Programmable Logic Controller Set for Complete Operation and Monitoring of Protection Interlock for Circulating Water Pump House

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Abstract : *This paper introduces the basics of a Programmable Logic Controller (PLC). It details the architecture and basic instruction set common to all PLC's. Basic programming techniques and logic designs are covered. This Paper describes the operating features of the PLC, the advantages of the PLC over hard-wired control systems, practical applications, troubleshooting and maintenance of PLC's. In Power plant operation PLC plays an important role for the Automation of System. Nowadays Power industry is experiencing many changes. One of the many developments is in the field of Automation with less interference of human being. Automation in Power industry would be useful for safety of Power plant. It increases the efficiency of the system in terms of speed, reliability, cost effectiveness, flexibility. PLC found its application in the operation of the Pumps, all auxiliaries / drives and Discharge Butter Fly Valves including motor operated Duct Interconnecting Valves. All the logic of permissive and interlocks for the operation of Circulating Water(CW) Pumps and Butter Fly Valves will be performed at PLC in Control Room. Start, stop, open , close command will be issued from Control Desk to Master Control Centre / Switchgear Via Programmable Logic Controller(PLC).All the interface signals from Limit & Torque Switches of Pump Discharge Butter Fly Valve shall be made available at PLC.*

Keywords: *PLC, Automation, CW pump house, CW pump, Butterfly Valve (BFV), Interlocks, Permissive.*

I.   Introduction

In the past Power plant systems were controlled manually using control desk. For operating various kind of mechanical and electrical equipment the signals are sends through relay devices by giving signal from control desk. But with the time the requirement for the flexibility of system start increasing that led to the introduction of PLC in power plant operation. Introduction of PLC introduces the concept of Automation. Automation means Self-moving .As it can be seen that it is made of two words Auto and matos. Auto means itself and Matos means moving. Automation reduces the excessive involvement of human being in the Power Plant thereby minimizing the human assistance and error. Various types of automation tools are used in power industry like Programmable logic Controller (PLC), SCADA i.e. Supervisory Control and Data   Acquisition, Distributed control System(DCS), Human Machine Interface (HMI).

In traditional systems the signaling was done by means of hardwired connection between the field instrument and the control desk via electromagnetic relay. Where relay act as a protecting device in the path which sense the variation in the normal value of voltage, current or frequency. If any variation occurs in the value, relay will trip the sub circuit or equipment from the main circuit in order to protect it from potential damage.

PLC has various advantages over its counter parts which are as follows:-
1) It require less wiring connection.
2) Interconnection between devices and relay are done in PLC program.
3) Reliability of the system is high.
4) It is an open area controller which means it cannot be affected by vibrations, temperature, humidity and noise.
5) It is easy to Program in PLC using ladder logic.
6) Interconnection between the devices and PLC can be change easily by changing program in PLC.
7) Cost effective.
8) It can be used for Analog /Digital controller both.
9) PLC system contains hardware and software which support multiple I/O system.

II. Circulating Water Pump House

In any Thermal power plant, Circulating Water System plays an important role that affects the operational efficiency of a thermal power plant. It also decides the location of a thermal power plant.

All thermal power plants follow the same process where the steam exiting from the steam turbine condenses in a condenser and then is reused in the steam cycle. Most of the thermal power plants in India use a surface condenser for cooling the steam. Other type of condensation technique use direct contact condenser.

Surface Condenser:-

In a surface condenser, the steam flows over a set of tubes caring condenser cooling water inside them. In a large thermal power plant, the condenser will have about 10,000 tubes .In this type of system heat exchange takes place through the surface of these tubes.

III. General

The Circulating Water(CW) Pump House of plant has 7 Nos. of CW Pumps fulfilling the water requirement of Power Plant.For two units of 600MW a configuration of three working Pumps is set for each unit and one common standby Pump,which is capable of delivering any one of the two units as per the requirement..

Operation of the Pumps, auxiliaries, drives and Discharge Butter Fly Valves including motor operated Duct Interconnecting Valves can be possible through Control Desk, located at CW Pump House.

All the logic of permissive and interlocks for the operation of Circulating Water(CW) Pumps and Butter Fly Valves will be performed at PLC in Control Room. Start, stop, open , close command will be issued from Control Desk to Master Control Centre / Switchgear Via Programmable Logic Cntroller(PLC).

A Local Emergency Push Button is provided near each CW Pump for Emergency tripping of CW Motor and local operation for maintenance purpose.

IV. Programmable Logic Controller

A digitally operating electronic apparatus which uses a programming memory for the internal storage of instructions for implementing specific functions such as logic, sequencing, timing, counting and arithmetic to control through digital or analog modules, various types of machines or process.

PLC finds it application in various areas like power , mining , food etc

Major Component of PLC:-
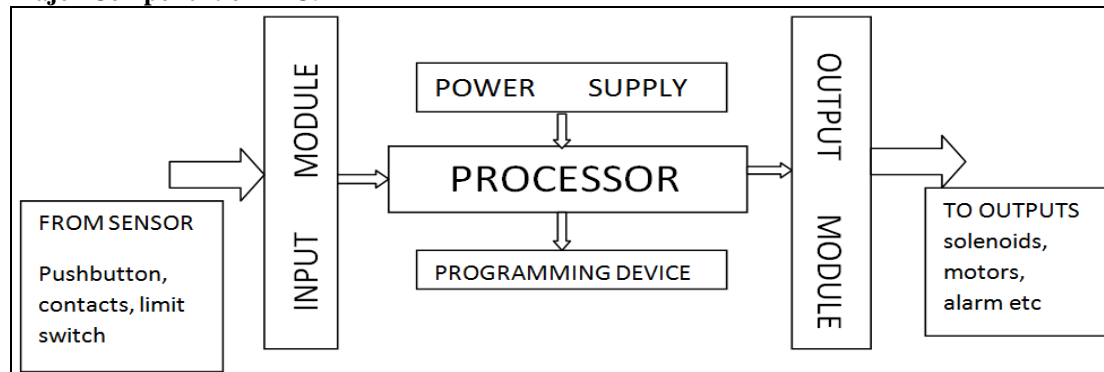
1)Power Supply:-

PLC consists of a power supply which provides 24 V dc output to the PLC module. These power supply are so perform the function of ADC i.e in input it receive 220 VAC and gives output of 24VDC.

2) I/O Module:-

PLC set consist of various input and output cards. These cards consist of Analog input cards (AI), Analog output cards (AO), Digital input cards (DI), Digital output cards (DO).
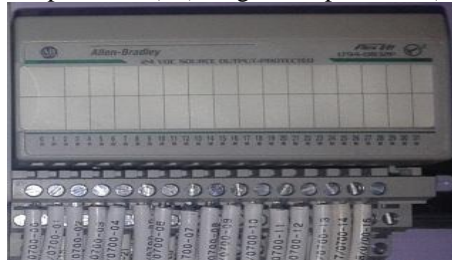
3) Processor:-

Processor will receive signals from I/O cards and on the basis of System program and user program installed in the memory processor will perform respective function and sends out the data through output cards to the equipment installed in the field.

4) Programming Devices:-

We uses RSLOGIX 5000 STANDARD EDITION software of Rockwell automation technologies for programming the logic. In this software we program the logic using ladder logic which define the sequence of operation, interlock protection, tripping logic of machineries.

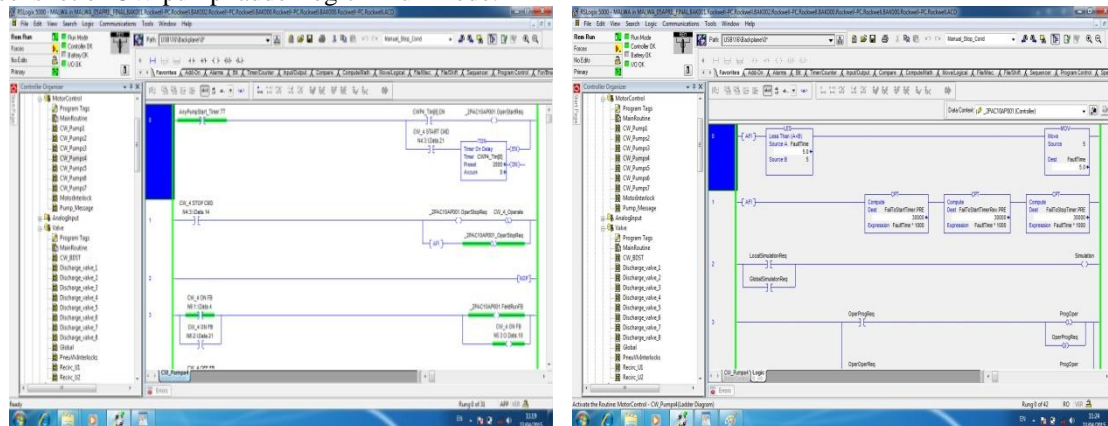Details of software:-

1) Installed Components:
- Ladder Diagram

2) Installed Controller Support:
- ControlLogix5500

3) Installed Firmware Support:
  v19
  v20

Screenshot of CW pump ladder logic in run mode.

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V.   Conclusion

Operation of the Pumps, auxiliaries, drives and Discharge Butter Fly Valves including motor operated Duct Interconnecting Valves can be possible through PLC ladder logic Program. All the logic of permissive and interlocks for the operation of Circulating Water(CW) Pumps and Butter Fly Valves will be performed by PLC Pogramr. Start, stop, open , close command can be issued from PLC.

Through PLC program we can monitor
- Discharge BFV is open/closed.
- Motor DE & NDE Bearing Temperatures are low/high.
- Motor Stator Winding Temperature are low/high.
- Emergency Stop PB position.
- Pump Reverse Rotation status.
- Motor Switchgear is availability.
- Switchgear position.
- Sump Level is low/high.

Acknowledgements

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