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## Control of Water Cooled Stator of Alternator Using PLC

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**ABSTRACT:** The power station Generator will be a high capacity machine. Because of the enormous current handling capacity, in terms of thousands of amperes- heat generation will be more. Hence cooling of generator plays vital role. Failure in cooling arrangement will result in tripping of the generator from grid. Monitoring Stator water cooling system is efficient by introducing Programmable Logic Controller as a control platform.

**KEYWORDS:** Programmable Logic Controller (PLC), Stator Water Cooling System (SWCS).

### I. INTRODUCTION

One method of taking away the losses from the windings of any electrical machines is by direct cooling using water. The optimum design of large capacity turbo-generator, as a rule envisages water cooling of stator windings. The generators employ a closed loop circulation of High quality De- Mineralized water through the stator windings made of hollow and solid conductors. The cooling system circuit uses Fully De- Mineralized water from WTP, which is free from Oxygen.

The pressure and flow of DM water from and to the generator will be monitored through pressure switches and flow meter. The conductivity of DM water should also be monitored and it should not exceed 2.5 micro mho/cm. It is proposed here to monitor Stator water cooling system with customized Programmable Logic Controller is introduced as a control platform.

For controlling we introduce Programmable logic controllers. PLCs, have become the industry standard, replacing the hard-wired electromechanical devices, in controlling complicated process machines. PLCs are playing ever-popular and critical roles in modern manufacturing systems. Introducing PLC our process becomes PC friendly (Human Machine Interface-HMI) and the control becomes user-friendly.

### II. SCHEME CONTROL OF SWCS

#### EXISTING CONTROL SCHEME

Industrial control should ensure first man safety then machine safety. Drive control normally uses Control supply or control voltage for safe and secured operation. The voltage levels might be 24 v /110 v ac or 220 v dc. In SWCS the control room and process area are separated at a distance of 250-300m. In general the switch gear area will be separated – from where the power flow is going to concerned drive. Here the control room is at first floor and the switch-gear area (Annex) is at ground floor.

The distance from control room and switch-gear is 100m approx. The control logic to control our drives in SWCS application is in control room. At present it is being carried out through Electro-Mechanical relays, timers. In control room Local/Remote selection switch is there to decide the SWP- series sequential starting/maintenance purpose. If the selection is in Local the drives will be controlled through local commands only. For this each and every drive is having

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its own control post near to the drive itself. In this selection the control logic will not respond for control room commands. This is for testing purpose. If the selection is in REMOTE, then the stream is started through a single start command- for the drive running there are some pre- defined conditions like local emergency switch should be in normal condition and the protection feedback should also be in healthy plus the pit level should be sufficient. Due to the drive capacity and pump nature these drives should not run without slurry.

## DRAWBACKS OF RELAYS

- Their coil needs a fairly high current to energize, which means some microelectronic circuits cannot drive them directly without additional circuitry.
- They cannot be switched on and off at high speed because they have a slow response and the switch contacts will rapidly wear due to the sparking.
  - Requires frequent maintenance.
- In case of control wire logic entire physical arrangement should be changed and reconfiguration cost is more.

## III. PROPOSED CONTROL SCHEME

Here we plan to introduce suitable Real-Time intelligent control technology, which will surmount the limitations of other control methods. Programmable Logic Controllers (PLC) is the system that will challenge any process control requirements with any level of complications.

Our proposed block layout for stator water cooling system is as follows.

In the proposed system, the hard wired relays are replaced by PLC. Instead of relay the PLC will control the pumps. The heat losses occur in the Generator parts are removed by the De-Mineralized (DM) water. There should not be chemicals, such as Ammonia, Hydrazine, and Phosphate etc, in DM water from boiler feed water plant. Part of DM water is bypassed, and is treated in mixed bed ion exchanger, connected in Parallel to the stator winding and return into suction side of the water Pump- thus maintaining the conductivity of closed loop circulating water within allowable level.

The DM water pump is connected to a three phase ac induction motor. Failure of working pump due to fault or power supply failure results in an automatic starting or changeover to standby pump drive. The condition for such a changeover is the diminishing of DM water pressure at the downstream. It is measured or sensed continuously through a Pressure switch. The heat absorbed by the DM water in the generator is dissipated to the secondary coolant in the primary water cooler. The difference of pressure between two end points such as at inlet and outlet of stator winding is of the amount of choking.

In addition to above, the system also provides for necessary instrumentation for indicating/signaling of the temperatures and pressures at various points of the system Pressure interlocking of the pumps is also provided.

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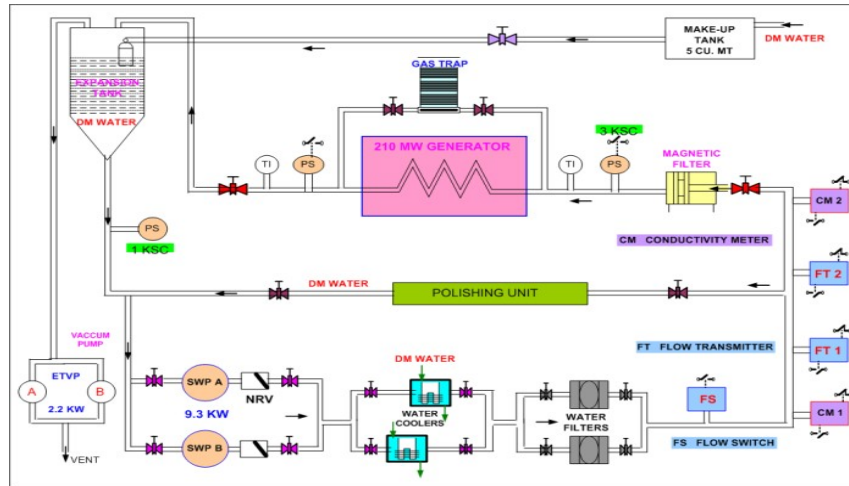
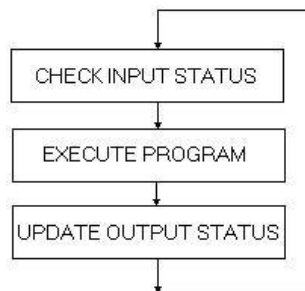


Fig 1. Flow diagram

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If at all any problem in any of its qualities the maximum allowed time will be only 60 seconds. If not recovered the “Control logic” of SWC system will trip the Generator from Grid. Hence power export will be stopped abruptly, causes major Revenue loss for the power industry. For continues operation of the generator the” stator water cooling system” should be maintained properly.

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## IV. CONCLUSION

While implementing PLC it is quite convenient to control the elements-i.e., circuit breakers, motors. Due to the superior communication facility with PC, system monitoring via computer is possible. Control of elements via PC makes this technology to widespread use in electrical engineering and instrumentation applications. PLC makes the system control with high reliability, relatively at faster speed of data transfer compared to other available technologies and consumes very less power, for its operation.

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