Abstract

Heat transfer parameters of concentric heat source cooling channel exposed to pressure reduction transient is studied experimentally and theoretically. The heat source is of constant heat flux cooled by upward flowing water in concentric channel. The heat source is located inside cylindrical shape tube which is fixed in an annular vertical channel. The cooling water pressure reduction transient is ensured by different shape disturbance functions. The theoretical investigation involved a mathematical modeling for axially, symmetric, simultaneously developing laminar water flow in a vertical annulus. The mathematical model is based on one dimensional flow. The boundary conditions of the studied case are based on adiabatic outer wall while the inner wall is subjected to a constant heat flux for upwards flow. The heat & mass balance equation derived for specified element of bulk water within the annulus, is solved to determine the variation of bulk water temperature, heat transfer coefficient, clad surface temperature and the boiling safety factor based on clad surface temperature versus length and time during transient course. The present theoretical work covers heat flux of 46345 W/m², channel inner to outer diameter ratio of 0.8, water sub-cooled degree in the channel inlet ranging (20-30°C), heat source length of 0.65, water pressure at channel inlet of 1.3 bars and pressure reduction transient according to step, ramp and sinusoidal shape disturbance function (1.3-1.0) bars. The experimental investigation included a set of
experiments carried out to investigate the temperature variation along the heat source for step, ramp and sinusoidal pressure reduction transients in cooling system during and after reaching the steady state condition.

References

Computer Science

Index Terms

Power Systems

Keywords

Pressure reduction  CHF prediction  Sub-cooled flow boiling  Heat transfer parameters  nucleate boiling and concentric annular channel