Flexible, cost-effective substation automation

Utility
Southern California Edison

UNITED STATES

Transparent FACTORY™
Open for Business

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Modicon
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The existing installation

One of the largest and most progressive electric utilities in the U.S., Southern California Edison, the largest subsidiary of Edison International, supplies power to over 11 million people in central and southern California. Their systems consist of over 4,900 transmission and distribution lines with over 900 substations operated at 138-12kV and 69-12kV that supply SCE's 12kV distribution system. Because the majority of traditional systems installed no longer met their needs, SCE embarked on a system-wide revamp of their SCADA systems, including substation automation, to standardize on a solution to meet current and future needs. The new system must perform a

One of over 900 SCE substations. Inset: A typical control panel.

variety of applications, ranging from automatic transformer, bus, line and loop restoration, volt/VAR control, LTC, feeder regulation, synchronous condenser, capacitor bank control and automatic transfer switch.

The objective

Overall project objectives were for an expandable, easy-to-configure system, incorporating utility-hardened off-the-shelf hardware components at an overall low installed cost. SCE defined critical system requirements:
- RTU functionality emulation. Metering functions must be embedded in protective relays, and control functions traditionally performed via manual switches moved to touch pads and CRTs.
- Protective relays and meters incorporated into IEDs, flexible native communications capabilities and interfaces to HMIs, PLCs and SCADA.
- An overall system architecture capable of integrating multiple local masters, a SCADA remote master and IEDs using standard Modbus, Modbus Plus (MB+), and DNP3.0.
- Intranet Base Data Display.

Schneider Electric

The solution

SCE developed the concept of substation component virtualization using IEDs (Intelligent Electronic Devices) in a multiple master- multiple slave architecture.
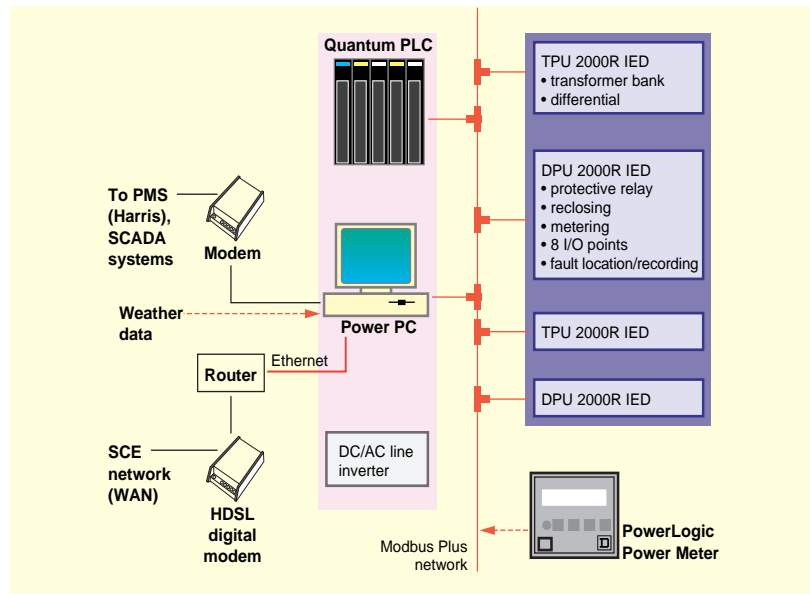
Systems Architecture

The systems solution is based on MB+ communications LAN in each substation. Modbus Plus has been used extensively in substations as a control network and many IED vendors provide direct MB and MB+ interface, thus making the overall integration process much simpler and cost-effective. The deterministic nature of the network ensures true 1 Megabaud performance for the control application. Modicon® TSX Quantum™ PLC was selected based on its long-standing performance record in the electrically dirty substation environment. The TSX Quantum PLC in conjunction with the MB+ network offers unique Global Registers configuration capabilities, allowing the mapping of up to 32 x 16-bit global registers per node on the network. Controller applications include the reclosing of multiple devices and monitoring of miscellaneous parameters in the substations. Concept™ programming software with IEC1131 compliant configuration editors was chosen because of its function block diagram (elementary and derived) capabilities, allowing custom design of function blocks to perform various control operations, then reuse of the blocks in subsequent substations, saving engineering time. The overall programming approach was to download one program at each substation and enable only the specific function blocks necessary for a given substation to further optimize cost savings.

For direct connect capabilities to the MB+ network, high performance capabilities, and lower cost, other IEDs were integrated into the system:

*   DPU2000R IED for feeder breaker protection, metering, reclosing and fault location/recording
*   TPU2000R IED for transformer bank and differential.
*   Powerlogic™ power meter for feeder analog data capture.

Each substation was also furnished with a PC/monitor with a multi-tasking UNIX operating system providing HMI capability to the historian database. SCE chose ABB's PriComm as the HMI software package. A fundamental function of the HMI is to provide an interface between SCE's power management systems (PMS) SCADA master and the substation LAN via a high-speed telephone line, also to make the substation noncritical database (such as historical data) accessible to the SCEnet (SCE Intranet) via a fiber optic WAN, and finally, to provide local operator interface.

The architecture for the SCE substation automation system

Systems Implementation

After selecting state of the art technology for the applications and developing the appropriate architecture for the systems, SCE's challenge was to orchestrate a plan to deploy the new system over 240 substations in three years. Each station, although very similar in design and configuration, had a database that required individual configuration. To meet an aggressive project schedule and to facilitate the programming process, SCE developed an automated design/configuration process. The criteria used to develop the substation modeling tool included: intuitive GUI for user input, the use of standard elements, and built-in diagnostics to eliminate errors resulting from incorrect programming. The programming tool allows data to be entered via a menu driven VBGUI with EXEL spreadsheet output automatically imported into the HMI and RTU emulation software. Given accurate input data, SCE can configure an entire substation HMI and RTU database in less than five man-days, significantly reducing the overall cost of implementation and time to service.

Customer benefits

*   Ease of installation and future expansion. The new substation automation design provides a flexible, high-performance network using modular, off-the-shelf components, locally supported.
*   Cost-effective RTU emulation. Standard programming tools and hardware allowed SCE to easily emulate traditional RTU functions and automated control.
*   Reduced cost and commissioning time. The development of a substation configuration tool, with a friendly user interface and accurate systems configuration, helped to minimize project time from start to finish.