Development of a layout of piping and valves for cold box of Helium refrigerator plant of cooling power about 1 kW at ~15 K

Abstract

It is planned to design and develop an indigenous Helium refrigerator (HR) plant of cooling power ~1 kW at ~15 K. Cooling capacity of the plant will be optimized for refrigeration purpose only, using 2 helium turbo-expanders connected hydraulically in series. It will have main systems like compressor with oil removal system and cold box system. Among these systems, cold box will have many critical cryogenic components to produce helium refrigeration. This project work involves the sizing and layout of pipe and valves for this cold box system. Layout of different components with support structures should be designed to reduce the heat load and mechanical stresses during operations which are also part of this project work.

Configuration of the proposed cold box is vertical cylindrical vacuum chamber with torrispherical dish ends assembled together by flanges with fasteners which can be easily disassembled. This chamber will contain all the cold equipment/elements e.g. heat exchangers, cryogenic valves, turbo expanders, 80 K absorber beds with filters for helium gas purifications with necessary piping, valves to produce helium refrigeration at 15 K. During the operation, at low temperature, these components will shrink and can lead to thermal stress. Internal piping and equipment can also face vibration due to fluid flow. External heat loads through support structures and other means should be minimized. All these aspects will be analyzed and optimum design should be made.

Following works will be involved in this project.

1. Study the cold box vacuum chamber and its internal component layout for Helium refrigerator/liquefier plant of SST-1 existing at IPR.
2. Study the PFD, PID, component requirements and dimensions and other parameters for the indigenous HR plant.
3. Study the literatures related to the helium plant design, layout and sizing of piping and valves, piping layout analysis methods.
4. Size the pipe and valve requirements.
5. Design the support structures for component and piping layout.
6. Do the layout and modelling of the piping with other components.
7. Analysis of piping layout for steady state, dynamic and seismic cases using piping analysis software and optimize the layout
8. Do the heat load and mechanical stress analysis of support structures and optimize the dimensions.
9. Make the report for the above work.

Required Period of work: About 10 months

Project Guide: A. K. Sahu

Division: Large Cryogenic Plant and Cryosystem (LCPC)

Stream/ Branch: Mech. Engg

Eligibility: Only students of ME/M.Tech in thermal/cryogenic/turbo-machinery or similar branch can submit their application at following email addresses

aksahu@ipr.res.in **[Project guide's e-mail address] and** project@ipr.res.in **and**

project_me@ipr.res.in