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Energy Monitoring System

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Abstract- In new era, effective utilization of electrical energy is a major task for the power engineers. Energy Monitoring Systems such as Supervisory Control and Data Acquisition (SCADA) system, Distributed Controlled System (DCS) etc may serve the purpose of monitoring the electrical energy generated and its availability for use to the consumers. Many power engineers proposed that, if 1 watt of energy saved at the consumer end is equal to 2 watts of energy available at the generation side. Energy monitoring typically involves- data collection and review, plant surveys and system measurements, observation and review of operating practices, data analysis. This research helps to study the run-time analysis of both renewable and non-renewable sources of electrical energy with the help of Programmable Logic Controller (PLC) which controls the load in industry. The overall automation of the industry is monitored by SCADA software after interfacing with the PLC.

Keywords—*Solar Energy, PLC, SCADA.*

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I. INTRODUCTION

Power management has been one of the most talked about topics in the past decade because of the decrease in the conventional energy reserves. As availability of energy sources are depleting rapidly. The use of non-renewable energy has increased by surplus amount, bringing the world to search for an alternative energy source to fulfil its needs. So it is beneficial to use those sources which are naturally available in abundance such as sun, wind and tidal energy etc.

The electricity we utilize is being generated mainly using thermal power. Thus, Coal which is used as the main energy source for thermal power generation is being exhausted with its increasing demand, which results in Load-shedding, causing inconvenience to the consumers. Hence, the use of non-conventional energy sources such as solar is being preferred as a source of energy for utilisation with certain advantages like – environment friendly source, readily available in abundance, emancipated use. This paper focuses on monitoring the sources of electrical energy by using PLC and SCADA.

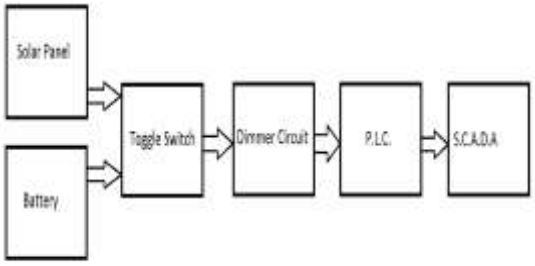

Fig. 1 Block Diagram

II. SOLAR ENERGY

Sustainable Energy is the provision of energy such that it meets the needs of the future without compromising the ability of future generations to meet their own needs. More efficient means are required for converting and utilizing this energy. Solar energy refers to the utilization of the radiant energy from the Sun. Solar power generally refers more specifically to the conversion of sunlight into electricity.

The Solar Photovoltaic cells are being used to absorb the solar energy from the sun. Solar photovoltaic cells are classified into mono-crystalline, amorphous-polycrystalline silicon solar cells. Currently, mono-crystalline silicon solar cells have the highest conversion efficiency among its classified types, so in this system mono-crystalline silicon solar cells are used.

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TABLE: 1

Specifications	Ratings
Type of solar cells	Thin film solar cell
Size	344 * 289 * 22 mm
Rated voltage(V_{max})	18V
Open circuit voltage	21.96V
Rated Power	10W
No. of solar cells	6*6
Tolerance	±3%

Fig. 2 Solar PV Panel

III. BATTERY

This paper focuses on monitoring of one or more energy sources, for test purposes a battery along with a solar panel is used. Batteries are classified as lead acid, nickel-cadmium, lithium ion battery. Due to its high efficiency and high current producing ability lead acid battery is used.

IV. PROGRAMMABLE LOGIC CONTROLLER

PLC is a device which is designed to perform the logical operations. Until past decade these operations were accomplished by relays, circuit breakers etc. Due to increasing errors and lack of efficiency relay and allied system became obsolete and PLC took its place. The PLC programming is done by using basic ladder logic. Machine control and allied operations can be performed with ease, high efficiency and increased security as compared to earlier relay systems. Reusability of PLC program is added advantage.

PLC is used as an interface between source and load whose data is collectively transferred to SCADA for recording monitoring and analysing .The details of the PLC used are as follows:-

TABLE: 2

Specifications	Ratings
Rated input voltage	24V DC
Rated output voltage	24V DC
No. Of Analog inputs/outputs	2
Manufacturer	Allen Bradley Pvt. Ltd
Series	Micro-Logix 1100 Series-B

Fig. 3. Micro Logix 1100 series-B

V. SUPERVISORY CONTROL AND DATA ACQUISITION

SCADA stands for Supervisory Control and Data Acquisition. As the name indicates it is not a full control system but rather focuses on the supervisory level. As such, it is a purely software package that is positioned on top of hardware to which it is interfaced, in general via PLCs or other commercial hardware. SCADA usually refers to centralized system which monitors and controls the entire complex process which spreads over large scale. Most of the control actions are performed automatically by remote terminal units or by programmable logic controllers.

SCADA is used for monitoring, analysing and recording the collective data transferred by the PLC. The data obtained can be used to take appropriate actions.

VI. METHODOLOGY

This paper mainly focuses on monitoring of one or more energy source, for test purposes a battery and a solar panel. Mainly monitoring is done by SCADA, supported by required hardware.

(a) Hardware: For PLC to operate, current and voltage signal in the range of 0-20 mA and 0-20VDC are required respectively. In order to provide PLC these signals, the electrical power from the source should be unaltered, for this

purpose a hardware circuit is fabricated. This circuit is connected to PLC and is constructed using resistors, potentiometers and a toggle switch. The toggle switch is used for toggling between the two sources.

(b) Software: The programming of the PLC is done by using RS logix 500 software. Basic ladder logic is used for programming.

Fig. 4. PLC Ladder Programming

Monitoring of current and voltage signal is done on the Excel operated SCADA.

VII. RUN TIME ANALYSIS

During test run following observations were made:-

- We intended to monitor the output of solar panel. The generated output voltage tends to vary with the light intensity. The following graph shows the monitored output voltage of solar panel.

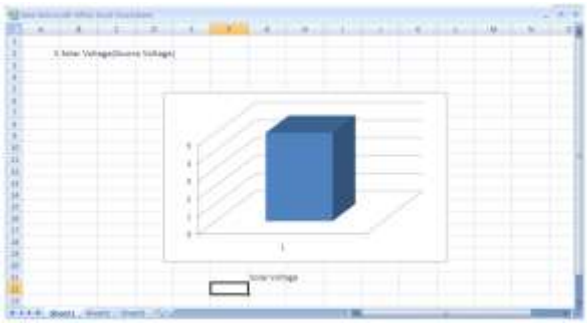

Fig. 5. Graph of output voltage (solar panel).

- Following graph shows the output voltage of battery:-

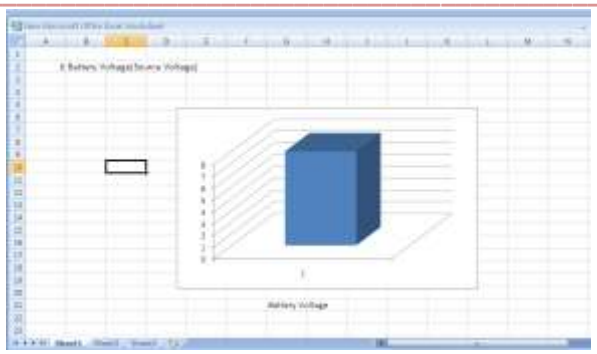

Fig. 6. Graph of Battery (non-renewable source) voltage.

VIII. CONCLUSIONS

At the end of this paper we were successfully able to monitor the voltage output for solar panel and battery. The system constructed is useful for the run time analysis of the output voltages, which is applicable for energy monitoring in household, commercial and industrial sector. If minimum light intensity for optimum functioning of solar panel is not available, toggling between the sources is done manually

IX. FUTURE SCOPE

- Manual toggling may result in human error and time delay. Hence automation of the system using relay is proposed.

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