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ANALYSIS ON NORMAL SERVICE WATER SYSTEM MONITORING AND CONTROL THE VARIOUS PARAMETER THROUGH PLC

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ABSTRACT- *Our project titled "ANALYSIS ON NORMAL SERVICE WATER SYSYTEM PARAMETERS MONITORING AND CONTROL THE VARIOUS PARAMETER THROUGH PLC" pays attention on how Normal Service Water System(NSWS) works based on present control logic, its importance, operation, advantages, limitations. Prototype Fast Breeder Reactor (PFBR) is the second stage reactor of Indian Nuclear system. Heat loads generated in the plant is cooled by various water systems based on safety aspects. Normal service water system is used to remove the heat loads from Turbo generator equipment, Generator transformer coolers, chiller units, Air compressors and Nitrogen plant by using Demineralized water (DM). Normal service water(i.e.) DM water is cooled by sea water through heat exchangers. NSWS is controlled through Programmable Logic Controller (PLC). Our project in this system is to control expansion tank level, changing the flow of water through stand by pump, when winding temperature increases beyond the limit and finding efficiency of controller using Particle Swarm Optimization and Firefly Algorithm. Here all the task of operations are performed with the SIEMENS PLC.*

Keywords- NSWS, PFBR, Demineralized water,PLC

1, INTRODUCTION

Our task is to handle and control the DM water supply and maintain the level constant in the expansion tank. For the purpose of cooling the various loads in the Nuclear Island. In order to maintain the level in the expansion tank, level switches were used, so that the level will maintain constantly and then it is connected to three pumps used for transferring the DM water from the expansion tank to Heat Exchanger. Here one will acts as primary and another will acts as secondary. In case of any emergency the third pump will start's automatically. In the Heat Exchanger unit we use parallel plate type heat exchanger, When compared to shell and tube exchangers, the stacked-plate arrangement typically has lower volume and cost. Another difference between the two is that plate exchangers typically serve low to medium pressure fluids, compared to medium and high pressures of shell and tube. The hot water entering into the exchanger will cooled with the help of auxiliary sea water simultaneously. so that the DM water allowed to cool the various loads in the system. Before entering into Heat exchanger sea water will be filtered and chlorinated in order to avoid corrosion of transmission lines. Where the service water pressure is kept higher than that of sea water, so there is no possibility of contamination of DM water by sea water. The overall process is performed either in

AUTO/MANUAL mode through PLC and it is continuously monitored from control room or Local Control Panel.

2,EXISTING SYSTEM

Service water system which is the terminal heat transport medium, caters to cool the various plant auxiliaries, secondary cooling water for heat exchangers of various plant auxiliary systems and equipment such as chillier condensers, air compressors, diesel generators, lubricating oil coolers, boiler feed pump auxiliaries, hydrogen coolers, transformer oil coolers and stator coolers. The system provides cooling for various heat exchangers/equipment's during both power operations of the reactor and shutdown state. During class IV power failure, the reactor is shutdown and certain essential loads which are required under shutdown conditions are supplied by the service water Provision is made to run the system with class III power supply.

NSWS is a closed loop DM water system for cooling turbo generator auxiliaries and some equipment like chillers and air compressors in nuclear island. The system consists of 3x50% pumps and 4x33% plate type heat exchangers, expansion tank and chemical dosing system.

The service water inlet temperature to equipment is 36°C. The service water outlet temperature for air compressor is 46°C considering 10°C range and 41°C for other equipment considering 5°c range. So the average inlet and outlet temperature on the primary side of unit cooler 41.3°C and 36°C.

Auxiliary sea water flowing in the secondary side cools DM water, which is delivered to the heat exchangers. The total service water flow rate for NSWS is 4700m^3/h and sea water flow is 4200m^3 /h. The optimum capacity of heat exchanger is 1400m^3/h on service water side and 1567 m^3 /h on sea water. Service water pressure is kept higher than that of sea water, so that there is no possibility of contamination of DM water by sea water.

The over head expansion tank of 20m^3 capacity is provided at an elevation in the turbine building supplies make up water and maintains positive pressure at the pump suction. Makeup to this tank is supplied from the DM water distribution system.

Some equipment under this system, like air compressors and chillers require cooling water even after class IV power failure, Since this system is connected to only class IV power, those cooling loads are cooled by ESWS during class IV power failure. This system is provided with chemical dosing to prevent dissolved oxygen and to maintain pH. For this purpose hydra zinc and ammonia dosing is done at the service water pump suction.

2.1 INSTRUMENTATION AND CONTROL

The instrumentation and control provided for the normal service water system comprises of the following

- Field instruments for measurement of flow, level, temperature and pressure.
- Local control panel is provided in service water pump house to operate/control and monitor the status of all the service water and its auxiliary pumps, unit coolers and expansion tank.
- Monitoring of the process parameters in the CRT in CR and the respective building LCC, for the heat exchangers located in the various buildings of the nuclear island. The signals arc hardwired to DDCS processors located in the respective LCC.

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- Indication and control is provided in the CRT in CR.
- Facility to start & stop the raw water and service water pumps catering to safety related equipment from the control room. These signals are hardwired to the backup panel in the control room.

2.2 BACKUP SYSTEM REQUIREMENTS

During class IV failure, the essential loads of Normal Service Water System like compressed air, chillier plant, etc... are fed by Emergency Service Water System as a backup. Safely Related Service Water System consists of two trains. each of 100% capacity. When one train is in service other train will be on auto standby and if one train is not available the other train can supply to all the loads.

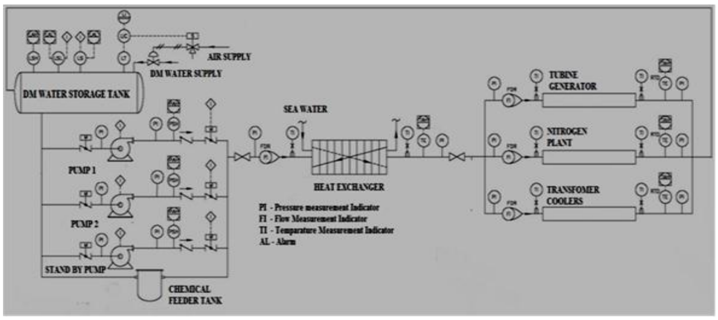

Fig2.1 Layout Of Normal Service Water System

3,PROPOSED SYSTEM

The aim of our project is to make a closed loop over the heat exchanger in order to reduce the excess amount of usage of water. In this system we control expansion tank level, Pump discharge, Pressure control and increases efficiency of single loop controller. Here overall operation of NSWS is controlled by SIEMENS PLC. Our task is to handle and control the DM water supply for the purpose of cooling various loads in Nuclear Island. In order to maintain the level in the expansion tank, level switches were used, so that the level will maintain constantly and then it is connected to three pumps used for transferring the DM water from the expansion tank to Heat Exchanger. Here one will acts as primary and another will acts as secondary. In case of any emergency the third pump will start's automatically. In the Heat Exchanger unit we use parallel plate type heat exchanger, When compared to shell and tube exchangers, the stacked-plate arrangement typically has lower volume and cost. Another difference between the two is that plate exchangers typically serve low to medium pressure fluids, compared to medium and high pressures of shell and tube. The hot water entering into the exchanger will cooled with the help of auxiliary sea water simultaneously. so that the DM water allowed to cool the various loads in the system. Before entering into Heat exchanger sea water will be filtered and chlorinated in order to avoid corrosion of transmission lines. Where the service water pressure is kept higher than that of sea water, so there is no possibility of contamination of DM water by sea water. In existing system the sea water directly enter into the heat exchanger and reduces the heat capacity and it will directly feed out to the atmosphere. The major impact behind this system is hot water will affects the aquatic species, minerals etc.. So in our proposed system we have developed a tank for cooling. We have used a PID controller in the outlet of the sea water

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storage tank, Where amount of temperature of DM water is measured, and it is transferred to the controller , according to temperature the position of valve will vary. The sea water temperature is also monitored continuously, if it exceeds the limit it cannot be used cooling the DM water, So it is discharged out to the atmosphere, Simultaneously the inlet valve is opened. We have also performed tuning operation for PID controller using PARTICLE SWAM OPTIMIZATION and FIREFLY ALGORITHM. We compared these algorithm's to obtain better output efficiency

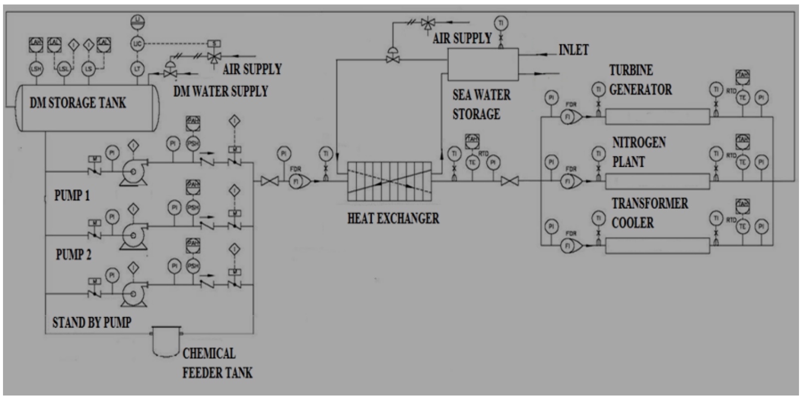

Fig 3.1 Layout Of Proposed System

4, CONCLUSION AND FUTURE WORK

Comparing to existing system, In our proposed system, we made the Heat Exchanger supply to be act as closed loop system, because the heat generated in this is less compared to the existing system. By using our proposed system we can reduce the amount of usage of water. our project provides very fast auto tuning method for determining the PID controller parameters using PSO and Firefly algorithms. The Proposed method also has the advantages of shorter calculation time and stable convergence which integrates the PSO and Firefly algorithms with the PID controller. From the simulation results of temperature level control system, the proposed controller can perform an efficient search to obtain optimal PID controller parameters. Therefore ,it is clear from the results that the proposed PSO and Firefly method has more robust, stability and efficiency and solve the tuning problems of PID controller parameters more easily and quickly than the existing method.

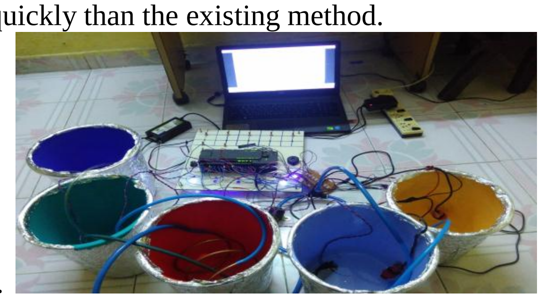

Fig 4.1 our Hardware setup Of Proposed System

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