ABSTRAK

Fenomena permulaan *flooding* atau *counter current flow limitation* (CCFL) merupakan salah satu fenomena penting dalam sistem keselamatan reaktor nuklir tipe *pressurized water reactor* (PWR), khususnya pada bagian *hot leg* saat terjadi kecelakaan seperti *small break loss of coolant accident* (SBLOCA). *Flooding* terjadi ketika aliran fluida gas yang berlawanan arah dengan fluida cair menghambat aliran cairan, sehingga mempengaruhi efektivitas pendinginan reaktor. Penelitian ini bertujuan untuk menganalisis pengaruh debit udara dan debit air terhadap permulaan *flooding* pada model *hot leg* PWR skala 1/30 dengan konfigurasi dua inlet udara paralel.

Metode penelitian dilakukan secara eksperimental menggunakan fluida udara dan air pada kondisi tekanan atmosfer dan suhu ruang. Parameter yang diamati meliputi debit udara, debit air, tekanan absolut (P_{Abs}), beda tekanan (Δ P), dan perubahan *water level*. Data diolah untuk menentukan batas kondisi permulaan *flooding* serta menganalisis karakteristik tekanan dan perilaku aliran.

Hasil penelitian menunjukkan bahwa peningkatan debit udara menyebabkan terjadinya *flooding* yang ditandai dengan perubahan signifikan pada tekanan dan kenaikan *water level*. Hubungan antara debit udara dan debit air membentuk batas kondisi *flooding* (*limit condition*) yang dapat digunakan untuk mengidentifikasi onset of *flooding*. Selain itu, tekanan absolut dan beda tekanan menunjukkan perubahan karakteristik yang jelas saat mendekati kondisi *flooding*.

Penelitian ini memberikan kontribusi dalam memahami fenomena *flooding* pada *hot leg* PWR serta dapat digunakan sebagai referensi dalam kajian keselamatan reaktor nuklir, khususnya terkait analisis aliran dua fase dan *counter current flow limitation*.

Kata kunci: Onset of *flooding*, hot leg PWR, debit udara, debit air, tekanan, water level

ABSTRACT

Onset of flooding or counter current flow limitation (CCFL) is an important phenomenon in the safety system of pressurized water reactors (PWR), especially in the hot leg section during accident conditions such as small break loss of coolant accident (SBLOCA). Onset of flooding occurs when gas flow moving in the opposite direction restricts liquid flow, which affects the cooling effectiveness of the reactor. This study aims to investigate the effect of air flow rate (Q_G) and water flow rate (Q_L) on the onset of flooding in a 1/30 scale PWR hot leg model with a parallel dual air inlet configuration.

The experimental method was conducted using air and water at atmospheric pressure and room temperature conditions. The observed parameters include air flow rate, water flow rate, absolute pressure (P_{Abs}), differential absolute pressure (ΔP_{Abs}), and water level changes. Δ water level were processed to determine the flooding limit condition and analyze pressure characteristics and flow behavior.

The results show that increasing air flow rate causes onset of flooding, indicated by significant pressure changes and water level rise. The relationship between air and water flow rates forms a onset of flooding limit condition that can be used to identify the onset of flooding. In addition, absolute pressure and differential pressure exhibit clear characteristic changes near *onset of flooding* conditions.

This study contributes to understanding *onset of flooding* phenomena in PWR hot legs and can be used as a reference for nuclear reactor safety analysis, particularly in two-phase flow and counter current flow limitation studies.

Keywords: Onset of flooding, PWR hot leg, air flow rate, water flow rate, pressure, water level