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Case Study

CS00004

Belden and Hirschmann are Supporting German Energy Suppliers With the Construction of an Underground Transformer Substation

Mainova AG, one of the largest communal energy suppliers in Germany, along with their subsidiary company NRM Netzdienste Rhein Main (Rhein-Main Network Services), has engaged Belden with the development and implementation of the industrial network of one of the first underground transformer substations across the country.



Transformer substations are used by suppliers to link different voltage levels between generators and consumers. Frequently, however, these large industrial units are felt to be unsightly and many landowners are concerned that a substation close to their property might reduce its value.

In the urban environment, this problem is exacerbated as the demand for power is high, but the space available for the construction of a transformer substation is limited. This was the starting point for Mainova AG. The company has been supplying its customers with power for 110 years. To cater to the rising energy demand of customers in the densely populated center of Frankfurt, Mainova AG wanted to expand its existing facilities.

After weighing numerous options, Mainova decided on a new concept that would benefit the customers as well as the community and the company – they built an underground transformer substation. Mainova's transformer substation, built 17 meters below street level, had to be able to fulfill all the functions of a traditional transformer substation and at the same time limit the required space above ground to a small access building. The required space at street level was so small that Mainova was

able to place a garden above the transformer substation, providing much needed green space in the city center. This also made the transformer substation's above-ground building less noticeable.

For the design and implementation of the infrastructure of the communications network, an important part of the project, Mainova turned to Belden. The communications network is the basis for reliable and safe remote management and monitoring of the transformer substation.

Project Structure and Details

- In recent years the demand for power has increased in the Frankfurt-Main metropolis, as companies and service providers have established themselves in the city center itself.
- The transformer substation was to supply customers in Frankfurt's financial quarter, hence reliable power supply was especially important.

**Be certain.
Belden.**





“This was a new approach for us and all of Germany. So, we wanted to choose a partner that had a strong reputation for network design expertise and high-quality products. The decision to use Belden was simple.”

– **Andreas Hallwirth,**
NRM Netzdienste Rhein-Main GmbH, a subsidiary of Mainova

- The transformer substation had to be operated remotely from a separate control center, including monitoring, control and management.
- Three transformers had to convert the electricity from 110,000 volts to 10,000 volts for the distribution network.
- The location of the transformer substation was in Liesel Christ Park, a central and populated area only a few hundred yards from the Opera House, so safety was one of the primary concerns.
- Its position between a main road and a river increased the risk of ground water contamination.
- Mainova took a gamble, as it was the first company to build an underground transformer substation in Germany. The energy supplier therefore needed partners with proven expertise.

The Belden and Hirschmann Solution

At the beginning of the project, staff from the competence centers of Belden and Mainova gathered for strategy meetings to develop a plan for a network configuration that was tailored to the requirements of this unique project, based on the urban environment and the objectives set by Mainova. In the planning stage, Belden also

took on board their local partner, Kapsch Carrier Solutions GmbH (formerly ITM GmbH), a systems integrator.

A ring topology was chosen for the network of the underground transformer substation. Within the plant, the compact RS20 managed open rail Ethernet switches installed were connected to two MACH1020 backbone ruggedized rack-mount switches for fast Ethernet.

Belden also recommended further network products for network design protection, to build in redundancy and allow for balancing during peak periods. Redundant communication for the complete network is guaranteed by the Media Redundancy Protocol (MRP) that optimizes reconfiguration time in the case of network outage.

For control and monitoring of the transformer substation, the local network was designed to connect all control and safety devices. A telecontrol system assembles the reports and measurement values from the individual field control devices and transfers them to the control center via the external backbone network. Commands from the control center are distributed via the local network to the appropriate field control devices.



View into the depths: The 10 kV control cabinet room of the new substation is located approximately 17 meters below the surface.

Because the installation was underground, certain equipment requirements had to be taken into account, including the temperature profile of the environment, permitted operating temperatures and heat dissipation.

Belden used its proven Hirschmann network devices that are robust enough for reliable and secure data communication under the harshest environmental conditions. The high transmission rates and large bandwidth of the products also guarantee the quickest possible processing of large data volumes and provide the highest level of reliability, availability and security.

To minimize down time, protect critical infrastructure and guarantee reliability, Belden also offered a five-year warranty and complete customer service package.

The whole project was completed on schedule and within the budget framework in 2013. In the course of the next two to four years, Mainova plans to use the network topology from this project in further transformer substations. Furthermore, Belden will continue to provide Mainova with technical support and product training from its competence centers.

Product Advantages and Features

The Belden products provide comprehensive and integrated solutions for network automation, as well as data communications and control information. Because of their robust and reliable specification, the following devices were chosen for use in Mainova's underground transformer substation.

First of all, network management software was required to monitor the station with all its systems throughout the network. Hirschmann's Industrial HiVision software provides user friendly topology maps that enable the network administrator to see, at a glance, how and where all components are connected, including the systems of



The substation provides a reliable energy supply for the Rhein-Main region.

other manufacturers. Using the MultiConfig function, network administrators can configure hundreds of devices with just a few mouse clicks. This facilitates routine maintenance tasks as well as the changing of device passwords for protection against cyber attacks.

With Industrial HiVision all SNMP capable devices, including device-specific characteristics, can be integrated into the management system. It also provides redundancy via hierarchical master/slave stations.

On the hardware side, Mainova required switches that were specially constructed for each level of the network. Together, the team decided upon the following products:

- The MACH4000 Gigabit Backbone Rack Mount Switch with layer 2 switching and layer 3 routing protocols for communication with the control center outside the transformer substation and with all other linked transformer



The substation used a MACH1000 Industrial Ethernet Switch in a vertical installation in the control cabinet.



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“Underground substations are the future of electricity in urban areas, and this project was a win for everyone. Our customers have the reliable energy they need, the community is happy that we minimized our footprint and maintained green space in the park by building a garden on top of the installation, and we have a secure system that will meet the electricity needs of this area for at least another 40 years.”

– **Andreas Hallwirth**,
NRM Netzdienste Rhein-Main GmbH, a subsidiary of Mainova



The new substation approach: small surface footprint with levels underground

- substations. With its industry-specific approvals, rapid redundancy processes, hot-swap capable media modules, numerous safety mechanisms and its high resistance to shock, vibration and electro-magnetic interference (EMC), the MACH4000 is the ideal solution, both now and for the future.
- The robust MACH1020 Fast Ethernet Rack Mount Switches as devices at the backbone level in the station. With its high port density (up to 26 ports) and excellent shielding against electro-magnetic and high-frequency interference under extreme conditions, the MACH1020 provides great flexibility in configuration and commissioning.
 - The compact RS20 Managed Industrial Open Rail Ethernet Switches for use at field level. With rapid redundancy protocols and numerous safety features, the RS20-0800 switches provide a high level of network availability and first-class data security. The switches are developed for a high level of resistance to shock, vibration and electro-magnetic interference and can be used in an extended temperature range of -40°C to +70°C.

About Belden

Belden Inc., a global leader in high quality, end-to-end signal transmission solutions, delivers a comprehensive product portfolio designed to meet the mission-critical network infrastructure needs of industrial, enterprise and broadcast markets. With innovative solutions targeted at reliable and secure transmission of rapidly growing amounts of data, audio and video needed for today's applications, Belden is at the center of the global transformation to a connected world. Founded in 1902, the company is headquartered in St. Louis, USA, and has manufacturing capabilities in North and South America, Europe and Asia.

For more information, visit us at www.belden.com and follow us on Twitter @BeldenInc

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