Letters to the Editor

Comments on "A Nodal Green's Function Method for Multidimensional Neutron Diffusion Calculations"

Reference 1 suffers a common deficiency of papers discussing nodal methods. It compares the computer running time of calculations that do not give the same amount of information. In Table II of the paper, the authors compare the running time of a 1.0-cm-mesh PDQ with that of their 20-cm-mesh nodal Green's function method (NGFM). This makes no sense at all. Why wasn't a 20-cm-mesh PDQ used for comparison of running times? This would have compared calculations that generate the same amount of information. An alternative would have been to compare the running time of the 1.0-cm-mesh PDQ with that of the 20-cm NGFM plus the computer time required to run additional auxiliary calculations to generate equivalent 1.0-cm-mesh flux distributions.

The implication of comparing NGFM with PDQ is that NGFM may be suitable to replace PDQ in reactor design and safety calculations. No "nodal" program can do this because the detailed point power distribution is essential to determine peak temperatures and heat fluxes. Nodal methods are ingenious ways of obtaining limited information at a minimum computer cost. They should be valued and appraised on this basis and nothing more.

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[1]R. D. LAWRENCE and J. J. DORNING, *Nucl. Sci. Eng.*, **76**, 218 (1980).

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For several years now, the value of coarse-mesh nodal methods for practical reactor design and safety calculations has been debated in the reactor physics community. The consensus, which was developed some time ago and also appears to be representative of present attitudes, is that these methods can play an important role in reactor analysis. For example, design studies are often carried out in two steps: Initially, equivalent homogenized diffusion theory parameters are calculated for relatively large subregions of the reactor such as entire assemblies in a pressurized water reactor (PWR); after these parameters are determined, global calculations are done to determine average fluxes and reaction rates in the "homogenized" assemblies. Since standard finite difference methods require very fine spatial meshes in order to achieve acceptable accuracy, there is considerable motivation to develop nodal methods, which, when applied on a mesh corresponding to the dimensions of the homogenized fuel assemblies, can compute node-averaged fluxes with high accuracy.

Demas' comments[1] reflect some misunderstanding of our[2] intention in comparing a coarse-mesh nodal Green's function method (NGFM) calculation with a fine-mesh PDQ finite difference calculation. These calculations were compared for the purpose of establishing the execution times required by each method to compute an acceptably accurate solution to the global problem. The results for the two-dimensional International Atomic Energy Agency problem presented in our Table II show that the 20-cm NGFM calculation (0.7% maximum error in assembly-averaged power densities) required roughly two orders of magnitude less computing time than the 1-cm PDQ calculation (1.5% maximum error). Since our purpose is to compare calculations with comparable (and acceptably small) errors, there would be little point in comparing our 20-cm NGFM calculation with a 20-cm PDQ calculation as Demas suggests, since the PDQ errors clearly would be unacceptably large. After all, not only the quantity,[1] but also the quality of the data generated is important.

In some applications, the lack of information concerning the node-interior flux distribution represents a limitation in the basic nodal approach. However, several methods for obtaining pointwise flux distributions using the results of coarse-mesh nodal calculations have been successfully implemented,[3] and still others have been suggested.[4]

Probably the most important potential application of nodal methods is in three-dimensional transient analyses, which are assuming greater importance due to increasingly stringent reactor safety and licensing requirements. Because of computer storage and cost limitations, finite difference calculations must often be performed using relatively coarse

[1]N. G. DEMAS, *Nucl. Sci. Eng.*, **77**, 502 (1981).

[2]R. D. LAWRENCE and J. J. DORNING, *Nucl. Sci. Eng.*, **76**, 218 (1980).

[3]K. KOEBKE and M. R. WAGNER, *Atomkernenergie*, **30**, 136 (1977).

[4]J. DORNING, "Modern Coarse-Mesh Methods—A Development of the '70's," *Proc. Computational Methods in Nuclear Engineering*, Williamsburg, Virginia, April 23-25, 1979, p. 3-1, American Nuclear Society, La Grange Park, Illinois (1979).