Central Control Station at Jaenschwalde mine

Lausitzer Braunkohle AG, Germany (2000)

1. Summary

Over a period of two years, ABB Open-Pit Mining installed, in several stages, a process control system for the lignite-mining company Lausitzer Braunkohle AG (LAUBAG) at their Jaenschwalde mine. The third stage, a quality-management system, was commissioned in April 2000 after a successful test run. This completes a control system which covers all large machines and conveyor lines of the mine, monitoring all processes from waste disposal through coal excavation to transport.

An information management system supervises and records all operations. The gathered data are made available to LAUBAG for central processing via the company's own network. A diagnostics system provides basic information for operative and prophylactic maintenance.

All process and video pictures can be displayed on the monitors of the control station as well as on a large screen measuring 4x1.5 metres.

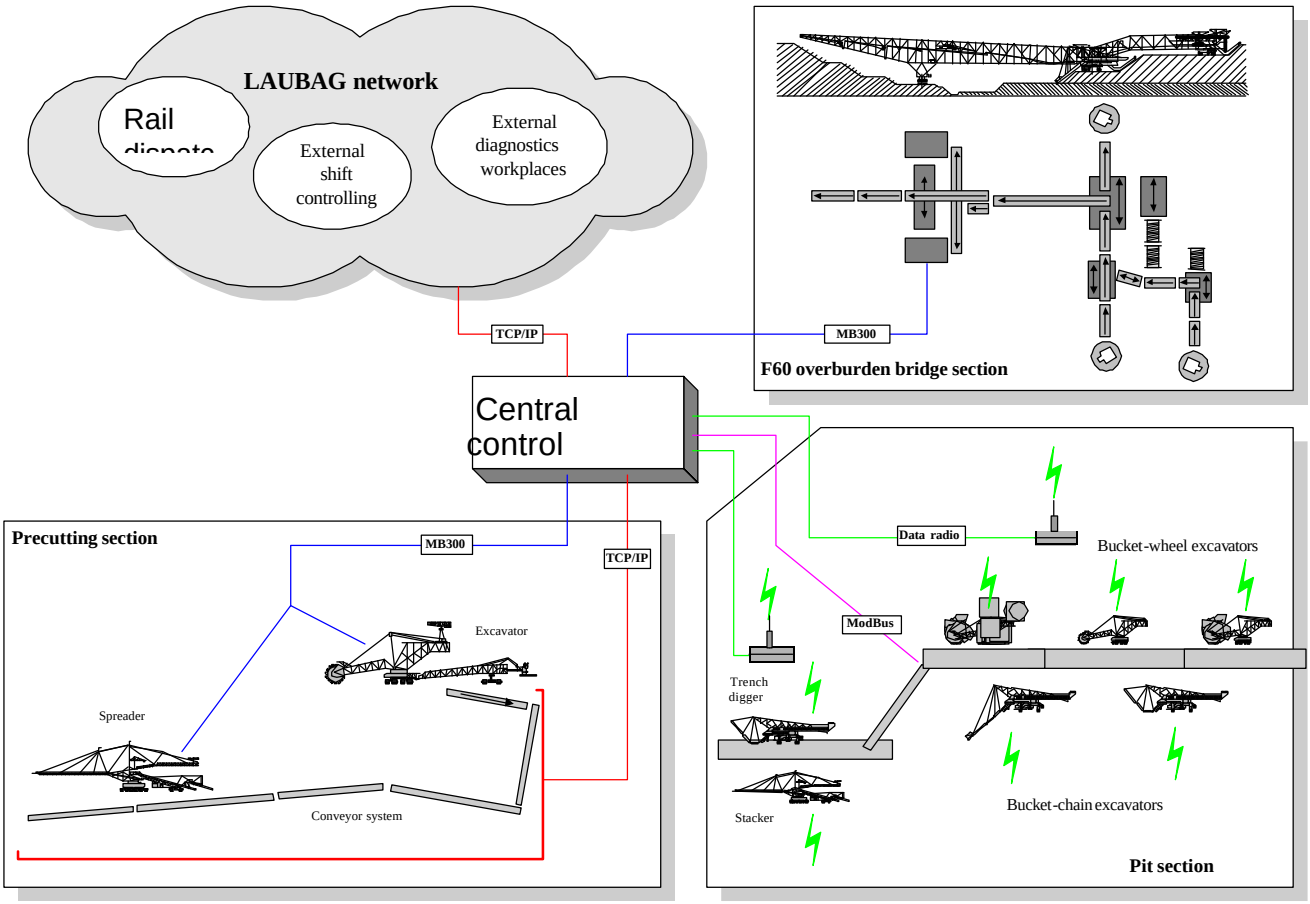
All the process information is stored and can be accessed by authorised personnel.

2. The Process Control System of the Mine

All technological sections of the mine, i.e.

- pre-cutting with 2 machines
- the F60 overburden bridge with 3 bucket-chain excavators
- the pit and the trench bunker with 7 machines

are connected to the central control station by optical-fibre cable or radio. Thus a comprehensive picture of all operations is created. The data of the individual sections are stored in a database server and kept for three months.



The central control station has been fully equipped with ABB Advant OCS control hardware.

A fast and secure transmission protocol couples to the AC450 Advant controllers in the central station the many decentralised components of other manufacturers that control the mining machines and conveyor lines. Serial interfaces such as MODBUS could not be used because of the large amount of data to be transmitted. The standardised Ethernet infrastructure proved to be the only applicable network solution.

The Transmission Control Protocol / Internet Protocol (TCP/IP) was chosen for transmission. That protocol has been used so far mainly in LAN and WAN but is getting applied more and more for transmission purposes as well.

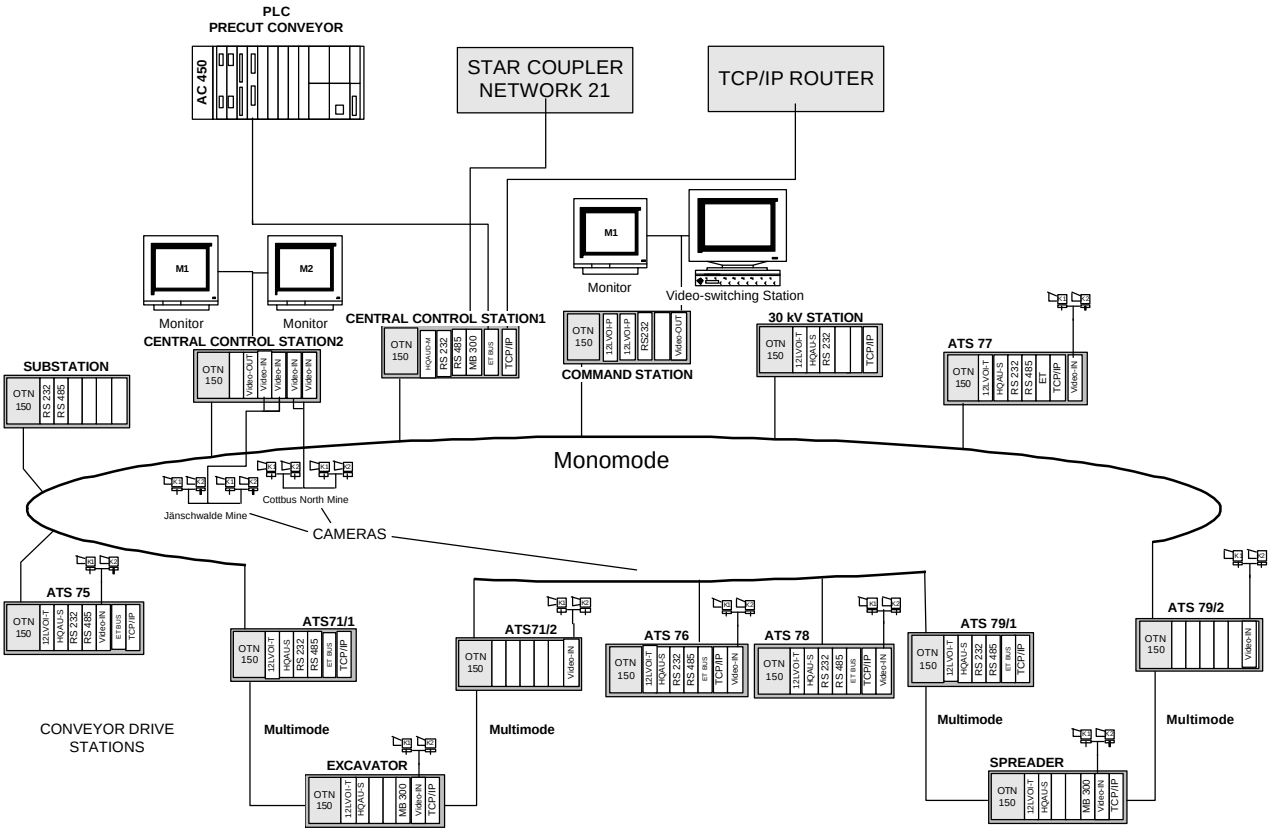
2.1 Communication Infrastructure

Four OTN (Open Transport Network) loops serve as data connections between the central control station and the individual technological lines.

Loop 1 pit
Loop 2 overland connection of the F60 overburden bridge
Loop 3 Cottbus North
Loop 4 pre-cut

Thanks to those redundant optical-fibre loops and the OTN nodes it is possible to transmit the signals of the individual bus systems and video signals to the central control station.

Loop 4 below shows the principle:



2.2 Communication Infrastructure of the Central Control Station

As regards connections of control station components, it is necessary to distinguish the equipment bus and the process network (PLAN) from the local area network (LAN).

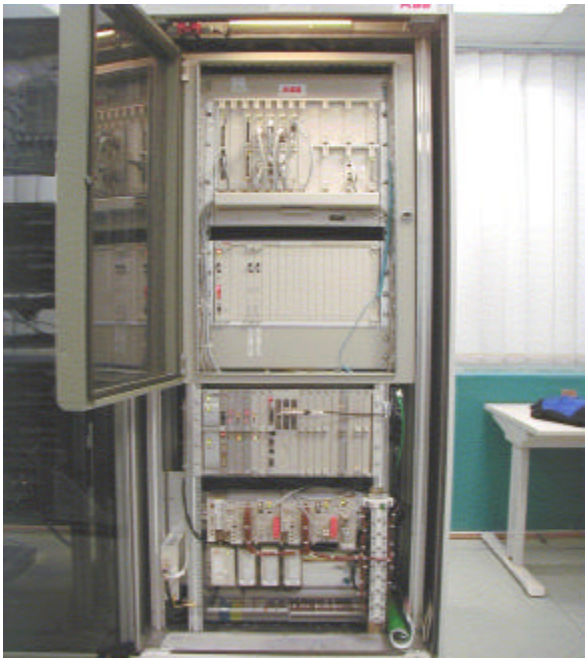
The equipment bus is an MB300 master bus system which has been made redundant with a view to higher availability. Participants are connected via two star couplers (for redundancy), executed in 19-inch technology. Participants are the active components of the “Advant” control system, such as operator stations, information management stations and computers.

The exchange of information between all subordinate units is made on Ethernet basis via TCP/IP by twisted-pair cable (category 5). Those units, such as servers and client PCs are divided into sub-networks according to tasks and security aspects.

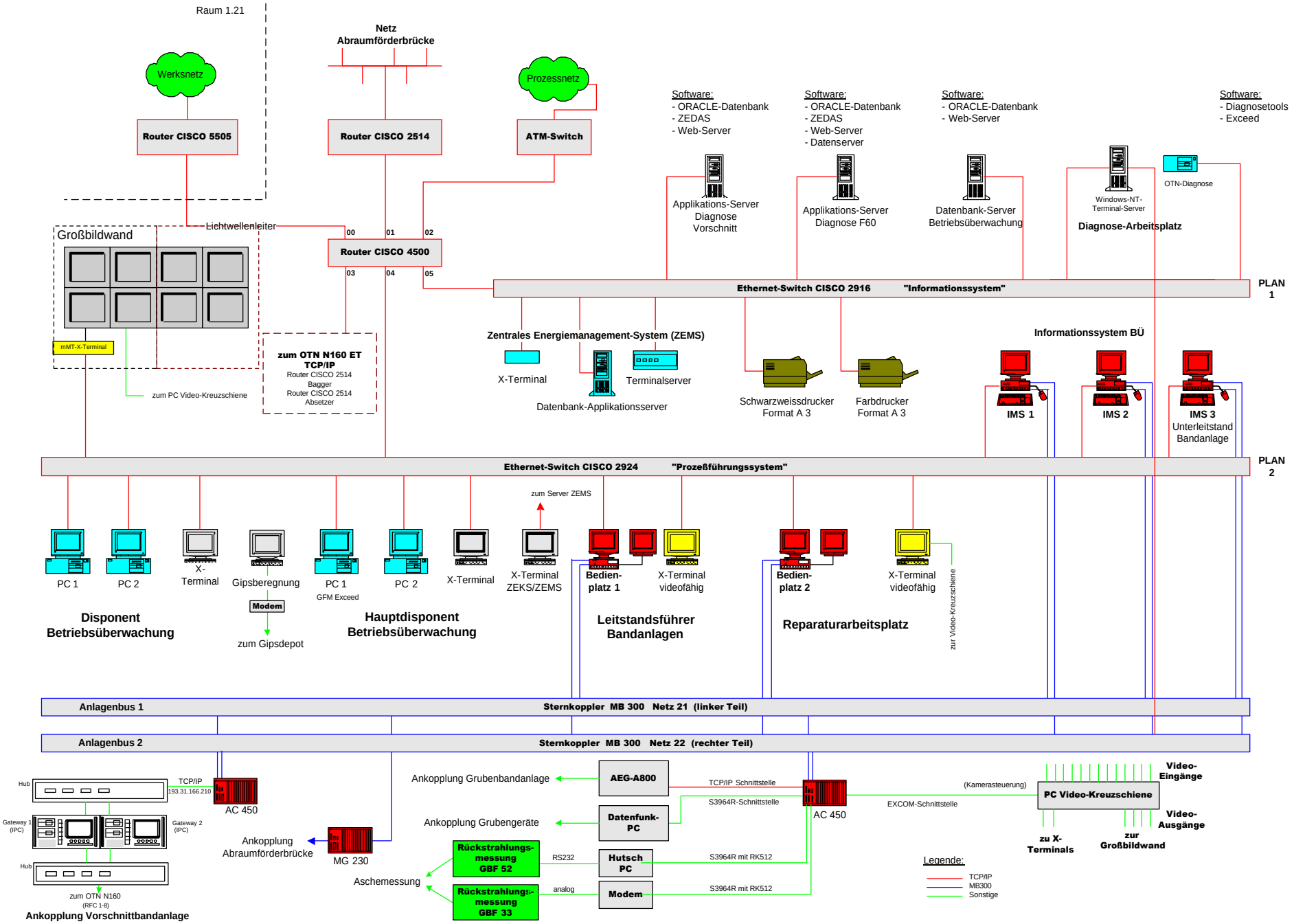
3. Conveyor Control

The CI546 multi-vendor interface of ABB supports TCP/IP and UDP and has therefore been chosen for coupling the entire coal and pre-cut conveyor system with the AC450.

The drive stations of the coal conveyor line are equipped with A800 controllers, those of the pre-cut conveyor line with remote-field controllers (RFC). The connection with the A800 head-station control is made by a WIN 3.11 IPC integrated into the system that on its part exchanges data with the PLC system via a dual-port RAM.



A redundant gateway CPC with the WIN-NT4.0 operating system couples the decentralised RFC of the pre-cut conveyor line with the AC450 Advant controller. The OPC server of that gateway communicates with the decentralised RFC clients of the drive stations and the OPC client of the CI546 TCP/IP interface in the AC450.

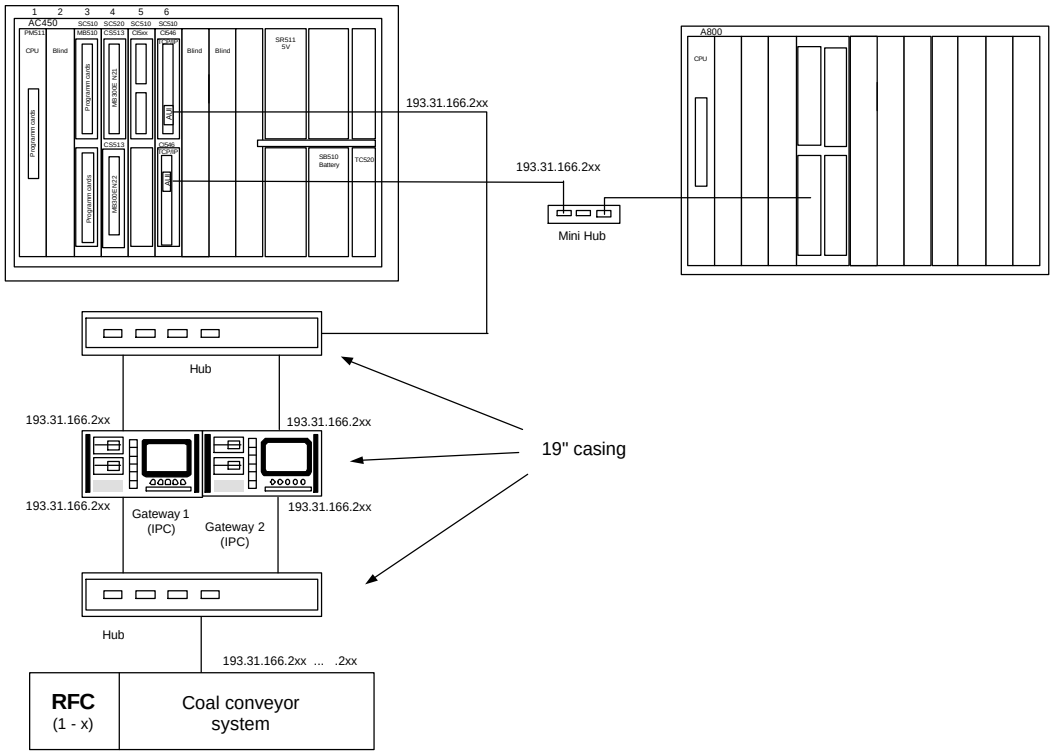

Raum 1.21
Netz
Abraumförderbrücke
Werksnetz
Prozessnetz
Router CISCO 5505
Router CISCO 2514
ATM-Switch
Software:
- ORACLE-Datenbank
- ZEDAS
- Web-Server
Software:
- ORACLE-Datenbank
- ZEDAS
- Web-Server
- Datenserver
Software:
- ORACLE-Datenbank
- Web-Server
Software:
- Diagnosetools
- Exceed
Applikations-Server
Diagnose
Vorschnitt
Applikations-Server
Diagnose F60
Datenbank-Server
Betriebsüberwachung
Windows-NT-
Terminal-Server
Diagnose-Arbeitsplatz
OTN-Diagnose
Lichtwellenleiter
Großbildwand
mMT-X-Terminal
zum PC Video-Kreuzschiene
00
01
02
03
04
05
Router CISCO 4500
zum OTN N160 ET
TCP/IP
Router CISCO 2514
Bagger
Router CISCO 2514
Absetzer
Ethernet-Switch CISCO 2916 "Informationssystem"
PLAN
1
Zentrales Energiemanagement-System (ZEMS)
X-Terminal
Terminalserver
Datenbank-Applikationsserver
Schwarzweissdrucker
Format A 3
Farbdrucker
Format A 3
Informationssystem BÜ
IMS 1
IMS 2
IMS 3
Unterleitstand
Bandanlage
Ethernet-Switch CISCO 2924 "Prozeßführungssystem"
PLAN
2
zum Server ZEMS
PC 1
PC 2
X-
Terminal
Gipsberegnung
Modem
zum Gipsdepot
PC 1
GFM Exceed
PC 2
X-Terminal
X-Terminal
ZEKS/ZEMS
Bedien-
platz 1
X-Terminal
videofähig
Bedien-
platz 2
X-Terminal
videofähig
zur Video-Kreuzschiene
Disponent
Betriebsüberwachung
Hauptdisponent
Betriebsüberwachung
Leitstandsführer
Bandanlagen
Reparaturarbeitsplatz
Anlagenbus 1
Sternkoppler MB 300 Netz 21 (linker Teil)
Anlagenbus 2
Sternkoppler MB 300 Netz 22 (rechter Teil)
Hub
TCP/IP
193.31.166.210
AC 450
Gateway 1
(IPC)
Gateway 2
(IPC)
Hub
zum OTN N160
(RFC 1-8)
Ankopplung Vorschnittbandanlage
Ankopplung
Abraumförderbrücke
MG 230
Aschemessung
Ankopplung Grubenbandanlage
AEG-A800
TCP/IP Schnittstelle
Ankopplung Grubengeräte
Datenfunk-
PC
S3964R-Schnittstelle
Rückstrahlungs-
messung
GBF 52
RS232
Hutsch
PC
S3964R mit RK512
Rückstrahlungs-
messung
GBF 33
analog
Modem
S3964R mit RK512
AC 450
EXCOM-Schnittstelle
(Kamerasteuerung)
PC Video-Kreuzschiene
Video-
Eingänge
Video-
Ausgänge
zu X-
Terminals
zur
Großbildwand
Legende:
TCP/IP
MB300
Sonstige

The gateway PC behaves like a fully transparent protocol converter. The Ethernet network is connected to the gateway CPC by the OTN communication network. The distances to be bridged are up to 12 kilometres.

For the pre-cut conveyor line 2000 integer words are passed on in the reception protocol and 600 integer words in the transmission protocol. The total cycle time from initiating the command in the operator station to the response is on average 800 milliseconds.

Later in the year 2000 the A800 drive control systems will be replaced by RFC, starting with drive station 36. The control concept of the coal conveyor system will then be adapted step by step to the one of the pre-cut conveyor system.

The hardware configuration of the TCP/IP coupling is shown below:



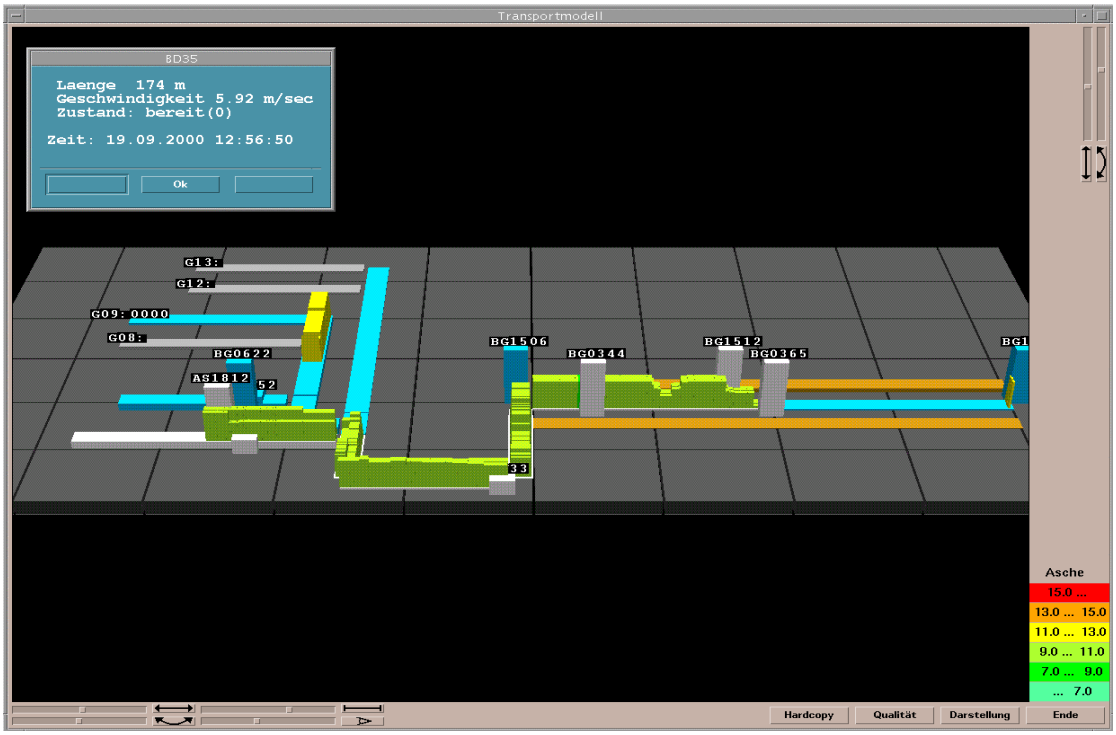
4. Coal-Quality Management

The quality management system plays a major role for the delivery of coal to the power stations to be supplied in conformity with existing contracts. The determining components of that system are a seam model, a transport model and a bunker model. The required process data are gathered on the mining machines and transmitted by data radio to the central control station.

4.1 Seam Model

The seam data (horizons and their thickness, ash and sulphur content) are collected at a workplace specially assigned to that purpose. The model thus established is updated monthly and fed online into the control system. This creates the conditions for quality calculations for every train, determining the ash and sulphur content of the coal on the basis of the location and performance of the excavators.

4.2 Transport Model



The transport model permits continuous tracking in space and time of the coal flow and its quality data on the conveyor lines from the mining machines or the bunker.

In addition to the integrated dynamic visualisation the model provides, at the same time, input data for stacking, reclaiming and loading on trains. Furthermore, a running-time prognostication for mass packages – when do certain packages with specific characteristics reach a point where corrective action is possible (mass divider, bunker, …) is a supporting tool for operative equipment control.

By means of the measuring systems on the excavators it is possible to determine the quantity of coal extracted as well as its ash content. Another average ash value is established for comparison on the basis of the points where the coal gets on the conveyors and the speed of the belt. An ash-measuring device at the collective conveyor attributes that value to a specific train.

In the Jaenschwalde mine the mass flow can be divided. When this is done it is necessary to consider the measuring points in the trench bunker. A belt scale measures how much of the transported coal is sent to the bunker.

4.3 Trench Bunker Model

The trench-bunker model is closely connected to the transport model by a direct input-output interface. Operational data, such as the operating conditions of the mining machines, their instant performance and the location of the stacking and reclaiming points, are used to describe the stacking and reclaiming process. The model uses an algorithm mix similar to the one described for the seam and transport models.

5. Diagnostics Workplace

A diagnostics workplace provided in the new central control station serves for operative diagnostic checks by means of monitoring the behaviour of individual electrical components. This is an important help for preventive maintenance.

The tools, specifically selected for each machine type, include

- Advant Function Chart Builder — Diagnosis of ABB Advant AC 450
- Network Control Center (NCC) — Diagnosis of the OTN system
- DIGSI — Diagnosis of protective devices on medium-voltage switchgear
- PC-Worx — Diagnosis of Interbus S
- SIMOVIS — Diagnosis of inverters
- VIBRONET — Vibration monitoring
- ELCAD View — Navigation in the equipment documentation (single-line diagrams)

The information supplied by the ABB control system in the form of
- alarm lists
- event logs
- system lists
- system status reports
- status records

is also used for diagnostic purposes.

The diagnostics workplace is the integrating platform for all those tools and unites all software modules and communication interfaces required for maintenance and trouble-shooting. The workplace is open for remote access over the network.

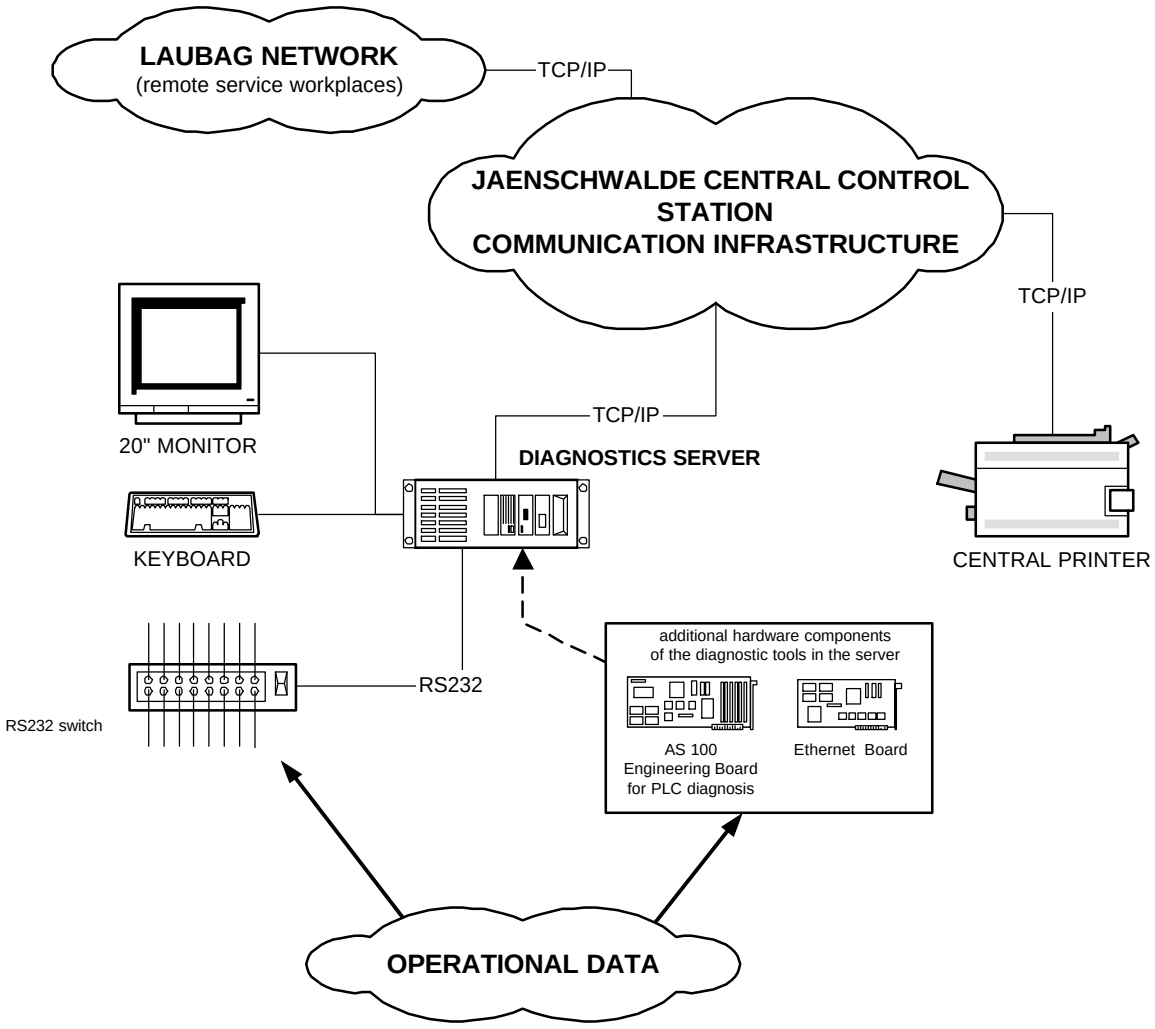
5.1 Equipment

The diagnostics workplace is equipped with a powerful industrial PC working on the terminal-server edition of Windows NT 4.0 and a Citrix Metaframe. The monitor and the keyboard are set up on one desk.

An RS232 switch is used for making the necessary RS232 connections. Up to 32 such connections are possible. The selection of the RS232 connection required for a specific diagnostic tools is made by the software.
Print-outs can be made on the printer installed in the central control station.

5.2 Software

A menu system is used to facilitate the start-up of individual programmes and help orientation. The different applications can be chosen and started by an index. Additional activities that may become necessary, such as software-based switching of an RS232 channel, are performed automatically.
The client software of the Metaframe system (ICA protocol) and the TCP/IP network connection make the workplace accessible for remote control.



Set-up of the diagnostics workplace

ABB Process Industries GmbH
Open-pit Mining
Gaglower Straße 17/18
03048 Cottbus
GERMANY
Phone: +49 (0) 355 596-225
Fax: +49 (0) 355 596-832
E-Mail: cottbus.deasy@de.abb.com
www.abb.com/mining