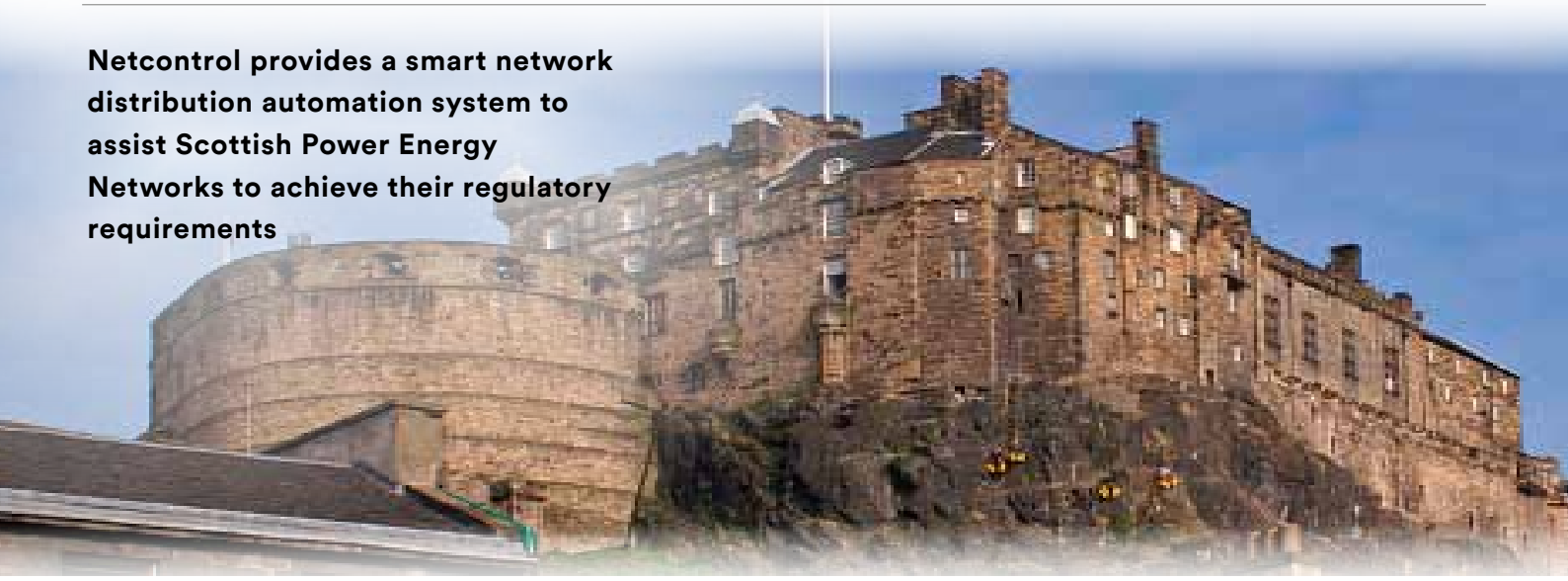
CASE STUDY

Smart Networks for Scottish Power



Netcontrol provides a smart network distribution automation system to assist Scottish Power Energy Networks to achieve their regulatory requirements

Over the past decade Scottish Power Energy Networks (SPEN) has been able to provide their customers with an **optimum quality of supply, through the use of Netcontrol's highly technical and reliable Distribution Automation products and services.**

WORKING PARTNERSHIP

Netcontrol has been at the forefront of one of Scotland's and Northern England's most important utility schemes, the goal to reduce the impact of power outages to the high voltage electrical network.

Before utilising the Netcontrol products, SPEN were reliant on customers calling their centres and informing the operator about the problem. They would then send teams of line engineers out into the field to search for the fault, based on the information from customers. This process was not onlytime consuming, considering the vast scale of the electrical network, but also very cost ineffective.

POST FAULT RESTORATION

SPEN turned to Netcontrol, experts in data radio communication and distribution automation systems and smart networks. The goal was simple: a reliable and cost effective system to increase efficiency and quality of supply. The system should be able to monitor both the electrical network and handle any fault on the network automatically. The system should also be able to be controlled and monitored via the utility's own SCADA system back at their control centres as well as at key locations and locally at each site.

AUTOMATION EXPERTISE

The project was a highly collaborative one, with both companies bringing their expertise to the continual development of the scheme. One of the key staff on the development team for SPEN stated “Netcontrol has been a key player in helping us provide a better service to our customers. Their in-depth knowledge has helped to significantly reduce the number of customers who have down time on our network”.

SIMPLE AUTOMATION DEPLOYMENT

The utilities network utilises a number of Netcontrol products from NM-CCU’s (Central Control Unit) in the primary substawtion (which provides the link to all the remote outstations, SCADA interfaces and logic routines) to the NMS 100 (switchgear motor control) which provides a very flexible interface to arange of remotely located switchgear. Netcontrol even developed a specific SCADA protocol (DSP4 and Ferranti MkIIa) for the utility. This protocol is now part of an increasing protocol library which also includes DNP3,IEC870-5-101, 103, 104, and IEC61850.

SIMPLE APPROACH

One key to the success of Smart Networks and Distribution Automation is to keep the complexity simple in order to maximise the time to roll-out the benefits. Faults are detected by utilising equipment fitted with current transformers and either manufacturers original fault detection or protection devices or the Netcontrol FPI100 (Fault Passage Indicator).

This information is passed very quickly back to the Central Control Unit (CCU) and then commands are given automatically to the remote devices to minimise the affected zone and bring as many people back on supply as possible. The CCU also acts as the gateway to the SPEN SCADA system, so that the control centre has full visibility of the secondary network and can switch in and out the automatic ‘post-fault restoration’ algorithms running in the CCU.

This automatic post-fault restoration is helped by the design of the SPEN network which is generally well interconnected with a large number of ‘open’ points in the network, which allow load to be easily picked up. A future refinement of the system is to look at load at various points prior to the fault to ensure that the remainder of the network is able to cope with the additional burden. SPEN required that faults on the network should be minimised within 60 seconds and given that many devices are fitted with motor operated actuators, this left little time for the logic and the communications, another reason for selecting the NetMan system of Wireless Data Radio Modems.

SPEN have installed a large number of Central Control Units, or system NetMan gateways at nearly all of their 33/11kV Primary Substations. The remote sites or outstations report to this gateway using the NetMan report-by-exception system, thus increasing the available communication bandwidth. The system NetMan data radios use a compressed method of communicating over-the-air, to reduce the normal transmit time a pure SCADA telegram would take. The CCU is fitted with an HMI, that allows an engineer, when arriving at the Primary Substation to view and control all of the secondary switchgear installed on the secondary distribution network, feed by that Primary. This functionality assists SPEN enormously during major network disturbances, such as after a major storm. An engineer can take control of the Primary CCU locally, removing the burden on the control centre and then perform coordinated switching operations on the associated secondary network.

Another advantage of running the post fault restoration logic at the Primary Substation, is that should the link between the Primary Substation and the SCADA system be lost, SPEN will continue to get the benefit of the Automation, if not the visibility.

LONG RANGE DATA RADIO

The heart of the System NetMan is the Netcontrol data radio. This powers the functionality of the system allowing for long range communication from the gateway to the remote locations. Since it is not common that all outstation locations can communicate directly with the gateway CCU, Netcontrol have developed a sophisticated communication algorithm that allows for each outstation device to pass a data telegram on to another outstation in order to increase the potential communication path. As a message leaves the master gateway unit is contains information on how it is to arrive at the outstation device. In fact a message can travel through 6 other slave devices before arriving at the destination device.

In order to assist the client, the menu within the radio, allows the installer to measure the best signal to and from neighbouring devices and this is used then to set up a main and standby communication path. Should a message not get through on the main route a standby route is used.

This methodology was critical in allowing SPEN to deploy such a large number of remote sites in such a short period of time. Since no costly and complex communication infrastructure is required to achieve the wide areas of coverage, it was very easy for SPEN to embark on such an ambitious project. Furthermore it also meant that SPEN did not have to reply on third party subscriber based technology such as GSM, which incurs monthly charges, does not provide communication to all of their sites and having a small back-up battery time on loss of supply, did not met SPEN's mission critical criteria.

Where an Intelligent switchgear device is installed, such as a 'Smart Recloser' (Noja) or a 'Smart Switch' (Novexia), the data radio is connected to the device directly using a serial cable.

The slave radio then acts as a DNP3 master and continually communicates with the slave recloser. The installation engineer, via a menu on the radio, can select the data points that they wish to bring back to SCADA and the radio will transfer these back to the gateway. This map can be saved and built in to the radio menu so that should another similar device be installed the data points can be set directly by the pre-set menu, reducing the installation time and the potential for an incorrect mapping to be configured. Where a legacy device is installed that utilises an early generation of protection relays, the NetMan data radio can be connected to a small Netcontrol RTU to allow a discrete interface to the RTU via volt free contacts.

AUTOMATIC FAULT RESTORATION LOGIC

Netcontrol worked with SPEN to look at the types of electrical feeder arrangements they had. From this they were able to identify approximately 8 standard types of feeder configuration for the majority of their networks. The Central Control Unit (CCU) was then loaded with these routines and each feeder was assigned one of the logic types. This approach means deployment is very quick since there is no 'bespoke' configuration of logic and the line-staff become quickly familiar with the automatic functions. Furthermore if the network is permanently altered it is very easy to re-allocated a new generic logic type to the new feeder configuration.

Initially it was envisaged that the project would focus more or less entirely on post-fault restoration and improving the Customer Minutes Lost and Customer Interruption figures, as reported to the regulator OFGEM, but SPEN quickly realised that the Netcontrol equipment could be used for much more than just reactive type of operations. Today the system is used mainly by the control centre engineers for fast and reliable remote switching of the network for planned maintenance and for reacting to changes in the network parameters. Post fault restoration still performs a significant part of the functionality of the system, but now it is more the 'tip of the iceberg' rather than the fundamental purpose.

LARGE SCALE DEPLOYMENT

SPEN have received equipment from Netcontrol that allowed them to remotely control and automate in excess of 4,500 switches, circuit breakers and reclosers. Netcontrol has interfaced to a range of switchgear both new and legacy, including the Novexia Auguste Switch, FKI GVR Recloser, Noja Recloser, Merlin Gerin Ring Main Units and oil switches and breakers from Long & Crawford and Alstom.

LARGE GEOGRAPHIC COVERAGE

The geographic area that the project covers is very large with over 65,000km of underground network and 47,000km of overhead. The area is made up of dense urban environments and hilly and mountainous rural expanses. SPEN have utilised the NetMan Wireless Data Radio Modems for all these locations, using the VHF spectrum which has given very good results for both types of their geographic network. The ability for any of the Netcontrol devices to forward messages to other units, in any format, with up to 6 forwarding hops in any one communication, means that SPEN have been able to keep their antennas inside buildings in the urban networks to avoid 3rd party damage of their installation.

BENEFITS

- Automatic Post Fault Restoration
- Additional devolved remote control
- Wide Area Coverage
- Low cost of instalment
- Integration of existing switchgear
- Ease and speed of deployment
- Intelligent Motor Control Functions
- Ability to integrate earth fault indicators
- Event Triggered Communication
- Battery Conditioning and Monitoring
- Operator Safety ensured

System Overview