Measuring power production

Information from Systems Automation and Management

Power utility companies need to accurately measure the power produced and used by their power stations on a 24/7 basis. The energy metering and data acquisition system (Emdas) has been a standard for Eskom over the past 15 years, and was recently redeveloped using the latest technology available.

Based on System Automation and Management's knowledge and experience in system integration of Emdas metering schemes, as well as many third party products and applications, the control system was seamlessly engineered and commissioned according to the end user's specifications.

The control solution consists of the following:

Emdas metering scheme for the counting of the active and reactive energy pulses for the metering panels; real time storage of input signal data for projection of hourly energy data; hourly storage of input signal data for historical storage; user-defined signal calculation (e.g. summation, subtraction, multiplication, square root extraction, etc.) can be used for group totals and energy losses etc.; comparison between main and check meters with alarm logging; scheduled FTP transfer of power station energy to national control centre; web-based user interface for accessing energy data reports; audit logging of all signal or configuration changes made, and user access level control.

The standard Emdas metering panel consists of dual independent Emdas systems; pulse counting input modules are standard 192 inputs expandable on request to accommodate energy pulses with software pulse filtering and de-bounce to count the 80 ms energy pulses;

digital output module used for system cross-checking, and alarm generation to station distributed control systems (DCS).

All data is stored within the step 7 programmable logic controller (PLC) card with 24-hour rollover registers for hourly energy data backup that can be reloaded in case of communication failure – operating completely independently from the PC data server. The Dot Net based Emdas server software running on the PC continuously monitors energy data on the controller storing current and hourly values into the Microsoft SQL database. Automated FTP file transfer of hourly values is generated and transmitted on the Eskom local area network (LAN) to the national control server.

Automated data verification by software and hardware hand-shaking and data comparison between the two Emdas systems continually verifies data and system integrity between main and check energy meters and the Emdas 1 and 2 data generating system. Audit and alarm data logs into the SQL server database, with hard-wired alarms provided to the DCS / station SCADA.

Hourly and daily energy reports can be viewed and printed. Data storage is only limited by hard disk space and is therefore basically unlimited.

Hard wiring of the input energy pulses is based

on a centralised connection to metering panels by UVG cables.

Remote users gain access to the web server via the Eskom LAN.

Data capturing overview

Energy measurement is done in the field by off-the-shelf energy meters providing field indication and storage of values. Pulse outputs are used to provide real time data for the PLC. The width of the pulses in the pulse train are continuously monitored, filtering out unwanted noise. Data is stored in the current hour data block and rolled over on a hourly basis into the 24 hour data blocks. Time syncing is achieved through a NTP time server set up on the Emdas server PC.

Emdas server time sync is done to the station NTP server. There is a continuous upload of the current hour data from the PLC into the database. Hourly data is uploaded and stored for historical purposes. User-defined calculations are done and results stored with the hourly data.

System errors (e.g. power failure, program failure etc.) and main check comparison errors are logged into the database. An audit log is kept of scheduled tasks run successfully and alarms logged when necessary.
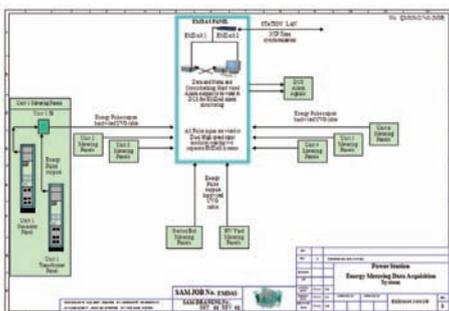

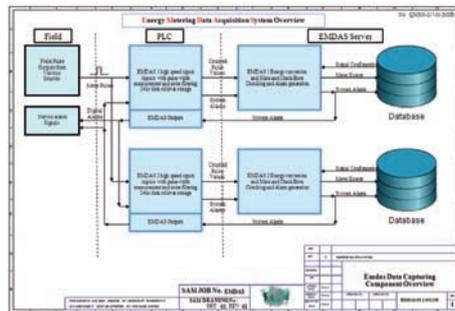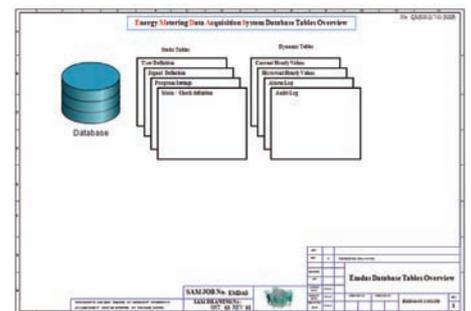*Fig. 1: Power station energy metering data acquisition system.*

Fig. 2: Data capturing component overview.

Fig. 3: Database tables overview.

Fig. 4: User interface overview.

Fig. 5: Hourly report.

Fig. 6: Technology options.

Database table overview

The database can be broken up into two subsections: static and dynamic tables. Table relations are set up to link signal configuration to the stored data and users to signal or configuration edits done during operation.

User interface overview

A web server provides the user interface to the Emdas data. Access control is done on all users. Standard reports consist of six pages that can be configured and grouped.

Reports available from the web interface are hourly reports for the current hour, last hour and historical hour and date selected; daily reports for the current day (values for the current day for all completed hourly periods), the last hour (values for the previous day) and historical (historical values for the day selected by the date controls).

For administrative purposes, the web interface also allows an administrative user to control access to the Emdas web interface through user account management.

An administrator user may also view a detailed report of all SQL queries and data transactions carried out on the SQL database, including user name, date and time and client machine name.

In the case of problems with the system values or the system faults there is an alarm indication on the screen. Hard wired alarm is also sent to the DCS. The alarm may be acknowledged but can only be cleared when the fault is corrected and an action taken has been logged.

Technology options

Technology advances over the past years have now provided energy metering equipment with Ethernet communications. The Emdas system can now be provided at a reduced cost with the same reliability.

Advantages

Reduced cabling: single Ethernet communication cable replaces multiple pulse signals.

Reduced hardware: no high speed pulse capturing modules are required. A dual Emdas server can be replaced with a single server as data is already duplicated in the field by the main and check meter configuration. Meters also have the built-in capability of storing more than 100 days of data arranged into hourly load profile data blocks.

Disadvantages

The Ethernet network gives rise to a single point of failure. However the risk can be reduced by splitting the main and check networks and using ring network configuration.

Real time data capturing is not possible as data uploads from the meters currently takes more than 2 s. However by prioritising, critical station data can be uploaded in reduced time frames.

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