

Status of the HeSS test facility for ITER HCCR's HCS

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1. Introduction

HeSS (Helium Supply System) is an experiment facility for design verification and experimental data production of the ITER HCCR TBM's HCS (Helium Cooling Ceramic Reflector Test Blanket Module Helium Cooling System). HeSS consists of a circulator, recuperator/cooler (printed circuit heat exchanger type), heater and filter and it was built with real-scale components to the HCS. HeSS can supply high temperature (300 °C) and pressure (8 MPa) of helium flow (1.5 kg/s) to a TBM first wall mockup [1].

In this paper, present status of HeSS including experimental and maintenance works and near term experimental plan are presented.

2. HeSS status and experimental works

With the real-scale helium circulator installation in 2019, the construction of HeSS was completed and trial tests was performed successfully [2]. The components tests carried out for the circulator and the recuperator to understand performance characteristics of the HeSS main components.

Pressure ratio and efficiency data of the circulator were measured using argon and helium gases up to 8 MPa pressure conditions. The measured pressure ratio data are well grouped according to the corrected flow rate in each test data and it shows that the pressure ratio data measured successfully [3]. The efficiency data were obtained by measuring the circulator inlet/outlet temperature. However, this did not consider the heat released out of the circulator and thus could not obtain accurate efficiency data. Therefore, additional tests should be performed to obtain accurate efficiency data by measuring the exact power directly applied to the circulator.

Effectiveness factor of the recuperator was obtained for single test condition by measuring inlet/out temperatures of each hot/cold side circuits of the recuperator. The effectiveness was measured as 0.989, which was much higher than the minimum design value of 0.92 [3]. Further tests with various flow/temperature conditions are needed to better understand the heat transfer characteristics of the recuperator.

During the performance tests, several items to be improved and modified at HeSS were identified. The vibration from the main helium loop is enough to handle, but the vibration from the secondary water coolant pipes

cannot be ignored. This causes problems with the integrity of the Coriolis type flow meter near the water coolant pipes. To solve this problem, flexible hoses are installed in the coolant pipes and the support is reinforced on the flowmeter flanges in present.

Components and pipes of HeSS (with specification of the helium pipes are DN80, Sch. 80/160 with #900 and #1500 of flanges) were initially assembled manually without any power tools and it was hard to assemble properly to minimize helium leakage. Therefore, the components and pipes of HeSS will be re-assembled in compliance with ASME PCC-1 using a hydraulic torque wrench [4].

3. Summary and future plans

HeSS was constructed and its main components were tested to obtain performance characteristic data. During the tests, the vibration and helium leak issues were identified. In present, HeSS is under maintenance and modification to solve these problems. Additional performance tests will be performed to obtain more data and to understand performance characteristics of the circulator and recuperator. Then, HCS operation scenario test will be follows.

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