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NRC Research and Technical Assistance Report

SSC Project Highlights

for

April - May 1980

PROGRAM: SSC Code Development and Validation

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This is the monthly highlight letter of (1) the SSC Code Development and (2) SSC Code Validation Program, Fast Reactor Safety Assessment, for the months of April and May, 1980. These programs are covered under the budget activity number 60-10-20-01. Only major accomplishments are noted in this letter.

A. CODE DEVELOPMENT (J. G. Cuppy)

I. SSC-L Code (J. G. Cuppy)

1. Steam Generator Modeling (S. F. Carter, W. C. Horak, R. J. Kennett, G. J. Van Tuyle)

Most of the recent modifications and corrections made for the SSC-W steam generating modules are common to the generic version of SSC. Downcomer level tracking subroutines have been coded and interfaced, and are currently being debugged. These subroutines are needed for the OTSG downcomer simulation, but are also applicable to LMFBR components, such as the steam drum in the CRBRP.

2. Plant Protection and Control Systems (M. Khatib-Rahbar and S-C. Dang)

A draft topical report describing the modeling of Plant Protection and Control Systems for the SSC code was completed and will be issued shortly.

Work is also proceeding on the debugging and testing of the steam generator system control models now assembled into the SSC program module.

3. LMFBR Accident Progression Analysis (K. M. Jamali, M. Khatib-Rahbar)

The CRBRP-SHRS fault tree has been reconstructed, using the existing fault tree. A number of modifications have been introduced to improve the logical representation and to incorporate failure dependency with SHRS subsystems.

Work began on the development of a computer code for the propagation of primary-event uncertainties into the probabilistic ordering of the minimal cut sets of a fault tree. The code will be called UPICO for Uncertainty Propogation in Cutset Ordering.

4. Low-Heat-Flux Sodium Boiling (M. Khatib-Rahbar)

A review of recent experimental and theoretical works at ORNL, ANL and elsewhere is underway in order to adopt an efficient and accurate model for low heat flux sodium boiling into SSC under conditions of natural circulation transients.

II. SSC-P Code (I. K. Madni)

1. Steady-state Natural Convec on at Low Power (I. K. Madni and E. G. Cazzoli).

The code is being used to si ulate the long term, low power thermal response of the Phenix reactor core under natural convection cooling conditions. These conditions are reached by scramming the reactor f m full power, and allowing the decay heat to remain constant at a given fraction of full reactor power.

2. Model Documentation (I. K. Madni)

A report documenting the steady-state and dynamic modeling for SSC-P is being prepared.

III. SSC-W Code (J. G. Guppy)

1. Code Applications (S. F. Carter, J. G. Guppy, W. C. Horak, R. J. Kennett, T. C. Nepsee, G. J. Van Tuyle)

The SSC-W code was exercised for numerous transient for a TMI-2 type plant design during this period. These runs included: loss of normal feedwater transients; natural circulation transients; and the TMI-2 event. Several of these operational transients were run out to almost 1000 seconds of simulation time. Such cases are run in less than real time on a CDC 7600.

The TMI-2 event has been thus far simulated out to 18 seconds using SSC-W. As the extent to which the TMI-2 event can be simulated with the present single phase (primary loop) representation is limited, these results are considered more significant with respect to the code development progress than analysis of the accident itself.

2. Steam Generator Modeling (S. F. Carter, W. C. Horak, R. J. Kennett, G. J. Van Tuyle)

A three-volume steam generator model data set was constructed, debugged and tested on a null transient. This representation includes the aspirator calculations. Additionally, a downcomer upstream of the heat exchanger is represented.

IV. SSC-S Code (J. G. Guppy)

1. Inter- and Intra-assembly Effects (B. Chan)

Intra-assembly: Several efforts in the input deck of the SPAC code have been corrected. The results of the sample run are identical with the results from the original code. Five different power and sodium flow rate cases for a CRBR radial blanket assembly model were run. These are being used to generate a set of normalized assembly maps. They will also enable us to understand quantitatively how the inter-assembly heat transfer effects can be factored into SSC.

Inter-assembly: A physical model of the inter-assembly heat transfer suitable for usage in SSC is being investigated. However, the model would not be implemented as yet.

B. CODE VALIDATION (J. G. Cuppy)

1. FFTF Acceptance Tests (L. G. Epel)

Work is continuing (in cooperation with HEDL personnel) to incorporate the thermocouple response of the FFTF instrumentation into the SSC-L/FFTF Code.

2. Inter-code Comparisons of SSC-L/FFTF to IANUS (L. G. Epel)

The comparison of simulations performed by the FFTF version of SSC-L and those done by IANUS continued during this period. Attention was focused on pump seizure scenarios, especially those in which there is an imbalance in the behavior of the pumps in different loops.

Also, a so-called "Contrived Tornado" scenario has been successfully run and resulted in good agreement with the analogous IANUS case. In this transient the reactor and pumps are tripped at the inception of the run and two of the three secondary circuits are assumed inoperative. At 230 seconds into the transient the power to all of the pony motors is assumed lost. Because of the large negative thermal head in the primary system that ensues, the core flow diminishes to near zero with a subsequent steep rise in core exit temperature. The SSC-L simulation matched the IANUS core flow and exit temperature predictions very well; the only significant discrepancy was due to differences in core flow estimates when this flow was near zero.

3. Inter-code Comparisons of SSC-L to DEMO/CRBRP (R. Pyare)

As mentioned in the previous monthly report, comparisons between SSC-L and DEMO output for coastdown to pony motor speed cases produced differences in the intermediate loop flow rates. It has been found that the net height summation for the intermediate loop in the particular DEMO input data used was +6 ft. This summation should be zero. Thus, an unrealistic positive pressure gain (due to gravitational forces) was present in the DEMO case. At high pump head this produced a negligible effect, but was the source of the discrepancy at pony motor speed/flow.

A coastdown to natural circulation case for which DEMO results are available has now also been run and the detailed comparisons are being made.

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