Towards the Understanding of the Irradiation Effect on Critical Heat Flux and Enhancement of the Safety Margin of In-vessel Reactor Cooling

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Abstract:

If many bubbles were generated, a bubble film formed and covered the surface. There is a risk that heat can no longer be transmitted through bubble evaporation. As a result, the temperature of the heated surface will rapidly increase, and it may damage the critical components. This limitation in heat transfer processes is called Critical Heat Flux (CHF). Therefore, we need to consider different ways to enhance the CHF, when we design the safety system in many fields such as power generation, chemical, and process industries. One of the most important reasons for investigating CHF lies in the nuclear field. For the severe accident case, the core may melt due to the large residual heat. One of the counter-measurements against core melt is called in-vessel retention external reactor vessel cooling (IVR-ERVC), which was adopted in some advanced water reactors like AP600 and AP1000. So, it is very important to investigate both the mechanism and enhancement method for CHF. The speaker has conducted experimental, theoretical, and numerical research investigating downward-facing flow boiling and CHF for nuclear safety. The applicant also conducted preliminary research on the irradiation effect. This problem has been discussed for many years to reveal the mechanism, yet no census has been achieved. We tried to reveal the mechanism of irradiation effects on CHF and to improve the safety margin of IVR.

Bio:

Prof. Wang Kai received a BSc and M.S. degree in Nuclear Engineering from Xian Jiaotong University, in 2013, and 2016 respectively. Then he obtained a Ph.D. degree in Nuclear Engineering and Management from the University of Tokyo, in 2019. He is currently an Associate Professor of the University of Tsukuba, where he works as a PI. His research intersects are resilience engineering, thermo-fluid sciences, nuclear thermal hydraulics, boiling and condensation, two-phase flow, CFD, nuclear safety and radiation induced surface activation effect. He is in collaboration with the University of Tokyo, JAEA, the University of Kyushu and QST.

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