Maximum Success through Minimal Downtimes

Fault analysis in Zurich using fault recorders and protection relays

The company

Power production, transport and distribution – as one Switzerland's few power companies, Elektrizitätswerke Zürich (ews) (Zurich electricity utility) offers all three from a single source. ewz supplies power and provides all related services, not just to Zurich but to about a third of the Kanton Graubünden; altogether, the company delivers power to approx. 240,000 customers, making it one of the 10 largest power stations in Switzerland.

The majority of ewz's power is generated by hydroelectric power plants in Graubünden and on the Limmat River. Using a power systems of over 700 kilometers of extra-high voltage overhead lines, power is fed via various nodes from Graubünden to the four connecting substations on the outskirts of Zurich, and from there is distributed via a 4000 kilometer cable system to the 17 substations in the various districts. These substations are connected to 670 transformer stations that supply power to all private and commercial customers as well as public facilities and municipal lighting.

The starting situation

Every fault that occurs in the power supply system of a large, densely-populated city with correspondingly high energy requirements is a major challenge for municipal utilities companies. Everyone affected wants to know as quickly as possible when and how power supply will be restored.

Quick assessments are especially difficult to make because today, the protection relays and fault recorders installed in most of the switchgear of many power supply companies came from different manufacturers. This problem is compounded by the fact that in a large number of cases, different technologies were also installed (such as electromechanical and numerical protection relays) that frequently belong to different generations (such as SIPROTEC 3 and 4 relays).

The result: A single power system fault suffices to trip several protection relays simultaneously. Whether one or more protection relays are tripped depends on the type of fault. Resolving the fault sometimes involves starting up operating software (such as DIGSI) from different manufacturers , retrieving the data from the IEDs (Intelligent Electronic Devices) and performing a complete analysis.

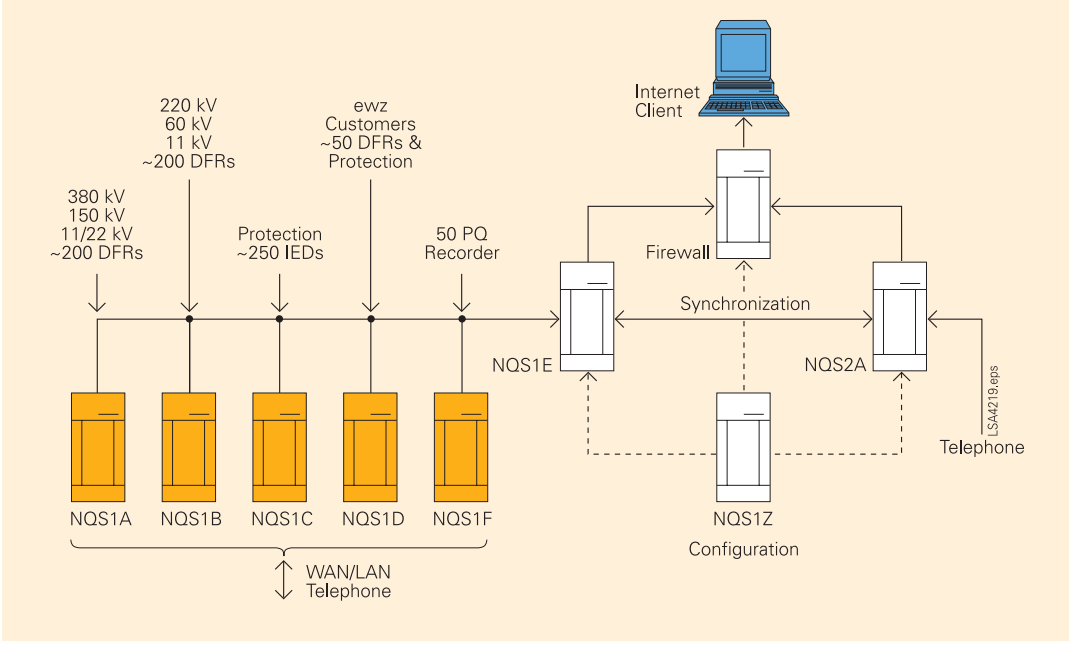

Fig. 1 Server PC configuration and the number of connected devices

The concept

Zurich needed a solution that would make the evaluation of fault logs as quick and easy as possible. In the present case, ewz was able to achieve an extremely intelligent and effective result by installing the Network Quality Analysis System (NQS), which can reduce fault resolution time to less than 30 minutes and usually to as little as 15 minutes. The complete system, which monitors the greater Zurich area, includes 8 high-capacity servers, 400 fault recorders (SIMEAS R and P531), 250 numerical protection relays and 50 SIMEAS Q power quality recorders. These are supplemented by 50 additional devices (40 P531 and 10 SIMEAS Q) belonging to other power supply companies but whose data is also analyzed by ewz.

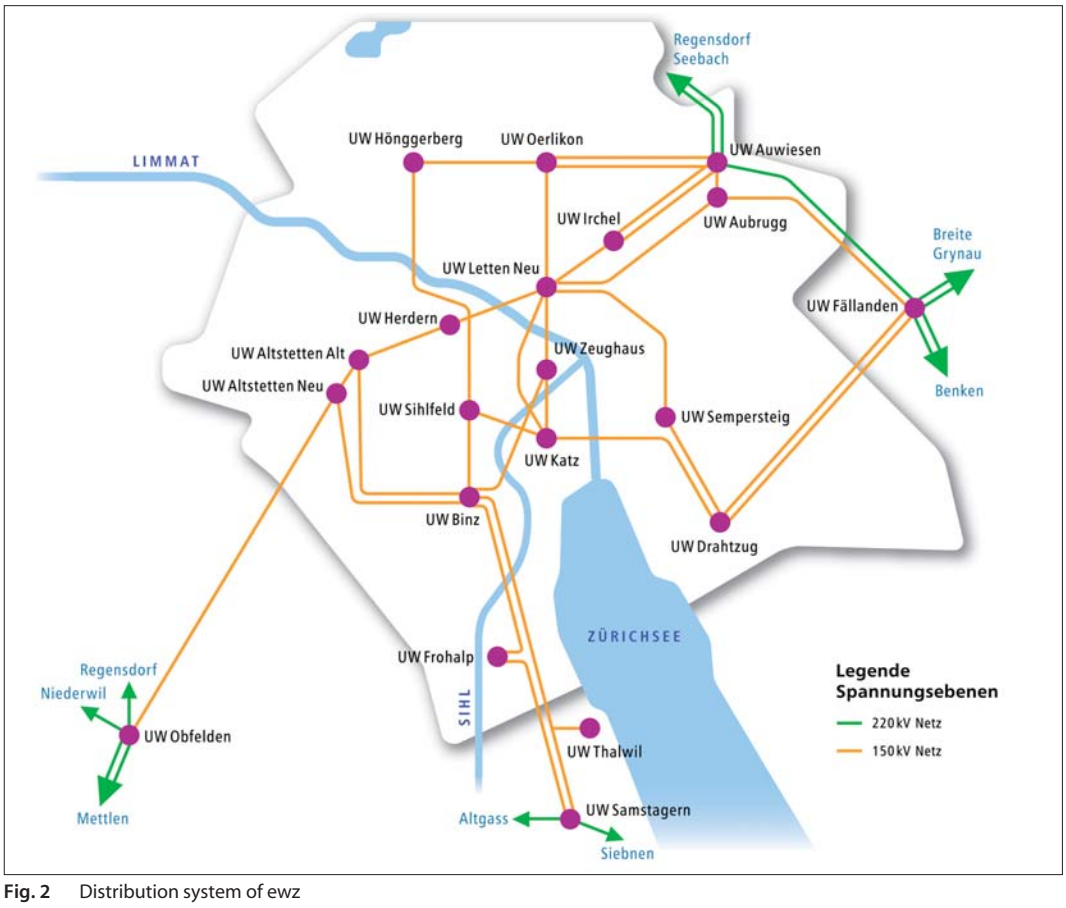

Fig. 2 Distribution system of ewz

Function of the NQS

Every ewz substation has at least one DAKON to which some or all of its IEDs are connected. A DAKON is an industrial PC with the OSCOP P software program that automatically retrieves the fault data recorded by the IEDs and stores it in a separate data base.

All of ewz's DAKONs are connected to the central server (see Fig. 1) via two independent communication channels (Ethernet and telephone, making it a redundant system), thus ensuring that all 750 devices belonging to ewz are indirectly connected to the main office. The OSCOP P software program also runs on the server PCs shown in Fig. 1. This program automatically retrieves all the data on the connected DAKONs and stores it in a separate data base.

Additional OSCOP P modules analyze the data, so that station engineers are presented only with the finished report. The servers are able to make these reports available on the Internet or Intranet in HTML format. Depending on parameterization, the reports can also be forwarded to individuals by fax or e-mail. In special cases, supervisors can also be instantly notified by SMS (text message).

The special advantages

The NQS is the only system in the world to provide a special feature known as "complex analysis". The OSCOP P system program sorts all the records in a time window and uses various methods to calculate fault locations. After several iterations, the location of the first fault is finally determined and all the consequences identified, meaning significant time savings because the station engineer does not have to perform the analysis manually. One advantage of this direct identification of the original fault is that the unaffected service sections can be started up immediately. A further benefit is faster fault correction, making it possible, for example, to minimize the production downtimes of an industrial plant.

From practical experience

As shown in Fig. 3, the NQS analyzes all the fault records and power quality data from the connected IEDs. Thus, for example, a production fault in an industrial complex can be located. In this case it is caused only by voltage dips provoked by a short-circuit in another power system section.

Conclusion

This project involves the world's first fault analysis system with automatic data collection, data analysis and report distribution. These innovations are beneficial, not just to ewz, the power supply company, but to the entire region. Faster fault correction saves the operator money while drastically reducing downtimes for local industry.

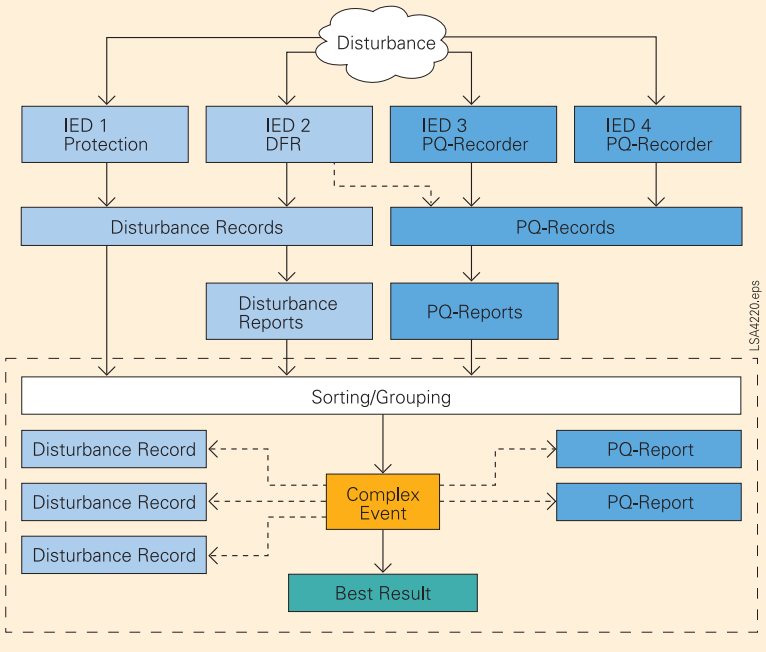

Fig. 3 Data flow for fault evaluation