INTERIM REPORT

Accession No.______________

| | |
|---|---|
| Contract Program or Project Title: | SUBTASK A: RAMONA Code Modification and Evaluation<br>SUBTASK B: IRT and RETRAN Code Modification and Evaluation<br>SUBTASK C: Simulator Model Evaluation |
| Subject of this Document: | April Monthly Highlight Letter |
| Type of Document: | Monthly Highlight |
| Author(s): | M. M. Levine<br>Department of Nuclear Energy<br>Brookhaven National Laboratory<br>Upton, New York 11973 |
| Date of Document: | April 1980 |
| Responsible NRC Individual and NRC Office or Division: | Dr. Stanislav Fabic, Chief<br>Analyses Development Branch<br>Reactor Safety Research Division<br>U.S. Nuclear Regulatory Commission<br>Washington, D. C. 20555 |

This document was prepared primarily for preliminary or internal use. It has not received full review and approval. Since there may be substantive changes, this document should not be considered final.

Brookhaven National Laboratory
Upton, NY 11973
Associated Universities, Inc.
for the
U.S. Department of Energy

Prepared for
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555
Under Interagency Agreement DE-AC02-76CH00016
NRC FIN No. A- 3014

INTERIM REPORT

THERMAL REACTOR SAFETY CODE DEVELOPMENT

HIGHLIGHTS

FOR

April 28, 1980

SUBTASK A: RAMONA Code Modification and Evaluation

SUBTASK B: IRT and RETRAN Code Modification and Evaluation

SUBTASK C: Simulator Model Evaluation

M. M. Levine, Principal Investigator

Department of Nuclear Energy
BROOKHAVEN NATIONAL LABORATORY
Upton, New York 11973

* Work carried out under the auspices of the United States Nuclear Regulatory Commission.

A. RAMONA-III Code Modification and Evaluation

A.1 Code Assessment

Comparisons between data from the Peach Bottom Turbine Trip Tests and RAMONA-III calculations continued. In order to use the BNL-TWIGL cross section data in a consistent manner, the hydraulic channel representation was changed. Thirty-one channels are now used in the quarter-core representation. New loss coefficients were obtained to give the correct steady state flow rate through the core and core bypass regions (sensitivity studies show that these coefficients do not have much effect on the transients). Steady states were obtained for all three tests.

Calculations for Test No. 3 (TT3) were used to study the effect of different aspects of the hydraulic model. The Bankoff-Jones (B-J) slip correlation was introduced into the code and different values for the parameters in the Bankoff-Malnes (B-M) correlation which already existed in the code were tried. These changes increased the slip and hence reduced the steady state void fraction. This gave better agreement for the average void fraction relative to calculations with other codes and improved the steady state average axial power distribution relative to the data.

The option which calculates hydraulic properties at a local pressure obtained from an inertia free momentum balance had little effect on the steady state average power but reduced the transient relative peak power. This option is not recommended for use.

The addition of compressibility terms proportional to the time rate of change of system pressure, especially the liquid term, gave a large increase in peak relative power. This is attributed to the increase in volume flow, in which equation these terms appear, in the downcomer and lower plenum where the flow is completely liquid.

Adjustments were made to the albedo parameters at the bottom of the core. Calculations with the B-J correlation, and the compressibility terms in place then gave good agreement for the average axial power distribution measured for TT1, TT2, and TT3. Agreement was also good with the power trace observed during those three tests.

The hydraulic model was also tested by comparing results for void fraction with heated channel experimental data. Three 6-rod bundle experiments and one 36-rod bundle experiment representing different pressures and inlet subcoolings were used. The comparisons indicated the adequacy of using either the B-J slip model or the P-M model with different input parameters. The calculations with the B-J slip were done in two ways. One way was to modify the code so that it would do a single channel independent of the rest of the system. The other way was to use the theoretical models and do a "hand" calculation. Both methods gave similar results. The code was also used to test the sensitivity to one of the parameters ($R_0$) in the correlation which enters into the bulk boiling component of the vapor generation equation. This had the effect of changing the onset of boiling.

The need for an improved cross section formulation and the corresponding data which would account for the effect of exposure on void feedback had been recognized previously. A proposal for doing this was received from Scandpower. It was reviewed and suggestions were made for improving it.

An expression for the vapor generation/condensation rate due to the time rate of change of system pressure was developed. This expression was added to the RAMONA-III code replacing an expression only used in the steam dome and only used for decreasing system pressures. In conjunction with this, the existing bulk fluid evaporation term was made small by adjusting input data. This tended to change the onset of boiling during the debugging stage, acceptable results were obtained without this term for TT1, TT2, and TT3.

A.2 Plant Protection System

Chapter 15 of the GE Standard Safety Analysis Report was reviewed with the intention of determining what additional features of the plant protection system should be implemented. The recommended additions (noted in a memo) would allow more plant transient scenarios to be analyzed.

A.3 Programming Considerations

Difficulties have been encountered with the Scandpower steam separator and recirculation loop models. Assistance has been requested from the authors.

A.4 Small-Break Capability

A review of available information on small break LOCA's in a BWR was initiated.

B. IRT and RETRAN Code Modification and Evaluation

B.1 IRT Code Modification

The Mark II version of the once-through steam generator has been successfully run on a stand alone basis. The results are in reasonably good agreement with the Mark I results. The instability that was previously reported was found to be caused by the momentum equation written for the aspirator between the downcomer and the tube region. This equation did not include an inertia term and thus could predict instantaneous flow reversals depending on the pressure difference between the downcomer and tube region. This equation was removed and the aspirator flow is now calculated in the same manner as the Mark I version.

Work was initiated on incorporating the Mark II version into the IRT code.

Progress was made on the IRT code input reorganization. A code has been written to sort the IRT input dictionary into logically connected groups. This code produces a new input dictionary with the parameters in a more organized manner.

## B.2 RETRAN Code Implementation

The two input decks obtained from the Tennessee Valley Authority for the Sequoyah plant have been successfully run on the BNL computer. Minor modifications to both decks were necessary to run them at BNL.

A listing of the RETRAN input for the Trojan plant has been obtained from the Portland General Electric Company. Card input decks are apparantly not available.

## B.3 Use of BNL Codes by Other Institutions

In the past the IRT code has been made available to E. Throm, S. Salah and J. Guttman of NRC Division of Systems Safety. Program and data files were set up for their use on the BNL computer. In April, 1980, the IRT code was sent to P. Abramson at Argonne National Laboratory.

During April, runs were made with the IRT code for an overcooling transient for a Babcock and Wilcox company reactor. These included cases with and without feedwater temperature ramp-down, with and without upper head node included. Results of these cases were sent to W. Jensen and N. Zuber of NRC. Previous calculations for reactors with U-tube steam generators have included steamline break analyses with concurrent steam generator tube rupture for a typical Westinghouse plant (BNL-NUREG-26562) and a typical Combustion Engineering plant (BNL-NUREG-25855).

## C. Simulator Model Evaluation

The primary effort during the month of April in the study of power plant simulators was in the area of information collection. BNL has been attempting to obtain RETRAN and simulator outputs for selected accident sequences and modeling details for two simulators. As jointly decided between NRC and BNL, the two power plants to be reviewed are Surry (VEPCO) and Browns Ferry (TVA).

Numerous telephone conversations have been held with both the VEPCO and TVA engineering staff to schedule both the RETRAN and the simulator runs. At this time, it is anticipated that the Surry simulator will be run, with BNL staff present, during the month of June. VEPCO has informed us of delays in the best estimate RETRAN runs due to manpower limitations. Therefore, BNL has requested and expects to receive the Surry input deck from VEPCO during the month of May. As discussed with the staff, BNL will then plan to run the needed calculations in hopes of expediting the program. VEPCO management has also indicated to BNL that we should request the needed simulator model details directly from the manufacturer, EAI. To this end, BNL has discussed the need with EAI management and will be meeting with them on May 7, 1980 to review the details and hand carry the documentation back to the laboratory.

Our efforts with TVA were halted this month when they requested that all requests for information must go through the NRC project manager. BNL has contacted the project manager and requested his help by letter dated May 1, 1980. At this time we have no information as to future schedules in this matter (reference letter to Dr. Zuber from R. Hall dated April 22, 1980). BNL had a meeting with the manufacturer of the Browns Ferry simulator, Singer, on April 14, 1980 to discuss the direct availability of the software models. Negotiations are continuing on this subject.

During the reporting period Dr. W. Wulff and Mr. C. Durston attended one week and two weeks, respectively, of a workshop held by Applied Dynamics International (ADI). With the completion of the workshop, BNL will develop a initial recommendation to the staff regarding hardware applications to fast running codes.

Distribution

S. Fabic, Chief - NRC
W. Y. Kato
H.J.C. Kouts
T. Murley - NRC
F. Odar - NRC
Z. Rosztoczy - NRC
J. B. Spraggins
L. S. Tong - NRC
G. M. Vineyard
N. Zuber - NRC

IRT personnel
RAMONA personnel
RSP Division Heads
RSP Group Leaders
NRC Technical Information Div. (Bethesda) (2)