**Development of a CO2 Two-phase Flow Rig for**

Flowmeters Calibration under CCS Conditions

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Measurement and monitoring of CO2 flows across the entire Carbon Capture and Storage (CCS) chain are essential to ensure accurate accounting of captured CO2 and help prevent leaking during transportation to storage sites. The significant changes in physical properties of CO2 depending on its state (gas, liquid, two-phase or supercritical) mean that CO2 flows in CCS pipelines are complex by their nature. Meanwhile, impurities in a CO2 pipeline also make the flow more likely in the form of two-phase mixture. These characteristics of CO2 flows present a number of challenges for their accurate measurement.

In order to calibrate and test flowmeters under CCS conditions, a dedicated gas-liquid CO2 two-phase flow rig has been developed. The CO2 flow rig offers a range of liquid, gaseous or gas-liquid two-phase flow conditions in horizontal and vertical pipelines. Fundamental design considerations, including the performance parameters, flow loop structure, working principle and traceability chain, will be presented. The design details of the key elements of the rig, including separator, mixer, weighing system and inspection windows together with reference flowmeters will be included. The measures for maintaining multiphase CO2 flow conditions and controlling flow pattern stability will also be presented and discussed. Finally, our experiences in operating the CO2 flow rig and experimental results of calibrating a Coriolis flowmeter will be introduced.