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INTERIM REPORT

Project Highlights

for

August 1982

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 August 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. CRBRP Accident Analysis (W.C. Horak, G.J. Van Tuyle)

A new set of boundary conditions has been completed for the steam generator system for the complete loss-of-feedwater transient.

A case involving complete loss of heat sink at the IHXs with pony motor flow in one loop is being prepared for use in a sodium boiling prediction test.

2. Sodium Boiling Modeling (M. Khatib-Rahbar)

Detailed numerical calculations were compared to an approximate flow-regime dependent dryout heat flux relationship similar to the Fauske-Ishii re-entry criterion for CRBRP fuel assemblies. Results indicate that sodium boiling can remove decay heat of about 2.7% at zero inlet subcooling, up to about 5% at maximum inlet subcooling provided core uncovery has not taken place. Approximate calculations show results which are in the conservative direction as compared with the detailed results; however, the flow regime dependence is quite significant and has therefore been included in the dryout heat flux relationship.

3. Intra-assembly Modeling (M. Khatib-Rahbar, E.G. Cazzoli)

Work was begun to assess the need for detailed rod bundle thermal-hydraulic modeling. Existing computer codes and modeling techniques are being reviewed.

4. Software Standards (T.C. Nepsee)

As part of a continuing effort to improve and maintain SSC/MINET software quality, the following ANSI documents have been acquired and are available for reference use by Group members:

- ANSI N413-1974, "American National Standard Guideline for the Documentation of Digital Computer Programs"
- ANSI X3.4-1977 "Code for Information Interchange"
- ANSI X3.5-1970 "Flowchart Symbols and Their Use in Information Processing"

- ANSI X3.22-1973 "Recorded Magnetic Tape for Information Interchange (800 CPI, NRZI)"
- ANSI X3-39-1973 "Recorded Magnetic Tape for Information Interchange (1600 CPI, PE)"
- ANSI X3.54-1976 "Recorded Magnetic Tape for Information Interchange (6250 CPI, group-coded recording)"
- ANSI X3.27-1978 "Magnetic Tape Labels and File Structure for Information Interchange"
- ANSI X3/TR-1-77 "Dictionary for Information Processing"

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

1. Code Maintenance (E.G. Cazzoli)

Due to the continued focus of this program to provide direct support for the CRBRP licensing activities, work on the SSC-P code has been slowed. However, modification of SSC-P to maintain its compatibility with the latest cycle of the SSC program library is continuing, but on a reduced level.

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

1. Improved Upper Plenum Modeling (B.C. Chan)

Work was concentrated on modifications to the model concerning buoyancy effects:

a) The Boussinesq approximation term was introduced into the momentum equations.

b) To account for the contribution of buoyancy to the turbulent kinetic energy and dissipation rate, a third transport equation for the mean square temperature fluctuations may need to be included in the model.

2. Long Term Transient with DRACS Operating (B.C. Chan, J.G. Guppy)

A transient was simulated out to 4500 seconds using an LDP prototypic design which includes an in-vessel direct reactor auxiliary cooling system (DRACS). The transient involved a loss of electric power, plant trip, coastdown to natural circulation and assumed loss of all cooling at the IHXs. With the DRACS operating, the in-core sodium temperatures had peaked and were gradually decreasing at the point where the simulation was terminated.

IV. SSC Validation (W.C. Horak)

1. FFTF Natural Circulation Tests (with J.G. Guppy)

The nominal 100% power case was completed with the addition of an increased locked rotor resistance. The results were improved as compared to the earlier pre-test simulations.

The 75% and 35% power tests were also simulated. The 75% power case was found to be in good agreement with the experimental data. The comparisons have not been completed for the 35% case, but the FOTA temperatures have been found to be in good agreement with the data.

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 Models (G.J. Van Tuyle, P. Perez)

The current MINET heat exchanger model is being extended so that it can be used to represent feedwater heaters and condensers in addition to steam generators. Correlations are to be added that will allow representation of heat transfer from condensing steam and to air (air-cooled condensers).

Our review of existing turbine models has been concluded, at least for the present. Most of the major modeling efforts to date have been design oriented, and involve lengthy efficiency calculations. MINET users will be assumed to "know" the turbine efficiency (perhaps as a function of turbine speed). The model will then consist of equations conserving mass, energy, and entropy which will be used to calculate fluid velocity, enthalpy, and entropy and therefore all state properties).

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

The modification set that factors the helical coil heat exchanger modeling improvements, developed by the PNC of Japan representative, has been made compatible with the latest cycle of the SSC program library.

The helical coil option has been tested by representing the Windscale Advanced Gas Reactor (AGR) facility. An error in the determination of the heat transfer length between the coil and the "pool" fluid was discovered and corrected.

The modification set that extends the data abstractions, from a pre-determined length to an expandable length, is undergoing testing and optimization. Further development of stand-alone capability for MINET and the representation of pumps using homologous pump curves awaits completion of this effort.

A major modification set that will allow representation of feedwater heaters and condensers is now under development. There are three tasks involved: a) extension of the highest level of system logic to allow unlimited heat exchanger linkages within and between sub-networks, b) stripping the MINET exchanger model of any steam generator bias, and c) extending the correlations to represent air and condensing steam.

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

Standard decks C-1, C-2, and C-3 continue to be used in production runs. Deck C-4 is still under development and will become the standard deck for the next cycle of the program.

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