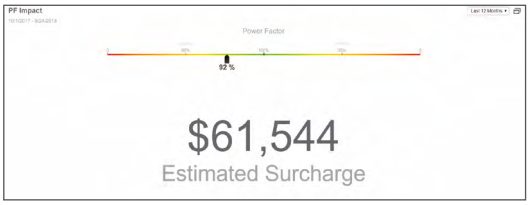
Outputs of the Application

Live data display

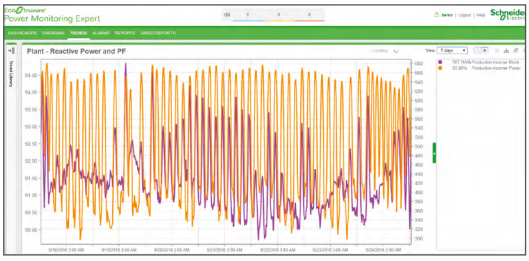
- Real-time trending of power factor or reactive power

Dashboards

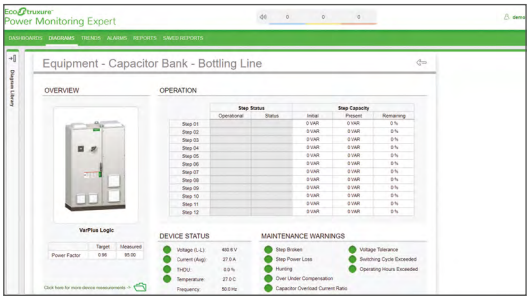
- Power Factor Estimated Cost gadgets
- Power Factor Impact gadgets
- Power Factor Correction Equipment diagrams



Power Factor Surcharges



Power Factor - Reactive Power Trending



Power Factor Equipment diagram

I want to implement this application: See details page 153

ASSET PERFORMANCE

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

1

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, preventative and condition-based maintenance models can help inform maintenance planning to reduce risk of early degradation, optimize maintenance activities and optimize maintenance related spending.

2

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 visibility into critical assets health 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

3

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

4

Using the connectivity of **EcoStruxure™ Power** and the wealth of data from connected assets, we are offering a condition based, predictive approach, with true 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

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

Outputs of the Application

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

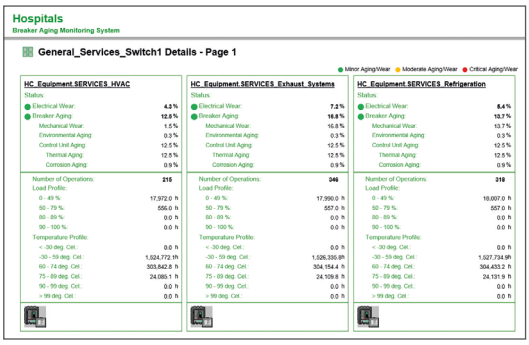
Reports and dashboards

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

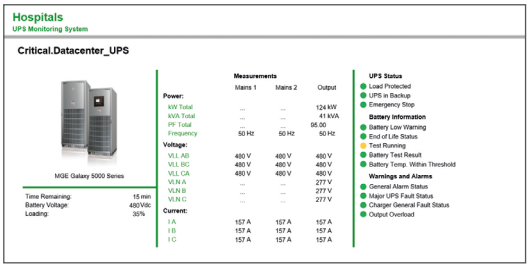
These reports provide the right information to help decide when to maintain circuit breakers, UPSs and generator start batteries.

Cloud-Based Analytics Services

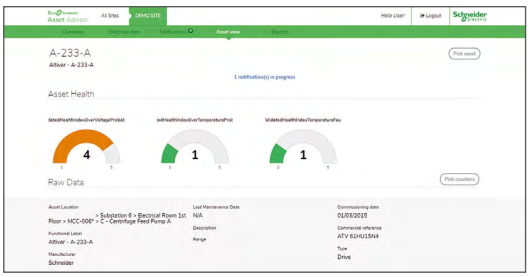
- Remote notifications in case of electrical asset condition anomalies
- Predictive analytics to determine equipment remaining lifetime and other health indicators
- Asset matrix to visualize asset health risks
- Pro-active asset maintenance optimization support by Schneider Electric Service Bureau



Aging diagram for circuit breakers



UPS monitoring diagram



EcoStruxure™ Asset Advisor Asset Health Dashboard

EcoStruxure™ Asset Advisor Risk Level Dashboard

I want to implement this application: See details page 157

ENERGY EFFICIENCY COMPLIANCE

Comply with Standards Related to Energy Management Systems

1

CONTEXT OF APPLICATION

Today's building owners are facing increasing pressure to make their facilities operate more efficiently on multiple fronts. Certainly, energy prices remain high in many regions and are primary drivers 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.

2

Problem to Solve

The Facility/Energy Manager needs to:

- Demonstrate compliance to 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

3

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 and improvement plan
- By providing transparency through reporting on energy performance indicators (EnPI) to regulators or stakeholders, and demonstrating continuous improvement

4

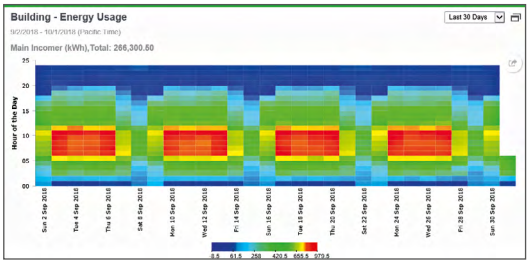
Outputs of the Application

Dashboards

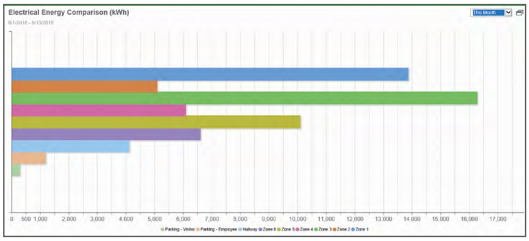
- Energy Cost Comparison
- Energy Consumption Ranking
- Energy Heat map
- Pareto charts
- Sankey diagram
- KPI dashboards
- General line graphs, bar charts and pie charts

Reports

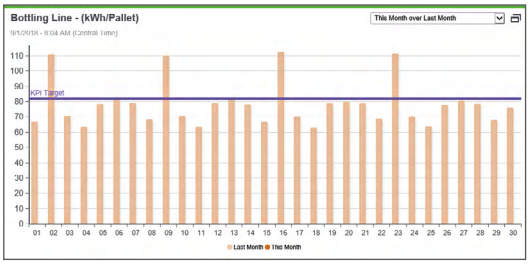
- Consumption Ranking reports
- Energy Comparison reports
- Energy Modeling reports
- Energy Usage reports
- Calendar Trend reports
- KPI Engine report



Energy Heat map



Pareto charts



KPI dashboard

I want to implement this application: See details page 136

GREENHOUSE GAS REPORTING

Track and Report Carbon Emissions

CONTEXT OF APPLICATION

Facing pressure from around the globe to curb carbon emissions and become more efficient by reducing energy and water consumption and waste, companies require accurate and timely environmental reporting.

Problem to Solve

The Facility Manager needs to:

- Convert energy consumption to greenhouse gas equivalents to communicate the results of reduction efforts to stakeholders (shareholders, public, regulatory bodies)
- Promote a green image

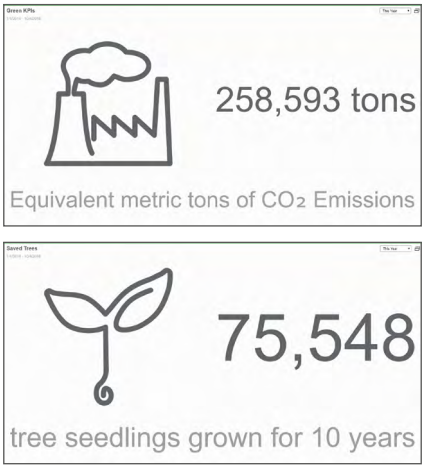
Purpose of Greenhouse Gas Reporting Application

Track and report carbon emissions and waste

Energy consumption and waste can be converted to carbon emissions and represented as:

- Equivalent tons of CO_2
- Saved trees
- Kilometers driven
- etc

In addition, Schneider Electric's modules can communicate water waste, and provide period over period usage comparison.



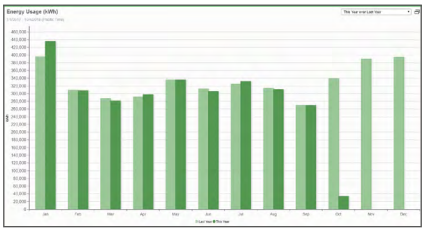
Energy Equivalency gadget

Outputs of the Application

Dashboard

- Energy Equivalency gadget

Carbon emissions are reported and segmented by source, scope and pollutant, and can be indexed to various specified metrics.



Period over period gadget

I want to implement this application: See details page 166

POWER QUALITY COMPLIANCE

Comply with International and Local Power Quality Standards

1

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 PQ measurement techniques standard

2

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 for ensuring electrical utility power quality service level

3

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 PQ industry standards such as CBEMA, ITIC, SEMI F47, EN 50160, IEC 61000-4-30, IEEE 519 and 1159.

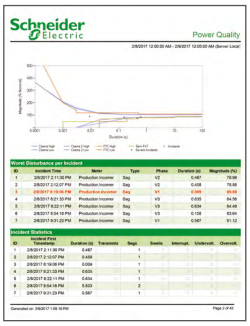
4

Outputs of the Application

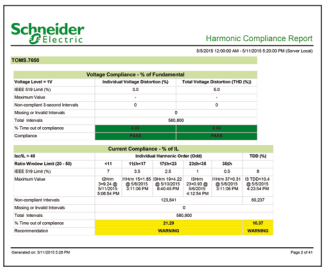
Reports

Power Quality reports:

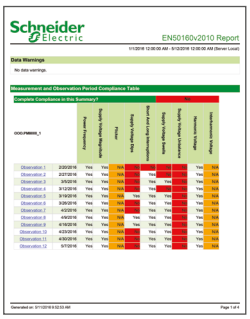
- Harmonics Compliance report
- IEC 61000-4-30 report
- EN 50160-2000 report
- EN 50160-2010 report
- CBEMA-ITIC Power Quality report



Power Quality report



Harmonic Compliance report



EN 50160-2010 report

I want to implement this application: See details page 171

REGULATORY COMPLIANCE

Simplify and Save Time in Compliance Reporting

CONTEXT OF APPLICATION

In some critical facilities such as hospitals, regulatory requirements specify how and how often the Backup/Emergency Power systems needs 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:

- Comply with local and international standards and satisfy reporting requirements of regulatory bodies in critical buildings
- Save time, improve productivity and accuracy of testing process and documentation per standards or manufacturer recommendations

Purpose of Regulatory Compliance Application

Automatically detect backup power tests and generate reports

- Automatic Transfer System
- Back-up generators
- UPS

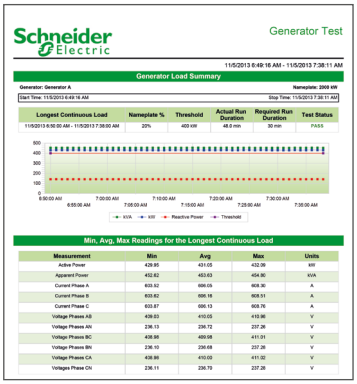
Record key legislated parameters for compliance reports including:

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

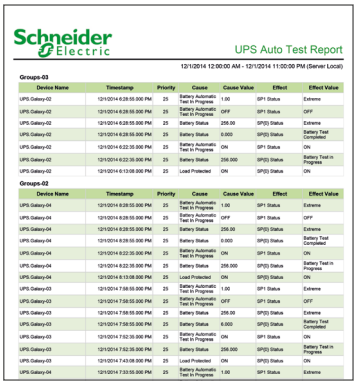
Outputs of the Application

Reports and dashboards

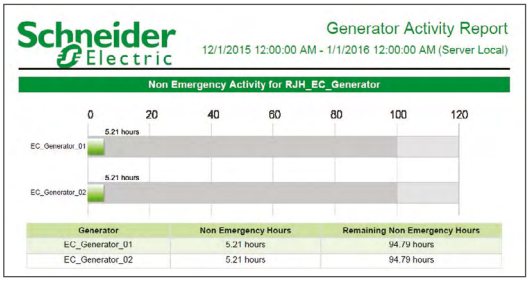
- Back-up Power (EPSS) Test report
- UPS Auto-test report
- Generator Activity report



Generator Test report



UPS Auto-test report



Generator Activity report

I want to implement this application: See details page 85

PART 2

Define the System Design Constraints

PART 2 | Define the System Design Constraints

Introduction

When designing a digital power distribution system, there are certain elements that should be considered to ensure the highest possible degree of compatibility, data integrity and reliability.

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

This part discusses the following system design constraints and their relevancy to the implementation of EcoStruxure™ Power applications in Part 3:

- Communications
- Data recording and time-stamping
- Data processing
- Data integration/interoperability between systems
- Cybersecurity

Communications

EcoStruxure™ Communication Protocols

EcoStruxure™ Power digital platform uses open communications protocols to aggregate data from connected products installed in MV/LV equipment, metering and other sensors through open protocols. It includes:

- Modbus serial through Ethernet gateways
- Modbus TCP/IP
- Industry standard wireless communications
- and other standard protocols used in the electrical distribution domain such as IEC 61850

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

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 loops with, typically, no more than eight devices.

EcoStruxure™ Native Communications Drivers

EcoStruxure™ Power supports three types of communications drivers:

- Native drivers for EcoStruxure™ Power devices
- Legacy device drivers allowing modernization of the systems with a step-by-step approach based on the lifecycle of the assets
- 3rd party device drivers using open protocols, such as Modbus, DNP3, IEC61850, BACnet, OPC DA, AE and UA can be easily created to capture real-time data using purpose-built productivity tools in EcoStruxure™ Power Monitoring Expert and Power SCADA Operation

Data Recording and Time-Stamping (1/3)

Data Recording Options

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

- All analog and event data recorded and time-stamped on board
- Alarm and event data only is recorded and time-stamped on-board
- No onboard recording, real-time data only. Data recording and time-stamping is done by a data logger or Edge Control.

Recommended Level of Data Recording

The criticality of the application and the required time-accuracy determines which level of data recording and time-stamping is recommended.

For high criticality applications, for example, recording and time stamping of all data for event reconstruction through sequence of events analysis should be done on-board the device.

The table below provides suggestions for the appropriate time accuracy of each EcoStruxure™ Power application.

Applications	Recommended Time Accuracy [+/-]	Minimum Required Time Accuracy [+/-]
Thermal Monitoring	1 min (PC logging)	5 min (PC logging)
Insulation Monitoring	1 s	5 s
ED Monitoring & Alarming	10 ms	1 s
Breaker Settings Monitoring	1 s	10 s
Capacity Management	1 s	10 s
Backup Power Testing	10 ms	100 ms
Power Events Analysis	1 ms	100 ms
Source / Network Control	10 ms	100 ms
Power Quality Monitoring	10 ms	100 ms
Power Quality Correction	1 s	10 s
Data Quality Management	N/A	N/A
Cost Allocation	1 s	10 s
Energy Usage Analysis	1 s	10 s
Energy Performance Analysis & Verification	1 s	10 s
Power Factor Correction	1 s	10 s
Energy Benchmarking	1 s	10 s
Microgrid	10 ms	100 ms
Utility Bill Verification	1 s	10 s
Asset Performance	1 s	10 s
Greenhouse Gas Reporting	1 s	10 s
Power Quality Compliance	1 s	10 s
Energy Efficiency Compliance	1 s	10 s
Regulatory Compliance	10 ms	100 ms

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

Data Recording and Time-Stamping (2/3)

Time Synchronization

Purpose of Time Synchronization

To maintain accurate time in the digital electrical distribution system, the connected products in the system must be time synchronized. There are several time synchronization mechanisms available with varying levels of accuracy.

These time synchronization methods are summarized below.

Time Synchronization via Modbus from Edge Control Software

This is the most common method of time synchronization in use today. It is the easiest and least expensive to deploy. However, the limitation of this method is the achievable time accuracy of +/- 1s. Often, the resulting accuracy is better than this, but realistically, +/- 1s is the commonly accepted limit.

Precision Time Protocol (PTP) - Embedded in some EcoStruxureTM Power Products

The Power Profile requires all Ethernet switches to be IEEE 1588-compliant to serve as “transparent clocks” and adjust PTP packets “on the fly.” This is required to achieve 1-µsec accuracy but unnecessary for less-demanding applications such as Sequence of Events Recording (SER). For these, Cyber Sciences proposes the “Simple PTP” (SPTP) Profile, based on the IEEE 1588 Default Profile.

This “Goldilocks solution” is just right for commercial/industrial EPMS, ensuring the required accuracy without imposing unnecessary restrictions or changes to the Ethernet data network. With SPTP, no special 1588 Ethernet switches are required. *[Reference: Cyber Sciences SER System Design Guide]*

IRIG-B – Requires External GPS Receiver/Clock

IRIG-B typically provides 1ms accuracy and is widely used by electric utilities and others, especially in the US. When applying IRIG-B, the number and type of devices to be synchronized, the protocols supported, and the distances involved all affect system architecture; therefore, each system must be engineered individually.

The first step may be to confirm that all devices support the same version of IRIG-B, for example: unmodulated IRIG-B (also known as 5V DC Level Shift, or DCLS), with or without the year (IEEE 1344 extensions), etc.

The IRIG-B signal is wired to a general-purpose or dedicated digital input, configured to decode IRIG-B. The IRIG-B source (e.g., GPS receiver/clock) may be capable of synchronizing a small number of devices in series (no more than 10 recommended) but a larger number of devices may require multiple circuits, repeaters and/or isolation means. Careful consideration is needed of clock specs, cable distances and device limitations. In some cases, it may be necessary to add appropriate termination impedance to each IRIG-B signal to eliminate signal reflections. *[CyberSciences IRIG-B Time Code Standard]*

Network Time Protocol (NTP) - Embedded in some EcoStruxure™ Power Products

Network Time Protocol (NTP) is a highly robust protocol, widely deployed throughout the Internet. Well tested over the years, it is generally regarded as the state of the art in distributed time synchronization protocols for unreliable networks. It can reduce synchronization offsets to times of the **order of a few milliseconds** over the public Internet, and to sub-millisecond levels over local area networks.

A simplified version of the NTP protocol, SNTP, can also be used as a pure single-shot stateless master-slave synchronization protocol, but lacks the sophisticated features of NTP, and thus has much lower performance and reliability levels. *[https://en.wikipedia.org/wiki/Clock_synchronization]*

Depending on the connected device and the synchronization mechanism, different levels of time accuracy can be achieved (refer to the chart below).

Data Recording and Time-Stamping (3/3)

Time Synchronization (cont.)

Time Synchronization Capabilities of EcoStruxure™ Power Connected Products

The table below highlights the supported time synchronization methods.

Device	Logging capabilities		Maximum reachable time sync accuracy / Time synchronization protocol				
	Event log	Measurement log	1 s	10 ms	1 ms	1 ms	100 ms
			Over Modbus	NTP / SNTP	PTP	IRIG-B	DCF 77
Masterpact MTZ	●		●				
Masterpact NT / NW	●		●				
Compact NS	●		●				
Compact NSX	●		●				
Smartlink SI D			●				
Smartlink SI B			●				
Powertag							
Powertag NSX							
Vigilohm IM20H	●		●				
Vigilohm IFL12H	●		●				
Easergy P3	●		●	●		●	
SEPAM 40	●		●	●			●
SEPAM 80	●		●	●			●
Vamp 125							
Vamp 321			●	●		●	
Easergy T300			●	●	●		
M580 with CRA module	●		●	●			
M580 with ERT module	●		●	●		●	●
M340	●		●	●			
ION9000	●	●	●	●	●	●	
ION7650	●	●	●	●		●	
PM8000	●	●	●	●	●		
PM5000			●				
iEM3000			●				
Accusine PCS			●				
Accusine PCS+			●				
Accusine PFV			●				
Accusine SWP	●		●				
Varplus Logic			●				
Galaxy VM	●		●				
Galaxy VX	●		●				
Galaxy 5500	●		●				
Smart UPS	●		●				

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

NOTICE
TIME ACCURACY PRECISION The time accuracy in the table above refers to the accuracy of the onboard data logging. This should not be confused with the speed at which protection or detection devices operate.

Data Processing

Data Processing Levels

Data processing in EcoStruxureTM Power is done at three possible levels:

- On-board devices
- In Edge Control software
- In cloud-based applications

Typically, all devices perform some level of on-board 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.

On-board devices Data Processing

Some EcoStruxure™ connected devices (e.g. PowerLogic ION9000, PM8000, Masterpact MTZ, etc.) provide significant on-board processing for sophisticated functionality such as Power Quality event detection and recording, and Disturbance Direction Detection. 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 SCADA 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 & Interoperability between Systems

1

Introduction

Data integration and interoperability in the EcoStruxure™ Power digital system occurs at the Edge Control level – EcoStruxure™ Power Monitoring Expert and/or EcoStruxure™ Power SCADA Operation.

2

Integration with Other Schneider Electric EcoStruxureTM Systems

For seamless integration with other EcoStruxure™ systems such as EcoStruxure™ Building Operation, EcoStruxure™ Web Services are used.

Additionally, for data integration in other Schneider Electric software, a database Extract, Transform & Load (ETL) tool may be used (e.g. EcoStruxure™ Data Center Operation or Power Advisor).

Finally, to enable remote services with EcoStruxure™ Asset Advisor, a dedicated cloud connector is available in EcoStruxureTM Power Monitoring Expert and Power SCADA Operation.

3

Interoperability with Third Party Systems

For interoperability with third party systems, EcoStruxure™ Power Monitoring Expert and Power SCADA Operation support OPC DA client and server functionality.

4

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, EcoStruxureTM Power SCADA Operation provides extended OPC AE server and OPC UA client functionality.

Cybersecurity (1/3)

Why Consider Cybersecurity while 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 cyber-attacks increase, operations must leverage industry standards to achieve consistent protection.

The challenges posed in operational technology are burgeoning regulations for cyber security, common protocols being increasingly exploited, the rapid expansion of connected devices and growing numbers of attack surfaces. Because of this, operational technology security has 3 main priorities – availability, integrity and confidentiality.

First, 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 important, ensuring high integrity data 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 the following blog post for more background:
For Operational Technology (OT), Make Cyber Resiliency and Reliability of Operational Process and Assets Your Top Priority.

IEC 62443 Standard

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

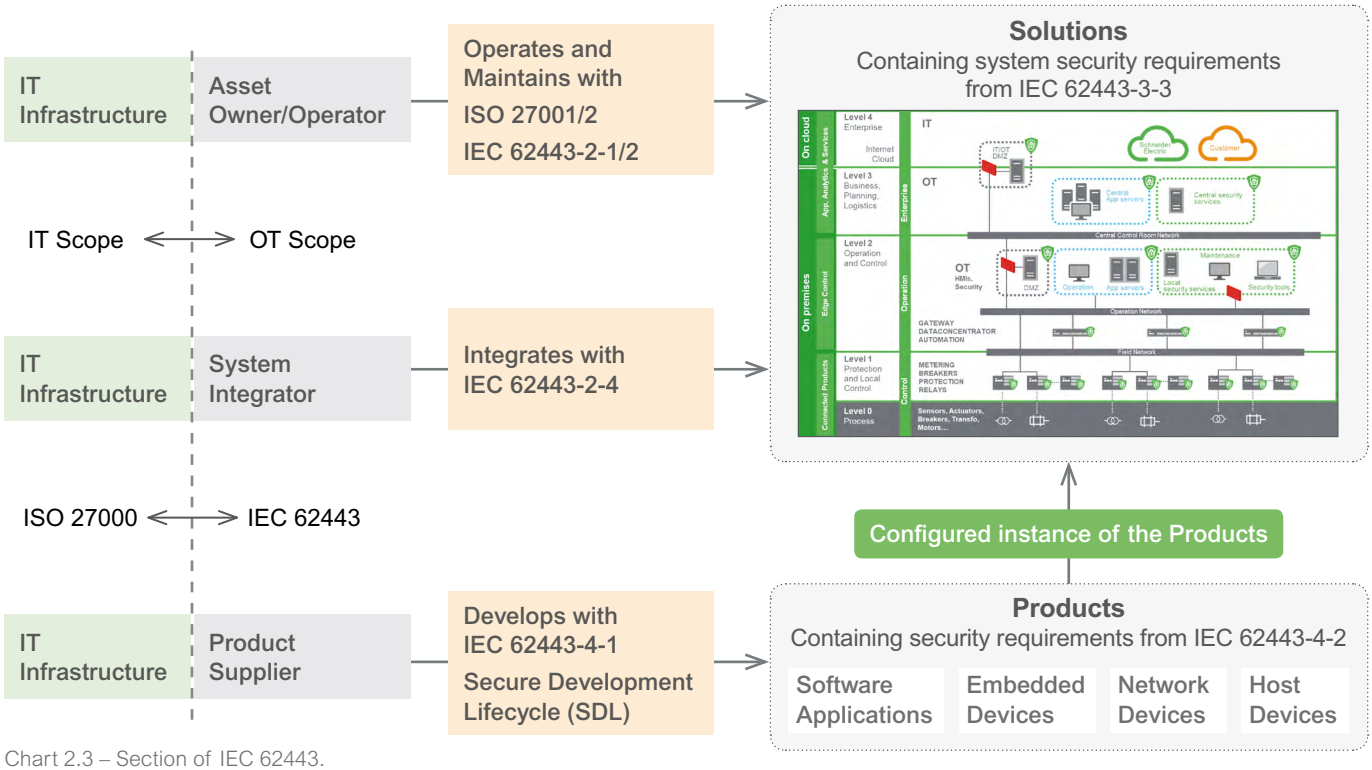


Chart 2.3 – Section of IEC 62443.

Cybersecurity (2/3)

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 cyber security requires an ongoing operational activity to maintain a high level of security.

As part of EcoStruxureTM Power, Schneider Electric promotes the use of products which are developed using the IEC 62443-4-1 secure development lifecycle process.

Schneider Electric, with its Cyber Security Service offer, can assess and help reduce Cyber Security risks inherent in a legacy installation and provide advice on how to modernize and improve the security of a facility's electrical distribution system.

Alignment with IEC 2700x

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

IEC 62443 Security Levels

As well, it 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	Hacktivist, 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.

Cybersecurity (3/3)

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. Selection of security assurance levels should be chosen based on a risk assessment of the infrastructure and operations, as seen in the example risk matrix from 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.

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

EcoStruxureTM 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 the most critical operations and infrastructure.

For more information on cyber security for EcoStruxure™, visit the website:
https://www.schneider-electric.com/en/work/solutions/cybersecurity/

PART 3

Implement the Selected Applications

PART 3 | Implement the Selected Applications

How to Use this Part?

Introduction

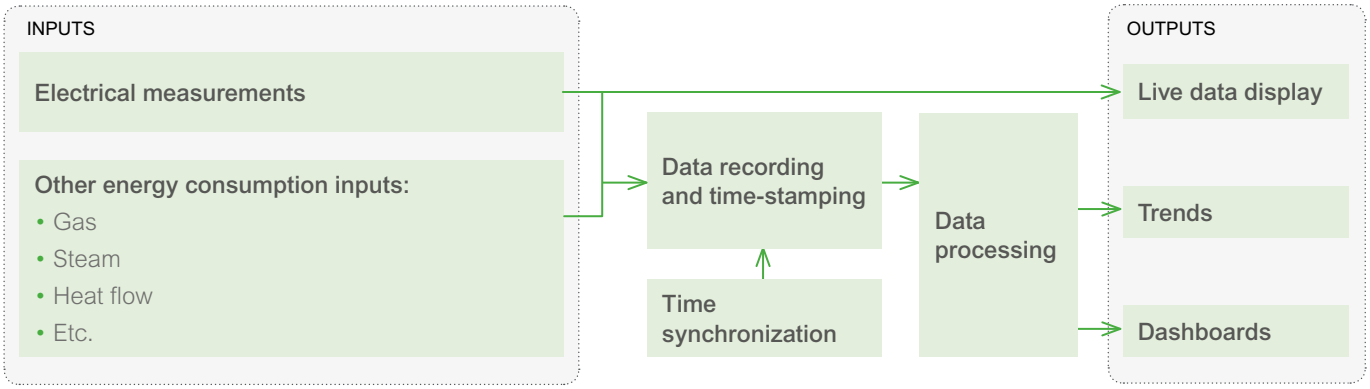
Once the required applications have been selected in part 1 and application constraints identified in part 2, part 3's purpose is to describe how to implement the selected applications in a given electrical architecture.

Comment: note that some implementation may be shared by several applications.

Embedded Information for each Application

A functional breakdown 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 time-stamping, 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.

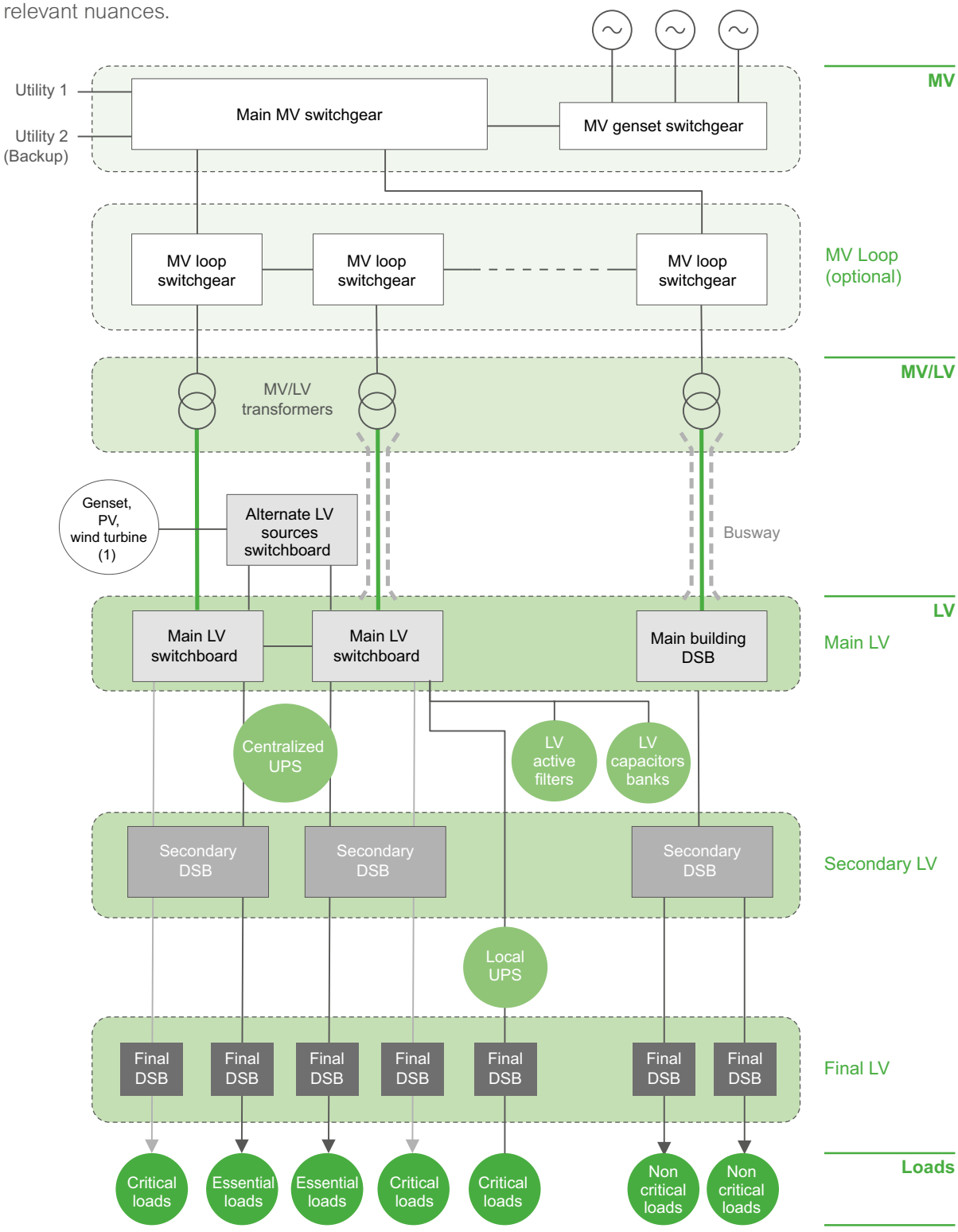
3 • **Electrical architecture**
Electrical distribution architectures (example on the following page) show the devices required at each level of the electrical distribution hierarchy (from medium voltage to final low voltage distribution) to perform the appropriate function required for the application.

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 Part?

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.



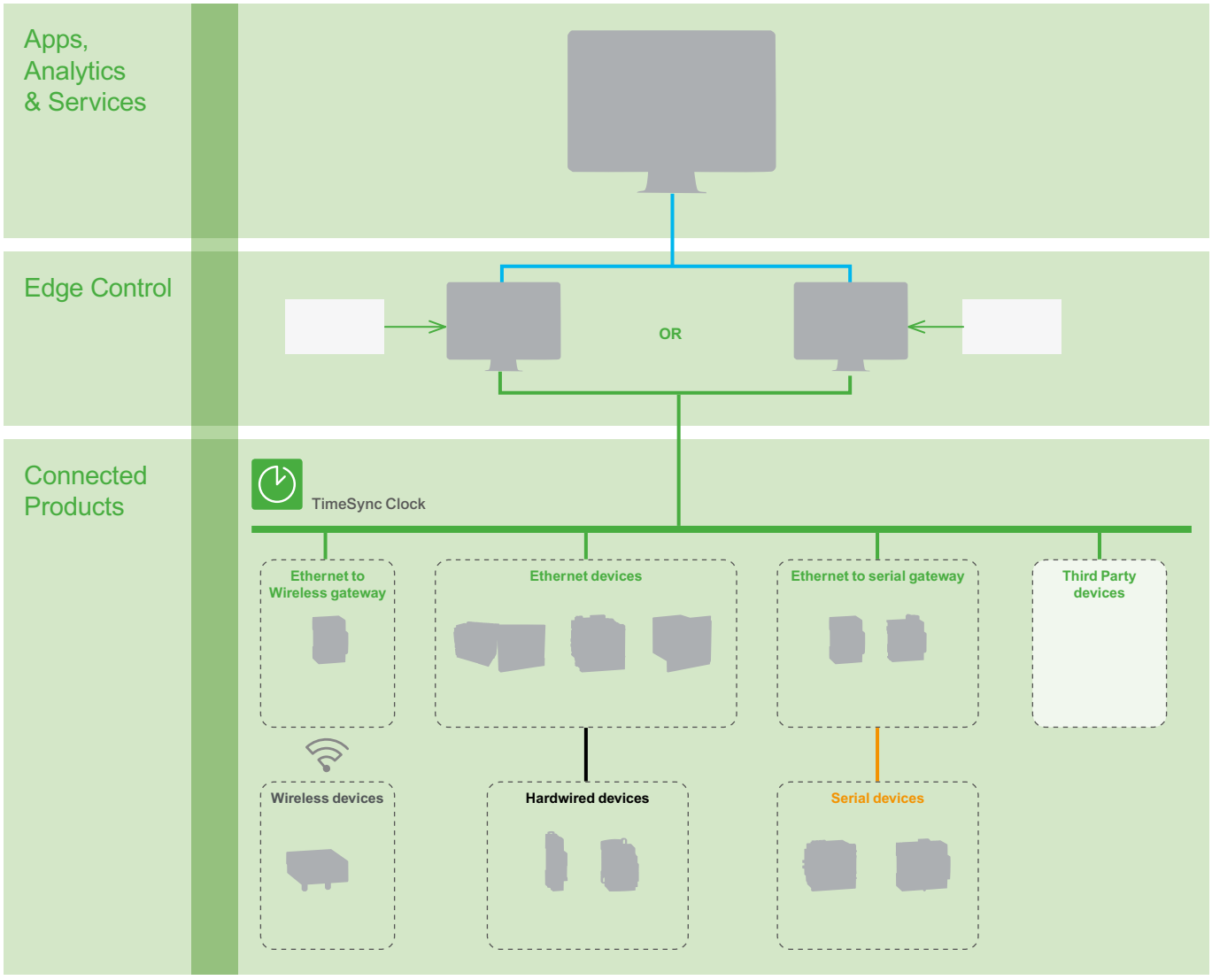
DSB = Distribution Switchboard

(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 Part?

Generic Digital Architecture Diagram

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

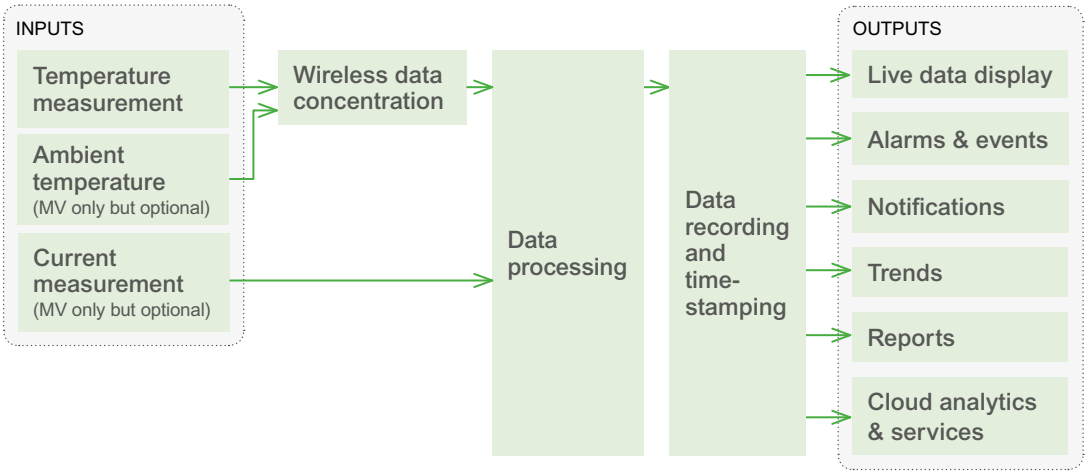


Ethernet - public LAN/WAN
Ethernet - technical LAN
Serial
Hardwired
Wireless

Functional Breakdown of the Application (1/3)

Data Flow

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



Data Flow in Detail

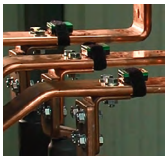
INPUTS

The following data are required:

Temperature Measurement

For MV switchgear and transformers, measurements are performed by Easergy TH110 temperature sensors. They are installed in the critical areas of the gear, particularly at cable, busbars, transformer, busway and withdrawable circuit breaker connections to measure corresponding temperatures.

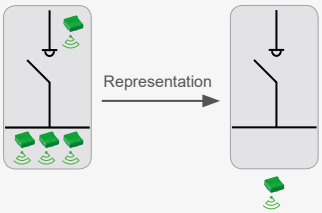
In the case of the LV Busway Thermal Monitoring application, temperature measurement is performed by Easergy CL110 sensors mounted on each busway junction or connection point (Easergy CL110 sensors may also be used to perform ambient temperature measurements).



Set of Easergy TH110 sensors fixed on the 3 phases of an electrical connection

MV Switchgear

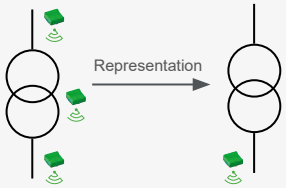
In MV switchgear*, up to 15 sensors may be installed, at each connection junction.



* Dependent of the MV switchgear

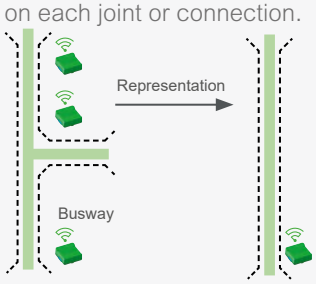
MV/LV Transformers

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



LV Busway

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



Easergy TH110

Easergy CL110

Sensors communicate wirelessly to a data concentrator.

Ambient temperature measurement (MV only but optional)

Ambient temperature measurement is used to dynamically adapt the temperature threshold.

It is performed by Easergy CL110 temperature sensor.

Product, Software and Services: See page 177

Functional Breakdown of the Application (2/3)

Data Flow in Detail (cont.)

Current Measurement (MV only but optional)

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

It is performed at this level of the architecture by a protection relay (e.g. Easergy P3/P5 or Sepam) or a power meter (e.g. PowerLogic ION9000, PM8000 or PM5000).

PowerLogic ION9000

PowerLogic PM8000

PowerLogic PM5000

Easergy P3

Easergy Sepam

WIRELESS DATA CONCENTRATION

The wireless signals from the temperature sensors are collected by a Sologate Harmony ZBRN32 wireless data concentrator.

Up to 60 sensors can be connected per Sologate data concentrator.

Harmony ZBRN32

DATA PROCESSING

For MV applications 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 SCADA Operation or Asset Advisor.

Currents and temperature measurements are processed in order to provide the following output:

Analog values outputs

- Temperature discrepancy between phases (in MV applications only)

Status

- Status indication of each measured point relative to the set thresholds
- Status indication of temperature discrepancies between phases

Substation Monitoring Device (SMD)

DATA RECORDING AND TIME-STAMPING

Measured and processed data are recorded with 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 exclusively by EcoStruxure™ Power Monitoring Expert, Power SCADA Operation, Asset Advisor or, optionally, by a local Enerlin'X Com'X when directly associated with EcoStruxure™ Asset Advisor. Therefore, no specific device for time synchronization is necessary.

Enerlin'X Com'X

Product, Software and Services: See page 177

Functional Breakdown of the Application (3/3)

Data Flow in Detail (cont.)

OUTPUTS

Display of Live Data, Alarms, Events and Trends is performed locally on the SMD HMI (except trends), remotely by EcoStruxure™ Power Monitoring Expert, Power SCADA 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 set point or calculated threshold (with color code)

Alarms & Events

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 (in MV applications only)

Additionally, sensors 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 SCADA Operation with the proper event notification Module (events, alarms through emails and SMS).

Trends

- The evolution of each measured value over time.

Reports

When EcoStruxure™ Power Monitoring Expert or Power SCADA 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 Analytics & Services

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

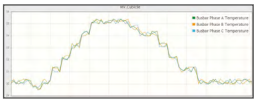
For Continuous Thermal Monitoring of assets, EcoStruxure™ Asset Advisor can provide analytics with condition-based, pro-active recommendations through periodic reports.

EcoStruxure™
Power Monitoring Expert

EcoStruxure™
Power SCADA Operation

EcoStruxure™
Power SCADA Operation
with Advanced
Reporting & Dashboards

SR2mod03



Temperature Trends

EcoStruxure™
Asset Advisor

Product, Software and Services: See page 177

Electrical Architecture (1/2)

Introduction

The following diagrams explain in which area of the architecture the devices should be installed, in order to implement the Continuous Thermal Monitoring Application.

Implementation for MV Switchgear (1) and Transformers

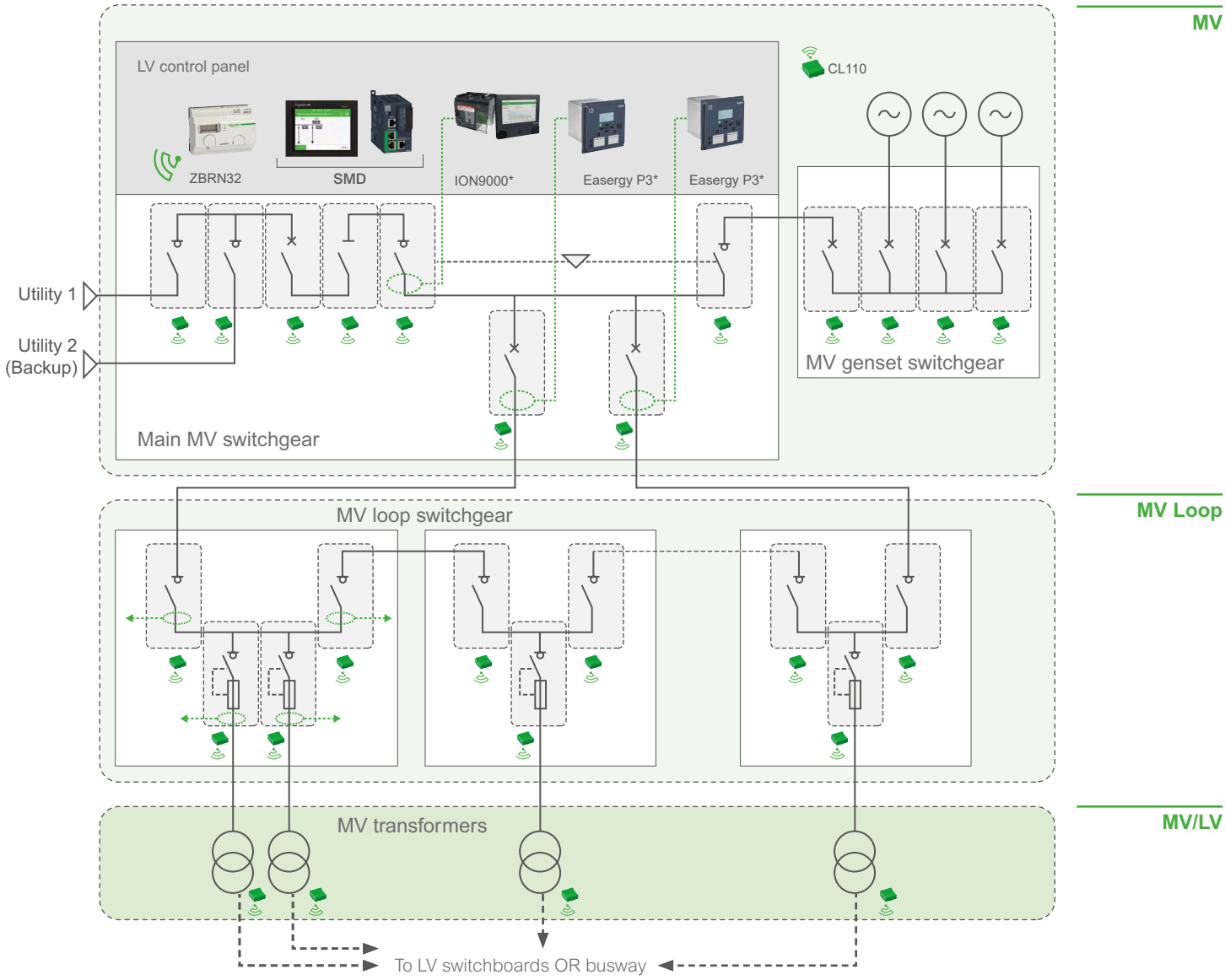
Depending on the switchgear configuration and transformers to monitor, the number of Easergy TH110 sensors, Sologate concentrators, current measurement points and SMD will have to be adapted.

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.

Comment about LV control panels

- Each MV Switchgear is associated to a LV control panel. For legibility reasons in the following diagram, the LV control panel has only been illustrated for the Main MV switchgear.
- An additional Thermal Monitoring Panel may be needed, depending on distance constraints and user needs.

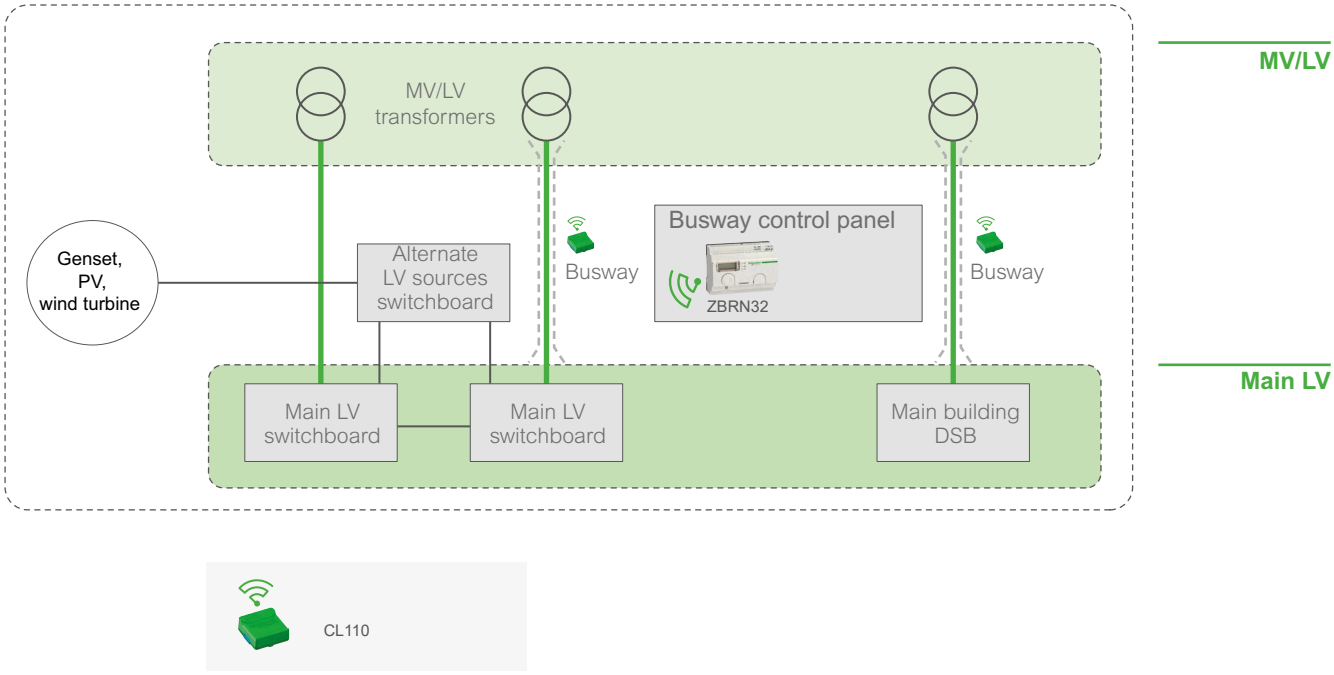


Electrical Architecture 2/2

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 Sologote Harmony ZBRN32 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.



Digital Architectures (1/5)

Introduction

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

- What data are 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?

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

Digital architecture feature comparison table

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

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

● Embedded
○ Available for MV thermal monitoring only
○ Available if GSM modem is installed
● Available if Events Notification Module is installed

* For MV thermal monitoring only, local monitoring is available with the SMD optional HMI. SMS notifications can be sent with a GSM Module

** Constraints on communication with sensors for busway

Comment: note that EcoStruxure™ Power SCADA Operation enables remote control on electrical installation, this may be an additional selection criteria to choose the best-fitted architecture.

Digital Architectures (2/5)

MV Digital Architectures

With Connected Products and Edge Control Software

EcoStruxure™ Power Monitoring Expert solution

The Continuous Thermal Monitoring application is available with EcoStruxure™ Power Monitoring Expert software. It provides live data, alarms & events and trends, as well as Thermal Monitoring predesigned graphics. It also enables reporting on thermal data through default reports.

EcoStruxure™ Power SCADA Operation solution

Continuous Thermal Monitoring application is available with EcoStruxure™ Power SCADA Operation software. In that case, it provides at edge level: live data, alarms & events and trends.

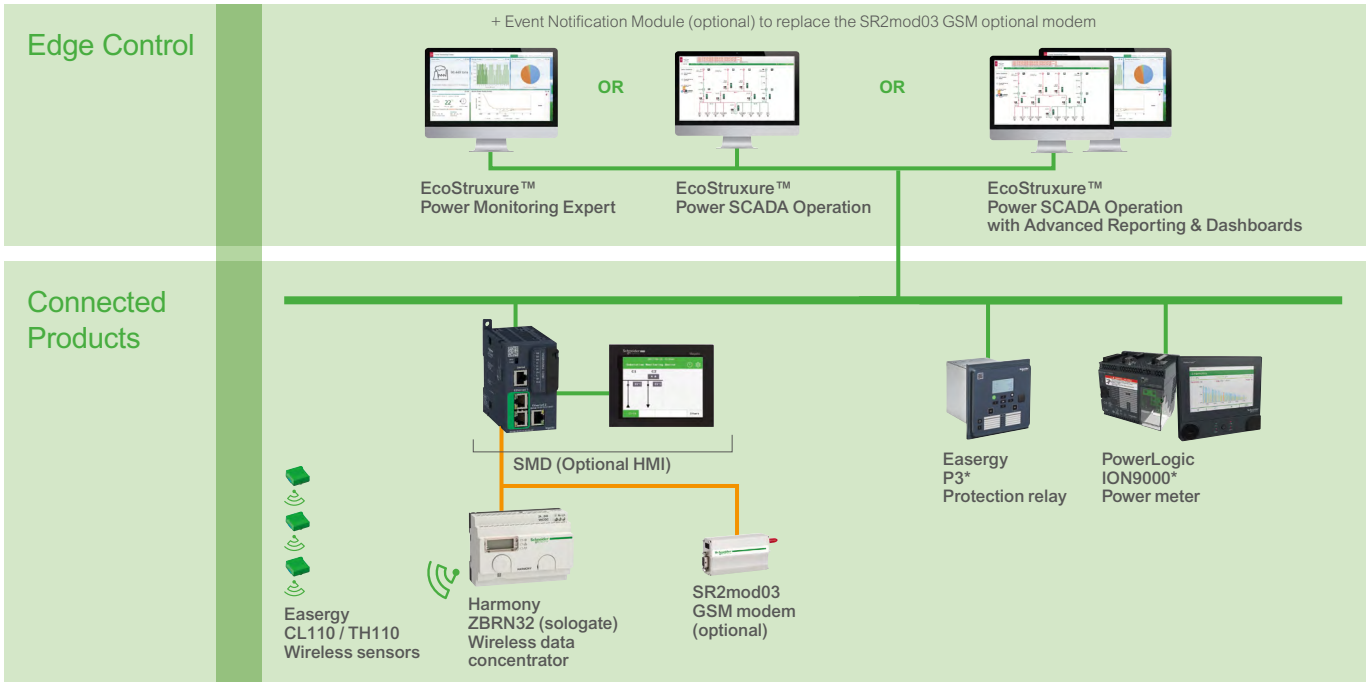
EcoStruxure™ Power SCADA Operation with Advanced Reporting & Dashboards solution

To embed EcoStruxure™ Power Monitoring Expert's features (in particular reports and dashboards) in an EcoStruxure™ Power SCADA Operation system, the solution is to purchase EcoStruxure™ Power SCADA Operation's Advanced Reporting & Dashboards option. It also enables reporting on thermal data through default reports.

HOW TO GET REMOTE NOTIFICATIONS?

For all three solutions, remote notifications can be sent either with the Event Notification Module option of EcoStruxure™ Power Monitoring Expert and Power SCADA Operation, or with a SR2mod03 modem connected to the SMD (with limited features: see table p. 63).

Here below is the recommended digital architecture for MV applications for EcoStruxure™ Power Monitoring Expert / Power SCADA Operation / Advanced Reporting & Dashboards applications:



* Or equivalent product

Ethernet - technical LAN
Serial
Wireless

Digital Architectures (3/5)

MV Digital Architectures (cont.)

With Connected Products and Remote Services

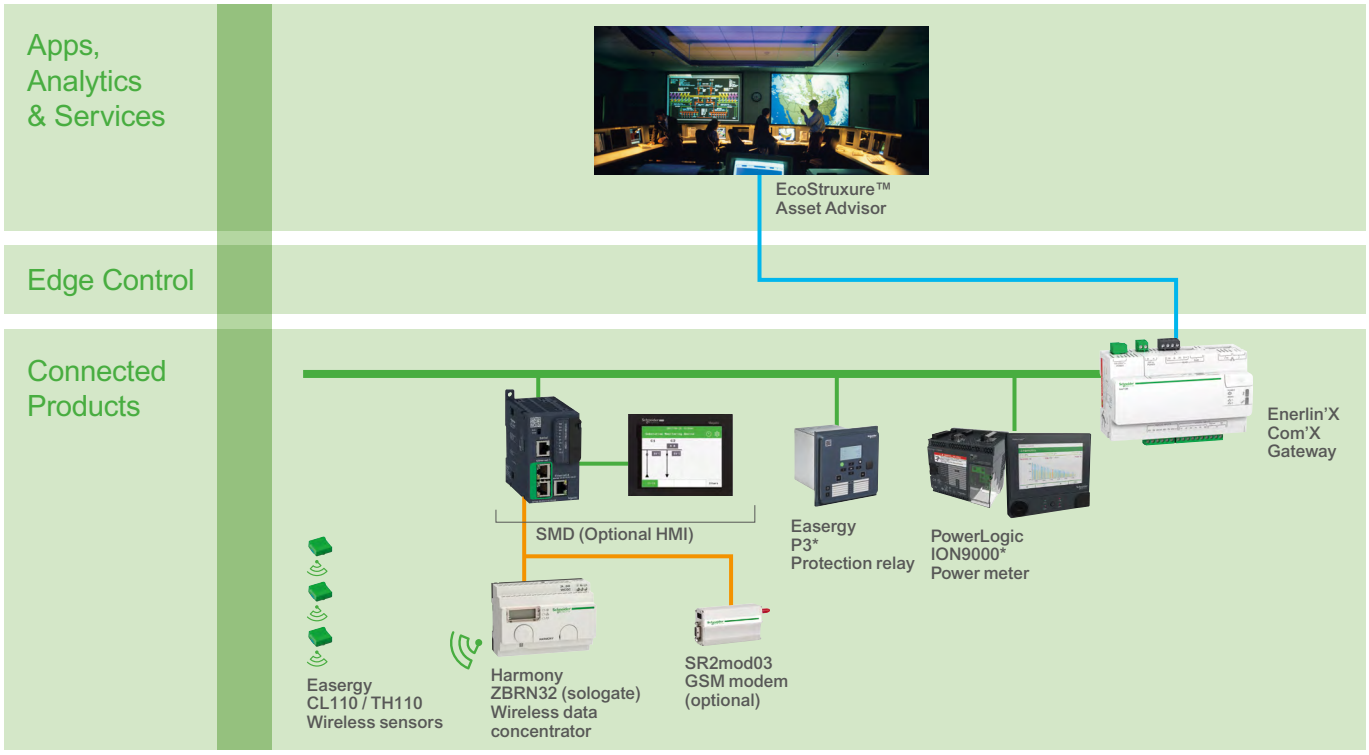
EcoStruxure™ Asset Advisor solution

Similar to the previous architecture, the data are collected from the thermal sensors using the Sologate data concentrator and passed onto the SMD (Substation Monitoring Device).

However, in this case data are now recorded using an Enerlin'x Com'X data logger and then passed onto the cloud based EcoStruxure™ Asset Advisor service offer.

EcoStruxure™ Asset Advisor uses temperature and environmental data to perform automatic, cloud based analytics.
A Schneider Electric service bureau provides consultative reporting and advisory on anomalies and proactively notifies the user (see illustrations opposite).

Here below is the recommended digital architecture for EcoStruxure™ Asset Asset Advisor in MV applications:



* Or equivalent product

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

Digital Architectures (4/5)

MV Digital Architectures (cont.)

With Connected Products, Edge Control Software and Remote Services

EcoStruxure™ Power Monitoring Expert + Asset Advisor solution

This solution combines onsite EcoStruxure™ Power Monitoring Expert capabilities as well as the cloud based monitoring and services of Asset advisor.

EcoStruxure™ Power SCADA Operation with Advanced Reporting & Dashboards + Asset Advisor solution

This solution provides EcoStruxure™ Power SCADA Operation with Advanced Reporting & Dashboards capabilities with the addition of cloud based monitoring and services of EcoStruxure™ Asset advisor.

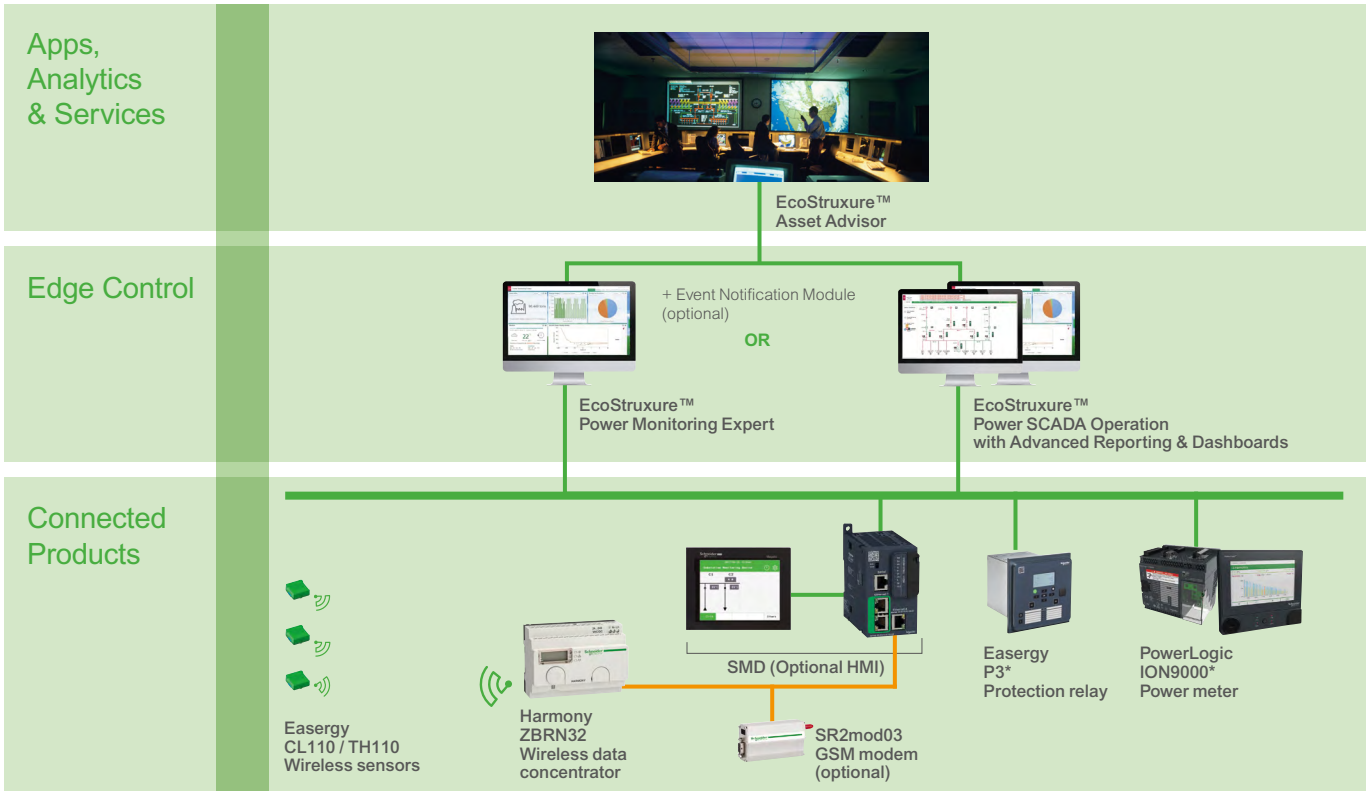
In this architecture, data logging is performed by EcoStruxure™ Power Monitoring Expert or the Advanced Reporting & Dashboards Module of EcoStruxure™ Power SCADA Operation and then passed to EcoStruxure™ Asset Advisor directly. Instead of leveraging an Enerlin'X Com'X to send the data to EcoStruxure™ Asset Advisor, Power Monitoring Expert or Advanced Reporting & Dashboards is taking its place.

HOW TO GET REMOTE NOTIFICATIONS?

EcoStruxure™ Asset Advisor offers periodic report notifications.

As an option for both solutions, remote notifications on alarms can be sent with the Event Notification Module option of EcoStruxure™ Power Monitoring Expert and Power SCADA Operation.

Below is the recommended architecture for MV applications where EcoStruxure™ Asset Advisor is getting its data from the Edge Control Layer (EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards).



* Or equivalent product

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

Digital Architectures (5/5)

Busway Digital Architecture

With Connected Products, Edge Control Software and Remote Services

Similar to architectures shown above, Busway Continuous Thermal Monitoring is relying on the Sologate Data concentrator to collect data from Easergy CL110 temperature sensors. However, as shown below SMD (Substation Monitoring device) is not used for data processing.

The reason for not needing an SMD is that for busway we have a single sensor per connection point, which makes data processing much simpler.

Similar to the MV architectures shown above, we have three scenarios for data visualization, reporting, alarming and service offer:

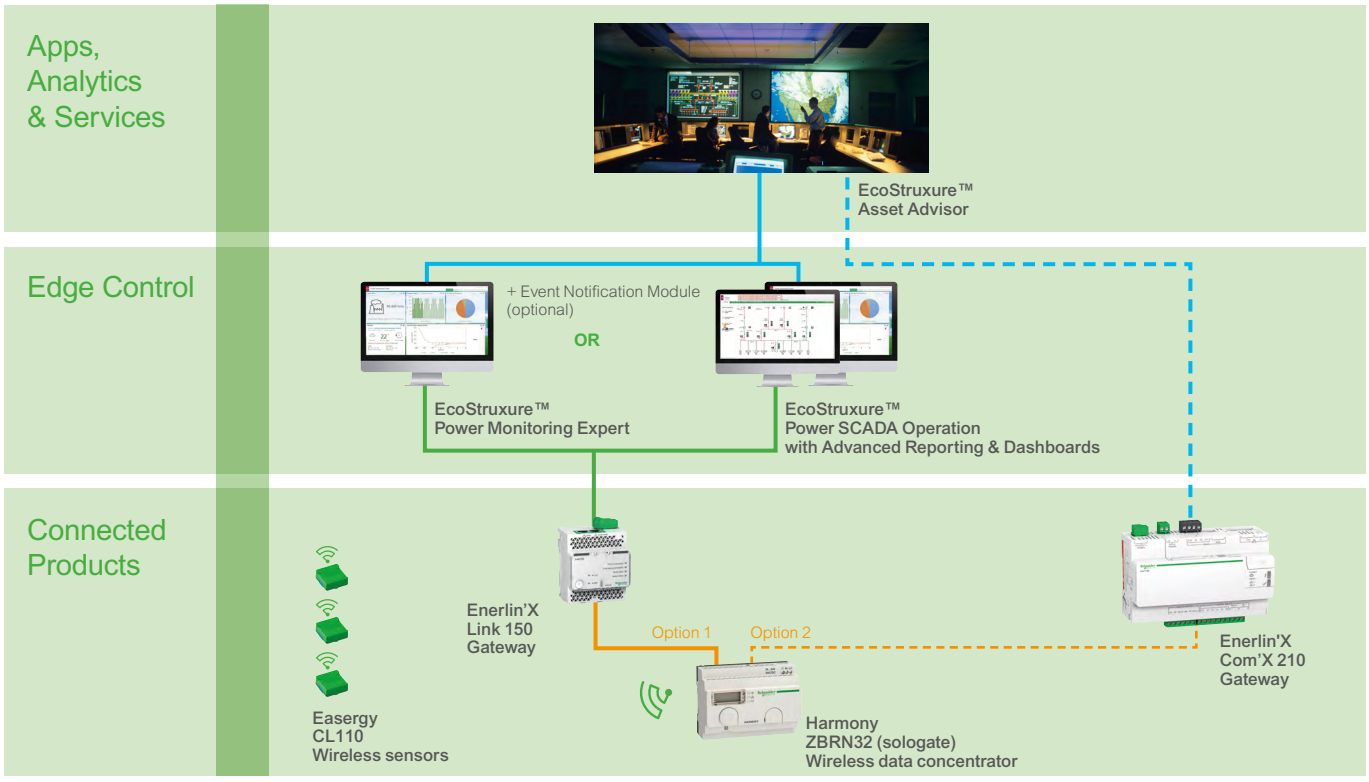
- Data are sent from Sologate to EcoStruxure™ Power Monitoring Expert or Power SCADA Operation.
  Optionally, data are forwarded by EcoStruxure™ Power Monitoring Expert (or Advanced Reporting & Dashboards) to EcoStruxure™ Asset Advisor.
- Data are sent from Sologate to EcoStruxure™ Asset Advisor via Enerlin'X Com'X.

HOW TO GET REMOTE NOTIFICATIONS AND REPORTING?

Same as for MV above, EcoStruxure™ Asset Advisor can provide dedicated reports and notifications based on Busway Continuous Thermal Monitoring data.

As an option for both solutions, remote notifications on alarms can be sent with the Event Notification Module option of EcoStruxure™ Power Monitoring Expert and Power SCADA Operation.

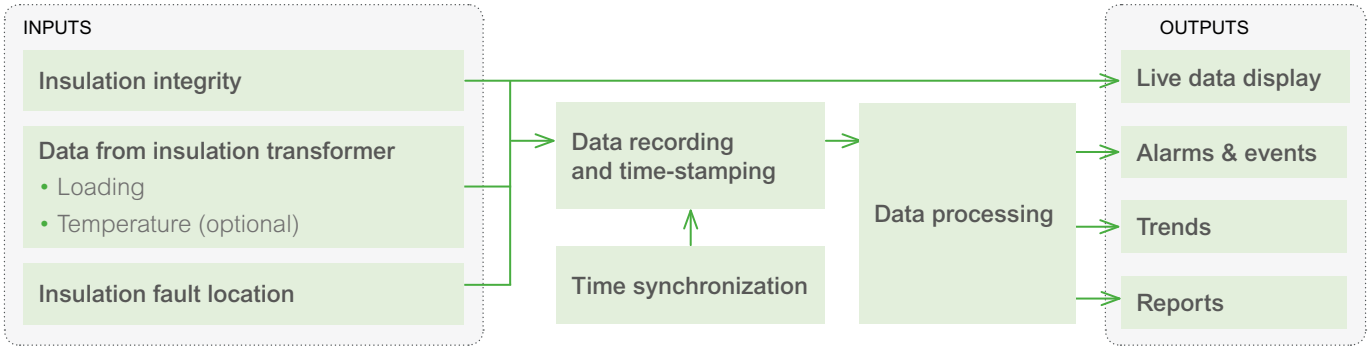
Below is the recommended architecture for Busway applications.
The three scenarios are combined in one diagram.



Functional Breakdown of the Application (1/2)

Data Flow

The Insulation Monitoring application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data are required, they are acquired from the Vigilohm IM20-H:

Vigilohm IM20-H

Insulation Integrity

- The integrity of the insulation of all downstream wiring

Isolation Transformer

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

In order to enable data processing, the isolation power transformer nameplate rating and impedance threshold are required to determine transformer percentage loading.

Insulation Fault Location

In case of an insulation fault, the location of the fault is indicated by the Vigilohm IFL12-H.


Vigilohm IFL12-H

DATA RECORDING AND TIME-STAMPING

The insulation integrity, transformer loading, and temperature, as well as the generated alarm/event data are recorded as historical values in the Edge Control Software (EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards).

The Vigilohm IM20-H records and time-stamps all insulation faults. Independently, the Vigilohm IFL12-H records and time-stamps the specific fault location(s).

TIME SYNCHRONIZATION

Time synchronization is performed by the Edge Control Software using the network.


TimeSync Clock

DATA PROCESSING

The insulation integrity, transformer loading and temperature are sent to EcoStruxure™ Power Monitoring Expert and Power SCADA Operation with Advanced Reporting & Dashboards for data processing. Here, the data is analyzed and converted to alarms and events.

Functional Breakdown of the Application (2/2)

Data Flow in Detail (cont.)

OUTPUTS

Display of outputs is performed locally by Vigilohm HRP or Vigilhom IMD LRDH for instant access to staff. Remote display and additional features are available with the Edge Control software EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboard.

Live Data Display

The following data are available natively:

- Insulation monitoring status (color code according to standard IEC 60364-7-710)
- Insulation monitoring absolute value (kOhm)

The following data are available with the Insulation Monitoring Module*:

- Default Isolated Panel diagrams

Alarms & Events

The following alarms can be raised by the Vigilohm IM20-H and IFL12-H:

- Insulation fault (visual & acoustic in operating rooms)
- Insulation fault location (per feeder/group of sockets)
- Transformer electrical fault (overload, overtemperature)

Trends

Any insulation monitoring parameter such as insulation integrity (kOhm) can be displayed as a trend in Edge Control software.

Reports*

The following report can be displayed or automatically sent by e-mail with the Insulation Monitoring Module:

Isolated Power report

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

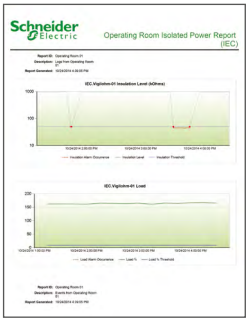
- Impedance graph - Displays a comparison of impedance measurements to the impedance threshold. The impedance threshold is a blue line and actual measurements are shown as a green line. A red line shows the time when the impedance dropped below the threshold.
- Transformer load graph - Displays a comparison 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.

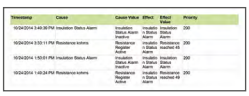
Vigilohm
HRP

Vigilohm
IMDLRDH

EcoStruxure™
Power Monitoring Expert

EcoStruxure™
Power SCADA Operation
with Advanced
Reporting & Dashboards





Isolated Power report

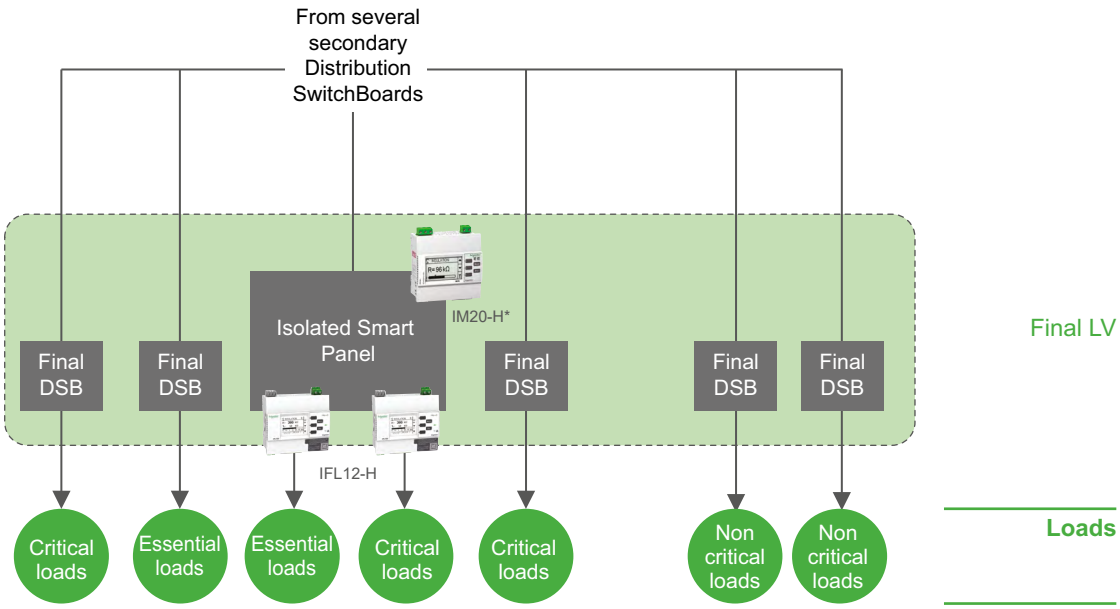
*The Insulation Monitoring Module of EcoStruxure™ Power Monitoring Expert and Power SCADA Operation with Advanced Reporting & Dashboards must be deployed to benefit from these features.

INSULATION MONITORING

Electrical architecture

Vigilohm IM20-H serves as the central insulation monitoring device to monitor the network insulation. Fault locators (IFL12-H) are installed on each feeder to identify the faulty circuit.

The following diagram explains in which area of the architecture the devices should be installed, in order to implement the Insulation Monitoring application.



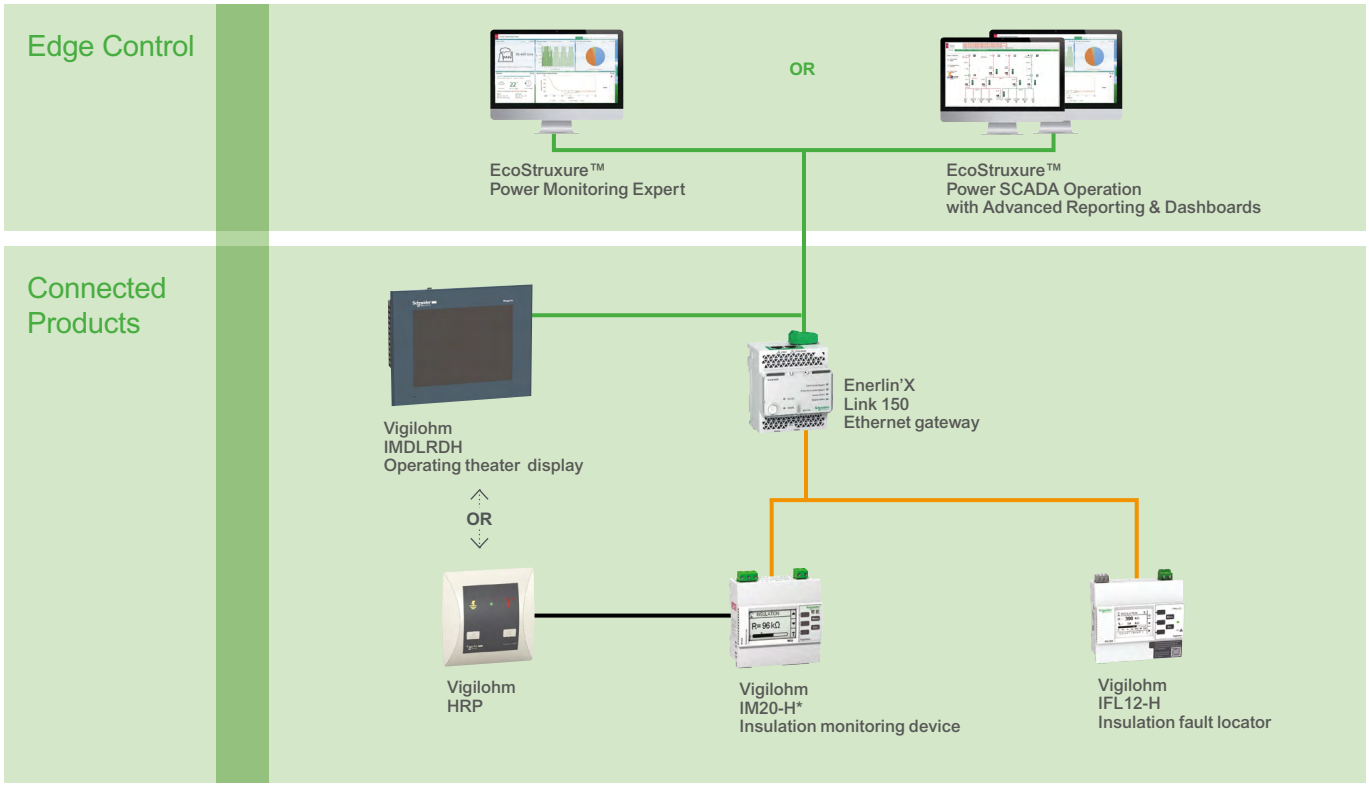
DSB = Distribution Switchboard

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

Digital architecture

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

Here below is the recommended digital architecture for the Insulation Monitoring application:



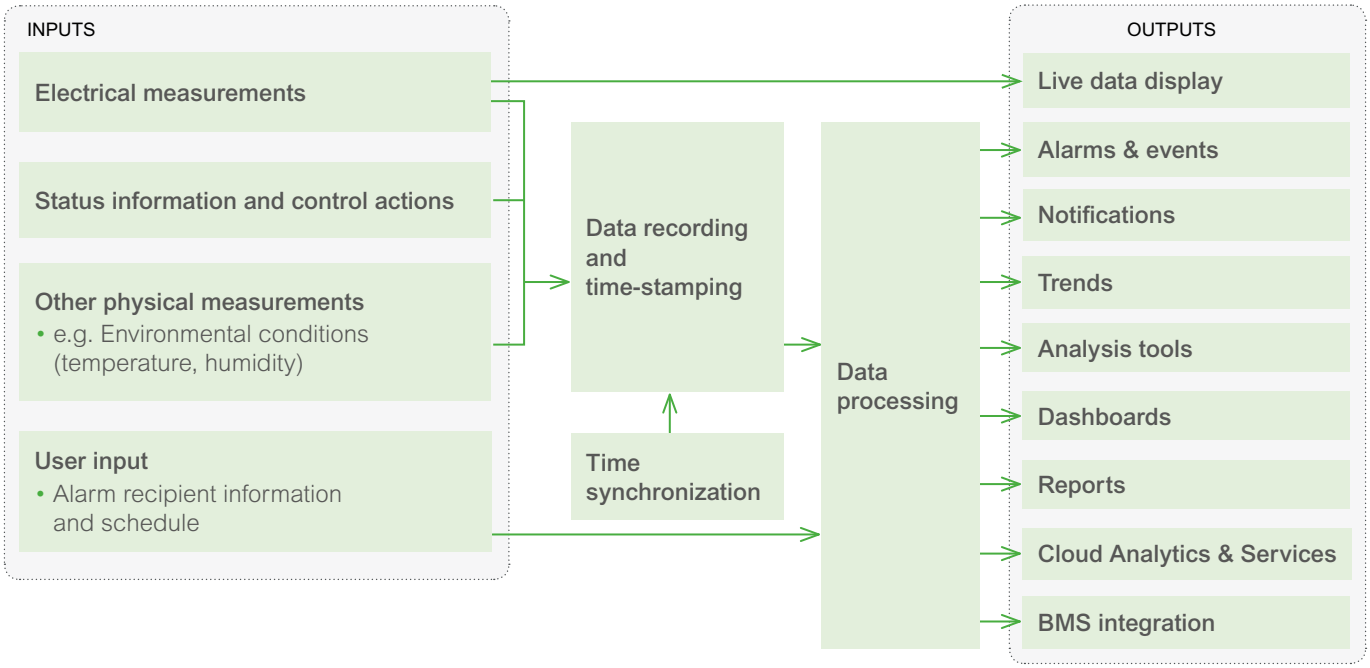
* In non Healthcare applications, the IM400 can be used (e.g. Marine, Industrial)

Ethernet - technical LAN
Serial
Hardwired

Functional Breakdown of the Application (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 on-site 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, Acti9 iEM3000, Acti9 PowerTag, Compact PowerTag NSX)
- protection devices such as Masterpact MTZ, Easergy P3 or SEPAM relays, Compact NSX
- or other equipment such as UPS (Galaxy VM/VX, Galaxy 5000), ATS controller (Easergy T300), Power Correction equipment (AccuSine PCS+, VarSet with Varplus Logic controller)
- Other equipment (see comment below)

EcoStruxure™ Power Monitoring Expert and Power SCADA Operation offer native support for a wide range of connected products as well as support for open protocols for communication to 3rd party equipment.


PowerLogic ION9000


PowerLogic PM5000


Acti9 PowerTag


Compact PowerTag NSX


Easergy P3


Masterpact MTZ with Micrologic X


Galaxy UPS


Easergy T300


AccuSine PCS+


VarPlus VarPlus Logic

Product, Software and Services: See page 177

Functional Breakdown of the Application (2/6)

Data Flow in Detail (cont.)

INPUTS (cont.)

Electrical Measurements

The following electrical measurements are collected from connected products (actual 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 like 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 SCADA Operation
with Advanced
Reporting & Dashboards

Product, Software and Services: See page 177

Functional Breakdown of the Application (3/6)

Data Flow in Detail (cont.)

DATA RECORDING AND TIME-STAMPING

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 time-stamped on board: PowerLogic ION9000, PM8000 (as well as legacy devices such as PowerLogic ION7650/7550) and some models of the PowerLogic PM5000 (PM53xx and PM55xx)
- Event data recorded and time-stamped on-board: Easergy P3, SEPAM, Masterpact MTZ, Compact NSX
- No onboard recording, real-time data only. Recording and time-stamping is done by a data logger (Cyber Sciences SER 3200/2408) or software (EcoStruxure™ Power Monitoring Expert or Power SCADA Operation): Lower end models of PowerLogic PM5000, Acti9 iEM3000, PowerTag, UPS, AccuSine PCS+, VarSet with Varplus Logic controller and other equipment (including third party)

To have the full view of device recording and time-stamping capabilities, refer to chart 2.2 in Part 2, page 46.

For the Electrical Distribution Monitoring & Alarming application, time accuracy of +/- 10 ms is recommended, in particular for highly critical applications. For less critical applications, 1 s is acceptable.


PowerLogic ION9000


PowerLogic PM8000


Easergy P3


Masterpact MTZ with Micrologic X


Cyber Sciences SER 3200 / 2408

TIME SYNCHRONIZATION

For system-wide electrical distribution monitoring & alarming, it is important to have consistent time-stamping. 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 is required and may be connected to a GPS antenna to reach the expected time precision.


TimeSync Clock

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 SCADA Operation or onboard some sophisticated devices.

Product, Software and Services: See page 177

Functional Breakdown of the Application (4/6)

Data Flow in Detail (cont.)

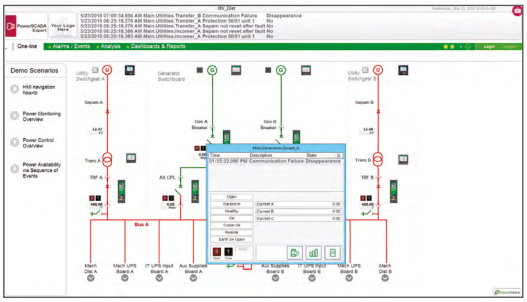
OUTPUTS

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 SCADA Operation) in various forms such as:

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



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

Detailed Diagrams

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

Device Diagram in EcoStruxure™ Power Monitoring Expert

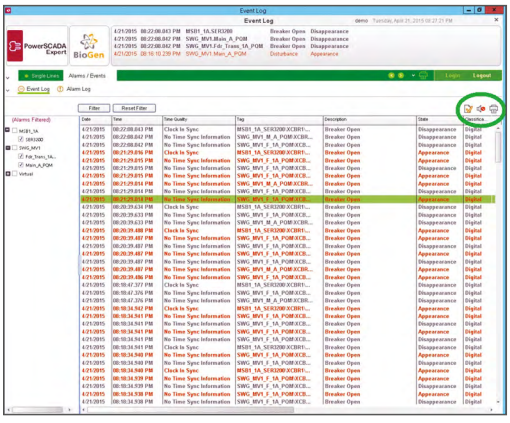
Alarms & Events

Event Log Viewers

Alarms and events are uploaded from devices or generated by the Edge Control software (EcoStruxure™ Power Monitoring Expert or Power SCADA Operation) and visualized 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 time-stamp



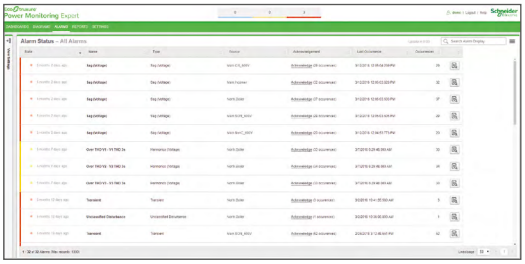
Events Log viewer in EcoStruxure™ Power SCADA Operation

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 the Power Event Analysis application).

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

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



Alarm Log viewer in EcoStruxure™ Power Monitoring Expert

Functional Breakdown of the Application (5/6)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

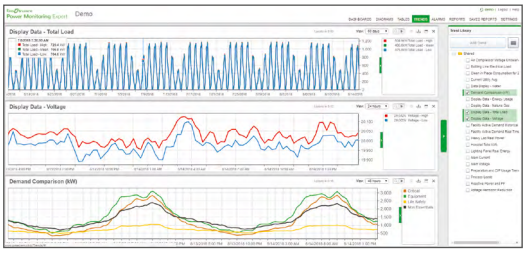
Notifications

Alarm notifications available with the optional Event Notification Module for EcoStruxure™ Power Monitoring Expert and Power SCADA 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.

Trends

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



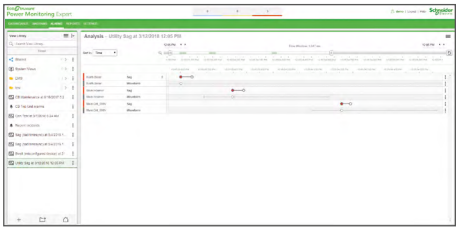
Real-Time trending in EcoStruxure™ Power Monitoring Expert

Analysis Tools

Power Events Incident Timeline

This feature of EcoStruxure™ Power Monitoring Expert 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 see the Power Events Analysis Application page 99



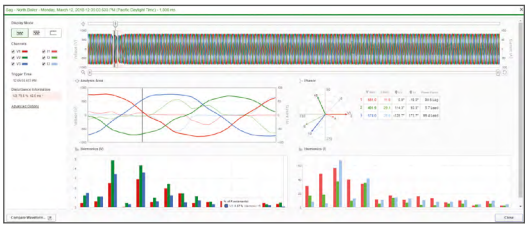
Power Events Incident Timeline

Waveform viewer

Electrical signal waveforms can be visualized with a native waveform viewer in both EcoStruxure™ Power Monitoring Expert and Power SCADA 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
- Allow multiple waveforms to be compared to each other



Waveform viewer

Functional Breakdown of the Application (6/6)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Dashboards

In addition to specialized dashboards, any historical data from the system can be visualized in graphical dashboard gadgets in EcoStruxure™ Power Monitoring Expert or Power SCADA 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.

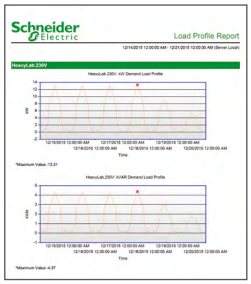
Dashboards

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 SCADA 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 or multiple trend report
- Single or multiple device usage
- Tabular report
- Load profile report
- Event history report

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



Load profile report

Event history report

Cloud 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:

- Abnormally high, low or unbalanced Voltage levels, based on industry standard practices
- Transformer Over Capacity
- Excessive Voltage Harmonics
- Poor Power Factor

EcoStruxure™ Power Advisor

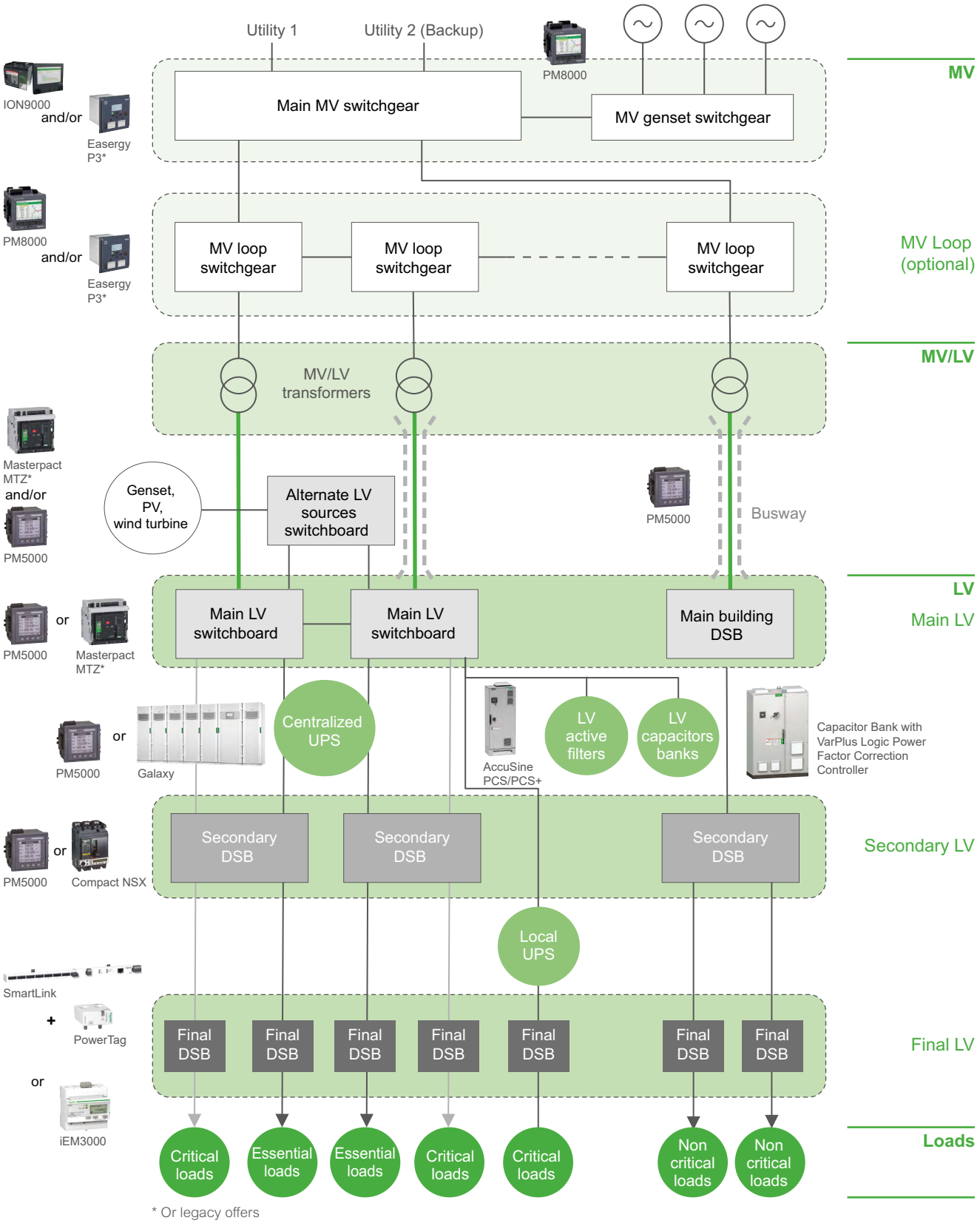
BMS Integration

EcoStruxure™ Energy Expert, a module of EcoStruxure™ Building Operation, enables real-time and historical electrical data visualization, dashboards and reporting.

EcoStruxure™ Building Operation

Electrical Architecture

The following diagram explains in which area of the architecture the connected products should be installed, in order to implement the Electrical Distribution Monitoring & Alarming application.

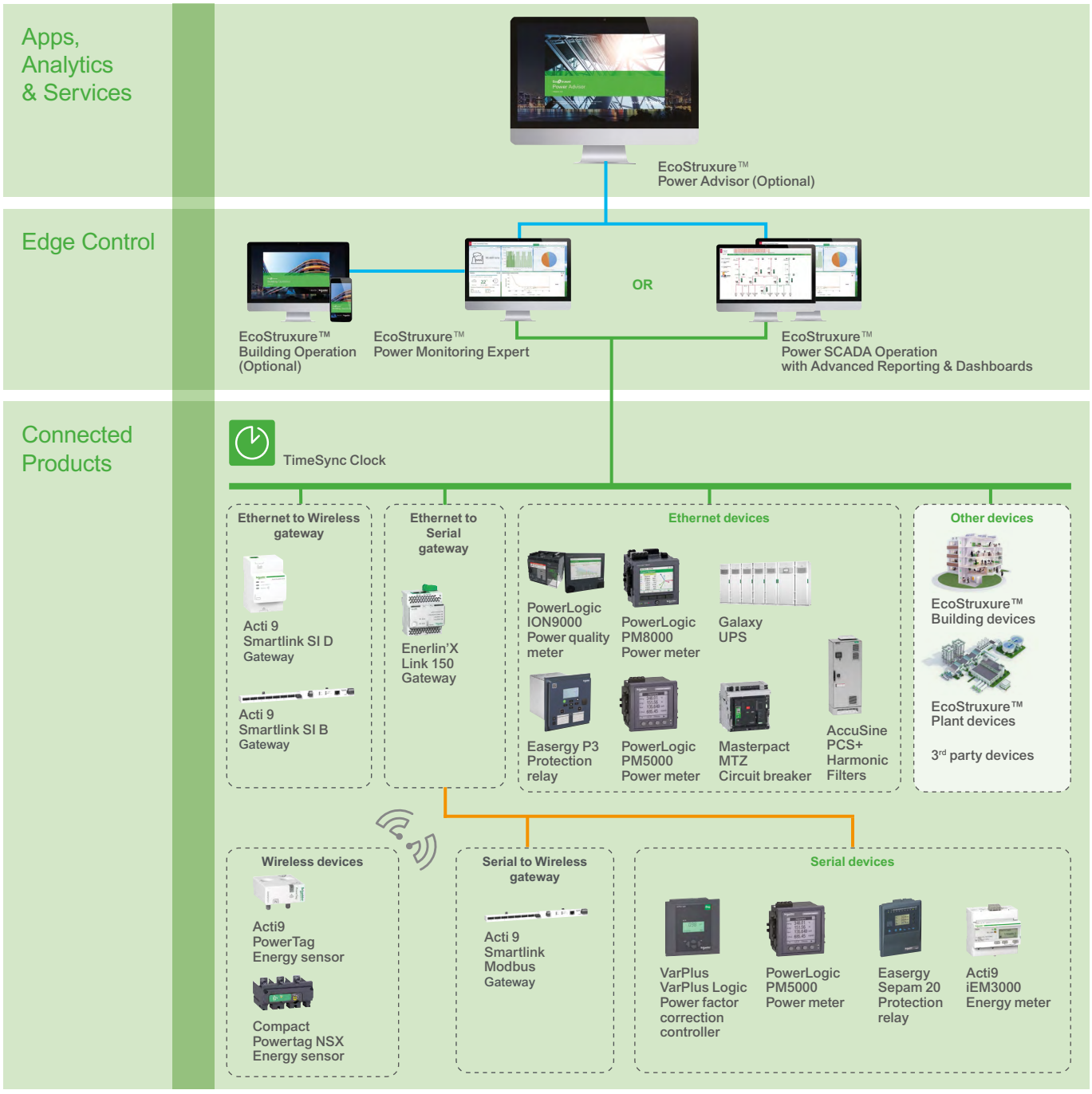


Digital Architecture

The digital architecture of the Electrical Distribution Monitoring & Alarming application consists in collecting the input data from the different products, either directly over Ethernet or via gateways. These data are then used by the Edge Control (EcoStruxure™ Power Monitoring Expert or Power SCADA Operation) for on-premise visualization analysis and reporting.

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

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

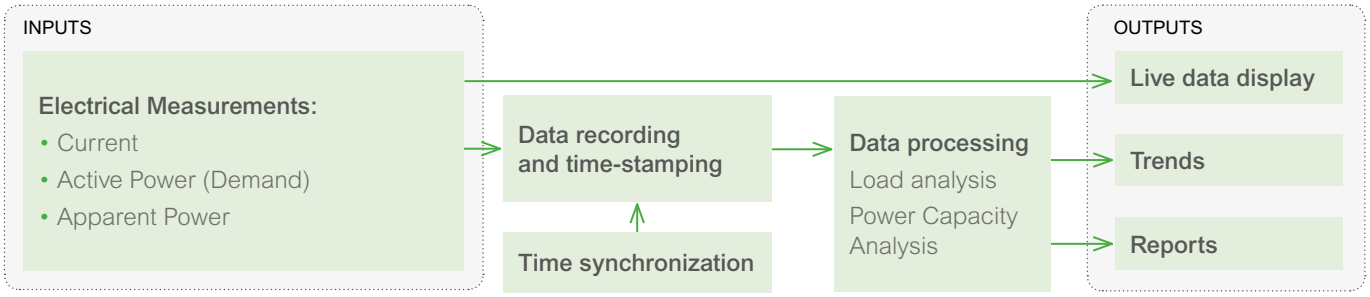


Ethernet - public LAN/WAN
Ethernet - technical LAN
Serial
Wireless

Functional Breakdown of the Application (1/3)

Data Flow

The Capacity Management Application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data are 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, Acti9 iEM3000, Acti9 PowerTag and Compact PowerTag NSX.

Embedded metering in circuit breakers such as the Masterpact MTZ, Compact NSX, MV protection relays such as Easergy P3 (or legacy offer like SEPAM) or Galaxy VM/VX are also suitable to provide the required electrical measurements.


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


Acti9 iEM3000


Acti9 PowerTag


Compact PowerTag NSX


Masterpact MTZ with Micrologic X


Compact NSX with Micrologic


Easergy P3


Easergy Sepam


Galaxy VM/VX

DATA RECORDING AND TIME-STAMPING

For the Capacity Management application, a time-stamp accuracy of +/- 1s 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 (as well as legacy devices such as PowerLogic ION7650/7550) and some models of the PowerLogic PM5000 (PM53xx and PM55xx) can timestamp and record onboard input data.

For other devices (Easergy P3, Masterpact MTZ, lower end models of PowerLogic PM5000, PowerTag range) measurements are performed by the devices and recorded by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation.

To have the full view of device recording and time-stamping capabilities, refer to chart 2.2 in Part 2, page 46.

Note: For devices without onboard logging, there is a risk of data loss in case of communications failure.

Product, Software and Services: See page 177

Functional Breakdown of the Application (2/3)

Data Flow in Detail (cont.)

TIME SYNCHRONIZATION

To achieve accurate time-stamping of all power and energy data, 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 SCADA Operation with Advanced Reporting & Dashboards.

Load Analysis

For the 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 warn about potential overloading.

For an Automatic Transfer Switch (ATS) or other equipment, peak load is compared with the rated capacity of the equipment to warn 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 SCADA Operation with
Advanced Reporting & Dashboards

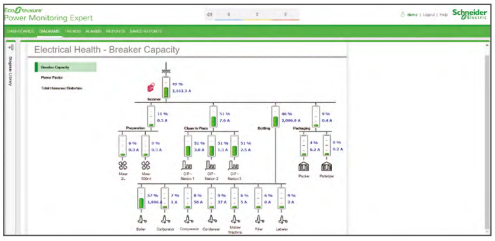
OUTPUTS

Display of outputs is performed by EcoStruxure™ Power Monitoring Expert or Power SCADA 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



Capacity Management diagram

Product, Software and Services: See page 177

Functional Breakdown of the Application (3/3)

Data Flow in Detail (cont.)

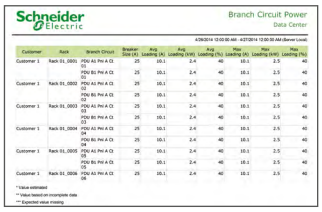
OUTPUTS (cont.)

Reports

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

Branch Circuit Power Report

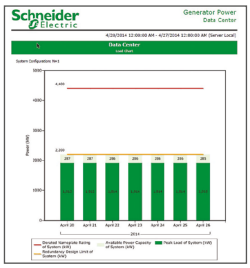
Monitor the capacity of branch circuits. Analyze IT branch circuit power loading. Understand remaining capacity at the branch circuit level – primarily for data center applications. Specific measurements required are Active Power (kW) and Current (A).

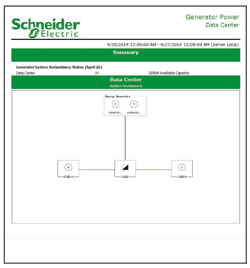


Branch Circuit Power report

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).

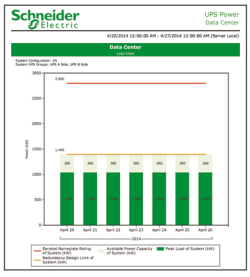


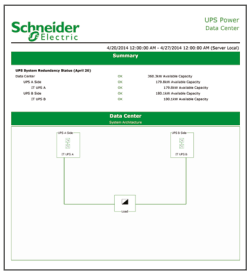


Generator Power report

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).

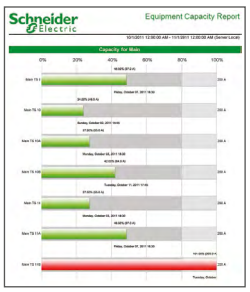


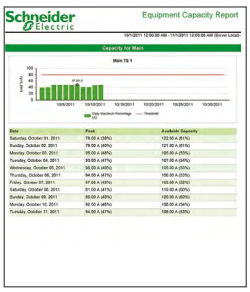


UPS Power report

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).

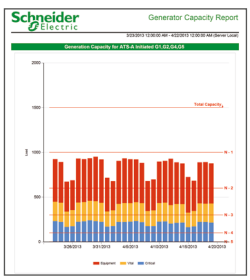




Equipment Capacity report

Generator Capacity Report

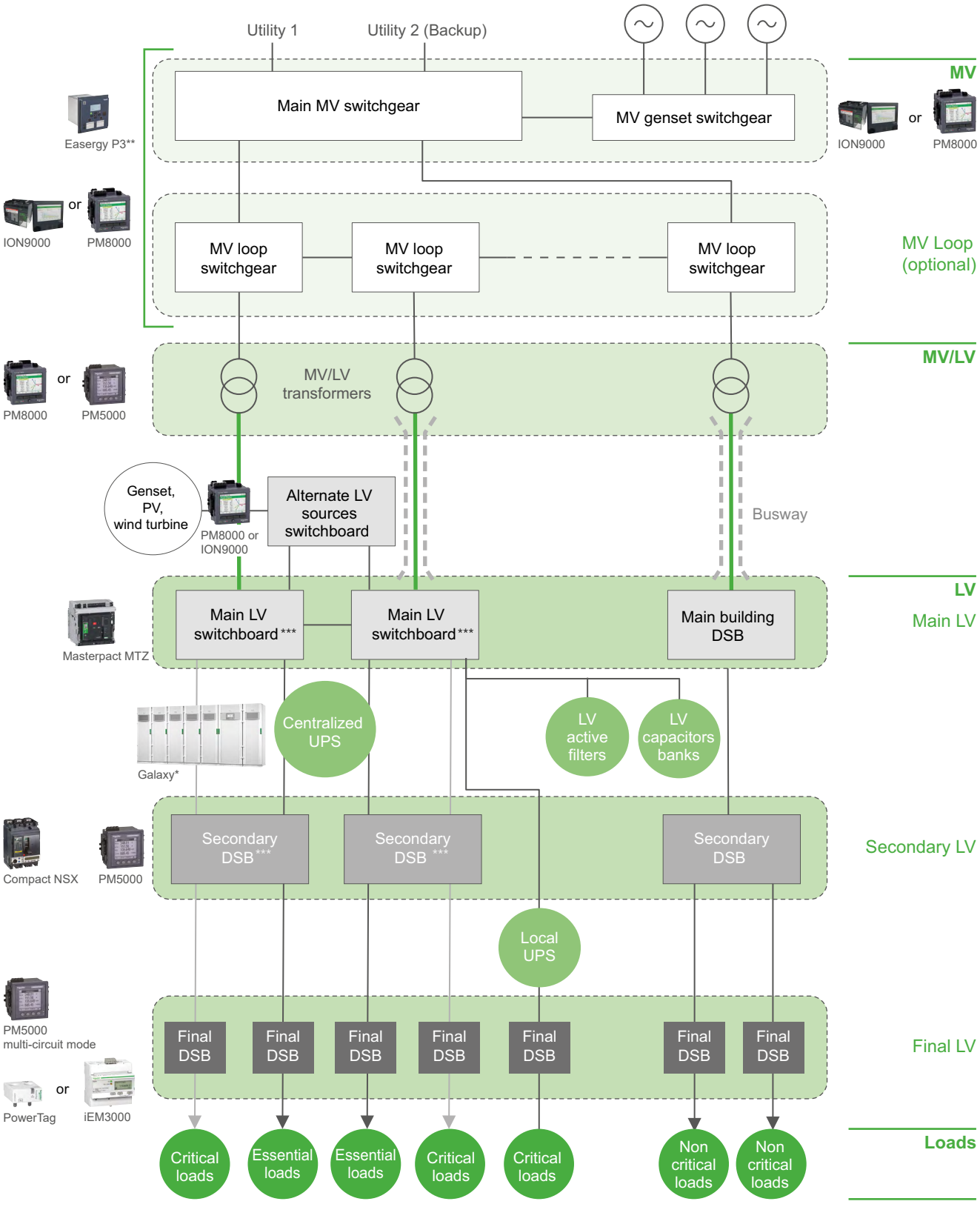
Helps verify that the generators can adequately support the loads required during a utility outage. Specific measurements required are Active Power (kW) or Apparent Power (kVA).



Generator Capacity report

Electrical Architecture

The following diagram explains in which area of the electrical architecture the devices should be installed, in order to implement the Capacity Management application.



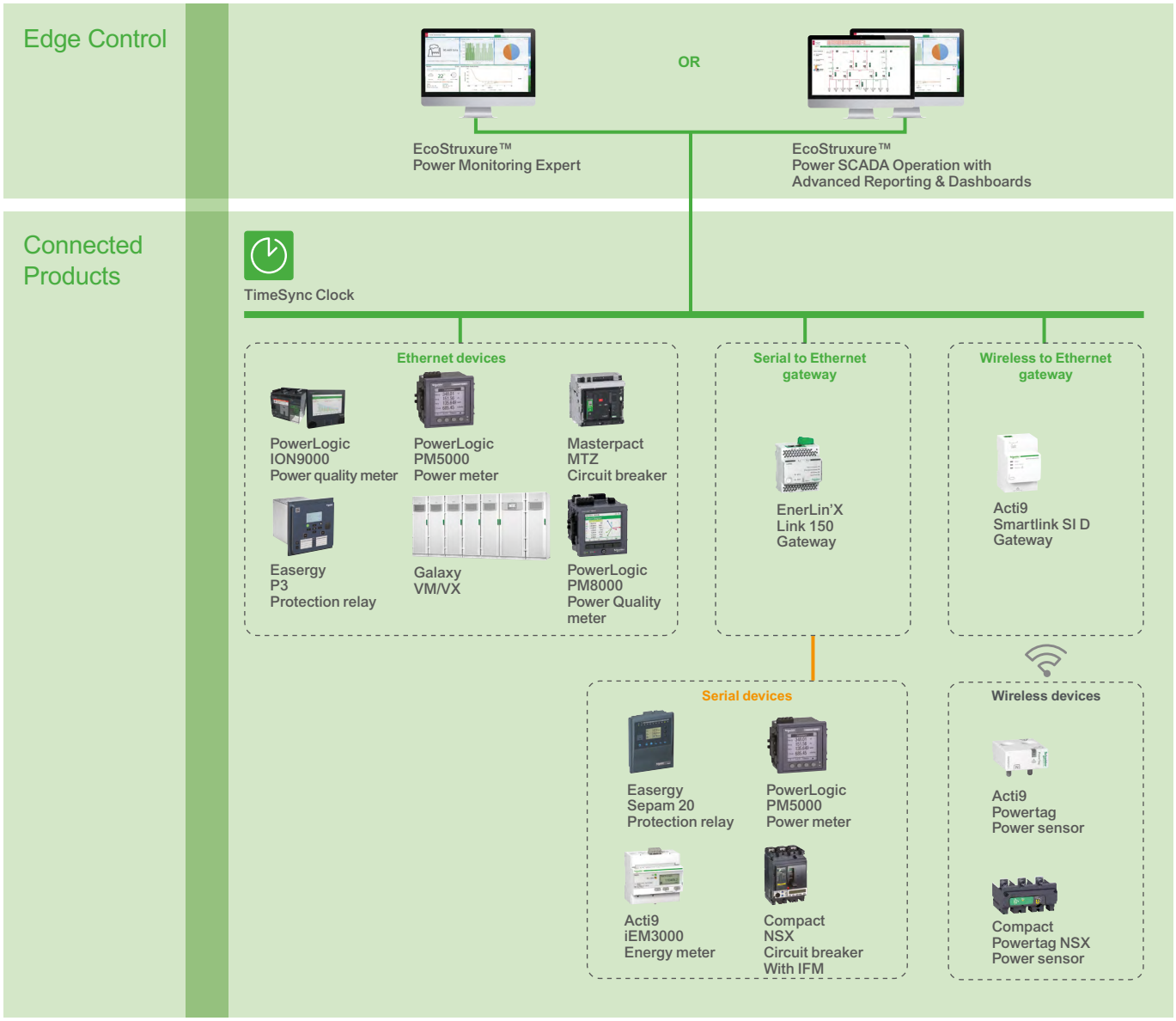
* Galaxy VM / VX is preferred, but Galaxy 5000 or Symmetra MW are also acceptable.
** Or legacy offers (e.g.: Sepam).
*** ATS is not represented but data can be acquired through inputs on the power meter.

DSB = Distribution Switchboard

Digital architecture

The digital architecture of the Capacity Management application uses recommended 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.

Here below is the recommended digital architecture for the Capacity Management application:

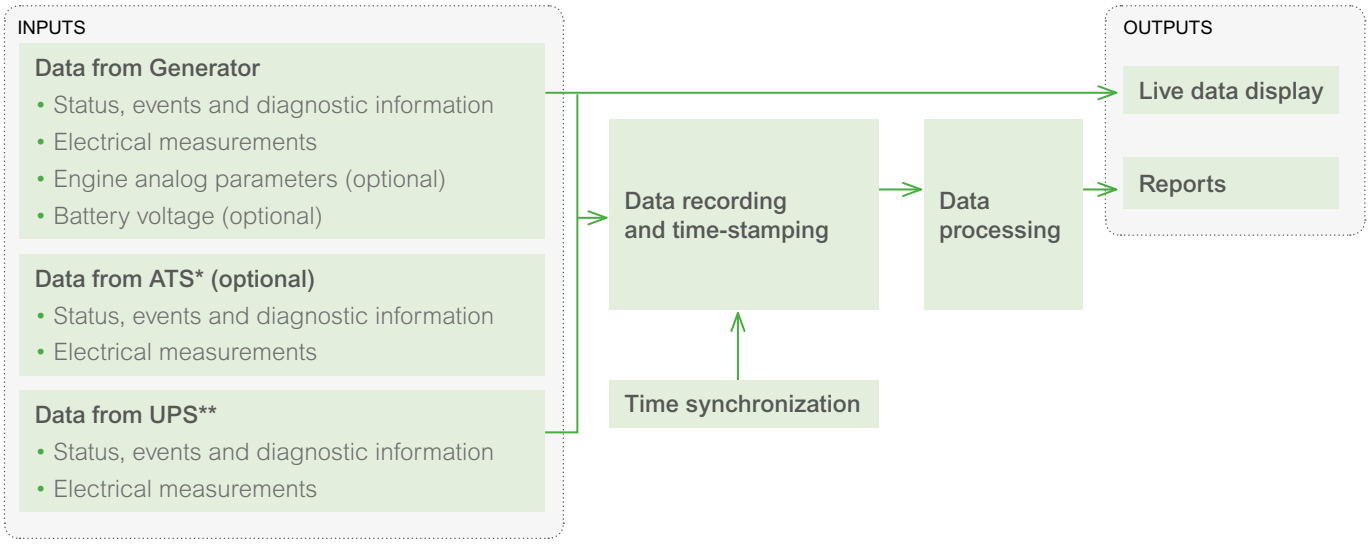


Ethernet - technical LAN
Serial
Wireless - 2,4 GHz

Functional Breakdown of the Application (1/5)

Data Flow

The Backup Power Testing application and Regulatory Compliance applications have a similar implementation which can be broken down as follows:



Data Flow in Detail

INPUTS

The following data are 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

These 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 P3/Masterpact MTZ embedded metering.

* ATS: Automatic Transfer Switch
** UPS: Uninterruptible Power Supply


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


Cyber Sciences SER 3200 / 2408


Easergy P3


Masterpact MTZ with Micrologic X

Product, Software and Services: See page 177

Functional Breakdown of the Application (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

These 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).


Easergy T300


Cyber Sciences SER 3200 / 2408


PowerLogic PM5000


PowerLogic ION9000


PowerLogic PM8000

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**

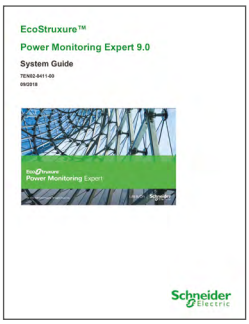
These input data are provided by the UPS (Galaxy VM/VX or Galaxy 5000 series).


Galaxy VM/VX

DATA RECORDING AND TIME-STAMPING

Advanced meters such as the PowerLogic ION9000, PM8000 (as well as legacy connected products such as ION7650/7550) and some models of the PM5000 (PM53xx and PM55xx) can record onboard input data, energy measurements as well as connected equipment states.

For other connected products (Easergy P3, Masterpact MTZ, lower end models of PM5000) measurements are performed by the connected products and recorded by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation.



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

Time-stamping Requirements for Backup Generator & ATS*

Due to the accuracy requirements of the Backup Power (EPSS***) Testing Reports, it is necessary to have all status data recorded with high time precision. Depending on jurisdiction, this is typically better 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 (EPSS*) Module in the EcoStruxure™ Power Monitoring Expert System Guide.

The following meters support this framework: PowerLogic ION9000 and PM8000 (and legacy ION7650 and ION7550).

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


Cyber Sciences SER 3200 / 2408

Time-stamping Requirements for UPS**

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

To have the full view of device recording and time-stamping capabilities, refer to chart 2.2 in Part 2, page 46.

Product, Software and Services: See page 177

Functional Breakdown of the Application (3/5)

Data Flow in Detail (cont.)

TIME SYNCHRONIZATION

To have a consistent chronological view of all events which happen throughout the facility, date and time should be accurately distributed to connected products and other Management Systems.

TimeSync Clock

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.

DATA PROCESSING

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 EPSS*** conformance tests, all success criteria are examined to provide a comprehensive fail/pass status

For the UPS**

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

- If it has auto-test capabilities, (e.g.: Galaxy VM, Galaxy VX, and MGE 5500 UPS), the module will gather all data relative to 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 SCADA Operation with Advanced Reporting & Dashboards.

EcoStruxure™
Power Monitoring Expert

EcoStruxure™
Power SCADA Operation
with Advanced
Reporting & Dashboards

* ATS: Automatic Transfer Switch
** UPS: Uninterruptible Power Supply
*** EPSS: Emergency Power Supply System

Product, Software and Services: See page 177

Functional Breakdown of the Application (4/5)

Data Flow in Detail (cont.)

OUTPUTS

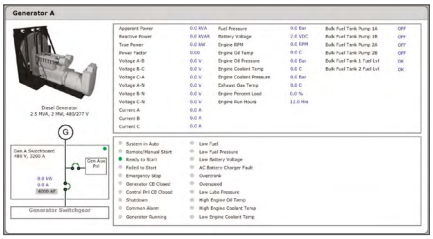
Display of outputs is performed remotely by the Edge Control software EcoStruxure™ Power Monitoring Expert or EcoStruxure™ Power SCADA Operation with Advanced Reporting & Dashboards.

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 (EPSS***) operator diagram helps monitoring 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



Operator interface

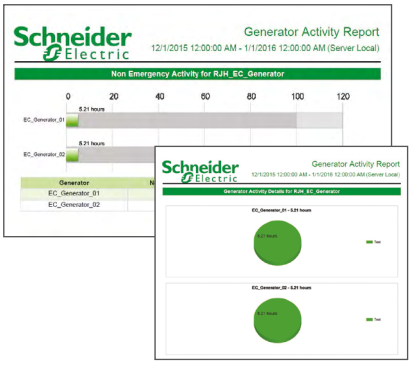
Reports

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

Backup Power Management reports

Generator Activity report

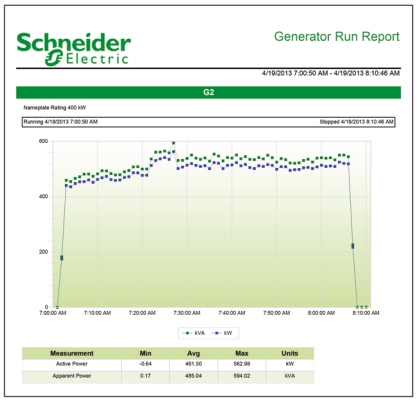
It shows the test run hours and other test run data for each generator in the selected group.



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
*** EPSS: Emergency Power Supply System

Functional Breakdown of the Application (5/5)

Data Flow in Detail (cont.)

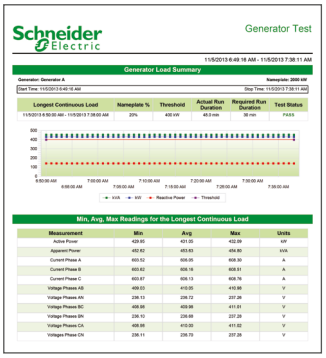
OUTPUTS (cont.)

Reports (cont.)

Backup Power Management reports (cont.)

Generator Test (EPSS***) report

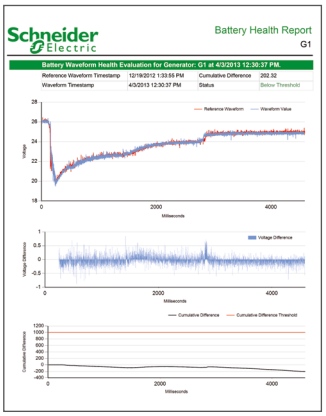
- Provides a standard methodology for testing the generators and provides a detailed report of the generator operation during the test.
- Can also be configured to conform to the requirements for an Emergency Power Supply System (EPSS***) test, including Automatic Transfer Switches (ATS*). For example, 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 Test (EPSS***) report

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, ION7550, ION7650) only.

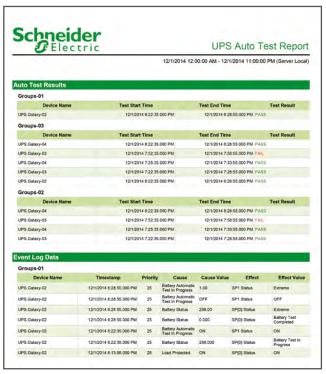


Generator Battery Health report

Uninterruptible Power Supply reports

UPS** Auto-Test report

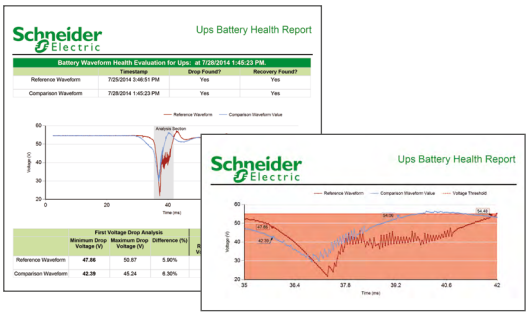
Provides information regarding the battery health of your Galaxy VM, Galaxy VX, and MGE 5500 UPS devices.



UPS** Auto-Test report

UPS** Battery Health report (For 3rd 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, ION7550, ION7650) only.
MGE 5500 UPS devices.



UPS** Battery Health report (For 3rd party UPS)

* ATS: Automatic Transfer Switch
** UPS: Uninterruptible Power Supply
*** EPSS: Emergency Power Supply System

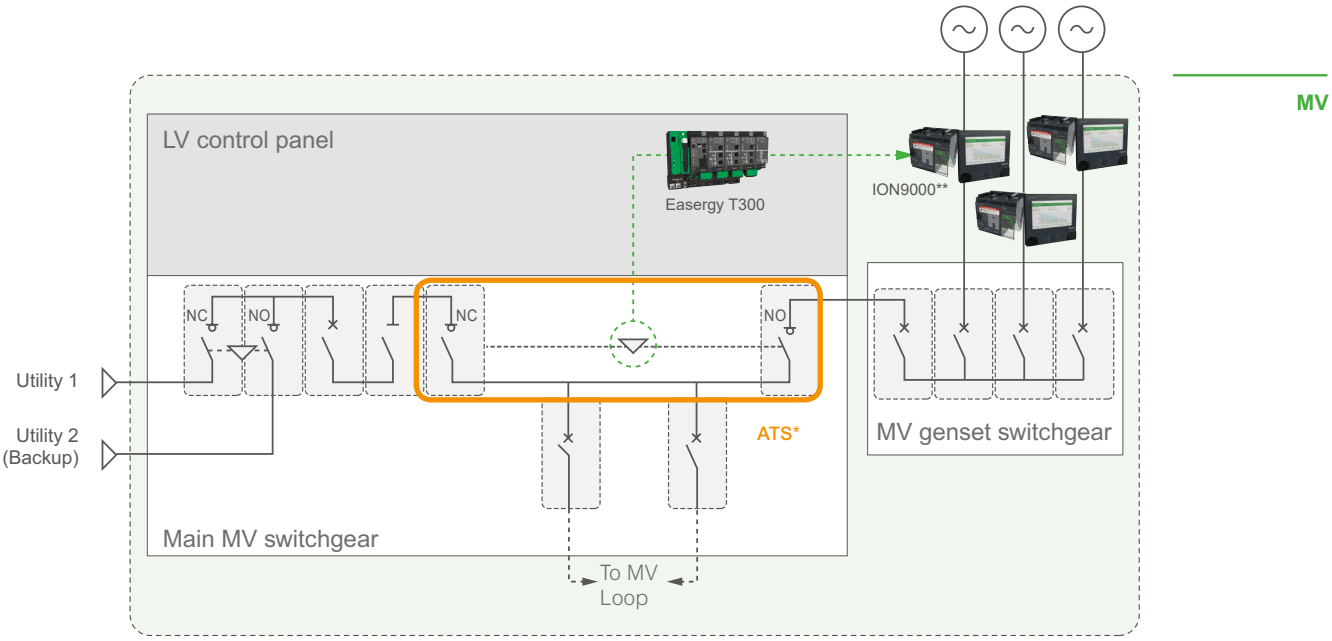
Electrical architecture (1/2)

Introduction

The implementation of the Backup Power Testing and Regulatory Compliance applications is different whether the generator is a MV or a LV system.
The following diagrams explain in which area of the architecture the connected products should be installed for both configurations.

Medium Voltage Generator Architecture

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



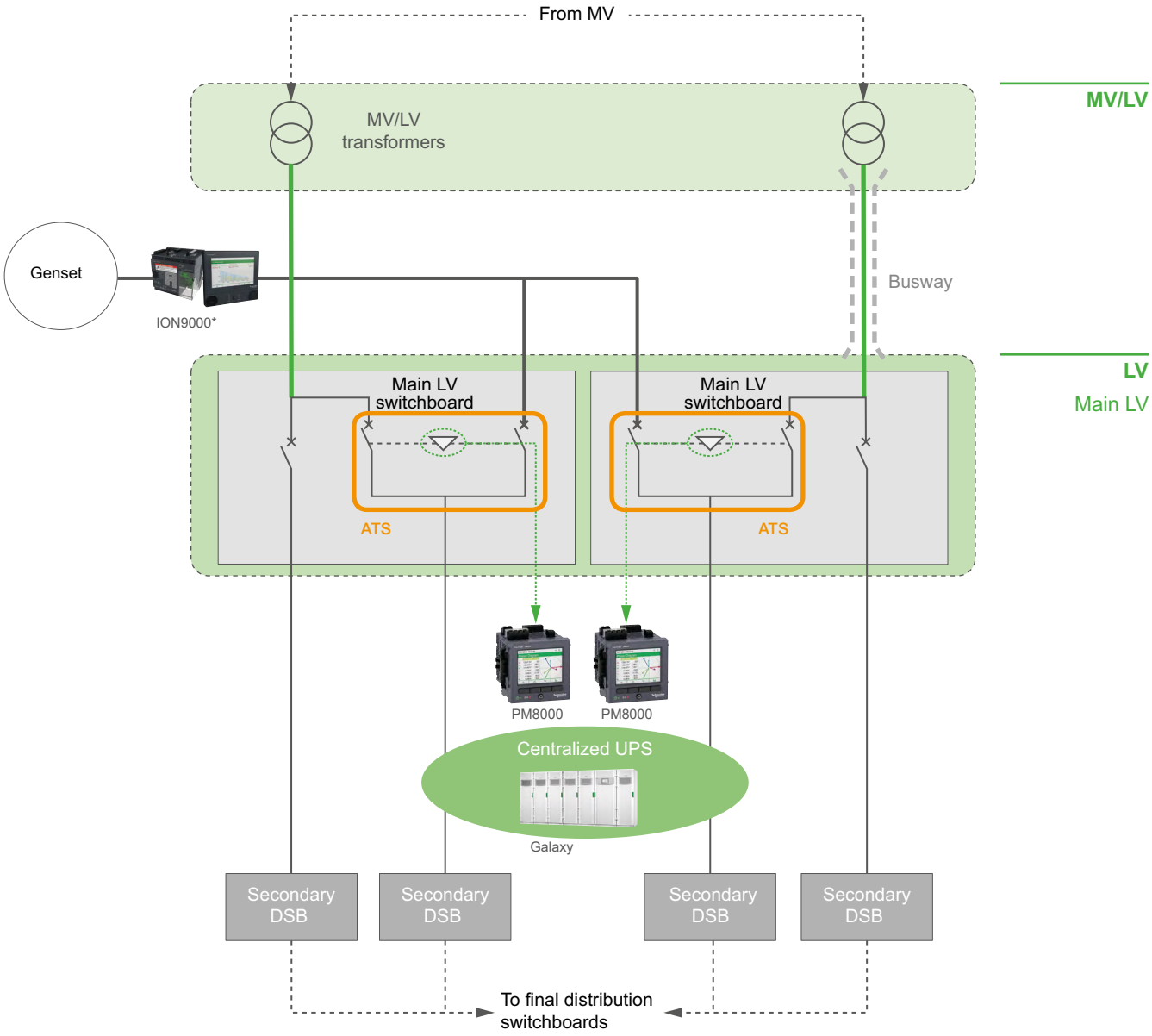
* ATS: Automatic Transfer Switch

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

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 ATS. 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, through digital I/O ports.



ATS status

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

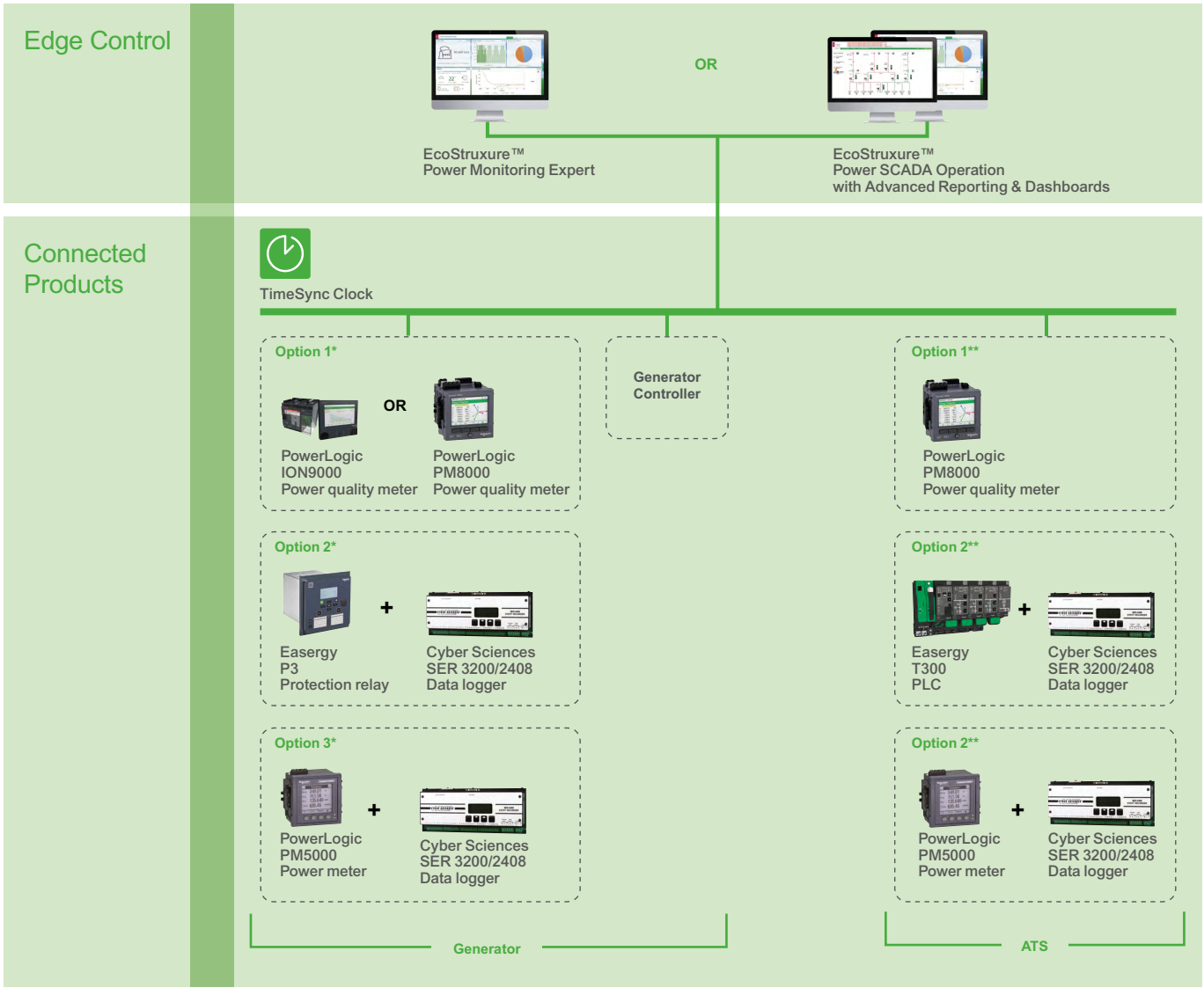
Digital Architecture (1/2)

Introduction

The digital architecture of the Backup Power Testing and the Regulatory Compliance applications is different if it relates to a MV or LV electrical architecture.

Medium Voltage Generator Architecture

Example of digital architecture to implement the Backup Testing and Regulatory Compliance applications with a medium voltage generator:



Ethernet - technical LAN

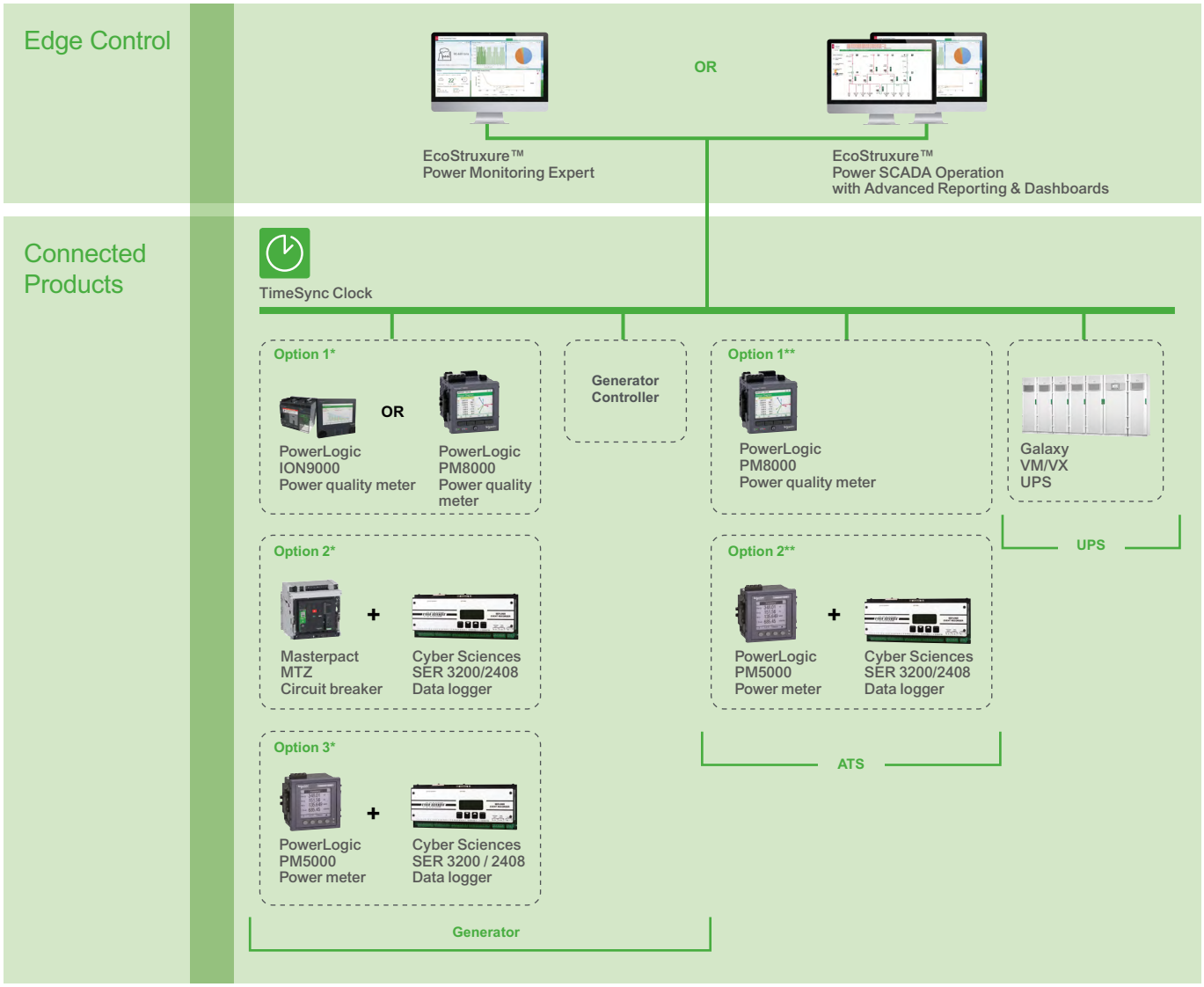
* Option 1 is the recommended architecture. Option 2 should be considered if Easergy P3 with embedded metering is already present in the architecture. Option 3 can be considered if a lower cost meter such as PowerLogic PM5000 is specified.

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

Digital Architecture (2/2)

Low Voltage Generator Architecture

Example of digital architecture to implement the Backup Testing and Regulatory Compliance applications with a low voltage generator:



Ethernet - technical LAN

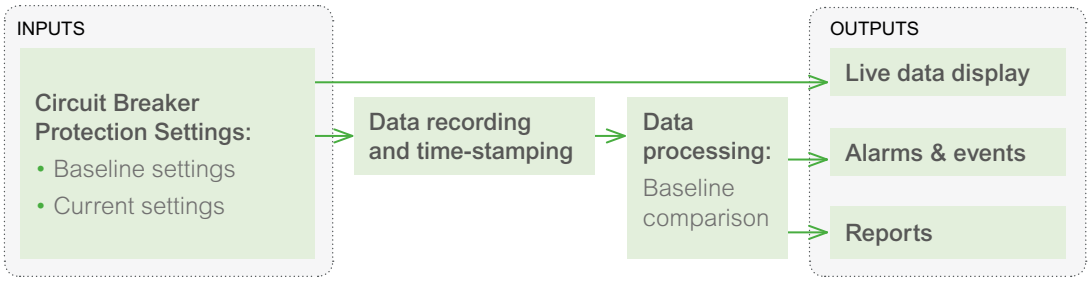
* Option 1 is the recommended architecture. Option 2 should be considered if Masterpact MTZ with embedded metering is already present in the architecture. Option 3 can be considered if a lower cost meter such as PowerLogic PM5000 is specified.

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

Functional Breakdown of the Application (1/3)

Data Flow

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



Data Flow in Detail

INPUTS

The following data are required:

Circuit Breaker Protection Settings

Circuit breaker protection settings are obtained from communicating circuit breakers 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
- Micrologic 3 X
- Micrologic 5 X
- Micrologic 6 X
- Micrologic 7 X


Micrologic X for Masterpact MTZ


Micrologic for masterpact


Micrologic for Compact NSX/PowerPact

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.

Product, Software and Services: See page 177

Functional Breakdown of the Application (2/3)

Data Flow in Detail (cont.)

DATA RECORDING AND TIME-STAMPING

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

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 SCADA 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 time-stamped, an event will be generated and the change will be noted in the reporting.

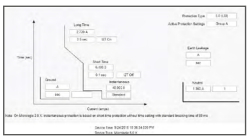
EcoStruxure™
Power SCADA Operation
with Advanced
Reporting & Dashboards

OUTPUTS

Display of outputs is performed remotely by the Edge Control software EcoStruxure™ Power Monitoring Expert and/or EcoStruxure™ Power SCADA Operation with Advanced Reporting & Dashboard.

Live Data Display

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



Default trip curve diagram
for Masterpact MTZ
in EcoStruxure™
Power Monitoring Expert

Alarms & Events*

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 upon any change to the following settings:

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

Product, Software and Services: See page 177

Functional Breakdown of the Application (3/3)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Reports*

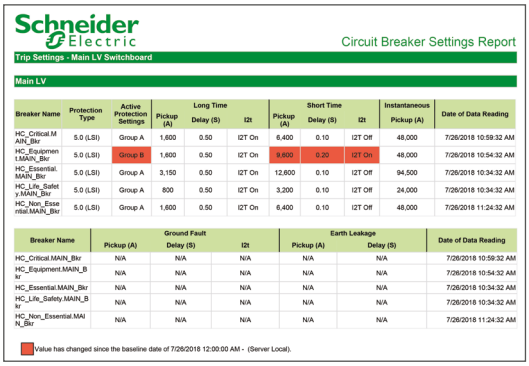
Reports can be configured to be generated upon detection of breaker setting change.

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)
- Change Detected On (date/time)
- Date/time of last Settings verification

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



Schneider Electric — Circuit Breaker Settings Report

Trip Settings - Main LV Switchboard

Main LV

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

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

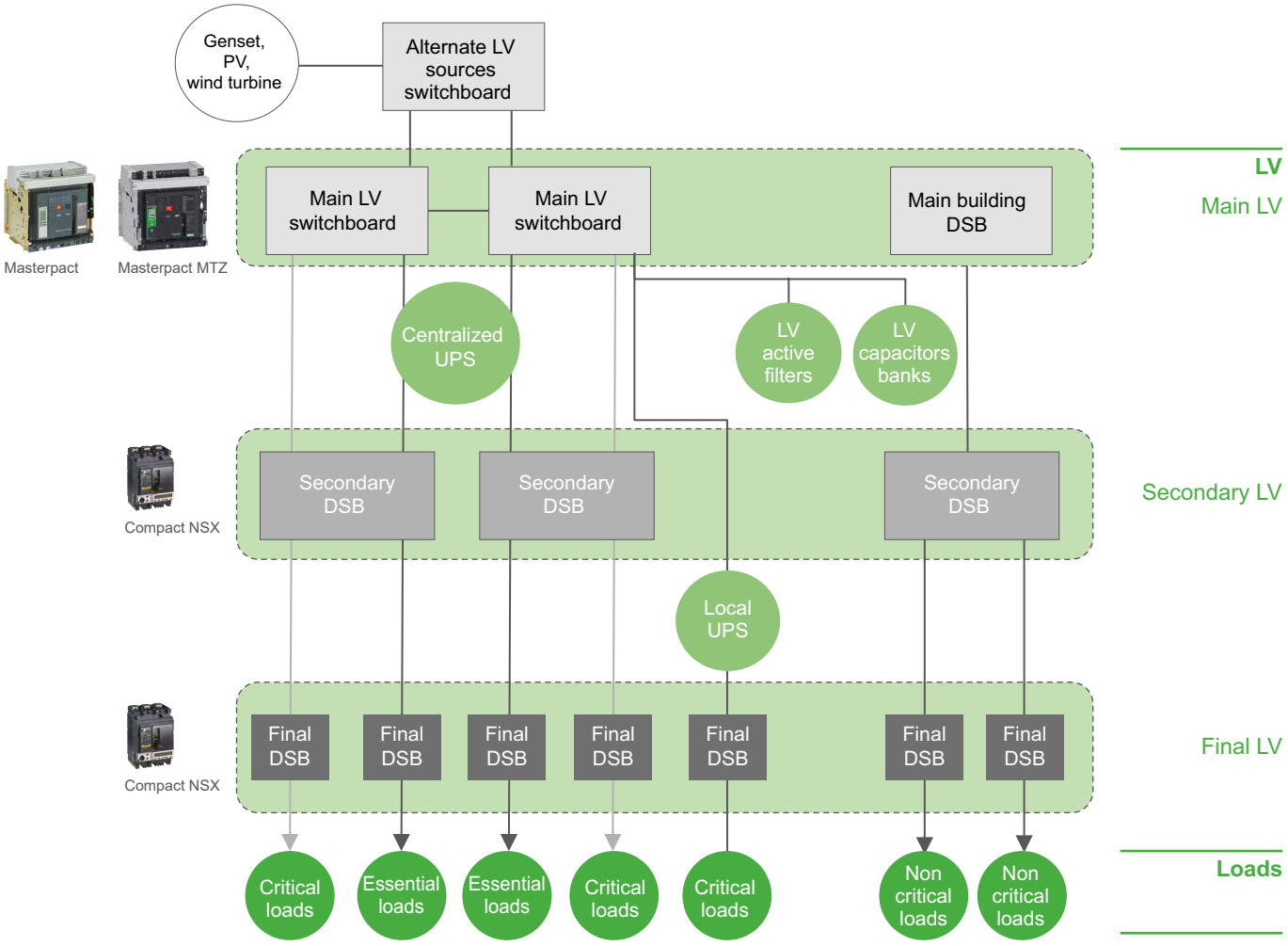
Value has changed since the baseline date of 7/26/2018 12:00:00 AM - (Server Local).

Circuit Breaker Settings report

BREAKER SETTINGS MONITORING

Electrical Architecture

The following diagram explains in which area of the electrical architecture may be located the devices which can contribute to the Breaker Settings Monitoring application.



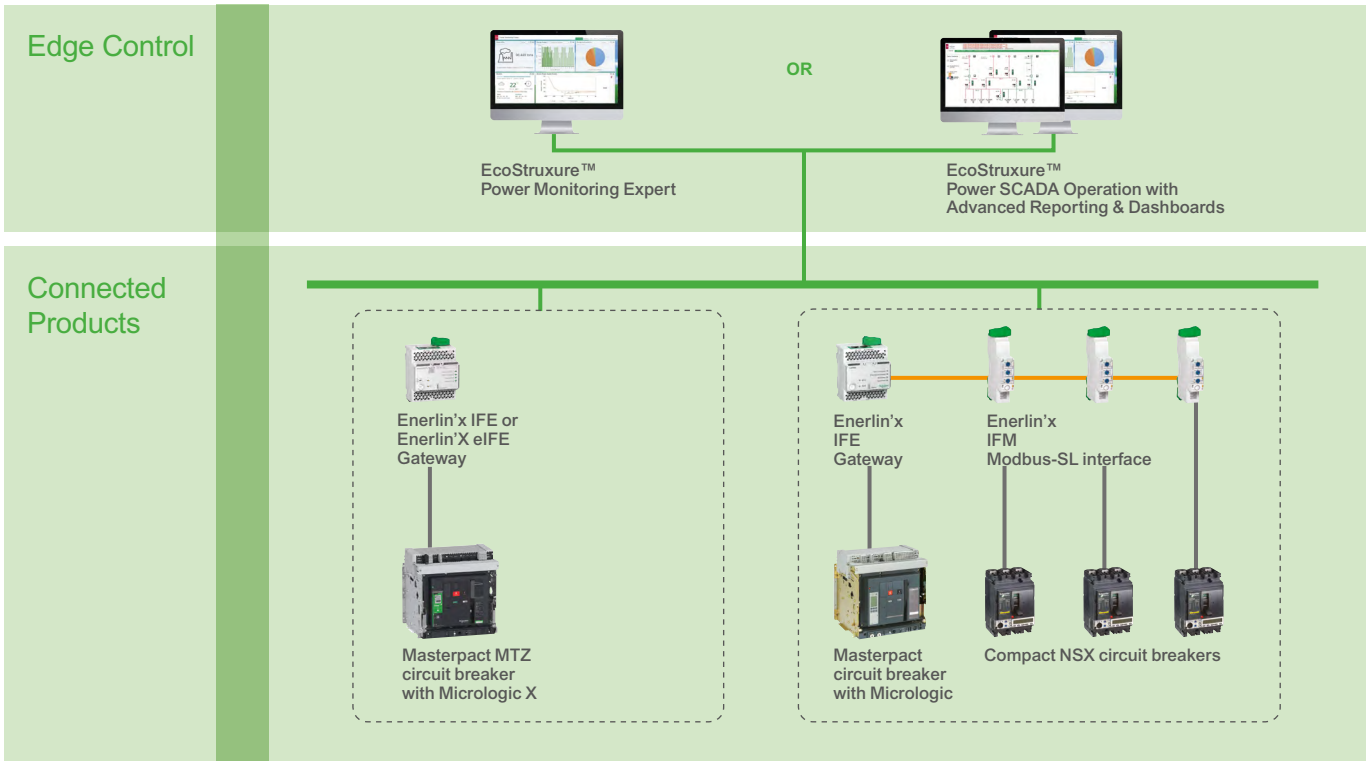
DSB = Distribution Switchboard

BREAKER SETTINGS MONITORING

Digital Architecture

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

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

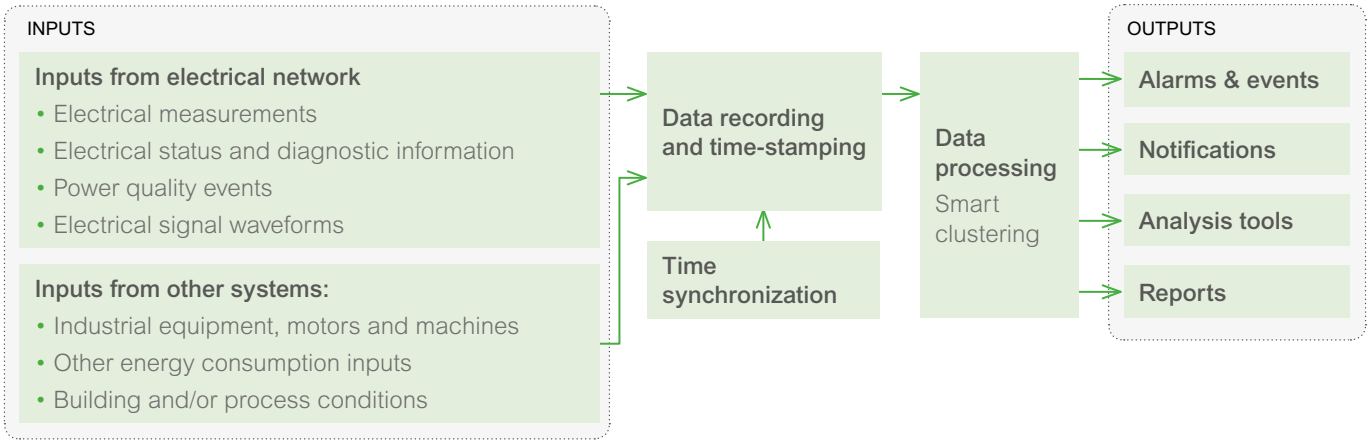


Ethernet - technical LAN
Serial
CAN/ULP

Functional Breakdown of the Application (1/3)

Data Flow

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



Data Flow in Detail

INPUTS

The following data are 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


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


Compact PowerTag NSX


Acti9 PowerTag


Easergy P3


Easergy Sepam 20


Masterpact MTZ with Micrologic X


Compact NSX with Micrologic


AccuSine PCS+


Varset LV


Galaxy


Easergy T300


Modicon M580


Easergy TH110


Acti9 iC60


TeSys D


EcoStruxure™ Building


EcoStruxure™ Plant & Machine

Product, Software and Services: See page 177

Functional Breakdown of the Application (2/3)

Data Flow in Detail (cont.)

DATA RECORDING AND TIME-STAMPING

For highly critical applications, optimal chronological correlation is achieved by having a time accuracy of +/- 1 ms (possible using PTP or GPS time synchronization).
For less critical applications, a time accuracy of +/- 100ms is adequate (with NTP and SNTP).

Advanced meters such as the PowerLogic ION9000, PM8000 (as well as legacy connected products such as PowerLogic ION7650/7550) and some models of the PowerLogic PM5000 (PM53xx and PM55xx) can timestamp and record onboard input data.

For other connected products (Easergy P3, Masterpact MTZ, lower end models of PowerLogic PM5000) steady state disturbances are measured by the connected products and recorded by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards. If data from these connected products require more accurate time-stamping, they should be relayed through another connected products with a better accuracy (like PowerLogic ION9000 power quality meter or M580 PLC) through digital or analog I/Os.

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

To have the full view of device recording and time-stamping capabilities, refer to chart 2.2 in Part 2, page 46.

EcoStruxure™
Power Monitoring Expert

EcoStruxure™
Power SCADA Operation

EcoStruxure™
Power SCADA Operation
with Advanced
Reporting & Dashboards

TIME SYNCHRONIZATION

To have a consistent chronological view of all events which happen throughout the facility, date and time should be accurately distributed to connected products and other Management Systems.

Time synchronization can be performed through various technologies (PTP, NTP, SNTP...). 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

The Smart clustering is performed by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards.

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

Product, Software and Services: See page 177

Functional Breakdown of the Application (3/3)

Data Flow in Detail (cont.)

OUTPUTS

Display of outputs is performed by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation or Power SCADA Operation with Advanced Reporting & Dashboards.

Alarms & Events

Alarms/Events Log Viewers

They offer chronological display with sorting and filtering capabilities.

- Power SCADA 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 combines related events, alarms, waveforms and other associated data in an incident timeline to simplify the root cause analysis of an incident.

Notifications

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

Analysis Tools

Power Events Incident Timeline

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

Waveform viewer

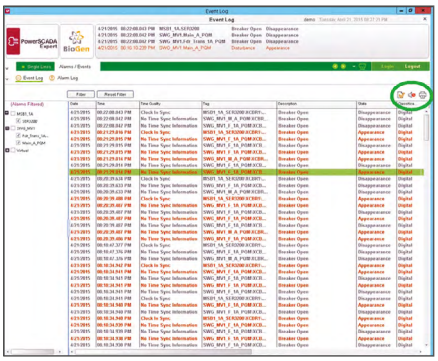
Electrical signal waveforms can be visualized with a native waveform viewer in both EcoStruxure™ Power Monitoring Expert and Power SCADA Operation with Advanced Reporting & Dashboards.

These viewers allow for the following:

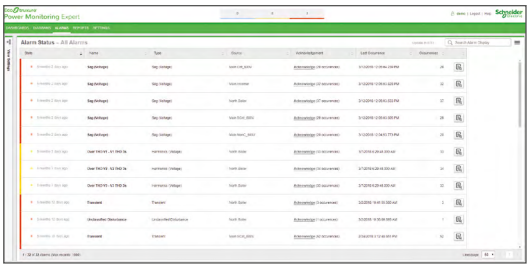
- Toggle on/off Voltage/Current channels
- RMS calculation, zoom, pan, export to CSV
- Interactive phasor and harmonic (voltage and current) diagrams
- Comparison of multiple waveforms with respect to each other

Reports

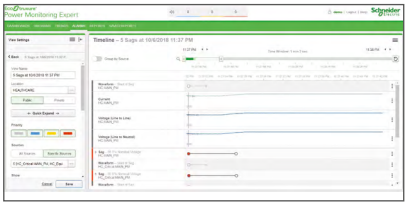
When EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Report is installed, reports can be generated, such as the Event History Report.



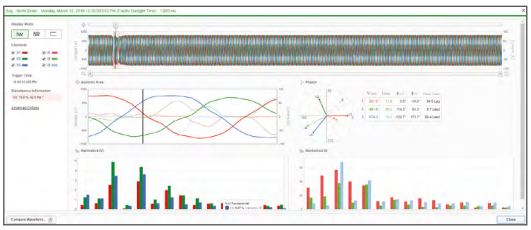
Event Log viewer in
EcoStruxure™ Power SCADA Operation



Alarms Log viewer in
EcoStruxure™ Power Monitoring Expert



Power Events Incident Timeline

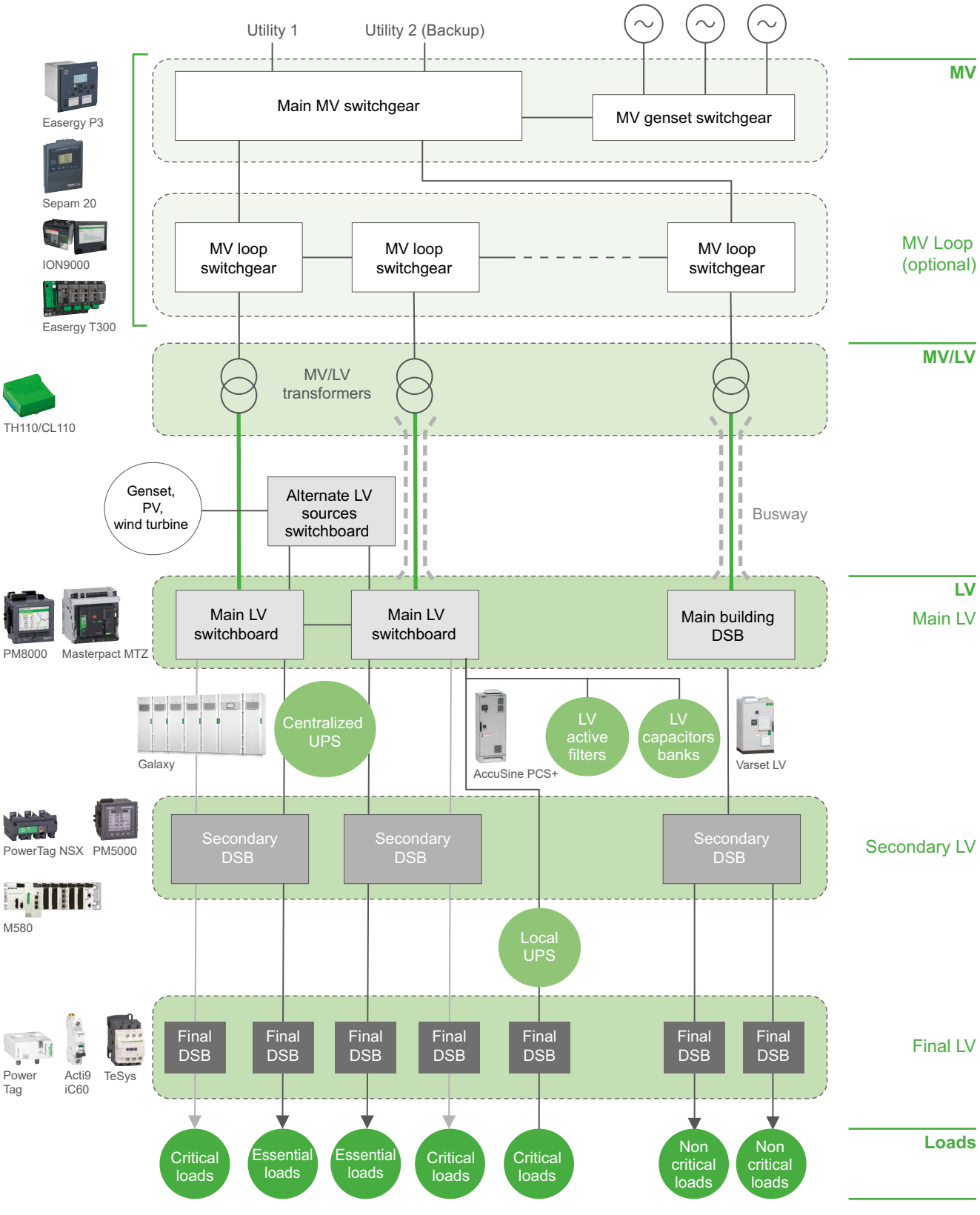


Waveform viewer

Event History report

Electrical Architecture

The following diagram explains in which area of the electrical architecture may be located the connected products which can contribute to the Power Events Analysis application.

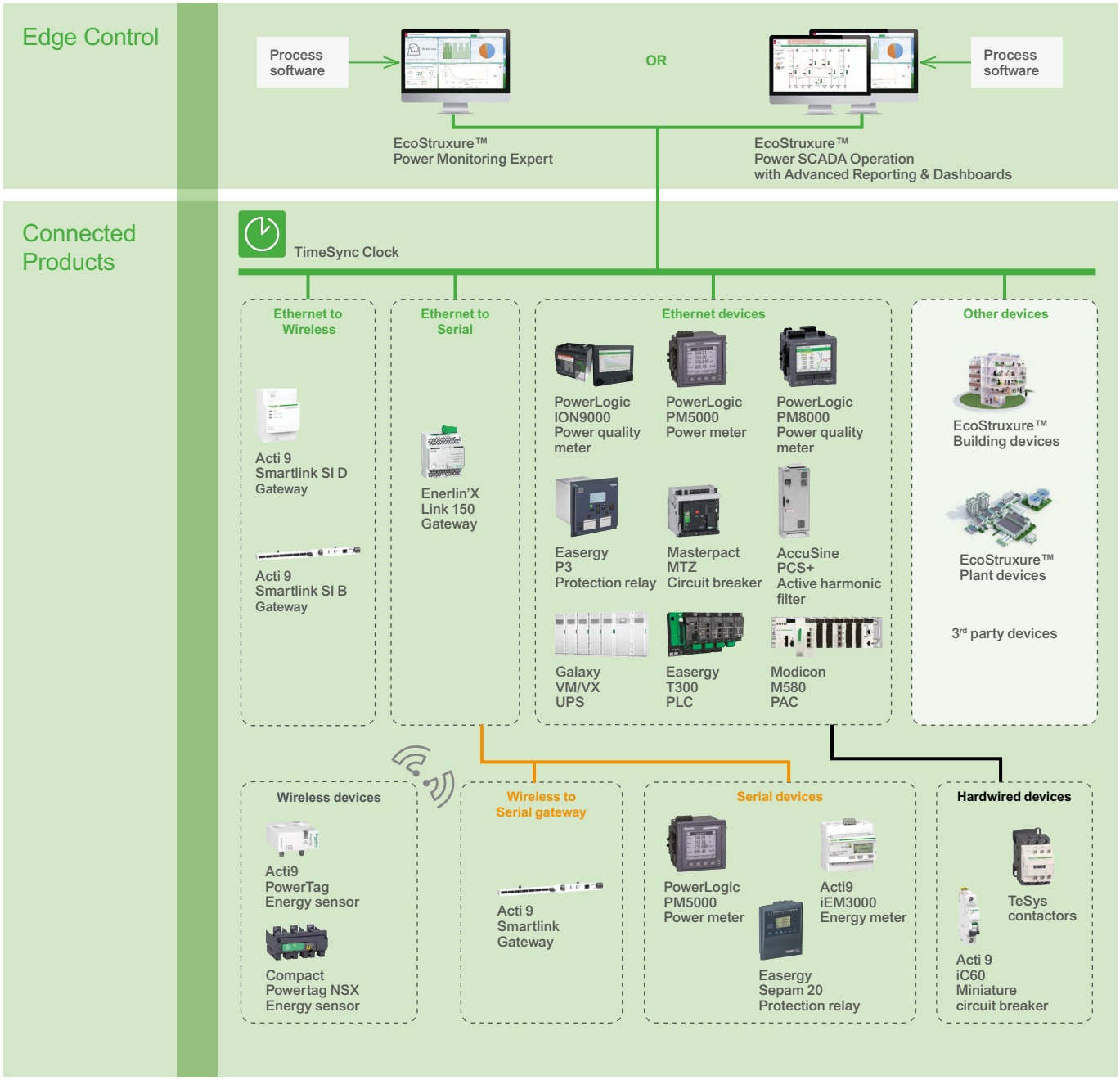


DSB = Distribution Switchboard

Digital Architecture

As the Power Event 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.

Here below is the recommended architecture for the Power Events Analysis application:

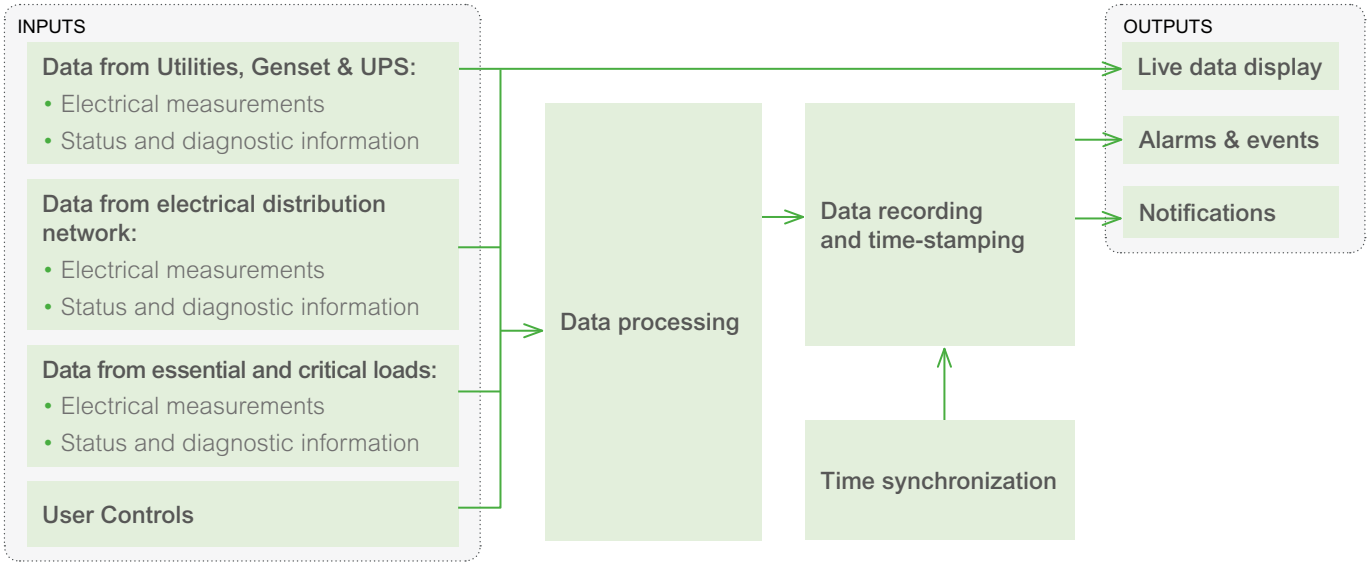


Ethernet - technical LAN
Serial
Hardwired
Wireless

Functional Breakdown of the Application (1/3)

Data Flow

The Source and Network Control application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data are required:

Data from Utilities, Genset & UPS

- Electrical measurements: power sources are monitored to launch automatic reconfigurations or to help operators decide about relevant actions to restore power
- Status and diagnostic information: if any source or network 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 P3 or Sepam (legacy), or directly from the genset controller.
For UPS, the measurements can be performed by Galaxy VM/VX and legacy Galaxy 5000.

Data from Electrical Distribution Network

The following data are acquired to help automatic systems or operators decide of 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
  - Trip context from circuit breakers
  - Status of automatic reconfiguration devices

This information is gathered from protection relays with embedded metering (Easergy P3 or SEPAM relays or Masterpact MTZ or Compact NSX) and from automation controllers (Easergy T300, Modicon M340 or M580 PAC).


Easergy P3


Easergy Sepam 20


Masterpact MTZ with Micrologic X


Compact NSX with Micrologic


Galaxy VM/VX


Easergy T300


Modicon M580


Modicon M340

Product, Software and Services: See page 177

Functional Breakdown of the Application (2/3)

Data Flow in Detail (cont.)

INPUTS (cont.)

Data from Essential and Critical Load

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

These 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).

Acti9 iC60

TeSys D

Modicon M580

Modicon M340

User Controls

In case the automation system halted (due to improper operating conditions) or for the purpose of maintenance, the user is able to issue external control actions (both from EcoStruxure™ Power SCADA Operation or device front panel), such as reset of controls or open/close orders.

EcoStruxure™ Power SCADA Operation

DATA PROCESSING

For this Source and Network Control application, most data processing occurs before the data recording and time-stamping. This is because Source and Network control relies on automation and mostly occurs without user intervention.

These automated actions are monitored and recorded with time-stamps in Edge Control software (EcoStruxure™ Power SCADA 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 case of halted automation, manual load control or maintenance activities. In this case, data processing consists of logging all user actions with date and time as well as their user ID for traceability purposes.

DATA RECORDING AND TIME-STAMPING

All Source and Network 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 on board smart equipment such as Easergy P3, Modicon M580 and M340, etc.

For less critical applications, +/- 100 ms may be adequate.

To have the full view of device recording and time-stamping capabilities, refer to chart 2.2 in Part 2, page 46.

Easergy P3

Masterpact MTZ with Micrologic X

Modicon M580

Modicon M340

TIME SYNCHRONIZATION

To have a consistent chronological view of all events which happen throughout the facility, date and time should be accurately distributed to connected products and other Management Systems.

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

TimeSync Clock

Product, Software and Services: See page 177

Functional Breakdown of the Application (3/3)

Data Flow in Detail (cont.)

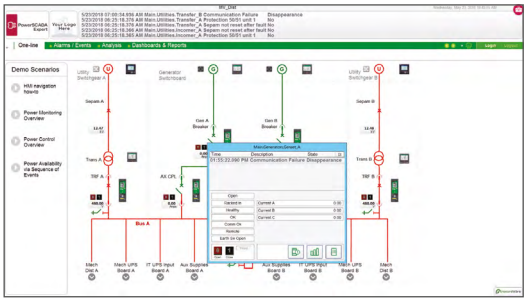
OUTPUTS

Display of outputs is performed remotely by EcoStruxure™ Power SCADA Operation or EcoStruxure™ Power SCADA Operation with Advanced Reporting & Dashboards.

EcoStruxure™
Power SCADA Operation

Live Data Display

Display is performed 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 understanding the status of each equipment.

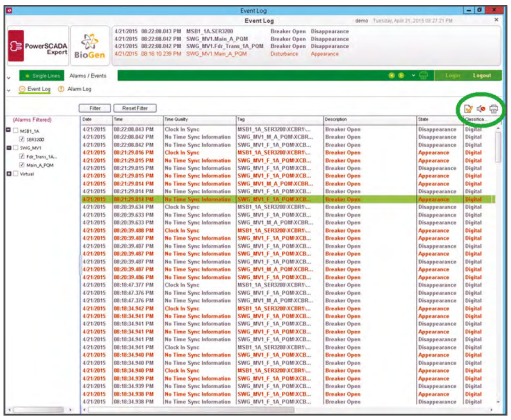


Live Data Display in EcoStruxure™ Power SCADA Operation

Alarms & Events

Alarms and events are uploaded from connected products or generated by the Edge Control software (EcoStruxure™ Power SCADA Operation or Power SCADA Operation with Advanced Reporting and Dashboards) and visualized 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 time-stamp



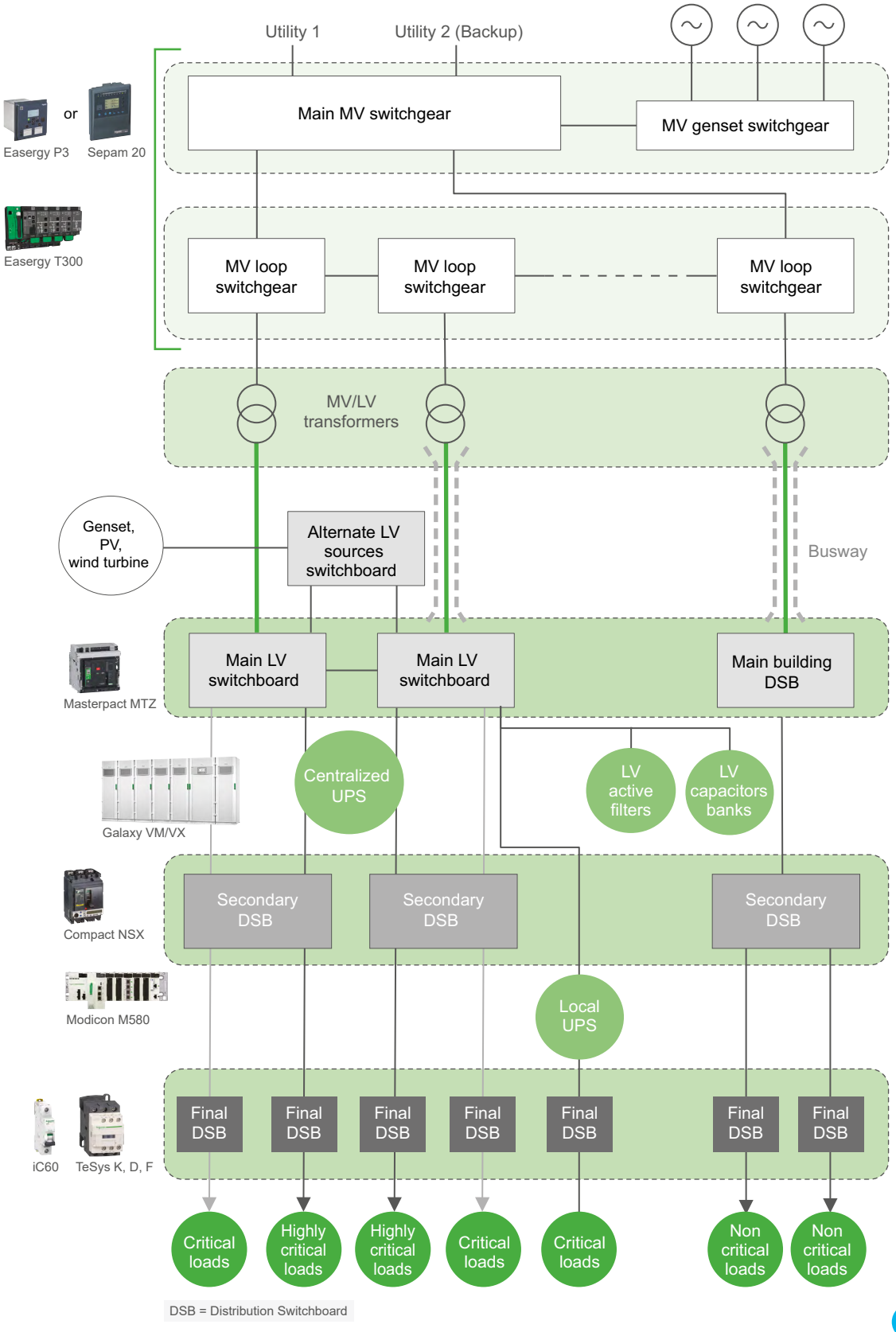
Alarms & Events Log viewer in EcoStruxure™ Power SCADA Operation

Notifications

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

Electrical Architecture

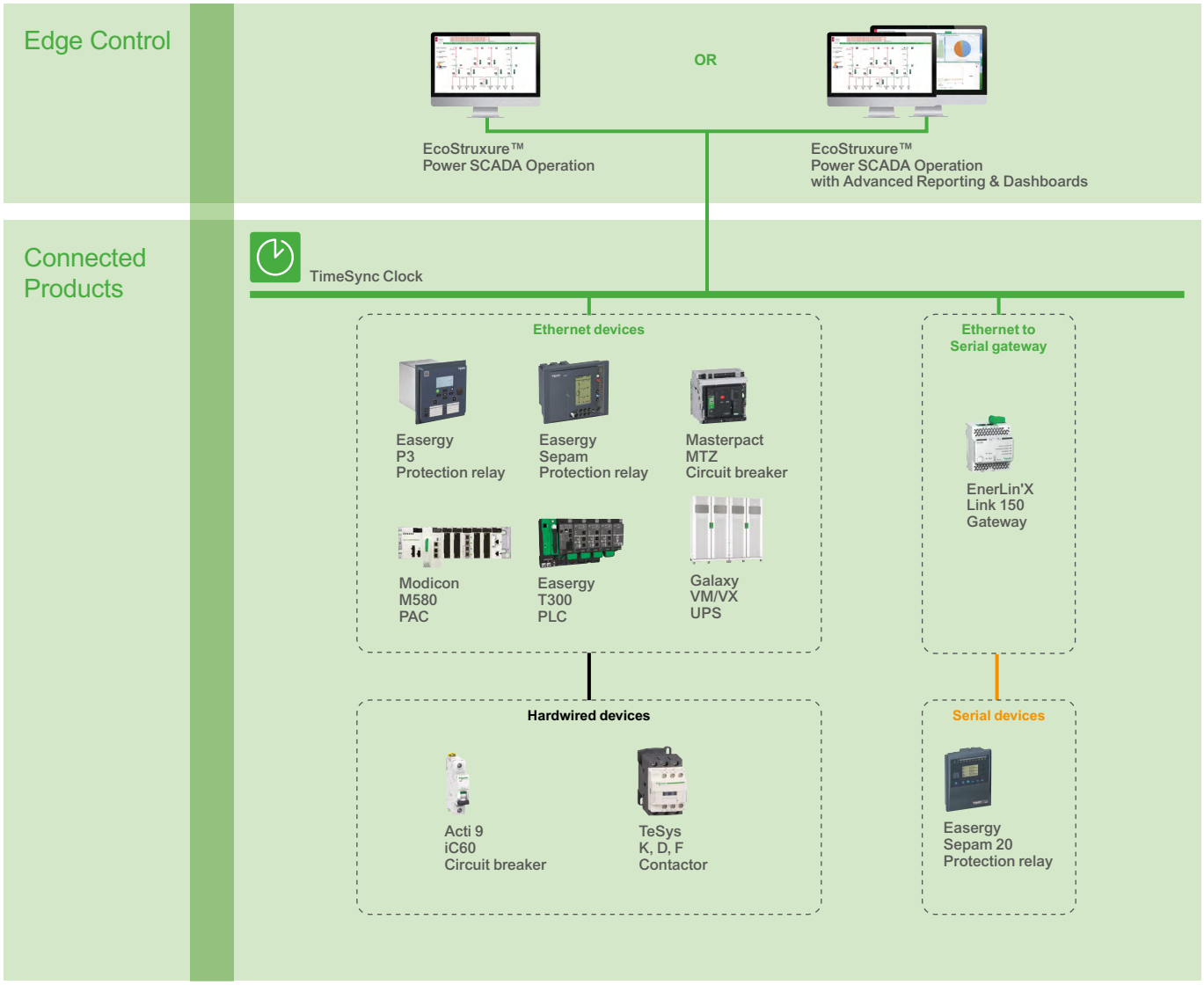
The following diagram explains in which area of the electrical architecture connected products should be installed in order to implement the Source and Network Control application.



SOURCE AND NETWORK CONTROL

Digital architecture

Ethernet based communications are 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 faster response time for user controls.
Legacy connected products can be accessed through protocols such as Serial Modbus but with slower performances.
Here below is the recommended digital architecture for the Source and Network Control application:

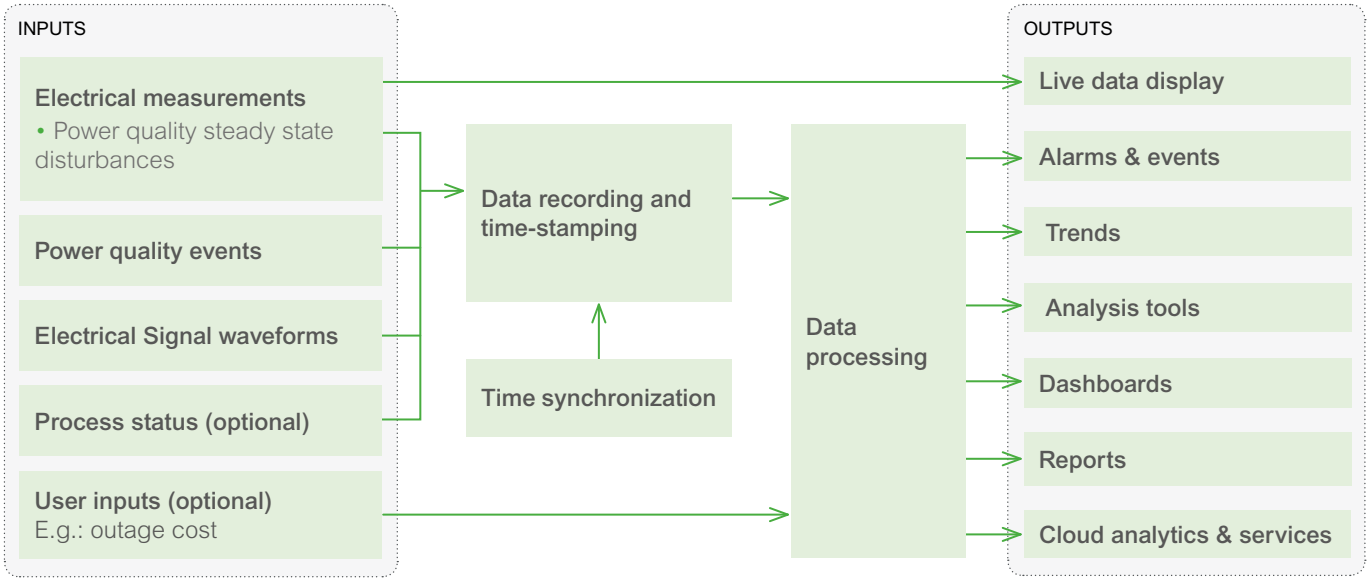


Ethernet - technical LAN
Serial
Hardwired

Functional Breakdown of the Application (1/6)

Data Flow

Power Quality Monitoring application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data are required:

Electrical Measurements

- Voltage, current and power measurements need to be captured with accuracy and 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

PowerLogic ION9000

PowerLogic PM8000

PowerLogic PM5000

Masterpact MTZ with Micrologic X

Easergy P3

Easergy Sepam

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 P3/SEPAM relays, Masterpact MTZ circuit breaker or by less sophisticated power meters such as PowerLogic PM5000.

Product, Software and Services: See page 177

Functional Breakdown of the Application (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 µs)	Yes	Yes	Yes (+TDD**) / Yes / No*	Yes
ION9000T (coming 2019)	Yes	Yes (100 ns)	Yes	Yes	Yes (+TDD**) / Yes / No*	Yes
ION7650 (legacy)	Yes	Yes (20 µs)	Yes	Yes	Yes / Yes / No*	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 P3	No	No	No	No	Yes/ No / No	Yes, on trip event only

* Does provide interharmonic measurements, but not THD for Interharmonics
**Total Demand Distortion

Process Status

For some additional, optional, analytics such as process or operations impact as a result of 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)
- Hard-wired 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 supply estimates of power quality financial impact.

DATA RECORDING AND TIME-STAMPING

For highly critical applications, optimal chronological correlation is achieved by having 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 (as well as legacy connected products such as PowerLogic ION7650/7550) and some models of the PowerLogic PM5000 (PM53xx and PM55xx) can timestamp and record onboard input data.

For other connected products (Easergy P3, Masterpact MTZ***, lower end models of PowerLogic PM5000) steady state disturbances are measured by the connected products and recorded by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards.

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

To have the full view of device recording and time-stamping capabilities, refer to chart 2.2 in Part 2, page 46.


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


Masterpact MTZ with Micrologic X


Easergy P3


Easergy Sepam

***For power quality measurements, Masterpact MTZ has the option of adding the:
- Individual Harmonics Analysis Digital Module
- Under/Over voltage Digital Module.

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

Functional Breakdown of the Application (3/6)

Data Flow in Detail (cont.)

TIME SYNCHRONIZATION

To reconstruct an accurate chronological view of events which happen during an electrical incident, all connected products must have onboard 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 are processed in some instances onboard the device and others in the Edge Control software for visualization in the software interface.

Advanced power quality data processing is performed onboard 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 SCADA 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 SCADA Operation
with Advanced
Reporting & Dashboards

With the addition of the Power Quality Performance Module in Power Monitoring Expert or Power SCADA 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
- “Power Quality Impact” is evaluated 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
ION9000

PowerLogic
PM8000

Product, Software and Services: See page 177

Functional Breakdown of the Application (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 SCADA Operation with Advanced Reporting and Dashboards) for visualizing power quality data.

The optional Power Quality Performance Module in EcoStruxure™ Power Monitoring Expert or Power SCADA 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.

EcoStruxure™
Power Monitoring Expert

EcoStruxure™
Power SCADA Operation
with Advanced
Reporting & Dashboards

EcoStruxure™
Power Advisor

Live Data Display

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

Alarms & Events

Power quality events captured and uploaded from connected products can be visualized 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 alarms interface for insight into the event details and root cause.

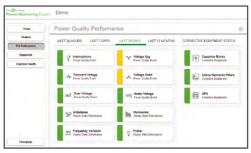
Trends

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

Analysis Tools

Power Quality Performance Diagrams*

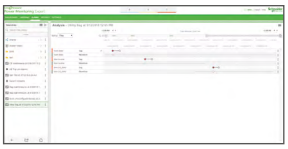
Green, yellow and red status indicators are used for each event or disturbance type to represent the severity during various timeframes (24 hours, one week, last 30 days, etc.), based on power quality standards and recommended thresholds described in the “data processing” section.



Power Quality Performance
diagrams

Power Events Incident Timeline

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



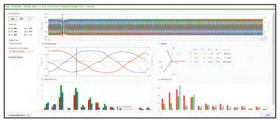
Power Events Incident Timeline

Waveform viewer

Electrical signal waveforms can be visualized with a native waveform viewer in both EcoStruxure™ Power Monitoring Expert and Power SCADA 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
- Allow multiple waveforms to be compared to each other



Waveform viewer

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

Functional Breakdown of the Application (5/6)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

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 Rating

Power Quality Incident Impact

Shows the number of power quality events, over a period of time, that might have had a process impact, compared to those that most likely did not have an impact. It is a simplified representation of the CBEMA/ITIC curve in a pie chart format. Events that are inside the curve are shown as “no impact events” and those outside the curve are shown as “likely impact events”.

Power Quality Incident Impact

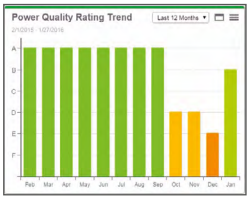
Power Quality Incident Location

Shows the number of power quality events, over a selected time period, grouped by location of origin (external, internal, undetermined). In addition, it indicates whether the events had a likely process impact or not. The information is shown in a column chart, grouped by impact assessment.

Power Quality Incident Location

Power Quality Rating Trend

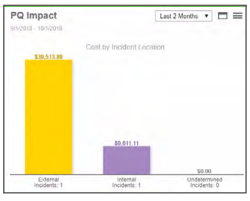
Shows the power quality rating, over a selected time period.



Power Quality Rating Trend

Power Quality Impact

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



Power Quality Impact

Power Quality Impact Trend

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

Power Quality Impact Trend

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

Functional Breakdown of the Application (6/6)

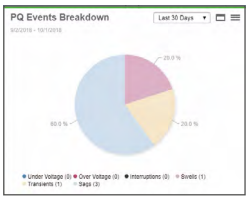
Data Flow in Detail (cont.)

OUTPUTS (cont.)

Dashboards*

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.



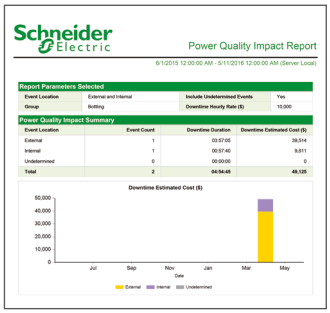
Power Quality Incident Breakdown

Reports*

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

Power Quality Impact Report

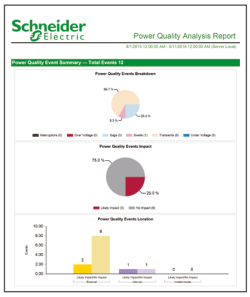
Indicates impact from downtime that occurred for a power quality group and provides an estimated cost associated for a given period of time that is calculated using the rate defined in the Power Quality Group configuration file. It also provides information about power quality events that might be the cause of the downtime, and indicates whether they occurred internally, externally, or are from an undetermined location.



Power Quality Impact report

Power Quality Analysis Report

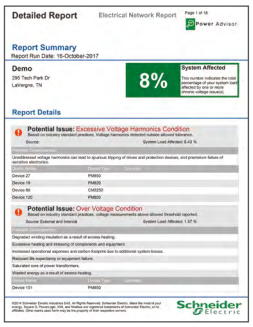
Summarizes power quality events and disturbances occurring in a production environment. The events include voltage transients, sags, swells, and interruptions, as well as overvoltage and under voltage events. Disturbances are related to harmonics, unbalances, flicker, and frequency variation. An understanding of these events and disturbances can help determine actions to reduce production downtime and to increase equipment lifetime and reliability.



Power Quality Analysis report

Cloud Analytics & Services

As an option, EcoStruxure™ Power Advisor connected service can perform cloud-bacsed 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.



Electrical Network Health Check report

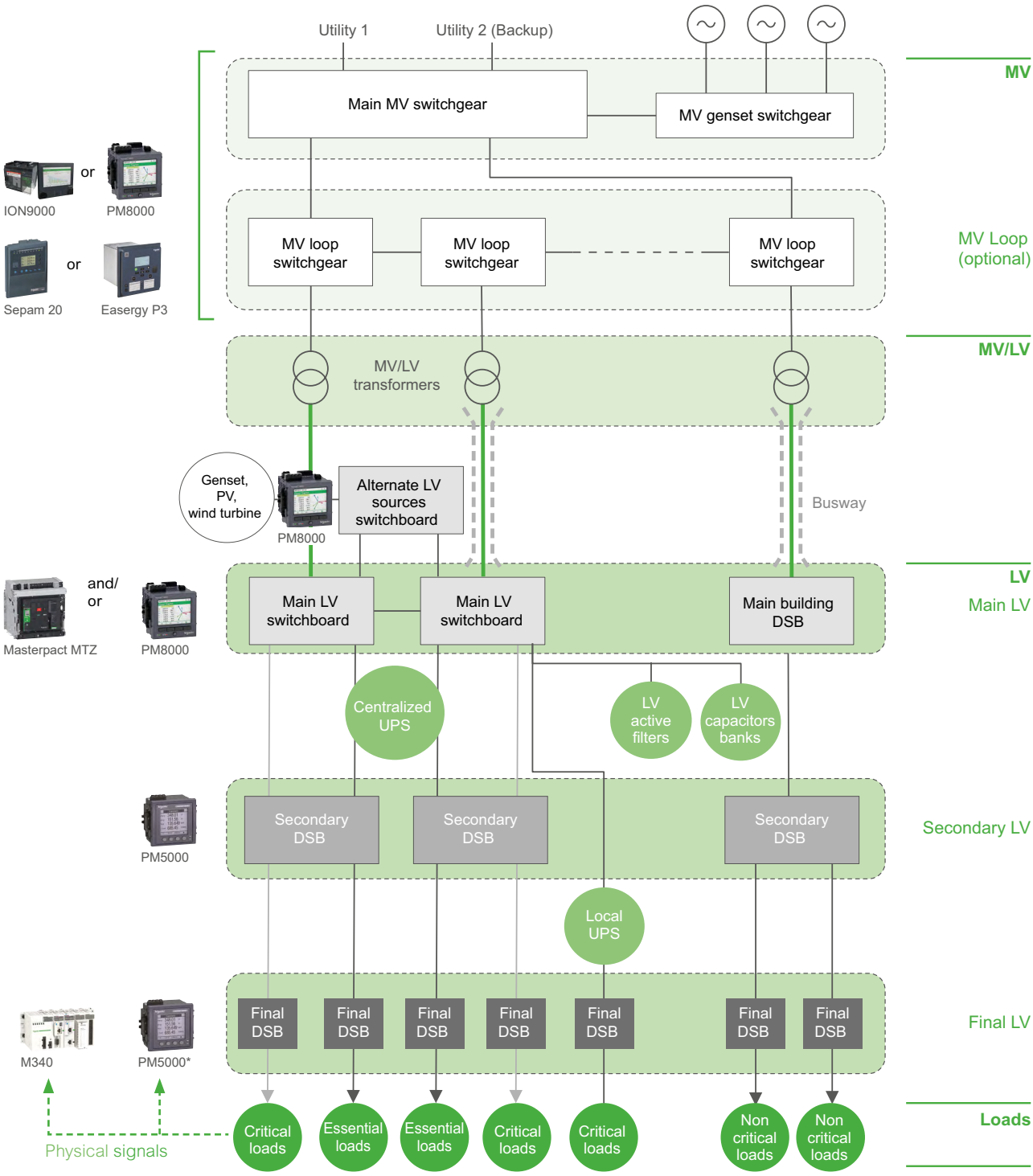

EcoStruxure™ Power Advisor

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

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 explains in which area of the architecture the connected products should be installed, in order to implement the Power Quality Monitoring application.



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

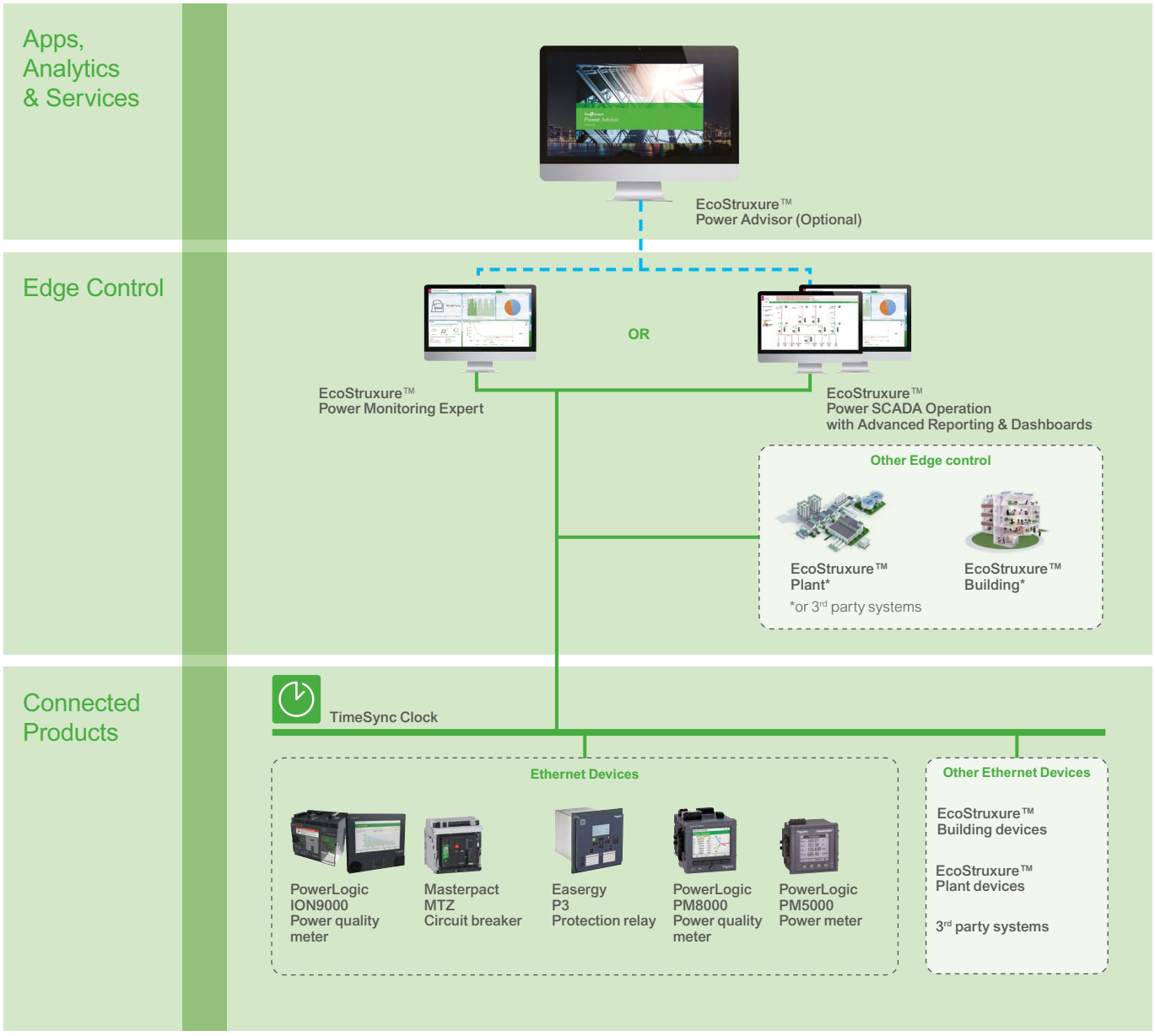
DSB = Distribution Switchboard

Digital Architecture

The digital architecture of the Power Quality Monitoring application uses recommended 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 SCADA Operation) for data processing, visualization and reporting.

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

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

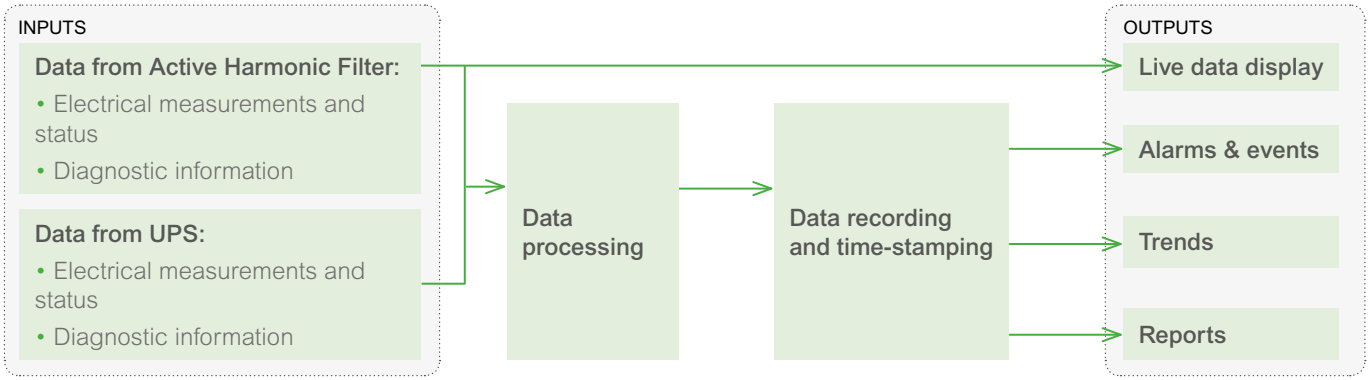


Ethernet - public LAN/WAN
Ethernet - technical LAN

Functional Breakdown of the Application (1/2)

Data Flow

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



Data Flow in Detail

INPUTS

The following data are required:

Data from Active Harmonic Filters

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.

These data are provided by AccuSine PCS+.

AccuSine PCS+

Data from UPS

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 warning, end of life

These data are provided by Galaxy VM/VX, or Galaxy 5000/5500.

Galaxy VM/VX

Functional Breakdown of the Application (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 SCADA Operation with Advanced Reporting & Dashboards).

EcoStruxure™
Power Monitoring Expert

DATA RECORDING AND TIME-STAMPING

Data recording is done by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards based on real-time values acquired by the driver.

Time-stamping is performed by the PC and recorded in the database, available to the HMI. Therefore, no specific device for time synchronization is necessary.

EcoStruxure™
Power SCADA Operation
with Advanced Reporting & Dashboards

OUTPUTS

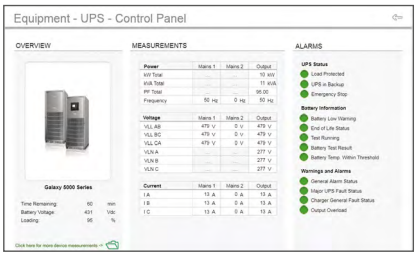
Live data, alarms, events, trends and dashboards are available by default in EcoStruxure™ Power Monitoring Expert and Power SCADA Operation with Advanced Dashboards & Reporting.

Live Data Display

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

One-page summary diagrams give quick access to the most useful real-time data including electrical measurements, operating modes and statuses and maintenance indicators.

When required, other measurements and status information can be investigated through more detailed diagrams.



UPS Live data display

Active harmonic filter live data display

Alarms & Events

Alarms and events are generated by the Edge Control Software upon change of the statuses. The events are time-stamped by the PC, recorded and visualized in the software's default alarms interface as diagnostics alarms.

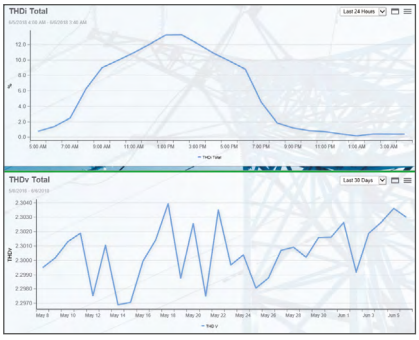
Trends

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

Dashboards

Electrical measurements acquired from correction equipment (AccuSine PCS+ or Legacy AccuSine PCS, 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)

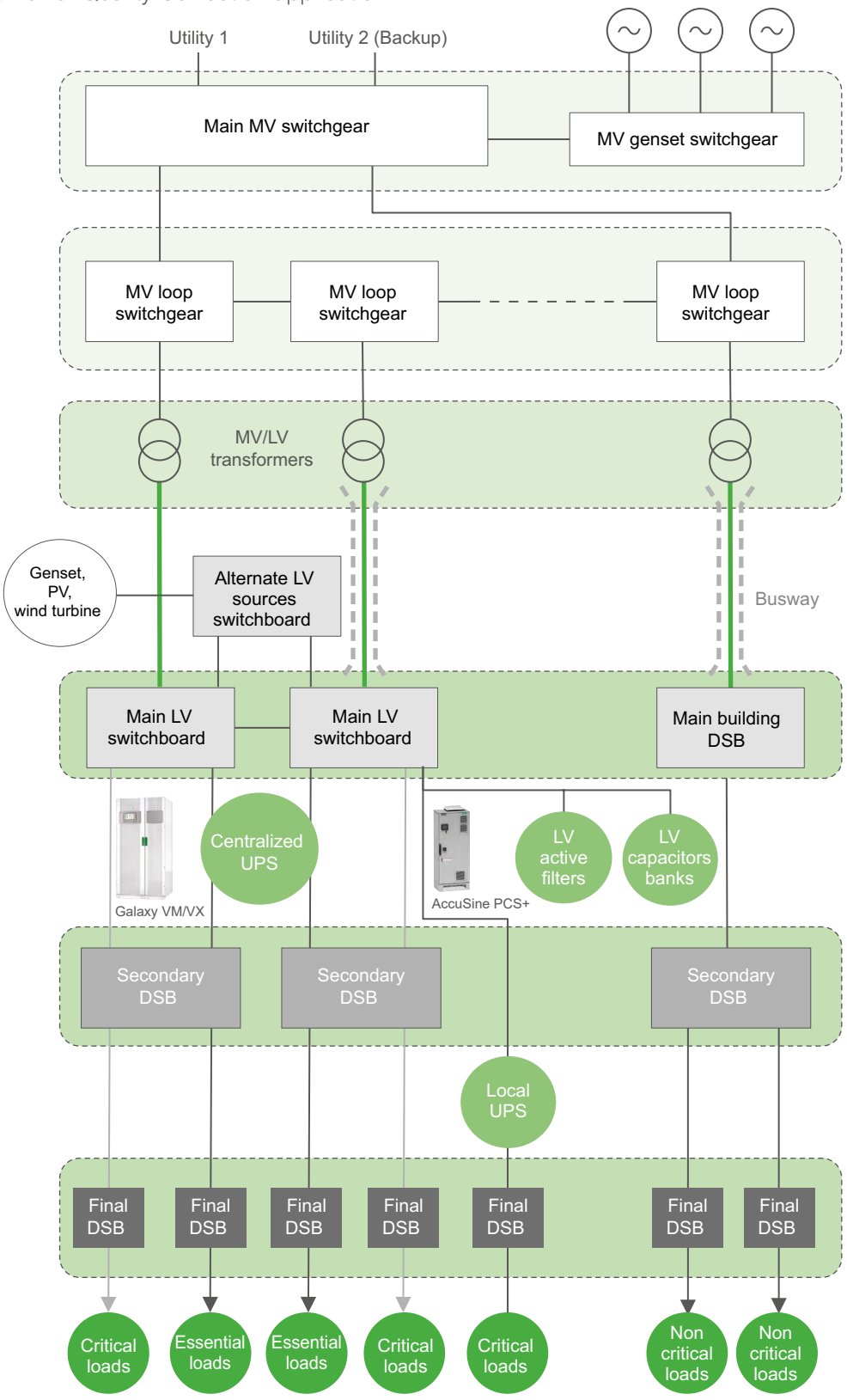


Active harmonic filter THDi and THDv dashboards

Product, Software and Services: See page 177

Electrical Architecture

The following diagram explains in which area of the architecture the devices should be installed, in order to implement the Power Quality Correction application.



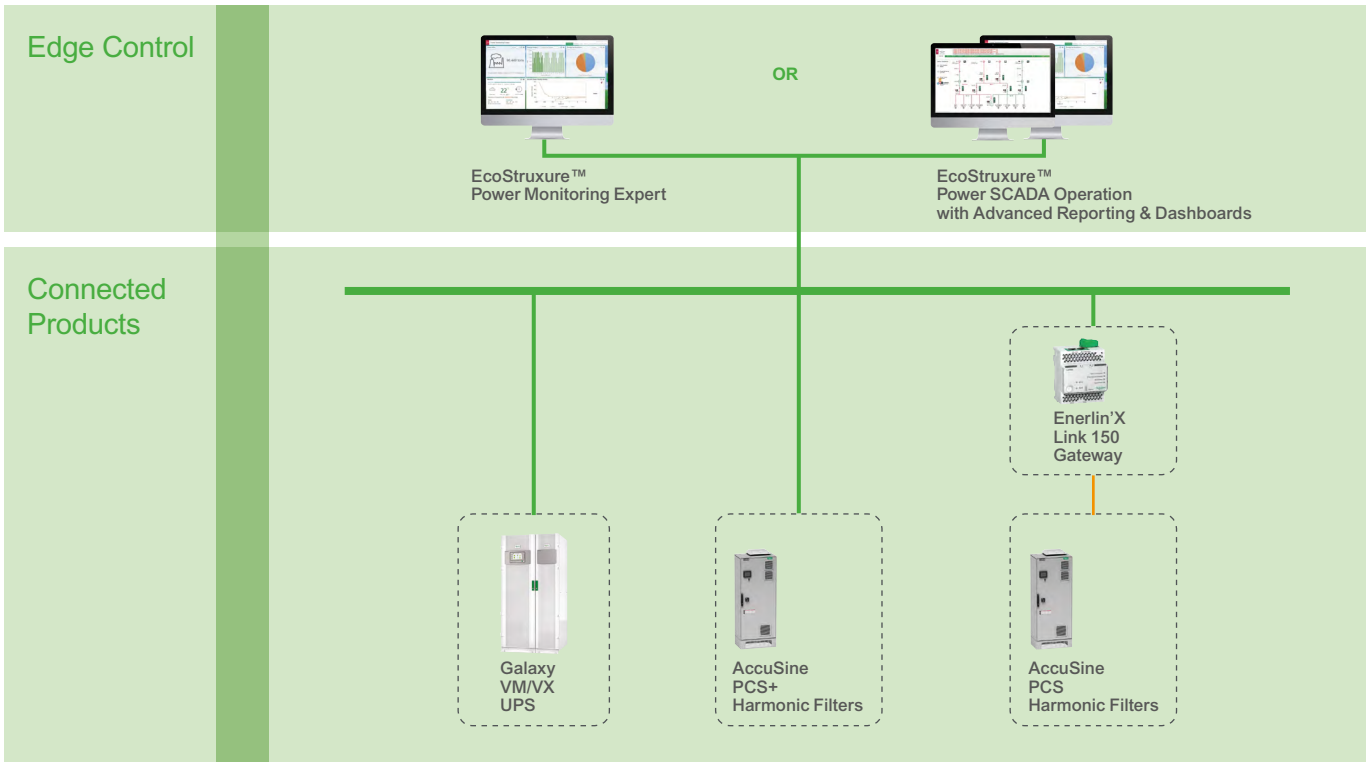
DSB = Distribution Switchboard

Digital Architecture

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

For legacy AccuSine PCS communication is done through a Modbus Serial connection. Enerlin'X Link150 gateway converts the Modbus serial communications to Ethernet for real-time data acquisition by the Edge Control software, EcoStruxure™ Power Monitoring Expert and EcoStruxure™ Power SCADA Operation with Advanced Reporting & Dashboards.

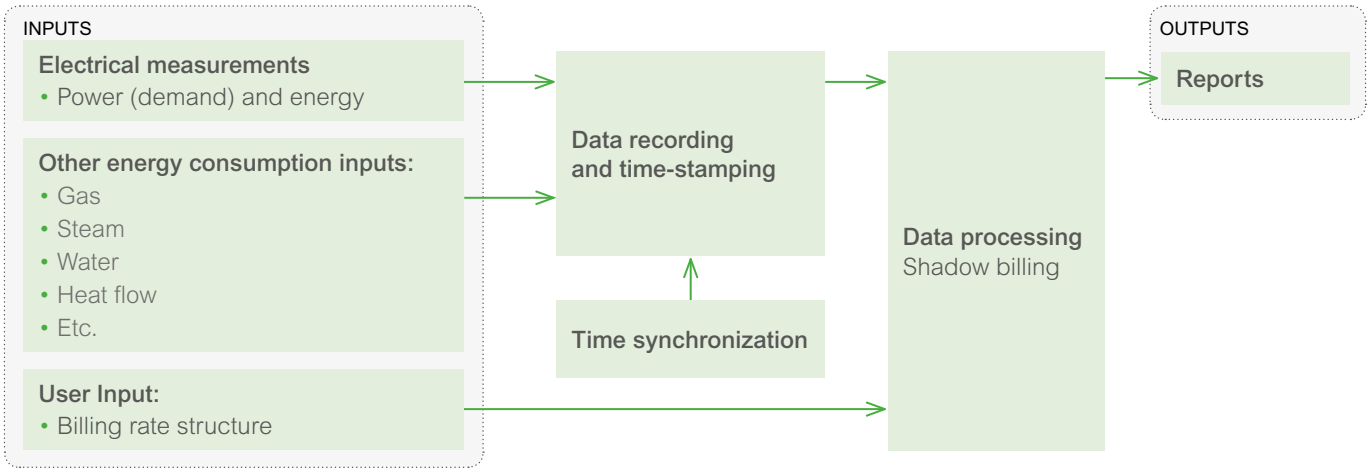
Here below is the recommended digital architecture for the Power Quality Correction application:



Functional Breakdown of the Application (1/2)

Data Flow

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



Data Flow in Detail

INPUTS

The following data are required:

Electrical Measurements

Power (Demand) and Energy

All power (demand) values (kW, kVAR, kVA) and energy values (kWh, kVARh, kVAh) must be measured by certifed utility-grade energy meters (PowerLogic ION9000/PM8000). These meters have an equal or better accuracy than the utility meter to achieve appropriate shadow billing accuracy.

PowerLogic ION9000

PowerLogic PM8000

Other Energy Consumption Inputs

- Gas
- Steam
- Water
- Heat Flow

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

DATA RECORDING AND TIME-STAMPING

For the Utility Bill Verification application, a time-stamp accuracy of +/- 1s is sufficient. The above energy measurements are recorded and timestamped on board smart equipment such as PowerLogic ION9000/PM8000.

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

To have the full view of device recording and time-stamping capabilities, refer to chart 2.2 in Part 2, page 46.

Note: For devices without onboard logging, there is a risk of data loss in case of communications failure.

Product, Software and Services: See page 177

Functional Breakdown of the Application (2/2)

Data Flow in Detail (cont.)

TIME SYNCHRONIZATION

To achieve accurate time-stamping of all power and energy data, 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

Shadow Billing

A comparison bill is established, based on demand (power) and energy measurements. The rate engine supports many different rate structures to take into account all contractual aspects of the utility billing:

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

EcoStruxure™
Power Monitoring Expert

OUTPUTS

Display of outputs is performed remotely by EcoStruxure™ Power Monitoring Expert or EcoStruxure™ Power SCADA Operation with Advanced Reporting & Dashboards. The Billing Module must be deployed to benefit from these features.

EcoStruxure™
Power SCADA Operation
with Advanced
Reporting & Dashboards

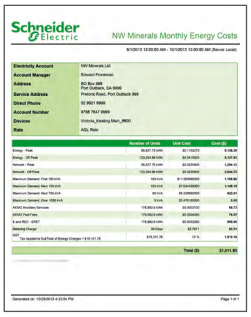
Reports

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 line items:

- Energy registers reading (start/end of billing period)
- Energy Consumption charge
- Transmission charge
- Line Maintenance charge
- On Peak and Off Peak usage charge
- Peak demand charge
- State tax
- Daily charge
- Processing fee
- Recycling fee
- Etc.



Billing report

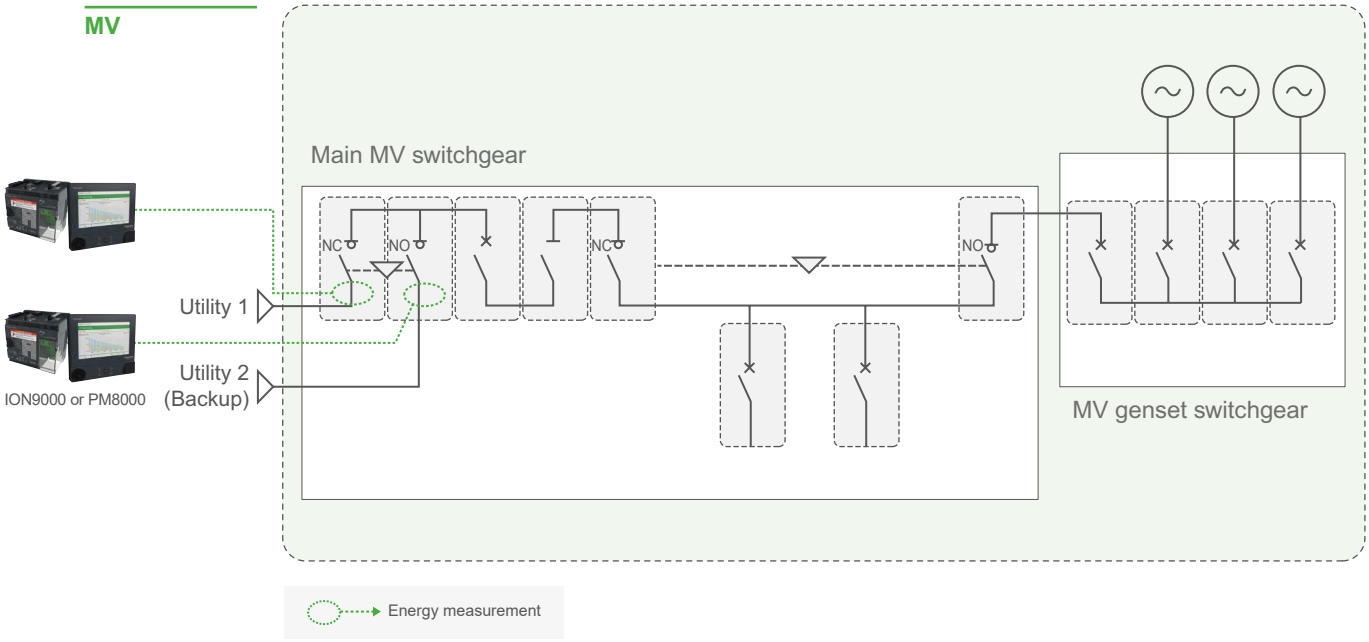
Product, Software and Services: See page 177

UTILITY BILL VERIFICATION

Electrical architecture

The following diagram explains in which area of the architecture the devices 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 serve for utility bill verification.



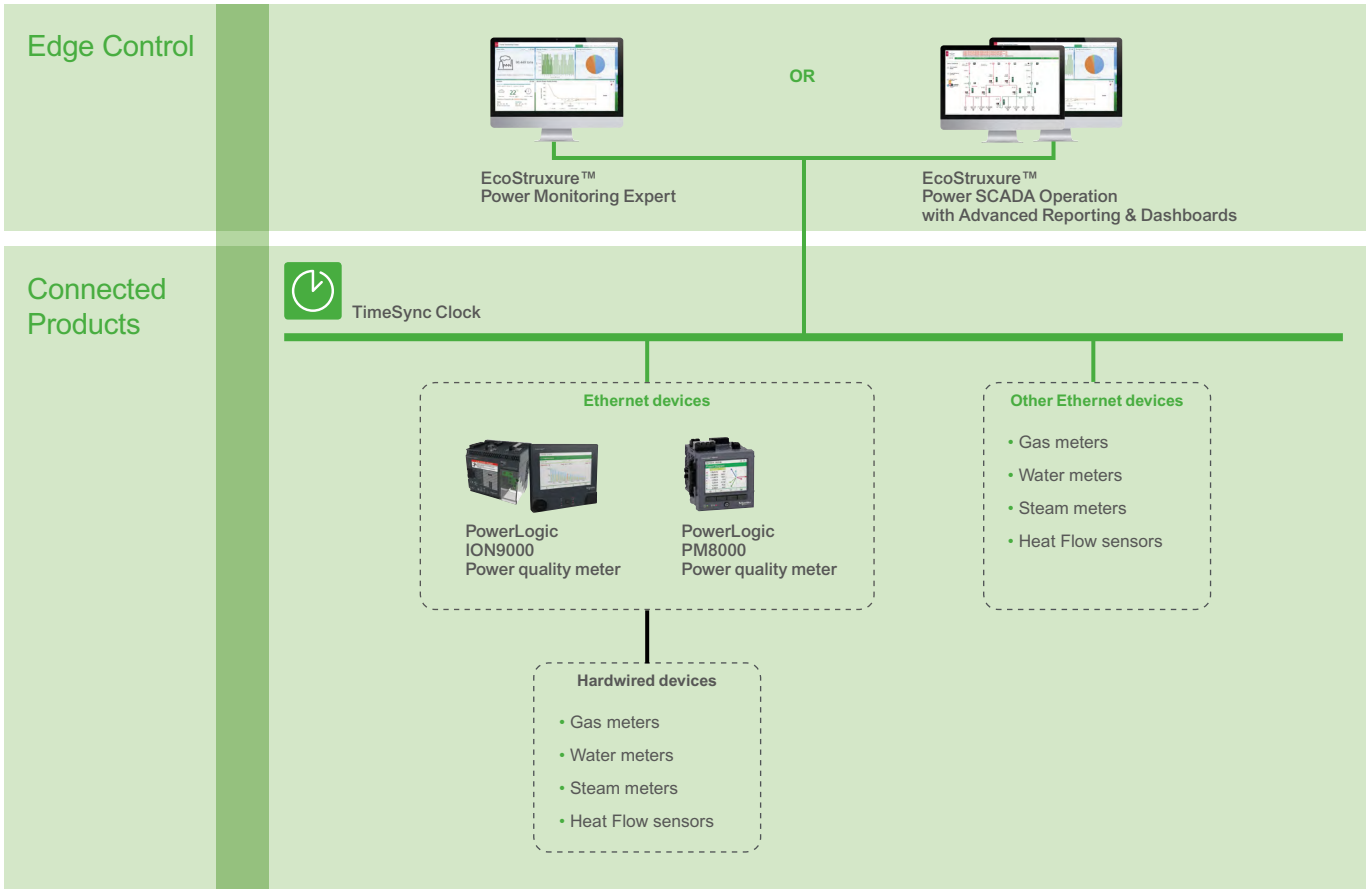
UTILITY BILL VERIFICATION

Digital Architecture

The digital architecture of the Utility Bill Verification application consists of utility-grade energy meters collecting accurate energy and demand (power) data. These data are then transferred by IP communication to the Edge Control (EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting and Dashboards) for reporting.

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

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

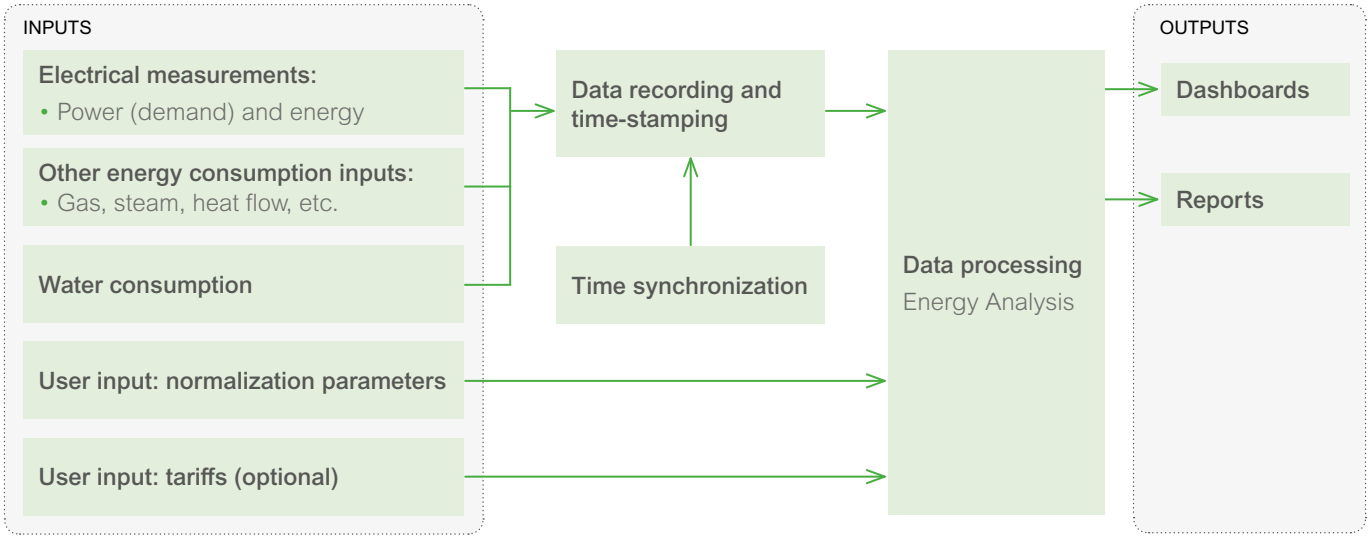


Ethernet - technical LAN
Hardwired

Functional Breakdown of the Application (1/4)

Data Flow

The Energy Benchmarking application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data are required:

Electrical Measurements

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

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

Connected products with embedded metering (Eg: 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 an 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.


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


Acti9 iEM3000


Easergy P3


Acti9 Smartlink & PowerTag


Masterpact MTZ with Micrologic X


Compact NSX with Micrologic


Galaxy VM/VX

Product, Software and Services: See page 177

Functional Breakdown of the Application (2/4)

Data Flow in Detail (cont.)

INPUTS (cont.)

User Input: Tariffs (optional)

Tariffs can be used to convert energy or water consumption into costs

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 SCADA Operation with Advanced Reporting and Dashboards.

TIME SYNCHRONIZATION

To have accurate time-stamping of all power and energy data, 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 RECORDING AND TIME-STAMPING

For the Energy Benchmarking application, a time-stamp accuracy of ±1s 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 (as well as legacy connected products such as ION7650/7550) and some models of the PM5000 (PM53xx and PM55xx) can timestamp and record onboard energy measurements as well as connected equipment states.


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


PowerLogic ION7650

For other connected products (Easergy P3, Masterpact MTZ, lower end models of PowerLogic PM5000) energy measurements and equipment states are acquired by the connected products and recorded by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards.

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

To have the full view of device recording and time-stamping capabilities, refer to chart 2.2 in Part 2, page 46.

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 SCADA 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.


EcoStruxure™ Power Monitoring Expert


EcoStruxure™ Power SCADA Operation with Advanced Reporting & Dashboards

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

Product, Software and Services: See page 177

Functional Breakdown of the Application (3/4)

Data Flow in Detail (cont.)

OUTPUTS

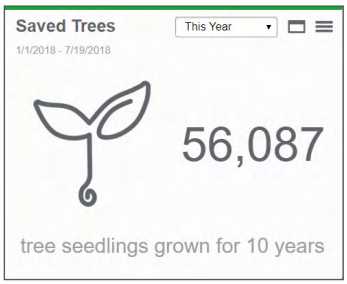
Display of outputs is performed by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting and Dashboards.

Dashboards

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

Energy equivalency gadget

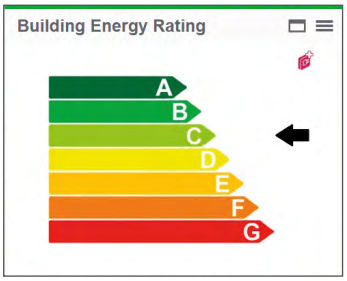
Shows a single value that is equivalent to the aggregated consumption input data, over a selected time period.
The value can be scaled or normalized to represent a consumption equivalent measurement. The information is shown as a numeric value with unit, a custom text, and a custom graphic.



Energy equivalency gadget

Building energy rating (BER) gadget

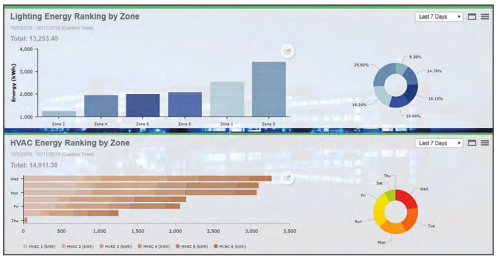
Displays a graphical representation of the energy performance of a building. It is similar to energy ratings commonly displayed on consumer products.



Building energy rating gadget

Consumption ranking gadget*

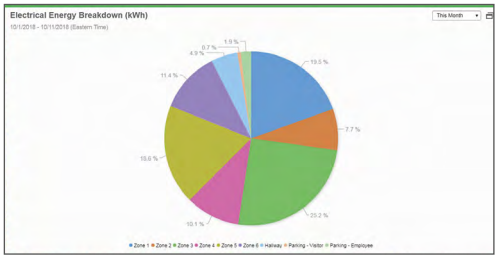
Compares the consumption of different loads, areas, processes or buildings over a period of time.



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.

Product, Software and Services: See page 177

Functional Breakdown of the Application (4/4)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

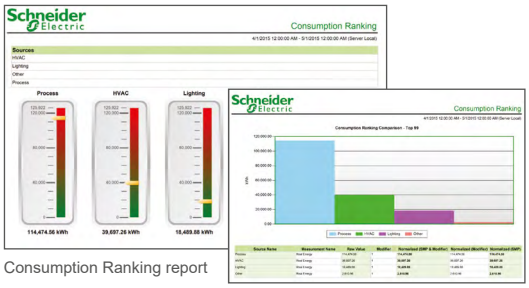
Display of outputs is performed by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting and Dashboards.

Reports

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

Consumption ranking Report

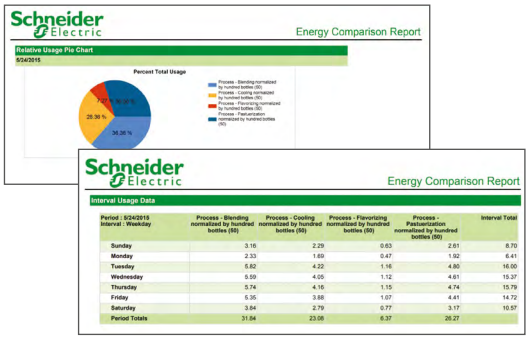
- Displays the relative ranking of energy consumption for one or more source/measurement pairs. Consumption data can be normalized to facilitate comparison.
- Intended to assist in building energy awareness through relative visualization



Consumption Ranking report

Energy comparison report

- Allows the comparison of 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.



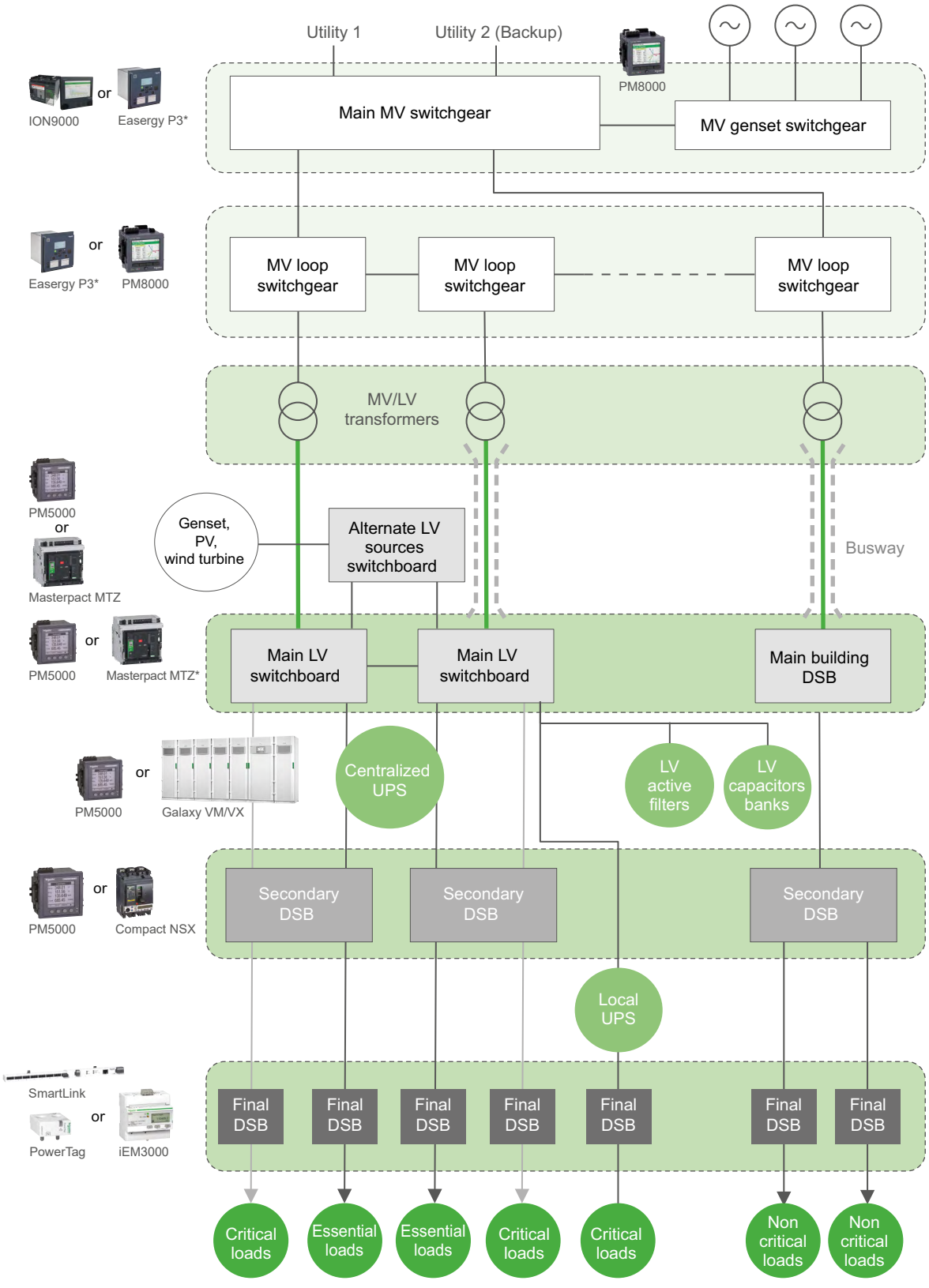
Energy comparison report

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

Product, Software and Services: See page 177

Electrical architecture

The following diagram explains in which area of the architecture the connected products should be installed, in order to implement the Energy Benchmarking Analysis Application.



* Or legacy offers

DSB = Distribution Switchboard

Digital architecture

1

The digital architecture of the Energy Benchmarking application uses recommended 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 SCADA Operation with Advanced Reporting & Dashboards) for data processing, visualization and reporting.

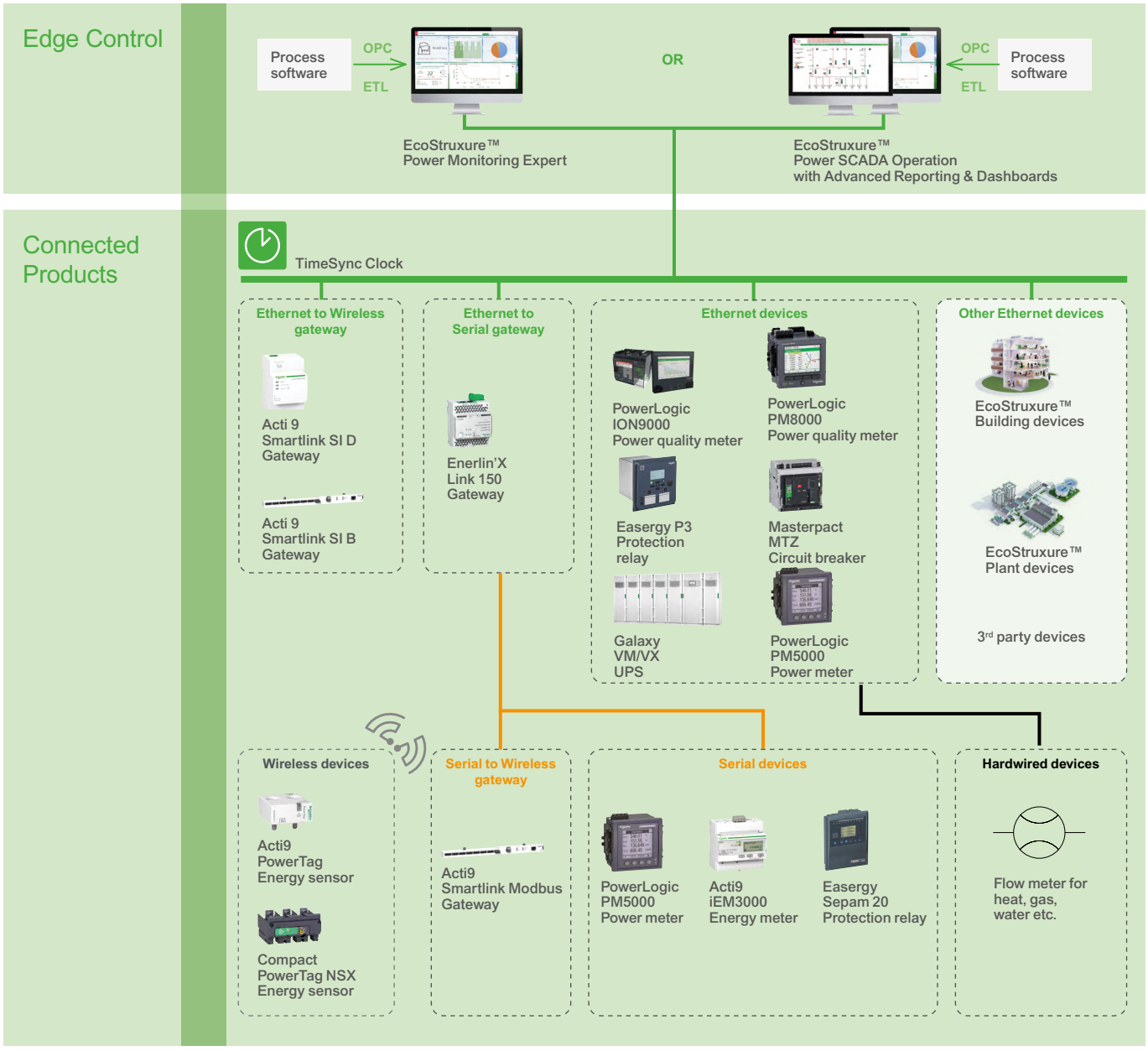
Other energy consumption inputs and equipment states can also be directly acquired over Ethernet or through hardwired signals from basic meters and sensors.

Here below is the recommended digital architecture for Energy Benchmarking:

2

3

4

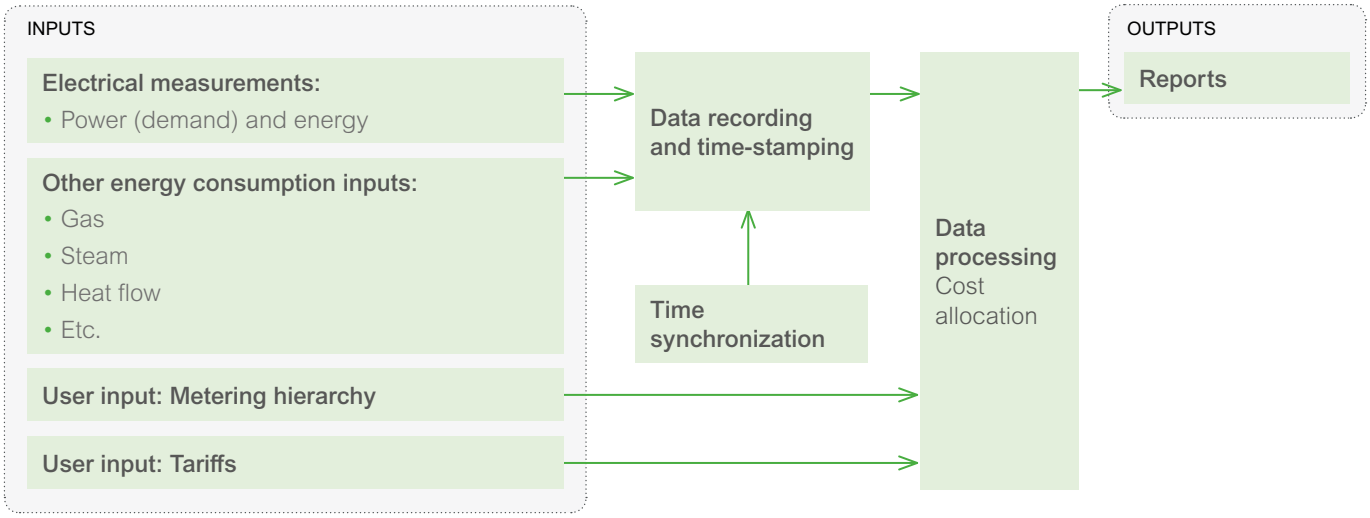


Ethernet - technical LAN
Serial
Hardwired
Wireless

Functional Breakdown of the Application (1/3)

Data Flow

The Cost Allocation application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data are required:

Electrical Measurements

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

These data may be acquired from power/energy meters such as PowerLogic ION9000, PM8000, PM5000, 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 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.

PowerLogic ION9000 | PowerLogic PM8000

PowerLogic PM5000 | Acti9 iEM3000

Easergy P3

Masterpact MTZ with Micrologic X | Compact NSX with Micrologic

Other Energy Consumption Inputs

- 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

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

User Input: Tariffs

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

Product, Software and Services: See page 177

Functional Breakdown of the Application (2/3)

Data Flow in Detail (cont.)

DATA RECORDING AND TIME-STAMPING

For the Cost Allocation application, a time-stamp accuracy of ±1s is sufficient. Advanced meters such as the PowerLogic ION9000, PM8000 (as well as legacy connected products such as PowerLogic ION7650/7550) and some models of the PowerLogic PM5000 (PM53xx and PM55xx) can timestamp and record onboard energy measurements as well as connected equipment states.

For other connected products (Easergy P3, Masterpact MTZ, lower end models of PowerLogic PM5000) energy measurements and equipment states are acquired by the connected products and recorded by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards.

For the Power Quality Compliance application, a time accuracy of ±1s is sufficient.

To have the full view of device recording and time-stamping capabilities, refer to chart 2.2 in Part 2, page 46.

Note: for connected products without onboard logging, there is a risk of data loss in case of communications failure.


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


PowerLogic ION7650

TIME SYNCHRONIZATION

To have accurate time-stamping of all power and energy data, 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

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 SCADA Operation with Advanced Reporting & Dashboards.


EcoStruxure™ Power Monitoring Expert


EcoStruxure™ Power SCADA Operation with Advanced Reporting & Dashboards

Product, Software and Services: See page 177

Functional Breakdown of the Application (3/3)

Data Flow in Detail (cont.)

OUTPUTS

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

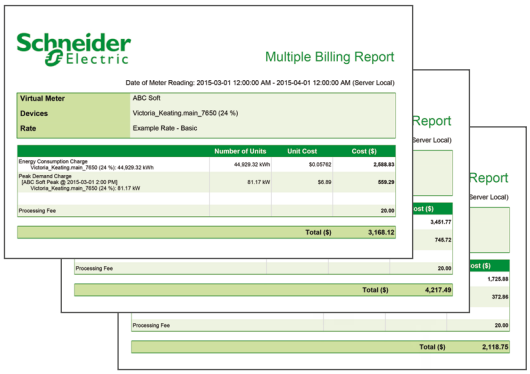
Reports

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

- **Billing Summary Report**

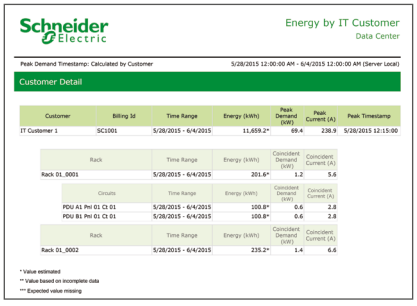
  Provides a summary view of Multiple Billing Report.

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.

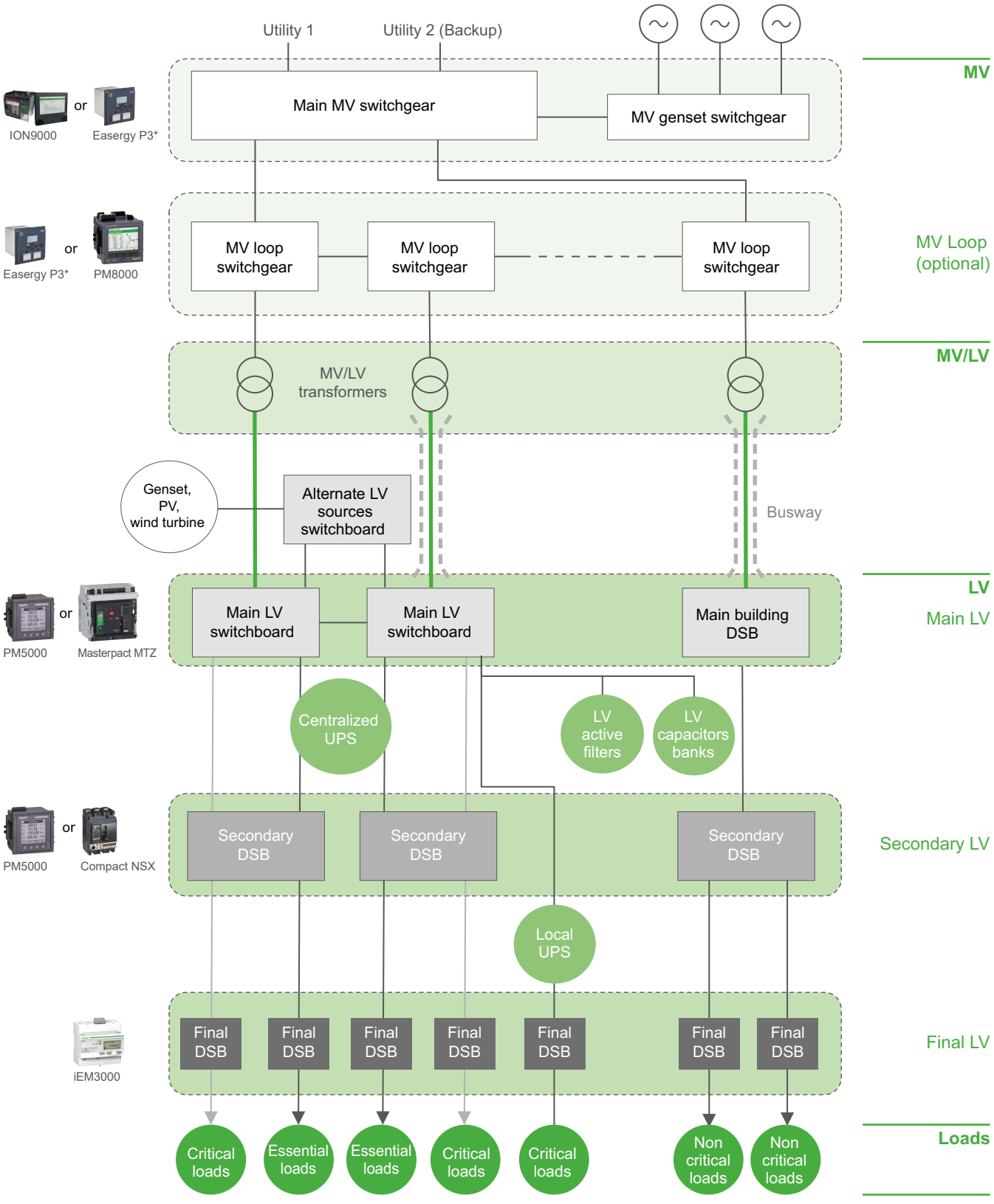


Energy by IT Customer

Product, Software and Services: See page 177

Power Architecture

The following diagram explains in which area of the architecture the connected products should be installed, in order to implement the Cost Allocation application.



* Or legacy offers

DSB = Distribution Switchboard

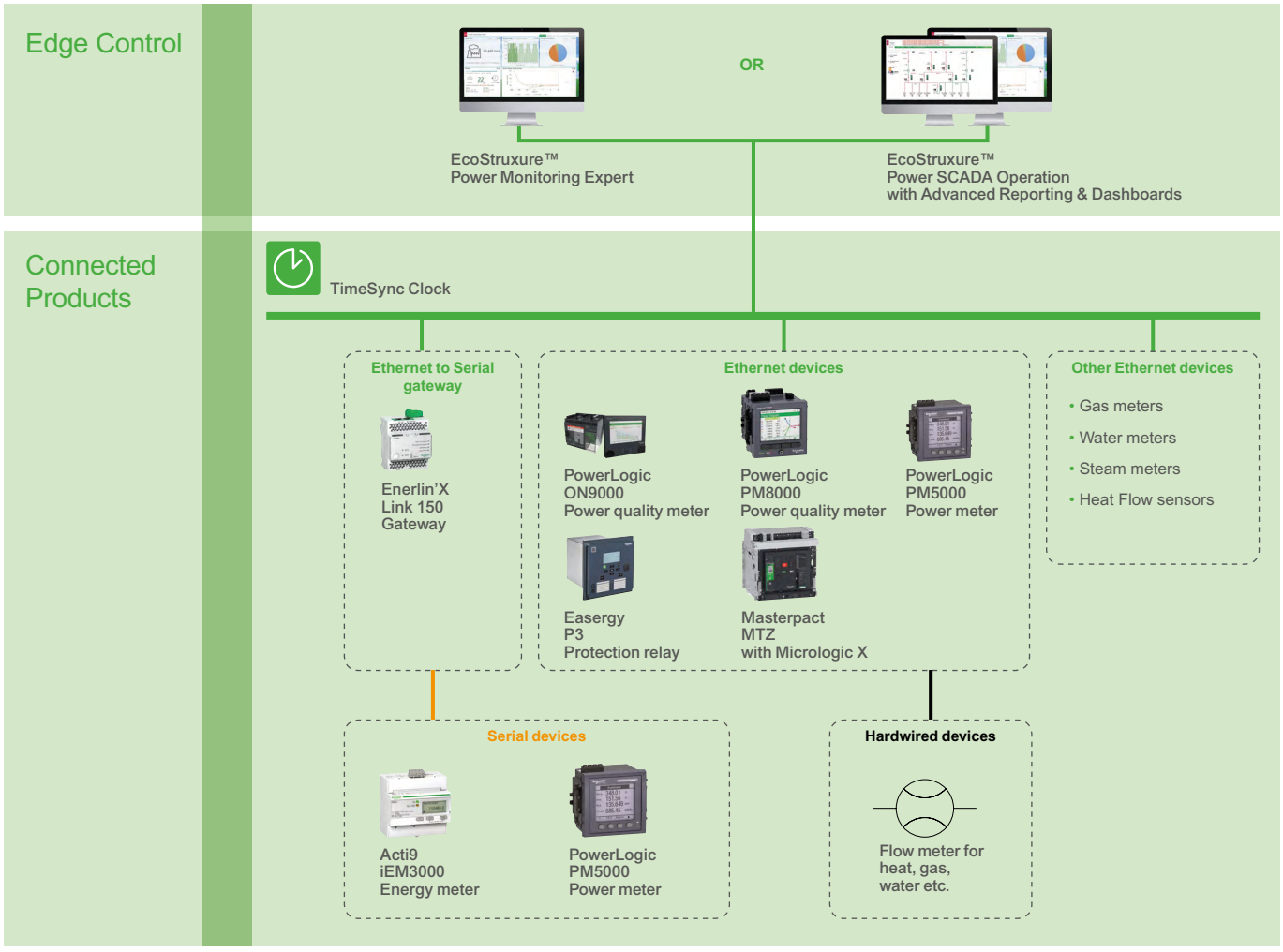
COST ALLOCATION

Digital Architecture

The digital architecture of the Cost Allocation application uses 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 SCADA Operation with Advanced Reporting & Dashboards) for data processing, visualization and reporting.

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

Here below is the recommended digital architecture for the Cost Allocation application:

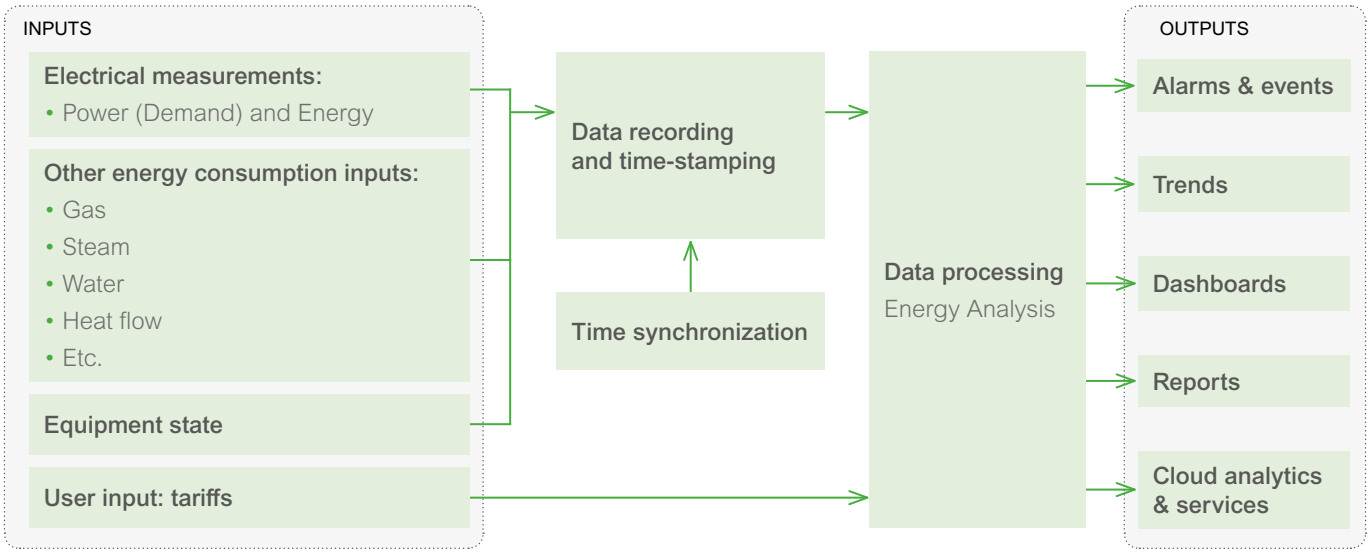


Ethernet - technical LAN
Serial
Hardwired

Functional Breakdown of the Application (1/10)

Data Flow

The Energy Usage Analysis and Energy Efficiency Compliance application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data are required:

Electrical Measurements

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

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

Connected products with embedded metering (e.g.: 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

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

Equipment State

To correlate Energy consumption with the different states of equipment and processes, those states must be monitored.

Examples:

- Process batch A/B/C…
- Equipment in Normal/Maintenance mode
- Motor Low/Medium/High speed
- Generator Starting/Running/Stopped
- ATS in Normal/Test/Emergency mode
- Etc.


PowerLogic ION9000

PowerLogic PM8000


PowerLogic PM5000


Acti9 iEM3000


Easergy P3


Acti9 Smartlink and Powertag


Masterpact MTZ with Micrologic X


Compact NSX with Micrologic


Galaxy VM/VX

Functional Breakdown of the Application (2/10)

Data Flow in Detail (cont.)

INPUTS (cont.)

Equipment State (cont.)

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 SCADA Operation with Advanced Reporting & Dashboards from customer systems through OPC or ETL*.

User Input: Tariffs

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

DATA RECORDING AND TIME-STAMPING

For the Energy Usage Analysis and Energy Efficiency Compliance applications, a time-stamp accuracy of ±1 s is sufficient.

Advanced meters such as the ION9000, PM8000 (as well as legacy connected products such as ION7650/7550) and some models of the PM5000 (PM53xx and PM55xx) can time-stamp and record onboard energy measurements as well as connected equipment states.

For other connected products (Easergy P3, Masterpact MTZ, lower and models of PM5000) energy measurements and equipment states are acquired by the connected products and recorded by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards.

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

To have the full view of device recording and time-stamping capabilities, refer to chart 2.2 in Part 2, page 46.

TIME SYNCHRONIZATION

To have accurate time-stamping of all power and energy data, 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

Specialized dashboards and the 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…)
- Assess energy usage by process area or by product output
- Highlight what factors (process state, external conditions…) contribute most to energy usage

Energy data processing is embedded in the reporting engine and in the dashboards of EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards.

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

EcoStruxure™
Power Monitoring Expert

EcoStruxure™
Power SCADA Operation
with Advanced
Reporting & Dashboards

PowerLogic
ION9000

PowerLogic
PM8000

PowerLogic
PM5000

PowerLogic
ION7650

TimeSync Clock

Product, Software and Services: See page 177

Functional Breakdown of the Application (3/10)

Data Flow in Detail (cont.)

OUTPUTS

Display of outputs is performed by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards except in specified 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 SCADA Operation
with Advanced
Reporting & Dashboards

Alarms & Events

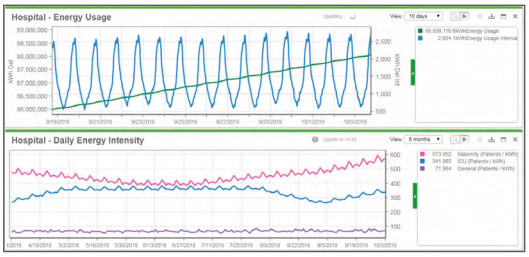
In EcoStruxure™ Power Monitoring expert:

- Smart setpoints offer threshold-based alarming on energy usage

Trends

- Energy Usage trending

All input data detailed above can be visualized as trends.



Energy Usage Trending

Dashboards

All dashboards can be configured to run automatically in slide show mode to perform the function of an "Energy Kiosk".

- Generic data visualization dashboards:
  - to analyze energy consumption parameters by day of the week, hour of the day, season etc.
  - to compare different energy consumption parameters between buildings, areas or departments and load types
  - to detect increasing energy consumption caused by deteriorating equipment

Dashboard

Product, Software and Services: See page 177

Functional Breakdown of the Application (4/10)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

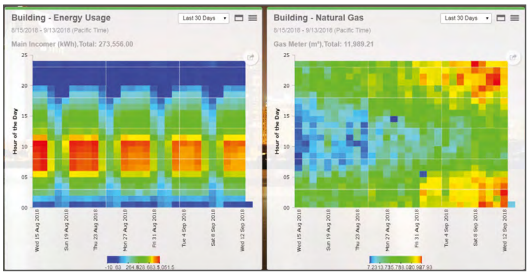
Dashboards (cont.)

Energy Usage Gadgets*

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

- **Heat Map gadget**

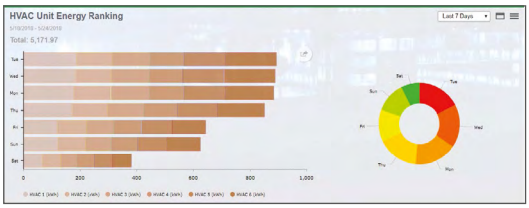
  Creates a graphical representation of data where the individual values are represented as colors in a matrix format. This gadget can be used with consumption data to identify usage patterns and anomalies.



Heat Map gadget

- **Consumption/Aggregated Consumption Ranking gadget**

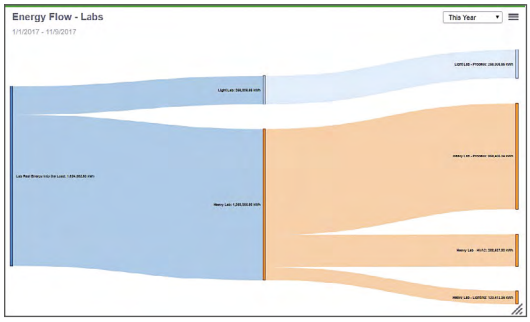
  Compares the consumption of consumers during specific time intervals, for example by hour, by day of week, or by day.



Consumption/Aggregated Consumption Ranking gadget

- **Sankey gadget**

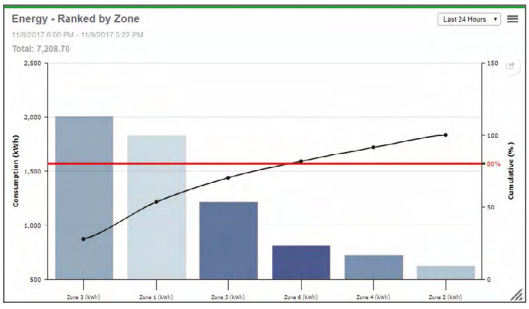
  - Shows a flow diagram, in which the width of the arrows is proportional to the data values. The diagram starts as a combined flow for all the selected consumers, and then breaks out into individual flows for each consumer.
  - Used to show WAGES consumption broken down by load type, or to visualize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



Sankey gadget

- **Pareto/Aggregated Pareto Chart gadgets**

  - Used to perform an 80/20 analysis, identifying those consumers that together make up the largest portion, or 80% of the overall consumption.
  - Shows consumption data, by consumer, for multiple consumers, 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 gadgets

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

Product, Software and Services: See page 177

Functional Breakdown of the Application (5/10)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

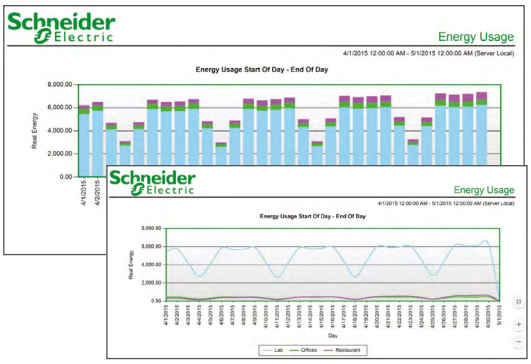
Reports

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

Energy Management reports:

- **Energy Usage report**

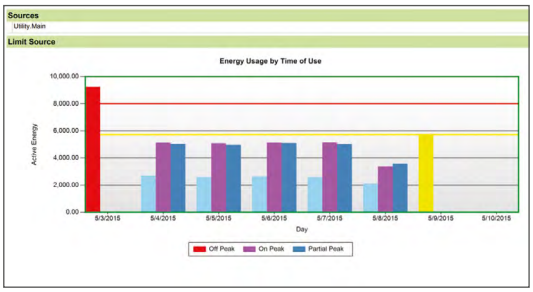
  Highlights discrepancies and provides a visual interpretation of energy consumption data.



Energy Usage report

- **Energy Usage by Time of Use report**

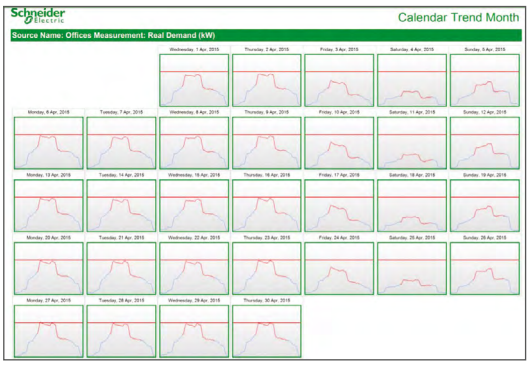
  Compares consumption for different time of use periods (e.g.: On-peak vs off-peak vs partial-peak).



Energy Usage by Time of Use report

- **Calendar Trend report**

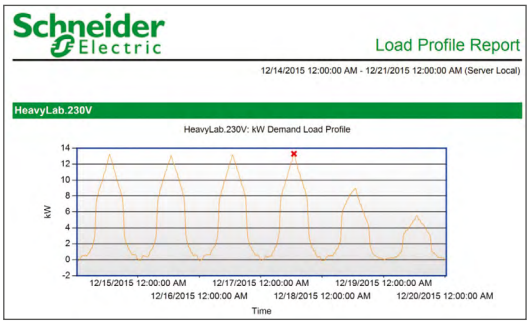
  Provides a monthly or weekly interpretation of hourly. Usage data, enchmarks performance targets, and identifies peak and off-peak usage patterns.



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

Product, Software and Services: See page 177

Functional Breakdown of the Application (6/10)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

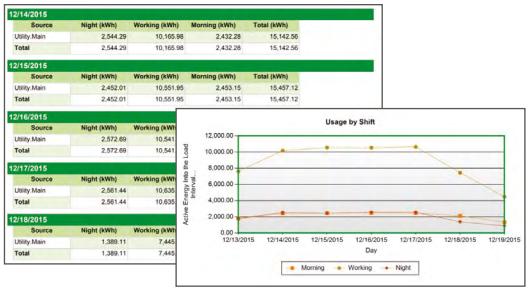
Reports (cont.)

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

Energy Management reports:

- **Energy Usage by Shift report**

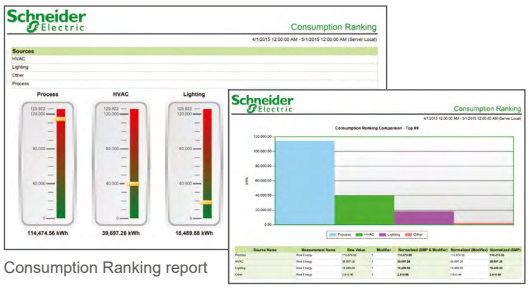
  Compares a measurement from multiple devices for specified time periods (or shifts). This allows comparison of energy usage between shifts (for example, 6:00-1:00 vs. 1:00 to 8:00).



Energy Usage by Shift report

- **Consumption Ranking report**

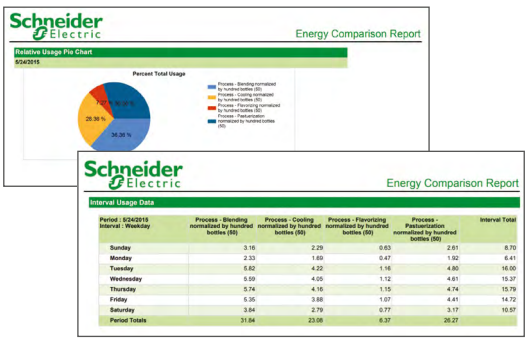
  Highlights the relative ranking of energy consumption for several loads or areas. Consumption data can be normalized to facilitate the comparison. This report is intended to assist in building energy awareness through relative visualization.



Consumption Ranking report

- **Energy comparison report**

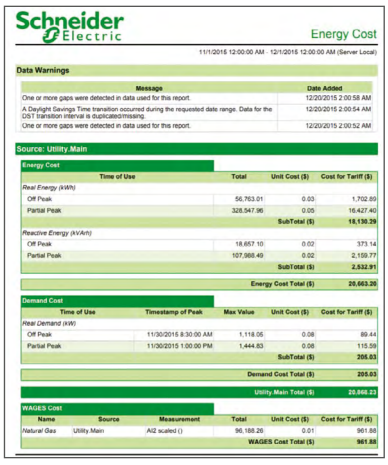
  Compares energy consumption by process, equipment or area.



Energy comparison report

- **Energy cost report**

  Converts energy consumption into costs by applying the relevant tariffs.



Energy cost report

Product, Software and Services: See page 177

Functional Breakdown of the Application (7/10)

Data Flow in Detail (cont.)

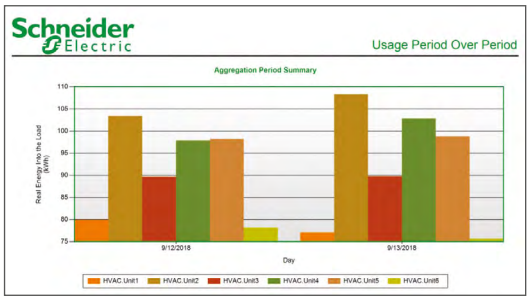
OUTPUTS (cont.)

Reports (cont.)

Energy Management reports (cont.):

- **Energy period over period report**

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

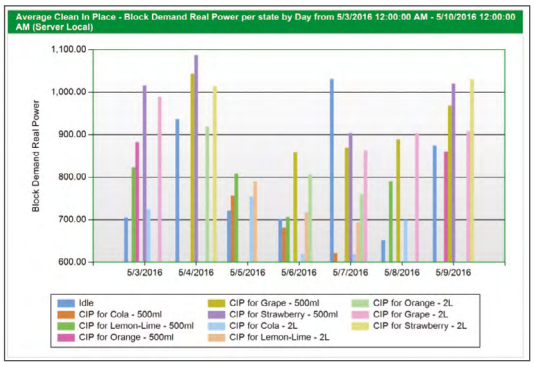


Energy period over period report

Energy Analysis reports*:

- **Power usage per state report***

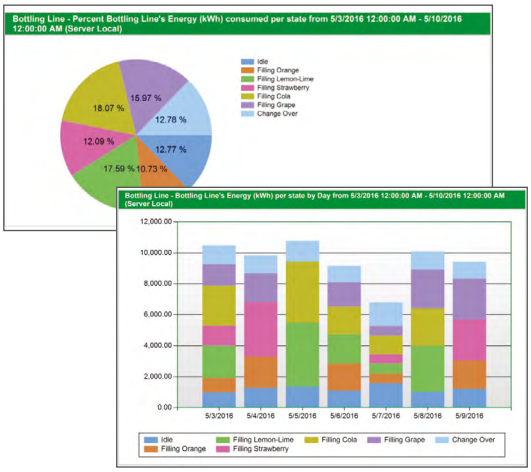
  Details power usage per state of operation of a machine or process.



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 177

Functional Breakdown of the Application (8/10)

Data Flow in Detail (cont.)

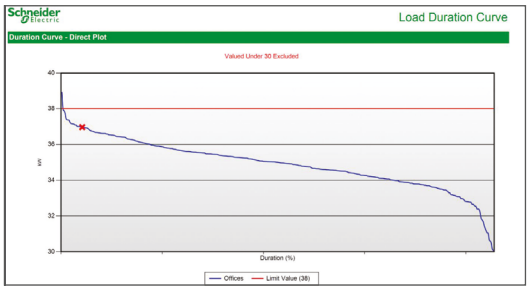
OUTPUTS (cont.)

Reports (cont.)

Energy Analysis reports* (cont.):

- **Duration Curve report***

  Shows distribution of power consumption versus duration to detect potential capacity or utilization issues.

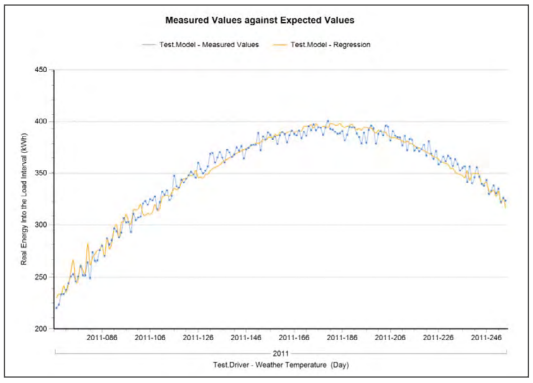


Duration Curve report

- **Energy Modeling report***

  Analyzes energy consumption versus related energy drivers such as outside temperature, occupancy, productivity etc.

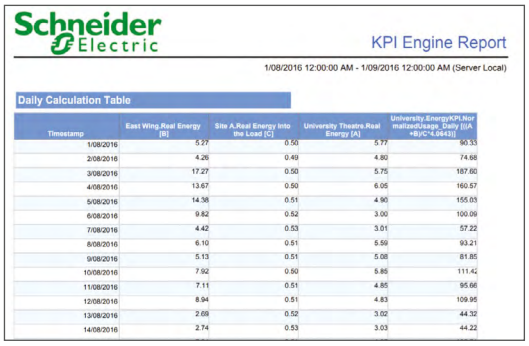
  See Energy Performance Analysis & Verification application.



Energy Modeling report*

- **KPI Engine report***

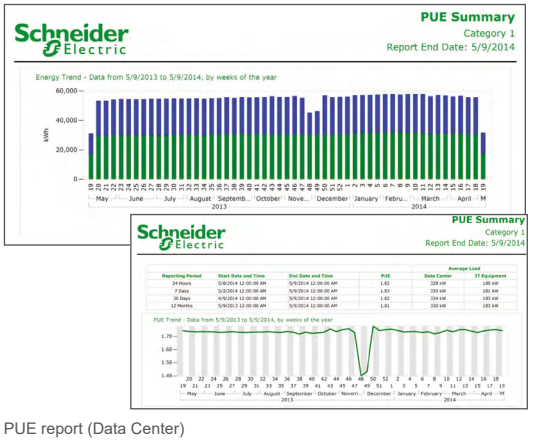
  Allows the calculation of complex energy KPIs.



KPI Engine report

- **PUE report (Data Center)***

  Displays and analyzes of Power Usage Effectiveness by day, week, month and year. Compares the IT loads and support loads.



PUE report (Data Center)

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

Product, Software and Services: See page 177

Functional Breakdown of the Application (9/10)

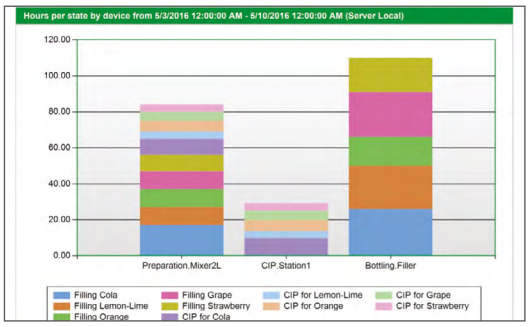
Data Flow in Detail (cont.)

OUTPUTS (cont.)

Reports (cont.)

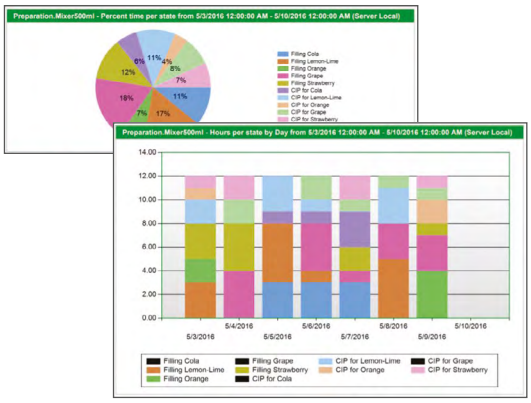
Energy Analysis reports* (cont.):

- **Multi-equipment operation report***
  Compares duration per state per machine or process.



Multi-equipment operation report

- **Single equipment operation report***
  Compares duration per state for a single machine or process.



Single equipment operation report

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

Product, Software and Services: See page 177

Functional Breakdown of the Application (10/10)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

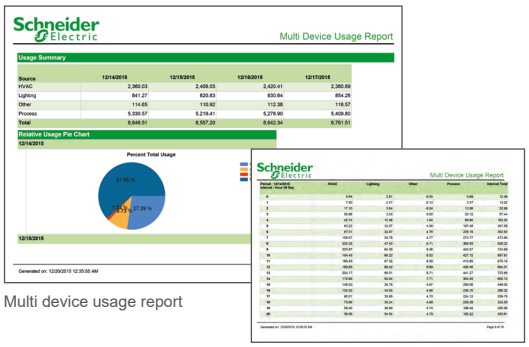
Reports (cont.)

Usage Trending reports:

- **Multi device usage report**

  Use the Multi Device Usage report template to view consumption information for multiple devices.

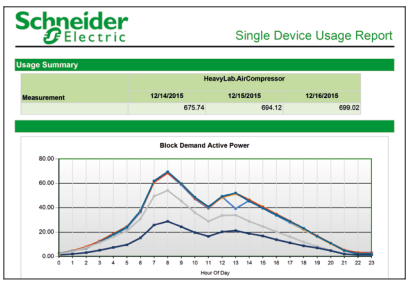
  View energy usage for a single period, or compare two periods, for example, this month versus last month.



Multi device usage report

- **Single device usage report**

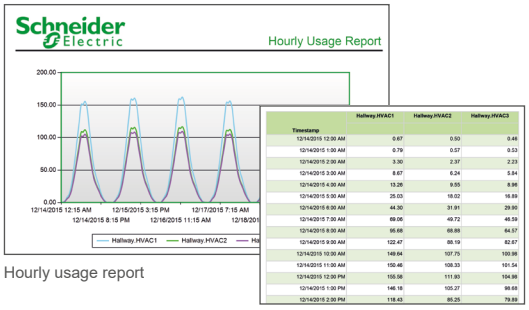
  Use the Single Device Usage report template to view energy information for one device. View energy usage for a single period, or compare two periods, for example, this month versus last month.



Single device usage report

- **Hourly usage report**

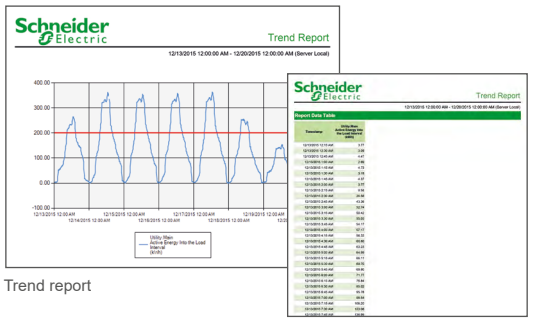
  Displays usage of various types of quantities (such as consumption of Water, Natural Gas, and so on) per hour for a specific day. A single report might contain consumption figures for different types of measurements from more than one source.



Hourly usage report

- **Trend report**

  Use the Trend report template to create a report that displays trend information in a line, column, bar, or pie chart. Select devices and measurements for a selected period of time.



Trend report

Cloud Analytics & Services

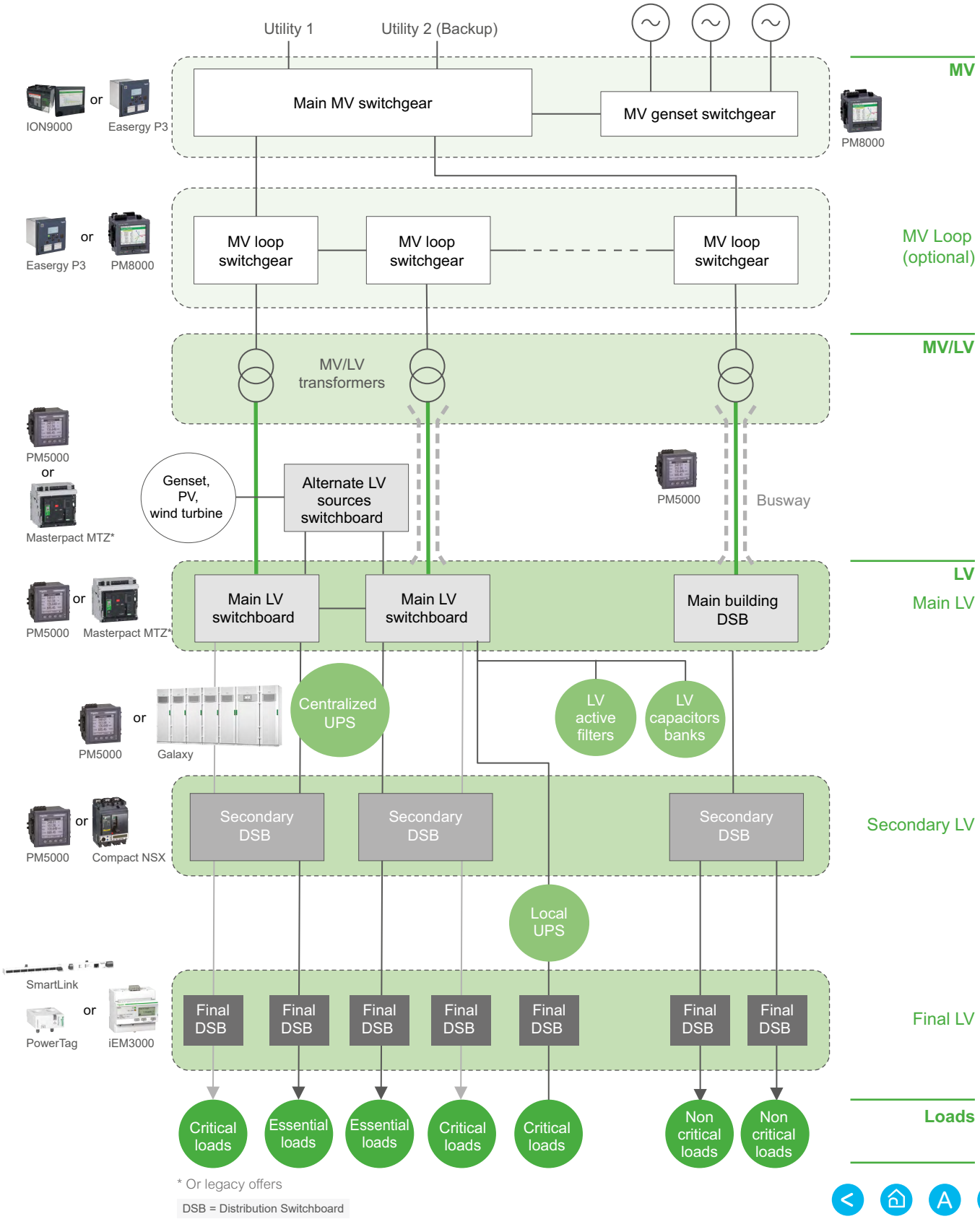
EcoStruxure™ Power Advisor System health checks can be used to ensure data is accurate and reliable for Energy Usage Analysis. For more details, refer to the Data Quality Management application.

Product, Software and Services: See page 177

EcoStruxure™ Power Advisor

Electrical Architecture

The following diagram explains in which area of the architecture the connected products should be installed, in order to implement the Energy Usage Analysis and Energy Efficiency Compliance applications.



* Or legacy offers

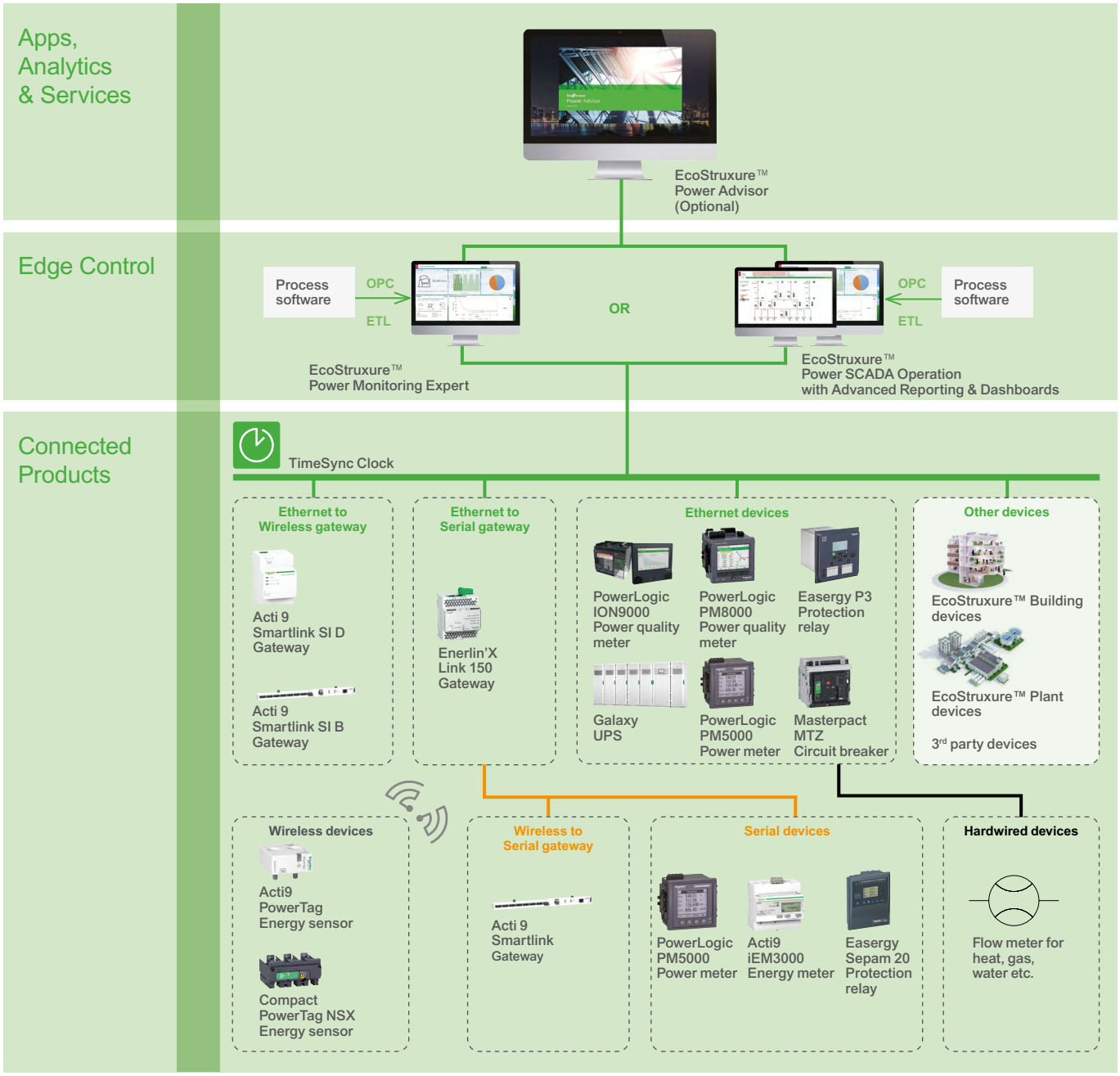
DSB = Distribution Switchboard

Digital Architecture

The digital architecture of the Energy Usage Analysis and Energy Efficiency Compliance applications uses recommended 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 SCADA Operation with Advanced Reporting & Dashboards) for data processing, visualization and reporting.

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

To include customer process or equipment related data in the analyses, OPC or ETL can be used to acquire data from external process software. Here below is the recommended digital architecture for the Energy Usage Analysis and Energy Efficiency Compliance applications:

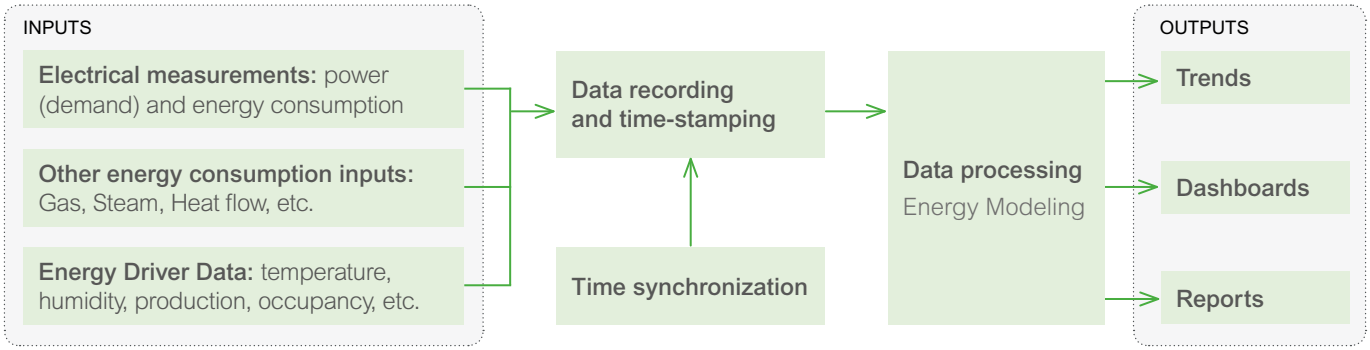


Ethernet - technical LAN
Serial
Hardwired
Wireless

Functional Breakdown of the Application (1/3)

Data Flow

The Energy Performance Analysis and Verification application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data are required:

Electrical Measurements

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

These data may be acquired from power/energy meters such as PowerLogic ION9000, PM8000, PM5000, Acti9 iEM3000, Powertag, 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 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.


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


Acti9 iEM3000


Acti9 Smartlink and Powertag


Easergy P3


Masterpact MTZ with micrologic


Compact NSX with Micrologic

Other Energy Consumption Inputs

To have a complete model of energy consumption, other sources of energy should also be considered:

- Gas
- Steam
- Heat Flow
- Etc.

These energy data can be acquired via digital/analog inputs on meters or directly via Modbus from third party devices.

Energy Driver Data

Any data which might have an impact on energy consumption should be included. 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 user systems through OPC or ETL, or imported from XML web feeds.

Functional Breakdown of the Application (2/3)

Data Flow in Detail (cont.)

DATA RECORDING AND TIME-STAMPING

Advanced meters such as the PowerLogic ION9000, PM8000 (as well as legacy connected products such as ION7650/7550) and some models of the PM5000 (PM53xx and PM55xx) can timestamp and record onboard energy measurements.
For other connected products (Easergy P3, Masterpact MTZ, lower end models of PowerLogic PM5000) energy measurements are acquired by the connected products and recorded by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards.
When acquiring data from other user systems, timestamps are also be imported through OPC or ETL*.
For the Energy Perfomance Analysis & Verification application, a time accuracy of ±1s is sufficient.

To have the full view of device recording and time-stamping capabilities, refer to chart 2.2 in Part 2, page 46.

PowerLogic ION9000

PowerLogic PM8000

PowerLogic PM5000

PowerLogic ION7650

TIME SYNCHRONIZATION

To have accurate time-stamping of all power, energy data and driver data, 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

Energy Modeling

Based on acquired input data, a regression analysis is performed to define a model of energy/power in relation with different energy drivers. The application uses this model to forecast consumption, highlight unexpected changes in consumption or verify savings resulting from energy conservation measures.

Please note that 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 Energy Analysis Reports Module of EcoStruxure™ Power Monitoring Expert and Power SCADA Operation with Advanced Reporting & Dashboards.

EcoStruxure™
Power Monitoring Expert

EcoStruxure™
Power SCADA Operation
with Advanced
Reporting & Dashboards

OUTPUTS

Display of outputs is performed remotely by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards.

The Energy Analysis Reports Module of EcoStruxure™ Power Monitoring Expert and Power SCADA Operation with Advanced Reporting & Dashboards must be deployed to benefit from these features.

Trends

Modeled data can be saved in the database and visualized as a trend.

Dashboards

Modeled data can be saved in the database and visualized as a dashboard.

Example of dashboard

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

Functional Breakdown of the Application (3/3)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

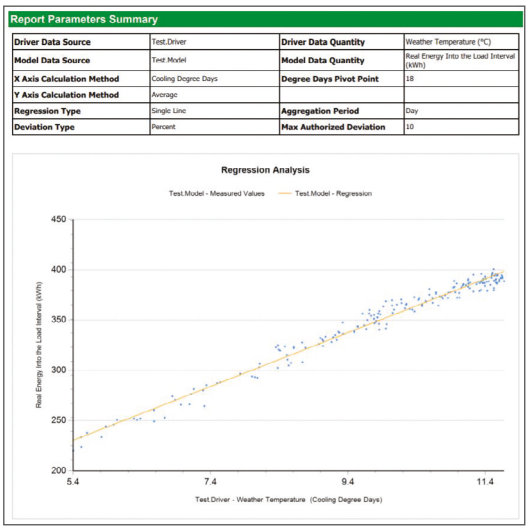
Reports

The first step in the use of the Energy Performance Analysis & Verification application is to build an energy model (using the "Create Model report"). This energy model is then used for the various analyses and verifications (with the "Use Model report").

Create Model report

This report is used to create a model of a facility or process compared to various energy drivers such as outside temperature, production volumes, etc. After the model has been created, this report will not need to be run unless a new model needs to be created.

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 EcoStruxure™ Power Monitoring Expert database for the reporting period.



Create Model report

Use Model report

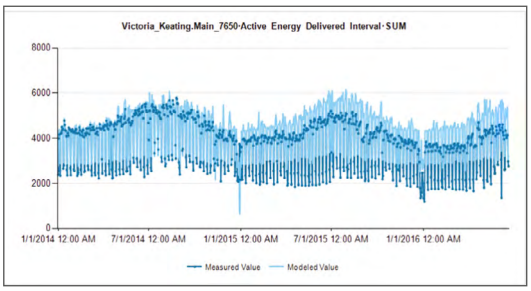
The Use Model report shows the expected consumption of a facility or process, based on a model created with the Create Model report. The report shows a graphical representation of the modeled data, the actually measured data, and the delta between the two. It also includes tables with numeric data. The objective is to compare expected consumption to actual consumption in order to:

- identify unexpected changes in consumption related to abnormal load use or load malfunction
- identify actual savings as a result of energy conservation measures

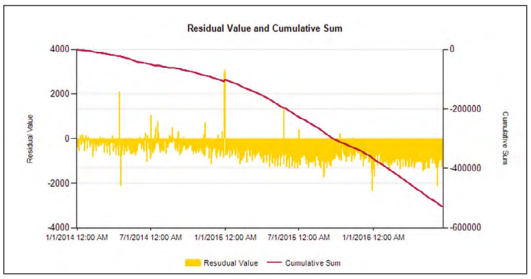
This report can be generated and displayed on-demand or automatically generated and sent by e-mail.

Note: The report is not limited to energy consumption modeling. It can be used to model any quantity that is dependent on drivers, for example power factor based on power demand.

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 EcoStruxure™ Power Monitoring Expert database for the reporting period.



Use Model report: comparison between expected and actual energy consumption

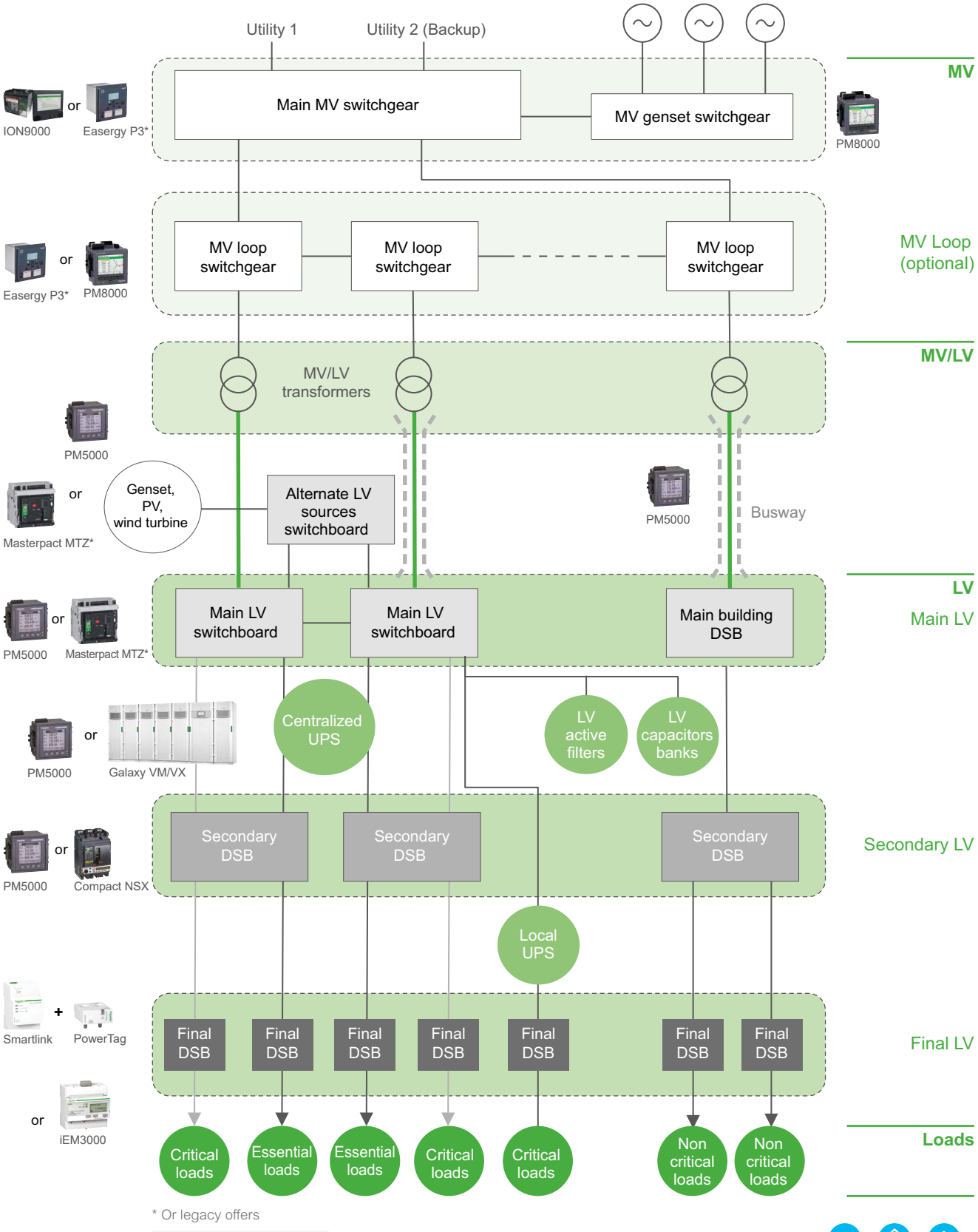


Use Model report: residual value & cumulative sum of difference between expected and actual energy consumption

Product, Software and Services: See page 177

Electrical Architecture

The following diagram explains in which area of the architecture the connected products should be installed, in order to implement the Energy Usage Analysis application.



* Or legacy offers

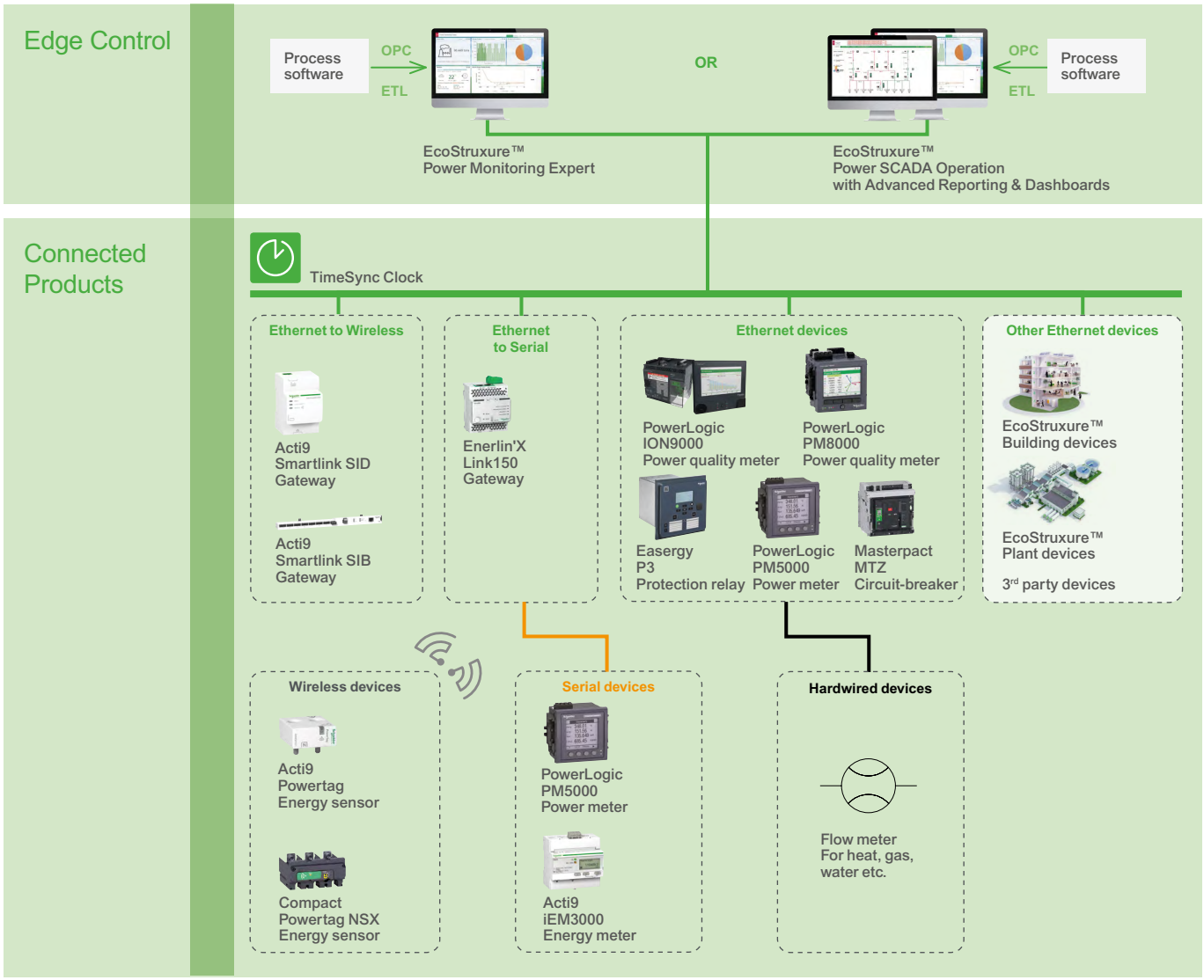
DSB = Distribution Switchboard

Digital Architecture

The digital architecture of the Performance Analysis & Verification application uses recommended direct Ethernet connection to energy meters or gateways. Data is captured onboard connected products and uploaded into the edge control software (EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards) for data processing, visualization and reporting.

Other energy consumption inputs can also be directly acquired over Ethernet or serial communication.

Here below is the recommended digital architecture for the Energy Performance Analysis & Verification application:

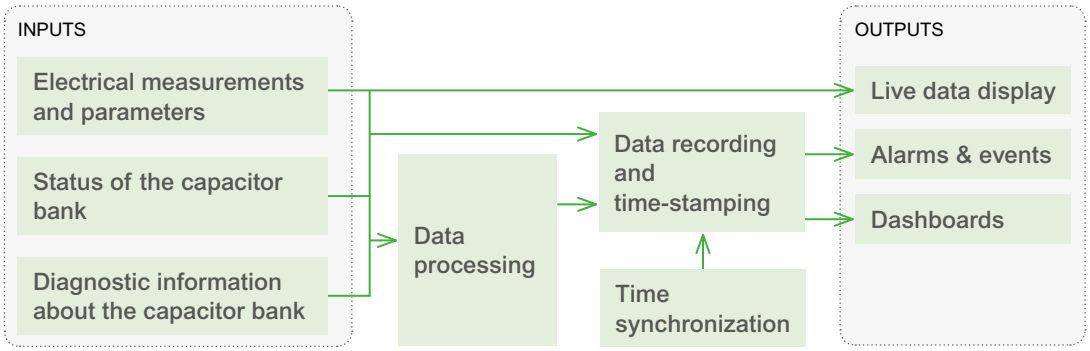


Ethernet - technical LAN
Serial
Hardwired
Wireless

Functional Breakdown of the Application (1/2)

Data Flow

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



Data Flow in Detail

INPUTS

The following data are 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.

PowerLogic ION9000

PowerLogic PM8000

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, over current
- 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.

VarPlus Logic

VarSet

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 SCADA Operation with Advanced Reporting & Dashboards).

EcoStruxure™ Power Monitoring Expert

Functional Breakdown of the Application (2/2)

Data Flow in Detail (cont.)

DATA RECORDING AND TIME-STAMPING

For Power Factor Correction equipment, data recording is performed by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards, based on real-time values acquired by the driver.
For the power quality meters located at the service entrance, data recording is performed onboard the device(s). For these device(s), time synchronization is required with a recommended accuracy of +/-100 ms or better.

To have the full view of device recording and time-stamping capabilities, refer to chart 2.2 in Part 2, page 46.

EcoStruxure™
Power SCADA Operation
with Advanced
Reporting & Dashboards

TIME SYNCHRONIZATION

To have a consistent chronological view of all events which happen throughout the facility, 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.

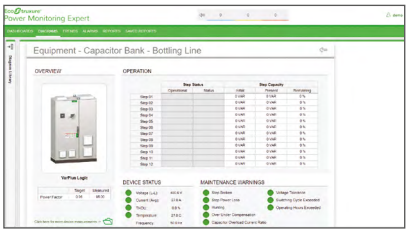
TimeSync Clock

OUTPUTS

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

Live Data Display

Live data acquired by the software driver can be visualized in Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards through equipment diagrams. The real-time data displayed include electrical measurements, operating modes, statuses and maintenance indicators.



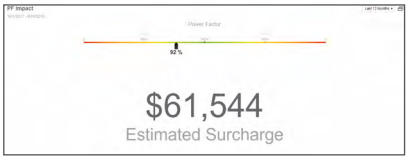
Default diagram for capacitor banks

Alarms & Events

Events and alarms are generated by the Edge Control Software upon change of the statuses. The events are time-stamped by the PC, recorded and visualized in the software's default alarms interface as diagnostics alarms.

Trends

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



Power Factor Impact dashboard

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

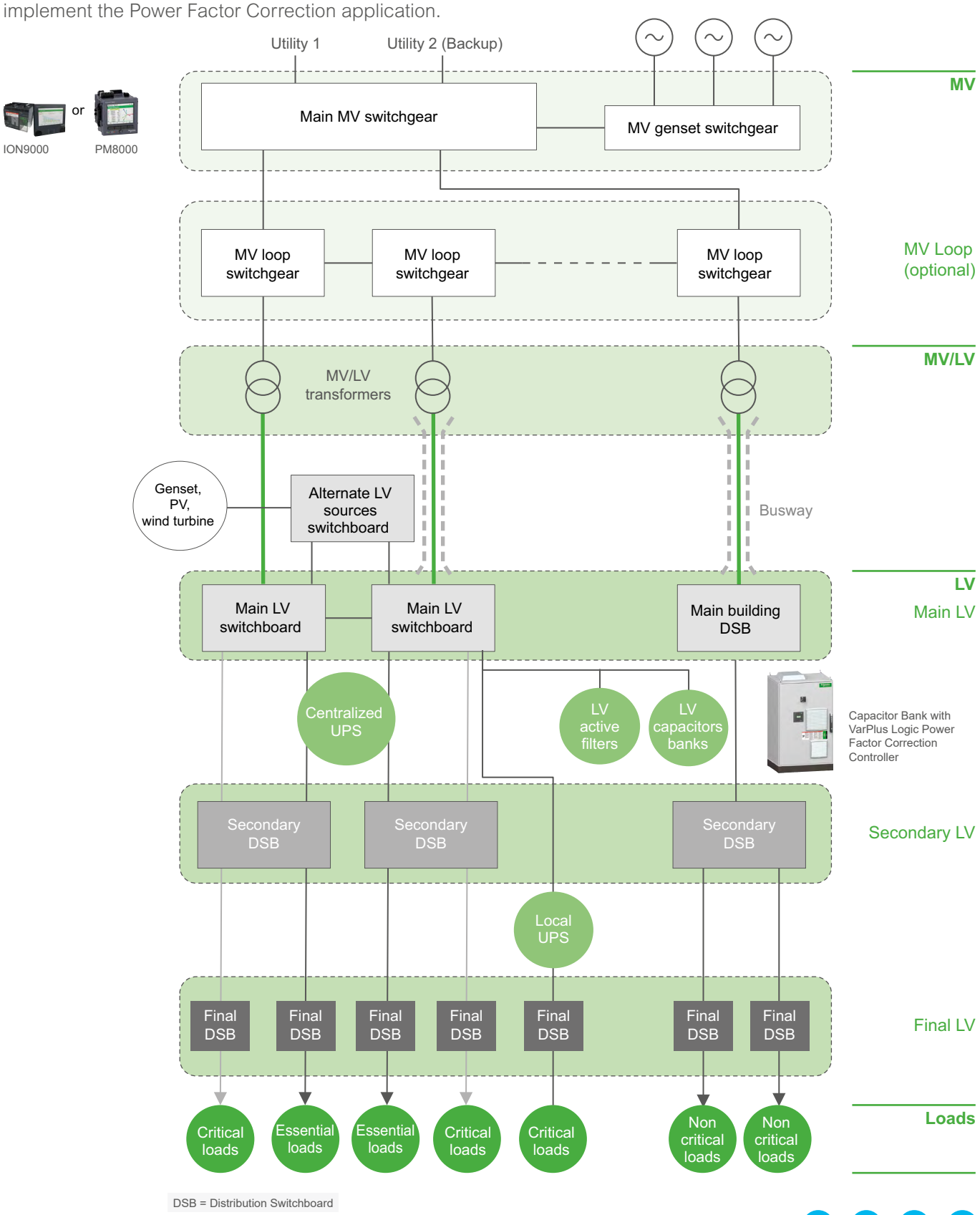
Power Factor Impact Trend dashboard

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

POWER FACTOR CORRECTION

Electrical architecture

The following diagram explains in which area of the architecture the devices should be Installed, in order to implement the Power Factor Correction application.

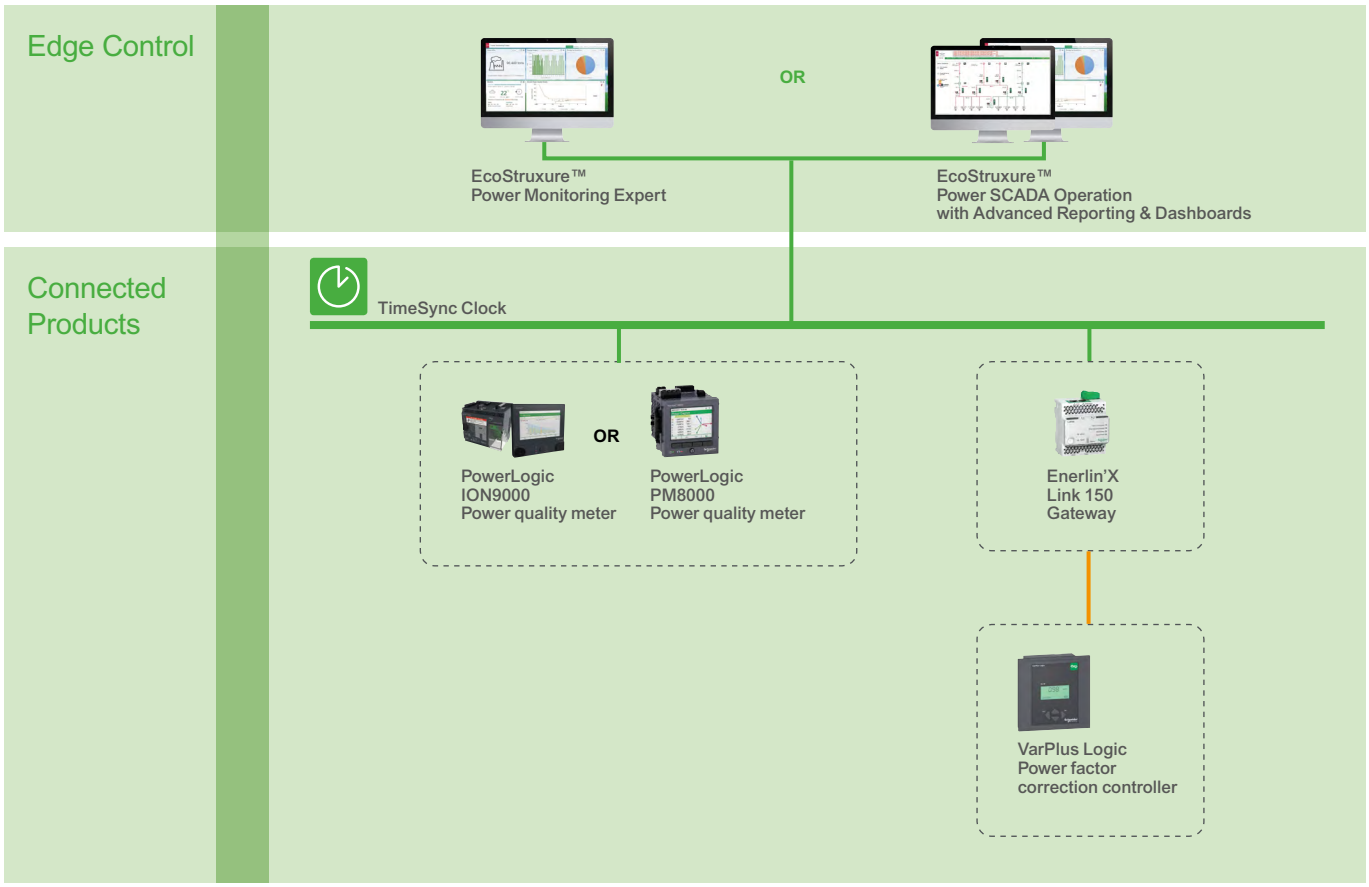


DSB = Distribution Switchboard

Digital Architecture

Communications for VarPlusLogic Power Factor Controller are done through a Modbus Serial connection. Enerlin'X Link150 gateway converts the Modbus communications to Ethernet for real-time data acquisition by the Edge Control software, EcoStruxure™ Power Monitoring Expert and EcoStruxure™ Power SCADA Operation.

Here below is the recommended digital architecture for the Power Factor Correction application:

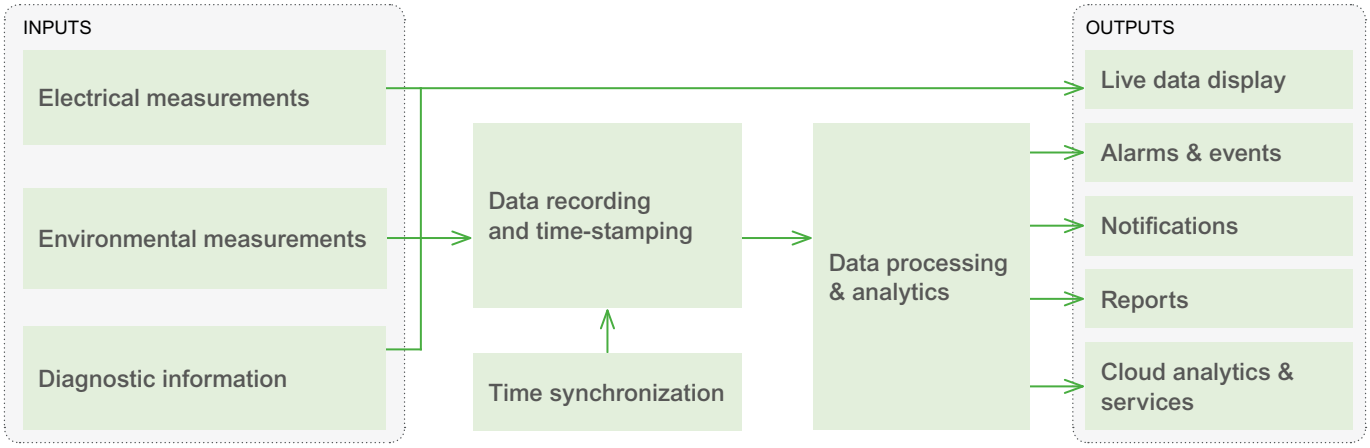


Ethernet - technical LAN
Serial

Functional Breakdown of the Application (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 Switchgear
- LV Circuit Breakers
- LV Busway
- UPS
- Variable Speed Drives
- MV/LV Motors

The following data are 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 P3 or Sepam relays, Masterpact MTZ, Compact NSX
- UPS controller (Galaxy VM/VX, Galaxy 5000)
- 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 CL110 temperature & humidity sensors (associated with a Substation Monitoring Device - SMD - for MV switchgear).

- 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.


Easergy P3


Masterpact MTZ with Micrologic X


PowerLogic ION9000


PowerLogic PM8000


Galaxy VM/VX


Altivar ATV 61/71


Easergy TH110/CL110


SMD

Product, Software and Services: See page 177

Functional Breakdown of the Application (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 operation: Trip, Draw out
- Time for operation: tripping, charging…
- Output velocity and torque
- Drive Thermal State

DATA RECORDING AND TIME-STAMPING

For advanced connected products such as the PowerLogic ION9000, PM8000, Masterpact MTZ, Easergy P3/Sepam, the aforementioned data is recorded and time-stamped onboard.

For other connected products or 3rd party devices, depending on the chosen digital architecture, data recording and time-stamping is done by the Edge Control software (EcoStruxure™ Power Monitoring Expert or EcoStruxure™ Power SCADA Operation with Advanced Reporting & Dashboards), by Enerlin'X Com'X or by Asset Advisor.

Time-stamping of digital data, while not critical for asset performance, should be accurate to +/- 1 s for consistency and data integrity.

To have the full view of device recording and time-stamping capabilities, refer to chart 2.2 in Part 2, page 46.

EcoStruxure™
Power Monitoring Expert

EcoStruxure™
Power SCADA Operation
with Advanced
Reporting & Dashboards

TIME SYNCHRONIZATION

To have a consistent chronological view of all events which happen throughout the facility, date and time should be accurately distributed to connected products and other Management Systems.

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

TimeSync Clock

DATA PROCESSING

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

A first level of asset diagnostics, monitoring and alarming, as well as some simple analytics are computed in EcoStruxure™ Power Monitoring Expert and Power SCADA Operation with Advanced Reporting & Dashboards for on-premise, self-serve reporting (e.g.: Low voltage circuit breakers, UPS, generator batteries).

More advanced analytics - typically recommended for highly critical, capital intensive assets - predictive analysis and recommendations for maintenance optimization are available as cloud analytics and support service with EcoStruxure™ Asset Advisor.

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

Product, Software and Services: See page 177

Functional Breakdown of the Application (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 Switchgear	●		●
LV Circuit Breakers	●	●	●
LV Busway	●		●
UPS	●	●	
Variable Speed Drives	●		●
MV/LV Motors	●		●

OUTPUTS

Live Data Display

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

Alarms & Events

Asset related alarms and events can be raised in EcoStruxure™ Power Monitoring Expert and/or Power SCADA 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.).

EcoStruxure™
Power Monitoring Expert

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 3rd party equipment

EcoStruxure™
Power SCADA Operation
with Advanced
Reporting & Dashboards

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

Product, Software and Services: See page 177

Functional Breakdown of the Application (4/4)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Reports

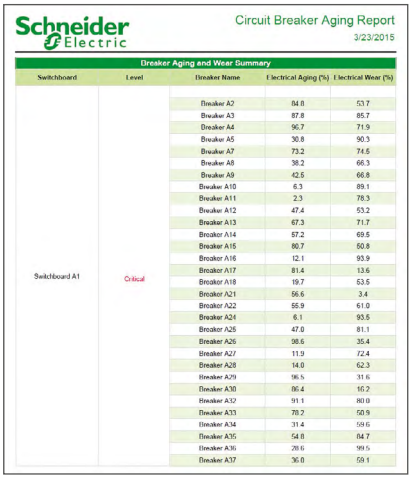
Reporting is available for asset health analysis with Edge Control Software (EcoStruxure™ Power Monitoring Expert and Power SCADA Operation with Advanced Reporting & Dashboards).

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)



Low Voltage Circuit Breaker Aging report

UPS and Generator Battery Health**

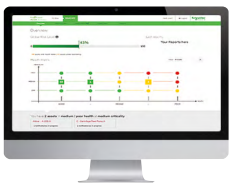
Reporting for assets such as generators, generator batteries and UPSs can be found in the Backup Power Testing Application section (page 85).

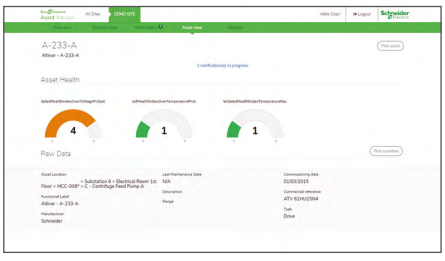
Cloud Analytics & Services

EcoStruxure™ Asset Advisor cloud 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 Service Bureau
- Pro-active expert Service Bureau recommendations
- Capex vs Opex recommendation to manage asset maintenance and end of life


EcoStruxure™ Asset Advisor Web Portal



EcoStruxure™ Asset Advisor Asset Health dashboard

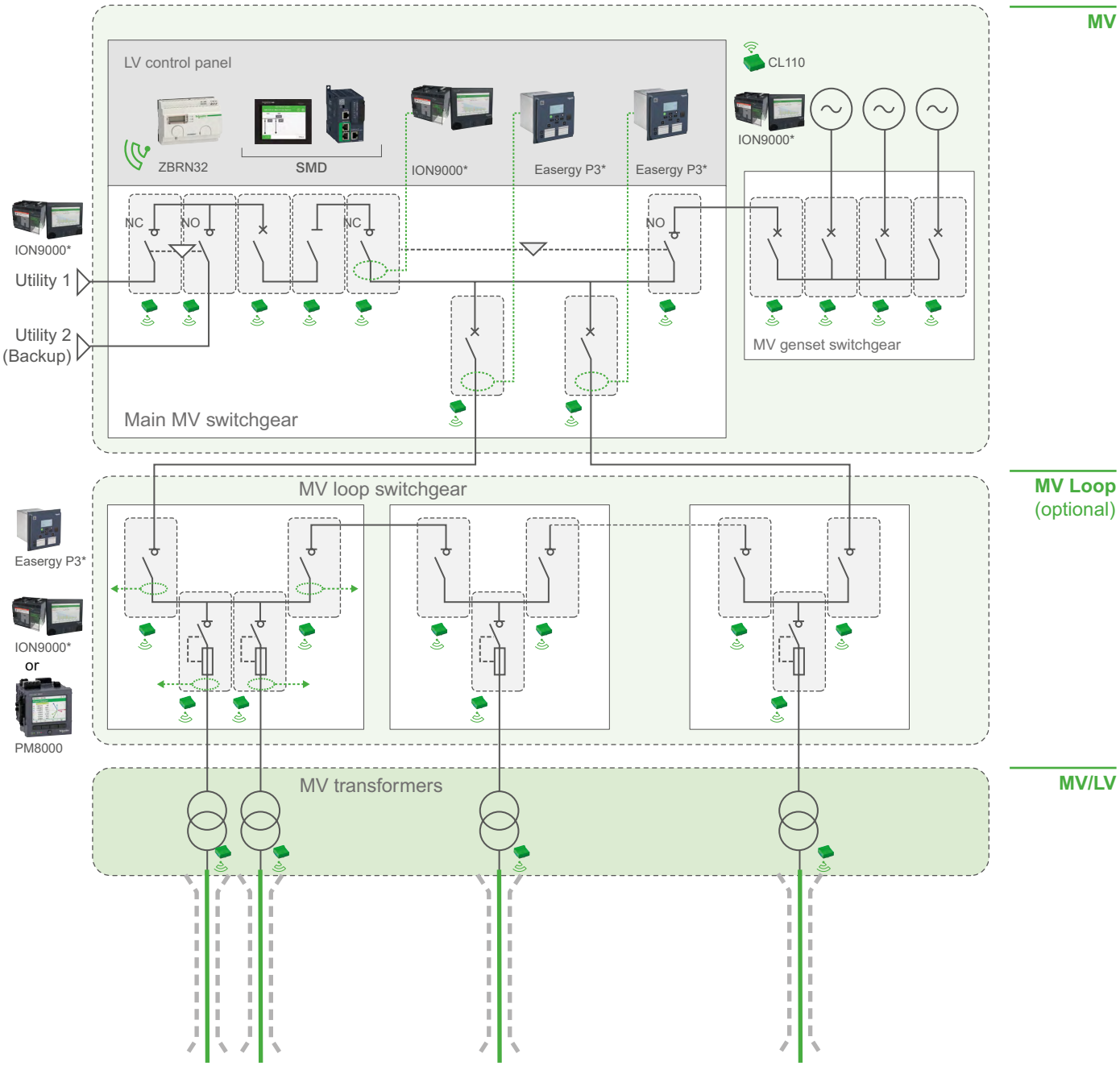
* Requires the Breaker Performance Module in EcoStruxure™ Power Monitoring Expert and Power SCADA Operation with Advanced Reporting & Dashboards.

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

Product, Software and Services: See page 177

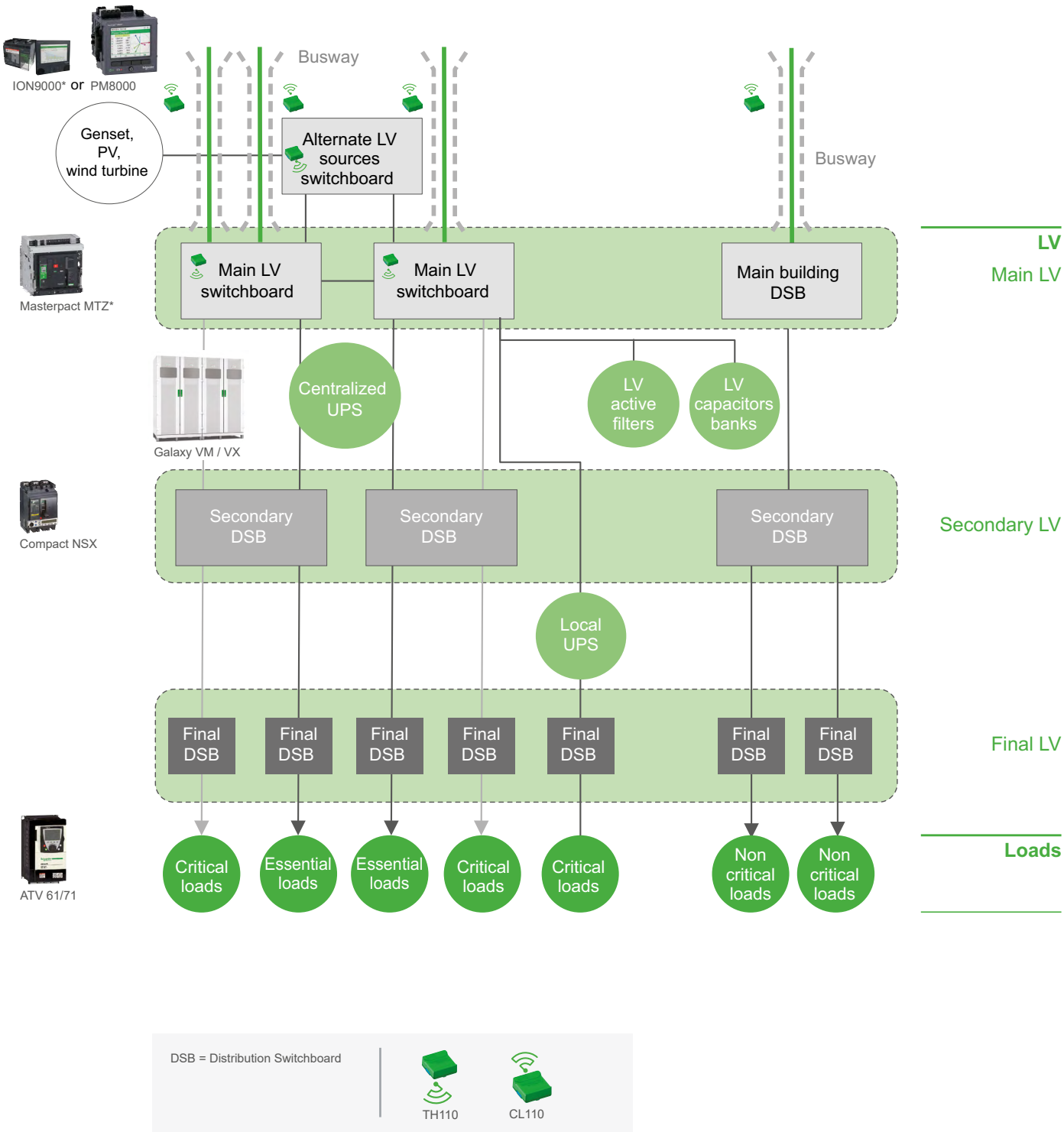
Electrical Architecture (1/2)

The following diagrams explain in which area of the architecture the connected products should be installed, in order to implement the Power Quality Compliance application. For more simplicity, the diagram has been split in two.
Here below is the upper part (MV) of the electrical architecture:



Electrical Architecture (2/2)

Here below is the lower part (LV) of the electrical architecture:



Digital Architecture (1/3)

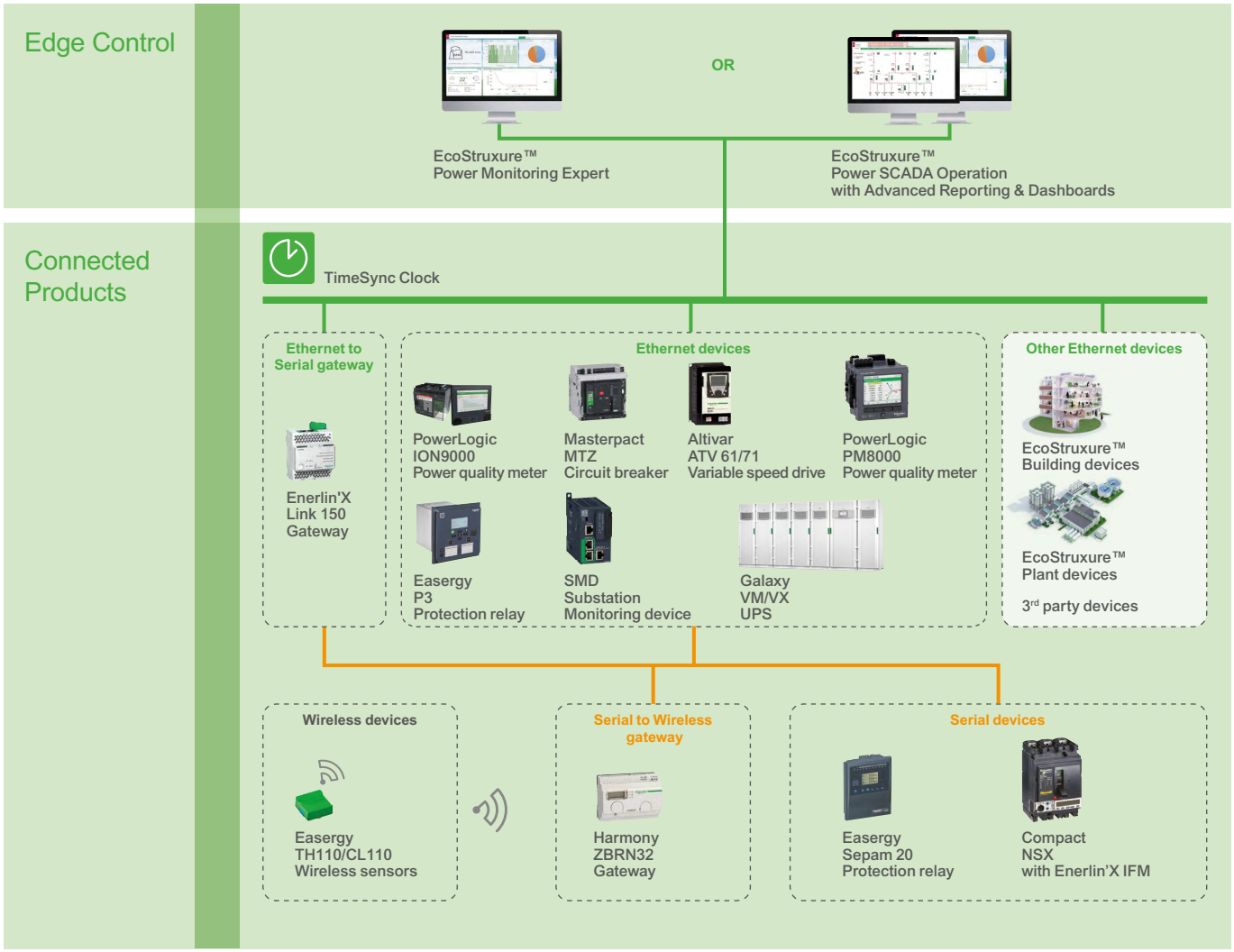
Introduction

Different architectures can support the Asset Performance application, with increasing capabilities:

- on-premise only with Edge Control software
- cloud only with EcoStruxure™ Asset Advisor
- complete asset performance solution with both Edge Control and cloud-based Apps, Analytics and Services

With Connected Products and Edge Control

In this architecture, all data are collected, processed and presented to the user by the Edge Control Layer.

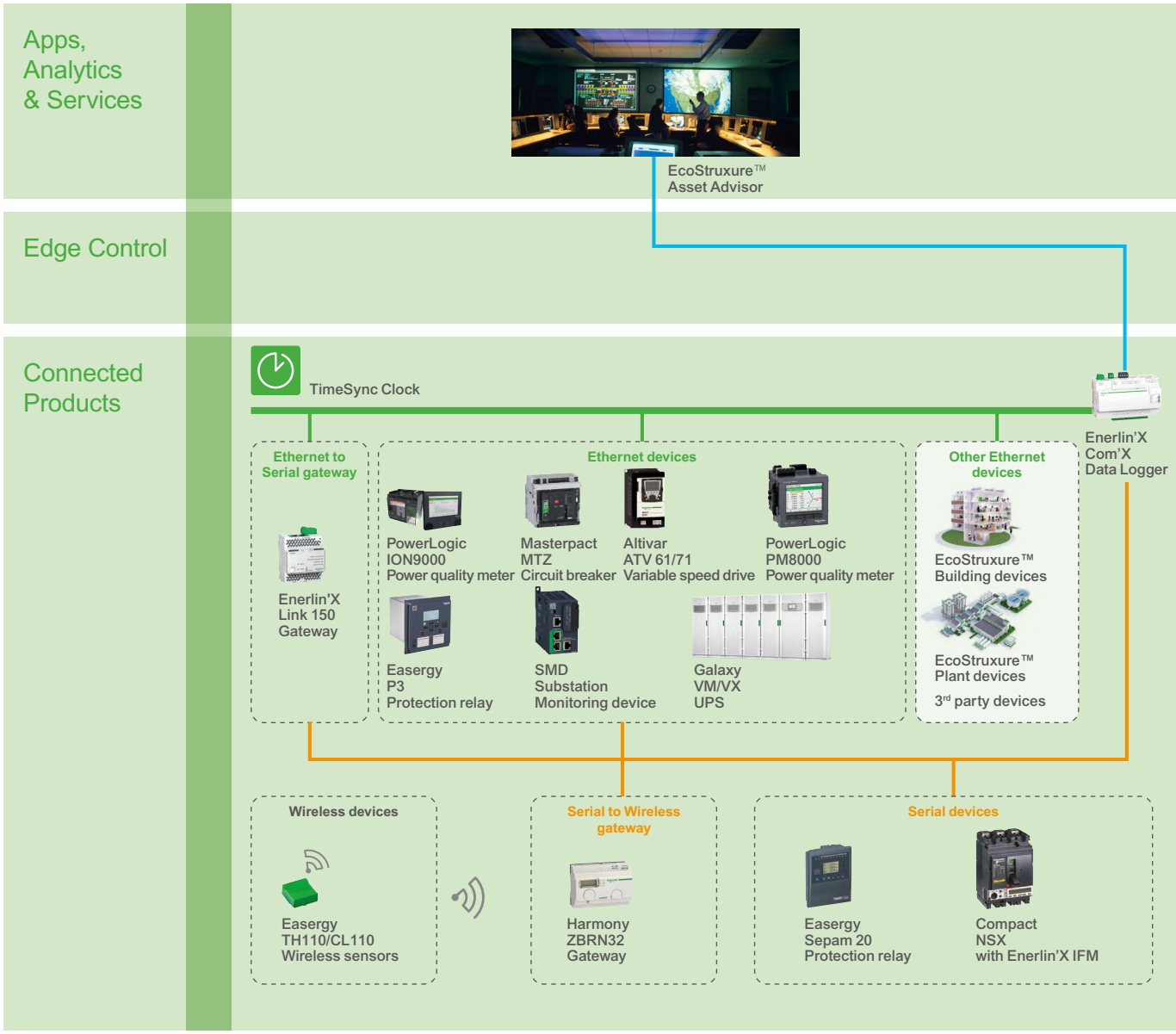


Ethernet - technical LAN
Serial
Wireless

Digital Architecture (2/3)

With Connected Products and Remote Services

In this architecture, the data are collected from all connected products using the Enerlin'x Com'X data logger and then passed onto the cloud based EcoStruxure™ Asset Advisor service offer.

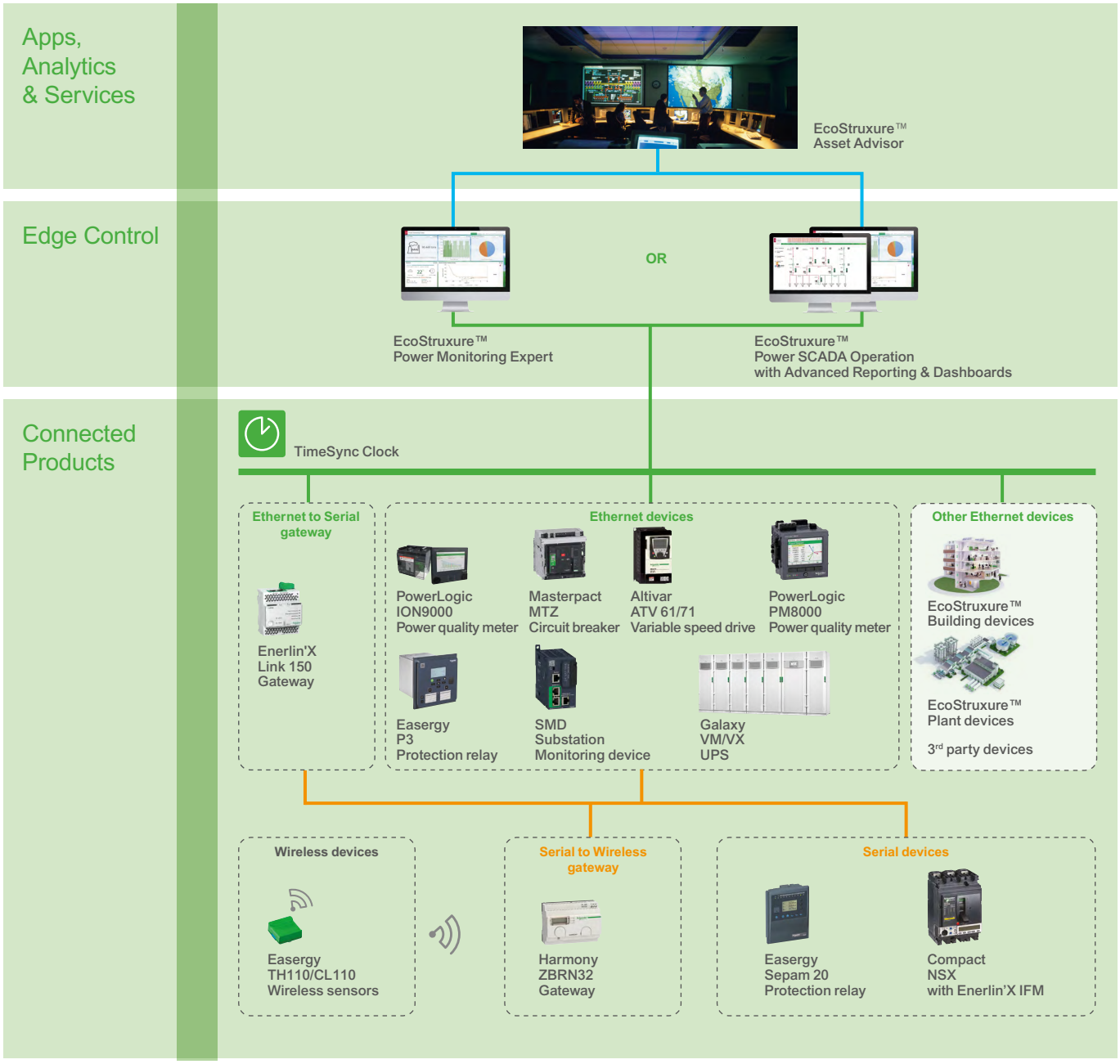


Ethernet - public LAN/WAN
Ethernet - technical LAN
Serial
Wireless

Digital Architecture (3/3)

With Connected Products, Edge Control and Remote Services

In this architecture, all data are collected by the Edge Control Layer and then passed onto the cloud based EcoStruxure™ Asset Advisor service offer.

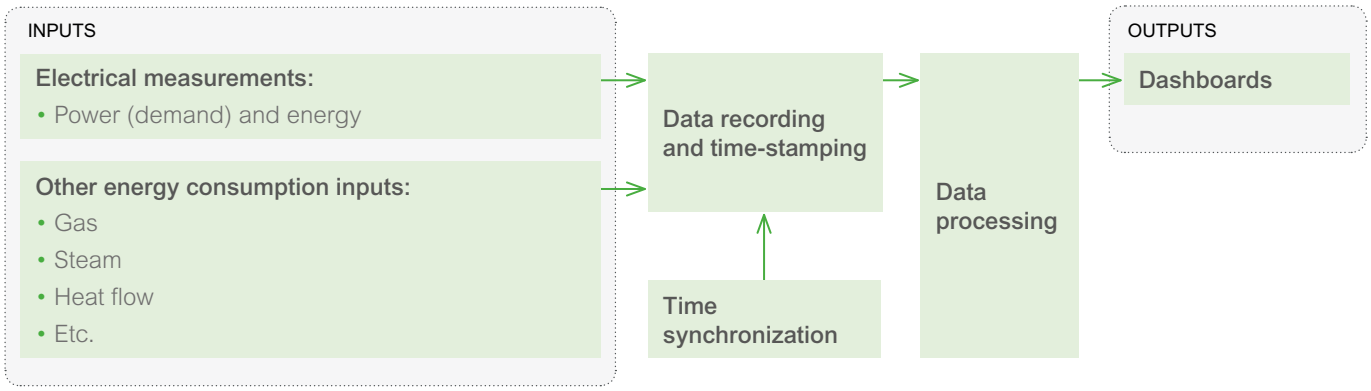


Ethernet - public LAN/WAN
Ethernet - technical LAN
Serial
Wireless

Functional Breakdown of the Application (1/3)

Data Flow

The Greenhouse Gas Reporting application can be broken down as follows:



Data Flow in Detail

INPUTS

The following data are required:

Electrical Measurements

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

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

Connected products with embedded metering (e.g.: 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

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


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


Acti9 iEM3000


Easergy P3


Acti9 Smartlink & PowerTag


Masterpact MTZ with Micrologic X


Compact NSX with Micrologic


Galaxy

Product, Software and Services: See page 177

Functional Breakdown of the Application (2/3)

Data Flow in Detail (cont.)

DATA RECORDING AND TIME-STAMPING

For the Greenhouse Gas Reporting application, a time-stamp accuracy of ± 1s is sufficient for time-based historical data visualization of greenhouse gas emissions of devices, processes, facilities or departments.

Advanced power meters such as the PowerLogic ION9000, PM8000 (as well as legacy connected products such as ION7650/7550) and some models of the PM5000 (PM53xx and PM55xx) can timestamp and record onboard energy measurements as well as connected equipment states.

For other connected products (Easergy P3, Masterpact MTZ, lower end models of PowerLogic PM5000 and other energy and power meters) energy measurements are acquired by the connected products and recorded by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards.

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

To have the full view of device recording and time-stamping capabilities, refer to chart 2.2 in Part 2, page 46.

PowerLogic ION9000

PowerLogic PM8000

PowerLogic PM5000

PowerLogic ION7650

TIME SYNCHRONIZATION

To have accurate time-stamping of all power and energy data, 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 associated to a GPS antenna to reach the expected time precision.

TimeSync Clock

DATA PROCESSING

The calculation engine in EcoStruxure™ Power Monitoring Expert and Power SCADA Operation with Advanced Reporting & Dashboards provides the ability to convert energy consumption data into greenhouse gas equivalent measurements.

EcoStruxure™ Power Monitoring Expert

EcoStruxure™ Power SCADA Operation with Advanced Reporting & Dashboards

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

Product, Software and Services: See page 177

Functional Breakdown of the Application (3/3)

Data Flow in Detail (cont.)

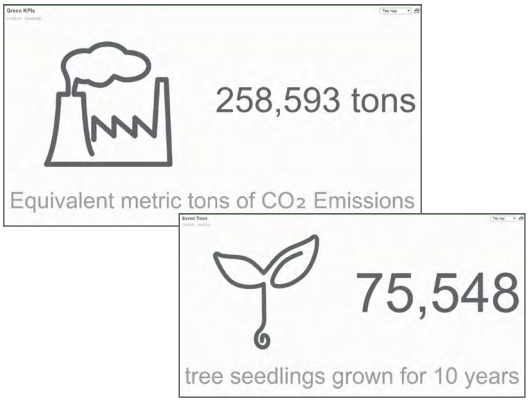
OUTPUTS

Display of outputs is performed by EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards.

Dashboards

Energy Equivalency gadget

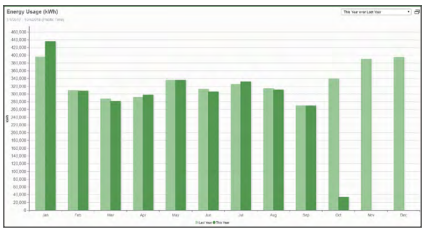
Shows a single value that is equivalent to the aggregated consumption input data, over a selected time period. The value can be scaled or normalized to represent a consumption equivalent measurement. The information is shown as a numeric value with unit, a custom text, and a custom graphic.



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

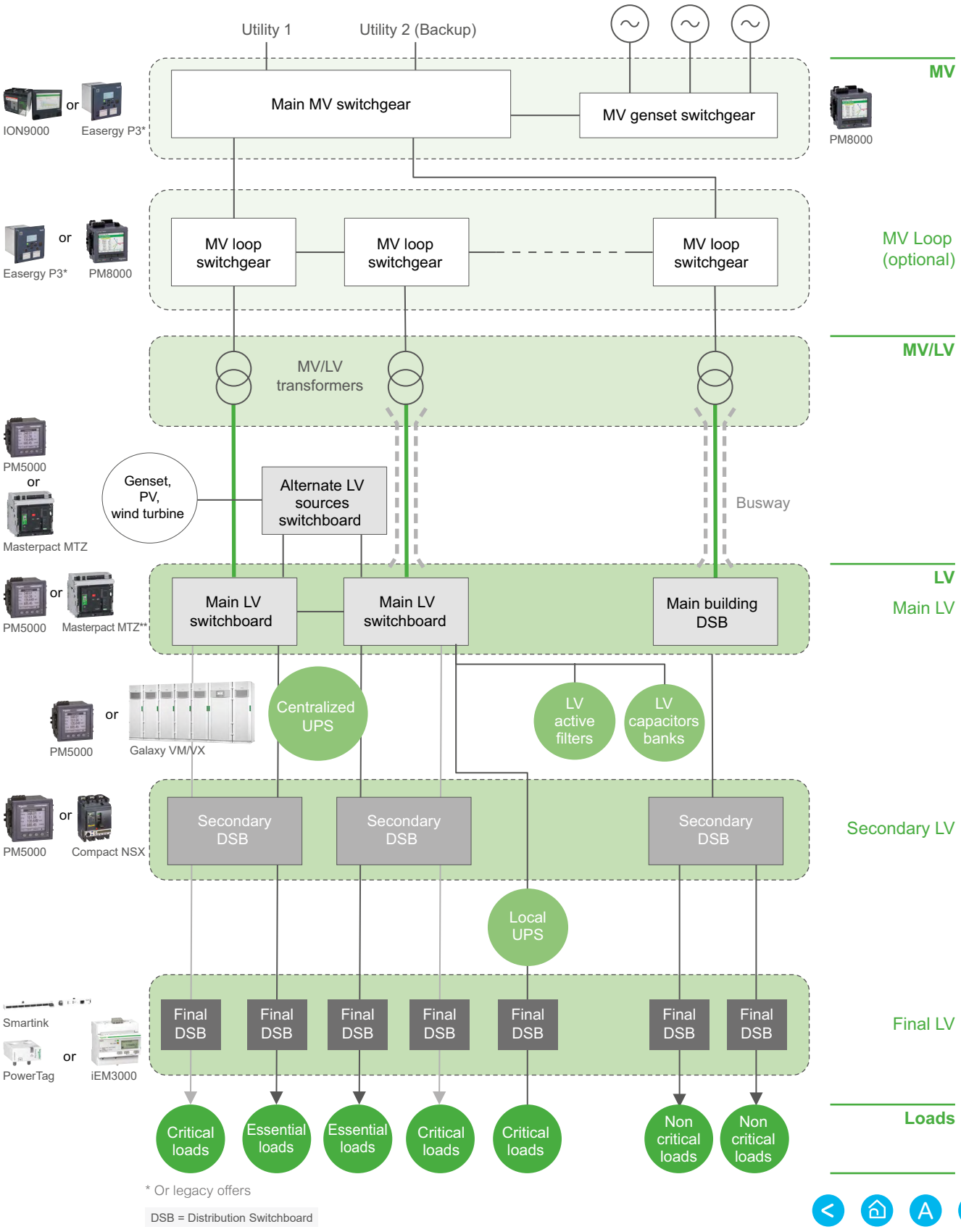
Other gadgets and trends

Many other gadgets or trends (such as those discussed in the Energy Usage Analysis application) can be used to display and analyze greenhouse gas equivalent measurements.

Product, Software and Services: See page 177

Electrical Architecture

The following diagram explains in which area of the architecture the connected products should be installed, in order to implement the Greenhouse Gas Reporting application.



* Or legacy offers

DSB = Distribution Switchboard

GREENHOUSE GAS REPORTING

Digital Architecture

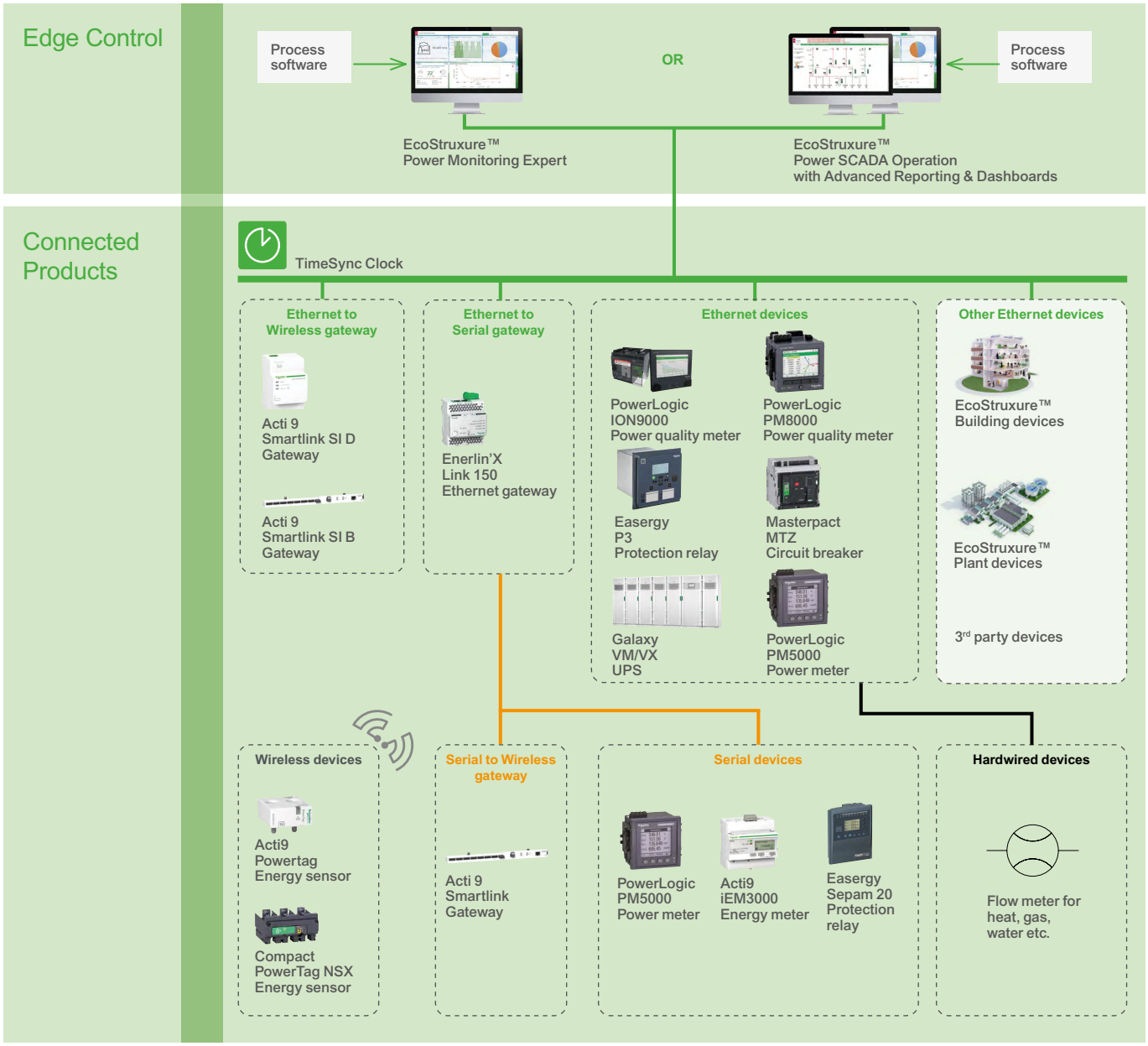
The digital architecture of the Greenhouse Gas Reporting application uses the recommended Ethernet connection or gateways to collect data from energy meters.

Data is captured on-board connected products and uploaded into the edge control software (EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards) for data processing, visualization, analysis and reporting.

Other wages parameters can also be directly acquired over 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.

Here below is the recommended digital architecture for the Greenhouse Gas Reporting application:

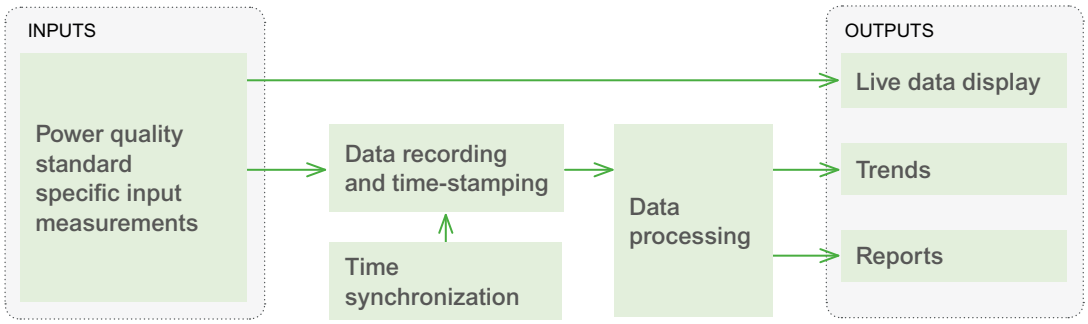


Ethernet - technical LAN
Serial
Hardwired
Wireless

Functional Breakdown of the Application (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 powermeter 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)*
ION7650 (legacy)	**Yes** (PME EN 50160 report)***	**Class A**	**Yes** (PME Harmonic Compliance report)** with specific framework (w/o EN 50160)	**Yes** (PME Harmonic Compliance report)**	**Yes** (PME PQ report)*

* EcoStruxure™ Power Monitoring Expert: Power Quality Report
** EcoStruxure™ Power Monitoring Expert: Harmonic Compliance Report
*** EcoStruxure™ Power Monitoring Expert: EN 50160 Report


PowerLogic ION9000


PowerLogic PM8000


PowerLogic ION7650 (legacy)

Product, Software and Services: See page 177

Functional Breakdown of the Application (2/3)

Data Flow in Detail (cont.)

DATA RECORDING AND TIME-STAMPING

Advanced meters such as the PowerLogic ION9000, PM8000 (as well as legacy connected products such as ION7650) can time-stamp and record the necessary power quality data on-board.

For the Power Quality Compliance application, a time accuracy of ±1s is sufficient.

To have the full view of device recording and time-stamping capabilities, refer to chart 2.2 in Part 2, page 46.

PowerLogic ION9000

PowerLogic PM8000

TIME SYNCHRONIZATION

To have 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 through various technologies (PTP, NTP, SNTP…). An external master clock may be required and associated 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 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 onboard advanced power quality meters such as PowerLogic ION9000 and PM8000 as well as in EcoStruxure™ Power Monitoring Expert or Power SCADA Operation with Advanced Reporting & Dashboards.

EcoStruxure™ Power Monitoring Expert

EcoStruxure™ Power SCADA Operation with Advanced Reporting & Dashboards

OUTPUTS

Display of outputs is performed by EcoStruxure™ Power Monitoring Expert or EcoStruxure™ Power SCADA Operation with Advanced Reporting & Dashboards.

Live Data Display

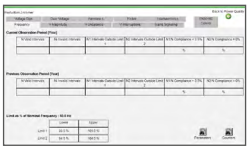
Predefined diagrams exist for the following power quality standards:

Analytic views for EN 50160

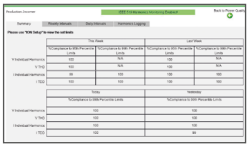
- Supply voltage dips, temporary overvoltages, flicker, harmonic and inter-harmonic voltage, frequency, voltage magnitude, supply voltage unbalance, short and long-term interruptions and mains signaling

Analytic views for IEEE 519

- Voltage individual harmonics, voltage THD, current individual harmonics, current TDD



Livre Data Display (EN 50160)



Livre Data Display (IEEE 519)

Trends

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)

Product, Software and Services: See page 177

Functional Breakdown of the Application (3/3)

Data Flow in Detail (cont.)

OUTPUTS (cont.)

Reports

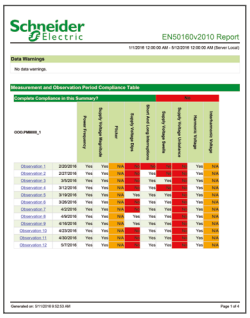
The following Power Quality Compliance reports can be generated and displayed on-demand or automatically generated and sent by e-mail:

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.

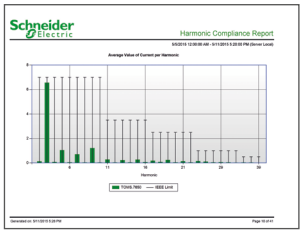
Comment: EN 50160:2000 and 2010, published in 2000 and 2010 respectively, is a set of power quality standards used by certain energy suppliers and energy consumers.



EN 50160-2010 report

Harmonic Compliance report

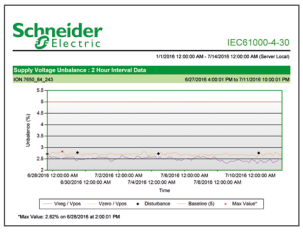
Shows an analysis of the harmonic compliance of selected sources based on the IEEE 519 reference limits.



Harmonic Compliance report

IEC 61000-4-30 report

Provides IEC 61000-4-30 compliance information by observation period (3 seconds, 10 minutes, or 2 hours measurement interval) for one or more sources: voltage profile; THD profile; unbalance profile; flicker profile; frequency profile; and summary table.



IEC 61000-4-30 report

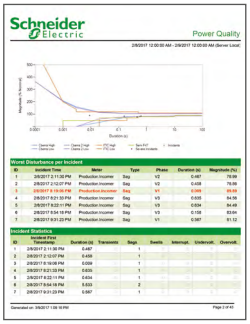
Power Quality report

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 small window 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.

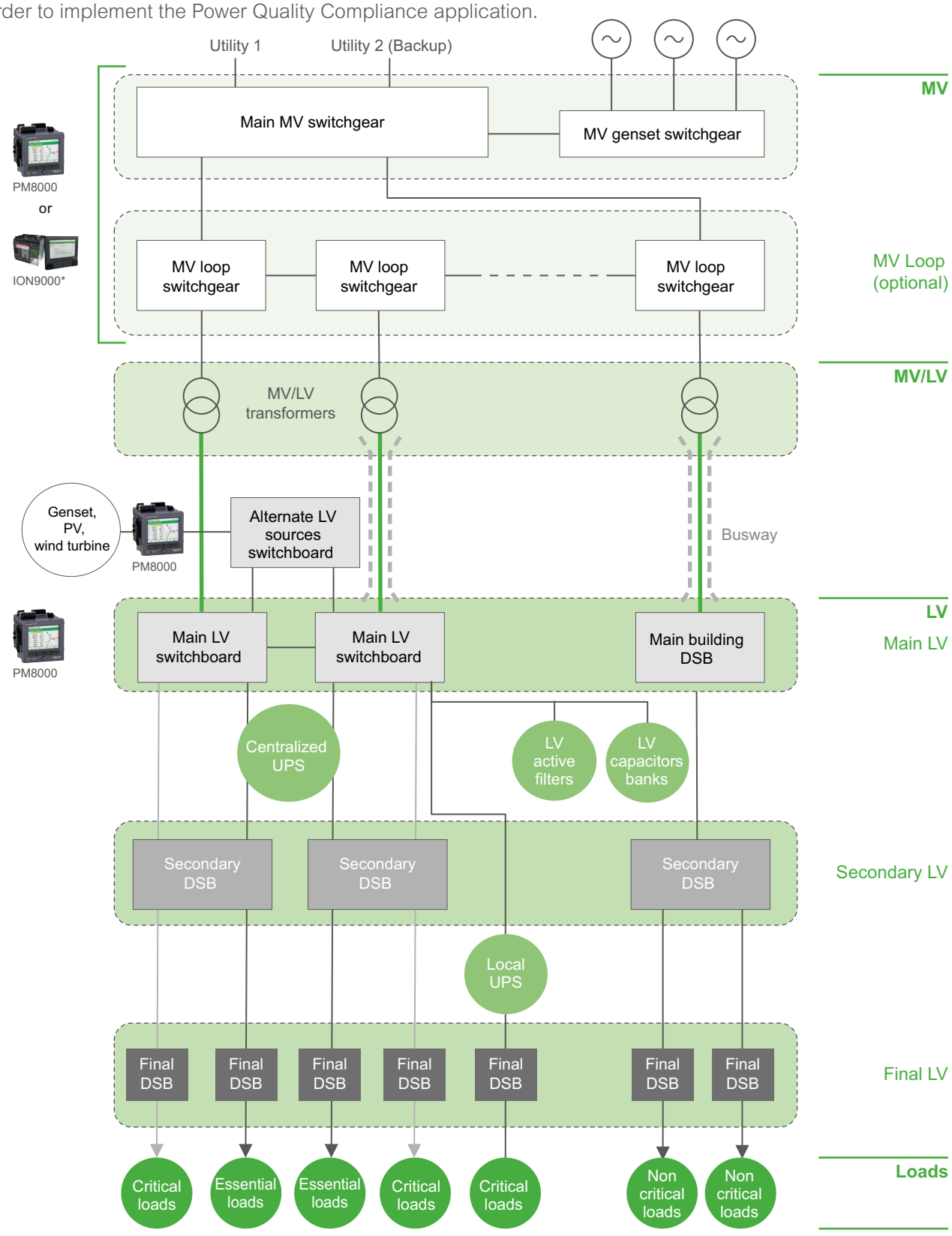


Power Quality report

Product, Software and Services: See page 177

Electrical Architecture

The following diagram explains in which area of the architecture the connected products should be installed, in order to implement the Power Quality Compliance application.



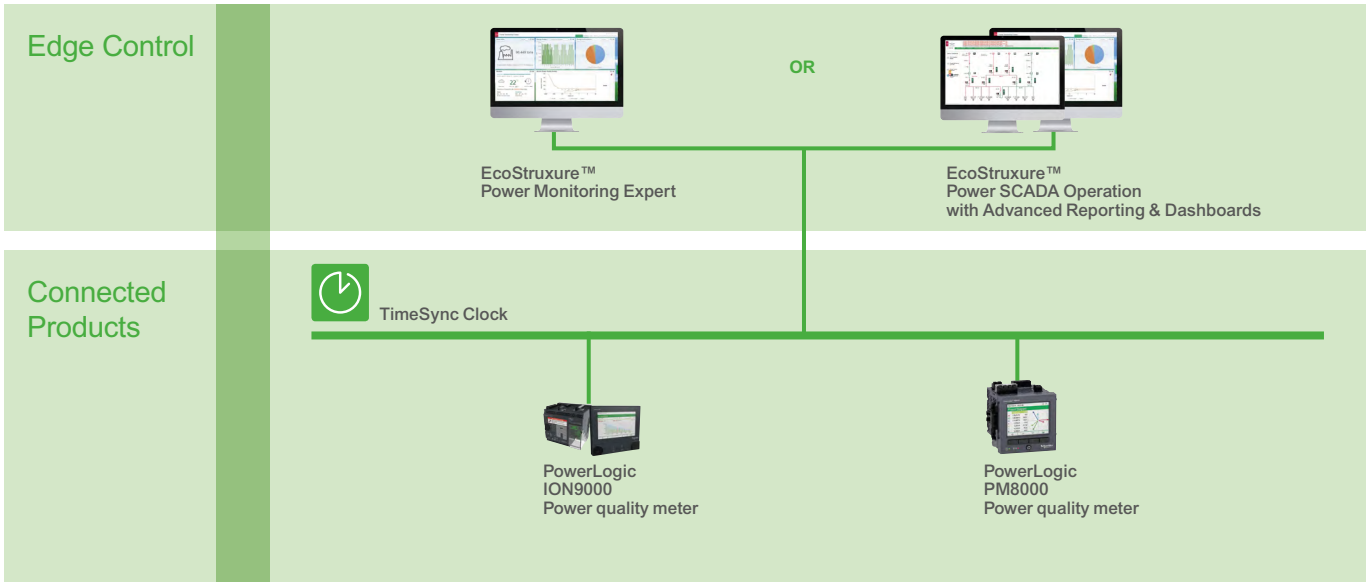
* Or legacy offers

DSB = Distribution Switchboard

Digital Architecture

The digital architecture of the Power Quality Compliance application uses recommended direct Ethernet connection to power quality meters. Data is captured on-board connected products and uploaded into the edge control software (EcoStruxure™ Power Monitoring Expert or Power SCADA operation with Advanced Reporting & Dashboards) for data processing, visualization and reporting.

Here below is the recommended digital architecture for the Power Quality Compliance application:



Ethernet - technical LAN

Appendix

Product, Software and Services for Digital Applications

Appendix | Product, Software and Services for Digital Applications

Connected Products

Protection, Monitoring & Control Devices

Easergy P3

Compact protection relays for standard MV applications

Easy-to-use protective relays for Medium Voltage applications with fast delivery, ideal for Panel builders, Contractors and Partners to save time. From overcurrent to advanced protection, with arc detection and Ethernet communication including IEC 61850.

Easergy Sepam series 80

High performance protection relay for MV applications

Sepam 80 has all the functionalities for protecting MV substations, transformers, busways, LV distribution and managing gensets. Thanks to advanced protection technology, it enables all kinds of troubleshooting.

Easergy Sepam series 20

Protection Relays for Standard or Usual MV applications

Sepam series 20 offers 7 types of digital current or voltage protection for standard distribution systems, each one dedicated to a single application. Models available: Sepam S20, S24, T20, T24, M20, B21, B22.

Easergy T300

Distribution network management for MV and LV applications

Is a modular platform of 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.
A powerful Remote Terminal Unit for feeder automation.
Remote control and monitoring for energy distribution 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.

Masterpact NW

High current air circuit breakers up to 6300 A for LV applications

Masterpact NW is a comprehensive range of air circuit breakers designed to protect electrical systems from damage caused by overloads, short circuits and equipment ground faults. The embedded Micrologic control unit contributes to safety and energy efficiency. The range covers ratings from 800 to 6300 A in two different sizes.

Products

Protection, Monitoring & Control Devices (cont.)

Compact NSX

Molded case circuit breakers up to 630A 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, or Powertag NSX is designed for wireless communication.

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 for the full complete line of accessories for motor and load control. TeSys Contactors are available for both IEC and NEMA applications and certified by major standards around the world.

Acti9 iC60

Miniature Circuit Breakers for Final LV applications

For circuit protection and continuity of service up to 63 A, the miniature circuit breakers are especially ideal for polluted environments and networks.

Products

Insulation Monitoring & Fault Location Devices

Vigilohm IM20-H

Insulation Monitoring Device for Hospital application

This device is compliant with the IEC 61557-8 and provides insulation integrity alarming, and isolation transformer overload and temperature monitoring.
The communication protocol is Modus RTU.

Vigilohm IMD IFL12H

Insulation Fault Locator for Hospital application

When installed in conjunction with an IM20-H, this insulation fault locator individually monitors each of the outputs. It reports faulty outputs, either locally, through a light and a contact, or remotely, through the Modbus communication port.

Vigilohm HRP

Hospital Remote Panel

When installed in conjunction with an IM20-H, the Vigilohm HRP provides local alarming in the Operating Theatre.

Vigilohm IMD LRDH

In addition to the functionality of the HRP above, the IMD LRDH provides insulation fault location indication on a graphical colour display

Products

Power Meters


PowerLogic ION9000


PowerLogic ION7650 (legacy)

PowerLogic ION9000 series and ION7650 (legacy)

Power Quality Meters for utility incomers or highly critical applications

The world's most innovative, most advanced power quality meter. Designed for the highest accuracy, energy cost, network management and power quality requirements.

PowerLogic PM8000 series

Power Quality Meters for critical applications

Simplifying power quality, maximizing versatility.
Compact, high-performance power meter for cost and network management applications on feeders and critical loads.

PowerLogic PM5000 series

Power Meters with basic power quality functionality

High-end cost management capabilities in an affordable power meter.
Compact, versatile power meters for energy cost and basic network management applications.

Acti 9 iEM3000 series

Energy meters (DIN rail-mounting)

This cost effective device can easily be integrated into an Energy Management System or a Building Management System thanks to native Modbus, BACnet, M-bus and LON protocols. Acti 9 iEM3000 series meters provide a full view of energy consumption and multiple tariffs give customers the flexibility to match the billing structure of their utility.


PowerTag NSX


Power Tag

Compact Powertag NSX & Acti-9 Powertag

Energy Sensors

A wireless energy sensor that provides precise, real-time data on energy, currents, power, voltage, and power factor. PowerTag energy sensors accurately monitor energy consumption and wirelessly communicate this data in real-time via a gateway. Use energy more efficiently and economically on all electrical loads, from heavy and critical equipment to smaller loads.

Products

PLC & PAC

Substation Monitoring Device (SMD)

Local and/or remote monitoring for MV applications

The Substation Monitoring Device performs analytics on temperature and environmental data for monitoring and alarming via a local HMI or SCADA system. The Condition Monitoring Device consists of an M251 PLC and optional Magelis HMI. It is configured in the factory and automatically integrates with Edge Control Software. The SMD can also send SMS messages in case of alarms. The optional colour display provides SLD representation with overlaid temperature values.

Modicon M580

Ethernet Programmable Automation Controller (ePAC)

This high-end ePAC features redundant controllers, new stand-alone safety controllers (safety PLC) with native Ethernet, and cybersecurity embedded in its core.

Modicon M340

Programmable Automation Controller (PAC)

This Modicon PAC is built to suit the needs of the process industry and a wide range of demanding automation applications such as Multitasking system for optimum reflex time.

Products

Power Quality Mitigation, Power Factor Correction & UPS Devices

AccuSine PCS+

Active Harmonic Filter

The AccuSine PCS+ is a flexible, high performance, cost-effective solution for stabilizing electrical networks by providing harmonic mitigation, power factor correction and load balancing.

VarSet

LV Capacitor Bank

This complete range of high quality power factor correction solutions is 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, your power factor is maintained at an ideal level for optimum power system efficiency and cost reduction.

Galaxy VM

UPS for midsize facilities

This 3 phase UPS power protection seamlessly integrates into medium data centers, industrial or facilities applications.

Galaxy VX

UPS for large facilities

This scalable, high-performance extension of the Galaxy V-Series solutions is designed for large data center and industrial applications.

Products

Communication Devices & Gateways

Enerlin'X Link150

Ethernet Gateway

This gateway for simple, cost-effective serial-to-ethernet connectivity. The Link150 gateway provides fast, reliable Ethernet connectivity in the most demanding applications, from single building to multi-site enterprises. It supports power and energy meters, circuit monitors, protective relays, trip units, motor controls and other devices that need to communicate data quickly and efficiently. It provides simple, cost-effective serial line to full ethernet connectivity.

Acti9 Smartlink SI B

Single access point for full analysis of the power distribution switchboard

The system supports:

- Alarm monitoring on current, voltage, power factor, tripping, power, consumption thresholds (Concentrator for PowerTags)
- Monitoring and control via web pages of loads, energy and power by zone and by usage

Acti 9 Smartlink Si D

Wireless to Modbus TCP/IP Concentrator

Acti 9 Smartlink SI D is the simplest and most efficient to achieve a fully connected panel.

The system supports:

- energy monitoring of final loads with PowerTags
- electrical uptime monitoring with pre-alarms

Enerlin'X IFE, EIFE and IFM

Communications interfaces for Masterpact, PowerPact, and Compact circuit breakers

IFE: Ethernet interface for Masterpact, Compact and PowerPact circuit breakers.
EIFE: Ethernet interface for drawout Masterpact MTZ air circuit breakers.
IFM: Modbus Serial interface for Masterpact, Compact and PowerPact circuit breakers.

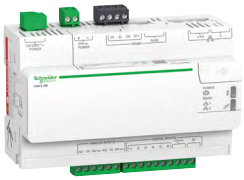
Harmony Sologate ZBRN32

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 input of the Zigbee concentrator, meaning the sensors ID is associated with the concentrator input and all information concerning the sensor can be read in Modbus table using the input index.

Products

Data Loggers



Enerlin'X
Com'X 200/210
Energy Server and Data Logger

Enerlin'X Com'X 200/210

Energy servers and data loggers

Data collector

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 over Ethernet or Wi-Fi.

Enerlin'X
Com'X 510
Energy Server and Data Logger

Enerlin'X Com'X 510

Energy servers and data loggers

Data collector

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.

Embedded energy management software

The Com'X provides immediate visibility into energy consumption throughout the site. As soon as the Com'X is connected to the Local Area Network (LAN), several web pages are accessible via any standard web browser. These web pages display real-time data as it is collected, in easy to understand tabular and summary formats. In addition, users can get simple analysis of historical data in bar graph or trending formats.

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 over Ethernet or Wi-Fi.

Cyber Sciences CyTime SER 2408 / 3200

Sequence of Event Recorder for high time accuracy applications

Record status changes of 32 channels, time-stamped 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.

Products

Sensors

Easergy TH110

Wireless thermal sensor for critical connections

The Easegy TH110 is a battery free wireless perform the continuous thermal monitoring of all the critical connections made on field like:

- 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 Easegy TH110 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

Edge Control Software

Software

EcoStruxure™ Power Monitoring Expert

Power Management software

EcoStruxure™ Power Monitoring Expert helps maximize system reliability and optimize operational efficiency to increase your profitability.

EcoStruxure™ Power SCADA Operation

High performance SCADA 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 SCADA Operation operators are more effective at protecting and optimizing their electrical distribution network, improving both its efficiency and productivity.

EcoStruxure™ Power SCADA Operation with Advanced Reporting & Dashboards

Advanced Power Monitoring Expert reporting and dashboards embedded in Power SCADA Operation.

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.

EcoStruxure™ Energy Expert

Embedded power management module, based on EcoStruxure™ Power Monitoring Expert, for EcoStruxure™ Building Operation.
It provides electrical systems management, power monitoring, and energy accounting capabilities that enable facility and building operators to monitor and manage your non-critical electrical network applications from a single view.

Apps, Analytics and Services

Advisor Services

EcoStruxure™ Asset Advisor

Cloud-based asset monitoring service for predictive and preventive maintenance

This 24/7 vendor-neutral solution provides peace of mind and fast issue resolution, enabled by a community-based chat with your own team or the Schneider Service Bureau. Monitor your critical equipment insights and smart alarming directly to your smartphone, and proactively minimize downtime.

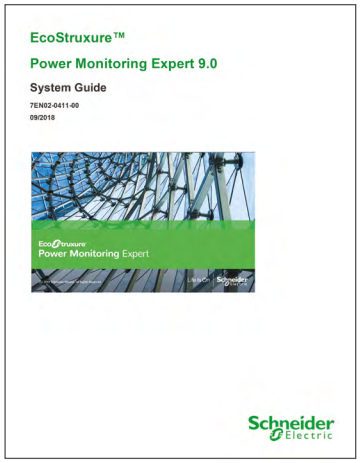
EcoStruxure™ Power Advisor

Cloud-based data quality and power quality monitoring service

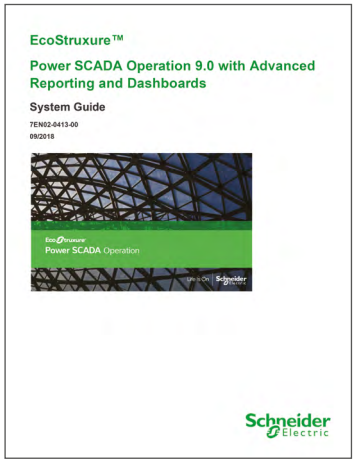
EcoStruxure™ Power Advisor raises metering diagnostics from device-based troubleshooting to full system analysis. It combines expert advice with advanced algorithms – applying it to data from your Power Monitoring Expert system – to identify gaps or issues in your power management system, as well as power quality issues within your larger electrical distribution system.

Useful Documentation

System guides



EcoStruxure™ Power Monitoring Expert 9.0
System Guide
Ref: PowerMonitoringExpertSysGuide
7EN02-0411-00
09/2018
https://www.schneider-electric.com/en/download/document/PowerMonitoringExpertSysGuide/



EcoStruxure™ Power SCADA Operation 9.0 with Advanced Reporting & Dashboards
System Guide
Ref: PowerSCADAOperationSystemGuide
7EN02-0413-00
09/2018
https://www.schneider-electric.com/en/download/document/PowerSCADAOperationSystemGuide/

Notes

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