8005140175 TIC

INTERIM REPORT

Accession No.______________

____

ıtract Program or Project Title: SUBTASK A: RAMONA Code Modification and Evaluation
SUBTASK B: IRT and RETRAN Code Modification and Evaluation

Subject of this Document: February Monthly Highlight Letter

Type of Document: Monthly Highlight

Author(s): M. M. Levine
Department of Nuclear Energy
Brookhaven National Laboratory
Upton, New York 11973

Date of Document: February 1980

Responsible NRC Individual and NRC Office or Division: Dr. Stanislav Fabic, Chief
Analyses Development Branch
Reactor Safety Research Division
U. S. Nuclear Regulatory Commission
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

FEBRUARY 1980*

SUBTASK A: RAMONA Code Modification and Evaluation

SUBTASK B: IRT and RETRAN Code Modification and Evaluation

M. M. Levine, Principal Investigator

Thermal Reactor Safety Division
Thermal-Hydraulic Development Division
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

Work continued to improve the agreement between RAMONA-III and the Peach Bottom Turbine Trip Tests. Efforts have concentrated on the cross section data and the void modelling both of which are felt to require improvements.

A point kinetics calculation was done for TT3 to demonstrate the sensitivity of results to void feedback. Reactivity components for void, fuel and moderator temperature, and control rod motion were taken from the BNL-TWIGL calculation of TT3. When the void reactivity was arbitrarily reduced by 20% the resultant power peak during the transient was reduced by 50%.

The BNL-TWIGL cross section formulation option was reintroduced into RAMONA-III. Cross section data from the BNL-TWIGL study of Peach Bottom were utilized in running RAMONA-III. As expected, the power peaking during Test 3 (TT3) was markedly increased due to the stronger void feedback with this data. However, the new data gave a distorted steady state average axial power distribution. This distortion is suspected of being due to the variance between void distributions in RAMONA-III and BNL-TWIGL. This is supported by the fact that artificially imposing the BNL-TWIGL axial void distribution in the RAMONA-III computation of cross sections improves the axial power distribution.

RAMONA-III was used to calculate scram (with no other disturbance) starting from the TT3 steady state. The core power was observed to decrease less rapidly than the power calculated by BNL-TWIGL for the same transient. This may be significant during the latter part of the turbine trip tests where control rod worth plays an important role. The comparison of rod worth, however, was not conclusive since void and temperature feedback also influence the scram power.

A comparison was made of several calculations of core average void fraction $\langle\alpha\rangle$ versus time during TT3. Results at steady state showed $\langle\alpha\rangle$ to be 0.36 using RAMONA-III and 0.29-0.30 using BNL-TWIGL, RETRAN, and ODYN. A calculation without slip in RAMONA-III showed an increase in the steady state $\langle\alpha\rangle$ of 0.06 which corresponded to the increase observed with RETRAN. The change in $\langle\alpha\rangle$ at 0.8s into the transient was similar for both the RAMONA-III and the BNL-TWIGL calculation. The initial power distribution as well as the power during the turbine trip transient will be sensitive to the void distribution. Hence it is important to understand why $\langle\alpha\rangle$ differs between these calculations.

The models for slip ratio and for vapor generation rate were compared by hand calculations, respectively, with the drift flux model and with the models of Saha and Zuber for subcooled boiling and of equilibrium for condensation by compression and for flashing. It has been found that for the initial steady state RAMONA predicts void formation at the core entrance while the Saha Zuber criterion predicts the onset of boiling at z=0.54 m measured from the entrance of the core. RAMONA computed slip ratios increasing in axial direction from 1.0 to 1.3, while the drift flux model predicts slip ratios from 1.2 to 1.7. RAMONA predicted the average void fraction $\bar{\alpha} = 0.365$, the hand calculations produced $\bar{\alpha} = 0.300$, both with inlet subcooling of 8.14 K. Modifications are being implemented to improve the slip model in RAMONA, since its predicted void fractions are recognized to be too high.

It has been found also that RAMONA has no terms proportional to the time rate of pressure change in its expressions for the divergence of the mixture volume flux. These terms were estimated to account for 30% of the total divergence at the onset of the pressure rise in the core, following the Turbine Stop Valve closure. Only part of this pressure rise effect can be compensated for by RAMONA's nonequilibrium condensation model. This nonequilibrium model may be inappropriate unless it can be adjusted to follow the equilibrium condensation and flashing processes observed in the Turbine Trip Tests. Efforts are continuing to select the appropriate input parameters for the nonequilibrium condensation and boiling model in RAMONA and to account for the correct pressure rise effects.

The original calculation of TT1 utilized the actual feedwater temperature as input. Due to an incorrect calculation of specific heat in RAMONA-III the steady state feedwater flow rate was low. An iteration was carried out on the input feedwater temperature to match the steady state feedwater flow rate. This correction resulted in about a 7% increase in peak relative power during the transient.

The effect of the BNL jet pump model, which was used in the original calculation, was determined by rerunning (TT1) with the pump head fixed at the steady state value. This resulted in a 13% increase in relative peak power during the transient.

A.2 Programming Considerations

The new version of the code which incorporates several new models and calculational features (see January Highlight Letter) has been successfully implemented and a memo describing its usage was issued.

B. IRT and RETRAN Code Modification and Evaluation

B.1 IRT Code Modification

The implementation of the downcomer equations in the Mark II version of the once-through steam generator model has continued. An instability has been observed during the testing of the model and a detailed comparison with the Mark I modeling is in progress.

Work was initiated on implementation of a momentum equation in the IRT code. The model being added will calculate the main coolant flow rate based on friction, elevation, and main coolant pump pressure differences. This calculation will provide the flow rate at the exit of the pump where it was previously specified as a code input parameter.

The reorganization of the IRT code input has continued. The input to the code is being modified so as to group logically connected parameters. For example, all left hand steam generator parameters will be specified in one contiguous group of input numbers. Most of the current input parameters have been catagorized and a code is being written to sort the input dictionary on these parameters.

B.2 RETRAN Code Implementation

RETRAN code input decks have been obtained for the Sequoyah plant. The decks are set up for low power natural circulation calculations and for calculations at rated conditions. Both models are currently being tested on the BNL computer.

RETRAN input models for the Trojan plant have been requested from the Portland General Electric Company.

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)