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C3Po1A-03: Structural Design of Distribution Valve Box of S3FEL Test Facility Cryogenic System

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Shenzhen SRF Soft Free Electron Laser (S3FEL) is a project in construction phase at Institute of Advanced Science Facilities, Shenzhen (IASF), in China. The purpose is to produce high intensity coherent X-ray with laser properties. The S3FEL accelerator is based on the TESLA technologies and will deliver electrons with the energies of up to 2.5GeV. The electrons will be accelerated by 1.3 GHz superconducting cavities cooled down to the 2 K level.

A 500 W@2 K helium refrigerator will be used for the test facility including two vertical test benches (VTB) for cavities, one magnet test bench for the superconducting magnet (MTB) and three horizontal test benches (HTBs) for cryomodules. The test benches are managed via a main cryogenic distribution valve box which is designed to operate each test facility independently.

This paper describes the detailed structural design of the main distribution valve box including: cryogenic valve arrangement diagram, mechanical compensation for deformation in low temperature, thermal analysis as well as static structural analysis in low temperature. A design method of cryogenic valve box is also discussed in aim of accelerating the design iteration progress. Design results regarding overall temperature profile, heat load performance and static structural stress is described in this paper.

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