

6.6.1 Introduction to Multiphase Flow Instabilities

Multiphase flows in general are susceptible to a wide range of instabilities over and above those that occur in single phase flows. A broad review of the state of knowledge of these is beyond the scope of this text. For such a review, the reader is referred to texts such as Brennen (2005). Nevertheless a brief review of the various types of instability that can occur in multiphase flows is appropriate and this will be followed by some examples that are pertinent to nuclear reactor applications.

It is appropriate to begin by mentioning the basic local instabilities that can occur in these flows. Well known and previously described are some of the local instabilities that can lead to changes in the flow regime, for example, the Kelvin-Helmholtz instability (section 6.2.5) or boiling crisis (section 6.5.4).

A second type of instability that can occur can be identified as the system instabilities within a internal flow system that lead to pressure, flow rate and volume fraction oscillations. These system instabilities can be further subdivided into those that can be analyzed using quasistatic methods (see Brennen 2005) assuming the oscillations progress through a series of quasisteady states and, on the other hand, those that are dynamic. An example of a quasistatic instability is the Ledinegg instability described below in section 6.6.3. An even simpler quasistatic example are the concentration waves that can occur in some circulating systems (section 6.6.2). However there are also instabilities that do not have a simple quasistatic explanation and occur in flows that are quasistatically stable. An example of a fundamentally dynamic instability is the chugging instability described in section 6.6.4.