Synchrowave® Monitoring

Power System Operations and Analytics Software

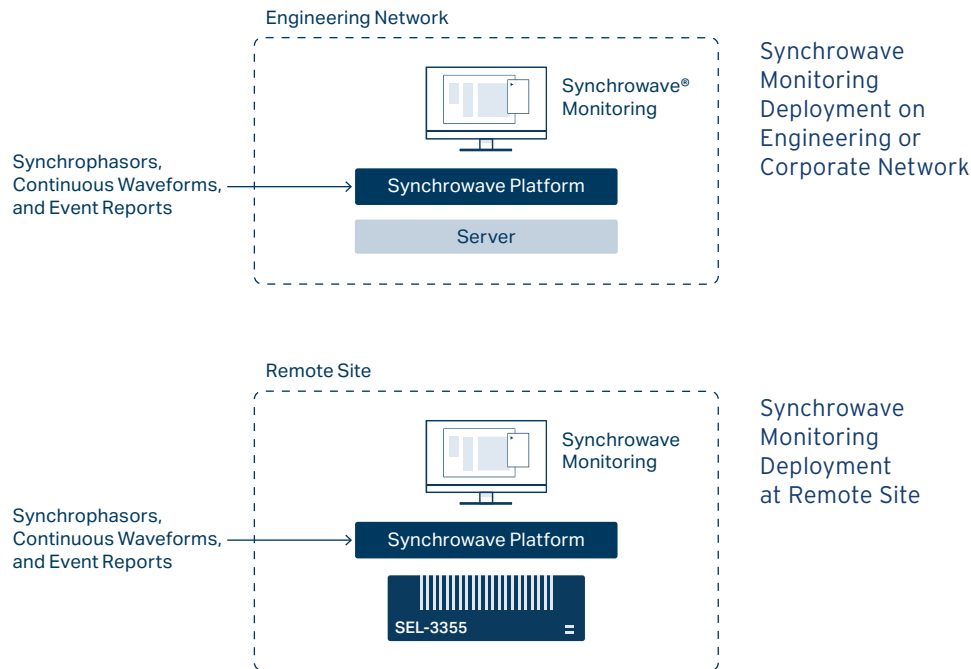## Improve disturbance analysis using real-time and historic trending and archiving

- Analyze synchrophasor data, continuous waveform streams, and event reports for complete power quality monitoring and disturbance analysis.

- Easily export system disturbance data to support NERC PRC-002-2, PRC-028-1, and IEEE 2800 compliance efforts.

- Gain power system insight that SCADA can't provide by using high-resolution time-series data.

- Detect disturbances induced by inverter-based resources, such as transients, subsynchronous oscillations, rapid voltage change (RVC), and harmonic distortion, to maintain power system stability.
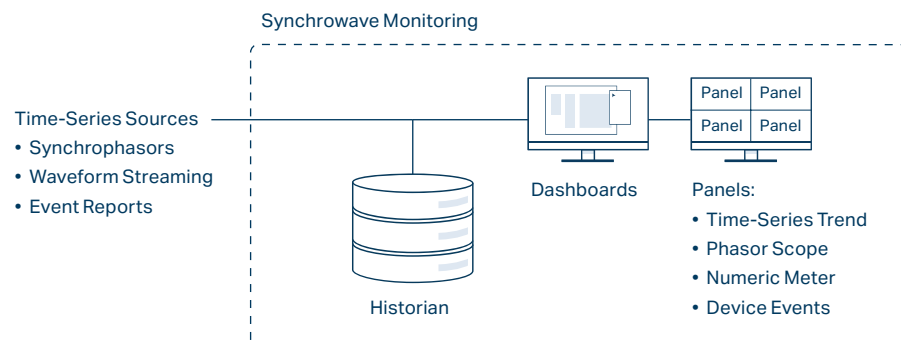
SEL

Synchrowave for Monitoring and Archiving

Improve understanding of system events and expedite root cause analysis by using high-resolution time-series data. SEL-5703 Synchrowave Monitoring brings synchrophasor data, continuous waveform streams, and event reports together into one place so engineers can analyze both the high-level system impact of an event and the detailed oscillography data.

Engineering Network

Synchrowave® Monitoring

Synchrowave Platform

Server

Synchrophasors, Continuous Waveforms, and Event Reports

Synchrowave Monitoring Deployment on Engineering or Corporate Network

Remote Site

Synchrowave Monitoring

Synchrowave Platform

SEL-3355

Synchrophasors, Continuous Waveforms, and Event Reports

Synchrowave Monitoring Deployment at Remote Site

Synchrowave Monitoring Functional Overview

Time-series sources stream data to a historian and dashboards. Engineers view the data on dashboards composed of various data visualization and analysis panels.

Synchrowave Monitoring

Time-Series Sources
• Synchrophasors
• Waveform Streaming
• Event Reports

Historian

Panel | Panel
Panel | Panel

Dashboards

Panels:
• Time-Series Trend
• Phasor Scope
• Numeric Meter
• Device Events

Key Benefits

Disturbance Monitoring and Archiving for Compliance

Analyze archived synchrophasor data, continuous waveform streams, and event reports together in one display for a complete disturbance monitoring solution. Easily find system disturbances, and export data to CSV and COMTRADE data formats to support NERC PRC-002-2, PRC-0028-1, and IEEE 2800 compliance efforts.

See the Real-Time System State

Improve system visibility by viewing live and time-aligned information from across the entire power system. Gain additional insight into the dynamic behavior of the power system through waveform signatures to aid in analysis during abnormal conditions.

Validate and Improve Power System Models

To accurately replicate events, power system studies rely on accurate system models. Synchrowave Monitoring records the system response to system events, such as capacitor switching, generator trips, load shedding, or other events. Comparing the recording to system models enables engineers to plan a safer and more reliable system.

Reliably Integrate Renewable Generation

High-resolution time-series data enable engineers to monitor and track the impact of renewables. Integrating renewable energy into the power system can result in reduced system stability and new oscillatory modes. System dynamics from these generation sources change quickly—too fast to see at traditional SCADA rates.

Record and Analyze Continuous Waveforms

Never miss an event again. We offer a line of hardware that streams continuous waveforms in real time, including the SEL-2240 Axion®, the SEL Real-Time Automation Controller (RTAC), the SEL-735 Power Quality and Revenue Meter, and the soon-to-release SEL-T35 Time-Domain Power Monitor. Sampling and streaming rates range from 3 kilosamples per second (ksps) to 14.4 ksps. Synchrowave Monitoring software receives these data streams, provides real-time metering values, trends these values, provides real-time alarms, and archives the data.
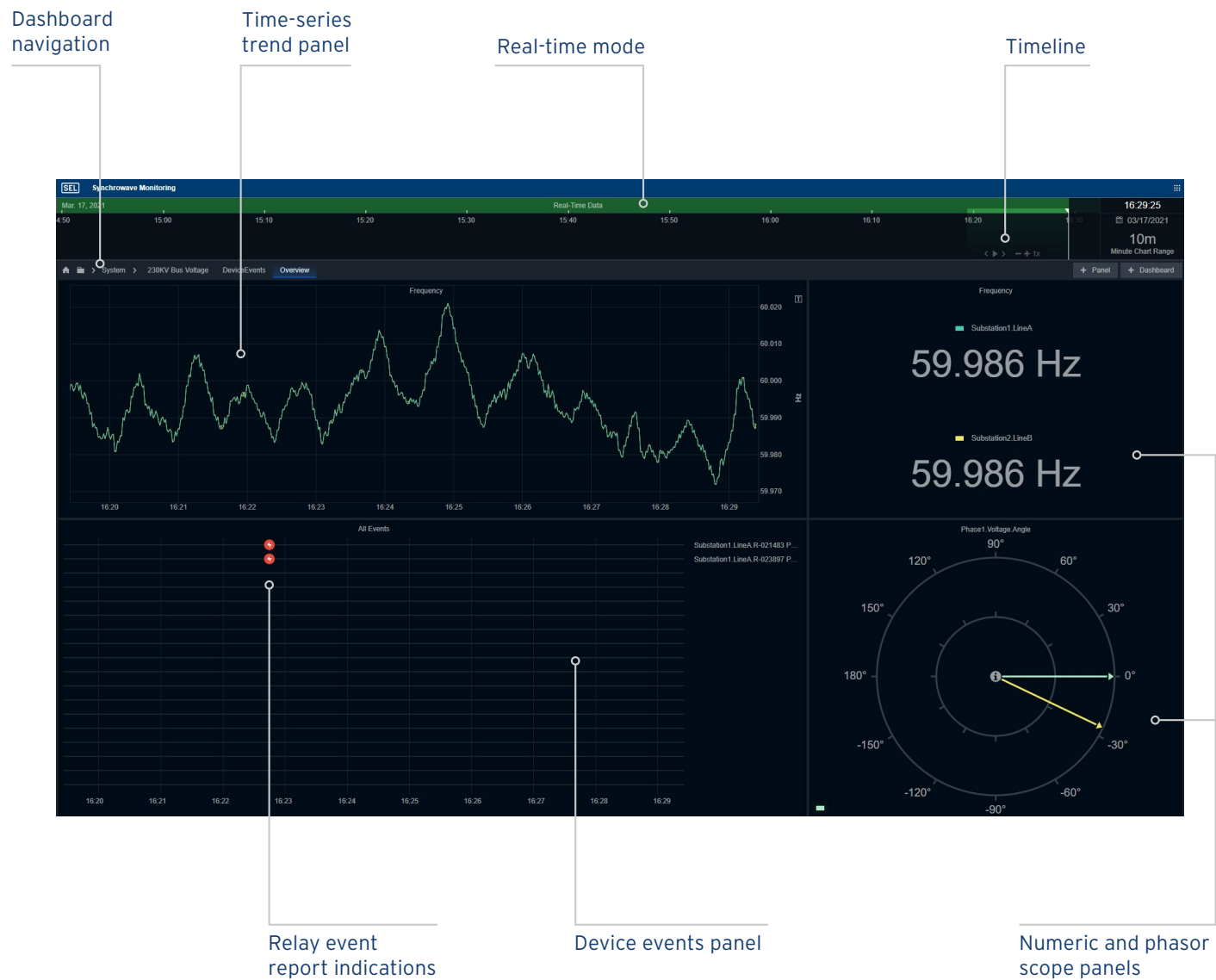
Customize Calculations

View and customize a suite of power monitoring measurements. Virtual metering calculations utilize the 3.0–14.4 ksps data streams to provide power metering measurements, including voltage, current, power, frequency, symmetrical components, and power factor. Additional power quality measurements include harmonics; RVC; voltage sag, swell, and interruption (VSSI); and flicker. The virtual metering application also calculates phasor measurement unit (PMU) quantities from continuous waveform streams.

Overview

User Interface

Synchrowave Monitoring uses a modern, intuitive design. Dashboards are customized with Trend, Phasor Scope, Numeric, and Device Events panels to ensure engineers always have access to the data they need displayed.

Dashboard navigation

Time-series trend panel

Real-time mode

Timeline

Relay event report indications

Device events panel

Numeric and phasor scope panels

Powerful and Intuitive Dashboards

Dashboards provide real-time and historic visualization of power system data and information through a collection of panels. Dashboards are customizable and provide engineers the insight they need to efficiently analyze the power system.


Dashboard Visualization

Improve system understanding by using dashboards to monitor system frequency, bus voltage, phase angle stress, power flow, and much more.

Creating a Dashboard

Create dashboards by adding panels. Simply drag and drop panels and resize them to meet specific monitoring needs. Each panel allows for individual configuration so engineers can choose the type and location of data for monitoring. Publish the dashboards to share insights and analyses across your organization.
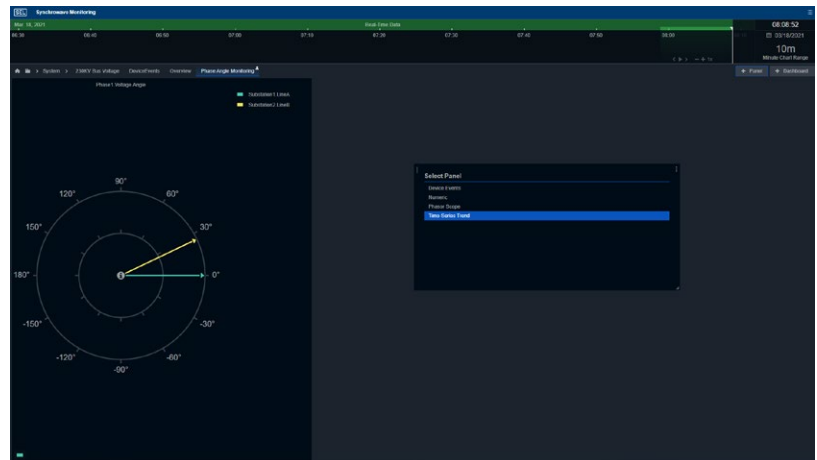
Alarming, Modeling, and Condition Detection*

Configure custom warning and alert thresholds to receive notifications of power system issues and anomalies. Associate signal measurements with physical power equipment using power system modeling. The ability to continuously observe the power system makes it possible for operators to quickly identify deviations from normal conditions and take corrective actions to maintain grid reliability and stability. Real-time monitoring and powerful algorithms enable operators to recognize oscillatory conditions and detect potential instrument transformer failure.
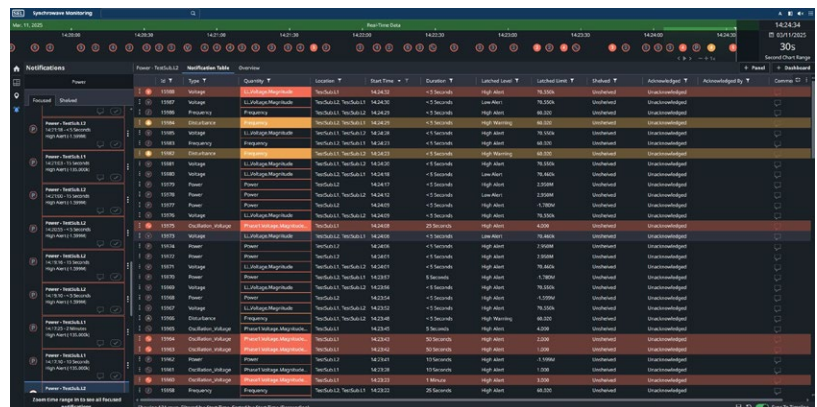
*These advanced features are only available in the Synchrowave Monitoring and Power Monitoring application packages.

Synchrowave Event Express

Synchrowave Event Express is web client-based relay event report analysis software that is included with the purchase of Synchrowave Monitoring. Synchrowave Event Express can open event reports displayed in the Device Events panel within Synchrowave Monitoring. SEL Blueframe® Data Management and Automation (DMA) and acSELerator Team® SEL-5045 Software automate the collection of event reports, providing seamless visualization in Synchrowave Event Express.

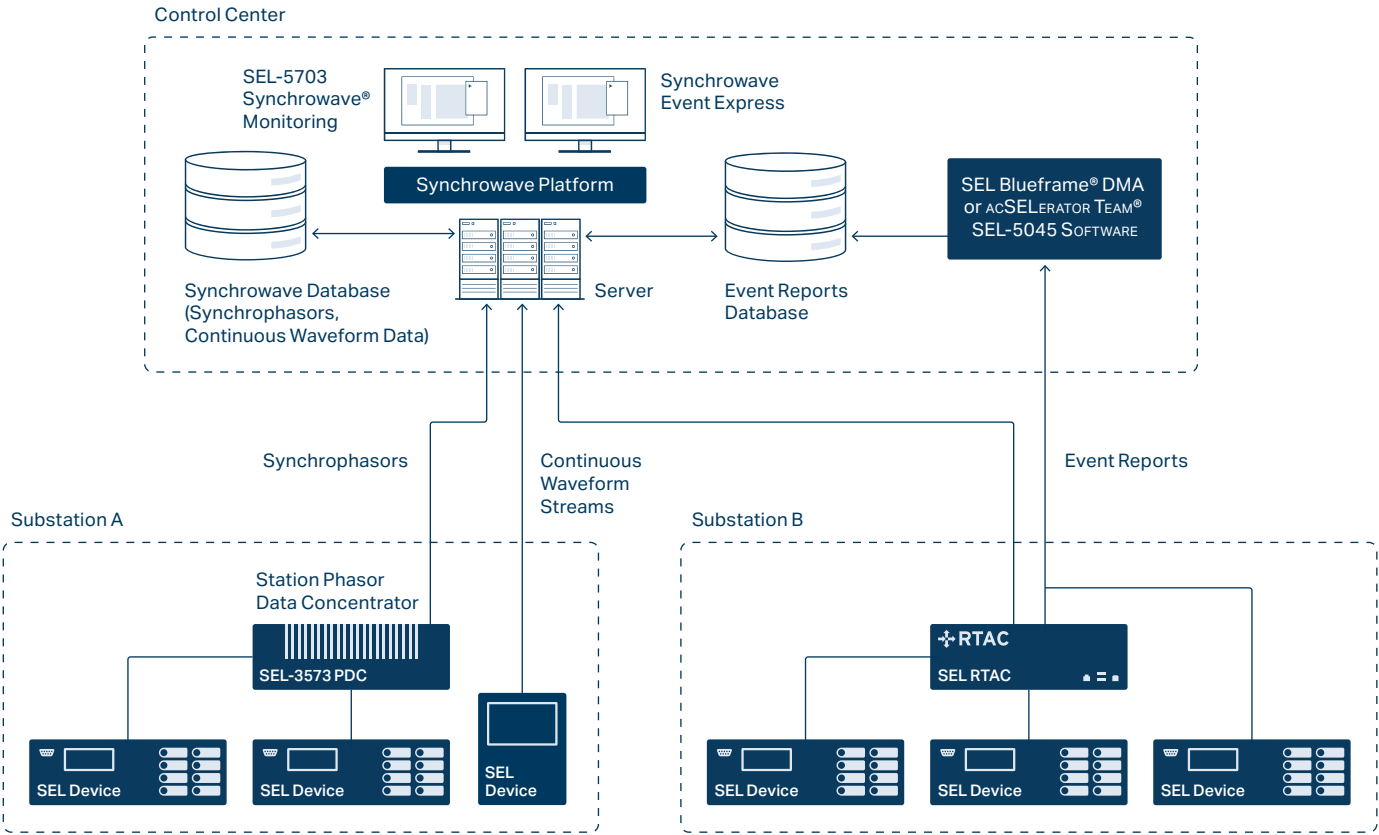Event report summary

Relay settings

Relay oscillography

Relay digitals
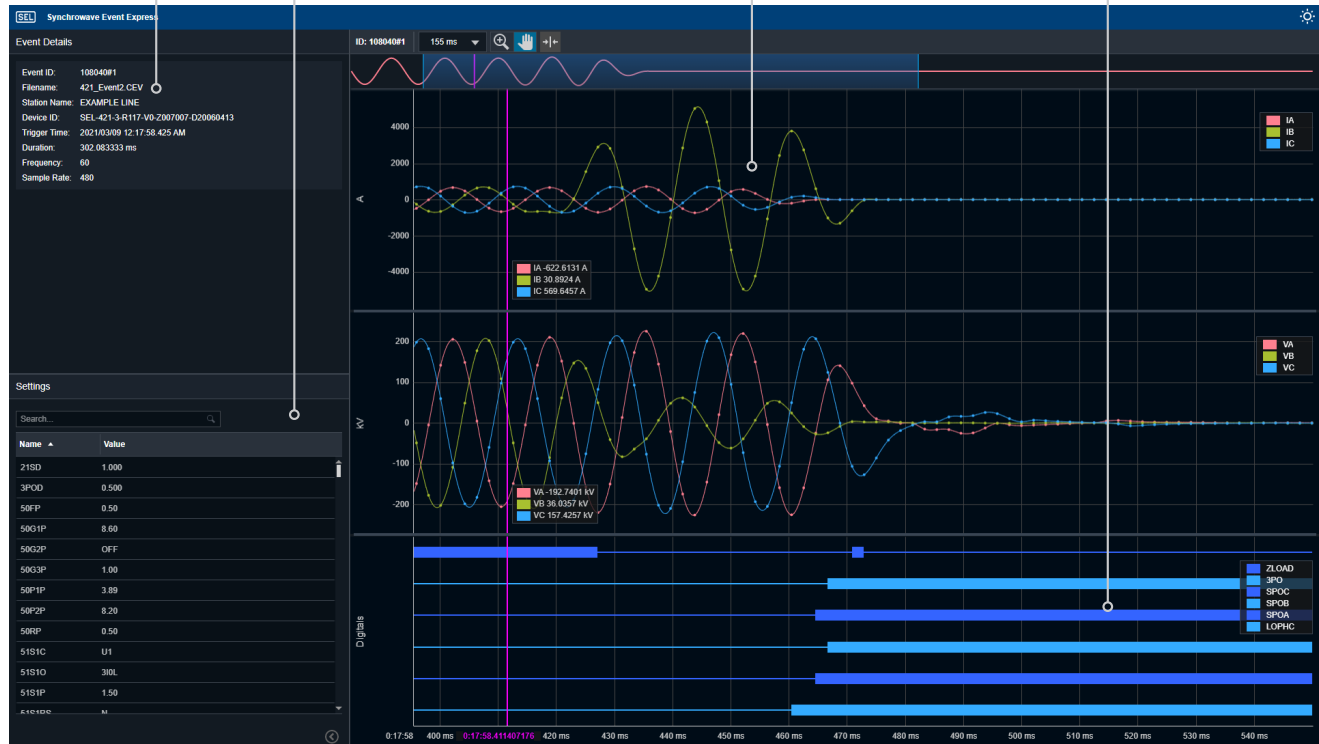
System Architecture Example

Synchrowave Monitoring connects to IEEE C37.118-compliant PMUs and phasor data concentrators (PDCs) for archiving and visualizing synchrophasor data. It also receives and analyzes continuous waveform streams directly from compatible SEL relays, meters, and controllers. In addition to real-time data, the software supports display and analysis of event reports collected by Blueframe DMA or TEAM software.

Control Center

SEL-5703 Synchrowave® Monitoring

Synchrowave Event Express

Synchrowave Platform

Synchrowave Database (Synchrophasors, Continuous Waveform Data)

Server

Event Reports Database

SEL Blueframe® DMA or ACSELERATOR TEAM® SEL-5045 SOFTWARE

Synchrophasors

Continuous Waveform Streams

Event Reports

Substation A

Station Phasor Data Concentrator

SEL-3573 PDC

SEL Device

SEL Device

SEL Device

Substation B

RTAC

SEL RTAC

SEL Device

SEL Device

SEL Device

Specifications

General	
Data Rates	1–14,400 samples per second
Data Formats	Synchrophasors, continuous waveform streams, relay event reports
Database	Time series—contact SEL for hard drive sizing requirements.

Recommended System Requirements	
File System	Local drive or external network file system
Web Browsers	Google Chrome, version 84.0 or higher
	Microsoft Edge, version 84.0 or higher
Server	**PMU deployment** 2.1 GHz processor with 16+ cores 32 GB RAM 1 Gbps network card 240 GB SSD **Continuous waveform streaming deployment** 2.7 GHz processor with 16+ cores 32 GB DDR4 RAM 1 Gbps network card 1 TB SSD See the instruction manual for minimum and high-performance recommendations.
Operating Systems	Microsoft Windows 10 (version 1909 or later, Enterprise edition), Windows 11, Windows Server 2016 Standard, Windows Server 2019 Standard, or Windows Server 2022 Standard
Network Speed	100 Mbps, 1 Gbps recommended

Configuration Requirements

Synchrowave Monitoring requires at least one real-time data source from an IEEE C37.118-compliant synchrophasor source or continuous waveform stream. Source data can come directly from compatible devices or be concentrated via the PDC(s). Synchrowave Monitoring requires Blueframe DMA or acSELerator® Database for event report archiving and visualization.

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