Automatic power managing and monitoring system applying for underground mines in Vinacomin

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Abstract-

In the situation of energy deficiency, the management of the economical and efficient power utilization plays an important role in the national energy policies and has been considered as an essential requirement for the coal production enterprises, especially in the underground ones. The report represents the features of the automatic power managing and monitoring system at Ha Lam Coal Company and the potentiality of its application to other underground mines in Vinacomin.

Keywords-

Management, monitoring, system, underground mine, automatic, energy efficiency, power, energy saving, Vinacomin.

Introduction

Electricity supply system has been playing an important role for stable production activities in mining industry. Due to the complicated conditions as well as the strict requirements to the flame and explosion-proof safety in hazardous environment, the power supply system of the underground mines is shown in Figure 1.1.

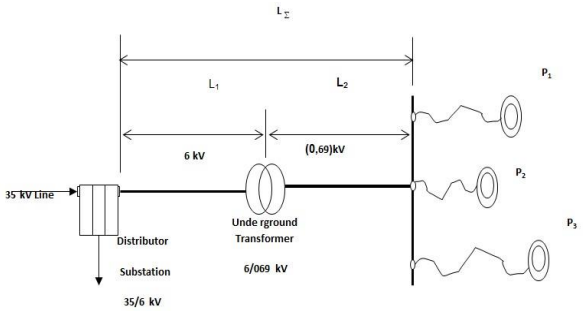

Figure 1.1. Principle diagram of the electric supply system in underground mine

In order to deal with the demand of power monitoring and its management which would help to improve management efficiency as well as reducing breakdown times related to the increase energy consumption performance. The author would like to describe the design and application results of automatic power monitoring and managing system implemented in underground mines belonging to Vinacomin.

System Description

Centralized power monitoring and managing system had been designed with the target for the collecting and storing the measured signals to the Dispatch center. From this data, the operators could have the comprehensive assessments following real-time parameters such as: Current, voltage, power quality, power factor, capacity, efficiency as well as monthly bill. The electric management system comprises four parts (Figure 1.2):

1) Management Software with convenient user interface. It is the electricity monitoring and control center.
2) Smart Collector to connect with the PC via optical fiber. It collects data directly or indirectly from the smart terminals and send the center's instruction and settings to the smart terminals.
3) Smart Terminals: The smart terminals are sensor sockets integrated with repeater function. Each smart terminal can establish a star network with itself.
4) Measurement instruments: Measure real-time parameters such as current, voltage, power quality, power factor, capacity etc. The measurement instruments be able to connect each other following RS-485 Modbus.

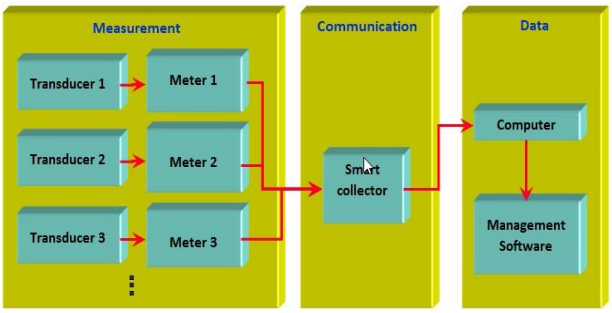

Figure 1.2. The monitoring system diagram

The monitoring network can be established, modified or expanded freely and easily by just adding or removing Smart Terminals. The system has functions as following:

- The system can be developed to manage the cluster monitoring devices in which could monitor the power consumption progress of the machines in the workshops; therefor, the faults can be infected on-time following the alarms in correspondence that the operators have the timely intervention.
- Storing and analysis the active parameters on the system software that can be drawn again on which the operator command. In addition, the software could give the forecasts relating the overload, the faults as well as the demand of consumption power.
- Analyzing electric quality based on the criterion such as: voltage, harmonics or frequency. Besides, the system would assess supply source quality.
- Monthly automatic power consumption reports and bills that represent as printout graphs, charts or tables.

The Application Of System In Ha Lam Underground Coal Mine

Centralized power monitoring and managing system applying in Ha Lam underground Coal Mine had been designed to respond the scale as well as production characters which has the ability to monitor energy consumption all machines not only in underground but also in mine surface as following:

- Measurement the characteristic activities of machines in underground: The three-phase power meter manufactured in flame-proof structure for measurement purposing the local transformers supplying electricity to power consumption loads in the workshops. The meters have communicated via the protocol of Modbus RS-485. Additionally, the data from these meters had been transmitted to master computer via the connected optical fibers between the smart terminals and the smart collector. (Figure 1.3)
- Measurement the performed characteristic of machines at the surface: The digital panel meters manufactured in flame-proof structure according to IP-54 standard for measurement purposing the local transformers supplying electricity to power consumption loads in workshops. The meters have communicated via the protocol of Modbus RS-485. And the data from these meters had been transmitted to master computer by GPRS package transmitter. (Figure 1.4)
- The master computer: The master computer in which setup the software that can collect the integrated data both in underground and at the surface.

Figure 1.3. The flame-proof meter used in underground

Figure 1.4. The meter used at the mine's surface

Table 1. Technical specifications of the measurement meters

Type of electrical system	3-phase with or without neutral wire
Accuracy	±(1,5%FS+1DGT) ±(0,5%FS+1DGT)
Rated input current	5 A
Rated input voltage	660 V
Measurement method	TRMS type
Current transformer	Prog.ratio from 1 to 999
Voltage transformer	Prog.ratio from 1 to 99.9
Serial port RS-485	2 or 4 wirings
Comm.protocol	Modbus/Jbus
Baud rate	9600 baud
Frequency	±0,1 HZ (48 ÷ 62 HZ)
Harmony	±3%FS.

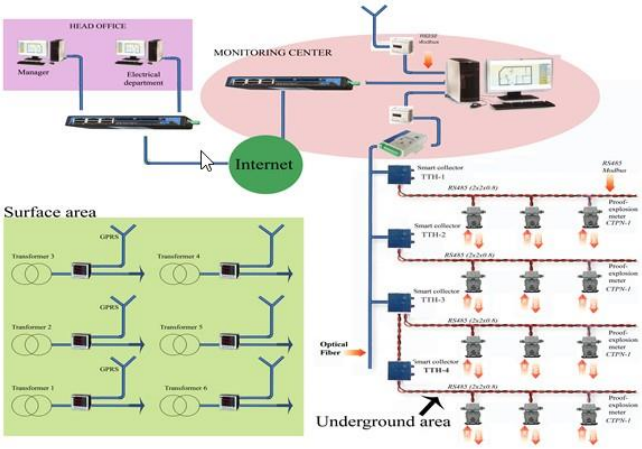

Figure 1.5. The structure of electrical management and monitoring system in Ha Lam Coal mine

The flowchart of centralized power monitoring and managing system applying in Ha Lam underground mine is shown in figure 1.6:

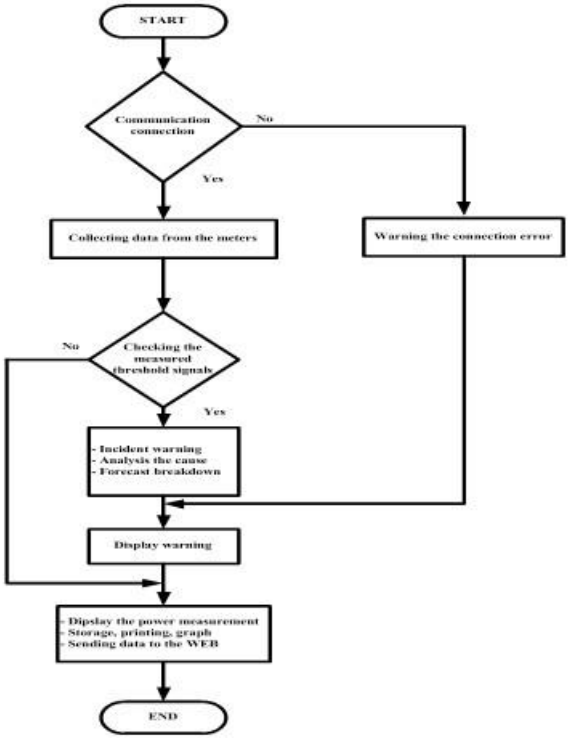

Figure 1.6. The flowchart of centralized power monitoring and managing system applied in Ha Lam underground Coal Mine

The Results And Discussions

The collected data have been drawn as graph containing 3-phase voltage, current and power consumption that generate to real-time. At the period of abnormal time that represents such as: over-voltage, low-voltage or overload, the operators can zoom in or zoom out to determine the detailed irregular intervals.

Figure 1.7. The graph of the real-time parameters

Besides, the system also has evaluated continuously the consumption power as well as machine operating hours. From this assessment, the managers would have reasonable operating load adjustments changing from rush hours to off-peak hours which decrease the energy consumption as well as energy expense.

Figure 1.8. The diagram of the power consumption

Last but not least, the system will alert the faults, breakdown to the operator in the form of sound or display on screen; thus, they could detect to deal with these problems correctly and timely.

Conclusion

Centralized power monitoring and managing system applied in underground mines has been implemented in accordance with the actual problem of coal production so that having useful features for managing the power consumption. Additionally, the system is an effective tool for the logical exploitation organization as well as the typical solution for appropriate energy management.

References

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