Transporting gas - with safety first!

Automation of an ethylene pipeline by HIMA

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Project planning and construction

Pipelines are the most cost-effective and safest transport systems for mineral oils, gases and other products. As a mass means of transport over long distances, they have to meet high requirements in terms of safety, availability and efficiency. The example of the automation of the Münchsmünster-Gendorf ethylene pipeline by HIMA shows how a modern safety-related automation solution can look.

The task of safety systems in pipelines is primarily to monitor critical parameters as well as to respond quickly and safely if an error occurs over long distances. In pipeline automation, predominantly conventional, non safety-related hardware technology and telecontrol systems with limited diagnostics as well as low fail-safe operation are still being used. The disadvantages of these solutions lie in the greater complexity e.g. for planning, hardware, wiring or testing and also in the more complex communication between the automation, process control and telecontrol systems. A larger number of error sources as well as a lower transparency also speak against these solutions.

The conventional approach is facing modern solutions with quick and safety-related telecontrol systems from the HIMA product families HIMatrix or H41q/H51q. The world's quickest safety controller HIMatrix is used where a very quick automation system is required. If a very high redundancy and availability are required, the H41q or H51q systems are used (Figure 1).

H41q/H51q for ethylene pipeline

An interesting reference for H41q/H51q is the automation of the Münchs-

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münster-Gendorf ethylene pipeline, which HIMA was commissioned to implement by InfraServ GmbH & Co. Gendorf KG. At the GENDORF Industrial Park, which is located in the Bavarian Chemical Triangle, ethylene is one of the basic raw materials and essential for many products from the site. The basic raw material is produced in the ethylene plant of the mineral oil concern Veba Oel AG at the Münchsmünster site near Ingolstadt. The ethylene oxide plants of Clariant GmbH and the EDC plant of Vinnolit GmbH & Co. KG at the GENDORF site are supplied with ethylene via a pipeline which is approximately 120 km long. The pipeline was constructed in the period 1971 to 1972.

The site at GENDORF, which had previously only housed the Hoechst Group, was restructured between the years 1993 and 1998 with the formation of several independently operating companies. Today, fourteen companies are operating in the GENDORF Industrial Park. The range of products produced at the site includes over 1,500 products. The GENDORF Industrial Park is undertaking extensive steps to ensure the safe operation of the pipeline in the future. These steps include a wide variety of measurement and safety devices as well as maintenance and monitoring measures for the pipeline, which is operated by the Business Unit Energy of InfraServ Gendorf.

InfraServ GmbH & Co. Gendorf KG, with approximately 950 employees, is the service company and the operating company of the industrial park. The company, which was founded in 1998 from the central specialist services departments of Hoechst AG at the GENDORF site, is a provider of both customer-orientated services specially for chemical production processes and also structural basic conditions.

Order awarded by InfraServ to HIMA

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In the middle of 2002, InfraServ Gendorf commissioned HIMA to modernise the safety-related automation technology of the ethylene pipeline and its slidegate valve stations. The pipeline can be shut off using slidegate valves, if needed, by means of twelve valve stations installed along the pipeline. Prior to modernisation, only two stations could be controlled electro-mechanically either locally or remotely. Two valves could only be operated manually. Eight new valve stations were installed.

The sheer physical length of the pipeline system and the need to secure the supply of the production facilities in GENDORF place high requirements in terms of the safety and availability of the automation system. In the course of modernisation, safety-related telecontrol systems were installed on every slidegate valve station which allow the data in the system to be communicated quickly and safely.

Modernisation with fail-safe automation technology

The installations are controlled and monitored by the use of high available, fault tolerant controllers from the H41q/H51q family from HIMA. The HIMA systems monitor the operation of the pipeline and ensure that specific sections or the entire installation can be shut down safely depending on the safety requirements.

The pipeline system or the slidegate valve stations are centrally controlled and monitored by a control room at the GENDORF Industrial Park on a 24-h/365-day basis with the aid of computers using a separate communication system. The visualisation system Operate^{IT} from ABB is used to implement the operation and monitoring of the pipeline as well as the control-specific requirements of the installation. The automation system from HIMA is coupled with the ABB control system via an OPC interface in redundant form. Today, the pipeline can be shut off, and thus be taken out of operati-

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on, at all twelve stations on the route between Münchsmünster and GENDORF by remote control. In addition, all the stations can now be operated locally, e.g. for trouble-shooting by the fire brigade.

Since the telecontrol system of the control centre forms the nodal point of the safety-related communication, this is completely constructed as redundant. The redundant construction ensures maximum availability.

Planning up to field level

The delivery of HIMA included the hardware and software of the safety-related controllers for the entire automation of the pipeline and the gas station in the industrial park. Also included in the delivery was the project management and engineering up to controlling the aggregates in the slide-gate valve stations, i.e. up to field level, as well as commissioning.

For the switch cabinets, InfraServ Gendorf had foundations made of concrete built for the individual stations which provided a surface area of merely 800 x 1,000 mm for the entire control and the corresponding components. The hardware solution was constructed by the HIMA experts on frames, tested at the HIMA plant in Brühl and only needed to be mounted locally afterwards.

The twelve slidegate valve stations are monitored by safety-related automation devices of type H41q-MS. The control systems are completely isolated from one another so that one station can always be maintained independently of the others. A H51q-HS or H41q-MS is being used in the two header stations. Besides this pipeline system, HIMA is also equipping the gas station in GENDORF. An existing electro-mechanical system is being replaced by a controller of type H41q-HS.

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Processing 2,000 signals

The automation devices have approximately 500 binary as well as approximately 100 analogue inputs and outputs and process approximately 2,000 communication signals (analogue and binary) from the control aspect. All the available signals are made available to the connected control system via an OPC coupling. In addition to the safety-relevant functions, operating data such as commands, measured values, messages and alarms can also be transmitted via the pipeline's telecontrol system from the control centre to the remote installations and back. Pressures and other status data are sent from the stations to the control centre. This information is needed, among other things, for detecting leaks or for triggering the slidegate valves.

The safety-related automation devices of the family H41q/H51q (Figure 2/3) used in the ethylene pipeline have TÜV/ BG certification and are also approved for safety-related applications in accordance with IEC 61508 (up to SIL 3) or EN 954-1 (up to Category 4). The quick, safety-related and redundant telecontrol systems have proven their worth in the process world in numerous distributed, networked automation solutions. They support comfortable visualisation and feature a high degree of clarity and transparency. The high degree of diagnostics across the entire system and the quick localisation and rectification of errors significantly increase availability. Thus the time spent on planning, installation, commissioning, maintenance and documentation is minimum. H41q/H51q systems were the first safety-related controllers in the world which could be used without restriction in mono configurations up to SIL 3/AK 6. They are also the first 2oo4D/QMR systems in the world which were certified according to the new international standard IEC 61508 from TÜV for applications up to SIL 3.

The combination of scalable availability of the I/O level and/or the central

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level with constant maximum safety means that the system can be adapted to meet the exact cost-effective requirements for the application. The controllers of the H41q/H51q family are executed in 19" technology. The compact H41q systems are suitable for use for automation tasks with up to 208 I/O points. The H51q systems with a modular structure are used in the automation of processes with more I/O points.

Communication via loop

A special feature of this project is the transmission medium: the communication for the pipeline takes place over an existing, pupinized copper cable, which had to be used further in order to cut costs. Coiled cables used to be used for improved voice transmission, yet they do not perform so well with higher frequencies. The existing cable was to be used for the communication with the new devices for controlling the pipeline remotely. Therefore, HIMA had the cables measured with modems, which are already being used in comparable applications, and was able to confirm that the existing cable was suitable for use with the corresponding modems for the communication.

To ensure the safe transmission of data, the copper cable was interconnected as a loop. This involved creating a connection on every second station in the direction of Münchsmünster as well as on the intermediate stations on the way back. The construction of an electrical loop allows the communication to take place on both sides of the loop. The advantage of this solution is that, even if the loop is interrupted on one side, communication to all systems is still possible (Figure 4).

HIMA was also required to establish a data line for the process data of the gas compressor in Münchsmünster to GENDORF. In this instance, a separate dedicated line was installed in order to establish a direct connection

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between the two locations for the non safety-related data. While a safe data protocol and a safe communication were constructed to control the slidegate valve stations, the direct connection of the dedicated line is exclusively for non-safe data.

Backup line for safe and non-safe data

To increase availability, a backup route was also integrated. The special feature of this solution is that the backup route is suitable for use both for the transfer of safe and non-safe data. If the case occurs that the loop is completely interrupted and data can only be retrieved or transmitted up to the breakpoint, the backup connection establishes the ISDN route, fetches the data from the loop via a switched connection in Münchsmünster and transmits it back over the dedicated line.

In the event of a complete interruption, a dial-up connection is established up to Münchsmünster, from where the remaining part of the loop is read. The data is then forwarded via the backup route. The connection is also established if the dedicated line for the non-safe data is interrupted. This data is then also transmitted via the ISDN backup line. This ensures that the system is generally available.

Normally, the slidegate valve stations are only supplied and operated by the GENDORF Industrial Park. The communication to the stations is only switched from Münchsmünster in urgent cases, i.e. if an interruption makes it necessary. If the loop is interrupted on one side, it does not have any effect on the quality of the communication and the operability of the installation. If the loop is interrupted on both sides, the backup route ensures that all the reachable stations can be reached.

Further requirements resulted from the centralised leak recognition and

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leak detection system, which requires a reliable and time accurate transmission of measured values via the telecontrol system of the pipeline. The redundant leak recognition and leak detection system is also to be used after the completion of the implementation of the far-distance transport and safety system. It was installed in collaboration with HIMA and connected via the existing redundant OPC coupling to the safety system. The measurement data entered there is transmitted, with a time stamp, via OPC to the two leak detection computers for evaluation.

Project processing in less than six months

In July 2002, HIMA was commissioned by InfraServ Gendorf to provide the complete planning and delivery of the safety-related automation technology. The start of planning up to the completion of the project took less then six months. The automation system was very extensively tested at the Brühl site prior to installation. All stations were constructed, interconnected and tested together with the customer and the supplier of the process control technology. The ABB visualisation system Operate^{IT} was also completely set up. This procedure was a means of excluding problems later during installation.

The slidegate valve stations were switched successively and put into operation starting from GENDORF. The experts from HIMA and InfraServ mounted and put into operation the automation system, while the pipeline continued to pump. All the tests of the telecontrol technology and the aggregates including the TÜV approval procedures were carried out while the plant was in operation. The plant could already be put into operation together with the customer by the end of 2002.

Figure 1: Modern HIMA solution for pipeline automation with H41q/H51q
Figure 2/Figure 3: System family H41q/H51q allows you to achieve a high

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level of availability.

Figure 4: The construction of a loop ensures the communication on both sides of the loop.

Figure 5: Gas transfer

Figure 6: Control room

Figure 7: Gendorf skyline

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Figures

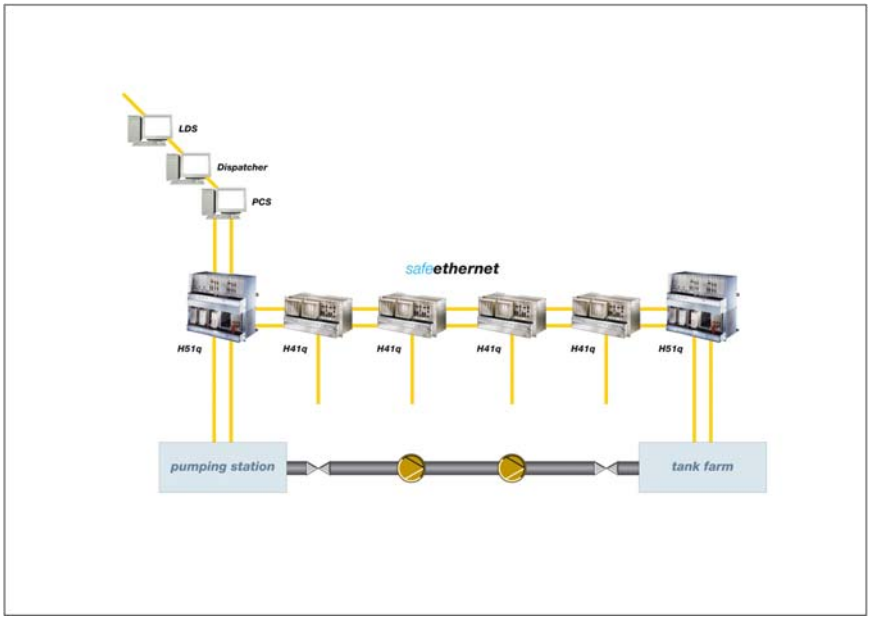
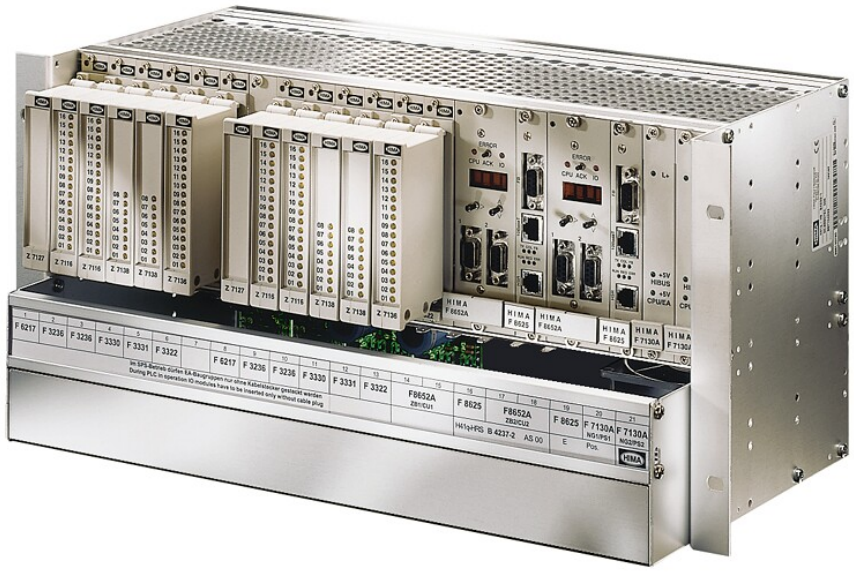


figure 1



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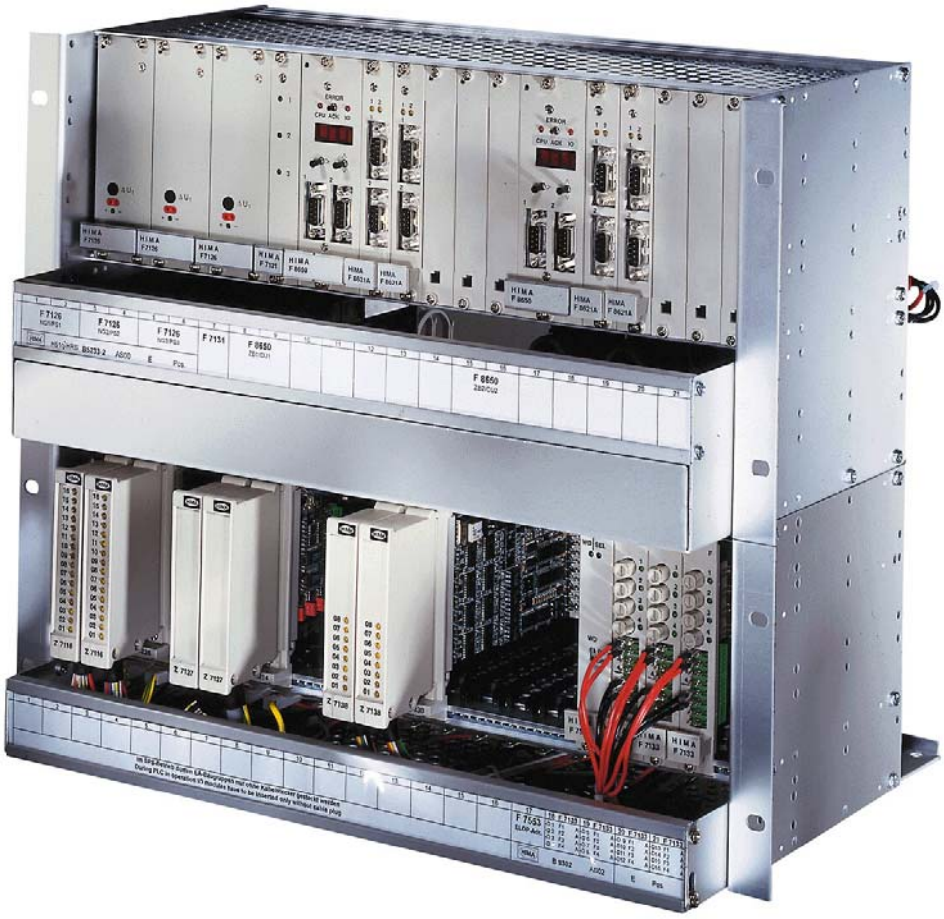

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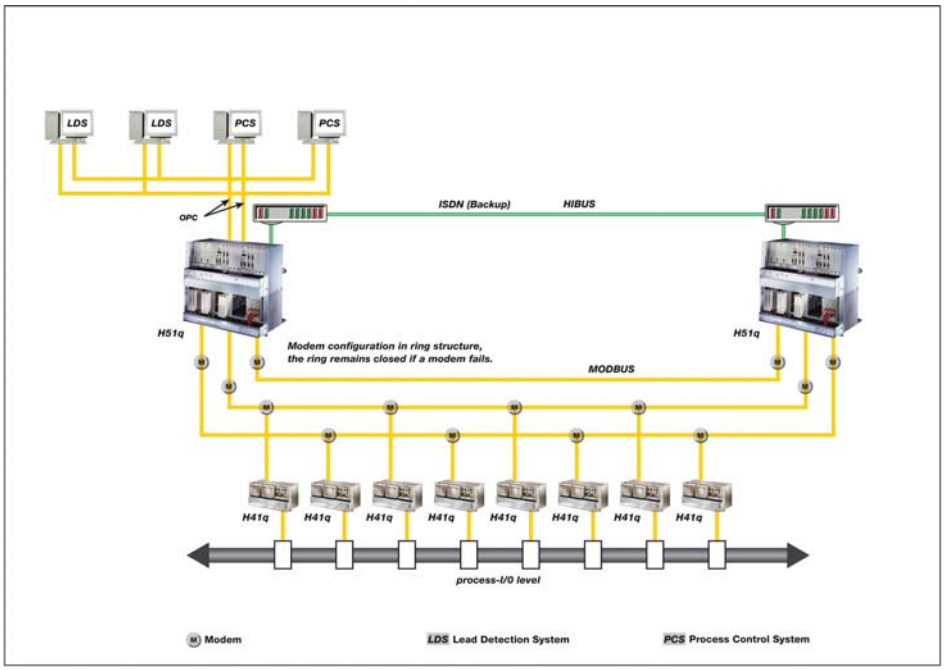

figure 4

figure 5

figure 6

figure 7

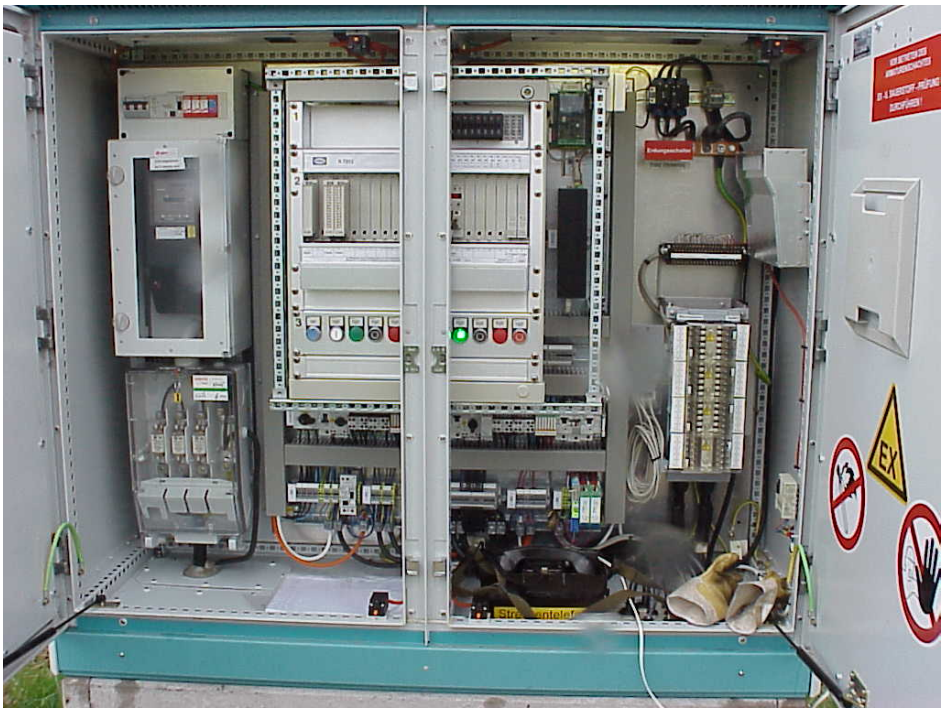

figure 8