

A P P L I C A T I O N N O T E

CHEMICAL INDUSTRY

Zakłady Azotowe
Kędzierzyn



Power Media Balancing and Settlement
System

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Zakłady Azotowe Kędzierzyn (Kędzierzyn Nitric Works) is one of the biggest Polish enterprises in the chemical industry. In 2005, the decision on carrying out the general overhaul of the measurement and settlement system that had been operated since the mid 1990s was made, putting particular emphasis on improvement in reliability and availability of data based on which the heat consumers were accounted for. The whole project, which included design, system procurement, assembly works, software and commissioning, was carried out between May and November 2005.

System tasks

As the organisational unit of the Nitric Works, comprising the heat and power plant, power and electric power media networks, as well as the whole water and sewage management of the Works, the Business and Service Unit Energetyka (Power Engineering) had operated the measurement and settlement system based on then available solutions since 1994. In November 2004, it was decided to carry out the general overhaul of the system that was replacement of its essential components: measurement concentrators, data server, communication buses and user terminals.

The following goals were determined for the expected project:

- restoration of technical efficiency of the measurement and settlement system, including provision of access to the reliable data for settlements with consumers and for media management,
- standardisation of hardware and software to provide the system availability for a long time, regardless of the original supplier and manufacturer,
- maintenance of the existing object infrastructure, including measurement transducers and sensors,
- adjustment of data structures to the current organisation of Zakłady Azotowe Kędzierzyn,
- meeting the growing requirements concerning the settlements and quality of supplied media and energy,
- flexibility and openness to allow easy extension and modification, especially in the face of the approaching restructuring changes in the Works.

The range of the project covers the part concerning measurements of non-electric media including:

- production and distribution of steam with various parameters for the needs of chemical technologies and heating purposes,
- heat measurements in heating water for the needs of the Works and heating the town of Kędzierzyn-Koźle for which the Works is the main supplier of heat energy,
- measurements of drinking, industrial, demineralised and other types of water,
- measurements of coke-oven gas, safety nitrogen and air for the instrumentation installations.

System structure

The basic indicator, which determines the capacity of a digital system, is the amount of processed data. For this project the figures are as follows:

No	Description	Qty
1	Analogue measurements (including redundancy)	712
2	Measurement quantities – external systems	214
3	Two-state signalling	64
4	Calculated volumes – mass and heat flows	320
5	Flow adders	320

The distributed system was proposed consisting of 16 Beckhoff CX1000 concentrators that collect all measurements and communication links with external systems. The concentrators were connected with

one another and the server by means of the separate Ethernet network and, depending on the site conditions, the electric, fibre-optic or wireless links were used.

All the cabinets where concentrators are installed are powered in two ways and equipped with capacitive buffers providing the appropriate voltage level of 24 VDC for the time when the power lines are switched over. This has eliminated one of the most frequent reasons for failures of the former system.

The configuration of the server, which is the most important component of the system, includes the disk array operating in RAID system and redundant power supply. On the board of the Windows 2003 Server operating system there were installed the SQL database and ASIX visualisation software, which is the user interface in the power media balancing and settlement system. The process data are received from the concentrators and other sources and gathered in the long-term archive. The timetable, which is called up automatically once every 24 hours, calculates the reports and gathers them as XLS and HTML files on the separate station. The reports are available from the web browser level for any number of authorised users on the computer stations within the site network. Ten selected users who operate on PCs with ASIX visualisation system have access to any gathered data and full range of the system functionality.

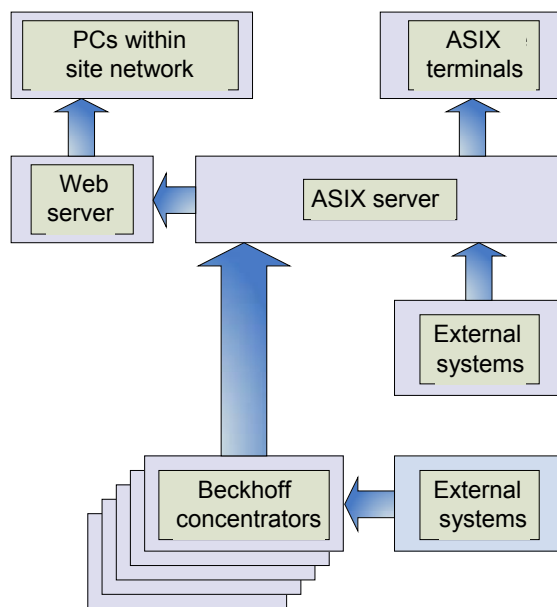


Figure 1. System diagram

Data acquisition and transport

Data collected from the analogue inputs of CX1000 concentrators are pre-processed, which means that their validity is checked, the correction procedures are calculated, exceeding the alarm thresholds is controlled, and the mass and heat expenses are calculated. Based on the corrected data the aggregates – minute averages and integrals (meters) – are created. These operations are performed in the concentrators – the Customer demanded that any calculation procedures up to determination of the minute averages should be moved to the process layer. The temporary values as well as the aggregates are transferred to the operating layer. The first of them are used for the on-going diagnostics of the measuring circuits, while the latter ones are the grounds for balances, statement of expenses and analyses. In addition to the temporary values, the group of diagnostic information also includes the supply system configurations, status of individual devices and

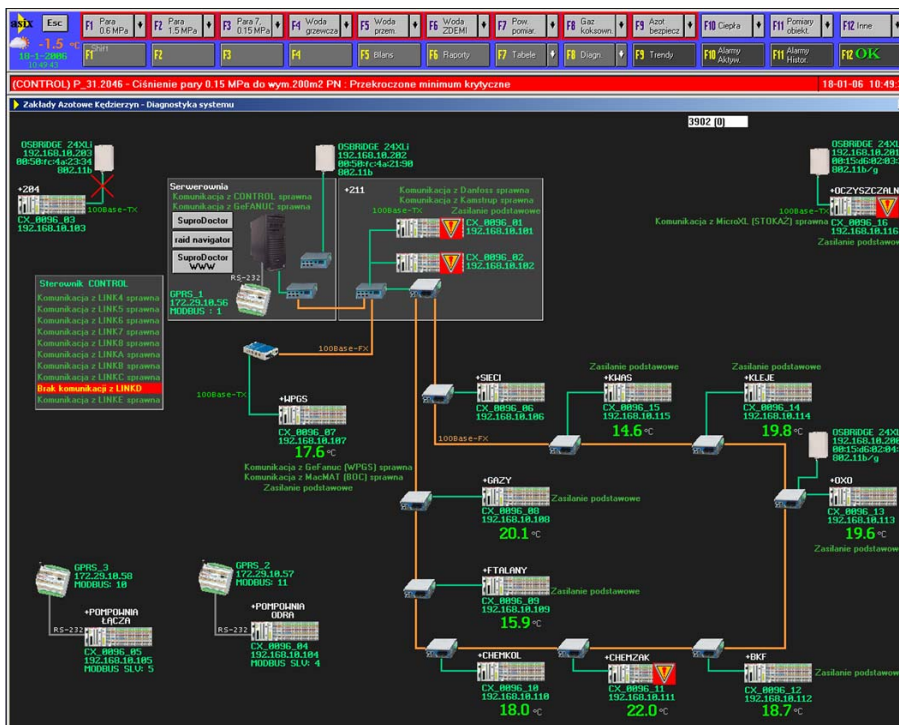


Figure 2. Diagnostic screen – communication networks and device status

signalisation of opening the concentrator cabinets, and most of them are installed on the trestle bridges outside the buildings.

According to the Works' requirements, the aggregates are buffered in the concentrators for at least 7 days. This buffering time is a consequence of the assumption that any damages to the communication networks between the concentrator and the server are to be repaired within one week. Upon re-establishment of communication the server will supplement the missing data using the buffer in the concentrator. For the event that the failure is longer, the concentrator boxes are equipped with the external RJ45 socket with the appropriate protection level, through which the archive can be copied onto the hard disk of the portable service PC (tablet PC) while being in the field. When the service PC is connected to the Ethernet network in which the server is operating, the missing system data will be automatically transferred to the long-term archive.

The basic structure in the network connecting concentrators with the ASIX server is the fibre-optical ring. As a part of the installation works, more than 6 km of the fibre-optic cable was laid out, mainly on the trestle bridges. For two locations outside the ring, which turned out to be hard to reach for laying the cable lines out, two radio links were used (in conformity with IEEE 802.11b/g), whereas the concentrators installed in the pumping stations outside the Works communicate directly with the server via the mobile telephone network (GPRS).

Data presentation

The information gathered in the system is presented to the user in two aspects. The primary one, which includes the aggregates and calculated balances, becomes a part of the basic tasks of the measurement and settlement system. The latter one, which the former solution was devoid of, makes the following diagnostic data available: temporary values of measurements, their statuses and statuses of individual concentrators and other components of the system.

The extremely important for the users and frequently used by them turned out to be presentation of the time trends in AStrend program. The ability to arbitrarily compose the set of variables, store the most often used summaries and diversity of the available forms of charts have decided that nowadays it is the basic tool for analysing minute aggregates.

The monthly balances presented as daily integers are the most essential, from the Customer's point of view, component of the system. All the reports defined on the designing stage based on the form sheets are calculated once every 24 hours, at night when the calculation period is closed, and stored on a separate external server. Thus, they are available during the working hours, virtually without any delays, regardless of the number of users referring to data, and handling the demands for these data does not overload the system server.

The balance information is made available in two ways: as tables on intranet page and as MS Excel files. The latter solution allows data to be edited and used in external programs.

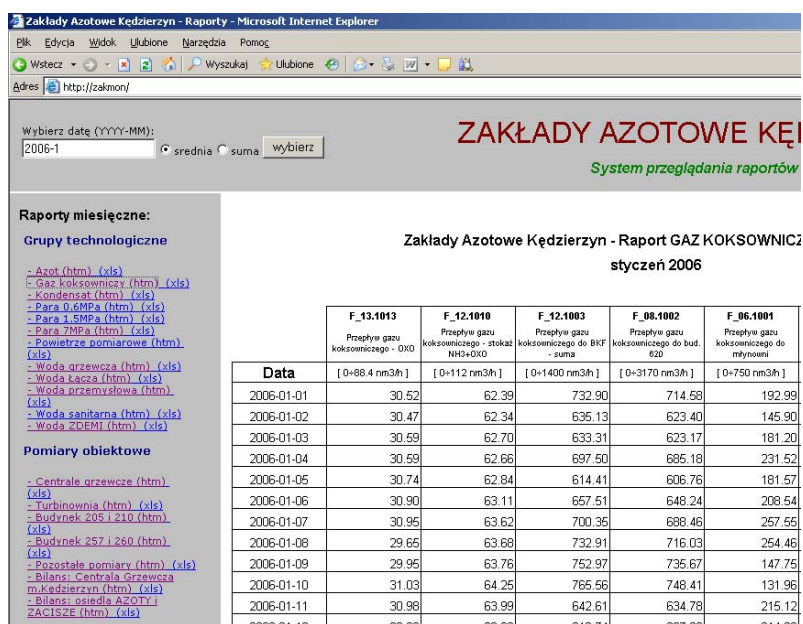


Figure 3. Visualisation – part of report.

Standardisation of solutions

For all the concentrators the common library of procedures for handling measurements, data buffers and communications was built, and the contents of modules that specify functioning of every device are transferred from the system database by the copy and paste method. Every concentrator is programmed for handling 300 measurements, 200 of which can be the signals directly connected to the analogue inputs. Every quantity recorded on the server is represented by several objects typical of the project. The reciprocal location of the objects and their distribution among the individual screens related to technological nodes can be set from the spreadsheet level.

The measurement and settlement system is the crucial cell of the energy and media management. By delivery of the reliable data, it becomes the source of significant and measurable advantages by:

- eliminating the necessity of "agreeing on" the settlement values with the customers in case of data loss,
- putting the information on the state of distribution network and media production in ordered and reliable approach to settlements. This allows the consumers to be disciplined in regard with to the currently uncontrolled media consumption and losses. It is estimated that the advantages due to that will reach a few per cents of the media and energy stream value when the system is started,
- making the complete information available in the real time, especially on the remote areas of the distribution network, which will allow quick reaction to any failures and thus reduce the ensued losses.