Special Issue on Proceedings of International Conference on Materials Manufacturing and Nanotechnology, June 2021. International Journal of Aquatic Science, Vol 12, Issue 03, 2021

Human Machine Interface Designed Generator Water Cooling System

A.S. Rajan, P. Siva, R. Bharathikanna

Nehru Institute of Technology, Kaliyapuram, Coimbatore 6411 05, Tamilnadu, India

***Correspondent Email:** nitbharathikanna@nehrucolleges.com

Abstract—**This paper focusses on how Stator water cooling system is being carried out using present control logic, its importance, operation, advantages and limitations in existing control.One of the ways 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 200/210/235 MW generators employ a closed loop circulation of High quality De-Mineralized water through the stator windings made of hollow and solid conductors.To enable software control we introduce Programmable logic controllers (PLC). Today's PLC consumes milli-seconds of time for each I/O scanning. It is a real-time operating system. They are playing ever-popular and critical roles in modern control systems. By introducing PLC into SWC System the total control is made possible with software. Incorporation of HMI and PC makes end-user to view system activities right through desktop screen.**

***Index Terms*—Push Button(PB),PLC,HMI,NLC**

I.INTRODUCTION

Our project titled "**HMI DesignedGenerator Cooling System**" will pay attention on how Stator water cooling system is being carried out using present control logic, its importance, operation, advantages and limitations in existing control.

The direct cooled machine are designed generally, to ensure quick removal of majority of heat by the water flowing in direct contact of the winding conductor, in addition to the removal of heat by hydrogen from the surface of hot winding insulation. The winding insulation besides having good dielectric strength has excellent thermal conductivity to ensure fast removal of heat. All strands of the reobel bar are brazed together, at the water .In the developing countries like India, the primary focus of utility is to make the units (Generators) available to its maximum and minimising the maintenance duration.The present IEC standards for Electrical Rotating Machines are referred for testing to establish the performance and quality. However they do not specify limits or trending of various operating parameters of generator Stator Water System, which needs to be continuously monitored.

One of the ways 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 200/210/235 MW generators employ a closed loop circulation of High quality De-Mineralized water through the stator windings made ofhollow and solid conductors**.**The winding insulation besides having good dielectric strength has excellent thermal conductivity to ensure fast removal of heat. All strands of the roebel bar are brazed together, at the water box connecting to header**.** The flexible connection between the high voltage (e.g. up to 15.75kV) conductors to water header is through Teflon tube.

We plan to do our project in the above area with Human Machine Interface based implementation. To enable software control we introduce Programmable logic controllers. Today's PLC consumes milli-seconds of time for each I/O scanning. It is a real-time operating system. They are playing ever-popular and critical roles in modern control systems. By introducing PLC into SWC System the total control is made possible with software. Incorporation of HMI and PC makes end-user to view system activities right through desktop screen.

II.DESCRIPTION OF STATOR WATER COOLING SYSTEM:

The heat losses arising in the stator winding, main terminal bushings and phase connectors are removed by de-mineralized water coming into direct contact with high voltage winding. The cooling water must have an electrical conductivityof less than 2.5 micro mho/Cm.

The De-mineralized (DM) water supply system comprises of following main components:

- Centrifugal pumps 2 * 100 % duty
- Distilled water cooler 2 * 100 % duty
- Polishing Unit
- Mechanical filters 2 * 100 % duty
- Magnetic filters 1 * 100 % duty

Other components employed in the system are gas trap device, expansion tank, water jet ejector, valves and associated instrumentation. Together with the

Special Issue on Proceedings of International Conference on Materials Manufacturing and Nanotechnology, June 2021. International Journal of Aquatic Science, Vol 12, Issue 03, 2021

connecting pipe work these components form the external circuit for the supply of cooling water to generator windings. Refer stator water system diagram. The cooling circuit makes use of either of the following water supplies, free from oxygen.

(a) Distilled Water.
(b) Fully de-mineralized water from boiler feed water treatment plant.
(c) Condensate.

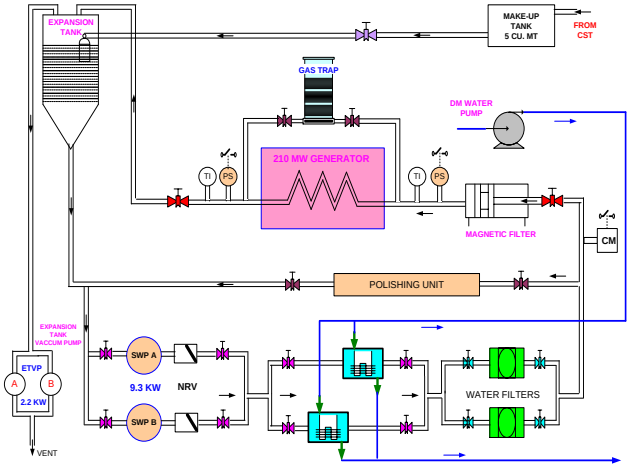
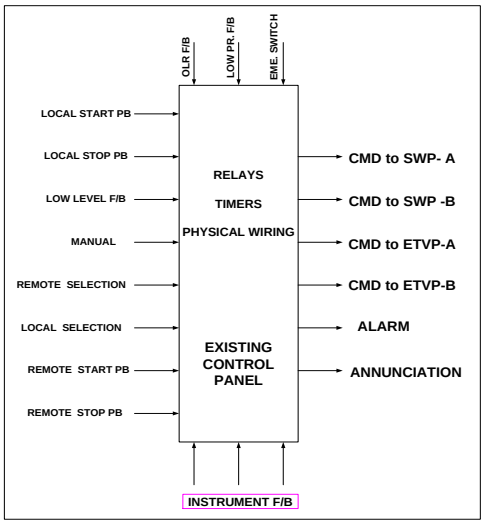


FIG: SCHEMATIC DIAGRAM OF STATOR WATER COOLING SYSTEM

III.EXISTING CONTROL OF STATOR WATER COOLING SYSTEM:

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal.

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching.



The control logic that uses relays, timers to fulfil process application requirement is said to as the traditional logic. Any level of complication will be successfully designed with this method. The major thing to keep in our mind is "The circuit diagram that solves the application" is must. The physical wiring according to circuit is essential.

IV.PROPOSED CONTROL:

Based on the de-merits of the existing control, we aim to design or propose a new control platform using PLC hardware and user-friendly software. It will be the best choice in our hand which will render brilliant communication facilities over PC.

This is one of the real time operating system working basically on a micro-processor with adequate control and Digital Signal Processing (DSP) integrated hardware- performs operations based on the software we written into its memory.

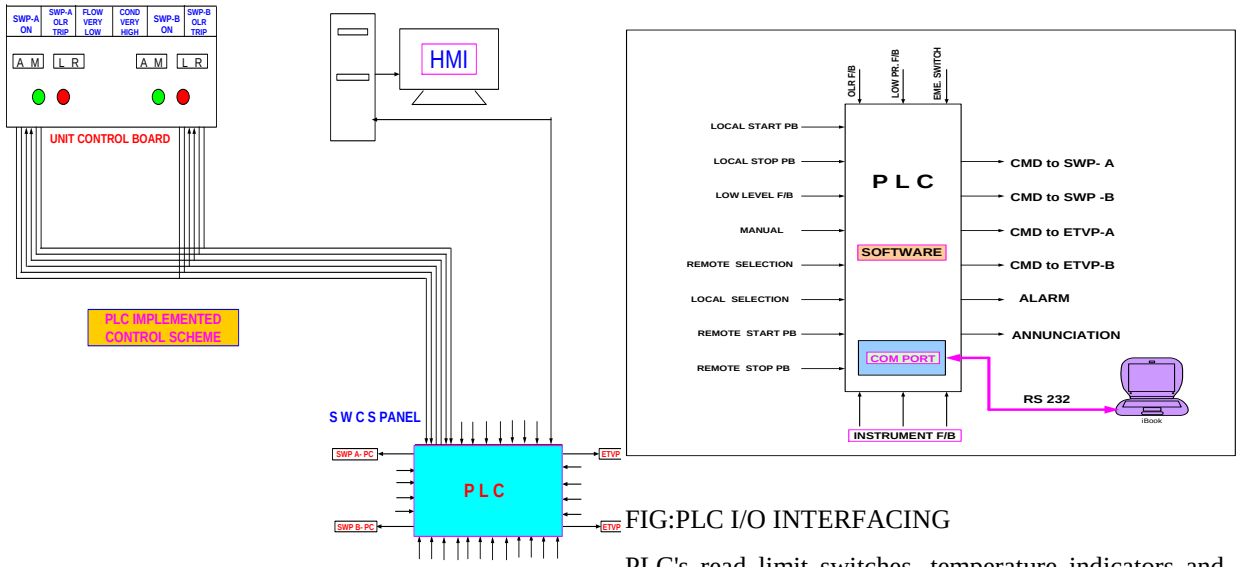


FIG:PLC I/O INTERFACING

Our aim of project is to update the system control technology using PLC. In simple words at present the EMR logic delivers the command (it may be a breaker or else a ordinary sw. gear) to the concerned switch-gear module to make or break the power to drive, if at all PLC is introduced the same command will be issued through PLC- here the control technology is software-ladder-user friendly one.On introducing PLC into action, now the process is PC compatible. The trouble shooting experience will be very interesting and much faster.

V.PROGRAMMABLE LOGIC CONTROLLER(PLC):

A Programmable Logic Controller (or PLC) is a specialized digital controller that can control machines and processes. It monitors inputs makes decisions, and controls outputs in order to automate machines and processes.

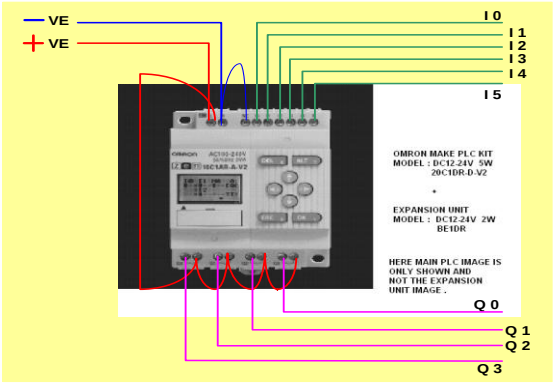


FIG:PLC

PLC's read limit switches, temperature indicators and the positions of complex positioning system. Some even use machine vision. On the actuator side, PLCs drive any kind of electric motor, pneumatic or hydraulic cylinders or diaphragms, magnetic relays or solenoids. The input/output arrangements may be built into a simple PLC, or the PLC may have external I/O modules attached to a proprietary computer network that plugs into the PLC.

VI. LADDER PROGRAMMING

The most frequently used instructions in a PLC ladder logic diagram are normally open (NO), the normally closed (NC), instruction and the output energized instruction. These instructions are represented as symbols placed on the rungs program.

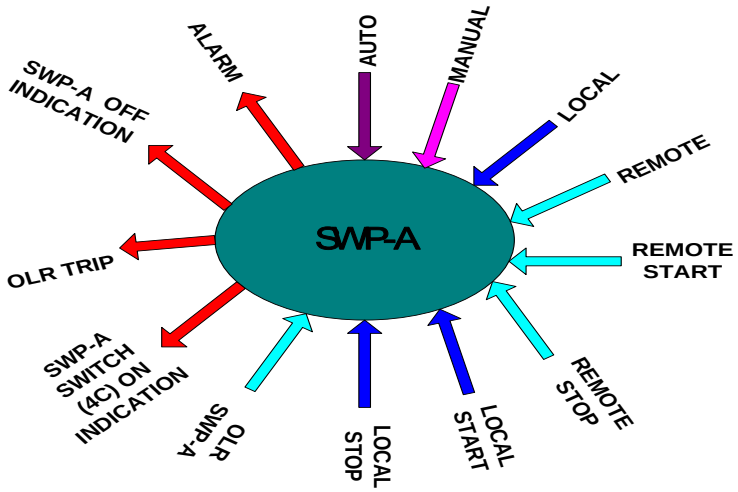


FIG: SWP-A INPUT/OUTPUT (I/O)

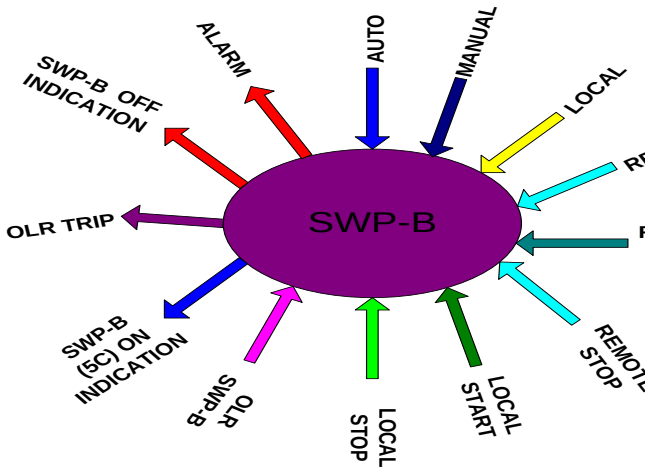


FIG: SWP-B INPUT/OUTPUT (I/O)

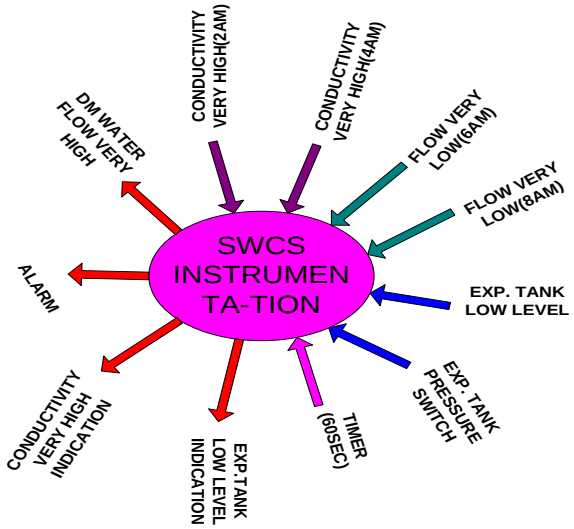
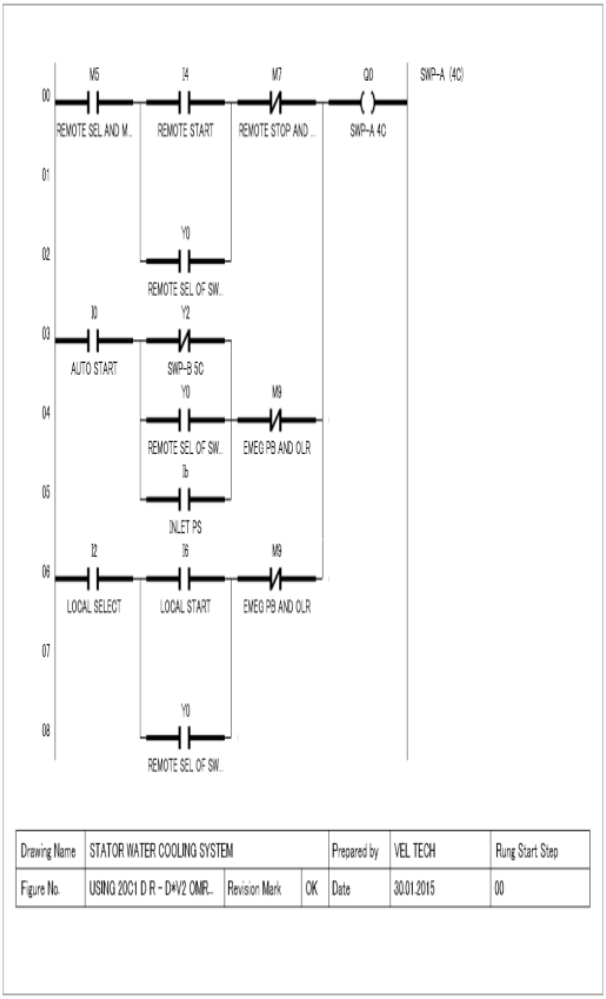


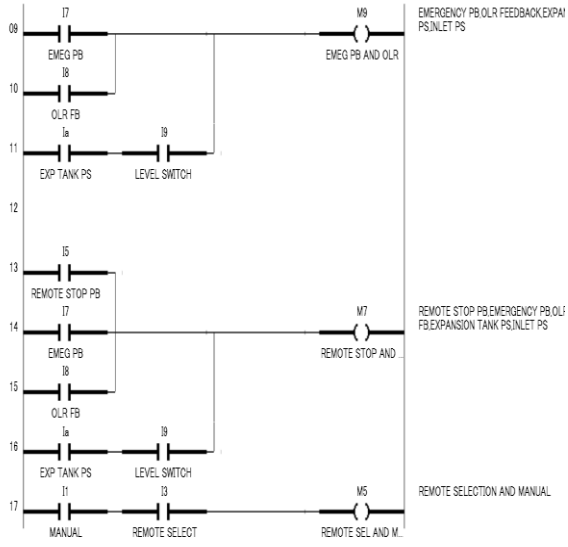
FIG: SWCS –INSTRUMENTATION INPUTS

VII.OPERATING LOGIC:

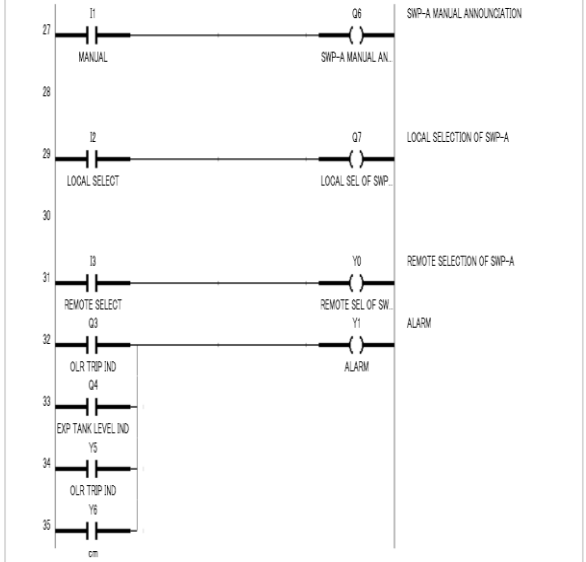
To operate SWP-A in a remote condition then the SWP-A A/M selection should be in Manual(M) and SWP-A L/R selection should be in Remote(R). When control room start PB(I4) is pressed then PLC will conform all other conditions and finally issues command to power contactor 4C via output Q0.

VIII.LADDER DIAGRAM OF STATOR WATER COOLING SYSTEM:

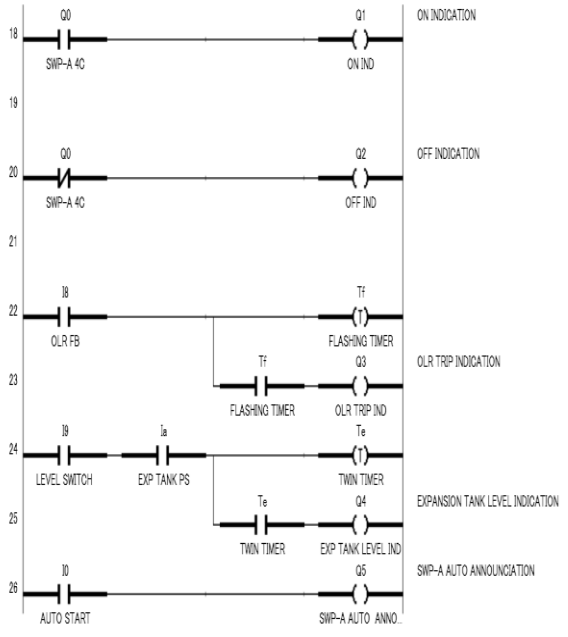




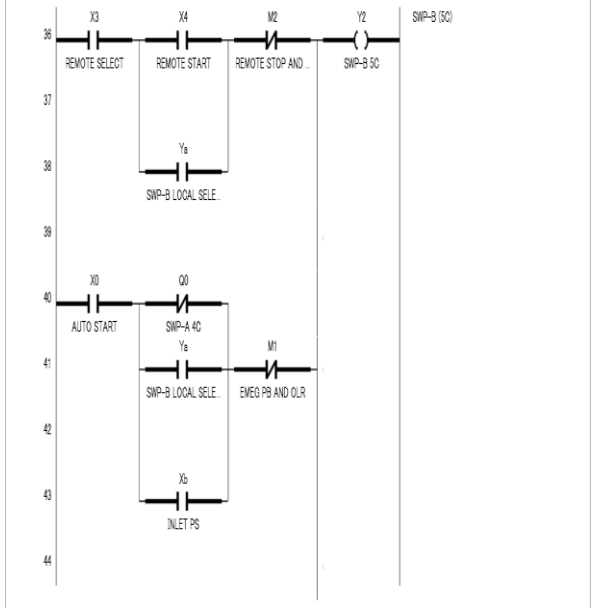
Drawing Name	STATOR WATER COOLING SYSTEM			Prepared by	VEL TECH	Rung Start Step
Figure No.	USING 20C1 D R - D#V2 OMR...	Revision Mark	OK	Date	30.01.2015	09



Drawing Name	STATOR WATER COOLING SYSTEM			Prepared by	VEL TECH	Rung Start Step
Figure No.	USING 20C1 D R - D#V2 OMR...	Revision Mark	OK	Date	30.01.2015	27

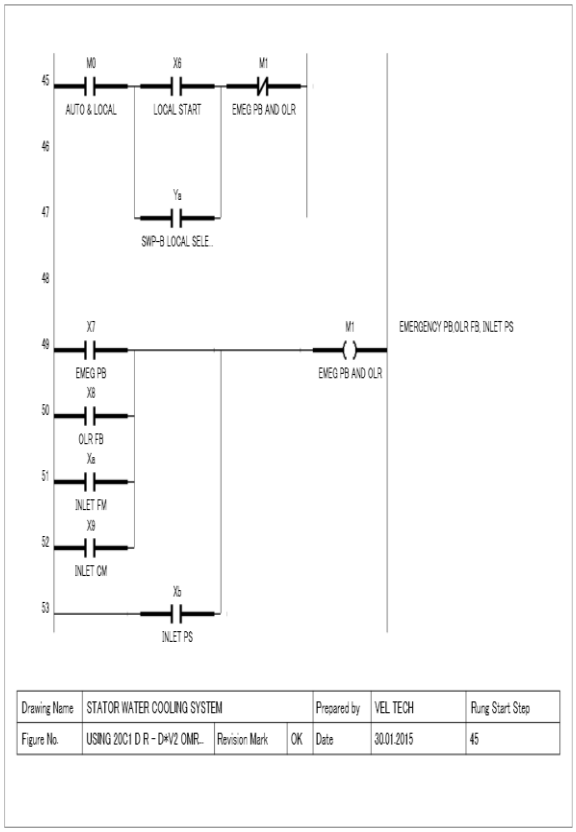


Drawing Name	STATOR WATER COOLING SYSTEM			Prepared by	VEL TECH	Rung Start Step
Figure No.	USING 20C1 D R - D#V2 OMR...	Revision Mark	OK	Date	30.01.2015	18

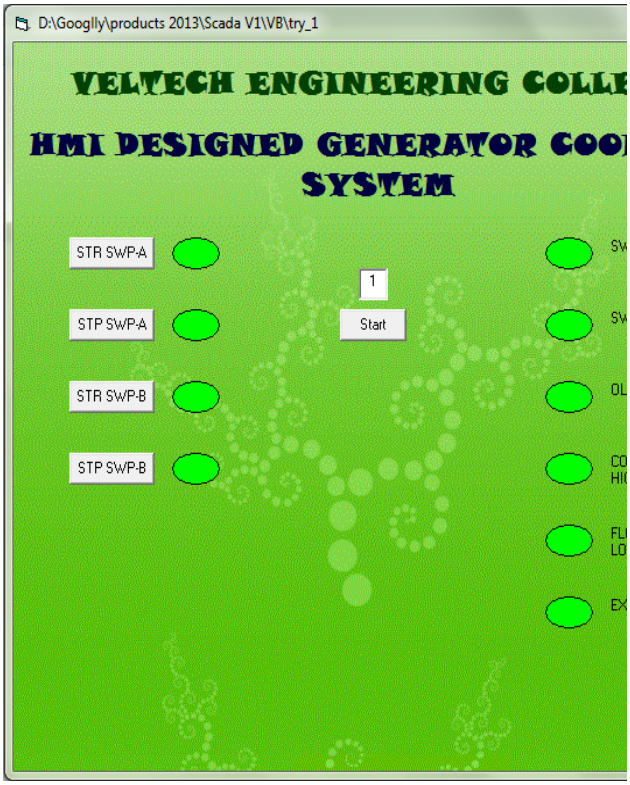


Drawing Name	STATOR WATER COOLING SYSTEM			Prepared by	VEL TECH	Rung Start Step
Figure No.	USING 20C1 D R - D#V2 OMR...	Revision Mark	OK	Date	30.01.2015	36

Special Issue on Proceedings of International Conference on Materials Manufacturing and Nanotechnology, June 2021. International Journal of Aquatic Science, Vol 12, Issue 03, 2021



XI.HMI – HUMAN MACHINE INTERFACE:



HMI stands for Human Machine Interface. It generally refers to industrial control systems: computer systems that monitor and control industrial, infrastructure, or facility based system.

Industrial processes include those of manufacturing, production, power generation, fabrication, and refining, and may run in continuous batch, repetitive, or discrete modes. Infrastructure processes may be public or private, and include water treatment and distribution, waste water collection and treatment, oil and gas pipelines, electrical power transmission and distribution, wind farms, civil defense siren systems, and large communication systems. Facility processes occur both in public facilities and private ones, including buildings, airports, ships, and space stations. They monitor and control heating, ventilation, and air conditioning systems (HVAC), access, and energy consumption. There are many parts of the working of HMI system. A HMI system usually includes signal hardware (input and output), controllers, networks, user interface (HMI), communication equipment and associated software packages. All together, the HMI refers to the entire central system. The central system usually monitors data from various sensors that are either in close or in open at site (sometimes kilometers away). For the most part, the brains of a HMI system are performed by the Remote Terminal Units – often referred as RTUs. The Remote Terminal Units consists of a programmable Logic Controllers.HMI systems are considered to be a closed loop system and run with relatively little human intervention. One of the key processes of a HMI is the ability to monitor the entire system in real time. This is facilitated by a data acquisition including meter reading, ON and OFF, status of inputs etc..that are communicated at regular intervals depending on the system speed. HMI can be seen as a system with many data elements called points or tags.

VISUAL BASIC 6.0:

Welcome to Microsoft Visual Basic, the fastest and easiest way to create applications for Microsoft Windows. Whether you are an experienced professional or brand new to Windows programming, Visual Basic provides you with a complete set of tools to simplify rapid application development .The "Visual" part refers to the method used to create the graphical user interface (GUI). Rather than writing numerous lines of code to describe the appearance and location of interface elements, you simply add prebuilt objects into place on screen. The "Basic" part refers to the BASIC (Beginners All-Purpose Symbolic Instruction Code) language, a language used by more programmers than any other language in the history of computing. Visual Basic has evolved from the original BASIC language and now contains several hundred statements,

Special Issue on Proceedings of International Conference on Materials Manufacturing and Nanotechnology, June 2021. International Journal of Aquatic Science, Vol 12, Issue 03, 2021

functions, and keywords, many of which relate directly to the Windows GUI.

X.CONCLUSION:

By Introducing PLC into action the process becomes more flexible, reliable and PC friendly. HMI activities may also be availed to have better visualization of our process and control also. The control technology is simply converted to software here-makes even complicated process to simple one. Trouble shooting experience becomes easier now compared to other existing technology. Electrical and electronics engineering find its valid use in the process control-in industries like power plants, chemical factories and cement factories to automate the process. The ladder software written was checked to simulation for its correctness and then downloaded to PLC. Command via PC also given and we found operation is being performed accordingly.

REFFERENCE:

1.Understanding, Diagnosing, and Repairing Leaks in Water-Cooled Generator Stator Windings- GE Power Systems
2. Behaviour of Copper in Generator Stator Cooling Water System by Robort Svoboda and Donald A. Palmer, Alstom Power
3. Forgotten Water: Stator Water Chemistry by David G Daniels
4. Deionised Water Application – Myron L Company
5. Generator Cooling System Operating Guidelines - EPRI
6. Handbook of Large turbo-generator Operation and Maintenance by Geoff Klempner
7. IEEE 50.13 Requirement for Cylindrical Rotor Synchronous Generators
8.http://www.software.rockwell.com/corporate/reference/Iec1131/st.cfm
http://www.sps-lehrgang.de/kontaktplan-kop/
http://www.plcmanual.com/plc-programming
http://www.plcsimulator.net/plc.php
http://www.amci.com/tutorials/tutorials-what-is-programmable-logic-controller.asp
http://www.scantime.co.uk/_docs/Mi/Structured%20Text%20Prog%20Manual.pdf