7.1.3 Multiphase flow during overheating

In any light water reactor, it is clear that in the event of any departure from normal operation whether through unexpected depressurization or through decrease in the coolant flow (for example a LOCA), conditions in the reactor core may lead to the critical heat flux (CHF) condition being exceeded with the concominant large increase in the fuel rod temperatures. Such a circumstance could be the precursor for a core meltdown and hence the importance of being able to predict the CHF.

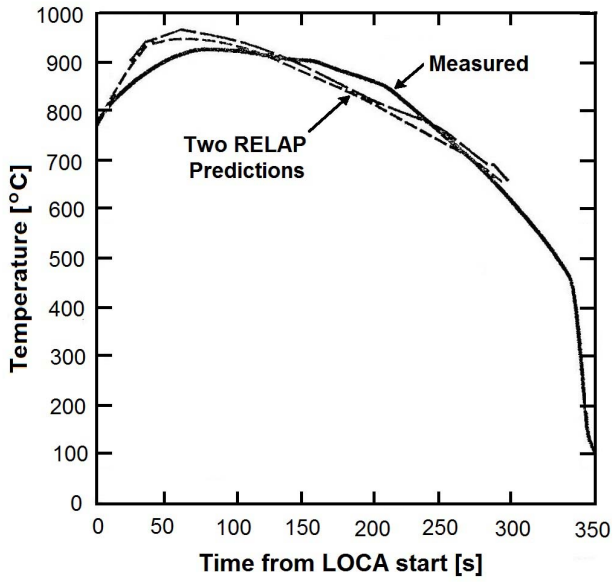

Figure 1: An example of a comparison between the measured cladding temperature following a simulated LOCA in a PWR model test facility (FLECHT) and the predictions of the RELAP code with two different choices of coefficients. Adapted from Hsu and Sullivan (1977).

As remarked at the end of the chapter 5 (section 5.6) the prediction of the flows and temperatures following postulated reactor excursions and accidents is an important input to the evaluation of reactor safety. Much effort has gone into the development and validation of multiphase flow computer codes for this purpose. The objective is to make reliable predictions for the purposes of designing effective safety systems for reactors. An example of the multiphase flow and heat transfer codes developed is the extensively used RELAP code (Aerojet Nuclear Co. 1976, and, for example, Jackson *et al.* 1981, Wagner and Ransom 1982). The details of these codes are beyond the scope of this text and the reader is referred to the references listed below for further information. As with most multiphase numerical methods, validation presents a real

challenge for the scaling of many of the phenomena involved contains uncertainties and the coefficients that govern the flow and heat transfer are hard to predict accurately. Consequently there is a need for large scale test facilities and experimental measurements that can be used for validation of these codes. Examples of these facilities and test programs, summarized by Hsu and Sullivan (1977), are the FLECHT program at Westinghouse (see, for example, Hassan 1986) and the LOFTand other facilities at the Idaho National Engineering Laboratory. Figure 1 presents one example of a comparison between a large scale facility measurement and a computer code. It shows a comparison between a measured cladding temperature in a FLECHT experiment simulating a LOCA and two corresponding predictions using the RELAP code. The discrepancies are typical of the uncertainties in these complex multiphase flow predictions.