Backup Power Testing (NEMA)

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

EcoStruxure Power Digital Application

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EcoStruxure™ Power

Schneider Electric™

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Overview

Context of Application

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

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

Problem to Solve

The facility/energy manager needs to:

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

Purpose of the Application

Provide automated backup power test reporting including:

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

Record key legislated parameters for compliance reports including:

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

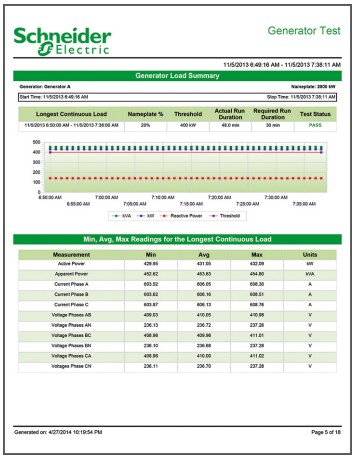
Application Outcomes

Live Data Display

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

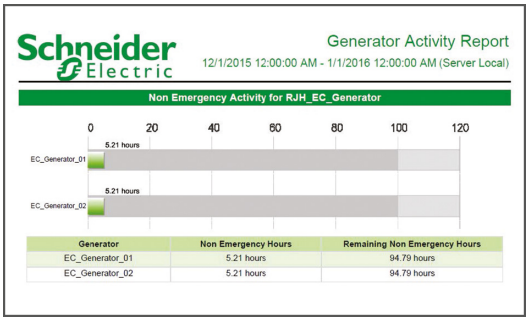
Reports

- Generator Test (EPSS) Report



Backup Power System Test Report

- Generator Activity Report



Generator Activity Report

- Generator Load Summary Report
- Generator Battery Health Report
- UPS Auto-Test Report

UPS Auto-Test Report

- UPS Battery Health Report

Electrical Architecture

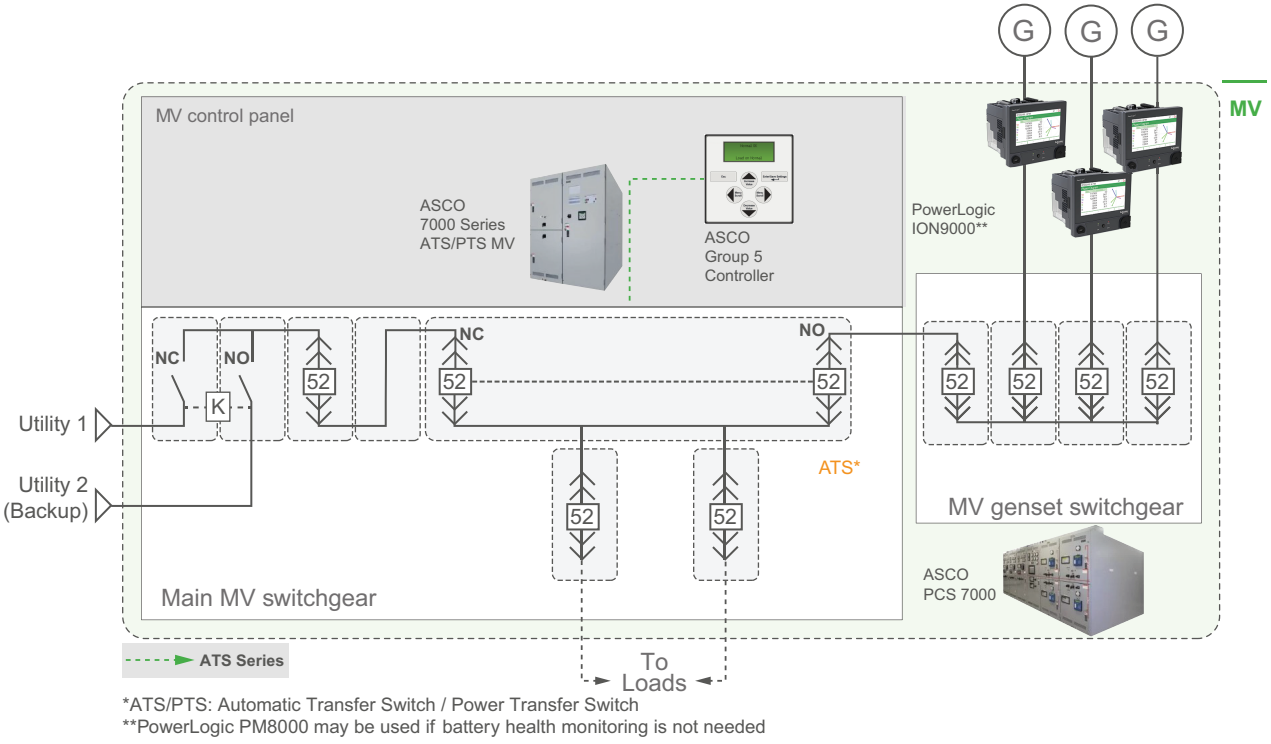
Introduction

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

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

Medium Voltage Generator Architecture

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



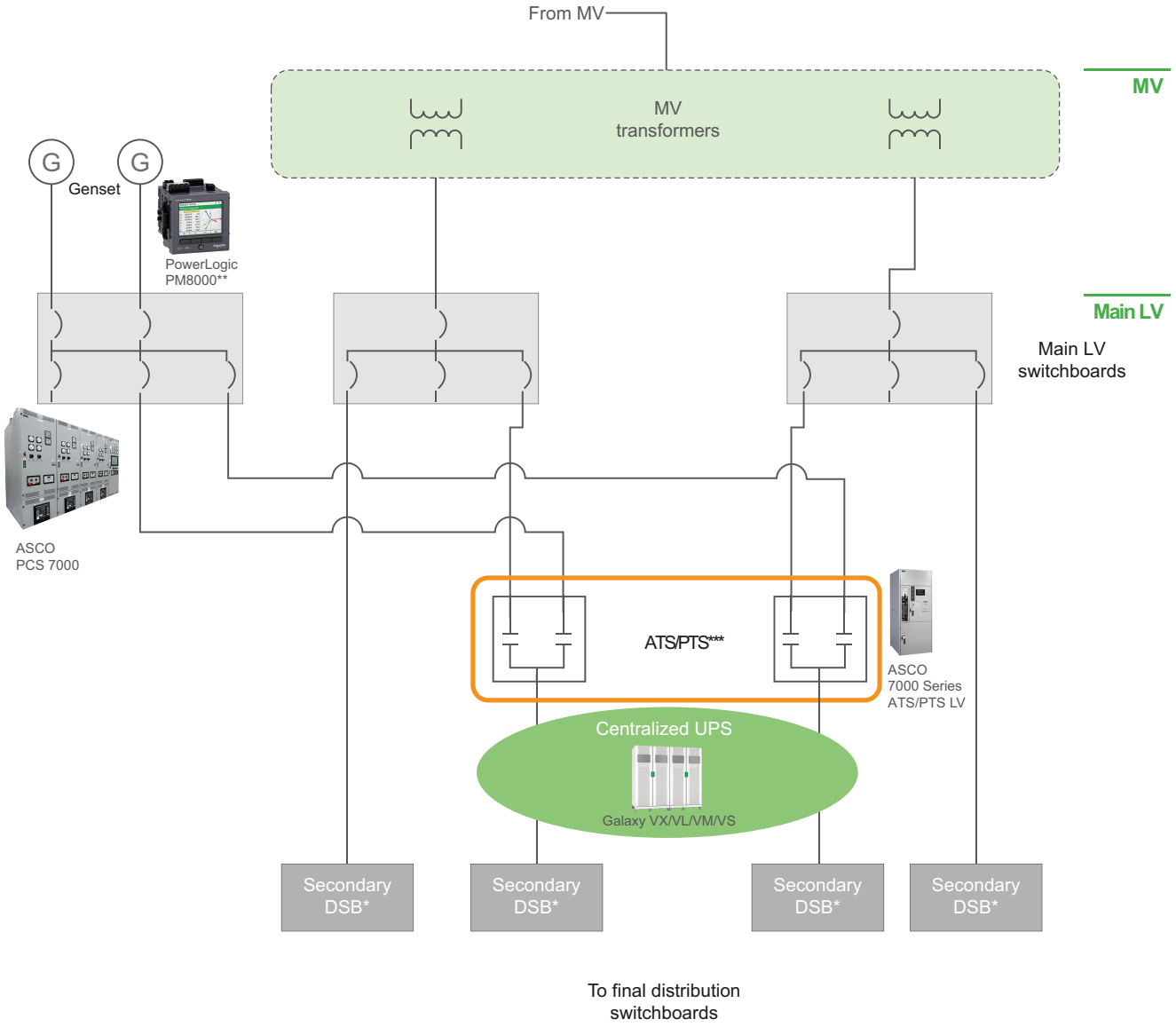
*ATS/PTS: Automatic Transfer Switch / Power Transfer Switch
**PowerLogic PM8000 may be used if battery health monitoring is not needed

Low Voltage Generator Architecture

If the backup/emergency power system operates on a low voltage section of the network, it will usually include several ATS/PTSs[1].

As illustrated below, the ATS/PTS[1] and the genset will each be equipped with a power meter that will collect analog electrical data from its power outputs as well as status details via digital I/O ports.

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



ATS/PTS*** status

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

Digital Architecture

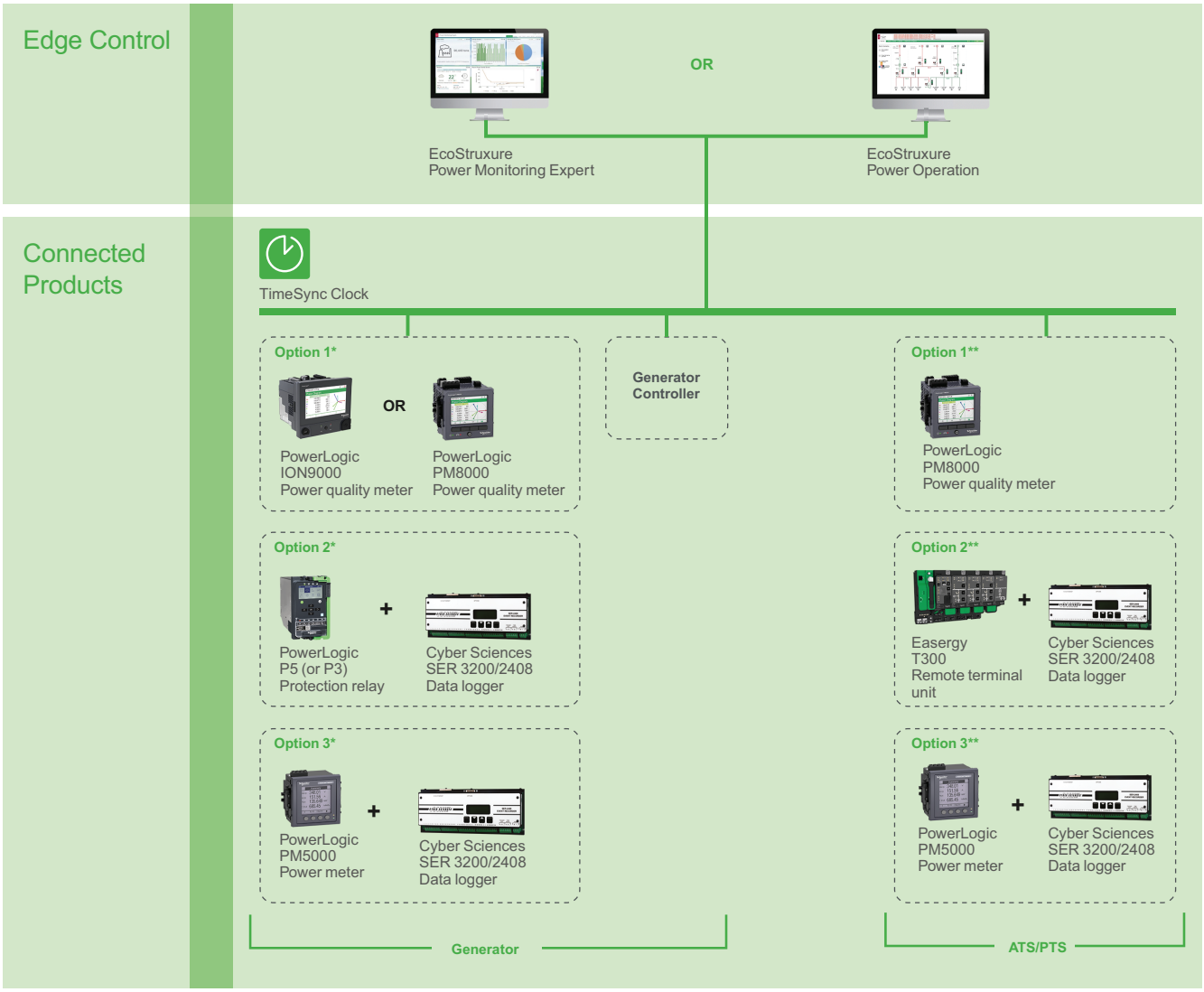
There are three possible digital architectures for the Backup Power Testing application:

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

Medium Voltage Generator Architecture

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

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



Ethernet - technical LAN

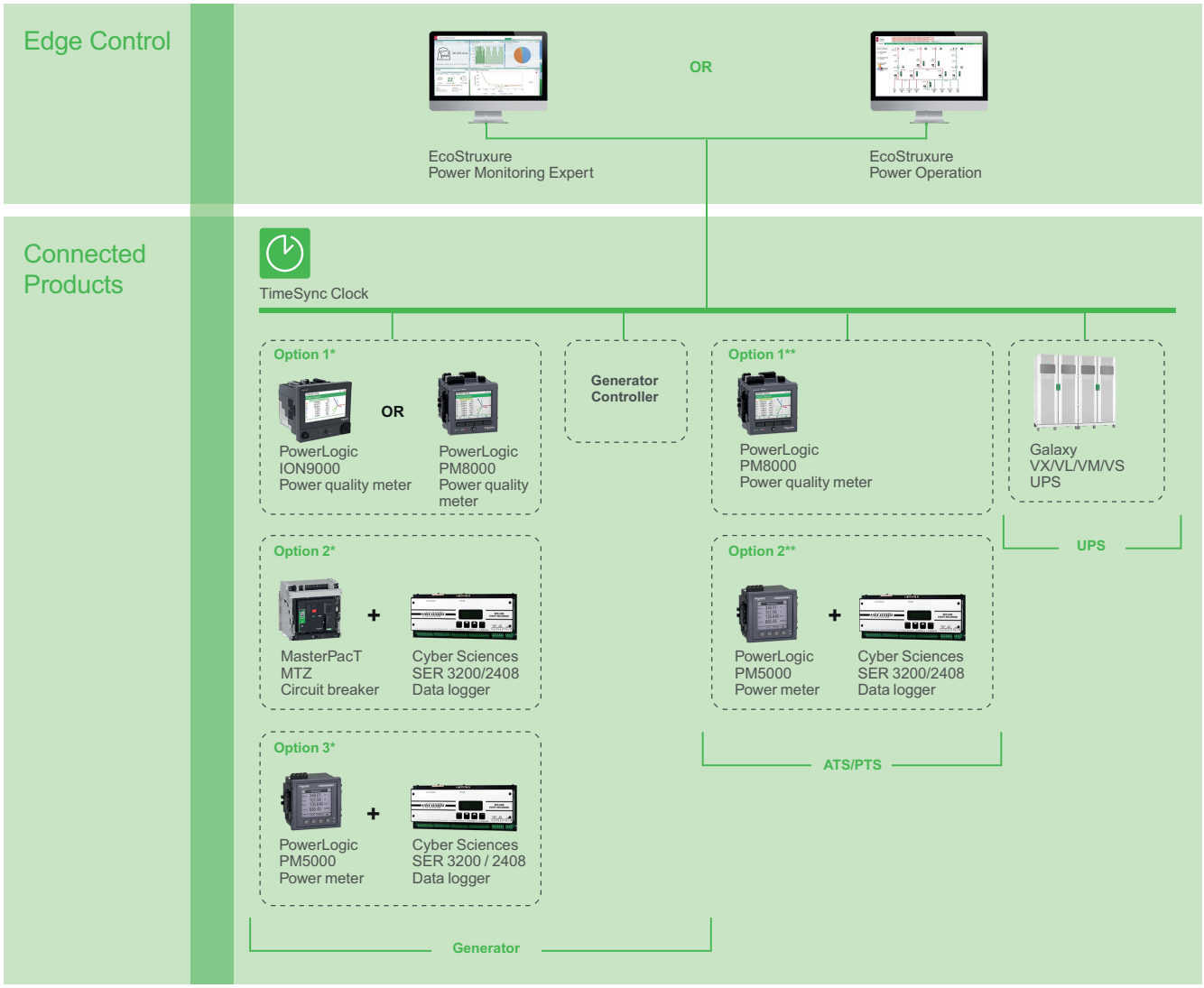
* Option 1 is the recommended architecture. Option 2 should be considered if PowerLogic P5, Easergy P3 with embedded metering is already present in the architecture.
Option 3 can be considered if an entry-level meter such as PowerLogic PM5000 is specified.

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

Low Voltage Generator Architecture

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

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



Ethernet - technical LAN

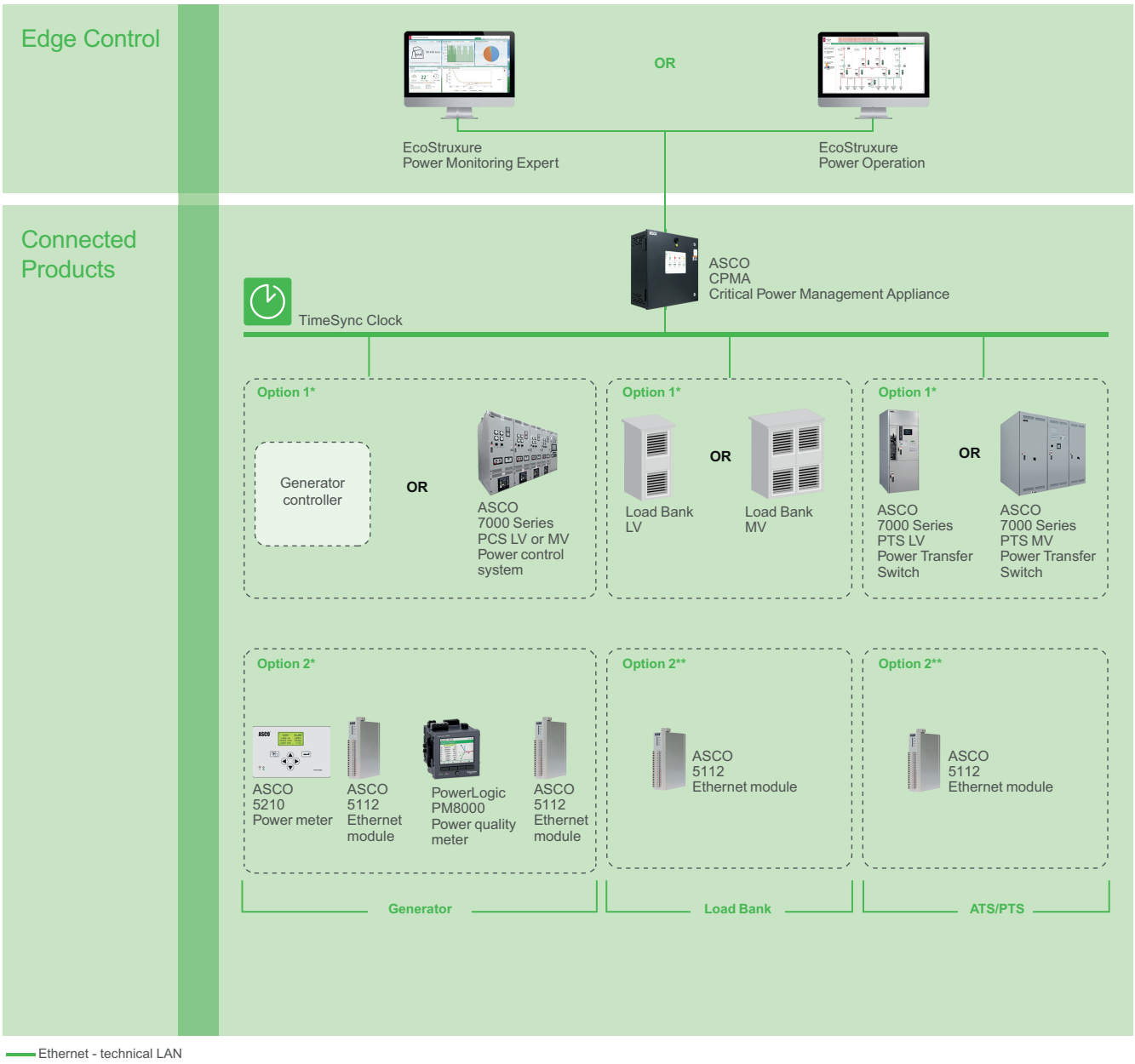
* Option 1 is the recommended architecture. Option 2 should be considered if MasterPacT MTZ with embedded metering is already present in the architecture.
Option 3 can be considered if an entry-level meter such as PowerLogic PM5000 is specified.

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

ASCO Medium and Low Voltage Architecture

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

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

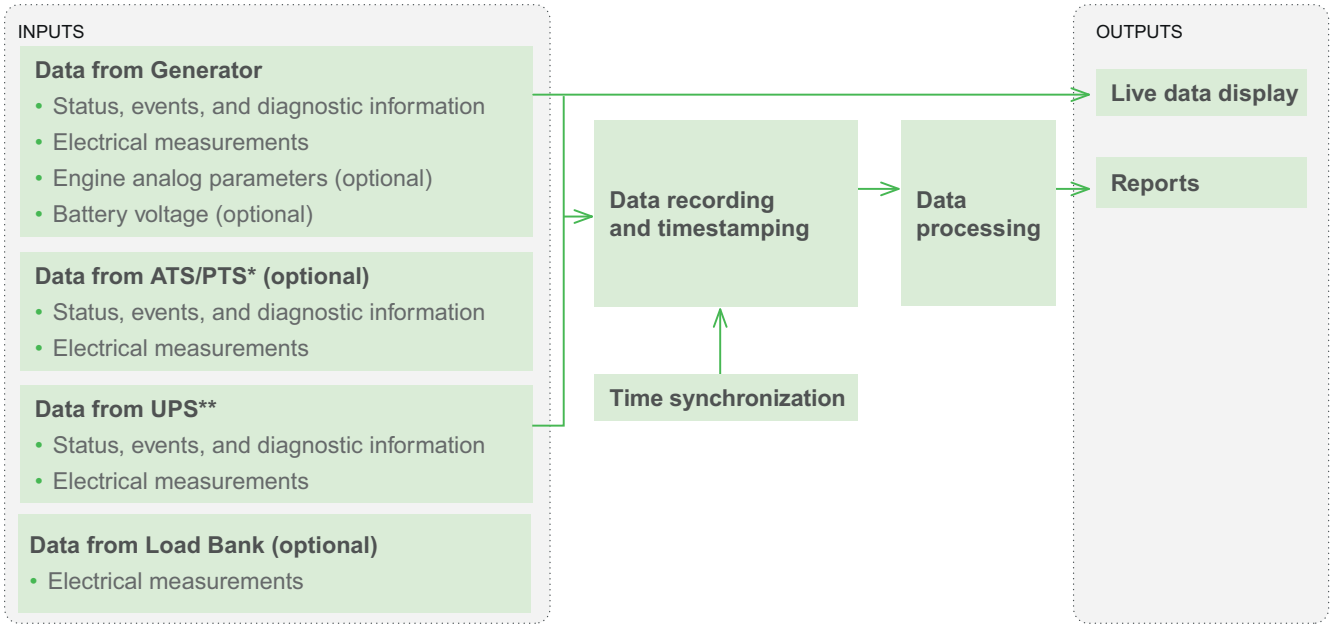


* Option 1 is the recommended architecture for Greenfield and/or Digital based solutions
** Option 2 is the recommended architecture for Brownfield / Retrofit or hardwired solutions.

System Description

Data Flow

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



* ATS/PTS: Automatic Transfer Switch / Power Transfer Switch

** UPS: Uninterruptible Power Suppy

Inputs

Data from Generator

The following data are required:

Status, events, and diagnostic information:

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

Electrical measurements:

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

Engine analog measurements (optional):

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

This input data may be provided by the generator controller, the power control system (ASCO 7000 Series PCS), power meters (PowerLogic ION9000, PM8000,

PM5000, ASCO 5210), data loggers (Cyber Sciences SER 3200/2408, ASCO 5112), and/or embedded metering (PowerLogic P5/P3, MasterPacT MTZ).


ASCO 7000 Series PCS


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


ASCO 5210


Cyber Sciences SER 3200/ 2408


ASCO 5112


PowerLogic P5


PowerLogic P3


MasterPacT MTZ

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

The following data are collected:

Status, events, and diagnostic information:

- Normal, Test, Emergency

Electrical measurements:

- ATS/PTS load data (optional)

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


PowerLogic T300


ASCO 7000 Series PTS MV


ASCO 7000 Series PTS LV


PowerLogic ION9000


PowerLogic PM8000


PowerLogic PM5000


Cyber Sciences SER 3200/2408

Data from Uninterruptible Power Supply (UPS)

The following data are collected:

Status, events, and diagnostic information:

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

Electrical measurements:

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

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

Galaxy
VX/VL/VM/VS

Data from Load Bank (optional)

The following data are collected:

Electrical measurements:

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

Load Bank MV

Load Bank LV

Data Recording and Timestamping

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

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

PowerLogic
ION9000

PowerLogic
PM8000

PowerLogic
PM5000

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


PowerLogic P5


PowerLogic P3


MasterPacT MTZ


PowerLogic PM5000


ASCO CPMA


Cyber Sciences SER 3200/2408

Timestamping Requirements for Backup Generator and ATS/PTS

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

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

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

Timestamping Requirements for UPS

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

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

Time Synchronization

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

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


TimeSync Clock

Data Processing

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

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

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

ASCO
CPMA

For the Backup Generator and ATS/PTS[2]

Data processing consists of:

- Analyzing the status information from the generator(s) and ATS/PTSs[2] and compiling the run history table which details each and every backup power run, including start, stop, and transfer time.
- Among others, the following indicators are extracted from available data:
  - Split of emergency / non-emergency running hours as an annual total.
  - Running hours broken out into categories for Test, Power Outage, Load Shedding.
- For the backup/emergency system[3] conformance tests, all success criteria are examined to provide a comprehensive fail/pass status.

For the UPS[4]

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

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

Outputs

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

2. ATS/PTS: Automatic Transfer Switch / Power Transfer Switch
3. Also sometimes referred to as Emergency Power Supply System (EPSS)
4. UPS: Uninterruptible Power Supply

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

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

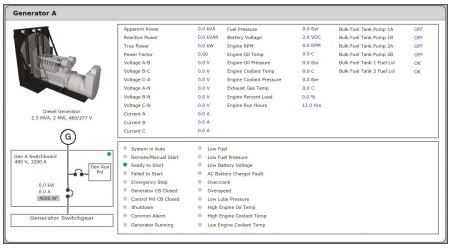
In the case of an ASCO architecture, outputs are displayed by the ASCO CPMA.

ASCO
CPMA

Live Data Display

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

- Default Generator, UPS[5], and ATS/PTS[6] diagrams
- Generator Performance (EPSS) operator interface. Helps monitor the following during tests in real time:
  - Electrical data: current, voltage, power, frequency, power factor
  - Generator and ATS/PTS run/stop status
- UPS[5] Auto-test diagrams



Generator Equipment Diagram

Reports

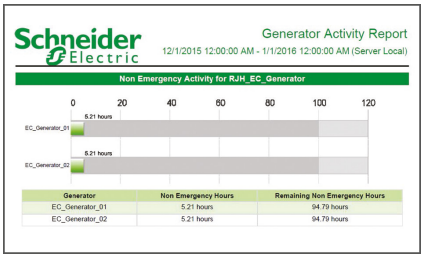
The following reports can be generated on-demand or automatically generated and sent by email:

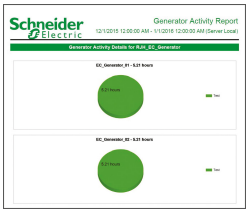
5. UPS: Uninterruptible Power Supply
6. ATS/PTS: Automatic Transfer Switch / Power Transfer Switch

Backup/Emergency Power Reports

- **Generator Activity Report**

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

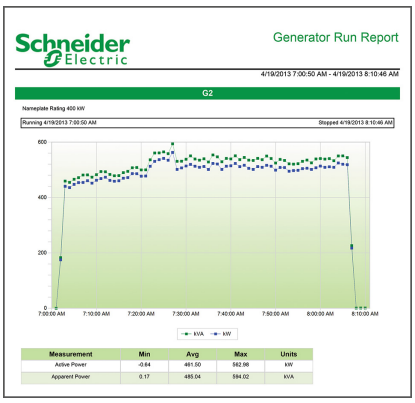




Generator Activity Report

- **Generator Load Summary Report**

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

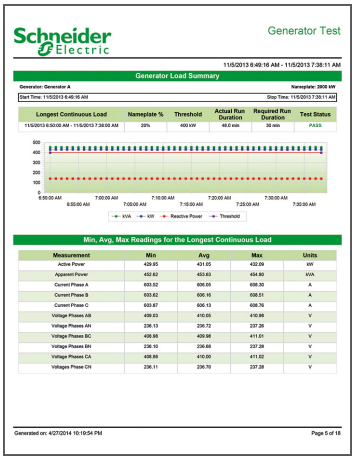


Generator Load Summary Report

- **Generator Test (EPSS) Report**

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

  Can also be configured to conform to the requirements for a Backup/ Emergency Power Supply System (EPSS)[7] test, including ATS/PTS[8]. For example, the report shows the transfer time of the lead ATS/PTS[8] and indicates whether the transfer time passes or does not pass the test requirements.



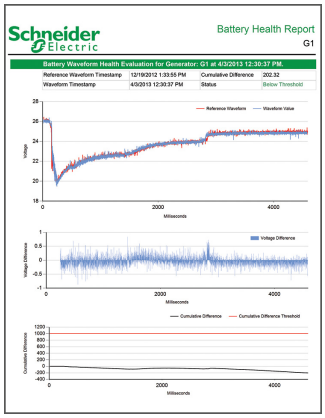
Backup Power System[7] Test Report

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

- **Generator Battery Health Report**

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

  Available with PowerLogic ION9000 only.



Generator Battery Health Report

Uninterruptible Power Supply (UPS) Reports

- **UPS Auto-Test Report**

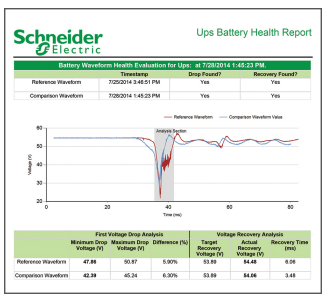
  Provides information regarding the battery health of your Galaxy VX/VL/VM/VS UPS devices.

UPS Auto-Test Report

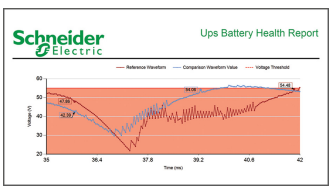
- **UPS Battery Health Report (For third-party UPS)**

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

  Available with PowerLogic ION9000 only.



UPS Battery Health Report (For third-party UPS)



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