World Academy of Science, Engineering and Technology
International Journal of Nuclear and Quantum Engineering
Vol:10, No:04, 2016

Analysis of Two-Phase Flow Instabilities in Conventional Channel of Nuclear Power Reactor

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Abstract : Boiling heat transfer plays a crucial role in cooling nuclear reactor for safe electricity generation. A two phase flow is susceptible to thermal-hydrodynamic instabilities, which may cause flow oscillations of constant amplitude or diverging amplitude. These oscillations may induce boiling crisis, disturb control systems, or cause mechanical damage. Based on their mechanisms, various types of instabilities can be classified for a nuclear reactor. From a practical engineering point of view one of the major design difficulties in dealing with multiphase flow is that the mass, momentum, and energy transfer rates and processes may be quite sensitive to the geometric configuration of the heat transfer surface. Moreover, the flow within each phase or component will clearly depend on that geometric configuration. The complexity of this two-way coupling presents a major challenge in the study of multiphase flows and there is much that remains to be done. Yet, the parametric effects on flow instability such as the effect of aspect ratio, pressure drop, channel length, its orientation inlet subcooling and surface roughness etc. have been analyzed. Another frequently occurring instability, known as the Kelvin–Helmholtz instability has been briefly reviewed. Various analytical techniques for predicting parametric effect on the instability are analyzed in terms of their applicability and accuracy.

Keywords : two phase flows, boiling crisis, thermal-hydrodynamic instabilities, water cooled nuclear reactors, kelvin–helmholtz instability
Conference Title : ICNPPE 2016 : International Conference on Nuclear Power Plants Engineering
Conference Location : Boston, United States
Conference Dates : April 25-26, 2016