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SCHOOL OF ENGINEERING AND
APPLIED SCIENCE
LOS ANGELES, CALIFORNIA

March 12, 1980

TO: A. Bates

FROM: I. Catton

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SUBJECT: Advanced Code Review Group Meeting,
24-25 January 1980, Willste Bldg.

The topic of the review group meeting was COBRA-TF. The project has stated two main objectives:

1. To develop a hot bundle/hot channel analysis capability which will be used in evaluating the thermal-hydraulic performance of LWR fuel bundles during postulated accidents.

2. To develop a LWR primary system simulation capability which is readily able to model complex internal vessel geometries such as those encountered in UHI-equipped PWR's.

The code supposedly will model fully three dimensional two phase flow using a three field representation (vapor, continuous liquid and droplet fields) and allow thermal non-equilibrium as well as unequal velocities.

In many respects the COBRA-TF effort is very similar to the TRAC effort. TRAC was to be the advanced code that would solve three dimensional problems with UVUT conditions and has three fields. The COBRA/TRAC combination to be used for UHI plant simulation reduces the TRAC code contribution almost to one-dimensional aspects of the plant. It is not clear why a fast running one-dimensional code such as RELAP5 is not used with COBRA-TF. I believe RELAP5 has less trouble with certain transients than does TRAC.

The second objective of the COBRA-TF project appears to be similar to the primary objective of the TRAC project. The performance of the COBRA-TF code developers seems to warrant their continuing with this objective as a goal. It is not clear, however, what the motivation of the NRC program manager is. One can only speculate that certain problems with TRAC have required a parallel effort as insurance. A re-evaluation of the advanced code program may be appropriate.

COBRA-TF appears to be an excellent matrix for implementation of calculations needed to meet the first objective. A number of physical models need to be developed and it is not clear where they will come from. Parameter adjustment to do the best job for a large number of experiments is the procedure chosen for TRAC. It is not clear that the present effort is going to be any different. Problems of available global data and constituitive relations based on local phenomena don't seem to go away. There are more equations than our understanding of the physics justifies. The review group members echoed this view. Some of their comments are paraphrased as follows:

P. Griffith: We don't understand the physics well enough to do any good.

R.T. Lahey: If predictions for simple geometries such as rod centered annuli are poor, then how can predictions be made in a rod bundle?

K. Miller: How can data from a 2 inch pipe be extrapolated to a 3 foot pipe?

G. Birkoff: We should abandon the hypocracy that we understand the physics.

Models for wall drag and heat transfer, interfacial drag and heat transfer, interfacial area per unit volume, and others all depend on the flow regime. The flow regime map currently used is the same as the one used in TRAC and THOR. No consideration has been given the transient flow regime data obtained by Dukler. Another effort at oversimplistic modeling based on complex physics does not seem worthwhile. To accommodate flashing phenomena (blowdown) a minimum bubble number density dependent only on void fraction is used. This allows the code to be developed in the face of lack of information. Interfacial heat transfer requires knowledge of interfacial heat transfer coefficient and area. Vapor production depends on interfacial heat transfer as well as bubble density or flow regime. Interfacial drag is equally complex. The code developers are far ahead of the physical understanding and it appears as if the gap is widening rather than closing.

Another example of code development without physical insight is the modeling of reflood. The code developers still do not know what boiling curve to use or how to separate the effects of precursor cooling from changes in the minimum film boiling point due to subcooling on the quench process. The entrainment model does not distinguish between subcooled and saturated coolant. It is my conviction that the experimentalist should develop the model for the code developer.

To be fair, I would like to summarize by noting that even with the problems and weaknesses noted above, COBRA-TF is probably the best matrix for models under development. The personnel are receptive to advice from the review group. How NRC plans to use COBRA-TF is not clear when the projects second objective is considered. Finally, the gap between code development and physical understanding should be closed by slowing down the code development, increase efforts at obtaining understanding of the basic processes or a combination of both. Of course, another alternative is to decrease our expectations and go back to more empirical modeling.