5.6 Critical heat flux

In the preceding two sections it was assumed that the critical heat flux conditions and temperatures were not reached within the reactor. Indeed care is taken to stay well below those temperatures during the designed normal operation of a boiling water reactor. However, since a postulated accident in a PWR, a BWR or any other liquid-cooled reactor core might result in enhanced boiling, analyses similar to those described in the preceding sections need to be carried out in order to predict the evolution of that accident scenario. If burnout and critical heat flux conditions were to occur at some elevation within the core this would further modify the conditions described in the last section. The coolant and fuel rod temperatures above that burnout location would rise rapidly as would the mass quality of the coolant that would approach unity. However this would result in yet another decrease in the reactivity and therefore in the local heat generation within the fuel. Moreover, in a loss-of-coolant accident or LOCA (see section 7.3) an evolving decrease in the coolant flow rate, $\dot{m}$, will result in an enhanced rate of increase in the mass quality (as illustrated in equation 2, section 5.3) and this would promote the chance of burnout.

Because of the potential for fuel rod damage and meltdown in such a postulated accident scenario it is very important to be able to predict the evolution of such an event. The above description of how such a calculation might proceed only serves to indicate what a complicated multiphase flow calculation that involves. Further comment on these efforts is included at the end of the next chapter.