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May 28, 1985

Dr. Gordon Robinson
Associate Professor of Nuclear Engineering
Pennsylvania State University
231 Sackett Building
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Dear Dr. Robinson:

At the NRC Advisory Panel meeting on April 11, you asked if we had considered the installation of a reactivity monitoring system as an additional precaution against criticality during TMI-2 defueling operations. Mr. E. E. Kintner, GPU Nuclear Executive Vice President, responded that installation of such a system had been considered and decided against, and he promised to provide to you more specifics on this subject. The purpose of this letter is to provide that additional promised information.

First, let me re-emphasize that our fundamental philosophy on the subject of criticality during defueling is that criticality will be prevented under all conceivable circumstances. That is, our systems and procedures at TMI-2 have all been developed with the objective of precluding criticality, rather than with the objective of detecting and then interrupting or mitigating the effects of a criticality event. Secondly, it is important to note that, for a core such as that in TMI-2, the only realistic means of controlling reactivity is by use of soluble neutron absorber. Thus, for all practical purposes, assurance of subcriticality is synonomous with assurance of an appropriate boron concentration. For that reason, and as described by Mr. Weller of the NRC at the April 11 meeting, we are maintaining a Reactor Coolant System (RCS) boron concentration which assures shutdown (with a very high degree of conservatism) regardless of configuration of fuel debris, movement of fuel material, distribution of the more highly enriched fuel, etc.

This line of defense against recriticality involves several key elements. First, the selection of an appropriately conservative boron concentration was based on extensive calculations and computer code benchmarking. This work was performed by recognized industry experts. The final conclusions were reviewed and approved by our personnel, by our independent overview groups (including the TMI-2 Safety Advisory Board and the General Office Review Board) and by NRC.

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Having selected a demonstrably safe RCS boron concentration, we have then taken extraordinary measures to ensure that it remains in place. We have implemented physical and administrative controls to prevent RCS boron dilution under all operating conditions. We monitor RCS water inventory and we regularly sample RCS water to verify its boron concentration.

In the process of selecting lines of defense, we did consider, as Mr. Kintner described, the installation of a reactivity monitoring system. However, we concluded that monitoring of boron concentration constitutes both a more reliable and simpler method of ensuring subcriticality.

Our assessment of reactivity monitoring systems can be summarized as follows:

1. Direct reactivity monitoring is not required to assure reactor safety and would not enhance public health and safety.

2. Several methods of reactivity monitoring are theoretically feasible but all would involve substantial verification and development in order to be suitable for use in this application.

3. In many cases, the value of these measurements would be very uncertain because they are analytically dependent upon the configuration of the core. The TMI-2 core configuration is not precisely known and it will be changing continually during the course of defueling.

4. The TMI-2 RCS boron concentration at this time is so high that the reactor will remain subcritical by a wide margin for any fuel configuration which will occur during defueling. Furthermore, the physics of neutron subcritical multiplication is such that changes in subcriticality at these large shutdown levels would be hard to measure and difficult to interpret.

5. A reactivity monitoring system would probably require insertion of equipment within the reactor vessel and, therefore, has the potential for interfering with defueling operations.

6. Similarly, because of the large core size and distribution of fuel material in the TMI-2 pressure vessel, no single instrument of any type could reliably measure reactivity throughout the reactor. In effect, there are "cores" in several regions of the TMI-2 reactor, separate but coupled to an uncertain degree. This reality adds to the complexity of the development and design of any TMI-2 reactivity monitoring system, and it raises concern about ambiguity of its interpretation.

In short, we are unaware of any currently available reactivity monitoring system which is suitable for operation in the TMI-2 reactor environment and which can provide meaningful information to our operators. By contrast, the on-line measurement of boron concentration is a well-proven, straight forward technique. It requires no development, is simple to install, and is fully compatible with defueling operations.

For these reasons, we decided last year to rely on on-line measurement of boron concentration to ensure reactor subcriticality during defueling.

Sincerely,

F. R. Standerfer
Director, TMI-2

FRS:JCD:ret

cc: Arthur E. Morris
Dr. Bernard J. Snyder
Dr. W. D. Travers