Closed loop control of Generator

Transformer temperature by using plc

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***Abstract*-The electro-mechanical relays and associated timers for required delay timings are being adopted in the control circuit of existing generator transformer's forced-oil-air cooling control system, with low reliability, little protection function, uneasily extended and no communication interface. There should be no compromise in its cooling activities otherwise it may lead to a major shut-down of the power distribution or revenue loss. The way that Master-Slave Logic Controller with high reliability and versatility replaces partial unreliable contact ants and relays to modify older system is presented, and a new transformer's forced-oil-air cooling control system is designed. Its site operation shows that the device is of high operation reliability and control accuracy, has perfect functions and notable effect of power saving. It is to be noted that revenue loss is also prevented.**

***Indexterms*-Generator Transformer (G.T), Programmable Logical Controller (PLC), Forced Oil Air Cooling Control System (FOAC).**

I.INTRODUCTION

To monitor and control the cooling activities of a 250 MVA Generator Transformer (G.T) along with enhanced Mulsifire system using PLC technology. The reasons for. monitoring the GT cooling process is temperature- of oil and winding plays the major role and has to be controlled within limit. Since the Generator Transformer is Power Transformer, monitoring the temperature of Oil and Winding will be a crucial and most required one.

A.GENERATOR TRANSFORMER

It is a 250MVA step-up transformer- huge assembly very big Power transformer. Generating Transformer shortly called G.T is a Power Transformer having a capacity of 250 MVA. The term Power Transformer is used for capacity more than one MVA. In Thermal Power Stations, apart from Boilers, Turbine and their accessories, next major equipment is Generator and Generator Transformer. Normally, in Thermal Power Stations, Turbine speeds are 3000 RPM. Hence, to maintain 50Hz A.C. supply at Generator Power Terminals, Generators are built with 2-poles only. Generators terminal voltages, now-a-days, are of the order of 15KV to 15.75KV.

B.RELAYS

The relays are normally open and they are closed at fault condition. Here the relays are gets closed as soon as the temperature is sensed by the temperature probes from the G.T. As soon as the relay contacts gets tripped, the timer circuit gets energized and gets closed. When the timer gets closed, the over-load relay(OLR) also gets closed. Thus the fan-series and then the oil-pump series starts. The OLR gets tripped when the temperature reduces and the relay gets opened.

C.EXISTING SYSTEM

Alarm facilities are available in transformer, through physical wiring. While Buckhholtz relay operates, it initiates relay to energize. Through auxiliary contacts of Relay the GT Breaker tripping coil getting 230 V d.c supply to trip breaker under severe fault conditions. There by isolating machine and transformer from grid. It consists of temperature sensor, relay, timer, level switches, switches, speaker for alarm and LEDs for indication. The temperature sensors sense the temperature of the generator transformer and start and stop the fan series and the oil pump series accordingly.

D.INTERNAL COOLING ACTIVITIES

- Oil Natural Air Natural (ONAN)
- Oil Natural Air Forced (ONAF)
- Oil Forced Air Forced (OFAF)

E.ELEMENTS OF FORCED AIR COOLING

- 3ϕ Fans– 20 Nos (each 2 KW).
- Divided into three serie s (7+7+6).

Table- I

Fan Series	**Temperature range**
First fan series (Seven 3ϕ fans)	50˚c
Second fan series (seven 3ϕ fans)	60˚c
Third fan series (six 3ϕ fans)	65˚c

Table- II

Pump series	**Pumps involved**	**Temperature range**
A	1 & 3	75˚c
B	2 & 4 (Come into service only when first series fails to start)	75˚c

G.PROPOSED SYSTEM

To eliminate the de-merits of existing EMR logic -to make the system control Intact and PC friendly – the best choice at our hand is PLC. Hence we introduce PLC into action – thereby making system reliability more effective and user-friendly. Here Safe and secured Control action of drives accomplished by Programmable Logic Controllers (PLC). Action of drives, ensured by inbuilt relays, timers and contactors. Each relay, timer and contactors are replaced by the ladder logic.

II.BLOCK DIAGRAM

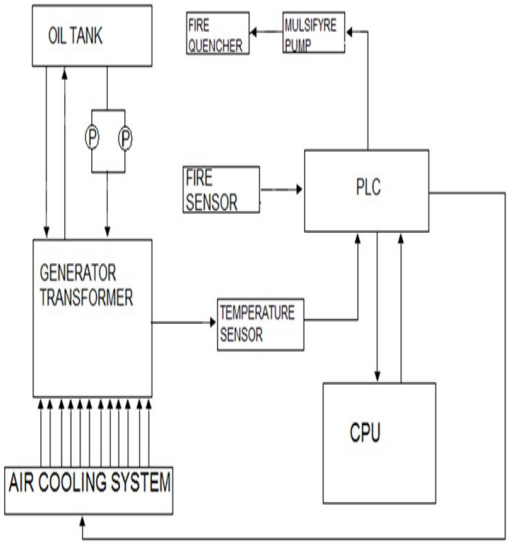

Fig. 1 Block Diagram

A.MULSIFIRE SYSTEM:

Quenches EXTERNAL fire during fire accident. Fire sensors placed in transformer surrounding. During break-out of fire SENSOR, deluge valve opens and activates the mulsifyre pump to quench fire. Mulsifire system extended to transformer fins. Mode of heat exchange is shifted from radiation to convection.

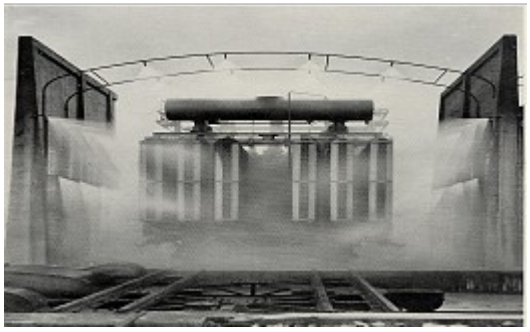

Fig. 2 Mulsifire System

III.EXPERIMENTAL HARDWARE COMPONENT DESCRIPTION

A.INTRODUCTION

A PLC (i.e. Programmable Logic Controller) is a device that was invented to replace the necessary sequential relay circuits for machine control. The PLC works by looking at its inputs and depending upon their state, turning on/off its outputs. The user enters a program, usually via software that gives desired results. PLCs are used in many "real world" applications. If there is industry present, chances are good that there is a plc present. If you are involved in machining, packaging, material handling, automated assembly or countless other industries you are probably already using them. If you are not, you are wasting money and time. Almost any application that needs some type of electrical control has a need for a plc.[1][2][3]

Fig. 3 Omeran

A.RELIABILITY

Once a program has been written and debugged, it can be easily transfer and downloaded to other PLC's. This reduces programming time, minimizes debugging and increase reliability. With all the logic existing in the PLC's memory, there is no chance of making a logic wiring error. The only wiring required is for power and input and outputs.

B.FLEXIBILITY

Program modification can be made with just a few keystrokes. OEMS (original equipment manufacturers) can easily implemented system update by sending to a new program instead of service person. End-users can modify the program in the field or conversely, OEMS can prevent end users from tinkering with the program(an important security feature).

C.ADVANCED FUNCTIONS

PLC's can perform a wide variety of control tasks, from a single, repetitive section to complex data modification. Standardizing on PLC's opens many doors for designers, and simplifies the job for maintenance personnel.

D.COMMUNICATION

Communicating with operator interfaces, other PLC's or computer facilities data collection and information exchange.

E.SPEED

Because some automated machines process thousands of items per minute-and objects spend only a fraction of a second in from a sensor- many automation applications require PLC's quick response capability.

F.TRADITIONAL APPLICATIONS OF PLC

Process using PLC's include:

- Packing
- Bottling and canning
- Material handling
- Machining
- Power generation
- HVAC/ building control systems
- Security systems
- Automated assembly
- Paint lines
- Water treatment

PLC's are applied in variety of industries including

- Food and beverages
- Automotive
- Chemical

- Plastics
- Pulp and paper
- Pharmaceuticals
- Metals
- Virtually any applications that requires electrical control can use a plc

IV.SIMULATION IN SOFTWARE

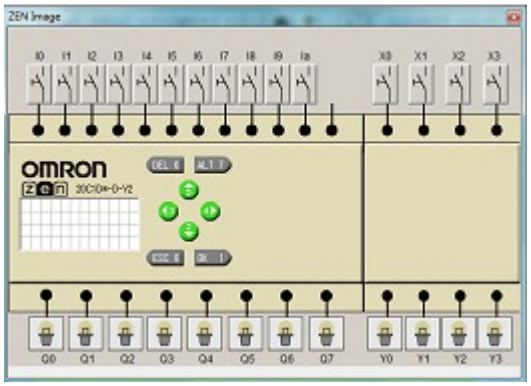

Fig. 4 Simulation in Software

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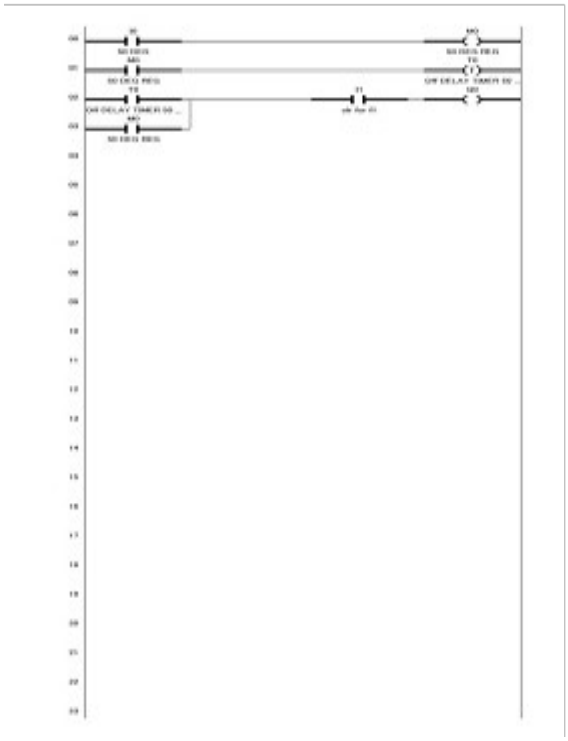


A.SOFTWARE PART WITH EXAMPLE PROGRAM

Fig. 5 Fan Series 1

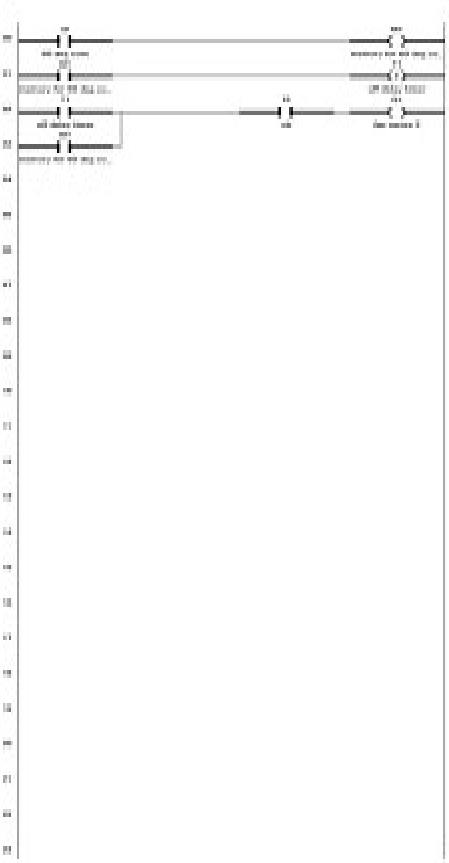
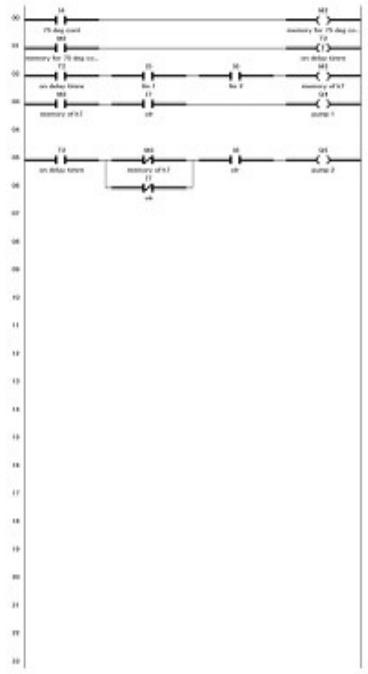
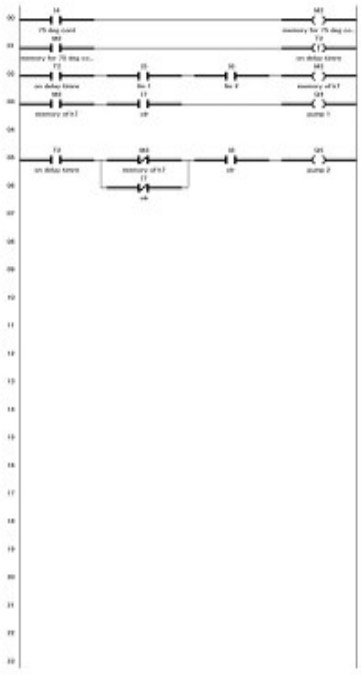
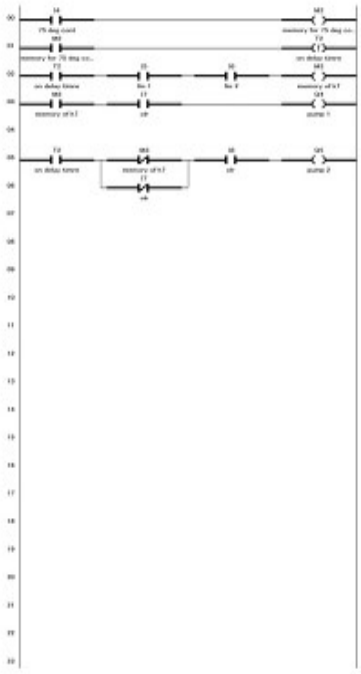


Fig. 6 Fan Series 2







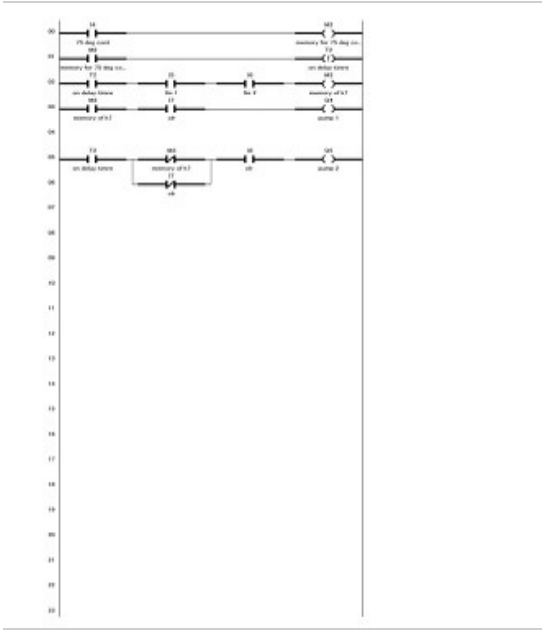


Fig. 7 Pump Series 1 & 2

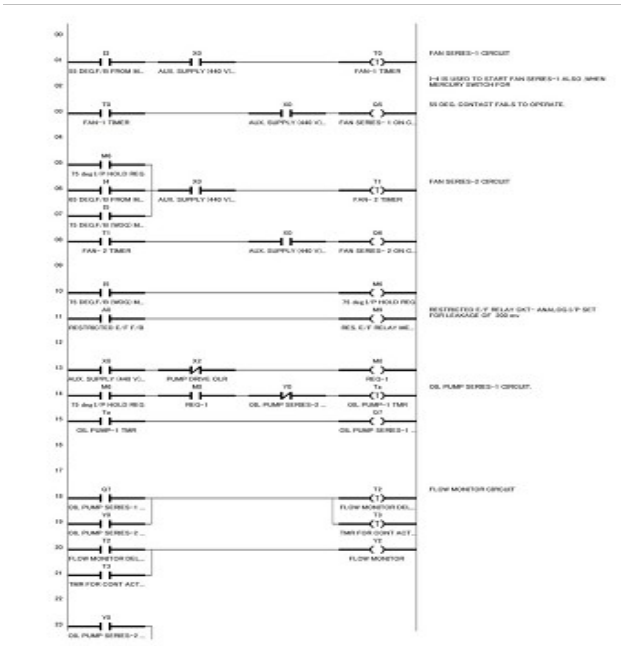
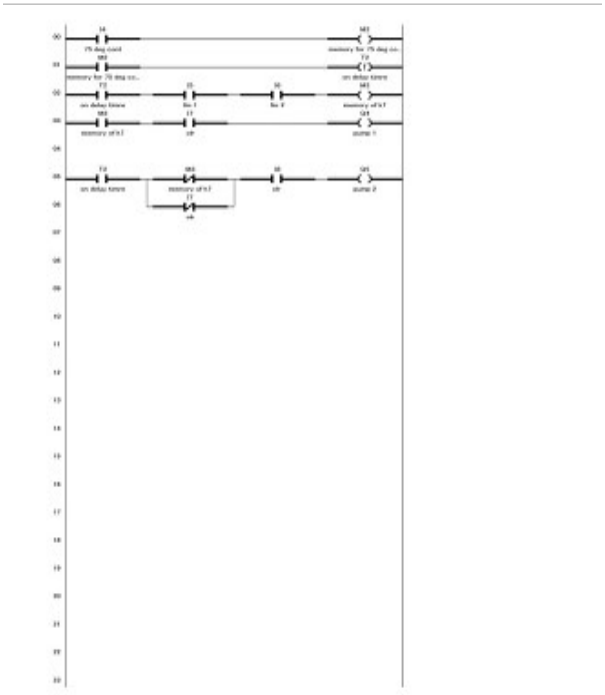


Fig. 8 Ladder logic for Complete GT monitoring Process



V.CONCLUSION

By introducing PLC into action the process becomes more flexible , reliable and PC friendly. The control technology is simply converted to software here – makes even complicated process to simple one. Trouble shooting experience becomes easier now compared to existing technology. With this updated technology, we monitor and control even trouble shoot our G.T monitoring activities right from Unit Control Board (UCB). The Modular PLC can be easily interfaced with other G.Ts also from a single master PLC- there by monitoring all G.Ts through a single MASTER is possible. This is compatible and reliable. So we prefer PLC for the real-time monitoring of GT cooling techniques than the other available control technologies.

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