Automation Based Energy Management System in Industry Using PLC AND SCADA

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ABSTRACT

Power is inevitable part in all industries. Power is generated in power plants, and transmitted through large distances to the loads which may be a small scale industry or a large scale industry or even a household. The power generated in power plants should be managed in order to facilitate the smooth operation of the system. The basic idea behind any power management system is to manage various loads. These loads are models for different areas of the city. If the load in any area increases then there is every chance that the power station may trip. Hence to avoid this from happening we have proposed a hardware based circuit.

When any one load increases then one of the loads that are connected out of many is disconnected. The priority of disconnecting is variable and can be changed from time to time. The current requirement of different load is different as the time varies. Hence according to that changing priority we assign different priority to different load.

When the current in any one load increases then the total load on the generation process increases. The excess load may cause the power plant to trip. The cost involved for restarting a power plant is much more. So when the load increases it is advisable to disconnect any one of the loads that are connected. This process is implemented in an automatic way in power management project.

The process of disconnecting the loads is based on the priority that is provided by the PLC & SCADA. The priority of disconnecting the loads can be changed at any point.

Key words: *Supervisory Control and Data Acquisition (SCADA), Programmable Logic Controller (PLC).*

I. INTRODUCTION

Technology is also being developed to harness these Renewable Resources to generate Power. The capital investment requirement is very high as compared to normally available resources. It can be quoted here that with the available technology, we could hardly generate 5% of total power generation as on date .Hence, to restrict the use or increase the life of diminishing type of resources. Let us see the other aspect of life, whereas everybody can't understand all technical reasons or benefits of the whole world until he himself realizes some benefit for his action or efforts. In this competitive world, cost competitiveness is very very essential for survival of every individual. To establish any work / motive or task, energy in one or other form is an essential component. Thus the need to conserve energy, particularly in industry and commerce is strongly felt as the energy cost takes up substantial share in the overall cost structure of the operation. Hence it calls management of energy.

Today automated energy control has become standard practice. Virtually all nonresidential buildings have automatic controllers with a computer as the central processor. These systems are called Energy Management Systems (EMS), Energy Management Control Systems (EMCS), or Building Automation Systems (BAS). Today's building owners and facility managers must regularly address the issue of computerized energy management— assessing existing systems, specifying and commissioning new systems, evaluating service contract options, or optimizing EMS operations.

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.
When overall industry load is greater than or equal to specified load during peak hours, the load can be controlled using PLC and SCADA.

II. BLOCK DIAGRAM

PLCs are having power supplies for the working of inputs and outputs. 24V DC is used for driving inputs and outputs. Programmable Logic Controller or programmable controller is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLCs are used in many industries

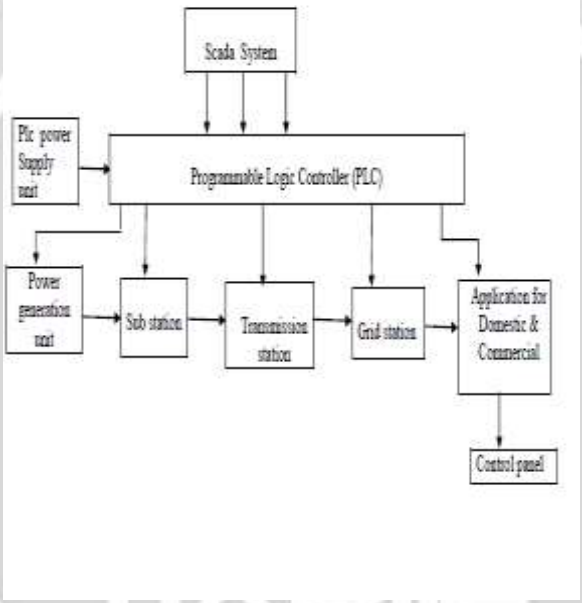

Figure 1. Block Diagram of Automation Based Energy Management in Industry Using PLC and SCADA

PLCs are designed for multiple analogue and digital inputs and output arrangements. The combination of telemetry and data acquisition is referred as SCADA(Supervisory Control And Data Acquisition system) SCADA systems are highly distributed systems used to control geographically dispersed assets, often scattered over thousands of square kilometers, where centralized data acquisition and control are critical to system operation. They are used in distribution systems such as water distribution and wastewater collection systems, oil and gas pipelines, electrical power grids, and railway transportation systems.
The power is generated in generating station from where power is transmitted through the transmission line. A substation receives its power from the transmission network, the power is stepped down with a transformer and sent to a bus from which feeders fan out in all directions across the country side.
High voltage transmission lines that carry power from distant source to demand centers, and distribution lines that connect individual customers.
An electrical grid is an interconnected network for delivering electricity from suppliers to consumers. from which the power is distributed to the different loads. For the home loads it not requires high voltage for that again voltage is stepped down using transformer, for the industries it requires high voltage.

III. WORKING

Total plant is monitoring their operation in control room itself. In any emergency condition, we can shut down the total system. In control window there we can observe the standard values of voltage and current for the main supply, industrial supply, complexes and for the home loads. On-off switches for the main supply, housing loads ,complexes and for the industrial supply. There are 6 sensors, For example if we switch on the power supply to the housing load1 sensor1 will blow Same for the other loads.

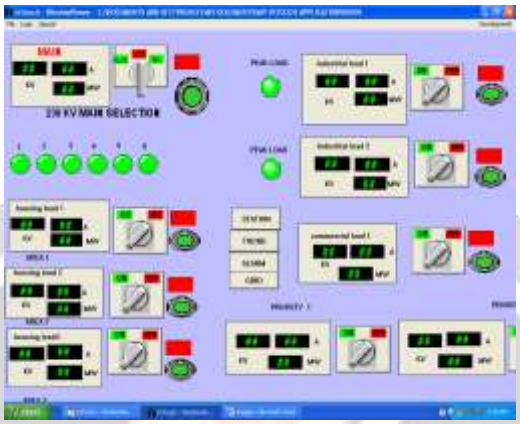

Figure 2. Control Window

Two sensors are there for the industrial load it will blow if industrial load reaches to peak demand, which means highest demand that has occurred over a specified time period. In this project we are giving priority for the houseload 1 and houseload 2.

By using this SCADA, we can reduce the man power and time delay of operation. Substation automation refers to using data from Intelligent (IED), control and automation capabilities within the substation, and control commands from remote users to control power-system devices. Since full substation automation relies on substation integration, the terms are often used interchangeably. Power-system automation includes processes associated with generation and delivery of power. Monitoring and control of power delivery systems in the substation and on the pole to reduce the occurrence of outages and shorten the duration of outages that do occur.

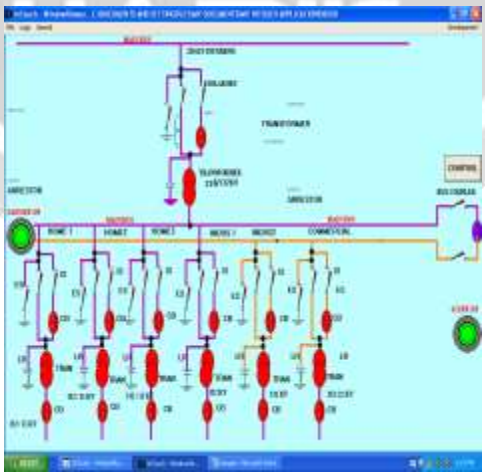

Figure 3. Substation Window

In substation window, the connection of switches and circuit breakers are monitoring the operating status.

Isolators- are the switches and very useful in maintenance period.

LA(Lightning arrestor)- Where all transmission lines are exposed to sunlight at such places LA should be provided.

CT(Current Transformer)- To measure current flowing in the transmission line.
PT(Pottentional transformer)- To check the voltage flowing in the transmission line.
Bus Coupler- It is used to couple two busbar distribution feeders transport power from the distribution substation.
CB(Circuit Breaker)- Which can make and break the circuit under normal as well as under faulty condition by manually as well as automatically.
ES(Earthing Switch)- Earthing switch is used to discharge the charges that are trapped in the line.
230kv is incomming to the substation and deliever electrical energy to the industrial, residential and commercial consumers.distribution feeders transport power from the distribution substation to the end consumer premises. These feeders serve large number of premises and usually contain many branches in which circuit breakers are installed. Supply lines are connected to the substation to perform maintenance or repair work.
Transformer stepped down votage from 230kv to 132kv which is distributed to the different feeders like home loads, industrial loads and commercial loads. As we know that to manage the load by manually is very difficult task for that we are using PLC and SCADA to manage the load automatically. Home loads requires less power as compare to the industriy and comeercial load.
If industry requires more power we can manage the load by giving priority to the houseloads, it will automatically cut the power which is given to the houseloads and that power can be supply to the industrial loads.

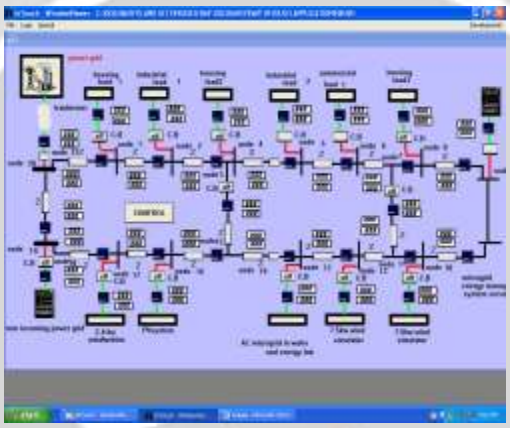

Figure 4. Electric Grid

An electrical grid is an interconnected network for delivering electricity from suppliers to consumers. It consists of generating stations that produce electrical power, high-voltage transmission lines that carry power from distant sources to demand centers, and distribution lines that connect individual customers. Power stations may be located near a fuel source, at a dam site, or to take advantage of renewable energy sources, and are often located away from heavily populated areas. They are usually quite large to take advantage of the economies of scale. The electric power that is generated is stepped up to a higher voltage at which it connects to the transmission network.
Bus bars can be found throughout the entire power system, from generation to industrial plants to electrical distribution boards. Bus bars are used to carry large current to distribute current to multiple circuits within switchgear or equipment. As same in the substation window here also we are giving a supply to the industry, For example: for the houseload1 we are giving a priority1 as a1 and for the houseload we are giving a priority as if we switch on the priority automatically the supply of power to the houseload1 will be stop and that power can be supply to the industry[1].
If we switch on the priority[2] the supply of power that is given to the houseload[2] it will automatically stop the supply of power, and that power can be given to the industryload2. By giving priority we can give continuous supply for the industries load.

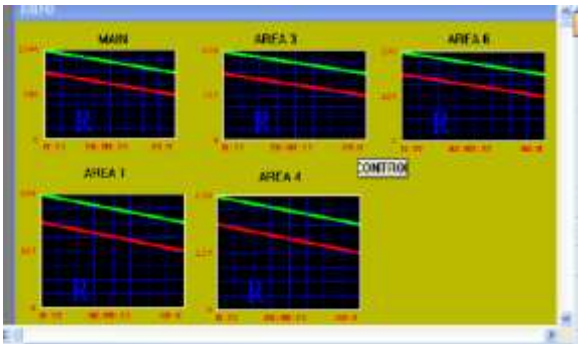

Figure 5. Trend Window

This SCADA screen displays the historical trend of energy management. It displays the historical data of energy consumption. Historical trends allow you to chart up to eight pens. Both types of trends are created using special tools in Window Maker. InTouch also provides you with complete control over the configuration of your trends.

TREND meter is based on standard measurements and data export methods. The TREND meter provides you with easy to read, graphed energy consumption and load information of each measured device. The graphs are run in the measuring equipments. In this trend we can get the old data for yearly auditing purpose. The TREND meter represents the starting point towards a more complex tool able to monitor a network infrastructure and to trigger energy saving techniques when traffic conditions change. Our tool has been developed inside the context of the European project TREND (Towards Real Energy Efficient Network design), which actually supported this work. The main goal of the TREND meter is to collect measurements of power and utilization from a variety of devices located in the Internet. The idea is to build a centralized server which collects the measurements from the devices. As second goal, the TREND meter aims at consolidating these measurements together to study whether there are similarities or not in the patterns of power and utilization of the devices. Additionally, the TREND meter aims at making publicly available the collected data to the community, and to easily show this information with a graphical representation. The design of TREND meter architecture had to face a complex and very heterogeneous scenario.

PROGRAMMABLE LOGIC CONTROLLER (PLC)

Programmable Logic Controller or programmable controller is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLCs are used in many industries and machines. PLCs are designed for multiple analogue and digital inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery-backed-up or non-volatile memory. The functionality of the PLC has evolved over the years to include sequential relay control, motion control, process control, distributed control systems and networking. The data handling, storage, processing power and communication capabilities of some modern PLCs are approximately equivalent to desktop computers. The main difference from other computers is that PLCs are armored for severe conditions (such as dust, moisture, heat, cold) and have the facility for extensive input/output arrangements.

SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM (SCADA)

The SCADA encompasses the collecting of information via RTU(Remote Terminal Unit) relocating it back to central site carrying out decisive rehash and control and then displaying that information on a number of operating screens or displays. SCADA systems are highly distributed systems used to control geographically dispersed assets, often scattered over thousands of square kilometers, where centralized data acquisition and control are critical to system operation. They are used in distribution systems such as water distribution and wastewater collection systems, oil and gas pipelines, electrical power grids, and railway transportation systems.

A SCADA control center performs centralized monitoring and control for field sites over long-distance communications networks, including monitoring alarms and processing status data. Based on information received from remote stations, automated or operator-driven supervisory commands can be pushed to remote station Control devices, which are often referred to as field devices. Field devices control local operations such as opening and closing valves and breakers, collecting data from sensor systems, and monitoring the local environment for alarm conditions. A SCADA system gathers data from sensors and instruments located to remote sides. Then, it transmits data at a central site for controller monitoring process. Automation systems are used to increase the efficiency of process control by trading off high personnel costs for low computer system costs. These automation system are

often referred to as process control system (PCS) or supervisory control and data acquisition (SCADA) systems, and the widespread use of such systems makes them critical to the safe, reliable, and efficient operation of many physical processes.

RESULT

When the industries load greater than or equal to specify load during peak hours then the PLC automatically shutdown the equipment's which are connected to the PLC according to the program stored in the PLC.

Figure 6. Substation Window

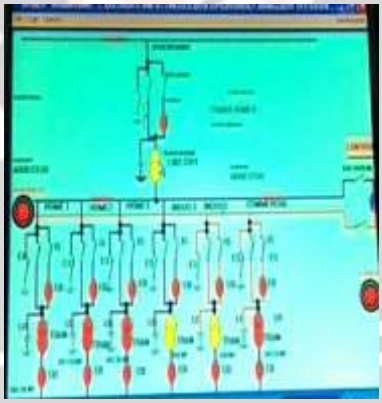

Figure 7. Electric Grid

As here we can observe in the picture taken the supply of power is continuous in the industries and there is no supply for the house loads and the commercial load. The process of disconnecting the load is based on the priority that is provided by the PLC and SCADA.

CONCLUSION

SCADA provides management with real time data on production operations, an implement more efficient control paradigms, improves plant and personnel safety, and reduces costs of operation. The proposed model that illuminates the categories of data, functionality, and interdependencies present in a SCADA. The model serves as a foundation for further research on how to best apply technical controls in substation and domestic distribution areas. From the historical trend company management can detect any power theft or analyze reason for fire, if it is due to any short circuit then energy consumption at that instant will be very high.

REFERENCES

[1] Sagar P. Jain Sanjay L. Haridas , "Energy EfficientAutomized Public Utility Building", International Journal of Advanced Research in Computer Science and Software Engineering", Volume 4, Issue 5, May 2014.

[2] Ravi Masand, Deepika Jadwani,Abhishek Sahu, " PLC and SCADA based Fault Diagnosis of Induction Motor", International Journal of Digital Application & Contemporary research ,Volume 2, Issue 6, January 2014.

[3] Pooja Dhandare, Pooja Moharir, A. A. Shinde, "Synchronization of ESR's with Main Line using PLC and SCADA", International Journal of Emerging Technology and Advanced Engineering , Volume 4, Issue 4, April 2014.

[4] Omkar Deepak Gawde, Kshitij Mahajan, Sanket Deshpande, Omkar Naik, "Automation of Alloy Making Industry", International Journal of ComputerTechnology and Electronics Engineering (IJCTEE), Volume 3, Special Issue, March-April 2013.

[5] Marihart,J.," Communications technology guidelines for EMS/SCADA systems", Power Delivery, IEEE Transactions on Volume16 , Issue 2 , 2001.

[6] Praveen Reddy, "Internet of things based intelligent ontology model for safety purpose using wireless networks", Wireless Communications and Mobile Computing, Volume 2022, Article ID 1342966, https://doi.org/10.1155/2022/1342966

[7]Praveen Reddy, "Smart Electronic Carrier in Shopping Malls Using Rfid and Zigbee", JOURNAL OF OPTOELECTRONICS LASER ISSN:1005-0086, Volume 40 Issue 12, 2021 DOI: 10050086.2021.12.3

[8] Praveen Reddy," Design and analysis of efficient adaptive equalizers for wireless communication application", IEEE Xplore Part Number: CFP21V66-ART; ISBN: 978-1-6654-2867-5, doi: 10.1109/ICESC51422.2021.9532774

[9] Praveen Reddy "Fruit Disease Detection and Identification Using Image Processing" International Research Journal of Engineering and technology", Volume 8 Issue 2 February 2021.

[10] Praveen Reddy "Intelligent Automatic Car Washing System With Sensor Triggered Conveyor Belt" IRE Journals Volume 3, Issue 6 December 2019.

[11] Praveen Reddy and Dr.Baswaraj Gadgay,"Low-Latency RLS Architecture for FPGA implementation with High throughput adaptive Applications", Journal of Radio and Television Broadcast, Vol 3, No.2,pp.1-6, (2018).

[12] Praveen Reddy and Dr.Baswaraj Gadgay, "FPGA Based Least mean square Algorithm for noise cancellation in communication systems", International Journal of Engineering and technology, Vol. 7, No. 3, pp. 165-167, (2018).

[13] Praveen Reddy "Automation Based Energy Management System In Industry Using Plc And Scada " IRE Journals Volume 1, Issue 11 May 2018.

[14] Praveen Reddy " Fault Detection In Switch yard And Transmission Lines Using Plc And Scada " IRE Journals Volume 1, Issue 11 May 2018

[15] Praveen Reddy and Dr.Baswaraj Gadgay, "Comparative analysis of FIR filter Designing for FPGA using system level tools and Xiinx ISE", International Journal of Electrical and Computational science(IJEECS),Vol. 6, No. 9, pp. 149-154, (2017).