ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 2, Issue 4 , April 2015

A New Approach For An Energy Management System Using Ladder Logic Program For Industry Application

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ABSTRACT--Energy Management System is an important cost factor in industry application. This paper reviewed the methods of implementing a load based auto switching method and proposed a better and cost effective approach to realizing the Energy Management System. In existing method, auto change over causes a major problem in switching over a high current rating. Each of these systems has some disadvantages that make it objectionable. Among these major drawbacks are time consumption, generation of noise, frequent failures, product loss and shutting power of the whole plant. In our proposed method, the auto changeover is replaced by load based auto switching method to improve the energy efficiency of the system with electro mechanical relays. Hence the shutdown of the entire system is prevented and energy is conserved.

KEY WORDS-PLC (Programmable Logic Controller), CT Coil, Electromechanical Relay.

I. INTRODUCTION

Now-a-days in industry life the energy management system is becoming more expansion due to complex in every unit mainly cement, steel and paper processing unit expansion and updating of machines. The objective of Energy Management is to achieve and sustain optimum energy utilization, throughout the organization. They are 1) In order to reduce the energy costs or waste without affecting production and quality, 2) To minimize the environmental effects. Energy saving is important and effective at all levels of human organizations in the whole world. Energy Conservation reduces the energy costs and improves the effectiveness. In existing method, maintaining of auto change over is the toughest job. The knobs in auto change over gets weaker often, so maintains cost gets high, due to this power source breakdown makes the whole process often get shutdown. In our proposed method, the auto changeover is to replace through a latest idea of a load based auto switching methods. Due to this technique each power source will be supply to an individual station according to it power consumption.

II. THEORY

A. PLC

A Programmable Logic Controller (PLC), is a digital computer used for an automation purposes typically industrial electro mechanical processes. PLC are designed for various analog and digital inputs and outputs arrangements and extended to temperature ranges, resistance to electrical noise, and resistance to vibration and effect. Programs are control machine operation is usually stored in battery-backed-up or non-volatile memory. A PLC is an example of a "hard" real-time system since output results must be produced in response to input conditions within a limited period of time, otherwise unintended operation will be result occur. PLC is an assembly of solid-state element designed to make logical and sequential decisions and provide outputs. Programmable logic controller has eliminated much of the hardwiring and associated with conventional relay control circuits.

a)Four Steps In the PLC Operations

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Step 1 : Input Scan

It detects the state of all input devices and connected to the PLC.

Step 2 : Program Scan

Program logic will be created and executed.

Step 3 : Output Scan

Energizes / de-energize in all of the output devices that are connected to the programmable logic controller.

Step 4 : Housekeeping

This step includes the communications with programming terminals, internal diagnostics, etc...

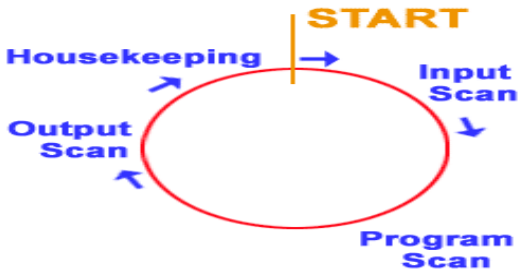

Fig. 1 Operation cycle in PLC

b)Advantages of Using PLC

1) It reduces a lot of space.
2) Energy saving since power consumed is very less when compared to other conventional systems.
3) Easy to maintain because of less hardware components.
4) Economical.
5) Higher flexibility because the program can be altered according to the needs.

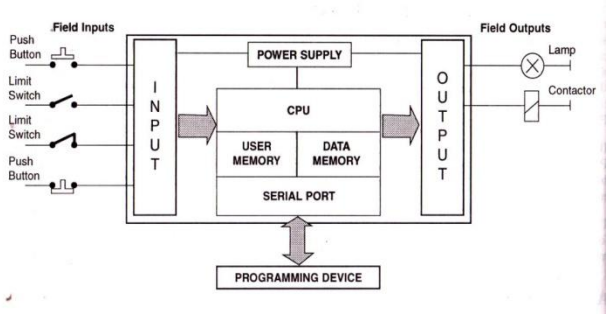

Fig. 2 Block diagram of PLC

A typical Programmable logic controller can be divided into the following parts are,

1) Central Processing Unit (CPU)
2) The Input or output (I/O)sections
3) Power supply
4) Programming device

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B. LADDER LOGIC

The Ladder logic in the Programmable logic controller (PLC) is actually a computer Program user can enter the value and be change according to the requirements. The ladder diagram language is mainly a symbolic set of instructions used to create the controller program used in PLC. These symbols are arranged to achieve the desired control logic that is to be enter into the memory of the Programmable logic controller. A ladder diagram consists of individual rungs just similar to a actual ladder. A line screening an input or several inputs and output is called as a rung. Ladder logic programming is a graphical representation of the program considered to look like relay logic. The many similarity between the ladder diagrams used to program PLCs and the relay ladder logic formerly used to be controlled industrial automation systems eased the shift from hardwired relay systems to PLC-based systems. Ability to monitor the PLC logic in ladder diagram format also made troubleshooting easier for those already familiar with relay -based control system. A ladder diagram (also called contact symbology) is a means of graphically representing the logic necessary in a relay logic system.

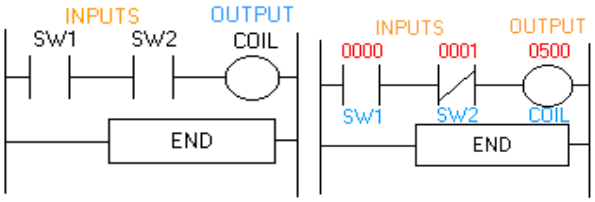

Fig. 3 Example of a Ladder Logic Program

C. Scan Time

A PLC in ladder logic program is generally executed continually as long as the controlled system is running. The Programmable logic controller became more advanced, and the methods were established to change the sequence of ladder execution, and subroutines were implemented. This scan time may be a few milliseconds for a small program or on a fast processor, but in older PLCs running very large programs could take much longer up to 100 ms to be carried out through the program. If scan time were too long, the response of the Programmable logic controller to process conditions would be too slow to be useful. This simplified programming could be used to save the scan time for high-speed processes, for an example the parts of the program can be used only for setting up the machine could be segregated from those required parts to run at greater speed.

D. CT Coil

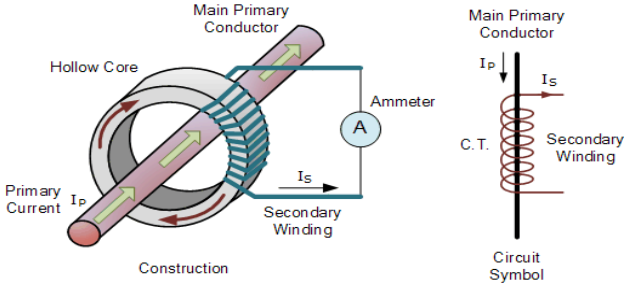

Fig.4 Diagram of CT Coil

The rated accuracy limit factor (Fn) is the ratio of the rated accuracy limit primary current to the rated primary current.

E. Relay

A switch whose operation is activated by an electromagnet is called as "relay". A relay is an electromagnetic switch is use a low voltage circuit to switch on and off a light bulb (or anything). Relays are components to be control signalsthat must be electrically isolated from the controlling circuititself. Generally relay coils are designed to operate from a particularsupply voltage often 12V or 5V or which allow a low-power circuit toswitch a relatively high current on and off conditions, when it's coupled to that supply voltage.

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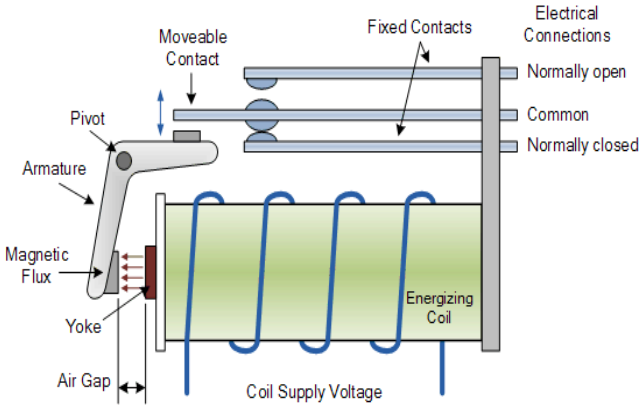

Fig.5 Diagram of Relay

The basic idea is to choose a relay with a coil designed to operatefrom the supply voltage .Sothat the low-power circuitry can be control the current throughthe relays coil. Typically it will be somewhere between 25ma and 70ma. So that the control signal Vin was switching between 0 and +12V.

III. EXISTING SYSTEM

A. Block Diagram

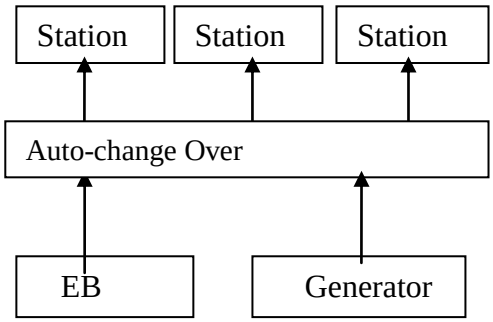

Fig.6 Existing System Block Diagram

B. Auto-change over

The need for continuous power supply and its reliability has improved rapidly, especially in all those areas where continuous power supply is a essential. Their complication has greater than before as continuous information and communications are desirable to control automated process be in industries, marketable complexes, etc. The essential for independent standby power system has subsequently increased manifold. The power delivery, manage, monitoring and safety of stand-in power system needs to be integrated. Stand-in generator systems, for an example, are necessary to provide to:

1) Sensitive Loads are delivered by UPS systems. The period of non- accessibility of power, before the stand by supply takes over, is bridged by battery banks. Usually the loads are CPUs, clinic equipments, micro processor controlled manufacturing machines etc.
2) In the critical loads typically includes stand by generator methods which supply power to lighting methods, air conditioner, winches etc.,
3) Important Loads also use stand by generator schemes typically in process industries as they relate to high down times.

Automatic transfer from main supply to standby supply is vital for all the exceeding types of loads. In the occurrence of power failure, the standby power is frequently estimated to take over automatically. Electrical preliminary equipment,

ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

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battery bank and the diesel generator are essential for the automatic task. The automatic transfer is attained commonly by automatic mains failure methods. The process of on the load transmission has to be checked & measured for a smooth Change over and within safety limits of all fundamentals of the method. This is succeeded only by Automatic Transfer Switch (ATS).

a) Limitations of auto changeover are,

1) Wasting of time on every occurrence there is power failure.
2) It is tough to operate.
3) It is the causes device, product damage or process.
4) It makes a lot of noise.
5) Maintenance is more when compared to Load based auto switching method.

IV. PROPOSED SYSTEM

In this proposed method, the PLC select 3030 is used. It contains 6 analog inputs and 8 digital outputs. This analog input measures the current value of the CT coil. The digital outputs are used to control the relay that switches the power sources, and then the CT coils are used to measure the ratio of current value from primary to secondary. This CT coil is used to measures the power consumed in each station and power produced in each sources. The CT coils used are as follows:

i) CT Coil 400/5(for station purpose).
ii) CT Coil 400/5 (for Input purpose- EB, Generator).

Then the values are given to PLC and it is sent to relay. A Relay consists of two parts, i) coil and ii) the contact(s). The relay is an electrical switch that is used to switch and the high voltage using a low voltage. In most of industry oil type contact are used. In our proposed method, single contact of 15amp PCB relay is used. Then the values are compared and given to the station according to the load consumed in each station. The power sources will be automatically changed affording to the requirement and the power will be applied from EB and generator. The limits of the existing works, the proposed method implements a load based auto switching mechanism that drastically reduced the defects of auto change over method.

A. Block Diagram

In this proposed method is an advantageous as it is.,

1) Easy to recognize the problematic in every individual station .
2) Then the overall system shutdown is also rectified due to problem in individual station.
3) It has long operating life.
4) Reduces the time consumption.

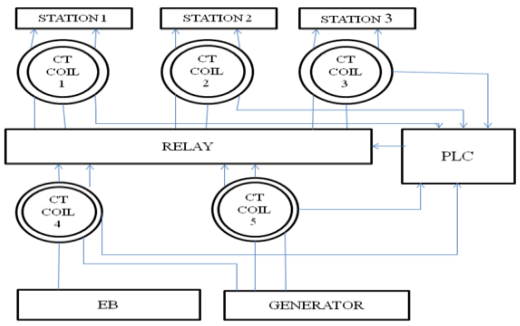

Fig .7 Proposed System Block Diagram

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V. RESULTS AND DISCUSSIONS

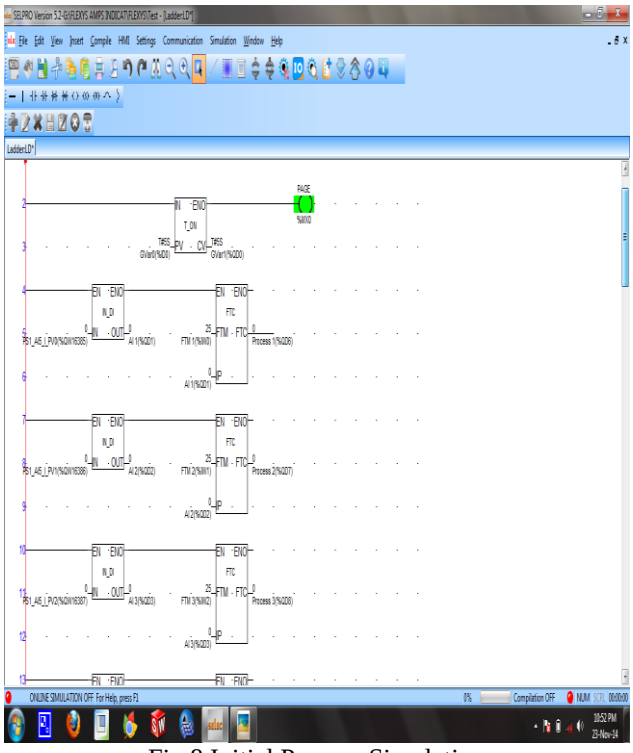

Fig.8 Initial Process Simulation.

Initial process of the system,once the system is implemented the process starts after 5ms. Then the current value from each coil (both in power sources coil and station coil) is measured.

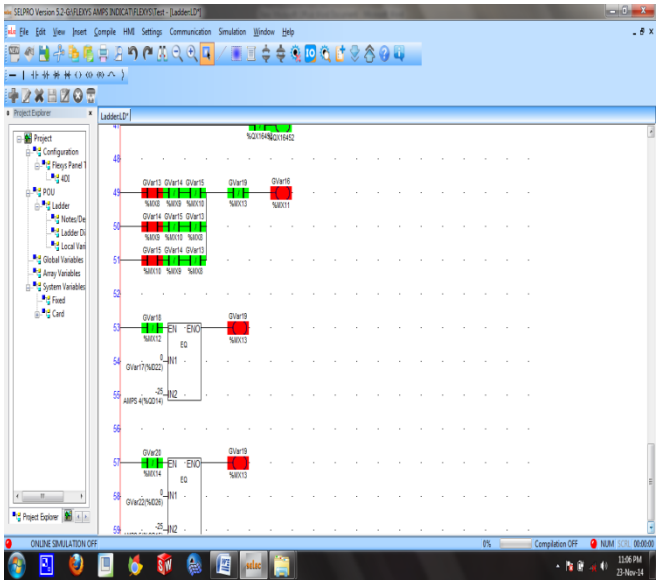

Fig .9 Setting up the Threshold Value.

The different value for EB and Generator are varying the global variables.

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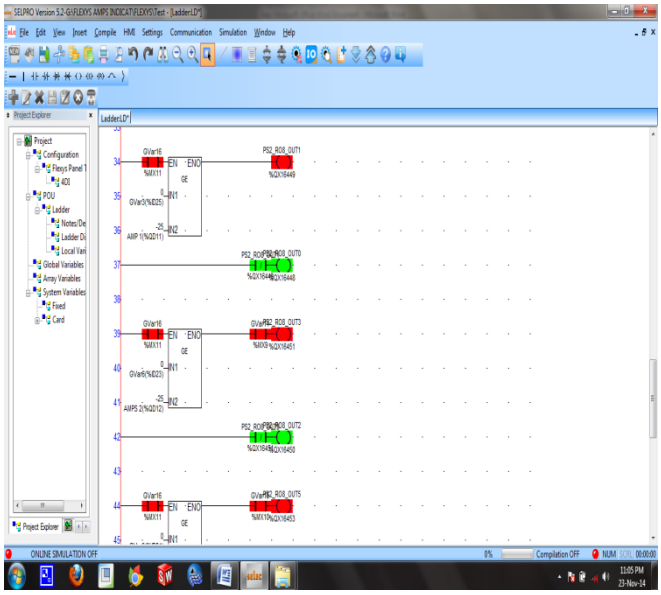

Fig.10 Final Simulation Results.

As shown in figure the different value for Generator and EB are set. Based on the values given different output is obtained.An efficient energy management system is implemented using the PLC using ladder logic program. Initially the coils are implemented and values from each coil are measured.

VI. CONCLUSIONS

In the modern era use of energy management system is a vital cost factor. The energy efficient enhancement is a vital technique to reduce the costs and to growths expected earning, particularly in times of high energy price explosive nature. In our proposed method, has been able to demonstration that auto changeover is a better replacement for electromechanical relays in PLC by load based auto switching method, it will definitely be of great support to concerning a better and reliable switching device for load based auto switching technique. Since the system operation mainly depends on ladder logic programming, we can extend the system as our concern and necessities. This method is time saving, consumes the less power and can be also made easily accessible. So that the small scale manufacturing industries and large scale industries can use this method in real time applications whenever and wherever with the small investment.

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