

## Scale-Up Study of Gas-Liquid Two Phase Flow in Downcomer

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**Abstract :** Downcomers are important conduits for multiphase flow transfer from offshore platforms to the seabed. Uncertainty in the predictions of the pressure drop of multiphase flow between platforms is often dominated by the uncertainty associated with the prediction of holdup and pressure drop in the downcomer. The objectives of this study are to conduct experimental and theoretical scale-up study of the downcomer. A 4-in. diameter vertical test section was designed and constructed to study two-phase flow in downcomer. The facility is equipped with baffles for flow area restriction, enabling interchangeable annular slot openings between 30% and 61.7%. Also, state-of-the-art instrumentation, the capacitance Wire-Mesh Sensor (WMS) was utilized to acquire the experimental data. A total of 76 experimental data points were acquired, including falling film under 30% and 61.7% annular slot opening for air-water and air-Conosol C200 oil cases as well as gas carry-under for 30% and 61.7% opening utilizing air-Conosol C200 oil. For all experiments, the parameters such as falling film thickness and velocity, entrained liquid holdup in the core, gas void fraction profiles at the cross-sectional area of the liquid column, the void fraction and the gas carry under were measured. The experimental results indicated that the film thickness and film velocity increase as the flow area reduces. Also, the increase in film velocity increases the gas entrainment process. Furthermore, the results confirmed that the increase of gas entrainment for the same liquid flow rate leads to an increase in the gas carry-under. A power comparison method was developed to enable evaluation of the Lopez (2011) model, which was created for full bore downcomer, with the novel scale-up experiment data acquired from the downcomer with the restricted area for flow. Comparison between the experimental data and the model predictions shows a maximum absolute average discrepancy of 22.9% and 21.8% for the falling film thickness and velocity, respectively; and a maximum absolute average discrepancy of 22.2% for fraction of gas carried with the liquid (oil).

**Keywords :** two phase flow, falling film, downcomer, wire-mesh sensor

**Conference Title :** ICFD 2018 : International Conference on Fluid Dynamics

**Conference Location :** London, United Kingdom

**Conference Dates :** October 15-16, 2018