Importance of Automation and It's Application to Optimize Energy

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ABSTRACT
Automation is basically the delegation of human control function to technical equipments. Modern process control systems are used in industrial automations for flexibility, modularity and reliability, employing state of the art technology based on three concepts: Distributed control System (DCS), Programmable Logic Controller (PLC) and monitoring system; Supervisory and Data Acquisition (SCADA).Power consumption is an important constraint in the design of induction heater. Regarding hardware point of view concern, a bunch of heater is arranged in sequential manner and using a property of temp heaters are shut off or shutdown at different time sharing mode, with the help of intelligent controller and transducers. The basic idea behind power management project is to manage the power in various loads. When any one load increases then one of the loads that is connected out of many is disconnected, in this priorities is assigned to various loads and with the help of hardware and relay logic we will try to manage the load automatically.

Keywords
PLC, SCADA, Dynamic power managements, Heater, automation.

1. INTRODUCTION
PLCs are often programmed in ladder logic. This is because PLCs originally replaced relay control systems, and forty years later, we still haven't quite let go. A PLC, like any microprocessor, executes a list of instructions in sequence. Ladder logic tools abstract this; you can program the PLC by wiring up relay contacts and coils on-screen, and the PLC runtime will simulate the circuit that you've drawn. Some of the relay contacts can be tied to input signals from the real world; some of the coils can be tied to outputs. That way you can make your simulated circuit interact with other devices, and actually control things. Actually it's more general than that, because you can incorporate timers and counters and arithmetic operations that you couldn't (easily) perform with just relays. The circuit concept is still useful though, partly just because it's intuitive, but also because it abstracts the concurrency issues

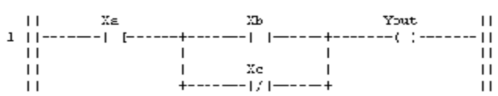

Fig1. Ladder for simple Combinational circuit

This is a simple piece of combinational logic. There are three input terms, Xa, Xb, and Xc. There is one output term, Yout. The expression is Yout: = Xa and (Xb or (not Xc)). This makes sense if you think of Xa and Xb as normally open relay contacts, Xc as normally closed relay contacts, and Yout as a relay coil. Of course it gets more complicated than that:

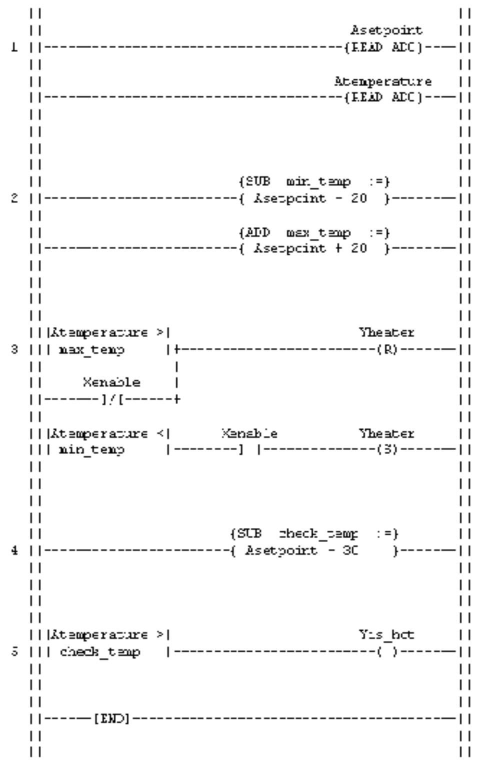

Fig 2. Ladder logic to Shut ON Heater

This is for a simple thermostat. There are two analog inputs; one of them is for the set point, so that it might, for example, be connected to a pot that the user turns to select the desired temperature. The other provides the temperature measurement; it might be a semiconductor temperature sensor, or platinum RTD with suitable interfacing circuitry. There is a digital output, Yheater. That might control a heating element, through a suitable switch (a TRIAC, or a relay, or a solid-state relay, or whatever). We close the loop with a simple hysteretic (bang-bang) controller. We have selected plus or minus 20 ADC units of hysteresis. That means that when the temperature falls below (setpoint - 20), we turn on the heater, and when it climbs above (setpoint + 20), we turn the heater off, by enable input: the heater is forced off when Xenable is low. I also added an indicator light, Yis_hot, to indicate that the temperature is within regulation. This compares against a threshold slightly colder than (setpoint - 20), so that the light does not flicker with the normal cycling of the thermostat.

2. ALLEN BRADLEY PLC

Programmable Logic Controller or PLC is an intelligent system of modules, which was introduced in the control, & instrumentation industry for replacing relay based logic [4]. Over a period of time, better I/O handling capabilities and more programming elements have been added along with improvement in communication.

PLC Working

At the beginning of each cycle the CPU brings in all the field input signals from the input signals from the module and store into internal memory as process of input signal. This internal memory of CPU is called as process input image (PII). User program (Application) will be available in CPU program memory. Once PII is read, CPU pointer moves in ladder program from left to right and from top to bottom. CPU takes status of input from PII and processes all the rungs in the user program. The result of user program scan is stored in the internal memory of CPU. This internal memory is called process output image or PIQ. At the end of the program run i.e., at the end of scanning cycle, the CPU transfers the signal states in the process image output to the output module and further to the field control.

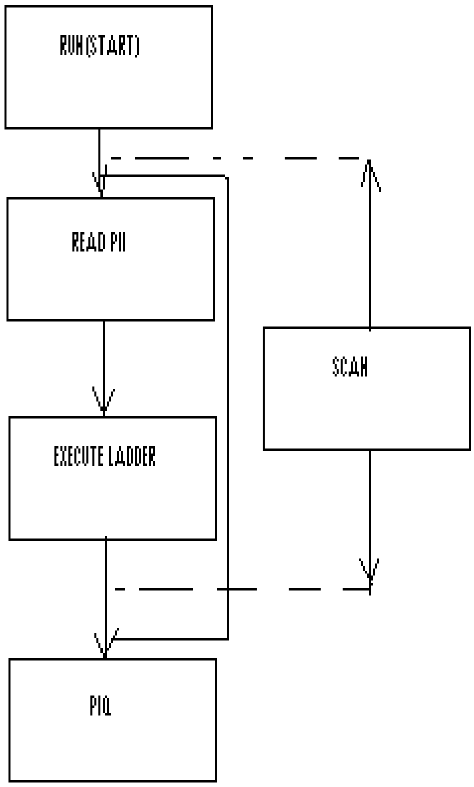

Fig 3. PLC Scan Cycle

I/O driver (SCADA) picks up PII and PIQ and transfers the image to database and this image is called driver image. This driver image available in SCADA database is used for graphical view of process monitoring from operator station (OS) in the central control room.

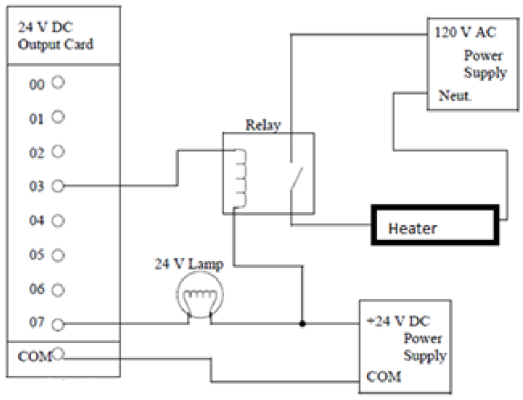

Fig4. Interfacing of PLC with input card

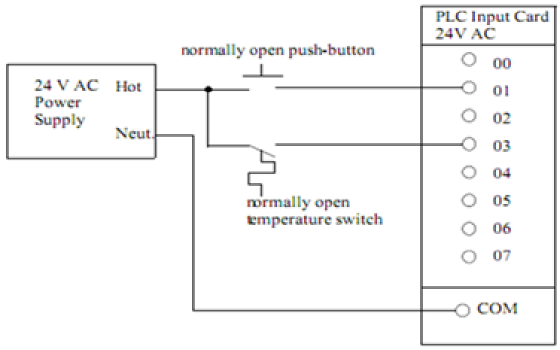

Fig5. Interfacing of PLC with output card

3. CRITICAL CONTROL PARAMETERS IN HEATER AND SYSTEM DESIGN PLATFORM

A. Pressure Control

Force draft pressure, Induced draft pressure, Steam drum pressure, de-aerator pressure, Turbine inlet steam pressure, balanced draft pressure

B. Flow Control

Air flow, Steam flow, Water flow

C. *Temperature Control*

De-aerator temperature, Steam drum temperature, Under-bed boiler temperature, Turbine inlet steam temperature, Flue gas temperature.Wide area controlling and monitoring systems are essentially based on the SCADA system. In contrast to conventional control systems, where e.g. Programmable Logic Controller (PLC) system [4] is used for acquisition of data, Remote Terminal Units (RTU) [5,11] acquire digital and analog current, voltage and frequency measurements for SCADA system. RTUs are installed at selected locations of different grid stations to acquire complete analog and digital data of the station and are time-synchronized via Global Positioning System (GPS) [6] receivers with an accuracy of one microsecond. These RTUs are getting digital data from field instruments connected with relays to show and operate live status of Circuit breakers or isolators, however for analog data, transducers are connected with CT and PT. For power electric system, generating stations are producing electricity and distribute it on the network. Some electricity imported from other electric resources e.g. Independent Power Plants and electric companies etc

4. AUTOMATION AND PLC

Delegation of Human Control to technical Equipment aimed towards achieving.

Advantages

Higher productivity, Superior quality of end product, efficient usage of raw materials and energy, improved safety in working condition.

A. History of Control and Automation PLC
ELECTRICAL CONTROL WITH LOGIC GATES
WITH LOGIC GATES
MANUAL CONTROL

In this, the Control and Automation are done by Manual Operations [9, 12, and 13].

Drawbacks:

Human Errors subsequently affect quality of end product.

Hard Wired Logic Control

In this, Contractor and relays together with timers and counters were used in achieving desired level of automation.

Bulky and complex wiring, Involves lot of rework to implement changes in control logic, the work can be started only when the takes is fully defined and this leads to longer project time.

Electronics Control with Logic Gates

In this, Contactor and Relays together with timers and counters were replaced with logic gates and electronic timers in the control circuits.

Advantages

Reduced space requirements, energy saving, less maintenance and hence greater reliability.

The Major Drawbacks

Implementation of changes in the control logic as well as reducing the project lead- time was not possible.

Programmable Logic Controller

In this, instead of achieving desired control and automation through physical wiring of control devices, it is achieving through program say software.

Advantages

Reduced Space, Energy saving, Modular Replacement, Easy trouble shooting, Error diagnostics programmer, Economical, Greater life and reliability, The Compatibilities of PLC'S, Logic Control, PID control, Operator control, Signaling and listing, Coordination and communication.

5. SCADA Architecture

A SCADA system is a common process automation system which is used to gather data from sensors and instruments located at remote sites and to transmit data at a central site for either controlor monitoring purposes. The collected data is usually viewed on one or more SCADA host computers located at the central or master site. 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.

Generally, a SCADA system includes the following components:

□ □ Instruments that sense process variables

□ □ Operatingequipment connected to instruments

□ □ Local processors that collect data and communicate with the site's instruments and operating

equipment called Programmable Logic Controller (PLC), Remote Terminal Unit (RTU), Intelligent Electronic Device (IED), or Process Automation Controller (PAC)

□ □ Short range communications between local processors, instruments, and operating equipment

□ □ Host computers as central point of human monitoring and control of the processes, storing

Databases and display of statistical control charts, and reports. Host computers are also known as Master Terminal Unit (MTU), the SCADA server, or a PC with Human Machine Interface (HMI)

□ □ Long range communications between local processors and host computers using wired and/or wireless network connections.

SCADA systems differ from DCSs (Distributed Control Systems) which are generally found in plant sites. While DCSs cover the plant site, SCADA systems cover much larger geographic areas.

Also, due to the remoteness many of these often require the use of wireless communications.

C. Connecting to the PLC

•Open a SCADA application

•Create a tag of type I/O discrete, select the type as discrete

•Select read only if you don't want to force values to PLC. Selecting read and write allows to the SCADA to read and force values to the PLC.

•Type an access name.

•The access name can visualized as a gateway for a group of resources.

•Most of PLC drivers communicate with SCADA package using DDE, DDE requires three parameters namely name of the DDE server, topic name and item name. In case of reading a number of items from a particular PLC driver application name topic name are common, so this application name that is name of the DDE server and Topic name combine to form an access name. Access name is required to be defined only once then other items of driver can be accessed by using the Access name and item name. These details will be provided by the driver vendor or developer.

•Click ok, the access name will be listed finally click done, then type the item name, click save to save the I/O tags. Go to run time to communicate with PLC.

Field Instrumentation

The SCADA RTU is a (hopefully) small ruggedized computer, which provides intelligence in the field, and allows the central SCADA master to communicate with the field instruments. It is a stand-alone data acquisition and control unit. Its function is to control process equipment at the remote site, acquire data from the equipment, and transfer the data back to the central SCADA system [14].

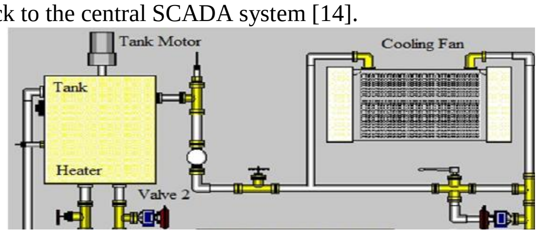

Fig 6. SCADA diagram for the system.

SCADA software enables you to configure a system environment that provides: [3]

Supervisory control, batch processing, data acquisition, continuous control, and statistical process control for industrial applications. Interfacing of PLC to PC and to SCADA is as follows:

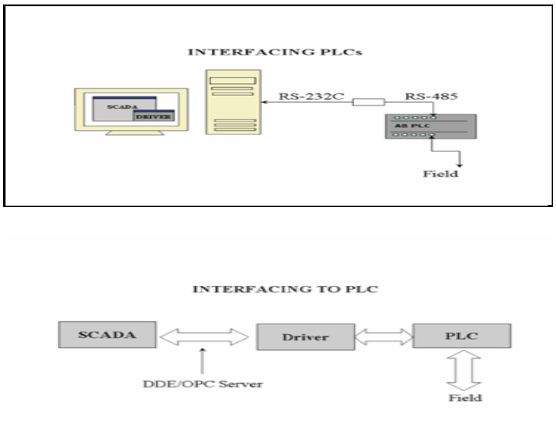

Fig 7. Interface diagram of PC to PLC and to SCADA.

6. CONCLUSIONS

This paper presents the importance of PLC and SCADA for automation; this allows remote and safe operation and monitoring, flexibility, scalability and power modular structure. A totally control is made in foundry industry using a PLC as control element and a SCADA system as supervisor software. Efficient control design is achieved in several senses by using proper automation so as to increase productivity, to increase quality, to reduce cost and to save energy.

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