LETTER TO THE EDITOR

On Murray's Reactor Kinetics Insight

Murray[1] has given, as always, a delightful account of the solution of the point reactor kinetics equations with a constant source and constant reactivity. I offer but a gloss to his technical note. The first comment is that there is an unstated assumption in the development: The system before the introduction of the constant reactivity ρ is quiescent, in steady state, and at a negative reactivity ρ_o. Only then do the initial conditions give the desired solution. Of course, this assumption in practice covers the usual treatment of reactor kinetics.

Owing to the linearity of the problem, even this assumption could be relaxed if we find the source-free solution from the more general initial conditions, $n_{w/o}(t)$ in Murray's notation, in two parts: $n_{w/oss}(t) + n(t)_{w/obal}$, where the former is the solution supposing the reactor initially quiescent and the latter is the additional solution arising from out-of-balance precursors. Only the former would be used in Murray's relationship but with the final addition of the latter in the total solution.

The proof in the Appendix of Ref. 1 using Laplace transforms can perhaps be shortened as follows. Since (with Murray),

$$\bar{n}(s) = n_o \frac{A(s)}{B(s)} + \frac{S}{sB(s)} \ ,$$

where

$$B(s) = sA(s) - \rho/\Lambda$$

then

$$\bar{n}_{w/o}(s) = n_o \frac{A(s)}{B(s)} = \frac{n_o}{s}\left[1 + \frac{\rho}{\Lambda}\frac{1}{B(s)}\right] \ ,$$

and on substituting for $B(s)$, we have

$$\bar{n}(s) = \bar{n}_{w/o}(s) + \frac{S\Lambda}{\rho}\left(\frac{\bar{n}_{w/o}}{n_o} - \frac{1}{s}\right) \ ,$$

whence

$$\bar{n}(s) = \bar{n}_{w/o}(s)\left(1 + \frac{S\Lambda}{n_o\rho}\right) - \frac{S\Lambda}{s\rho} \ .$$

The former term shows the multiplication of the source-free solution, and the latter shows a step function addition. Neither detailed knowledge of the functions nor the characteristic polynomial (inhour) equation is required. We may now substitute the quiescent relation that $-S\Lambda/\rho_o = n_o$.

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REFERENCES

1. R. L. MURRAY, "Reactor Kinetics Pedagogical Insight," *Nucl. Sci. Eng.*, **118**, 268 (1994).