

Simplest Possible Handling for Greater Security

SIPROTEC 4 enables maximum supply security in the petrochemical industry

■ The company

BP Cologne, headquartered in Worringen, a suburb of Cologne, is a wholly-owned subsidiary of Deutsche BP AG in Hamburg. As the fifth largest petrochemical location in western Europe, BP Cologne is an important supplier of raw material to the chemical industry, with about 1,900 employees. Each year BP Cologne derives millions of tons of chemical raw materials from the light gasoline produced by refineries during the refining of petroleum. The chemical industry uses these materials as basic components for the production of plastics and fibers. The BP Cologne plant relies on the northwest European ethylene pipeline to supply chemical companies. Economic and reliable operation of the facility depends on a secure supply of electrical power. BP Cologne has a power requirement of approx. 160 MW.

■ The starting situation

The supply of raw materials and the shipment of refined chemical products are inseparably linked to the actual chemical process. In the past, an enclosed single-busbar switchgear supplied power to the light gasoline tank farm and the compressor stations. Expanded production, higher supply security, and reduced personnel resources for operation and maintenance all combined to increase the demands placed on the switchgear and its primary and secondary systems. Failures in these areas have a direct impact on production, causing considerable damage and high costs. For this reason, a switchgear was built at a central point to guarantee a reliable supply of light petroleum for the cracker production and also the output of ethylene (over 1 million metric tons/year) into the 500-km long ethylene pipeline network.

Modern, low-cost standard solutions from a system provider offer maximum security for the power supply. A double-busbar switchgear with four busbar sections supplied by four incoming feeders was installed. The busbars feed the high-voltage motors of the compressor plants and the low-voltage network for supplying the tank farm pumps. A switchgear that relied on compact, low-maintenance technology was essential.



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Beside the new solution concept for the primary systems, the secondary systems also required highly efficient, state-of-the-art technology. Because the compressor station motors are installed in an explosion-protected environment, the secondary systems employ motor protection relays that comply with the requirements of ATEX 100 and are certified by the PTB.

■ **The concept**

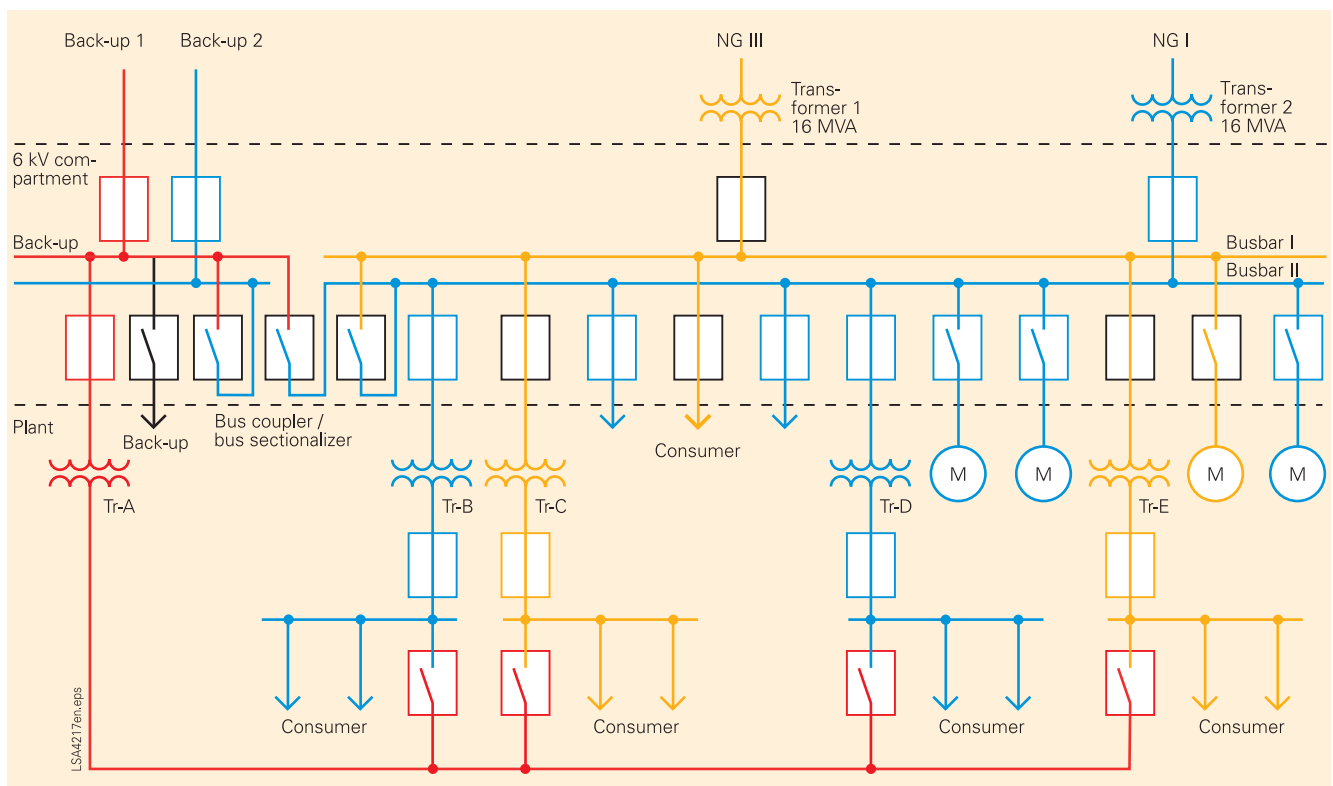
In collaboration with BP Cologne, Siemens PTD developed a solution with the highest reliability at the lowest cost, offering the following functions and advantages:

- Combined units implement protection and control functions to keep costs low.
- The station control system communicates with the power system center via the existing noise-immune fiber-optic cables between the buildings.
- The power system control center controls the switchgear under normal operation. For this reason, two control center terminals using a standardized IEC 60870-5-101 protocol connect the station control system to the power system management and to the signaling system. The bay control units feature convenient and reliable local control options at the emergency level.
- The combined protection and control units link to the station control system (station level) in the control and signaling direction via the standardized protocol IEC 60870-5-103.
- Simple, standardized, intuitive operation of the protection and control units saves scarce personnel resources. The equipment's comprehensive self-monitoring mechanisms reduce costs for precautionary maintenance.

- Using the same software for establishing parameters for all protection and control units cuts the time and costs of training.
- Overcurrent protection functions and suitable motor protection functions securely and reliably protect the outgoing circuits.
- The new phase-selective differential protection of the four incoming feeders uses the existing fiber-optic cables connecting the buildings. This provides maximum supply security using the existing infrastructure, thereby reducing investment costs.
- Overcurrent protection in the bay control units protects the incoming feeder units. To protect the investment against operator error, the integrated synchrocheck functionality allows users to check the synchronous conditions before connecting to the supply.
- Panel-internal interlocking can be installed for safe operation of the switchgear. These are implemented in the devices by means of software.

The maintenance-free compact double-busbar switchgear of type NXPLUS, in conjunction with the matching numerical protection relays of the SIPROTEC 4 product range, provides the required high level of reliability.

Fig. 1
System operations under normal operation



The housing design with large detached operator display was selected from the SIPROTEC 4 product range. This design allows installation in the cubicle door in an ergonomic position. It also provides advantages with regard to operation, relay installation position, and mechanical stressing of the switchgear door.



Fig. 2
NXPLUS switchgear with
SIPROTEC 4 relay

The control and monitoring functions can be performed easily and reliably on the relay display. All required operator control elements, such as the local key-operated switch, are integrated to avoid the need for external add-on elements. The user-friendly design allows intuitive operation of the devices even under emergency conditions, thus helping to ensure a reliable supply of electrical power for the production process.

The integrated graphical logic level (CFC) and a copper ring bus wires across the panels provide

the required switching interlocks. The interlock check prevents busbar sections from being accidentally coupled via the two outgoing feeder disconnectors of a feeder, and keeps the circuit-breaker of the bus sectionalizer from being opened during this operating state.

Because of the modularity of the protection functions in the SIPROTEC 4 combined relays used, 7SJ6 overcurrent-time protection relays can be used as standard and adapted to the object to be protected. Relying on standard operations cuts the required training time significantly, saving scarce personnel resources and reducing the risks of operator error.

Another positive point to be mentioned is the fact that fewer assets are tied up, because a lower stock of spares needs to be maintained.

In order to protect the high-voltage motors in the explosion-protected areas of the compressor station, the 7SJ6 relays have suitable and proven motor protection functions that are also ATEX100-certified.



Fig. 3
SIPROTEC 4 relay with detached panel

For this application, the 7SJ63 relays feature starting time supervision and restart inhibit for motors. The former protects the motor against excessively long start-up processes, thereby providing extra overload protection. The restart inhibit prevents the motor from restarting if the rotor is expected to heat up above the permissible temperature during start-up.

The overload protection prevents thermal overstressing of the objects to be protected. The protection relay (with memory function) displays a thermal replica of the object, taking into account the overload history as well as the heat dissipated to the environment. This is of crucial importance, particularly in explosion-protected areas, since it is necessary to ensure that equipment temperatures do not reach levels that could trigger an explosion.

The four incoming feeder panels have SIPROTEC 7SJ64 numerical overcurrent time protection relays and 7SD610 line differential protection relays. Thanks to standard SIPROTEC 4 technologies, users can operate these relays simply and intuitively according to the same philosophy, and parameterize and read them out easily using the DIGSI software, which is standard for all numerical Siemens relays.

The 7SD610 line differential protection relay communicates via the existing fiber-optic cables across buildings.

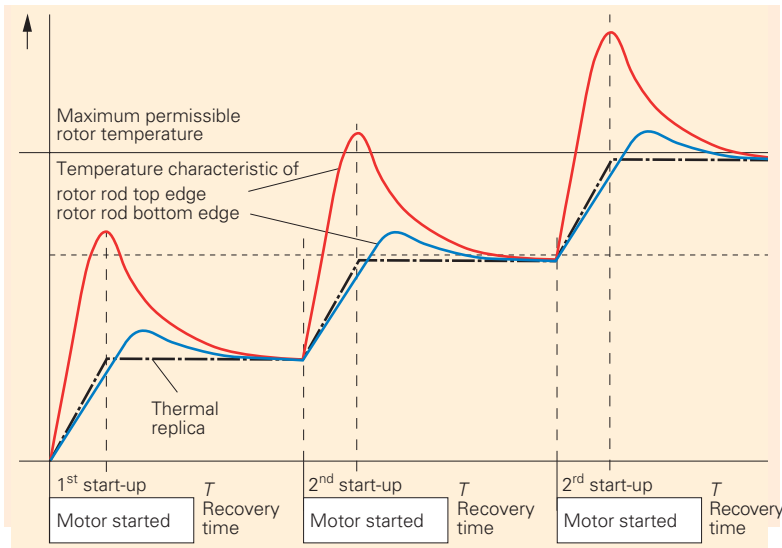


Fig. 4 Temperature characteristic of rotor

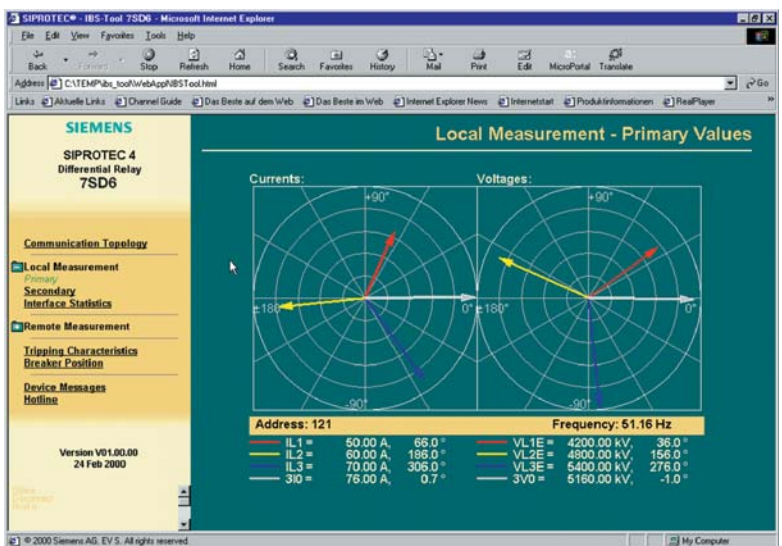


Fig. 5 Web browser in 7SD610

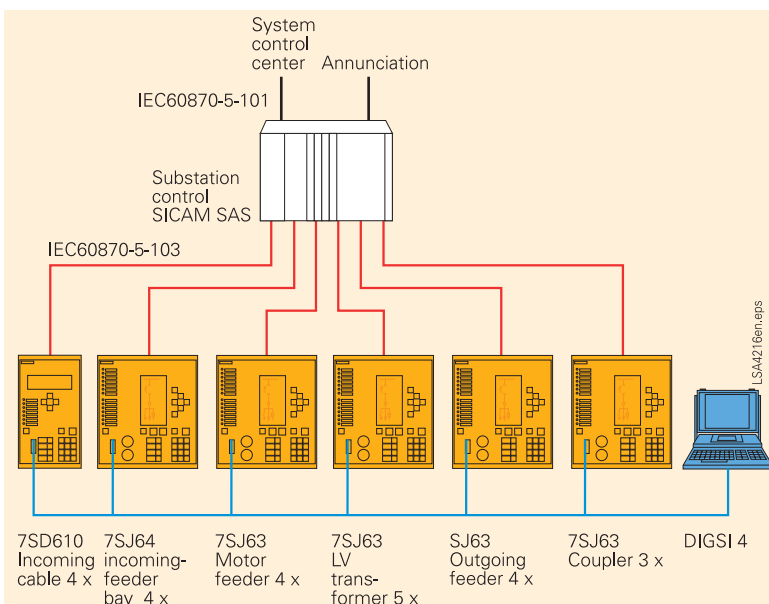


Fig. 6 Protection scheme

The integrated commissioning and monitoring help functions, based on Web technology, support efficient commissioning of the line sections. The Web technology cuts commissioning times and opens up the following new options for the service and maintenance personnel:

- Graphic display of local and remote measured values as vector diagrams
- Simple checking of the polarity of the transformer terminals
- Stability tests with display of the operating points in the tripping characteristic

Fiber-optic point-to-point connections link all SIPROTEC 4 relays to the station control system SICAM SAS. Communications in the control and signaling direction use the standardized protocol IEC 60870-5-103 between the bay unit and central unit. The station control system SICAM SAS connects to the power system control center and the signaling system via IEC 60870-5-101 protocol.

■ Conclusion

Because of standard equipment technology, users can operate the system safely even in emergency situations with little training, either from the control room or locally. The SIPROTEC 4 relays support operations through self-monitoring and comprehensive logging of events and messages.

Proven modular protection functions, adapted to the application, protect the electrical equipment important to production, such as switchgear, outgoing feeders, and motors. The control system logs and signals any faults immediately. As a result, users can analyze faults swiftly and take appropriate measures to prevent production losses. The all-in system solution, comprising primary and secondary systems, guarantees a high level of reliability for the entire plant, and ensures a reliable and efficient power supply for the compressor stations and the tank farm.