



SIEMENS

DATA CENTERS

Reference Architecture III

EPMS fault-tolerant design for high- and medium-voltage substations
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Introduction

A reference architecture is a standardized blueprint that outlines the components, communication protocols, and functional relationships between the different systems and devices in a data center. It provides a unified framework to ensure seamless integration of various components, including those from third-party vendors. Furthermore, a reference architecture facilitates scalability and adaptability as a data center's requirements evolve.

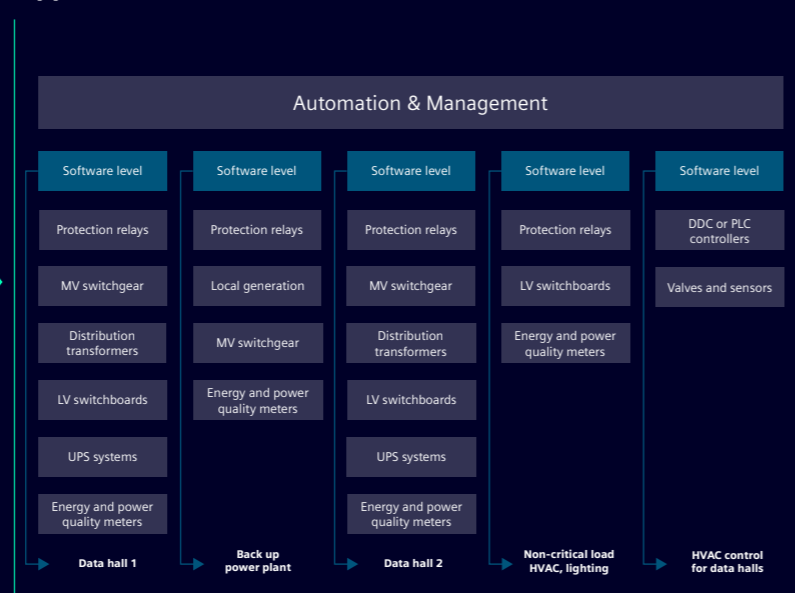
This flyer outlines one possible design, implementation, and operation of a data center's monitoring, control, and management system – commonly referred to as the Building Management System (BMS) and Electrical Power Management System (EPMS). By adopting this solution guideline, you will be in an even better position to enhance cost efficiency, reliability, and scalability.

Reference Architecture Concept

Product-based architecture



Application-based architecture



Redundancy in substations

A data center's substation is essential for achieving minimal downtime, optimized efficiency, and enhanced safety. But it takes more than redundant components: What's needed is secure and reliable communication within the substation to ensure seamless data flow in the case of a device failure. Redundant Electrical Power Management System (EPMS) architecture offers a comprehensive solution.

It takes a multipronged approach to obtain redundant EPMS architecture in a data center environment. Considerations need to be made for these areas in particular:

Field devices: In energy automation, Intelligent Electronic Devices (IEDs) are used to monitor and control switchgear, cables, and transformers. They are essentially protection devices, power quality devices, fault indicators, and intelligent switching devices in low-voltage systems. The IEDs are integrated into the EPMS via a highly available communication network using IEC 62439-3 through PRP/HSR. A high level of standardization is ensured through IEC 61850 communication. Furthermore, IEDs are integrated independently of the manufacturer using the IEC 61850 engineering approach via SCD/ICD/CID files. This means that a data point only needs to be entered once throughout the entire system. This also enables easy interchangeability of devices.

Automation and control devices: To achieve high availability and handle information received via central or distributed I/O, a centralized architecture with two redundant RTUs (remote terminal units)/gateways, such as SICAM A8000, is required. Additional data is integrated via standard communication protocols for the power supply of the data center. Controllers are also distributed in the medium/low-voltage substations (power module) to connect the medium-voltage switchgear and transformer with its IEDs and fault indicators to monitor and control the primary assets. The low-voltage devices such as power meters and air circuit breakers, like 3WA LV breakers, are further integrated via communication protocols. The optional local substation HMI capabilities integrated into the SICAM A8000 allow for the safe, local control of medium- and low-voltage equipment.

Network devices: Industrial communication network devices in ring configuration provide electrical substations with a communication backbone. Reliable devices such as Ruggedcom handle harsh environments and support protocols like IEC 61850-3. They also prioritize GOOSE messaging for automation schemes (i.e., ATS) and are deployed with redundant topology for maximum uptime.

Management platform: The electrical SCADA system must be able to manage high- and medium-voltage substations. SICAM SCC is a good solution, because it integrates easily, imports IEC 61850 data automatically, and keeps communication secure with encryption. An open interface (i.e., OPC UA, Modbus TCP) allows data exchange with the Building Management System (BMS).

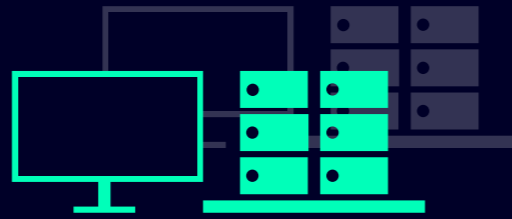


Reference architecture schematic

EPMS fault-tolerant design for high- and medium-voltage substations

Management

SICAM SCC
Redundant EPMS Servers

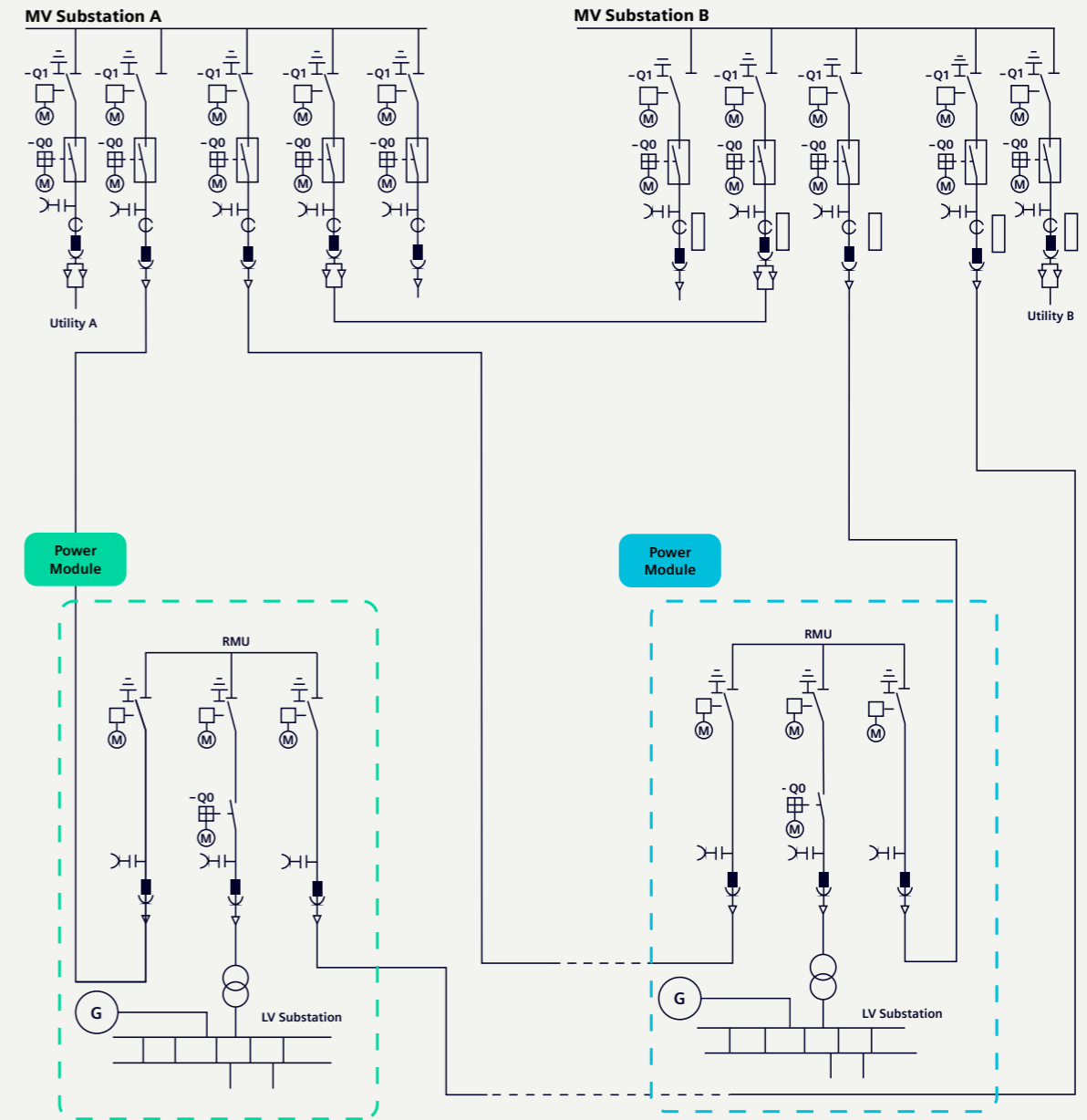
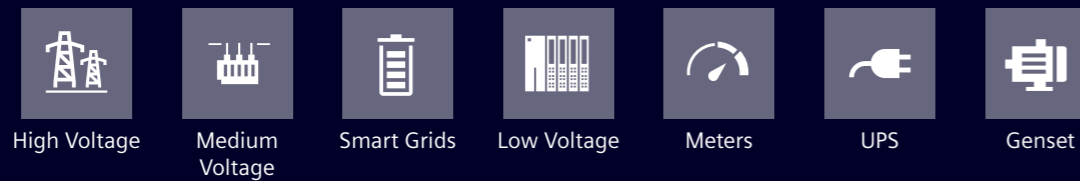


Automation

RUGGEDCOM Redundant Network



Field





DeepDive: Hot standby SICAM SCC configuration

SICAM SCC is the Siemens high- and medium-voltage EPMS solution, developed as an electrical SCADA system with a human-machine interface (HMI) for power automation systems (RTUs/Gateways).

Tailored for energy applications and grid support, SICAM SCC is a central element of energy automation solutions. It is independent of the installed substation technology and ensures high availability through the implementation of an automatic failover mechanism, which is designed to meet the Uptime Institute's Tier IV classification standards.

The hot standby configuration allows for the selection of a preferred server as the primary server for command transmission and client connection management. **Both servers maintain active connections** to the IEDs and ensure synchronization of archived data. This allows for quicker failover, as the redundant partner is already connected. In the event of a main server failure, client connections are seamlessly transferred to the secondary server. Once the main server is restored, it automatically synchronizes and, if necessary, resumes its role as the preferred server.

SICAM SCC comprises a comprehensive suite of tools to **streamline power grid design, visualization, and operation**. Users can effortlessly design single-line diagrams and graphical displays using the rich energy library. And it's also possible to gain a holistic understanding of a grid's health with features like alarm management, event logging, insightful short- and long-term trending charts, and automatic fault analysis from protection IEDs.

Simple to scale

Built on the foundation of SIMATIC WinCC, SICAM SCC offers unmatched scalability. The graduated licensing model allows users to effortlessly expand the system's capacity by **adding process tags as their needs evolve**. Additionally, SICAM SCC prioritizes cybersecurity by employing TLS encryption for communication protocols like IEC 61850 and IEC 60870-5-104. This ensures secure data exchange and protects the critical infrastructure.

In summary, SICAM SCC equips data centers with the tools and functionalities needed for efficient, secure, and scalable power grid management. From effortless design and visualization to real-time situational awareness and secure communication, SICAM SCC empowers operators to make informed decisions and ensure the smooth power grid operation.

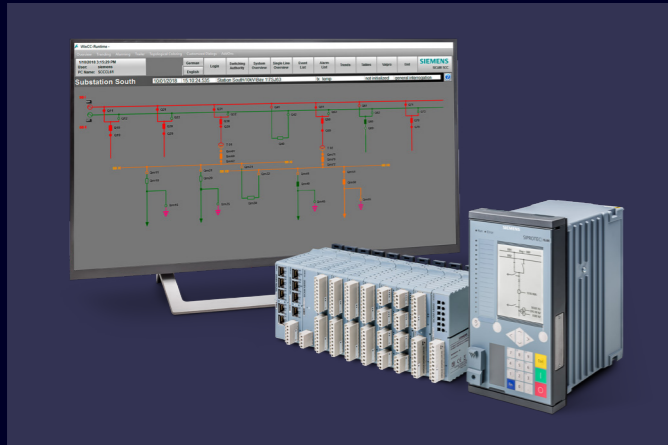
Benefits of high redundancy in substations

High-availability substation automation solutions offer a robust approach to ensuring reliable and uninterrupted power supply for data center infrastructure. Here are some key benefits of implementing such a system:

- Minimized Downtime and Enhanced Reliability:** Redundant components within the power automation system eliminate single points of failure. If a critical element malfunctions, a backup seamlessly takes over, guaranteeing a continuous flow of power to the data center. This significantly reduces downtime and safeguards mission-critical operations from disruptions.
- Optimized Efficiency and Potential Cost Savings:** Automation streamlines substation operations. Tasks like switching, voltage regulation, and data acquisition are automated, freeing up personnel for more strategic functions and proactive maintenance activities. Additionally, real-time data on power consumption and equipment health allows for optimized energy usage, potentially leading to reduced energy costs.
- Improved Safety and Risk Reduction:** Automatic shutdowns in case of critical events prevent equipment damage and ensure personnel safety. Redundancy means the system can operate safely even during faults, isolating issues and minimizing risk to personnel and equipment.
- Future Extensions Made Easy:** EPMS design is based on IEC 61850, which defines how engineering data must be shared among devices to facilitate adding new devices. Changing devices or adding new ones requires minimal time, reduces human error, and avoids operational interruption.



Siemens offerings that support this reference architecture:



SICAM SCC

This human-machine interface (HMI) for power automation systems is independent of the substation technology installed. It can communicate directly with bay units and protection devices that support the IEC 61850 communication standard. As a result, it can be used as an overall HMI system for devices.



SICAM A8000

These modular and scalable automation and remote terminal units range for telecontrol and automation applications in all areas of energy supply. It's suitable for rough ambient conditions thanks to mechanically stable modules and an extended temperature range from -40 to +70 °C.



RUGGEDCOM RSG900 series

These managed gigabit compact switches are tested and certified to withstand extreme environments, featuring High-availability Seamless Redundancy (HSR) and Parallel Redundancy Protocol (PRP). Their RedBox functionality enables simultaneous operation across HSR, PRP, or RSTP networks, ensuring continuous, secure, and reliable performance even during power failures. They are suitable for temperatures from -40°C to + 85°C and meet industry standards such as IEC 61850-3, IEEE 1613, and IEC Ex.

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Discover the Siemens data center offering and use cases that align with the strategic business goals.



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Discover more information and offerings for increased uptime with redundant automation design!



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