

Web-Based Monitoring of Sewerage Systems to DWA-M 207

by Uwe Frigger and Christof Burmann

As operator of one of the most extensive networks in Germany, the municipal sewerage authority in Frankfurt am Main has installed the innovative process-control system HydroDat® V8 and the web-based process-monitoring and control system HST TeleMatic as part of its modernisation program for monitoring special constructions in the sewerage system.

The municipal sewer network in Frankfurt am Main has an overall length of around 1600 km which is roughly equivalent to the distance from Frankfurt to London and back. In order to operate and monitor its numerous special constructions with maximum efficiency, the existing process-control system had to be modernised. The limited tender included an information and communications system which fulfilled not only the requirements of function and ergonomics, but also reduced the operating costs significantly in relation to conventional remote-control technology.

HST Hydro-Systemtechnik received the order for the project. The EMSR services were provided by the HST associate company Passavant & Watec in Aarbergen. Since autumn 2007, a total of 67 special constructions are being monitored continuously online. In addition, the new system documents waste-water volumes (which total around 300,000 m³ daily, even in dry weather) in full compliance with statutory requirements.

Innovative Communication to Code of Practice DWA-M 207

With the conventional remote-control technology previously in use, it was not possible to provide continuous online monitoring of special constructions in the sewerage system at a reasonable cost. With the introduction of the new process-control system, all the existing special constructions, previously linked to the central control station by analog switched lines, were converted to modern GPRS trans-

mission with internet technology. This type of solution follows the recommendations of the code of practice DWA-M 207 "Information and Communications Networks for Sewerage Technology" (1) re-published in July 2007. This suggests setting up new decentralised stations with internet-based GPRS communication systems. The guidelines also provide a practical review of the savings in operating costs which can be achieved. GPRS technology is a further development of the GSM mobile radiotelephone standards for package-based data transmission. For this purpose, point-to-point online links are established between

decentralised stations and a central communications server. The costs are based on the volume of data actually transmitted. HST attached particular importance to transparent data transmission between the server and the embedded control systems installed in the decentralised stations. This made it possible to install a digital video camera at the station entitled "Jacobswiher rainwater overflow" for online monitoring of the bar screen. The bandwidth required for the image transmission is provided by an EDGE-assisted modem. In order to secure the internet-based GPRS connections against external attack, the

Geographic overview in the process visualisation





transmission is protected by a virtual private network (VPN) with IPsec-based protocol. The central server is also protected by a firewall.

High-Performance Embedded Control System

According to DWA-M 207, the conversion of the process signals to the TCP/IP protocol is carried out by so-called "web connections" which frequently take the form of embedded computers or industrial computers. The type of embedded control systems used in Frankfurt is the TeleMatic

SMART-200, which combines SPC and industrial computer technology in one single unit. Unlike other systems, where the TCP/IP protocol is converted to a serial protocol by an intelligent modem, with the TeleMatic System it remains transparently available, right down to the control system. The equipment supplied by Beckhoff, which can be mounted on a top-hat rail and programmed to IEC 61131, makes use of the tried and tested I/O terminal system and is operated by Microsoft Windows CE. To permit more transparent TCP/IP-protocol data exchange between the process-control system and the em-

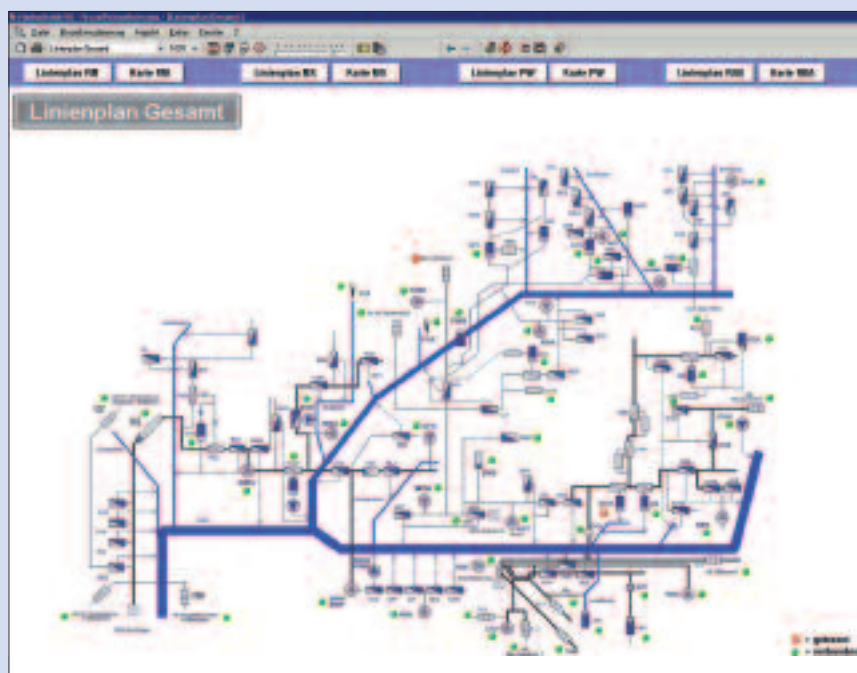
bedded control system, all the mechanisms for initiating the GPRS connection and the "re-connect" following automatic disconnection are implemented directly in the TeleMatic software by the provider T-Mobile.

A further advantage is the fact that the online and archive data are processed separately by the TeleMatic software. In the case of a broken connection or a disruption in the GPRS network, this makes it possible to store all the required measurement data directly at the sub-station using the Delta-Event process, and then to transmit them automatically to the process-control system when the connection is restored. The flash memory in the HST embedded controller has storage capacity for up to 30 days. Besides recording analog measurements by means of the Delta-Event process, figures and signals are recorded with the time-stamp of the slope change. The extensive freely parametered archiving process does not require compression. It therefore involves no loss and forms a good basis for optimum process analysis.

High Investment Safety

In purchasing this new system, the municipal authorities demanded a high degree of openness and safety of investment. For this reason, the embedded control systems coupled on via GPRS exchange their data by OPC with the main process-control system. OPC is an international standard which permits connection to a wide variety of processes by means of a uniform and clearly defined interface. Via the OPC inter-

Technical line-routing plan in the process visualisation



face it is therefore possible to integrate other processes in the HydroDat® V8 process-control system or to transmit the process data from the HST-TeleMatic stations to another visualisation system. In addition to this, HydroDat® V8 also allows direct access to archive data via Microsoft Excel as well as to the system configuration. Archive data can be added or read out in the Excel or any other ASCII format.

According to the code of practice DWA-M 207, conventional remote-control technology in sewerage technology is (with a few exceptions) being increasingly replaced by the interlinking of local networks by internet technology. The basic communications structure remains unchanged by any changes in transmission routes and for this reason future effectiveness is more or less guaranteed.

Compatible Process-Control System

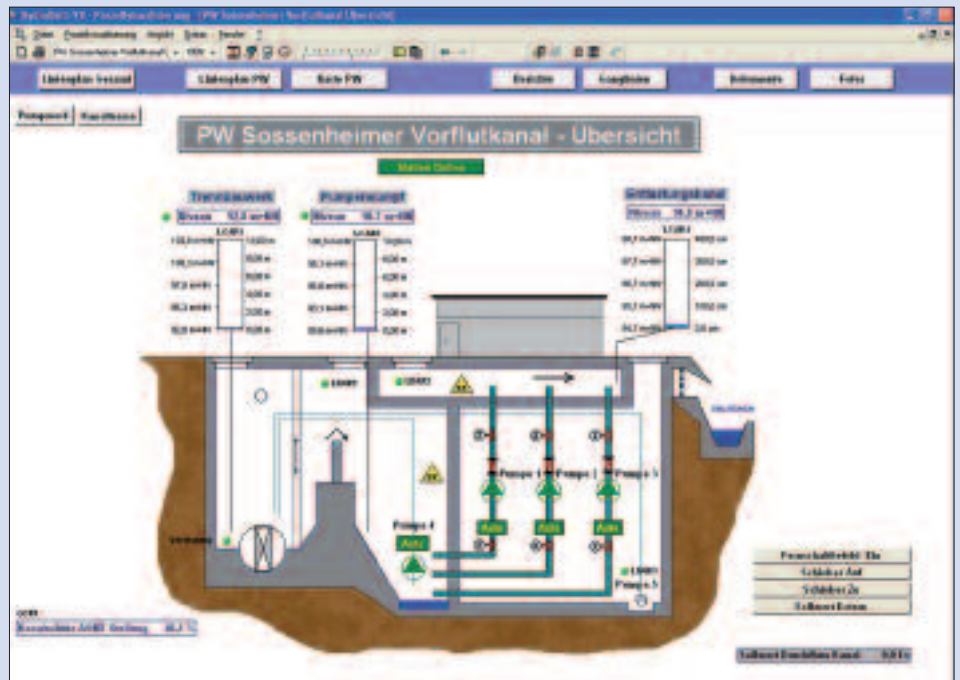
In changing from the existing to the new HST process-control system it was particularly important that all the data previously collected could continue to be evaluated and analysed by the new HydroDat® V8 system. A migration tool was therefore used to transfer configuration parameters and historic data to the new system. In this way it remains possible to analyse precipitation figures from 1993 up to the present day with hardly a break.

With the assistance of GPRS technology, the HydroDat® V8 process visualisation is able to display process figures almost in real time. Complex interrelated events in the sewerage system can be displayed with full transparency at any time. For example, during heavy rainfalls, personnel were able to monitor the amount of precipitation in the various districts of the city and its surroundings. Due to the online connection, it was also possible to observe levels in rainwater tanks.

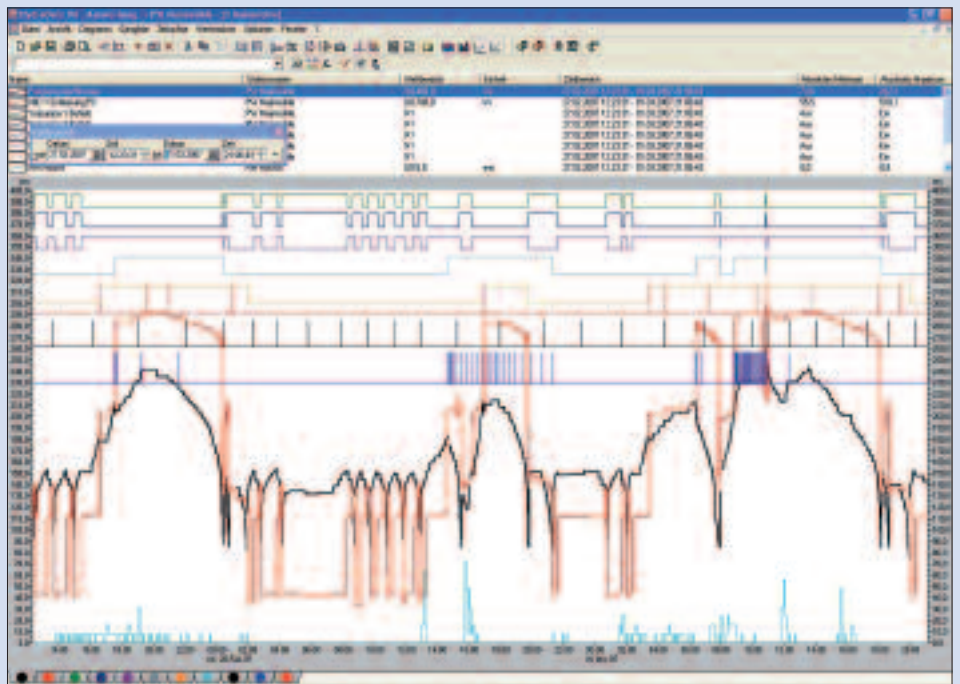
Flexible Reporting

Besides monitoring special constructions, rainwater gauges and sewage-measuring points, the process-control system is also used for analysing the data obtained. For this purpose, it provides an extensive reporting system as well as analysing hydro-graphic curves.

For the Frankfurt municipal authorities, the analysis of rainfall is particularly important. Precipitation is the factor which has the strongest effect on the dynamic behaviour of the sewerage network. The flexible reporting provided by the HydroDat® V8 system makes it possible to compile event reports to determine the annual pattern of precipitation events. The reports make



The pumping station as process diagram.



Graphic analysis of different data sets.

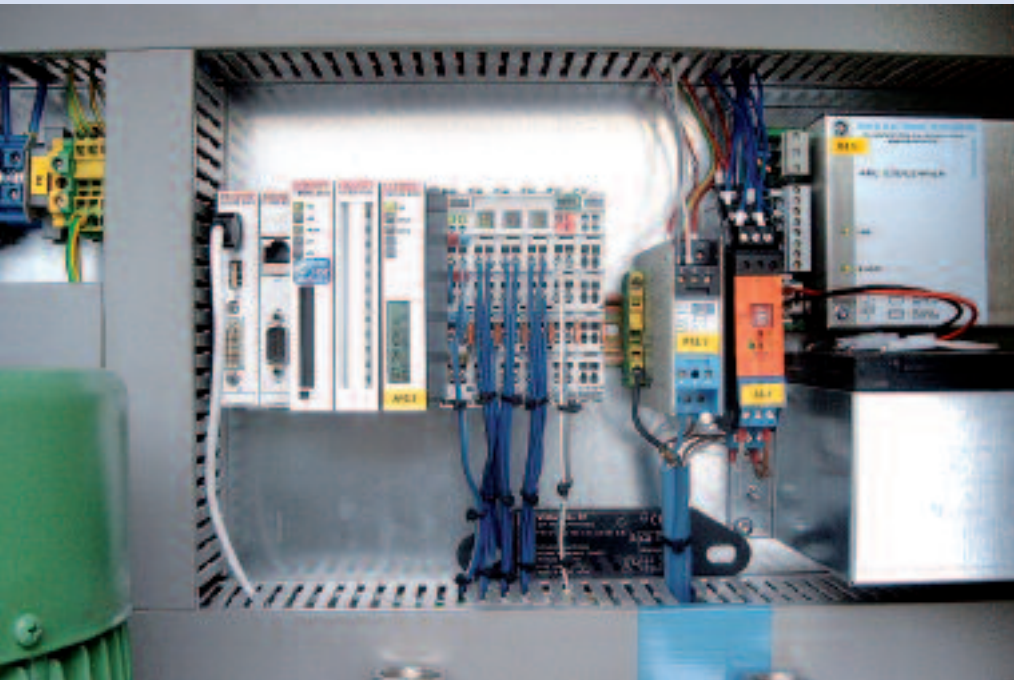
use of the applicable KOSTRA 2000 tables which provide coordinated information on heavy rainfall region by region. To permit analysis of the current situation, the process-control system supplies rainfall data for the past 30, 60 and 120 minutes online.

As well as analysing precipitation, detailed reports are generated for gauging systems and pumping stations. The entire reporting system is based on individual Excel reports which can be obtained from

the visualisation system. Here too, standard technologies and tools are in consistent use.

Easy Remote Access to Standby Services

Another important aspect in the introduction of the new process-control system was the support of standby personnel. In addition to reliable and efficient alarm systems, standby personnel also require detailed up-to-the-minute information on the state of the system on which to base



Embedded control with GPRS connection in operation.

their decisions. This requirement was fulfilled through remote access to the HydroDat® VB system via the UMTS broadband network. This remote access through the HST Web Navigator makes it possible for the emergency standby services to use all the features of the process-control system to monitor the current system status and obtain archived data. The HST Web Navigator is also used by the authorities responsible for municipal sewerage systems. In this way, more employees have direct access to the process-control system without having to install additional software on their work computers.

Conclusion

The Frankfurt sewerage project is an example of the trend towards "remote control via internet" and web-based process

control and monitoring in the management of water resources and sewerage. The continued development of the basic technologies in question means that, in future, conventional remote-control technologies will be limited to a few special cases only. The advantages of more modern systems are overwhelming, especially where factors such as operating cost, openness, safety of investment, range of function and ease of operation are important. The system used in Frankfurt am Main, with its embedded control systems is also impressive for its ability to incorporate monitoring, control and local visualisation of remote stations by camera into just one device. The municipal authorities in Frankfurt now have a state-of-the-art control system which provides important additional functions as well as saving costs.

Features of the Communications Network

- Embedded control systems as station hardware
- TCP/IP protocol from the central point to each individual control system (remote control via internet to DWA-M 207)
- GPRS transmission: fast data service in GSM network
- Invoicing based on actual data volume
- Stations continuously online (no dialling in and out)
- Low operating cost
- High IT security through VPN and encoding
- Central control without switching centre
- Local archiving of all data in case of link failure
- Independent of manufacturer due to OPC interface
- Integrated programmable SPC to IEC 61131-3
- Connection to existing control technology with E/A terminals, Profibus, Industrial Ethernet, S7-MPI, Modbus.

References:

[1] DWA Regulations, Code of Practice DWA-M 207 (July 2007): Information and Communication Networks for Waste-Water Technology, DWA, Hennef, www.dwa.de

