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To: Dr. M. S. Plesset, ACRS

From: T. Y. Wu, Consultant

Subject: ACRS Subcommittee Meeting on ECCS, January 16, 1979, Washington, D. C. - Comments and review of the meeting materials.

From my attending the subject meeting, reading relevant materials and review of the meeting minutes, I would like to make the following comments and suggestions.

NRC Audit of the Code QA Programs

From the NRC audits of the Vendors Code Quality Assurance (QA) Programs and the review of the audits presented at the meeting, it appears that the sources of code errors already identified can be put in two classes, one being those made by the code originators and the other by code users. In the former class errors have been traced to include (1) inadequate models, (2) wrong assumptions, and (3) programing errors, while in the latter, errors were generally due to erroneous and careless applications of various sorts. The overall view is that the QA procedures are infeasible to help make codes error free and experimental verifications can be expected to expose only large errors, leaving small ones mostly to remain hidden. Although the impact of most errors has been small, the intent should be to eliminate all latent errors in the present and future codes before they could cause any substantial mishap. From the safety point of view, the present reporting requirements under 10CFR21 requested of the vendors and users are regarded as stringent, which necessitate reporting any observations with departures of PCT greater than 20°F.

The most efficient way to avoid any significant errors is of course right at their source of origination. For instance, in regard to models adopted and assumptions introduced in codes, the considerable underprediction of the time for reflood take-over in the Semiscale S-07-6 ALTA tests discovered by using RELAP4 may well be of this nature (as will be further commented below). Not knowing the real magnitude of the task in developing a code, I cannot comment on the feasibility of establishing requirements for cross checking by programers, such as by line-by-line independent checking. Compared with the program writing, the effort for such a round of checking should be relatively small and well invested, especially since the majority of ECCS Code errors to date have been programing errors.

It would be more difficult to scrutinize a theoretical model for having a quantitative evaluation of the impact due to its inadequate and weak components and simplifying assumptions, for the number of physical factors involved and relevant to ECCS considerations must be quite large. In searching for an effective way in this direction, I wish to support, with appreciation, Dr. Theofanous's suggestion that a set of (standard) problems might be set up with the intention to identify inconsistancies and errors between codes. More specifically, the designers of a code would be encouraged to make the original scope more flexible in order to include certain physical parameters (even if not essential for the code objectives) so that the resulting code has the capability of handling at least one standard problem for which case the code can be compared with other existing codes.

For the interest of users, it may be suggested that specifications of applying the codes might be provided as fully and clearly as possible with the intention of keeping the users from committing unnecessary mistakes.

Semiscale S-07-6 tests

In the recent Semiscale S-07-6 blowdown-reflood tests, the reflood portion was found to have a number of periods of refill and emptying of the downcomer and core, with the reflood taking over at 500 seconds versus a predicted 140-150 seconds by the RELAP4 Code.

This discrepancy has been thought attributable to several possible causes, including excess heat transfer within the downcomer and within the core as one, and oscillating core stream production as another. Aside from a considerable difference between the experimental and code-predicted reflood takeover time, the predicted core heater temperature given by RELAP4 also lacks the oscillatory characteristics of the measured data. This valuable comparison seems to clearly indicate that the first place to explore the deficiencies of the code would be the theoretical basis of the model and the underlying assumptions. On physical ground, heat transfer is a diffusive effect; it alone is not likely to cause the unsteady thermal phenomena as observed. Consequently, the code should not be expected to be able to predict such a phenomena unless the necessary physical mechanism for its manifest is already included.

The Two-Loop Test Apparation (TLTA) Experiments

In this first series of TLTA experiments conducted with combined blowdown and ECC injection (BD/ECCI), a slower depressurization of the entire system was observed, but not expected, with the ECC injection. Although some physical explanation of this surprising result has been subsequently ascertained, which relates to the stream production in the reactor core being greater than previously contended, the result would nevertheless require some modification of the original ECCS concept since the FCC liquid was first designed for condensing steam and thereby reducing pressure.

Since the new light seems to cast on the prospect that the increased core steam production may be very effective in cooling the core, it would be important to examine in more detail the phase separation and fluid velocity distribution in the core region so that a new basis of understanding can be achieved. Falling short of this it would be difficult to deny the argument that a slower rate of depressurization in the system will have a negative effect on the effectiveness of the ECCS as originally intended.