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A Review on Industrial Energy Monitoring System Using PLC and SCADA

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Abstract - *Proposed system monitors the energy consumption by the different sections of the plant during different time and during different process steps. This data gives us energy requirement of the plant with respect to various parameters. It enables to understand sudden changes in energy requirement with different aspects like at particular time, at particular section of the plant or during certain process. Using this data corrective/preventive maintenance or improvement can be done to particular section of the plant. The aim is achieved by using systems used in industry PLC and SCADA. PLC collects all information from the plant with different sensors and energy meters, Flow meters etc. Also it can gets data on communications from DCS of the plant. And finally all this data i.e. electric power consumption, steam flow, instrument air pressure etc. is compiled and represented in the SCADA in different format. This data plays vital role in understanding and managing energy requirement of the industry.*

Key Words: **PLC, SCADA, DCS, Energy Monitoring System.**

1. INTRODUCTION

Energy monitoring System is an energy efficiency technique based on the standard management axiom stating that "you cannot manage what you cannot measure". Energy monitoring techniques provide energy managers with feedback on operating practices, results from energy management projects, and direction on the level of energy use that is expected in a definite period. Importantly, they also provide early warning of unpredicted excess consumption caused by equipment malfunctions, operator error, lack of effective maintenance and the like. The Energy monitoring System lies in determining the relationships of energy consumptions to related causes and the aim is to help business managers identify and explain excessive energy use as

- Become aware of instances when energy consumption is surprisingly higher or lower than would usually have been the case.
- Envision energy consumption trends (daily, weekly, seasonal, operational…)
- Identifying future energy use and costs while planning changes in the business.
- Identify specific areas of wasted energy.
- Observe how it changes to relevant driving factors impact energy efficiency.
- Develop performance targets for EM programs.
- Manage energy consumption, rather than accept it as a permanent cost.

The ultimate aim is to reduce energy costs through improved energy efficiency and energy management control. Another benefits generally include increased resource efficiency, improved production budgeting and reduction in greenhouse gas (GHG) emissions.

1.1 Energy Structure Evaluation

Energy monitoring system (EMS) is one of the emerging technologies that enable an industrial organization to collect real-time information on the energy use through assessing, monitoring, and visualizing energy consumption. This concept not only monitors energy consumption but also helps in making data driven decisions and enhances enterprise-level operation and financial decision. Monitoring information of energy use established for energy management and explains deviations from an established pattern. Its primary aim is to maintain said pattern, by providing all the necessary data on energy consumption, certain driving factors, as identified during preliminary investigation (production, weather, etc.) As shown in the figure 1, direct consumption, auxiliary consumption, and common consumption are independent parts of overall energy consumption. Reduction of any of these three types of consumption would reduce overall energy consumption.

1.2 Energy Monitoring System (EMS)

An EMS is a systematic process for continually improving energy performance. The objective of an EMS is to engage and encourage staff at all levels of an organization to manage energy use on an on-going basis. It is suitable for all organizations, whatever the size but IT is particularly helpful

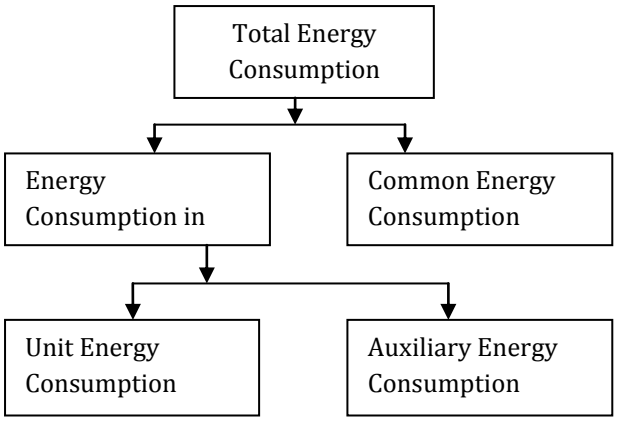

Fig -1: Energy Structure

to operate energy-intensive processes. Establishing an EMS requires to:

- Development and implement an energy policy.
- Identify main energy users.
- Set energy objectives and measurable targets.
- Check and take corrective action as necessary.
- Evaluate system continually and improve where possible.

Continual improvement, which is a key feature of the standard, ensures alert for new opportunities as they arise and exploit all areas where energy savings can be achieved.

2. LITERATURE SURVEY

The literature survey is conducted on different energy management systems fetching the data from the generation to consumption by using different means and approaches. Gilberto P. Azevedo [1] et al enlightened that in the software development area, as in most fields of the computer industry, new technologies are trumpeted as innovative solutions almost daily, just to disappear silently some time later. This was not the case with open-architecture EMS. About 10 years after their conception, they have proven to be a good technological approach. Although they have some limitations; in fact, this is a vibrant research area and raising challenges for the near future. Jim see [2] et al describes the Electric utilities are finding it progressively more necessary to better monitor, analyses and control their distribution systems. Planning and operation of the grid is complex on one hand but subject to ever more binding constraints on the other. Real-time analysis is a need to achieve acceptable operational efficiencies and quality of service. K. Collins [3] explained about the Smart Energy Monitoring and Management for Industrial application. Importance of managing the energy consumption is demonstrated with industrial facility. To address this issue, an energy monitoring and management system is developed. The energy consumption of individual machines is identified first and then a graphical user interface and operation scheduling are developed along with the feedback to the operator through fuzzy inference system. The result gives significant savings energy consumption. Theodora C. Kouloura [4] explained about a "proof of concept" system methodology for the energy management of industrial units. The cybernetic Viable System Model (VSM) of

Beer is considered as an industrial unit. With this case study relating to a fertilizers production plant, a framework is developed that could be extensively utilized for energy management in industrial units. This systems framework emerges to implement the principles of sustainability in industrial energy management. The main advantages of this form of analysis are that it incorporates the principles of sustainability and the analyst can determine technical as well as the organizational procedures amenable to interventions for saving energy, compared to commonly used methods that mostly focus on technical aspects only. Barreiro-Gomez [5] discussed distributed resource management by using population dynamics in wastewater treatment application. Author stated that proper management of the energy resource would be achieved by having a central decision maker for task by using information of all the control signals. However, this centralized scheme would require an expensive communication network. Xiaofeng He [6] et al described the changeable necessities due to privatization and deregulations have created needs for analyzing information from various sources. These needs require new high performance solutions represented by the latest data warehouse of SCADA/EMS system along with its characteristics and structure outlined in the paper. Utilities have started to take benefit of this new technique and many other plans to pursue. As the industry gains experience from this new tool latest applications will develop on the SCADA/EMS system. Jian Wu [7] elaborated that Supervision Control and Data Acquisition (SCADA) system is a communication and control system utilized to monitor, to do operation, and maintenance of energy infrastructure grids. As compared file, highlight all of the contents and import your prepared text file. You are now ready to style your paper. with traditional applications, a SCADA system has a crucial deadline for critical tasks. SCADA systems have special time constraint for the real time database. The real time database in SCADA extends traditional database to include in-memory database and that is used for operations in the harsh environment of real time systems, with strict requirements for resource utilization, and it provides the performance and reliability required by real-life applications. In this paper, the key principle of real time database has been introduced.

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.

2.1 Programmable Logic Controller (PLC)

PLC is a device which is designed to execute the logic

functions. Previously this work was accomplished by relays, timers etc. These are bulky systems, chances of errors are more and if the fault taking place in these systems then it's more time consuming to find the fault in these systems. This problem is overcome by PLC. RICHARD E. MORLEY invented the first PLC in 1969. The PLC programming is written in high level language, which is easier for understandable of the more people. 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.

2.2 Supervisory Control and Data Acquisition (SCADA)

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.

3. PROPOSED WORK

The various energy monitoring and management strategies adopted in the last three decades have been reviewed. Based on this survey a new methodology for energy monitoring in industry is introduced. In proposed methodology S7-1200 PLC with WinCC SCADA software is used. Data is collected from different energy meters using serial Modbus communication. WinCC softaware is used to monitor and logging of the data. Data analysis in different format can be done in this SCADA station. Also reports are generated which can be printed automatically and on demand using printer. WinCC used SQL server to store the data. By using Analog inputs and outputs other forms of energies like Steam, Compressed Air, and water can be measure. Totalizers in the PLC will take record of all energy uses.

4. CONCLUSIONS

The energy efficient improvement is a significant way to reduce the costs and to increases predictable earning, especially in times of high energy price volatility. Since the system operation mainly dependent on PLC and SCADA, it helps in monitoring the energy uses in different sections of the plant and generates the reports as per requirements by the customer. Extension can be provided to the system as our interest and requirements. This system is time saving, consumes less power and can be also made easily available. So, that the small scale industries, large scale industries can use this system in real time applications whenever and wherever with small investment.

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