June 22, 2000

Dr. Y. Anoda
Thermal-Hydraulic Safety Research Lab.
Japan Atomic Energy Research Institute
Tokai-mura, Maka-gun
Ibaraki-ken, 319-11
Japan

Dear Dr. Anoda:

As you are aware, we at USNRC are involved in an exciting research effort to hopefully replace the flow regime maps used in our system analysis codes with a dynamic model using a transport equation for interfacial area concentration.

In order to accomplish this goal, we have constructed 2 horizontal and 4 vertical loops at the University of Wisconsin and Purdue University, respectively. These loops are low pressure air/water facilities with extensive instrumentation. Prof. Ishii has developed a 4 sensor probe to measure large sized structures, such as cap bubbles and slugs but can also be run in a 2 sensor mode to measure spherical bubbles. Currently, work is underway to benchmark the measured values of a_i with visual images obtained with a digital camera and to cross-calibrate with the optical probe technique developed by CEA, France. A neural network is also used to perform flow-regime identification and several advances have been made with respect to signal processing with both the 2 and 4 sensor probes.

Currently in the vertical set up, we have obtained data for the bubbly and transition to the slug flow regime. Based on scaling rationale, these data are applicable to both large and small sized pipes in prototypic reactors. In the next phase of the experimental plan, the slug flow regime and transition to churn turbulent will be studied. In the horizontal set up, the bubbly to stratified flow regime transition has been studied as well as the wavy and intermittent flow regimes. In the next phase of work, the effect of geometric perturbations, such as elbows and flow area changes will be investigated.

Using the data taken so far, the one-group model has been developed and implemented into a developmental version of the NRC code, TRAC-M. Good results were obtained, which gave us confidence to continue this project. Progress has also been made on the two-group model, which is expected to be necessary to model the transition to slug flow and is expected to be adequate to model all flow regimes, from bubbly to annular.

Unfortunately, in order to accomplish our objective of replacing the flow regime maps with a dynamic model, the source and sink terms for interfacial area have to be developed for all geometries and flow conditions of nuclear reactors. We are hoping to rely on international collaboration to help defray the costs associated with this development. If possible, we propose that we can share with you our experience in setting up these measurement systems required to perform a_i measurements in your high pressure steam/water facilities, and hope to have access to these data in exchange for our database. Improving the modeling of the interfacial

transfer terms of the two-fluid model represents the best chance for improving our modeling capabilities, which is required to reduce unnecessary conservatism in our safety analysis codes. These advances may help to improve the efficiency of operating reactors while also minimizing the uncertainties in our safety analyses.

If you are interested in participating in this research effort, it would be advantageous to tentatively define a work scope and outline some details of exchange. It is also possible to make some arrangements through the CAMP agreement, which is currently under discussion. These preliminary options can then be discussed by Ashok Thadani, the Director of the Office of Nuclear Regulatory Research, and the appropriate JAERI management when Mr. Thadani visits in September. We look forward to hearing from you and to future collaboration.

Sincerely,

/RA/

Jennifer Uhle
Safety Margins and Systems Analysis Branch
Division of Systems Analysis and Regulatory Effectiveness
Office of Nuclear Regulatory Research

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