Low Conductivity Water System

Cyclotron subsystems such as magnets, power supplies, RF cavities, trim coil lead, beam transport system, etc. gets heated during operation of cyclotron due to joules heating. Some of these components operate at high voltage. Low conductivity water is used for cooling the cyclotron subsystems to avoid leakage current, scaling and corrosion of the components being cooled. The conductivity and pH of water is maintained below the prescribed level. LCW system (Fig. 1) has been designed, fabricated, installed and commissioned for both the K130 and K500 cyclotrons.

A PLC based 2 cu.m/hr Reverse Osmosis (RO) system with mixed bed unit (Fig. 2) having 60% recovery is designed, installed and commissioned to produce low conductivity water. The raw water received from Bidhannagar municipality is pumped through pretreatment unit to arrest suspended particles, turbidity and to eliminate free chlorine. An oxidation reduction potential meter is installed at the membrane inlet to monitor and adjust online chemical dosing to remove free chlorine, which can damage the RO membrane. In order to remove the dissolved salts, the pretreated water is passed through the RO membrane by means of high pressure multistage centrifugal pump and the permeate water is stored in the storage tank. The permeate water is then pumped through mixed bed unit to get de-mineralised water and reduce the conductivity of water. The quality of the de-mineralised water is continuously monitored using online conductivity meter and pH meter installed at the outlet of the mixed bed unit. The system shall trip with alarm, if any problem arises during operation of the RO plant (Fig. 3). This plant is now utilized to supply low conductivity water for both the cyclotrons.

LCW is stored in an epoxy coated MS tank and is circulated to the different loads. The LCW system with series of pumps, cooling tower, heat exchangers and screw air compressors supply LCW and instrument quality air to both the cyclotrons on round the clock basis. An Ethernet based distributed data acquisition system (Fig. 4) is used for online monitoring of the parameters of the LCW system.

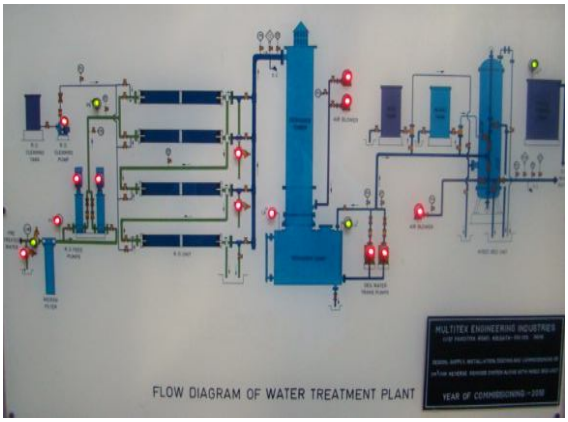
A separate closed loop LCW cooling system (Fig.5) has been designed, installed and commissioned to control the temperature difference between magnet yoke and pole tip within ±0.5 °C by manipulating the chilled water flow to the heat exchanger at the superconducting cyclotron. A PLC based automatic Mixed Bed deionizer (Fig.6) unit with all instruments has been incorporated to control the conductivity of water in this closed loop.

The performance of Low-conductivity water (LCW) systems is of crucial importance at accelerator facilities. An imbalance of water chemistry, supply temperature, change in flow rate can have a direct impact on machine performance. Downtime of the LCW system for any reason can result in downtime of the entire accelerator; hence the system has been designed for ensuring operational reliability by proper selection of components and operation procedures.

The LCW team is involved in regular testing of raw water, soft water and cooling tower circulated water using a single beam spectrophotometer. It is also involved in chemical treatment of cooling tower water and calibration of process instruments.

Fig. 1: LCW plant

Fig. 2: RO plant



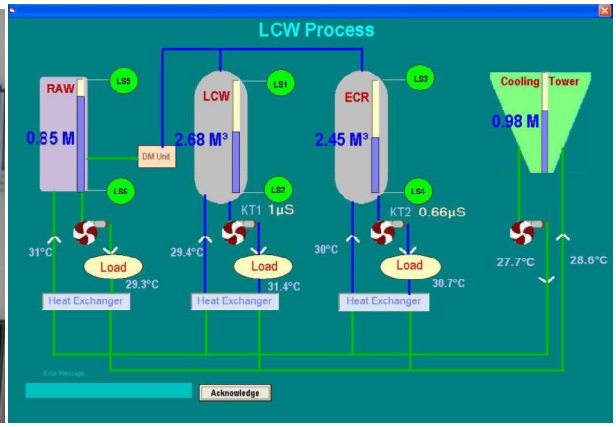


Fig. 3: RO plant mimic diagram

Fig. 4: LCW mimic diagram

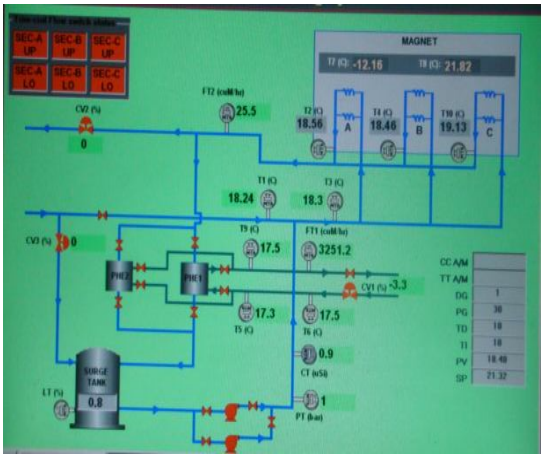


Fig. 5: Trim coil lead cooling system

Fig. 6: PLC based automatic Mixed Bed unit