Process automation

with modern communication system in a chemical plant
Remote I/O-System with fibre-optic bus in hazardous areas

by R. Koch and A. Muggenthaler

Figure 1: The Alkoxy plant at WACKER Chemie in Nünchritz, Germany

50 kilometres to the north of Dresden in Germany lies the municipality of Nünchritz. It has been a chemical site for over a century. In 1998, the Munich WACKER Group took over the production complex there manufacturing silicones and their intermediate products, chlorosilanes, silicates and pyrogenic silicic acids (Figure 1). The plant now employs a workforce of around 870.

In the year 2000, WACKER launched an investment programme with a volume of over 400 million Euro for expansion of the production installations and the plant infrastructure. Of course, the new installations were to be equipped with state-of-the-art control and instrumentation systems. After in-depth market investigations, the Siemens PCS 7 process control systems in conjunction with the explosion protected Remote I/O System I.S. 1 from R. STAHL, were selected as the standard solution for the automation system.

Why I.S. 1 of R. STAHL?

The advantages of using field bus technology for communicating between process automation systems and field peripheral devices (transmitters, sensors and actuators) remain undisputed since its inception.

Important arguments are as follows:

- Improved functionality
- Cost savings in regard to hardware, assembly, installation and commissioning
- Cost reduction during maintenance
- High degree of flexibility (enlarging and modifying existing systems) [1]

Modern system engineering will only be accepted by the market, if it represents the current state of the art, contributes to lowering costs and is simple for the user to plan, install and use. With the System I.S. 1, it has been possible to unite state-of-the-art technology with a very easy-to-use system concept.

A Remote I/O consists of only three basic components, i.e.

- a BusRail which can be expanded in modular fashion,
- a CPM with CPU and power module,
- and the I/O modules for the process signals to be connected.

All components are simply snapped on to a standard top hat rail (DIN rail).

The I/O modules can be combined as required within the system limitations, the power supply requires no complex engineering and the firmware for modifications, adaptations and expansions can be downloaded easily from the supplier's server.

Alkoxy BS 15 – the hour of truth

The Alkoxy BS 15 project was the first project for the system combination PCS 7 – Remote I/O I.S. 1. The installation, with an investment volume exceeding 10 million Euros, produces silicone-based masonry water repellents. The complex consists of two sub-systems, each with related stores, and a central tank farm for feed materials and final products.

The bus structure reflects this topology and sub-systems are each assigned to groups of field stations which, in turn, are linked to the automation system via corresponding, separate bus line (Figure 2).

Communication between Remote I/O stations in the field in Zone 1 and the PCS 7 process control system is performed using the Profibus DP protocol, whereby all stations are connected redundantly, i.e. each station features two separate CPMs, which are connected to the primary or redundant bus line (Figure 3). The primary and redundant bus is "looped" from station to station. This multidrop technology allows connection of up to 10 field stations in Zone 1 to one bus segment. This maximum configuration was not used on any bus segment so that additional field stations can be connected to the groups at any time, if necessary, even without interrupting communication. This is an advantage for continuously operating installations. Basically, each field station of →

➔ the I.S. 1 system features a connection for the R. STAHL ServiceBus. This multi-function bus performs the following tasks:

- Configuration and programming of field stations, if this is not permitted by the bus protocol (e.g. Modbus RTU)
- Back-documentation of the bus structure and station complement
- Fault diagnosis in several levels (station, module and signal)
- Loop check of the entire field periphery without connected automation system
- HART communication via stand-alone HART management systems

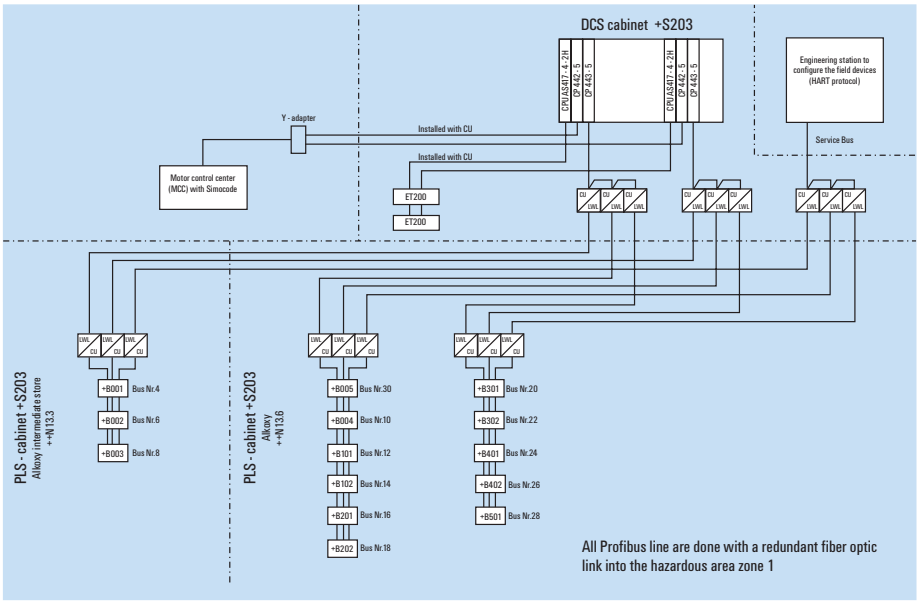

Figure 2: Section of the bus topology for the Alkoxy BS15 plant at WACKER in Nünchritz, Germany

In the installation, all field stations are linked group-by-group via the ServiceBus to the engineering station in the control room. The HART management system installed in the control room allows access to all HART field units connected to the I.S. 1.

Testing the installation (loop checks) and commissioning are frequently difficult on complex I/O systems in large-scale installations, since both hardware and software tests need to be run simultaneously in some cases. With the IS Wizard program which was developed in-house, R. STAHL has created a Windows-based program with which the entire I/O system can be checked and configured, besides other functions, using a laptop or PC, even if there is no connection to the superior control system as yet. All sensors and actuators connected to the Remote I/O System can be "moved" and checked. This option allows the installation technicians to accomplish parallel and independent work on automation system and Remote I/O System, which is of major advantage when implementing complex installations.

After mechanical erection of the field stations, connection of the power supply (24 V DC) and connection of the field units to the stations, technicians were immediately able to accomplish loop checks with the IS Wizard on the Alkoxy BS 15 project during installation, independently of the status of the work on the process control system. For this purpose, a laptop was connected to the relevant field station directly on site in the installation as explosive atmosphere still did not occur at this time, and all required tests of the field circuits and field units were implemented with the IS Wizard. This allowed a great deal of time and, of course, money to be saved during this "hot" phase.

During normal service, the IS Wizard is installed on the engineering station in the control room and can be used from there at any time via the ServiceBus.

Fibre-optic bus technology for Zone 1 – an innovation

The use of fibre-optic technology in automation and communication engineering is conventional and now unproblematic in the non-hazardous area. One main problem needs to be solved in order to be able to use and, thus, reap the benefits of fibre-optic technology for installations in hazardous areas as well: the energy level of the light in such optical transmission links has to be limited in the event of fault (cable fracture) to prevent a potential ignition of a hazardous, explosive atmosphere. [3].

The field bus isolating repeaters, Series 9372 of R. STAHL are isolators which, besides providing the gateway function of copper cable => fibre-optic light guide and vice versa, also limit the optical energy on the fibre-optic link. The energy is limited to a level of < 35 mW so that there is no possibility of ignition in the event of fault. With this solution, fibre-optic technology can be used in Zone 1 as well in virtually the same way as it is in a non-hazardous area.

The transmission links from the field to the control room are cabled entirely using fibre-optic light guides (the Alkoxy BS15 system is an open-air installation). The individual field stations are multidrop-interconnected with Profibus copper cables in the open-air installation itself.

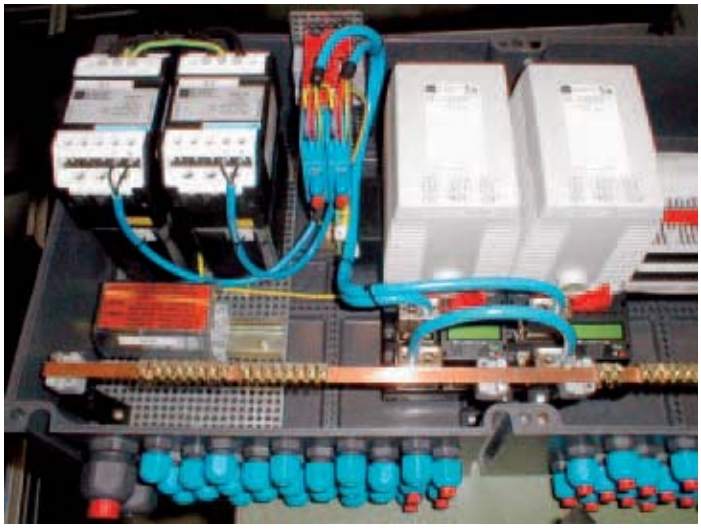

Figure 3: Field station for Zone 1 installation with fibre-optic bus connection and redundant CPM´s

Rugged mechanical system – field stations for applications in hazardous areas

All components of the I.S. 1 field station are accommodated in explosion protected enclosures featuring type of protection Increased safety "e" of Series 8146 made of glass fibre-reinforced polyester, manufactured by R. STAHL (Figure 4). Each station consists of two single enclosures that are flange-mounted to each other. The stations were provided with breather glands at the request of the customer. Air is ducted through these glands and it ensures a slight gauge pressure above atmospheric pressure in the enclosure, preventing penetration by or depositing of aggressive materials from the environment. Breather glands also discharge any condensation occurring in the housing.

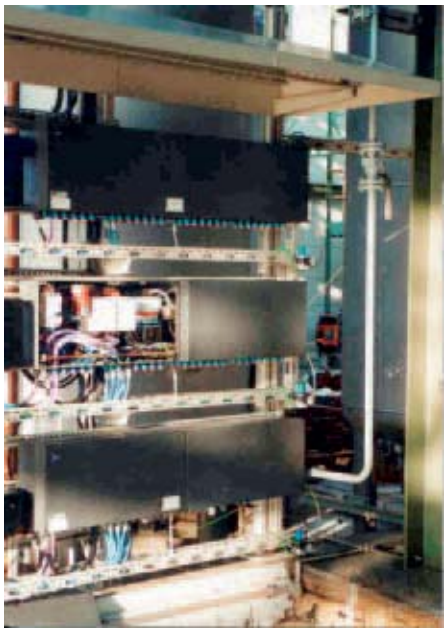

Figure 4: Field stations installed outdoors

Many years of project experience

R. STAHL has been supplying Remote I/O systems for the hazardous area for over 15 years now. An extensive "repertoire" of field enclosures made of a wide variety of materials ensures that the optimum project solution is available. It is only the combination of I/O components and rugged mechanical systems that meet the project-specific requirements on hazardous installations which ensures reliable service for many years. Bringing into service the remote I/O field stations and project-specific training of the installation and maintenance personnel on site are also included in the scope of delivery.

The Wacker production plant was officially put into service on 26 November 2001 after a project handling time of two years. The experience gained from this project has been incorporated in other projects, and three further installations have now been equipped with R. STAHL Remote I/O. Over 80 I.S. 1 field stations of a wide variety of designs operate reliably at WACKER in its Nünchritz plant and make their contribution to success of this project.

Literature

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Figures:
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