Contribution ID: **139** Type: **Poster**

Preliminary Pipe Stress Analysis of High Pressure, High Temperature Experimental Helium Cooling System

Tuesday, 23 October 2018 08:30 (20 minutes)

Experimental Helium Cooling Loop (EHCL) is a high pressure-high temperature helium gas system. EHCL is similar to the First Wall Helium Cooling System (FWHCS) of LLCB TBM and in this loop First wall mock ups up to one fourth (¼) size of TBM can be tested.

EHCL modelling consists of equipment arrangement, pipe routing, support, cable tray routing, instrumentation arrangement and tube routing. EHCL lab floor dimensions are 18m x 18m length and width respectively while the vertical height is 5 meter. The lab is divided in three major areas: process area, control room and free space for maintenance activities. The process and control room covers 9m x 9m and 14m x 5m floor area respectively.

The EHCL is designed to operate with helium gas at 8.0 MPa (gauge) pressure and at 300-400 C temperature. The flow rate varies from 0.2 kg/s to 0.4 kg/s. The selected size for the connection pipes is DN 50. The high temperature pipes in this loop are at 400 C and at 8 MPa pressure, and these pipes are connected to equipment in a limited space. The detailed flexibility analysis was carried out, to ensure safety of the piping system and to maintain the structural integrity under loading conditions (both external and internal), which may occur during the lifetime of the system. SS 316L is used as structural material for piping and equipment.

This poster presents the modelling of EHCL and the results of detailed flexibility analysis of EHCL pipes. To carry out the analysis, the entire piping system of the loop was modeled and the static and dynamic analysis was carried out in CAESAR II software. For the floor response spectra, the floor level in two horizontal and one vertical direction was computed.

As IPR lies in seismic zone –III, and the process loop is planned to be located at ground level at IPR campus, accordingly the FRS was used to find out the induced stress in the process loop. The dynamic effect and weight effects are considered in the design so that the stresses created by the combined loads do not exceed the allowable stresses prescribed by the design codes. Finally the piping layout satisfying the code requirements along with the results are presented in the poster.

Country or International Organization

India

Paper Number

FIP/P1-9

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Session Classification: P1 Posters

Track Classification: FIP - Fusion Engineering, Integration and Power Plant Design