### 3.9.2 Point Kinetics Model

In order to incorporate the delayed neutrons in the analytical model and therefore allow modeling of the transients associated with practical reactor control as described in section 2.3.4 it is necessary to expand the above model to allow for the neutron flux associated with the delayed neutrons. To do this the source term, $S$, in equation 1, section 3.9.1 must be subdivided into contributions from the prompt neutrons and the delayed neutrons. If the fraction of delayed neutrons is denoted by $\beta$, then the contribution to $S$ from the prompt neutrons will be $(1-\beta)k_\infty\Sigma_a\phi$. The contribution from the delayed neutrons is normally modeled as the sum of contributions from each of the chosen precursor types (usually 6 in number), each with its own concentration $C_i$, $i = 1$ to 6, and decay constant, $\lambda_i$. Consequently the diffusion equation 1, section 3.9.1, becomes

$$\frac{1}{\bar{u}}\frac{\partial\phi}{\partial t} - D\bigtriangledown^2\ \ \phi = \left\{(1-\beta)k_\infty\Sigma_a - 1\right\}\phi + \sum_{i=1}^{6}\lambda_i C_i \qquad (1)$$

This modified diffusion equation along with a population equation for the concentration (see, for example, Knief 1992) of each of the six precursor types, constitute what is known as a *point kinetics model* for the dynamics of reactors. This type of model is essential for the realistic modeling of reactor dynamics.