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Integrated 0.4 KV Bus Monitoring and Drives Control of Fuel Oil Pump House MCC in Thermal Power Station in NLC

[1]Selvaganapathy, [2]Nishavithri and [3]Manochandar

[1,3]Department of Electronics & Comm. Engg., CK College of Engg. & Tech., Cuddalore, India
[2]Department of Electronics & Comm. Engg., Mailam Engineering College, Mailam, India

Abstract: In general, Fuel Oil Pump House (FOPH) plays a vital role in power generating stations. FOPH supplies fuel oil to Boiler furnace during Boiler light-up conditions and for flame stability purpose at the time unscheduled reduction in lignite flow to the Boiler furnace. Actually, Lignite is the main fuel for Thermal Power Stations in Neyveli Lignite Corporation. The high capacity electric drives for this application are controlled by Hard-wired logic circuits using the conventional Electro – Mechanical Relays. But, this control technique has lot of disadvantages and limitations. More over any process – automation requires large number of relays to satisfy the application need. Large number of relays makes the physical wiring more complex and naturally the trouble- shooting time will become long. These limitations and de-merits can be greatly avoided by introducing Programmable Logic Controllers (PLCs). In recent trends of automation, PLC plays a leading role in maintaining high system reliability when compared with the existing technology. More-over it has superior communication capabilities with PC and other networked peripherals. The reason for adopting PLC technique is to reduce the trouble – shooting time and minimize physical wiring/cabling (for control activities). Hence simply we make our process control technology-interfaced to PC. Even if any fault occurs, it can be easily identified through HMI or SCADA facilities in Real – Time.In our project we are going to explain the PLC system technology for monitoring and control of drives employed in FOPH in an elaborate and clear way.

Key words: FOPH · TPS – II · PLC / SCADA · HMI · EM Relays

INTRODUCTION

The Second Thermal Power Station consists of 7 numbers of 210 MW Units and hence having an installed capacity of 1470 MW. Units 1, 2 & 3 were constructed in the First Stage followed by the Second Stage Units 4, 5, 6&7. Lignite for the station is supplied from mine – II having an annual capacity of 10.5 Million Tonnes. Unit 1 was commissioned in March 1986 and commissioning of the 7th unit was carried out in June 1993. Year after year production records are broken by Thermal Power Station –II. The southern states of Tamil Nadu, Kerala, Karnataka and Andhra Pradesh and the Union Territory of Pondicherry are the beneficiaries of the power produced in the power station.

The First Stage units are fully of foreign origin. Boilers are of M/s EVT Germany design and manufactured, supplied and erected by M/S Trans electro of Hungary. Turbines are of M/S Westing house U.S.A design and manufactured, supplied and erected by the erstwhile M/S Franco Tosi of Italy (now merged with M/S Ansaldo of Italy). Generator is of Ercole Morelli, Italy's supply.

Stage – II units are fully of M/S BHEL's supply even though the Boilers are of M/S EVT Germany's design, Turbines are of M/S KWU Germany's (a Siemens subsidiary) design and Generator is of Russian design. 9014.04 Million units of Electricity can be generated per annum from this power station at 70% annual plant load factor; but the actual production figures in recent years are much higher.

Motivation: In Stage – I Boilers only LSHS (Low Sulphur Heavy Stock) is used. In Stage – II Boilers, both Light Diesel Oil and LSHS are used. There are two separate Fuel Oil Pump Houses (FOPH), one meant for Stage – I and the other for Stage – II. LDO and LSHS are received in boozers. There are two storage tanks of 100 M3 capacity

Corresponding Author: Mr. M. Selvaganapathy, Dept. of ECE, CK College of Engineering and Technology, Cuddalore, India.

each for LDO and two tanks of capacity 1900 M3 each for storing LSHS. No heating is necessary for LDO. In the oil handling system there are facilities for decanting, heating, filtering, pumping functions and metering of oil flow.

Floor coil heaters are installed in LSHS tanks to prevent solidification as the pour point of LSHS is high (600°C). The storage tanks are also insulated. Trace heating system is employed to prevent temperature drop of LSHS from pump house to Boilers. Even though Lignite is the main fuel, LDO and LSHS are used during startup, shutdown and when the unit is in service at low loads for the oil flame stability in the Furnace.

Existing System: Existing electrical control system uses electro – mechanical type contactor logic control system. However, existing fuel oil pumping system, fuel oil receiving system all will be in service. Similarly, in the same pump house, 0.4KV bus system will also continue to be in service. Normally, these electro – mechanical type contactor logics are also called as RELAY LOGIC CONTROL; simply called RLC. So, in simple terms, in this project, an attempt is being made to change the controlling technology from RLC to PLC. All these modifications are going to be made in the same FUEL OIL PUMP HOUSE premises itself in Thermal Power Station – II.

Proposed System: The existing technology is replaced by mesh topology which overcomes the drawback of bus and star topologies. So implementing mesh topology in ZIGBEE network with many numbers of nodes forms an effective communication without any loss in data while transmission. Thus efficient communication is achieved using mesh topology with multiple number nodes by achieving the coverage area. Thus using the ZIGBEE protocol, it provides a secure transmission over the wireless communication devices.

Literature Survey

PLC Based Industrial Crane Automation and Monitoring - Prof. Burali Y. N.: In a traditional industrial crane control system, all control devices are wired directly to each other according to how the system is supposed to operate. Here human is the main to control the crane & that passes through large drawbacks such as more wiring work, appears large mechanical faults & difficulties in troubleshooting & repair work. Due to these drawbacks industrial production decreases largely. In this paper we are using PLC to control the crane movements. Programmable Logic Controller (PLC)is a small computer used for automation of real-world processes, such as control of machinery on factory assembly lines. The PLC usually uses a microprocessor. The program can often control complex sequencing andis often written by engineers. The program is stored in battery-backed memory and/or EEPROMs. Unlike general-purpose computers, the PLC is packaged and designed for extended temperature ranges, dirty or dusty conditions, immunity to electrical noise and is mechanically more rugged and resistant to vibration and impact. By implementing this project we decreases man power, thus increase in production of the industry .A digital electronic device that uses a programmable memory to store instruction and to implement function such as logic, sequencing, timing, counting and arithmetic in order to control machines and processes. The term logic is use primarily concerned with implementing logic and switching operations. Input devices e.g. switches and output devices e.g. motors, being controlled are connected to the PLC and then the controller monitors the inputs and outputs according to this program stored in the PLC by the operator and so controls the machine or process.

Automation for Industrial Reverse Osmosis System using SCADA Controller – M. Gowri Shankar, R. Nadhiya, A. Padma Priya, R. Selvi: Reverse Osmosis (RO) is reliable, cost effective and energy efficient in producing pure water compared to other desalination process. The operation parameters includes pressure drop, flow rate, temperature and PH which can be automated and monitored during the process. RO are widely used in water treatment plants. It ensures safe, continuous, high quality of water to industries. This paper describes how the automation of industrial Reverse Osmosis system is done using PLC and SCADA. Reverse osmosis invented in 1959, is the new method of purification of water. This process removes dissolved organic and salt membranes. PLC's are used for variety of automated systems and processes. PLC system monitors the input by controlling the output to automate the machines. Inputs and outputs are in the form of digital and Analog or by both. Inputs include AC, DC, analog, thermocouple, RTD, frequency, transistor and interrupt inputs. Output includes DC, AC and Relay. SCADA stands for Supervisory Control and Data Acquisition System. SCADA runs on DOS, VMS and UNIX.SCADA control performs monitoring, control for sites over longer distance of communication which including monitoring alarms and to process the data. The water is treated regularly and continuous process using PLC Operations are shown in blocks. The Major Flow Lines shown with arrows giving direction to flow. The flow goes from left to right. Light streams such as gases towards top with heavy stream such as liquids and solids towards bottom. If line cross, then the horizontal line is continuous and the vertical line is broken . From service tank, water is fed in to the tank. The anti – scale tank which removes the hardness of the Calcium and Magnesium of the water. Perma care 191 is the chemical used to remove the salinity in the water. Next the water is fed into SMBS (sodium metabi sulphate) dosing tank. Here the chlorinated water may oxidize the membrane, to avoid that SMBS is used. HDPE (High Density Poly Ethylene) is a chemical reaction used for recycling. Finally, the water is fed in to acid dosing tank, the chlorine is dosed which acts as a bleaching detergent and used to pure the water. Now from service water the water is moved to RO CIP tank then moves to the RO CIP pump then pump to RO CIP cartridge filter.

Both the process is connected to energy recovery turbo charger which acts as an energy analysing tool which allows to calculate the energy level quickly and easily. Then, the water is moved to the filter which removes the impurities and thus finally pure water is obtained from RO product outlet.

General Time Synchronisation Method for PLC Programs – Henrik Carlsson, Fredrik Danielson, Bengt Lennart Son: The latest state-of-the-art Computer Aided Production Engineering (CAPE) simulation technology offers OPC integration for PLC verification. A critical drawback with this technology has been identified and described within this paper. A new time synchronisation method and simulation architecture are therefore presented and proposed. The method described in this paper is general and should work on any PLCs that are compatible with the IEC 61131-3 standard.

A test case was also carried out, showing that by disregarding time synchronization. it is impossible to verify real-time dependent PLC functions together with CAPE tools in a reliable way. However, the test case also shows that by applying the proposed time synchronisation method together with the described simulation architecture a successful industrial verification method is achieved. The term industrial control system (ICS) is a broad definition for programmable controllers used in industry to control machines or processes. An example of an ICS commonly used in industry today is the PLC (Programmable Logic Controller).

A characteristic feature of ICSs is the reprogrammable control function that is described by the control code. The most common control code development and verification method is to program and verify the control code without any connection to a real process, instead using manual stimuli to simulate the real process.

Other existing methods are to connect the real ICS to the real process (Furusawa, 2002) or to a specially built process hardware model (mock-up) (Schluder mann *et al*., 2000). Today, however, it is possible to verify and develop the control code against a virtual prototype using simulation software (Freund *et al*., 2002).

One recent trend in conducting verification by means of a virtual prototype is to connect a real ICS to a CAPE simulation tool. CAPE (Computer Aided Production Engineering) is a classification for production-related simulation tools.

The most common CAPE tools used for ICS development and verification are discrete event-based simulation (DES) and Computer Aided Robotics (CAR) (Ng, 2003), (Cho, 2005), (Qingwei Ma, 2001). A common feature of all of these tools is their ability to simulate several types of production scenarios on different levels where a variety of robots, machines, manufacturing resources, control logic representation etc. are integrated into the simulation.

Technology Used for Control of Drives: Existing logic for control of drives Electro Mechanical relays are used. Electromechanical relays are also called as switching relays or control relays. A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism, but other operating principles are also used.

Relays find applications where it is necessary to control a circuit by a low – power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re – transmitting it to another.

Relays found extensive use in telephone exchanges and early computers to perform logical operations. A type of relay that can handle the high power required to directly drive an electric motor is called a contactor.

Solid – state relays control power circuits with no moving parts, instead using a semiconductor device triggered by light to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protection relays".

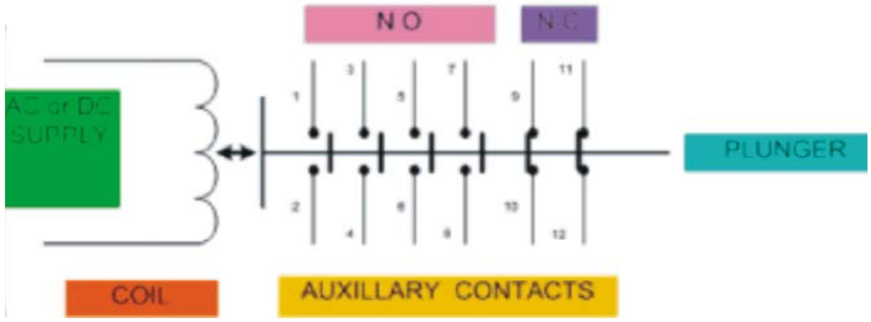

Fig. 1: Function of control relays

Motor Protection Relays: AC motors need over current protection against short circuits from external faults in connecting cables and from internal faults in motor windings. In addition, motors are thermally rated and limited and protective relays must be applied to prevent overheating during operating conditions where no fault is present.

Power Circuit Design Calculations for 3 PH Drive:

The below example taken for a 3ph 10 H.P drive,

Hence,

P=10 H.P.

Cos θ=0.85

V=415 Volts

The Power required is given by,

$P = \sqrt{3} * V * I * \cos\theta$

Then the current, Iis given by,

1 h.p= 746 W
I = 7460
P =√3 * 415 * 0.85
I=12.2 A

This current is the rated current,

I_r= 12.2 A

And the current through the fuse rating is given by,

F_r=(3.5 to 4) * I_r
= 12.2 * 4
= 48.8 ~ 50.0 A

where,

F_r = Fuse rating in amps
I_r = Rated current in amps.

(OLR) Over Load Relay Setting

OLR Setting = (1.2 to 1.25) * I_r
= 12.2 * 1.2
= 14.4 A which is normally 120 % of loading.

RESULTS AND DISCUSSION

The high capacity electric drives for this application are controlled by Hard-wired logic circuits using the conventional Electro- Mechanical Relays. But, this control technique has lot of disadvantages and limitations. More over any process- automation requires large number of relays to satisfy the application need. Large number of relays makes the physical wiring more complex and naturally the trouble- shooting time will become long.

These limitations and de-merits can be greatly avoided by introducing Programmable Logic Controllers (PLCs). In recent trends of automation, PLC plays a leading role in maintaining high system reliability when compared with the existing technology. More-over it has superior communication capabilities with PC and other networked peripherals. The discussion about the result using ZEN software has been performed so far. The stimulation output of “INTEGRATED 0.4KV BUS MONITORING AND DRIVES CONTROL OF FOPH MCC IN TPS – II” is being obtained.

After selecting the input in the property setting page, ladder diagram of PLC simulation. After execute the ladder diagram , we monitoring the control action of FOPH drives in TPS – II and reducing the manpower in performing a work.

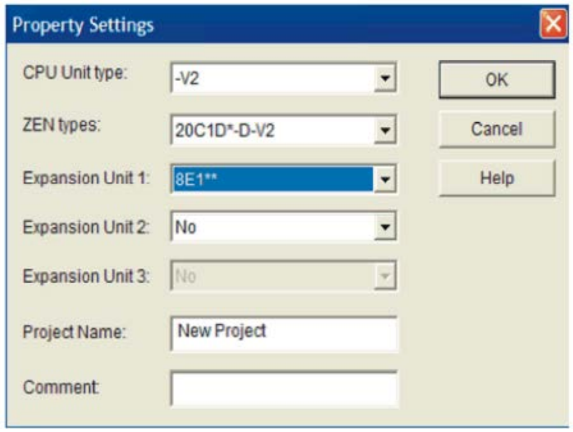

Fig. 2: Initial Simulation Page

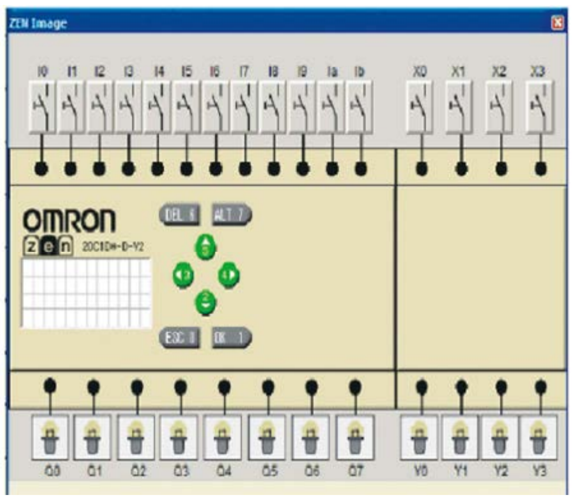

Fig. 3: Output Simulation Page

Conclusion and Future Enhancement

Conclusion: Thus by using this project to make effective, safe and cheaper control of drives with PLC control in Fuel Oil Pump House of Thermal Power Station.

This is a very great opportunity for us to gather adequate ideas of PLC control system from both electrical and mechanical point of view by having continuous technical discussions with Power Station Engineers during our project period.

We gained full confidence and satisfaction in our project; did in a good way, collected lot of technical information. We also suggested a proposal sketch for our project that will play effective role in the controlling part on Real – Time basis, because latest PLCs are now – a – days proving their mettle in Real– Time applications.

The software for our project is available in this record and the same was loaded and tested with PLC. The performance of the system was found satisfactory.

Future Enhancement: All PLC units are having communication port. Hence, it is very easy to connect them with Desktop Computers or with Laptop computers for programs uploading and downloading purpose.

Due to this communication facility, it is also possible to extend these PLCs usages upto the level of Human – Machine Interface (HMI). Once, HMI is created, then it is possible to view entire FOPH scheme on the computer monitor and all power flow control related activities can be executed from HMI itself.

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