COMPUTER-BASED MONITORING AND REMOTE CONTROLLING FOR OIL WELL PUMPS USING SCADA

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ABSTRACT

The research aims to change manually the monitoring and controlling of oil well pumps into a computer-based system using SCADA (Supervisory and Data Acquisition) system. To design the protection system which consists of controller unit and display system, RTU (Remote Terminal Unit) and MTU (Master Terminal Unit) are used. The research results in a controller unit which is able to communicate to personal computer using RS-232 C and an alarm system to protect oil pump motors by detecting sensors installed at the pumps.

***Keywords**: monitoring and controlling, oil pumps, Remote Terminal Unit (RTU), Master Terminal Unit (MTU), SCADA, sensor detecting*

ABSTRAK

Penelitian ini bertujuan untuk mengubah secara manual pemantauan dan pengontrolan pompa sumur minyak ke sistem berbasis komputer menggunakan sistem SCADA (Supervisory Akuisisi dan Data). Untuk merancang sistem perlindungan yang terdiri dari unit pengontrol dan sistem tampilan, digunakan RTU (Remote Terminal Unit) dan MTU (Master Terminal Unit). Penelitian ini menghasilkan sebuah unit pengontrol yang mampu berkomunikasi dengan komputer PC menggunakan RS-232 C dan sistem alarm untuk melindungi mesin pompa minyak dengan mendeteksi sensor yang dipasang di pompa.

***Kata kunci:** pemantauan dan pengontrolan, pompa minyak, Remote Terminal Unit (RTU), Master Terminal Unit (MTU), SCADA, deteksi sensor.*

INTRODUCTION

Oil well pumps in Cilacap Jawa Tengah is located at unreachable places. Meanwhile, the physical values of them are needed to protect from damage. Therefore, a remote system in necessarily needed to monitor and control the oil pumps.

A SCADA system (Supervisory Control And Data Acquisition) is designed and implemented in this research. The system makes acquisition of the data parameter of the motors. Then, the measured values will be sent to the display system. This system is an upgrade from the old manual system.

Some of the data parameters are also connected to an alarm system. If there are not any normal values that are able to be detected soon, the motors will be protected against damage. The new system uses a PLC (Programmable Logic Controller) instead of relays and timers. It is a compact system as there are many switches on the system to control particular programs.

METHOD

This research uses the following methods: (1) field study by conducting direct surveys to an oil well pump location in Cilacap, Jawa Tengah, and interviewing the site engineers to discover how the available system works and define the problems; (2) literature study about SCADA RTU and MTU; (3) design and prototype implementation; (4) prototype testing.

RESULTS AND DISCUSSION

SCADA RTU requires: (1) enough capacity for the designed system; (2) rigid construction; (3) reliable power supply; (4) communication port availability; (5) NVRAM for storing the designed firmware; (6) real time clock; (7) watch dog timer to detect the malfunction of RTU devices.

Meanwhile the SCADA MTU requires: (1) flexible and good responses to sensors; (2) 24 hour- working period; (3) detail displayed information; (4) readiness for development; (5) reliable alarm system.

Design and Implementation

Remote oil pumps are monitored from the central station using radio system and SCADA. The protection circuit consists of a controller unit and a display system connected by cables. The control system is connected to a personal computer using standard interface RS 232 C.

The protection system monitors and displays the following values: (1) current electrical phase; (2) starting time and current time; (3) electrical phase voltage; (4) unbalance condition of electrical voltage and current condition of electrical voltage; (5) power supply; (6) output relay states; (7) electrical power; (8) average electrical current phase and average electrical current voltage; (9) electrical frequency; (10) electrical phase rotation; (11) control switch states; (12) input switch pressure; (13) power factor.

Some motor parameters connected to the alarm system are: (1) lacking and overload motors; (2) current electrical unbalance state and current electrical voltage; (3) pressure switches; (4) over and under voltage; (5) low power factor. There are three output relays needed to control the system: (1) main contactor; (2) red lamp, which is used for alarm status. It can be programmed to control the SCADA system (Figure 1) directly; (3) yellow lamp, which is used for restart state. It can also be programmed to control SCADA system, especially to operate the test valve.

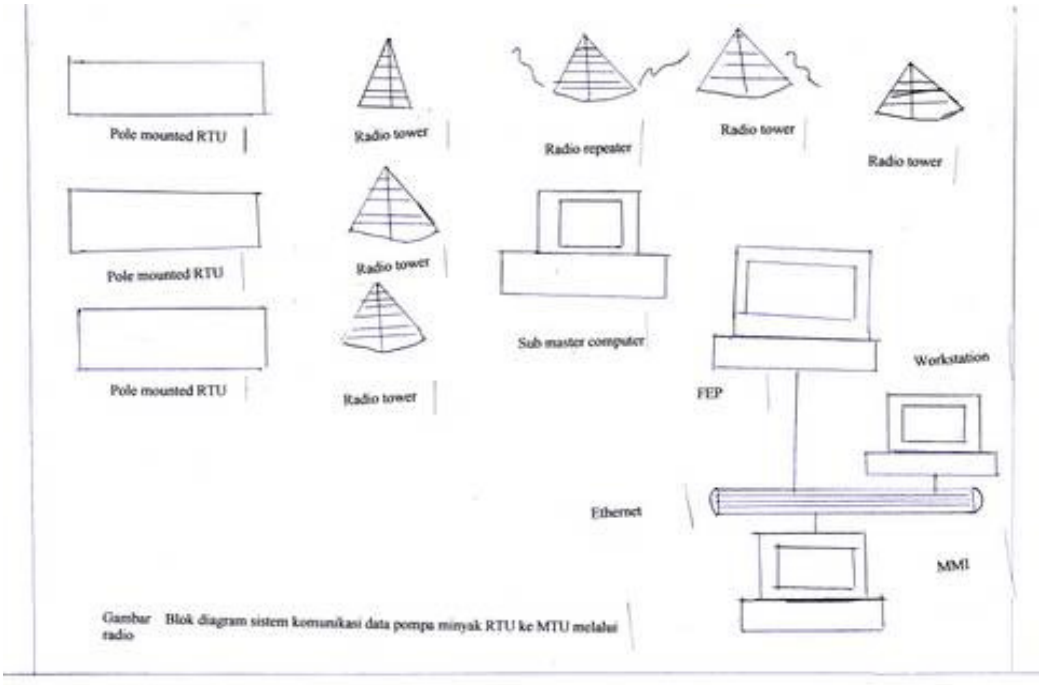

Figure 1. SCADA system.

The Protection Motor Functions

Here are several functions of the protection motor: (1) to make possible the "hand off automatic control" operation that can restart the system automatically. This operation makes possible from manual operation to automatic one without stopping the motors; (2) to display how many times the motors restart, to keep the normal restart amount and alarm controlling the starting timer; (3) to be able to receive sent data from operator and other locations of the oil pumps; (4) to have real time operation; (5) to give information about "setup procedures". It gives information about work procedures for operators as device information suggestion before "start up"; (6) to give statistical data about oil pumps' motors and alarm information, sent to the display system. The used computers can be maintained locally and also its databases. The computer program enables the operator to read all data from motor protection system. It can also be used to draw a graph, read and change the "setpoints". The program is able to transfer database files from-and-to the controller unit. The file is stored in SCADA central computer system and can be printed on a printer.

Remote Terminal Unit (RTU)

The motor protection has a communication line that can be used together by radio modem or by computer. There are data of switches. The switches work automatically as the serial cable is connected. If it is not connected, the communication occurs between radio modems.

Master Terminal Unit (MTU)

This unit is a desktop computer used as “man-machine interface”. The SCADA program is used to trace the highly prioritized oil well pumps. The information needed can be obtained by request. The data from well oil pumps are withdrawn once a day and are stored in the SQL server to be analyzed in the future. The program also enables remote operation from all devices to be controlled by the central station.

The control system can access a printer when an alarm occurs, with the following information: (1) time when it happened; (2) in-trouble device name; (3) current states of motors; (4) indication – it informs what happened during alarm occurs, and when the current condition is back to normal.

On the screen the MMI (Man Machine Interface) program displays the main map of oil wells, view of the wells and remote control function in detail, set points, occurred alarm and communication diagnostic.

Pole-mounted RTU has the following functions: (1) to give responses when a state change happens on the incoming data; (2) to do remote controlling; (3) to do self diagnostic; (4) to have real time clock setting.

Pole-mounted RTU will send signals via radio modem. These signals are received by sub master computer. Signals via radio can be received remotely by FEP (Front End Processors). This is one of the workstations of the Ethernet computer network. The other workstation is also connected on the network works as MMI (Man Machine Interface).

CONCLUSION

A system for detecting and monitoring oil well pumps is designed for oil pump well in Cilacap, Central Java, using SCADA. Its RTU is used to detect the states of electrical oil pumps, and functions as actuators in the telemetry system. RTU can be connected via modem to radio, and its signals can be received remotely by FEP and a personal computer as the Man Machine Interface (MMI). The states of motors and the system is able to be controlled remotely.

REFERENCE

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