Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

New Departure from Nucleate Boiling model relying on first principle energy balance at the boiling surface.[1] ETIENNE DEMARLY, EMILIO BAGLIETTO, Massachusetts Inst of Tech-MIT — Predictions of Departure from Nucleate Boiling have been a longstanding challenge when designing heat exchangers such as boilers or nuclear reactors. Many mechanistic models have been postulated over more than 50 years in order to explain this phenomenon but none is able to predict accurately the conditions which trigger the sudden change of heat transfer mode. This work aims at demonstrating the pertinence of a new approach for detecting DNB by leveraging recent experimental insights. The new model proposed departs from all the previous models by making the DNB inception come from an energy balance instability at the heating surface rather than a hydrodynamic instability of the bubbly layer above the surface (Zuber, 1959). The main idea is to modulate the amount of heat flux being exchanged via the nucleate boiling mechanism by the wetted area fraction on the surface, thus allowing a completely automatic trigger of DNB that doesn't require any parameter prescription. This approach is implemented as a surrogate model in MATLAB in order to validate the principles of the model in a simple and controlled geometry. Good agreement is found with the experimental data leveraged from the MIT Flow Boiling at various flow regimes.

[1]Consortium for Advanced Simulation of Light Water Reactors (CASL)

Etienne Demarly
Massachusetts Inst of Tech-MIT

Date submitted: 31 Jul 2017 Electronic form version 1.4