Advanced Protection and Automation (NEMA)

Improve the Management of Large and Complex Electrical Distribution Networks Through Sophisticated Protection and Automation Schemes

EcoStruxure Power Digital Application

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EcoStruxure™ Power

Schneider Electric™

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Overview

Context of Application

Facility managers of large sites and critical buildings expect a reliable power network to maximize uptime and meet their business goals. However, growing grid instability due to increasing power demand and shortfalls in sequence of operation procedures are leading to unpredictable events and unplanned outages that ultimately jeopardize continuity of service and long-term performance objectives.

To maximize electrical infrastructure investment, they require solutions that bring operational sustainability and resiliency through fault tolerant automation schemes such as fast self-healing, automatic transfer systems, load-shedding, and load-restore to help bring more autonomous responses to the Medium Voltage power distribution systems.

Problem to Solve

The facility manager needs to:

- Help protect electrical networks from faults (short-circuit, overload, etc.).
- Maintain continuity of service in case of outages with an autonomous and fast response to events (fast self-healing, automatic transfer switch, load-shedding, etc.).
- Plan effective operation and maintenance programs.

Purpose of the Application

Provide protection and fault tolerant automation schemes

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

Application Outcomes

Protection Schemes

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

- Thermal overload protection
- Generator protection
- Transformer protection
- Arc flash protection

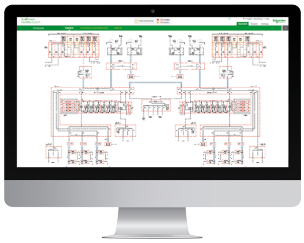
Automation Schemes

- Fast Self-Healing: detects, isolates and restores the power in MV open loop electrical topologies in less than 300 ms.
- Automatic Transfer Switch / Power Transfer Switch: automatically switches to backup power in the event of a fault on the primary source.

- Load-shedding: keeps critical loads connected while shedding non-critical ones to balance generation and consumption.
- Load-restore: limits the inrush current while reconnecting the loads by sequentially reclosing power transformers.
- Emergency Genset Capacity Management: balances the emergency genset's capacity with the energy consumption according to the available power.

Live Data Display

- Animated Single-Line Diagrams (SLD) display the status of the system with color animation to distinguish sections with and without a power supply.



Single Line Diagram Live Display

Events and Alarms

- System events and alarms are displayed in chronological order with sorting and filtering capabilities.

Trends

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

Remote Control

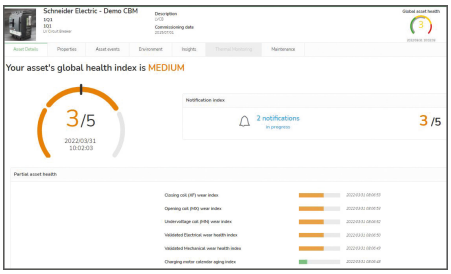
- Select-before-operate commands are available from SCADA HMI.

Cloud-Based Analytics and Service

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

It includes:

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

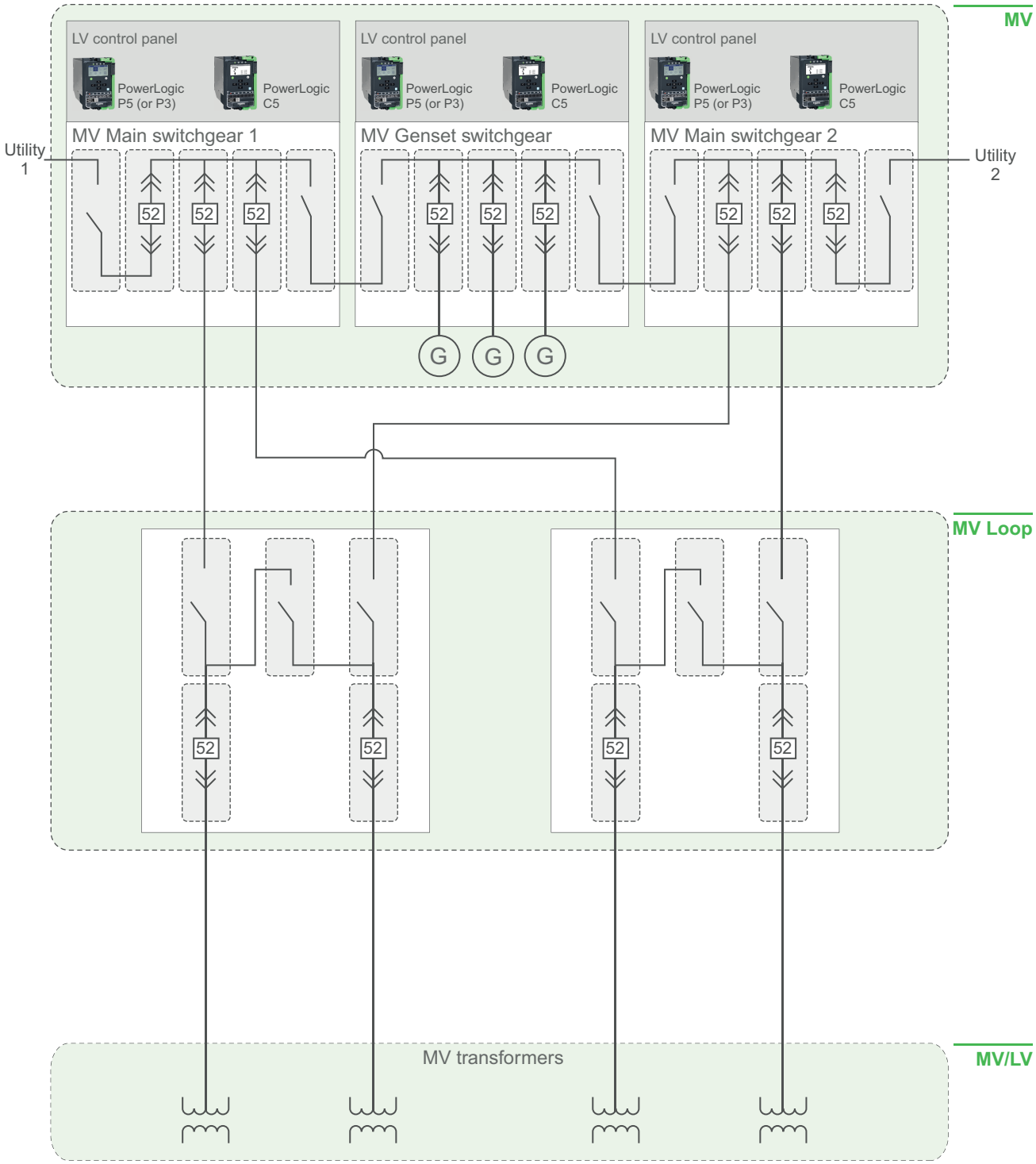


EcoStruxure Asset Advisor Asset Health Dashboard

EcoStruxure Asset Advisor Risk Level Dashboard

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Advanced Protection and Automation application.



Digital Architecture

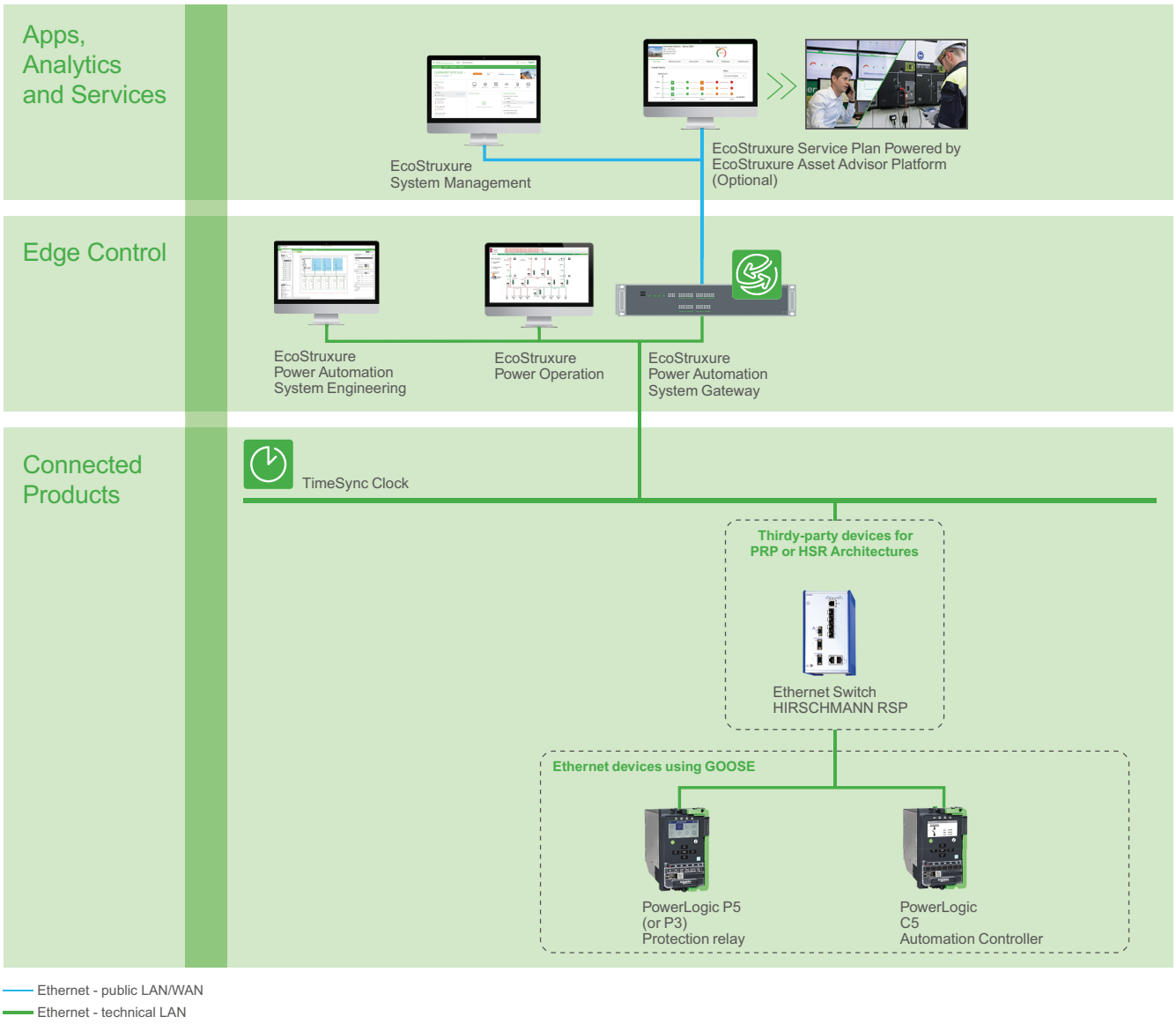
The digital architecture of the Advanced Protection and Automation application involves collecting the input data from the different products, either directly over Ethernet or via gateways. Ethernet-based communication is required for high-performance network reconfiguration response time.

This data is then used by the Edge Control layer which consists of a set of software-defined applications across the following levels:

- Operations: EcoStruxure Power Operation (HMI) and EcoStruxure Power Automation System Gateway
- Maintenance: EcoStruxure Power Automation System Engineering and System Management.

As an option, data from EcoStruxure Power Operation or EcoStruxure Power Automation System Gateway can be passed on to the EcoStruxure Asset Advisor[1] platform and interpreted by experts as part of the EcoStruxure Service Plan.

The recommended digital architecture for the application is shown below:

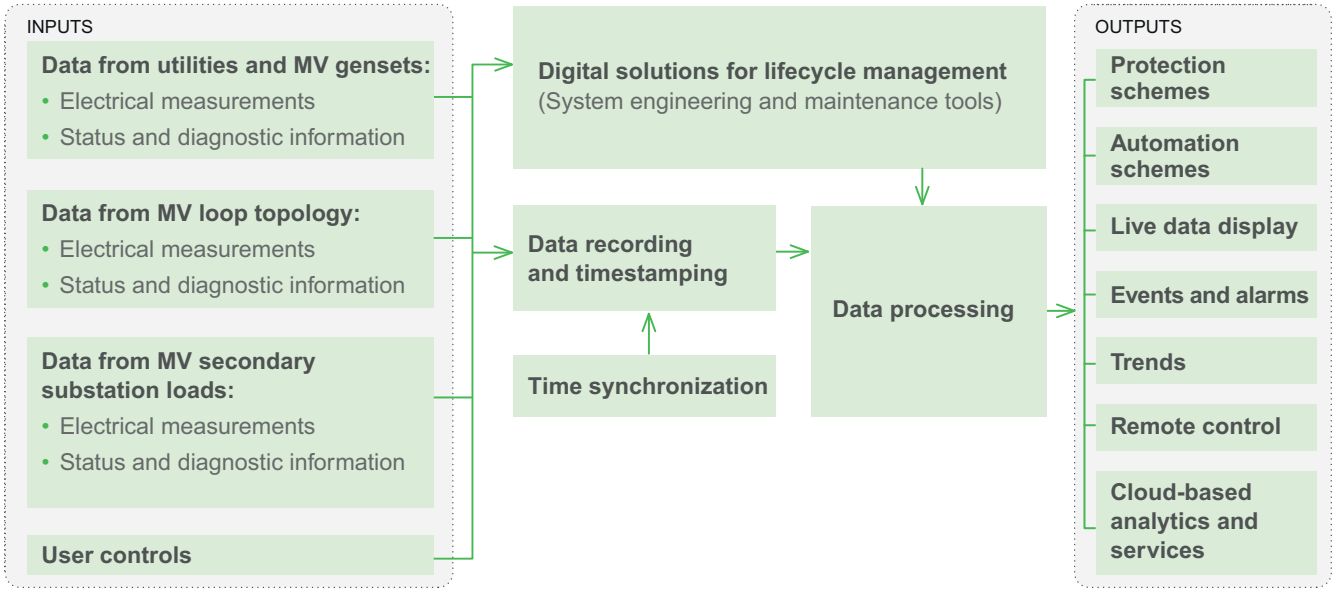


1. EcoStruxure Asset Advisor integrates asset performance data from EcoStruxure Power Automation System Gateway to enable more optimized electrical asset management. See Asset Performance application for more details.

System Description

Data Flow

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



Inputs

Data from Utilities and MV Gensets

The following data is required:

- **Electrical measurements**: power sources and feeders are monitored to process real-time protection algorithms and automation schemes to automatically operate actuators in case of electrical fault. Incoming (from utilities) and generated (from genset) power data is collected in real time and shared across an IEC 61850 network to execute load-shedding and load-restore automation schemes.
- **Status and diagnostic information**: if any source or network control operations involve the utility incomers, MV secondary substations, or gensets in the facility, it is essential to determine their status and to access diagnostic information to run proper automatic reconfiguration sequences.

For the utility incomer and for the genset(s), these measurements are collected by protection relays (such as the PowerLogic P5/P3), automation controllers (such as PowerLogic C5), or EcoStruxure Power Automation System Gateway (EPAS-GTW) in the case of Modbus devices.


PowerLogic P5


PowerLogic P3


PowerLogic C5


EcoStruxure Power Automation System Gateway

Data from MV Loop Topology

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


PowerLogic P5


PowerLogic P3


PowerLogic C5

- **Electrical measurements:** measurements such as voltage, current, and power are collected to process real-time protection algorithms and automation schemes for power restoration, load shedding, etc.
- **Status and diagnostic information:**
  - Status and diagnostics from contactors, switches, and circuit breakers
  - Trip signals from protection relays
  - Operation mode of automation schemes (local/remote, manual/auto, test)
  - Status and diagnostics from protection relays and/or automation controllers

Data from MV Secondary Substation Loads

In critical facilities, the preservation of essential loads such as motors, machines, or other equipment is of utmost importance. Therefore, the following data is key:

- **Electrical measurements**: consumed power data is collected in real-time and shared across the IEC 61850 high-performance Ethernet network to execute load-shedding and load-restore automation schemes.
- **Status and diagnostic information** are necessary to understand the conditions of these essential loads prior to shedding or restoring them.

This data can be collected from automation controllers (PowerLogic C5), through digital and analog inputs connected to MV secondary circuits, or through EcoStruxure Power Automation System Gateway in case of Modbus devices.


PowerLogic C5


EcoStruxure Power Automation System Gateway

User Controls

In the event the protection or automation system halts due to improper operating conditions or for the purpose of maintenance, the user is able to issue external control actions such as resetting of controls or open/close orders either:

- from a Central HMI (EcoStruxure Power Operation) or
- from the front panel of local devices (PowerLogic P5/P3 or C5).


PowerLogic C5


PowerLogic P5


PowerLogic P3


EcoStruxure Power Operation

Data Recording and Timestamping

All protection, automation, and control system activities are recorded and timestamped for postmortem analysis, traceability, and auditing.

For critical applications, a timestamp accuracy of ±1 ms is required to help ensure a correct sequence of events.

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

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


EcoStruxure Power Automation System Gateway


PowerLogic P5


PowerLogic C5


PowerLogic P3

Time Synchronization

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

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


TimeSync Clock

Data Processing

Real-time data is processed to execute protection and automation schemes and control functions over the IEC 61850 high-performance Ethernet network.

The results are monitored and recorded in Edge Control software (EcoStruxure Power Operation and EcoStruxure Power Automation System Gateway) for a better understanding of protection and automation schemes, sequence of operation, and potential system issues due to abnormal conditions (device in local mode, tripped circuit breaker, etc.).

User intervention may be necessary in the event of halted automation, manual load control, or maintenance activities. In this case, data processing consists of logging all user actions with the date and time as well as user ID for traceability purposes.

EcoStruxure
Power Operation

EcoStruxure
Power Automation System Gateway

Digital Solutions For Lifecycle Management

The IEC 61850 standard offers digital solutions that help specify, design, automate, configure, monitor, operate, and maintain protection, automation and control systems. EcoStruxure Power Automation System offers digital tools that add the necessary software intelligence for managing the electrical system's lifecycle.

EcoStruxure Power Automation System Engineering (EPAS-E)

This tool complies with IEC 61850 standards for specification and configuration of vendor-agnostic protection, automation, and control systems:

- Vendor-agnostic system configuration
- Application standardization to optimize project deployment
- Intuitive interface to simplify implementation
- Advanced template management for future system evolutions/extensions
- Automated data flow configuration for protection relays, HMIs, and gateways

EcoStruxure
Power Automation System Engineering

EcoStruxure System Management

This tool provides IEC 61850 vendor-agnostic inventory management that helps maintain protection, automation, and control systems:

- Storage and backup of configuration, setting files, and documentation
- System level version baselining
- Real-time monitoring of device firmware and configuration changes
- Automatic collection, storage, and display of disturbance recorder files
- Mass firmware upgrade (PowerLogic T300 only)

EcoStruxure
System Management

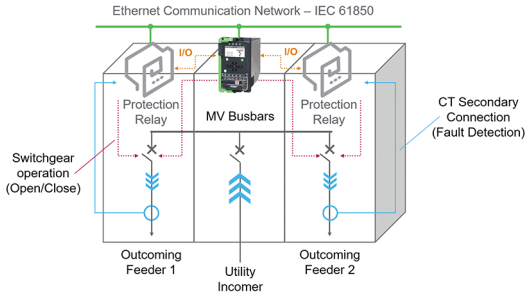
Outputs

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

Protection Schemes

A wide range of protection functions are available via PowerLogic P5 and P3 relays to meet the requirements of electrical utilities point of connection and MV electrical systems:

- Feeder Protection (ANSI 67/67N, 50BF)
- Generator Protection (ANSI 50/51, 24, 64REF)
- Transformer Protection (ANSI 87T, 50/51)
- Motor Protection (ANSI 27/59, 49, 66)
- Arc Flash Protection

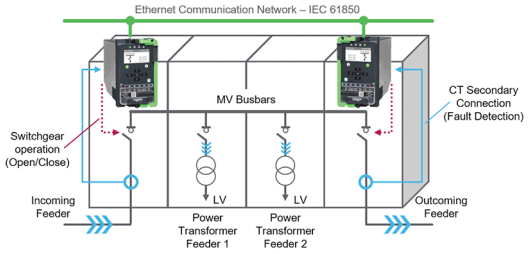


Protection and Automation in MV Incomer Substation

Automation Schemes

PowerLogic C5 processes real-time and fault-tolerant automation schemes based on the IEC 61131-3 standard over interoperable IEC 61850 Ethernet network communication services for a more autonomous response of MV electrical system applications:

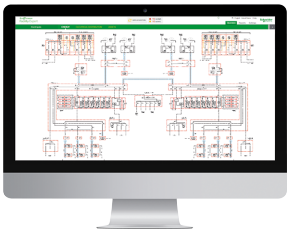
- Fast Self-Healing (in less than 300 ms)
- Redundant Automatic Transfer Switch / Power Transfer Switch (ATS/PTS)
- Load-shedding
- Load-restore
- Genset Capacity Management



Protection and Automation in MV Secondary Substation

Live Data Display

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



Live Data Display in EcoStruxure Power Operation

Events and Alarms

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

Chronological views include:

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

EcoStruxure Power Operation

EcoStruxure Power Automation System Gateway

Trends

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

Remote Control

In the event of a halt in the automation system (due to improper operating conditions) or for maintenance, the user is able to issue external control actions (both from EcoStruxure Power Operation or the front panel of the device), such as open/close orders or resetting of alarms.

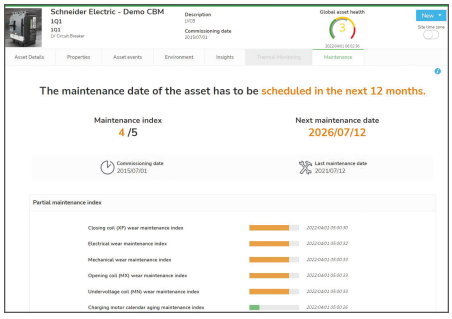
Cloud-Based Analytics and Services

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

It includes:

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

EcoStruxure Service Plan Powered by EcoStruxure Asset Advisor Platform



EcoStruxure Asset Advisor Maintenance Index

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