



HIRSCHMANN

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Case Study

CA00014HE

Industrial Ethernet Switches from Belden Upgrade the Substations of a Regional Power Grid to IEC 61850 Standard.



Karlsruhe Needed to Upgrade Its Power Grid

System Integrator IDS GmbH selects Hirschmann industrial Ethernet switches for modernizing three substations in Karlsruhe, southwestern Germany.

Electric energy operators around the world are working to increase reliability, resiliency and capacity with smart investments in new technologies. This includes [Stadtwerke Karlsruhe Netzservice GmbH \(SWKN\)](#), the municipal utility that provides electricity, gas, water and heating to the 300,000 inhabitants of the city of Karlsruhe in southwestern Germany.

The power grid of SWKN covers 65km² and provides household electricity plus energy for critical infrastructures including hospitals and a regional railway system. Its power grid includes:

- Low voltage (LV) with 1-kV-grid and 1.904 km of lines
- Medium voltage (MV) with 20kV-grid and 835 km of lines
- High voltage (HV) with the 110kV-grid with 58 km of lines
- Nine substations

In conjunction with replacing primary electric transmission equipment with new gas insulated switchgear (GIS), SWKN improved the reliability of its substations. This included upgrading the control and automation system from legacy protocols to the IEC 61850 communication standard.

The utility partnered with a local energy systems integrator, IDS GmbH, who provided a new substation control system, including the communications network. The protection devices were delivered and engineered by Siemens within the IEC 61850 standard. Critical aspects of the network were redundancy at the substation level and fast integration of IDS's bay control units.

Stadtwerke Karlsruhe Substation Design Requirements

To meet the state of the technology as well as to improve reliability, SWKN decided to update some of their substations with modern GIS that improves the electrical power supply in the manner of reliability, maintenance cost and losses.

The project involved updating the largest substation (West) as well as two other substations (Blöbe and Heide). At Substation-West, the goal was to completely renew the existing 110kV outdoor primary equipment with SF6 GIS. In addition, new Substation Automation Systems (SAS) were required to protect, monitor and control the switchgear operations for all three substations.

Unique requirements for the substation communication infrastructure were:

- High performance for handling large – and growing – data volumes
- Two-way communication between the control center and substations; conversion of substation IEC 61850 transmissions to control center IEC 60870-5-104 transmissions and vice versa
- IEC 61850 compliance for a future-proof investment; use of this standard allows the utility to change, update and expand the system using interoperable equipment from a variety of manufacturers
- A redundant communication infrastructure at each substation for enhanced reliability
- Ease and security of remote connectivity to IEDs (Intelligent Electronic Devices) in the Substation



**Be certain.
Belden.**



High Performance Ethernet Switches Update Substations to IEC 61850



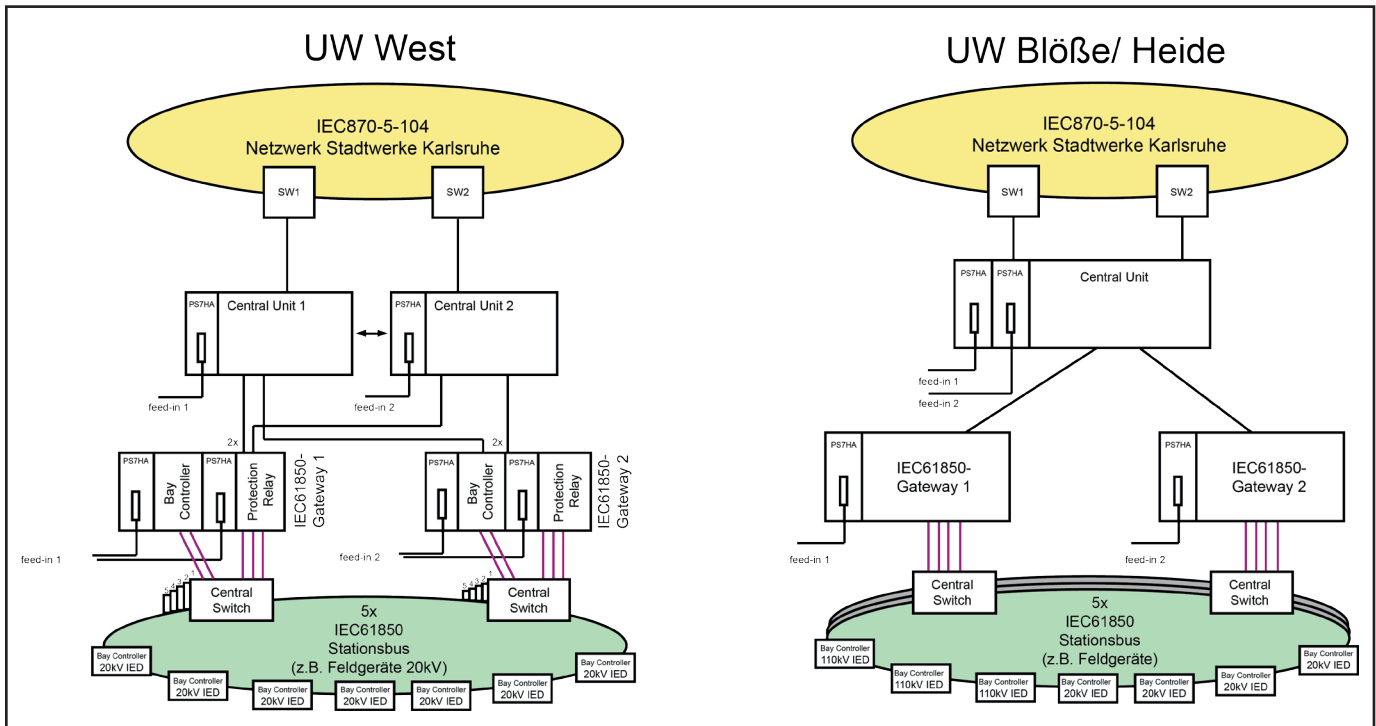
Hirschmann Industrial Ethernet Switches in a Substation

IDS Systems created network architecture for each substation that includes two identically designed and redundant central processing units with SCADA gateways (IDS ACOS 750 SAS). These devices communicate to the control center using the IEC 60870-5-104 protocol and to the substations using the IEC 61850 protocol gateways. They also control all the general functions of the substation and system redundancy.

The type of information exchanged includes metering, status change, events and fault data from the substations to the control center and control information out to the substations.

The SCADA gateways communicate with Hirschmann switches that are connected to Intelligent Electronic Devices (IEDs) using a ring topology. There are up to five rings per 20kV level and two rings for the 110kV level. This topology guarantees enough bandwidth for communication amongst devices in the same bay and delivers faster reconfiguration times in case the communication is broken at any point of the ring.

Only communications between devices in different bays and between devices in one bay and the control center pass through the main switches, reducing the loads and allowing sufficient bandwidth when a fast event needs to be transmitted. Communication between different voltage levels is also limited to mission-critical application traffic.



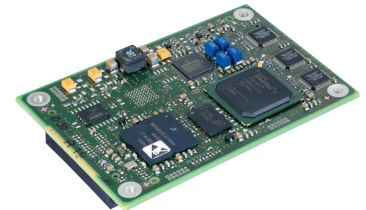
Hirschmann Industrial Ethernet Switches in Substation



The Belden Solution

Embedded Ethernet Switches

Belden provided two key components of the final solution. One component is Hirschmann Embedded Ethernet Switches (EES) for the SCADA gateways. These switches provide an easy way to add network connectivity into field devices. Using tested, high quality switching components also reduces risk and development costs and speeds up the project. The Hirschmann EES modules also include built-in support for redundancy protocols for an immediate improvement in reliability.



Hirschmann Embedded Ethernet Switch EES20

Key product benefits:

Flexible, Fast, Data Transmission

- Six Fast Ethernet ports that can be configured for either 10/100 TX or 100 FX

High Reliability through Security and Redundancy Capabilities

- Extensive management and filtering functions plus a variety of redundancy protocols and port security
- Supports precise synchronization as per IEEE 1588v2, plus redundancy protocols RSTP and MRP

Easy to Manage

- Can be integrated into the leading Network Management Software, Hirschmann Industrial HiVision
- Integrated MMS Server for easy integration in the Substation SCADA System

Managed Industrial Ethernet Switches

The second component is Hirschmann RSR managed industrial Ethernet switches which are DIN rail mounted. These switches meet the SWKN project requirements including Fast Ethernet connectivity, very high environmental tolerances and long, maintenance-free life cycles.

Key product benefits:

Flexibility

- With up to 11 ports and connected to a wide range of power supplies, they allow the exact implementation of the required product configuration close to the primary equipment

High Reliability

- Able to operate in extreme environments with temperatures ranging from -40°C up to +85°C
- GOOSE protocol handling, redundant ring topology and fanless design guarantees low failure rate
- Redundant high voltage power supplies

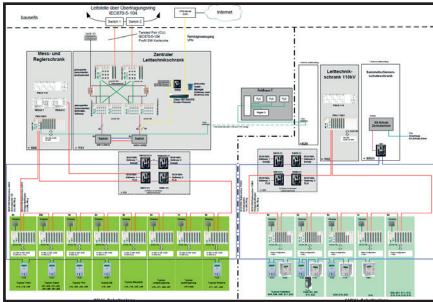


Fast Ethernet RSR-Switch

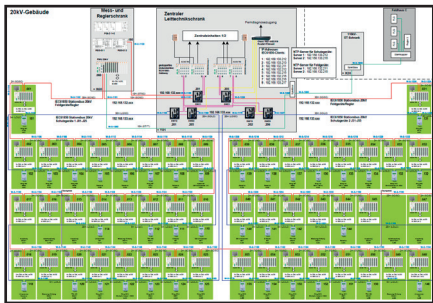
In addition to state-of-the-art technology and a broad product portfolio, the IDS GmbH selected Belden because of its experience and references in the power market, its local support and its five year product warranty.



IEC 61850 Substation Communication Design



Substation West Network Diagram

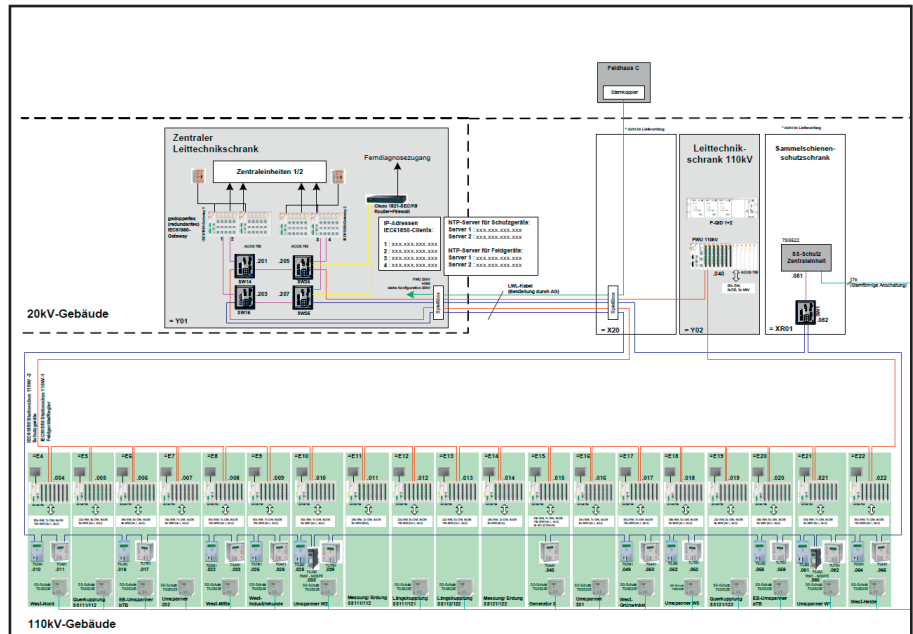


Substation West Network Diagram of the 20kv Rings

This project shows how it's possible to update substations from communicating via serial or legacy protocols to modern technologies based on TCP/IP such as IEC 61850 or IEC 60870-5-104. In this case SWKN went from using a mix of different protocols, including proprietary ones, to communicating via standardized future-proof protocols.

The use of Hirschmann managed and embedded industrial Ethernet switches not only addressed the complex switching requirements but delivered built-in redundancy and security capabilities. They played a significant role in the update and instantly delivered a higher level of safety and reliability than was possible with older substation technologies.

This is a real-life example of how a utility can phase in migration to the Smart Grid vision of real-time monitoring / control and quick rerouting of power transmission as required.



Substation West Network Diagram of the 110kv Ring

About the IDS GmbH

IDS GmbH specializes in IT and automation solutions for smart grid and smart metering applications for the international utilities industry. Our innovative portfolio of products and services covers all aspects of technical network operation plus geographically-based information management and metering systems.

With an integrated and scalable range of automation, SCADA systems, remote meter reading systems and complete IT solutions, IDS GmbH is one of the leading providers of innovative turn-key solutions.

More Information

White Paper: [Cyber Security for Electrical Substations](#)

White Paper: [Guide to Wireless Communication in Smart Grid Deployments](#)

White Paper: [Substation Communications Design Legacy to IEC 61850 Best Practices](#)