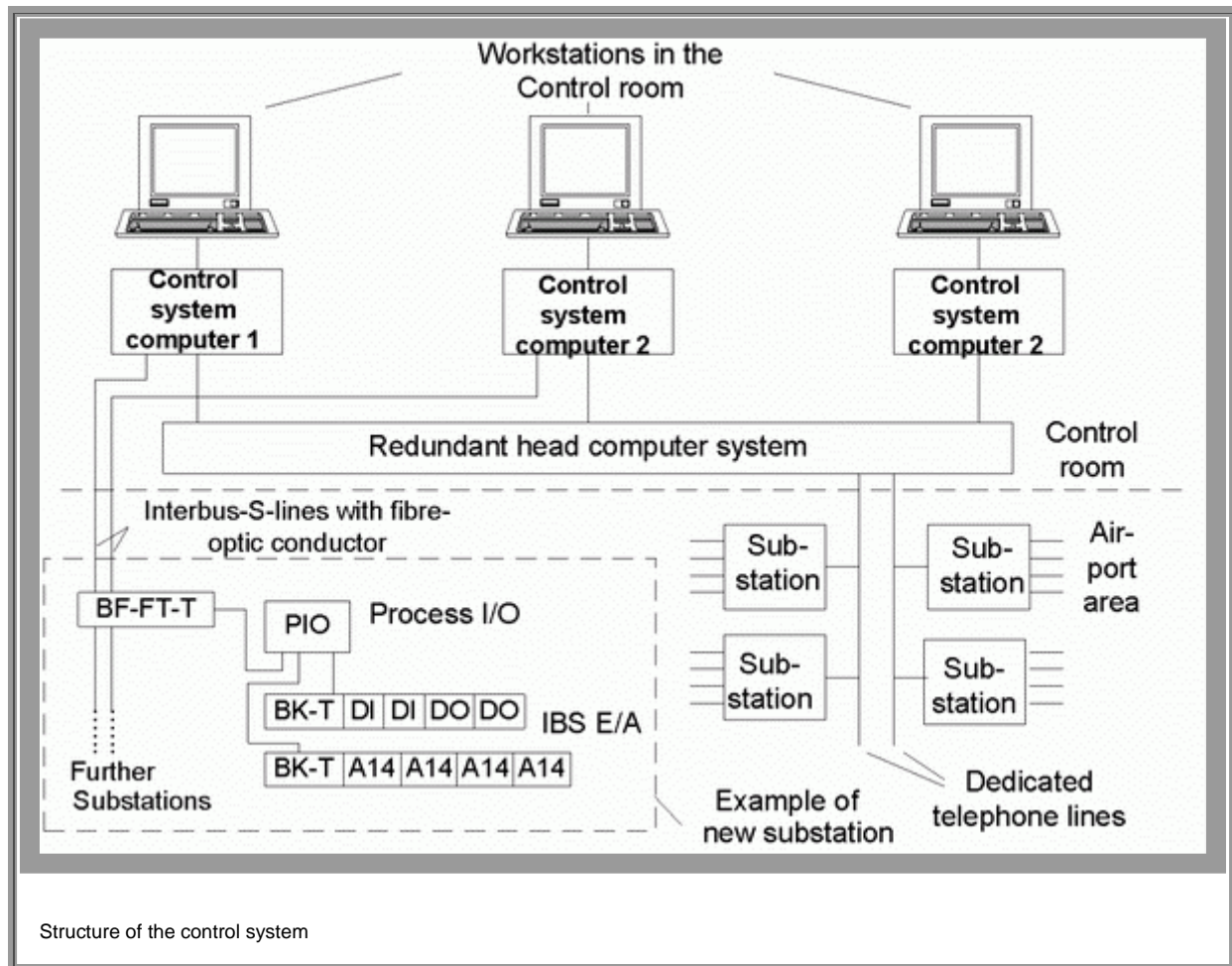




Enhanced failure immunity thanks to redundant I/O level (HBG Frankfurt Airport)

The hydrant installation for aircraft refuelling at Frankfurt Airport is subject to very stringent requirements as regards failure immunity. Consequently, the control system which controls all actuators and sensors of the installation must guarantee maximum availability. ECKELMANN AG equipped the control system for the refuelling installation in the apron area of the airport with a redundant field bus system in order to meet these demands even at the I/O level.



"No fuel - no flight"

The Hydranten-Betriebs-Gesellschaft company (HBG) operates a tank farm at Rhein-Main airport and a hydrant installation, distributed over the airport apron, allowing aircraft to be refuelled directly at their parking positions. The system covers an approx. 50 km-long pipe network which is split into individual pipe sections between which remotely controlled motorised slide valves allow the various sections to be isolated. Approx. 650 pressure and temperature sensors are installed and over 350 alarm sources need to be monitored.

All parts of the system must meet extremely stringent requirements as regards operational safety and availability. Since the refuelling system is used round the clock on 365 days of the year, the system



must be fail-safe. Consequently, the control system was equipped with a redundant networked system comprising three ECKELMANN control system computers in the year 1994. Then, in 1999, it was also intended to upgrade the I/O level to the state of the art.



Requirements applicable to the new I/O level

The input/output signals are acquired or output at distributed locations in substations which are distributed over the entire airport apron. The I/O data is forwarded to three networked control system computers via a front-end computer. These control system computers are very largely identical as regards the software application and each feature their own interface to the front-end computer and, thus, to the I/O signal level. This ensures that each control system computer is capable, on its own, of covering the entire functionality of the control system. The operator formulated clear requirements for modernisation of the I/O technology which had become outdated:

- Use of standard technology.
- Redundant interfacing of the substations to the control system via 2 bus lines.
- Use of fibre-optic waveguides to span the large distances on the airport site (up to 1500 m) between 2 substations.
- The two bus lines were to be laid as a ring and they were to be interfaced redundantly to the control system computers so that the system remains fully operable even if both lines are separated at a specific location.
- Use of analogue inputs with full 16-bit resolution in order to allow highly precise leakage checks on the piping system.
- Installation of the hardware for the substations in pressure-resistant, explosion-protected housings (Ex enclosure).

Solution incorporating dual field bus

The basis of the solution developed by ECKELMANN AG is formed by the Interbus-S field bus system manufactured by Phoenix Contact. Two redundant bus lines are connected to two of the existing control system computers via fibre-optic waveguide converters and an interface module. The communication functions between I/O level and control system are thus performed directly by the control system computers. The two Interbus lines are connected to the hardware in the substations via a redundant bus terminal. In the event of failure of one line, this terminal automatically switches over to the remaining, operable line. Further standard Interbus-S modules manufactured by Phoenix Contact are used downstream of the redundant bus terminal. For reasons relating to cost and space, the design at this point is not redundant. In order to guarantee the required high accuracy, the process I/O stations with 16-bit resolution developed by Messrs. Phoenix Contact specifically for process engineering, were used for the first time.



Project implementation and commissioning

Modernisation of substations is to be completed successively as specified by the operator. Consequently, the control system software has been modified so as to allow parallel operation of old and new substations with the control system. Switching over a station from the old technology to the new, redundant technology now merely requires a change to a configuration file. The adapted software has already been commissioned. The substations will now be replaced successively.

Extensive failure strategies have been incorporated in the software of the modernised control system in order to allow possible faults and errors at the distributed I/O level to be detected and remedied. If, for instance, a control system computer detects a fault in its bus segment, it shuts off the section of the bus lying downstream of the fault location and continues operation with the remaining stations. The remaining stations are then still operated by the second control system computer.

Standard technology for standard applications

The modernisation project for a distributed I/O level with very stringent requirements as regards availability and system safety, implemented for the Hydranten-Betriebs-Gesellschaft company at Frankfurt Airport, demonstrates what sophisticated solutions can be implemented today in the sector of control systems engineering with standard components. The system described offers clear price advantages over a proprietary system and, in addition, renders the operator independent of promises on the part of one single manufacturer or developer to supply.