Letters to the Editor

Comments on a Paper on Nuclear Reactor Thermal Design

Fenech and Guéron[1] incorrectly state that Judge and Bohl[2] "present the idea that power distribution flattening can be detrimental to the total power output of a reactor" and also that "power flattening leads to a lower total power output." In fact, in Ref. 2, it was clearly demonstrated how power flattening actually minimizes the nonfailure probability for a reactor (and thus allows an *increase* in total core power).

The key point made by Judge and Bohl[2] was that *not all* of the apparent gains reported by usual single hot-channel analysis resulting from flattening power distributions should be quoted because of the increase in the number of channels close to being limiting. Judge[3] extended this work by actually calculating the number of "effective" hot channels for a reactor with a cosine power shape. Thus, the true gain in power capability due to power flattening such a system could be readily evaluated using the data in Refs. 2 and 3. However, it is clear that these gains would be overstated in usual single-channel thermal design analysis.

In summary, Fenech and Guéron[1] were incorrect in attributing to Judge and Bohl[2] the suggestion that power flattening leads to a lower total power output. The inference made by the authors of Ref. 9 was neither stated nor implied in Ref. 2, where, in fact, it was proved in Ref. 10 that the flattening actually either increases the total power output or increases the nonfailure probability at constant power output.

F. D. Judge
L. S. Bohl

Knolls Atomic Power Laboratory
General Electric Company
Schenectady, New York 12301

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[1] HENRI FENECH and HENRI M. GUÉRON, *Nucl. Sci. Eng.*, **31**, 505 (1968).
[2] F. D. JUDGE and L. S. BOHL, *Nucl. Sci. Eng.*, **28**, 296 (1967).
[3] F. D. JUDGE, *Nucl. Sci. Eng.*, **31**, 147 (1968).

Reply to Comments on a Paper on Nuclear Reactor Thermal Design by Judge and Bohl

Judge and Bohl[1] erroneously state that the quotations from Ref. 2 that appear in their letter refer to Ref. 3. Actually, these quotations refer to Ref. 4. Reference 4 is, by its very nature, less complete than Ref. 3 as it does not contain the detailed study of power flattening included there.

The misunderstanding to which Judge and Bohl refer can be illustrated by the following quotations from Ref. 3, p. 298:

> That is, the nominal power in the N channel case would have to be reduced by the ratio (f/f_N), as compared with the allowable single-channel nominal power case, in order to assure with the same confidence that the design power Q_D is not exceeded in any channel . . . . The multiple-channel cases reach a given overpower probability at power levels considerably lower than the single-channel case . . . . In other words, the nonoverpower probabilities are the same when the nominal power in the 100-channel case is 1σ lower than that of the single-channel case.

This statement appeared to suggest that going from a nonflat power distribution with one limiting channel and 99 near-limiting channels to a flat power distribution with 100 limiting channels would reduce the nominal power by nearly 1σ. Our point, expressed in Refs. 2, 5, and 6, was that this reduction will itself be either reduced or reversed, if all the channels are considered, whether the power distribution is flat or not.

In other words, there is in our conception no such thing as a "single-channel case" or an "N-channel case"; this is because what is sought is the probability that overpower occurs in any one channel, whichever it is, not the probability that overpower occurs in the "limiting" channel or channels. The analysis of power flattening in Ref. 3 indicates that Judge and Bohl also consider the right approach to be that of the "every channel case." This approach is used in Ref. 7: "Since most reactors have a wide distribution of nearly limiting channels, it is difficult to know what to use for N." Hence, Judge proceeds to analyze all the channels to obtain the overpower probability for the whole core in order to determine the number N of effective limiting channels that yields the same probability.

In summary, it seems that the contested statements of Ref. 2 result from a misunderstanding as to what consequences could be drawn from Ref. 4—not from Ref. 3. More important, I believe that the discussion of these misunderstandings has shown that there now is general agreement that the "every channel case" approach is the correct one. I hope that these exchanges have contributed to clarification of a question in which precision of language is an absolute necessity.

Henri M. Guéron

15 West 81 Street
New York, New York 10024

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[1] F. D. JUDGE and L. S. BOHL, *Nucl. Sci. Eng.*, **33**, 146 (1968).
[2] H. FENECH and H. M. GUÉRON, *Nucl. Sci. Eng.*, **31**, 505 (1968).
[3] F. D. JUDGE and L. S. BOHL, *Nucl. Sci. Eng.*, **28**, 296 (1967).
[4] F. D. JUDGE and L. S. BOHL, *Trans. Am. Nucl. Soc.*, **7**, 497 (1964).
[5] H. M. GUÉRON and H. FENECH, *Trans. Am. Nucl. Soc.*, **9**, 563 (1966).
[6] H. M. GUÉRON and F. D. JUDGE, *Nucl. Sci. Eng.*, **29**, 466 (1967).
[7] F. D. JUDGE, *Nucl. Sci. Eng.*, **31**, 147 (1968).