

EN 634 Nuclear Reactor Thermal-Hydraulics

Assignment -9

1. Starting from the length scale and velocity scale as discussed in class, and using the constants for the exponents suggested, get the final form of
 - (a) Rohsenow's correlation,
 - (b) Forster and Zuber Correlation
2. Using the above correlations, compare the value of $T_w - T_{sat}$ for a flat plate in a saturated pool of water at 1 bar with a heat flux, q'' , equal to 10, 100, 1000 kW/m². Assume that the plate is of SS which is ground. Obtain the value of C_{sf} from any text book
3. Consider a circular plate being designed to dissipate 10 kW. One of the suggestion given by an engineer is to build a pool over the plate and fill it with water, so that the boiling water can become an effective heat transfer medium. It has been decided to use a factor of safety of 1.5 to avoid burnout of the plate. (a) Calculate the minimum diameter of the plate that can dissipate the heat safely. (b) Estimate the surface temperature of the plate. Assume that the pool is at 1 bar-absolute. You may make suitable assumptions and use appropriate empirical correlations. Justify everything you do suitably.
4. Consider a thin walled cylindrical container of Diameter D and Height L filled to a height y with a low boiling point liquid (A) at $T_{sat,A}$. The container is located in an environment filled with vapour of a high boiling point fluid (B). Vapour B condenses into a laminar film on the outer surface of the cylindrical container extending from the location of the liquid-A free surface. The condensation process sustains nucleate boiling in liquid-A along the container wall according to the relation,

$$q'' = C(T_s - T_{sat})^n$$

- (a) For the portion of the wall covered with the condensate film, derive an equation for the average temperature of the container T_s . Assume that all the properties of fluids A and B are known
- (b) At what rate heat is supplied to liquid-A?
- (c) Assuming that the container is completely filled with liquid, i.e. $y=L$, derive an expression for the time required to evaporate all the liquid in the container

