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Solution of the decay equation of the three natural decay series-Numerical method

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ABSTRACT

Many aspects of nuclear fuel cycle require accurate and detailed knowledge of energy release rate from the decay of radioactive nuclides produced in the reactor operation. In addition to the safety assessment of nuclear power plant, decay heat estimates are needed for the evaluation of shielding requirements of fuel discharge and transport routes and for the safe management of the radioactive waste products extracted from spent fuel during reprocessing. The decay heat estimates may be derived by either summation calculation or standard equations.

The three naturally occurring radioactive decay series i.e. the Thorium series, the Uranium series and the Actinium series are studied. The solutions of these series are obtained by writing them as set of coupled ordinary first differential equations and then solving them. This will help us to calculate the number density as a function of time and hence calculate the activity of the isotopes and therefore the decay heat produced in the reactor. The equations for the Thorium,Uranium and Actinium chain are solved by numerical scheme of Euler method.

1 kg of parent element is considered and hence the inventories and activities are calculated.

The inventories obtained are in match with the one obtained analytically.