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Energy Management System using PLC and SCADA

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***Abstract* — This paper presents the load control in the industry during peak hours by using PLC and monitors all load parameters of the motors on PC by using SCADA. The Energy management is the highest demand of the organizations to reduce their energy cost.Conform to the regulatory requirements and improve their corporate image. The automation used in the industries has several benefits. To accomplish the automation in the industry we have knowledge of PLC and SCADA. PLC is a programmable logic controller which controls the load or machines in industry.PLC programming is done by using ladder logic. The overall automation of the industry is controlled by SCADA software. SCADA define as a centralized system that control and monitor the whole sites. SCADA is used for collecting the data from various sensors or machines and then monitor the proper functioning of the machines. Automation will make the industry safe, cheap, highly efficient and maintained free.**

Keywords: PLC, SCADA, Energy saving earning and productivity.

I. INTRODUCTION

Energy management main goal to produce the goods with the minimum cost and the effect on the environment also reduces. Energy management defines that the effective amount of energy used so that profit increases and cost decreases. It also means that adjusting the energy used by the system and procedures so that energy requirement per unit output reduces while reducing the total cost of the producing output from these systems. In today's fast moving, highly competitive world, a company must be cost effective, efficient and flexible if it wishes to survive. Automation is defined as a control system and technologies which reduces the human work in the production field. Automation control system is that system which controls the process automatically and reduces the human mentor and mental requirement. Automation system has ability to initiate, adjust the process automatically and stop the process when desired output obtained. In the industry automation is the important way to decreases the costs or increases the production. The main objectives of the automation control system used in the industry are following

1. Control production cost.
2. Improve quality of the products.
3. Increase productivity.

After the introduction section the paper is organized as follows: Section II deals with PLC and SCADA Section III describes the problem; Section IV presents a methodology; Section V gives results; section deals with the conclusion.

II. PLC and SCADA

a. PLC

PLC is a device which is designed to perform the logic functions. In the past times these functions are accomplished by relays, timers etc. These are bulky systems, chances of errors are more and if the fault occurring in these systems then its more time consuming to find the fault in these systems. This problem is overcome by PLC. PLC stands for programmable logic controller. RICHARD E. MORLEY invented the first PLC in 1969. The PLC programming procedure replaced a wiring of the relays, timers etc. The PLC programming is written in high level language, which is easier for understandable of the more people. Any machine can be controlled automatically by use of PLC. For automatic control of machines the firstly make the program in the software according to the working process of the machine, then transfer the program to the PLC and after that connect the PLC to the machine. A single PLC can run many machines at same time if their working procedure is same. The PLC has capability for handling several inputs and outputs signal.

b. SCADA

SCADA define as supervisory control and data Acquisition. The main function of the SCADA system is the collection of data and control at the supervisory level. There are different types of software for SCADA system; some are used for the data acquisition and not for control. Supervisory control system is a system which is provided to control the process that is external to the SCADA system. This means that the system is not control the process in a real time but there is a separate automated control system that responds quickly to compensate for process changes with constant time of the process. SCADA system is a branch of instrumentation engineering, which consist of input output signal hardware, controllers, Human machine interface ("HMI"), networks, databases, communications and software. SCADA usually refers to centralized system which monitors and controls the entire process, or complexes process which spread over large scale. Most of the control actions are performed automatically by remote terminal units or by programmable logic controllers. For example, a PLC may control the flow

of cooling water through part of process, but SCADA system may allow the person to change the set points for flow such as high temperature and loss of flow, to be displayed and recorded.

III. PROBLEM FORMULATION

The literature review reveals that researches faced difficulty automating electrical system in the industry using conventional methods like manual supervision, hardwired control etc. Because in manual supervision of the equipment required a supervisor to control the equipment manually. In manually supervision the chances of errors are more. Furthermore hardwired systems were too bulky to be designed or redesigned. In the present work research work, these difficulties overcome by using PLC and SCADA. In industries major problems are load control in the industry during peak hours. Punjab electricity board mentions that overall plant load less than 60% of the specified load during peak hours for every industry. Every industry has a different peak hour which varies according to the seasons. If the industry load above 60% of the specified load during peak hours then the industry suffering from penalty charges. Another problem in the industries is poor efficiency system. Main objective of the work

1. Automatic load control in the industry during peak hours.
2. Automatically monitoring all the load parameters of the machines on PC.
3. Automatic work leads to the reduction in time for operation.
4. Reduction in chances of errors caused by manually operation.

IV. METHODOLOGY

1. Load control during peak hours has been done by two approaches i.e. hardware and software approaches.
(a) Approach: In this approach, a hardware circuit is fabricated in order to provide automatic load control. It includes installation of MCB, SMPS, PLC, Relays.
(b) Software Approach: The programming of the PLC is done on the software named Unity pro XL
2. Monitoring all the load parameters of the machines on PC has been done by two approaches i.e. hardware and software approaches.
(a) Hardware Approach: It includes installation of Energy meter, Gateway, Ethernet switch, computer.
(b) Software Approach: Monitoring of all load parameters is done on the software named vijeo citect 7.2 version.
3. Programming in the SCADA software vijeo citect 7.2 version helps to store all the load parameters of the motors. We can check any previous load data of any motor at any time.

LOAD CONTROL IN THE INDUSTRY

The load can be controlled using PLC when overall industry load is greater than or equal to specified load during peak hours. Punjab electricity board mention the peak hours for every industry. Every industry has different peak hours. Every industry takes the permission of load from electricity board as per requirement of the industry load during peak hours. When the industries load greater than or equal to specify load during peak hours then the PLC automatically shutdown the equipments which are connected to the PLC according to the program stored in the PLC. PLC used for control the load is M340. The Software used for M340 PLC is Unity Pro XL. Equipments for load control in the industries during peak hours is PLC PLC M340, SMPS, Indicators, MCB, Relays. Equipments for energy monitoring with SCADA is Energy Meter, Gateway, Ethernet switch, Ethernet cable, SMPS, Server station, Client station

a. *Simulation:*

we have studied the different types of PLC. After that we decided to use the M340PLC. All the working is done according to ladder diagram. The main features of M340 PLC are that online and offline modification can be done.

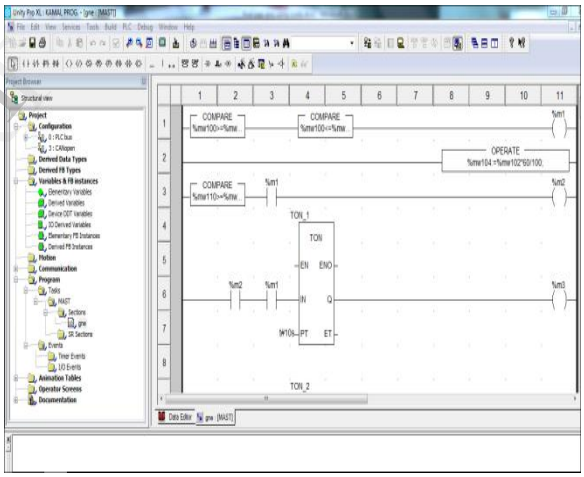


Fig (a) PLC programming for load control

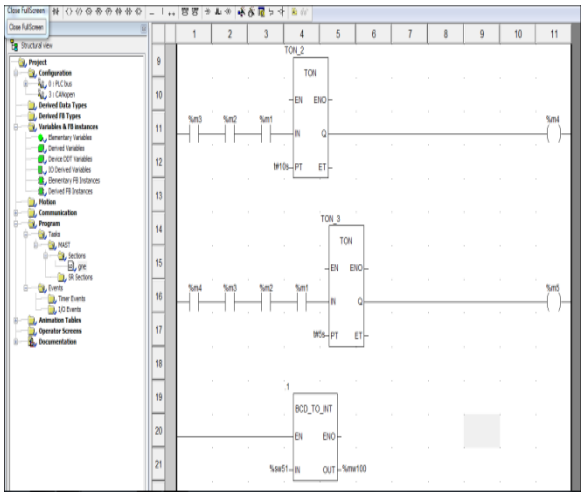


Fig (b) PLC programming for load control

Elementary variables

Elementary variables used for defining the address for each input/output.

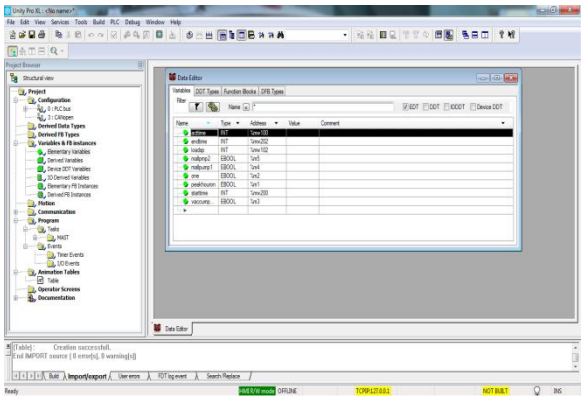


Fig (c) Table of elementary variables

Animation table

Animation table shows the actual parameters of the load. In the animation table must be put the value of start time, end time and specified load.

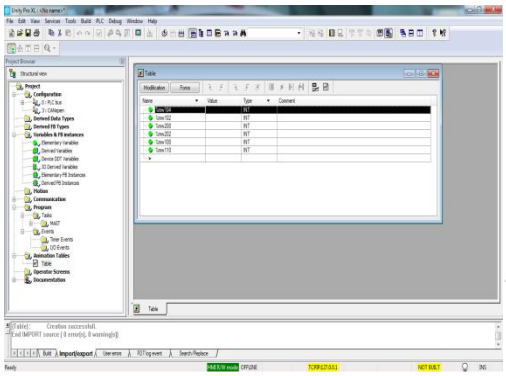


Fig (d) Animation table

b. *SCADA software*

Vijeo citect software monitors, supervises and control processes for a variety of industries in the world. This software can be used to build from simplest supervisory control and data acquisition system to highly distributed architectures. The application of changes during production will be more rapid via server-side online changes, eliminating the need to restart or interrupt the system. Vijeo citect 7.2 version is a latest version for SCADA. Window overview of SCADA Software:

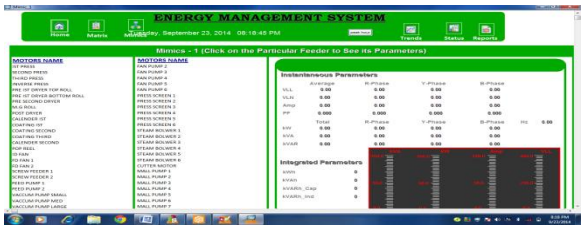


Fig (e) window overview of SCADA screen

The matrix pages in the fig. (e) We can monitors VLL, KW, KVA, P.F, HZ, KWh, KVAH for all the machines at any time

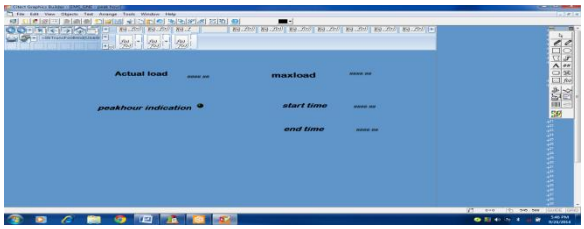
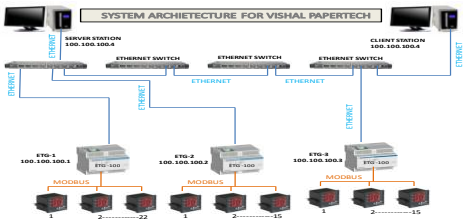


Fig (f) SCADA screen of peak load hour

From the peak hour SCAD screen, we can see the actual value of the load, maximum load, start time and end time and peak hour indication.

Architecture for monitoring the energy using SCADA



Energy meter: The main function of energy meters to measure all load parameters of the machine. 6400 series meters are commonly used in the industries for energy monitoring. Because these series meters have several benefits such as it has brilliant LED display with auto scaling capability for kilo, mega, gega. Five different models available based on the parameters require for monitoring. Gateway: Gateway mainly used for converting the modbus signals into Ethernet signals. Because modbus signals are slow speed signals but Ethernet signals are high speed signals. TSX ETG 1000 gateway used in this project. Ethernet switch: Ethernet switch transmit the data at Ethernet rate. Ethernet switch used for collection of different types of signals then brought together with a specific set of standards. Ethernet switches also used for connecting the different parts of the computer network together.

V. RESULTS:

The proposed system is designed for the automatic load control in the industry so that we can reduce the penalty charges for the industry and for the online monitoring of the various energy meters to reduces the labour cost and chances of error.

VI. CONCLUSIONS

The paper presented the load control applications during peak hours. From this we concluded that:

1. By manually control of load during peak hours causes industry suffering from penalty charges. But the automatic controls of the load overcome such difficulty. The automatic control of load during peak hours by using PLC and SCADA completely eliminate the penalty charges.
2. When the load increases above the load which is mentioned by electricity board during peak hours then automatically shutdown of some machine. There is no need of worker to shutdown the machine manually.
3. By using SCADA we can check any parameter of the load of any machine at anytime on computer. So due to overloading and under loadings cause damaging of motors reduced.
4. Reducing the damaging of motors by automation so production increases.
5. The manually process needs lot of workers in the industry. Due to which labour cost increases. But the automation reduces the labour cost.
6. Chances of errors reduced by automation.
7. The unskilled person checks any load parameter on computer.
8. Manually control is a lot of time consuming process. But automatic control is a time saving processes.

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