LETTERS TO THE EDITOR

COMMENTS ON "DETERMINATION OF OPTIMUM FUEL LOADINGS IN PRESSURIZED WATER REACTORS USING DYNAMIC PROGRAMMING"

The article by Stout and Robinson [*Nucl. Technol.*, **20**, 86 (1973)] concerning optimal fuel loadings neglects to reference a paper presented at the 1971 Boston ANS Meeting [*Trans. Am. Nucl. Soc.*, **14**, 89 (1971)]. In this paper, based on work done by the author in 1967, a thorough discussion was presented relevant to the common shuffling rules used to converge a loading pattern with minimum radial power peak. Some of these rules are reiterated in the recent article by Stout and Robinson.

While this writer welcomes the introduction of automated shuffling methods, based on this writer's experience, Stout and Robinson, among others, tend to underemphasize the crucial problems occurring in PWR shuffling, namely, (1) *local* peaking effects, calculable at a minimum by one-mesh-square-per-rod diffusion calculations (e.g., PDQ/HARMONY), ultimately determine the X-Y hot channel factor, (2) separability of local and assembly-average factors is usually too crude an assumption, and (3) a pattern obtained via automated optimization based on crude geometry (one node, or even four nodes, per assembly) is no better a starting point (and may even be a worse starting point) for further refinement of a loading pattern than that based upon the judgment of an experienced and judicious engineer. Concerning this last point, a nuclear design engineer can, with proper training, shuffle a PWR core to achieve an essentially minimum hot channel factor with fewer than 9 PDQ (quarter-core) runs; unusual loading patterns, necessitated, for example, by fuel failure occurrences, would be only a little more difficult to handle.

The method proposed by Stout and Robinson may well simplify the task of fuel shuffling pattern determination in many instances, but the individual engineer must be the judge of this. Perhaps this is one of those rare instances in technology where subjective judgment is in order.

B. M. Rothleder

Nuclear Associates International Corporation
Rockville, Maryland 20852

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REPLY TO "COMMENTS ON 'DETERMINATION OF OPTIMUM FUEL LOADINGS IN PRESSURIZED WATER REACTORS USING DYNAMIC PROGRAMMING'"

In response to the "Letter-to-the-Editor" by B. M. Rothleder, we would like to apologize to Mr. Rothleder for not referencing his paper in our article.

As stated in our paper, the automated shuffling scheme was not meant to determine the ultimate reactor loading without being checked by a pin-by-pin diffusion theory calculation. We do not agree with the statement that a pattern obtained via an automated optimization program is no better than, or even worse than, a loading pattern based on judgment.

While the optimization program is searching for an optimum loading, the search patterns are printed out and can be easily surveyed in a few minutes. Even if for some reason the engineer rejects the final loading from the optimization program, many times the program will explore loading patterns which may not have been thought of at the time by the engineer. An optimization program explores and rejects many patterns which may seem reasonable, but for some reason are rejected as bad patterns. As a minimum, a survey of these may prevent trial loadings which are bad loadings from being run on a pin-by-pin basis. An optimized shuffling program can survey hundreds of loading patterns in about one-tenth the computer time it takes to do one pin-by-pin diffusion theory calcultion. This doesn't include the man-hours required per pin-by-pin calculation. If an optimized shuffling pattern program reduces by only a few the number of times a quarter core pin-by-pin calculation must be performed, a time and computer savings have been realized.

Rothleder stated an optimized shuffling pattern program should never be used as a replacement for the subjective judgment of an experienced engineer. We agree with this statement, but feel an optimization program can greatly simplify the engineer's task.

R. B. Stout
A. H. Robinson

Oregon State University
Corvallis, Oregon 97331

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