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Communication with Energy Meter and Field Devices using PLC

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Abstract: Managing electrical power has always been a cumbersome and complex task. Ever expanding load demand has further necessitized continuous, sufficient and good quality supply of electric power. Blackouts and Brownouts are still a major problem in developing countries like India. This paper suggests a simple yet effective way of auditing energy automatically on a regular basis.

The real time energy consumption and generation parameters can be monitored and analyzed by interfacing the energy meters in the field to the PLC (Programmable Logic Controller) which then in turn transmits the collected data from the energy meters to HMI (Human Machine Interface) or a SCADA (Supervisory Control And Data Acquisition) system usually installed at the control station miles away from the field. This real time data can further be monitored, audited and field machines can be programmed to operate as per requirement.

Keywords: PLC, SCADA, HMI, Energy Meter

I. INTRODUCTION

Over the past 20 years or so, the main focus of energy industry has been on the Distribution Automation and Generation Automation because these are the fields wherein the largest scope for effective automation lies at this moment as they require continuous coordination with each other in demand-generation aspect.

For this purpose, remote monitoring and controlling of equipment has become indispensable. With the advent of PLCs and advancement of energy meters and communication system, power utilities worldwide are increasingly adopting the remote energy monitoring technologies that enables them to cut losses and provide sufficient and good quality of power to their consumers.

II. OBJECTIVE

A. In This Paper We Are Going To Cover The Following Objectives

1) To devise a simple &fast way of energy auditing
2) Reduce the manual cost and labour
3) To maintain synchronism between power consumption and generation
4) Improve power quality
5) Prevent unplanned downtime
6) Make the load dispatch economical
7) Maximize operational life of the machines
8) To help in designing and upgrading power plants.

III. SYSTEM SPECIFICATION

A. Hardware Requirements

1) Energy Meter with RS485 ports (eg. Schneider Electric Conzerv 6436)
2) Programmable Logic Controller (eg. NEXGEN 2000)
3) Human Machine Interface (HMI)
4) Current Transformer (Ratio: 60/5)
5) RS485 Cable

B. Software Requirements

1) CodeSys Software for Ladder Programming

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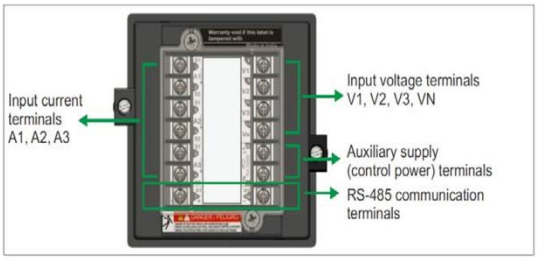
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IV. WIRING DESCRIPTION

A. The energy meter is connected to the load. Schneider Electric Conzerv 6436 energy Meter Terminals Are located On the Rear panel. 14 Terminals are Provided, Seven tErminals On each Side

1) Six terminals for current, one in and one out per phase
2) Four terminals for voltage, for three phases and neutral.
3) Two terminals for auxiliary power supply (control power).
4) Two terminals for the RS 485 communication port.

Figure 1-2: Rear panel



One end of RS485 cable is connected to the dedicated terminals. More than one energy meter can also be connected to theRS485 cable by interconnecting the terminals in series.
Now, the NEXGEN 2000 PLC comes with 2 communication ports. The other end of the energy meter's RS485 cable is connected into one of the two ports on the PLC. HMI device is connected to the PLC via another RS485 cable connected into the second port on the PLC and a dedicated port on the HMI. HMI can also be connected to the PLC via an ethernet Module. That will eliminate the need ofanother wire cable and the data could be accessed just by logging into the internet.

B. A Potential Application

This energy monitoring using PLC interfaced with the energy meter can be used for energy management for economic dispatch in generating stations known as Unit Commitment.
Consider the following example There are three generating units in the power plant which are most economical to run for a power demand as ranged below:
Now if there were no PLC control system, the generating units would have to be switched on and off manually according to the ever changing power demand. This would have affected the efficiency and power quality of the generating station because the switching would neither have been fast enough nor perfect.
Whereas, because we have a PLC system installed, this switching can be made both fast and automatic requiring no human supervision.
For this a Ladder Program is designed according to the application and downloaded onto the PLC.
Following is the Ladder Program representation for above application:
Index-

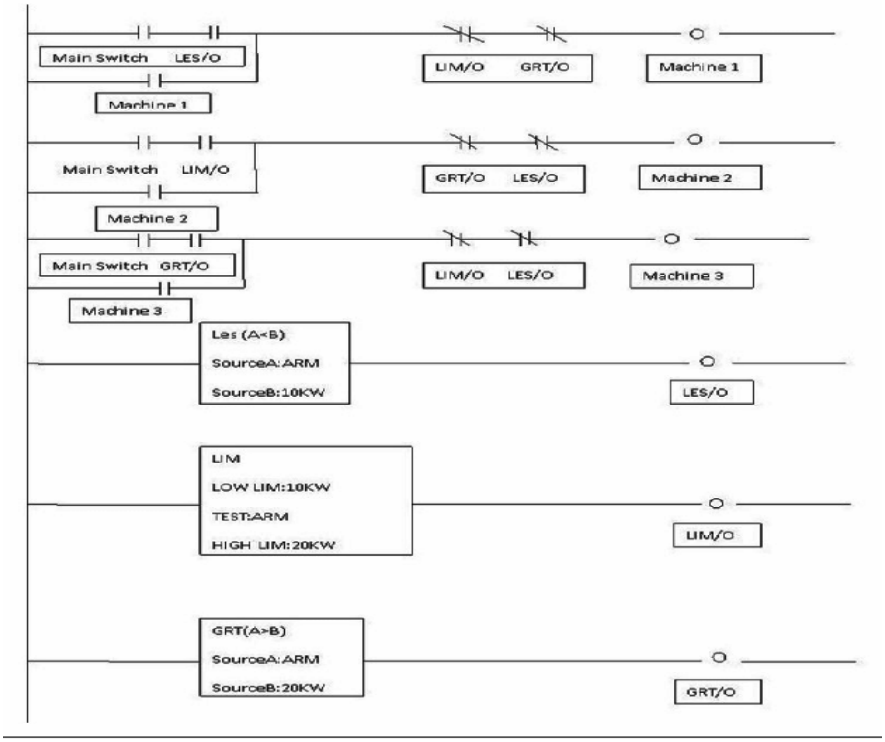
1) ARM: Automatic Reading of Meter
2) LES: Less than function
3) GRT: Greater than function
4) LIM: Limit function

C. Explanation of Working-

The readings of interfaced energy meter is continuously changing and monitored by PLC functions in real time. As soon as the above mathematical functions are satisfied, the corresponding output coil goes high which in turn toggles the state of its corresponding switch (NO/NC).
Changing of the state of a switch turns on/off the connected generating unit.

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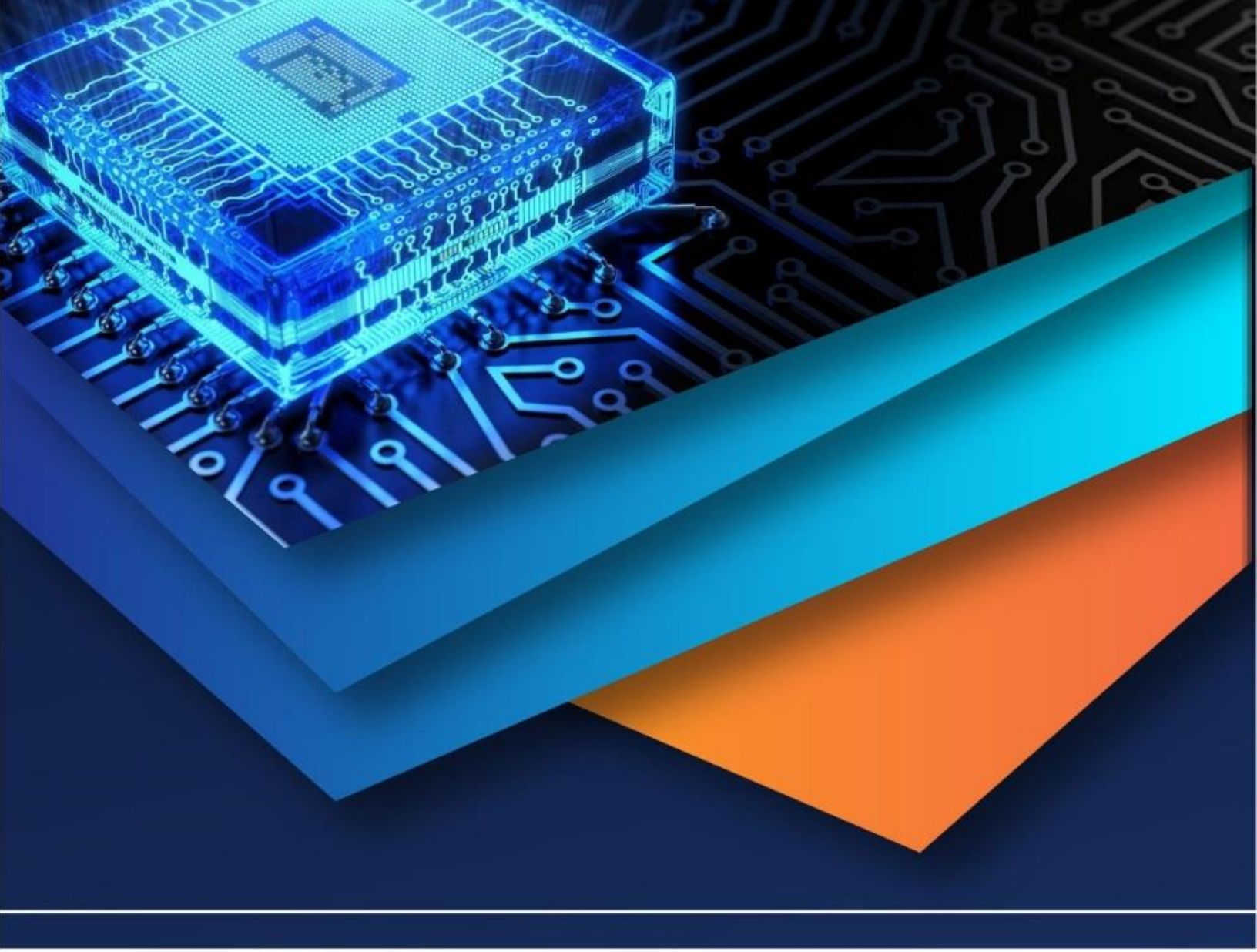
Thanks to the wiring connection and ladder programming, over hundred parameters (eg. currents, voltages, power, frequency, power factor) that are measured by the energy meter are taken up by the PLC and transmitted over miles of distance to the HMI device or a computer system installed at the control station. It can be further used to audit, analyze, record or design an automation infrastructure that can be accessed sitting at the control station work desk.



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