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INTERIM REPORT

Project Highlights

for

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PROGRAM: A. SSC Development, Validation and Application (FIN No. A-3015)
B. Generic Balance of Plant Modeling (FIN No. A-3041)

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This is the monthly highlights letter for (A), the Super System Code (SSC) Development, Validation and Application Program and (B) the Generic Balance of Plant (BOP) Modeling Program for the month of July 1982. These programs are covered under the budget activity number 60-19-01-40. The SSC Development, Validation and Application Program is currently focused to provide direct support to the on-going CRBRP licensing activities within NRC.

A. SSC DEVELOPMENT, VALIDATION AND APPLICATION (J.G. Guppy)

I. SSC-L Code (M. Khatib-Rahbar)

1. Loss of Feedwater Transient for CRBRP (W.C. Horak, G.J. Van Tuyle)

Analysis of the LOHS test case is proceeding with several improvements in models and data being factored in. Responses to several of our questions and requests for information have recently been provided, and the new information is being reviewed and, where applicable, is being used to update the input data. A new seven channel model of the CRBR heterogeneous core is being assembled. Modifications to MINET are expected to improve representation of the steam drum and the pumps.

2. Check Valve Modification (E.G. Cazzoli, J.G. Guppy)

The impact of a check-valve on the primary system was modified to account for its closing and reopening during all transients. This is a generalization of the previous model, which was valid only for pipe ruptures near the reactor vessel inlet.

3. Pipe Break Analysis (B.C. Chan, J.G. Guppy and E.G. Cazzoli)

Two test cases for the CRBRP, simulating double-ended pipe breaks in the hot leg between the pump and the IHX, have been conducted. In these cases, the pony motor and the check valve 1) fail or 2) function in the damaged loop, after the pump trip. Results of both cases are being studied.

4. Three-Dimensional Graphics Package (R.J. Kennett)

The latest version of the DISSPLA graphics library has been obtained and is now operational on the BNL CDC-7600. The library is now being tested on a series of three-dimensional graphs generated using SSC.

5. User Support (T.C. Nepsee)

The code revisions developed to correct the IBM FORTRAN compatibility problem in the SSC-L Version 3.0 (CY 40) Input Processor have been installed at GRS. Although this has corrected the major part of the problem, other revisions were found to be necessary before a successful steady state run could be completed. Dr. Quast reported that, as of July 28, further code revisions would be necessary to correct problems in the Transient Reader.

II. SSC-P Code (E.G. Cazzoli)

1. Loss-of-Flow Paper (E.G. Cazzoli)

A paper entitled "Analysis of Loss-of-Flow Transients in a Pool-Type LMFBR using SSC-P" was written, and presented in Lyon, France at the International Topical Meeting on LMFBR Safety and Related Design & Operational Aspects by the co-author, I.K. Madni (now at the UPM, Dharhan, K.S.A.). The paper presented results obtained by using cycle 5 of SSC-P with cycles 28 and 31 of SSC-L on several simulation runs of a Phenix-type reactor under natural circulation and pipe rupture conditions.

III. SSC-S Code (B.C. Chan)

1. Improved Upper Plenum Modeling (B.C. Chan, R.J. Kennett)

A two dimensional plot package was modified for use with our stand alone upper plenum test code. This package facilitates 2-D velocity and temperature plots, and can be used with either fixed or variable mesh spacing.

Work is continuing on upper plenum model modification and code debugging.

IV. SSC Validation (W.C. Horak)

1. Simulation of FFTF Natural Circulation Tests (W.C. Horak, R.J. Kennett)

Validation efforts during this month were concentrated on the development of a nominal pump model for FFTF. The present model was designed to yield conservative results through the use of a frictional torque representation that led to reduced coastdown times. Using the experimental data, a new frictional torque model has been developed and is now being tested on the 100% and 75% power tests.

The 75% power test was simulated for a total of 200(s). While the transient results were generally satisfactory, small errors in the hot leg temperatures were noticeable. These discrepancies were traced to mismatches between SSC steady state results and the experimental data. The input data set is being revised so as to remove these mismatches and the transient will be recalculated.

2. Stuck Rod Simulation (W.C. Horak, R.J. Kennett)

A small bug in the simulation of stuck control rods, which led to large positive increases in reactivity, was detected and is now being corrected.

B. GENERIC BALANCE OF PLANT MODELING (J.G. Guppy)

The Generic Balance of Plant (BOP) Modeling Program deals with the development of safety analysis tools for system simulation of nuclear power plants. It provides for the development and validation of models to represent and link together BOP components (e.g., steam generator components, feedwater heaters, turbine/generator, condensers) that are generic to all types of nuclear power plants. This system transient analysis package is designated MINET to reflect the generality of the models and methods, which are based on a momentum integral network method.

1. Balance of Plant Component Models (G.J. Van Tuyle, P. Perez)

The concept of extending our heat exchanger model, currently used to represent steam generators, so that it can also be used to represent feedwater heaters and condensers, has been further considered. This approach has significant advantages in terms of code size and complexity, and is clearly the way for us to proceed. The required modifications are principally on a global level, and require reformulation of some of the network approaches used in the steady-state solution. This task is currently in process.

The process of formulating a turbine model has begun. Most of the currently available textbooks and papers deal with turbine design, and are far too detailed for our needs. However, we have made significant progress in defining those specific aspects which are needed to properly simulate plant transient behavior.

2. MINET Code Improvements (G.J. Van Tuyle, T.C. Nepsee)

A modification set that facilitates representation of a "three region accumulator" using two smaller accumulators and a short connecting pipe has been tested and appears to be working correctly. We used this feature to improve our representation of the Clinch River steam drum, and made several test runs. In these runs we adjusted the boundary conditions to drive the drum through several different states. We have established that the modifications are functioning as intended. A test against experimental data (reported by Collins) is planned as the next step in validating this model.

Introduction of the short pipe in the "three region accumulator" test runs revealed an error in the accelerative pressure loss term. This error was generally inconsequential, and was observed in the short pipe only because the frictional losses were very small. This error has been corrected and the modification has been tested in subsequent runs.

Several relatively small changes are being made to the print subroutine. These changes will make the printout more compact and informative, as well as easier to interpret.

The modification set that allows representation of pumps using homologous pump curves has been tested in the primary loop of SSC, but awaits some modifications in the MINET input processor before it can be further tested. The modifications required in the input processor are similar to those that will be needed to develop the stand alone version of MINET. Thus, we are working to achieve both goals with the current homologous pump modification set.

An enhancement has been developed for the NODE and MODULE Data Abstraction implementations to allow extensibility and deallocation. This is expected to allow more efficient overall use of the available main memory in fixed memory size environments.

3. MINET Input Decks (G.J. Van Tuyle)

MINET decks C-1 through C-3 are currently in use. MINET deck C-4 is our developmental deck and has undergone several revisions already, with more planned. Current plans are for MINET deck C-4 to replace decks C-1 through C-3 when we go to the next cycle of SSC/MINET.

We are beginning to get additional information on the Clinch River pumps and control systems. This, combined with the introduction of homologous pump curves in MINET, will soon lead to significant improvements in our Clinch River input decks.

4. MINET Applications (G.J. Van Tuyle)

The Clinch River Station Black-out event (without auxiliary feedwater) was run to six minutes with the new "three region" steam drum model. The new drum model appeared to be functioning correctly, but problems in the evaporator terminated the run before the drum dried out completely. It now appears that the coarse mesh nodalization we have been using (8 nodes/evaporator, 6 nodes/superheater) is going to have to be increased for runs where severe conditions are anticipated.

We are preparing to simulate Collins' steam drum test, in order to validate our new "three region" drum model. The test data have been used previously to validate a model by Slovik. While the formulation of our model is much simpler than the one developed by Slovik, both models are based on the same assumptions.

5. User Support (G.J. Van Tuyle)

The helical coil related update set developed by the PNC representative, Mr. Iwashita, has been reviewed for modifications that should be factored into the main program library of MINET. An appropriate update set has been developed and will soon be tested using deck C-4.

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