COMPONENT TESTING AND INTEGRATION OF A PLUG AND PLAY SCO_2 POWER GENERATION SYSTEM

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ABSTRACT

The supercritical carbon dioxide (sCO_2) heat to power generation cycle is the subject of increasing academic and industry research. Based on its high energetic density and compressibility, the thermodynamic efficiency at high heat source temperatures of the sCO2 power cycle promises to be higher than conventional Rankine cycles currently available on the market. While most projects are targeting large power plants - such as coal, solar and nuclear of MW power output capacity, the sCO2 system being developed under the H2020 I-ThERM project has been designed for Plug-&-Play distributed power generation applications primarily from waste heat sources. A compact 50 kWe integrated solution within a mobile container aims to be adaptable to various Waste Heat Recovery (WHR) and operating conditions. Such applications include iron & steel, chemical processes, cement and glass manufacturing as well as other highly energy intensive industries. All these industries can benefit from this high temperature heat to power conversion technology being developed in this project.

The turbo-machinery is a single shaft Compressor Generator and Turbine (CGT) system. After successful fabrication and description of initial rotational tests using air as the working fluid, this paper will focus on the integration phase of the CGT with the rest of the components of the sCO2 cycle. This step brings some technical challenges. First, high pressure testing to comply with the Pressure Equipment Directive (PED) are undertaken. These are followed by the selection and integration of sensors, automation controls and by component assembly.

The thermodynamic cycle is designed for sCO2 pressures up to 127 bar and temperatures up to 400 °C. To test the system at these conditions, a High Temperature Heat To power Conversion facility (HT2C) has been designed and is being built at Brunel University London, UK. The paper will discuss these facilities and their integration to enable the testing and evaluation of the sCO2 system over a wide range of operating conditions. The results will enable design and control optimisation of the system and will lead to further development of individual components and the overall system towards commercialisation.