

10  
2

BNL-NUREG-34141  
CONF - 840614 - 43

BNL-NUREG--34141  
DE84 007379

MINET VALIDATION STUDY USING  
EER-II TRANSIENT DATA

### DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

by

Gregory J. Van Tuyle

Department of Nuclear Energy  
Brookhaven National Laboratory  
Upton, New York 11973

Paper Submitted for Presentation at the 1984 Annual Meeting of the American Nuclear Society at New Orleans, Louisiana.

**MASTER**

Work prepared under the auspices of the U.S. Nuclear Regulatory Commission

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

## MINET VALIDATION STUDY USING

### EBR-II TRANSIENT DATA

G. J. VAN TUYLE

MINET is a computer code (Ref. 1) developed to provide a comprehensive representation of large and complex thermal-hydraulic systems, such as those found in the balance of plant of power generating facilities. It can be used stand-alone, or interfaced to another computer code for concurrent analysis. In a recent study, an EBR-II transient was simulated using MINET, and calculated results were compared against the plant transient data.

MINET is based on a Momentum Integral NETWORK method (Ref. 2), which allows representation of large plant thermal-hydraulic systems. This integral approach contrasts with the local momentum approach used in many system codes, which provide detailed simulation of local processes, but require prohibitive amounts of storage and computation time for large problems. The integral momentum approach, used in MINET, results in fewer local pressures, which reduces the order of the matrix equation needed to advance the system in time.

MINET contains the necessary component models and options, as well as the required constitutive relations, to simulate the balance of plant. In addition to stand-alone applications for systems and sub-systems analysis, it is used with the SSC code (Ref. 3) to simulate LMFBR systems, and is currently being interfaced with the RAMONA-3B code (Ref. 4) for BWR system transient analysis.

Validation of the MINET code is an ongoing process, with intercode comparisons and simulation of component test transients preceding the EBR-II study described here. The Experimental Breeder Reactor II (EBR-II) is a 62.5 Mwt sodium cooled reactor and power plant (Ref. 5). Heat is transferred from the primary "loop" through an intermediate heat exchanger (IHX) to a secondary sodium system, and through evaporators and superheaters to the steam system.

The portion of the EBR-II system simulated includes half of the secondary sodium loop, and the part of the steam system significant to the transient, as shown schematically in Figure 1. This representation facilitated boundary condition specification. In the simulation, MINET component modules for pipes, valves, heat exchangers, and volumes were used. The volume modules were used for representing tanks, e.g., the steam drum, significant flow junctions, and other locations where a dynamic pressure calculation was desirable.

The EBR-II test transient analyzed was a coastdown from 36% full power and 39% full primary flow. Transient boundary conditions, determined from test results, included secondary flow and IHX outlet temperature, feedwater flow and temperature, and drain flow. The auxiliary flow and the turbine bypass (throttle was closed) valve characteristics were obtained from a previous simulation (Ref. 6). Specifically, the secondary, feedwater, and auxiliary flows decreased, the drain flow was shut off quickly, the feedwater temperature held nearly constant, the IHX outlet temperature decreased steadily, and the bypass valve closed in response to reduced steam pressure. Fourteen system parameters were compared, including temperatures, pressures, flows, and drum level. Figure 2 compares two such parameters, the superheater inlet and outlet sodium temperatures. As can be seen, MINET yields results in good

agreement with the experimental data. The tendency of the MINET calculated temperatures to lead the measured values was traced to thermocouple response times, which ranged from 10 seconds to 1 minute (Ref. 6).

While not all of the MINET component modules were employed in this study, the results were highly supportive of the basic methodology and the component modules utilized.

In summary, the MINET code, developed to simulate large and complex thermal-hydraulic systems, such as balance of plant, was used to simulate an EBR-II test transient. MINET calculations agreed well with measured parameters, confirming the validity of the basic MINET methodology and key component models.

#### References

1. G.J. Van Tuyle, T.C. Nepsee, J.G. Guppy, "MINET Code Documentation," February, 1984, BNL Report to be published.
2. G.J. Van Tuyle, et al., "MINET-Transient Analysis of Fluid Flow and Heat Transfer Networks," 1983 ASME Computers in Engineering Conference Proceedings, Vol. 1, pg. 189, BNL-NUREG-32858, August 1983.
3. J.G. Guppy, et al., "Super System Code (SSC, Rev. 2), An Advanced Thermo-hydraulic Simulation Code for Transients in LMFBRs," Brookhaven National Laboratory, NUREG/CR-3169, BNL-NUREG-51650, April 1983.
4. W. Wulff, et al., "A Description and Assessment of RAMONA-3B: A Computer Code with Three-Dimensional Neutron Kinetics for BWR System Transients," BNL Report to be published, 1984.
5. L.J. Koch, et al., "Hazard Summary Report, Experimental Breeder Reactor II (EBR-II), Argonne National Laboratory, ANL-5719, May 1957.
6. D. Mohr and E.E. Feldman, "A Dynamic Simulation of the EBR-II Plant During Natural Convection with the NATDEMO Code," Published in Decay Heat Removal and Natural Convection in Fast Breeder Reactors, Agrawal and Guppy, Hemisphere Publishing Corporation, New York, 1981.

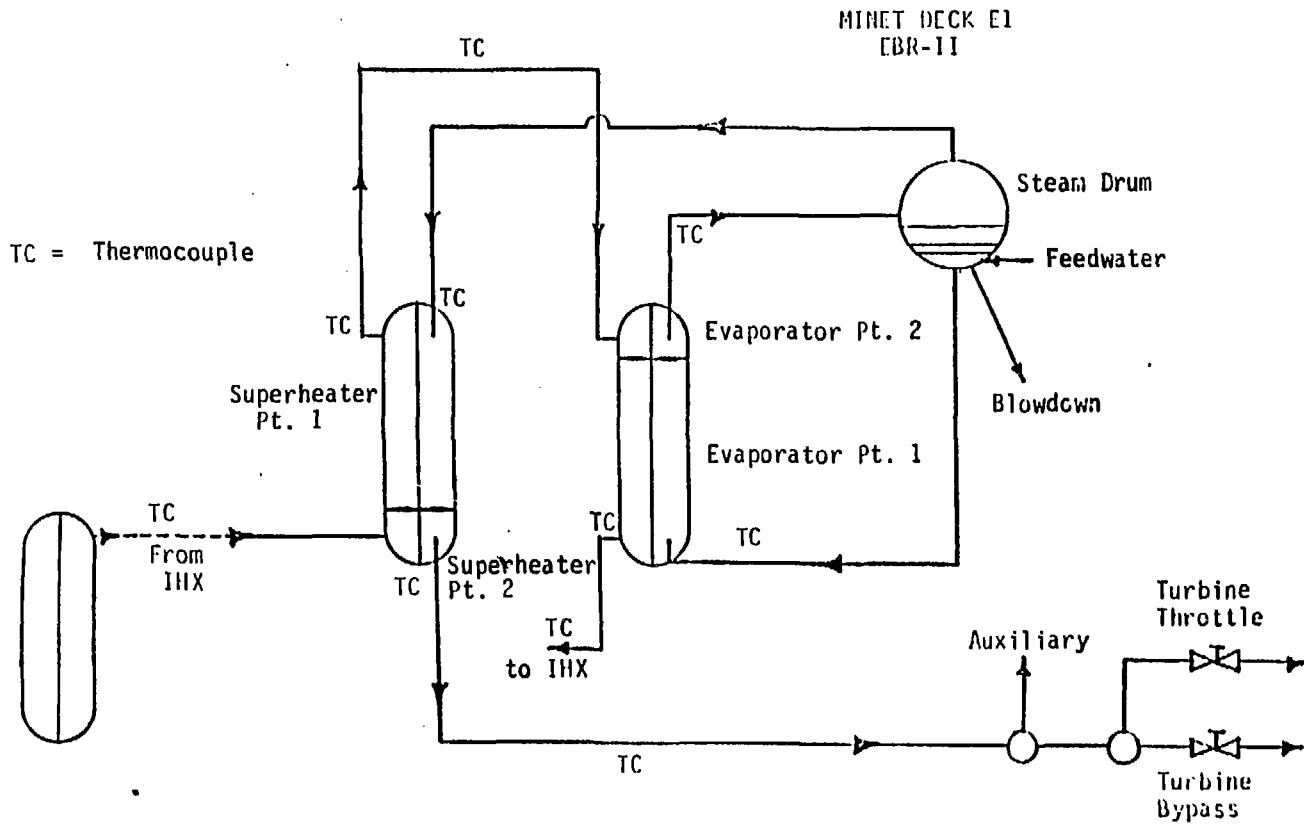


Figure 1 - MINET Representation of EBR-II System Utilized in Study

# Superheater Sodium Temperatures

