

# 26th National Symposium on Cryogenics and Superconductivity

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## Invited Talk-IT- " Process Instrumentation and Control for Cryogenic System of VECC"

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### Content :

Superconducting Cyclotron, which comprises of superconducting main magnet and cryopanel operating at 4.3 K, are operational at VECC in three phases starting from 2005; finally without interruption from July, 2010 to November, 2016. Cryogenic loads of the Cyclotron are catered by any of the two helium liquefiers / refrigerators (250W and 415W @ 4.5K) and associated cryogen distribution system with extensive helium gas management system. The system also consists of 31 K liters of liquid Nitrogen (LN<sub>2</sub>) storage and delivery system, necessary for radiation shield. The pure and impure helium gas management system with helium cycle compressor and recovery compressor are located in Cryogenic Plant Building and adjacent buffer tank area, whereas the liquefier/refrigerators are situated at the Superconducting Cyclotron Building, more than 100m away from cryogenic plant building. The field sensors and actuators are scattered at different locations and are connected with the input / output modules of four Programmable Logic Controllers (PLCs), which are present one each for controlling the two liquefiers separately, overall gas management system along with the LN<sub>2</sub> delivery system and Purification system, respectively. EPICS (Experimental Physics and Industrial Control System) architecture is open source, flexible and has unlimited tags as compared to the commercial Supervisory control and data acquisition (SCADA) packages. Hence, it has been adopted to design the SCADA module. The EPICS Input Output Controller (IOC) communicates with four PLCs over Ethernet based control LAN to control/monitor 618 numbers of field Inputs/ Outputs (I/O). The control system is fully automated and does not require any human intervention for routine operation. Since these two liquefiers share the same high pressure (HP) and low pressure (LP) pipelines, any pressure fluctuation due to rapid change in flow sometimes causes trip of the liquefiers. Few modifications were made in the control scheme in HP and LP zones to avoid liquefier trip. The plant is running very reliably round the clock and the historical data of important parameters during plant operation are archived for plant maintenance, easy diagnosis and future modifications. Total pure helium cycle gas inventory is monitored through EPICS for early detection of helium loss from its trend.

Extensive work has been done at VECC for development of cryogenic instrumentation in the form of LHe and LN<sub>2</sub> level sensors. A calibration facility for cryogenic thermometers has been designed and developed for calibrating industrial cryogenic thermometers that include a temperature sensor and the wires heat-intercept in the 2.2 K to 325 K temperature range. Measured data is presented in comparison to the standard thermometers at fixed points and it is possible to infer that the absolute accuracy achieved is better than  $\pm 0.5\%$  of the reading in comparison to the fixed point temperature. Purity analyser plays a pivotal role in running the helium refrigeration system. Hence, a sensor for sensing moisture in helium has been developed and evaluation of the accuracy and precision of the measurement is under process.

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