ANL-80-6

197
6/18/80

mmB

14. 1345

ANL-80-6

MASTER

**SACO-1: A Fast-running
LMFBR Accident-analysis Code**

by

**C. J. Mueller, J. E. Cahalan,
and J. K. Vaurio**

BASE TECHNOLOGY

ARGONNE NATIONAL LABORATORY, ARGONNE, ILLINOIS
SPONSORED BY THE U. S. DEPARTMENT OF ENERGY

REPRODUCTION OF THIS DOCUMENT IS UNLIMITED

The facilities of Argonne National Laboratory are owned by the United States Government. Under the terms of a contract (W-31-109-Eng-38) among the U. S. Department of Energy, Argonne Universities Association and The University of Chicago, the University employs the staff and operates the Laboratory in accordance with policies and programs formulated, approved and reviewed by the Association.

MEMBERS OF ARGONNE UNIVERSITIES ASSOCIATION

The University of Arizona
Carnegie-Mellon University
Case Western Reserve University
The University of Chicago
University of Cincinnati
Illinois Institute of Technology
University of Illinois
Indiana University
The University of Iowa
Iowa State University

The University of Kansas
Kansas State University
Loyola University of Chicago
Marquette University
The University of Michigan
Michigan State University
University of Minnesota
University of Missouri
Northwestern University
University of Notre Dame

The Ohio State University
Ohio University
The Pennsylvania State University
Purdue University
Saint Louis University
Southern Illinois University
The University of Texas at Austin
Washington University
Wayne State University
The University of Wisconsin-Madison

NOTICE

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government or any agency thereof, nor any of their employees, make any warranty, express or implied, or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represent that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, mark, 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.

Printed in the United States of America
Available from
National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

NTIS price codes
Printed copy: A15
Microfiche copy: A01

[illegible]

ANL-80-6

*Now at Knolls Atomic Power Laboratory, Schenectady, New York
**Formerly St. Norbert College, West DePere, Wisconsin

TABLE OF CONTENTS

	<u>Page</u>
ABSTRACT	9
I. INTRODUCTION AND SUMMARY	10
A. Introduction	10
B. Organization of Report	12
II. PROGRAMMING FRAMEWORK.	12
III. PHYSICAL MODELS AND BASIC EQUATIONS	14
A. Prevoding Heat-transfer and Coolant Dynamics	17
1. Coolant and Cladding Temperatures	17
2. Fuel Temperatures	27
3. Coolant Dynamics	30
B. Voiding-phase Heat-transfer and Coolant Motion.	31
1. Coolant-void and Film-dryout-front Motion	32
2. Coolant and Cladding Temperatures	34
3. Fuel Temperatures	38
C. Fuel Motion	43
1. Criteria for Fuel Failure (Motion)	43
2. Fuel Relocation	43
D. Neutronics	49
1. Point-kinetics Module	49
2. Reactivity-feedback Calculations	52
E. Time-weighted Power and Energy Modeling	55
IV. CALCULATION'S AND RESULTS	57
A. Model Verification.	57
B. Sensitivity Analyses.	60
V. CURRENT STATUS AND FUTURE EFFORTS	62
APPENDIXES	
A. Subroutine Functional Listing and Flow Charts	64
B. Input Description and Definitions	72

TABLE OF CONTENTS

	<u>Page</u>
C. SACO Program Listing.	81
D. Sample Problem--Input/Output	208
E. Sample Plotting Input/Output.	315
F. Heat-transfer Properties and Lumped Parameters	324
ACKNOWLEDGMENTS	327
REFERENCES.	327

LIST OF FIGURES

<u>No.</u>	<u>Title</u>	<u>Page</u>
1.	Interfacing of SACO and PROSA in Probabilistic/Deterministic Accident Analysis	11
2.	Probabilistic/Deterministic Core-disruptive-accident Analysis .	11
3.	Representative Fuel Pin and Associated Coolant, Cladding, and Structure.	14
4.	Representative Fuel-temperature Profiles for Two-dimensional Modeling.	28
5.	SACO Voiding-phase-model Representation.	31
6.	SAS Predicted Typical Voiding-phase Behavior	31
7.	SACO Fuel-motion-model Representation	44
8.	SACO-SLUMPY Fuel-motion-representation Comparison.	45
9.	SAS-SACO Prevvoiding-temperature-profile Comparisons.	58
10.	SAS-SACO Temperature-profile and Reactivity-calculation Comparisons	58
11.	SAS-SACO Radial Fuel-temperature-profile Comparisons	59
A.1.	DRIVER Flow Chart	66
A.2.	DRVR01 Flow Chart	67
A.3.	DRVR02 Flow Chart	68
A.4.	DRVR02 Decision Tree	69
A.5.	DRVR03 Flow Chart	69
A.6.	TSPK Flow Chart	70
A.7.	TWODTF Flow Chart.	71
B.1.	Axial Node Structure in SACO.	73
B.2.	Axial Power Profiles in SACO.	73
E.1.	Reactivity vs Time, Comparison between SACO and SAS	315
E.2.	Normalized Reactor Power vs Time, Comparison between SACO and SAS.	315
E.3.	Normalized Transient Energy vs Time, Comparison between SACO and SAS	316
E.4.	Temperature Comparison between SACO and SAS, ~0.10 s	316
E.5.	Temperature Comparison between SACO and SAS, 2 s	316

LIST OF FIGURES

<u>No.</u>	<u>Title</u>	<u>Page</u>
E.6.	Temperature Comparison between SACO and SAS, 4 s	316
E.7.	Temperature Comparison between SACO and SAS, 6 s	317
E.8.	Temperature Comparison between SACO and SAS, 8 s	317
E.9.	Temperature Comparison between SACO and SAS, 10 s	317
E.10.	Temperature Comparison between SACO and SAS, 11.28 s	317
E.11.	Temperature Comparison between SACO and SAS, 11.68 s	318
E.12.	Temperature Comparison between SACO and SAS, 12.07 s	318
E.13.	Temperature Comparison between SACO and SAS, 12.86 s	318
E.14.	Temperature Comparison between SACO and SAS, 13.22 s	318
E.15.	Temperature Comparison between SACO and SAS, 13.58 s	319
E.16.	Temperature Comparison between SACO and SAS, 13.9 s	319
E.17.	Voiding and Dryout Profiles, Channel 8	319
E.18.	Axial Power Profile, Channels 1-5	319
E.19.	Axial Power Profile, Channels 6-10	320
E.20.	Fuel-reactivity-worth Curves, Channels 1-5	320
E.21.	Fuel-reactivity-worth Curves, Channels 6-10	320
E.22.	Steel-reactivity Worth, Channels 1-5	320
E.23.	Steel-reactivity Worth, Channels 6-10	321
E.24.	Sodium-voiding-reactivity Worth, Channels 1-5	321
E.25.	Sodium-voiding-reactivity Worth, Channels 6-10	321
E.26.	Doppler-reactivity-worth Curves (Sodium in), Channels 1-5 . .	321
E.27.	Doppler-reactivity-worth Curves (Sodium in), Channels 6-10 . .	322
E.28.	Net Reactivity vs Time, Channels 1-5	322
E.29.	Net Reactivity vs Time, Channels 6-10	322
E.30.	Doppler Reactivity vs Time, Channels 1-5	322
E.31.	Doppler Reactivity vs Time, Channels 6-10	323
E.32.	Void Reactivity vs Time, Channels 1-5	323
E.33.	Void Reactivity vs Time, Channels 6-10	323
E.34.	Temperature vs Time	323
F.1.	Coordinate System and Notation	324

LIST OF TABLES

<u>No.</u>	<u>Title</u>	<u>Page</u>
I.	SACO Accident-analysis Input	15
II.	Sensitivity-study Input Parameters and Assigned Distributions . .	61
III.	Sensitivity-study Distribution Characteristics of Selected Consequences.	61
B.1.	SACO 1.0 Input Blocks	77
B.2.	SACO 1.0 Input Data	77
B.3.	Input Definitions	78

SACO-1: A Fast-running LMFBR
Accident-analysis Code

by

C. J. Mueller, J. E. Cahalan,
and J. K. Vaurio

ABSTRACT

SACO is a fast-running computer code that simulates hypothetical accidents in liquid-metal fast breeder reactors to the point of permanent subcriticality or to the initiation of a prompt-critical excursion. In the tradition of the SAS codes, each subassembly is modeled by a representative fuel pin with three distinct axial regions to simulate the blanket and core regions. However, analytic and integral models are used wherever possible to cut down the computing time and storage requirements. The physical models and basic equations are described in detail.

Because of its fast-running nature, SACO is ideally suited to sensitivity and scoping-study applications that are not feasible with the comprehensive accident-analysis codes. Its speed and low storage requirements are such that virtually an unlimited number of subassemblies can be explicitly represented. The sensitivity analysis capability of SACO makes it an ideal tool for use in probabilistic evaluations of LMFBR accidents. The application of SACO in this mode and the resultant evaluations are described.

Comparisons of SACO results to analogous SAS3D results comprise the qualifications of SACO and are illustrated and discussed. The code has been verified to analyze loss-of-flow transients through to the point of fuel and cladding motion. Beyond this point, a parametric fuel-motion model is provided to allow the user to perform reactivity-effects studies for user-specified modes of fuel relocation. Although the code modeling can theoretically handle transient-overpower (TOP) scenarios to the point of fuel ejection, only preliminary verification of the code in this mode has been performed. Modeling of fuel-coolant interactions and the resultant voiding are listed among the future efforts.

Finally, the appendixes provide a manual for users of the code and include a program listing and sample output.

I. INTRODUCTION AND SUMMARY

A. Introduction

SACO is a fast-running code that simulates hypothetical accidents in liquid-metal-cooled fast breeder reactors (LMFBR's) to the point of permanent subcriticality or to the initiation of a prompt-critical excursion. Because of its fast-running nature, it is ideally suited to uses that are simply not feasible with the expensive and bulky comprehensive accident-analysis codes.

The development of the SACO computer code was originally undertaken in mid-1975 as part of the effort to develop and apply a probabilistic methodology for the assessment of LMFBR safety. Specifically, a code was needed to provide a fast-running, core-disruptive-accident analysis capability to perform the many calculations required to determine the sensitivities of accident consequences to changes in accident parameters. An additional motivation was to provide a capability to analyze, with a large number of representative subassemblies, a reactor to assess the effects of subassembly coherence on accident behavior under transient conditions. At the time, the state-of-the-art accident-analysis code, SAS3A,¹ was limited by computer storage requirements to 10 such representative subassemblies.

The features of speed and many-channel capability have been incorporated into the SACO code.^{2,3,26} For example, analogous calculations of a CRBR unprotected flow-coastdown transient run 1.5 to 2.5 orders of magnitude faster with SACO than with SAS3D.⁴ Of course, the calculations are performed with simpler, more approximate models than those of the SAS code, which represents the most comprehensive mechanistic tool for studying core-disruptive-accident phenomenology. The storage requirements are such that virtually an unlimited number of subassemblies can be explicitly represented by SACO. These features make the code an ideal tool for studying the sensitivity of accident consequences to changes in accident response, and identifying phases of accident phenomenology requiring more comprehensive (e.g., SAS) treatment.

As an illustration of the above, SACO has been used extensively in sensitivity studies in conjunction with the PROSA²⁵ code as part of a combined deterministic/probabilistic procedure for analyzing LMFBR core disruptive accidents.^{5,6} Although SACO is an independent (stand-alone) accident simulation code and not limited to probabilistic studies, the probabilistic/deterministic procedure is briefly described here to illustrate this important application. In this procedure, probability distributions are assigned to the input parameters of a deterministic accident-analysis code (SACO), and parameter values are systematically chosen from these distributions. These input combinations are then used in SACO, and the results of the deterministic SACO analyses are used in PROSA to generate the coefficients for multivariate polynomials (response surfaces) that approximate the consequences in terms of the selected system and model input parameters. These approximating polynomials are

Fig. 1. Interfacing of SACO and PROSA in Probabilistic/Deterministic Accident Analysis

then used to generate the probability distributions of the consequences, with random sampling being used to obtain the accident parameters from their distributions. The interfacing between SACO and PROSA is indicated in Fig. 1.

Figure 2 illustrates the entire calculational framework. Experiments and the analyses of comprehensive mechanistic accident-analysis codes (CMAAC) provide the insight for predicting the course of the accident with a fast semi-mechanistic accident-analysis code (FSMAAC), namely, SACO, featuring simple and economical calculational models. SACO is then used to evaluate the postulated accident for many different combinations of system and model input parameters. To select and properly weigh meaningful combinations of input parameters for analysis, each important parameter is assigned a probability distribution based on the available experimental or analytic evidence. A probability range of interest is selected, and the impact of variation of the input parameters is investigated as follows: Combinations of input parameters $\bar{z}_i$ are systematically selected by a consequence

approximation and distribution code (CADC), namely, PROSA. The consequences $\zeta(\bar{z}_i)$ for each selected combination $\bar{z}_i$ are then calculated by the FSMAAC and input to the CADC which generates the consequence approximations $\tilde{\zeta}(\bar{z})$, namely, multivariate polynomials as functions of input parameters. The CADC then randomly samples from the assigned probability distribution $p(\bar{z})$ of the parameters and uses the polynomial approximation $\tilde{\zeta}(\bar{z})$ to generate a probability distribution (histogram) of consequences, $p(\tilde{\zeta})$.

Fig. 2
Probabilistic/Deterministic Core-disruptive-accident Analysis

The ability to calculate consequences with SACO and to then approximate these consequences with polynomials and generate consequence distributions with a code such as PROSA makes the procedure an inexpensive technique for probabilistically analyzing core-disruptive accidents.

B. Organization of Report

Section II of this report describes the programming framework and delineates how the code can be used for sensitivity analyses and how a special version was programmed for use with the PROSA code. Section III describes the physical models and basic equations for the code computations used in the deterministic analysis of core-disruptive accidents. It also suggests when a given model is appropriate. An attempt is made in this section to acquaint the user with the basic ideas and assumptions underlying the calculations without burdening him unduly with the details of programming and code structure at this point. Section IV relates the work performed to verify the code, provides a sample problem, and relates the results of sensitivity studies. Section V describes the current status of and future developments planned for SACO.

The appendixes serve as a user's manual and provide flow charts, input definitions, a program listing, sample-problem output, and sample-problem plots. Modeling suggestions are also provided. The appendixes go into the details of programming and describe the overall code structure and logic by means of which the various drivers and subroutines are linked together through the main program. The relevant flow diagrams are included. The practical use of the code in performing calculations is illustrated in Appendixes D and E by presenting the output (both printed and plotted) from sample problems. Finally, Appendix F describes the lumped-parameter modeling used for some of the thermophysical properties.

II. PROGRAMMING FRAMEWORK

The programming framework of SACO was originally established to allow a complete sensitivity study of a given accident analysis to user-specified changes in many input parameters in a single computer run. Accordingly, the input to SACO was divided into two categories: the "base-case" data needed to define the information for a single deterministic accident analysis and the sensitivity-study data used to vary the base-case data.

The deterministic data include the necessary physical, material, and neutronics information to characterize the reactor and the transient of interest. These data are described in Sec. III and Appendix B, and are provided to the code from card input and/or files.

The current version of the code allows the sensitivity logic to be provided by the user. An example of the programming framework used by

the authors for sensitivity studies^{5,6} is discussed below. In these studies, the sensitivity data consisted of values by which the deterministic user-specified parameters were multiplied and were provided by card input appended to the deterministic data-input cards. The base-case deterministic data were altered via the sensitivity-input data at the beginning and reset at the end of each distinct-accident-analysis case with the number of cases specified by an input parameter NCASE. A complete and independent accident analysis was performed for each NCASE sensitivity case. The distinct sensitivity-parameter multipliers were specified on an individual input card(s) for each case.

III. PHYSICAL MODELS AND BASIC EQUATIONS

The basic calculational model is designed to treat the configurations most commonly found in current, large LMFBR designs. This includes reactor cores ranging from extreme pancake designs to those having length-to-diameter ratios closer to one and axial and radial breeding blankets. The analysis is predicated on the assumption that the behavior of an entire subassembly can be represented by that of a single fuel pin and its associated coolant, cladding, and structure. The model then treats the core as a collection of such representative fuel pins, each represented by two blanket regions and an active core region. The physical picture is shown in Fig. 3.

Fig. 3. Representative Fuel Pin and Associated Coolant, Cladding, and Structure. ANL Neg. No. 900-77-360.

The analysis is designed for the following types of situations:

1. Whole-core power perturbations resulting from reactivity insertions due to malfunction of the control system or other sources.
2. Gross failure of coolant flow due to pump or piping-system failures.

The accident-analysis section of the code proceeds from steady-state preaccident conditions through the fuel-motion phase of an accident that might result from computed initial accident events. It initializes the thermal-hydraulic conditions of the core, via a steady-state initialization routine, to the user's specifications and thus defines the preaccident steady operating state of the system (normally the reactor steady-state design power conditions). A calculation of

the transient history of the reactor response to power/flow perturbations resulting from a reactivity insertion (or a specified power increase) and/or a specified reduction of coolant flow is then started. Throughout this portion of the calculation, a basic assumption in most of the computer models is that the reactor-core geometry remains intact; that is, coolant channels are still well defined and the fuel remains in place. Effects of changes in core geometry from fuel motion can be handled, however, and reactivity effects due to fuel relocation are treated.

Some of the salient features of the accident-analysis section of SACO are described below.

1. Speed

To calculate to the same point in an LOF transient with the same numbers of nodes and channels, SACO runs roughly one and a half to two and a half orders of magnitude faster than the analogous SAS3D calculation.⁴

2. Multichannel Capability

SACO can handle an unlimited number of channels. Each channel consists of a fuel pin and its associated coolant and structure. Each channel is considered to be typical of some fraction of the reactor. The multichannel treatment allows for consideration of different power levels at different points in the core, due to the spatial variation of reactor power density in the radial direction and to different fuel-irradiation histories in different parts of the reactor. Two otherwise identical fuel pins can respond to an accident situation quite differently when they are located at different points in the reactor, or when they are located in the same part of the reactor but have different burnups. Since fuel recycling affects only a portion of the fuel pins at one time, the reactor will contain fuel elements with several different burnups that may be located in the same part of the reactor. With the capability for a large number of channels, the effects on subassembly coherence can be investigated by simulating the same transient with differing numbers of channels.

3. Required and Optional Input

The required input is shown in Table I. The power shapes are simple-polynomial fits in the blanket regions and chopped-sine fits in the

TABLE I. SACO Accident-analysis Input

Required Input	Optional Input
1. Initial power per subassembly	1. Voiding interfaces versus time
2. Power shapes	2. Programmed reactivity versus time
3. Doppler profile per subassembly	3. Dryout interfaces versus time
4. Material-worth profile per subassembly	
5. Kinetics parameters	
6. Initial flow per subassembly	
7. Flow-coastdown trace	
8. Geometry, material, and heat-transfer properties	

active core region to power profiles obtained from a neutronics code such as FXVARI.⁷ The shapes are normalized such that the axially integrated power for each axial region and the total power for each subassembly are conserved. The Doppler and material-reactivity-worth profiles for each subassembly and the core-kinetics parameters are also obtained from a neutronics code, with the profiles being read as tabular input according to channel and axial position. The initial coolant flow rates for each subassembly and the core flow-coastdown characteristics are obtained from design data. For the constant-property models (see Item 5 below), the material and heat-transfer properties are input as radially and axially averaged parameters for each axial region and are selected to be most representative of the temperature conditions over the time of the transient. Studies with SACO have supported earlier work⁸ indicating the adequacy of lumped-parameter models.

4. Power and Reactivity Calculations

The steady-state calculations are performed to provide the initial temperature conditions. At each time step, the power and reactivity are extrapolated using a slightly modified version of the SAS2A⁹ point-kinetics sub-routines that employ the modified Kaganove technique.¹⁰ The extrapolated power is used to calculate the reactor-temperature conditions. If the concomitant reactivity feedback at the end of the time step agrees with the extrapolated reactivity feedback, the time step is advanced. The reactivity feedbacks due to Doppler effect, coolant voiding, and cladding and fuel relocation can be computed. There is also an input option for adding the reactivity change due to control-rod scram.

5. Transient-temperature Calculations

Transient fuel, cladding, and coolant temperatures are calculated with any of a variety of models, with the steady-state calculations providing the initial conditions. The actual choice of models used can be specified by the user to satisfy the particular needs for computational speed and accuracy. Both one- and two-dimensional (radial) temperature calculation options are provided, with the modeling details and suggestions for use outlined in this report.

Since axial and angular conduction of heat are relatively unimportant for the class of problems under consideration with SACO, only radial heat flow is considered. The channel is divided into axial segments, and the temperature calculations are made for each section in succession following the direction of coolant flow. Since successive sections are thermally coupled through the coolant, the Storrer effect of heat transfer from downstream coolant to the fuel in the axial blanket is automatically included. Calculations have shown that the neglect of axial conduction is quite reasonable. The advantage of not having to solve the heat-flow equations in a two-dimensional space represents a large saving in computing time.

6. Prevoiding and Voiding Coolant Dynamics

Prior to voiding, flow is calculated analytically from the input coastdown function. After voiding, the flow is implicitly accounted for by the (single-bubble) voiding model, which tracks the positions of the voiding and dryout interfaces for each subassembly. Two options are provided to predict the behavior of the voiding fronts. The first is based on dominance of the void front by heat-capacity effects as identified by Grolmes.¹¹ The second is to specify by input the void interface as a function of time. The location of the "dryout" interface (that point at which the sodium film becomes negligibly thin) is currently input as a parametric function of the voiding interface.

7. Fuel Motion

A simple fuel-motion model has been incorporated to facilitate reactivity-effects studies of fuel relocation with the user input-specifying different fuel-relocation modes, rates, and final dispositions of molten fuel. The approach is to provide flexible parametric models which can be easily manipulated by the user to simulate plausible modes of fuel-pin disruption as summarized, for example, by Deitrich and Ostensen.¹²

8. Sensitivity Studies

At the conclusion of a SACO run, the code can be prepared to punch cards that can be directly input into the PROSA code for calculations to determine the functionality (response surfaces) of SACO output to changes in SACO input and to calculate probability distributions of selected SACO output (consequences), as illustrated in Sec. IV.

The remaining material in this section describes the basic models and differential equations used in the code. The discussion is organized along modular lines to clearly delineate the calculational options.

A. Prevoiding Heat-transfer and Coolant Dynamics

1. Coolant and Cladding Temperatures

SACO provides the option of using three distinct heat-transfer models for calculating coolant and cladding temperatures prior to boiling in a subassembly. The first is based on the Eulerian finite-difference formulation used in SAS and should be considered the reference model with general applicability for all transients. The other two are analytic models and, as indicated, are limited to analyses in which power is a well-behaved function of time, as in the earlier stages of an LOF scenario. The models for all three are described in the following subsections. The descriptions include the modeling details, pertinent assumptions, limitations, calculational techniques and relevant subroutines, and suggestions for use.

a. Eulerian-box Model. The model described here is based on the analogous model of SAS2A.⁹ Two differences are that SACO uses constant (versus temperature-dependent) heat-transfer coefficients and does not treat a volume heat source due to direct heating of the cladding and coolant by neutron and gamma radiation. A third difference is that the temperature of the structure (can wall and wire wrap) is not calculated; however, the heat capacity of the structure is accounted for in the heat capacity of the cladding.

This model is considered the "reference" model for calculating coolant and cladding temperatures. The two other models, explained in Secs. III.A.1.b and III.A.1.c, and executed in subroutines PTEMPZ and QTEMPZ, are faster, numerically simpler models. The Eulerian model described here is executed in STEMPZ and used only if the input variable ISUSE = 1.

The basic equation used for conservation of energy in the liquid is

$$(\rho c_p A)_c \dot{T}_c(z, t) = 2\pi R_{cl} h_{cl-c} [T_{cl}(z, t) - T_c(z, t)] - (c_p A)_c G(t) \frac{\partial T_c(z, t)}{\partial z}, \quad (1)$$

where h_{cl-c} is the conductance parameter accounting for the heat-transfer resistance between the cladding midwall and the coolant;* R_{cl} is the outer radius of the cladding; ρ , c_p , and A are the density, specific heat, and flow area of the coolant, which is denoted by the subscript "c"; G is the mass flow rate ($\text{g}/\text{cm}^2 \cdot \text{s}$) of the coolant; T denotes temperature; and T_{cl} is evaluated at the cladding midwall, with the "cl" subscript denoting the cladding.

A "box" method is used to calculate the temperatures and derivatives in Eq. 1, as follows:

$$G \frac{\partial T_c}{\partial z} = \frac{1}{2\Delta z} \{G(t + \Delta t)[T_c(z + \Delta z, t + \Delta t) - T_c(z, t + \Delta t)] + G(t)[T_c(z + \Delta z, t) - T_c(z, t)]\}; \quad (2)$$

$$\dot{T}_c = \frac{1}{2\Delta t} [T_c(z + \Delta z, t + \Delta t) - T_c(z + \Delta z, t) + T_c(z, t + \Delta t) - T_c(z, t)]; \quad (3)$$

$$\Delta T_{cl-c} = \frac{1}{4} [\Delta T_{cl-c}(z + \Delta z, t + \Delta t) + \Delta T_{cl-c}(z + \Delta z, t) + \Delta T_{cl-c}(z, t + \Delta t) + \Delta T_{cl-c}(z, t)]; \quad (4)$$

*See Appendix F for general derivations of lumped conductance parameters in terms of individual fuel, gap, cladding, and coolant resistance to heat transfer.

where

$$\Delta T_{cl-c} = T_{cl} - T_c. \quad (5)$$

The time and space dependencies of the coolant density are accounted for by

$$\rho' = \frac{1}{2}[\rho(z + \Delta z, t) + \rho(z, t)]. \quad (6)$$

Note that a density interpolation to the middle of the time step is not made. The time and space dependencies of the coolant specific heat are accounted for by

$$c_p = c_p(z, t) = 1.256 + 4.64 \times 10^{-7}[T_c(z, t) - 621.0]^2; \quad (7)$$

the above temperature correlation is based on Ref. 13 and is also used in the SAS code. Neither a density nor a time-step interpolation is made.

With the above approximations and some manipulations, Eq. 1 can be cast as

$$\begin{aligned} T_c(z + \Delta z, t + \Delta t) = & \left[\rho' + \frac{\Delta t G(t + \Delta t)}{\Delta z} + d_1 h_{cl-c} \right]^{-1} \\ & \times \left\{ T_c(z + \Delta z, t) \left[\rho' - \frac{\Delta t G(t)}{\Delta z} - d_1 h_{cl-c} \right] \right. \\ & + T_c(z, t + \Delta t) \left[-\rho' + \frac{\Delta t G(t + \Delta t)}{\Delta z} - d_1 h_{cl-c} \right] \\ & + T_c(z, t) \left[\rho' + \frac{\Delta t G(t)}{\Delta z} - d_1 h_{cl-c} \right] \\ & + d_1 h_{cl-c} [T_{cl}(z + \Delta z, t + \Delta t) + T_{cl}(z + \Delta z, t) \\ & \left. + T_{cl}(z, t + \Delta t) + T_{cl}(z, t)] \right\}, \quad (8) \end{aligned}$$

where

$$d_1 = \frac{\pi R_{cl} \Delta t}{(c_p A)_c}. \quad (9)$$

The coolant temperatures at the bottom axial node are determined by the inlet temperature, T_{IN} . Then, with the cladding and coolant temperatures at the beginning of the time step known, the cladding temperature at the new time step is extrapolated according to

$$T_{cl}(z, t + \Delta t) = T_{cl}(z, t) + \frac{\Delta t}{(\rho c_p A)_{cl+st}} \times \{h'_{F-cl}[T_F(z, t) - T_{cl}(z, t)] - h'_{cl-c}[T_{cl}(z, t) - T_c(z, t)]\}. \quad (10)$$

The heat capacity of the structure denoted by the subscript "st" is included with the cladding. Implicit in this treatment is the fact that the heat transfer from cladding to coolant/structure is essentially instantaneous. If the radial fuel-temperature profiles are being calculated (see Sec. III.A.2), h'_{F-cl} is the conductance parameter accounting for the heat-transfer resistance between the fuel surface and the cladding midwall, and T_F is the temperature at the fuel surface. If the one-dimensional fuel-temperature model is being used, T_F is the radially averaged fuel temperature and h'_{F-cl} is the conductance parameter accounting for the heat-transfer resistance between (1) the point in the fuel where the pointwise temperature and the radially averaged temperature are the same (roughly $0.707R_F$, where R_F is the radius of the fuel) and (2) the cladding midwall.

Thus, with the extrapolation of Eq. 10, the right-hand side of Eq. 8 is completely specified.

All the equations presented for the Eulerian Box Model are treated in the STEMPZ subroutine.

b. Fractional-energy Model. The one-dimensional heat transfer equations for a representative pin in a subassembly with flowing coolant are

$$(\rho c_p A)_F \dot{T}_F(z, t) = P(z, t) - h'_{F-cl}(T_F(z, t) - T_{cl}(z, t)), \quad (11)$$

$$(\rho c_p A)_{cl} \dot{T}_{cl}(z, t) = h'_{F-cl}[T_F(z, t) - T_{cl}(z, t)] - h'_{cl-c}[T_{cl}(z, t) - T_c(z, t)], \quad (12)$$

and

$$(\rho c_p A)_c \dot{T}_c(z, t) = h'_{cl-c}[T_{cl}(z, t) - T_c(z, t)] - (c_p)_c W(t) \frac{\partial T_c(z, t)}{\partial z} \quad (13)$$

where h'_{cl-c} is the conductance parameter accounting for the heat-transfer resistance between the cladding midwall and the coolant, and T_{cl} is evaluated at the cladding midwall. The relation between h'_{F-cl} and T_F is as shown for Eq. 10. $P(z, t)$ is the local time-dependent fission power generated per unit length of pin, $W(t)$ is the mass flow (g/s) of the coolant, and the other notation is standard.

The heat capacity of the structure is included with the cladding. Implicit in this treatment is the fact that the heat transfer from cladding

to coolant/structure is essentially instantaneous. This assumption, which follows from the excellent heat-conduction properties of stainless steel and sodium coolant, allows the approximation

$$\dot{T}_c(z, t) \approx \dot{T}_{cl}(z, t), \quad (14)$$

which is valid through the prevoiding phase of a LOF transient. This allows Eqs. 1-3 to be combined to

$$(\rho c_p A)_F \dot{T}_F(z, t) + (\rho c_p A)_{c+cl} \dot{T}_c(z, t) = P(z, t) - c_p W(t) \frac{\partial T_c(z, t)}{\partial z} \quad (15)$$

where the nonparenthesized c_p denotes the specific heat of the coolant only. Defining the function

$$\gamma'(z, t) \equiv \frac{\dot{T}_F(z, t)}{\dot{T}_c(z, t)}, \quad (16)$$

an approximation of which is derived later in this section, and the function

$$\gamma(z, t) \equiv \frac{\gamma'(z, t)(\rho c_p A)_F + (\rho c_p A)_{c+cl}}{(\rho c_p A)_{pin}}, \quad (17)$$

where

$$(\rho c_p A)_{pin} \equiv (\rho c_p A)_{c+cl} + (\rho c_p A)_F, \quad (18)$$

we can rewrite Eq. 15 as

$$\gamma(z, t)(\rho c_p A)_{pin} \dot{T}_c(z, t) = P(z, t) - c_p W(t) \frac{\partial T_c(z, t)}{\partial z}. \quad (19)$$

Consider next the integral equation

$$\int_{z_{in}}^z g(z', t) P_z(z') \beta(t) dz' = c_p W(t) [T_c(z, t) - T_{in}], \quad (20)$$

where the power is considered separable, $P = P_z(z)P_t(t)$, and

$P_z(z)$ = the power-shape function = steady-state power per unit length of pin,

$\beta(t)$ = the time-weighted time-dependent power

$$= \int_{t-\Delta}^t P_t(t') \delta(t - t') dt' / \int_{t-\Delta}^t \delta(t - t') dt',$$

where the weighting function $\delta(t)$ accounts for the time-delay for the fission power in the pin to be reflected in heat transfer to the coolant (this function is described in Sec. III.E),

and

$g(z, t)$ = the fraction of the time-averaged power produced in the fuel pin at z that is removed by the flowing coolant. An expression for this function is derived in the following paragraphs.

The right-hand side of Eq. 20 represents the energy-removal rate of the flowing coolant in terms of the temperature rise up the channel. By defining

$$\hat{P}_z(z) \equiv \int_{z_{in}}^z P_z(z') dz' \quad (21)$$

and

$$\tilde{g}(z, t) \equiv \frac{\int_{z_{in}}^z g(z', t) P_z(z') dz'}{\hat{P}_z(z)}, \quad (22)$$

we can rewrite Eq. 10 as

$$\tilde{g}(z, t) \hat{P}_z(z) \beta(t) = c_p W(t) [T_c(z, t) - T_{in}]. \quad (23)$$

Differentiation of Eq. 23 (or equivalently, Eq. 20) with respect to z yields

$$g(z, t) P_z(z) \beta(t) = c_p W(t) \frac{\partial T_c(z, t)}{\partial z}. \quad (24)$$

Combining Eqs. 9 and 14, we obtain

$$\gamma(z, t) (\rho c_p A)_{pin} \dot{T}_c(z, t) = P_z(z) P_t(t) - g(z, t) P_z(z) \beta(t). \quad (25)$$

At the inlet to the active fuel region, although the power is finite, there is very little change in coolant, cladding, or fuel temperature during the pre-voiding phase of the transient. Therefore, at this point,

$$\gamma(z, t) (\rho c_p A)_{pin} \dot{T}_c(z, t) \big|_{z=z_{in}} \approx 0. \quad (26)$$

From Eqs. 25 and 26 and the fact that the power is reasonably constant during the prevoiding phase, the approximation is made that

$$g(z, t) \Big|_{z=z_{in}} \simeq \frac{P_t(t)}{\beta(t)} \simeq 1. \quad (27)$$

Consider now the average coolant-temperature rise in a given axial segment of the channel. This rise will be dominated by the approximately time-weighted power-to-flow ratio as long as the $\gamma(\rho c_p A)_{pin} \dot{T}_c$ term is small relative to the pointwise power (see Eq. 19). For current LMFBR design concepts, the combination of good heat-transfer characteristics and reasonably constant power during the prevoiding phase allows this condition to be satisfied. Therefore, we write

$$c_p W(t) \frac{\frac{T_c(z, t) - T_{in}}{z - z_{in}}}{\frac{\hat{P}_z(z) \beta(t)}{z - z_{in}}} = \frac{c_p W(t)}{2} \left[\frac{\frac{\partial T_c(z, t)}{\partial z}}{\frac{P_z(z) \beta(t)}{z - z_{in}}} \Big|_{z=z_{in}} + \frac{\frac{\partial T_c(z, t)}{\partial z}}{P_z(z) \beta(t)} \right]; \quad (28)$$

i.e., the quotient of the average temperature gradient and average linear power-to-flow ratio over any axial segment of the fuel region, with the bottom of the active fuel defining one end of the segment, is given by the average of the analogous pointwise quotients at the end points.

Combining Eqs. 23, 24, 27, and 28 yields

$$\tilde{g}(z, t) = \frac{1 + g(z, t)}{2}. \quad (29)$$

Differentiating Eq. 23 with respect to time and manipulating yields

$$\frac{\dot{T}_c(z, t) - \dot{T}_{in}}{T_c(z, t) - T_{in}} = \frac{\dot{\beta}(t)}{\beta(t)} - \frac{\dot{W}(t)}{W(t)} + \frac{\dot{\tilde{g}}(z, t)}{\tilde{g}(z, t)}. \quad (30)$$

With slowly varying power (and transmission of the resultant heat to coolant), the excellent heat-transfer characteristics of the sodium coolant imply that a change in W will be nearly immediately reflected by an offsetting change in $(T_c - T_{in})$. Therefore, the time derivative of $\tilde{g}$ will be very small and we use the approximation

$$\frac{\dot{\beta}(t)}{\beta(t)} - \frac{\dot{W}(t)}{W(t)} \gg \frac{\dot{\tilde{g}}(z, t)}{\tilde{g}(z, t)} \quad (31)$$

to eliminate $\dot{\tilde{g}}/\tilde{g}$ from Eq. 30.

Using the reduction of Eq. 30 with Eqs. 25, 23, and 29, we obtain

$$\gamma(z, t)(\rho c_p A)_{pin} \left[\frac{\dot{\beta}(t)}{\beta(t)} - \frac{\dot{W}(t)}{W(t)} \right] \frac{\tilde{g}(z, t) \hat{P}_z(z) \beta(t)}{c_p W(t)} = P_z(z) P_t(t) - P_z(z) \beta(t) [2\tilde{g}(z, t) - 1], \quad (32)$$

which reduces to

$$\tilde{g}(z, t) = \frac{P_t(t) + \beta(t)}{2\beta(t)} \frac{1}{1 + \frac{\gamma(z, t)(\rho c_p A)_{pin}}{2c_p W(t)} \frac{\hat{P}_z(z)}{P_z(z)} \left[\frac{\dot{\beta}(t)}{\beta(t)} - \frac{\dot{W}(t)}{W(t)} \right]}. \quad (33)$$

Equation 33 is used to evaluate the $\tilde{g}(z, t)$ term at each time step and each node, and Eq. 23 is then used to calculate the coolant temperature as

$$T_c(z, t) = T_{in} + \frac{\tilde{g}(z, t) \hat{P}_z(z) \beta(t)}{c_p W(t)}. \quad (34)$$

The $\beta(t)$ term, shown in Sec. III.E, is approximated by the average power from $t - \text{BETADT}$ to t , where BETADT is input-specified but should approximate the time constant of the fuel. The expression for γ follows from Eq. 17, where γ' is assumed to be independent of z , but depends on t approaching the constant,

$$\gamma'_{\infty} = \text{GAMA} + \text{VRHOD}/\text{VRHOV} * \text{GAMB}, \quad (35)$$

where the terms on the right-hand side of Eq. 35 are input-specified and explained in the following paragraph.

Since in an LOF accident, the time-derivative of the fuel temperature is essentially zero at the beginning of the transient, and the temperature rise follows from the reduction in heat transfer to the coolant, the assumption is made that for $t < \text{THOLD}$,

$$\gamma'(z, t) = \gamma'_{\infty} \frac{t}{\text{THOLD}}, \quad (36)$$

where THOLD is input-specified, but should approximate a time delay of roughly two times the fuel time constant (time constant ≈ 1 s for FTR-type mixed-oxide fuel). In sensitivity-study versions of the code, GAMA and GAMB were determined for a given value of THOLD by comparing the values of $T(z_v, t) - T(z_v, t = 0)$ for fuel and coolant over the prevoiding phase obtained with the reference Eulerian scheme in SACO for calculating coolant temperatures for two different values of VRHOD/VRHOV (see Sec. III.D.2.e). In the version of the code here, VRHOD and VRHOV have been set to unity.

The sample problem values (see Appendix D) were obtained from comparisons with SAS calculations of LOF transients with and without axial expansion-reactivity feedback.

Equation 34 is differentiated to provide the expression for $\partial T_c / \partial z$, which is used to evaluate fuel temperatures in the one-dimensional modeling (see Sec. III.A.2, Eq. 49). The result is

$$\frac{\partial T_c(z, t)}{\partial z} = \frac{P_z(z) \beta(t)}{c_p W(t)} [2 \tilde{g}(z, t) - 1]. \quad (37)$$

The cladding temperature is simply assumed to follow the coolant temperature; i.e.,

$$T_{cl}(z, t + \Delta t) = T_{cl}(z, t) + T_c(z, t + \Delta t) - T_c(z, t). \quad (38)$$

Equations 34, 37, and 38 are evaluated in the PTEMPZ subroutine.

The fractional energy model is used to evaluate coolant temperatures only at nodes in the lower-blanket and active-core regions, that is, those regions in which the axial-coolant-temperature profile is dominated by the axial-power profile. The value of T_{in} in Eq. 34 is input-specified as T_{IN} for nodal calculations in the lower-blanket region. In the active-core region, which has a grossly different power profile, the value of T_{in} is that at the lower blanket/core interface, and is calculated using the fractional energy model in the subroutine TINSET.

Above the active core, i.e., in the upper blanket, the nodal coolant temperatures are calculated as in an initial value problem according to

$$T_c(z + \Delta z, t + \Delta t) = T_c(z, t + \Delta t) + \frac{\Delta z}{c_p W(t + \Delta t)} h'_{F-cl} [T_F(z + \Delta z, t + \Delta t) - T_{cl}(z + \Delta z, t + \Delta t)] - \frac{(\rho c_p A)_{c+cl}}{\Delta t} [T_c(Z_{ref}, t + \Delta t) - T_c(Z_{ref}, t)]; \quad (39)$$

where Z_{ref} is the location of the highest node in the active-core region. The approximation here is that the coolant temperature in the upper blanket is dominated by the coolant temperature at the entrance to the upper blanket.

The fractional-energy model is used to estimate the initial voiding time of the channel with the highest power/flow ratio. Equation 34 is solved for t using a Newton-Raphson scheme with $T_c(z, t)$ being set to the solution temperature of the sodium TSTAR, where TSTAR is the sum of the input variables TBOIL and TSH (superheat). These calculations are performed by the LIMCH and TOB subroutines before the start of the transient calculations.

c. Constant-profile Model. The basis of this model is that in a nonboiling channel, the shape (not amplitude) of the axial coolant-temperature profile above the coolant-inlet remains essentially the same from some prescribed time following the initiation of a flow coastdown until boiling occurs. As such, it is applicable only for LOF situations and only well after the initiation of the coastdown, since during the initiation of the coastdown, the axial profile is not constant. This model was generated to provide a complement for the fractional energy model during the transient when the nearly constant-power assumption of the latter is no longer valid. Accordingly, the QTEMPZ subroutine, which contains the constant-profile model, is called only if PTEMPZ is used (input variable ISUSE = 0) and only after the initiation of voiding in the hottest channel VDFRST. Finally, it is used only if the input variable IQUSE = 1 or 2.

Consider the fractional-energy formulation of Sec. III.A.1.b for the rise in coolant temperature during a flow coastdown:

$$T_c(z, t) - T_{in} = \frac{\int_{z_{in}}^z g(z', t) P_z(z') \beta(t) dz'}{c_p W(t)}, \quad (40)$$

where the notation is defined in Sec. b above.

Partially separating the time and space dependence by defining

$$\theta(t) \equiv \frac{\beta(t)}{c_p W(t)} \quad (41)$$

and

$$Z(z, t) \equiv \int_{z_{in}}^z g(z', t) P_z(z') dz', \quad (42)$$

we obtain

$$T_c - T_{in} = \theta Z, \quad (43)$$

where the arguments have been dropped for brevity.

Differentiating Eq. 43 yields

$$\frac{\partial T_c}{\partial z} = \theta Z'. \quad (44)$$

If Z is a weak function of time after a prescribed time t_0 , we can use Eqs. 43 and 44 to obtain

$$\frac{\partial T_c}{\partial z} = \frac{Z'}{Z} (T_c - T_{in}) = \frac{Z'_0}{Z} (T_c - T_{in}) = \frac{\frac{\partial T_{c0}}{\partial z}}{T_{c0} - T} (T_c - T_{in}), \quad (45)$$

where the zero subscript denotes the value at the prescribed time. This analytic expression is used to evaluate the derivative for the subsequent calculation of fuel temperatures in the one-dimensional model in Section III.A.2.a. Below the upper blanket, the coolant temperature is obtained in QTEMPZ from the explicit difference equation

$$T_c(z, t + \Delta t) = T_c(z, t) + \frac{\Delta t}{(\rho c_p A)_{c+cl}} \times \left\{ h'_{F-cl}(z, t) [\bar{T}_F(z, t) - T_{cl}(z, t)] - c_p W(t) \frac{\partial T_c(z, t)}{\partial z} \right\}, \quad (46)$$

where the z -dependence of the "effective" lumped conductance parameter is accounted by defining in the subroutine QSET

$$h'_{F-cl}(z, t_0) = P(z, t_0) - (\rho c_p A)_F \bar{T}_F(z, t_0) / [\bar{T}_F(z, t_0) - T_{cl}(z, t_0)]. \quad (47)$$

Above the active core the nodal calculation is further simplified by assuming

$$T_c(z, t) = T_{in} + \frac{T_c(z, t_0) - T_{in}}{T_c(z_{ref}, t_0) - T_{in}} [T_c(z_{ref}, t) - T_{in}], \quad (48)$$

where z_{ref} is the location of the highest node in the active core.

The "prescribed time" t_0 in SACO is the initiation of voiding in the hottest channel and generally occurs about 10 s after the initiation of the transient for CRBR-type postulated LOF accidents. At this time, the function Z' can be shown to be a very weak function of time, justifying the above modeling.

2. Fuel Temperatures

a. One-dimensional Model. In the one-dimensional modeling, only the radially averaged fuel temperature is considered. It is calculated from the explicit heat-transfer equation

$$\bar{T}_F(z, t) = \bar{T}_F(z, t - \Delta t) + \frac{\Delta t}{(\rho c_p A)_F} \left\{ P(z, t) - h'_{F-cl} [\bar{T}_F(z, t - \Delta t) - T_{cl}(z, t - \Delta t)] \right\}. \quad (49)$$

The notation here is standard and was defined in Sec. III.A.1. The assumption has been made that the cladding, coolant, and structure temperatures have changed by the same amount. Updated values for the cladding temperatures, flow, and power are used in Eq. 49 with the cladding temperature information having been obtained as described in Sec. III.A.1.

All one-dimensional model fuel-temperature calculations are performed in the DRVRO1 subroutine.

b. Two-dimensional Model. Time-dependent fuel-temperature profiles for the representative fuel pins are calculated by subroutine TWODTF. This subroutine also calculates the average fuel temperature (that determines the Doppler feedback in each axial node of every pin/channel), the locations of the fuel solidus and liquidus fronts during melting, and cladding temperatures after cladding melting has started. The calculations are performed in seven successive phases: (1) steady state, (2) quasistatic phase, (3) before fuel melting, (4) fuel-centerline temperature constant at the melting point, (5) central part of the pin completely molten, (6) major part of the pin completely molten, and (7) fuel-surface melting. Integral models have been developed for each phase, using up to fourth-degree polynomials with time-dependent coefficients. Figure 4 shows typical temperature profiles in phases 1-7. Phases 1-3 are explained in this section, phases 4-7 in Sec. III.B.3.b. In the steady state, a parabolic fuel-temperature profile is assumed and the coefficients are determined by the total heat transfer balance.

Fig. 4
Representative Fuel-temperature Profiles for Two-dimensional Modeling.
ANL Neg. No. 900-78-597.

In phase 2, the coefficients of the parabolic profile $T = A - Br^2$ are time-dependent. At each time step, the new average fuel temperature $\bar{T}$ is first calculated, based on

$$\rho c_p \dot{\bar{T}} = q + k \nabla^2 T = q - 4kB, \quad (50)$$

where q is the power density, ρ the fuel density, c_p the fuel specific heat, k the fuel thermal conductivity, and ∇ operates on the radial variable r only. The new value of B satisfies

$$h[T(R) - T_{cl}] = -k \nabla T(R) = 2kBR, \quad (51)$$

where R is the fuel radius, T_{cl} the cladding midwall temperature, $T(R) = \bar{T} - (BR^2/2)$, and h is the effective gap conductance from the fuel surface to the cladding midwall. (Both q and T_{cl} are known from other subroutines.) Then A is obtained from

$$A = \bar{T} + (BR^2/2). \quad (52)$$

In phase 3, the profile is $T = A - Br^2 + Cr^4$. The phase starts at a specified time (before sodium boiling) and ends when the fuel centerline reaches the melting-point temperature. The basic equations are

$$\rho c_p \dot{\bar{T}} = q + [2k \nabla T(R)/R] = q - 4k(B - 2CR^2), \quad (53)$$

$$\rho c_p \dot{A} = q + k \nabla^2 T(0) = q - 4kB, \quad (54)$$

$$h[T(R) - T_{cl}] = -k \nabla T(R) = 2kBR - 4kCR^3, \quad (55)$$

and

$$\bar{T} = A - (BR^2/2) + (CR^4/3). \quad (56)$$

Equations 53 and 54 are first used to calculate new values of $\bar{T}$ and A , using the previous time-step values of B and C on the right-hand sides of these equations. Equations 55 and 56 form an algebraic pair to solve for new B and C :

$$B = \left[3(A - \bar{T}) + \frac{hR}{hR + 8k} (A - 3\bar{T} + 2T_{cl}) \right] / R^2; \quad (57)$$

$$C = 3(\bar{T} - A + BR^2/2) / R^4. \quad (58)$$

This procedure yields smooth continuous values of $\bar{T}$ and A , even when T_{cl} or h changes rapidly as during sodium boiling. On cladding melting, the coefficients B , and especially C , absorb the most sudden changes. Phase 3 normally continues beyond sodium voiding.

Control Variables: TWODTF is bypassed if the input variable I2D = 0. TWODTF is in normal use if I2D = 1. TWODTF is in extended use if I2D = 2. In this case, the fuel temperatures are calculated in 11 radial nodes (0 = pin centerline, 11 = fuel surface), and the subroutine, TFEDIT, edits these temperatures for channel ITF, with the default ITF = IMAX, the channel of maximum power/flow ratio.

The duration of the quasi-static phase 2 can be controlled by a data variable SETIME that is normally set to 0 in TWODTF.

3. Coolant Dynamics

Before initiation of voiding in the hottest channel, VDFRST, plus a time specified by the input variable DFQUIT, the coolant in every channel is assumed to coast down according to

$$G(t) = G_0 e^{A1 \cdot t + A2 \cdot t^2 + A3 \cdot t^3}, \quad (59)$$

where A1, A2, and A3 are input variables and G_0 is the mass flow rate (g/cm²·s) specified for each channel by the input variables GZERO. The exponential terms for t and $t + \Delta t$ are calculated in the subroutine COAST. The calculations of $G(t)$ and

$$W(t) = G(t)A_c, \quad (60)$$

where A_c is the input-specified coolant-flow area associated with a representative pin (one common value for all channels), are performed in the WTIME subroutine.

After $t'' \equiv VDFRST + DFQUIT$, the flow in each nonboiling channel is held at its value at t'' . This approximation was shown to be very good based on studies of SAS3A simulations of CRBR LOF transients in which the flow in nonboiling channels during the voiding phase of the transient remained essentially constant after initial boiling (corresponding to $DFQUIT = 0$).

After voiding, the coolant dynamics are implicitly accounted for by the coolant void and film-dryout-interface modeling described in Sec. III.B.1.

Finally, a simplified algorithm to explicitly account for flow-reversal effects in boiling channels upon flow in nonboiling channels given a pump-coastdown function has been written. However, it had not been incorporated into SACO at the time of this writing. This algorithm will eventually be programmed into the WPUMP subroutine, which is currently bypassed by specifying input variable IWPUMP = 0.

B. Voiding-phase Heat-transfer and Coolant Motion

To simplify the calculational simulation of the complicated phenomenology that exists in a voiding channel, we chose the axial regional representation, pictured in Fig. 5. This representation breaks the modeling down to a series of distinct, simple models for each of these regions. These can then be synthesized to account for the voiding process. The interfaces of these regions represent a smoothing of the corresponding SAS-predicted interfaces for a voiding channel, as shown in Fig. 6.

Fig. 5. SACO Voiding-phase-model Representation. ANL Neg. No. 900-78-604.

Fig. 6
SAS Predicted Typical Voiding-phase
Behavior. ANL Neg. No. 900-78-603.

The following paragraphs briefly discuss a voiding-behavior scenario predicted by SAS as illustrated in Fig. 6 and explain the rationale for the SACO-approximating modeling.

Voiding is initiated slightly above the top of the active fuel region. For the first several tenths of a second, the main coolant-pump pressure is sufficient to balance the building vapor pressure in the boiling region and force

coolant into the channel. At about 0.5 s, evaporation generates enough vapor to overcome the pump pressure and drive liquid coolant down the channel. The time at which the net flow W becomes zero at the inlet to the channel is designated as the time of flow reversal. This downward thrust of the coolant is shown by the steep slope of the lower void interface between roughly 0.5 and 0.8 s. After this initial thrust, the vapor pressures driving the lower and upper voiding interfaces apart reflect the competition between the evaporation and condensation mechanisms in the voided region. This competition effects the "chugging" or oscillatory behavior of the voiding fronts. Note that full reentry of the coolant into the channel is not predicted. The SACO modeling defines the region below the lower voiding front and above the upper front as a distinct calculational region designated as the liquid-coolant region in Fig. 5.

The two-phase sodium "film" region is initially defined by the boundaries of the upper and lower void interfaces shown in Fig. 5. This region is characterized by two-phase flow through the channel with the surface tension between cladding and coolant being sufficient to maintain a film of sodium on the cladding. At roughly 0.8 s after voiding, due to the acceleration provided by the rising vapor pressures, the streaming vapor in this two-phase region acts to strip this film from the cladding. The region in which this film has been stripped from the cladding is designated as the dryout region in Fig. 5. Because of the different fuel-pin heat-removal rates in the film region (loss of heat to the film) and the dryout (negligible film-essentially adiabatic heatup of the pin) region resulting from the transfer of energy to the film, each of these regions is treated as a distinct calculational region in SACO.

After dryout occurs, the cladding becomes heated until it eventually becomes molten. The cladding-melting front is the last region indicated in Figs. 5 and 6, but does not affect the modeling described in this section.

The rest of this section describes the models for coolant and coolant-film motion in a voiding channel and the associated coolant, cladding and fuel temperature modeling. The DRVRO2 subroutine acts as the driver for all heat transfer and voiding dynamics calculations. The relevant flowcharts are shown in Appendix A.

1. Coolant-void and Film-dryout-front Motion

The time dependence of the voiding interfaces can be calculated either by (IVDRAT = 1) or input (IVDRAT = 0) to SACO. In either case, the location of initial voiding is user-specified by the input variable ZVOIDO. The next two subsections describe the associated models. The locations of the voiding interfaces are determined in the subroutine ZBOIL and serve as input for the heat-transfer models of or called by DRVRO2.

a. Heat-capacity Model. The calculated determination of the voiding front is based on the dominance of heat-capacity effects on the location of the voiding front, as demonstrated by Grolmes.¹¹ The SACO model

calculates the fission energy at each point in the channel and uses the heat-capacity measure

$$X(z, t) = g_{VFC}(\rho A c_p)_{pin} [T^* - T_c(z, t_v)] - \int_{t_v - BETADT}^{t - BETADT} P_z(z) \beta(t) dt \quad (61)$$

to determine whether voiding has occurred at axial location z . The right-hand side of Eq. 61 represents the difference between the energy required to raise the temperature of the pin-associated coolant, cladding, fuel, and structural materials $g_{VFC}[T^* - T_c(z, t_v)]$ degrees and the energy transmitted to the cladding at that point since the initial voiding time, t_v , in that channel. When $X(z, t)$ becomes negative, the sum of the input-specified saturation temperature and superheat T^* has been reached, and the void front is defined to have reached z . The exact formulation used in the strictly adiabatic heatup model of Grolmes could be obtained by setting the user-specified input variable g_{VFC} as

$$g_{VFC} = \frac{(\rho A c_p)_{f+cl}}{(\rho A c_p)_{pin}} \quad (62)$$

and ignoring the time delay for fission power to affect the cladding by setting $\beta(t) = P_t(t)(IBETA = 0)$ or input variable $BETADT = 0$. (The physical interpretation and calculational treatment of the time-weighted power integral in Eq. 61 are described in Sec. III.E.2.) Calculations with SACO of CRBR transients have shown that the adiabatic modeling of Grolmes, which was predicated on constant power experiments, overestimates the velocities of the void fronts. Therefore, the treatment of the time constant of the fuel was considered to be essential for analyzing the CRBR core, or any system with sodium-void worths comparable to or greater than that of CRBR.

The void/dryout regions interface is user-specified as a time- and space-dependent function of the voiding front. This function is explained in the following paragraph. Calculations have shown that the progression of the accident is not affected by the choice of this functionality as long as reasonable parameters are chosen. Since the dominant mechanism removing sodium film from the cladding is the frictional drag from streaming vapor, the use of an evaporation model to remove film is not warranted.

The time dependence of the dryout front is partially specified by the input variable $DTIVDO$, which defines an initial duration after channel voiding for which no dryout is allowed. For simulation of the scenario depicted in Fig. 6, 0.8 s would be a reasonable choice. The second element of time dependence is accounted for by the input variable $DTVDDO$, which prohibits dryout at location Z_v from occurring sooner than $DTVDDO$ seconds after the void front has reached Z_v . The spatial dependence of dryout is specified by the input variable $DZDOZV$, which defines the separation in centimeters between the voiding and dryout fronts, given that the time-dependence criteria above are satisfied.

b. Input-specified Motion. The time dependence of the voiding interfaces can also be input to SACO. The SAS3A analysis of "base-case" LOF transients for CRBR have shown similar voiding patterns in all channels, despite voiding in the last-to-void channels generally taking place at a somewhat higher reactor power level than voiding in the earlier channels. This has allowed the following single time-dependent functionality to suffice for all channels for generally nonenergetic transients. The voiding input package specifies the velocity of the lower void front as a function of the following input variables: according to VDRAT1 cm/s between axial locations ZVOIDO and VDZ1, VDRAT2 between axial locations VDZ1 and VDZ2, VDRAT3 between locations VDZ2 and VDZ3, and VDRAT4 between VDZ3 and VDZ4. The velocity of the upper void front is implicitly defined through the relationship for the upper and lower void interfaces:

$$ZVDU - ZVOIDO = 2(ZVOIDO - ZVDL).$$

This approximation was based on observations of numerous SAS analyses of LOF transients; also the low reactivity-feedback characteristics of the region above ZVOIDO, which generally is slightly above the top of the active core, have made more detailed modeling unnecessary.

The treatment of the dryout front is the same as that described in Sec. III.B.1.a above.

2. Coolant and Cladding Temperatures

a. Liquid-coolant-region Model. The governing one-dimensional energy equations are

$$(\rho A c_p)_F \dot{\bar{T}}_F = P(z, t) - h'_{F-cl}(\bar{T}_F - T_{cl}), \quad (63)$$

$$(\rho A c_p)_{cl} \dot{T}_{cl} = h'_{F-cl}(\bar{T}_F - T_{cl}) - h'_{cl-c}(T_{cl} - T_c), \quad (64)$$

and

$$(\rho A c_p)_c \dot{T}_c = h'_{cl-c}(T_{cl} - T_c) - c_p W \frac{\partial T_c}{\partial z}, \quad (65)$$

where radially averaged temperatures and heat-transfer parameters are used and the notation has been defined in Sec. III.A. The difficulty in treating these equations lies in the calculation of the $c_p W \partial T_c / \partial z$ term. The flow oscillations that result from the competition between the vapor pressures in the vapor bubble(s) above the lower-void interface and the driving-pump pressures are reflected in the mass-flow-rate term W being alternately positive and negative. The phenomenon is graphically illustrated in Fig. 6, which shows the oscillatory behavior of the location of the void interface calculated by SAS3A for a postulated LOF transient in the CRBR.

Although the average time-integrated flow after initial flow reversal is small and asymptotically approaches zero with time, the $c_p W \partial T_C / \partial z$ term must be treated to account for the effect of flow oscillations upon the axial-temperature profiles. If this term is not treated, the coolant temperatures will be overestimated in the active-core region and underestimated in the lower-blanket region, resulting in an overestimation of voiding reactivity, the magnitude of which depends on the sodium-reactivity worth. Calculations have shown that ignoring this term (i.e., setting it to zero) has reduced the duration of the voiding phase by about 20% for the "base-case" CRBR LOF transient in comparison to treating it in the fashion described below. This modeling produces durations comparable to those predicted by SAS3A. For cores with relative void worths greater than CRBR, proper treatment of the $c_p W \partial T_C / \partial z$ term is obviously critical.

In the SACO modeling, the need to calculate the mass flow rate W from momentum equations is eliminated by factoring the $c_p W \partial T_C / \partial z$ term into two separate effects terms which are then treated in an integral fashion:

- (1) An energy-removal or heat-sink term.
- (2) An energy-redistribution term.

The energy-removal term represents the amount of heat (energy) being transferred to the upward-flowing coolant for transport in the flow channel. Flow is considered to be either positive or negative--not zero--since the competing pressurization mechanisms will allow flow to be stagnant only instantaneously. The energy-redistribution term accounts for the effects of reversed-flow transport on the axial coolant and cladding temperature profiles; i.e., the effect of the hot coolant from above being forced down the channel into cooler regions.

Denoting the energy-removal term as a fraction f_{CO} of the recent time-averaged fission power (again accounting for the time constant of the fuel as described in Sec. III.E.2) and denoting the energy-redistribution term by $S(z, t)$, the convection-flow term is factored according to

$$c_p W \frac{\partial T_C}{\partial z} = f_{CO}(z, t) \beta(t) P_z(z) - S(z, t). \quad (66)$$

Note that before voiding (actually initial-flow reversal), W is always positive, implying that S is zero and f_{CO} is the fraction of time-weighted power at any point being removed by flowing coolant (in steady state, $f_{CO} = 1$). Defining f_F to be the fraction of pin power being conducted through the fuel to the cladding, i.e.,

$$f_F = \frac{h_{F-cl}(\bar{T}_F - T_{cl})}{P(z, t)} \quad (67)$$

and, based on the excellent heat-transfer characteristics of stainless steel cladding and sodium coolant, making the approximation

$$\dot{T}_c = \dot{T}_{cl} \quad (68)$$

reduce Eqs. 64 and 65 to

$$(\rho c_p A)_{c+cl} \dot{T}_c = f_F P(z, t) - f_{co} P_z(z) \beta(t) + S(z, t). \quad (69)$$

Consider now the energy-removal fraction f_{co} . Since the ΔT between fuel and (essentially) single-phase-region liquid coolant does not change significantly from its prevoiding-phase value during the voiding phase, and convection remains the dominant mode of heat transfer to the single-phase liquid coolant, the approximation is made that the ratio of the coolant-removal rate of fuel energy and the "time-delayed" power in the single-phase coolant region is the same before and after voiding initiation. This leads to the equation for fractional-energy removal by positive flow,

$$f_{co}(z, t > t_v) \approx f_{co}(z, t = t_v), \quad (70)$$

or

$$f_{co}(z, t) \equiv \frac{c_p W(t) \frac{\partial T_c(z, t)}{\partial z}}{\beta(t) P_z(z)} \approx \frac{c_p W(t_v) \frac{\partial T_c(z, t_v)}{\partial z}}{\beta(t_v) P_z(z)}. \quad (71)$$

To determine $S(z, t)$, the rate of the redistribution of energy due to reversed flow, two "boundary conditions" are assumed:

(1) The temperature at the inlet to the lower blanket remains constant, meaning that heat losses to the regions below the lower blanket through reversed flow of heated coolant are assumed negligible. This implies

$$S(Z_{LB}, t) = 0. \quad (72)$$

(2) The net energy gained or lost through the void interface and lost by the coolant in heating the subassembly below the lower-blanket regions is negligible. This energy conservation equation takes the form

$$\int_{Z_{LB}}^{Z_v(t)} S(z, t) dz = \int_{Z_{LB}}^{Z_v(t)} f_{co} \beta(t) P_z(z) dz, \quad (73)$$

where $Z_v(t)$ denotes the location of the void interface.

These two conditions allow a two-parameter model to be assumed for the redistribution term. The form

$$S(z, t) = a(t) \left[1 - \left(\frac{Z_v - z}{Z_v - Z_{LB}} \right)^n \right] \quad (74)$$

was chosen for two reasons:

- (1) It represents a smoothing of the shape

$$\int_{Z_{LB}}^z f_{co}(z) P_z(z) dz,$$

which, because the integral reflects the shape of the coolant temperature, is expected to represent reasonably the shape of the energy redistribution.

- (2) It is simple. Two parameter models better reflecting the shape of

$$\int f_{co}(z) P_z(z) dz$$

could have been chosen; however, more complex modeling was unwarranted considering the basic simplicity of the model.

Defining and normalizing according to

$$\hat{S} \equiv \int_{Z_{LB}}^{Z_v} S(z, t) dz = \int_{Z_{LB}}^{Z_v} f_{co}(z) \beta(t) P_z(z) dz \quad (75)$$

yields

$$a(t) = \frac{n+1}{n} \frac{\hat{S}}{Z_v - Z_{LB}}. \quad (76)$$

Note that although providing an intuitive basis for the assumed shape of $S(z, t)$, Eq. 73 cannot be used for solving for $a(t)$ and n . Therefore, the choice of n is left to the user. Temperature predictions generated with varying n (input variable ANAX) values indicate a relative insensitivity to the precise value of n within an acceptable range, roughly, $n = 2$ to $n = 3$.

The actual calculations for the coolant and cladding temperatures are performed in DRV02, as follows: The value of f_F is defined (by Eq. 67) using extrapolated or updated values of T_F , T_{cl} , and $P(z, t)$. We calculate $\hat{S}$ and, hence, $S(z, t)$ using the extrapolated or updated values of $\beta(t)$ from subroutine BETEXT and Z_v from subroutine ZBOIL. The advanced time-step value of $T_c(z, t)$ is then obtained from Eq. 69 using the values above and the extrapolated or updated value of $P(z, t)$. The new cladding temperature follows from Eq. 68.

b. Voided-region Model. In the sodium film region, the coolant temperature is held at the saturation temperature (input variable TBOIL) plus a user-specified super heat (input variable TSH). The cladding temperature is then calculated assuming the surface of the cladding to be at the coolant temperature and using the quasi-steady-state relationship.

$$T_{cl} = T_c + \frac{P(z,t) \ln(R_{cl}/R_F)}{4\pi k_{cl}} \quad (77)$$

In the dryout region, before the cladding has reached its melting temperature (no sodium), the cladding temperature at the advanced time step is calculated from Eq. 64 using the extrapolated values of $\bar{T}_F$ and T_{cl} and assuming no loss of heat to the flow channel.

After cladding melting, the cladding temperature is calculated from the absolute-energy balance

$$T_{cl}(z,t) = \left\{ \int_{t_{cl,m}}^t P(z,t) dt - (\rho c_p A)_F [\bar{T}_F(z,t) - \bar{T}_F(z,t_{cl,m})] - L_{cl}(\rho A)_{cl} / (\rho c_p A)_{cl} \right\} + T_{cl,m} \quad (78)$$

where

$t_{cl,m}$ = the time cladding melting completed at z ,

$T_{cl,m}$ = cladding-melting temperature

L_{cl} = the latent heat of melting,

and extrapolated or updated values are used for $\bar{T}_F$ and t .

The above calculations are conducted by DRVR02. If the two-dimensional fuel-temperature modeling option is used (input variable I2D = 1 or 2), the subroutine TWODTF calculates $T_{cl}(z,t)$ after cladding melting begins, as described in Sec. III.B.3.b.

3. Fuel Temperatures

a. One-dimensional Model. The following discussion applies only if the one-dimensional modeling option for fuel temperatures is used (input variable I2D = 0) and if the radially averaged fuel temperature $\bar{T}_F(z,t)$ is less than the melting temperature (input variable TFUELM). Fuel temperatures at the advanced time step are calculated in DRVR02 from Eq. 63 (Sec. III.B.2) using extrapolations or updated values of $\bar{T}_F$, $\bar{T}_{cl}$, and $P(z,t)$. After cladding melting has begun, the gap-resistance contribution to the overall conductance is set to zero.

Once $\bar{T}_F(z, t)$ reaches TFUELM, it is held at that value. Explicit calculation of $\bar{T}_F(z, t)$ beyond the time $\bar{T}_F(z, t) = \text{TFUELM}$ are only performed if the two-dimensional fuel-temperature option was specified (I2D = 1 or 2). Since no coding currently exists to transfer from one-dimensional modeling to two-dimensional modeling, one-dimensional model-temperature calculations for a node having reached TFUELM effectively terminate at this point.

b. Two-dimensional Model. This section continues the description of subroutine TWODTF started in Sec. III.A.2.b. Phase 4 in this subroutine starts when the fuel-centerline temperature reaches the melting point. The temperature profile is

$$\begin{aligned} T &= T_m \text{ (constant) when } r \leq S \text{ (Region B),} \\ T &= A - Br^2 + Cr^4 \text{ when } r > S \text{ (Region C),} \end{aligned} \quad (79)$$

where T_m is the fuel-melting temperature and S is the radius of the time-dependent solidus front. At each time step, the new average temperature $\bar{T}_C$ of Region C is calculated based on

$$\rho c_p \dot{\bar{T}} = q + [2k\nabla T(R)R/(R^2 - S^2)] = q - 4k(B - 2CR^2)R^2/(R^2 - S^2). \quad (80)$$

No heat conduction is assumed across the boundary $r = S$. The motion of S is estimated based on the equation

$$-\frac{\partial T(S+)}{\partial r} dS = \dot{T}(S+)dt = [q + k\nabla^2 T(S+)]dt/(\rho c_p),$$

leading to

$$\frac{dS^2}{dt} = \frac{q - 4k(B - 4CS^2)}{\rho c_p(B - 2CS^2)}, \quad (81)$$

with the initial condition $S = 0$. Previous time-step values of B , C , and S are used on the right-hand sides of Eqs. 80 and 81.

The equations for solving A , B , and C at a new time step are

$$\bar{T}_C = A - B(R^2 + S^2)/2 + C(R^4 + R^2S^2 + S^4)/3, \quad (82)$$

$$h[T(R) - T_{C1}] = -k\nabla T(R), \quad (83)$$

and

$$T(S) = T_m. \quad (84)$$

These yield

$$C = 3[T_m - \bar{T}_c - \beta(\bar{T}_c - T_{cl})]/[(2 - \beta)(R^2 - S^2)^2], \quad (85)$$

$$B = 2[T_m - \bar{T}_c + C(R^4 + R^2S^2 - 2S^4)/3]/(R^2 - S^2), \quad (86)$$

and

$$A = T_m + BS^2 - CS^4, \quad (87)$$

where

$$\beta = h(R^2 - S^2)/[(R^2 - S^2)h + 4kR]. \quad (88)$$

The average fuel temperature is

$$\bar{T} = [S^2T_m + (R^2 - S^2)\bar{T}_c]/R^2. \quad (89)$$

Phase 4 ends when the energy accumulated during this phase at the pin centerline equals the latent heat of melting, L . The radius S of the solidus front at this time is denoted by S_0 . The internal energy above the solidus,

$$E = \int q\pi S^2 dt,$$

is also calculated during phase 4. Both S_0 and E will determine how fast the liquidus front moves in phase 5.

When phase 5 starts, the liquidus front F starts moving outward from the pin centerline. The temperature profiles of Eq. 79 are used when $r > F$. For the calculation of F and the liquid-fuel temperature profile, it is first necessary to know the accumulated internal (latent) energy distribution in Region B at the end of phase 4.

The profile

$$\left. \begin{aligned} U_0(r) &= \rho L \left[1 - x \left(\frac{r}{S_0} \right)^2 + (x - 1) \left(\frac{r}{S_0} \right)^4 \right] \text{ for } r \leq S_0; \\ U_0(r) &= 0 \text{ for } r > S_0, \end{aligned} \right\} \quad (90)$$

satisfies the obvious boundary conditions $U_0(0) = \rho L$ and $U_0(S_0) = 0$. The only unknown parameter x is determined by the condition

$$E = \int_0^{S_0} U_0(r) 2\pi r dr, \quad (91)$$

where the right-hand side is easily integrated with U_0 from Eq. 90, and E was calculated in phase 4. The equation for x , calculated at the end of phase 4, is

$$x = 4 - 6E/(\rho L \pi S_0^2). \quad (92)$$

If x falls outside the interval $0 < x < 2$, a message appears in the output, but calculation continues with x set to 2 (or 0). This message typically indicates time steps that are too large in the later phases of an accident.

The liquid-fuel temperature in Region A ($r \leq F$) is

$$T_a = T_m + D \left[1 - y \left(\frac{r}{F} \right)^2 + (y - 1) \left(\frac{r}{F} \right)^4 \right], \quad (93)$$

with time-dependent parameters D , y , and F . In melting Region B ($F \leq r \leq S$), the temperature is $T = T_m$. The internal energy in this region is $U(r) = U_0(r) + Q(t)$, where $Q(t)$ is the integrated power density, $\int q \, dt$, since the beginning of phase 5. The conduction of heat from the liquid at $r = F$ moves F so that for each time step $-2\pi F k \nabla T(F) dt = 2\pi F \, dF [\rho L - U(r)]$; i.e.,

$$\frac{dF^2}{dt} = \frac{4kD(2 - y)}{\rho L - U(F)}. \quad (94)$$

At each time step, the new average liquid temperature $\bar{T}_a$ of Region A is calculated based on

$$\rho c_p \dot{\bar{T}}_a = q - 2k \nabla T_a(F)/F = q - 4kD(2 - y)/F^2, \quad (95)$$

and the new value of D from the condition that the basic thermal diffusion equation is satisfied at the pin centerline:

$$\rho c_p \dot{D} = q + k \nabla^2 T_a(0) = q - 4kDy/F^2. \quad (96)$$

The average liquid temperature from Eq. 93 is $\bar{T}_a = T_m + D(4 - y)/6$. Thus, with new values of $\bar{T}_a$ and D from Eqs. 95 and 96, a new value of y is calculated from

$$y = 4 - 6(\bar{T}_a - T_m)/D. \quad (97)$$

The motion of S and the temperature in Region C are calculated in phase 5 using Eqs. 80-88 used in phase 4. The average fuel temperature is

$$\bar{T} = [F^2 \bar{T}_a + (S^2 - F^2) T_m + (R^2 - S^2) \bar{T}_c]/R^2. \quad (98)$$

The end of phase 5 is defined when $F = S_0$. The value of S at this time is denoted by S_1 .

In phase 6, the calculation of S and the temperatures in Region C can also be based on Eqs. 80-88 used in phases 4 and 5.

In Region A, the calculation of F and the temperatures can be carried out through Eqs. 93-98 used in phase 5, except that, because $U_0(r) = 0$ for $r > S_0$, the internal energy is

$$U(r) = Q(t)(S^2 - r^2)/(S^2 - S_0^2) \text{ for } F \leq r \leq S. \quad (99)$$

This satisfies the continuity condition $U(F) = Q(t)$ at the end of phase 5 and at the beginning of phase 6 (when $F = S_0$) and is zero for all t at $r = S$.

Phase 7 starts when $S = R$ and is included to allow stable fuel-temperature calculations in the later phases of an accident, although TWODTF does not consider fuel in motion. Simple models are used because fuel motion normally starts before $S = R$. Equations 93-98 are used as in phase 6 with the internal energy profile $U(r)$ using $S = R$ in Eq. 99. The average temperature is

$$\bar{T} = [F^2 \bar{T}_a + (R^2 - F^2) T_m] / R^2. \quad (100)$$

Subroutine TWODTF also takes into account the possibility that phase 7 can be reached directly from phase 4 or 5. If cladding melting starts in any of the phases 3-6, the value of h is increased to simulate cladding in contact with the fuel. The maximum $h = \text{HBMAX}$ is input-specified. In phases 4-7, the fuel specific heat is taken as temperature dependent with the correlation

$$c_p = 0.3985 + 0.1536 \cdot 10^{-3}(\bar{T}_c - 1900) + 0.1287 \cdot 10^{-6}(\bar{T}_c - 1900)^2 \quad (101)$$

for solid fuel, and $c_p = 0.5020$ for molten fuel (the units $\text{J/g}\cdot\text{K}$ for c_p and $^\circ\text{C}$ for $\bar{T}_c$). This correlation is obtained by fitting to the fuel-specific-heat curve of Ref. 14.

The control variables I2D and ITF have been explained at the end of Sec. III.A.2.b.

C. Fuel Motion

1. Criteria for Fuel Failure (Motion)

Currently the two main criteria for fuel failure, the satisfaction of which initiate fuel motion in SACO, are:

- a. The attainment of the fuel solidus, TFUELM, by the radially averaged fuel temperature, TBAR(J).
- b. The movement of the solidus isotherm RMRF(J) to a user-specified radius, RFFAIL.

The first criterion can be used with either the one- or two-dimensional modeling (I2D = 0 or 1). The second criterion can only be used with the latter modeling, since the motion of the solidus isotherm is only calculated in subroutine TWODTF.

With the one-dimensional modeling, temperature calculations for the fuel and cladding at the node satisfying the fuel-motion criterion are terminated. The two-dimensional modeling option continues the calculations and ignores the effects of fuel motion on the temperature calculations, which are performed as shown in Sec. III.B.3.b. This is a reasonable first approximation if fuel motion is reasonably slow, because the fuel density and the power density decrease with the same relative rate in the early part of the motion. If fuel motion is rapid and extensive, the temperature calculations are invalid. However, in this latter case, the fuel-motion reactivity effects would completely dominate the accident scenario.

Additional fuel-motion criteria variables TFTOP (for fuel-centerline temperature) and TFEXTR (for average fuel temperature in excess of melting point) are available in subroutine DRVR02. However, in the CRBR-type accidents analyzed to date, fuel motion is normally initiated by the first criterion if I2D = 0 and by the second if I2D = 1 or 2.

2. Fuel Relocation

The purpose of the fuel-motion model described here is to allow the investigation of the reactivity-feedback effects from user-supplied modes of fuel relocation. This model has been used to verify the fuel-motion reactivity-feedback subroutines, which currently use time-independent input-worth tables analogous to those provided for SAS3A analyses.

The SACO fuel-motion approach exemplified by the model reported here is to provide flexible parametric models that can be easily manipulated by the user to simulate currently postulated modes of fuel-pin disruption.¹² Although this somewhat nonmechanistic approach to fuel-motion simulation

was used early in accident analysis with codes such as FREADM¹⁵ and MELT,¹⁶ the current state of knowledge and the complexity (expense) of a mechanistic compressible-hydrodynamics treatment as used in SLUMPY or LEVITATE¹⁷ seem to preclude any other approach for a fast-running sensitivity/scoping analysis tool.

A graphic illustration of the fuel-motion model is presented in Fig. 7. At the initiation of fuel motion, the cladding is assumed to be molten but not

Fig. 7. SACO Fuel-motion-model Representation

moving, following the flooding assumptions of Fauske.¹⁸ The flow channel is largely voided and no fuel-coolant-interaction effects are considered by the model. The "source term" for the fuel that is allowed to move is defined to be, and is restricted to, the molten-fuel region inside the pin cavity. The model itself is based on a "frothing scenario" in which the fuel, steel, and gases in the froth are assumed homogeneous and allowed to move in the channel. A comparative illustration of fuel-motion dispositions calculable with both SLUMPY and SACO is presented in Fig. 8.

Fig. 8. SACO-SLUMPY Fuel-motion-representation Comparison

Given the physical picture illustrated by Fig. 7, the integrated continuity equation for molten-fuel mass in the cavity is

$$(\dot{\rho V})_{mf} = -\rho_{mf} v_{mf-out} A_{out} + \rho_{mf0} \dot{V}_{mf}, \quad (102)$$

where

$v_{mf-out} A_{out}$ = a characteristic volumetric flow rate of molten fuel escaping the confines of the cavity and entering the voided coolant channel,

ρ_{mf} = smear density of the fuel in the cavity,

ρ_{mf0} = density of the fuel melting into the cavity,

and

V_{mf} = volume of the cavity.

Obviously then, the rate of accumulation of fuel in the channel for subsequent dispersal depends on the behavior of ρ_{mf} . The assumption made here is that the fuel essentially "relaxes" out into the channel according to

$$\frac{\partial}{\partial t} \rho_{mf} = -\frac{1}{\tau_e} (\rho_{mf} - \rho_e), \quad (103)$$

where the time constant τ_e and the assumed constant terminal or asymptotic density of the "froth" in the channel, ρ_e , are specified by the user.

The solution of Eq. 103 yields

$$\rho_{mf}(t) - \rho_e = (\rho_{mf0} - \rho_e) \exp(-t/\tau_e), \quad (104)$$

with the zero subscript denoting the initial condition.

Assuming that the density of the fuel in the coolant channel is ρ_e , the conservation of total fuel mass can be expressed by

$$\rho_{mf0} V_{mf}(t) = \rho_{mf}(t) V_{mf}(t) + [Z_2(t) - Z_1(t)] A_{ch} \rho_e, \quad (105)$$

where

Z_2, Z_1 = top, bottom of froth region inside channel

and

A_{ch} = channel area defined by the sum of the original (steady-state) coolant and cladding cross-section areas, $A_c + A_{c1}$.

The definition of the channel area tacitly assumes that the cladding is instantaneously mixed into the froth as the froth region expands in the channel. With this assumption, there is no reactivity feedback from cladding relocation (unless the froth expands beyond the blanket/core region). Therefore, cladding-relocation effects were not considered in this model.

The final simplifying assumption in the programming of this model is that the volume of the cavity does not change after the onset of fuel motion. This assumption can be factored in with Eqs. 104 and 105 to yield the froth-region length:

$$\Delta Z \equiv Z_2(t) - Z_1(t) = \frac{V_{mf0}[\rho_{mf0} - \rho_{mf}(t)]}{\rho_e A_{ch}}. \quad (106)$$

The location of the lower froth boundary is then calculated from

$$Z_1(t) = Z_{fm0} - 0.5\Delta Z - 0.5\xi(t)g(t - t_{fm})^2, \quad (107)$$

with

$$\xi \equiv \text{GRAV1} + \frac{\text{GRAV2}}{t - t_{fm}} + \left(\frac{\text{GRAV3}}{t - t_{fm}} \right)^2, \quad (108)$$

where

Z_{fm0} = the location of initial fuel motion in the channel undergoing melting specified by input variable FMOVO with a default set at the location of peak axial power,

g = the acceleration of gravity,

t_{fm} = the time of fuel-motion initiation,

and

ξ = a parameter with which to explore different sweepout and draining rates determined by the input variables GRAV1, GRAV2, and GRAV3.

By varying GRAV1, GRAV2, and GRAV3, we can explore various assumptions, including pure-gravity acceleration, constant velocity, and suspension ($\xi = 0$).

From Eq. 5, the froth upper boundary is given by

$$Z_2(t) = Z_1(t) + \Delta Z. \quad (109)$$

The reactivity-feedback calculations depend on the mass of fuel at each node. The linear distribution of fuel mass in the representative pin/channel in the froth region is

$$m_f(z) = \rho_{mf}(t)A_{mf}(z) + \rho_f[A_f - A_{mf}(z)] - \rho_e A_{ch}, \quad (110)$$

where

A_{mf} = the cross-sectional area of the molten fuel cavity at z (time dependence not accounted),

A_f = the steady-state area of the solid fuel,

and

ρ_f = the steady-state density of solid fuel.

Above and below the froth region, the last term is zero. A_{mf} is currently specified in SACO as

$$A_{mf}(z) = \pi R_f^2 (RFFAIL)^2 P_z^0(z), \quad (111)$$

where

R_f = radius of the fuel in the pin at steady state,

$RFFAIL$ = user-specified input-variable,

and

$P_z^0(z)$ = user-specified axial-power shape normalized such that $\text{Max } P_z^0 = 1$, which assumes that the solidus-isotherm axial profile in the fuel can be approximated by the axial-power shape.

Figure 8 illustrates the type of fuel relocation obtained from this model and compares this relocation with that obtainable from SLUMPY. The parameters ρ_e , τ_e , and ξ can be varied to allow the user to explore different fuel-relocation modes, rates, and final dispositions. Additional flexibility can be easily factored in to improve the modeling described here.

The fuel-motion subroutines include FMSET, which initializes the appropriate parameters at the onset of fuel motion, and DRVR03, which calls FMOV1 and FMOV2. Subroutine FMOV1 is used to specify the fuel-distribution parameters, and FMOV2 is used to calculate the mass of fuel at each node for use in the reactivity-feedback calculations performed in FEEDBK.

D. Neutronics

The point-kinetics formulation developed for SAS and used in SACO and the basic equations and their method of solution have been described by Dunn et al.⁹ The neutronics programming in SACO is found in the TSPK subroutine, which is an appropriately modified version of the SAS-TSPK subroutine.

1. Point-kinetics Module

a. Basic Equations. A one-group, space-independent (point) kinetics model is used to describe the neutron kinetics of the reactor. The power is separated in space and time

$$Q(\vec{r}, t) = n(t)S(\vec{r}), \quad (112)$$

where $S(\vec{r})$ is a specified shape function and $n(t)$ is a solution of the point-kinetics equations

$$\frac{dn}{dt} = \frac{\rho - \beta}{\Lambda} n + \sum_{i=1}^6 \lambda_i C_i \quad (113)$$

and

$$\frac{dC_i}{dt} = \frac{\beta_i}{\Lambda} n - \lambda_i C_i; \quad i = 1, 6, \quad (114)$$

where

n = neutron density,

C_i = concentration of i th delayed-neutron precursor,

β_i = delayed-neutron fraction from the i th group,

$\beta = \sum_{i=1}^6 \beta_i$ = delayed-neutron fraction,

λ_i = decay constant for the i th precursor,

Λ = prompt-neutron generation time = ℓ/k_{eff} ,

ℓ = prompt-neutron lifetime,

k_{eff} = effective multiplication factor,

and

ρ = reactivity = $(k_{\text{eff}} - 1)/k_{\text{eff}}$.

Most stepwise-integration procedures for solving Eq. 113 involve the use of previously calculated values of n to obtain the next value. Thus, to compute n^{k+1} , knowledge of n^k , n^{k-1} , n^{k-2} , ..., is required (k denotes time nodes). These methods have the disadvantage that several initial values of n , needed to start the calculations, must be obtained by an auxiliary process. This disadvantage can be eliminated by using one of the Runge-Kutta integration methods. Even then, the fact that Λ in Eq. 113 is very small ($\sim 10^{-7}$ s) in fast reactors limits the size of the time step Δt^k to about 1000Λ for stable integration.

b. Method of Solution. The method used here for the solution of Eqs. 113 and 114 was formulated by Kaganove.¹⁰ It has the advantages of being self-starting, being stable for large integration intervals, and having a procedure for changing the integration interval as the nature of the problem changes. Kaganove's method is described briefly here. Equation 114 is solved for $\lambda_i C_i$, and the results are substituted in Eq. 113 to give

$$\frac{dn}{dt} = \frac{\rho}{\Lambda} n - \sum_{i=1}^6 \frac{dC_i}{dt}. \quad (115)$$

Equation 115 is integrated across a time interval τ :

$$n(\tau) - n^k = \int_{t^k}^{t^k + \tau} \frac{\rho n}{\Lambda} dt - \sum_{i=1}^6 [C_i(\tau) - C_i^k], \quad (116)$$

where τ is the time interval for numerical integration, n^k and C_i^k are $n(t^k)$ and $C_i(t^k)$, and $n(\tau)$ and $C(\tau)$ are $n(t^k + \tau)$ and $C(t^k + \tau)$, respectively. With the transformation $t' = t - t^k$, Eq. 116 becomes

$$n(\tau) - n^k = \int_0^\tau \frac{\rho n}{\Lambda} dt' - \sum_{i=1}^6 [C_i(\tau) - C_i^k], \quad (117)$$

where

$$n(0) = n^k$$

and

$$C_i(0) = C_i^k. \quad (118)$$

Equation 114 can be solved in functional form:

$$C_i(\tau) - C_i^k = -C_i^k [1 - \exp(-\lambda_i \tau)] + \frac{\beta_i}{\Lambda} \int_0^\tau \exp[-\lambda_i(\tau - \tau')] n d\tau'. \quad (119)$$

Substitution of Eq. 119 into Eq. 116 yields

$$n(\tau) - n^k = \int_0^\tau \frac{\rho n}{\Lambda} dt' - \sum_{i=1}^6 \frac{\beta_i}{\Lambda} \int_0^\tau \exp[-\lambda_i(\tau - \tau')] n d\tau' + \sum_{i=1}^6 C_i^k [1 - \exp(-\lambda_i \tau)]. \quad (120)$$

For the time interval under consideration, let ρ and n be represented by second-order polynomials

$$\rho = \rho^k + \rho_1 t' + \rho_2 (t')^2 \quad (121)$$

and

$$n = n^k + n_1 t' + n_2 (t')^2. \quad (122)$$

Substitution of Eqs. 121 and 122 into Eq. 120 with the condition that Eq. 120 be satisfied both at $\tau = \Delta t^{k+1}$ and at $\tau = \Delta t^{k+1}/2$ yields two linear equations in the two unknowns n_1 and n_2 . Substitutions of the values of n_1 and n_2 in Eq. 122 gives $n(t)$ for this time interval.

In SACO the net reactivity ρ in Eq. 121 is the sum of five contributions:

$$\rho = \rho_p + \rho_D + \rho_c + \rho_{cl} + \rho_f, \quad (123)$$

where

ρ_p = programmed reactivity input (initial ramp and scram),

ρ_D = Doppler-feedback reactivity,

ρ_c = coolant-density (voiding) reactivity,

ρ_{cl} = cladding-relocation-feedback reactivity,

and

ρ_f = fuel-relocation-feedback reactivity.

The net reactivity is a function of $n(t)$, which is itself a function of ρ . These two functions must be compatible. Due to the interdependence of the functions and the fact that ρ is not known explicitly, an iterative scheme is used to achieve compatibility.

2. Reactivity-feedback Calculations

The current version of SACO includes four feedback-reactivity components: Doppler, coolant density (voiding), cladding relocation, and fuel relocation. A brief description of the methods of calculating these follows. These calculations are all performed in the subroutine FEEDLK.

a. Doppler Reactivity. The Doppler reactivity is based on the volume-averaged temperature over a fuel-pin segment. The total Doppler reactivity for the reactor at any time is then given by

$$\rho_D = \sum_{I=1}^{NC} \sum_{j=1}^N A_{jI}^k \ln \frac{\bar{T}_{jI}^k}{\bar{T}_{jI}^0}, \quad (124)$$

where

$\bar{T}_{jI}^k$ = volume-averaged temperature over the jth axial segment at time node k (K) in channel I,

$\bar{T}_{jI}^0$ = volume-averaged temperature over the jth axial segment at time zero (K) in channel I,

N = number of axial segments,

and

NC = number of channels.

The local Doppler coefficient A_{jI}^k is given by

$$A_{jI}^k = \omega_{jI} \left[A_{DI} + (B_{DI} - A_{DI}) \alpha_{jI}^k \right],$$

where

ω_{jI} = local Doppler (axial) weighting factor,

A_{DI} = Doppler coefficient for channel I with all sodium present,

B_{DI} = Doppler coefficient for channel I with no sodium present,

and

α_{jI}^k = local equivalent sodium-void fraction at time node k.

The foregoing is based on the assumption that A_{DI} and B_{DI} are given by equations of the form

$$A_{DI} = \bar{T}_{jI} \frac{d\rho_D}{dT_{jI}} = \text{constant.}$$

The coefficients A_{DI} and B_{DI} as well as the axial weighting-factor vector, $\vec{W}$, are determined from a separate diffusion or transport calculation and specified in the problem input and read by the subroutine INPUTF. The local sodium-void-fraction calculation is described below.

b. Coolant Density/Voiding Reactivity. The reactivity feedback due to changes in coolant density prior to voiding is calculated according to

$$\rho_c(t) = \sum_{I=1}^{NC} \sum_{j=1}^N (\rho_c)_{jI} \alpha_{jI}^k,$$

where

$(\rho_c)_{jI}$ = reactivity worth of sodium in axial segment j of channel I determined from a separate diffusion or transport calculation and read in by the subroutine INPUTF

and

α_{jI}^k = equivalent sodium-void fraction in segment j of channel I at time node k .

The latter term is given by

$$\alpha_{jI}^k = 1 - \text{DAV2}(J)/\text{DAVSS}(J)$$

where

$\text{DAV2}(J)$ = the density of the coolant in segment j of the channel at time node k (calculated each time step in subroutine NADEN),

and

$\text{DAVSS}(J)$ = the steady-state density of the coolant in segment j of the channel.

After voiding, the time-dependent density DAV2 is multiplied by the volumetric fraction of the coolant-channel segment occupied by coolant. This volumetric fraction is determined in NADEN using voiding-interface locations calculated in ZBOIL.

c. Cladding-relocation Reactivity. The reactivity feedback due to cladding relocation can be calculated according to

$$\rho_{cl}^{(t)} = \sum_{I=1}^{NC} \sum_{j=1}^N (\rho_{cl})_{jI} \left(1 - \frac{m_{cl}^{jIk}}{m_{cl}^{jI0}} \right),$$

where

$(\rho_{cl})_{jI}$ = reactivity worth of cladding in axial segment j of channel I (determined from a separate neutronics calculation and read in by INPUTF),

m_{cl}^{jIk} = mass of cladding in axial segment j of channel I at time step k ,

and

m_{cl}^{jI0} = analogous mass of cladding at steady state.

The current version of SACO does not explicitly calculate cladding motion, although the applicable programming for feedback calculation exists in FEEDBK.

d. Fuel-relocation Reactivity. The reactivity feedback due to fuel relocation is calculated according to

$$\rho_f^{(t)} = \sum_{I=1}^{NC} \sum_{j=1}^N (\rho_f)_{jI} \left(1 - \frac{m_f^{jIk}}{m_f^{jI0}} \right),$$

where

$(\rho_f)_{jI}$ = reactivity worth of fuel in axial segment j of channel I (determine from a separate neutronics calculation and read as input,

m_f^{jIk} = mass of fuel in axial segment j of channel I at time step k ,

and

m_f^{jI0} = analogous steady-state mass of fuel.

After fuel-motion initiation, the time-dependent fuel variable m_f^{jIk} is calculated for each time step as described in Sec. III.C.2.

e. Expansion and Other Reactivity-feedback Mechanisms. No explicit mechanism for calculating reactivity feedback effects other than those listed exists in SACO. However, in the sensitivity studies described earlier, the input-specified variables VRHOD and VRHOV were defined and used to multiply the Doppler and coolant-density feedbacks at each time step. This allowed a treatment of other feedbacks as a linear function of Doppler and coolant-density feedbacks. Although this is a strictly fictitious treatment, it can be used to explore effects of other feedback mechanisms parametrically. For example, enhancement of the Doppler effect by 50% (i.e., VRHOD = 1.5) gave a reasonable approximation of the Doppler-plus-axial-expansion effects calculated by SAS3A in exploratory loss-of-flow calculations using a CRBR-type core.

E. Time-weighted Power and Energy Modeling

To effectively use one-dimensional heat-capacity-based modeling in situations in which the power is fluctuating, the time delay in transferring energy from one component to another must be taken into account. For example, the temperature gain in a fuel pin resulting from an increase in fission power is immediate; however, the transfer of this added heat to the cladding, and then to the coolant, takes place over a finite time. The accounting of the finite time is necessary in the fractional energy treatments of prevoiding heat transfer and postvoiding motion of the coolant liquid/void interfaces, both of which are based on heat-capacity models.

To account for these time delays, the time-averaged power $\beta(t)$ has been defined. Mathematically, this function would have the form

$$\beta(t) = \int_{t-\Delta}^t P_t(t') \delta(t - t') dt' / \int_{t-\Delta}^t \delta(t - t') dt', \quad (125)$$

where the power $P(z, t)$ is assumed separable into time and space components $P_t(t)$ and $P_z(z)$, respectively, and the function δ properly weights the time dependence of the power to account for that power being reflected in heat transfer to the cladding and coolant.

In SACO this time-averaged power is approximated by the expression

$$\beta(t) = \int_{t-\Delta}^t P_t(t') dt' / \Delta, \quad (126)$$

which effectively approximates as constant the importance of the power between $t - \Delta$ and t . This calculation is performed in the BETEXT subroutine with the value Δ being specified with the input variable BETADT.

The integral in Eq. 126 is approximated in BETEXT from a quadratic-polynomial fit to energy values at specified times, depending on the time in the transient. The value of BETADT should reflect the time constant of the fuel, here defined as the time for $(1 - 1/e)$ of a rise in the average fuel temperature to be reflected in the coolant temperature at the same location. The time constant for CRBR-type mixed-oxide fuel is on the order of 1 s, and BETADT = 1.5 s has been used in SACO simulations of CRBR to successfully approximate SAS simulations. The results of SACO simulations have been very insensitive to values of BETADT, as long as values around the time constant are chosen.

IV. CALCULATIONS AND RESULTS

This section relates the results of two classes of calculations with SACO:

1. Those performed to verify the phenomenological modeling of SACO.
2. Those performed in sensitivity-study applications.

A. Model Verification

To date, the verification of the phenomenological modeling in SACO has been accomplished^{2,3,26} by the successful duplication or approximation of SAS3A analyses of transient overpower and loss of flow with failure-to-scrum transients.¹⁹ This avenue of model verification has been chosen to ensure that the SACO models predict roughly the same reactivity-feedback behavior for a full-core analysis that SAS predicts. SAS, of course, represents the state of the art in LMFBR loss-of-flow transient analysis.

Specifically, the SACO models have been verified by successful comparisons of the individual channel-temperature predictions and the concomitant core Doppler and coolant-density (voiding) reactivity feedback with the corresponding predictions of SAS.

The reported SAS3A analysis²⁰ of a postulated CRBR EEC LOF transient primarily has been used as the benchmark calculation to verify the SACO code. Both SAS and SACO analyses were 10-channel "full-core" simulations with the same initial power levels, flows, and Doppler and voiding-reactivity-worth curves for each channel. The SACO axial-power shape was composed of a simple sine function over the active core and simple polynomial fits over the blankets, all appropriately normalized to conserve both region-wise and total subassembly power for each channel. The flow-coastdown input to SAS was also used for SACO. Although axial expansion was calculated in SAS, the expansion-reactivity feedback was set to zero for the comparison, since SACO does not calculate axial expansion.

Figures 9 and 10 compare the SAS and SACO predictions of the average fuel, cladding, and coolant temperatures as functions of time and space for the highest power/flow channel and the core-total predictions of the Doppler, coolant density, and net reactivities. Initial core voiding began at roughly 11 s, the final subassembly to void began voiding at roughly 13.5 s, and fuel motion began at roughly 14.1 s. The "flat" regions of the coolant and cladding profiles indicate that the coolant and cladding in those regions are at the coolant-saturation temperature (~950°C) and cladding-melting temperature (1371°C), respectively.

Fig. 9. SAS-SACO Prevoiding-temperature-profile Comparisons (CRBR EEC TUC transient without axial-expansion feedback). A, D = SAS, SACO coolant temperature; B, E = SAS, SACO cladding temperature; C, F = SAS, SACO fuel temperature. ANL Neg. Nos. 900-78-595 and -596.

Fig. 10. SAS-SACO Temperature-profile and Reactivity-calculation Comparisons. ANL Neg. No. 900-78-602.

The coolant-density reactivity peaks and valleys of SAS resulting from explicit treatment of flow oscillations are "smoothed" by the SACO modeling, but are still well represented in an integral sense. This is further illustrated by the agreement of the Doppler curve, which is nearly immune to the oscillatory effects.

In summary, the agreement of individual-channel fuel temperatures and the Doppler-reactivity curves shows that the SACO prediction of fuel temperatures is sufficiently accurate. The agreement of the individual-channel coolant temperatures and the coolant-density reactivity curves verifies the accuracy of the SACO coolant-temperature predictions. The agreement of the net reactivity follows.

The above curves were generated with the fast-calculation option of SACO which uses the fractional energy and constant-profile modeling for coolant and cladding temperatures (ISUSE = 0, IQUSE = 1) in nonvoiding subassemblies and the 1-D or lumped-parameter fuel-temperature (I2D = 0) model. Since this comparison was to verify the temperature-predicting aspects of the SACO modeling, the initial voiding times for the subassemblies were input, as were representative voiding rates (IVDTIM = 0, IVD RAT = 0).

Fig. 11. SAS-SACO Radial Fuel-temperature-profile Comparisons. ANL Neg. No. 900-78-601.

To verify the two-dimensional fuel-temperature modeling (subroutine TWODTF), a CRBR loss of flow with failure-to-scrum transients was analyzed with SACO with control variable I2D set greater than zero. The power, temperature, and reactivity behavior were in good agreement with the results of SAS3A, with both (IVDTIM, IVD RAT) = (0, 0) and (1, 1). With I2D = 2, SACO also edits the radial fuel-temperature profiles in all axial nodes of a representative fuel pin of a specified channel. Figure 11 compares these temperature profiles of SAS and SACO in a near-midplane node of the channel with highest power/flow ratio.²⁶ The differences are mainly caused by the slightly different timing of events in the SACO and SAS codes. These comparisons verify the integral modeling in SACO used to predict the radial fuel-temperature profiles.

The combined verification was performed with the voiding modeling turned on so that SACO calculated both initial voiding

times and rates (IVDTIM = 1, IVD RAT = 1) to compare with SAS results the time between the initiation of the first and last subassemblies to void and the associated reactivity behavior. The results of these runs with all model combinations (ISUSE = 0, 1, I2D = 0, 1, IQUSE = 0, 1) again verified that the voiding, fuel temperature, and concomitant reactivity behavior predicted by SACO were in general agreement with that predicted by SAS.

B. Sensitivity Analyses

To illustrate the sensitivity-study applications of SACO in the probabilistic/deterministic procedure of Ref. 5, the postulated CRBR transient mentioned above was analyzed through the voiding phase to a point in the accident where considerable amounts of cladding and fuel are molten and fuel/cladding motion would occur. Fuel motion per se was not calculated in these sensitivity analyses. This transient had the advantage of the availability of the SAS3A code "benchmark results," mentioned previously.

The first step in the calculational procedure was to analyze the "base-case" transient with the SACO code, providing an initial basis of comparison between the SAS and SACO codes. The input to SACO was matched as closely as possible to the input of SAS as in the model verification discussed above. Both codes used 10 "channels," representative groups of subassemblies, to represent the CRBR core. The initial power and flow for each SAS channel were used in the analogous SACO channels. The SACO power shapes were curve fits to the power shapes used by SAS3A. The material-worth reactivity curves and Doppler profiles for each SAS channel were input to the analogous SACO channels. Axial-expansion-reactivity feedback was set to zero in the SAS calculations to allow comparison with SACO, which does not calculate axial expansion. The elimination of axial-expansion feedback from the SAS analysis represents the only differences between the reported SAS results²⁰ and the SAS results referred to here.

The next phase of the analysis was the selection of the accident parameters to be systematically varied to determine the impact of their uncertainties on the accident consequences. The parameters shown in Table II were selected and assigned probability distributions with the distributional parameters indicated.

The dependencies of the Doppler- and voiding-reactivity factors upon the fraction of fuel-cycle time, referred to as burnup, were chosen as representative based on neutronics calculations for CRBR.^{19,21} The probability-distribution characteristics were chosen as reasonable; however, the main thrust was to illustrate the sensitivities of the consequences, not to imply a precise knowledge of parameter uncertainties. The PROSA²⁵ code was then used to generate the necessary combinations of input parameters. Each of these combinations provided input for a separate, deterministic, SACO calculational case. However, the programming in the main routine was provided such that all cases were part of the same SACO computer run.

TABLE II. Sensitivity-study Input Parameters and Assigned Distributions

Parameter	Distribution	Mean Value	Distributional Characteristic ^a
Fraction of fuel-cycle time (burnup)	Uniform	0.5	0.1 ^b
Fuel specific heat	Normal	357 J/kg·K	12%
Doppler coefficient factor	Normal	1.00 ^c	8% ^d
Void-worth factor	Normal	1.00 ^e	10% ^d

^aLower and upper limits for uniform distribution; standard deviation for normal distribution.

^bLimits correspond to BOEC and EOEC, respectively.

^c0.94 at BOEC; 1.06 at EOEC.

^dAt fixed burnup.

^e0.92 at BOEC; 1.08 at EOEC.

The SACO code was then used to analyze the transient for the generated combinations of the input accident parameters. The consequences investigated and output by SACO included end-of-analysis energetics, power levels, reactivities, and fractions of core with molten cladding and fuel. The DAMAGE subroutine was modified to provide these outputs. The power and reactivity consequences were chosen because they provide an important set of state variables at the initiation of cladding and fuel motion. The molten core fractions serve as core damage indicators and plausible source terms for fuel and cladding relocation. Although these consequences depend on a large number of system and model parameters, a preliminary study⁵ indicated that only a few parameters make major contributions to their uncertainties. The parameters listed in Table II were selected for this study.

Table III presents results for the selected consequences. The difference between the SAS and SACO base-case consequence results should be

TABLE III. Sensitivity-study Distribution Characteristics of Selected Consequences^a

Consequences	Base Case		SACO-PROSA Consequence Distribution Characteristics	
	SACO	SAS	Mean Value	Standard Deviation
Power ^b	15.9	19.8	19.0	13.0
Energy ^c	17.3	17.9	17.4	0.9
Net reactivity (\$)	0.88	0.88	0.87	0.06
Fraction of cladding molten	0.14	- ^d	0.16	0.08
Fraction of fuel molten	0.09	- ^d	0.15	0.18

^aEvaluated at 0.6 s after boiling initiated in the coldest group of subassemblies.

^bRelative to steady-state full power.

^cSteady-state full-power seconds.

^dMolten fractions not edited by SAS.

interpreted to indicate reasonable consistency between the two codes. The exceptional agreement shown was obtained not by a judicious choice of input parameters in SACO, but rather by a fortuitous choice. Although the study prescribed here verifies the modeling of SACO, the agreement indicated in Table III should not be expected in all cases. The differences between the base-case value and the mean value of each consequence reflect the non-linearity of the consequence dependence on the input parameters.

The analyses performed with SACO for this study used the fast-calculation option mentioned above with voiding rates and time input (IVDRAT = 0, IVDTIM = 0). The SACO analyses required an average of 20 s computing time on the IBM 370/195 for each case. The computer-storage requirements for the SACO evaluations reported here were less than 250 kilobytes.

V. CURRENT STATUS AND FUTURE EFFORTS

The SACO computer code has been described in ANL Reactor Development Program Progress Reports intermittently from October 1975 issue through April 1978. Modeling, verification, and sensitivity applications of the code were reported in the literature.^{2,3,5,6,26} The code capability to treat the initiating phase of an unprotected flow-coastdown accident to the point where fuel and cladding motion begin has been demonstrated by successful comparison of transient calculations with analogous SAS3A calculations. Beyond fuel-motion initiation, the approach is parametric.

The fuel-motion model has been designed to facilitate reactivity-effects studies of fuel relocation with the user specifying different fuel-relocation models, rates, and final dispositions of molten fuel. Since it is a parametric model, no phenomenological "verification" has been performed; however, the use of the model with the associated reactivity-feedback routines to produce appropriate feedback has been verified.

Cladding motion per se is not treated; however, the movement of cladding is treated implicitly by the fuel-motion model.

With the appropriately modified Eulerian finite-difference routine from SAS3D to calculate coolant temperatures and the radial-temperature modeling described in Sec. III, the SACO code can be used to perform "reference" calculations which can provide a benchmark against which the faster one-dimensional models of SACO can be tested. The benchmark mode of calculation of SACO is between one and two orders of magnitude faster than the analogous calculation of SAS3D, but roughly two to five times slower than the fast-calculation-mode option, where the latter requires, depending upon input-specified convergence criteria and time steps, roughly 10-50 s of IBM 370/195 CPU time to calculate, with a 10-channel, 20-node model, a CRBR LOF transient to a point where fuel and cladding motion have begun.

This preliminary version of SACO does not have variable dimensioning. The common blocks (COMM deck) included in the program listing are dimensioned for 20 axial nodes and therefore could handle up to 20 nodes. (The code logic is programmed for variable numbers of channels and nodes.)

To use a greater number of nodes than dimensioned would require re-compilation of the source deck with larger arrays dimensioned. A 10-channel/20-node run of SACO requires about 350 kilobytes on the IBM 370/195. However, the brunt of this storage is required by the logic, not the arrays. Thus, running with large numbers of channels, say for coherence-effect studies, does not require excessive storage.

Although the capability to input a power history into SACO exists, no fuel-coolant-interaction model has been developed to evaluate the fuel-motion phase of a transient-overpower accident. Accordingly, no TOP or LOF'd TOP scenarios have been completely analyzed with SACO. In light of the assumptions associated with the various temperature models, the prevoiding phase of a TOP is treated with the Eulerian finite-difference routine and the integral fuel-modeling routines in SACO.

The above summarizes the SACO code to date. A preliminary version of SACO was released in October 1977 to the Neutron Physics Division at Oak Ridge and the Nuclear and Safety Division at General Electric--Sunnyvale. The release followed a request for a fast-running LMFBR accident-analysis code that could be used in sensitivity studies.^{5,6} The version released has the features reported here, except the two-dimensional fuel temperature calculations (TWDDTF).

Future phenomenological development efforts in SACO should include the verification and further development of flexible parametric fuel-motion models, the incorporation of a simple parametric fuel-coolant-interaction model, and the inclusion of a simple disassembly model. Replacement of parametric dependencies with improved physical modeling is an ever-continuing aspect of this code, as well as any core-disruptive-accident code currently under development.

Another future effort may include the interfacing of SACO with computer codes such as TRANSIT²² and VENUS²³ (or their fast-running counterparts), which analyze the transition and disassembly stages of core-disruptive accidents.²⁴

APPENDIX A

Subroutine Functional Listing and Flow Charts

BETEXT: Calculates average power over specified interval
COAST: Calculates pump or flow-coastdown function
CPFUNC: Calculates fuel heat capacity
CRED: Moves data in core
DAMAGE: Calculates and edits damage variables
DATMOV: Manages data movement
DATOUT: Manages input-data edit
DRED: Moves data between core and disk
DRIVER: Calls temperature and reactivity drivers
DRVR01: Drives temperature calculations
DRVR02: Drives calculations after initial voiding
DRVR03: Drives fuel motion
DYNALL: Allocates dynamic core size
ERROR: Terminates upon error condition
FEEDBK: Calculates reactivity feedback
FEQUAT: Equates two arrays
FFCRIT: Defines transient-overpower fuel failure criteria
FITZ: Calculates quadratic approximation
FLTSET: Initializes integer array
FMOV1: Calculates fuel-ejection parameters
FMOV2: Calculates nodal fuel masses during fuel motion
FMSET: Records parameters at initiation of fuel motion
FOUT: Prints an integer data pack
INITAL: Initializes
INPDRV: Drives data input
INTSET: Initializes integer array
IOUT: Prints an integer data pack
LIMCH: Estimates voiding time(s) for limiting channel
LINES: Edits printed output

MAIN: Drives overall calculation
NADEN: Calculates nodal sodium densities
POINST: Defines data packs
POWER: Defines some power-profile variables
 PREA: (Function) feeds programmed reactivity
PROPED: Edits salient input
 PROPM: Calculates material and geometry parameters
PTEMPZ: Calculates coolant temperatures analytically
 QSET: Sets coolant-temperature-profile parameters
QTEMPZ: Calculates coolant temperatures analytically
READEC: Moves data into core
READIN: Reads input data cards
 REED: Moves data between core and disk
RPROF: Calculates radial profile parameters
START: Initializes data management
SSCALC: Calculates steady-state parameters
STEMPZ: Calculates coolant temperatures implicitly
TEMPCK: Records temperatures at specified time
 TEXT: Calculates quadratic approximation of temperature versus time
TFEDIT: Edits channel information
 TIMER: Provides problem timing
TINSET: Calculates region inlet temperatures for PTEMPZ
 TOB: Estimates time of boiling with Newton-Raphson
TSCALC: Drives transient calculation
 TSPK: Calculates power/reactivity via point kinetics
TWODTF: Calculates temperature profiles within pin
VDTEMP: Sets parameters at initiation of voiding
WPUMP: Calculates flow given pump coastdown
WRITEC: Moves data from core
 WTIME: Calculates flow given flow coastdown
 ZBOIL: Calculates voiding and dryout interfaces
 ZINIT: Calculates Z-dependent parameters

Fig. A.1. DRIVER Flow Chart. ANL Neg. No. 900-77-1713.

Fig. A.2. DRVRO1 Flow Chart. ANL Neg. No. 900-77-1707.

Fig. A.3. DRVR02 Flow Chart. ANL Neg. No. 900-77-1709.

Notation

- A: Single Phase Liquid Coolant Calculations
- B: Coolant Film Region Calculations
- C: Dryout Region (Solid Clad/Solid Fuel) Calculations
- D: Solid Clad/Melting Fuel Calculations
- E: Melting Clad/Solid Fuel Calculations
- F: Melting Clad/Melting Fuel Calculations

Numbers represent CONTINUE starts in the DRVR02 Subroutine

Fig. A.4. DRVR02 Decision Tree. ANL Neg. No. 900-77-1708.

Fig. A.5
DRVR03 Flow Chart. ANL
Neg. No. 900-77-1712.

Fig. A.6. TSPK Flow Chart. ANL Neg. No. 900-77-1710.

Fig. A.7. TWODTF Flow Chart

APPENDIX B

Input Description and Definitions

This appendix provides an input description for the SACO code and instructions in the use of this input to run SACO. The input can be divided into several categories: channel- and axial-node-dependent variables (programmed as two-dimensional arrays); channel-only-dependent variables (programmed as one-dimensional arrays); and core variables which may be either scalars or arrays. Note that each channel may represent any specified number of subassemblies.

The first three sections of this appendix describe the axial node- and channel-dependence aspects of the code and give an overview of the input required to perform an accident analysis. The first section discusses the axial-node aspects of the code, the input data needed to define the axial structure, and the input data that are axially dependent. The next section discusses the channel aspects of the code, the input data needed to describe the channels, and the input data that are channel-dependent. The third section discusses the global scalar core parameters and input required to drive the accident with an input power excursion or reactivity ramp. The fourth section describes the input format for SACO, the current version of which is labeled SACO 1.0.

1. Axial Node Structure

The axial node structure in a channel is constructed from input giving the lower- and upper-core/blanket evaluations ($Z1$ and $Z2$) and the elevation at the top of the upper axial blanket ($Z3$). In the lower blanket, the mesh height is given by

$$AXHI(J) = Z1/NZS1, 1 \leq J \leq NZS1,$$

where $NZS1$ is the number of mesh intervals in the lower blanket. Likewise, in the active core region, the mesh height is given by

$$AXHI(J) = (Z2 - Z1)/NZS2, NZS1 + 1 \leq J \leq NZS1 + NZS2$$

and in the upper blanket by

$$AXHI(J) = (Z3 - Z2)/(NZS - NZS1 - NZS2), 1 + NZS1 + NZS2 \leq J \leq NZS.$$

The axial-node elevations are specified by the FORTRAN variables $AZ(J)$, where

$$AZ(1) = AXHI(1)/2$$

and

$$AZ(J) = AZ(J - 1) + [AXHI(J - 1) + AXHI(J)]/2, 2 \leq J \leq NZS.$$

Figure B.1 illustrates the axial node structure. Although the variable AXHI is channel-dependent to account for axial expansion, the axial-expansion-calculation capability is not present in the current version of SACO.

Fig. B.1. Axial Node Structure in SACO

The only axial-node-dependent input is the reactivity-worth information (which is also channel-dependent). The axial-node-dependent variables are evaluated at the node locations specified by $AZ(J)$. For example, the linear steady-state power density of a channel at the J th node is given by $PZZ(J)$ and represents the power at location $AZ(J)$.

Although the power is evaluated at each node, the spatial distribution of the power is input-specified by variables driving simple polynomial and sine-cosine functions. Figure B.2 illustrates the power shape used by SACO and the concomitant input and

FORTTRAN variables. The relevant input variables are described herewith according to region:

$$\text{Region 1: } P(z) = a_1 z^{a_2},$$

where a_2 is specified by input variable ANFR1 and a_1 is obtained from

$$\int_0^{Z1} P(z) dz \equiv PZERO * PFRAC1$$

with the variables PZERO and PFRAC1 representing the total channel power and the Region 1 fraction of power for the channel.

Fig. B.2
Axial Power Profiles in SACO

$$\text{Region 2: } P(z) = P_a \sin[x(z - Z_0)],$$

where

$$x = \frac{\pi}{Z_2 - Z_1 + 2EXL},$$

with Z_1 and Z_2 the input-specified core-blanket-interface locations and EXL the extrapolation length of the sine profile; where $Z_0 \equiv Z_1 - EXL - ASY$, with ASY the input-specified distance separating the core midplane and the location of the power peak; and where P_a , the power peak, is obtained from

$$\int_{Z_1}^{Z_2} P(z) dz \equiv PZERO * PFRAC2$$

with the variables $PZERO$ and $PFRAC2$ representing the total channel power and the Region 2 fraction of power for the channel. Note: $PFRAC2$ is obtained in subroutine $ZINIT$ from the relation $PFRAC2 = 1 - PFRAC1 - PFRAC3$.

$$\text{Region 3: } P(z) = a_3(Z_3 - z)^{a_4},$$

where a_4 is specified by input variable $ANFR3$; a_3 is obtained from

$$\int_{Z_2}^{Z_3} P(z) dz \equiv PZERO * PFRAC3$$

with the variables $PZERO$ and $PFRAC3$ representing the total channel power and the Region 3 fraction of power for the channel.

2. Channel Structure and Input

Each SACO channel represents a group of subassemblies depicted by a single fuel pin with associated cladding, coolant, and structure as discussed in Sec. III.

Specific channel-dependent input excluding that also nodally dependent is limited to the coolant-in and coolant-out Doppler coefficients, $ADOP$ and $BDOP$, the number of subassemblies per channel, $NSAC$, the total steady-state pin power and flow, $PZERO$ and $GZERO$, and the voiding and flow-reversal times, $VDTIME$ and $FRTIME$. As described in Sec. III, however, these times can also be calculated if the user specifies input variable $IVDTIM = 1$.

3. Core Input

This input includes all input not specifically arrayed to accommodate axial node and channel dependence. It includes the neutronics data, lumped-parameter thermophysical data, geometric data, timing and convergence

parameters, nonnodal power and temperature parameters, and all fixed-point parameters specifying calculational-model options, editing options, and file information.

Also included here is the input required to drive reactivity or power insertions as might be needed to simulate transient-overpower accidents. If a reactivity insertion is required, the PREA function must be hand-programmed to define this insertion. For example, if a programmed reactivity ramp of 10 ϕ /s were needed to simulate a control-rod withdrawal accident, this would be accomplished by including in this subroutine function the FORTRAN statement

$$\text{PREA} = 0.1 * \text{TIME}.$$

For programmed reactivity insertions, SACO calculates reactivity feedback as described in Sec. III.

PREA may also be used to input power. For example, if a linear power rise of from one to 50 times nominal power over 5 s were required, the FORTRAN statement

$$\text{PREA} = 1. + \frac{\text{TIME} * 49.}{5}$$

would be hard-programmed as the PREA function. For programmed power insertions, the input variable IPOWER must be set greater than zero. This prevents calculations of feedback reactivity in the TSPK subroutine, allowing power to be completely specified by the user.

4. SACO 1.0 Input Format

a. Introduction

The current version of the SACO computer code is a completely reprogrammed version of the original developmental version. This section describes the current input format for SACO 1.0.

b. Input Format and Definitions

(1) First and Second Cards. The first and second cards each contain 72 columns of hollerith problem identification. These two cards will be used as a heading on each page of problem output.

(2) Third Card. The third input card is read with a 3I3 format. In order, the three integer fields contain:

- (a) NCH, the numbers of channels in the calculations.
- (b) IDBUGP, data-management debug print,
 - = 0, no debug print,
 - ≠ 0, debug print.
- (c) IPDECK, input deck punch,
 - = 0, no input deck punch,
 - ≠ 0, input deck punched on logical unit 7.

(3) Input Data Blocks. The remainder of the SACO 1.0 input is made up of input-data blocks. Each of the input blocks consist of (1) a header card, (2) the input data, and (3) a block termination card. The header card is read with an A8, I4, I6, I6 format, with each of these fields having the following meaning:

- (a) A8, eight-column hollerith block name.
- (b) I4, integer block number.
- (c) I6, input-data channel number.
- (d) I6, background input-data channel number.

Either the block name or number must be supplied in order to identify the location in COMMON to which the current block must be written. For channel-dependent input blocks, the channel for which input data is being defined must be specified. If a block of the same name has been previously input for another channel, it is possible to fill COMMON for the current channel by specification of the channel number from which background values are to be taken in the last field. Leaving this final field blank or specifying "0" will yield a numerical zero in each location in the block prior to any data input.

The input data immediately follows the block header card. All data in a particular block are of the same type, either integer or floating-point. Integer-input-data cards are read on a I2I6 format, with the first field giving the initial linear location within the block into which data is to be read, the second field giving the number of data points entered with this card (≤ 10), and the third and subsequent fields containing the integer-input data. Floating-point input-data cards are read with a 2I6, 5E12.5 format, with the first two fields containing the initial block location and number of input data points (≤ 5), and the remaining fields the floating-point input. The final card of all input blocks must contain a "-1" in the first I6 field to signify block termination. Input-block reading is terminated when a card with the six-character hollerith label "ENDJOB" is encountered in the input stream.

The SACO 1.0 input blocks are listed in Table B.1. Blocks "INPCOM" and "FLTCOM" are channel-independent blocks, and "INPCHN" and "FLTCHN" are channel-dependent. Table B.2 contains a listing of the SACO 1.0 input data for block with the location of each input variable. The variable names are defined in Table B.3.

TABLE B.1. SACO 1.0 Input Blocks

Block Name	Block Number	Data Type	Block Length
INPCOM	1	Integer	40
FLTCOM	2	Floating	200
INPCHN	11	Integer	20
FLTCHN	12	Floating	150

TABLE B.2. SACO 1.0 Input Data

Location	Name	Location	Name	Location	Name	Location	Name
Input Block: INPCOM				Input Block: FLTCOM (Contd.)			
1	IBBUG	18	ISUSE	73	FRDT	100	TFTOP
2	IBETA	19	ITFBUG	74	FRES1	101	TFUELM
3	ICHP	20	IVDRAT	75	FRES3	102	THOLD
4	IDBUG	21	IVDTIM	76	FRSIDT	103	TIN
5	IFPMAX	22	IZP	77	GAMA	104	TIMCK
6	IGVFC	23	IZQREF	78	GAMB	105-124	TIMPLT(20)
7	INOEDT	24	I2D	79	GRAV	125-144	TIMWRT(20)
8	INOSS	25	NCASE	80	GRAV1	145	TOA
9	IPLOT	26	NCONSO	81	GRAV2	146	TPRINT
10	IPLOTS	27	NDELAY	82	GRAV3	147	TSH
11	IPLOTT	28	NDKGRP	83	HBMAX	148	TSTM
12	IPOWER	29	NPARAM	84	HCOL	149	VDRAT1
13	IPROSA	30	NPLT	85	HGAP	150	VDRAT2
14	IPUNCH	31	NSAC	86	P	151	VDRAT3
15	IQBASE	32	NWRT	87	PDOTP	152	VDRAT4
16	IQUSE	33	IWPUMP	88	RCLD	153	VDZ1
17	ISPLOT	34-40	Reserved	89	RF	154	VDZ2
Input Block: FLTCOM				90	RFFAIL	155	VDZ3
1	AHT	42	DF	91	RL	156	VDZ4
2	AKCL	43	DFMELT	92	RS	157	WZERO
3	AKF	44	DFQUIT	93	RST	158	ZLL
4	AKST	45	DKYLDs	94	SETIME	159	ZVOIDO
5-10	ALAM(6)	46-51	DKLAM(6)	95	STLATH	160	PTOP
11	ANAX	52	DMFE	96	TAUEJ	161	FRACP1
12	ANT	53	DRT	97	TBOIL	162	FRACP2
13	AX	54	DS	98	TCLADM	163	FRACP3
14	A1	55	DST	99	TFEXTR	164-200	Reserved
15	A2	56	DT	Input Block: INPCHN			
16	A3	57	DT1	1	NSACH	4	NZS2
17-22	BETA(6)	58	DT11	2	NZS	5-20	Reserved
23	BETABR	59	DT3	3	NZS1		
24	BETADT	60	DTCCCL	Input Block: FLTCHN			
25-30	BETAH(6)	61	DTIVDO	1	ADOP	11	PZERO
31	BETREF	62	DTSTAR	2	ANFR1	12	VDTIME
32	CHENH1	63	DTVDDO	3	ANFR3	13-32	VOIREA(20)
33	CHENH3	64	DTVDFR	4	ASY	33-52	WDOP(20)
34	CLLATH	65	DZDOZV	5	BDOP	53-72	WORTHCI(20)
35	CPCL	66	EL	6	EXL	73-92	WORTHFI(20)
36	CPF	67	EPS	7	FRTIME	93	Z1
37	CPS	68	EPSCT	8	GZERO	94	Z2
38	CPST	69	EPSPHI	9	PFRAC1	95	Z3
39	DCL	70	EPSREA	10	PFRAC3	96-150	Reserved
40	DCPCL	71	FLATH				
41	DCPST	72	FMOVO				

TABLE B.3. Input Definitions (Alphabetically)

Units of the Input Variables	
Area	Square centimeter
Decay constants	One per second
Energy	Megajoule
Length	Centimeter
Mass	Gram
Power	Megawatt
Temperature	Degrees Celsius
Time	Second
Volume	Cubic centimeter
Input Variable	Definition/Comment
ADOP	Doppler coefficient
AHT	Length of active core ($= Z2 - Z1$)
AKCL	Cladding thermal conductivity
AKF	Fuel thermal conductivity
AKST	Structure thermal conductivity
ALAM	Decay constant for precursor group L
ANAX	Energy redistribution parameter used during voiding
ANFR1	Shape parameter of power in lower blanket
ANFR3	Shape parameter of power in upper blanket
ANT	Radial power shape parameter
ASY	Offset of peak power from center of active core
AX	Radial power shape parameter
A1	Flow decay constant
A2	Flow decay constant
A3	Flow decay constant
BDOP	Voided Doppler coefficient
BETA	Delayed neutron fraction for precursor group L
BETABR	Effective delayed neutron fraction (all groups)
BETADT	Time interval over which power is smoothed
BETAH	Fraction of decay heating group L
BETREF	Not currently used
CHENH1	Effective overall fuel-cladding heat-transfer coefficient multiplier for lower blanket
CHENH3	Effective overall fuel-cladding heat-transfer coefficient multiplier for upper blanket
CLLATH	Cladding latent heat of melting
CPCL	Cladding specific heat
CPF	Fuel specific heat
CPS	Coolant specific heat
CPST	Structure specific heat
DCL	Cladding density
DCPCL	Cladding density times specific heat
DCPST	Structure density times specific heat
DF	Fuel density (g/cm^3)
DFMELT	Density of molten fuel
DFQUIT	Time after initial voiding that fractional energy model is turned off
DKYLDS	Total fraction of power in decay heat
DKLAM	Decay heat decay constant for group L
DMFE	Density of final disposition froth in channel
DRT	Doppler-reduced fuel-pin power (not currently used)
DS	Coolant density
DST	Structure density
DT	Initial time-step size
DT1	Time-step size in initial analysis phase
DT11	Time-step size in second phase of analysis
DT3	Time-step size when normalized power is above PTOF
DTCCCL	Representative difference between coolant and average cladding temperature
DTIVDO	Time between initial boiling and initial dryout
DTSTAR	Derivative of coolant saturation temperature with respect to axial location
DTVDDO	Time between voiding and dryout during voiding process
DTVDFO	Time between initial boiling and flow reversal
DZDOZV	Distance between power voiding and dryout fronts
EL	Prompt-neutron generation time (s)
EPS	Convergence criterion for time-of-boiling guess in TOB subroutine
EPSCT	Radial power shape parameters
EPSPH1	Flux (power)-iteration convergence criterion

TABLE B.3 (Contd.)

EPSREA	Reactivity-iteration convergence criterion
EXL	Extrapolation length of sine approximation in power shape
FLATH	Fuel latent heat of melting
FMOV0	Location of initial fuel motion
FRACP1	Lower blanket power fraction
FRACP2	Core power fraction
FRACP3	Upper blanket power fraction
FRDT	Time increment after initial voiding that voiding parameters are initialized
FRES1	Fuel heat-transfer resistance multiplier for lower blanket
FRES3	Fuel heat-transfer resistance multiplier for upper blanket
FRSIDT	Time for flow to decay to zero from value at initial boiling
FRTIME	Input flow-reversal time for each channel
GAMA	Parameter used to multiply total heat capacity in prevoiding fractional energy model
GAMB	Parameter used to multiply total heat capacity in prevoiding fractional energy model
GRAV	Gravitational constant
GRAV1	Parameter in fuel-motion equation
GRAV2	Parameter in fuel-motion equation
GRAV3	Parameter in fuel-motion equation
GZERO	Steady-state flow in each channel
HBMAX	Maximum gap conductance
HCOL	Heat-transfer coefficient for coolant-cladding transfer
HGAP	Heat-transfer coefficient for fuel cladding gap transfer
IBBUG	Debugging flag (if = 1, extended output is edited)
IBETA	Flag to turn on power-smoothing subroutines
ICHP	Channel for which plot desired
IDBUG	Debugging flag (if = 1, extended output is edited)
IFPMAX	Flag to determine treatment of fractional energy model prior to voiding
IGVFC	Flag to determine multiplier in heat capacity voiding model
INOEDT	Editing flag (if = 1, temperature output suppressed)
INOSS	Editing flag (if = 1, steady-state output suppressed)
IPLOT	Flag, if = 1, calls plot for at least one channel (see ISPLOT)
IPLOTS	Flag, if = 1, calls PLOTSS
IPLOTT	Flag, if = 1, calls PLOTTS
IPOWER	Flag, if = 1, SACO uses programmed power
IPROSA	Editing flag (if = 1, cards are punched for PROSA code)
IPUNCH	File from which cards produced
IQBASE	Flag to determine whether extrapolation of fuel or coolant-temperature behavior should be used in constant-temperature-profile model
IQUSE	Flag to turn on constant-temperature-profile model
ISPLOT	Flag, if = 1, use plot for all channels
ISUSE	Flag to turn on Eulerian Box Model for coolant temperatures
ITFBUG	Debugging flag (if = 1, extended output is edited)
IVDRAT	Flag to calculate voiding rates (= 0 input via VDRAT1; = 1 calculate)
IVDTIM	Flag to calculate initial voiding times (= 0 input via VDTIME; = 1 calculate)
IWPUMP	Set = 0, not currently used
IZP	Node for which plot desired
IZQREF	Node at which heat-transfer coefficient is set for use in upper blanket in constant-temperature-profile model
I2D	Flag to turn on two-dimensional modeling
NCASE	Number of cases to be run
NCONSQ	Number of consequences to be evaluated and punched on cards for PROSA
NDELAY	Number of delayed-neutron groups
NDKGRP	Number of decay-heating groups
NPARAM	Number of parameters to be perturbed for sensitivity analyses
NPLT	Number of temperature plots requested
NSAC	Number of subassemblies in the core
NSACH	Number of subassemblies in each channel
NWRT	Number of temperature printouts requested
NZS	Number of axial nodes
NZS1	Number of axial nodes in axial region 1
NZS2	Number of axial nodes in axial region 2
P	Integrated power in representative fuel pin (MW)
PDOTP	Time derivative of power divided by power (not currently used)
PFRAC1	Fraction of subassembly power in lower blanket
PFRAC3	Fraction of subassembly power in upper blanket
PTOP	Power at which time step becomes DT3
PZERO	Steady-state power in each channel
RCLD	Cladding outer radius

TABLE B.3 (Contd.)

RF	Fuel-pin radius
RFFAIL	Fuel-motion criteria radius relative to fuel radius
RL	Extrapolating parameter used in TOB subroutine Newton-Raphson scheme for determining time-of-boiling guess
RS	Coolant effective outer radius
RST	Structure effective outer radius
SETIME	Duration of the quasistatic phase in subroutine TWODTF
STLATH	Structure latent heat of melting
TAUEJ	Time constant for fuel ejection
TBOIL	Coolant boiling temperature
TCLADM	Cladding melting temperature
TFEXTR	Fuel-motion criteria pin ave temperature
TFTOP	Fuel-motion criteria pin max temperature
TFUELM	Fuel-melting temperature
THOLD	Time at which fractional energy model uses full value of total heat capacity
TIN	Coolant temperature at inlet to lower blanket
TIMCK	Time at which temperatures recorded for constant profile modeling
TIMPLT	Times for which temperature plots requested
TIMWRT	Times for which temperature edits requested
TOA	Time at which transient analysis terminated
TPRINT	Interval for temperature editing
TSH	Coolant superheat
TSTM	Structure melting temperature
VDRAT1	Voiding rates for specified locations in the channel
VDRAT2	Voiding rates for specified locations in the channel
VDRAT3	Voiding rates for specified locations in the channel
VDRAT4	Voiding rates for specified locations in the channel
VDTIME	Input voiding time for each channel
VDZ1	Input locations for voiding-rate specifications
VDZ2	Input locations for voiding-rate specifications
VDZ3	Input locations for voiding-rate specifications
VDZ4	Input locations for voiding-rate specifications
VOIREA	Coolant void reactivity worth
WDOP	Axial Doppler weighting factor
WORTHC	Cladding reactivity worth
WORTHF	Fuel reactivity worth
WZERO	Mass flow rate in steady state (g/s)
ZLL	Location of bottom of region in which flow reversal effects cause temperature redistribution
ZVOID0	Location of initial voiding (cm)
Z1	Location of top of lower blanket
Z2	Location of top of active core
Z3	Location of top of upper blanket

5. Suggestions for Code Use and Model Parameters

As described in the text, the code can be used in either a fast-running mode or a "reference-calculation" mode. This section describes the input flags to best operate in these modes and describes reasonable values for input parameters for most efficient use of the different models.

Power, flow, neutronics, and thermophysical properties are case-dependent and not covered here, but sample values for an LOF transient are provided in Appendix D. This appendix also reports input parameter values that have been verified for successful use in extensive simulations of CRBR core transients as described in the text. It is recommended that input model parameters not explicitly shown in Appendix D be set to the values indicated in the input sample of Appendix D.

APPENDIX C SACO Program Listing

*COMDECK BLNC	1	1
C* BLNC	BLNC...1	2
COMMON/ /NSACH,NZS,NZS1,NZS2,IDUM(16)	BLNC...2	3
COMMON/ /A0OP,ANFR1,ANFR3,ASY,BOOP,EXL,FRTIME,GZERO,PFRAC1	BLNC...3	4
1,PFRAC3,PZERO,VDTIME,VOIREA(20),WDOP(20),WORTH(20),WORTHF(20)	BLNC...4	5
2,Z1,Z2,Z3	BLNC...5	6
COMMON/ /ICMOV,IFMOV,IVOID,NZR2L,NZR2U,NZR3L,MZ,IDUM1(3)	BLNC...6	7
COMMON/ /AA(20),AASV(20),AHQ(20),AHQ1(20),AHQ2(20),ANF(20)	BLNC...7	8
1,ANFR11,ANFR31,BB(20),BBSV(20),CC(20),CCSV(20),CHREA,CHREAD,CHREAV	BLNC...8	9
2,CLRDBV,CHTIME(20),CXZZOZ(20),CXZ1Z0,CXZ2Z0,DAVSS(20),DAV2(20)	BLNC...9	10
3,DDTIME(20),DPRDBV,DTDZQ(20),DTDZTQ(20),DTDZT0(20),DTTINQ(20)	BLNC...10	11
4,DTTIND(20),ECLAD(20),ECLSV(20),EDIVPV,EI(20),EIR(20),EIRSV(20)	BLNC...11	12
5,EISV(20),ENCH(20),ENFM(20),ENFR(20),ENTC(20),ENTCSV(20),ENV(20)	BLNC...12	13
6,ENVZ(20),F(20),FFACTV,FHTIME(20),FRACTC(20),FSV(20),GCH,GCHV,BPV	BLNC...13	14
7,PBV,PHIXV,PINTGV,PFRAC2,PH,PHCH,PHCHV,PZINTZ(20),PZNT1Z,BETAGV	BLNC...14	15
8,PZNT2Z,PZNT3Z,PZZ(20),PZ1LZ,PZ2RZ,Q(20),QR(20),QRSV(20),QSV(20)	BLNC...15	16
9,REACCH,REACL(20),READBV,REAF(20),REAFCH,RHFR2(20)	BLNC...16	17
A,RHFR2S(20),S(20),SLUMFR,SSV(20),SXZZOZ(20),SXZ1Z0,SXZ2Z0,TBAR(20)	BLNC...17	18
B,TCCK(20),TCLAD(20),TCLDO(20),TCLSS(20),TCLSV(20),TCLV(20)	BLNC...18	19
C,TCLVZ(20),TCOOL(20),TCOOL1(20),TCSS(20),TCSV(20),TCV(20),TF(11,20)	BLNC...19	20
D),TFCK(20),TFCH(20),TFDO(20),TFHART(20),TFHOV,TFR(20),TFRSV(20)	BLNC...20	21
E),TFSS(20),TFSV(20),TFV(20),TFVZ(20),TF0(20),TF0SV(20),TF1(20)	BLNC...21	22
F,TF1SV(20),THETAZ(20),THET1Z,THET2Z,TREF(20),TCOOLZ(3)	BLNC...22	23
COMMON/ /VHFO,WCH,WCHV,HZERCH,XX,ZDL,ZDU,ZFHOV,ZMFL,ZMFU	BLNC...23	24
1,ZHACHN,ZNAUP,Z0,Z12,Z22,Z32,AXHI(20),AZ(20),ENDO(20),DTDZ0(20)	BLNC...24	25
2,SU2(20),XNX(20),SUU2(20)	BLNC...25	26
*COMDECK INPC	BLNC...26	27
C* INPC	INPC...1	28
COMMON/INPCOM/IBBBUG,IBETA,ICHP,IDBUG,IFPMAX,IGVFC,INOEDT,INOSS	INPC...2	29
1,IPL0T,IFLOTS,IPL0TT,IPONER,IFPROSA,IPUNCH,IQBASE,IQUSE,ISFLOT	INPC...3	30
2,IUSE,ITFBUG,IVDRAT,IVDTIM,IZP,IZQREF,I2D,NCASE,NCONSQ,NDELAY	INPC...4	31
3,NOKGRP,NPARAM,NPLT,NSAC,NWRT,IWPUMP	INPC...5	32
*COMDECK FLTC	INPC...6	33
C* FLTC	FLTC...1	34
COMMON/FLTCOM/AHT,AKCL,AKF,AKST,ALAM(6),ANAX,ANT,AX,A1,A2,A3	FLTC...2	35
1,BETA(6),BETABR,BETADT,BETAH1(6),BETREF,CHENH1,CHENH3,CLLATH,CPCL	FLTC...3	36
2,CPF,CPS,CPST,DCL,DCPCL,DCPST,DF,DFMELT,DFQUIT,DKYLD,DKLAMI(6)	FLTC...4	37
3,DMFE,DRT,DS,DST,DT,DT1,DT11,DT3,DTCC,DTIVDO,DTSTAR,DTVDDO,DTVDFR	FLTC...5	38
4,DZDOZV,EL,EFS,EPSC,EPSPH,EPSREA,FLATH,FMOV0,FRDT,FRES1,FRES3	FLTC...6	39
5,FRSIDT,GAMA,GAMB,GRAV,GRAV1,GRAV2,GRAV3,HBMAX,HCOL,HGAP,P,POOTP	FLTC...7	40
6,RCLD,RF,RFFAIL,RL,RS,RST,SETIME,STLATH,TAUEJ,TBOIL,TCLADH,TFEXTR	FLTC...8	41
7,TFTOP,TFUELM,THOLD,TIN,TINCK,TIMPLT(20),TIMHRT(20),TOA,TFRINT	FLTC...9	42
8,TSH,TSTM,VDRAT1,VDRAT2,VDRAT3,VDRAT4,V0Z1,V0Z2,V0Z3,V0Z4,HZERO	FLTC...10	43
9,ZLL,ZVOID0,PTOP,FRACP1,FRACP2,FRACP3	FLTC...11	44
*COMDECK TCOM	FLTC...12	45
C* INTG	INTG...1	46
COMMON/INTGR1/IBURN,ICASE,ICH,ICM,ICPF,IERROR,IFLAG,IFM,IHGAP	INTG...2	47
1,IICOUN,IJKK,IK,IKF,IMAX,INDEX,INDEXJ,INDEXK,INTC,IPART,IPHI,IR	INTG...3	48
2,IREA,IREV,IRHOD,IRHOV,ITIME,ITOA,IVARY,IVOIDT,IVRAT,IZ,JCLMAC	INTG...4	49
3,JCLMC,JCVDAC,JCVDC,JFMAC,JFMC,JSACC,JSACLC,JSAFC,KI1,KPOW,LTVOID	INTG...5	50
4,NCHAN,NTS,NZP,N1,N12,N21,N22,N3,IVDMAX	INTG...6	51
C* DAMA	DAMA...1	52
COMMON/DAMAG1/FCVDAC,FCLMAC,FFMAC	DAMA...2	53
C* EPSX	EPSX...1	54
COMMON/EPSXXX/EPS3,EBETA(6)	EPSX...2	55
C* FLOW	FLOW...1	56
COMMON/FLOW1/A,AEX,CPH,CPHDTZ,COPH0W,EXA,EXAEX,G,W,WDOT,WDOTDT	FLOW...2	57
1,WDOTW,HEX	FLOW...3	58

C* FMOV	FMOV...1	59
COMMON/FMOVE/AFFAIL,DMF,DMF0,DZMIX,VFAIL,ZMIXL,ZMIXU	FMOV...2	60
C* PENE	PENE...1	61
COMMON/PENER1/ASLOPE,BDOT,BDOTB,BETAG,BETINV,BETPHI,BETSS,BPSS	PENE...2	62
1,BSLOPE,CCLH,CLRDB,CLROT,COLRDB,COLREA,CRDB,DOPRDB,DOPREA,DPROT	PENE...3	63
1,EDIVP,EDPSS,ENTC1,ENTH,FERHIN,FFACT,FFSS,FIN,FPTC,FPTCL,FRDB,PA	PENE...4	64
2,FBSS,FHAT1,FHAT2,FHAT3,PHIBET,PHIX,PINTGX,PINTRF,FOLD,PZ,PZINT	PENE...5	65
3,PZINT1,PZINT2,REACDB,REACT,READT,THETA,TIMREF,VBURN,VRHOD,VRHOV,XPENE	PENE...6	66
4,ENTHF	PENE...7	67
C* POHE	POHE...1	68
COMMON/POWER2/A0(5),BETAH(6),BETAS,C(6),CLADRT,CO(6),DKHET(6)	POHE...2	69
1,DKHETP(6),EPS1,ERROR,PHI,PHIDOT,PHIP,PHIPP,PINTG,PINTG0,POWDK	POHE...3	70
2,POWDKP,POHFS,POHFSP,REABOI,REACTL,READEN,REACOL,READOP,REACLD	POHE...4	71
3,REAFRG,REASCH,REASLU,REASTR,VREAT(3),VRZDUM(9)	POHE...5	72
C* PROP	PROP...1	73
COMMON/PROP1/ACH,ACLD,AF,AS,AST,CHENAL,CHENH,CHENCF,CHENCC,CHENLC	PROP...2	74
1,CHENLF,CLHMLT,CLDRES,COLRES,CONST,CP,CPM,CFHCCL,CPHFCL,CPMP,CO	PROP...3	75
2,COSAV,C1,C2,DCPAFL,DCPAF,DCPAS,DCPAST,DCPF,DCPS,DXAE,DXX,FHMLT	PROP...4	76
3,FRES,GAM,GAPRES,HCL,HCLP,HCOLP,HF,HFCL,HFCLM,HFCLP,HFCLMP,HFP	PROP...5	77
4,HF1CL,HF1CLP,HGAPP,PI2RCL,PI2RF,STHMLT,TSTAR,VCPF,VHGAP,VKF,X1,X2FROP	PROP...6	78
C* RPRO	RPRO...1	79
COMMON/RPROF1/PI,RHOBAR,RHOREV,Y,Y1,Y2	RPRO...2	80
C* SETV	SETV...1	81
COMMON/SETVAR/CDBVMX,DPBVMX,GOIMAX,PNTGLV,PNTGMX,POIMAX,RDBVMX	SETV...2	82
1,VDFRST,VOLAST	SETV...3	83
C* TEMP	TEMP...1	84
COMMON/TEMP/AQ(3,3),B,BINT(3,3,6),CBURN(3,6),CDOT(6),CLAM(6)	TEMP...2	85
1,DEQ(3),EH(2,3),O(8,6,5),REAT(3),SUMB(3,3),SUNREA(3),T(8,5),TERM	TEMP...3	86
2,TEX,TN,TZERO,XI,Z	TEMP...4	87
C* TMP1	TMP1...1	88
COMMON/TEMP1/DTDZ,DTZERO,TAVG,TINC	TMP1...2	89
C* TIME	TIME...1	90
COMMON/TIME2/BOILT,DTP,DT2,SASTIM,TIME,TIMEJ,TOFF	TIME...2	91
C* VOID	VOID...1	92
COMMON/VOID1/DELTD0,GVFC,VVRAT,ZDO,ZDOO,ZVOIDL,ZVOIDU	VOID...2	93
C* ZZZZ	ZZZZ...1	94
COMMON/ZZZZ1/AL1,AL2,CXZZ0, SXZZ0	ZZZZ...2	95
*COMDECK PTIT	ZZZZ...3	96
C* PTIT	PTIT...1	97
COMMON/PTITLE/ TITLE(18),TIMES(10),XNAME,KOUT,KOUT2,IPRNCH	PTIT...2	98
*COMDECK IOPU	PTIT...3	99
C* IOPU	IOPU...1	100
COMMON/IOPUT/ IREAD,IWRITE,IWRIT2	IOPU...2	101
*COMDECK PACK	IOPU...3	102
C* PACK	PACK...1	103
COMMON/PACK/ BLKHAM(10),NCH,NCHMAX,IDBUGP,IPDECK,MAXPAK,	PACK...2	104
1 NOINDP,NBLKIN,IOFFST,MSTART,IRATFI,MCHST(200),	PACK...3	105
2 ISTRLC(10),LNGTHF(10),LNGTHI(10),LNGHT(10),	PACK...4	106
3 NUMBLK(10),IFK(10),LNGTHB(10),IFORMA(10),	PACK...5	107
4 LNLBLC(20),NSPACE(30)	PACK...6	108
*DECK	PACK...7	109

UPDAT/195 12/31/79

C* MAIN	MAIN...1	110
CDC*	MAIN...2	111
C PROGRAM MAIN(INPUT,OUTPUT,PUNCH,TAPE5=INPUT,TAPE6=OUTPUT,	MAIN...3	112
C 1 TAPE7=PUNCH)	MAIN...4	113
CIBH	MAIN...5	114
IMPLICIT REAL*8(A-H,O-Z)	MAIN...6	115
CEND	MAIN...7	116
*CALL PACK	MAIN...8	117
COMMON/INPCOM/ INPCOM(40)	MAIN...9	118
COMMON/FLTCOM/ FLTCOM(200)	MAIN..10	119
COMMON/ / BLANK(3000)	MAIN..11	120
COMMON/WORKSP/ WORKSP(2000)	MAIN..12	121
*CALL PTIT	MAIN..13	122
*CALL IOPU	MAIN..14	123
CDC*	MAIN..15	124
C LEVEL 2, LARGE	MAIN..16	125
CEND	MAIN..17	126
COMMON/LARGE / LARGE(1)	MAIN..18	127
C	MAIN..19	128
CALL START	MAIN..20	129
C	MAIN..21	130
CALL INPDV	MAIN..22	131
C	MAIN..23	132
CALL SSCALC	MAIN..24	133
C	MAIN..25	134
CALL TSCALC	MAIN..26	135
C	MAIN..27	136
STOP	MAIN..28	137
END	MAIN..29	138

UPDAT/195 12/31/79

C* STAR	STAR...1	139
SUBROUTINE START	STAR...2	140
CIBH	STAR...3	141
IMPLICIT REAL*8(A-H,O-Z)	STAR...4	142
CEND	STAR...5	143
*CALL PACK	STAR...6	144
*CALL PTIT	STAR...7	145
*CALL IOPU	STAR...8	146
COMMON/INPCOM/ INPCOM(1)	STAR...9	147
COMMON/FLTCOM/ FLTCOM(1)	STAR...10	148
COMMON/ / BLANK(1)	STAR...11	149
COMMON/WORKSP/ WORKSP(1)	STAR...12	150
DATA PLANK/6H /,I0/0/,I2/2/,I3/3/	STAR...13	151
CIBH	STAR...14	152
DATA ZERO/0.000/	STAR...15	153
CDC*	STAR...16	154
C DATA ZERO/0.0E0/	STAR...17	155
CEND	STAR...18	156
IREAD=5	STAR...19	157
IWRITE=6	STAR...20	158
IWRITE=0	STAR...21	159
XNAME=PLANK	STAR...22	160
KOUT=IWRITE	STAR...23	161
KOUT2=IWRITE	STAR...24	162
IPRICH=10	STAR...25	163
CALL TIHER(I0,TIMES)	STAR...26	164
DO 100 I=4,10	STAR...27	165
MODE=I	STAR...28	166
CALL TIHER(MODE,TIMES)	STAR...29	167
100 CONTINUE	STAR...30	168
CIBH	STAR...31	169
NMDS=350	STAR...32	170
CDC*	STAR...33	171
C NMDS=360	STAR...34	172
CEND	STAR...35	173
CALL INTSET(BLKNAM,I0,NMDS)	STAR...36	174
READ(IREAD,1000) (TITLE(I),I=1,9),SEQ	STAR...37	175
READ(IREAD,1000) (TITLE(I),I=10,18),SEQ1	STAR...38	176
READ(IREAD,1020) NCH,IDBUGP,IPDECK,SEQ2	STAR...39	177
NCHMAX=200	STAR...40	178
IF((NCH.GT.0).AND.(NCH.LT.NCHMAX)) GO TO 110	STAR...41	179
CALL LINES(I2,IPAGE)	STAR...42	180
WRITE(IWRITE,1040)	STAR...43	181
IER=-100	STAR...44	182
CALL ERROR(6HSTART ,IER)	STAR...45	183
CALL ERROR(6HFATAL ,IER)	STAR...46	184
110 CONTINUE	STAR...47	185
IF(IPDECK.NE.0) IPDECK=7	STAR...48	186
C	STAR...49	187
CALL POINST	STAR...50	188
C	STAR...51	189
CALL FLTSET(INPCOM,ZERO,LNGLBC(1))	STAR...52	190
CALL FLTSET(FLTCOM,ZERO,LNGLBC(2))	STAR...53	191
CALL FLTSET(WORKSP,ZERO,LNGLBC(8))	STAR...54	192
CALL FLTSET(BLANK ,ZERO,LNGLBC(9))	STAR...55	193
C	STAR...56	194

UPDAT/195 12/31/79

C	CALL DYNALL	STAR..57	195
	IF(IDBUGP.NE.0) CALL LINES(I0,IPAGE)	STAR..58	196
	CALL LINES(I3,IPAGE)	STAR..59	197
	WRITE(IWRITE,1010) (TITLE(I),I=1,9),SEQ	STAR..60	198
	WRITE(IWRITE,1010) (TITLE(I),I=10,18),SEQ1	STAR..61	199
	WRITE(IWRITE,1030) NCH,IDBUGP,IPDECK,SEQ2	STAR..62	200
	RETURN	STAR..63	201
1000	FORMAT(10A8)	STAR..64	202
1010	FORMAT(5X,10A8)	STAR..65	203
1020	FORMAT(3I3,63X,A8)	STAR..66	204
1030	FORMAT(5X,3I3,63X,A8)	STAR..67	205
1040	FORMAT(1H0,48H(START) THE INPUT VALUE FOR NCH IS OUT OF RANGE.)	STAR..68	206
	END	STAR..69	207
		STAR..70	208

UPDAT/195 12/31/79

C*	POIN					POIN...1	209
	SUBROUTINE	POINST				POIN...2	210
CIBM						POIN...3	211
	IMPLICIT	REAL*8(A-H,O-Z)				POIN...4	212
CEND						POIN...5	213
*CALL	PACK					POIN...6	214
*CALL	IOPU					POIN...7	215
	DIMENSION	BLABEL(10)				POIN...8	216
	DATA	BLABEL/	8HINPCOM	8HFLTCOM	8HINPCHN	8HFLTCHN	POIN...9
	18HALLCHN	8H	8H	8H	8H	8H	POIN...10
	MAXPAK=3						POIN...11
	NOINDP=0						POIN...12
	NBLKIN=4						POIN...13
	MSTAR=1						POIN...14
CDC*							POIN...15
C	IRATFI=1						POIN...16
CIBM							POIN...17
	IRATFI=2						POIN...18
CEND							POIN...19
C							POIN...20
C	DATA	PACKS					POIN...21
C							POIN...22
C	NO.	NAME	LENGTH				POIN...23
C							POIN...24
C	1	INPCHN					POIN...25
			LNGETH(1)=0				POIN...26
			LNGETHI(1)=20				POIN...27
C	2	FLTCHN					POIN...28
			LNGETH(2)=150				POIN...29
			LNGETHI(2)=0				POIN...30
C	3	ALLINP	THIS DATA PACK IS THE COLLECTION OF ALL CHANNEL				POIN...31
C			DEPENDENT DATA PACKS FOR ONE CHANNEL.				POIN...32
			LNGETH(3)=3000				POIN...33
			LNGETHI(3)=0				POIN...34
	DO	100 I=1,MAXPAK					POIN...35
		LNGETH(I)=LNGETH(I)+LNGETHI(I)/IRATFI					POIN...36
100	CONTINUE						POIN...37
C							POIN...38
C	INPUT	BLOCKS					POIN...39
C							POIN...40
C	INDEX	NO.	NAME	PACK	LENGTH	FORMAT	POIN...41
C							POIN...42
C	1	1	INPCOM	0	40	0	POIN...43
	NUMBLK(1)=1						POIN...44
	BLKNAM(1)=BLABEL(1)						POIN...45
	IPK(1)=0						POIN...46
	LNGETHB(1)=40/IRATFI						POIN...47
	IFORMA(1)=0						POIN...48
C	2	2	FLTCOM	0	200	1	POIN...49
	NUMBLK(2)=2						POIN...50
	BLKNAM(2)=BLABEL(2)						POIN...51
	IPK(2)=0						POIN...52
	LNGETHB(2)=200						POIN...53
	IFORMA(2)=1						POIN...54
C	3	11	INPCHN	1	20	0	POIN...55
	NUMBLK(3)=11						POIN...56

UPDAT/195 12/31/79

	BLKNAM(3)=BLABEL(3)	POIN..57	265
	IPK(3)=1	POIN..58	266
	LNGLB(3)=20/IRATFI	POIN..59	267
	IFORMA(3)=0	POIN..60	268
C	4 12 FLTCHN 2 150 1	POIN..61	269
	NUMBLK(4)=12	POIN..62	270
	BLKNAM(4)=BLABEL(4)	POIN..63	271
	IPK(4)=2	POIN..64	272
	LNGLB(4)=150	POIN..65	273
	IFORMA(4)=1	POIN..66	274
C		POIN..67	275
C	COMMON LENGTHS	POIN..68	276
C		POIN..69	277
C	INPCOH	POIN..70	278
	LNGLB(1)=LNGLB(1)	POIN..71	279
C	FLTCOH	POIN..72	280
	LNGLB(2)=LNGLB(2)	POIN..73	281
C	WORKSP	POIN..74	282
	LNGLB(8)=2000	POIN..75	283
C	BLANK	POIN..76	284
	LNGLB(9)=3000	POIN..77	285
C		POIN..78	286
C	STARTING LOCATIONS FOR CHANNEL DEPENDENT PACKS	POIN..79	287
C		POIN..80	288
	ISTRLC(1) = 0	POIN..81	289
	ISTRLC(2) = ISTRLC(1) + LNGLB(1)	POIN..82	290
	ISTRLC(3) = ISTRLC(1)	POIN..83	291
	MCHST(1)=MSTART	POIN..84	292
	LEN=LNGLB(3)	POIN..85	293
	DO 140 ICH=2,MCH	POIN..86	294
	MCHST(ICH)=MCHST(ICH-1)+LEN	POIN..87	295
140	CONTINUE	POIN..88	296
C		POIN..89	297
C	COMPUTE CONTAINER LENGTH	POIN..90	298
C		POIN..91	299
	LNGLB(10)=MCHST(MCH)+LEN-MSTART	POIN..92	300
C		POIN..93	301
	IF(IDBUGP.EQ.J) GO TO 160	POIN..94	302
	NL=11+NBKIN	POIN..95	303
	CALL LINES(NL,IPAGE)	POIN..96	304
	WRITE(IWRITE,1000) MCH,IDBUGP,IPDECK,MAXPAK,NOINDP,	POIN..97	305
	1 NBKIN,MSTART,IRATFI	POIN..98	306
1000	FORMAT(/48X,37H*** SACOZ DATA STORAGE ALLOCATION **/,//33X,	POIN..99	307
	1 66HNMCH IDBUGP IPDECK MAXPAK NOINDP NBKIN MSTART	POIN.100	308
	2ATFI,//33X,I3,7I9,///56X,20H*** INPUT BLOCKS **/,//43X,47HINDEX	POIN.101	309
	3LKNAM NUMBLK IPK LNGLB IFORMA,/) POIN.102	310	
	WRITE(IWRITE,1010) (I,BLKNAM(I),NUMBLK(I),IPK(I),LNGLB(I),	POIN.103	311
	1 IFORMA(I),I=1,NBKIN)	POIN.104	312
1010	FORMAT(44X,I2,5X,A8,I5,I7,I8,I9)	POIN.105	313
	NL=7+MAXPAK	POIN.106	314
	CALL LINES(NL,IPAGE)	POIN.107	315
	WRITE(IWRITE,1020)	POIN.108	316
1020	FORMAT(///57X,18H*** DATA PACKS **/,//47X,39HNO. LNGLB LNGLB	POIN.109	317
	1 LNGLB ISTRLC,/) POIN.110	318	
	WRITE(IWRITE,1030) (I,LNGLB(I),LNGLB(I),LNGLB(I),ISTRLC(I),	POIN.111	319
	1 I=1,MAXPAK)	POIN.112	320

UPDAT/195 12/31/79

```
1030 FORMAT(47X,I2,1X,4I9)
      NB=NCH/13
      IF(NB*13.LT.NCH) NB=NB+1
      NL=3*NB
      CALL LINES(NL,IPAGE)
      IE=0
      DO 150 NBI=1,NB
        IS=IE+1
        IE=IE+8
        IF(IE.GT.NCH) IE=NCH
        WRITE(IWRITE,1040) (I,I=IS,IE)
        WRITE(IWRITE,1050) (NCHST(I),I=IS,IE)
1040  FORMAT(/9X,3HIGH,2X,13I9)
1050  FORMAT(4X,10HIGHST(ICH),13(3X,I6))
      150 CONTINUE
      160 CONTINUE
      RETURN
      END
```

POIN. 113	321
POIN. 114	322
POIN. 115	323
POIN. 116	324
POIN. 117	325
POIN. 118	326
POIN. 119	327
POIN. 120	328
POIN. 121	329
POIN. 122	330
POIN. 123	331
POIN. 124	332
POIN. 125	333
POIN. 126	334
POIN. 127	335
POIN. 128	336
POIN. 129	337
POIN. 130	338

UPDAT/195 12/31/79

C* DYNA	DYNA...1	339
SUBROUTINE DYNALL	DYNA...2	340
CIBM	DYNA...3	341
IMPLICIT REAL*8(A-H,O-Z)	DYNA...4	342
CEND	DYNA...5	343
INTEGER ALLOC1	DYNA...6	344
*CALL PACK	DYNA...7	345
*CALL IOPU	DYNA...8	346
CIBM	DYNA...9	347
COMMON/LARGE/ LARGE(1)	DYNA...10	348
CDC*	DYNA...11	349
C LEVEL 2, LARGE(1)	DYNA...12	350
C COMMON/LARGE/ LARGE(1)	DYNA...13	351
CEND	DYNA...14	352
DATA I4/4/	DYNA...15	353
C	DYNA...16	354
NMDS=IRATFI*LNGLBC(10)	DYNA...17	355
CIBM	DYNA...18	356
KLOC=ALLOC1(IERR,NMDS)	DYNA...19	357
CDC*	DYNA...20	358
C KLOC=LOCF(LARGE)	DYNA...21	359
CEND	DYNA...22	360
IF(IERR) 100,100,110	DYNA...23	361
100 CONTINUE	DYNA...24	362
NL=3	DYNA...25	363
CALL LINES(NL,IPAGE)	DYNA...26	364
WRITE(IWRITE,1000) NMDS	DYNA...27	365
IERR=-100	DYNA...28	366
CALL ERROR(6HDYNALL,IERR)	DYNA...29	367
CALL ERROR(6HFATAL ,IERR)	DYNA...30	368
110 CONTINUE	DYNA...31	369
JLOC=LOCF(LARGE)	DYNA...32	370
CIBM	DYNA...33	371
IOFFST=(KLOC-JLOC)/8	DYNA...34	372
CDC*	DYNA...35	373
C IOFFST=KLOC-JLOC	DYNA...36	374
CEND	DYNA...37	375
IOFFS2=IRATFI*IOFFST	DYNA...38	376
DO 120 I=1,NMDS	DYNA...39	377
LARGE(I+IOFFS2)=0	DYNA...40	378
120 CONTINUE	DYNA...41	379
IF(IDBUGP.EQ.0) GO TO 130	DYNA...42	380
CALL LINES(I4,IPAGE)	DYNA...43	381
WRITE(IWRITE,1010) NMDS,IOFFST	DYNA...44	382
130 CONTINUE	DYNA...45	383
RETURN	DYNA...46	384
1000 FORMAT(1H0,38H(DYNALL) UNABLE TO ALLOCATE SPACE FOR ,I6,24H SINGLE	DYNA...47	385
1 PRECISION WORDS.,/10X,25HEXECUTION WILL TERMINATE.)	DYNA...48	386
CDC*	DYNA...49	387
C1010 FORMAT(/41X,22HDATA CONTAINER LENGTH ,I6,23H SINGLE PRECISION WORD	DYNA...50	388
C 1S, /41X,22HDATA CONTAINER OFFSET ,I6,23H SINGLE PRECISION WORDS)	DYNA...51	389
CIBM	DYNA...52	390
1010 FORMAT(/41X,22HDATA CONTAINER LENGTH ,I6,23H SINGLE PRECISION WORD	DYNA...53	391
C 1S, /41X,22HDATA CONTAINER OFFSET ,I6,23H DOUBLE PRECISION WORDS)	DYNA...54	392
CEND	DYNA...55	393
END	DYNA...56	394

UPDAT/195 12/31/79

C* ERRO	ERRO...1	395
SUBROUTINE ERROR(SUBNAM,NERR)	ERRO...2	396
CIBM	ERRO...3	397
IMPLICIT REAL*8 (A-H,O-Z)	ERRO...4	398
CIBM	ERRO...5	399
C	ERRO...6	400
C SUBROUTINE ERROR PRINTS THE ERROR NUMBER NERR WHICH OCCURED	ERRO...7	401
C IN SUBROUTINE SUBNAM. IF ERROR IS CALLED WITH SUBNAM=FATAL AND	ERRO...8	402
C ONE OR MORE PREVIOUS CALLS TO ERROR HAVE OCCURRED WITH NERR.LT.0, ERRO...9	ERRO...9	403
C EXECUTION IS TERMINATED VIA A CALL TO ABEND. IF ALL CALLS TO ERROR	ERRO...10	404
C HAD NERR.GT.0, THERE IS A RETURN TO THE CALLING PROGRAM	ERRO...11	405
C	ERRO...12	406
C SUBNAM	DOUBLE PRECISION NAME OF SUBPROGRAM WHICH CALLED	ERRO...13
C	SUBROUTINE ERROR. IF SUBNAM=FATAL, A TEST	ERRO...14
C	IS MADE FOR THE OCCURRENCE OF ANY PREVIOUS	ERRO...15
C	CALLS WITH NERR.LT.0	ERRO...16
C NERR	ERROR NUMBER SET BY CALLING SUBPROGRAM	ERRO...17
C		ERRO...18
C SUBPROGRAMS CALLED BY SUBROUTINE ERROR		ERRO...19
C		ERRO...20
C ABEND	SYSTEM ERROR HANDLING ROUTINE	ERRO...21
C		ERRO...22
*CALL IOPU	ERRO...23	417
DATA FATAL/6HFATAL /,NCNT/0/,I4/4/	ERRO...24	418
IF(SUBNAM.EQ.FATAL) GO TO 110	ERRO...25	419
CALL LINES(I4,IFLGP)	ERRO...26	420
WRITE (IWRITE,1030)	ERRO...27	421
IF(NERR.LT.0) GO TO 100	ERRO...28	422
WRITE (IWRITE,1000) NERR,SUBNAM	ERRO...29	423
WRITE (IWRITE,1040)	ERRO...30	424
RETURN	ERRO...31	425
100 CONTINUE	ERRO...32	426
NCNT=NCNT+1	ERRO...33	427
WRITE (IWRITE,1010) NERR,SUBNAM	ERRO...34	428
WRITE (IWRITE,1040)	ERRO...35	429
RETURN	ERRO...36	430
110 CONTINUE	ERRO...37	431
IF(NCNT.EQ.0) RETURN	ERRO...38	432
CALL LINES(I4,IFLGP)	ERRO...39	433
WRITE (IWRITE,1030)	ERRO...40	434
WRITE(IWRITE,1020) NCNT	ERRO...41	435
WRITE (IWRITE,1040)	ERRO...42	436
CIBM	ERRO...43	437
REWIND IWRITE	ERRO...44	438
CALL ABEND	ERRO...45	439
CIBM	ERRO...46	440
CDC*	ERRO...47	441
C STOP	ERRO...48	442
CDC*	ERRO...49	443
1000 FORMAT(1H ,26X,1H*,18X,13HERROR NUMBER ,I6,15H IN SUBROUTINE ,A6,	ERRO...50	444
1 22X,1H*)	ERRO...51	445
1010 FORMAT(1H ,26X,1H*,15X,19HFATAL ERROR NUMBER ,I6,	ERRO...52	446
1 15H IN SUBROUTINE ,A6,19X,1H*)	ERRO...53	447
1020 FORMAT(1H ,26X,1H*,2X,I4,68H FATAL ERRORS HAVE BEEN ENCOUNTERED. EXECUTION IS BEING TERMINATED ,6X,1H*)	ERRO...54	448
1030 FORMAT(1H0,26X,82(1H*))	ERRO...55	449
	ERRO...56	450

UPDAT/195 12/31/79

1040 FORMAT(1H ,26X,82(1H*))
RETURN
END

ERRO..57
ERRO..58
ERRO..59

451
452
453

UPDAT/195 12/31/79

```
C* INTS
  SUBROUTINE INTSET(IA,ISET,ILEN)
C
C   INTSET INITIALIZES AN INTEGER ARRAY IA OF LENGTH ILEN
C   TO A VALUE OF ISET.
C
  DIMENSION IA(1)
  DO 100 I=1,ILEN
    IA(I)=ISET
100 CONTINUE
  RETURN
  END
```

```
INTS...1 454
INTS...2 455
INTS...3 456
INTS...4 457
INTS...5 458
INTS...6 459
INTS...7 460
INTS...8 461
INTS...9 462
INTS...10 463
INTS...11 464
INTS...12 465
```

UPDAT/195 12/31/79

C*	FLTS	FLTS...1	466
	SUBROUTINE FLTSET(XA,XSET,ILEN)	FLTS...2	467
CIBH		FLTS...3	468
	IMPLICIT REAL*8 (A-H,O-Z)	FLTS...4	469
CIBH		FLTS...5	470
C		FLTS...6	471
C	FLTSET INITIALIZES A FLOATING POINT ARRAY XA OF LENGTH ILEN TO A	FLTS...7	472
C	VALUE OF XSET.	FLTS...8	473
C		FLTS...9	474
	DIMENSION XA(1)	FLTS...10	475
	DO 100 I=1,ILEN	FLTS...11	476
	XA(I)=XSET	FLTS...12	477
100	CONTINUE	FLTS...13	478
	RETURN	FLTS...14	479
	END	FLTS...15	480

UPDAT/195 12/31/79

```
C* FEQU
      SUBROUTINE FEQUAT(A,B,LEN)
CIBH
      IMPLICIT REAL*8(A-H,O-Z)
CEND
      DIMENSION A(1),B(1)
      DO 100 I=1,LEN
        A(I)=B(I)
      100 CONTINUE
      RETURN
      END
```

```
FEQU...1      481
FEQU...2      482
FEQU...3      483
FEQU...4      484
FEQU...5      485
FEQU...6      486
FEQU...7      487
FEQU...8      488
FEQU...9      489
FEQU...10     490
FEQU...11     491
```

C* LINE	LINE...1	492
SUBROUTINE LINES(NUMLIN, IFLAG1)	LINE...2	493
CIBM	LINE...3	494
REAL*8 XNAME, TIMES, TITLE, DATE, WTIME	LINE...4	495
CIBM	LINE...5	496
C	LINE...6	497
C LINES KEEPS TRACK OF THE NUMBER OF LINES PRINTED ON A PAGE AND	LINE...7	498
C SKIPS TO THE NEXT PAGE AND HEADS IT EITHER ON COMMAND OR WHEN THE	LINE...8	499
C PREVIOUS PAGE IS FULL.	LINE...9	500
C	LINE...10	501
C NUMLIN NUMLIN=0 ... SKIP TO NEXT PAGE, HEAD IT, AND	LINE...11	502
C SET NUMBER OF LINES PRINTED ON	LINE...12	503
C IT TO 0	LINE...13	504
C NUMLIN.GT.0 ... NUMLIN LINES ARE TO BE PRINTED.	LINE...14	505
C IF THEY FIT ON CURRENT PAGE,	LINE...15	506
C LINES INCREMENTS LINCNT BY	LINE...16	507
C NUMLIN AND RETURNS. IF THEY	LINE...17	508
C WILL NOT FIT ON CURRENT PAGE	LINE...18	509
C (NUMLIN+LINCNT.GT.LINLIN), LINES	LINE...19	510
C WILL SKIP TO NEXT PAGE, HEAD IT,	LINE...20	511
C AND SET LINCNT TO NUMLIN	LINE...21	512
C IFLAG1 IF LINES HAS SKIPPED TO THE NEXT PAGE AND HEADED	LINE...22	513
C IT, IFLAG1 WILL BE SET TO 1 FOR RETURN. IF NOT,	LINE...23	514
C IFLAG1 IS RETURNED AS 0	LINE...24	515
C	LINE...25	516
*CALL FTIT	LINE...26	517
DIMENSION LINLIN(2), IFLAG0(2), LINCNT(2), IPGCNT(2)	LINE...27	518
DATA MAXLIN, LINCNT, IPGCNT, IFLAG0 / 58, 0, 0, 0, 0, 0, 0 /	LINE...28	519
C	LINE...29	520
IENTRY=1	LINE...30	521
IOUT=KOUT	LINE...31	522
GO TO 100	LINE...32	523
CIBM	LINE...33	524
ENTRY LINES2(NUMLIN, IFLAG1)	LINE...34	525
CIBM	LINE...35	526
CDC*	LINE...36	527
C ENTRY LINES2	LINE...37	528
CDC*	LINE...38	529
IOUT=KOUT2	LINE...39	530
IENTRY=2	LINE...40	531
100 CONTINUE	LINE...41	532
IF(IOUT.EQ.0) RETURN	LINE...42	533
IF(IFLAG0(IENTRY).GT.0) GO TO 110	LINE...43	534
C	LINE...44	535
C INITIAL CALL TO LINES	LINE...45	536
C	LINE...46	537
DATE=TIMES(4)	LINE...47	538
IFLAG0(IENTRY)=1	LINE...48	539
LINLIN(1)=MAXLIN	LINE...49	540
LINLIN(2)=MAXLIN	LINE...50	541
GO TO 120	LINE...51	542
C	LINE...52	543
C SUBSEQUENT CALLS TO LINES	LINE...53	544
C	LINE...54	545
C	LINE...55	546
110 CONTINUE	LINE...56	547
IF(IOUT.EQ.0) RETURN		

UPDAT/195 12/31/79

IF(NUMLIN.EQ.0) GO TO 120	LINE..57	548
IF((LINCNT(IENTRY)+NUMLIN).GT.LINLIN(IENTRY)) GO TO 120	LINE..58	549
LINCNT(IENTRY)=LINCNT(IENTRY)+NUMLIN	LINE..59	550
IFLAG1=0	LINE..60	551
GO TO 130	LINE..61	552
120 CONTINUE	LINE..62	553
WTIME=TIMES(6)	LINE..63	554
IPGCHT(IENTRY)=IPGCHT(IENTRY)+1	LINE..64	555
IFLAG1=1	LINE..65	556
IF(IPRNCH.LE.0) WRITE(IOUT,1000) (TITLE(I),I=1,9),DATE,WTIME,	LINE..66	557
1 IPGCHT(IENTRY)	LINE..67	558
IF(IPRNCH.GT.0) WRITE(IOUT,1010) IPRNCH,(TITLE(I),I=1,9),DATE,	LINE..68	559
1 WTIME,IPGCHT(IENTRY)	LINE..69	560
WRITE(IOUT,1020) (TITLE(I),I=10,18)	LINE..70	561
LINCNT(IENTRY)=NUMLIN	LINE..71	562
130 CONTINUE	LINE..72	563
RETURN	LINE..73	564
1000 FORMAT(1H1,13X,9HSACO 1.0,2X,9A8,2(2X,A8),2X,4HPAGE,I4)	LINE..74	565
1010 FORMAT(1H1,8HCHANNEL ,13,2X,9HSACO 0.0,2X,9A8,2(2X,A8),2X,	LINE..75	566
1 4HPAGE,I4)	LINE..76	567
1020 FORMAT(25X,9A8)	LINE..77	568
END	LINE..78	569

UPDAT/195 12/31/79

```

C= DATH
SUBROUTINE DATHOV(WORK,NPACK,NCHANL,KIND)
CIBM
IMPLICIT REAL*8(A-H,O-Z)
CEND
*CALL IOPU
*CALL PACK
DIMENSION WORK(1)
DATA I2/2/,XDATHD/6NDATHOV/,XFATAL/6HFATAL /
IER=0
IF((NPACK.GT.0).AND.(NPACK.LE.MAXPAK)) GO TO 100
IER=-100
CALL LINES(I2,IPAGE)
WRITE(IHWRITE,1000) NPACK
CALL ERROR(XDATHD,IER)
100 CONTINUE
IF(NPACK.LE.NOINDP) GO TO 110
IF((NCHANL.GT.0).AND.(NCHANL.LE.NCH)) GO TO 110
IER=-110
CALL LINES(I2,IPAGE)
WRITE(IHWRITE,1010) NCHANL
CALL ERROR(XDATHD,IER)
110 CONTINUE
IF(LNGTHT(NPACK).LE.0) GO TO 160
IF((KIND.EQ.1).OR.(KIND.EQ.-1)) GO TO 120
IER=-120
CALL LINES(XDATHD,IPAGE)
WRITE(IHWRITE,1020) KIND
1020 FORMAT(IH9,37H (DATHOV) KIND HAS THE ILLEGAL VALUE ,I6)
CALL ERROR(XDATHD,IER)
120 CONTINUE
IF(IER.NE.0) CALL ERROR(XFATAL,IER)
LOCUS=NCHST(NCHANL)
IF(NPACK.LE.NOINDP) LOCUS=HSTART
LOCUS=LOCUS+ISTRLC(NPACK)
LONG=LNGTHT(NPACK)*IRATFI
LCHPT=IRATFI*(LOCUS-1)+1
IF(KIND.EQ.1) GO TO 140

C
C MOVE DATA FROM SCH TO LCH
C
IF(IDBUGP.EQ.0) GO TO 130
CALL LINES(I2,IPAGE)
WRITE(IHWRITE,1030) NPACK,NCHANL,LOCUS,LNGTHT(NPACK)
130 CONTINUE
CALL CRIT(WORK,LCHPT,LONG,IER)
GO TO 160

C
C MOVE DATA FROM LCH TO SCH
C
140 CONTINUE
IF(IDBUGP.EQ.0) GO TO 150
CALL LINES(I2,IPAGE)
WRITE(IHWRITE,1040) NPACK,NCHANL,LOCUS,LNGTHT(NPACK)
150 CONTINUE
CALL CRED(WORK,LCHPT,LONG,IER)

```

DATH...1	570
DATH...2	571
DATH...3	572
DATH...4	573
DATH...5	574
DATH...6	575
DATH...7	576
DATH...8	577
DATH...9	578
DATH...10	579
DATH...11	580
DATH...12	581
DATH...13	582
DATH...14	583
DATH...15	584
DATH...16	585
DATH...17	586
DATH...18	587
DATH...19	588
DATH...20	589
DATH...21	590
DATH...22	591
DATH...23	592
DATH...24	593
DATH...25	594
DATH...26	595
DATH...27	596
DATH...28	597
DATH...29	598
DATH...30	599
DATH...31	600
DATH...32	601
DATH...33	602
DATH...34	603
DATH...35	604
DATH...36	605
DATH...37	606
DATH...38	607
DATH...39	608
DATH...40	609
DATH...41	610
DATH...42	611
DATH...43	612
DATH...44	613
DATH...45	614
DATH...46	615
DATH...47	616
DATH...48	617
DATH...49	618
DATH...50	619
DATH...51	620
DATH...52	621
DATH...53	622
DATH...54	623
DATH...55	624
DATH...56	625

UPDAT/195 12/31/79

160 CONTINUE
RETURN

1000 FORMAT(1H0.38H (DATHOV) NPACK HAS THE ILLEGAL VALUE ,I6)
1010 FORMAT(1H0.39H (DATHOV) NCHANL HAS THE ILLEGAL VALUE ,I6)
1030 FORMAT(1H0.21H (DATHOV) WRITE PACK ,I3.5X,12HFOR CHANNEL ,I3,
1 5X,19H TO LCH LOCATION ,I9.5X,9HNO. WORDS,I6)
1040 FORMAT(1H0.21H (DATHOV) READ PACK ,I3.5X,12HFOR CHANNEL ,I3,
1 5X,19H FROM LCH LOCATION ,I9.5X,9HNO. WORDS,I6)
END

DATH..57	626
DATH..58	627
DATH..59	628
DATH..60	629
DATH..61	630
DATH..62	631
DATH..63	632
DATH..64	633
DATH..65	634

UPDAT/195 12/31/79

```

C* CPED
  SUBROUTINE CRED(B,LPT,NMDS,IER)
CIBH
  IMPLICIT REAL*8(A-H,O-Z)
CEND
*CALL PACK
  DIMENSION B(1)
CIBH
  NMDS=NMDS/IRATFI
  LCH=(LPT-1)/IRATFI+1
CEND
  CALL READEC(B,LCH,NMDS)
  IER=0
  RETURN
CIBH
  ENTRY CRIT(B,LPT,NMDS,IER)
CDC*
C  ENTRY CRIT
CEND
CIBH
  NMDS=NMDS/IRATFI
  LCH=(LPT-1)/IRATFI+1
CEND
  CALL WRITEC(B,LCH,NMDS)
  IER=0
  RETURN
  END

```

```

CRED...1 635
CRED...2 636
CRED...3 637
CRED...4 638
CRED...5 639
CRED...6 640
CRED...7 641
CRED...8 642
CRED...9 643
CRED..10 644
CRED..11 645
CRED..12 646
CRED..13 647
CRED..14 648
CRED..15 649
CRED..16 650
CRED..17 651
CRED..18 652
CRED..19 653
CRED..20 654
CRED..21 655
CRED..22 656
CRED..23 657
CRED..24 658
CRED..25 659
CRED..26 660
CRED..27 661

```

UPDAT/195 12/31/79

```

C* DRED
SUBROUTINE DRED(LUN,IREC,LCH,NMDS,MODE)
CIBH
IMPLICIT REAL*8(A-H,O-Z)
CEND
*CALL PACK
CDC*
C LEVEL 2. LARGE
CEND
COMMON/LARGE/ LARGE(1)
IPT=IRATFI*IOFFST*LCH
CALL REED(LUN,IREC,LARGE(IPT),NMDS,MODE)
RETURN
CIBH
ENTRY DRIT(LUN,IREC,LCH,NMDS,MODE)
CDC*
C ENTRY DRIT
CEND
IPT=IRATFI*IOFFST*LCH
CALL RITE(LUN,IREC,LARGE(IPT),NMDS,MODE)
RETURN
END

```

```

DRED...1 662
DRED...2 663
DRED...3 664
DRED...4 665
DRED...5 666
DRED...6 667
DRED...7 668
DRED...8 669
DRED...9 670
DRED..10 671
DRED..11 672
DRED..12 673
DRED..13 674
DRED..14 675
DRED..15 676
DRED..16 677
DRED..17 678
DRED..18 679
DRED..19 680
DRED..20 681
DRED..21 682
DRED..22 683

```

UPDAT/195 12/31/79

C= REEC	REEC...1	684
CC	REEC...2	685
CC NOTE THAT THE INTEGER LCM IS A POINTER TO A LOCATION IN THE	REEC...3	686
CC CONTAINER.	REEC...4	687
CC	REEC...5	688
CC*	REEC...6	689
C IDENT READEC SUBROUTINE READEC(SCH,LCM,N)	REEC...7	690
C ENTRY READEC BLOCK TRANSFER FROM: LCM TO SCH	REEC...8	691
CREADEC TITLE READEC SCH=SCH ADDRESS, LCM=LCM POINTER, N=NO. WORDS	REEC...9	692
CREADEC DATA 0LREADEC ENTRY POINT	REEC...10	693
CSTART SA4 A1	REEC...11	694
C SA2 A1*2 X2= NUMBER OF WORDS LEFT TO TRANSFER	REEC...12	695
C SA3 A1*1	REEC...13	696
C SB7 A0 SAVE A0 IN B7	REEC...14	697
C SA3 X3	REEC...15	698
C SA2 X2	REEC...16	699
C SX5 1777B	REEC...17	700
C SA0 X4 A0= SCH ADDRESS	REEC...18	701
C BX0 X3 X0= LCM ADDRESS	REEC...19	702
C ZR X2,FINI START LOOP ON 1777 WORD BLOCKS, END TEST	REEC...20	703
C HI X2,FINI	REEC...21	704
CLOOPS SB2 1777B B2= NO OF WORDS IN BLOCK	REEC...22	705
C IX3 X2-X5	REEC...23	706
C PL X3,L1 AT A TIME	REEC...24	707
C SB2 X2	REEC...25	708
CL1 RL B2 BLOCK COPY	REEC...26	709
C IX2 X2-X5	REEC...27	710
C SA0 A0+1777B	REEC...28	711
C IX0 X0+X5	REEC...29	712
C PL X2,LOOPS	REEC...30	713
CFINI SA0 B7 END OF LOOP, RESTORE A0 AND RETURN	REEC...31	714
C JP READEC	REEC...32	715
C END	REEC...33	716
CIBM	REEC...34	717
SUBROUTINE READEC (H,LOCUS,LONG)	REEC...35	718
IMPLICIT REAL*8 (A-H,O-Z)	REEC...36	719
*CALL PACK	REEC...37	720
COMMON / LARGE / BIG(1)	REEC...38	721
DIMENSION W(2)	REEC...39	722
CEND	REEC...40	723
CC	REEC...41	724
CC NOTE THAT THE INTEGER LOCUS IS A POINTER TO A LOCATION IN THE	REEC...42	725
CC CONTAINER.	REEC...43	726
CC	REEC...44	727
CIBM	REEC...45	728
NPLACE=LOCUS+IDFFST	REEC...46	729
NPL=NPLACE	REEC...47	730
LAST=LONG	REEC...48	731
LIMIT=LAST/5	REEC...49	732
LIMIT=LIMIT*5	REEC...50	733
IF (LIMIT.LT.5) GO TO 110	REEC...51	734
DO 100 I=1,LIMIT,5	REEC...52	735
W(I)=BIG(NPLACE)	REEC...53	736
W(I+1)=BIG(NPLACE+1)	REEC...54	737
W(I+2)=BIG(NPLACE+2)	REEC...55	738
W(I+3)=BIG(NPLACE+3)	REEC...56	739

UPDAT/195 12/31/79

```
      NI+4)=BIG(NPLACE+4)
      NPLACE=NPLACE+5
100  CONTINUE
      NPL=NPL+LIMIT
110  LOW=LIMIT+1
      IF (LAST.LT.LOW) GO TO 130
      DO 120 I=LOW, LAST, 1
      NI)=BIG(NPL)
      NPL=NPL+1
120  CONTINUE
130  RETURN
      END
CEND
```

REEC..57	740
REEC..58	741
REEC..59	742
REEC..60	743
REEC..61	744
REEC..62	745
REEC..63	746
REEC..64	747
REEC..65	748
REEC..66	749
REEC..67	750
REEC..68	751
REEC..69	752

UPDAT/195 12/31/79

C= WREC			WREC...1	753
CC			WREC...2	754
CC	NOTE THAT THE INTEGER LCH IS A POINTER TO A LOCATION IN THE		WREC...3	755
CC	CONTAINER.		WREC...4	756
CC			WREC...5	757
CC=			WREC...6	758
C	IDENT WRITEC	SUBROUTINE WRITEC(SCH,LCH,N)	WREC...7	759
C	ENTRY WRITEC	BLOCK TRANSFER FROM SCH TO LCH	WREC...8	760
WRITEC	TITLE WRITEC	SCH=SCH ADDRESS, LCH=LCH ADDRESS, N=NO. WORDS	WREC...9	761
WRITEC	DATA 0LWRITEC	ENTRY POINT	WREC...10	762
CSTART	SA4 A1		WREC...11	763
C	SA2 A1*2	X2= NUMBER OF WORDS LEFT TO TRANSFER	WREC...12	764
C	SA3 A1*1		WREC...13	765
C	SB7 A0	SAVE A0 IN B7	WREC...14	766
C	SA3 X3		WREC...15	767
C	SA2 X2		WREC...16	768
C	SA5 1777B		WREC...17	769
C	SA0 X4	A0= SCH ADDRESS	WREC...18	770
C	BX0 X3	X00 LCH ADDRESS	WREC...19	771
C	ZR X2,FINI	START LOOP ON 1777 WORD BLOCKS, END TEST	WREC...20	772
C	NI X2,FINI		WREC...21	773
C	SB2 1777B	B2= NO. OF WORDS IN BLOCK	WREC...22	774
C	IX3 X2-X5		WREC...23	775
C	PL X3,L1	AT A TIME	WREC...24	776
C	SB2 X2		WREC...25	777
CL1	HL B2	BLOCK COPY	WREC...26	778
C	IX2 X2-X5		WREC...27	779
C	SA0 A0+1777B		WREC...28	780
C	IX0 X0-X5		WREC...29	781
C	PL X2,LOOPS	REPEAT LOOP IF NECESSARY	WREC...30	782
CFINI	SA0 B7	END OF LOOP, RESTORE A0 AND RETURN	WREC...31	783
C	JP WRITEC		WREC...32	784
C	END		WREC...33	785
CIBM			WREC...34	786
	SUBROUTINE WRITEC (H,LOCUS,LONG)		WREC...35	787
	IMPLICIT REAL*8 (A-H,O-Z)		WREC...36	788
*CALL	PACK		WREC...37	789
	COMMON / LARGE / BIG(1)		WREC...38	790
	DIMENSION H(2)		WREC...39	791
CEND			WREC...40	792
CC			WREC...41	793
CC	NOTE THAT THE INTEGER LOCUS IS A POINTER TO A LOCATION IN THE		WREC...42	794
CC	CONTAINER.		WREC...43	795
CC			WREC...44	796
CIBM			WREC...45	797
	HPLACE=LOCUS+IOFFST		WREC...46	798
	HPL=HPLACE		WREC...47	799
	LAST=LONG		WREC...48	800
	LIMIT=LAST/5		WREC...49	801
	LIMIT=LIMIT*5		WREC...50	802
	IF (LIMIT.LT.5) GO TO 110		WREC...51	803
	DO 100 I=1,LIMIT,5		WREC...52	804
	BIG(HPLACE)=H(I)		WREC...53	805
	BIG(HPLACE+1)=H(I+1)		WREC...54	806
	BIG(HPLACE+2)=H(I+2)		WREC...55	807
	BIG(HPLACE+3)=H(I+3)		WREC...56	808

UPDAT/195 12/31/79

```
      BIG(NPLACE+4)=W(I+4)
      NPLACE=NPLACE+5
100  CONTINUE
      NPL=NPL+LIMIT
110  LOW=LIMIT+1
      IF (LAST.LT.LOW) GO TO 130
      DO 120 I=LOW, LAST, 1
      BIG(NPL)=W(I)
      NPL=NPL+1
120  CONTINUE
130  CONTINUE
      RETURN
      END
CEND
```

WREC..57	809
WREC..58	810
WREC..59	811
WREC..60	812
WREC..61	813
WREC..62	814
WREC..63	815
WREC..64	816
WREC..65	817
WREC..66	818
WREC..67	819
WREC..68	820
WREC..69	821
WREC..70	822

UPDAT/195 12/31/79

C= REED	REED...1	823
SUBROUTINE REED (LUN,IREC,B,NMDS,MODE)	REED...2	824
C	REED...3	825
C	REED...4	826
C	REED...5	827
C	REED...6	828
C	REED...7	829
C	REED...8	830
C	REED...9	831
C	REED..10	832
C	REED..11	833
C	REED..12	834
C	REED..13	835
C	REED..14	836
C	REED..15	837
C	REED..16	838
C	REED..17	839
C	REED..18	840
C	REED..19	841
C	REED..20	842
C	REED..21	843
C	REED..22	844
C	REED..23	845
C	REED..24	846
C	REED..25	847
C	REED..26	848
C	REED..27	849
C	REED..28	850
C	REED..29	851
C	REED..30	852
C	REED..31	853
C	REED..32	854
C	REED..33	855
C	REED..34	856
C	REED..35	857
C	REED..36	858
C	REED..37	859
C	REED..38	860
C	REED..39	861
C	REED..40	862
C	REED..41	863
C	REED..42	864
C	REED..43	865
C	REED..44	866
C	REED..45	867
C	REED..46	868
C	REED..47	869
C	REED..48	870
C	REED..49	871
C	REED..50	872
C	REED..51	873
C	REED..52	874
C	REED..53	875
C	REED..54	876
C	REED..55	877
C	REED..56	878

```

SUBROUTINE REED (LUN,IREC,B,NMDS,MODE)
  SUBROUTINE REED AND ENTRY RITE ARE GENERAL PURPOSE INPUT/OUTPUT
  ROUTINES CONSISTENT WITH CCCC RECOMMENDATIONS. THIS VERSION
  OF REED/RITE MAKES USE OF STANDARD FORTRAN SEQUENTIAL I/O
  ONLY AND REPRESENTS A SIMPLIFICATION OF THE MORE GENERAL
  APL PROGRAM.

  LUN          LOGICAL UNIT NUMBER OF FILE FOR WHICH I/O
                OPERATION IS TO BE PERFORMED
  IREC         LOGICAL RECORD NUMBER ON FILE LUN AT WHICH
                THE TRANSFER IS TO START. IF IREC.EQ.0
                A REWIND OPERATION IS PERFORMED AND NO DATA ARE
                TRANSFERRED.
  B            ARRAY INTO WHICH (OR OUT OF WHICH) DATA ARE
                TO BE TRANSFERRED FROM (TO) FILE LUN.
  NMDS         NUMBER OF SINGLE PRECISION WORDS OF DATA
                TO BE TRANSFERRED IN THE I/O OPERATION.
  MODE        BUFFERED I/O INDEX
                MODE=0 COMPLETE I/O ORDER PRIOR TO RETURN
                TO CALLING PROGRAM.
                MODE=1 DO NOT COMPLETE I/O TRANSFER PRIOR TO
                RETURN TO CALLING PROGRAM.
                MODE=2 COMPLETE PRIOR I/O OPERATION ON FILE
                LUN.

  CALL IOPU
  DIMENSION B(NMDS),DUM(1)
  DIMENSION NREC(99)

  CIBM REAL*8 SUBNAM,OUTPUT,ANAME,INPUT
  CIBM DATA INPUT/6HREED /,OUTPUT/6HRITE /
  DATA NREC/99*1/
  DATA DUM/4HDUM/,ISM/0/,ANAME/6H /

  C IENTRY=1
  CIBM SUBNAM=INPUT
  CIBM IF (NMDS.NE.0.OR.IREC.EQ.0) GO TO 10
  RETURN
  CIBM ENTRY RITE(LUN,IREC,B,NMDS,MODE)
  CIBM CDC=
  C ENTRY RITE
  CDC=
  IENTRY=2
  SUBNAM=OUTPUT
  10 CONTINUE
  IERR=0
  IF (MODE.EQ.2) RETURN
  IF (IREC.EQ.0) IENTRY=3

```

UPDAT/195 12/31/79

```

      LUN1=LUN
C
C CHECK ON LEGITIMATE VALUES OF ARGUMENTS PASSED TO REED/RITE
C
      IF (LUN.LE. 0.OR.LUN.GE.100) GO TO 900
      IF (MODE.LT.0.OR.MODE.GT.2) GO TO 910
      IF (IREC.LT.0) GO TO 920
      IF (IHDS.LT.0) GO TO 930
C
C
      NSKP=0
      IF (IENTRY.EQ.3) GO TO 210
      NSKP=IREC-IHREC(LUN1)
      IF (NSKP.GE.0) GO TO 210
      REMIND LUN
      NSKP=IREC-1
210 CONTINUE
      IF (NSKP.EQ.0) GO TO 520
      DO 510 I=1,NSKP
CIBM READ (LUN,END=999)
CIBM CDC#
C READ (LUN)
C IF (EOF(LUN).NE.0) GO TO 999
CDC#
510 CONTINUE
520 CONTINUE
      GO TO (530,540,550), IENTRY
530 CONTINUE
CIBM READ (LUN,END=999) B
CIBM CDC#
C READ (LUN) B
C IF (EOF(LUN).NE.0) GO TO 999
CDC#
      GO TO 1000
540 CONTINUE
      IF (IHDS.EQ.0) GO TO 545
      WRITE(LUN) B
      GO TO 1000
545 CONTINUE
C*****
C
C ERROR ..... WRITING A RECORD WITH IHDS=0
C
C*****
      WRITE (LUN) DUM
      GO TO 1000
550 CONTINUE
      REMIND LUN
1000 CONTINUE
      IHREC(LUN1)=IREC+1
      RETURN
C

```

```

REED..57 879
REED..58 880
REED..59 881
REED..60 882
REED..61 883
REED..62 884
REED..63 885
REED..64 886
REED..65 887
REED..66 888
REED..67 889
REED..68 890
REED..69 891
REED..70 892
REED..71 893
REED..72 894
REED..73 895
REED..74 896
REED..75 897
REED..76 898
REED..77 899
REED..78 900
REED..79 901
REED..80 902
REED..81 903
REED..82 904
REED..83 905
REED..84 906
REED..85 907
REED..86 908
REED..87 909
REED..88 910
REED..89 911
REED..90 912
REED..91 913
REED..92 914
REED..93 915
REED..94 916
REED..95 917
REED..96 918
REED..97 919
REED..98 920
REED..99 921
REED.100 922
REED.101 923
REED.102 924
REED.103 925
REED.104 926
REED.105 927
REED.106 928
REED.107 929
REED.108 930
REED.109 931
REED.110 932
REED.111 933
REED.112 934

```


C***** ERROR CONDITIONS *****	REED.113	935
C	REED.114	936
900 CONTINUE	REED.115	937
C*****	REED.116	938
C	REED.117	939
C FATAL ERROR LOGICAL UNIT NUMBER IS OUT OF RANGE	REED.118	940
C	REED.119	941
C*****	REED.120	942
ASSIGN 1900 TO NERR	REED.121	943
GO TO 2000	REED.122	944
910 CONTINUE	REED.123	945
C*****	REED.124	946
C	REED.125	947
C FATAL ERROR MODE INDEX OUT OF RANGE	REED.126	948
C	REED.127	949
C*****	REED.128	950
ASSIGN 1910 TO NERR	REED.129	951
GO TO 2000	REED.130	952
920 CONTINUE	REED.131	953
C*****	REED.132	954
C	REED.133	955
C FATAL ERROR RECORD NUMBER OUT OF RANGE	REED.134	956
C	REED.135	957
C*****	REED.136	958
ASSIGN 1920 TO NERR	REED.137	959
GO TO 2000	REED.138	960
930 CONTINUE	REED.139	961
C*****	REED.140	962
C	REED.141	963
C FATAL ERROR NUMBER OF WORDS IS NEGATIVE	REED.142	964
C	REED.143	965
C*****	REED.144	966
ASSIGN 1930 TO NERR	REED.145	967
GO TO 2000	REED.146	968
999 CONTINUE	REED.147	969
C*****	REED.148	970
C	REED.149	971
C FATAL ERROR ATTEMPTING TO READ PAST END OF FILE	REED.150	972
C	REED.151	973
C*****	REED.152	974
ASSIGN 1999 TO NERR	REED.153	975
2000 CONTINUE	REED.154	976
WRITE(ROUT,3000)	REED.155	977
CIBM	REED.156	978
CALL TRACER(ANAME,ISN)	REED.157	979
WRITE(ROUT,3400) SUBNAM,ISN,ANAME	REED.158	980
CIBM	REED.159	981
GO TO NERR, (1900,1910,1920,1930,1999)	REED.160	982
1900 CONTINUE	REED.161	983
WRITE(ROUT,3500)	REED.162	984
IEPR=-100	REED.163	985
GO TO 120	REED.164	986
1910 CONTINUE	REED.165	987
WRITE(ROUT,3600)	REED.166	988
IEPR=-110	REED.167	989
GO TO 120	REED.168	990

UPDAT/195 12/31/79

1920 CONTINUE	REED.169	991
WRITE(NOUT,3700)	REED.170	992
IERR=-120	REED.171	993
GO TO 120	REED.172	994
1930 CONTINUE	REED.173	995
WRITE(NOUT,3800)	REED.174	996
IERR=-130	REED.175	997
GO TO 120	REED.176	998
1999 CONTINUE	REED.177	999
WRITE(NOUT,4100)	REED.178	1000
IERR=-140	REED.179	1001
120 CONTINUE	REED.180	1002
IF(IENTRY.EQ.2) GO TO 110	REED.181	1003
WRITE (NOUT,3100) NADS,IREF,LUN,MODE	REED.182	1004
GO TO 130	REED.183	1005
110 CONTINUE	REED.184	1006
WRITE (NOUT,3300) NADS,IREF,LUN,MODE	REED.185	1007
130 CONTINUE	REED.186	1008
WRITE(NOUT,3200)	REED.187	1009
CALL ERROR (6HREED ,IERR)	REED.188	1010
CALL ERROR (6HFATAL ,IERR)	REED.189	1011
C	REED.190	1012
C	REED.191	1013
C	REED.192	1014
3000 FORMAT(/5X,91(1H=)/5X,1H=,89X,1H=)	REED.193	1015
3100 FORHAT(5X,22H= ATTEMPTING TO READ, 16, 8X, 19H WORDS FROM REREED.194	REED.194	1016
1CORD,16,29X,1H=/5X,23H= ON LOGICAL UNIT NO.,	REED.195	1017
213,8X,12H WITH MODE=,11,43X,1H=)	REED.196	1018
3200 FORHAT(5X,1H=,89X,1H=/5X,91(1H=)/)	REED.197	1019
3300 FORHAT(5X,23H= ATTEMPTING TO WRITE,16,8X, 19H WORDS INTO REREED.198	REED.198	1020
1CORD,16,29X, 1H=/5X,23H= ON LOGICAL UNIT NO.,	REED.199	1021
213,8X, 12H WITH MODE=,11,43X,1H=)	REED.200	1022
CIBH	REED.201	1023
3400 FORHAT(5X,4H= A4,20H WAS CALLED FROM ISN 15,15H OF SUBPROGRAM	REED.202	1024
1A6,36X,1H=)	REED.203	1025
CIBH	REED.204	1026
3500 FORHAT(5X,43H= THE LOGICAL UNIT NUMBER IS OUT OF RANGE47X,1H=)	REED.205	1027
3600 FORHAT(5X,34H= THE MODE INDEX IS OUT OF RANGE56X,1H=)	REED.206	1028
3700 FORHAT(5X,37H= THE RECORD NUMBER IS OUT OF RANGE53X,1H=)	REED.207	1029
3800 FORHAT(5X,53H= THE NUMBER OF WORDS TO BE TRANSFERRED IS NEGATIVE	REED.208	1030
137X,1H=)	REED.209	1031
4100 FORHAT(5X,42H= ATTEMPTING TO READ PAST AN END OF FILE48X,1H=)	REED.210	1032
RETURN	REED.211	1033
END	REED.212	1034

C*	TIHR	TIHR...1	1035
	SUBROUTINE TIMER(I,T)	TIHR...2	1036
C		TIHR...3	1037
C	SUBROUTINE TIMER WAS SPECIFIED BY THE CCCC AS A GENERAL TIMING	TIHR...4	1038
C	ROUTINE	TIHR...5	1039
C		TIHR...6	1040
C	I.LT.0 RETURN ALL ITEMS OF T ARRAY	TIHR...7	1041
C	I=0 INITIALIZE PROCESSOR TIME TO ZERO	TIHR...8	1042
C	I=1 ELAPSED CPU TIME (SEC.) SINCE LAST CALL WITH	TIHR...9	1043
C	I=0	TIHR...10	1044
C	I=2 RETURN REMAINING PROCESSOR TIME (SEC.)	TIHR...11	1045
C	I=3 ELAPSED PERIPHERAL PROCESSOR TIME (SEC.)	TIHR...12	1046
C	SINCE LAST CALL WITH I=0	TIHR...13	1047
C	I=4 RETURN DATE IN EBCDIC AS MM/DD/YY	TIHR...14	1048
C	I=5 RETURN USERS INITIALS (HAS BEEN IMPLEMENTED	TIHR...15	1049
C	TO RETURN USERS BADGE NUMBER IN FORM BXXXXX)	TIHR...16	1050
C	I=6 RETURN USERS CHARGE NUMBER IN FORM	TIHR...17	1051
C	CCCCAAAA WHERE CCC IS COST CENTER AND AAAAA	TIHR...18	1052
C	IS ACCOUNT CODE	TIHR...19	1053
C	I=7 RETURN USERS CASE ID (JOB NAME)	TIHR...20	1054
C	I=8 RETURN PRESENT WALL CLOCK TIME IN EBCDIC AS	TIHR...21	1055
C	HHMM.T WHERE T IS IN TENTHS OF A MINUTE	TIHR...22	1056
C	I=9 RETURN PRESENT WALL CLOCK TIME IN EBCDIC AS	TIHR...23	1057
C	HH.MM.TT	TIHR...24	1058
C	I=10 USERS OPTION (NOT IMPLEMENTED)	TIHR...25	1059
C	T A DOUBLE PRECISION ARRAY WITH THE INFORMATION	TIHR...26	1060
C	REQUESTED	TIHR...27	1061
C		TIHR...28	1062
C	OPTIONS WHICH ARE NOT IMPLEMENTED RETURN 0.0 IN NUMERIC	TIHR...29	1063
C	FIELDS AND NOT IMPL IN HOLLERITH FIELDS	TIHR...30	1064
C		TIHR...31	1065
C	SUBPROGRAMS CALLED BY SUBROUTINE TIMER	TIHR...32	1066
C		TIHR...33	1067
C	CLOCK SUBROUTINE RETURNS WALL CLOCK TIME IN	TIHR...34	1068
C	HUNDRETHS OF A SECOND	TIHR...35	1069
C	DATE1 FUNCTION RETURNS CURRENT DATE AS MM/DD/YY	TIHR...36	1070
C	JOBID SUBROUTINE RETURNS THE JOB NAME SUPPLIED BY	TIHR...37	1071
C	USER ON THE JOB CARD	TIHR...38	1072
C	SECOND RETURN ELAPSED CPU TIME (SEC.)	TIHR...39	1073
C	TIME1 FUNCTION RETURNS WALL CLOCK TIME AS HH.MM.SS	TIHR...40	1074
C	TLEFT FUNCTION RETURNS TIME REMAINING IN PROBLEM	TIHR...41	1075
C	IN HUNDRETHS OF A SECOND	TIHR...42	1076
C	THAIT FUNCTION RETURNS THE ELAPSED PERIPHERAL	TIHR...43	1077
C	PROCESSOR TIME FOR THE JOB STEP IN HUNDRETHS	TIHR...44	1078
C	OF A SECOND	TIHR...45	1079
C	USERID SUBROUTINE RETURNS USERS BADGE NUMBER AND	TIHR...46	1080
C	ACCOUNTING INFORMATION	TIHR...47	1081
C		TIHR...48	1082
C	*****	TIHR...49	1083
C	*	TIHR...50	1084
C	* THIS VERSION OF TIMER IS INTENDED FOR EXPORT ONLY	TIHR...51	1085
C	* =====	TIHR...52	1086
C	*	TIHR...53	1087
C	* OPTIONS IMPLEMENTED	TIHR...54	1088
C	* =====	TIHR...55	1089
C	*	TIHR...56	1090

UPDAT/195 12/31/79

C	*	IBH STANDALONE	1,4,7,8,9	* TIMR..57	1091
C	*	CDC STANDALONE	1	* TIMR..58	1092
C	*	ANL PRODUCTION	1,2,3,4,5,6,7,8,9	* TIMR..59	1093
C	*			* TIMR..60	1094
C		*****		TIMR..61	1095
C				TIMR..62	1096
CIBH				TIMR..63	1097
		DOUBLE PRECISION T,TIME1,DATE1,DUM,T7,ELAPS,T1		TIMR..64	1098
		INTEGER=2 I2,F0F0,ITEMP,F6,A5		TIMR..65	1099
		DIMENSION I2(4)		TIMR..66	1100
		EQUIVALENCE (T7,I2(1))		TIMR..67	1101
		DATA F0F0/ZF0F0/,F6/Z00F6/,A5/ZA500/		TIMR..68	1102
CIBH				TIMR..69	1103
		DIMENSION T(10)		TIMR..70	1104
C				TIMR..71	1105
		DATA DUM/8H0T INPL/,IENTER/0/,T1/0.0/		TIMR..72	1106
		IF (IENTER.GT.0) GO TO 20		TIMR..73	1107
		DO 10 J=1,3		TIMR..74	1108
		T(J)=0.0		TIMR..75	1109
10		CONTINUE		TIMR..76	1110
		DO 15 J=4,10		TIMR..77	1111
		T(J)=DUM		TIMR..78	1112
15		CONTINUE		TIMR..79	1113
		IENTER=IENTER+1		TIMR..80	1114
20		CONTINUE		TIMR..81	1115
		IF (I.NE.0) GO TO 30		TIMR..82	1116
		T(1)=0.0		TIMR..83	1117
		CALL SECOND(T1)		TIMR..84	1118
CIBH				TIMR..85	1119
		T2=0.0100*TLEFT(DUMMY)		TIMR..86	1120
CIBH				TIMR..87	1121
		RETURN		TIMR..88	1122
30		CONTINUE		TIMR..89	1123
		J=1		TIMR..90	1124
		IF (J.LT.0) J=11		TIMR..91	1125
		GO TO (35,40,45,50,65,65,55,70,90,60,35),J		TIMR..92	1126
35		CONTINUE		TIMR..93	1127
		CALL SECOND(ELAPS)		TIMR..94	1128
		T(1)=ELAPS-T1		TIMR..95	1129
		IF (I.EQ.1) RETURN		TIMR..96	1130
40		CONTINUE		TIMR..97	1131
CIBH				TIMR..98	1132
		T(2)=0.0100*TLEFT(DUMMY)		TIMR..99	1133
CIBH				TIMR..100	1134
		IF (I.EQ.2) RETURN		TIMR..101	1135
45		CONTINUE		TIMR..102	1136
CIBH				TIMR..103	1137
		CALL SECOND(ELAPS)		TIMR..104	1138
		T(3)=(T2-0.0100*TLEFT(DUMMY))-(ELAPS-T1)		TIMR..105	1139
CIBH				TIMR..106	1140
		IF (I.EQ.3) RETURN		TIMR..107	1141
50		CONTINUE		TIMR..108	1142
CIBH				TIMR..109	1143
		T(4)=DATE1(DUMMY)		TIMR..110	1144
CIBH				TIMR..111	1145
		IF (I.EQ.4) RETURN		TIMR..112	1146

UPDAT/195 12/31/79

```

65 CONTINUE
  IF (I.EQ.5.OR.I.EQ.6) RETURN
55 CONTINUE
CIBH  CALL JOBID(T(7))
CIBH  IF (I.EQ.7) RETURN
60 CONTINUE
  IF (J.NE.11) RETURN
70 CONTINUE
CIBH  CALL CLOCK(DUMMY)
      X=DUMMY*.2777778E-05
      ITEMP=X
      L=ITEMP/10
      IZ(1)=ITEMP+FOFO+L*F6
      X=(X-ITEMP)*60.
      ITEMP=X
      L=ITEMP/10
      IZ(2)=ITEMP+FOFO+L*F6
      ITEMP=(X-ITEMP)*10.
      IZ(3)=ITEMP+FOFO-A5
      IZ(4)=FOFO
      T(8)=T7
CIBH  IF (I.EQ.8) RETURN
90 CONTINUE
CIBH  T(9)=TIME1(DUMMY)
CIBH  RETURN
      END

```

TIMR.113	1147
TIMR.114	1148
TIMR.115	1149
TIMR.116	1150
TIMR.117	1151
TIMR.118	1152
TIMR.119	1153
TIMR.120	1154
TIMR.121	1155
TIMR.122	1156
TIMR.123	1157
TIMR.124	1158
TIMR.125	1159
TIMR.126	1160
TIMR.127	1161
TIMR.128	1162
TIMR.129	1163
TIMR.130	1164
TIMR.131	1165
TIMR.132	1166
TIMR.133	1167
TIMR.134	1168
TIMR.135	1169
TIMR.136	1170
TIMR.137	1171
TIMR.138	1172
TIMR.139	1173
TIMR.140	1174
TIMR.141	1175
TIMR.142	1176
TIMR.143	1177
TIMR.144	1178

UPDAT/195 12/31/79

```
C* INFO
SUBROUTINE INPDV
CIBM IMPLICIT REAL*8(A-H,O-Z)
CEND
C
CALL READIN
C
CALL DATOUT
C
CALL INITAL
C
RETURN
END
```

```
INPD...1 1179
INPD...2 1180
INPD...3 1181
INPD...4 1182
INPD...5 1183
INPD...6 1184
INPD...7 1185
INPD...8 1186
INPD...9 1187
INPD...10 1188
INPD...11 1189
INPD...12 1190
INPD...13 1191
INPD...14 1192
```

UPDAT/195 12/31/79

```

C= REDI
  SUBROUTINE READIN
CIBM  IMPLICIT REAL*8(A-H,O-Z)
CEND
*CALL IOFU
*CALL PACK
COMMON/INPCOM/ INPCOM(1)
COMMON/FLTCOM/ FLTCOM(1)
COMMON/      / FBLOCK(1)
DIMENSION IBLOCK(1),FSTORE(10),ISTORE(1)
EQUIVALENCE (FBLOCK(1),IBLOCK(1)),(FSTORE(1),ISTORE(1))
DATA ENDJOB/8HENDJOB /,XREADI/6HREADIN/,
1 XFATAL/6HFATAL /,I1/1/,I7/7/,ZERO/0.000/
IER=0

C
C  BEGIN INPUT BLOCK READ
C
100 CONTINUE
  READ(IREAD,1000) BLKNIM,NIMBLK,IICH,IZERO,SEQNUM
  CALL LINES(I1,IPAGE)
  WRITE(IWRITE,1010) BLKNIM,NIMBLK,IICH,IZERO,SEQNUM

C
C  SEARCH ON BLOCK NAME
C
  IF(BLKNIM.EQ.ENDJOB) GO TO 440
  DO 110 I=1,NBLKIN
    INDEX=I
    IF(BLKNIM.EQ.BLKNAM(INDEX)) GO TO 140
110 CONTINUE

C
C  SEARCH ON BLOCK NUMBER
C
  IF(NIMBLK.LE.0) GO TO 440
  DO 120 I=1,NBLKIN
    INDEX=I
    IF(NIMBLK.EQ.NIMBLK(INDEX)) GO TO 140
120 CONTINUE

C
C  ERROR ON BLOCK IDENTIFIER CARD -- SKIP THIS BLOCK
C
125 CONTINUE
  CALL LINES(I7,IPAGE)
  WRITE(IWRITE,1020)
  IER=100
  CALL ERROR(XREADI,IER)

130 CONTINUE
  READ(IREAD,1030) LOC,NMDS,(FSTORE(I),I=1,8),SEQNUM
  CALL LINES(I1,IPAGE)
  WRITE(IWRITE,1040) LOC,NMDS,(FSTORE(I),I=1,8),SEQNUM
  IF(LOC.EQ.-1) GO TO 100
  GO TO 130

C
C  BLOCK IDENTIFIED -- INITIALIZE BLANK COMMON
C
140 CONTINUE

```

REDI...1	1193
REDI...2	1194
REDI...3	1195
REDI...4	1196
REDI...5	1197
REDI...6	1198
REDI...7	1199
REDI...8	1200
REDI...9	1201
REDI...10	1202
REDI...11	1203
REDI...12	1204
REDI...13	1205
REDI...14	1206
REDI...15	1207
REDI...16	1208
REDI...17	1209
REDI...18	1210
REDI...19	1211
REDI...20	1212
REDI...21	1213
REDI...22	1214
REDI...23	1215
REDI...24	1216
REDI...25	1217
REDI...26	1218
REDI...27	1219
REDI...28	1220
REDI...29	1221
REDI...30	1222
REDI...31	1223
REDI...32	1224
REDI...33	1225
REDI...34	1226
REDI...35	1227
REDI...36	1228
REDI...37	1229
REDI...38	1230
REDI...39	1231
REDI...40	1232
REDI...41	1233
REDI...42	1234
REDI...43	1235
REDI...44	1236
REDI...45	1237
REDI...46	1238
REDI...47	1239
REDI...48	1240
REDI...49	1241
REDI...50	1242
REDI...51	1243
REDI...52	1244
REDI...53	1245
REDI...54	1246
REDI...55	1247
REDI...56	1248

UPDAT/195 12/31/79

IPAK=IPK(INDEX)	REDI..57	1249
IF(IPAK.LE.NOTIMP) GO TO 150	REDI..58	1250
IF((IICH.GT.0).AND.(IICH.LE.NCH)) GO TO 150	REDI..59	1251
GO TO 125	REDI..60	1252
150 CONTINUE	REDI..61	1253
IF(IZERO.LT.0) GO TO 125	REDI..62	1254
NHDS=LENGTH(INDEX)	REDI..63	1255
IF(IZERO.GT.0) GO TO 160	REDI..64	1256
C	REDI..65	1257
C ZERO INITIALIZATION	REDI..66	1258
C	REDI..67	1259
CALL FLTSET(FBLOCK,ZERO,NHDS)	REDI..68	1260
IF(IIFORMAT INDEX).EQ.0) GO TO 230	REDI..69	1261
GO TO 270	REDI..70	1262
C	REDI..71	1263
C INITIALIZE FROM COMMON OR LCH	REDI..72	1264
C	REDI..73	1265
160 CONTINUE	REDI..74	1266
IF(INDEX.GT.2) GO TO 220	REDI..75	1267
GO TO (170,180). INDEX	REDI..76	1268
170 CONTINUE	REDI..77	1269
CALL FEQUAT(FBLOCK,INPCOM,NHDS)	REDI..78	1270
GO TO 230	REDI..79	1271
180 CONTINUE	REDI..80	1272
CALL FEQUAT(FBLOCK,FLTCON,NHDS)	REDI..81	1273
GO TO 270	REDI..82	1274
220 CONTINUE	REDI..83	1275
IF(IZERO.GT.NCH) GO TO 125	REDI..84	1276
MODE=1	REDI..85	1277
CALL DATHOV(FBLOCK,IPAK,IZERO,MODE)	REDI..86	1278
IF(IIFORMAT INDEX).EQ.0) GO TO 230	REDI..87	1279
GO TO 270	REDI..88	1280
C	REDI..89	1281
C READ AN INTEGER FORMAT INPUT BLOCK	REDI..90	1282
C	REDI..91	1283
230 CONTINUE	REDI..92	1284
READ(IREAD,1050) LOC,NHDS,(ISTORE(I),I=1,10),SEQNUM	REDI..93	1285
IF(LOC.EQ.-1) GO TO 350	REDI..94	1286
CALL LINES(I,IPAGE)	REDI..95	1287
WRITE(IWRITE,1060) LOC,NHDS,(ISTORE(I),I=1,10),SEQNUM	REDI..96	1288
IF((NHDS.GT.0).AND.(NHDS.LT.11)) GO TO 240	REDI..97	1289
CALL LINES(I7,IPAGE)	REDI..98	1290
WRITE(IWRITE,1070)	REDI..99	1291
IER=110	REDI..100	1292
CALL ERROR(XREADI,IER)	REDI..101	1293
GO TO 230	REDI..102	1294
240 CONTINUE	REDI..103	1295
LOC=LOC-1	REDI..104	1296
IF((LOC.GE.0).AND.(((LOC*NHDS).LE.((IRATFI*LENGTH(INDEX))))	REDI..105	1297
1 GO TO 250	REDI..106	1298
CALL LINES(I7,IPAGE)	REDI..107	1299
WRITE(IWRITE,1080)	REDI..108	1300
IER=120	REDI..109	1301
CALL ERROR(XREADI,IER)	REDI..110	1302
GO TO 230	REDI..111	1303
250 CONTINUE	REDI..112	1304

UPDAT/195 12/31/79

```

      DO 260 I=1,NMDS
      IBLOCK(LOC+I)=ISTORE(I)
260  CONTINUE
      GO TO 230
C
C   READ A FLOATING FORMAT INPUT BLOCK
C
270  CONTINUE
      READ(IREAD,1090) LOC,NMDS,(FSTORE(I),I=1,5),SEQNUM
      IF(LOC.EQ.-1) GO TO 350
      CALL LINES(I1,IPAGE)
      WRITE(IWRITE,1100) LOC,NMDS,(FSTORE(I),I=1,5),SEQNUM
      IF((NMDS.GT.0).AND.(NMDS.LT.6)) GO TO 280
      CALL LINES(I7,IPAGE)
      WRITE(IWRITE,1070)
      IER=110
      CALL ERROR(XREADI,IER)
      GO TO 270
280  CONTINUE
      LOC=LOC-1
      IF((LOC.GE.0).AND.(((LOC+NMDS).LE.LENGTH(INDEX)))) GO TO 290
      CALL LINES(I7,IPAGE)
      WRITE(IWRITE,1030)
      IER=120
      CALL ERROR(XREADI,IER)
      GO TO 270
290  CONTINUE
      DO 300 I=1,NMDS
      FBLOCK(LOC+I)=FSTORE(I)
300  CONTINUE
      GO TO 270
C
C   INPUT BLOCK READ IS COMPLETE
C
C
350  CONTINUE
      CALL LINES(I1,IPAGE)
      WRITE(IWRITE,1130) LOC,SEQNUM
      IF(INDEX.GT.2) GO TO 410
C
C   STORE BLOCK IN COMMON
C
      NMDS=LENGTH(INDEX)
      GO TO (360,370), INDEX
360  CONTINUE
      CALL FEQUAT(IFPCOM,FBLOCK,NMDS)
      GO TO 420
370  CONTINUE
      CALL FEQUAT(IFLTCOM,FBLOCK,NMDS)
      GO TO 420
C
C   STORE BLOCK IN LCM
C
410  CONTINUE
      MODE=-1
      CALL DATHOV(FBLOCK,IPAK,IICH,MODE)
C

```

REDI. 113	1305
REDI. 114	1306
REDI. 115	1307
REDI. 116	1308
REDI. 117	1309
REDI. 118	1310
REDI. 119	1311
REDI. 120	1312
REDI. 121	1313
REDI. 122	1314
REDI. 123	1315
REDI. 124	1316
REDI. 125	1317
REDI. 126	1318
REDI. 127	1319
REDI. 128	1320
REDI. 129	1321
REDI. 130	1322
REDI. 131	1323
REDI. 132	1324
REDI. 133	1325
REDI. 134	1326
REDI. 135	1327
REDI. 136	1328
REDI. 137	1329
REDI. 138	1330
REDI. 139	1331
REDI. 140	1332
REDI. 141	1333
REDI. 142	1334
REDI. 143	1335
REDI. 144	1336
REDI. 145	1337
REDI. 146	1338
REDI. 147	1339
REDI. 148	1340
REDI. 149	1341
REDI. 150	1342
REDI. 151	1343
REDI. 152	1344
REDI. 153	1345
REDI. 154	1346
REDI. 155	1347
REDI. 156	1348
REDI. 157	1349
REDI. 158	1350
REDI. 159	1351
REDI. 160	1352
REDI. 161	1353
REDI. 162	1354
REDI. 163	1355
REDI. 164	1356
REDI. 165	1357
REDI. 166	1358
REDI. 167	1359
REDI. 168	1360

UPDAT/195 12/31/79

C	BRANCH TO READ NEXT INPUT BLOCK	REDI.169	1361
C		REDI.170	1362
	420 CONTINUE	REDI.171	1363
	GO TO 100	REDI.172	1364
C		REDI.173	1365
C	ALL INPUT DATA HAS BEEN LOADED	REDI.174	1366
C		REDI.175	1367
	440 CONTINUE	REDI.176	1368
	IF(IER.NE.0) CALL ERROR(XFATAL,IER)	REDI.177	1369
	RETURN	REDI.178	1370
	1000 FORMAT(A8,I4,2I6,48X,A8)	REDI.179	1371
	1010 FORMAT(5X,A8,I4,2I6,48X,A8)	REDI.180	1372
	1020 FORMAT(1H0,130(1H*),//5X,61H(READIN) THE ABOVE CARD IS NOT A LEGAL	REDI.181	1373
	1 BLOCK IDENTIFIER CARD.,/14X,62HALL CARDS UP TO THE NEXT BLOCK DEL	REDI.182	1374
	2INITER CARD WILL BE SKIPPED.,//1X,130(1H*))	REDI.183	1375
	1030 FORMAT(2I6,7A8,A4,A8)	REDI.184	1376
	1040 FORMAT(5X,2I6,7A8,A4,A8,5X,12HDATA SKIPPED)	REDI.185	1377
	1050 FORMAT(12I6,A8)	REDI.186	1378
	1060 FORMAT(5X,12I6,A8)	REDI.187	1379
	1070 FORMAT(1H0,130(1H*),//5X,66H(READIN) THE ABOVE CARD HAS AN ILLEGAL	REDI.188	1380
	1 NUMBER OF WORDS TO BE READ.,/14X,25HTHE DATA WILL BE SKIPPED.,	REDI.189	1381
	2 //1X,130(1H*))	REDI.190	1382
	1080 FORMAT(1H0,130(1H*),//5X,75H(READIN) THE ABOVE CARD REFERENCES AN	REDI.191	1383
	1ILLEGAL ADDRESS FOR THIS INPUT BLOCK.,/14X,25HTHE DATA WILL BE SKIP	REDI.192	1384
	2PPED.,//1X,130(1H*))	REDI.193	1385
	1090 FORMAT(2I6,5E12.5,A8)	REDI.194	1386
	1100 FORMAT(5X,2I6,1P5E12.5,A8)	REDI.195	1387
	1110 FORMAT(2I6,10A6,A8)	REDI.196	1388
	1120 FORMAT(5X,2I6,10A6,A8)	REDI.197	1389
	1130 FORMAT(5X,I6,66X,A8)	REDI.198	1390
	END	REDI.199	1391

UPDAT/195 12/31/79

```

C= DATO
  SUBROUTINE DATOUT
CIBM
  IMPLICIT REAL*8(A-H,O-Z)
CEND
  COMMON/INPCOM/ INPCOM(1)
  COMMON/FLTCON/ FLTCON(1)
  COMMON/      / BLOCK(1)
=CALL PACK
=CALL PTIT
=CALL IOFU
  DATA ENDJOB/8HEHDJOB /.10/0/.11/1/.13/3/,MINUS1/-1/
C
  CALL LINES(I0,IPAGE)
  CALL LINES(I3,IPAGE)
  WRITE(IWRITE,1000) (TITLE(I),I=1,9)
  WRITE(IWRITE,1000) (TITLE(I),I=10,18)
  WRITE(IWRITE,1010) NCH,IDBUGP,IPDECK
  IF(IPDECK.EQ.0) GO TO 100
  WRITE(IPDECK,1020) (TITLE(I),I=1,9)
  WRITE(IPDECK,1020) (TITLE(I),I=10,18)
  WRITE(IPDECK,1030) NCH,IDBUGP,I0
100 CONTINUE
C
C  SCH RESIDENT INPUT BLOCKS
C
  DO 160 INDEX=1,2
  CALL LINES(I1,IPAGE)
  WRITE(IWRITE,1040) BLKNAH(INDEX),NUMBLK(INDEX),I0,I0
  IF(IPDECK.NE.0) WRITE(IPDECK,1050) BLKNAH(INDEX),NUMBLK(INDEX),
  1 I0,I0
  LONG=LENGTHB(INDEX)
  GO TO (110,120), INDEX
110 CONTINUE
  LONG=IRATFI*LENGTHB(INDEX)
  CALL IOUT(INPCOM,LONG)
  GO TO 160
120 CONTINUE
  CALL FOUT(FLTCON,LONG)
  GO TO 160
160 CONTINUE
C
C  LCH RESIDENT CHANNEL DEPENDENT INPUT B'  'S
C
  MODE=1
  DO 240 IICH=1,NCH
  DO 230 INDEX=3,NBLKIN
  CALL LINES(I1,IPAGE)
  WRITE(IWRITE,1040) BLKNAH(INDEX),NUMBLK(INDEX),IICH,I0
  IF(IPDECK.NE.0) WRITE(IPDECK,1050) BLKNAH(INDEX),NUMBLK(INDEX),
  1 IICH,I0
  LONG=LENGTHB(INDEX)
  IPAK=IFK(INDEX)
  CALL OATHOV(BLOCK,IPAK,IICH,MODE)
  IF(IFORMA(INDEX).NE.0) GO TO 210
  LONG=IRATFI*LENGTHB(INDEX)

```

DATO...1	1392
DATO...2	1393
DATO...3	1394
DATO...4	1395
DATO...5	1396
DATO...6	1397
DATO...7	1398
DATO...8	1399
DATO...9	1400
DATO...10	1401
DATO...11	1402
DATO...12	1403
DATO...13	1404
DATO...14	1405
DATO...15	1406
DATO...16	1407
DATO...17	1408
DATO...18	1409
DATO...19	1410
DATO...20	1411
DATO...21	1412
DATO...22	1413
DATO...23	1414
DATO...24	1415
DATO...25	1416
DATO...26	1417
DATO...27	1418
DATO...28	1419
DATO...29	1420
DATO...30	1421
DATO...31	1422
DATO...32	1423
DATO...33	1424
DATO...34	1425
DATO...35	1426
DATO...36	1427
DATO...37	1428
DATO...38	1429
DATO...39	1430
DATO...40	1431
DATO...41	1432
DATO...42	1433
DATO...43	1434
DATO...44	1435
DATO...45	1436
DATO...46	1437
DATO...47	1438
DATO...48	1439
DATO...49	1440
DATO...50	1441
DATO...51	1442
DATO...52	1443
DATO...53	1444
DATO...54	1445
DATO...55	1446
DATO...56	1447

UPDAT/195 12/31/79

```
      CALL IOUT(BLOCK, LONG)
      GO TO 230
210  CONTINUE
      IF (IFORMA( INDEX ).NE.1) GO TO 220
      CALL FCUT(BLOCK, LONG)
      GO TO 230
220  CONTINUE
230  CONTINUE
240  CONTINUE
      CALL LINES(I1, IPAGE)
      WRITE(IWRITE, 1040) ENDJOB, MINUS1
      IF (IPDECK.NE.0) WRITE(IPDECK, 1050) ENDJOB, MINUS1
      RETURN
1000  FORMAT(5X, 9A8)
1010  FORMAT(5X, 24I3)
1020  FORMAT(9A8)
1030  FORMAT(12I6)
1040  FORMAT(5X, A8, I4, 2I6)
1050  FORMAT(A2, I4, 2I6)
      END
```

DATO..57	1448
DATO..58	1449
DATO..59	1450
DATO..60	1451
DATO..61	1452
DATO..62	1453
DATO..63	1454
DATO..64	1455
DATO..65	1456
DATO..66	1457
DATO..67	1458
DATO..68	1459
DATO..69	1460
DATO..70	1461
DATO..71	1462
DATO..72	1463
DATO..73	1464
DATO..74	1465
DATO..75	1466
DATO..76	1467

UPDAT/195 12/31/79

C= FOUT	FOUT...1	1468
SUBROUTINE FOUT(BLOCK, LONG)	FOUT...2	1469
CIDM	FOUT...3	1470
IMPLICIT REAL*8(A-H,O-Z)	FOUT...4	1471
CEND	FOUT...5	1472
=CALL PACK	FOUT...6	1473
=CALL IOFU	FOUT...7	1474
DIMENSION CARD(5), BLOCK(1)	FOUT...8	1475
DATA I1/1/, MINUS1/-1/	FOUT...9	1476
K2=0	FOUT...10	1477
100 CONTINUE	FOUT...11	1478
IF(K2.EQ.LONG) GO TO 120	FOUT...12	1479
K1=K2+1	FOUT...13	1480
K2=MIN0(K2+5, LONG)	FOUT...14	1481
IEND=K2-K1+1	FOUT...15	1482
IPT=0	FOUT...16	1483
DO 110 I=1, IEND	FOUT...17	1484
CARD(I)=BLOCK(K1+I-1)	FOUT...18	1485
IF(CARD(I).EQ.0.000) GO TO 110	FOUT...19	1486
IPT=1	FOUT...20	1487
110 CONTINUE	FOUT...21	1488
IF(IPT.EQ.0) GO TO 100	FOUT...22	1489
CALL LINES(I1, IPAGE)	FOUT...23	1490
WRITE(IWRITE, 1000) K1, IEND, (CARD(I), I=1, IEND)	FOUT...24	1491
IF(IPDECK.NE.0) WRITE(IPDECK, 1010) K1, IEND, (CARD(I), I=1, IEND)	FOUT...25	1492
1000 FORMAT(5X, 2I6, 1P6E12.5)	FOUT...26	1493
1010 FORMAT(2I6, 1P6E12.5)	FOUT...27	1494
GO TO 100	FOUT...28	1495
120 CONTINUE	FOUT...29	1496
CALL LINES(I1, IPAGE)	FOUT...30	1497
WRITE(IWRITE, 1000) MINUS1	FOUT...31	1498
IF(IPDECK.NE.0) WRITE(IPDECK, 1010) MINUS1	FOUT...32	1499
RETURN	FOUT...33	1500
END	FOUT...34	1501

UPDAT/195 12/31/79

```

C* IOUT
SUBROUTINE IOUT(IBLOCK, LONG)
CIBH
IMPLICIT REAL*8(A-H,O-Z)
CEND
*CALL PACK
*CALL IOPU
DIMENSION ICARD(10), IBLOCK(1)
DATA I1/1/, MINUS1/-1/
K2=0
100 CONTINUE
IF(K2.EQ.LONG) GO TO 120
K1=K2+1
K2=MIN0(K2+10, LONG)
IEND=K2-K1+1
IPT=0
DO 110 I=1, IEND
ICARD(I)=IBLOCK(K1+I-1)
IF(ICARD(I).EQ.0) GO TO 110
IPT=1
110 CONTINUE
IF(IPT.EQ.0) GO TO 100
CALL LINES(I1, IPAGE)
WRITE(IHWRITE, 1000) K1, IEND, (ICARD(I), I=1, IEND)
IF(IPDECK.NE.0) WRITE(IPDECK, 1010) K1, IEND, (ICARD(I), I=1, IEND)
1000 FORMAT(5X, I2I6)
1010 FORMAT(12I6)
GO TO 100
120 CONTINUE
CALL LINES(I1, IPAGE)
WRITE(IHWRITE, 1000) MINUS1
IF(IPDECK.NE.0) WRITE(IPDECK, 1010) MINUS1
RETURN
END

```

IOUT...1	1502
IOUT...2	1503
IOUT...3	1504
IOUT...4	1505
IOUT...5	1506
IOUT...6	1507
IOUT...7	1508
IOUT...8	1509
IOUT...9	1510
IOUT...10	1511
IOUT...11	1512
IOUT...12	1513
IOUT...13	1514
IOUT...14	1515
IOUT...15	1516
IOUT...16	1517
IOUT...17	1518
IOUT...18	1519
IOUT...19	1520
IOUT...20	1521
IOUT...21	1522
IOUT...22	1523
IOUT...23	1524
IOUT...24	1525
IOUT...25	1526
IOUT...26	1527
IOUT...27	1528
IOUT...28	1529
IOUT...29	1530
IOUT...30	1531
IOUT...31	1532
IOUT...32	1533
IOUT...33	1534
IOUT...34	1535

UPDAT/195 12/31/79

C= RPRO	RPRO...1	1536
SUBROUTINE RPROF	RPRO...2	1537
CIBM	RPRO...3	1538
IMPLICIT REAL*8(A-H,O-Z)	RPRO...4	1539
CEND	RPRO...5	1540
*CALL INPC	RPRO...6	1541
*CALL FLTC	RPRO...7	1542
*CALL TCOM	RPRO...8	1543
C	RPRO...9	1544
C THIS SUBROUTINE CALCULATES RADIAL TEMPERATURE PROFILES OVER THE SUB-	RPRO...10	1545
C ASSEMBLY. IT IS CURRENTLY USED ONLY TO PROVIDE HOT CHANNEL PEAKING	RPRO...11	1546
C FACTORS FOR LINCH.	RPRO...12	1547
C	RPRO...13	1548
IF(ICH.NE.1) RETURN	RPRO...14	1549
Y=1.-2.*EPSCT/(ANT+2.)	RPRO...15	1550
RHOBAR=(2./(ANT+2.))* (1./ANT)	RPRO...16	1551
RHOEV=RHOBAR	RPRO...17	1552
RETURN	RPRO...18	1553
END	RPRO...19	1554

UPDAT/195 12/31/79

C* CPFU	CPFU...1	1555
FUNCTION CPI'UNC(X)	CPFU...2	1556
CIBH	CPFU...3	1557
IMPLICIT REAL*8 (A-H,O-Z)	CPFU...4	1558
CEND	CPFU...5	1559
C	CPFU...6	1560
C THIS FUNCTION DEFINES THE TEMPERATURE DEPENDENCE OF THE COOLANT HEAT	CPFU...7	1561
C CAPACITY. SEE ANL-8138, THE SAS2A MANUAL.	CPFU...8	1562
C	CPFU...9	1563
CPFURIC=1.0D-6*(1.256+4.64D-7*(X-621.0)**2)	CPFU...10	1564
RETURN	CPFU...11	1565
END	CPFU...12	1566

UPDAT/195 12/31/79

C= FITZ	FITZ...1	1567
SUBROUTINE FITZ(Y,X,DT,DTP)	FITZ...2	1568
CIBM	FITZ...3	1569
IMPLICIT REAL*8(A-H,O-Z)	FITZ...4	1570
CEND	FITZ...5	1571
DIMENSION X(3),Y(3)	FITZ...6	1572
C	FITZ...7	1573
C THIS SUBROUTINE CALCULATES THE COEFFICIENTS Y(I) FOR A QUADRATIC GIVEN	FITZ...8	1574
C THE VALUES X(I) AT -DTP,0, AND DT	FITZ...9	1575
C	FITZ...10	1576
Y(1)=X(2)	FITZ...11	1577
Y(2)=((X(2)-X(1))*DT/DTP+(X(3)-X(2))*DTP/DT)/(DT+DTP)	FITZ...12	1578
Y(3)=((X(3)-X(2))/DT-(X(2)-X(1))/DTP)/(DT+DTP)	FITZ...13	1579
RETURN	FITZ...14	1580
END	FITZ...15	1581

UPDAT/195 12/31/79

C= WPUM	WPUM...1	1582
SUBROUTINE WPUMP	WPUM...2	1583
CIBM	WPUM...3	1584
IMPLICIT REAL*8(A-H,O-Z)	WPUM...4	1585
CEND	WPUM...5	1586
C	WPUM...6	1587
C THIS SUBROUTINE CALCULATES FLOW PARAMETERS GIVEN THE PUMP COASTDOWN	WPUM...7	1588
C IT IS NOT CURRENTLY AVAILABLE.	WPUM...8	1589
C	WPUM...9	1590
RETURN	WPUM...10	1591
END	WPUM...11	1592

C=	WTIM	WTIM...1	1593
	SUBROUTINE WTIME(TIM)	WTIM...2	1594
CIBM		WTIM...3	1595
	IMPLICIT REAL*8(A-H,O-Z)	WTIM...4	1596
CEND		WTIM...5	1597
*CALL	BLNC	WTIM...6	1598
*CALL	INPC	WTIM...7	1599
*CALL	FLTC	WTIM...8	1600
*CALL	TCON	WTIM...9	1601
*CALL	IOPU	WTIM...10	1602
C		WTIM...11	1603
C	THIS SUBROUTINE CALCULATES FLOW PARAMETERS GIVEN THE FLOW COASTDOWN.	WTIM...12	1604
C	AFTER VOIDING WTIME ASSUMES FLOW HELD AT INITIATION OF VOIDING VALUE.	WTIM...13	1605
C	FOR FLOW REVERSAL EFFECT WPUMP MUST BE CALLED.	WTIM...14	1606
C		WTIM...15	1607
	IF(IWUMP.EQ.1) GO TO 140	WTIM...16	1608
	TSAV=TIM	WTIM...17	1609
	IF(TIM) 120,120,100	WTIM...18	1610
100	CONTINUE	WTIM...19	1611
	IF(TIM.GT.VDFRST+DFQUIT) TIM=VDFRST+DFQUIT	WTIM...20	1612
110	CONTINUE	WTIM...21	1613
	T2=TIM+TIM	WTIM...22	1614
	T3=TIM+T2	WTIM...23	1615
	A=A1+TIM+A2+T2+A3+T3	WTIM...24	1616
	W=WZERO+EXAEX	WTIM...25	1617
	WEX=WZERO+EXAEX	WTIM...26	1618
C	LIMIT FLOW DECAY DURING VOIDING	WTIM...27	1619
	IF(TIM.EQ.VDFRST+DFQUIT) W=WZERO+DEXP(A)	WTIM...28	1620
	IF(TIM.EQ.VDFRST+DFQUIT) WEX=W	WTIM...29	1621
	G=W/AS	WTIM...30	1622
	GCH=G	WTIM...31	1623
	WCH=W	WTIM...32	1624
	PMCH=P/W+1.0+6	WTIM...33	1625
	CPW=CP+W	WTIM...34	1626
	IF(TIM.LE.0T) GO TO 130	WTIM...35	1627
	ADOT=A1+2.*A2+TIM+3.*A3+T2	WTIM...36	1628
	ADTDT=2.*A2+6.*A3+TIM	WTIM...37	1629
	WDT=W+ADOT	WTIM...38	1630
	WDTW=ADOT	WTIM...39	1631
	WDTDT=ADTDT	WTIM...40	1632
	COFMDW=C0*(PDOTP-WDTW)/W	WTIM...41	1633
	IF(ICH.NE.1) GO TO 115	WTIM...42	1634
	IF(IDBUG.NE.2) GO TO 115	WTIM...43	1635
	WRITE(IWRITE,1000)	WTIM...44	1636
	WRITE(IWRITE,1001) TIM,W,ADOT,C0,PDOTP,WZERO	WTIM...45	1637
115	CONTINUE	WTIM...46	1638
	TIM=TSAV	WTIM...47	1639
	RETURN	WTIM...48	1640
120	CONTINUE	WTIM...49	1641
	ZERO=0.000	WTIM...50	1642
	A=ZERO	WTIM...51	1643
	ADOT=ZERO	WTIM...52	1644
	ADTDT=ZERO	WTIM...53	1645
	W=WZERO	WTIM...54	1646
	G=W/AS	WTIM...55	1647
	GCH=G	WTIM...56	1648

12/31/79

WTIH..57	1649
WTIH..58	1650
WTIH..59	1651
WTIH..60	1652
WTIH..61	1653
WTIH..62	1654
WTIH..63	1655
WTIH..64	1656
WTIH..65	1657
WTIH..66	1658
WTIH..67	1659
WTIH..68	1660
WTIH..69	1661
WTIH..70	1662
WTIH..71	1663
WTIH..72	1664
WTIH..73	1665
5WTIH..74	1666
WTIH..75	1667
WTIH..76	1668
WTIH..77	1669

UPDAT/195 12/31/79

```

C* INIT
  SUBROUTINE INITIAL
CIBM  IMPLICIT REAL*8(A-H,O-Z)
CEND
*CALL BLNC
*CALL INPC
*CALL FLTC
*CALL TCOM
*CALL IOPU
*CALL PTIT
*CALL PACK
  DATA IO/O/
C
C THIS SUBROUTINE INITIALIZES PARAMETERS AND EDITS KINETICS DATA.
C
  TIME=0.000
  PI=4.*DATAN(1.000)
  ICASE=1
C INITIALIZE COMMON BLOCK/POWER2/
  DO 100 I=1,100
  100 A0(I)=0.000
C INITIALIZE COMMON BLOCK/TEMP/
  DO 110 I=1,403
  110 A00(I,1)=0.000
    CALL LINES(I0,IPAGE)
    WRITE(IWRITE,1040) ICASE,(TITLE(I),I=1,9)
    WRITE(IWRITE,1050) NCH
    IF(ICASE.EQ.1)
      WRITE(IWRITE,1000)
      DO 120 I=1,NDELAY
      EBETA(I)=BETA(I)/EL
      CO(I)=EBETA(I)/ALAM(I)
      C(I)=CO(I)
      IF(ICASE.EQ.1)
        WRITE(IWRITE,1010) I,BETA(I),ALAM(I),C(I)
  120 BETAS=BETAS+BETA(I)
    BETABR=BETAS
    BETINV=1./BETABR
    DO 130 I=1,5
    OI=DFLOAT(I)
  130 A0(I)=1.0/OI
    EPS1=0.1*EPSPHI
    BETAG=1.0
    PHIBET=1.0
    FIN=1.0
    FFACT=1.0
    FERMIN=1.0
    EDPSS=1.0
    BETSS=1.0
    FFSS=1.0
    PBSS=1.0
    BPSS=1.0
    VHGAP=1.0
    VKF=1.0
    VVRAT=1.0

```

INIT...1	1670
INIT...2	1671
INIT...3	1672
INIT...4	1673
INIT...5	1674
INIT...6	1675
INIT...7	1676
INIT...8	1677
INIT...9	1678
INIT..10	1679
INIT..11	1680
INIT..12	1681
INIT..13	1682
INIT..14	1683
INIT..15	1684
INIT..16	1685
INIT..17	1686
INIT..18	1687
INIT..19	1688
INIT..20	1689
INIT..21	1690
INIT..22	1691
INIT..23	1692
INIT..24	1693
INIT..25	1694
INIT..26	1695
INIT..27	1696
INIT..28	1697
INIT..29	1698
INIT..30	1699
INIT..31	1700
INIT..32	1701
INIT..33	1702
INIT..34	1703
INIT..35	1704
INIT..36	1705
INIT..37	1706
INIT..38	1707
INIT..39	1708
INIT..40	1709
INIT..41	1710
INIT..42	1711
INIT..43	1712
INIT..44	1713
INIT..45	1714
INIT..46	1715
INIT..47	1716
INIT..48	1717
INIT..49	1718
INIT..50	1719
INIT..51	1720
INIT..52	1721
INIT..53	1722
INIT..54	1723
INIT..55	1724
INIT..56	1725

UPDAT/195 12/31/79

```

      VBURN=1.0
      VCPF=1.0
      VRHOD=1.0
      VRHOV=1.0
      VFAIL=1.0
      IMAX=1
      IVDHAX=0
      IVARY=1
      PHI=1.0
      PHIP=1.0
      PHIPF=PHIP
      POOTP=PHIDOT
      POWFS=1.0-DKYLOS
      POWFSP=POWFS
      POWDKP=DKYLOS
      POWDKP=POWDKP
      IF(IHDKGRP.LE.0) GO TO 150
      DO 140 I=1,IHDKGRP
      BETAH(I)=BETAH(I)
      DKHETP(I)=BETAH(I)*POWFSP/DKLAH(I)
      DKHET(I)=DKHETP(I)
140  CONTINUE
150  CONTINUE
      IF(ICASE.EQ.1)
      1WRITE(IWRITE, 1020) BETAS,PHIP,DKYLOS
      IF(IHDKGRP.LE.0) GO TO 170
      IF(ICASE.GT.1) GO TO 170
      1WRITE(IWRITE, 1030) IHDKGRP
      DO 160 I=1,IHDKGRP
160  1WRITE(IWRITE, 1010) I,BETAH(I),DKLAH(I)
170  CONTINUE
      KPOH=1
      ITOA=0
      IVOIDT=0
      LTVOID=0
      ICH=0
      IFH=0
      VCFIRST=1000.000
      VOLAST=1000.000
      CALL PROP1 TO OBTAIN MATERIAL PROPERTIES
      CALL PROP1
      CALL PROPE TO EDIT MATERIAL PROPERTIES.
      CALL PROPE
      NCHAN=NCH
      NNPAK=3
      DO 190 ICH=1,NCHAN
      MODE=1
      CALL DATHOV TO MOVE DATA FROM LCH FOR CHANNEL ICH.
      CALL DATHOV(MSACH,NNPAK,ICH,MODE)
      MZ=MZS
      CALL ZINIT TO GET Z-DEPENDENT PROPERTIES.
      CALL ZINIT
      C DEFAULT FOR ZVOID0
      ZVOID0=DMAX1(ZVOID0,ZZ)
      ZNAUF=ZVOID0
      ZNADMI=ZVOID0

```

```

INIT..57 1726
INIT..58 1727
INIT..59 1728
INIT..60 1729
INIT..61 1730
INIT..62 1731
INIT..63 1732
INIT..64 1733
INIT..65 1734
INIT..66 1735
INIT..67 1736
INIT..68 1737
INIT..69 1738
INIT..70 1739
INIT..71 1740
INIT..72 1741
INIT..73 1742
INIT..74 1743
INIT..75 1744
INIT..76 1745
INIT..77 1746
INIT..78 1747
INIT..79 1748
INIT..80 1749
INIT..81 1750
INIT..82 1751
INIT..83 1752
INIT..84 1753
INIT..85 1754
INIT..86 1755
INIT..87 1756
INIT..88 1757
INIT..89 1758
INIT..90 1759
INIT..91 1760
INIT..92 1761
INIT..93 1762
INIT..94 1763
INIT..95 1764
INIT..96 1765
INIT..97 1766
INIT..98 1767
INIT..99 1768
INIT.100 1769
INIT.101 1770
INIT.102 1771
INIT.103 1772
INIT.104 1773
INIT.105 1774
INIT.106 1775
INIT.107 1776
INIT.108 1777
INIT.109 1778
INIT.110 1779
INIT.111 1780
INIT.112 1781

```

UPDAT/195

12/31/79

ZD00=ZVOID0	INIT. 113	1782
ZD0=ZD00	INIT. 114	1783
ZDU=ZD00	INIT. 115	1784
ZDL=ZD00	INIT. 116	1785
ZFNOV=Z1+.5*AH1-ASY	INIT. 117	1786
ZHFL=ZFNOV	INIT. 118	1787
ZHFU=ZFNOV	INIT. 119	1788
GCHV=1000.	INIT. 120	1789
HCHV=1000.	INIT. 121	1790
PHCHV=1000.	INIT. 122	1791
HZERCH=GZERO*AS	INIT. 123	1792
PH=PZERO/HZERCH	INIT. 124	1793
IF(IVDTIN.EQ.1) VDTIME=1000.	INIT. 125	1794
FRTIME=1000.	INIT. 126	1795
TFNOV=1000.	INIT. 127	1796
IFNOV=0	INIT. 128	1797
ICHNOV=0	INIT. 129	1798
IVOID=0	INIT. 130	1799
PHIXV=1000.	INIT. 131	1800
FINTGV=1000.	INIT. 132	1801
VHF0=0.000	INIT. 133	1802
IF(ADOP.NE.0.000) BDOF=1.000-BDOF/ADOP	INIT. 134	1803
SUM=0.000	INIT. 135	1804
DO 175 J=NZR2L,NZR2U	INIT. 136	1805
SUM=SUM+HDOF(J)	INIT. 137	1806
175 CONTINUE	INIT. 138	1807
IF(SUM.EQ.0.000) GO TO 177	INIT. 139	1808
SUM=1.000/SUM	INIT. 140	1809
DO 176 J=1,NZ	INIT. 141	1810
HDOF(J)=HDOF(J)*SUM	INIT. 142	1811
176 CONTINUE	INIT. 143	1812
177 CONTINUE	INIT. 144	1813
DO 180 J=1,NZ	INIT. 145	1814
TCSV(J)=TCOOLZ(1)	INIT. 146	1815
TCLSV(J)=TCOOLZ(1)	INIT. 147	1816
TFSV(J)=TCOOLZ(1)	INIT. 148	1817
FRACTC(J)=1.000	INIT. 149	1818
DOTIME(J)=1000.	INIT. 150	1819
CHTIME(J)=1000.	INIT. 151	1820
FHTIME(J)=1000.	INIT. 152	1821
180 CONTINUE	INIT. 153	1822
CALL DATNOV TO WRITE DATA INTO LCH FOR CHANNEL ICH	INIT. 154	1823
MODE=-1	INIT. 155	1824
CALL DATNOV(11SACH,MNPAK,ICH,MODE)	INIT. 156	1825
190 CONTINUE	INIT. 157	1826
RETURN	INIT. 158	1827
1000 FORMAT(//50X,31H***** POINT KINETICS DATA *****,	INIT. 159	1828
1 ///52X,26HDELAYED NEUTRON PRECURSORS,	INIT. 160	1829
2 ///37X,58HFAMILY BETAI) LAMBOA(I) CO(	INIT. 161	1830
31),/)	INIT. 162	1831
1010 FORMAT(34X,I6,3I5X,1PE14.5))	INIT. 163	1832
1020 FORMAT(//45X,20HTOTAL EFFECTIVE BETA,5X,1PE14.5,	INIT. 164	1833
1/45X,22HNORMALIZED TOTAL POWER,3X,1PE14.5,/45X,22HNORMALIZED DECAY	INIT. 165	1834
2 POWER,3X,1PE14.5)	INIT. 166	1835
1030 FORMAT(45X,22HNUMBER OF DECAY GROUPS,6X,I3,///51X,27H***** DECAY H	INIT. 167	1836
1EAT DATA *****//38X,5HGROUP,6X,9HBETAI(I),12X,8HDKLAN(I),/)	INIT. 168	1837

UPDAT/195 12/31/79

1040	FORMAT(1H0,129(1H*))//5H CASE,I5,46X,17HSACO WELCOMES YOU,//53X,24H	INIT.169	1838
	1THIS PROBLEM IS ENTITLED//29X,9A8,//1X,129(1H*))	INIT.170	1839
1050	FORMAT(1H0,48X,16HTHIS PROBLEM HAS,I3,15H FLOW CHANNELS.)	INIT.171	1840
	END	INIT.172	1841

UPDAT/195 12/31/79

```

C= TINS
SUBROUTINE TINSET
CIBM IMPLICIT REAL*8(A-H,O-Z)
CEND
=CALL BLNC
=CALL INPC
=CALL FLTC
=CALL TCOM
=CALL IOPU
DIMENSION FPCOE(3),FPEST(3)
C
C THIS SUBROUTINE CALCULATES INLET TEMPERATURES TO THE AXIAL REGIONS.
C
CALCULATE INLET TEMPERATURE TO AXIAL REGION 2
PZ=PZ1LZ*PHIX
PZINT=PZNT1Z*PHIX
THETA=THET1Z
FPTC=FIN
TINC=FPTC*PZINT*BETPHI/CPH
TCOOLZ(1)=TIN
TCOOLZ(2)=TCOOLZ(1)+TINC
CALCULATE INLET TEMPERATURE TO AXIAL REGION 3
DO 100 J=1,2
JJ=NZR2U-2+J
THETA=THETAZ(JJ)
FPTC0=1./(1.+COPMDW*THETA)
FPEST(J)=FPTC0*PZINTZ(JJ)
100 CONTINUE
THETA=THET2Z
FPTC0=1./(1.+COPMDW*THETA)
FPEST(3)=FPTC0*PZNT2Z
DTFUT=AZ(NZR2U)-AZ(NZR2U-1)
DTFUT=Z2-AZ(NZR2U)
CALL FITZ TO OBTAIN FPTC*PZINT APPROXIMATION
CALL FITZ(FPCOE,FPEST,DTFUT,DTFUT)
ZTHAX=-.5*FPCOE(2)/FPCOE(3)
ZTHAX=DHIN1(ZTHAX,Z2-AZ(NZR2U))
FPMAX=FPCOE(1)+ZTHAX*(FPCOE(2)+FPCOE(3)+ZTHAX)
ZTHAX=ZTHAX+AZ(NZR2U)
PZTHAX=PFRAC2*PZERO/(CXZ120-CXZ220)*(CXZ120
1-DCOS(X*(ZTHAX-Z0)))
FPMAX=DHIN1(FPMAX,PZTHAX)
FBRMIN=FPMAX/PZTHAX
FBCPH=FFACT*BETAG/CPH
C FBRMIN MODEL
TINC=FBRMIN*PZNT2Z*FB*PH
C FPMAX MODEL
IF(1FFMAX.EQ.1)
TINC=FPMAX*FBCPH
TCOOLZ(3)=TCOOLZ(2)+TINC
IF(1DBUG.NE.1) RETURN
C DEBUG ROUTINE
IF(TIME.LE.0.D0) RETURN
IF(1CH.GT.1) RETURN
WRITE(1WRITE, 1000)

```

TINS...1	1842
TINS...2	1843
TINS...3	1844
TINS...4	1845
TINS...5	1846
TINS...6	1847
TINS...7	1848
TINS...8	1849
TINS...9	1850
TINS...10	1851
TINS...11	1852
TINS...12	1853
TINS...13	1854
TINS...14	1855
TINS...15	1856
TINS...16	1857
TINS...17	1858
TINS...18	1859
TINS...19	1860
TINS...20	1861
TINS...21	1862
TINS...22	1863
TINS...23	1864
TINS...24	1865
TINS...25	1866
TINS...26	1867
TINS...27	1868
TINS...28	1869
TINS...29	1870
TINS...30	1871
TINS...31	1872
TINS...32	1873
TINS...33	1874
TINS...34	1875
TINS...35	1876
TINS...36	1877
TINS...37	1878
TINS...38	1879
TINS...39	1880
TINS...40	1881
TINS...41	1882
TINS...42	1883
TINS...43	1884
TINS...44	1885
TINS...45	1886
TINS...46	1887
TINS...47	1888
TINS...48	1889
TINS...49	1890
TINS...50	1891
TINS...51	1892
TINS...52	1893
TINS...53	1894
TINS...54	1895
TINS...55	1896
TINS...56	1897

UPDAT/195 12/31/79

```
      WRITE(IWRITE, 1010) ZTHAX,FPMAX,PZTHAX,FBRMIN,TINC,TCOOLZ(2),
1FPEST(1),FPEST(2),FPEST(3),PZINT
      RETURN
1000 FORMAT(1H0,7X,5HZTHAX,8X,5HFPMAX,7X,6HPZTHAX,7X,6HFBRMIN
1,9X,4HTINC,9X,4HTIN2,7X,6HFPEST1,7X,6HFPEST2,7X,6HFPEST3
2,7X,6HPZNTZZ)
1010 FORMAT(10D13.5)
      END
```

```
TINS..57      1898
TINS..58      1899
TINS..59      1900
TINS..60      1901
TINS..61      1902
TINS..62      1903
TINS..63      1904
TINS..64      1905
```

UPDAT/195 12/31/79

```

C* ZINI
  SUBROUTINE ZINIT
C10M  IMPLICIT REAL*8(A-H,O-Z)
CEND
*CALL BLNC
*CALL INPC
*CALL FLTC
*CALL TCON
*CALL IOPU
C
C
C ZINIT--THIS SUBROUTINE INITIALIZES Z-DEPENDENT VARIABLES
C
  HZ=HZS
  NZR2L=NZS1+1
  NZR2U=NZS1+NZS2
  NZR3L=NZR2U+1
  ANFR11=ANFR1+1.
  ANFR31=ANFR3+1.
  Z0=Z1-EXL-ASY
  Z12=Z1*Z1
  Z22=Z2*Z2
  Z32=Z3*Z3
  PFRAC2=1.000-PFRAC3-PFRAC1
  X=PI/(AHT+2.*EXL)
  CXZ120=DCOS(X*(Z1-Z0))
  CXZ220=DCOS(X*(Z2-Z0))
  SXZ120=DSIN(X*(Z1-Z0))
  SXZ220=DSIN(X*(Z2-Z0))
  XX=CXZ120-CXZ220
  DELZ=Z1/DFLOAT(NZS1)
  DO 100 J=1,NZS1
    AXHI(J)=DELZ
100 CONTINUE
  DELZ=(Z2-Z1)/DFLOAT(NZS2)
  DO 110 J=NZR2L,NZR2U
    AXHI(J)=DELZ
110 CONTINUE
  DELZ=(Z3-Z2)/DFLOAT(NZS-NZS1-NZS2)
  DO 120 J=NZR3L,NZS
    AXHI(J)=DELZ
120 CONTINUE
  AZ(1)=AXHI(1)/2.0
  DO 130 J=2,HZ
    AZ(J)=(AZ(J-1)+(AXHI(J-1)+AXHI(J))/2.0
130 CONTINUE
  DO 140 I=NZR2L,NZR2U
    SXZZ0Z(I)=DSIN(X*(AZ(I)-Z0))
    CXZZ0Z(I)=DCOS(X*(AZ(I)-Z0))
140 CONTINUE
  PZCOF1=PFRAC1*PZERO*ANFR11/Z1**ANFR11
  PZCOF3=PFRAC3*PZERO*ANFR31/(Z3-Z2)**ANFR31
  PA=PFRAC2*PZERO*X/XX
  PZ1LZ=PZCOF1*Z1*ANFR1
  PZ1LZ=PFRAC1*PZERO

```

ZINI...1	1906
ZINI...2	1907
ZINI...3	1908
ZINI...4	1909
ZINI...5	1910
ZINI...6	1911
ZINI...7	1912
ZINI...8	1913
ZINI...9	1914
ZINI...10	1915
ZINI...11	1916
ZINI...12	1917
ZINI...13	1918
ZINI...14	1919
ZINI...15	1920
ZINI...16	1921
ZINI...17	1922
ZINI...18	1923
ZINI...19	1924
ZINI...20	1925
ZINI...21	1926
ZINI...22	1927
ZINI...23	1928
ZINI...24	1929
ZINI...25	1930
ZINI...26	1931
ZINI...27	1932
ZINI...28	1933
ZINI...29	1934
NI...30	1935
NI...31	1936
ZINI...32	1937
ZINI...33	1938
ZINI...34	1939
ZINI...35	1940
ZINI...36	1941
ZINI...37	1942
ZINI...38	1943
ZINI...39	1944
ZINI...40	1945
ZINI...41	1946
ZINI...42	1947
ZINI...43	1948
ZINI...44	1949
ZINI...45	1950
ZINI...46	1951
ZINI...47	1952
ZINI...48	1953
ZINI...49	1954
ZINI...50	1955
ZINI...51	1956
ZINI...52	1957
ZINI...53	1958
ZINI...54	1959
ZINI...55	1960
ZINI...56	1961

UPDAT/195 12/31/79

	PZ2RZ=PA* $SXZ2Z0$	ZINI..57	1962
	PZNT2Z=PFRAC2*PZERO	ZINI..58	1963
	PZNT3Z=PFRAC3*PZERO	ZINI..59	1964
	THET1Z=PZIT1Z/PZ1LZ	ZINI..60	1965
	THET2Z=PZNT2Z/PZ2RZ	ZINI..61	1966
	DO 150 J=1,NZS1	ZINI..62	1967
	ASLOPE=PZERO*FRACP1*2./Z12	ZINI..63	1968
	PZZ(J)=PZCOF1*AZ(J)**ANFR1	ZINI..64	1969
	PZINTZ(J)=PZCOF1/ANFR11*AZ(J)**ANFR11	ZINI..65	1970
	THETAZ(J)=PZINTZ(J)/PZZ(J)	ZINI..66	1971
150	CONTINUE	ZINI..67	1972
	DO 160 J=NZR2L,NZR2U	ZINI..68	1973
	PZZ(J)=PA* $SXZZ0Z(J)$	ZINI..69	1974
	PZINTZ(J)=PA/X*($CXZ1Z0-CXZZ0Z(J)$)	ZINI..70	1975
	THETAZ(J)=PZINTZ(J)/PZZ(J)	ZINI..71	1976
160	CONTINUE	ZINI..72	1977
	DO 170 J=NZR3L,NZ	ZINI..73	1978
	BSLOPE=PZERO*FRACP3*2./(Z22-Z32)	ZINI..74	1979
	PZZ(J)=PZCOF3*(Z3-AZ(J))**ANFR3	ZINI..75	1980
	PZINTZ(J)=-PZCOF3/ANFR31*(Z3-AZ(J))**ANFR31-(Z3-Z2)**ANFR31	ZINI..76	1981
	THETAZ(J)=PZINTZ(J)/PZZ(J)	ZINI..77	1982
170	CONTINUE	ZINI..78	1983
180	CONTINUE	ZINI..79	1984
	RETURN	ZINI..80	1985
	END	ZINI..81	1986

UPDAT/195 12/31/79

```

C* SSCA
  SUBROUTINE SSCALC
CIBH  IMPLICIT REAL*8(A-H,O-Z)
CEND
*CALL BLNC
*CALL INPC
*CALL FLTC
*CALL TCOM
*CALL IOFU
*CALL PTIT
  DATA IO/0/
C
C THIS SUBROUTINE PERFORMS STEADY STATE CALCULATIONS
C
  DTSAB=DT
C AVOID REDUNDANT EDITING
  INOSS=INOSS
  IF(ICASE.LE.1) GO TO 100
  I=INGAP+IKF+ICPF
  IF(I.NE.0) GO TO 100
  INOSS=1
100 CONTINUE
  TIME=.1
  PHIX=1.
  PINTG=1.
  IF(TIME.LE.0.) GO TO 110
  BETAG=PINTG/(TIME+DT)
  GO TO 120
110 BETAG=PHIX
120 CONTINUE
  FFACT=1.00
  FFSS=1.00
  FBRHIN=1.00
  PHIBET=PHIX/BETAG
  BETPHI=1./PHIBET
  DO 210 ICH=1,NCHAN
CALL DATMOV TO TRANSFER DATA FROM LCM TO COMMON.
  NNPAK=3
  MODE=1
  CALL DATMOV(INSACH,NNPAK,ICH,MODE)
CALL RPROF TO GET RADIAL TEMPERATURE PROFILES.
  CALL RPROF
  P=PZERO
  WZERO=GZERO*AS
  CALL POWER
  CALL WTIME(TIME)
  CALL TINSET
  CCC=0.0
  DDD=0.0
  EEE=0.0
  DO 125 J=1,NZ
  CCC=CCC+VOIREA(J)
  DDD=DDD+WORTH(J)
  EEE=EEE+WORTHF(J)
125 CONTINUE

```

SSCA...1	1987
SSCA...2	1988
SSCA...3	1989
SSCA...4	1990
SSCA...5	1991
SSCA...6	1992
SSCA...7	1993
SSCA...8	1994
SSCA...9	1995
SSCA...10	1996
SSCA...11	1997
SSCA...12	1998
SSCA...13	1999
SSCA...14	2000
SSCA...15	2001
SSCA...16	2002
SSCA...17	2003
SSCA...18	2004
SSCA...19	2005
SSCA...20	2006
SSCA...21	2007
SSCA...22	2008
SSCA...23	2009
SSCA...24	2010
SSCA...25	2011
SSCA...26	2012
SSCA...27	2013
SSCA...28	2014
SSCA...29	2015
SSCA...30	2016
SSCA...31	2017
SSCA...32	2018
SSCA...33	2019
SSCA...34	2020
SSCA...35	2021
SSCA...36	2022
SSCA...37	2023
SSCA...38	2024
SSCA...39	2025
SSCA...40	2026
SSCA...41	2027
SSCA...42	2028
SSCA...43	2029
SSCA...44	2030
SSCA...45	2031
SSCA...46	2032
SSCA...47	2033
SSCA...48	2034
SSCA...49	2035
SSCA...50	2036
SSCA...51	2037
SSCA...52	2038
SSCA...53	2039
SSCA...54	2040
SSCA...55	2041
SSCA...56	2042

UPDAT/195 12/31/79

C NOTE TREATMENT OF BDOP AS IT IS TRANSFERRED FROM SAS	SSCA..57	2043
DDOP=ADOP*(1.-BDOP)	SSCA..58	2044
IF(IH0SS.EQ.1) GO TO 130	SSCA..59	2045
IPRNCH=ICH	SSCA..60	2046
CALL LINES(I0,IPAGE)	SSCA..61	2047
WRITE(IWRITE,1000) ICH,PZERO,PW,PFRAC3,ADOP,PFRAC2,DDOP,PFRAC1,	SSCA..62	2048
ICCC,GZERO,DDD,HZERCH,EEE	SSCA..63	2049
WRITE(IWRITE,1010)	SSCA..64	2050
130 CONTINUE	SSCA..65	2051
DO 140 J=1,MZ	SSCA..66	2052
JJ=J	SSCA..67	2053
IZ=J	SSCA..68	2054
CALL PTEMPZ(JJ,TFUEL)	SSCA..69	2055
TREF(J)=TFUEL	SSCA..70	2056
TBAR(J)=TREF(J)	SSCA..71	2057
TCOOL(J)=TAVG	SSCA..72	2058
TCSS(J)=TAVG	SSCA..73	2059
TCLSS(J)=TAVG+PZ*(COLRES+.5*CLDRES)	SSCA..74	2060
TCLAD(J)=TCLSS(J)	SSCA..75	2061
TFSS(J)=TFUEL	SSCA..76	2062
TCSV(J)=TCSS(J)	SSCA..77	2063
TCLSV(J)=TCLSS(J)	SSCA..78	2064
TFSV(J)=TFSS(J)	SSCA..79	2065
DTDZ0(J)=PZZ(J)/(CP*HZERO)	SSCA..80	2066
DTTIN0(J)=TCSS(J)-TCOOLZ(1)	SSCA..81	2067
DTDZT0(J)=DTDZ0(J)/DTTIN0(J)	SSCA..82	2068
140 CONTINUE	SSCA..83	2069
DO 250 JK=1,MZ	SSCA..84	2070
J=JZ-JK+1	SSCA..85	2071
DTFCL=TFSV(J)-TCLSV(J)	SSCA..86	2072
ADTF=2.*DTFCL/(1.+4.*AKF/(RF*HF1CL))	SSCA..87	2073
TF0(J)=TBAR(J)+.5*ADTF	SSCA..88	2074
TF1(J)=TBAR(J)-.5*ADTF	SSCA..89	2075
TFR(J)=TBAR(J)	SSCA..90	2076
TF0SV(J)=TF0(J)	SSCA..91	2077
TF1SV(J)=TF1(J)	SSCA..92	2078
TFRSV(J)=TFR(J)	SSCA..93	2079
TAVG=TCOOL(J)	SSCA..94	2080
TFUEL=TREF(J)	SSCA..95	2081
TCL=TCLAD(J)	SSCA..96	2082
TFIN=TF0(J)	SSCA..97	2083
TFOUT=TF1(J)	SSCA..98	2084
DAVSS(J)=0.95140+00-2.3920-04*TAVG	SSCA..99	2085
DAV2(J)=DAVSS(J)	SSCA.100	2086
IF(ISUSE.GT.0) GO TO 250	SSCA.101	2087
IF(IH0SS.EQ.1) GO TO 250	SSCA.102	2088
WRITE(IWRITE,1030)AZI(J),TAVG,TCL,TFOUT,TFUEL,TFIN	SSCA.103	2089
250 CONTINUE	SSCA.104	2090
IF(ISUSE.LE.0) GO TO 180	SSCA.105	2091
DO 170 J=1,MZ	SSCA.106	2092
JJ=J	SSCA.107	2093
IZ=J	SSCA.108	2094
PZ=PZZ(J)	SSCA.109	2095
TCP=TCSV(J)	SSCA.110	2096
CPHUSE=HZERO*CPFUNC(TCP)	SSCA.111	2097
IF(J.GT.1) GO TO 150	SSCA.112	2098

	PZDIF=PZINTZ(1)	SSCA. 113	2099
	TDOWN=TCOOLZ(1)	SSCA. 114	2100
	GO TO 160	SSCA. 115	2101
150	CONTINUE	SSCA. 116	2102
	TDOWN=TCSV(J-1)	SSCA. 117	2103
	PZDIF=PZINTZ(J)-PZINTZ(J-1)	SSCA. 118	2104
	IF(J.EQ.(NZS1+1)) PZDIF=PZDIF+PZNT1Z	SSCA. 119	2105
	IF(J.EQ.(NZS1+NZS2+1)) PZDIF=PZDIF+PZNT2Z	SSCA. 120	2106
160	CONTINUE	SSCA. 121	2107
	TAVG=TDOWN+PZDIF/CPHUSE	SSCA. 122	2108
	TFUEL0=TAVG+PZ*(COLRES+CLDRES+GAPRES)	SSCA. 123	2109
	TFUEL=TFUEL0+PZ*.5*FRES	SSCA. 124	2110
	TREF(J)=TFUEL	SSCA. 125	2111
	TBAR(J)=TREF(J)	SSCA. 126	2112
	TCOOL(J)=TAVG	SSCA. 127	2113
	TCSS(J)=TAVG	SSCA. 128	2114
	TCLSS(J)=TAVG+PZ*(COLRES+.5*CLDRES)	SSCA. 129	2115
	TCLAD(J)=TCLSS(J)	SSCA. 130	2116
	TFSS(J)=TFUEL	SSCA. 131	2117
	TCSV(J)=TCSS(J)	SSCA. 132	2118
	TCLSV(J)=TCLSS(J)	SSCA. 133	2119
	TFSV(J)=TFSS(J)	SSCA. 134	2120
	DTDZ0(J)=PZZ(J)/(CP*HZERO)	SSCA. 135	2121
	DTTIN0(J)=TCSS(J)-TCOOLZ(1)	SSCA. 136	2122
	DTDZT0(J)=DTDZ0(J)/DTTIN0(J)	SSCA. 137	2123
170	CONTINUE	SSCA. 138	2124
	DO 260 JK=1,MZ	SSCA. 139	2125
	J=HZ-JK+1	SSCA. 140	2126
	DTFCL=TFSV(J)-TCLSV(J)	SSCA. 141	2127
	ADTF=2.*DTFCL/(1.+4.*AKF/(RF*HF1CL))	SSCA. 142	2128
	TF0(J)=TBAR(J)+.5*ADTF	SSCA. 143	2129
	TF1(J)=TBAR(J)-.5*ADTF	SSCA. 144	2130
	TFR(J)=TBAR(J)	SSCA. 145	2131
	TF0SV(J)=TF0(J)	SSCA. 146	2132
	TF1SV(J)=TF1(J)	SSCA. 147	2133
	TFRSV(J)=TFR(J)	SSCA. 148	2134
	TCL=TCLAD(J)	SSCA. 149	2135
	TFIN=TF0(J)	SSCA. 150	2136
	TFOUT=TF1(J)	SSCA. 151	2137
	TAVG=TCOOL(J)	SSCA. 152	2138
	TFUEL=TREF(J)	SSCA. 153	2139
	DAVSS(J)=0.95140+00-2.3920-04*TAVG	SSCA. 154	2140
	DAY2(J)=DAVSS(J)	SSCA. 155	2141
	IF(INOSS.EQ.1) GO TO 260	SSCA. 156	2142
	WRITE(IWRITE, 1030)AZ(J),TAVG,TCL,TFOUT,TFUEL,TFIN	SSCA. 157	2143
260	CONTINUE	SSCA. 158	2144
180	CONTINUE	SSCA. 159	2145
	IF(INOSS.EQ.1) GO TO 200	SSCA. 160	2146
	WRITE(IWRITE, 1020)	SSCA. 161	2147
	DO 190 JK=1,MZ	SSCA. 162	2148
	J=HZ-JK+1	SSCA. 163	2149
	WRITE(IWRITE, 1040)AZ(J),PZZ(J),PZINTZ(J),WDOP(J)	SSCA. 164	2150
	1,VOIPRE(J),WORTHF(J),WORTH(CJ)	SSCA. 165	2151
190	CONTINUE	SSCA. 166	2152
200	CONTINUE	SSCA. 167	2153
	PH=PZERO/HZERO	SSCA. 168	2154

UPDAT/195 12/31/79

IF(ICH.EQ.1) PIMAX=PH	SSCA.169	2155
PIMAX=DMAX1(PH,PIMAX)	SSCA.170	2156
IF(PIMAX.NE.PH) GO TO 220	SSCA.171	2157
P0IMAX=PZERO	SSCA.172	2158
G0IMAX=GZERO	SSCA.173	2159
IMAX=ICH	SSCA.174	2160
220 CONTINUE	SSCA.175	2161
CALL DATHOV TO SAVE DATA IN LCH.	SSCA.176	2162
MODE=-1	SSCA.177	2163
CALL DATHOV(INSACH,NMPAK,ICH,MODE)	SSCA.178	2164
210 CONTINUE	SSCA.179	2165
IPRICH=10	SSCA.180	2166
INOS=INOSSS	SSCA.181	2167
OT=DTSV	SSCA.182	2168
CALL LINC TO OBTAIN VOIDING TIME PREDICTIONS	SSCA.183	2169
CALL LINC	SSCA.184	2170
RETURN	SSCA.185	2171
1000 FORMAT(1H0, 45X,35H***** STEADY STATE DATA FOR CHANNEL,14,6H *****SSCA.186	SSCA.186	2172
1H, //	SSCA.187	2173
26X,30HAVERAGE PIN POWER(10**6 WATTS),6X,1PE12.5,19X,25HPOWER/FLOW(SSCA.188	SSCA.188	2174
310**6 H-SEC/G),11X,1PE12.5/6X,31HPOWER FRACTION IN UPPER BLANKET,5SSCA.189	SSCA.189	2175
4X,1PE12.5,19X,31HDOPPLER COEFFICIENT(COOLANT IN),5X,1PE12.5/6X,29HSSCA.190	SSCA.190	2176
5POWER FRACTION IN ACTIVE CORE,7X,1PE12.5,19X,32HDOPPLER COEFFICIENSSCA.191	SSCA.191	2177
6T(COOLANT OUT),4X,1PE12.5/6X,31HPOWER FRACTION IN LOWER BLANKET,5XSSCA.192	SSCA.192	2178
7,1PE12.5,19X,27HVOIDING REACTIVITY(DELTA K),9X,1PE12.5/6X,26HMASS SSCA.193	SSCA.193	2179
8FLOWRATE(G/SEC-CH**2),10X,1PE12.5,19X,24HCLAD REACTIVITY(DELTA K),SSCA.194	SSCA.194	2180
912X,1PE12.5/6X,20HMASS FLOWRATE(G/SEC),16X,1PE12.5,19X,24HFUEL REASSCA.195	SSCA.195	2181
ACTIVITY(DELTA K),12X,1PE12.5)	SSCA.196	2182
1010 FORMAT(/31X,5HAXIAL,7X,7HCOOLANT,6X,8HCLADDING,4X,10HFUEL BORY. SSCA.197	SSCA.197	2183
1,5X,9HFUEL AVE.,3X,11HFUEL CENTER	SSCA.198	2184
2,/28X,8HLOCATION,5(3X,11HTEMPERATURE),/30X,6H(CH),5(9X,5H(C))SSCA.199	SSCA.199	2185
1020 FORMAT(/24X,5HAXIAL,11X,3HPIN,4X,10HINTEGRATED,7X,7HDOPPLER	SSCA.200	2186
1,7X,7HVOIDING,10X,4HFUEL,10X,4HCLAD	SSCA.201	2187
2,/21X,8HLOCATION,2(19X,5HPOWER),8X,6HHEIGHT,3(4X,10HREACTIVITY)	SSCA.202	2188
3,/23X,6H(CH),5X,9H(MW/CH),8X,6H(MW),14X,3(3X,11H(DELTA K))SSCA.203	SSCA.203	2189
4)	SSCA.204	2190
1030 FORMAT(22X,6F14.3,1P3E14.5)	SSCA.205	2191
1040 FORMAT(15X,F14.3,1P8E14.5)	SSCA.206	2192
END	SSCA.207	2193

UPDAT/195 12/31/79

C* LIMC	LIMC...1	2194
SUBROUTINE LIMCH	LIMC...2	2195
CIBM	LIMC...3	2196
IMPLICIT REAL*8(A-H,O-Z)	LIMC...4	2197
CEND	LIMC...5	2198
*CALL INFC	LIMC...6	2199
*CALL FLTC	LIMC...7	2200
*CALL TCON	LIMC...8	2201
*CALL IOFU	LIMC...9	2202
DATA IO/O/	LIMC...10	2203
C	LIMC...11	2204
C THIS SUBROUTINE DETERMINES MAXIMUM POWER/FLOW CHANNEL AND CALCULATES	LIMC...12	2205
C THE AVERAGE(SAS) AND HOTSPOT INITIAL BOILING TIMES	LIMC...13	2206
C	LIMC...14	2207
P=P0IMAX	LIMC...15	2208
WZERO=60IMAX*AS	LIMC...16	2209
CALL POWER	LIMC...17	2210
CALL POWER	LIMC...18	2211
BOILT=1000.	LIMC...19	2212
CALL TOB FOR AVERAGE CHANNEL TIME OF BOILING	LIMC...20	2213
IF(A1+A2+A3.NE.0.) CALL TOB	LIMC...21	2214
SASTIM=BOILT	LIMC...22	2215
CALL LINES(10,IPAGE)	LIMC...23	2216
WRITE(IWRITE, 1000)	LIMC...24	2217
WRITE(IWRITE, 1010) SASTIM	LIMC...25	2218
C RESET SASTIM	LIMC...26	2219
SASTIM=SASTIM-1.5	LIMC...27	2220
PMT=P/W	LIMC...28	2221
Y1=Y1/Y	LIMC...29	2222
Y2=Y2/Y	LIMC...30	2223
CALL POWER	LIMC...31	2224
CALL POWER	LIMC...32	2225
CALL TOB FOR HOT CHANNEL TIME OF BOILING	LIMC...33	2226
IF(A1+A2+A3.NE.0.) CALL TOB	LIMC...34	2227
WRITE(IWRITE, 1020) BOILT	LIMC...35	2228
WRITE(IWRITE, 1030)	LIMC...36	2229
PMT=P/W	LIMC...37	2230
RETURN	LIMC...38	2231
1000 FORMAT(1H0,50(1H*))	LIMC...39	2232
1010 FORMAT(' PREDICTED SAS BOILING TIME=',1E15.5)	LIMC...40	2233
1020 FORMAT(' HOTSPOT BOILING TIME=',1E15.5)	LIMC...41	2234
1030 FORMAT(1X,50(1H*))	LIMC...42	2235
END	LIMC...43	2236

UPDAT/195 12/31/79

C* PTEM	PTEM...1	2237
SUBROUTINE PTEMPZ(INZ,TFUELA)	PTEM...2	2238
CIBN	PTEM...3	2239
IMPLICIT REAL*8(A-H,O-Z)	PTEM...4	2240
CEND	PTEM...5	2241
*CALL BLNC	PTEM...6	2242
*CALL INPC	PTEM...7	2243
*CALL FLTC	PTEM...8	2244
*CALL TCOM	PTEM...9	2245
*CALL IOFU	PTEM...10	2246
C	PTEM...11	2247
C THIS SUBROUTINE CALCULATES COOLANT TEMPERATURES USING THE FRACTIONAL	PTEM...12	2248
C ENERGY MODEL.	PTEM...13	2249
C	PTEM...14	2250
IFLAG=0	PTEM...15	2251
IF(AZ(INZ).GT.Z2) IFLAG=1	PTEM...16	2252
IF(AZ(INZ).LT.Z1) IFLAG=-1	PTEM...17	2253
PZ=PZ2(INZ)*PHIX	PTEM...18	2254
PZINT=PZINT2(INZ)*PHIX	PTEM...19	2255
THETA=THEYAZ(INZ)	PTEM...20	2256
C 5/PASS FRACTIONAL ENERGY MODEL IN UPPER BLANKET WHERE POWER DOES NOT	PTEM...21	2257
C DOMINATE AXIAL PROFILE OF COOLANT TEMPERATURE.	PTEM...22	2258
IF(TIME.GT..0.AND.NZ.GT.NZR2U) GO TO 130	PTEM...23	2259
100 CONTINUE	PTEM...24	2260
IF(TIME.GT.(VDFRST+DFQUIT))GO TO 110	PTEM...25	2261
FPTC0=1./(1.+COPNDW*THETA)	PTEM...26	2262
FPTC=FPTC0*FFACT	PTEM...27	2263
FRACTC(INZ)=2.*FPTC-FIN	PTEM...28	2264
FFF=FRACTC(INZ)	PTEM...29	2265
GO TO 120	PTEM...30	2266
110 CONTINUE	PTEM...31	2267
FFF=FRACTC(INZ)	PTEM...32	2268
FFSS=1.	PTEM...33	2269
FPTC=.5*(FFF+FIN)*FFSS	PTEM...34	2270
FFF=2.*FPTC-FIN	PTEM...35	2271
120 CONTINUE	PTEM...36	2272
TINC=FPTC*PZINT*BETPHI/CPH	PTEM...37	2273
OTDZ=FFF*PZ/CPH	PTEM...38	2274
OTDZ=OTDZ*BETPHI	PTEM...39	2275
TAVG=TCOOLZ(IFLAG+2)+TINC	PTEM...40	2276
GO TO 140	PTEM...41	2277
130 CONTINUE	PTEM...42	2278
J=NZ	PTEM...43	2279
IF(J.EQ.NZ) J=NZ-1	PTEM...44	2280
OTDZ=(TCSV(NZ)-TCSV(NZR3L))/(AZ(NZ)-AZ(NZR3L))	PTEM...45	2281
C FACTOR OF CHEM3 TO ACCT FOR TEMP DEPENDENCE OF AKF	PTEM...46	2282
TFCL=TBAR(INZ)-TCLAD(INZ)	PTEM...47	2283
HOTFCL=TFCL*HFCLP*CHEM3	PTEM...48	2284
DTAVG=AXHI(INZ)/CPH	PTEM...49	2285
1*(HOTFCL-CPH*CL=(TCOOL(NZR2U)-TCSV(NZR2U))/DT)	PTEM...50	2286
TAVG=TCOOL(INZ-1)+DTAVG	PTEM...51	2287
IF(INZ.EQ.NZR3L)TAVG=TCOOLZ(3)+(AZ(NZ)-Z2)/(AZ(INZ)-AZ(INZ-1))*DTAVG	PTEM...52	2288
140 CONTINUE	PTEM...53	2289
TAVG=OMAX1(TAVG,TCSV(NZ))	PTEM...54	2290
TCOOL(INZ)=TAVG	PTEM...55	2291
TFUELO=TAVG*PZ*(COLRES+CLORES+GAPRES)	PTEM...56	2292

UPDAT/195 12/31/79

```
      TFUELA=TFUELO*PZ*.5*FRES
C FACTORS OF FRES TO ACCT FOR TEMP DEPENDENCE OF AKF
      IF(INZ.LE.NZS1)TFUELA=TFUELO*PZ*.5*FRES*FRES1
      IF(INZ.GT.NZS2U) TFUELA=TFUELO*PZ*.5*FRES*FRES3
      TFUELI=TFUELO*PZ*FRES
      CPMOTZ=CPH*DTDZ
      TCLAD(INZ)=TCLSV(INZ)+TCDL(INZ)-TCSV(INZ)
      RETURN
1000 FORMAT(8E15.5)
      END
```

PTEN..57	2293
PTEN..58	2294
PTEN..59	2295
PTEN..60	2296
PTEN..61	2297
PTEN..62	2298
PTEN..63	2299
PTEN..64	2300
PTEN..65	2301
PTEN..66	2302

UPDAT/19E 12/31/79

C* PROP	PROP...1	2303
SUBROUTINE PROPH	PROP...2	2304
CIBM	PROP...3	2305
IMPLICIT REAL*8(A-H,O-Z)	PROP...4	2306
CEND	PROP...5	2307
*CALL INPC	PROP...6	2308
*CALL FLTC	PROP...7	2309
*CALL TCON	PROP...8	2310
*CALL IOPU	PROP...9	2311
C	PROP...10	2312
C	PROP...11	2313
C THIS SUBROUTINE CALCULATES HEAT TRANSFER AND OTHER MATERIAL PROPERTIES	PROP...12	2314
C	PROP...13	2315
C GEOMETRIC PROPERTIES	PROP...14	2316
RF2=RF*RF	PROP...15	2317
RCLD2=RCLD*RCLD	PROP...16	2318
RS2=RS*RS	PROP...17	2319
RST2=RST*RST	PROP...18	2320
AF=PI*RF2	PROP...19	2321
ACLD=PI*(RCLD2-RF2)	PROP...20	2322
AS=PI*(RS2-RCLD2)	PROP...21	2323
AST=PI*(RST2-RS2)	PROP...22	2324
ACH=AS*ACLD	PROP...23	2325
C THERMOPHYSICAL PROPERTIES	PROP...24	2326
DCPF=DF*CPF	PROP...25	2327
DCPS=DS*CPS	PROP...26	2328
DCPAF=DCPF*AF	PROP...27	2329
DCPACL=DCPCL*ACLD	PROP...28	2330
DCPAS=DCPS*AS	PROP...29	2331
DCPAST=DCPST*AST	PROP...30	2332
CLHMLT=CLLATH*DCL*ACLD	PROP...31	2333
STHMLT=STLATH*DST*AST	PROP...32	2334
CPHCLL=DCPAS*DCPACL*DCPAST	PROP...33	2335
CPHFCL=DCPAF*DCPACL	PROP...34	2336
CPH1=DCPAF*DCPACL*DCPAS*DCPAST	PROP...35	2337
CPH2=2.*(DCPACL*DCPAS*DCPAST)	PROP...36	2338
CPH1P=CPH1-DCPAS-DCPAST	PROP...37	2339
C HEAT TRANSFER RESISTANCES	PROP...38	2340
COLRES=1./(2.*PI*RCLD*HCOL)	PROP...39	2341
CLDRES=DLOG(RCLD/RF)/(2.*PI*AKCL)	PROP...40	2342
EAFRES=1./(2.*PI*RF*HEAP)	PROP...41	2343
FRES=1./(4.*PI*AKF)	PROP...42	2344
C VOIDING FRONT CORRELATOR	PROP...43	2345
C GROLMES MODEL	PROP...44	2346
IF(IGVFC.EQ.0) GVFC=(DCPAF*DCPACL*DCPAST)/CPH1	PROP...45	2347
C MUELLER VARIATION	PROP...46	2348
IF(IGVFC.EQ.1) GVFC=1.	PROP...47	2349
C TDOFS EQUAL ASSUMPTION	PROP...48	2350
CPH=CPH1	PROP...49	2351
CO=CPH*.5/CPS	PROP...50	2352
C THIS CARD MODIFIES TFDOT=TCDOT ASSUMPTION TO MATCH USER SPECIFICATIONS	PROP...51	2353
C THE APPROXIMATION IS THAT DURING PREVOIDING TFDOT=GAH*TCDOT	PROP...52	2354
C IN CRBR LDF STUDIES TFDOT=ROUGHLY .8*TCDOT DURING PREVOIDING	PROP...53	2355
C HOWEVER THIS VARIED ACCORDING TO THE NEGATIVE FEEDBACK FROM AXIAL	PROP...54	2356
C EXPANSION WHICH, IN SACO, WAS ACCOUNTED FOR BY AUGMENTING THE DOPPLER		2357
C BY A FACTOR OF VRHOO.	PROP...56	2358

C THE ABOVE COMMENTS APPLY ONLY IF THE FRACTIONAL ENERGY MODEL(PTEMPZ)	PROP..57	2359
C IS USED.	PROP..58	2360
VRHOD=1.0	*****	2361
VRHOV=1.0		2362
GAH=GAHA*VRHOD/VRHOV+GAHB	PROP..59	2363
C0=(DCPAFL+DCPAS+DCPAST+GAH*DCPAF)*.5/CPS	PROP..60	2364
COSAV=C0	PROP..61	2365
CP=CPS	PROP..62	2366
COMBINING CONSTANTS	PROP..63	2367
AFFAIL = RFFAIL*RFFAIL	PROP..64	2368
PI2RF=2.*PI*RF	PROP..65	2369
PI2RCL=2.*PI*RCLD	PROP..66	2370
CALCULATE EFFECTIVE LUMPED HEAT TRANSFER CONDUCTANCES	PROP..67	2371
HF=4.*AKF/RF	PROP..68	2372
HFP=HF*PI2RF	PROP..69	2373
HCL=AKCL/(RF*DLOG(RCLD/RF))*2.	PROP..70	2374
HCLP=HCL*PI2RF	PROP..71	2375
HFCL=1./(1./HF+1./HGAP+1./HCL)	PROP..72	2376
HFCLP=HFCL*PI2RF	PROP..73	2377
HCOLP=HCOL*PI2RCL	PROP..74	2378
HGAPP=HGAP*PI2RF	PROP..75	2379
HF1CL=1./(1./HGAP+1./HCL)	PROP..76	2380
HF1CLP=HF1CL*PI2RF	PROP..77	2381
HFCLH=1./(1./HF+1./HCL)	PROP..78	2382
HFCLHP=HFCLH*PI2RF	PROP..79	2383
CHEM PARAMETERS	PROP..80	2384
CHEH=1./(PI2RF*(.5*FRES+GAPRES+.5*CLDRES))	PROP..81	2385
DENOMC=CHENH*PI2RF	PROP..82	2386
CHEHCF=DCPAF/DENOMC	PROP..83	2387
CHEHCC=DCPAFL/DENOMC	PROP..84	2388
CHEMLF=DCPAF/CF/HFCL	PROP..85	2389
CHEMLC=DCPAFL/CF/HFCL	PROP..86	2390
CHEHAL=1./CHEHCF+1./CHEHCC	PROP..87	2391
C TEMPERATURE PARAMETERS	PROP..88	2392
TSTAR=TBOIL+TSH	PROP..89	2393
CONST=CFHP*(TCLADH-TSTAR-DTCCL)	PROP..90	2394
RETURN	PROP..91	2395
END	PROP..92	2396

UPDAT/195 12/31/79

C* TOBO	TOBO...1	2397
SUBROUTINE TOB	TOBO...2	2398
CIBM	TOBO...3	2399
IMPLICIT REAL*8(A-H,O-Z)	TOBO...4	2400
CEND	TOBO...5	2401
*CALL INPC	TOBO...6	2402
*CALL FLTC	TOBO...7	2403
*CALL TCOM	TOBO...8	2404
*CALL IOPU	TOBO...9	2405
C	TOBO...10	2406
C THIS SUBROUTINE PREDICTS THE INITIAL TIME OF BOILING FROM EQ(18) OF	TOBO...11	2407
C 9/15/75 MEMO TO DRF	TOBO...12	2408
C	TOBO...13	2409
DATA TIM/8.D0/	TOBO...14	2410
IF (IDBUG.EQ. 1)	TOBO...15	2411
*WRITE (6, 1000) A1,A2,A3,RL,EPS,X1,X2,Y1,Y2,HZERO	TOBO...16	2412
IC=0	TOBO...17	2413
100 CONTINUE	TOBO...18	2414
T2=TIM*TIM	TOBO...19	2415
T3=TIM*T2	TOBO...20	2416
A=A1*TIM+A2*T2+A3*T3	TOBO...21	2417
H=HZERO*DEXP(A)	TOBO...22	2418
ADOT=A1+2.*A2*TIM+3.*A3*T2	TOBO...23	2419
ADTDOT=2.*A2+6.*A3*TIM	TOBO...24	2420
HDOT=H*ADOT	TOBO...25	2421
HDOTH=ADOT	TOBO...26	2422
HDOTD=ADTDOT	TOBO...27	2423
ADOTP=HDOTH-FOOTP	TOBO...28	2424
ADOTH=ADOTP/H	TOBO...29	2425
FFF=H*(Y1/(1.-ADOTH*X1)+Y2/(1.-ADOTH*X2))	TOBO...30	2426
FFF=FFF*H	TOBO...31	2427
ADOT=ADOTP	TOBO...32	2428
ADTDOT=HDOTD	TOBO...33	2429
FPRIME=2.*H*(HDOT-HDOT*(ADOT*(X1+X2)+Y1+Y2)-H*ADTDOT*(X1+X2)+ADTDOT	TOBO...34	2430
1*(2.*ADOT*X1*X2+X2*Y1+X1*Y2)	TOBO...35	2431
IF (FPRIME.EQ.0.) GO TO 110	TOBO...36	2432
DIFF=FFF/FPRIME	TOBO...37	2433
IC=IC+1	TOBO...38	2434
TIM=TIM-RL*DIFF	TOBO...39	2435
IF (IDBUG.EQ.1) WRITE (6, 1010) IC,TIM,F,FPRIME,DIFF,A,ADOT,ADTDOT	TOBO...40	2436
1,H,	TOBO...41	2437
X*HDOT	TOBO...42	2438
IF (DABS(DIFF).LT.EPS.OR.IC.GT.300) GO TO 110	TOBO...43	2439
GO TO 100	TOBO...44	2440
110 IF (IC.GT.300) WRITE (6, 1020) IC	TOBO...45	2441
BOILT=TIM	TOBO...46	2442
IF (IDBUG.EQ. 1)	TOBO...47	2443
*WRITE (6, 1030) BOILT	TOBO...48	2444
RETURN	TOBO...49	2445
C	TOBO...50	2446
C	TOBO...51	2447
C	TOBO...52	2448
1000 FORMAT (1X,10E11.4)	TOBO...53	2449
1010 FORMAT (1X,I10,1P9E11.4)	TOBO...54	2450
1020 FORMAT (27H DOES NOT CONVERGE ICOUNT =,I10)	TOBO...55	2451
1030 FORMAT (16H TIME TO BOILING,E15.5)	TOBO...56	2452

UPDAT/195

12/31/79

END

T080..57

2453

UPDAT/195 12/31/79

```

C*  POWE
      SUBROUTINE POWER
CIBM
      IMPLICIT REAL*8(A-H,O-Z)
CEND
*CALL BLNC
*CALL INPC
*CALL FLTC
*CALL TCOM
*CALL IOPU
C
C THIS SUBROUTINE CALCULATES 'INTERESTING' POWER PARAMETERS
C
      PHAT1T=FRACP1*P
      PHAT2T=FRACP2*P
      PHAT3T=FRACP3*P
      PZINT1=PHAT1T
      PZINT2=PHAT1T+PHAT2T
      ASLOPE=2.*PHAT1T/Z12
      BSLOPE=2.*PHAT3T/(Z22-Z32)
      PA=PHAT2T*X/XX
      PZ1L=ASLOPE*Z1
      PZ1R=PA*SXZ1Z0
      PZ2L=PA*SXZ2Z0
      PZ2R=BSLOPE*(Z2-Z3)
      THETA1=PHAT1T/PZ1L
      THETA2=PHAT2T/PZ2L
      THETA3=PHAT3T/PZ2R
      X1=C0*THETA1
      X2=C0*THETA2
      C2=1./ICP*(TSTAR-TIN))
      Y1=C2*PHAT1T
      Y2=C2*PHAT2T
      RETURN
      END

```

POWE...1	2454
POWE...2	2455
POWE...3	2456
POWE...4	2457
POWE...5	2458
POWE...6	2459
POWE...7	2460
POWE...8	2461
POWE...9	2462
POWE...10	2463
POWE...11	2464
POWE...12	2465
POWE...13	2466
POWE...14	2467
POWE...15	2468
POWE...16	2469
POWE...17	2470
POWE...18	2471
POWE...19	2472
POWE...20	2473
POWE...21	2474
POWE...22	2475
POWE...23	2476
POWE...24	2477
POWE...25	2478
POWE...26	2479
POWE...27	2480
POWE...28	2481
POWE...29	2482
POWE...30	2483
POWE...31	2484
POWE...32	2485
POWE...33	2486
POWE...34	2487
POWE...35	2488

UPDAT/195 12/31/79

C* BETE	BETE...1	2489
SUBROUTINE BETEXT	BETE...2	2490
CIBM	BETE...3	2491
IMPLICIT REAL*8(A-H,O-Z)	BETE...4	2492
CEND	BETE...5	2493
*CALL INPC	BETE...6	2494
*CALL FLTC	BETE...7	2495
*CALL TCOM	BETE...8	2496
*CALL IOFU	BETE...9	2497
DIMENSION ECOEF(3),EEST(3)	BETE..10	2498
C	BETE..11	2499
C THIS SUBROUTINE CALCULATES THE APPROPRIATE TIME-AVERAGED POWER	BETE..12	2500
C USING THE QUADRATIC EXTRAPOLATION TECHNIQUE IN FITZ. IT IS CALLED	BETE..13	2501
C BY DRIVER. IF NOT USED BETAG=1.	BETE..14	2502
C	BETE..15	2503
IF(I*BETA.EQ.1) GO TO 110	BETE..16	2504
100 CONTINUE	BETE..17	2505
C BETAG HAS BEEN DETERMINED ELSEWHERE	BETE..18	2506
RETURN	BETE..19	2507
110 CONTINUE	BETE..20	2508
CALCULATE ENERGY AT TIME OF INTEREST, TIMINT=TIME+DT-BETADT. BETAG=Ave.	BETE..21	2509
C POWER FROM TIMINT TO TIME+DT	BETE..22	2510
C REFERENCE POINT FOR INTERPOLATION IS T00	BETE..23	2511
IF(TIME.GT.BETADT) GO TO 120	BETE..24	2512
C IF TIME.LT.BETADT BETAG=1.	BETE..25	2513
BETAG=1.	BETE..26	2514
BDOT=0.	BETE..27	2515
BDOTB=0.	BETE..28	2516
GO TO 180	BETE..29	2517
120 CONTINUE	BETE..30	2518
IF(TIME.GT.VDFRST) GO TO 130	BETE..31	2519
C BEFORE VOIDING PRETRANSIENT POWER =1 IS USED IN INTERPOLATION.	BETE..32	2520
T00=.5*(TIME+DT)	BETE..33	2521
E00=.5*PINTGX	BETE..34	2522
DTPREV=T00	BETE..35	2523
DTFUT=TIME+DT-T00	BETE..36	2524
EEST(1)=0.	BETE..37	2525
EEST(2)=E00	BETE..38	2526
EEST(3)=PINTGX	BETE..39	2527
GO TO 170	BETE..40	2528
130 CONTINUE	BETE..41	2529
IF(TIME.GT.VDLAST+BETADT) GO TO 140	BETE..42	2530
GO TO 150	BETE..43	2531
140 CONTINUE	BETE..44	2532
IF(IMAX.NE.LTVOID) GO TO 160	BETE..45	2533
150 CONTINUE	BETE..46	2534
C BETWEEN VDFRST AND VDFRST+BETADT ENERGY AT TIMREF IS	BETE..47	2535
C LINEARLY INTERPOLATED AS SHOWN. TIMREF IS DEFINED IN VOTEMP.	BETE..48	2536
T00=VDFRST	BETE..49	2537
E00=FNTHGX	BETE..50	2538
DTPREV=T00-TIMREF	BETE..51	2539
DTFUT=TIME+DT-T00	BETE..52	2540
EEST(1)=TIMREF/T00*E00	BETE..53	2541
EEST(2)=E00	BETE..54	2542
EEST(3)=PINTGX	BETE..55	2543
GO TO 170	BETE..56	2544

UPDAT/195 12/31/79

```

160 CONTINUE
C AFTER VDFRST*BETADT ENERGIES AT INITIATION OF VOIDING OF FIRST
C AND LAST CHANNELS TO VOID ARE USED IN INTERPOLATION.
T00=VDFRST
E00=PHGLV
DTFUT=T00-VDFRST
DTFUT=TIME+DT-T00
EEST(1)=PHGMX
EEST(2)=E00
EEST(3)=PINTGX
170 CONTINUE
CALL FITZ TO OBTAIN QUADRATIC ESTIMATE OF ENERGY AT TIMINT,EINT.
CALL FITZ(ECOEF,EEST,DTFUT,DTFUT)
TIMINT=TIME+DT-BETADT
DTINT=TIMINT-T00
EINT=ECOEF(1)+DTINT*(ECOEF(2)+DTINT*ECOEF(3))
BETAG=(PINTGX-EINT)/BETADT
BDOOT=2.*ECOEF(3)
BDOOTB=BDOOT/BETAG
180 CONTINUE
IF(IDBUG.NE.3) RETURN
WRITE(IWRITE, 1010)
WRITE(IWRITE, 1000)T00,E00,PINTG,BETADT,TIMINT,DTINT,EINT,BETAG
RETURN
1000 FORMAT(9E15.5)
1010 FORMAT(1H0,12X,3HT00,12X,3HE00,10X,5HPINTG,9X,6HBETADT
1,9X,6HTIMINT,10X,5HDTINT,11X,4HEINT,10X,5HBETAG)
END

```

BETE..57	2545
BETE..58	2546
BETE..59	2547
BETE..60	2548
BETE..61	2549
BETE..62	2550
BETE..63	2551
BETE..64	2552
BETE..65	2553
BETE..66	2554
BETE..67	2555
BETE..68	2556
BETE..69	2557
BETE..70	2558
BETE..71	2559
BETE..72	2560
BETE..73	2561
BETE..74	2562
BETE..75	2563
BETE..76	2564
BETE..77	2565
BETE..78	2566
BETE..79	2567
BETE..80	2568
BETE..81	2569
BETE..82	2570
BETE..83	2571
BETE..84	2572

UPDAT/195 12/31/79

```
C* COAS
      SUBROUTINE COAST
CIBM      IMPLICIT REAL*8(A-H,O-Z)
CEND
*CALL INPC
*CALL FLTC
*CALL TCOM
*CALL IOPU
C
C THIS SUBROUTINE CALCULATES FLOW AND/OR PUMP COASTDOWN
C
      T2=TIME*TIME
      T3=T2*TIME
      A=A1*TIME+A2*T2+A3*T3
      EXA=DEXP(A)
      TIMEX=TIME*DT
      T2=TIMEX*TIMEX
      T3=T2*TIMEX
      AEX=A1*TIMEX+A2*T2+A3*T3
      EXAEX=DEXP(AEX)
      RETURN
      END
```

```
COAS...1      2573
COAS...2      2574
COAS...3      2575
COAS...4      2576
COAS...5      2577
COAS...6      2578
COAS...7      2579
COAS...8      2580
COAS...9      2581
COAS...10     2582
COAS...11     2583
COAS...12     2584
COAS...13     2585
COAS...14     2586
COAS...15     2587
COAS...16     2588
COAS...17     2589
COAS...18     2590
COAS...19     2591
COAS...20     2592
COAS...21     2593
COAS...22     2594
COAS...23     2595
```

UPDAT/195 12/31/79

```
C* FFCR
  SUBROUTINE FFCRIT
C
C THIS SUBROUTINE DEFINES FUEL FAILURE IF THE INDICATED CRITERIA ARE
C MET. IT IS CALLED BY DRVRO1 AND USED ONLY IN CHANNELS WHERE COOLANT
C FLOW IS CONTINUOUS.
C
  RETURN
END
```

FFCR...1	2596
FFCR...2	2597
FFCR...3	2598
FFCR...4	2599
FFCR...5	2600
FFCR...6	2601
FFCR...7	2602
FFCR...8	2603
FFCR...9	2604

UPDAT/195 12/31/79

```
C* PREA
  FUNCTION PREA(TIME)
CIBM
  IMPLICIT REAL*8(A-H,O-Z)
CEND
C
C THIS SUBROUTINE FEEDS IN PROGRAMMED REACTIVITY
C
  PREA=0.
  RETURN
  END
```

PREA...1	2605
PREA...2	2606
PREA...3	2607
PREA...4	2608
PREA...5	2609
PREA...6	2610
PREA...7	2611
PREA...8	2612
PREA...9	2613
PREA...10	2614
PREA...11	2615

UPDAT/195 12/31/79

C* CRIV	CRIV...1	2616
SUBROUTINE DRIVER	DRIV...2	2617
CIBM	DRIV...3	2618
IMPLICIT REAL*8(A-H,O-Z)	DRIV...4	2619
CEND	DRIV...5	2620
*CALL BLNC	DRIV...6	2621
*CALL INFC	DRIV...7	2622
*CALL FLTC	DRIV...8	2623
*CALL TCON	DRIV...9	2624
*CALL IOPU	DRIV...10	2625
DATA I1/1/	DRIV...11	2626
C	DRIV...12	2627
C THIS SUBROUTINE CALLS THE REACTIVITY/POWER DRIVING SUBROUTINE(TSPK)	DRIV...13	2628
C AND THE TEMPERATURE DRIVING SUBROUTINE(DRVRO1). IF THE TEMPERATURE	DRIV...14	2629
C FEEDBACK PRODUCES THE EXTRAPOLATED REACTIVITY THE TIME IS ADVANCED.	DRIV...15	2630
C	DRIV...16	2631
ITEMP=0	CRIV...17	2632
DTPP=DT/DTP	DRIV...18	2633
IF(TIME.EQ.0.0) DTPP=0.0	DRIV...19	2634
PHIX=PHI+(PHI-PHIP)*DTPP	DRIV...20	2635
PINTGX=PINTG+(PINTG-PINTG0)*DTPP	DRIV...21	2636
COLREA=0.0	DRIV...22	2637
CROB=0.0	DRIV...23	2638
FRDB=0.0	DRIV...24	2639
CLROB=0.0	DRIV...25	2640
PREADB=0.0	DRIV...26	2641
100 CONTINUE	DRIV...27	2642
IF(TIME.LE.THOLD) CO=COSAV*TIME/THOLD	DRIV...28	2643
CALL BETEXT TO OBTAIN AVERAGEPOWER,PETAG, BETWEEN TIME+DT-BETADT AND	DRIV...29	2644
C TIME+DT	DRIV...30	2645
CALL BETEXT	DRIV...31	2646
PHIDOT=0.0	DRIV...32	2647
C BOOTB OVERRIDE	DRIV...33	2648
PDOTP=0.	DRIV...34	2649
PDOTP=BOOTB	DRIV...35	2650
CALL COAST TO CALCULATE FLOW AND/OR PUMP COASTDOWN	DRIV...36	2651
CALL COAST	DRIV...37	2652
C TIMING PARAMETERS	DRIV...38	2653
EDIVP=PINTGX/PHIX	DRIV...39	2654
PHIBET=PHIX/BETAG	DRIV...40	2655
BETPHI=1./PHIBET	DRIV...41	2656
FFACT=(PHIX*BETAG)*.5/BETAG	DRIV...42	2657
IF(TIME.GT.(VDFRST+DFQUIT)) GO TO 110	DRIV...43	2658
EDIVFS=EDIVP	DRIV...44	2659
BETAGS=BETAG	DRIV...45	2660
FFACTS=FFACT	DRIV...46	2661
PBS=PHIBET	DRIV...47	2662
BPS=BETPHI	DRIV...48	2663
110 CONTINUE	DRIV...49	2664
EDPSS=EDIVP/EDIVPS	DRIV...50	2665
BETSS=BETAG/BETAGS	DRIV...51	2666
FFSS=FFACT/FFACTS	DRIV...52	2667
PBSS=PHIBET/PBS	DRIV...53	2668
BPSS=BETPHI/BPS	DRIV...54	2669
CALL DRVRO1 AND TSPK FOR TEMPERATURE AND POWER/REACTIVITY CALCULATIONS	DRIV...55	2670
CALL DRVRO1	DRIV...56	2671

UPDAT/195 12/31/79

```

      CALL TSPK
120  CONTINUE
      GO TO (130,130,140),KPOW
130  CONTINUE
      PHIX=PHI
      PINTGX=PINTG
      GO TO 100
140  CONTINUE
      ITEMP=0
      TIME=TIME+DT
      REACT=VREAT(3)*EL
      REACDB=REACT*BETINV
      PREACB=EL*REAFRG*BETINV
      DOPREA=READOP*EL
      DOPROB=DOPREA*BETINV
      COLREA=REACOL*EL
      CPDB=COLREA*BETINV
      CLROB=REACLO*EL*BETINV
      FROB=REASLU*EL*BETINV
      TSTAR=TBOIL+TSH
      NMPAK=3
      DO 230 ICH=1,NCHAN
      MODE=1
      CALL DATMOV TO MOVE DATA FROM LCH FOR CHANNEL ICH.
      CALL DATMOV(NSACH,NMPAK,ICH,MODE)
      CALL VOTEMP FOR VOIDING INITIALIZATION
      IF(IVOID.EQ.1) GO TO 200
      CALL VOTEMP IF TIME=INPUT-SPECIFIED VOTIME-FROD
      IF(IVOTIM.EQ.0) GO TO 190
      CALL VOTEMP IF TEMPERATURE IN FIRST NODE ABOVE ACTIVE CORE.GT.TSTAR
      IF(TCOOL(NZR3L).GT.TSTAR) CALL VOTEMP
      GO TO 200
190  CONTINUE
      IF(0ABS(TIME-VOTIME-FROD).LE.0.000100) CALL VOTEMP
200  CONTINUE
      DO 210 J=1,MZ
      TTEMP=TCSV(J)
      TCSV(J)=TCOOL(J)
      TCOOL(J)=TCSV(J)+TCOOL(J)-TTEMP
      TTEMP=TCLSV(J)
      TCLSV(J)=TCLAD(J)
      TCLAD(J)=TCLSV(J)+TCLAD(J)-TTEMP
      TTEMP=TFSV(J)
      TFSV(J)=TBAR(J)
      TBAR(J)=TFSV(J)+TBAR(J)-TTEMP
      TTEMP=TFOSV(J)
      TFOSV(J)=TF0(J)
      TF0(J)=TFOSV(J)+TF0(J)-TTEMP
      TTEMP=TFISV(J)
      TFISV(J)=TF1(J)
      TF1(J)=TFISV(J)+TF1(J)-TTEMP
      TTEMP=TFRSV(J)
      TFRSV(J)=TFR(J)
      TFR(J)=TFRSV(J)+TFR(J)-TTEMP
      RMPF2S(J)=RMPF2(J)
      IF(I2D.EQ.0) GO TO 210

```

```

DRIV..57 2672
DRIV..58 2673
DRIV..59 2674
DRIV..60 2675
DRIV..61 2676
DRIV..62 2677
DRIV..63 2678
DRIV..64 2679
DRIV..65 2680
DRIV..66 2681
DRIV..67 2682
DRIV..68 2683
DRIV..69 2684
DRIV..70 2685
DRIV..71 2686
DRIV..72 2687
DRIV..73 2688
DRIV..74 2689
DRIV..75 2690
DRIV..76 2691
DRIV..77 2692
DRIV..78 2693
DRIV..79 2694
DRIV..80 2695
DRIV..81 2696
DRIV..82 2697
DRIV..83 2698
DRIV..84 2699
DRIV..85 2700
DRIV..86 2701
DRIV..87 2702
DRIV..88 2703
DRIV..89 2704
DRIV..90 2705
DRIV..91 2706
DRIV..92 2707
DRIV..93 2708
DRIV..94 2709
DRIV..95 2710
DRIV..96 2711
DRIV..97 2712
DRIV..98 2713
DRIV..99 2714
DRIV.100 2715
DRIV.101 2716
DRIV.102 2717
DRIV.103 2718
DRIV.104 2719
DRIV.105 2720
DRIV.106 2721
DRIV.107 2722
DRIV.108 2723
DRIV.109 2724
DRIV.110 2725
DRIV.111 2726
DRIV.112 2727

```

UPDAT/195 12/31/79

QRSV(J)=QR(J)	ORIV.113	2728
EIRSV(J)=EIR(J)	ORIV.114	2729
SSV(J)=S(J)	ORIV.115	2730
FSV(J)=F(J)	ORIV.116	2731
QSV(J)=Q(J)	ORIV.117	2732
EISV(J)=EI(J)	ORIV.118	2733
ECLSV(J)=ECLAD(J)	ORIV.119	2734
AASV(J)=AA(J)	ORIV.120	2735
BRSV(J)=BB(J)	ORIV.121	2736
CCSV(J)=CC(J)	ORIV.122	2737
210 CONTINUE	ORIV.123	2738
CALL TEMPK TO RECORD TEMPERATURES FOR EXTRAPOLATION.	ORIV.124	2739
IF(DABS(TIME-TIMCK).LE..000100) CALL TEMPK	ORIV.125	2740
MODE=-1	ORIV.126	2741
CALL OATHOV TO WRITE CHANNEL ICH DATA INTO LCH	ORIV.127	2742
CALL OATHOV(NSACH,NIPAK,ICH,MODE)	ORIV.128	2743
230 CONTINUE	ORIV.129	2744
CALL LINES(I1,IPAGE)	ORIV.130	2745
IF(IPAGE.EQ.0) GO TO 150	ORIV.131	2746
NL=3	ORIV.132	2747
CALL LINES(NL,IPAGE)	ORIV.133	2748
WRITE(IWRITE,1040)	ORIV.134	2749
150 CONTINUE	ORIV.135	2750
WRITE(IWRITE,1000) TIME,PHI,PHIDOT,PINTG,BETAG,DOPROB,	ORIV.136	2751
ICRDB,CLRDB,FRDB,PREADB,REACDB,IPHI,IREA	ORIV.137	2752
IF(PHI.GT.PTOP) DT=DT3	ORIV.138	2753
IREA=0	ORIV.139	2754
1000 FORMAT(F10.3,1P10E11.3,2I6)	ORIV.140	2755
1010 FORMAT(1H0,10X,'IERROR WAS SET, IPHI,IREA',I3,1X,I3)	ORIV.141	2756
1020 FORMAT(1H0,10X,'HELP--KPOW = -1 ON RETURN FROM TSPK')	ORIV.142	2757
1030 FORMAT(1H0,10X,'KPOW,IPHI,IREA,PHI,REACT',3I3,2E12.5)	ORIV.143	2758
1040 FORMAT(//6X,4HTIME,6X,5HFOHER,7X,4HFDOT,5X,6HENERGY,	ORIV.144	2759
1 6X,5HBETAG,4X,7HDOPPLER,4X,7HCOOLANT,7X,4HCLAD,7X,4HFUEL,	ORIV.145	2760
2 1X,10HPROGRAMMED,3X,8HNET REAC,2X,4HIPHI,2X,4HIREA)	ORIV.146	2761
RETURN	ORIV.147	2762
END	ORIV.148	2763

UFDAT/195 12/31/79

```

C* DRV1
SUBROUTINE DRV1
CIBM IMPLICIT REAL*8(A-H,O-Z)
CEND
*CALL BLNK
*CALL INPC
*CALL FLTC
*CALL TCOM
*CALL IOPU
C
C THIS SUBROUTINE DIRECTS TRAFFIC. IF THE CHANNEL HAS COOLANT FLOW
C PTEMPZ,STEMPZ(ISUSE=1),OR QTEMPZ(IQUSE=1) IS CALLED
C TO PERFORM TEMPERATURE CALCULATIONS. IF THE CHANNEL HAS STARTED TO
C VOID DRV102 IS CALLED TO DRIVE THE VOIDING CALCULATIONS.
C SEE DESCRIPTIONS AT THE BEGINNINGS OF THESE SUBROUTINES.
C
IF(KPOW.NE.3) GO TO 90
REACOL=0.0
90 CONTINUE
READOP=0.0
REASLU=0.0
REACLO=0.0
ICHEDT=0
IF(IICOUN.GT.NMRT) GO TO 500
IF(KPOW.NE.3) GO TO 500
IF((TIME+DT).LT.TIMMRT(IICOUN)) GO TO 500
ICHEDT=1
IICOUN=IICOUN+1
500 CONTINUE
INPAK=3
DO 230 ICH=1,NCHAN
MODE=1
CALL DATMOV TO MOVE DATA FROM LCH FOR CHANNEL ICH.
CALL DATMOV(MSACH,INPAK,ICH,MODE)
IF(ICHEDT.NE.0) CALL TFEDIT
P=PZERO*PHIX
IF(IVOID.NE.1) GO TO 100
CALL DRV102
GO TO 125
100 CONTINUE
WZERO=GZERO*AS
CALL WTIME(TIME+DT)
IF(ISUSE.EQ.0) CALL TINSET
DO 180 J=1,MZ
JJ=J
IZ=J
IF((TIME+.5*DT).GT.VDFRST) GO TO 140
110 CONTINUE
IF(ISUSE.EQ.1) GO TO 120
CALL PTEMPZ(JJ,TFUEL)
GO TO 150
120 CONTINUE
CALL STEMPZ
GO TO 150
140 CONTINUE

```

DRV1...1	2764
DRV1...2	2765
DRV1...3	2766
DRV1...4	2767
DRV1...5	2768
DRV1...6	2769
DRV1...7	2770
DRV1...8	2771
DRV1...9	2772
DRV1...10	2773
DRV1...11	2774
DRV1...12	2775
DRV1...13	2776
DRV1...14	2777
DRV1...15	2778
DRV1...16	2779
DRV1...17	2780
DRV1...18	2781
DRV1...19	2782
DRV1...20	2783
DRV1...21	2784
DRV1...22	2785
DRV1...23	2786
DRV1...24	2787
DRV1...25	2788
DRV1...26	2789
DRV1...27	2790
DRV1...28	2791
DRV1...29	2792
DRV1...30	2793
DRV1...31	2794
DRV1...32	2795
DRV1...33	2796
DRV1...34	2797
DRV1...35	2798
DRV1...36	2799
DRV1...37	2800
DRV1...38	2801
DRV1...39	2802
DRV1...40	2803
DRV1...41	2804
DRV1...42	2805
DRV1...43	2806
DRV1...44	2807
DRV1...45	2808
DRV1...46	2809
DRV1...47	2810
DRV1...48	2811
DRV1...49	2812
DRV1...50	2813
DRV1...51	2814
DRV1...52	2815
DRV1...53	2816
DRV1...54	2817
DRV1...55	2818
DRV1...56	2819

UPDAT/195 12/31/79

CALL QTEMPZ	DRV1..57	2820
150 CONTINUE	DRV1..58	2821
IF(TIME.LE.THOLD) TCOOL1(J)=TAVG	DRV1..59	2822
C PARTITIONS OF ENERGY FOR REMOVAL BY COOLANT,ENTC1,HEATUP OF CLAD,	DRV1..60	2823
C COOLANT, AND STRUCTURE,CCLH, AND HEATUP OF FUEL,ENTHF.	DRV1..61	2824
OTCOOL=TCOOL(J)-TCSS(J)	DRV1..62	2825
CCLH=OTCOOL*(DCPAS+DCPAFL+DCPAST)	DRV1..63	2826
160 CONTINUE	DRV1..64	2827
ENTC1=ENTC(J)+CPHDTZ*DT	DRV1..65	2828
ENTC1=DMAX1(ENTC1,0.00)	DRV1..66	2829
ENTH=PZ*EQIVP-ENTC1	DRV1..67	2830
ENTH=DMAX1(ENTH,0.00)	DRV1..68	2831
ENTHF=ENTH-CCLH	DRV1..69	2832
ENTHF=DMAX1(ENTHF,0.00)	DRV1..70	2833
TFUEL=TBAR(J)	DRV1..71	2834
C IF SAS-BASED EULERIAN ROUTINE IS USED FUEL TEMPERATURES HAVE ALREADY	DRV1..72	2835
C BEEN CALCULATED. IF NOT A 1-0 HEAT BALANCE IS USED TO PREDICT FUEL	DRV1..73	2836
C TEMPERATURES. NOTE CORRECTION TERMS FOR HEAT TRANSFER IN BLANKETS.	DRV1..74	2837
IF(ISUSE.EQ.1) GO TO 170	DRV1..75	2838
C OLD TEMPERATURE EXPRESSION USED IN ORIGINAL SACO VERSION.	DRV1..76	2839
C TFUEL=TFSS(J)+ENTHF/DCPAF	DRV1..77	2840
TFCL=TFSV(J)-TCLSV(J)	DRV1..78	2841
HDTFCL=TFCL*HFCLP	DRV1..79	2842
IF(AZ(J).LE.Z1) HDTFCL=HDTFCL*CHEM1	DRV1..80	2843
IF(AZ(J).GE.Z2) HDTFCL=HDTFCL*CHEM3	DRV1..81	2844
TFUEL=TFSV(J)+DT/DCPAF*(PZ-HDTFCL)	DRV1..82	2845
170 CONTINUE	DRV1..83	2846
TBAR(J)=TFUEL	DRV1..84	2847
CALL THOOTF FOR RADIAL TEMPERATURE PROFILES	DRV1..85	2848
IF(I2D.GT.0) CALL THOOTF	DRV1..86	2849
ENTCSV(J)=ENTC1	DRV1..87	2850
CALL FFCRIT TO CHECK FOR FUEL FAILURE IN NONVOIDED CHANNELS	DRV1..88	2851
CALL FFCRIT	DRV1..89	2852
180 CONTINUE	DRV1..90	2853
185 CONTINUE	DRV1..91	2854
IF(IPONER.NE.1) CALL FEEDBK	DRV1..92	2855
MODE =-1	DRV1..93	2856
CALL DATHOV TO WRITE CHANNEL ICH DATA INTO LCH.	DRV1..94	2857
CALL DATHOV(HSACH,NHPAK,ICH,MODE)	DRV1..95	2858
230 CONTINUE	DRV1..96	2859
RETURN	DRV1..97	2860
END	DRV1..98	2861

```

C* DRV2
SUBROUTINE DRV2
CIBM
IMPLICIT REAL*8(A-H,O-Z)
CEND
*CALL BLNC
*CALL INPC
*CALL FLTC
*CALL TCOH
*CALL IOPU
C
C THIS SUBROUTINE DRIVES THE TEMPERATURE AND MATERIAL MOTION CALC-
C LATIONS AFTER VOIDING.
C
      TCOMP = TFUELM + TFEXTR
      CALL ZBOIL TO LOCATE VOIDING AND DRYOUT INTERFACES
      CALL DRV203 FOR MATERIAL MOTION CALCULATIONS
      J=IFNOV+1
      GO TO (501,502),J
501 CONTINUE
      CALL ZBOIL
      GO TO 503
502 CONTINUE
      CALL DRV203 TO DRIVE FUEL MOTION SUBROUTINES.
      CALL DRV203
503 CONTINUE
C OBTAIN PARAMETERS FOR HEAT TRANSFER TO LIQUID COOLANT
      IF(ZVOIDL.LT.Z1) GO TO 602
      IF(ZVOIDL.GT.Z3) GO TO 604
C CALCULATION FOR ZVOIDL IN ACTIVE CORE
      PZLINT=(PZHT1Z+PZHT2Z/XX*(CXZ1Z0-DCOS(X*(ZVOIDL-Z0))))
      I=PHIX
      FBARZL=.5*(FIN+FRAC1C(NZR2U))
      IF(ZVOIDL.GT.AZ(NZR2U)) GO TO 603
      NZS11=NZS1+1
      DO 600 I=NZS11,NZR2U
      ISAV=I
      IF(ZVOIDL.LT.AZ(I)) GO TO 601
600 CONTINUE
601 CONTINUE
      ISAV=ISAV-1
      DAZ=(ZVOIDL-AZ(ISAV))/(AZ(ISAV)-AZ(ISAV1))
      FFF=FRAC1C(ISAV)+DAZ*(FRAC1C(ISAV)-FRAC1C(ISAV1))
      FBARZL=.5*(FIN+FFF)
      GO TO 603
602 CONTINUE
C CALCULATION FOR ZVOIDL BELOW ACTIVE CORE
      PZLINT=0.
      FBARZL=1.
      IF(ZVOIDL.LE.0.) GO TO 603
      PZLINT=(ZVOIDL/Z1)**ANFR11*PZHT1Z*PHIX
      GO TO 603
604 CONTINUE
C CALCULATION FOR ZVOIDL ABOVE ACTIVE CORE
      PZLINT=(1.-((Z3-ZVOIDL)/(Z3-Z2))**ANFR31*PFRAC3)*PZERO
      I=PHIX

```

```

DRV2...1 2862
DRV2...2 2863
DRV2...3 2864
DRV2...4 2865
DRV2...5 2866
DRV2...6 2867
DRV2...7 2868
DRV2...8 2869
DRV2...9 2870
DRV2...10 2871
DRV2...11 2872
DRV2...12 2873
DRV2...13 2874
DRV2...14 2875
DRV2...15 2876
DRV2...16 2877
DRV2...17 2878
DRV2...18 2879
DRV2...19 2880
DRV2...20 2881
DRV2...21 2882
DRV2...22 2883
DRV2...23 2884
DRV2...24 2885
DRV2...25 2886
DRV2...26 2887
DRV2...27 2888
DRV2...28 2889
DRV2...29 2890
DRV2...30 2891
DRV2...31 2892
DRV2...32 2893
DRV2...33 2894
DRV2...34 2895
DRV2...35 2896
DRV2...36 2897
DRV2...37 2898
DRV2...38 2899
DRV2...39 2900
DRV2...40 2901
DRV2...41 2902
DRV2...42 2903
DRV2...43 2904
DRV2...44 2905
DRV2...45 2906
DRV2...46 2907
DRV2...47 2908
DRV2...48 2909
DRV2...49 2910
DRV2...50 2911
DRV2...51 2912
DRV2...52 2913
DRV2...53 2914
DRV2...54 2915
DRV2...55 2916
DRV2...56 2917

```

UPDAT/195 12/31/79

FBARZL=.5*(FIN+FRAC(C(NZR2U)))	DRV2..57	2918
603 CONTINUE	DRV2..58	2919
C THIS SET OF OPERATIONS DEFINES THE FRACTION OF ENERGY REDISTRIBUTION	DRV2..59	2920
FREMOV=FBARZL	DRV2..60	2921
DTVD=TIME-VDTIME	DRV2..61	2922
C ENERGY REDISTRIBUTION TERM DERIVATION PER 10/76 ANL-RDP.	DRV2..62	2923
ZVLR=ZVOIDL-ZLL	DRV2..63	2924
UZ1=(ANAX+1.)/(ANAX*ZVLR)	DRV2..64	2925
SI=FBARZL*PZLINT*BETPHI	DRV2..65	2926
C ACCOUNT FOR ENERGY REMOVED BY COOLANT DURING TRANSITION FROM BUBBLY	DRV2..66	2927
C TO SLUG FLOW.	DRV2..67	2928
TF=DTVD/(T.FRSIDT) SI=SI*DTVD/FRSIDT	DRV2..68	2929
C PER HAND CALCULATIONS OF 5/13/76 FRACTION OF SFILM TO COOLANT IS SMALL	DRV2..69	2930
SFILM=0.	DRV2..70	2931
SSS=SI+SFILM	DRV2..71	2932
C NODAL CALCULATIONS*****	DRV2..72	2933
DO 100 J=1,MZ	DRV2..73	2934
C ACCOUNT FOR Z-DEPENDENCE OF TSAT.	DRV2..74	2935
TSTAR=TBOIL+TSH*(ZVOID0-AZ(J))/ZVOID0*DTSTAR	DRV2..75	2936
JJ=J	DRV2..76	2937
IZ=J	DRV2..77	2938
PZ=PZZ(J)*PHIX	DRV2..78	2939
FFF=FRAC(C(J))	DRV2..79	2940
FPTC=.5*(FFF+FIN)	DRV2..80	2941
FFF=2.*FPTC-FIN	DRV2..81	2942
FC=FFF*BETPHI	DRV2..82	2943
FF=HFCLP*(TFSV(J)-TCLSV(J))/PZ	DRV2..83	2944
IF(AZ(J).LT.Z1) FF=CHENH1*FF	DRV2..84	2945
IF(AZ(J).GT.Z2) FF=CHENH3*FF	DRV2..85	2946
EZ=PZ*EDIVP	DRV2..86	2947
IF(AZ(J).GE.ZVOIDL.AND.AZ(J).LE.ZVOIDU) GO TO 102	DRV2..87	2948
101 CONTINUE	DRV2..88	2949
C	DRV2..89	2950
C SINGLE-PHASE LIQUID COOLANT REGION CALCULATIONS	DRV2..90	2951
C	DRV2..91	2952
C RESTRICT DRYOUT TIME.	DRV2..92	2953
DRYTIM=TIME+DTVDDO	DRV2..93	2954
DOTIME(J)=DMAX1(DRYTIM,DOTIME(J))	DRV2..94	2955
EPOSTV=EZ-ENV(J)	DRV2..95	2956
IF(L.OSTV.LE.0.) EPOSTV=0.	DRV2..96	2957
IF(AZ(J).GT.Z2) GO TO 300	DRV2..97	2958
C PER 10/76 RDP.	DRV2..98	2959
UZ=UZ1*(1.-((ZVOIDL-AZ(J))/ZVLR)**ANAX)	DRV2..99	2960
SZ=SSS*UZ	DRV2.100	2961
TCDL(J)=TCSV(J)+1./CPHCL*((FF-FC)*PZ+SZ)*DT	DRV2.101	2962
GO TO 301	DRV2.102	2963
300 CONTINUE	DRV2.103	2964
C HEAT TRANSFER BALANCE USED FOR UPPER BLANKET LIQUID COOLANT.	DRV2.104	2965
TCDL(J)=TCSV(J)+FF*PZ*DT/CPHCL	DRV2.105	2966
301 CONTINUE	DRV2.106	2967
TCDL(J)=DMIN1(TCDL(J),TSTAR+1.)	DRV2.107	2968
TCLAD(J)=TCLSV(J)+TCDL(J)-TCSV(J)	DRV2.108	2969
TBAR(J)=TFSV(J)+PZ*DT*(1.-FF)/DCPAF	DRV2.109	2970
CALL TWODTF FOR RADIAL TEMPERATURE PROFILES. IF TWODTF IS USED TBAR IS	DRV2.110	2971
C RECALCULATED.	DRV2.111	2972
IF(I20.GT.0) CALL TWODTF	DRV2.112	2973

UPDAT/195 12/31/79

TCLVZ(J)=TCLAD(J)	DRV2.113	2974
TCLDO(J)=TCLAD(J)	DRV2.114	2975
TFVZ(J)=TBAR(J)	DRV2.115	2976
TFDO(J)=TBAR(J)	DRV2.116	2977
TFCH(J)=TBAR(J)	DRV2.117	2978
ENVZ(J)=EZ	DRV2.118	2979
ENDO(J)=EZ	DRV2.119	2980
ENCH(J)=EZ	DRV2.120	2981
ENFH(J)=EZ	DRV2.121	2982
GO TO 100	DRV2.122	2983
102 CONTINUE	DRV2.123	2984
CHECK FOR DRYOUT.	DRV2.124	2985
IF(TIME-DOTIME(J))103,103,113	DRV2.125	2986
113 CONTINUE	DRV2.126	2987
IF(AZ(J)-ZDO)114,114,104	DRV2.127	2988
114 CONTINUE	DRV2.128	2989
DOTIME(J)=TIME	DRV2.129	2990
103 CONTINUE	DRV2.130	2991
C	DRV2.131	2992
C SODIUM FILM REGION CALCULATIONS	DRV2.132	2993
C	DRV2.133	2994
EPOST=EZ-ENVZ(J)	DRV2.134	2995
TCOOL(J)=TSTAR	DRV2.135	2996
TCLAD(J)=TCOOL(J)+BETAG/BETAGV*(TCLVZ(J)-TSTAR)	DRV2.136	2997
TBAR(J)=TFSV(J)+PZ*DT*(1.-FF)/DCPAF	DRV2.137	2998
CALL THODTF FOR RADIAL TEMPERATURE PROFILES. IF THODTF IS USED TBAR IS	DRV2.138	2999
C RECALCULATED.	DRV2.139	3000
IF(I2D.GT.0) CALL THODTF	DRV2.140	3001
TCLDO(J)=TCLAD(J)	DRV2.141	3002
TFDO(J)=TBAR(J)	DRV2.142	3003
TFCH(J)=TBAR(J)	DRV2.143	3004
ENDO(J)=EZ	DRV2.144	3005
ENCH(J)=EZ	DRV2.145	3006
ENFH(J)=EZ	DRV2.146	3007
GO TO 100	DRV2.147	3008
104 CONTINUE	DRV2.148	3009
DTDO=TIME-DOTIME(J)	DRV2.149	3010
DTENDO=TFDO(J)-TCLDO(J)	DRV2.150	3011
CHECK FOR CLAD AND FUEL MOTION.	DRV2.151	3012
IF(TIME.GE.CHTIME(J)) GO TO 106	DRV2.152	3013
IF(TIME.GE.FHTIME(J)) GO TO 105	DRV2.153	3014
105 CONTINUE	DRV2.154	3015
C	DRV2.155	3016
C BARE SOLID CLAD/SOLID FUEL (DRYOUT) CALCULATIONS	DRV2.156	3017
C	DRV2.157	3018
EPOST=EZ-ENDO(J)	DRV2.158	3019
TCOOL(J)=TFSV(J)	DRV2.159	3020
TBAR(J)=TFSV(J)+PZ*DT*(1.-FF)/DCPAF	DRV2.160	3021
TBAR(J)=DIIH1(TBAR(J),TFUELH)	DRV2.161	3022
TCLAD(J)=TCLSV(J)+PZ*DT*FF/DCPAF	DRV2.162	3023
TCLAD(J)=DIIH1(TCLAD(J),TCLADH)	DRV2.163	3024
CALL THODTF FOR RADIAL TEMPERATURE PROFILES. IF THODTF IS USED TBAR IS	DRV2.164	3025
C RECALCULATED.	DRV2.165	3026
IF(I2D.GT.0) CALL THODTF	DRV2.166	3027
TFCH(J)=TBAR(J)	DRV2.167	3028
ENCH(J)=EZ	DRV2.168	3029

UPDAT/195 12/31/79

ENFM(J)=EZ	DRV2.169	3030
C****SET FAILURE TIME(S) *****	DRV2.170	3031
IF(TCLAD(J).GE.TCLADM) CHTIME(J)=TIME	DRV2.171	3032
IF(TFQSV(J).GE.TFTOP) FHTIME(J)=TIME	DRV2.172	3033
IF(TBAR(J).GE.TCONP) FHTIME(J)=TIME	DRV2.173	3034
GO TO 100	DRV2.174	3035
106 CONTINUE	DRV2.175	3036
CHECK FOR FUEL MOTION.	DRV2.176	3037
IF(TIME.GE.FHTIME(J)) GO TO 110	DRV2.177	3038
107 CONTINUE	DRV2.178	3039
C	DRV2.179	3040
C MELTING CLAD/SOLID FUEL CALCULATIONS	DRV2.180	3041
C	DRV2.181	3042
EPOST=EZ-ENCM(J)	DRV2.182	3043
DTCH=TIME-CHTIME(J)	DRV2.183	3044
IF(I2D.EQ.0) GO TO 408	DRV2.184	3045
IF(TCLAD(J).GT.TCLADM) GO TO 407	DRV2.185	3046
408 CONTINUE	DRV2.186	3047
FF=FF*HFCLM/HFCL	DRV2.187	3048
TBAR(J)=TFSV(J)+PZ*DT*(1.-FF)/DCPAF	DRV2.188	3049
TBAR(J)=DMIN!(TBAR(J),TFUELM)	DRV2.189	3050
C****SET FAILURE TIME(S) *****	DRV2.190	3051
IF(TBAR(J).GE.TCONP) FHTIME(J)=TIME	DRV2.191	3052
ETHF=DCPAF *(TBAR(J)-TFCM(J))	DRV2.192	3053
ETHCL=EPOST-ETHF-CLHMLT	DRV2.193	3054
TCLAD(J)=TCLSV(J)	DRV2.194	3055
IF(ETHCL.GT.0.)	DRV2.195	3056
1TCLAD(J)=ETHCL/DCPAF+TCLADM	DRV2.196	3057
TCLAD(J)=DMIN!(TCLAD(J),TCLAD(J))	DRV2.197	3058
407 CONTINUE	DRV2.198	3059
TCDL(J)=TCSV(J)	DRV2.199	3060
CALL THODTF FOR RADIAL TEMPERATURE PROFILES. IF THODTF IS USED TBAR IS	DRV2.200	3061
C RECALCULATED.	DRV2.201	3062
IF(I2D.GT.0) CALL THODTF	DRV2.202	3063
ENFM(J)=EZ	DRV2.203	3064
C****SET FAILURE TIME(S) *****	DRV2.204	3065
IF(RHREF2S(J).GE.AFFAIL) FHTIME(J)=TIME	DRV2.205	3066
GO TO 100	DRV2.206	3067
108 CONTINUE	DRV2.207	3068
C	DRV2.208	3069
C SOLID CLAD/MOLTEN FUEL CALCULATIONS	DRV2.209	3070
C	DRV2.210	3071
C FUEL TEMPERATURES CALCULATED ONLY WITH THODTF IN THIS PHASE.	DRV2.211	3072
CALL THODTF FOR RADIAL TEMPERATURES EVEN IF FUEL MOTION STARTED. IF	DRV2.212	3073
C THODTF IS USED TBAR WILL BE RECALCULATED.	DRV2.213	3074
IF(I2D.GT.0) CALL THODTF	DRV2.214	3075
IF(I2D.GT.0) GO TO 109	DRV2.215	3076
TBAR(J)=TFSV(J)	DRV2.216	3077
TCLAD(J)=TCLSV(J)+PZ*DT*FF/DCPAF	DRV2.217	3078
TCLAD(J)=DMIN!(TCLAD(J),TCLADM)	DRV2.218	3079
109 CONTINUE	DRV2.219	3080
TCDL(J)=TCSV(J)	DRV2.220	3081
C****SET FAILURE TIME(S) *****	DRV2.221	3082
IF(TCLAD(J).GE.TCLADM) CHTIME(J)=TIME	DRV2.222	3083
WRITE(IWRITE,9000) ICH,J	DRV2.223	3084
GO TO 100	DRV2.224	3085

UPDAT/195 12/31/79

110 CONTINUE	DRV2.225	3086
C	DRV2.226	3087
C MOLTEN CLAD AND FUEL CALCULATIONS	DRV2.227	3088
C	DRV2.228	3089
C FUEL AND CLAD TEMPERATURES CALCULATED ONLY WITH THODTF IN THIS PHASE.	DRV2.229	3090
CALL THODTF FOR RADIAL TEMPERATURE PROFILES. IF THODTF IS USED TBAR IS	DRV2.230	3091
C RECALCULATED.	DRV2.231	3092
IF(I2D.GT.0) CALL THODTF	DRV2.232	3093
IF(I2D.GT.0) GO TO 111	DRV2.233	3094
TBAR(J)=TFSV(J)	DRV2.234	3095
TCLAD(J)=TCLSV(J)	DRV2.235	3096
111 CONTINUE	DRV2.236	3097
TCOOL(J)=TCSV(J)	DRV2.237	3098
CALL FMSET FOR FUEL MOTION INITIALIZATION.	DRV2.238	3099
IF(IFMOV.EQ.0) CALL FMSET	DRV2.239	3100
100 CONTINUE	DRV2.240	3101
RETURN	DRV2.241	3102
9000 FORMAT(' DRV02 IS IN A MOLTEN FUEL/SOLID CLAD REGION-CHANNEL	DRV2.242	3103
1,NODE=',2I4)	DRV2.243	3104
END	DRV2.244	3105

UPDAT/195 12/31/79

C* DRV3	DRV3...1	3106
SUBROUTINE DRV303	DRV3...2	3107
CIBM	DRV3...3	3108
IMPLICIT REAL*8(A-H,O-Z)	DRV3...4	3109
CEND	DRV3...5	3110
C	DRV3...6	3111
C THIS SUBROUTINE DRIVES FUEL MOTION	DRV3...7	3112
C	DRV3...8	3113
CALL FHOV1 TO OBTAIN FUEL EJECTION PARAMETERS	DRV3...9	3114
CALL FHOV1	DRV3...10	3115
CALL FHOV2 TO OBTAIN FUEL EJECTION NODAL PROPERTIES FOR REACTIVITY CALCSDRV3..11	DRV3...11	3116
CALL FHOV2	DRV3...12	3117
RETURN	DRV3...13	3118
END	DRV3...14	3119

C* FMSE	FMSE...1	3120
SUBROUTINE FMSET	FMSE...2	3121
CIBH	FMSE...3	3122
IMPLICIT REAL*8(A-H,O-Z)	FMSE...4	3123
CEND	FMSE...5	3124
*CALL BLNC	FMSE...6	3125
*CALL INPC	FMSE...7	3126
*CALL FLTC	FMSE...8	3127
*CALL TCON	FMSE...9	3128
*CALL IOPU	FMSE...10	3129
C	FMSE...11	3130
C THIS SUBROUTINE RECORDS CHANNEL AND CORE PARAMETERS AT FUEL MOTION	FMSE...12	3131
C INITIATION TIMES	FMSE...13	3132
C	FMSE...14	3133
IF(IFMOV.EQ.1) RETURN	FMSE...15	3134
IFM=1	FMSE...16	3135
IFMOV=1	FMSE...17	3136
TFMOV=TIME	FMSE...18	3137
NL=MZ+6	FMSE...19	3138
CALL LINES(NL,IPAGE)	FMSE...20	3139
WRITE(IWRITE, 1010)	FMSE...21	3140
C THIS MODEL ASSUMES PROFILE OF RADIAL MELT FRONT IN PIN THAT OF POWER	FMSE...22	3141
C DEFAULT FUEL FAILURE CRITERIA =	FMSE...23	3142
C FAILURE AT MOLTEN AREA=.5*PIN AREA	FMSE...24	3143
DMFO=DFMELT	FMSE...25	3144
DMFO=DF	FMSE...26	3145
IF(RFFAIL.LT..100.OR.RFFAIL.GT.1.00) RFFAIL = .707D0	FMSE...27	3146
C DEFAULT FAILURE LOCATION	FMSE...28	3147
ZFMOV=Z1+.5*AHF-ASY	FMSE...29	3148
IF(I2D.GT.0) ZFMOV=AZ(I2)	FMSE...30	3149
ZFMOV=DMAX1(ZFMOV,FMOV0)	FMSE...31	3150
U1=X*(Z1-Z0)	FMSE...32	3151
U2=X*(Z2-Z0)	FMSE...33	3152
S1=DSINH(2.00*U1)	FMSE...34	3153
S2=DSINH(2.00*U2)	FMSE...35	3154
ZINT=.5/X*(U2-U1-.5*(S2-S1))	FMSE...36	3155
ACON1=PI*RF*RF*RFFAIL*RFFAIL	FMSE...37	3156
IF(I2D.GT.0) ACON1=AF *RMRF2S(MZ/2)	FMSE...38	3157
VMFO=ACON1*ZINT	FMSE...39	3158
WRITE(IWRITE, 1000) ICH,TFMOV,ZFMOV,VMFO,DMFO	FMSE...40	3159
WRITE(IWRITE, 1020)	FMSE...41	3160
WRITE(IWRITE, 1030)	FMSE...42	3161
VMFO=0.	FMSE...43	3162
DO 100 JJ=1,MZ	FMSE...44	3163
J=MZ-JJ+1	FMSE...45	3164
THETAH=SXZ20Z(J)	FMSE...46	3165
RMF=THETAH*RF*RFFAIL	FMSE...47	3166
IF(I2D.GT.0) THETAH=DSQRT(RMRF2S(J))	FMSE...48	3167
IF(I2D.GT.0) RMF=THETAH*RF	FMSE...49	3168
RMRF2(J)=RMF*RMF	FMSE...50	3169
AHF(J)=PI*RMRF2(J)	FMSE...51	3170
VMFO=VMFO+AHF(J)*AXHI(J)	FMSE...52	3171
PZ=PZZ(J)*PHIX	FMSE...53	3172
EZ=PZ*EDIVP	FMSE...54	3173
WRITE(IWRITE, 1040) AZ(J),TCOOL(J),TCLAD(J),TF1(J)	FMSE...55	3174
1,TBAR(J),TF0(J),EZ,THETAH,RMF,AHF(J),TFHART(J)	FMSE...56	3175

UPDAT/195 12/31/79

100	CONTINUE	FMSE..57	3176
	WRITE(IWRITE, 1010)	FMSE..58	3177
CALL	DAMAGE	FMSE..59	3178
	CALL DAMAGE	FMSE..60	3179
	RETURN	FMSE..61	3180
1000	FORMAT(1H0,'CHANNEL',I4,3X,'INITIAL FUEL MOTION TIME=',F9.5	FMSE..62	3181
	1,'',LOCATION=',F9.5,'',CAVITY VOLUME=',F9.5,'',DENSITY=',F9.5)	FMSE..63	3182
1010	FORMAT(130(1H*1):	FMSE..64	3183
1020	FORMAT(1H0,'TEMPERATURE PROFILE PARAMETERS AT ONSET OF FUEL MOTION	FMSE..65	3184
	1')	FMSE..66	3185
1030	FORMAT(10X,1H2.6X,5HTCOOL,6X,5HTCLAD,8X,3HTF1,6X,5HTFAVE	FMSE..67	3186
	1,8X,3HTFD,5X,6HENERGY,5X,6HTHETAM,8X,3HHRMF,8X,3HAMF,5X,6HTFMOLT)	FMSE..68	3187
1040	FORMAT(6F11.4,5E11.4)	FMSE..69	3188
	END	FMSE..70	3189

UFDAT/195 12/31/79

C* FMV1	FMV1...1	3190
SUBROUTINE FMOV1	FMV1...2	3191
CIBM	FMV1...3	3192
IMPLICIT REAL*8(A-H,O-Z)	FMV1...4	3193
CEND	FMV1...5	3194
*CALL BLNC	FMV1...6	3195
*CALL INPC	FMV1...7	3196
*CALL FLTC	FMV1...8	3197
*CALL TCOM	FMV1...9	3198
*CALL IOPU	FMV1...10	3199
C	FMV1...11	3200
C THIS SUBROUTINE DETERMINES TRANSIENT FUEL EJECTION PARAMETERS	FMV1...12	3201
C	FMV1...13	3202
ACH=ACLD*AS	FMV1...14	3203
TIMEJ=TIME-TFMOV	FMV1...15	3204
TIMEJ2=TIMEJ*TIMEJ	FMV1...16	3205
GRAVH=GRAV1+GRAV2/TIMEJ+GRAV3/TIMEJ2	FMV1...17	3206
DMF=DMFE+(DMF0-DMFE)*DEXP(-TIMEJ/TAUEJ)	FMV1...18	3207
DZMIX=VIF0*(DMF0-DMF)/(DMFE*ACH)	FMV1...19	3208
ZHIXL=ZFMOV-0.5*DZMIX	FMV1...20	3209
ZHIXL=ZHIXL-.5*GRAVH*GRAV*TIMEJ2	FMV1...21	3210
ZHIXU=ZHIXL+DZMIX	FMV1...22	3211
ZHFL=ZHIXL	FMV1...23	3212
ZHFU=ZHIXU	FMV1...24	3213
C EXCLUDE FCI CALCULATIONS	FMV1...25	3214
C SET ALL VOIDING AND DRYOUT INTERFACES OUTSIDE THE MOVING FUEL REGION.	FMV1...26	3215
ZVOIDL=DMIN1(ZHADH,ZHIXL)	FMV1...27	3216
ZVOIDU=DMAX1(ZHAUP,ZHIXU)	FMV1...28	3217
ZNADWL=ZVOIDL	FMV1...29	3218
ZNAUP=ZVOIDU	FMV1...30	3219
ZDL=DMIN1(ZDL,ZHIXL)	FMV1...31	3220
ZDU=DMAX1(ZDU,ZHIXU)	FMV1...32	3221
ZDO=ZDL	FMV1...33	3222
RETURN	FMV1...34	3223
END	FMV1...35	3224

UPDAT/195 12/31/79

C* FMV2	FMV2...1	3225
SUBROUTINE FMV2	FMV2...2	3226
CIBM	FMV2...3	3227
IMPLICIT REAL*8(A-H,O-Z)	FMV2...4	3228
CEND	FMV2...5	3229
*CALL BLNC	FMV2...6	3230
*CALL INPC	FMV2...7	3231
*CALL FLTC	FMV2...8	3232
*CALL TCON	FMV2...9	3233
*CALL IOPU	FMV2...10	3234
C	FMV2...11	3235
C THIS SUBROUTINE DETERMINES EQUIVALENT NODAL FUEL DENSITIES FOR FUEL-	FMV2...12	3236
C MOTION REACTIVITY CALCULATIONS	FMV2...13	3237
C	FMV2...14	3238
C DETERMINE NODAL INDECES FOR EQUIVALENT NODAL FUEL DENSITIES	FMV2...15	3239
ZDN=0.	FMV2...16	3240
ZUP=0.	FMV2...17	3241
DO 100 J=1,MZ	FMV2...18	3242
JL=J	FMV2...19	3243
ZDN=ZDN+AXHI(J)	FMV2...20	3244
IF(ZDN.GT.ZHIXL) GO TO 110	FMV2...21	3245
100 CONTINUE	FMV2...22	3246
110 CONTINUE	FMV2...23	3247
ZDN=ZDN-AXHI(JL)	FMV2...24	3248
C ZDN=THE BOTTOM OF THE NODAL REGION (JL) CONTAINING OR CLOSEST TO THE	FMV2...25	3249
C BOTTOM OF THE FUEL IN THE CHANNEL	FMV2...26	3250
DO 120 J=1,MZ	FMV2...27	3251
JU=J	FMV2...28	3252
ZUP=ZUP+AXHI(J)	FMV2...29	3253
IF(ZUP.GT.ZHIXU) GO TO 130	FMV2...30	3254
120 CONTINUE	FMV2...31	3255
130 CONTINUE	FMV2...32	3256
C ZUP=THE TOP OF THE NODAL REGION (JU) CONTAINING OR CLOSEST TO THE	FMV2...33	3257
C TOP OF THE FUEL IN THE CHANNEL	FMV2...34	3258
C PERFORM EQUIVALENT DENSITY CALCULATIONS	FMV2...35	3259
DXX=(DF-DNF)/DCPAF*CPF	FMV2...36	3260
DXAE=DNFE/DCPAF*ACH*CPF	FMV2...37	3261
DO 140 J=1,MZ	FMV2...38	3262
REAF(J)=-DXX*AMF(J)	FMV2...39	3263
140 CONTINUE	FMV2...40	3264
IF(JU-JL) 150,160,170	FMV2...41	3265
150 CONTINUE	FMV2...42	3266
WRITE(IWRITE, 1000) ZHIXL,ZHIXU	FMV2...43	3267
RETURN	FMV2...44	3268
160 CONTINUE	FMV2...45	3269
REAF(JU)=REAF(JU)+DZMIX/AXHI(JU)*DXAE	FMV2...46	3270
RETURN	FMV2...47	3271
170 CONTINUE	FMV2...48	3272
JBOT=JL+1	FMV2...49	3273
JTOP=JU-1	FMV2...50	3274
IF(ZHIXL.LT.ZDN) JBOT=1	FMV2...51	3275
IF(ZHIXU.GT.ZUP) JTOP=MZ	FMV2...52	3276
IF(JBOT.GT.1)	FMV2...53	3277
1REAF(JL)=REAF(JL)+(ZDN+AXHI(JL)-ZHIXL)/AXHI(JL)	FMV2...54	3278
2*DXAE	FMV2...55	3279
IF(JTOP.LT.MZ)	FMV2...56	3280

UPDAT/195 12/31/79

```
1 REAF(JU)=REAF(JU)+(ZHIXU-ZUP*AXHI(JU))/AXHI(JU)
2 *DXAE
  IF(JTOP.LT.JBOT) RETURN
  DO 180 J=JBOT,JTOP
    REAF(J)=REAF(J)+DXAE
180 CONTINUE
1000 FORMAT( ' HELP-ZHIXU.LT.ZHIXL IN FMOV2,ZHIXL=',F9.5,',ZHIXU=',
1 F9.5)
  RETURN
  END
```

```
FHV2..57 3281
FHV2..58 3282
FHV2..59 3283
FHV2..60 3284
FHV2..61 3285
FHV2..62 3286
FHV2..63 3287
FHV2..64 3288
FHV2..65 3289
FHV2..66 3290
```

UPDAT/195 12/31/79

```

C* TSCA
SUBROUTINE TSCALC
CIBM
IMPLICIT REAL*8(A-H,O-Z)
CEND
C
C THIS SUBROUTINE IS THE MAIN TRANSIENT ROUTINE.
C
*CALL INPC
*CALL FLTC
*CALL TCON
*CALL IOPU
DATA IO/O/
IPART=1
IICOUN=1
TIME=0.000
DT=DT1
CALL TSPK TO OBTAIN INITIAL REACTIVITY AND POWER EXTRAPOLATIONS.
CALL TSPK
C TOFF IS THE TIME AT WHICH FIRST PHASE TRANSIENT CALCULATIONS
C END. AFTER TOFF, DT=DT11.
TOFF=DHINI(SASTIM,TOA)
CALL LINES(IO,IPAGE)
NL=6
CALL LINES(NL,IPAGE)
WRITE(IWRITE,1000)
120 CONTINUE
CALL DRIVER TO DRIVE THE TRANSIENT CALCULATIONS.
CALL DRIVER
IF(TIME-TOFF) 120,140,140
140 CONTINUE
IF(TOFF.GE.TOA) GO TO 190
GO TO (150,160),IPART
150 CONTINUE
IPART=2
DT=DT11
GO TO 120
160 CONTINUE
C SECOND PHASE CALCULATIONS BEGIN HERE
170 CONTINUE
C TOFF OVERRIDE. SECOND PHASE CALCULATIONS WILL END AT TOFF.
TOFF=TOA
CALL DRIVER TO DRIVE TRANSIENT CALCULATIONS.
CALL DRIVER
IF(TIME-TOFF) 170,190,190
190 CONTINUE
CALL FINAL EDITING SUBROUTINE.
CALL DAMAGE TO GET CORE INVOLVMENT IN VOIDING AND MELTING.
IF(IPART.EQ.2) CALL DAMAGE
STOP
1000 FORMAT(1H0,/,48X,35H***** TRANSIENT STATE RESULTS *****
1//,6X,4HTIME,6X,5HPOWER,7X,4HFOOT,5X,6HENERGY,6X,5HSETAG
2,4X,7HDOPPLER,4X,7HCOOLANT,7X,4HCLAD,7X,4HFUEL,1X,10HPROGRAMMED
3,3X,8HNET REAC,2X,4HIPHI,2X,4HIREA
END

```

TSCA...1	3291
TSCA...2	3292
TSCA...3	3293
TSCA...4	3294
TSCA...5	3295
TSCA...6	3296
TSCA...7	3297
TSCA...8	3298
TSCA...9	3299
TSCA...10	3300
TSCA...11	3301
TSCA...12	3302
TSCA...13	3303
TSCA...14	3304
TSCA...15	3305
TSCA...16	3306
TSCA...17	3307
TSCA...18	3308
TSCA...19	3309
TSCA...20	3310
TSCA...21	3311
TSCA...22	3312
TSCA...23	3313
TSCA...24	3314
TSCA...25	3315
TSCA...26	3316
TSCA...27	3317
TSCA...28	3318
TSCA...29	3319
TSCA...30	3320
TSCA...31	3321
TSCA...32	3322
TSCA...33	3323
TSCA...34	3324
TSCA...35	3325
TSCA...36	3326
TSCA...37	3327
TSCA...38	3328
TSCA...39	3329
TSCA...40	3330
TSCA...41	3331
TSCA...42	3332
TSCA...43	3333
TSCA...44	3334
TSCA...45	3335
TSCA...46	3336
TSCA...47	3337
TSCA...48	3338
TSCA...49	3339
TSCA...50	3340
TSCA...51	3341
TSCA...52	3342
TSCA...53	3343
TSCA...54	3344
TSCA...55	3345

UPDAT/195 12/31/79

C* TSPK	TSPK...1	3346
SUBROUTINE TSPK	TSPK...2	3347
CIBH	TSPK...3	3348
IMPLICIT REAL*8(A-H,O-Z)	TSPK...4	3349
CEND	TSPK...5	3350
*CALL BLNC	TSPK...6	3351
*CALL INPC	TSPK...7	3352
*CALL FLTC	TSPK...8	3353
*CALL TCOM	TSPK...9	3354
*CALL IOPU	TSPK...10	3355
C	TSPK...11	3356
C THIS SUBROUTINE PERFORMS TRANSIENT STATE POINT KINETICS.	TSPK...12	3357
C	TSPK...13	3358
C PROGRAMMED REACTIVITY	TSPK...14	3359
IF (IPOWER.GT.0) GO TO 540	TSPK...15	3360
CC	TSPK...16	3361
CC DETERMINATION OF INTERNAL TIME STEPS AND OTHER CONSTANTS OVER	TSPK...17	3362
CC A CONSTANT TIME STEP (DT)	TSPK...18	3363
CC	TSPK...19	3364
TEX=0.125*DT	TSPK...20	3365
DO 180 J=1,8	TSPK...21	3366
T(J,1)=TEX	TSPK...22	3367
DO 100 I=2,5	TSPK...23	3368
100 T(J,I)=T(J,I-1)*TEX	TSPK...24	3369
DO 170 K=1,NOELAY	TSPK...25	3370
DO 110 I=1,5	TSPK...26	3371
110 O(J,K,I)=0.0	TSPK...27	3372
B=ALAM(K)*T(J,1)	TSPK...28	3373
IF (DABS(B).LT.1.) GO TO 130	TSPK...29	3374
RX=1.0/ALAM(K)	TSPK...30	3375
O(J,K,1)=(1.0-DEXP(-B))*RX	TSPK...31	3376
DO 120 JJ=2,5	TSPK...32	3377
XI=JJ	TSPK...33	3378
120 O(J,K,JJ)=(T(J,JJ-1)-(XI-1.0)*O(J,K,JJ-1))*RX	TSPK...34	3379
GO TO 170	TSPK...35	3380
130 SUM=A0(5)*T(J,5)	TSPK...36	3381
EPS3=SUM*1.0E-20	TSPK...37	3382
FJ2=6.0	TSPK...38	3383
TERM=SUM	TSPK...39	3384
140 TERM=-B*TERM/FJ2	TSPK...40	3385
IF (DABS(TERM).LE.EPS3) GO TO 150	TSPK...41	3386
SUM=SUM+TERM	TSPK...42	3387
FJ2=FJ2+1.0	TSPK...43	3388
GO TO 140	TSPK...44	3389
150 O(J,K,5)=SUM	TSPK...45	3390
DO 160 JJ=2,5	TSPK...46	3391
I2=6-JJ	TSPK...47	3392
160 O(J,K,I2)=(T(J,I2)-ALAM(K)*O(J,K,I2+1))*A0(I2)	TSPK...48	3393
170 CONTINUE	TSPK...49	3394
180 TEX=0.5*TEX	TSPK...50	3395
GO TO (190,420,490), KPOW	TSPK...51	3396
CC	TSPK...52	3397
CC INITIALIZATION	TSPK...53	3398
CC	TSPK...54	3399
190 PINTG=0.0	TSPK...55	3400
PINTG0=0.0	TSPK...56	3401

UPDAT/195 12/31/79

	IERROR=0	TSPK..57	3402
	IREA=0	TSPK..58	3403
	READOP=0.0	TSPK..59	3404
	REACOL=0.0	TSPK..60	3405
	REACLO=0.0	TSPK..61	3406
	REASLU=0.	TSPK..62	3407
	OTP=DT	TSPK..63	3408
	KI1=1	TSPK..64	3409
	BETAS=BETAS/EL	TSPK..65	3410
	REAFRG=PREA(TIME+DT)*BETAS/EL	TSPK..66	3411
	VREAT(3)=REAPRG	TSPK..67	3412
	VREAT(2)=0.0	TSPK..68	3413
210	VREAT(1)=-VREAT(3)	TSPK..69	3414
220	J3=1	TSPK..70	3415
	SUMN=0.0	TSPK..71	3416
	ERROR=0.0	TSPK..72	3417
	DTIME=0.0	TSPK..73	3418
	J4=0	TSPK..74	3419
	IPHI=0	TSPK..75	3420
	CALL FITZ (REAT,VREAT,DT,OTP)	TSPK..76	3421
	REAJ=REAT(1)	TSPK..77	3422
CC		TSPK..78	3423
CC	MAIN ROUTINE	TSPK..79	3424
CC		TSPK..80	3425
230	SUMCD=0.0	TSPK..81	3426
	IPHI=IPHI+1	TSPK..82	3427
	DT2=T(J3,1)	TSPK..83	3428
	DO 240 I=1,NDELAY	TSPK..84	3429
	CLAM(I)=C(I)*ALAM(I)	TSPK..85	3430
	CDOT(I)=EBETA(I)*POWFS-CLAM(I)	TSPK..86	3431
240	SUMCD=SUMCD+CDOT(I)	TSPK..87	3432
	DO 270 J5=1,3	TSPK..88	3433
	J2=J3-1+J5	TSPK..89	3434
	SUMCI=0.0	TSPK..90	3435
	DO 250 I=1,3	TSPK..91	3436
	SUMREA(I)=A0(I)*T(J2,I)*REAJ+A0(I+1)*T(J2,I+1)*(REAT(2)+2.0*REAT(3)	TSPK..92	3437
	1)*DTIME)+A0(I+2)*T(J2,I+2)*REAT(3)	TSPK..93	3438
250	SUMB(J5,I)=0.0	TSPK..94	3439
	DO 260 I=1,NDELAY	TSPK..95	3440
	CBURN(J5,I)=CLAM(I)*O(J2,I,1)	TSPK..96	3441
	SUMCI=SUMCI+CBURN(J5,I)	TSPK..97	3442
	DO 260 I1=1,3	TSPK..98	3443
	BIHT(J5,I1,I)=EBETA(I)*O(J2,I,I1)	TSPK..99	3444
	SUMB(J5,I1)=SUMB(J5,I1)+BIHT(J5,I1,I)	TSPK..100	3445
260	CONTINUE	TSPK..101	3446
	AQQ(J5,1)=T(J2,1)-SUMREA(2)+SUMB(J5,2)	TSPK..102	3447
	AQQ(J5,2)=T(J2,2)-SUMREA(3)+SUMB(J5,3)	TSPK..103	3448
	AQQ(J5,3)=POWFS*(SUMREA(1)-SUMB(J5,1))+SUMCI	TSPK..104	3449
270	CONTINUE	TSPK..105	3450
	DO 280 J5=2,3	TSPK..106	3451
	J2=J5-1	TSPK..107	3452
	DEQ(1)=AQQ(J2,3)+AQQ(J5,2)-AQQ(J2,2)+AQQ(J5,3)	TSPK..108	3453
	DEQ(2)=AQQ(J2,1)+AQQ(J5,3)-AQQ(J2,3)+AQQ(J5,1)	TSPK..109	3454
	DEQ(3)=AQQ(J2,1)+AQQ(J5,2)-AQQ(J2,2)+AQQ(J5,1)	TSPK..110	3455
	EN(J2,1)=DEQ(1)/DEQ(3)	TSPK..111	3456
	EN(J2,2)=DEQ(2)/DEQ(3)	TSPK..112	3457

UPDAT/195 12/31/79

	EN(J2,3)=POWFS+DT2*(EN(J2,1)+DT2*EN(J2,2))	TSPK. 113	3458
280	CONTINUE	TSPK. 114	3459
CC		TSPK. 115	3460
CC	FLUX CONVERGENCE	TSPK. 116	3461
CC		TSPK. 117	3462
	EPSILN=1.0-EN(1,3)/EN(2,3)	TSPK. 118	3463
	IF (DABS(EPSILN).GT.EPSPHI) GO TO 290	TSPK. 119	3464
	J4=J4+2*(6-J3)	TSPK. 120	3465
	IF (DABS(EPSILN)-EPSI) 300,310,310	TSPK. 121	3466
290	J3=J3+1	TSPK. 122	3467
	IF (J3.LE.6) GO TO 230	TSPK. 123	3468
	J3=6	TSPK. 124	3469
	J4=J4+1	TSPK. 125	3470
	GO TO 310	TSPK. 126	3471
300	J3=J3-1	TSPK. 127	3472
	IF (J3.GT.0) GO TO 310	TSPK. 128	3473
	J3=1	TSPK. 129	3474
310	DTIME=DTIME+DT2	TSPK. 130	3475
	IF(NOKGRP.LE.0) GO TO 350	TSPK. 131	3476
	DO 340 I=1,NOKGRP	TSPK. 132	3477
	DTLAI=DT2*DKLAI(I)	TSPK. 133	3478
	IF(DTLAI.GT.0.01) GO TO 320	TSPK. 134	3479
	FAC3=2.0*DTLAI*DTLAI*DTLAI*(1.0/6.0-DTLAI/24.0)	TSPK. 135	3480
	FAC2=(DTLAI*DTLAI-FAC3)/2.0	TSPK. 136	3481
	FAC1=DTLAI-FAC2	TSPK. 137	3482
	GO TO 330	TSPK. 138	3483
320	CONTINUE	TSPK. 139	3484
	FAC1=1.0-DEXP(-DTLAI)	TSPK. 140	3485
	FAC2=DTLAI-FAC1	TSPK. 141	3486
	FAC3=DTLAI*DTLAI-2.0*FAC2	TSPK. 142	3487
330	CONTINUE	TSPK. 143	3488
	DKHET(I)=DKHET(I)*DEXP(-DTLAI)+BETAH(I)*(POWFS *FAC1+EN(1,1)*	TSPK. 144	3489
	1 FAC2/DKLAI(I)+EN(1,2)*FAC3/(DKLAI(I)*DKLAI(I)))/DKLAI(I)	TSPK. 145	3490
340	CONTINUE	TSPK. 146	3491
350	CONTINUE	TSPK. 147	3492
	ERROR=ERROR+EPSILN	TSPK. 148	3493
	REAJ=REAJ+DTIME*(REAJ+DTIME*REAJ)	TSPK. 149	3494
	SUMN=SUMN+DT2*(POWFS+DT2*(EN(1,1)/2.0+DT2*EN(1,2)/3.0))	TSPK. 150	3495
	POWFS=EN(1,3)	TSPK. 151	3496
	DO 360 I=1,NDELAY	TSPK. 152	3497
360	C(I)=C(I)-CBURN(1,I)+POWFS*BINT(1,1,I)+EN(1,1)*BINT(1,2,I)+EN(1,2)	TSPK. 153	3498
	1 *BINT(1,3,I)	TSPK. 154	3499
	IF (J4-256) 380,390,370	TSPK. 155	3500
370	WRITE (IWRITE, 1000)	TSPK. 156	3501
	IERROR=1	TSPK. 157	3502
	RETURN	TSPK. 158	3503
380	DT2=T(J3,1)	TSPK. 159	3504
	IF (2*(6-J3)-256+J4.LE.0) GO TO 230	TSPK. 160	3505
	J3=J3+1	TSPK. 161	3506
	IF (J3.LE.6) GO TO 380	TSPK. 162	3507
	J3=J3-1	TSPK. 163	3508
390	CONTINUE	TSPK. 164	3509
	POWOK=0.0	TSPK. 165	3510
	IF(NOKGRP.LE.0) GO TO 410	TSPK. 166	3511
	DO 400 I=1,NOKGRP	TSPK. 167	3512
	POWOK=POWOK+DKLAI(I)*DKHET(I)	TSPK. 168	3513

UPOAT/195 12/31/79

400	CONTINUE	TSPK. 169	3514
410	CONTINUE	TSPK. 170	3515
	PHI=POWFS+POWOK	TSPK. 171	3516
	DEQ(1)=PHIPP	TSPK. 172	3517
	DEQ(2)=PHIP	TSPK. 173	3518
	DEQ(3)=PHI	TSPK. 174	3519
	CALL FITZ(CDOT,DEQ,DT,DTP)	TSPK. 175	3520
	PHIDOT=CDOT(2)+2.0*CDOT(3)*DT	TSPK. 176	3521
	SUMN=SUMN+DT*(POWOK+POWOKP)/2.0	TSPK. 177	3522
	QMULT=SUMN/DT	TSPK. 178	3523
	KPOH=2	TSPK. 179	3524
	PINTG=PINTG0+SUMN	TSPK. 180	3525
	RETURN	TSPK. 181	3526
CC		TSPK. 182	3527
CC	END MAIN	TSPK. 183	3528
CC		TSPK. 184	3529
420	CONTINUE	TSPK. 185	3530
	REAFRG=PREA(TIME+DT)*BETAS/CL	TSPK. 186	3531
	XI=VREAT(3)	TSPK. 187	3532
	IF (DABS(READOP).LE.1.0E-10) READOP=0.0	TSPK. 188	3533
	VREAT(3)=REAFRG*REASLU+READOP*REACLD+REACOL	TSPK. 189	3534
CC		TSPK. 190	3535
CC	REACTIVITY CONVERGENCE	TSPK. 191	3536
CC		TSPK. 192	3537
	EPSLON=(XI-VREAT(3))/BETAS	TSPK. 193	3538
	IF (DABS(EPSLON).LT.EPSREA) GO TO 480	TSPK. 194	3539
	IREA=IREA+1	TSPK. 195	3540
	IF (IREA.GT.30) GO TO 470	TSPK. 196	3541
	POWFS=POWFSP	TSPK. 197	3542
	DO 440 I=1,NDELAY	TSPK. 198	3543
440	C(I)=CO(I)	TSPK. 199	3544
	IF(NDKGRP.LE.0) GO TO 460	TSPK. 200	3545
	DO 450 I=1,NDKGRP	TSPK. 201	3546
450	DKHET(I)=DKHETP(I)	TSPK. 202	3547
460	CONTINUE	TSPK. 203	3548
	GO TO (210,220), KI1	TSPK. 204	3549
470	WRITE (IWRITE, 1010) VREAT(3),XI	TSPK. 205	3550
	IERROR=1:	TSPK. 206	3551
	RETURN	TSPK. 207	3552
480	CONTINUE	TSPK. 208	3553
	DEQ(1)=PHIPP	TSPK. 209	3554
	DEQ(2)=PHIP	TSPK. 210	3555
	DEQ(3)=PHI	TSPK. 211	3556
	CALL FITZ(CDOT,DEQ,DT,DTP)	TSPK. 212	3557
	PHIDOT=CDOT(2)+2.0*CDOT(3)*DT	TSPK. 213	3558
	DEQ(1)=PHIP	TSPK. 214	3559
	DEQ(2)=QMULT	TSPK. 215	3560
	DEQ(3)=PHI	TSPK. 216	3561
	XI=DT/2.0	TSPK. 217	3562
	CALL FITZ (CDOT,DEQ,XI,XI)	TSPK. 218	3563
	QMULT=CDOT(1)+DT*(CDOT(2)+DT*CDOT(3))	TSPK. 219	3564
	KPOH=3	TSPK. 220	3565
	DTP=DT	TSPK. 221	3566
	PINTG=PINTG0+QMULT*DT	TSPK. 222	3567
	RETURN	TSPK. 223	3568
490	CONTINUE	TSPK. 224	3569

UPDAT/195 12/31/79

```

PINTG0=PINTG
VREAT(1)=VREAT(2)
VREAT(2)=VREAT(3)
REAPRG=PREA(TIME+DT)*BETAS/EL
IF (DASS(READOP).LE.1.0E-10) READOP=0.0
VREAT(3)=REAPRG+REASLU*PEADOP+REACLD+REACOL
IF(NDKGRP.LE.0) FOMDK=0.0
IF(NDKGRP.LE.0) GO TO 520
DO 510 I=1,NDKERP
510 DKHETP(I)=DKHET(I)
520 POWDKP=POWDK
POWFSP=POWFS
PHIPP=PHIP
PHIP=PHI
DO 530 I=1,NDELAY
530 CO(I)=C(I)
KI=2
GO TO 220

CC
CC          POWER AS A FUNCTION OF TIME ONLY
CC
540 GO TO (550,560,570), KPOW
550 PINTG=0.0
PINTG0=0.0
IERROR=0
IPHI=0
IREA=0
GO TO 570
560 IF (DTP.NE.DT) GO TO 570
KPOW=3
DTP=DT
REAPRG=PREA(TIME+DT)*BETAS/EL
RETURN
570 PHIP=PHI
PHI=PREA(TIME+DT)
DTP=DT
QMULT=(PREA(TIME)+PREA(TIME+DT/2.0)+PHI)/3.0
IF (KPOW.EQ.3) PINTG0=PINTG
PINTG=PINTG0+QMULT*DT
KPOW=2
RETURN

CC
CC
CC
1000 FORMAT(12H ERROR IN PK)
1010 FORMAT(35H REACTIVITY ITER. COUNT EXCEEDS MAX,1P3E15.7)
END

```

TSPK.225	3570
TSPK.226	3571
TSPK.227	3572
TSPK.228	3573
TSPK.229	3574
TSPK.230	3575
TSPK.231	3576
TSPK.232	3577
TSPK.233	3578
TSPK.234	3579
TSPK.235	3580
TSPK.236	3581
TSPK.237	3582
TSPK.238	3583
TSPK.239	3584
TSPK.240	3585
TSPK.241	3586
TSPK.242	3587
TSPK.243	3588
TSPK.244	3589
TSPK.245	3590
TSPK.246	3591
TSPK.247	3592
TSPK.248	3593
TSPK.249	3594
TSPK.250	3595
TSPK.251	3596
TSPK.252	3597
TSPK.253	3598
TSPK.254	3599
TSPK.255	3600
TSPK.256	3601
TSPK.257	3602
TSPK.258	3603
TSPK.259	3604
TSPK.260	3605
TSPK.261	3606
TSPK.262	3607
TSPK.263	3608
TSPK.264	3609
TSPK.265	3610
TSPK.266	3611
TSPK.267	3612
TSPK.268	3613
TSPK.269	3614
TSPK.270	3615
TSPK.271	3616

UPDAT/195 12/31/79

C* FEED	FEED...1	3617
SUBROUTINE FEEDBK	FEED...2	3618
CIBM	FEED...3	3619
IMPLICIT REAL*8(A-H,O-Z)	FEED...4	3620
CEND	FEED...5	3621
*CALL BLNC	FEED...6	3622
*CALL INFC	FEED...7	3623
*CALL FLTC	FEED...8	3624
*CALL TCON	FEED...9	3625
*CALL IOPU	FEED...10	3626
C	FEED...11	3627
C THIS SUBROUTINE COMPUTES FEEDBACK REACTIVITIES.	FEED...12	3628
C	FEED...13	3629
CALL NADEN	FEED...14	3630
IF(TIME.EQ.0.0) GO TO 100	FEED...15	3631
IF(KPOH.NE.3) GO TO 120	FEED...16	3632
100 CONTINUE	FEED...17	3633
CC COOLANT REACTIVITY	FEED...18	3634
REA=0.0	FEED...19	3635
DO 110 J=1,MZ	FEED...20	3636
S5=1.-DAV2(J)/DAVSS(J)	FEED...21	3637
110 REA=REA+S5*VOIREA(J)	FEED...22	3638
CHREAV=REA*BETINV	FEED...23	3639
REA=REA/EL	FEED...24	3640
IF (DABS(REA).LE.1.0E-10) REA=0.0	FEED...25	3641
REACOL=REACOL+REA	FEED...26	3642
120 CONTINUE	FEED...27	3643
CC DOPPLER REACTIVITY	FEED...28	3644
REA=0.0	FEED...29	3645
DO 140 J=1,MZ	FEED...30	3646
REA=REA+DLOG((TBAR(J)+273.16)/(TREF(J)+273.16))*WDOP(J)*ADOP*(1.0-	FEED...31	3647
1BDOP*(1.0-DAV2(J)/DAVSS(J)))	FEED...32	3648
140 CONTINUE	FEED...33	3649
CHREAD=REA*BETINV	FEED...34	3650
REA=REA/EL	FEED...35	3651
READOP=READOP+REA	FEED...36	3652
CC FUEL MOTION REACTIVITY	FEED...37	3653
IF(IFM.EQ.0) GO TO 180	FEED...38	3654
IF(IFMOV.EQ.0) GO TO 180	FEED...39	3655
REA=0.	FEED...40	3656
DO 160 J=1,MZ	FEED...41	3657
REA=REA+WORTHF(J)*REAF(J)	FEED...42	3658
160 CONTINUE	FEED...43	3659
REAFCH=REA*BETINV	FEED...44	3660
REA=REA/EL	FEED...45	3661
SLU:IFR=REA	FEED...46	3662
REASLU=REASLU+REA	FEED...47	3663
180 CONTINUE	FEED...48	3664
CC CLAD MOTION REACTIVITY	FEED...49	3665
IF(ICH.EQ.0) GO TO 200	FEED...50	3666
IF(ICMOV.EQ.0) GO TO 200	FEED...51	3667
REA=0.	FEED...52	3668
DO 190 J=1,MZ	FEED...53	3669
REA=REA+WORTHF(J)*REACL(J)	FEED...54	3670
190 CONTINUE	FEED...55	3671
REACCH=REA*BETINV	FEED...56	3672

UPDAT/195 12/31/79

200 REA=REA/EL
REACLD=REACLD+REA
CONTINUE
CHREA=CHREAV+CHREAD+REAFCH+REACCH
RETURN
END

FEED..57 3673
FEED..58 3674
FEED..59 3675
FEED..60 3676
FEED..61 3677
FEED..62 3678

UPDAT/195 12/31/79

C* ZBOI	ZBOI...1	3679
SUBROUTINE ZBOIL	ZBOI...2	3680
CIBM	ZBOI...3	3681
IMPLICIT REAL*8(A-H,O-Z)	ZBOI...4	3682
CEND	ZBOI...5	3683
*CALL BLNC	ZBOI...6	3684
*CALL INPC	ZBOI...7	3685
*CALL FLTC	ZBOI...8	3686
*CALL TCOM	ZBOI...9	3687
*CALL IOPU	ZBOI...10	3688
C	ZBOI...11	3689
C THIS SUBROUTINE CALCULATES VOIDING AND DRYOUT INTERFACES	ZBOI...12	3690
C	ZBOI...13	3691
TIME=TIME+DT	ZBOI...14	3692
FRTIME=VOTIME+DTVD*FRT	ZBOI...15	3693
FRT=FRTIME	ZBOI...16	3694
DO 140 J=1,MZ	ZBOI...17	3695
TSTAR=TBOIL+TSH+(ZVOID0-AZ(J))/ZVOID0*DTSTAR	ZBOI...18	3696
C SKIP VOIDING ROUTINE IF IVDRAT=0	ZBOI...19	3697
IF(IVDRAT.EQ.0) GO TO 110	ZBOI...20	3698
C VARIATION OF GROLNES VOIDING FRONT CORRELATION	ZBOI...21	3699
FFF=FRCTC(J)	ZBOI...22	3700
PZ=PZZ(J)*PHIX	ZBOI...23	3701
RHS=CPH*(TSTAR-TCV(J))*GVFC	ZBOI...24	3702
IF(RHS.LT.0.) RHS=CPH*GVFC*(TSTAR-TBOIL-TSH)	ZBOI...25	3703
ALHS=PZ*EDIVP-ENV(J)	ZBOI...26	3704
C THE FF. TREATS ONLY THE ENERGY AVAILABLE TO HEAT CLAD ADIABATICALLY	ZBOI...27	3705
ALHS=ALHS+PZZ(J)*BETADT*(BETAGV-BETAG)	ZBOI...28	3706
RHS=DHAX1(0.00,RHS)	ZBOI...29	3707
ALHS=DHAX1(ALHS,0.00)	ZBOI...30	3708
ALR=ALHS-RHS	ZBOI...31	3709
IF(ALR) 130,130,100	ZBOI...32	3710
100 Z=AZ(J)-ALR/(ALR-ALR1)*(AZ(J)-AZ(J-1))	ZBOI...33	3711
C LIMIT VOID FRONT TRAVEL OVER A TIME STEP	ZBOI...34	3712
Z=DHAX1(Z,ZHADWH-.500*AXHI(J),Z)	ZBOI...35	3713
ZVOIDL=Z	ZBOI...36	3714
IF(IDBUG.EQ.2) WRITE(IWRITE, 1000)J,ICH,TIME,BETAG,ALHS,ALR,ALR1,Z	ZBOI...37	3715
GO TO 120	ZBOI...38	3716
C	ZBOI...39	3717
C RATE OF VOIDING LIMITED	ZBOI...40	3718
C	ZBOI...41	3719
110 CONTINUE	ZBOI...42	3720
ZVOIDL=VDZ3	ZBOI...43	3721
ZVOIDL=VDZ4	ZBOI...44	3722
DTVD=TIME-VOTIME	ZBOI...45	3723
ZLIM=ZVOID0-DTVD*VDRAT1	ZBOI...46	3724
IF(TIME.GE.FRT) ZLIM=VDZ1-(TIME-FRT)*VDRAT2	ZBOI...47	3725
ZVOIDL=DHAX1(ZVOIDL,ZLIM)	ZBOI...48	3726
ZLIM=VDZ2-DTVD*VDRAT3	ZBOI...49	3727
ZVOIDL=DHAX1(ZVOIDL,ZLIM)	ZBOI...50	3728
120 CONTINUE	ZBOI...51	3729
ZVOIDU=Z2+(Z2-ZVOIDL)*2.	ZBOI...52	3730
ZVOIDU=ZVOID0+(ZVOID0-ZVOIDL)*2.	ZBOI...53	3731
ZHADWH=ZVOIDL	ZBOI...54	3732
ZHAUP=ZVOIDU	ZBOI...55	3733
ZDO=ZVOIDL+0ZDOZV	ZBOI...56	3734

UPDAT/195 12/31/79

```
      ZDO=DMIN1(ZDO,ZVOID0)
      ZDL=ZDO
      ZDU=ZD00+(ZD00-ZDO)*2.
      TIME=TIME-DT
      RETURN
130  RHS1=RHS
      ALHS1=ALHS
      ALR1=ALR
140  CONTINUE
      ZVOIDL=ZNADIN
      ZVOIDU=ZNAUP
      TIME=TIME-DT
      RETURN
1000 FORMAT(2I6,8E15.4)
      END
```

ZBOI..57	3735
ZBOI..58	3736
ZBOI..59	3737
ZBOI..60	3738
ZBOI..61	3739
ZBOI..62	3740
ZBOI..63	3741
ZBOI..64	3742
ZBOI..65	3743
ZBOI..66	3744
ZBOI..67	3745
ZBOI..68	3746
ZBOI..69	3747
ZBOI..70	3748
ZBOI..71	3749

UPDAT/195 12/31/79

C= QSET	QSET...1	3750
SUBROUTINE QSET	QSET...2	3751
CIBM	QSET...3	3752
IMPLICIT REAL*8(A-H,O-Z)	QSET...4	3753
CEND	QSET...5	3754
*CALL BLNC	QSET...6	3755
*CALL INPC	QSET...7	3756
*CALL FLTC	QSET...8	3757
*CALL TCON	QSET...9	3758
*CALL IOPU	QSET...10	3759
C	QSET...11	3760
C THIS SUBROUTINE SETS HEAT TRANSFER PARAMETERS FOR USE IN CONSTANT	QSET...12	3761
C COOLANT TEMPERATURE PROFILE CALCULATIONS	QSET...13	3762
C	QSET...14	3763
NNPAK=3	QSET...15	3764
MODE=-1	QSET...16	3765
CALL DATHOV(NSACH,NNPAK,ICH,MODE)	QSET...17	3766
DO 120 KCH=1,NCHAN	QSET...18	3767
MODE=1	QSET...19	3768
CALL DATHOV(NSACH,NNPAK,KCH,MODE)	QSET...20	3769
NZERO=GZERO*AS	QSET...21	3770
CALL NTIME(TIME)	QSET...22	3771
DO 100 J=1,MZ	QSET...23	3772
IZ=J	QSET...24	3773
PZ=PZZ(J)*PHIX	QSET...25	3774
FFF=FRACFC(J)	QSET...26	3775
TFCL=TFSV(J)-TCLSV(J)	QSET...27	3776
IF(DABS(TFCL).LT.1.)	QSET...28	3777
1TFCL=TFCL/DABS(TFCL)	QSET...29	3778
CPHOTZ=FFF*PZ*BETPHI	QSET...30	3779
IF(J.GT.NZR2U)	QSET...31	3780
1CPHOTZ=CPW*(TCSV(MZ)-TCSV(NZR3L))/(AZ(MZ)-AZ(NZR3L))	QSET...32	3781
DZDZ=CPHOTZ/CPW	QSET...33	3782
DZDZ(J)=DZDZ	QSET...34	3783
DTTINQ(J)=TCSV(J)-TCOOLZ(1)	QSET...35	3784
DZDZTQ(J)=DZDZ/DTTINQ(J)	QSET...36	3785
TFDOTG=(TFSV(J)-TFSS(J))/TIME	QSET...37	3786
TCDOTG=(TCSV(J)-TCSS(J))/TIME	QSET...38	3787
CALL TEXT TO OBTAIN TIME-DERIVATIVES OF TEMPERATURES	QSET...39	3788
IF(IQUSE.EQ.2) CALL TEXT(TCDOTG,TFDOTG)	QSET...40	3789
AHQ1(J)=(PZ-DCPA*TFDOTG)/TFCL	QSET...41	3790
AHQ2(J)=(CPHCCL*TCDOTG+CPHOTZ)/TFCL	QSET...42	3791
AHQ(J)=(AHQ1(J)+AHQ2(J))*0.5	QSET...43	3792
IF(IQBASE.EQ.1) AHQ(J)=AHQ1(J)	QSET...44	3793
IF(IQBASE.EQ.2) AHQ(J)=AHQ2(J)	QSET...45	3794
IF(J.GT.IZQREF) AHQ(J)=AHQ(IZQREF)	QSET...46	3795
100 CONTINUE	QSET...47	3796
NL=MZ+5	QSET...48	3797
CALL LINES(NL,IPAGE)	QSET...49	3798
WRITE(IWRITE,1000)	QSET...50	3799
WRITE(IWRITE,1100) KCH	QSET...51	3800
DO 110 JZ=1,MZ	QSET...52	3801
J=MZ-JZ+1	QSET...53	3802
WRITE(IWRITE,1200) AZ(J),AHQ1(J),AZ(J),AHQ2(J)	QSET...54	3803
110 CONTINUE	QSET...55	3804
MODE=-1	QSET...56	3805

UPDAT/195 12/31/79

CALL DATMOV(NSACH,NNPAK,KCH,MODE)	QSET..57	3806
120 CONTINUE	QSET..58	3807
MODE=1	QSET..59	3808
CALL DATMOV(NSACH,NNPAK,ICH,MODE)	QSET..60	3809
NL=3	QSET..61	3810
CALL LINES(NL,IPAGE)	QSET..62	3811
WRITE(IWRITE,1300)	QSET..63	3812
RETURN	QSET..64	3813
1000 FORMAT(48X,10(1H*),12HQSET FACTORS,1X,10(1H*),/28X,10HFUEL BASED,	QSET..65	3814
1 53X,13HCOOLANT BASED)	QSET..66	3815
1100 FORMAT(/60X,8HCHANNEL ,I3,/(26X,5HAXIAL,8X,4HQSET,22X),	QSET..67	3816
1 /2(23X,8HLOCATION,6X,6HFACTOR,22X))	QSET..68	3817
1200 FORMAT(2(20X,F11.3,3X,E11.4,20X))	QSET..69	3818
1300 FORMAT(/6X,4HTIME,6X,5HPOWER,7X,4HPOOT,5X,6HENERGY,	QSET..70	3819
1 6X,5HBETAG,4X,7HDOPPLER,4X,7HCOOLANT,7X,4HCLAD,7X,4HFUEL,	QSET..71	3820
2 1X,10HPROGRAMMED,3X,8HNET REAC,2X,4HIPHI,2X,4HIREA)	QSET..72	3821
END	QSET..73	3822

UPDAT/195 12/31/79

```

C* THPC
  SUBROUTINE TEMPC
CIBM  IMPLICIT REAL*8(A-H,O-Z)
CEND
*CALL BLHC
*CALL INPC
*CALL FLTC
*CALL TCCN
*CALL IOPU
C
C THIS SUBROUTINE RECORDS DATA AT TIME=TIMCK FOR EXTRAPOLATION
C
  DO 100 J=1,MZ
    TCCK(J)=TCSV(J)
    TFCK(J)=TFSV(J)
  100 CONTINUE
  IF(ICH.NE.1) RETURN
  NL=1
  CALL LINES(NL,IPAGE)
  WRITE(1WRITE, 1000)TIME,TIMCK
  RETURN
1000 FORMAT(' TEMPC WAS CALLED AT TIME',ZE12.5)
END

```

THPC...1	3823
THPC...2	3824
THPC...3	3825
THPC...4	3826
THPC...5	3827
THPC...6	3828
THPC...7	3829
THPC...8	3830
THPC...9	3831
THPC...10	3832
THPC...11	3833
THPC...12	3834
THPC...13	3835
THPC...14	3836
THPC...15	3837
THPC...16	3838
THPC...17	3839
THPC...18	3840
THPC...19	3841
THPC...20	3842
THPC...21	3843
THPC...22	3844
THPC...23	3845
THPC...24	3846

C* TFED	TFED...1	3847
SUBROUTINE TFEIT	TFED...2	3848
CIBH	TFED...3	3849
IMPLICIT REAL*8(A-H,O-Z)	TFED...4	3850
CEND	TFED...5	3851
*CALL BLNC	TFED...6	3852
*CALL INPC	TFED...7	3853
*CALL FLTC	TFED...8	3854
*CALL TCSH	TFED...9	3855
*CALL IOFU	TFED...10	3856
*CALL PTIT	TFED...11	3857
IF(I2D.NE.0) GO TO 104	TFED...12	3858
NL=MZ+6	TFED...13	3859
CALL LINES(NL,IPAGE)	TFED...14	3860
WRITE(IWRITE,1000) ICH	TFED...15	3861
WRITE(IWRITE,1140)	TFED...16	3862
DO 150 JZ=1,MZ	TFED...17	3863
J=MZ-JZ+1	TFED...18	3864
WRITE(IWRITE,1150) AZ(J),TCSV(J),TCLSV(J),TFSV(J)	TFED...19	3865
150 CONTINUE	TFED...20	3866
GO TO 110	TFED...21	3867
104 CONTINUE	TFED...22	3868
IF(ICH.EQ.IMAX) GO TO 105	TFED...23	3869
NL=MZ+7	TFED...24	3870
CALL LINES(NL,IPAGE)	TFED...25	3871
WRITE(IWRITE,1000) ICH	TFED...26	3872
WRITE(IWRITE,1010)	TFED...27	3873
DO 100 JZ=1,MZ	TFED...28	3874
J=MZ-JZ+1	TFED...29	3875
WRITE(IWRITE,1020) AZ(J),TCSV(J),TCLSV(J),TF1SV(J),TFSV(J),TF0SV(J)	TFED...30	3876
100 CONTINUE	TFED...31	3877
GO TO 110	TFED...32	3878
105 CONTINUE	TFED...33	3879
NL=8+MZ	TFED...34	3880
CALL LINES(NL,IPAGE)	TFED...35	3881
WRITE(IWRITE,1030)	TFED...36	3882
WRITE(IWRITE,1040) ICH	TFED...37	3883
WRITE(IWRITE,1050)	TFED...38	3884
DO 120 JZ=1,MZ	TFED...39	3885
J=MZ-JZ+1	TFED...40	3886
THH=DSQRT(RHMF2(J))	TFED...41	3887
RH=THH*RF	TFED...42	3888
WRITE(IWRITE,1060) AZ(J),TCSV(J),TCLSV(J),TF1SV(J),TFSV(J),TF0SV(J)	TFED...43	3889
1),RH,THH,TFR(J)	TFED...44	3890
120 CONTINUE	TFED...45	3891
IF(I2D.NE.2) GO TO 110	TFED...46	3892
NL=8+MZ	TFED...47	3893
CALL LINES(NL,IPAGE)	TFED...48	3894
WRITE(IWRITE,1030)	TFED...49	3895
WRITE(IWRITE,1040) ICH	TFED...50	3896
WRITE(IWRITE,1090)	TFED...51	3897
DO 130 JZ=1,MZ	TFED...52	3898
J=MZ-JZ+1	TFED...53	3899
WRITE(IWRITE,1070) AZ(J),(TF(I,J),I=1,11)	TFED...54	3900
WRITE(IWRITE,1080) T FHART(J)	TFED...55	3901
130 CONTINUE	TFED...56	3902

UPDAT/195 12/31/79

110 CONTINUE	TFED..57	3903
NL=10	TFED..58	3904
CALL LINES(NL,IPAGE)	TFED..59	3905
WRITE(IWRITE,1110) VDTIME,ZNAUP,CHREAD,GCH,FRTIME,ZNADWN,CHREAV,	TFED..60	3906
1MCH	TFED..61	3907
WRITE(IWRITE,1120) TFMHV,ZDU,REACCH,PMCH,PHIXV,ZDL,REAFCH,GC"V	TFED..62	3908
WR1,Z(IWRITE,1130) PINTGV,ZMFU,CHREA,WCHV,ZHFL,PMCHV	TFED..63	3909
IF(ICH.NE.NCHAN) GO TO 140	TFED..64	3910
NL=3	TFED..65	3911
CALL LINES(NL,IPAGE)	TFED..66	3912
WRITE(IWRITE,1100)	TFED..67	3913
140 CONTINUE	TFED..68	3914
RETURN	TFED..69	3915
1000 FORMAT(1H0,40X,51H***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT **	TFED..70	3916
1****/60X,8HCHANNEL ,I3)	TFED..71	3917
1010 FORMAT(31X,5HAXIAL,7X,7HCOOLANT,6X,8HCLADDING,4X,10HFUEL BDRY.,5X,TFED..72	TFED..72	3918
19HFUEL AVE.,3X,11HFUEL CENTER,/28X,8HLOCATION,5(3X,11HTEMPERATURE)TFED..73	TFED..73	3919
2,/30X,6H(CH),5(9X,5H(C)))	TFED..74	3920
1020 FORMAT(22X,6F14.3)	TFED..75	3921
1030 FORMAT(1H0,10X,10(1H*),24HRADIAL,TEMPERATURE EDITS,10(1H*))	TFED..76	3922
1040 FORMAT(1H0,17HEDITS FOR CHANNEL,I4)	TFED..77	3923
1050 FORMAT(1H0,9X,5HAXIAL/6X,8HLOCATION/8X,6H(CH),10X,4HTAVG,9X,5HTCTFED..78	TFED..78	3924
1LAD,3X,11HTFUEL OUTER,5X,9HTFUEL AVG,2X,12HTFUEL CENTER,12X,2HRM,1TFED..79	TFED..79	3925
21X,3HTHM,11X,3HTER)	TFED..80	3926
1060 FORMAT(7F14.3,2014.5)	TFED..81	3927
1070 FORMAT(F9.3,11F10.3)	TFED..82	3928
1080 FORMAT(43H EFFECTIVE AVERAGE LIQUID FUEL TEMPERATURE,F11.3/)	TFED..83	3929
1090 FORMAT(1H0,2X,5HAXIAL/9H LOCATION,5X,1H1,9X,1H2,9X,1H3,9X,1H4,9X,1TFED..84	TFED..84	3930
1H5,9X,1H6,9X,1H7,9X,1H8,9X,1H9,8X,2H10,8X,2H11/5H (CH))	TFED..85	3931
1100 FORMAT(/6X,4HTIME,6X,5HPOWER,7X,4HPOOT,5X,6HENERGY,	TFED..86	3932
1 6X,5HBETAG,4X,7HDOPPLER,4X,7HCOOLANT,7X,4HCLAD,7X,4HFUEL,	TFED..87	3933
2 1X,10HPROGRAMMED,3X,8HNET PEAC,2X,4HIFI,2X,4HIREA)	TFED..88	3934
1110 FORMAT(/30X,6HVDTIME,2X,F9.3,3X,6HZVOIDU,2X,F9.3,3X,5HRHO-D,3X,01TFED..89	TFED..89	3935
11.4,3X,1HG,4X,F9.3/30X,6HFRTIME,2X,F9.3,3X,6HZVOIDL,2X,F9.3,3X,5HRTFED..90	TFED..90	3936
1HO-C,3X,011.4,3X,1HH,4X,F9.3)	TFED..91	3937
1120 FORMAT(30X,5HTFMHV,3X,F9.3,3X,4HZDOU,4X,F9.3,3X,6HRHO-CL,2X,011.4,TFED..92	TFED..92	3938
13X,3HP/W,2X,F9.3/30X,5HPHIXV,3X,F9.3,3X,4HZDOL,4X,F9.3,3X,5HRHO-F,TFED..93	TFED..93	3939
23X,011.4,3X,2HGV,3X,F9.3)	TFED..94	3940
1130 FORMAT(30X,6HPINTGV,2X,F9.3,3X,4HZMFU,4X,F9.3,3X,7HRHO-NET,1X,011,TFED..95	TFED..95	3941
14,3X,2HVV,3X,F9.3/50X,4HZHFL,4X,F9.3,25X,3HPHV,2X,F9.3)	TFED..96	3942
1140 FORMAT(41X,5HAXIAL,10X,7HCOOLANT,9X,8HCLADDING,8X,9HFUEL AVE./38X,TFED..97	TFED..97	3943
18HLOCATION,3(6X,11HTEMPERATURE)/40X,6H(CH),3(12X,5H(C)))	TFED..98	3944
1150 FORMAT(36X,4(F10.3,7X))	TFED..99	3945
END	TFED.100	3946

UPDAT/195 12/31/79

C* QTEM	QTEM...1	3947
SUBROUTINE QTEMPZ	QTEM...2	3948
CIBM	QTEM...3	3949
IMPLICIT REAL*8(A-H,O-Z)	QTEM...4	3950
CEND	QTEM...5	3951
*CALL BLNC	QTEM...6	3952
*CALL INFC	QTEM...7	3953
*CALL FLTC	QTEM...8	3954
*CALL TCOM	QTEM...9	3955
C	QTEM...10	3956
C THIS SUBROUTINE CALCULATES COOLANT TEMPERATURES ASSUMING A CONSTANT	QTEM...11	3957
C Z-DEPENDENCE. IT IS USED ONLY AFTER VOIDING INITIATION AND ONLY IF	QTEM...12	3958
C PTEMPZ HAS USED TO CALCULATE PREVOIDING COOLANT TEMPERATURES(ISUSE=0).	QTEM...13	3959
C	QTEM...14	3960
J=IZ	QTEM...15	3961
C DEFER TO STEMPZ IF ISUSE.GT.0.	QTEM...16	3962
IF(ISUSE.GT.0) GO TO 120	QTEM...17	3963
C DEFER TO PTEMPZ IF IQUSE=0.	QTEM...18	3964
IF(IQUSE.EQ.0) GO TO 110	QTEM...19	3965
PZ=PZZ(J)*PHIX	QTEM...20	3966
TFCL=TFSV(J)-TCLSV(J)	QTEM...21	3967
QHF=AHQ(J)	QTEM...22	3968
IF(AZ(J).GT.22) GO TO 100	QTEM...23	3969
CPHDTZ=CPH*(TCSV(J)-TCOOLZ(1))*DTDZTQ(J)	QTEM...24	3970
DTDZ=CPHDTZ/CPH	QTEM...25	3971
TCOOL(J)=TCSV(J)+DT/CPHCL*(QHF*TFCL-CPHDTZ)	QTEM...26	3972
TAVG=TCOOL(J)	QTEM...27	3973
TCLAD(J)=TCLSV(J)+TCOOL(J)-TCSV(J)	QTEM...28	3974
RETURN	QTEM...29	3975
100 CONTINUE	QTEM...30	3976
JZ=IZGREF	QTEM...31	3977
TCOOL(J)=TCOOLZ(1)+DTTINQ(J)/DTTINQ(JZ)*(TCOOL(JZ)-TCOOLZ(1))	QTEM...32	3978
DTDZ=(TCOOL(J)-TCOOLZ(1))*DTDZTQ(J)	QTEM...33	3979
CPHDTZ=CPH*DTDZ	QTEM...34	3980
TAVG=TCOOL(J)	QTEM...35	3981
TCLAD(J)=TCLSV(J)+TCOOL(J)-TCSV(J)	QTEM...36	3982
RETURN	QTEM...37	3983
110 CONTINUE	QTEM...38	3984
CALL PTEMPZ(J,TFUELA)	QTEM...39	3985
RETURN	QTEM...40	3986
120 CONTINUE	QTEM...41	3987
CALL STEMPZ	QTEM...42	3988
RETURN	QTEM...43	3989
END	QTEM...44	3990

UPDAT/195 12/31/79

C* STEM	STEM...1	3991
SUBROUTINE STEMPZ	STEM...2	3992
CIBM	STEM...3	3993
IMPLICIT REAL*8(A-H,O-Z)	STEM...4	3994
CEND	STEM...5	3995
*CALL BLNC	STEM...6	3996
*CALL INPC	STEM...7	3997
*CALL FLTC	STEM...8	3998
*CALL TCON	STEM...9	3999
*CALL IOFU	STEM...10	4000
C	STEM...11	4001
C THIS SUBROUTINE CALCULATES COOLANT TEMPERATURES USING THE EULERIAN	STEM...12	4002
C ROUTINE OF SAS2A BUT WITH A QUADRATIC APPROXIMATION FOR DTDZ.	STEM...13	4003
C	STEM...14	4004
DIMENSION TEMPE(3),TEMCO(3)	STEM...15	4005
J=IZ	STEM...16	4006
PZ=PZZ(J)*PHIX	STEM...17	4007
100 CONTINUE	STEM...18	4008
CPSAVE=CP	STEM...19	4009
CP=CPFUNH(TCSV(J))	STEM...20	4010
D1=PI*RCLO*DT/(AS*CP)	STEM...21	4011
B3=D1/(1./HCOL+1./HCL)	STEM...22	4012
G=GZERO*EXA	STEM...23	4013
H=G*AS	STEM...24	4014
GEX=GZERO*EXAEX	STEM...25	4015
HEX=GEX*AS	STEM...26	4016
JP1=J+1	STEM...27	4017
JP1=MIN(JP1,NZS)	STEM...28	4018
I2D1=I2D+1	STEM...29	4019
IF(I2D1.GT.0) GO TO 140	STEM...30	4020
110 CONTINUE	STEM...31	4021
TERM1=(TFSV(J)-TCLSV(J))*HFCL	STEM...32	4022
TERM3=(TFSV(JP1)-TCLSV(JP1))*HFCLP	STEM...33	4023
IF(J.LE.NZS1) GO TO 120	STEM...34	4024
IF(JP1.GT.(NZS1+NZS2)) GO TO 130	STEM...35	4025
GO TO 150	STEM...36	4026
120 CONTINUE	STEM...37	4027
TERM1=TERM1*CHENN1	STEM...38	4028
IF(JP1.LE.NZS1) TERM3=TERM3*CHENN1	STEM...39	4029
GO TO 150	STEM...40	4030
130 CONTINUE	STEM...41	4031
TERM3=TERM3*CHENN3	STEM...42	4032
IF(J.GT.(NZS1+NZS2)) TERM1=TERM1*CHENN3	STEM...43	4033
GO TO 150	STEM...44	4034
140 CONTINUE	STEM...45	4035
TERM3=(TF1SV(JP1)-TCLSV(JP1))*HF1CLP	STEM...46	4036
TERM1=(TF1SV(J)-TCLSV(J))*HF1CLP	STEM...47	4037
150 CONTINUE	STEM...48	4038
TERM2=(TCLSV(J)-TCSV(J))*PI2RCL/(1./HCOL+1./HCL)	STEM...49	4039
TERM4=(TCLSV(JP1)-TCSV(JP1))*PI2RCL/(1./HCOL+1./HCL)	STEM...50	4040
TCLAD(J)=TCLSV(J)+(TERM1-TERM2)*DT/(DCPACL+DCPAST)	STEM...51	4041
TCLAD(JP1)=TCLSV(JP1)+(TERM3-TERM4)*DT/(DCPACL+DCPAST)	STEM...52	4042
TCOOL(JP1)=TCSV(JP1)+TCLAD(JP1)-TCLSV(JP1)	STEM...53	4043
IF(J.EQ.1) GO TO 160	STEM...54	4044
GO TO 170	STEM...55	4045
160 CONTINUE	STEM...56	4046

	DZ=AZ(J)	STEM..57	4047
	B1=DAV2(J)	STEM..58	4048
	B2=DT/DZ	STEM..59	4049
	TCOOL(1)=(1./(B1+GEX*B2+B3))*(TCSV(1)*(B1-G*B2-B3)+TCOOLZ(1)*(GEX	STEM..60	4050
	*B2+G*B2-2.*B3)+B3*(TCLAD(1)+TCLSV(1)+2.*TCOOLZ(1)))	STEM..61	4051
	DZLAST=AZ(J)	STEM..62	4052
	DZNEXT=AZ(JP1)-AZ(J)	STEM..63	4053
	TEMPES(1)=TCOOLZ(1)	STEM..64	4054
	TEMPES(2)=TCSV(J)	STEM..65	4055
	TEMPES(3)=TCSV(JP1)	STEM..66	4056
	CALL FITZ(TEMCO,TEMPES,DZNEXT,DZLAST)	STEM..67	4057
	DTDZ=TEMCO(2)	STEM..68	4058
	TEMPES(1)=TCOOLZ(1)	STEM..69	4059
	TEMPES(2)=TCOOL(J)	STEM..70	4060
	TEMPES(3)=TCOOL(JP1)	STEM..71	4061
	CALL FITZ(TEMCO,TEMPES,DZNEXT,DZLAST)	STEM..72	4062
	DTDZEX=TEMCO(2)	STEM..73	4063
	CPHOTZ=.5*CP*(DTDZEX*WEX+DTDZ*W)	STEM..74	4064
	GO TO 200	STEM..75	4065
170	CONTINUE	STEM..76	4066
	DZ=AZ(J)-AZ(J-1)	STEM..77	4067
	B1=.5*(DAV2(J)+DAV2(J-1))	STEM..78	4068
	B2=DT/DZ	STEM..79	4069
	TCOOL(J)=(1./(B1+GEX*B2+B3))*(TCSV(J)*(B1-G*B2-B3)+TCOOL(J-1)*(-B1	STEM..80	4070
	*+GEX*B2-B3)+TCSV(J-1)*(B1+G*B2-B3)+B3*(TCLAD(J)+TCLSV(J)+TCLAD(J-1)	STEM..81	4071
	*)+TCLSV(J-1)))	STEM..82	4072
	IF(J.EQ.NZ) GO TO 180	STEM..83	4073
	DZLAST=AZ(J)-AZ(J-1)	STEM..84	4074
	DZNEXT=AZ(JP1)-AZ(J)	STEM..85	4075
	TEMPES(1)=TCSV(J-1)	STEM..86	4076
	TEMPES(2)=TCSV(J)	STEM..87	4077
	TEMPES(3)=TCSV(JP1)	STEM..88	4078
	CALL FITZ(TEMCO,TEMPES,DZNEXT,DZLAST)	STEM..89	4079
	DTDZ=TEMCO(2)	STEM..90	4080
	TEMPES(1)=TCOOL(J-1)	STEM..91	4081
	TEMPES(2)=TCOOL(J)	STEM..92	4082
	TEMPES(3)=TCOOL(JP1)	STEM..93	4083
	CALL FITZ(TEMCO,TEMPES,DZNEXT,DZLAST)	STEM..94	4084
	DTDZEX=TEMCO(2)	STEM..95	4085
	GO TO 190	STEM..96	4086
180	CONTINUE	STEM..97	4087
	DZ2=AZ(JP1)-AZ(J-1)	STEM..98	4088
	DZTERM=DZ/(DZ2+DZ2)	STEM..99	4089
	DTDZ=(TCSV(JP1)-TCSV(J-1))*DZTERM	STEM.100	4090
	DTDZEX=(TCOOL(JP1)-TCOOL(J-1))*DZTERM	STEM.101	4091
190	CONTINUE	STEM.102	4092
	CPHOTZ=.5*CP*(DTDZEX*WEX+DTDZ*W)	STEM.103	4093
200	CONTINUE	STEM.104	4094
	TFUEL=TFSV(J)+DT/DCPAF*(PZ-HFCLP*(TFSV(J)-TCLSV(J)))	STEM.105	4095
	IF(AZ(J).LE.Z1) TFUEL=TFSV(J)+DT/DCPAF*(PZ-HFCLP*(TFSV(J)-TCLS	STEM.106	4096
	&V(J))*CHENH1)	STEM.107	4097
	IF(AZ(J).GE.Z2) TFUEL=TFSV(J)+DT/DCPAF*(PZ-HFCLP*(TFSV(J)-TCLS	STEM.108	4098
	&V(J))*CHENH3)	STEM.109	4099
	TBAR(J)=TFUEL	STEM.110	4100
	TAVG=TCOOL(J)	STEM.111	4101
	FRACTC(J)=CPHOTZ/PZ	STEM.112	4102

UPDAT/195

12/31/79

CP=CPSAVE
RETURN
END

STEM. 113
STEM. 114
STEM. 115

4103
4104
4105

UPDAT/195 12/31/79

C* TEXT	TEXT...1	4106
SUBROUTINE TEXT(TC00TG,TFDOTG)	TEXT...2	4107
CIBM	TEXT...3	4108
IMPLICIT REAL*8(A-H,O-Z)	TEXT...4	4109
CEND	TEXT...5	4110
*CALL BLNC	TEXT...6	4111
*CALL INPC	TEXT...7	4112
*CALL FLTC	TEXT...8	4113
*CALL TCOM	TEXT...9	4114
*CALL IOPU	TEXT...10	4115
DIMENSION TEST(3),TCOEF(3)	TEXT...11	4116
C	TEXT...12	4117
C THIS SUBROUTINE DEVELOPS FUNCTIONAL FORM FOR TIME-DEPENDENCE OF TEM-	TEXT...13	4118
C PERATURE	TEXT...14	4119
C	TEXT...15	4120
J=IZ	TEXT...16	4121
DTFUT=TIME-TIMCK	TEXT...17	4122
DTPREV=TIMCK	TEXT...18	4123
TEST(1)=TCSS(J)	TEXT...19	4124
TEST(2)=TCCK(J)	TEXT...20	4125
TEST(3)=TCNV(J)	TEXT...21	4126
CALL FITZ(TCOEF,TEST,DTFUT,DTPREV)	TEXT...22	4127
TC00TG=TCOEF(2)+2.*TCOEF(3)*DTFUT	TEXT...23	4128
TEST(1)=TFSS(J)	TEXT...24	4129
TEST(2)=TFCK(J)	TEXT...25	4130
TEST(3)=TFNV(J)	TEXT...26	4131
CALL FITZ(TCOEF,TEST,DTFUT,DTPREV)	TEXT...27	4132
TFDOTG=TCOEF(2)+2.*TCOEF(3)*DTFUT	TEXT...28	4133
RETURN	TEXT...29	4134
END	TEXT...30	4135

UPDAT/195 12/31/79

```

C* VOTE
  SUBROUTINE VOTEMP
CIBM
  IMPLICIT REAL*8(A-H,O-Z)
CEND
*CALL BLNC
*CALL INPC
*CALL FLTC
*CALL TCOM
*CALL IOPU
C
C THIS SUBROUTINE RECORDS CHANNEL AND CORE PARAMETERS AT VOIDING
C INITIATION TIMES
C
  IF(IVOID.EQ.1) RETURN
  IF(ICH.NE.IMAX) GO TO 80
  IVOID=1
  VOFST=TIME
  ITEMP2=0
  CALL QSET
80 CONTINUE
  IVOID=1
  IVOIDT=IVOIDT+1
  LTVOID=ICH
  ITEMP2=ITEMP2+1
  IF(ITEMP2.NE.NCHAN) GO TO 90
  VOLAST=TIME
  PNTGLV=PINTG
90 CONTINUE
  IF(IVDTIM.EQ.0) GO TO 100
  VDTIME=TIME
100 CONTINUE
  FRTIME=VDTIME+DTVDFR
  WRITE(IWRITE, 1010)
  NL=MZ+7
  IF(INOEDT.EQ.1) NL=4
  CALL LINES(NL,IPAGE)
  WRITE(IWRITE, 1000) ICH,VDTIME
  IF(INOEDT.EQ.1) GO TO 110
  WRITE(IWRITE, 1020)
  WRITE(IWRITE, 1030)
110 CONTINUE
  PHIXV=PHIX
  PINTGV=PINTG
  DPRDBV=DPRDB
  CLROBV=CLRODB
  IF(ICH.NE.IMAX) GO TO 130
  CRDBHX=CLROBV
  DPBVHX=DPRDBV
  FNTGIX=PINTGV
130 CONTINUE
  READBV=REACDB
  EDIVPV=EDIVP
  FFACTV=FFACT
  BETAGV=BETAG

```

```

VOTE...1 4136
VOTE...2 4137
VOTE...3 4138
VOTE...4 4139
VOTE...5 4140
VOTE...6 4141
VOTE...7 4142
VOTE...8 4143
VOTE...9 4144
VOTE...10 4145
VOTE...11 4146
VOTE...12 4147
VOTE...13 4148
VOTE...14 4149
VOTE...15 4150
VOTE...16 4151
VOTE...17 4152
VOTE...18 4153
VOTE...19 4154
VOTE...20 4155
VOTE...21 4156
VOTE...22 4157
VOTE...23 4158
VOTE...24 4159
VOTE...25 4160
VOTE...26 4161
VOTE...27 4162
VOTE...28 4163
VOTE...29 4164
VOTE...30 4165
VOTE...31 4166
VOTE...32 4167
VOTE...33 4168
VOTE...34 4169
VOTE...35 4170
VOTE...36 4171
VOTE...37 4172
VOTE...38 4173
VOTE...39 4174
VOTE...40 4175
VOTE...41 4176
VOTE...42 4177
VOTE...43 4178
VOTE...44 4179
VOTE...45 4180
VOTE...46 4181
VOTE...47 4182
VOTE...48 4183
VOTE...49 4184
VOTE...50 4185
VOTE...51 4186
VOTE...52 4187
VOTE...53 4188
VOTE...54 4189
VOTE...55 4190
VOTE...56 4191

```

PBV=PHIBET	VOTE..57	4192
BPV=BETPHI	VOTE..58	4193
TIMREF=VDFRST-BETADT	VOTE..59	4194
PINTRF=PNTGHX*TIMREF/VDFRST	VOTE..60	4195
GCHV=GCH	VOTE..61	4196
NCHV=HCH	VOTE..62	4197
PNCHV=PNCH	VOTE..63	4198
DD 120 JJ=1,MZ	VOTE..64	4199
J=MZ-JJ+1	VOTE..65	4200
PZ=PZZ(J)*PHIX	VOTE..66	4201
EZ=PZ*EDIVP	VOTE..67	4202
ENV(J)=EZ	VOTE..68	4203
ENVZ(J)=EZ	VOTE..69	4204
END0(J)=EZ	VOTE..70	4205
ENCH(J)=EZ	VOTE..71	4206
ENFM(J)=EZ	VOTE..72	4207
TCV(J)=TCOOL(J)	VOTE..73	4208
TCLAD(J)=TCOOL(J)+PZ*(COLRES*.5*CLDRES)	VOTE..74	4209
TCLV(J)=TCLAD(J)	VOTE..75	4210
TCLVZ(J)=TCLAD(J)	VOTE..76	4211
TCLD0(J)=TCLAD(J)	VOTE..77	4212
TFV(J)=TBAR(J)	VOTE..78	4213
TFVZ(J)=TBAR(J)	VOTE..79	4214
TFD0(J)=TBAR(J)	VOTE..80	4215
TFCH(J)=TBAR(J)	VOTE..81	4216
DOTIME(J)=VDTIME+DTIV00	VOTE..82	4217
IF(IH0EDT.EQ.1) GO TO 120	VOTE..83	4218
WRITE(IWRITE, 1040) AZI(J),TCOOL(J),TCLAD(J),TF1(J)	VOTE..84	4219
1,TBAR(J),TF0(J),EZ	VOTE..85	4220
120 CONTINUE	VOTE..86	4221
WRITE(IWRITE, 1010)	VOTE..87	4222
IF(IVOIDT.EQ.NCHAN) CALL DAMAGE	VOTE..88	4223
NL=3	VOTE..89	4224
CALL LINES(NL,IPAGE)	VOTE..90	4225
WRITE(IWRITE,1050)	VOTE..91	4226
RETURN	VOTE..92	4227
1000 FORMAT(1H0,'CHANNEL',I4,' VOIDING TIME=',E12.5)	VOTE..93	4228
1010 FORMAT(130(1H*))	VOTE..94	4229
1020 FORMAT('H0,'TEMPERATURE PROFILES AT VOIDING')	VOTE..95	4230
1030 FORMAT(11X,1HZ,7X,5HTCOOL,7X,5HTCLAD,9X,3HTF1,7X,5HTFAVE	VOTE..96	4231
1,9X,3HTF0,6X,6HENERGY)	VOTE..97	4232
1040 FORMAT(6F12.5,4E12.5)	VOTE..98	4233
1050 FORMAT(/6X,4HTIME,6X,5HPOWER,7X,4HPDOT,5X,6HENERGY,	VOTE..99	4234
1 6X,5HBETAG,4X,7HDOPLER,4X,7HCOOLANT,7X,4HCLAD,7X,4HFUEL,	VOTE.100	4235
2 1X,10HPROGRAMMED,3X,8HNET REAC,2X,4HIPHI,2X,4HIREA)	VOTE.101	4236
END	VOTE.102	4237

UPDAT/195 12/31/79

```

C* NADE
  SUBROUTINE NADEN
CIBM
  IMPLICIT REAL*8(A-H,O-Z)
CEND
*CALL BLNC
*CALL INPC
*CALL FLTC
*CALL TCOM
*CALL IOPU
C
C THIS SUBROUTINE DETERMINES EQUIVALENT MODAL SODIUM DENSITIES FOR
C VOIDING REACTIVITY FEEDBACK CALCULATIONS.
C
  J1=MZ+1
  J2=MZ
  IF(ZNAUP-ZNADWN) 190,190,100
100  ZDN=0.0
     DO 110 J=1,MZ
        J1=J
        ZDN=ZDN+AXHI(J)
        IF(ZNADWN-ZDN) 120,110,110
110  CONTINUE
     GO TO 190
120  ZDN=ZDN-AXHI(J1)
     ZUP=0.0
     DO 130 J=1,MZ
        J2=J
        ZUP=ZUP+AXHI(J)
        IF(ZUP-ZNAUP) 130,130,140
130  CONTINUE
     J2=MZ
140  IF(J2-J1) 190,150,160
150  FRAC=1.0-(ZNAUP-ZNADWN)/AXHI(J1)
     FRAC=DHAX1(FRAC,0.000)
     TDENS=DHIN1(TSTAR,TCOOL(J1))
     DAV2(J1)=FRAC*(0.95140+00-2.3920-04*TDENS)
     GO TO 190
160  FRAC=(ZNADWN-ZDN)/AXHI(J1)
     FRAC=DHAX1(FRAC,0.000)
     TDENS=DHIN1(TSTAR,TCOOL(J1))
     DAV2(J1)=FRAC*(0.95140+00-2.3920-04*TDENS)
     FRAC=(ZUP-ZNAUP)/AXHI(J2)
     FRAC=DHAX1(FRAC,0.000)
     TDENS=DHIN1(TSTAR,TCOOL(J2))
     DAV2(J1)=FRAC*(0.95140+00-2.3920-04*TDENS)
     IF(J2-J1-1) 190,190,170
170  JBOT=J1+1
     JTOP=J2-1
     DO 180 J=JBOT,JTOP
180  DAV2(J)=0.0
190  CONTINUE
     J1=J1-1
     J2=J2+1
     IF(J1) 240,240,200
200  CONTINUE

```

```

NADE...1 4238
NADE...2 4239
NADE...3 4240
NADE...4 4241
NADE...5 4242
NADE...6 4243
NADE...7 4244
NADE...8 4245
NADE...9 4246
NADE...10 4247
NADE...11 4248
NADE...12 4249
NADE...13 4250
NADE...14 4251
NADE...15 4252
NADE...16 4253
NADE...17 4254
NADE...18 4255
NADE...19 4256
NADE...20 4257
NADE...21 4258
NADE...22 4259
NADE...23 4260
NADE...24 4261
NADE...25 4262
NADE...26 4263
NADE...27 4264
NADE...28 4265
NADE...29 4266
NADE...30 4267
NADE...31 4268
NADE...32 4269
NADE...33 4270
NADE...34 4271
NADE...35 4272
NADE...36 4273
NADE...37 4274
NADE...38 4275
NADE...39 4276
NADE...40 4277
NADE...41 4278
NADE...42 4279
NADE...43 4280
NADE...44 4281
NADE...45 4282
NADE...46 4283
NADE...47 4284
NADE...48 4285
NADE...49 4286
NADE...50 4287
NADE...51 4288
NADE...52 4289
NADE...53 4290
NADE...54 4291
NADE...55 4292
NADE...56 4293

```

UPDAT/195

12/31/79

```
      DO 210 J=1,J1
      TDENS=DHIN1(TSTAR,TCOOL(J))
      DAV2(J)=0.95140+00-2.3920-04*TDENS
210   CONTINUE
      IF(J2-MZ) 220,240,240
220   CONTINUE
      DO 230 J=J2,IJ2
      TDENS=DHIN1(TSTAR,TCOOL(J))
      DAV2(J)=0.95140+00-2.3920-04*TDENS
230   CONTINUE
240   CONTINUE
      RETURN
      END
```

```
NADE..57      4294
NADE..58      4295
NADE..59      4296
NADE..60      4297
NADE..61      4298
NADE..62      4299
NADE..63      4300
NADE..64      4301
NADE..65      4302
NADE..66      4303
NADE..67      4304
NADE..68      4305
NADE..69      4306
```

UPDAT/195 12/31/79

C* TH00	TH00...1	4307
SUBROUTINE TH00TF	TH00...2	4308
CIBM	TH00...3	4309
IMPLICIT REAL*8(A-H,O-Z)	TH00...4	4310
CEND	TH00...5	4311
C	TH00...6	4312
IN A GIVEN CHANNEL AND AXIAL NODE AT A CERTAIN TIME	TH00...7	4313
C THIS SUBROUTINE CALCULATES RADIAL TEMPERATURE PROFILES OVER THE FUEL	TH00...8	4314
C PIN, AVERAGE FUEL TEMPERATURE , CLAD TEMPERATURE AFTER CLAD MELTING	TH00...9	4315
C STARTED , AND LOCATIONS OF FUEL SOLIDUS FRONT AND LIQUIDUS FRONT	TH00...10	4316
C DURING FUEL MELTING. NEEDS(FROM OUTSIDE) POWER AND CLAD TEMPERATURE	TH00...11	4317
C BEFORE CLAD MELTING STARTS.	TH00...12	4318
=CALL BLNC	TH00...13	4319
=CALL INFC	TH00...14	4320
=CALL FLTC	TH00...15	4321
=CALL TDM	TH00...16	4322
J=12	TH00...17	4323
SHQ = PZ/AF	TH00...18	4324
SHQDT = SHQ*DT	TH00...19	4325
SHR= 0.	TH00...20	4326
RF2= RF*RF	TH00...21	4327
OR =RF*0.1	TH00...22	4328
APU1 =HF1CL*RF	TH00...23	4329
BETA1=2.*HF1CL/(4.*AKF*RF +HF1CL*RF2)	TH00...24	4330
BETA2 = APU1/(APU1 + 8.*AKF)	TH00...25	4331
APU2 = HEMAX * RF	TH00...26	4332
BETA3 = APU2/ (APU2 + 8.*AKF)	TH00...27	4333
IF(TIME.GT.0.) GO TO 20	TH00...28	4334
H=J	TH00...29	4335
SUJ2(M)= 0.	TH00...30	4336
SU2(M)= 0.	TH00...31	4337
S(M)= 0.	TH00...32	4338
F(M)= 0.	TH00...33	4339
Q(M)= 0.	TH00...34	4340
EI(M)= 0.	TH00...35	4341
ECLAD(M)= 0.	TH00...36	4342
CC(M)= 0.	TH00...37	4343
RHRF2(M)=0.	TH00...38	4344
TF0SV(M) = TF0(M)	TH00...39	4345
QSV(M) = 0.	TH00...40	4346
FSV(M) = 0.	TH00...41	4347
SSV(M) = 0.	TH00...42	4348
QR(M)=0.	TH00...43	4349
QRSV(J)=0.	TH00...44	4350
EIR(J)=0.	TH00...45	4351
EIRSV(J)=0.	TH00...46	4352
XDX(M) = 1.	TH00...47	4353
11 CONTINUE	TH00...48	4354
12 CONTINUE	TH00...49	4355
C DATA	TH00...50	4356
C	TH00...51	4357
DEFAULT FOR FUEL LATENT HEAT OF MELTING	TH00...52	4358
IF(FLATH.LT.1.0-04) FLATH = 230.00-06	TH00...53	4359
IF (FLATH.GT.1.0-03) FLATH = 280.00-06	TH00...54	4360
20 L = 1	TH00...55	4361
IF(TIME.GT.0.) L=2	TH00...56	4362
IF(TIME.GT.SETIME) L=3		
IF(TF0SV(J).GE.TFUELH) L=4		

```

      IF(QSV(J)) .GE. FLATH) L=5
      IF(FSV(J).GT.SU2(J).AND.SU2(J).GT.0.) L=6
      IF(SSV(J).GE.RF2)L=7
C TFR( 1) = SOLID FUEL AVERAGE TEMPERATURE (1E. REGION 3 OF GIVEN NODE.
C TBAR( 1) = FUEL AVERAGE TEMPERATURE OVER PIN CROSS SECTION(GIVEN NODE,
      GO TO (100,110,120,130,140,150,160),L
    100 B = SHQ/(4.*AKF)
      BRF2 = B*RF2
      TBAR(J) = TREF (J)
      A = TBAR(J) + BRF2/2.
      TF0(J) = A
      TFHART(J) = TF0(J)
      TF1(J) = A - BRF2
      TFR(J) = A - BRF2/2.
      DO 102 I=1,11
        SHR = (FLOAT(I)-1.) DR
        TF(I,J) = A - B*SHR*SHR
    102 CONTINUE
      RETURN
    110 OTFCL = TFSV(J) - TCLSV(J)
      B = BETA1* OTFCL
      BRF2 = B*RF2
      TBAR(J) = TFSV(J) + OT*(SHQ -4.*AKF*B)/DCPF
      A = TBAR(J) + BRF2*0.5
      TF0(J) = A
      TFHART(J) = TF0(J)
      TF1(J) = A -BRF2
      TFR(J) = TBAR(J)
      DO 112 I=1,11
        SHR = (FLOAT(I)-1.) DR
        TF(I,J) = A - B*SHR*SHR
    112 CONTINUE
      BB(J) = B
      RETURN
C OLD PROFILE FIRST
    120 A = TFSV(J)
      TB = TFSV(J)
      TC = TCLSV(J)
      S2 = 0.
      DCPAFS = DCPAF
      DCPFSV = DCPF
      CPFSV=CPF
CC BETA = BETA2 FOR SOLID CLAD, BETA3 FOR LIQUID CLAD, INTERPOLATION
      CLNFR = ECLSV(J)/CLHMLT
      CLNFR = DHIN1(CLNFR,1.00)
      BET = CLNFR*BETA3 + (1.00-CLNFR)*BETA2
      B = (3.*(A-TB)+ BET * (A -3.*TB +2.*TC))/RF2
      V = 3.*(TB -A + B*RF2*0.5 )/(RF2*RF2)
      EDEL = OT*4.*PI*AKF*RF2 * (B - 2.*V*RF2 )
C CLAD CONTACT TEST
      IF( TC.LT.TCLADM) GO TO 122
C TEMPERATURE DEPENDENT CPF , SIMPLE CORRELATION
      RATIO = .3985 + .1536D-03* (TB - 1900.) + 1.287D-07*(TB -1900.)**2THOD.109
      RATIO = (RATIO/CPF)*1.0-06
      DCPAF = RATIO * DCPAF
      DCPF = RATIO * DCPF

```

```

THOD..57 4363
THOD..58 4364
THOD..59 4365
THOD..60 4366
THOD..61 4367
THOD..62 4368
THOD..63 4369
THOD..64 4370
THOD..65 4371
THOD..66 4372
THOD..67 4373
THOD..68 4374
THOD..69 4375
THOD..70 4376
THOD..71 4377
THOD..72 4378
THOD..73 4379
THOD..74 4380
THOD..75 4381
THOD..76 4382
THOD..77 4383
THOD..78 4384
THOD..79 4385
THOD..80 4386
THOD..81 4387
THOD..82 4388
THOD..83 4389
THOD..84 4390
THOD..85 4391
THOD..86 4392
THOD..87 4393
THOD..88 4394
THOD..89 4395
THOD..90 4396
THOD..91 4397
THOD..92 4398
THOD..93 4399
THOD..94 4400
THOD..95 4401
THOD..96 4402
THOD..97 4403
THOD..98 4404
THOD..99 4405
THOD.100 4406
THOD.101 4407
THOD.102 4408
THOD.103 4409
THOD.104 4410
THOD.105 4411
THOD.106 4412
THOD.107 4413
THOD.108 4414
THOD.109 4415
THOD.110 4416
THOD.111 4417
THOD.112 4418

```

UPDAT/195 12/31/79

CPF = RATIO * CPF	THOD.113	4419
CC	THOD.114	4420
ECLAD(J) = ECLSV(J) + EDLT	THOD.115	4421
CLNFR = ECLAD(J)/CLNHLT	THOD.116	4422
CLNFR = DMIN(CLNFR,1.00)	THOD.117	4423
BCT = CLNFR*BETA3 + (1.00 - CLNFR) * BETA2	THOD.118	4424
C CLNHLT = CLLATH * DCL * ACLO	THOD.119	4425
TC = TCLADH + (ECLAD(J) - CLNHLT)/DCPAFL	THOD.120	4426
IF(TC.LT.TCLAOH) TC = TCLADH	THOD.121	4427
TCLAD(J) = TC	THOD.122	4428
122 CONTINUE	THOD.123	4429
C NEW	THOD.124	4430
TBARR = TB + (PZ*DT - EDLT)/DCPAF	THOD.125	4431
A = A + DT * (SHQ -4.*AKF*B)/DCPF	THOD.126	4432
IF(A.GT.TFUELN.AND.B.GT.0.) S2= (A-TFUELN)/B	THOD.127	4433
IF(A.GT.TFUELN) TBARR = TBARR - .500*S2* (A - TFUELN)/RF2	THOD.128	4434
TBAR(J) = TBARR	THOD.129	4435
B = (3.*(A-TBAR(J)) +BET *(A-3.*TBAR(J)+2.*TCLAD(J)))/RF2	THOD.130	4436
V = 3.*(TBAR(J) -A + B*RF2*0.5)/(RF2*RF2)	THOD.131	4437
TF0(J) = A	THOD.132	4438
IF(A.GT.TFUELN) TF0(J) = TFUELN	THOD.133	4439
TFHART(J) = TF0(J)	THOD.134	4440
TF1(J) = A -B*RF2 + V*RF2*RF2	THOD.135	4441
TFRI(J) = TBAR(J)	THOD.136	4442
IF(A.GT.TFUELN) TFRI(J) =TBARR-S2*(TFUELN-TBARR)/(RF2-S2)	THOD.137	4443
IF(I2D.NE. 2) GO TO 124	THOD.138	4444
DO 124 I=1,11	THOD.139	4445
SHR = (FLOAT(I)-1.) * DR	THOD.140	4446
THOTF = A - (B - V*SHR*SHR)*SHR*SHR	THOD.141	4447
IF(THOTF.GT.TFUELN) THOTF = TFUELN	THOD.142	4448
TF(I,J) = THOTF	THOD.143	4449
124 CONTINUE	THOD.144	4450
AA(J) =A	THOD.145	4451
BB(J) =B	THOD.146	4452
CC(J) =V	THOD.147	4453
SI(J) = S2	THOD.148	4454
IF(A.GT.TFUELN) Q(J) = CPF*(A-TFUELN)	THOD.149	4455
CPF=CPFSV	THOD.150	4456
DCPF=DCPFSV	THOD.151	4457
DCPAF=DCPAFS	THOD.152	4458
RETURN	THOD.153	4459
C SI(J) AND SSV(J) AND S2 ARE SQUARES OF THE SOLIDUS FRONT RADIUS	THOD.154	4460
130 S2 = SSV(J)	THOD.155	4461
B = BBSV(J)	THOD.156	4462
V = CCSV(J)	THOD.157	4463
TB = TFRSV(J)	THOD.158	4464
TC= TCLSV(J)	THOD.159	4465
C TEMPERATURE DEPENDENT CPF , SIMPLE CORRELATION	THOD.160	4466
DCPAFS = DCPAF	THOD.161	4467
DCPFSV = DCPF	THOD.162	4468
RATIO = .3985 + .1536D-03* (TB - 1900.) + 1.217D-07*(TB -1900.)**2	THOD.163	4469
RATIO = (RATIO/CPF)*1.0-06	THOD.164	4470
DCPAF = RATIO * DCPAF	THOD.165	4471
DCPF = RATIO * DCPF	THOD.166	4472
CC	THOD.167	4473
EDLT = 4.*PI*AKF*RF2*DT *(B -2.*V*RF2)	THOD.168	4474


```

DELTB = (PZ *DT - EDELT*RF2/(RF2 -S2))/DCPAF
TB = TB + DELTB
DELT = (SNQ - 4.*AKF*(B-4.*V*S2))*DT/(DCPF*(B-2.*V*S2))
IF(DELTB.GT.0.00.AND.DELTS.LT.0.00) DELTS = 0.00
IF(DELT.LT.0.) TB=TB -(DELT*PZ*DT/DCPAF)/(RF2-S2)
IF(TB.GT.TFUELH) TB= TFUELH
S2 =S2 + DELTS
IF(TB.GT.TFUELH) S2 = RF2
IF(S2.LT.0.) S2 = 0.
IF(S2.GT.RF2) S2 = RF2
TBR(J) = (S2*TFUELH + (RF2 -S2)* TB)/RF2
BET = (RF2 -S2)* HF1CL
BET = BET /(BET +4.*AKF*RF)
C CLAD CONTACT TEST
IF(TC.LT.TCLADH) GO TO 132
ECLAD(J) = ECLSV(J) + EDELT
CLMFR = ECLAD(J)/CLMHLT
CLMFR = MIN1(CLMFR,1.00)
HEFF = CLMFR*HBHAX + (1.00 - CLMFR) * H1CL
BET = (RF2-S2) * HEFF
BET = BET / (BET + 4.*AKF*RF)
TC = TCLADH + (ECLAD(J) - CLMHLT)/DCPAF
IF(TC.LT.TCLADH) TC = TCLADH
TCLAD(J) = TC
132 TC = TCLAD(J)
IF(S2.GE.RF2) GO TO 139
VV= 3. *(TFUELH - TB -BET) /((2.-BET) *(RF2-S2)**2)
V = VV
B = 2. *(TFUELH - TB + V *( RF2*RF2 +RF2*S2 -2.*S2*S2)/3.)/( RF2
1-S2 )
A = TFUELH *(B - V*S2) *S2
139 CONTINUE
QNEH = QSV(J) + SNQ * DT/DTF
EIF = EISV(J) + (S2-.500*DELT) * SNQDT
IF(DELT.LT.0.) EIF = EIF + DELTS*SNQ*DT
IF(S2.GE.RF2) EIF= EISV(J) + RF2*SNQDT
IF (EIF.LT.0.) EIF = 0.
TF0(J) = TFUELH
TFHART(J) = TF0(J)
TF1(J) = A - B*RF2 + V*RF2*RF2
TFR(J) = TB
IF(S2.GE.RF2) TF1(J) = TFUELH
IF(S2.GE.RF2) TFR(J) = TFUELH
SI(J) = S2
EI(J) = EIF
Q (J) = QNEH
RHRF2(J) = S2/RF2
IF(I20.NE. 2 ) GO TO 133
DO 133 I=1,11
SHR2=((FLOAT(I) -1.) * DR)**2
THDTF = A - (B - V* SHR2)*SHR2
TF(I,J) = THDTF
IF (SHR2.LE.S2 ) TF(I,J) = TFUELH
133 CONTINUE
IF (QNEH .LT.FLATH) GO TO 134
QSV(J) = QNEH

```

```

TH00.169 4475
TH00.170 4476
TH00.171 4477
TH00.172 4478
TH00.173 4479
TH00.174 4480
TH00.175 4481
TH00.176 4482
TH00.177 4483
TH00.178 4484
TH00.179 4485
TH00.180 4486
TH00.181 4487
TH00.182 4488
TH00.183 4489
TH00.184 4490
TH00.185 4491
TH00.186 4492
TH00.187 4493
TH00.188 4494
TH00.189 4495
TH00.190 4496
TH00.191 4497
TH00.192 4498
TH00.193 4499
TH00.194 4500
TH00.195 4501
TH00.196 4502
TH00.197 4503
TH00.198 4504
TH00.199 4505
TH00.200 4506
TH00.201 4507
TH00.202 4508
TH00.203 4509
TH00.204 4510
TH00.205 4511
TH00.206 4512
TH00.207 4513
TH00.208 4514
TH00.209 4515
TH00.210 4516
TH00.211 4517
TH00.212 4518
TH00.213 4519
TH00.214 4520
TH00.215 4521
TH00.216 4522
TH00.217 4523
TH00.218 4524
TH00.219 4525
TH00.220 4526
TH00.221 4527
TH00.222 4528
TH00.223 4529
TH00.224 4530

```

UPDAT/195 12/31/79

SU21J) = S2	TH00.225	4531
IF(S2.LE.0.) EIF = 0.	TH00.226	4532
IF(S2.LE.0.) S2 = 1.0-05	TH00.227	4533
EX = 4. - 6.* EIF/ (DF* FLATH * S2)	TH00.228	4534
C THESE MESSAGES USUALLY INDICATE TOO LARGE DT IN THE FUEL MOTION PHASE	TH00.229	4535
IF (EX .LT.-0..OR.EX .GT.2.) WRITE(IWRITE,1500) EX ,J,K	TH00.230	4536
IF(EX.LT.0..OR.EX.GT.2.) WRITE(IWRITE,1501) S2,RF2,EIF,QNEH,FLATH,	TH00.231	4537
1(TF(I,J),I=1,11)	TH00.232	4538
1500 FORMAT(1H0,1H*****EX =,F6.2, 8H IN NODE,I4,8H CHANNEL,I4//)	TH00.233	4539
1501 FORMAT(1H ,F7.4,F7.4,3E12.5/1H ,11F8.2/)	TH00.234	4540
IF(EX.LT..100) EX = 0.100	TH00.235	4541
IF(EX.GT.2.00) EX = 2.00	TH00.236	4542
XX(XJ) = EX	TH00.237	4543
C INITIALIZE QR(J) = LIQUID FUEL CENTERLINE TEMPERATURE RISE	TH00.238	4544
C AND EIR(J) = LIQUID FUEL AVERAGE TEMPERATURE RISE	TH00.239	4545
C	TH00.240	4546
QRRR = SHQ * DT/OCPF	TH00.241	4547
QR(J) = QRRR	TH00.242	4548
EIR(J) = (4.00 - EX)* QRRR/6.00	TH00.243	4549
C	TH00.244	4550
C THESE INITIALIZE YX = EX FOR NEXT PHASE	TH00.245	4551
C	TH00.246	4552
C F2 ALSO TO BE INITIALIZED TO HAVE CORRECT RATIOS AND F2.NE.0	TH00.247	4553
C F2 = F(J) = SQUARE OF THE LIQUID RADIOS	TH00.248	4554
F(J) = SHQ * DT * S2 / (DF * FLATH) / EX	TH00.249	4555
C	TH00.250	4556
C QR,EIR AND F2 COULD BE SCALED DOWN,RATIOS ONLY IMPORTANT	TH00.251	4557
SCALE= (QNEH-FLATH)=DF / (SHQ*DT)	TH00.252	4558
QRSV(J) = SCALE*QRRR	TH00.253	4559
EIRSV(J) = SCALE* EIR(J)	TH00.254	4560
FSV(J) = SCALE * F(J)	TH00.255	4561
134 CONTINUE	TH00.256	4562
AA(J) = A	TH00.257	4563
BB(J) = B	TH00.258	4564
CC(J) = V	TH00.259	4565
DCPAF = DCPAFS	TH00.260	4566
DCPF = DCPF*SV	TH00.261	4567
RETURN	TH00.262	4568
C F(J) , FSV(J) AND F2 ARE SQUARES OF THE LIQUIDUS FRONT RADIUS	TH00.263	4569
140 S2 = SSV(J)	TH00.264	4570
B = BBSV(J)	TH00.265	4571
V = CCSV(J)	TH00.266	4572
TB= TFRSV(J)	TH00.267	4573
TC= TC*SV(J)	TH00.268	4574
DCPAFS = DCPAF	TH00.269	4575
DCPFSV = DCPF	TH00.270	4576
CPFSV = CPF	TH00.271	4577
C TEMPERATURE DEPENDENT CPF , SIMPLE CORRELATION	TH00.272	4578
RATIO = .398500+ .15360-03* (TB - 1900.) + 1.2870-07*(TB - 1900.)**2	TH00.273	4579
RATIO = (RATIO/CPF)*1.0-06	TH00.274	4580
DCPAF = RATIO * DCPAF	TH00.275	4581
DCPF = RATIO * DCPF	TH00.276	4582
CPF = .5020-06	TH00.277	4583
CC	TH00.278	4584
EDEL = 4.*PI*AKF* RF2 *DT * (B - 2.*V* RF2)	TH00.279	4585
DELTTB = (PZ *DT - EDEL*RF2/(RF2 - S2))/DCPAF	TH00.280	4586

```

TB = TB + DELTTB
DEMA = 2.*V* S2
QNEH = QSV(J) + SHQ * DT/DT
DELTS = (SHQ - 4.*AKF * (B - 2.*DEMA)) * DT / (DCPF * (B - DEMA))
IF(DELTTB.GT.0.00.AND.DELTS.LT.0.00) DELTS = 0.00
IF(DELTS.LT.0.) TB=TB -(DELTS*PZ*DT/DCPAF)/(RF2-S2)
IF(TB.GT.TFUELM) TB= TFUELM
S2 = S2 + DELTS
IF(TB.GT.TFUELM) S2 = RF2
IF(S2.GE.RF2 ) S2 = RF2
IF(S2.LT.0.) DELTS = 0.
IF(S2.LT.0.) S2=0.
EIF = EISV(J) + (S2-.500*DELTS) * *MQOT
BET = (RF2 - S2) * HF1CL
BET = BET / (BET + 4.*AKF * RF )
C CLAD CONTACT TEST
IF(TC.LT.TCLADM) GO TO 142
ECLAD(J) = ECLSV(J) + EDEL
CLNFR = ECLAD(J)/CLNHLT
CLNFR = DMIN1(CLNFR,1.00)
HEFF = CLNFR*HBNAX + (1.00 - CLNFR) * HF1CL
BET = (RF2-S2) * HEFF
BET = BET / (BET + 4.*AKF*RF)
TC = TCLADM + (ECLAD(J) - CLNHLT)/DCPA/L
IF(TC.LT.TCLADM) TC = TCLADM
TCLAD(J) = TC
142 TC = TCLAD(J)
DRS2 = RF2 - S2
IF(DRS2.LE.0.) GO TO 149
VV= 1.*(TFUELM - TB -BET *(TB -TC)) /((2.-BET )*DRS2* DRS2)
V = VV
B = 2.*(TFUELM - TB +V *( RF2*RF2 +RF2*S2 -2.*S2*S2)/3.)/DRS2
A = TFUELM + (B - V*S2 ) *S2
149 SUX = SU2(J)
IF(SUX.LE.0.) WRITE(IWRITE,1600) J,K,SUX,RF2
IF(SUX.LE.0.) SU2(J) = S2
IF(SUX.LE.0.) SUX = S2
1600 FORMAT(1H ,5H NODE,I4,5H CHAN,I4,4H SUX,F7.4,4H RF2,F8.4/)
EX = XDX(J)
C
C
QRRR = QRSV(J)
EIRR = EIRSV(J)
YX = 4.00 - 6.00*EIRR/QRRR
IF(YX.GE.2.) YX = 1.900
IF(YX.LE.0.) YX= 0.100
F2 = FSV(J)
ELOSS = 4.*AKF * QRRR/F2
QRRR = (SHQ - ELOSS * YX) * DT / DCPF
IF(QRRR.LT.0.00) QRRR = SHQ*DT/DCPF
DEIR = (SHQ - ELOSS *(2.00 -YX)) * DT/ DCPF
IF(DEIR.LT.0.00) DEIR = (4.00-YX) * QRRR/6.00
QRI(J) = QRRR + QRRR
EIR(J) = EIRR + DEIR
TINBAR = TFUELM + EIRR + DEIR
FSRAT = F2/SUX

```

```

TH00.281 4587
TH00.282 4588
TH00.283 4589
TH00.284 4590
TH00.285 4591
TH00.286 4592
TH00.287 4593
TH00.288 4594
TH00.289 4595
TH00.290 4596
TH00.291 4597
TH00.292 4598
TH00.293 4599
TH00.294 4600
TH00.295 4601
TH00.296 4602
TH00.297 4603
TH00.298 4604
TH00.299 4605
TH00.300 4606
TH00.301 4607
TH00.302 4608
TH00.303 4609
TH00.304 4610
TH00.305 4611
TH00.306 4612
TH00.307 4613
TH00.308 4614
TH00.309 4615
TH00.310 4616
TH00.311 4617
TH00.312 4618
TH00.313 4619
TH00.314 4620
TH00.315 4621
TH00.316 4622
TH00.317 4623
TH00.318 4624
TH00.319 4625
TH00.320 4626
TH00.321 4627
TH00.322 4628
TH00.323 4629
TH00.324 4630
TH00.325 4631
TH00.326 4632
TH00.327 4633
TH00.328 4634
TH00.329 4635
TH00.330 4636
TH00.331 4637
TH00.332 4638
TH00.333 4639
TH00.334 4640
TH00.335 4641
TH00.336 4642

```

```

DNIMIT = DF * (FLATH * (EX*FSRAT - (EX-1.00)*FSRAT**2) - QSV(J) +
* FLATH )
DELT2 = 4.*AKF * QRRR * (2.00 - YX) / DNIMIT * DT
IF(DNIMIT.LE.0.)DELT2= SHR*DT*SUX / (DF*FLATH)
IF(DELT2.LT.0.) DELT2 = 0.00
F2 = F2 + DELT2
IF(F2.GT.S2) F2 = S2
C
TBAR(J) = (F2 * TINBAR + (S2 - F2)* TFUELH + (RF2 - S2)* TB) / RF2
TFHART(J) = (2.*F2*TINBAR + (S2-F2)*TFUELH) / (S2+F2)
TFR(J) = TB
TFB(J) = TFUELH + QRRR + DQRR
TF1(J) = A - (B - V*RF2) * RF2
IF(DRS2.LE.0.) TF1(J) = TFUELH
F(J) = F2
RHRF2(J) = S2 / RF2
IF(I20.NE. 2 ) GO TO 143
DO 143 I = 1,11
SHR2 = ((FLOAT(I) - 1.) * DR )**2
IF(SHR2.GT.F2) GO TO 147
SHRAT = SHR2 / F2
THOTF = TFUELH + (QRRR+DQRR)*(1.00-YX*SHRAT + (YX-1.00)*SHRAT**2)
TF(I,J) = THOTF
147 IF( SHR2.GT. F2 ) TF(I,J) = TFUELH
IF( SHR2.GT. S2 ) TF(I,J) = A - (B -V* SHR2)*SHR2
143 CONTINUE
IF( F2.LT. SUX ) GO TO 144
SUX2(J) = S2
144 CONTINUE
S(J) = S2
EI(J) = EIF
Q (J) = QNEW
AA(J) = A
BB(J) = B
CC(J) = V
DCPAF = DCPAFS
DCPF = DCPFSV
CPF = CPFSV
RETURN
150 S2 = SSV(J)
F2 = FSV(J)
B = BBSV(J)
V = CCSV(J)
TB = TFRSV(J)
TC = TCLSV(J)
DCPAF = DCPAF
DCPFSV = DCPF
CPFSV = CPF
C TEMPERATURE DEPENDENT CPF , SIMPLE CORRELATION
RATIO = .398508 + .15360-03* (TB - 1900.) + 1.2870-07*(TB -1900.)**2
RATIO = (RATIO/CPF)**1.0-06
DCPAF = RATIO * DCPAF
DCPF = RATIO * DCPF
CPF = .5020-06
EDEL2 = 4.*PI *AKF * RF2 *DT * ( B - 2.*V* RF2 )
IF(F2.GE.S2) EDEL2= EDEL2- 4.*PI*AKF*S2*DT*(B-2.*V*S2)

```

```

TH00.337 4643
TH00.338 4644
TH00.339 4645
TH00.340 4646
TH00.341 4647
TH00.342 4648
TH00.343 4649
TH00.344 4650
TH00.345 4651
TH00.346 4652
TH00.347 4653
TH00.348 4654
TH00.349 4655
TH00.350 4656
TH00.351 4657
TH00.352 4658
TH00.353 4659
TH00.354 4660
TH00.355 4661
TH00.356 4662
TH00.357 4663
TH00.358 4664
TH00.359 4665
TH00.360 4666
TH00.361 4667
TH00.362 4668
TH00.363 4669
TH00.364 4670
TH00.365 4671
TH00.366 4672
TH00.367 4673
TH00.368 4674
TH00.369 4675
TH00.370 4676
TH00.371 4677
TH00.372 4678
TH00.373 4679
TH00.374 4680
TH00.375 4681
TH00.376 4682
TH00.377 4683
TH00.378 4684
TH00.379 4685
TH00.380 4686
TH00.381 4687
TH00.382 4688
TH00.383 4689
TH00.384 4690
TH00.385 4691
TH00.386 4692
TH00.387 4693
TH00.388 4694
TH00.389 4695
TH00.390 4696
TH00.391 4697
TH00.392 4698

```

```

DELTB = (PZ *DT - EDELT*RF2/(RF2 -S2))/DCPAF
TB = TB + DELTB
DEMA = 2.*V* S2
QNEH = QSV (J) + SMQ = DT/DF
DELTS = (SMQ - 4.*AKF *(B - 2.*DEMA ))*DT/(DCPF*(B-DEMA))
IF(DELTTB.GT.0.00.AND.DELTS.LT.0.00) DELTS = 0.00
S2 =S2 + DELTS
IF(TB.GT.TFUELN) S2 = RF2
IF(DELTS.LT.0.) TB=TB -(DELTS*PZ*DT/DCPAF)/(RF2-S2)
IF(TS.GT.TFUELN) TB= TFUELN
IF(S2.GT.RF2) S2 = RF2
IF(S2.LT.0.) S2=0.
EIF = EISV(J) + (S2-.500*DELTS) * SHOOT
BET = (RF2 -S2) * HF1CL
BET = BET /(BET + 4.* AKF * RF)
C CLAD CONTACT TEST
IF(TC.LT.TCLADN) GO TO 152
ECLAD(J) = ECLSV(J) + EDELT
CLNFR = ECLAD(J)/CLHMLT
CLNFR = ONIN1(CLNFR,1.00)
HEFF = CLNFR*HBMAX + (1.00 - CLNFR) * HF1CL
BET = (RF2-S2) * HEFF
BET = BET / (BET + 4.*AKF*RF)
TC = TCLADN + (ECLAD(J) - CLHMLT)/DCPACL
IF(TC.LT.TCLADN) TC = TCLADN
TCLAD(J) = TC
152 TC = TCLAD(J)
DRS2 = RF2 - S2
IF(DRS2.LE.0.) GO TO 154
VV= 3.*(TFUELN - TB - BET *(TB -TC)) /((2.-BET )*DRS2 *DRS2)
V = VV
B = 2.*(TFUELN - TB + V *(RF2*RF2 +RF2*S2 -2.*S2*S2)/3.)/DRS2
A = TFUELN + (B - V*S2) * S2
154 CONTINUE
SUX = SU2(J)
EX = XX(X(J))
C
C
QRRR = QRSV(J)
EIRR = EIRSV(J)
YX = 4.00 - 6.00*EIRR/QRRR
IF(YX.GE.2.) YX = 1.900
IF(YX.LE.0.) YX= 0.100
ELOSS = 4.*AKF * QRRR/RF2
QRRR = (SMQ - ELOSS * YX) * DT / DCPF
IF(QRRR.LT.0.00) QRRR = 0.00
DEIR = (SMQ - ELOSS *(2.00 -YX)) * DT/ DCPF
IF(DEIR.LT.0.00) DEIR = 0.00
QRI(J) = QRRR + QRRR
EIR(J) = EIRR + DEIR
TIMBAR = TFUELN + EIRR + DEIR
FSLAT = F2/SUX
ONIMIT = DF* (FLATH- (QSV(J)- FLATH) *(S2-F2)/(S2-SU2(J)) )
IF(F2.GE.SSV(J)) ONIMIT = DF*FLATH
DELT2 = 4.*AKF * QRRR *(2.00- YX) /ONIMIT *DT
IF(F2.GE.SSV(J))DELT2=DELT2-4.*AKF*F2*(B-2.*V*F2)/ONIMIT *DT

```

```

TH00.393 4699
TH00.394 4700
TH00.395 4701
TH00.396 4702
TH00.397 4703
TH00.398 4704
TH00.399 4705
TH00.400 4706
TH00.401 4707
TH00.402 4708
TH00.403 4709
TH00.404 4710
TH00.405 4711
TH00.406 4712
TH00.407 4713
TH00.408 4714
TH00.409 4715
TH00.410 4716
TH00.411 4717
TH00.412 4718
TH00.413 4719
TH00.414 4720
TH00.415 4721
TH00.416 4722
TH00.417 4723
TH00.418 4724
TH00.419 4725
TH00.420 4726
TH00.421 4727
TH00.422 4728
TH00.423 4729
TH00.424 4730
TH00.425 4731
TH00.426 4732
TH00.427 4733
TH00.428 4734
TH00.429 4735
TH00.430 4736
TH00.431 4737
TH00.432 4738
TH00.433 4739
TH00.434 4740
TH00.435 4741
TH00.436 4742
TH00.437 4743
TH00.438 4744
TH00.439 4745
TH00.440 4746
TH00.441 4747
TH00.442 4748
TH00.443 4749
TH00.444 4750
TH00.445 4751
TH00.446 4752
TH00.447 4753
TH00.448 4754

```

UPDAT/195

12/31/79

```

      IF(DELTF2.LT.0.) DELTF2 = 0.00
      F2 = F2 + DELTF2
      IF(F2.GT.S2) S2 = F2
C
      TSU = TINBAR
      TSUF = TINBAR
      TBAR(J) = (SUX* TSU+(F2-SUX)*TSUF +(S2-F2)*TFUELH+(RF2-S2)* TB)/
      RF2
      TFHART(J) = (2.*SUX*TSU+ 2.*(F2-SUX)*TSUF+(S2-F2)*TFUELH)/
      1(S2 + F2)
      TFR(J) = TB
      TF0(J) = TFUELH + QRRR + DQRR
      TF1(J) = A - (B - V*RF2 )*RF2
      IF(S2.GE.RF2) TF1(J) = TFUELH
      F(J) = F2
      RRF2(J) = S2/RF2
      IF(I2D.HE. 2 ) GO TO 153
      DO 153 I = 1,11
      SHR2 = ((FLOAT(I) -1.) * DR) **2
      SHRAT = SHR2/F2
      THOTF = TFUELH + (QRRR+DQRR)*(1.00-YX*SHRAT + (YX-1.00)*SHRAT**2)
      TF(I,J) = THOTF
      IF( SHR2.GT.F2 ) TF(I,J) = TFUELH
      IF( SHR2.GT.S2 ) TF(I,J) = A - (B -V*SHR2 )* SHR2
153 CONTINUE
      S(J) = S2
      EI(J) = EIF
      Q1(J) = QNEH
      AA(J) = A
      BB(J) = B
      CC(J) = V
      DCPAF = DCPAFS
      DCPF = DCPFSV
      CPF = CPFSV
      RETURN
160 SUX = SU2(J)
      SULX = SU2(J)
      TC = TCLSV(J)
      EDEL2 = 2.*PI*DT*APU2*( TFUELH - TC)
CC SOLID CLAD TEMPERATURE CALCULATION INCLUDED ONLY BECAUSE DRVRO2
CC DOES NOT HANDLE. SIMPLE ADIABATIC MODEL HERE.
      IF(TC.LT.TCLADH) TCLAD(J)= TC+EDEL2/DCPACL
C CLAD CONTACT TEST AND TEMPERATURE
      IF(TC.LT.TCLADH) GO TO 162
      ECLAD(J) = ECLSV(J) + EDEL2
      TC = TCLADH + (ECLAD(J) - CLHRLT)/DCPACL
      IF(TC.LT.TCLADH) TC = TCLADH
      TCLAD(J) = TC
162 CONTINUE
C TEMPERATURE DEPENDENT CPF , SIMPLE CORRELATION
      CPFSV = CPF
      CPF = .502D-06
      EIF = EISV(J) + RF2 * SHQ * DT
      QNEH = QSV(J) + SHQ * DT/DF
      EX= XRX(J)

```

```

TH00.449 4755
TH00.450 4756
TH00.451 4757
TH00.452 4758
TH00.453 4759
TH00.454 4760
TH00.455 4761
TH00.456 4762
TH00.457 4763
TH00.458 4764
TH00.459 4765
TH00.460 4766
TH00.461 4767
TH00.462 4768
TH00.463 4769
TH00.464 4770
TH00.465 4771
TH00.466 4772
TH00.467 4773
TH00.468 4774
TH00.469 4775
TH00.470 4776
TH00.471 4777
TH00.472 4778
TH00.473 4779
TH00.474 4780
TH00.475 4781
TH00.476 4782
TH00.477 4783
TH00.478 4784
TH00.479 4785
TH00.480 4786
TH00.481 4787
TH00.482 4788
TH00.483 4789
TH00.484 4790
TH00.485 4791
TH00.486 4792
TH00.487 4793
TH00.488 4794
TH00.489 4795
TH00.490 4796
TH00.491 4797
TH00.492 4798
TH00.493 4799
TH00.494 4800
TH00.495 4801
TH00.496 4802
TH00.497 4803
TH00.498 4804
TH00.499 4805
TH00.500 4806
TH00.501 4807
TH00.502 4808
TH00.503 4809
TH00.504 4810

```

UPDAT/195 12/31/79

```

      Q(J) = QNEW
      EI(J) = EIF
      RRRF2(J) = 1.
      F2 = FSV(J)
      QDEL = QNEW - FLATH
      IF(SUX.LE.0.00) SU2(J) = FLATH*RF2/QSV(J)
C IF( SUX.LE.0.) NODE JUMPS FROM L=4 TO L=7 BEFORE Q.GT.FLATH
C IN SUCH CASES EX HAS NOT BEEN CALCULATED AND IS INITIALLY=1.
      IF(EX.EQ.1.) GO TO 171
      IF(EX.LE.0.00) GO TO 171
161 CONTINUE
C
      QRRR = QRSV(J)
      EIRR = EIRSV(J)
      YX = 4.00 - 6.00*EIRR/QRRR
      IF(YX.GE.2.) YX = 1.900
      IF(YX.LE.0.) YX = 0.100
      ELOSS = 4.*AKF * QRRR/F2
      IF(F2.GE.RF2) ELOSS = 0.00
      DQRR = (SHQ - ELOSS * YX) * DT / DCPF
      IF(DQRR.LT.0.00) DQRR = 0.00
      DEIR = (SHQ - ELOSS *(2.00 - YX)) * DT/ DCPF
      IF(DEIR.LT.0.00) DEIR = 0.00
      QRI(J) = QRRR + DQRR
      EIR(J) = EIRR + DEIR
      TDBAR = TFUELH + EIRR + DEIR
C
      FSRAT = F2/SUX
      DNIMIT = DF* (FLATH- (QSV(J)- FLATH)*(RF2-F2)/(RF2-SU2(J)) )
      DELTF2 = 4.*AKF * QRRR *(2.00- YX) /DNIMIT *DT
      IF(DELTF2.LT.0.) DELTF2 = 0.00
      F2 = F2 + DELTF2
      IF(F2.GT.RF2) F2 = RF2
      IF(F2.GT.S2) S2 = F2
      TSU = TDBAR
C
      TBAR(J) = (F2*TSU +(RF2-F2)*TFUELH) /RF2
      TFHART(J) = TBAR(J)
      TF0(J) = TFUELH + QRRR + DQRR
      TF1(J) = TFUELH
      IF(F2.GE.RF2) TF1(J) = TF1SV(J)+ SHQ*DT/(DF*CPF)
      TFR(J) = TFUELH
      F(J) = F2
      IF(I2D.NE. 2 ) GO TO 163
      DO 163 I= 1,11
      SHR = (FLOAT(I) -1.00)*OR
      SHR2 = SHR*SHR
      SHRAT = SHR2/F2
      THOTF = TFUELH + (QRRR+DQRR)*(1.00-YX*SHRAT + (YX-1.00)*SHRAT**2)
      IF(F2.GE.RF2) THOTF = TF1(J) +
      * (TF0(J)-TF1(J)) *(1.00-YX*SHRAT +(YX-1.00) *SHRAT**2 )
      TF1(J) = THOTF
      IF(SHR2.GT.F2) TF(I,J) = TFUELH
163 CONTINUE
      CPF = CPF5V
      RETURN

```

TH00.505	4811
TH00.506	4812
TH00.507	4813
TH00.508	4814
TH00.509	4815
TH00.510	4816
TH00.511	4817
TH00.512	4818
TH00.513	4819
TH00.514	4820
TH00.515	4821
TH00.516	4822
TH00.517	4823
TH00.518	4824
TH00.519	4825
TH00.520	4826
TH00.521	4827
TH00.522	4828
TH00.523	4829
TH00.524	4830
TH00.525	4831
TH00.526	4832
TH00.527	4833
TH00.528	4834
TH00.529	4835
TH00.530	4836
TH00.531	4837
TH00.532	4838
TH00.533	4839
TH00.534	4840
TH00.535	4841
TH00.536	4842
TH00.537	4843
TH00.538	4844
TH00.539	4845
TH00.540	4846
TH00.541	4847
TH00.542	4848
TH00.543	4849
TH00.544	4850
TH00.545	4851
TH00.546	4852
TH00.547	4853
TH00.548	4854
TH00.549	4855
TH00.550	4856
TH00.551	4857
TH00.552	4858
TH00.553	4859
TH00.554	4860
TH00.555	4861
TH00.556	4862
TH00.557	4863
TH00.558	4864
TH00.559	4865
TH00.560	4866

UPDAT/195 12/31/79

```
171 CONTINUE
  IF(QHEN.GT.FLATH) GO TO 174
  TF0(J) = TFUELM
  TF1(J) = TFUELM
  TBAR(J) = TFUELM
  IF(I2D.NE.2) GO TO 173
  DO 173 I=1,11
    SHR = (FLOAT(I) - 1.00) * DR
    SHR2 = SHR*SHR
    TF(I,J) = TFUELM
173 CONTINUE
  CPF = CPFSV
  RETURN
174 GO TO 161
  END
```

TW00.561	4867
TW00.562	4868
TW00.563	4869
TW00.564	4870
TW00.565	4871
TW00.566	4872
TW00.567	4873
TW00.568	4874
TW00.569	4875
TW00.570	4876
TW00.571	4877
TW00.572	4878
TW00.573	4879
TW00.574	4880
TW00.575	4881

UPDAT/195 12/31/79

```

C= PROD
  SUBROUTINE PROPED
CIBM  IMPLICIT REAL*8(A-H,O-Z)
CEND
=CALL INPC
=CALL FLTC
=CALL TCON
=CALL IOFU
  DATA IO/O/
C
C
C THIS SUBROUTINE EDITS ALL INPUT PARAMETERS
C
  CALL LINES(IO,IPAGE)
  WRITE(IWRITE, 1060)
  WRITE(IWRITE, 1070)
  WRITE(IWRITE, 1140)DF,CPF,RF,AF,DCPF,DCPAF,AKF
  WRITE(IWRITE, 1080)
  WRITE(IWRITE, 1140)DFMELT,FLATH,RFFAIL
  WRITE(IWRITE, 1090)
  WRITE(IWRITE, 1140)DCL,CPCCL,RCLD,ACLD,DCPCL,DCPACL,AKCL
  WRITE(IWRITE, 1100)
  WRITE(IWRITE, 1140)JCLLATH,CLHMLT
  WRITE(IWRITE, 1110)
  WRITE(IWRITE, 1140)OS,CPS,RS,AS,DCPS,DCPAS,HCOL
  WRITE(IWRITE, 1120)
  WRITE(IWRITE, 1140)OST,CPST,RST,AST,DCPST,DCPAST,AKST
  WRITE(IWRITE, 1130)
  WRITE(IWRITE, 1140)HGAP
  WRITE(IWRITE, 1180)
  WRITE(IWRITE, 1140)CHENH,CHENCF,CHENCC,CHENLF,CHENLC,CHENAL
  WRITE(IWRITE, 1190)
  WRITE(IWRITE, 1140)COLRES,CLORES,GAPRES,FRES,CPH,CPHCLL
  WRITE(IWRITE, 1210)
  WRITE(IWRITE, 1140)HF,HCL,HCOL,HGAP,HFCL,HF1CL,HFCLH
  WRITE(IWRITE, 1220)
  WRITE(IWRITE, 1140)HFP,HCLP,HCOLP,HGAPP,HFCLP,HF1CLP,HFCLNP
  WRITE(IWRITE, 1200)
  WRITE(IWRITE, 1140)CHENH1,CHENH3,FRES1,FRES3
  CALL LINES(IO,IPAGE)
  WRITE(IWRITE, 1230)
  WRITE(IWRITE, 1260)
  WRITE(IWRITE, 1140)FRACP1,FRACP2,FRACP3
  WRITE(IWRITE, 1270)
  WRITE(IWRITE, 1280)
  WRITE(IWRITE, 1140)TBOIL,TSH,TCLADM,TFUELM,DTCCCL,TIN
  WRITE(IWRITE, 1290)
  WRITE(IWRITE, 1140)EPSCT,ANT,AX
  WRITE(IWRITE, 1300)
  WRITE(IWRITE, 1140)FIN,FBRHIN,ANAX
  WRITE(IWRITE, 1310)
  WRITE(IWRITE, 1320)
  WRITE(IWRITE, 1140)ZVOID0,DZD0ZV,ZLL
  WRITE(IWRITE, 1330)
  WRITE(IWRITE, 1140)VDZ1,VDZ2,VDZ3,VDZ4

```

```

PROD...1 4882
PROD...2 4883
PROD...3 4884
PROD...4 4885
PROD...5 4886
PROD...6 4887
PROD...7 4888
PROD...8 4889
PROD...9 4890
PROD...10 4891
PROD...11 4892
PROD...12 4893
PROD...13 4894
PROD...14 4895
PROD...15 4896
PROD...16 4897
PROD...17 4898
PROD...18 4899
PROD...19 4900
PROD...20 4901
PROD...21 4902
PROD...22 4903
PROD...23 4904
PROD...24 4905
PROD...25 4906
PROD...26 4907
PROD...27 4908
PROD...28 4909
PROD...29 4910
PROD...30 4911
PROD...31 4912
PROD...32 4913
PROD...33 4914
PROD...34 4915
PROD...35 4916
PROD...36 4917
PROD...37 4918
PROD...38 4919
PROD...39 4920
PROD...40 4921
PROD...41 4922
PROD...42 4923
PROD...43 4924
PROD...44 4925
PROD...45 4926
PROD...46 4927
PROD...47 4928
PROD...48 4929
PROD...49 4930
PROD...50 4931
PROD...51 4932
PROD...52 4933
PROD...53 4934
PROD...54 4935
PROD...55 4936
PROD...56 4937

```

UPDAT/195

12/31/79

WRITE(IWRITE, 1340)	PROD..57	4938
WRITE(IWRITE, 1140) VDRAT1,VDRAT2,VDRAT3,VDRAT4	PROD..58	4939
WRITE(IWRITE, 1350)	PROD..59	4940
WRITE(IWRITE, 1140)DTVOFR,DTVDDO,DTIVDO	PROD..60	4941
WRITE(IWRITE, 1360)	PROD..61	4942
WRITE(IWRITE, 1370)GVFC	PROD..62	4943
WRITE(IWRITE, 1380)	PROD..63	4944
WRITE(IWRITE, 1390)	PROD..64	4945
WRITE(IWRITE, 1140)TOA,DT,THOLD,DFQUIT,FROT,FRSIDT,BETADT	PROD..65	4946
WRITE(IWRITE, 1400)	PROD..66	4947
WRITE(IWRITE, 1140)TIMCK,DT1,DT11,DT3	PROD..67	4948
WRITE(IWRITE, 1410)	PROD..68	4949
WRITE(IWRITE, 1420)	PROD..69	4950
WRITE(IWRITE, 1140)JRL, EPS	PROD..70	4951
WRITE(IWRITE, 1430)	PROD..71	4952
WRITE(IWRITE, 1140)EPSREA, EPSPHI	PROD..72	4953
WRITE(IWRITE, 1440)	PROD..73	4954
WRITE(IWRITE, 1450)	PROD..74	4955
WRITE(IWRITE, 1140)TAUEJ, DMFE	PROD..75	4956
CALL LINES(10, IPAGE)	PROD..76	4957
WRITE(IWRITE, 1460)	PROD..77	4958
WRITE(IWRITE, 1470)	PROD..78	4959
WRITE(IWRITE, 1150)ICASE, NCASE	PROD..79	4960
WRITE(IWRITE, 1480)	PROD..80	4961
WRITE(IWRITE, 1150)IREAD, IWRITE, IPUNCH, IPROSA	PROD..81	4962
WRITE(IWRITE, 1520)	PROD..82	4963
WRITE(IWRITE, 1150)IDBUG, IBUG, ITFBUG, INOEDT, INOSS	PROD..83	4964
WRITE(IWRITE, 1510)	PROD..84	4965
WRITE(IWRITE, 1150)IPL0T IPLOTS, IPLOTT, ISPLOT, ICHP, IZP	PROD..85	4966
WRITE(IWRITE, 1490)	PROD..86	4967
WRITE(IWRITE, 1150)IBETA, ITOA, IVDAT, IVDTIM, IQUSE, IZQREF, IGVFC	PROD..87	4968
X, IQBASE	PROD..88	4969
WRITE(IWRITE, 1500)	PROD..89	4970
WRITE(IWRITE, 1150)ISUSE, I2D, IMPUMP, IFPMAX	PROD..90	4971
RETURN	PROD..91	4972
1060 FORMAT(1H0,40(1H*), 'MATERIAL PROPERTIES AND OTHER SALIENT INPUT'	PROD..92	4973
1,40(1H*))	PROD..93	4974
1070 FORMAT(1H0, 'FUEL PROPERTIES', 18X	PROD..94	4975
1,7HDENSITY, 13X, 2HCP, 9X, 6HRADIUS, 11X, 4HAREA, 9X, 6HRHO*CP, 4X	PROD..95	4976
2, 11HRHO*CP*AREA, 14X, 1HK)	PROD..96	4977
1080 FORMAT(1H0, 28X, 12HMELT DENSITY, 7X, 8HLAT HEAT, 1X, 14HFAILURE RADIUS	PROD..97	4978
1090 FORMAT(1H0, 'CLAD PROPERTIES', 18X	PROD..98	4979
1,7HDENSITY, 13X, 2HCP, 9X, 6HRADIUS, 11X, 4HAREA, 9X, 6HRHO*CP, 4X	PROD..99	4980
2, 11HRHO*CP*AREA, 14X, 1HK)	PROD..100	4981
1100 FORMAT(1H0, 32X, 8HLAT HEAT, 2X, 13HL HT*RHO*AREA)	PROD..101	4982
1110 FORMAT(1H0, 'CONT. ANT PROPERTIES', 15X	PROD..102	4983
1,7HDENSITY, 13X, 2HCP, 9X, 6HRADIUS, 11X, 4HAREA, 9X, 6HRHO*CP, 4X	PROD..103	4984
2, 11HRHO*CP*AREA, 14X, 1HK)	PROD..104	4985
1120 FORMAT(1H0, 'STRUCTURE PROPERTIES', 13X	PROD..105	4986
1,7HDENSITY, 13X, 2HCP, 9X, 6HRADIUS, 11X, 4HAREA, 9X, 6HRHO*CP, 4X	PROD..106	4987
2, 11HRHO*CP*AREA, 14X, 1HK)	PROD..107	4988
1130 FORMAT(1H0, 'GAP PROPERTIES', 19X	PROD..108	4989
1,4HNGAP)	PROD..109	4990
1140 FORMAT(25X, 7E15.5)	PROD..110	4991
1150 FORMAT(1H0, 29X, 10I10)	PROD..111	4992
1170 FORMAT(2I10, 7E13.5)	PROD..112	4993

1180	FORMAT(1H0,'CHEM PARAMETERS',20X	PROD. 113	4994
	1,5HCHEM1,9X,6HCHEMCF,9X,6HCHEMCC,9X,6HCHEMNF,9X,6HCHEMLC,9X,	PROD. 114	4995
	26HCHEMAL)	PROD. 115	4996
1190	FORMAT(1H0,'RESISTANCE VALUES',17X	PROD. 116	4997
	1,6HCOLRES,9X,6HCLORES,9X,6HGAPRES,11X,4HFRES	PROD. 117	4998
	2,12X,3HCPH,9X,6HCPHCL)	PROD. 118	4999
1200	FORMAT(1H0,'REGIONAL MULTIPLIERS',14X	PROD. 119	5000
	1,6HCHEM1,9X,6HCHEM2,10X,5HFRES1,10X,5HFRES2)	PROD. 120	5001
1210	FORMAT(1H0,38X	PROD. 121	5002
	1,2HF,12X,3HNC1,11X,4HNCOL,11X,4HNGAP,11X,4HNFCL,10X,5HNF1CL	PROD. 122	5003
	2,10X,5HNFCLM)	PROD. 123	5004
1220	FORMAT(1H0,37X	PROD. 124	5005
	1,3HMF,11X,4HHC1P,10X,5HNCOLP,10X,5HNGAPP,10X,5HNFCLP,9X,6HNF1CLP	PROD. 125	5006
	2,9X,6HNFCLMP)	PROD. 126	5007
1230	FORMAT(1H0,40(1H*),'POWER PROFILE PARAMETERS',40(1H*))	PROD. 127	5008
1260	FORMAT(1H0,'REGION POWER FRACTIONS',12X	PROD. 128	5009
	1,6HFRACP1,9X,6HFRACP2,9X,6HFRACP3)	PROD. 129	5010
1270	FORMAT(1H0,40(1H*),'TEMPERATURE INPUT PARAMETERS',40(1H*))	PROD. 130	5011
1280	FORMAT(1H0,'INPUT TEMPERATURES',17X	PROD. 131	5012
	1,5HTBOIL,6X,9HSUPERHEAT,9X,6HTCLAOM,9X,6HTFUELM,10X,5HDTCC1	PROD. 132	5013
	2,9X,6HTINLET)	PROD. 133	5014
1290	FORMAT(1H0,'RADIAL PROFILE PARAMETERS',10X	PROD. 134	5015
	1,5HEPSC1,12X,3HANT,13X,2HAX)	PROD. 135	5016
1300	FORMAT(1H0,'AXIAL PROFILE PARAMETERS',13X	PROD. 136	5017
	1,3HFIN,9X,6HFBRRIN,11X,4HANAX)	PROD. 137	5018
1310	FORMAT(1H0,40(1H*),'VOIDING INPUT PARAMETERS',40(1H*))	PROD. 138	5019
1320	FORMAT(1H0,'SPATIAL INPUT',21X	PROD. 139	5020
	1,6HZVOID0,5X,10HZVOID1-200,12X,3AZLL)	PROD. 140	5021
1330	FORMAT(1H0,'SAS CRBR EEC LOF DEFAULTS',11X	PROD. 141	5022
	1,4HVDZ1,11X,4HVDZ2,11X,4HVDZ3,11X,4HVDZ4)	PROD. 142	5023
1340	FORMAT(1H0,34X	PROD. 143	5024
	1,6HVDROT1,9X,6HVDROT2,9X,6HVDROT3,9X,6HVDROT4)	PROD. 144	5025
1350	FORMAT(1H0,34X	PROD. 145	5026
	1,6HDTVDFR,9X,6HDTVDDO,9X,6HDTIVDO)	PROD. 146	5027
1360	FORMAT(1H0,'VOIDING FRONT CORRELATORS',11X	PROD. 147	5028
	1,4HGVFC)	PROD. 148	5029
1370	FORMAT(8X,'(SEE 1GVFC)',6X,7E15.5)	PROD. 149	5030
1380	FORMAT(1H0,40(1H*),'TIME PARAMETERS',40(1H*))	PROD. 150	5031
1390	FORMAT(1H0,'TIME INPUT',26X	PROD. 151	5032
	1,3HTOA,13X,2HDT,10X,5HTHOLD,9X,6HDFQUIT,11X,4HFRDT,9X,6HFRSDT	PROD. 152	5033
	2,9X,6HBETADT)	PROD. 153	5034
1400	FORMAT(1H0,35X	PROD. 154	5035
	1,5HTIMCK,12X,3HDT1,11X,4HDT11,12X,3HDT3)	PROD. 155	5036
1410	FORMAT(1H0,40(1H*),'CONVERGENCE INPUT',40(1H*))	PROD. 156	5037
1420	FORMAT(1H0,'TOB INPUT',28X	PROD. 157	5038
	1,2HRL,12X,3HEPS)	PROD. 158	5039
1430	FORMAT(1H0,'TSPK INPUT',23X	PROD. 159	5040
	1,6HEPSREA,9X,6HEPSPHI)	PROD. 160	5041
1440	FORMAT(1H0,40(1H*),'FUEL MOTION INPUT',40(1H*))	PROD. 161	5042
1450	FORMAT(1H0,'EJECTION PARAMETERS',15X	PROD. 162	5043
	1,5HTAUJ,3X,12HEQUIL. DENS.)	PROD. 163	5044
1460	FORMAT(1H0,40(1H*),'MODEL/EDIT OPTIONS',40(1H*))	PROD. 164	5045
1470	FORMAT(1H0,'CASES',30X	PROD. 165	5046
	1,5HCASE,5X,5HNCASE)	PROD. 166	5047
1480	FORMAT(1H0,'FILES',30X	PROD. 167	5048
	15HIREAD,4X,6HIWRITE,4X,6HIPUNCH	PROD. 168	5049

UPDAT/195 12/31/79

1,2X,8H(IPROSA))	PROD. 169	5050
*490 FORMAT(1H0,'MODEL FLAGS',24X	PROD. 170	5051
1,5HIBETA,6X,4HITOA,4X,6HIVORAT,4X,6HIVDTIM,5X,5HIQUSE	PROD. 171	5052
2,4X,6HIZQREF,5X,5HIGVFC,4X,6HIQBASE)	PROD. 172	5053
1500 FORMAT(1H0,35X	PROD. 173	5054
1,5HISUSE,7X,3HI2D,4X,6HIMPUMP,4X,6HIFPMAX)	PROD. 174	5055
1510 FORMAT(1H0,'PLOTING FLAGS',21X	PROD. 175	5056
1,5HIPL0T,4X,6HIPL0TS,4X,6HIPL0TT,4X,6HISPLOT,6X,4HICHP,7X,3HIZP)	PROD. 176	5057
1520 FORMAT(1H0,'DEBUGGING/EDITS',20X	PROD. 177	5058
1,5HIDBUG,5X,5HIB8UG,4X,6HITF8UG,4X,6HIND0EDT,5X,5HIN0SS)	PROD. 178	5059
END	PROD. 179	5060

UPDAT/195 12/31/79:

```
C* DAMA
      SUBROUTINE DAMAGE
CIBM  IMPLICIT REAL*8(A-H,O-Z)
CEND
*CALL BLNC
*CALL INFC
*CALL FLTC
*CALL TCOM
*CALL IOPU
C
C THIS SUBROUTINE EDITS DAMAGE PARAMETERS.
C
      RETURN
      END
```

```
DAMA...1      5061
DAMA...2      5062
DAMA...3      5063
DAMA...4      5064
DAMA...5      5065
DAMA...6      5066
DAMA...7      5067
DAMA...8      5068
DAMA...9      5069
DAMA...10     5070
DAMA...11     5071
DAMA...12     5072
DAMA...13     5073
DAMA...14     5074
DAMA...15     5075
```

E N D

APPENDIX D

Sample Problem--Input/Output

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

```

10 0 0
INPCN 11 1 0
1 4 6 20 3 13 0 0 0 0 0 0
-1
INPCN 11 2 0
1 4 12 20 3 13 0 0 0 0 0 0
-1
INPCN 11 3 0
1 4 12 20 3 13 0 0 0 0 0 0
-1
INPCN 11 4 0
1 4 18 20 3 13 0 0 0 0 0 0
-1
INPCN 11 5 0
1 4 18 20 3 13 0 0 0 0 0 0
-1
INPCN 11 6 0
1 4 18 20 3 13 0 0 0 0 0 0
-1
INPCN 11 7 0
1 4 24 20 3 13 0 0 0 0 0 0
-1
INPCN 11 8 0
1 4 12 20 3 13 0 0 0 0 0 0
-1
INPCN 11 9 0
1 4 30 20 3 13 0 0 0 0 0 0
-1
INPCN 11 10 0
1 4 48 20 3 13 0 0 0 0 0 0
-1
FLTCN 12 1 0
1 5-3.477560-04 1.500000+00 3.000000+00 3.000000+00-2.175590-04
6 5 2.400000+01 1.000000+02 5.576500+02 2.472080-02 1.486040-02
11 2 2.495550-02 1.124000+01 0.0 0.0 0.0
13 5-2.346200-06-4.591000-06-9.601900-06-3.098300-06 2.467400-05
18 5 5.313300-05 7.898500-05 9.912000-05 1.112100-04 1.135900-04
23 5 1.056900-04 8.910300-05 6.577000-05 3.853200-05 1.092100-05
28 5-1.550900-05-2.066900-05-1.068200 05-4.388500-06-3.053800-06
33 5 3.085500-02 3.611300-02 4.461100-02 4.314700-02 5.399000-02
38 5 6.496300-02 7.583200-02 8.428700-02 8.915600-02 9.053100-02
43 5 8.642500-02 7.869900-02 6.645200-02 5.372500-02 4.000300-02
48 5 2.564400-02 1.905600-02 9.423500-03 3.975700-03 2.505400-03
53 5 7.798800-07 2.515300-06 4.580600-06-1.550300-05-6.002000-05
58 5-1.055900-04-1.467600-04-1.786900-04-1.977100-04-2.012800-04
63 5-1.884700-04-1.613100-04-1.241700-04-7.985400-05-3.409800-05
68 5 1.063700-05 2.846900-05 1.678800-05 7.328600-06 5.016100-06
73 5 4.701500-04 5.607200-04 7.065300-04 9.233900-04 1.172900-03
78 5 1.436500-03 1.676800-03 1.864500-03 1.975700-03 1.996800-03
83 5 1.920900-03 1.764400-03 1.542400-03 1.282000-03 1.014100-03
88 5 7.722300-04 5.484500-04 3.060400-04 1.382100-04 8.998300-05
93 3 3.570000+01 1.293000+02 1.625000+02 0.0 0.0
-1
FLTCN 12 2 0
1 5-5.576820-04 1.500000+00 3.000000+00 3.000000+00-3.437680-04
6 5 2.400000+01 1.000000+02 5.576500+02 3.820650-02 2.296710-02

```

SACO 1.0 10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 2

```

11 2 2.190640-02 1.349000+01 0.0 0.0 0.0
13 5-6.026100-06-9.484200-06-1.684900-05-9.786400-07 5.253300-05
18 5 1.085100-04 1.595300-04 1.989900-04 2.221000-04 2.258300-04
23 5 2.037400-04 1.735000-04 1.250900-04 6.969200-05 1.446600-05
28 5-3.118900-05-3.584900-05-1.883200-05-8.511800-06-5.514300-06
33 5 3.490200-02 4.059300-02 4.911300-02 4.213000-02 5.297100-02
38 5 6.431400-02 7.456700-02 8.398200-02 8.805400-02 9.050500-02
43 5 8.456300-02 7.726400-02 6.418800-02 5.052600-02 3.731000-02
48 5 2.489200-02 2.311600-02 9.632600-03 4.613900-03 2.672600-03
53 5 2.707300-06 5.580900-06 8.679700-06-2.886300-05-1.119400-04
58 5-1.984200-04-2.767800-04-3.370900-04-3.720700-04-3.774800-04
63 5-3.508100-04-2.963900-04-2.212100-04-1.342700-04-4.604300-05
68 5 2.992300-05 4.995300-05 2.879800-05 1.351200-05 8.643400-06
73 5 6.058100-04 7.629900-04 9.971300-04 1.341900-03 1.684700-03
78 5 2.037200-03 2.355900-03 2.601400-03 2.741000-03 2.763200-03
83 5 2.655100-03 2.438000-03 2.134000-03 1.783600-03 1.430200-03
88 5 1.101700-03 7.547700-04 3.996900-04 1.879100-04 1.123000-04
93 3 3.570000+01 1.298000+02 1.625000+02 0.0 0.0
-1
FLTCN 12 3 0
1 5-5.955370-04 1.500000+00 3.000000+00 3.000000+00-3.815330-04
6 5 2.400000+01 1.000000+02 5.576500+02 2.754460-02 1.655790-02
11 2 2.293350-02 1.277000+01 0.0 0.0 0.0
13 5-4.832600-06-7.091000-06-1.203700-05 4.446200-07 4.571000-05
18 5 9.393700-05 1.385400-04 1.735000-04 1.944000-04 1.983500-04
23 5 1.839900-04 1.541800-04 1.126200-04 6.487400-05 1.749800-05
28 5-3.070100-05-4.474300-05-1.923800-05-6.712400-06-3.910200-06
33 5 3.410600-02 3.838700-02 4.692900-02 4.339400-02 5.509200-02
38 5 6.647300-02 7.761700-02 8.661900-02 9.116200-02 9.251900-02
43 5 8.820300-02 7.994100-02 6.682600-02 5.305900-02 3.782400-02
48 5 2.129100-02 1.299800-02 3.936100-03 1.646800-03 9.738900-04
53 5 1.173200-06 2.324200-06 2.437900-06-3.083100-05-1.026300-04
58 5-1.785600-04-2.482700-04-3.026100-04-3.348200-04-3.405300-04
63 5-3.177400-04-2.707100-04-2.046500-04-1.275600-04-4.859700-05
68 5 3.511700-05 7.674300-05 3.610900-05 1.347800-05 7.756100-06
73 5 7.374600-04 8.841000-04 1.115800-03 1.477300-03 1.880700-03
78 5 2.299400-03 2.679900-03 2.975800-03 3.149500-03 3.180500-03
83 5 3.056000-03 2.803400-03 2.447000-03 2.032000-03 1.609800-03
88 5 1.262400-03 8.858100-04 4.404000-04 1.822200-04 1.080100-04
93 3 3.570000+01 1.298000+02 1.625000+02 0.0 0.0
-1
FLTCN 12 4 0
1 5-7.642580-04 1.500000+00 3.000000+00 3.000000+00-4.850360-04
6 5 2.409000+01 1.000000+02 5.189800+02 3.587730-02 2.156700-02
11 2 2.052430-02 1.356000+01 0.0 0.0 0.0
13 5-1.006100-05-1.404500-05-2.155600-05-1.331400-06 6.440700-05
18 5 1.350500-04 2.003900-04 2.514700-04 2.816100-04 2.867400-04
23 5 2.646100-04 2.191800-04 1.567700-04 8.580200-05 1.579100-05
28 5-5.047500-05-5.673500-05-2.275200-05-7.871000-06-4.064800-06
33 5 3.492200-02 4.029000-02 4.832400-02 4.343200-02 5.489000-02
38 5 6.662000-02 7.733900-02 8.721200-02 9.165200-02 9.314700-02
43 5 8.771100-02 7.977500-02 6.604900-02 5.143900-02 3.647400-02
48 5 2.054300-02 1.294200-02 4.125600-03 1.689700-03 8.685100-04
53 5 7.152500-06 9.681900-06 1.058600-05-3.857300-05-1.426500-04
58 5-2.533200-04-3.543400-04-4.337500-04-4.798900-04-4.873700-04
63 5-4.525500-04-3.814100-04-2.823600-04-1.689300-04-5.312900-05
68 5 6.180900-05 9.346900-05 4.139900-05 1.547300-05 8.008800-06
73 5 8.167100-04 1.004600-03 1.286300-03 1.715500-03 2.158000-03

```



```

78 5 2.612100-03 3.022800-03 3.341200-03 3.523800-03 3.554500-03
83 5 3.415400-03 3.136000-03 2.744600-03 2.275800-03 1.849000-03
88 5 1.479500-03 1.016000-03 4.801800-04 2.023700-04 1.102600-04
93 3 3.570000+01 1.298000+02 1.625000+02 0.0 0.0
-1
FLTCN 12 5 0
1 5-7.622720-04 1.500000+00 3.000000+00 3.000000+00-4.590000-04
6 5 2.400000+01 1.000000+02 5.189800+02 1.964890-02 1.181160-02
11 2 2.217340-02 1.251000+01 0.0 0.9 0.0
13 5-6.904000-06-1.271500-05-2.586000-05-1.491500-05 4.647760-05
18 5 1.098700-04 1.681400-04 2.139600-04 2.419200-04 2.477600-04
23 5 2.303300-04 1.930300-04 1.401400-04 7.783700-05 1.422200-05
28 5-4.462600-05-5.098600-05-2.518600-05-8.990500-06-5.351700-06
33 5 2.936000-02 3.356400-02 5.131300-02 4.276100-02 5.376100-02
38 5 6.523500-02 7.605900-02 8.624100-02 9.035900-02 9.221700-02
43 5 8.732300-02 7.978200-02 6.711300-02 5.406700-02 3.938200-02
48 5 2.361500-02 1.641300-02 7.303900-03 2.610300-03 1.457000-03
53 5 5.596300-06 1.096600-05 1.832900-05-2.302700-05-1.224100-04
58 5-2.266200-04-3.178000-04-3.907000-04-4.347600-04-4.436300-04
63 5-4.153200-04-3.552000-04-2.693500-04-1.669800-04-5.979100-05
68 5 4.274400-05 7.383900-05 4.169400-05 1.610600-05 9.604600-06
73 5 1.017300-03 1.250100-03 1.593600-03 2.122300-03 2.712700-03
78 5 3.338200-03 3.911200-03 4.361600-03 4.630900-03 4.685500-03
83 5 4.509200-03 4.140800-03 3.614400-03 2.996000-03 2.358900-03
88 5 1.757100-03 1.212800-03 6.462500-04 2.669100-04 1.618600-04
93 3 3.570000+01 1.298000+02 1.625000+02 0.0 0.0
-1
FLTCN 12 6 0
1 5-6.606550-04 1.500000+00 3.000000+00 3.000000+00-4.135760-04
6 5 2.400000+01 1.000000+02 4.918200+02 2.745040-02 1.650130-02
11 2 1.968340-02 1.353000+01 0.0 0.0 0.0
13 5-7.049300-06-1.329800-05-2.380700-05-1.654800-05 3.514000-05
18 5 9.200400-05 1.449800-04 1.867500-04 2.118100-04 2.167400-04
23 5 1.998500-04 1.645900-04 1.154800-04 5.925000-05 4.121500-06
28 5-4.742800-05-5.514600-05-2.341500-05-7.811100-06-3.935600-06
33 5 3.102100-02 3.724200-02 4.639800-02 4.346700-02 5.488800-02
38 5 6.675500-02 7.774300-02 8.827800-02 9.245600-02 9.428100-02
43 5 8.839200-02 8.098400-02 6.739700-02 5.310900-02 3.746700-02
48 5 2.090800-02 1.275500-02 3.768900-03 1.434900-03 7.565200-04
53 5 5.484100-06 1.087900-05 1.577100-05-1.519600-05-9.999500-05
58 5-1.919100-04-2.767000-04-3.431200-04-3.826100-04-3.900600-04
63 5-3.626500-04-3.057300-04-2.257300-04-1.327900-04-3.777200-05
68 5 5.529700-05 9.117100-05 4.268200-05 1.541700-05 7.924900-06
73 5 7.492600-04 9.335800-04 1.205000-03 1.639900-03 2.093000-03
78 5 2.553100-03 2.980900-03 3.311000-03 3.504700-03 3.541100-03
83 5 3.403900-03 3.123300-03 2.723100-03 2.269200-03 1.803700-03
88 5 1.403200-03 9.757800-04 4.781100-04 1.933500-04 1.075100-04
93 3 3.570000+01 1.298000+02 1.625000+02 0.0 0.0
-1
FLTCN 12 7 0
1 5-7.533070-04 1.500000+00 3.000000+00 3.000000+00-4.806860-04
6 5 2.400000+01 1.000000+02 4.374900+02 2.505530-02 1.506180-02
11 2 1.859530-02 1.319000+01 0.0 0.0 0.0
13 5-1.276600-05-2.279600-05-3.564800-05-2.488800-05 3.572300-05
18 5 1.025400-04 1.647100-04 2.137900-04 2.434600-04 2.496100-04
23 5 2.305600-04 1.902800-04 1.338300-04 6.895600-05 4.939400-06
28 5-6.365500-05-6.902400-05-2.254000-05-5.308200-06-2.246800-06
33 5 3.094500-02 3.773500-02 4.741900-02 4.382200-02 5.539100-02

```

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 4

```

38 5 6.726300-02 7.835400-02 8.900300-02 9.327000-02 9.520900-02
43 5 8.997800-02 8.191300-02 6.847700-02 5.414600-02 3.791400-02
48 5 1.959800-02 6.918500-03 1.859600-03 5.229300-04 2.603900-04
53 5 1.327100-05 2.228800-05 2.759500-05-1.284700-05-1.144700-04
58 5-2.247300-04-3.263400-04-4.060700-04-4.538700-04-4.633900-04
63 5-4.318100-04-3.654000-04-2.715100-04-1.615600-04-4.874000-05
68 5 7.726000-05 1.178100-04 4.416900-05 1.274000-05 5.975500-06
73 5 8.722700-04 1.095300-03 1.416400-03 1.933500-03 2.476100-03
78 5 3.033500-03 3.542000-03 3.941200-03 4.177800-03 4.225500-03
83 5 4.066200-03 3.735800-03 3.266500-03 2.720400-03 2.166900-03
88 5 1.734000-03 1.175600-03 5.206900-04 1.903700-04 1.035900-04
93 3 3.570000+01 1.298000+02 1.625000+02 0.0 0.0
-1
FLTCIN 12 8 0
1 5-3.025930-04 1.500000+00 3.000000+00 3.000000+00-1.909590-04
6 5 2.400000+01 1.000000+02 5.576500+02 1.414000-02 8.500000-03
11 2 2.501520-02 1.103000+01 0.0 0.0 0.0
13 5-7.777400-05-1.419400-05-2.374700-05-2.095800-05 6.460400-06
18 5 3.437500-05 6.096300-05 8.131800-05 9.353400-05 9.613200-05
23 5 8.847100-05 7.215600-05 4.903400-05 2.205900-05-4.899200-06
28 5-3.523600-05-3.484100-05-1.212300-05-3.348300-06-1.610900-06
33 5 3.058100-02 3.673000-02 5.993800-02 4.271100-02 5.404200-02
38 5 6.534600-02 7.696400-02 8.641200-02 9.125300-02 9.267900-02
43 5 8.842000-02 8.005900-02 6.737300-02 5.331900-02 3.797500-02
48 5 2.061500-02 1.026200-02 3.501000-03 1.166000-03 6.529400-04
53 5 9.918500-06 1.638200-05 2.302900-05 3.811000-06-4.352900-05
58 5-9.252100-05-1.372400-04-1.719900-04-1.927100-04-1.969500-04
63 5-1.835600-04-1.552700-04-1.149100-04-6.712800-05-1.779400-05
68 5 3.830000-05 5.573700-05 2.238500-05 7.208000-06 3.692600-06
73 5 6.819000-04 8.640900-04 1.122600-03 1.562000-03 2.093400-03
78 5 2.656600-03 3.175000-03 3.581600-03 3.825500-03 3.874900-03
83 5 3.715400-03 3.380800-03 2.905300-03 2.347100-03 1.776500-03
88 5 1.283200-03 8.008300-04 3.749100-04 1.479200-04 8.623600-05
93 3 3.570000+01 1.298000+02 1.625000+02 0.0 0.0
-1
FLTCIN 12 9 0
1 5-5.790710-04 1.500000+00 3.000000+00 3.000000+00-3.644790-04
6 5 2.400000+01 1.000000+02 5.189500+02 1.788760-02 1.075280-02
11 2 2.043560-02 1.351000+01 0.0 0.0 0.0
13 5-1.663300-05-3.447500-05-6.539600-05-8.007500-05-2.733400-05
18 5 2.659200-05 7.515700-05 1.129100-04 1.349800-04 1.396000-04
23 5 1.248200-04 9.400700-05 5.064200-05 4.913900-07-4.986300-05
28 5-9.227300-05-6.735200-05-2.621800-05-8.681500-06-4.334600-06
33 5 2.899400-02 3.631100-02 5.812000-02 4.097600-02 5.211500-02
38 5 6.395300-02 7.510100-02 8.483500-02 8.916600-02 9.219800-02
43 5 8.635400-02 7.873100-02 6.548400-02 5.144600-02 3.740900-02
48 5 2.355500-02 2.203400-02 7.820900-03 3.361300-03 1.932700-03
53 5 2.193200-05 4.210400-05 7.007600-05 5.726000-05-3.633200-05
58 5-1.324500-04-2.187000-04-2.854300-04-3.242200-04-3.319500-04
63 5-3.051600-04-2.497300-04-1.713200-04-7.952400-05 1.478100-05
68 5 9.910300-05 9.239000-05 4.104800-05 1.511700-05 7.806500-06
73 5 1.080900-03 1.455000-03 1.981500-03 2.832200-03 3.860900-03
78 5 4.890300-03 5.835100-03 6.571400-03 7.005700-03 7.033000-03
83 5 6.783400-03 6.155800-03 5.273200-03 4.249100-03 3.216000-03
88 5 2.290200-03 1.406200-03 6.912700-04 3.020400-04 1.762500-04
93 3 3.570000+01 1.298000+02 1.625000+02 0.0 0.0
-1
FLTCIN 12 10 0

```

```

1 5-6.169180-04 1.500000+00 3.000000+00 3.600000+00-4.352050-04
6 5 2.400000+01 1.000000+02 4.017300+02 1.265870-02 7.609570-03
11 2 1.716700-02 1.325000+01 0.0 0.0 0.0
13 5-1.960000-05-4.431100-05-9.069600-05-1.413100-04-1.347200-04
18 5-1.174500-04-1.015900-04-8.826500-05-8.096700-05-7.834200-05
23 5-8.233200-05-9.108300-05-1.040800-04-1.184400-04-1.313100-04
28 5-1.362800-04-8.737700-05-3.695400-05-1.273100-05-7.570700-06
33 5 2.412380-02 3.142000-02 5.019800-02 3.785300-02 4.964900-02
38 5 6.209300-02 7.363800-02 8.454500-02 8.897900-02 9.129300-02
43 5 8.658100-02 7.896500-02 6.652600-02 5.382100-02 4.060800-02
48 5 2.744800-02 2.712800-02 1.461900-02 6.272400-03 4.233300-03
53 5 2.696400-05 5.798900-05 1.083800-04 1.524900-04 1.074700-04
58 5 5.896500-05 1.542300-05-1.954600-05-3.949200-05-4.512300-05
63 5-3.324000-05-7.869800-06 2.947100-05 7.286800-05 1.165400-04
68 5 1.492000-04 1.101400-04 5.087100-05 1.875100-05 1.125400-05
73 5 1.106900-03 1.586600-03 2.260900-03 3.464100-03 4.754900-03
78 5 6.103900-03 7.342100-03 8.315500-03 8.912200-03 9.042600-03
83 5 8.683100-03 7.907000-03 6.797000-03 5.483500-03 4.123700-03
88 5 2.829500-03 1.762900-03 9.322200-04 4.035500-04 2.717600-04
93 3 3.570000+01 1.298000+02 1.625000+02 0.0 0.0
-1
INPCOM 1 1 0
1 10 0 1 8 0 0 1 0 0 0 0
11 10 0 0 0 7 1 2 0 0 1 1
21 10 0 10 16 0 1 1 6 6 1 1
21 10 0 10 16 1 1 1 6 6 1 1
31 2 12 6 0 0 0 0 0 0 0 0
-1
FLTCOM 2 0 0
1 5 9.410000+01 2.500000-07 1.974000-08 2.500000-07 1.290000-02
6 5 3.120000-02 1.338000-01 3.450000-01 1.399000+00 3.741000+00
11 5 2.500000+00 6.000000+00 0.0 -1.790000-01 6.000000-03
16 5-7.000000-05 8.145000-05 7.554000-04 6.438000-04 1.287000-03
21 5 5.533000-04 1.732000-04 3.499650-03 1.500000+00 8.145000-05
26 5 7.554000-04 6.438000-04 1.287000-03 5.538000-04 1.732000-04
31 5 1.000000+01 1.000000+00 1.000000+00 2.830000-04 5.900000-07
36 5 3.570000-07 1.256000-06 5.900000-07 7.972380+00 4.700000-05
41 5 4.700000-06 9.444810+00 8.729000+00 0.0 6.559500-02
46 5 1.985400-01 1.436600-02 9.362000-04 7.620000-05 9.125000-06
51 5 8.875000-07 5.000000+00 9.600000-01 7.900000-01 7.172880+00
56 5 1.000000-02 1.000000-02 1.000000-02 5.000000-03 1.500000+01
56 5 1.000000-01 1.000000-01 1.000000-02 5.000000-03 1.500000+01
61 5 8.000000-01 4.000000+01 1.000000-01 5.000000-01 1.750000+01
66 5 5.000000-07 1.000000-05 3.920000-01 1.000000-03 1.000000-01
71 5 2.800000-04 1.120000+02 0.0 0.0 0.0
71 5 2.800000-04 1.120000+02 0.0 5.000000-01 6.000000-01
76 5 2.000000-01-2.500000-01 1.000000+00 9.800000+02 0.0
81 5 0.0 0.0 1.500000-06 1.153700-05 4.600000-07
86 5 2.500000-02 0.0 2.851000-01 2.472000-01 5.500000-01
91 5 1.000000+00 3.807000-01 3.877000-01 0.0 2.830000-04
96 5 2.000000-01 9.500000+02 1.371000+03-3.000000+02 4.200000+03
101 4 2.767000+03 2.000000+00 3.877780+02 6.000000+00 0.0
105 3 2.000000+00 5.000000+00 1.000000+01 0.0 0.0
125 5 1.000000-01 2.000000-01 3.000000-01 4.000000-01 5.000000-01
125 5 1.000000-01 2.000000-01 1.108000+01 1.109000+01 1.190000+01
130 1 5.000000+00 0.0 0.0 0.0 0.0
130 1 1.390000+01 0.0 0.0 0.0 0.0
145 5 5.000000+00 2.000000+00 1.000000+01 1.371000+03 3.000000+01

```

SACO 1.0 10 CHANNEL SACO 1.0 EXAHPLR PROBLEM -- 10/79

145	5	1.390000+01	2.000000+00	1.000000+01	1.371000+03	3.000000+01
150	5	1.667000+02	1.250000+01	1.250000+01	1.188600+02	8.250000+01
155	5	4.570000+01	3.570000+01	1.115300+02	0.0	1.338630+02
160	4	5.700000+00	1.414000-02	9.773600-01	8.500000-03	0.0
-1						
ENDJOB	0	0	0			

9/10/79 1911.300 PAGE 6

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

```

10 0
INPCOM 1 0 0 0 0 0 0 0 0 0 0
1 10 0 1 8 0 0 1 0 0 0 0
11 10 0 0 0 7 1 2 0 0 1 1
21 10 0 10 16 1 1 1 6 6 1 1
31 10 12 6 0 0 0 0 0 0 0 0
-1
FLTCOM 2 0 0
1 5 9.410000+01 2.500000-07 1.974000-08 2.500000-07 1.290000-02
6 5 3.120000-02 1.338000-01 3.450000-01 1.399000+00 3.741000+00
11 5 2.500000+00 6.000000+00 0.0 -1.790000-01 6.000000-03
16 5 -7.000000-05 8.145000-05 7.554000-04 6.438000-04 1.287000-03
21 5 5.563000-04 1.732000-04 3.499650-03 1.500000+00 8.145000-05
26 5 7.554000-04 6.438000-04 1.287000-03 5.588000-04 1.732000-04
31 5 1.000000+01 1.000000+00 1.000000+00 2.830000-04 5.900000-07
36 5 3.570000-07 1.256000-06 5.900000-07 7.972880+00 4.700000-06
41 5 4.700000-06 9.444810+00 8.729000+00 0.0 6.559500-02
46 5 1.935400-01 1.435600-02 9.362000-04 7.620000-05 9.725000-06
51 5 8.875000-07 5.000000+00 9.600000-01 7.900000-01 7.972880+00
56 5 1.000000-01 1.000000-01 1.000000-02 5.000000-03 1.500000+01
61 5 8.000000-01 4.000000+01 1.000000-01 5.000000-01 1.750000+01
66 5 5.000000-07 1.000000-05 3.920000-01 1.000000-03 1.000000-01
71 5 2.800000-04 1.120000+02 0.0 5.000000-01 6.000000-01
76 5 2.000000-01 -2.500000-01 1.000000+00 9.800000+02 0.0
81 5 0.0 0.0 1.500000-06 1.153700-05 4.600000-07
86 5 2.500000-02 0.0 2.851000-01 2.472000-01 5.500000-01
91 5 1.000000+00 3.807000-01 3.877000-01 0.0 2.830000-04
96 5 2.000000-01 9.500000+02 1.371000+03 -3.000000+02 4.200000+03
101 5 2.767000+03 2.000000+00 3.877780+02 6.000000+00 2.000000+00
106 5 5.000000+00 1.000000+01 0.0 0.0 0.0
121 5 0.0 0.0 0.0 0.0 1.000000-01
126 5 2.000000-01 1.108000+01 1.109000+01 1.190000+01 1.390000+01
141 5 0.0 0.0 0.0 0.0 1.390000+01
146 5 2.000000+00 1.000000+01 1.371000+03 3.000000+01 1.667000+02
151 5 1.250000+01 1.250000+01 1.188600+02 8.250000+01 4.500000+01
156 5 3.570000+01 1.115300+02 0.0 1.338630+02 5.000000+00
161 5 1.414000-02 9.773600-01 8.500000-03 0.0 0.0
-1
INPCOM 11 0 0 0 0 0 0 0 0 0
1 10 6 20 3 13 0 0 0 0 0 0
-1
FLTCOM 12 1 0
1 5 -3.477560-04 1.500000+00 3.000000+00 3.000000+00 -2.175590-04
6 5 2.400000+01 1.000000+02 5.576500+02 2.472000-02 1.486040-02
11 5 2.495550-02 1.124000+01 -2.346200-06 -4.591000-06 -9.601900-06
16 5 -3.098300-06 2.467400-05 5.313300-05 7.898500-05 9.912000-05
21 5 1.112100-04 1.135900-04 1.056900-04 8.910300-05 6.577000-05
26 5 3.853200-05 1.092100-05 -1.550900-05 -2.066900-05 -1.068200-05
31 5 -4.338500-06 -3.053800-06 3.035500-02 3.611700-02 4.461100-02
36 5 4.314700-02 5.399000-02 6.496800-02 7.580000-02 8.488700-02
41 5 8.915600-02 9.053100-02 8.642500-02 7.899900-02 6.645200-02
46 5 5.372500-02 4.000300-02 2.564400-02 1.905600-02 9.423500-03
51 5 3.975700-03 2.505400-03 7.798300-07 2.515300-06 4.580500-06
56 5 -1.550300-05 -6.002000-05 -1.055900-04 -1.467600-04 -1.785900-04
61 5 -1.977100-04 -2.012800-04 -1.834700-04 -1.618100-04 -1.241700-04
66 5 -7.985400-05 -3.409800-05 1.068700-05 2.846900-05 1.678800-05

```

SACO 1.0 10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 8

```

71 5 7.328600-06 5.016100-06 4.701500-04 5.607200-04 7.065300-04
76 5 9.233900-04 1.172900-03 1.436500-03 1.676300-03 1.864500-03
81 5 1.975700-03 1.996300-03 1.920900-03 1.764400-03 1.542400-03
86 5 1.282000-03 1.014100-03 7.722300-04 5.484500-04 3.060400-04
91 5 1.382100-04 8.998300-05 3.570000+01 1.298000+02 1.625000+02
-1
INPCHN 11 2 0
1 10 12 20 3 13 0 0 0 0 0 0
-1
FLTCHN 12 2 0
1 5-5.576820-04 1.500000+00 3.000000+00 3.000000+00-3.437680-04
6 5 2.400000+01 1.000000+02 5.576500+02 3.820650-02 2.296710-02
11 5 2.190640-02 1.349000+01-6.026100-06-9.484200-06-1.684900-05
16 5-9.786400-07 5.253300-05 1.085100-04 1.595300-04 1.539900-04
21 5 2.221000-04 2.252800-04 2.087400-04 1.735000-04 1.250900-04
26 5 6.969200-05 1.446600-05-3.118900-05-3.534900-05-1.883200-05
31 5-8.511800-06-5.514300-06 3.490200-02 4.059300-02 4.911300-02
36 5 4.213000-02 5.297100-02 6.431400-02 7.456700-02 8.398200-02
41 5 8.805400-02 9.050500-02 8.466300-02 7.726400-02 6.418800-02
46 5 5.052600-02 3.731000-02 2.423200-02 2.311600-02 9.632600-03
51 5 4.613900-03 2.672600-03 2.707300-06 5.580900-06 8.679700-06
56 5-2.886300-05-1.119400-04-1.984200-04-2.767800-04-3.370900-04
61 5-3.720700-04-3.774800-04-3.508100-04-2.963900-04-2.212100-04
66 5-1.342700-04-4.604800-05 2.592300-05 4.995300-05 2.879800-05
71 5 1.351200-05 8.643400-06 6.058100-04 7.629900-04 9.971300-04
76 5 1.341900-03 1.684700-03 2.037200-03 2.355900-03 2.601400-03
81 5 2.741000-03 2.763200-03 2.655100-03 2.438000-03 2.134000-03
86 5 1.783600-03 1.430200-03 1.101700-03 7.447700-04 3.996900-04
91 5 1.879100-04 1.123000-04 3.570000+01 1.298000+02 1.625000+02
-1
INPCHN 11 3 0
1 10 12 20 3 13 0 0 0 0 0 0
-1
FLTCHN 12 3 0
1 5-5.955370-04 1.500000+00 3.000000+00 3.000000+00-3.815330-04
6 5 2.400000+01 1.000000+02 5.576500+02 2.754460-02 1.655790-02
11 5 2.293350-02 1.277000+01-4.832600-06-7.091000-06-1.203700-05
16 5 4.446200-07 4.571000-05 9.393700-05 1.385400-04 1.735000-04
21 5 1.944000-04 1.983500-04 1.839900-04 1.541800-04 1.126200-04
26 5 6.487400-05 1.749300-05-3.070100-05-4.474300-05-1.923800-05
31 5-6.712400-06-3.910200-06 3.410600-02 3.829700-02 4.692900-02
36 5 4.389400-02 5.509200-02 6.647300-02 7.761700-02 8.661900-02
41 5 9.116200-02 9.251900-02 8.820300-02 7.994100-02 6.682600-02
46 5 5.305900-02 3.782400-02 2.129100-02 1.299800-02 3.936100-03
51 5 1.646800-03 9.738900-04 1.173200-06 2.324200-06 2.437900-06
56 5-3.083100-05-1.026300-04-1.785600-04-2.482700-04-3.026100-04
61 5-3.343200-04-3.405300-04-3.177400-04-2.707100-04-2.046500-04
66 5-1.275600-04-4.857700-05 3.511700-05 7.674300-05 3.610900-05
71 5 1.347300-05 7.756100-06 7.374600-04 8.841000-04 1.115800-03
76 5 1.477300-03 1.850700-03 2.299400-03 2.679900-03 2.975800-03
81 5 3.149500-03 3.180500-03 3.056000-03 2.803400-03 2.447000-03
86 5 2.032000-03 1.609300-03 1.262400-03 8.858100-04 4.404000-04
91 5 1.822200-04 1.080100-04 3.570000+01 1.298000+02 1.625000+02
-1
INPCHN 11 4 0
1 10 18 20 3 13 0 0 0 0 0 0
-1
FLTCHN 12 4 0

```

```

1 5-7.642580-04 1.500000+00 3.000000+00 3.000000+00-4.850360-04
6 5 2.400000+01 1.000000+02 5.189800+02 3.587730-02 2.156700-02
11 5 2.052430-02 1.355000+01-1.006100-05-1.404500-05-2.155600-05
16 5-1.331400-06 6.440700-05 1.350500-04 2.003900-04 2.514700-04
21 5 2.816100-04 2.857400-04 2.646100-04 2.191800-04 1.567700-04
26 5 8.580200-05 1.579100-05-5.047500-05-5.673500-05-2.275200-05
31 5-7.871000-06-4.064800-06 3.492200-02 4.029000-02 4.832400-02
36 5 4.348200-02 5.489000-02 6.662000-02 7.733900-02 8.721200-02
41 5 9.165200-02 9.314700-02 8.771100-02 7.977500-02 6.604900-02
46 5 5.143900-02 3.647400-02 2.054800-02 1.294200-02 4.125600-03
51 5 1.689700-03 8.685400-04 7.152500-06 9.681900-06 1.058600-05
56 5-3.857300-05-1.426500-04-2.533200-04-3.543400-04-4.337500-04
61 5-4.798900-04-4.873700-04-4.525500-04-3.814100-04-2.828600-04
66 5-1.689300-04-5.312900-05 6.180900-05 9.346900-05 4.139900-05
71 5 1.547300-05 8.005300-06 8.167100-04 1.004600-03 1.286300-03
76 5 1.715500-03 2.158000-03 2.612100-03 3.022800-03 3.341200-03
81 5 3.523800-03 3.554500-03 3.415400-03 3.136000-03 2.744600-03
86 5 2.295300-03 1.849000-03 1.479500-03 1.016000-03 4.801800-04
91 5 2.023700-04 1.102600-04 3.570000+01 1.298000+02 1.625000+02
-1
INPCHN 11 5 0
1 10 18 20 3 13 0 0 0 0 0 0
-1
FLTCHN 12 5 0
1 5-7.622720-04 1.500000+00 3.000000+00 3.000000+00-4.590000-04
6 5 2.400000+01 1.000000+02 5.189800+02 1.964890-02 1.181160-02
11 5 2.217840-02 1.251000+01-6.904000-06-1.271500-05-2.585000-05
16 5-1.491500-05 4.647700-05 1.098700-04 1.681400-04 2.139600-04
21 5 2.419200-04 2.477600-04 2.303300-04 1.930300-04 1.401400-04
26 5 7.783700-05 1.422200-05-4.442600-05-5.098500-05-2.518500-05
31 5-8.990800-06-5.351700-06 2.936000-02 3.356400-02 5.131300-02
36 5 4.276100-02 5.376100-02 6.523500-02 7.605900-02 8.624100-02
41 5 9.035900-02 9.221700-02 8.739800-02 7.978200-02 6.711300-02
46 5 5.406700-02 3.938200-02 2.361500-02 1.641300-02 7.305900-03
51 5 2.510300-03 1.457000-03 5.596300-06 1.096600-05 1.832900-05
56 5-2.302700-05-1.224100-04-2.246200-04-3.178000-04-3.907000-04
61 5-4.347600-04-4.436300-04-4.153200-04-3.552000-04-2.693500-04
66 5-1.669800-04-5.979100-05 4.274400-05 7.383900-05 4.169400-05
71 5 1.610500-05 9.604600-06 1.017300-03 1.250100-03 1.593600-03
76 5 2.122300-03 2.712700-03 3.338200-03 3.911200-03 4.361600-03
81 5 4.630900-03 4.625500-03 4.509200-03 4.140800-03 3.614400-03
86 5 2.996000-03 2.358900-03 1.757100-03 1.212800-03 6.462500-04
91 5 2.669100-04 1.618600-04 3.570000+01 1.298000+02 1.625000+02
-1
INPCHN 11 6 0
1 10 18 20 3 13 0 0 0 0 0 0
-1
FLTCHN 12 6 0
1 5-6.605550-04 1.500000+00 3.000000+00 3.000000+00-4.135760-04
6 5 2.400000+01 1.000000+02 4.918200+02 2.745040-02 1.650130-02
11 5 1.968340-02 1.353000+01-7.049300-06-1.329800-05-2.380700-05
16 5-1.654300-05 3.514000-05 9.200400-05 1.449800-04 1.867500-04
21 5 2.118100-04 2.167400-04 1.998500-04 1.645900-04 1.154800-04
26 5 5.925000-05 4.121500-06-4.742800-05-5.514600-05-2.341500-05
31 5-7.811100-06-3.935600-06 3.102100-02 3.724200-02 4.639800-02
36 5 4.346700-02 5.485300-02 6.675500-02 7.774300-02 8.827800-02
41 5 9.245600-02 9.428100-02 8.839200-02 8.098400-02 6.739700-02
46 5 5.310900-02 3.746700-02 2.090300-02 1.275500-02 3.768900-03

```

SACO 1.0 10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 10

```

51 5 1.434900-03 7.565200-04 5.484100-06 1.087900-05 1.577100-05
56 5-1.519600-05-9.999500-05-1.919100-04-2.767000-04-3.431200-04
61 5-3.826100-04-3.900600-04-3.626500-04-3.057300-04-2.257300-04
66 5-1.324900-04-3.777200-05 5.529700-05 9.117100-05 4.268200-05
71 5 1.541700-05 7.924900-06 7.492600-04 9.335800-04 1.205000-03
76 5 1.639900-03 2.093000-03 2.558100-03 2.980900-03 3.311000-03
81 5 3.504700-03 3.541100-03 3.403900-03 3.123800-03 2.728100-03
86 5 2.269200-03 1.803700-03 1.408200-03 9.757800-04 4.781100-04
91 5 1.933500-04 1.075100-04 3.570000+01 1.298000+02 1.625000+02
-1
INPCNN 11 7 0
1 10 24 20 3 13 0 0 0 0 0 0
-1
FLTCNN 12 7 0
1 5-7.533070-04 1.500000+00 3.000000+00 3.000000+00-4.806360-04
6 5 2.400000+01 1.000000+02 4.374900+02 2.505530-02 1.506180-02
11 5 1.859530-02 1.319000+01-1.276600-05-2.279500-05-3.564300-05
16 5-2.463300-05 3.572300-05 1.025400-04 1.647100-04 2.137900-04
21 5 2.434600-04 2.496100-04 2.305500-04 1.902800-04 1.333300-04
26 5 6.895500-05 4.939400-06-6.365500-05-6.902400-05-2.254000-05
31 5-5.308200-06-2.246800-06 3.094500-02 3.773500-02 4.741900-02
36 5 4.382200-02 5.539100-02 6.726300-02 7.835400-02 8.900300-02
41 5 9.327000-02 9.520900-02 8.997800-02 8.191300-02 6.847700-02
46 5 5.414600-02 3.791400-02 1.959300-02 6.918500-03 1.859600-03
51 5 5.229300-04 2.603900-04 1.327100-05 2.220300-05 2.759500-05
56 5-1.284700-05-1.144700-04-2.247300-04-3.263400-04-4.060700-04
61 5-4.538700-04-4.633900-04-4.318100-04-3.654000-04-2.715100-04
66 5-1.615600-04-4.874000-05 7.726000-05 1.178100-04 4.416900-05
71 5 1.274000-05 5.975500-06 8.722700-04 1.095300-03 1.416400-03
76 5 1.933500-03 2.474000-03 3.333500-03 3.542000-03 3.941200-03
81 5 4.177800-03 4.225500-03 4.066200-03 3.735800-03 3.266500-03
86 5 2.720400-03 2.166900-03 1.734000-03 1.175600-03 5.206900-04
91 5 1.903700-04 1.035900-04 3.570000+01 1.298000+02 1.625000+02
-1
INPCNN 11 8 0
1 10 12 20 3 13 0 0 0 0 0 0
-1
FLTCNN 12 8 0
1 5-3.025930-04 1.500000+00 3.000000+00 3.000000+00-1.909590-04
6 5 2.400000+01 1.000000+02 5.576500+02 1.414000-02 8.500000-03
11 5 2.501820-02 1.103000+01-7.777400-06-1.419400-05-2.374700-05
16 5-2.095300-05 6.460400-06 3.487500-05 6.096300-05 8.131300-05
21 5 9.353400-05 9.613200-05 8.847100-05 7.215600-05 4.903400-05
26 5 2.205900-05-4.899200-06-3.523600-05-3.484100-05-1.212300-05
31 5-3.348500-06-1.610900-06 3.053100-02 3.673000-02 5.993300-02
36 5 4.271100-02 5.404200-02 6.534600-02 7.696400-02 8.641200-02
41 5 9.125300-02 9.267900-02 8.842000-02 8.005900-02 6.737300-02
46 5 5.331900-02 3.797500-02 2.061500-02 1.026200-02 3.501000-03
51 5 1.166000-03 6.529400-04 9.918500-06 1.633200-05 2.302900-05
56 5 3.811000-06-4.352900-05-9.252100-05-1.372400-04-1.719900-04
61 5-1.927100-04-1.969500-04-1.835600-04-1.552700-04-1.149100-04
66 5-6.712800-05-1.779400-05 3.830000-05 5.573700-05 2.238500-05
71 5 7.203000-06 3.692600-06 6.819000-04 8.640900-04 1.122600-03
76 5 1.562000-03 2.073400-03 2.656600-03 3.175000-03 3.581600-03
81 5 3.825500-03 3.874900-03 3.715400-03 3.380800-03 2.905300-03
86 5 2.347100-03 1.776500-03 1.283200-03 8.003300-04 3.749100-04
91 5 1.479200-04 8.623600-05 3.570000+01 1.298000+02 1.625000+02
-1

```



```

INPCIN 11 9 0
1 10 30 20 3 13 0 0 0 0 0 0
-1
FLTCIN 12 9 0
1 5-5.790710-04 1.500000+00 3.000000+00 3.000000+00-3.644790-04
6 5 2.400000+01 1.000000+02 5.189500+02 1.783760-02 1.075280-02
11 5 2.043550-02 1.351000+01-1.663300-05-3.447500-05-6.539600-05
16 5-8.007500-05-2.733400-05 2.659200-05 7.515700-05 1.129100-04
21 5 1.319300-04 1.356000-04 1.249200-04 9.400700-05 5.064200-05
26 5 4.913900-07-4.936300-05-9.227300-05-6.735200-05-2.621800-05
31 5-8.681500-06-4.334600-06 2.899400-02 3.631100-02 5.812000-02
36 5 4.097600-02 5.211500-02 6.395300-02 7.510100-02 8.488500-02
41 5 8.916600-02 9.219800-02 8.635400-02 7.873100-02 6.548400-02
46 5 5.144600-02 3.740900-02 2.355500-02 2.208400-02 7.820900-03
51 5 3.361300-03 1.932700-03 2.193200-05 4.210400-05 7.007600-05
56 5 5.726000-05-3.638200-05-1.324600-04-2.187000-04-2.854300-04
61 5-3.242200-04-3.319500-04-3.051600-04-2.497300-04-1.713200-04
66 5-7.952400-05 1.478100-05 9.910300-05 9.289000-05 4.104300-05
71 5 1.511700-05 7.806500-06 1.080900-03 1.455000-03 1.981500-03
76 5 2.832200-03 3.860900-03 4.890300-03 5.835100-03 6.571400-03
81 5 7.005700-03 7.038000-03 6.783400-03 6.155300-03 5.273200-03
86 5 4.249100-03 3.216000-03 2.290200-03 1.406200-03 6.912700-04
91 5 3.020400-04 1.762500-04 3.570000+01 1.298000+02 1.625000+02
-1
INPCIN 11 10 0
1 10 48 20 3 13 0 0 0 0 0 0
-1
FLTCIN 12 10 0
1 5-6.169180-04 1.500000+00 3.000000+00 3.000000+00-4.352050-04
6 5 2.400000+01 1.000000+02 4.017300+02 1.265370-02 7.609570-03
11 5 1.716700-02 1.325000+01-1.960000-05-4.431100-05-9.069600-05
16 5-1.493100-04-1.347200-04-1.174500-04-1.015900-04-8.826500-05
21 5-8.096700-05-7.834200-05-8.233200-05-9.108300-05-1.040800-04
26 5-1.184400-04-1.313400-04-1.362300-04-8.737700-05-3.695400-05
31 5-1.273000-05-7.570700-06 2.412300-02 3.142000-02 5.019800-02
36 5 3.785300-02 4.964900-02 6.209300-02 7.363800-02 8.454500-02
41 5 8.897900-02 9.129300-02 8.658100-02 7.896500-02 6.652600-02
46 5 5.382100-02 4.050300-02 2.744300-02 2.712900-02 1.461900-02
51 5 6.272400-03 4.233300-03 2.696400-05 5.795700-05 1.083800-04
56 5 1.524900-04 1.074700-04 5.896500-05 1.542300-05-1.954600-05
61 5-3.949200-05-4.512300-05-3.324000-05-7.869800-06 2.947100-05
66 5 7.285300-05 1.165400-04 1.492000-04 1.101400-04 5.087100-05
71 5 1.875100-05 1.125400-05 1.105900-03 1.586600-03 2.260900-03
76 5 3.464100-03 4.754900-03 6.103900-03 7.342100-03 8.315500-03
81 5 8.912200-03 9.042600-03 8.683100-03 7.907000-03 6.797000-03
86 5 5.483500-03 4.123700-03 2.829500-03 1.762900-03 9.322200-04
91 5 4.035500-04 2.717600-04 3.570000+01 1.298000+02 1.625000+02
-1
ENDJOB -1

```

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 12

CASE 1

SACO WELCOMES YOU

THIS PROBLEM IS ENTITLED

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

THIS PROBLEM HAS 10 FLOW CHANNELS.

***** POINT KINETICS DATA *****

DELAYED NEUTRON PRECURSORS

FAMILY	BETA(I)	LAMBDA(I)	C0(I)
1	8.14500D-05	1.29000D-02	1.26279D+04
2	7.55400D-04	3.12000D-02	4.84231D+04
3	6.43300D-04	1.33300D-01	9.62332D+03
4	1.28700D-03	3.45000D-01	7.46087D+03
5	5.58800D-04	1.39900D+00	7.98856D+02
6	1.73200D-04	3.74100D+00	9.25956D+01

TOTAL EFFECTIVE BETA	3.49965D-03
NORMALIZED TOTAL POWER	1.00000D+00
NORMALIZED DECAY POWER	6.55950D-02
NUMBER OF DECAY GROUPS	6

***** DECAY HEAT DATA *****

GROUP	BETAH(I)	DKLAM(I)
1	8.14500D-05	1.98540D-01
2	7.55400D-04	1.43560D-02
3	6.43300D-04	9.36200D-04
4	1.28700D-03	7.62000D-05
5	5.58800D-04	9.72500D-06
6	1.73200D-04	8.87560D-07

*****MATERIAL PROPERTIES AND OTHER SALIENT INPUT*****

FUEL PROPERTIES	DENSITY	CP	RADIUS	AREA	RHO*CP	RHO*CP*AREA	K
	0.944430+01	0.357000-06	0.247200+00	0.191980+00	0.337180-05	0.647300-06	0.197400-07
	MELT DENSITY	LAT HEAT	FAILURE RADIUS				
	0.872900+01	0.280000-03	0.550000+00				
CLAD PROPERTIES	DENSITY	CP	RADIUS	AREA	RHO*CP	RHO*CP*AREA	K
	0.797290+01	0.590000-06	0.285100+00	0.633790-01	0.470000-05	0.297880-06	0.250000-06
	LAT HEAT	L HT*RHO*AREA					
	0.283000-03	0.143000-03					
COOLANT PROPERTIES	DENSITY	CP	RADIUS	AREA	RHO*CP	RHO*CP*AREA	H
	0.790000+00	0.125600-05	0.380700+00	0.199960+00	0.992240-06	0.198410-06	0.115370-04
STRUCTURE PROPERTIES	DENSITY	CP	RADIUS	AREA	RHO*CP	RHO*CP*AREA	K
	0.797290+01	0.590000-06	0.387700+00	0.168980-01	0.470000-05	0.794210-07	0.250000-06
GAP PROPERTIES	HGAP						
	0.460000-06						
CHEN PARAMETERS	CHENH	CHENCF	CHENCC	CHENLF	CHENLC	CHENAL	
	0.186040-06	0.224010+01	0.103090+01	0.684840+00	0.315160+00	0.141650+01	
RESISTANCE VALUES	COLRES	CLDRES	GAPRES	FRES	CPH	CPHCCL	
	0.483370+05	0.908090+05	0.139960+07	0.403130+07	0.122300-05	0.575710-06	
	HF	HCL	HCOL	HGAP	HFCL	HF1CL	HFCLM
	0.319420-06	0.141800-04	0.115370-04	0.460000-06	0.186040-06	0.445550-06	0.312380-06
	HFP	HCLP	HCOLP	HGAPP	HFCLP	HF1CLP	HFCLMP
	0.496120-06	0.220240-04	0.206670-04	0.714470-06	0.288960-06	0.692020-06	0.485190-06
REGIONAL MULTIPLIERS	CHENH1	CHENH2	FRES1	FRES2			
	0.100000+01	0.100000+01	0.500000+00	0.600000+00			

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 14

*****POWER PROFILE PARAMETERS*****

REGION POWER FRACTIONS	FRACP1	FRACP2	FRACP3
	0.141400-01	0.977360+00	0.850000-02

*****TEMPERATURE INPUT PARAMETERS*****

INPUT TEMPERATURES	TBOIL	SUPERHEAT	TCLADH	TFUELM	DTCCCL	TINLET
	0.950000+03	0.100000+02	0.137100+04	0.276700+04	0.150000+02	0.387780+03

RADIAL PROFILE PARAMETERS	EPSCY	ANT	AX
	0.392000+00	0.600000+01	0.0

AXIAL PROFILE PARAMETERS	FIN	FBRNIN	ANAX
	0.100000+01	0.100000+01	0.250000+01

*****VOIDING INPUT PARAMETERS*****

SPATIAL INPUT	ZVOID0	ZVOIDL-Z00	ZLL
	0.133860+03	0.175000+02	0.0

SAS CRBR EEC LOF DEFAULTS	VDZ1	VDZ2	VDZ3	VDZ4
	0.118860+03	0.825000+02	0.450000+02	0.357000+02

	VDRAT1	VDRAT2	VDRAT3	VDRAT4
	0.300000+02	0.166700+03	0.125000+02	0.125000+02

	DTVDFR	DTV000	DTIV00
	0.500000+00	0.100000+00	0.800000+00

VOIDING FRONT CORRELATORS (SEE IGVC)	GVFC
	0.100000+01

*****TIME PARAMETERS*****

TIME INPUT	TOA	DT	THOLD	DFQUIT	FRDT	FRSIDT	BETADT
	0.139000+02	0.100000+00	0.200000+01	0.0	0.0	0.200000+00	0.150000+01

	TINCK	DT1	DT11	DT3
	0.600000+01	0.100000+00	0.100000-01	0.500000-02

*****CONVERGENCE INPUT*****

TOB INPUT	RL	EPS
	0.100000+01	0.100000-04

TSPK INPUT	EPSREA	EPSPHI
	0.100000+00	0.100000-02

*****FUEL MOTION INPUT*****

EJECTION PARAMETERS	TAUEJ	EQUIL. DENS.
	0.200000+00	0.500000+01

*****MODEL/EDIT OPTIONS*****

CASES	ICASE	NCASE							
	1	1							
FILES	IREAD	IWRITE	IPUNCH	(IPROSA)					
	5	6	7	0					
DEBUGGING/EDITS	IDBUG	IBBUE	ITFBUG	INOEDT	INOSS				
	0	0	1	0	0				
PLOTTING FLAGS	IPLOT	IPLOTS	IPLOTT	ISPLOT	ICHP	IZP			
	0	0	0	0	8	10			
MODEL FLAGS	IBETA	ITOA	IVDRAT	IVDTIM	IQUSE	IZQREF	IGVFC	IQBASE	
	1	0	1	0	2	16	1	1	
	ISUSE	I2D	IMPUMP	IFPMAX					
	0	1	0	0					

CHANNEL 1 SACO 0.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 16

***** STEADY STATE DATA FOR CHANNEL 1 *****

AVERAGE PIN POWER(10**6 WATTS)	2.495550-02	POWER/FLOW(10**6 W-SEC/G)	2.237960-04
POWER FRACTION IN UPPER BLANKET	1.486040-02	DOPPLER COEFFICIENT(COOLANT IN)	-3.477560-04
POWER FRACTION IN ACTIVE CORE	9.604190-01	DOPPLER COEFFICIENT(COOLANT OUT)	-2.175590-04
POWER FRACTION IN LOWER BLANKET	2.472030-02	VOIDING REACTIVITY(DELTA K)	7.167830-04
MASS FLOWRATE(G/SEC-CM**2)	5.576500+02	CLAD REACTIVITY(DELTA K)	-1.417790-03
MASS FLOWRATE(G/SEC)	1.115100+02	FUEL REACTIVITY(DELTA K)	2.216270-02

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	565.959	565.967	566.066	566.203	566.340
150.237	565.907	566.132	568.783	572.482	576.180
142.062	565.556	566.595	578.870	595.993	613.115
133.887	564.408	567.253	600.942	647.927	694.911
126.181	559.469	574.421	804.775	1126.091	1447.406
118.942	550.179	568.875	856.931	1258.732	1660.533
111.704	538.952	560.916	899.312	1371.330	1843.349
104.465	526.076	550.746	930.834	1461.007	1991.181
97.227	511.880	538.625	950.692	1525.472	2100.252
89.983	496.726	524.854	953.379	1563.077	2167.775
82.750	481.002	509.813	953.698	1572.861	2192.023
75.512	465.110	493.858	936.769	1554.574	2172.378
68.273	449.455	477.405	908.024	1508.683	2109.342
61.035	434.439	460.876	868.199	1436.362	2004.524
53.796	420.443	444.693	818.310	1339.457	1860.605
46.558	407.827	429.270	759.633	1220.447	1681.261
39.319	396.913	415.000	693.667	1082.372	1471.076
29.750	390.570	393.653	427.313	474.265	521.217
17.850	388.557	389.989	405.633	427.454	449.276
5.950	387.828	388.104	391.114	395.314	399.513

AXIAL LOCATION (CM)	PIN POWER (MW/CM)	INTEGRATED POWER (MW)	DOPPLER WEIGHT	VOIDING REACTIVITY (DELTA K)	FUEL REACTIVITY (DELTA K)	CLAD REACTIVITY (DELTA K)
158.412	8.860140-08	3.707590-04	2.935530-03	-3.053800-06	8.998300-05	5.016100-06
150.237	2.392240-06	3.635160-04	4.658340-03	-4.388500-06	1.382100-04	7.328600-06
142.062	1.107520-05	3.142630-04	1.104150-02	-1.068200-05	3.060400-04	1.678800-05
133.887	3.039030-05	1.534650-04	2.232800-02	-2.066900-05	5.484500-04	2.846900-05
126.181	1.594110-04	2.342950-02	3.004710-02	-1.550900-05	7.722300-04	1.068700-05
118.942	1.993420-04	2.212830-02	4.687160-02	1.092100-05	1.014100-03	-3.409800-05
111.704	2.341780-04	2.055600-02	6.294970-02	3.853200-05	1.282000-03	-7.985400-05
104.465	2.630300-04	1.875260-02	7.786200-02	6.577000-05	1.542400-03	-1.241700-04
97.227	2.851600-04	1.676430-02	9.221180-02	8.910300-05	1.764400-03	-1.618100-04
89.983	3.000030-04	1.464200-02	1.012640-01	1.056900-04	1.920900-03	-1.834700-04
82.750	3.071790-04	1.243970-02	1.060750-01	1.135900-04	1.996800-03	-2.012800-04
75.512	3.055050-04	1.021390-02	1.044640-01	1.112100-04	1.975700-03	-1.977100-04
68.273	2.979990-04	8.021390-03	9.946230-02	9.912000-05	1.864500-03	-1.786900-04
61.035	2.818770-04	5.918190-03	8.285250-02	7.898500-05	1.676800-03	-1.467600-04
53.796	2.585520-04	3.958070-03	7.612320-02	5.313300-05	1.436500-03	-1.055900-04
46.558	2.286190-04	2.191110-03	6.326020-02	2.467400-05	1.172900-03	-6.002000-05
39.319	1.928440-04	6.624750-04	5.055540-02	-3.098300-06	9.233900-04	-1.550300-05
29.750	3.286460-05	3.910590-04	5.227080-02	-9.601900-06	7.065300-04	4.580600-06
17.850	1.527410-05	1.090570-04	4.231370-02	-4.591000-06	5.607200-04	2.515300-06
5.950	2.939500-06	6.996010-06	3.615290-02	-2.346200-06	4.701500-04	7.798800-07

***** STEADY STATE DATA FOR CHANNEL 2 *****

AVERAGE PIN POWER(10**6 WATTS)	2.190640-02	POWER/FLOW(10**6 W-SEC/G)	1.964530-04
POWER FRACTION IN UPPER BLANKET	2.296710-02	DOPPLER COEFFICIENT(COOLANT IN)	-5.576820-04
POWER FRACTION IN ACTIVE CORE	9.338260-01	DOPPLER COEFFICIENT(COOLANT OUT)	-3.437680-04
POWER FRACTION IN LOWER BLANKET	3.820650-02	VOIDING REACTIVITY(DELTA K)	1.425800-03
MASS FLOWRATE(G/SEC-CM**2)	5.576500+02	CLAD REACTIVITY(DELTA K)	-2.603570-03
MASS FLOWRATE(G/SEC)	1.115100+02	FUEL REACTIVITY(DELTA K)	3.038850-02

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BORY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	544.188	544.200	544.333	544.519	544.705
150.237	544.118	544.423	548.020	553.038	558.055
142.062	543.641	545.050	561.704	584.935	608.165
133.887	542.084	545.951	591.649	655.393	719.136
126.181	537.299	550.129	747.793	1023.508	1299.224
118.942	529.328	545.371	792.547	1137.325	1482.104
111.704	519.694	538.541	828.913	1233.944	1638.975
104.465	508.645	529.814	855.961	1310.894	1765.227
97.227	496.464	519.414	873.001	1366.210	1859.419
89.988	483.461	507.605	879.597	1398.478	1917.359
82.750	469.968	494.690	875.581	1406.874	1938.167
75.512	456.331	480.999	861.054	1391.182	1921.310
68.273	442.899	466.882	836.389	1351.804	1867.219
61.035	430.013	452.699	802.215	1289.746	1777.277
53.796	418.004	438.812	759.407	1206.594	1653.782
46.558	407.178	425.578	709.057	1104.473	1499.890
39.319	397.813	413.333	652.452	985.993	1319.534
29.750	391.566	395.748	441.415	505.114	568.813
17.850	388.834	390.778	412.002	441.606	471.211
5.950	387.846	388.220	392.304	398.002	403.699

AXIAL LOCATION (CM)	PIN POWER (MW/CM)	INTEGRATED POWER (MW)	DOPPLER HEIGHT	VOIDING REACTIVITY (DELTA K)	FUEL REACTIVITY (DELTA K)	CLAD REACTIVITY (DELTA K)
158.412	1.202040-07	5.030050-04	3.199350-03	-5.514300-06	1.123000-04	8.643400-06
150.237	3.245520-06	4.931780-04	5.523270-03	-8.511800-06	1.879100-04	1.351200-05
142.062	1.502550-05	4.263560-04	1.153110-02	-1.883200-05	3.996900-04	2.879800-05
133.887	4.123010-05	2.082030-04	2.767200-02	-3.584900-05	7.547700-04	4.995300-05
126.181	1.367880-04	2.010450-02	2.978610-02	-3.118900-05	1.101700-03	2.992300-05
118.942	1.710520-04	1.898790-02	4.466360-02	1.446600-05	1.430200-03	-4.604800-05
111.704	2.009440-04	1.763870-02	6.048440-02	6.969200-05	1.783600-03	-1.342700-04
104.465	2.257020-04	1.609130-02	7.683910-02	1.250900-04	2.134000-03	-2.212100-04
97.227	2.446910-04	1.438520-02	9.249230-02	1.735000-04	2.438000-03	-2.963900-04
89.988	2.574270-04	1.256400-02	1.013500-01	2.087400-04	2.655100-03	-3.508100-04
82.750	2.635850-04	1.067430-02	1.083430-01	2.253800-04	2.763200-03	-3.774800-04
75.512	2.630070-04	8.764380-03	1.054090-01	2.221000-04	2.741000-03	-3.720700-04
68.273	2.557080-04	6.883020-03	1.005340-01	1.989900-04	2.601400-03	-3.370900-04
61.035	2.418740-04	5.078300-03	8.926370-02	1.595300-04	2.355900-03	-2.767800-04
53.796	2.218590-04	3.396350-03	7.695990-02	1.085100-04	2.037200-03	-1.984200-04
46.558	1.961740-04	1.880160-03	6.341130-02	5.253300-05	1.684700-03	-1.119400-04
39.319	1.654760-04	5.684580-04	5.043360-02	-9.786400-07	1.341900-03	-2.886300-05
29.750	4.458700-05	5.305360-04	5.879290-02	-1.684900-05	9.971300-04	8.679700-06
17.850	2.072220-05	1.479560-04	4.859370-02	-9.484200-06	7.629900-04	5.580900-06
5.950	3.987980-06	9.491400-06	4.178100-02	-6.026100-06	6.058100-04	2.707300-06

CHANNEL 3 SACS 0.0

10 CHANNEL SACS 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 18

***** STEADY STATE DATA FOR CHANNEL 3 *****

AVERAGE PIN POWER(10**6 WATTS)	2.293350-02	POWER/FLOW(10**6 W-SEC/G)	2.056630-04
POWER FRACTION IN UPPER BLANKET	1.655790-02	DOPPLER COEFFICIENT(COOLANT IN)	-5.955370-04
POWER FRACTION IN ACTIVE CORE	9.558970-01	DOPPLER COEFFICIENT(COOLANT OUT)	-3.815330-04
POWER FRACTION IN LOWER BLANKET	2.754460-02	VOIDING REACTIVITY(DELTA K)	1.248780-03
MASS FLOWRATE(G/SEC-CM**2)	5.576500+02	CLAD REACTIVITY(DELTA K)	-2.332420-03
MASS FLOWRATE(G/SEC)	1.115100+02	FUEL REACTIVITY(DELTA K)	3.520750-02

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLAADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	551.522	551.531	551.631	551.771	551.912
150.237	551.469	551.699	554.414	558.201	561.988
142.062	551.109	552.173	564.742	582.275	599.808
133.887	549.933	552.852	587.343	635.453	683.562
126.181	545.297	558.972	769.666	1063.557	1357.448
113.942	536.799	553.900	817.370	1184.877	1552.385
111.704	526.531	546.620	856.133	1287.865	1719.597
104.465	514.754	537.318	884.965	1369.888	1854.811
97.227	501.769	526.232	903.129	1428.851	1954.573
89.988	487.909	513.645	910.159	1463.246	2016.333
82.750	473.527	499.879	905.878	1472.195	2038.512
75.512	458.991	485.285	890.394	1455.469	2020.543
68.273	444.673	470.237	864.103	1413.495	1962.887
61.035	430.938	455.119	827.676	1347.346	1867.016
53.796	418.137	440.317	782.045	1258.713	1735.380
46.558	406.598	426.210	728.376	1149.860	1571.343
39.319	396.615	413.158	668.041	1023.569	1379.098
29.750	390.637	393.793	428.260	476.336	524.413
17.850	388.575	390.042	406.061	428.405	450.748
5.950	387.829	388.111	391.194	395.494	399.794

AXIAL LOCATION (CM)	PIN POWER (MW/CM)	INTEGRATED POWER (MW)	DOPPLER HEIGHT	VOIDING REACTIVITY (DELTA K)	FUEL REACTIVITY (DELTA K)	CLAD REACTIVITY (DELTA K)
158.412	9.072330-03	3.796390-04	1.131750-03	-3.910200-06	1.080100-04	7.756100-06
150.237	2.449530-06	3.722220-04	1.913730-03	-6.712400-06	1.822200-04	1.347800-05
142.062	1.134040-05	3.217890-04	4.574090-03	-1.923800-05	4.404000-04	3.610900-05
133.887	3.111810-05	1.571400-04	1.510480-02	-4.474300-05	8.858100-04	7.674300-05
126.181	1.458050-04	2.142930-02	2.474200-02	-3.070100-05	1.262400-03	3.511700-05
113.942	1.823280-04	2.023970-02	4.395480-02	1.749800-05	1.609800-03	-4.859700-05
111.704	2.141910-04	1.820150-02	6.165920-02	6.487400-05	2.032000-03	-1.275600-04
104.465	2.405800-04	1.715210-02	7.765770-02	1.126200-04	2.447000-03	-2.046500-04
97.227	2.608210-04	1.533350-02	9.289350-02	1.541800-04	2.803400-03	-2.707100-04
89.988	2.743980-04	1.339230-02	1.025000-01	1.839900-04	3.056000-03	-3.177400-04
82.750	2.809610-04	1.137300-02	1.075150-01	1.983500-04	3.180500-03	-3.405800-04
75.512	2.803450-04	9.342150-03	1.059330-01	1.944000-04	3.149500-03	-3.348200-04
68.273	2.725650-04	7.336760-03	1.006590-01	1.735000-04	2.975800-03	-3.026100-04
61.035	2.578190-04	5.413070-03	9.019780-02	1.385400-04	2.679900-03	-2.482700-04
53.796	2.364840-04	3.620250-03	7.724750-02	9.393700-05	2.299400-03	-1.785600-04
46.558	2.091060-04	2.004100-03	6.402180-02	4.571000-05	1.880700-03	-1.026300-04
39.319	1.763350-04	6.059320-04	5.100370-02	4.446200-07	1.477300-03	-3.083100-05
29.750	3.355170-05	4.004550-04	5.453560-02	-1.203700-05	1.115800-03	2.437900-06
17.850	1.563990-05	1.116690-04	4.519010-02	-7.091000-06	8.841000-04	2.324200-06
5.950	3.009900-06	7.163560-06	3.963420-02	-4.832600-06	7.374600-04	1.173200-06

***** STEADY STATE DATA FOR CHANNEL 4 *****

AVERAGE PIN POWER(10**6 WATTS)	2.052430-02	POWER/FLOW(10**6 W-SEC/G)	1.977730-04
POWER FRACTION IN UPPER BLANKET	2.156700-02	DOPPLER COEFFICIENT(COOLANT IN)	-7.642580-04
POWER FRACTION IN ACTIVE CORE	9.425560-01	DOPPLER COEFFICIENT(COOLANT OUT)	-4.850360-04
POWER FRACTION IN LOWER BLANKET	3.587730-02	VOIDING REACTIVITY(DELTA K)	1.772930-03
MASS FLOWRATE(G/SEC-CH**2)	5.189300+02	CLAD REACTIVITY(DELTA K)	-3.281690-03
MASS FLOWRATE(G/SEC)	1.037770+02	FUEL REACTIVITY(DELTA K)	3.976460-02

AXIAL LOCATION (CH)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	545.239	545.269	545.367	545.530	545.694
150.237	545.173	545.441	548.606	553.020	557.435
142.062	544.722	545.962	560.614	581.052	601.489
133.887	543.250	546.652	586.857	642.938	699.019
126.181	538.511	550.579	736.508	995.854	1255.201
118.942	530.454	545.545	778.046	1102.355	1426.665
111.704	520.717	538.445	811.578	1192.562	1573.547
104.465	509.550	529.462	836.246	1264.170	1692.094
97.227	497.238	518.826	851.421	1315.348	1779.276
89.988	484.096	506.807	856.714	1344.789	1832.865
82.750	470.459	493.713	851.990	1351.740	1851.491
75.512	456.676	479.879	837.370	1336.025	1834.679
68.273	443.099	465.658	813.228	1298.043	1782.858
61.035	430.075	451.414	780.180	1238.766	1697.353
53.796	417.937	437.510	739.071	1159.709	1580.348
46.558	406.995	424.303	690.952	1062.893	1434.834
39.319	397.530	412.128	637.052	950.790	1264.529
29.750	391.359	395.039	435.216	491.257	547.299
17.850	388.777	390.487	409.159	435.205	461.251
5.950	387.842	388.171	391.765	396.777	401.790

AXIAL LOCATION (CH)	PIN POWER (MW/CH)	INTEGRATED POWER (MW)	DOPPLER HEIGHT	VOIDING REACTIVITY (DELTA K)	FUEL REACTIVITY (DELTA K)	CLAD REACTIVITY (DELTA K)
158.412	1.057550-07	4.425400-04	1.014250-03	-4.064800-06	1.102600-04	8.008800-06
150.237	2.855380-06	4.338940-04	1.973170-03	-7.871000-06	2.023700-04	1.547300-05
142.062	1.321940-05	3.751050-04	4.817720-03	-2.275200-05	4.801800-04	4.139900-05
133.887	3.627390-05	1.831760-04	1.511320-02	-5.673500-05	1.016000-03	9.346900-05
126.181	1.286670-04	1.891090-02	2.399520-02	-5.047500-05	1.479500-03	6.180900-05
118.942	1.608960-04	1.786060-02	4.259300-02	1.579100-05	1.849000-03	-5.312900-05
111.704	1.890140-04	1.659150-02	6.006860-02	8.580200-05	2.295800-03	-1.689300-04
104.465	2.123020-04	1.513600-02	7.712960-02	1.567700-04	2.744600-03	-2.828600-04
97.227	2.301640-04	1.353110-02	9.315830-02	2.191800-04	3.136000-03	-3.814100-04
89.988	2.421440-04	1.181810-02	1.024260-01	2.646100-04	3.415400-03	-4.525500-04
82.750	2.479360-04	1.004060-02	1.087740-01	2.867400-04	3.554500-03	-4.873700-04
75.512	2.473930-04	8.244050-03	1.070280-01	2.816100-04	3.523800-03	-4.798900-04
68.273	2.405270-04	6.474380-03	1.018430-01	2.514700-04	3.341200-03	-4.337500-04
61.035	2.275140-04	4.776300-03	9.031360-02	2.003900-04	3.022800-03	-3.548400-04
53.796	2.086870-04	3.194710-03	7.779640-02	1.350500-04	2.612100-03	-2.533200-04
46.558	1.845280-04	1.768530-03	6.409850-02	6.440700-05	2.158000-03	-1.426500-04
39.319	1.554520-04	5.347090-04	5.077670-02	-1.331400-06	1.715500-03	-3.857300-05
29.750	3.922730-05	4.668050-04	5.701490-02	-2.155600-05	1.286300-03	1.058600-05
17.850	1.823120-05	1.301710-04	4.704920-02	-1.404500-05	1.004600-03	9.681900-06
5.950	3.508600-06	8.350460-06	4.078060-02	-1.006100-05	8.167100-04	7.152500-06

CHANNEL 5 SACS 0.0

10 CHANNEL SACS 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 20

***** STEADY STATE DATA FOR CHANNEL 5 *****

AVERAGE PIN POWER(10**6 WATTS)	2.217840-02	POWER/FLOW(10**6 W-SEC/G)	2.137120-04
POWER FRACTION IN UPPER BLANKET	1.181160-02	DOPPLER COEFFICIENT(COOLANT IN)	-7.622720-04
POWER FRACTION IN ACTIVE CORE	9.685390-01	DOPPLER COEFFICIENT(COOLANT OUT)	-4.590000-04
POWER FRACTION IN LOWER BLANKET	1.964890-02	VOIDING REACTIVITY(DELTA K)	1.488350-03
MASS FLOWRATE(G/SEC-CM**2)	5.189800+02	CLAD REACTIVITY(DELTA K)	-3.004710-03
MASS FLOWRATE(G/SEC)	1.037770+02	FUEL REACTIVITY(DELTA K)	5.128760-02

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	557.930	557.936	558.005	558.102	558.199
150.237	557.891	558.049	559.922	562.535	565.147
142.062	557.624	558.358	567.029	579.124	591.219
133.887	556.752	558.766	582.560	615.749	648.938
126.181	552.220	565.620	772.072	1060.045	1318.018
118.942	543.273	560.030	818.195	1178.302	1538.409
111.704	532.462	552.147	855.428	1278.466	1701.504
104.465	520.062	542.172	882.819	1357.978	1833.137
97.227	506.391	530.361	899.669	1414.805	1929.942
89.988	491.798	517.316	905.546	1447.496	1989.446
82.750	476.655	502.477	900.301	1455.214	2010.128
75.512	461.351	487.116	884.067	1437.764	1991.460
68.273	446.275	471.325	857.260	1395.590	1933.919
61.035	431.814	455.508	820.564	1329.770	1838.976
53.796	418.337	440.070	774.918	1241.987	1709.056
46.558	406.187	425.405	721.487	1134.483	1547.480
39.319	395.676	411.887	661.637	1010.007	1358.377
29.750	389.897	392.075	415.852	449.018	482.184
17.850	388.369	389.381	400.432	415.846	431.260
5.950	387.816	388.011	390.137	393.104	396.070

AXIAL LOCATION (CM)	PIN POWER (MW/CM)	INTEGRATED POWER (MW)	DOPPLER HEIGHT	VOIDING REACTIVITY (DELTA K)	FUEL REACTIVITY (DELTA K)	CLAD REACTIVITY (DELTA K)
158.412	6.258650-08	2.618980-04	1.698170-03	-5.351700-06	1.618600-04	9.604600-06
150.237	1.689840-06	2.567820-04	3.042380-03	-8.990800-06	2.669100-04	1.610600-05
142.062	7.823310-06	2.219900-04	8.512900-03	-2.518600-05	6.462500-04	4.169400-05
133.887	2.146720-05	1.084050-04	1.912980-02	-5.098600-05	1.212800-03	7.383900-05
126.181	1.428690-04	2.099830-02	2.752400-02	-4.442600-05	1.757100-03	4.274400-05
118.942	1.726560-04	1.983210-02	4.590080-02	1.422200-05	2.358900-03	-5.979100-05
111.704	2.098780-04	1.842290-02	6.301660-02	7.783700-05	2.996000-03	-1.669800-04
104.465	2.357360-04	1.680670-02	7.822210-02	1.401400-04	3.614400-03	-2.693500-04
97.227	2.555700-04	1.502470-02	9.298820-02	1.930300-04	4.140800-03	-3.552000-04
89.988	2.683720-04	1.312260-02	1.018530-01	2.303300-04	4.509200-03	-4.153200-04
82.750	2.753040-04	1.114890-02	1.074820-01	2.477600-04	4.685500-03	-4.436300-04
75.512	2.747000-04	9.154040-03	1.053160-01	2.419200-04	4.630900-03	-4.347600-04
68.273	2.670760-04	7.189030-03	1.005160-01	2.139600-04	4.361600-03	-3.907000-04
61.035	2.526270-04	5.304070-03	8.864890-02	1.681400-04	3.911200-03	-3.178000-04
53.796	2.317220-04	3.547350-03	7.603320-02	1.098700-04	3.338200-03	-2.246200-04
46.558	2.048960-04	1.963750-03	6.266000-02	4.647700-05	2.712700-03	-1.224100-04
39.319	1.728330-04	5.937310-04	4.983920-02	-1.491500-05	2.122300-03	-2.302700-05
29.750	2.321500-05	2.762590-04	5.980680-02	-2.586000-05	1.593600-03	1.832900-05
17.850	1.078940-05	7.703600-05	3.911980-02	-1.271500-05	1.250100-03	1.096600-05
5.950	2.076410-06	4.941860-06	3.421990-02	-6.904000-06	1.017300-03	5.596300-06

***** STEADY STATE DATA FOR CHANNEL 6 *****

AVERAGE PIN POWER(10**6 WATTS)	1.96834D-02	POWER/FLOW(10**6 W-SEC/G)	2.00144D-04
POWER FRACTION IN UPPER BLANKET	1.65013D-02	DOPPLER COEFFICIENT(COOLANT IN)	-6.60655D-04
POWER FRACTION IN ACTIVE CORE	9.56048D-01	DOPPLER COEFFICIENT(COOLANT OUT)	-4.13576D-04
POWER FRACTION IN LOWER BLANKET	2.74504D-02	VOIDING REACTIVITY(DELTA K)	1.23228D-03
MASS FLOWRATE(G/SEC-CM**2)	4.91820D+02	CLAD REACTIVITY(DELTA K)	-2.51934D-03
MASS FLOWRATE(G/SEC)	9.83462D+01	FUEL REACTIVITY(DELTA K)	3.90082D-02

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BODY TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	547.128	547.135	547.221	547.341	547.461
150.237	547.076	547.273	549.595	552.834	556.074
142.062	546.727	547.637	558.328	573.385	588.381
133.887	545.587	548.083	577.585	618.735	659.886
126.181	541.078	552.817	733.680	985.961	1238.242
118.942	532.807	547.487	773.654	1089.128	1404.603
111.704	522.812	540.057	805.749	1176.355	1546.961
104.465	511.350	530.719	829.146	1245.412	1661.678
97.227	498.712	519.711	843.245	1294.534	1745.823
89.988	485.221	507.314	847.688	1322.467	1797.246
82.750	471.223	493.844	842.361	1328.497	1814.633
75.512	457.075	479.646	827.399	1312.468	1797.538
68.273	443.139	465.084	803.185	1274.792	1746.400
61.035	429.770	450.528	770.337	1216.431	1662.524
53.796	417.311	436.351	729.696	1138.876	1548.055
46.558	406.080	422.915	682.300	1044.109	1405.917
39.319	376.363	410.564	629.360	934.552	1239.743
29.750	390.551	393.251	422.731	463.853	504.975
17.850	388.551	389.806	403.507	422.619	441.731
5.950	387.828	388.069	390.706	394.384	398.062

AXIAL LOCATION (CM)	PIN POWER (MW/CM)	INTEGRATED POWER (MW)	DOPPLER WEIGHT	VOIDING REACTIVITY (DELTA K)	FUEL REACTIVITY (DELTA K)	CLAD REACTIVITY (DELTA K)
158.412	7.75998D-08	3.24722D-04	8.72950D-04	-3.93560D-06	1.07510D-04	7.924.0D-06
150.237	2.09519D-06	3.18379D-04	1.65573D-03	-7.81110D-06	1.93360D-04	1.54170D-05
142.062	9.69997D-06	2.75241D-04	4.34894D-03	-2.34150D-05	4.78110D-04	4.26820D-05
133.887	2.66167D-05	1.34409D-04	1.47180D-02	-5.51460D-05	9.75780D-04	9.11710D-05
126.181	1.25162D-04	1.83957D-02	2.41258D-02	-4.74280D-05	1.40820D-03	5.52970D-05
118.942	1.56513D-04	1.73741D-02	4.32312D-02	4.12150D-06	1.80370D-03	-3.77720D-05
111.704	1.83855D-04	1.61395D-02	6.12826D-02	5.92500D-05	2.26920D-03	-1.32490D-04
104.465	2.06518D-04	1.47236D-02	7.77695D-02	1.15480D-04	2.72810D-03	-2.25730D-04
97.227	2.23894D-04	1.31625D-02	9.34676D-02	1.64590D-04	3.12380D-03	-3.05730D-04
89.988	2.35547D-04	1.14961D-02	1.02573D-01	1.99850D-04	3.40390D-03	-3.62650D-04
82.750	2.41182D-04	9.76706D-03	1.08791D-01	2.16740D-04	3.54110D-03	-3.90060D-04
75.512	2.40653D-04	8.01946D-03	1.06685D-01	2.11810D-04	3.50470D-03	-3.82610D-04
68.273	2.33974D-04	6.29800D-03	1.01864D-01	1.86750D-04	3.31100D-03	-3.43120D-04
61.035	2.21316D-04	4.64667D-03	8.97078D-02	1.44930D-04	2.98090D-03	-2.76700D-04
53.796	2.03002D-04	3.10768D-03	7.70287D-02	9.20040D-05	2.55810D-03	-1.91910D-04
46.558	1.79501D-04	1.72035D-03	6.33354D-02	3.51400D-05	2.09300D-03	-9.99950D-05
39.319	1.51412D-04	5.20143D-04	5.01566D-02	-1.65480D-05	1.63990D-03	-1.51960D-05
29.750	2.87830D-05	3.42528D-04	5.35387D-02	-2.38070D-05	1.20500D-03	1.57710D-05
17.850	1.33775D-05	9.55155D-05	4.29736D-02	-1.32930D-05	9.33580D-04	1.08790D-05
5.950	2.57450D-06	6.12732D-06	3.57952D-02	-7.04930D-06	7.49260D-04	5.48410D-06

CHANNEL 7 SACO 0.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 22

***** STEADY STATE DATA FOR CHANNEL 7 *****

AVERAGE PIN POWER(10**6 WATTS)	1.859530-02	POWER/FLOW(10**6 W-SEC/G)	2.125610-04
POWER FRACTION IN UPPER BLANKET	1.506180-02	DOPPLER COEFFICIENT(COOLANT IN)	-7.533070-04
POWER FRACTION IN ACTIVE CORE	9.598820-01	DOPPLER COEFFICIENT(COOLANT OUT)	-4.806860-04
POWER FRACTION IN LOWER BLANKET	2.505530-02	VOIDING REACTIVITY(DELTA K)	1.379530-03
MASS FLOWRATE(G/SEC-CM**2)	4.374900+02	CLAD REACTIVITY(DELTA K)	-2.959710-03
MASS FLOWRATE(G/SEC)	8.748220+01	FUEL REACTIVITY(DELTA K)	4.639410-02

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BORY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
153.412	557.014	557.020	557.094	557.198	557.301
150.237	556.964	557.133	559.136	561.929	564.722
142.062	556.625	557.410	566.681	579.613	592.544
133.887	555.520	557.673	583.112	618.597	654.081
126.181	550.818	561.952	733.503	972.793	1212.084
118.942	541.998	555.922	770.444	1069.674	1368.904
111.704	531.341	547.698	799.709	1151.232	1502.755
104.465	519.119	537.491	820.551	1215.383	1610.215
97.227	505.643	525.561	832.436	1260.487	1688.539
89.928	491.258	512.213	835.061	1285.393	1735.725
82.750	476.332	497.788	828.359	1289.463	1750.567
75.512	461.246	482.655	812.501	1272.593	1732.686
68.273	446.385	467.200	787.892	1235.216	1682.539
61.035	432.130	451.819	755.161	1178.285	1601.408
53.796	418.845	436.905	715.145	1103.255	1491.365
46.558	406.869	422.838	668.867	1012.045	1355.224
39.319	396.508	409.978	617.508	906.985	1196.462
29.750	390.466	392.794	418.216	453.675	489.135
17.850	388.528	389.610	401.424	417.905	434.385
5.950	387.826	388.034	390.308	393.480	396.651

AXIAL LOCATION (CM)	PIN POWER (MW/CM)	INTEGRATED POWER (MW)	DOPPLER HEIGHT	VOIDING REACTIVITY (DELTA K)	FUEL REACTIVITY (DELTA K)	CLAD REACTIVITY (DELTA K)
153.412	6.691490-08	2.800110-04	2.978140-04	-2.246800-06	1.035900-04	5.975500-06
150.237	1.806700-06	2.745400-04	5.980870-04	-5.308200-06	1.903700-04	1.274000-05
142.062	8.364360-06	2.373420-04	2.126870-03	-2.254000-05	5.206900-04	4.416900-05
133.887	2.295180-05	1.159020-04	7.912840-03	-6.902400-05	1.175600-03	1.178100-04
126.181	1.187170-04	1.744850-02	2.241470-02	-6.365500-05	1.734000-03	7.726000-05
118.942	1.434540-04	1.647950-02	4.336310-02	4.939400-06	2.166900-03	-4.874000-05
111.704	1.743980-04	1.530850-02	6.192300-02	6.895600-05	2.720400-03	-1.615600-04
104.465	1.953340-04	1.396550-02	7.831870-02	1.338300-04	3.266500-03	-2.715100-04
97.227	2.123650-04	1.248480-02	9.368570-02	1.902800-04	3.735800-03	-3.654000-04
89.928	2.234190-04	1.090420-02	1.029100-01	2.305600-04	4.066200-03	-4.318100-04
82.750	2.287630-04	9.264140-03	1.083930-01	2.496100-04	4.225500-03	-4.633900-04
75.512	2.232610-04	7.606520-03	1.066750-01	2.434600-04	4.177800-03	-4.538700-04
68.273	2.219260-04	5.973700-03	1.017950-01	2.137900-04	3.941200-03	-4.060700-04
61.035	2.099200-04	4.407410-03	8.961520-02	1.647100-04	3.542000-03	-3.263400-04
53.796	1.925490-04	2.947660-03	7.693020-02	1.025400-04	3.033500-03	-2.247300-04
46.558	1.702530-04	1.631770-03	6.335190-02	3.572300-05	2.476100-03	-1.144700-04
39.319	1.436150-04	4.933600-04	5.012020-02	-2.483800-05	1.933500-03	-1.284700-05
29.750	2.482050-05	2.953640-04	5.423420-02	-3.564800-05	1.416400-03	2.759500-05
17.850	1.153550-05	8.235370-05	4.315840-02	-2.279600-05	1.095300-03	2.220800-05
5.950	2.220020-06	5.283640-06	3.539250-02	-1.276600-05	8.722700-04	1.327100-05

***** STEADY STATE DATA FOR CHANNEL 8 *****

AVERAGE PIN POWER(10**6 WATTS)	2.50182D-02	POWER/FLOW(10**6 W-SEC/G)	2.24359D-04
POWER FRACTION IN UPPER BLANKET	8.50000D-03	DOPPLER COEFFICIENT(COOLANT IN)	-3.02593D-04
POWER FRACTION IN ACTIVE CORE	9.77360D-01	DOPPLER COEFFICIENT(COOLANT OUT)	-1.90959D-04
POWER FRACTION IN LOWER BLANKET	1.41400D-02	VOIDING REACTIVITY(DELTA K)	4.46267D-04
MASS FLOWRATE(G/SEC-CM**2)	5.57650D+02	CLAD REACTIVITY(DELTA K)	-1.19314D-03
MASS FLOWRATE(G/SEC)	1.11510D+02	FUEL REACTIVITY(DELTA K)	4.02608D-02

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BORY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	566.407	566.412	566.468	566.547	566.625
150.237	566.377	566.506	568.027	570.147	572.268
142.062	566.176	566.771	573.811	583.629	573.448
133.837	565.517	567.152	586.467	613.409	640.352
126.181	560.969	576.222	811.229	1139.034	1466.839
118.942	551.491	570.565	864.438	1274.354	1684.270
111.704	540.037	562.445	907.675	1389.226	1870.778
104.465	526.901	552.069	939.834	1480.715	2021.596
97.227	512.418	539.704	960.093	1546.481	2132.870
89.988	496.959	525.665	967.935	1584.845	2201.756
82.750	480.917	510.310	963.160	1594.827	2226.494
75.512	464.704	494.032	945.889	1576.171	2206.453
68.273	448.733	477.247	916.564	1529.353	2142.143
61.035	433.413	460.385	875.934	1455.571	2035.279
53.796	419.135	443.875	825.037	1356.710	1888.382
46.558	406.264	428.140	765.175	1235.296	1705.417
39.319	395.129	413.582	697.877	1094.432	1490.987
29.750	389.379	391.147	410.448	437.377	464.295
17.850	388.225	389.046	398.017	410.529	423.042
5.950	387.807	387.965	389.691	392.099	394.507

AXIAL LOCATION (CM)	PIN POWER (MW/CM)	INTEGRATED POWER (MW)	DOPPLER HEIGHT	VOIDING REACTIVITY (DELTA K)	FUEL REACTIVITY (DELTA K)	CLAD REACTIVITY (DELTA K)
158.412	5.08063D-08	2.12603D-04	7.61741D-04	-1.61090D-06	8.62360D-05	3.69260D-06
150.237	1.37177D-06	2.08449D-04	1.36029D-03	-3.34880D-06	1.47920D-04	7.20800D-06
142.062	6.35078D-06	1.80206D-04	4.08438D-03	-1.21230D-05	3.74910D-04	2.23850D-05
133.837	1.74265D-05	8.80004D-05	1.19720D-02	-3.48410D-05	8.00830D-04	5.57370D-05
126.181	1.62631D-04	2.39027D-02	2.40501D-02	-3.52360D-05	1.28820D-03	3.83000D-05
118.942	2.03368D-04	2.25752D-02	4.43029D-02	-4.89920D-06	1.77650D-03	-1.77940D-05
111.704	2.38908D-04	2.09711D-02	6.22037D-02	2.20590D-05	2.34710D-03	-6.71280D-05
104.465	2.68342D-04	1.91313D-02	7.85995D-02	4.90340D-05	2.90530D-03	-1.14910D-04
97.227	2.90919D-04	1.71029D-02	9.33994D-02	7.21560D-05	3.38080D-03	-1.55270D-04
89.988	3.06062D-04	1.49377D-02	1.03154D-01	8.84710D-05	3.71540D-03	-1.83560D-04
82.750	3.13383D-04	1.26910D-02	1.08122D-01	9.61320D-05	3.87490D-03	-1.96950D-04
75.512	3.12696D-04	1.04202D-02	1.06459D-01	9.35340D-05	3.82550D-03	-1.92710D-04
68.273	3.04317D-04	8.18339D-03	1.00811D-01	8.13180D-05	3.58160D-03	-1.71990D-04
61.035	2.87570D-04	6.03772D-03	8.97887D-02	6.09630D-05	3.17500D-03	-1.37240D-04
53.796	2.63774D-04	4.03801D-03	7.62348D-02	3.48750D-05	2.65660D-03	-9.25210D-05
46.558	2.33236D-04	2.23536D-03	6.30472D-02	6.46040D-06	2.09340D-03	-4.35290D-05
39.319	1.96739D-04	6.75854D-04	4.98280D-02	-2.09580D-05	1.56200D-03	3.81100D-06
29.750	1.88454D-05	2.24260D-04	6.99256D-02	-2.37470D-05	1.12260D-03	2.30290D-05
17.850	8.75855D-06	6.25361D-05	4.28504D-02	-1.41940D-05	8.64090D-04	1.63820D-05
5.950	1.68558D-06	4.01169D-06	3.56768D-02	-7.77740D-06	6.81900D-04	9.91850D-06

CHANNEL 9 SACO 0.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 24

***** STEADY STATE DATA FOR CHANNEL 9 *****

AVERAGE PIN POWER(10**6 WATTS)	2.04356D-02	POWER/FLOW(10**6 W-SEC/G)	1.96929D-04
POWER FRACTION IN UPPER BLANKET	1.07528D-02	DOPPLER COEFFICIENT(COOLANT IN)	-5.79071D-04
POWER FRACTION IN ACTIVE CORE	9.71360D-01	DOPPLER COEFFICIENT(COOLANT OUT)	-3.64479D-04
POWER FRACTION IN LOWER BLANKET	1.78876D-02	VOIDING REACTIVITY(DELTA K)	2.86564D-04
MASS FLOWRATE(G/SEC-CM**2)	5.18950D+02	CLAD REACTIVITY(DELTA K)	-1.67276D-03
MASS FLOWRATE(G/SEC)	1.03771D+02	FUEL REACTIVITY(DELTA K)	7.31945D-02

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLAODING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	544.568	544.573	544.632	544.713	544.794
150.237	544.535	544.668	546.240	548.431	550.623
142.062	544.312	544.927	552.201	562.346	572.492
133.887	543.581	545.269	565.228	593.068	620.908
126.181	539.463	551.846	742.628	1008.745	1274.862
118.942	531.195	546.679	785.250	1118.026	1450.802
111.704	521.203	539.394	819.657	1210.587	1601.518
104.465	509.744	530.176	844.968	1284.063	1723.159
97.227	497.110	519.261	860.538	1336.577	1812.616
89.988	483.623	506.927	865.969	1366.786	1867.602
82.750	469.629	493.491	861.121	1373.918	1886.714
75.512	455.486	479.295	846.119	1357.791	1869.463
68.273	441.554	464.702	821.345	1318.817	1816.288
61.035	428.189	450.085	787.434	1257.992	1728.550
53.796	415.734	435.818	745.251	1176.870	1608.490
46.558	404.506	422.265	695.875	1077.526	1459.176
39.319	394.792	409.772	640.567	962.496	1284.425
29.750	389.556	391.382	411.327	439.148	466.968
17.850	388.274	389.123	398.392	411.322	424.252
5.950	387.810	387.973	389.757	392.245	394.734

AXIAL LOCATION (CM)	PIN POWER (MW/CM)	INTEGRATED POWER (MW)	DOPPLER WEIGHT	VOIDING REACTIVITY (DELTA K)	FUEL REACTIVITY (DELTA K)	CLAD REACTIVITY (DELTA K)
158.412	5.24991D-08	2.19687D-04	2.29708D-03	-4.33460D-06	1.76250D-04	7.80650D-06
150.237	1.41748D-06	2.15395D-04	3.99502D-03	-8.68150D-06	3.02040D-04	1.51170D-05
142.062	6.56239D-06	1.86211D-04	9.29540D-03	-2.62180D-05	6.91270D-04	4.10480D-05
133.887	1.80072D-05	9.09326D-05	2.62476D-02	-6.73520D-05	1.40620D-03	9.28900D-05
126.181	1.32026D-04	1.94046D-02	2.79959D-02	-9.22730D-05	2.29020D-03	9.91030D-05
118.942	1.65097D-04	1.83269D-02	4.44618D-02	-4.98630D-05	3.21600D-03	1.47810D-05
111.704	1.93949D-04	1.70247D-02	6.11453D-02	4.91390D-07	4.24910D-03	-7.95240D-05
104.465	2.17844D-04	1.55311D-02	7.78299D-02	5.06420D-05	5.27320D-03	-1.71320D-04
97.227	2.36172D-04	1.38844D-02	9.35744D-02	9.40070D-05	6.15580D-03	-2.49730D-04
89.988	2.48465D-04	1.21266D-02	1.02635D-01	1.24820D-04	6.78340D-03	-3.05160D-04
82.750	2.54409D-04	1.03027D-02	1.09580D-01	1.39600D-04	7.08800D-03	-3.31950D-04
75.512	2.53851D-04	8.45926D-03	1.05977D-01	1.34980D-04	7.00570D-03	-3.24220D-04
68.273	2.46806D-04	6.64339D-03	1.00889D-01	1.12910D-04	6.57140D-03	-2.85430D-04
61.035	2.33453D-04	4.90151D-03	8.92601D-02	7.51570D-05	5.83510D-03	-2.18700D-04
53.796	2.14135D-04	3.27811D-03	7.60103D-02	2.65920D-05	4.89030D-03	-1.32460D-04
46.558	1.89345D-04	1.81470D-03	6.19404D-02	-2.73340D-05	3.86090D-03	-3.63820D-05
39.319	1.59716D-04	5.43663D-04	4.87013D-02	-8.00750D-05	2.88220D-03	5.72600D-05
29.750	1.94733D-05	2.31733D-04	6.90776D-02	-6.53960D-05	1.98150D-03	7.00760D-05
17.850	9.05039D-06	6.46198D-05	4.31568D-02	-3.44750D-05	1.45500D-03	4.21040D-05
5.950	1.74175D-06	4.14536D-06	3.44603D-02	-1.66330D-05	1.08090D-03	2.19320D-05

***** STEADY STATE DATA FOR CHANNEL 10 *****

AVERAGE PIN POWER(10**6 WATTS)	1.71670D-02	POWER/FLOW(10**6 W-SEC/G)	2.13702D-04
POWER FRACTION IN UPPER BLANKET	7.60957D-03	DOPPLER COEFFICIENT(COOLANT IN)	-6.16918D-04
POWER FRACTION IN ACTIVE CORE	9.79732D-01	DOPPLER COEFFICIENT(COOLANT OUT)	-4.35205D-04
POWER FRACTION IN LOWER BLANKET	1.26587D-02	VOIDING REACTIVITY(DELTA K)	-1.71349D-03
MASS FLOWRATE(G/SEC-CM**2)	4.01730D+02	CLAD REACTIVITY(DELTA K)	9.41505D-04
MASS FLOWRATE(G/SEC)	8.03315D+01	FUEL REACTIVITY(DELTA K)	9.20889D-02

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	557.923	557.926	557.960	558.008	558.057
150.237	557.897	557.976	558.910	560.213	561.516
142.062	557.725	558.091	562.415	568.447	574.478
133.887	557.164	558.168	570.033	586.584	603.134
126.181	552.885	563.377	725.026	950.505	1175.984
118.942	543.835	556.955	759.095	1041.054	1323.013
111.704	532.899	548.312	785.777	1117.010	1448.243
104.465	520.357	537.669	804.390	1176.433	1548.476
97.227	506.528	525.297	814.459	1217.804	1621.149
89.988	491.767	511.512	815.726	1240.065	1664.404
82.750	476.451	496.668	808.159	1242.649	1677.138
75.512	460.970	481.143	791.951	1225.487	1659.024
68.273	445.721	465.334	767.516	1189.021	1610.525
61.035	431.093	449.645	735.479	1134.180	1532.881
53.796	417.460	434.477	696.658	1062.367	1428.076
46.558	405.171	420.218	652.046	975.417	1298.787
39.319	394.539	407.232	602.783	875.551	1148.320
29.750	389.143	390.229	402.086	418.625	435.164
17.850	388.159	388.663	394.174	401.861	409.547
5.950	387.802	387.900	388.960	390.439	391.919

AXIAL LOCATION (CM)	PIN POWER (MW/CM)	INTEGRATED POWER (MW)	DOPPLER WEIGHT	VOIDING REACTIVITY (DELTA K)	FUEL REACTIVITY (DELTA K)	CLAD REACTIVITY (DELTA K)
158.412	3.12102D-08	1.30602D-04	5.02765D-03	-7.57070D-06	2.71760D-04	1.12540D-05
150.237	8.42676D-07	1.28050D-04	7.44937D-03	-1.27300D-05	4.08550D-04	1.87510D-05
142.062	3.90128D-06	1.10700D-04	1.73622D-02	-3.69540D-05	9.32220D-04	5.08710D-05
133.887	1.07051D-05	5.40585D-05	3.22184D-02	-8.73770D-05	1.76290D-03	1.10140D-04
126.181	1.11865D-04	1.64414D-02	3.25984D-02	-1.36280D-04	2.82950D-03	1.49200D-04
118.942	1.39836D-04	1.55283D-02	4.82278D-02	-1.31340D-04	4.12370D-03	1.16540D-04
111.704	1.64331D-04	1.44249D-02	6.39201D-02	-1.18440D-04	5.48350D-03	7.28680D-05
104.465	1.84578D-04	1.31594D-02	7.90091D-02	-1.04080D-04	6.79700D-03	2.94710D-05
97.227	2.00107D-04	1.17642D-02	9.37822D-02	-9.10880D-05	7.90700D-03	-7.86980D-06
89.988	2.10523D-04	1.02748D-02	1.02827D-01	-8.23820D-05	8.68310D-03	-3.32400D-05
82.750	2.15559D-04	8.72942D-03	1.08423D-01	-7.83420D-05	9.04260D-03	-4.51230D-05
75.512	2.15086D-04	7.16748D-03	1.05675D-01	-8.09670D-05	8.91220D-03	-3.94920D-05
68.273	2.09117D-04	5.62891D-03	1.00409D-01	-8.82650D-05	8.31550D-03	-1.95460D-05
61.035	1.97804D-04	4.15302D-03	8.74556D-02	-1.01590D-04	7.34210D-03	1.54230D-05
53.796	1.81435D-04	2.77753D-03	7.37443D-02	-1.17450D-04	6.10390D-03	5.89650D-05
46.558	1.60431D-04	1.53759D-03	5.89653D-02	-1.34720D-04	4.75490D-03	1.07470D-04
39.319	1.35326D-04	4.64883D-04	4.49618D-02	-1.49310D-04	3.46410D-03	1.52490D-04
29.750	1.15767D-05	1.37763D-04	5.96173D-02	-9.06960D-05	2.26090D-03	1.08380D-04
17.850	5.33036D-06	3.84153D-05	3.73157D-02	-4.43110D-05	1.58660D-03	5.79890D-05
5.950	1.03545D-06	2.46436D-06	2.86495D-02	-1.96000D-05	1.10690D-03	2.69640D-05

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 26

```
*****  
PREDICTED SAS BOILING TIME= 0.110140+02  
HOTSPOT BOILING TIME= 0.110140+02  
*****
```


***** TRANSIENT STATE RESULTS *****

TIME	POWER	POOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
0.100	1.0030+00	4.9180-02	9.0680-02	1.0000+00	0.0	9.9140-04	0.0	0.0	9.9140-04	23	0

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 1							
AXIAL LOCATION (CH)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)		
153.412	569.456	569.465	566.023	566.203	566.382		
150.237	569.404	569.628	567.644	572.482	577.320		
142.062	569.045	570.084	573.596	595.993	618.389		
133.887	567.874	570.725	586.470	647.927	709.383		
126.181	562.839	577.790	803.722	1126.091	1448.460		
118.942	553.366	572.062	855.614	1258.732	1661.851		
111.704	541.918	563.882	897.764	1371.330	1844.896		
104.465	528.789	553.459	929.096	1461.007	1992.919		
97.227	514.313	541.059	948.808	1525.472	2102.136		
89.988	498.862	526.999	956.396	1563.077	2169.757		
82.750	482.828	511.639	951.668	1572.861	2194.053		
75.512	466.624	495.371	934.744	1554.574	2174.404		
68.273	450.661	478.611	906.055	1508.683	2111.311		
61.035	435.349	461.787	866.336	1436.362	2006.387		
53.796	421.078	445.328	816.602	1339.457	1862.313		
46.558	408.214	429.657	758.122	1220.447	1682.772		
39.319	397.085	415.172	692.393	1082.372	1472.351		
29.750	390.625	393.708	407.805	474.265	540.725		
17.850	388.572	390.005	396.566	427.454	458.342		
5.950	387.829	388.105	389.369	395.314	401.258		
VDTIME	11.240	ZVOIDU	133.863	RHO-D	0.0	G	547.790
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.97420-04	W	109.538
TFICOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/W	228.572
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.97420-04	WV	1000.000
		ZHFL	79.750			PHV	1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 28

***** C^o LANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 2							
AXIAL LOCATION (CH)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)		
158.412	547.255	547.266	544.276	544.519	544.762		
150.237	547.183	547.438	546.474	553.038	559.601		
142.062	546.697	548.106	554.549	584.935	615.320		
133.837	545.109	548.976	572.015	655.393	738.770		
126.181	540.230	553.060	746.889	1023.508	1300.127		
118.942	532.102	548.145	791.416	1137.325	1483.234		
111.704	522.279	541.126	827.585	1233.944	1640.303		
104.465	511.013	532.182	854.470	1310.894	1767.319		
97.227	498.592	521.542	871.334	1366.210	1861.036		
89.988	485.333	509.477	877.896	1398.478	1919.060		
82.750	471.575	496.297	873.839	1406.874	1939.909		
75.512	457.670	482.338	859.316	1391.182	1923.048		
68.273	443.973	467.956	834.699	1351.804	1868.909		
61.035	430.834	453.519	800.617	1289.746	1778.875		
53.796	413.588	439.397	757.940	1206.594	1655.248		
46.558	407.550	425.949	707.760	1104.473	1501.187		
39.319	398.000	413.520	651.359	985.993	1320.628		
29.750	391.641	395.823	414.943	505.114	595.280		
17.850	388.855	390.799	399.701	441.606	483.512		
5.950	387.847	388.221	389.937	398.002	406.066		
VOTIME	13.490	ZVOIDU	133.863	RHO-D	0.0	G	547.790
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.1679D-03	H	109.538
TFIXOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	200.644
PHIXV	1000.000	ZDOU	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.1679D-03	HV	1000.000
		ZHFL	79.750			PHV	1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 3							
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)		
153.412	554.735	554.744	551.588	551.771	551.955		
150.237	554.681	554.911	553.247	558.201	563.155		
142.062	554.314	555.378	559.342	582.275	605.208		
133.887	553.115	556.034	572.524	635.453	698.381		
126.181	548.387	562.063	768.702	1063.557	1358.412		
118.942	539.723	556.823	816.165	1184.877	1357.589		
111.704	529.252	549.342	854.718	1287.865	1721.012		
104.465	517.244	539.808	883.375	1369.888	1856.401		
97.227	504.804	528.467	901.405	1428.851	1956.297		
89.988	489.871	515.607	908.346	1463.246	2018.146		
82.750	475.206	501.558	904.021	1472.195	2040.368		
75.512	460.384	486.678	868.541	1455.469	2022.396		
68.273	445.784	471.348	862.301	1413.495	1964.688		
61.035	431.779	455.960	825.972	1347.346	1868.719		
53.796	418.726	440.907	780.483	1258.713	1736.943		
46.558	406.960	426.573	726.995	1149.860	1572.725		
39.319	396.781	413.324	666.875	1023.565	1380.263		
29.750	390.693	393.850	468.284	476.336	544.388		
17.850	388.591	390.058	396.777	428.405	460.032		
5.950	387.830	388.112	389.408	395.494	401.581		
VOLUME	12.770	ZVOIDU	133.863	RHO-D	0.0	G	547.790
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.15200-03	H	109.538
TFIXOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/W	210.052
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.15200-03	WV	1000.000
		ZHFL	79.750			PMV	1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 30

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CH)	COOLANT TEMPERATURE (C)	CHANNEL 4 CLADDING TEMPERATURE (C)	FUEL BORY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)		
158.412	548.327	548.337	545.316	545.530	545.744		
150.237	548.259	548.527	547.246	553.020	558.795		
142.062	547.800	549.039	554.319	581.052	607.785		
133.827	546.298	549.700	559.583	642.938	716.293		
126.181	541.467	553.535	735.658	995.854	1256.051		
118.942	533.251	548.342	776.983	1102.355	1427.728		
111.704	523.323	541.051	810.329	1192.562	1574.796		
104.465	511.936	531.848	834.843	1264.170	1693.497		
97.227	499.382	520.969	849.900	1315.348	1780.797		
89.988	485.981	508.692	855.114	1344.789	1834.465		
82.750	472.075	495.330	850.352	1351.740	1853.129		
75.512	458.021	481.225	835.735	1336.025	1836.314		
68.273	444.177	466.737	811.638	1298.043	1784.447		
61.035	430.897	452.236	778.676	1238.766	1698.856		
53.796	418.521	438.094	737.692	1159.709	1581.727		
46.558	407.364	424.671	689.732	1062.893	1436.053		
39.319	397.712	412.311	636.023	950.790	1265.558		
29.750	391.430	395.109	411.930	491.257	570.585		
17.850	388.796	390.506	398.337	435.205	472.073		
5.950	387.843	388.172	389.682	396.777	403.872		
VOTIME	13.560	ZVOIDU	133.863	RHO-D	0.0	6	509.803
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.20850-03	H	101.942
TFNOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	201.993
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	6V	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.20850-03	HV	1000.000
		ZHFL	79.750			PHV	1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CHANNEL 5 CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	561.271	561.277	557.975	558.102	558.229
150.237	561.231	561.390	559.118	562.535	565.952
142.062	560.959	561.693	563.303	579.124	594.945
133.887	560.070	562.084	572.337	615.749	659.161
126.181	555.449	558.849	771.127	1060.045	1348.962
118.942	546.326	563.083	817.014	1178.302	1539.590
111.704	535.302	554.987	854.041	1278.466	1702.891
104.465	522.658	544.768	881.261	1357.978	1834.694
97.227	508.718	532.689	897.980	1414.805	1931.630
89.988	493.838	519.056	903.769	1447.496	1991.222
82.750	478.398	504.219	898.482	1455.214	2011.947
75.512	462.793	488.557	882.252	1437.764	1993.275
68.273	447.420	472.470	855.495	1395.590	1935.684
61.035	432.675	456.369	818.895	1329.770	1840.645
53.796	418.932	440.666	773.326	1241.987	1710.587
46.558	406.544	425.761	720.133	1134.483	1548.834
39.319	395.826	412.036	660.495	1010.007	1359.519
29.750	389.939	392.117	402.071	449.018	495.964
17.850	388.381	389.393	394.027	415.846	437.664
5.950	387.817	388.011	388.905	393.104	397.303

VDTIME	12.510	ZVOIDU	133.863	RHO-D	0.0	G	509.803
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.19180-03	H	101.942
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	218.272
PHIXV	1000.000	ZDDL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.19180-03	HV	1000.000
		ZHFL	79.750			PHV	1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 32

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CH)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	CHANNEL 6 FUEL BDRY: TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)		
158.412	550.255	550.262	547.184	547.341	547.498		
150.237	550.202	550.399	548.597	552.834	557.071		
142.062	549.846	550.756	553.769	573.385	573.000		
133.887	548.684	551.180	564.910	618.735	572.561		
126.181	544.086	555.825	732.853	985.961	1239.069		
118.942	535.652	550.332	772.620	1089.128	1405.637		
111.704	525.461	542.706	804.534	1176.355	1548.176		
104.465	513.773	533.143	827.781	1245.412	1663.043		
97.227	500.886	521.886	841.766	1294.534	1747.303		
89.988	487.130	509.223	846.132	1322.467	1798.803		
82.750	472.857	495.478	840.767	1328.497	1816.226		
75.512	458.431	481.002	825.808	1312.468	1799.128		
68.273	444.220	466.165	801.638	1274.792	1747.946		
61.035	430.589	451.346	768.875	1216.431	1663.987		
53.796	417.835	436.924	728.355	1138.876	1549.394		
46.558	406.432	423.268	681.114	1044.109	1407.103		
39.319	396.525	410.726	628.359	934.552	1240.744		
29.750	390.606	393.305	405.645	463.853	522.061		
17.850	388.566	389.821	395.566	422.619	449.672		
5.950	387.829	388.070	389.170	394.384	399.590		
VDTIME	13.530	ZVOIDJ	133.863	RHO-D	0.0	G	483.124
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.14540-03	H	96.607
TFI0V	1000.000	ZDOU	133.863	RHO-CL	0.0	P/W	204.415
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.14540-03	NV	1000.000
		ZHFL	79.750			PHV	1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CH)	COOLANT TEMPERATURE (C)	CHANNEL 7 CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	560.335	560.342	557.062	557.198	557.333
150.237	560.285	560.454	558.276	561.929	565.583
142.062	559.939	560.724	562.698	579.613	596.527
133.887	558.812	560.965	572.182	618.597	665.011
126.181	554.017	565.152	732.718	972.793	1212.869
118.942	545.025	558.948	769.463	1069.674	1369.885
111.704	534.158	550.515	798.557	1151.232	1503.907
104.465	521.695	540.067	819.256	1215.383	1611.509
97.227	507.954	527.872	831.033	1260.487	1689.942
89.988	493.286	514.241	833.584	1285.393	1737.201
82.750	478.066	499.522	826.847	1289.463	1752.079
75.512	462.684	484.093	810.992	1272.593	1734.195
68.273	447.531	468.346	786.425	1235.216	1684.006
61.035	432.996	452.684	753.774	1178.285	1602.795
53.796	419.449	437.509	713.873	1103.255	1492.638
46.558	407.238	423.206	667.742	1012.045	1356.349
39.319	396.673	410.143	616.559	906.985	1197.411
29.750	390.519	392.847	403.482	453.675	503.869
17.850	388.542	389.624	394.577	417.905	441.232
5.950	387.827	388.035	388.990	393.480	397.969

VDTIME	13.190	ZVOIDU	133.863	RHO-D	0.0	G	429.754
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.17670-03	H	85.935
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	217.097
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.17670-03	WV	1000.000
		ZHFL	79.750			PHV	1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 34

*****RADIAL,TEMPERATURE EDITS*****

EDITS FOR CHANNEL 8

AXIAL LOCATION (CM)	TAVG	TCLAD	TFUEL OUTER	TFUEL AVG	TFUEL CENTER	RM		THM	TFR
158.412	569.916	569.921	566.444	566.547	566.649	0.0	0.0		0.566550+03
150.237	569.886	570.015	567.373	570.147	572.921	0.0	0.0		0.570150+03
142.062	569.680	570.276	570.786	583.629	596.472	0.0	0.0		0.583630+03
133.887	569.009	570.644	578.169	613.409	648.650	0.0	0.0		0.613410+03
126.181	564.371	579.624	810.155	1139.034	1467.914	0.0	0.0		0.113900+04
118.942	554.706	573.781	863.094	1274.354	1685.614	0.0	0.0		0.127440+04
111.704	543.028	565.435	906.096	1389.226	1872.357	0.0	0.0		0.138920+04
104.465	529.633	554.802	933.060	1480.715	2023.369	0.0	0.0		0.148070+04
97.227	514.866	542.151	958.170	1546.481	2134.792	0.0	0.0		0.154650+04
89.988	499.102	527.808	965.912	1584.845	2203.778	0.0	0.0		0.158480+04
82.750	482.745	512.137	961.089	1594.827	2228.565	0.0	0.0		0.159480+04
75.512	466.213	495.541	943.822	1576.171	2208.519	0.0	0.0		0.157620+04
68.273	449.928	478.442	914.555	1529.353	2144.152	0.0	0.0		0.152940+04
61.035	434.306	461.278	874.033	1455.571	2037.109	0.0	0.0		0.145560+04
53.796	419.748	444.487	823.294	1356.710	1890.125	0.0	0.0		0.135670+04
46.558	406.624	428.499	763.634	1235.296	1706.958	0.0	0.0		0.123530+04
39.319	395.270	413.722	696.577	1094.432	1492.287	0.0	0.0		0.109440+04
29.750	389.411	391.178	399.262	437.372	475.482	0.0	0.0		0.437370+03
17.850	388.233	389.055	392.817	410.529	428.241	0.0	0.0		0.410530+03
5.950	387.807	387.965	388.691	392.099	395.508	0.0	0.0		0.392100+03

VDTIME	11.080	ZVOIDU	133.863	RHO-D	0.0	G	547.790
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.59860-04	H	109.538
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	229.146
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZIFU	79.750	RHO-NET	0.59860-04	HV	1000.000
		ZHFL	79.750			PHV	1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 9							
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BODY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)		
158.412	547.648	547.653	544.607	544.713	544.819		
150.237	547.614	547.747	545.565	548.431	551.298		
142.062	547.386	548.001	549.076	562.346	575.617		
133.887	546.640	548.329	556.653	593.068	629.483		
126.181	542.442	554.825	741.756	1008.745	1275.734		
118.942	534.011	549.495	784.159	1118.026	1451.892		
111.704	523.823	542.014	818.375	1210.587	1602.799		
104.465	512.138	532.570	843.529	1284.063	1724.598		
97.227	499.255	521.406	858.978	1336.577	1814.176		
89.988	485.504	508.808	864.327	1366.786	1869.244		
82.750	471.235	495.096	859.440	1373.918	1888.395		
75.512	456.813	480.622	844.441	1357.791	1871.140		
68.273	442.607	465.755	819.714	1318.817	1817.919		
61.035	428.979	450.875	785.891	1257.992	1730.093		
53.796	416.279	436.363	743.836	1176.870	1609.905		
46.558	404.830	422.589	694.624	1077.526	1460.428		
39.319	394.926	409.905	639.512	962.496	1285.481		
29.750	389.591	391.417	399.768	439.148	478.528		
17.850	388.284	389.132	393.020	411.322	429.624		
5.950	387.810	387.974	388.723	392.245	395.768		
VDTIME	13.510	ZVOIDU	133.863	RHO-D	0.0	6	509.774
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.30750-04	W	101.936
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/W	201.131
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	6V	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.30750-04	WV	1000.000
		ZHFL	79.750			PHV	1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 36

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BORY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	561.266	561.268	557.945	558.008	558.071
150.237	561.240	561.319	558.509	560.213	561.917
142.062	561.064	561.430	560.558	568.447	576.336
133.887	560.492	561.496	564.935	586.584	608.232
126.181	556.129	566.621	724.286	950.505	1176.723
118.942	546.901	560.021	758.170	1041.054	1323.937
111.704	535.750	551.163	784.691	1117.010	1449.329
104.465	522.961	540.273	803.171	1176.433	1549.695
97.227	508.860	527.629	813.137	1217.804	1622.471
89.988	493.809	513.554	814.335	1240.065	1665.796
82.750	478.191	498.409	806.734	1242.649	1678.563
75.512	462.406	482.579	790.529	1225.487	1660.445
68.273	446.857	466.470	766.134	1189.021	1611.907
61.035	431.941	450.494	734.172	1134.180	1534.188
53.796	418.041	435.058	695.459	1062.367	1429.275
46.558	405.510	420.557	650.986	975.417	1299.847
39.319	394.669	407.361	601.889	875.551	1149.214
29.750	389.170	390.256	395.214	418.625	442.036
17.850	388.166	388.671	390.980	401.861	412.741
5.950	387.803	387.900	388.345	390.439	392.533

VDTIME	13.250	ZVOIDU	133.863	RHO-D	0.0	G	394.627
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	-0.2389D-03	H	78.911
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/W	218.262
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	-0.2389D-03	HV	1000.000
		ZHFL	79.750			P/W	1000.000

TIME	POWER	PDOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
0.200	1.0050+00	3.852D-03	1.910D-01	1.000D+00	-7.449D-04	2.104D-03	0.0	0.0	1.359D-03	18	0

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 1					
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	569.456	569.465	567.722	566.428	566.269
150.237	569.404	569.628	570.239	572.826	577.148
142.062	569.045	570.084	579.566	596.785	617.997
133.887	569.293	572.143	600.529	649.716	708.498
126.181	565.205	580.156	807.178	1126.450	1448.330
118.942	555.807	574.504	859.234	1259.117	1661.721
111.704	544.314	566.278	901.453	1371.733	1844.768
104.465	531.061	555.731	932.772	1461.421	1992.795
97.227	516.407	543.152	952.400	1525.889	2102.017
89.988	500.737	528.875	959.840	1563.488	2169.645
82.750	484.461	513.271	954.904	1573.259	2193.950
75.512	467.997	496.744	937.720	1554.952	2174.310
68.273	451.770	479.720	908.730	1509.034	2111.229
61.035	436.197	462.635	868.674	1436.679	2006.316
53.796	421.678	445.928	818.578	1339.736	1862.255
46.558	408.585	430.028	759.721	1220.682	1682.726
39.319	397.254	415.341	693.609	1082.561	1472.317
29.750	390.677	393.759	423.793	476.385	539.676
17.850	388.587	390.019	403.988	428.439	457.855
5.950	387.830	388.106	390.796	395.503	401.164

VDTIME	11.240	ZVOIDU	133.863	RHO-D	-0.47890-04	G	538.168
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.19600-03	H	107.614
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/W	232.971
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZMFU	79.750	RHO-NET	0.14810-03	HV	1000.000
		ZIFL	79.750			PHV	1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 38

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	547.255	547.266	545.782	544.718	544.662
150.237	547.183	547.488	549.196	553.398	559.421
142.062	546.697	548.106	561.850	585.904	614.840
133.887	546.183	550.050	589.940	657.715	737.622
126.181	542.301	555.130	749.889	1023.819	1300.015
118.942	534.237	550.280	794.558	1137.658	1483.122
111.704	524.375	543.222	830.785	1234.292	1640.192
104.465	513.002	534.171	857.660	1311.252	1767.211
97.227	500.428	523.378	874.502	1366.570	1850.933
89.988	486.982	511.127	880.886	1398.834	1918.963
82.750	473.015	497.738	876.651	1407.218	1939.819
75.512	458.888	483.556	861.906	1391.509	1922.966
68.273	444.964	468.947	837.029	1352.108	1868.837
61.035	431.601	454.287	802.658	1290.021	1778.813
53.796	419.143	439.951	759.671	1206.836	1655.197
46.558	407.908	426.308	709.167	1104.678	1501.146
39.319	398.185	413.706	652.438	986.158	1320.597
29.750	391.711	395.893	436.639	507.990	593.856
17.850	388.875	390.818	409.770	442.942	482.850
5.950	387.848	388.222	391.873	398.259	405.939
VDTIME	13.490	ZVOIDU	133.863	RHO-D -0.9651D-04	G 538.168
FRTIME	1000.000	ZVOIDL	133.863	RHO-C 0.3378D-03	H 107.614
TFMOV	1000.000	ZDOU	133.863	RHO-CL 0.0	P/H 204.506
PHIXV	1000.000	ZDOL	133.863	RHO-F 0.0	GV 1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET 0.2413D-03	HV 1000.000
		ZHFL	79.750		PWV 1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 3						
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)	
158.412	554.735	554.744	553.152	551.978	551.851	
150.237	554.681	554.911	555.729	553.530	562.991	
142.062	554.314	555.378	565.280	583.063	604.817	
133.887	554.381	557.300	586.668	637.262	697.486	
126.181	550.560	564.236	771.871	1063.886	1358.293	
118.942	541.965	559.066	819.484	1185.230	1553.470	
111.704	531.452	551.542	858.100	1288.234	1720.894	
104.465	519.330	541.895	886.746	1370.267	1856.287	
97.227	505.927	530.390	904.698	1429.232	1956.187	
89.988	491.595	517.331	911.503	1463.623	2018.043	
82.750	476.708	503.059	906.988	1472.560	2040.274	
75.512	461.649	487.943	891.272	1455.815	2022.310	
68.273	446.807	472.371	864.756	1413.816	1964.612	
61.035	432.563	456.745	828.119	1347.637	1868.655	
53.796	419.284	441.464	782.298	1258.968	1736.889	
46.558	407.308	426.921	728.465	1150.076	1572.683	
39.319	396.944	413.488	667.995	1023.743	1380.232	
29.750	390.746	393.903	424.655	478.507	543.313	
17.850	388.606	390.073	404.377	429.413	459.533	
5.950	387.831	388.113	390.868	395.688	401.485	
VDTIME	12.770	ZVOIDU	133.863	RHO-D -0.8000D-04	6	538.168
FRTIME	1000.000	ZVOIDL	133.863	RHO-C 0.30730-03	M	107.614
TFMOV	1000.000	ZDOU	133.863	RHO-CL 0.0	P/H	214.095
PHIXV	1000.000	ZDOL	133.863	RHO-F 0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET 0.22730-03	WV	1000.000
		ZHFL	79.750		PHV	1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 40

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 4					
AXIAL LOCATION (CH)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	548.327	548.337	546.827	545.730	545.644
150.237	548.259	548.527	549.826	553.362	558.624
142.062	547.800	549.039	560.927	581.929	607.350
133.887	547.321	550.724	585.570	645.006	715.271
126.181	543.496	555.563	738.608	996.159	1255.939
118.942	535.362	550.452	780.069	1102.680	1427.616
111.704	525.404	543.132	813.467	1192.901	1574.686
104.465	513.918	533.830	837.965	1264.516	1693.390
97.227	501.214	522.801	852.943	1315.696	1780.695
89.988	487.629	510.340	858.025	1345.131	1834.369
82.750	473.516	496.770	853.082	1352.071	1853.041
75.512	459.240	482.443	838.242	1336.338	1836.234
68.273	445.169	467.728	813.887	1298.333	1784.378
61.035	431.664	453.003	780.639	1239.028	1698.796
53.796	419.073	438.646	739.349	1159.939	1581.678
46.558	407.719	425.026	691.072	1063.086	1436.014
39.319	397.892	412.491	637.043	950.945	1265.529
29.750	391.496	395.175	431.018	493.788	569.332
17.850	388.815	390.525	407.197	436.380	471.491
5.950	387.845	388.174	391.385	397.003	403.761

VDTIME	13.560	ZVOIDU	133.863	RHO-D	-0.11240-03	G	500.849
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.41920-03	H	100.152
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/W	205.881
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.30670-03	HV	1000.000
		ZHFL	79.750			PHV	1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 5							
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)		
158.412	561.271	561.277	559.590	558.316	558.122		
150.237	561.231	561.390	561.364	562.833	565.804		
142.062	560.959	561.693	567.935	579.739	594.640		
133.887	561.398	563.412	582.815	617.068	658.508		
126.181	557.648	571.048	774.356	1060.380	1348.839		
118.942	548.616	565.373	820.394	1178.659	1539.467		
111.704	537.560	557.245	857.479	1278.839	1702.771		
104.465	524.805	546.915	884.680	1358.359	1834.578		
97.227	510.700	534.670	901.312	1415.188	1931.519		
89.988	495.615	520.833	906.955	1447.873	1991.118		
82.750	479.944	505.765	901.466	1455.578	2011.851		
75.512	464.092	489.857	884.989	1438.108	1993.189		
68.273	448.468	473.517	857.945	1395.908	1935.608		
61.035	433.473	457.167	821.027	1330.057	1840.581		
53.796	419.492	441.226	775.179	1242.238	1710.534		
46.558	406.884	426.102	721.574	1134.695	1548.792		
39.319	395.973	412.183	661.581	1010.176	1359.488		
29.750	389.978	392.156	413.368	450.516	495.223		
17.850	388.392	389.404	399.270	416.541	437.320		
5.950	387.817	388.012	389.913	393.238	397.237		
VOTIME	12.510	ZVOIDU	133.863	RHO-D	-0.8901D-04	G	500.849
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.3870D-03	H	100.152
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	222.473
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.2980D-03	HV	1000.000
		ZHFL	79.750			PHV	1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 42

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 6							
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)		
158.412	550.255	550.262	548.702	547.542	547.30		
150.237	550.202	550.399	550.900	553.139	556.9		
142.062	549.846	550.756	559.028	574.083	592.654		
133.887	549.757	552.253	577.182	620.306	671.784		
126.181	546.096	557.835	735.801	986.266	1238.956		
118.942	537.760	552.439	775.704	1039.452	1405.524		
111.704	527.547	544.792	807.667	1176.691	1548.065		
104.465	515.763	535.133	830.892	1245.755	1662.936		
97.227	502.728	523.727	844.793	1294.878	1747.201		
89.988	488.787	510.879	849.021	1322.805	1798.708		
82.750	474.303	496.924	843.470	1328.822	1816.139		
75.512	459.651	482.222	828.283	1312.776	1799.050		
68.273	445.209	467.154	803.851	1275.076	1747.877		
61.035	431.348	452.106	770.798	1216.687	1663.928		
53.796	418.425	437.465	729.971	1139.099	1549.348		
46.558	406.770	423.606	682.412	1044.297	1407.066		
39.319	396.683	410.885	629.337	934.702	1240.716		
29.750	390.657	393.356	419.654	465.710	521.142		
17.850	388.581	389.836	402.068	423.482	449.245		
5.950	387.830	388.071	390.427	394.550	399.508		
VDTIME	13.530	ZVOIDU	133.863	RHO-D	-0.79580-04	G	474.638
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.29710-03	H	94.910
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	208.349
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.21750-03	WV	1000.000
		ZHFL	79.750			PHV	1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 7						
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BORY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)	
158.412	560.335	560.342	558.669	557.410	557.227	
150.237	560.285	560.454	560.559	562.232	565.432	
142.062	559.939	560.724	567.529	580.254	596.209	
133.887	559.812	561.965	583.091	619.991	664.321	
126.181	556.036	567.171	735.726	973.105	1212.750	
118.942	547.181	561.104	772.608	1070.002	1369.768	
111.704	536.313	552.670	801.745	1151.570	1503.792	
104.465	523.763	542.136	822.414	1215.726	1611.399	
97.227	509.876	529.794	834.095	1260.829	1659.838	
89.988	495.020	515.975	836.496	1285.727	1737.104	
82.750	479.583	501.039	829.559	1289.783	1751.990	
75.512	463.965	485.374	813.463	1272.895	1734.115	
68.273	448.570	469.385	788.623	1235.493	1683.937	
61.035	433.793	453.482	755.673	1178.533	1602.737	
53.796	420.015	438.075	715.456	1103.471	1492.590	
46.558	407.589	423.558	669.001	1012.225	1356.312	
39.319	396.835	410.304	617.496	907.128	1197.384	
29.750	390.568	392.896	415.567	455.277	503.075	
17.850	388.556	389.638	400.185	418.648	440.864	
5.950	387.828	388.036	390.068	393.623	397.898	
VDTIME	13.190	ZVOIDU	133.863	RHO-D	-0.82570-04	G 422.206
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.35860-03	H 84.426
TFNOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H 221.275
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV 1000.000
PINT6V	1000.000	ZHFU	79.750	RHO-NET	0.27600-03	HV 1000.000
		ZHFL	79.750			PHV 1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 44

*****RADIAL,TEMPERATURE EDITS*****

EDITS FOR CHANNEL 8

AXIAL LOCATION (CM)	TAVG	TCLAD	TFUEL OUTER	TFUEL AVG	TFUEL CENTER	RM	THH	TFR
158.412	569.916	569.921	568.133	566.770	566.538	0.0	0.0	0.566990+03
150.237	569.886	570.015	569.577	570.439	572.776	0.0	0.0	0.570730+03
142.062	569.995	570.590	575.054	584.178	596.199	0.0	0.0	0.584730+03
133.887	570.585	572.219	587.259	614.530	648.095	0.0	0.0	0.615650+03
126.181	566.749	582.002	813.648	1139.399	1467.782	0.0	0.0	0.113930+04
118.942	557.162	576.236	866.756	1274.745	1635.483	0.0	0.0	0.127510+04
111.704	545.436	567.844	909.828	1389.635	1872.227	0.0	0.0	0.139000+04
104.465	531.915	557.084	941.779	1481.134	2023.243	0.0	0.0	0.148160+04
97.227	516.965	544.251	961.804	1546.904	2134.672	0.0	0.0	0.154730+04
89.988	500.980	529.686	969.394	1585.263	2203.665	0.0	0.0	0.158570+04
82.750	484.374	513.767	964.358	1595.231	2228.461	0.0	0.0	0.159560+04
75.512	467.578	496.906	946.828	1576.554	2208.425	0.0	0.0	0.157690+04
68.273	451.023	479.537	917.252	1529.709	2144.069	0.0	0.0	0.153010+04
61.035	435.136	462.107	876.387	1455.893	2037.038	0.0	0.0	0.145620+04
53.796	420.324	445.063	825.279	1356.992	1890.067	0.0	0.0	0.135730+04
46.558	406.966	428.842	765.233	1235.534	1706.912	0.0	0.0	0.123580+04
39.319	395.407	413.859	697.786	1094.622	1492.253	0.0	0.0	0.109480+04
29.750	389.440	391.208	408.430	438.587	474.880	0.0	0.0	0.439800+03
17.850	388.242	389.063	397.073	411.094	427.962	0.0	0.0	0.411660+03
5.950	387.808	387.966	389.509	392.208	395.454	0.0	0.0	0.392320+03

VDTIME	11.080	ZVOIDU	133.863	RHO-D	-0.33510-04	G	538.168
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.12610-03	H	107.614
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	233.556
PHIXV	1000.000	ZDOL	133.863	RIIO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.92530-04	HV	1000.000
		ZHFL	79.750			PHV	1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 9					
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	547.648	547.653	546.092	544.909	544.721
150.237	547.614	547.747	547.581	543.698	551.164
142.062	547.407	548.023	553.101	562.879	575.353
133.887	547.886	549.575	565.628	594.192	628.927
126.181	544.469	556.852	744.735	1009.054	1275.621
118.942	536.122	551.607	787.278	1118.356	1451.779
111.704	525.904	544.095	821.548	1210.931	1602.688
104.465	514.117	534.549	846.684	1284.415	1724.490
97.227	501.081	523.232	862.053	1336.930	1814.073
89.988	487.141	510.445	867.266	1367.133	1869.148
82.750	472.658	496.520	862.193	1374.254	1888.307
75.512	458.009	481.818	846.965	1358.108	1871.061
68.273	443.570	466.718	821.974	1319.111	1817.849
61.035	429.712	451.608	787.857	1258.257	1730.033
53.796	416.791	436.875	745.488	1177.102	1609.856
46.558	405.140	422.899	695.950	1077.721	1460.389
39.319	395.056	410.036	640.510	962.652	1285.453
29.750	389.624	391.450	609.243	840.404	1077.906
17.850	388.293	389.142	597.418	811.905	1029.335
5.950	387.811	387.974	589.569	792.358	995.712

VDTIME	13.510	ZVOIDU	133.863	RHO-D	-0.6647D-04	G	500.820
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.8234D-04	H	100.146
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/W	205.003
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.1636D-04	WV	1000.000
		ZHFL	79.750			PHV	1000.000

SACO 1.0

15 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 46

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 10					
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	561.266	561.268	559.548	558.221	557.965
150.237	561.240	561.319	560.427	560.467	561.790
142.062	561.064	561.430	563.664	568.859	576.131
133.887	561.526	562.530	571.110	587.347	607.854
126.181	558.064	568.556	727.243	950.812	1176.604
118.942	549.004	562.124	761.266	1041.376	1323.820
111.704	537.871	553.284	787.826	1117.341	1449.215
104.465	525.006	542.318	806.269	1176.767	1549.586
97.227	510.765	529.533	816.134	1218.135	1622.368
89.988	495.528	515.273	817.175	1240.388	1665.700
82.750	479.693	499.911	809.370	1242.957	1678.476
75.512	463.672	483.845	792.920	1225.776	1660.368
68.273	447.877	467.491	768.248	1189.285	1611.840
61.035	432.717	451.269	735.986	1134.416	1534.132
53.796	418.580	435.597	696.959	1062.571	1429.229
46.558	405.830	420.877	652.165	975.586	1299.813
39.319	394.794	407.487	602.749	875.685	1149.190
29.750	389.195	390.281	400.853	419.372	441.666
17.850	388.173	388.678	393.596	402.208	412.569
5.950	387.803	387.900	388.848	390.506	392.500

VDTIME	13.250	ZVOIDU	133.863	RHO-D	-0.56940-04	G	337.695
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	-0.40800-03	H	77.525
TFHOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	222.463
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	-0.46490-03	HV	1000.000
		ZMFL	79.750			PHV	1000.000

TIME	POWER	POOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
0.300	1.0050+00	-2.9160-03	2.9150-01	1.0000+00	-1.5140-03	3.0490-03	0.0	0.0	1.5340-03	8	0
0.400	1.0050+00	2.6040-03	3.9200-01	1.0000+00	-2.3110-03	3.9850-03	0.0	0.0	1.6740-03	8	0
0.500	1.0050+00	2.2770-03	4.9260-01	1.0000+00	-3.1360-03	4.9580-03	0.0	0.0	1.8220-03	8	0
0.600	1.0060+00	1.9560-03	5.9310-01	1.0000+00	-3.9890-03	5.9390-03	0.0	0.0	1.9500-03	8	0
0.700	1.0060+00	1.7790-03	6.9370-01	1.0000+00	-4.8690-03	6.9280-03	0.0	0.0	2.0590-03	8	0
0.800	1.0060+00	1.5960-03	7.9430-01	1.0000+00	-5.7770-03	7.9260-03	0.0	0.0	2.1490-03	8	0
0.900	1.0060+00	1.4120-03	8.9500-01	1.0000+00	-6.7100-03	8.9320-03	0.0	0.0	2.2210-03	8	0
1.000	1.0060+00	1.2310-03	9.9560-01	1.0000+00	-7.6690-03	9.9450-03	0.0	0.0	2.2760-03	8	0
1.100	1.0060+00	1.0540-03	1.0960+00	1.0000+00	-8.6520-03	1.0970-02	0.0	0.0	2.3150-03	8	0
1.200	1.0060+00	8.8230-04	1.1970+00	1.0000+00	-9.6590-03	1.2000-02	0.0	0.0	2.3380-03	8	0
1.300	1.0070+00	7.1590-04	1.2980+00	1.0000+00	-1.0690-02	1.3030-02	0.0	0.0	2.3470-03	8	0
1.400	1.0070+00	5.5570-04	1.3980+00	1.0000+00	-1.1740-02	1.4080-02	0.0	0.0	2.3420-03	8	0
1.500	1.0070+00	4.0190-04	1.4990+00	1.0000+00	-1.2800-02	1.5130-02	0.0	0.0	2.3250-03	8	0
1.600	1.0070+00	1.6540-04	1.6000+00	1.0000+00	-1.3890-02	1.6180-02	0.0	0.0	2.2900-03	8	0
1.700	1.0070+00	1.7560-05	1.7000+00	1.0000+00	-1.5000-02	1.7240-02	0.0	0.0	2.2420-03	8	0
1.800	1.0070+00	-1.0030-05	1.8010+00	1.0000+00	-1.6120-02	1.8310-02	0.0	0.0	2.1910-03	8	0
1.900	1.0070+00	-3.0190-04	1.9020+00	1.0010+00	-1.7260-02	1.9380-02	0.0	0.0	2.1220-03	8	0
2.000	1.0070+00	-6.7040-04	2.0020+00	1.0010+00	-1.8410-02	2.0440-02	0.0	0.0	2.0270-03	8	0

TIME	POWER	PDOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
2.100	1.0070+00	-9.0760-04	2.1030+00	1.0010+00	-1.9530-02	2.1490-02	0.0	0.0	1.9110-03	8	0
2.200	1.0070+00	7.5290-04	2.2030+00	1.0020+00	-2.0770-02	2.2660-02	0.0	0.0	1.8950-03	8	0
2.300	1.0060+00	-9.2290-04	2.3040+00	1.0020+00	-2.1990-02	2.3800-02	0.0	0.0	1.8130-03	8	0
2.400	1.0060+00	-1.0090-03	2.4050+00	1.0020+00	-2.3240-02	2.4940-02	0.0	0.0	1.6990-03	8	0
2.500	1.0060+00	-1.2820-03	2.5050+00	1.0020+00	-2.4520-02	2.6090-02	0.0	0.0	1.5620-03	8	0
2.600	1.0060+00	-1.5380-03	2.6060+00	1.0020+00	-2.5330-02	2.7240-02	0.0	0.0	1.4050-03	8	0
2.700	1.0060+00	-1.7760-03	2.7070+00	1.0020+00	-2.7170-02	2.8400-02	0.0	0.0	1.2310-03	8	0
2.800	1.0060+00	-1.9980-03	2.8070+00	1.0030+00	-2.8520-02	2.9570-02	0.0	0.0	1.0420-03	8	0
2.900	1.0060+00	-2.2060-03	2.9080+00	1.0030+00	-2.9900-02	3.0740-02	0.0	0.0	8.3350-04	8	0
3.000	1.0050+00	-2.4000-03	3.0080+00	1.0030+00	-3.1300-02	3.1920-02	0.0	0.0	6.2310-04	8	0
3.100	1.0050+00	-2.5830-03	3.1090+00	1.0030+00	-3.2710-02	3.3110-02	0.0	0.0	3.9690-04	8	0
3.200	1.0050+00	-2.7550-03	3.2090+00	1.0030+00	-3.4140-02	3.4300-02	0.0	0.0	1.6110-04	8	0
3.300	1.0050+00	-2.9170-03	3.3100+00	1.0030+00	-3.5590-02	3.5500-02	0.0	0.0	-8.3180-05	8	0
3.400	1.0040+00	-3.0700-03	3.4100+00	1.0030+00	-3.7050-02	3.6710-02	0.0	0.0	-3.3510-04	8	0
3.500	1.0040+00	-3.2150-03	3.5100+00	1.0030+00	-3.8520-02	3.7930-02	0.0	0.0	-5.9370-04	8	0
3.600	1.0040+00	-3.3520-03	3.6110+00	1.0030+00	-4.0000-02	3.9150-02	0.0	0.0	-8.5840-04	8	0
3.700	1.0030+00	-3.4820-03	3.7110+00	1.0030+00	-4.1500-02	4.0370-02	0.0	0.0	-1.1280-03	8	0
3.800	1.0030+00	-3.6060-03	3.8110+00	1.0030+00	-4.3010-02	4.1610-02	0.0	0.0	-1.4030-03	8	0
3.900	1.0030+00	-3.7230-03	3.9120+00	1.0030+00	-4.4530-02	4.2840-02	0.0	0.0	-1.6820-03	8	0
4.000	1.0020+00	-3.8350-03	4.0120+00	1.0030+00	-4.6050-02	4.4090-02	0.0	0.0	-1.9650-03	8	0
4.100	1.0020+00	-3.9420-03	4.1120+00	1.0030+00	-4.7590-02	4.5340-02	0.0	0.0	-2.2500-03	8	0
4.200	1.0010+00	-4.0440-03	4.2120+00	1.0030+00	-4.9140-02	4.6600-02	0.0	0.0	-2.5390-03	8	0
4.300	1.0010+00	-4.1410-03	4.3120+00	1.0030+00	-5.0690-02	4.7860-02	0.0	0.0	-2.8300-03	8	0
4.400	1.0010+00	-4.2340-03	4.4120+00	1.0030+00	-5.2250-02	4.9130-02	0.0	0.0	-3.1240-03	8	0
4.500	1.0000+00	-4.3230-03	4.5120+00	1.0030+00	-5.3820-02	5.0400-02	0.0	0.0	-3.4190-03	8	0
4.600	9.9970-01	-4.4080-03	4.6120+00	1.0030+00	-5.5390-02	5.1680-02	0.0	0.0	-3.7160-03	8	0
4.700	9.9930-01	-4.4900-03	4.7120+00	1.0030+00	-5.6970-02	5.2960-02	0.0	0.0	-4.0140-03	8	0
4.800	9.9880-01	-4.5680-03	4.8120+00	1.0020+00	-5.8560-02	5.4250-02	0.0	0.0	-4.3130-03	8	0
4.900	9.9830-01	-4.6440-03	4.9120+00	1.0020+00	-6.0150-02	5.5540-02	0.0	0.0	-4.6140-03	8	0
5.000	9.9790-01	-4.7160-03	5.0110+00	1.0020+00	-6.1750-02	5.6840-02	0.0	0.0	-4.9150-03	8	0
5.100	9.9740-01	-4.7860-03	5.1110+00	1.0020+00	-6.3360-02	5.8140-02	0.0	0.0	-5.2160-03	8	0
5.200	9.9690-01	-4.8530-03	5.2110+00	1.0020+00	-6.4970-02	5.9450-02	0.0	0.0	-5.5180-03	8	0
5.300	9.9640-01	-4.9170-03	5.3100+00	1.0020+00	-6.6580-02	6.0760-02	0.0	0.0	-5.8200-03	8	0
5.400	9.9590-01	-4.9790-03	5.4100+00	1.0020+00	-6.8200-02	6.2070-02	0.0	0.0	-6.1220-03	8	0
5.500	9.9540-01	-5.0390-03	5.5100+00	1.0020+00	-6.9820-02	6.3390-02	0.0	0.0	-6.4250-03	8	0
5.600	9.9490-01	-5.0970-03	5.6090+00	1.0020+00	-7.1440-02	6.4710-02	0.0	0.0	-6.7270-03	8	0
5.700	9.9440-01	-5.1530-03	5.7080+00	1.0010+00	-7.3070-02	6.6040-02	0.0	0.0	-7.0290-03	8	0
5.800	9.9390-01	-5.2070-03	5.8080+00	1.0010+00	-7.4700-02	6.7370-02	0.0	0.0	-7.3300-03	8	0
5.900	9.9340-01	-5.2590-03	5.9070+00	1.0010+00	-7.6340-02	6.8700-02	0.0	0.0	-7.6320-03	8	0
TEMPCK HAS CALLED AT TIME 0.600000+01 0.600000+01											
6.000	9.9280-01	-5.3100-03	6.0060+00	1.0010+00	-7.7970-02	7.0040-02	0.0	0.0	-7.9320-03	8	0
6.100	9.9230-01	-5.3590-03	6.1060+00	1.0010+00	-7.9610-02	7.1380-02	0.0	0.0	-8.2330-03	8	0
6.200	9.9180-01	-5.4060-03	6.2050+00	1.0010+00	-8.1260-02	7.2720-02	0.0	0.0	-8.5320-03	8	0
6.300	9.9120-01	-5.4520-03	6.3040+00	1.0010+00	-8.2900-02	7.4070-02	0.0	0.0	-8.8310-03	8	0
6.400	9.9070-01	-5.4970-03	6.4030+00	1.0000+00	-8.4550-02	7.5420-02	0.0	0.0	-9.1300-03	8	0
6.500	9.9010-01	-5.5400-03	6.5020+00	1.0000+00	-8.6190-02	7.6770-02	0.0	0.0	-9.4270-03	8	0
6.600	9.8960-01	-5.5820-03	6.6010+00	1.0000+00	-8.7840-02	7.8120-02	0.0	0.0	-9.7240-03	8	0
6.700	9.8900-01	-5.6230-03	6.7000+00	1.0000+00	-8.9490-02	7.9470-02	0.0	0.0	-1.0020-02	8	0
6.800	9.8850-01	-5.6620-03	6.7980+00	9.9980-01	-9.1150-02	8.0830-02	0.0	0.0	-1.0320-02	8	0
6.900	9.8790-01	-5.7010-03	6.8970+00	9.9960-01	-9.2800-02	8.2190-02	0.0	0.0	-1.0610-02	8	0
7.000	9.8730-01	-5.7380-03	6.9960+00	9.9940-01	-9.4450-02	8.3550-02	0.0	0.0	-1.0900-02	8	0
7.100	9.8670-01	-5.7750-03	7.0950+00	9.9920-01	-9.6110-02	8.4910-02	0.0	0.0	-1.1200-02	8	0
7.200	9.8620-01	-5.8100-03	7.1930+00	9.9910-01	-9.7760-02	8.6280-02	0.0	0.0	-1.1490-02	8	0
7.300	9.8560-01	-5.8450-03	7.2920+00	9.9890-01	-9.9420-02	8.7640-02	0.0	0.0	-1.1780-02	8	0
7.400	9.8500-01	-5.8780-03	7.3900+00	9.9870-01	-1.0110-01	8.9000-02	0.0	0.0	-1.2070-02	8	0

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 48

TIME	POWER	PDOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
7.500	9.8440-01	-5.9110-03	7.4890+00	9.9850-01	-1.0270-01	9.0370-02	0.0	0.0	-1.2360-02	8	0
7.600	9.8380-01	-5.9430-03	7.5870+00	9.9830-01	-1.0440-01	9.1740-02	0.0	0.0	-1.2640-02	8	0
7.700	9.8320-01	-5.9740-03	7.6850+00	9.9810-01	-1.0600-01	9.3100-02	0.0	0.0	-1.2930-02	8	0
7.800	9.8260-01	-6.0040-03	7.7830+00	9.9790-01	-1.0770-01	9.4470-02	0.0	0.0	-1.3210-02	8	0
7.900	9.8200-01	-6.0340-03	7.8820+00	9.9770-01	-1.0930-01	9.5840-02	0.0	0.0	-1.3500-02	8	0
8.000	9.8140-01	-6.0630-03	7.9800+00	9.9750-01	-1.1100-01	9.7210-02	0.0	0.0	-1.3780-02	8	0
8.100	9.8080-01	-6.0910-03	8.0780+00	9.9730-01	-1.1260-01	9.8570-02	0.0	0.0	-1.4060-02	8	0
8.200	9.8020-01	-6.1180-03	8.1760+00	9.9710-01	-1.1430-01	9.9940-02	0.0	0.0	-1.4350-02	8	0
8.300	9.7960-01	-6.1450-03	8.2740+00	9.9680-01	-1.1590-01	1.0130-01	0.0	0.0	-1.4630-02	8	0
8.400	9.7900-01	-6.1710-03	8.3720+00	9.9660-01	-1.1760-01	1.0270-01	0.0	0.0	-1.4900-02	8	0
8.500	9.7830-01	-6.1960-03	8.4690+00	9.9640-01	-1.1920-01	1.0400-01	0.0	0.0	-1.5180-02	8	0
8.600	9.7770-01	-6.2210-03	8.5670+00	9.9620-01	-1.2090-01	1.0540-01	0.0	0.0	-1.5460-02	8	0
8.700	9.7710-01	-6.2450-03	8.6650+00	9.9600-01	-1.2250-01	1.0680-01	0.0	0.0	-1.5730-02	8	0
8.800	9.7650-01	-6.2690-03	8.7620+00	9.9570-01	-1.2410-01	1.0810-01	0.0	0.0	-1.6010-02	8	0
8.900	9.7580-01	-6.2910-03	8.8600+00	9.9550-01	-1.2580-01	1.0950-01	0.0	0.0	-1.6280-02	8	0
9.000	9.7520-01	-6.3140-03	8.9570+00	9.9530-01	-1.2740-01	1.1080-01	0.0	0.0	-1.6550-02	8	0
9.100	9.7460-01	-6.3360-03	9.0550+00	9.9510-01	-1.2900-01	1.1220-01	0.0	0.0	-1.6830-02	8	0
9.200	9.7390-01	-6.3570-03	9.1520+00	9.9480-01	-1.3070-01	1.1360-01	0.0	0.0	-1.7100-02	8	0
9.300	9.7330-01	-6.3780-03	9.2500+00	9.9460-01	-1.3230-01	1.1490-01	0.0	0.0	-1.7370-02	8	0
9.400	9.7270-01	-6.3980-03	9.3470+00	9.9430-01	-1.3390-01	1.1630-01	0.0	0.0	-1.7630-02	8	0
9.500	9.7200-01	-6.4180-03	9.4440+00	9.9410-01	-1.3550-01	1.1760-01	0.0	0.0	-1.7900-02	8	0
9.600	9.7140-01	-6.4370-03	9.5410+00	9.9390-01	-1.3710-01	1.1890-01	0.0	0.0	-1.8170-02	8	0
9.610	9.7130-01	-7.2040-03	9.5510+00	9.9380-01	-1.3730-01	1.1910-01	0.0	0.0	-1.8200-02	8	0
9.620	9.7120-01	-6.5350-03	9.5610+00	9.9380-01	-1.3740-01	1.1920-01	0.0	0.0	-1.8230-02	8	0
9.630	9.7120-01	-6.4730-03	9.5700+00	9.9380-01	-1.3760-01	1.1930-01	0.0	0.0	-1.8250-02	8	0
9.640	9.7110-01	-6.5190-03	9.5800+00	9.9380-01	-1.3780-01	1.1950-01	0.0	0.0	-1.8280-02	8	0
9.650	9.7110-01	-6.6130-03	9.5900+00	9.9370-01	-1.3790-01	1.1960-01	0.0	0.0	-1.8310-02	8	0
9.660	9.7100-01	-6.6330-03	9.5990+00	9.9370-01	-1.3810-01	1.1980-01	0.0	0.0	-1.8340-02	8	0
9.670	9.7090-01	-6.6170-03	9.6090+00	9.9370-01	-1.3830-01	1.1990-01	0.0	0.0	-1.8370-02	8	0
9.680	9.7090-01	-6.6060-03	9.6190+00	9.9370-01	-1.3840-01	1.2000-01	0.0	0.0	-1.8400-02	8	0
9.690	9.7080-01	-6.6070-03	9.6280+00	9.9370-01	-1.3860-01	1.2020-01	0.0	0.0	-1.8420-02	8	0
9.700	9.7070-01	-6.6120-03	9.6380+00	9.9360-01	-1.3870-01	1.2030-01	0.0	0.0	-1.8450-02	8	0
9.710	9.7070-01	-6.6140-03	9.6480+00	9.9360-01	-1.3890-01	1.2040-01	0.0	0.0	-1.8480-02	8	0
9.720	9.7060-01	-6.6160-03	9.6580+00	9.9360-01	-1.3910-01	1.2060-01	0.0	0.0	-1.8510-02	8	0
9.730	9.7050-01	-6.6160-03	9.6670+00	9.9360-01	-1.3920-01	1.2070-01	0.0	0.0	-1.8540-02	8	0
9.740	9.7050-01	-6.6180-03	9.6770+00	9.9350-01	-1.3940-01	1.2080-01	0.0	0.0	-1.8570-02	8	0
9.750	9.7040-01	-6.6190-03	9.6870+00	9.9350-01	-1.3960-01	1.2100-01	0.0	0.0	-1.8590-02	8	0
9.760	9.7030-01	-6.6200-03	9.6960+00	9.9350-01	-1.3970-01	1.2110-01	0.0	0.0	-1.8620-02	8	0
9.770	9.7030-01	-6.6220-03	9.7060+00	9.9350-01	-1.3990-01	1.2120-01	0.0	0.0	-1.8650-02	8	0
9.780	9.7020-01	-6.6230-03	9.7160+00	9.9340-01	-1.4000-01	1.2140-01	0.0	0.0	-1.8680-02	8	0
9.790	9.7010-01	-6.6240-03	9.7260+00	9.9340-01	-1.4020-01	1.2150-01	0.0	0.0	-1.8710-02	8	0
9.800	9.7010-01	-6.6250-03	9.7350+00	9.9340-01	-1.4040-01	1.2160-01	0.0	0.0	-1.8730-02	8	0
9.810	9.7000-01	-6.6260-03	9.7450+00	9.9340-01	-1.4050-01	1.2180-01	0.0	0.0	-1.8760-02	8	0
9.820	9.6990-01	-6.6280-03	9.7550+00	9.9330-01	-1.4070-01	1.2190-01	0.0	0.0	-1.8790-02	8	0
9.830	9.6990-01	-6.6290-03	9.7640+00	9.9330-01	-1.4080-01	1.2200-01	0.0	0.0	-1.8820-02	8	0
9.840	9.6980-01	-6.6300-03	9.7740+00	9.9330-01	-1.4100-01	1.2220-01	0.0	0.0	-1.8850-02	8	0
9.850	9.6970-01	-6.6310-03	9.7840+00	9.9330-01	-1.4120-01	1.2230-01	0.0	0.0	-1.8870-02	8	0
9.860	9.6970-01	-6.6320-03	9.7930+00	9.9320-01	-1.4130-01	1.2240-01	0.0	0.0	-1.8900-02	8	0
9.870	9.6960-01	-6.6340-03	9.8030+00	9.9320-01	-1.4150-01	1.2260-01	0.0	0.0	-1.8930-02	8	0
9.880	9.6950-01	-6.6350-03	9.8130+00	9.9320-01	-1.4170-01	1.2270-01	0.0	0.0	-1.8960-02	8	0
9.890	9.6950-01	-6.6360-03	9.8230+00	9.9320-01	-1.4180-01	1.2280-01	0.0	0.0	-1.8990-02	8	0
9.900	9.6940-01	-6.6370-03	9.8320+00	9.9320-01	-1.4200-01	1.2300-01	0.0	0.0	-1.9010-02	8	0
9.910	9.6930-01	-6.6380-03	9.8420+00	9.9310-01	-1.4210-01	1.2310-01	0.0	0.0	-1.9040-02	8	0
9.920	9.6930-01	-6.6390-03	9.8520+00	9.9310-01	-1.4230-01	1.2320-01	0.0	0.0	-1.9070-02	8	0
9.930	9.6920-01	-6.6400-03	9.8610+00	9.9310-01	-1.4250-01	1.2340-01	0.0	0.0	-1.9100-02	8	0

TIME	POWER	PDOF	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL	PROGRAMMED	NET REAC	IPHI	IREA
9.940	9.6910-01	-6.6410-03	9.8710+00	9.9310-01	-1.4260-01	1.2350-01	0.0	0.0	0.0	-1.9120-02	8	0
9.950	9.6910-01	-6.6420-03	9.8810+00	9.9300-01	-1.4280-01	1.2360-01	0.0	0.0	0.0	-1.9150-02	8	0
9.960	9.6900-01	-6.6440-03	9.8900+00	9.9300-01	-1.4290-01	1.2380-01	0.0	0.0	0.0	-1.9180-02	8	0
9.970	9.6890-01	-6.6450-03	9.9000+00	9.9300-01	-1.4310-01	1.2390-01	0.0	0.0	0.0	-1.9210-02	8	0
9.980	9.6890-01	-6.6460-03	9.9100+00	9.9300-01	-1.4330-01	1.2400-01	0.0	0.0	0.0	-1.9230-02	8	0
9.990	9.6880-01	-6.6470-03	9.9190+00	9.9290-01	-1.4340-01	1.2420-01	0.0	0.0	0.0	-1.9260-02	8	0
10.000	9.6870-01	-6.6480-03	9.9290+00	9.9290-01	-1.4360-01	1.2430-01	0.0	0.0	0.0	-1.9290-02	8	0
10.010	9.6870-01	-6.6490-03	9.9390+00	9.9290-01	-1.4370-01	1.2440-01	0.0	0.0	0.0	-1.9320-02	8	0
10.020	9.6860-01	-6.6500-03	9.9480+00	9.9290-01	-1.4390-01	1.2460-01	0.0	0.0	0.0	-1.9340-02	8	0
10.030	9.6850-01	-6.6510-03	9.9580+00	9.9280-01	-1.4410-01	1.2470-01	0.0	0.0	0.0	-1.9370-02	8	0
10.040	9.6850-01	-6.6520-03	9.9680+00	9.9280-01	-1.4420-01	1.2480-01	0.0	0.0	0.0	-1.9400-02	8	0
10.050	9.6840-01	-6.6530-03	9.9780+00	9.9280-01	-1.4440-01	1.2500-01	0.0	0.0	0.0	-1.9430-02	8	0
10.060	9.6830-01	-6.6540-03	9.9870+00	9.9280-01	-1.4450-01	1.2510-01	0.0	0.0	0.0	-1.9450-02	8	0
10.070	9.6830-01	-6.6550-03	9.9970+00	9.9270-01	-1.4470-01	1.2520-01	0.0	0.0	0.0	-1.9480-02	8	0
10.080	9.6820-01	-6.6560-03	1.0010+01	9.9270-01	-1.4490-01	1.2540-01	0.0	0.0	0.0	-1.9510-02	8	0
10.090	9.6810-01	-6.6570-03	1.0020+01	9.9270-01	-1.4500-01	1.2550-01	0.0	0.0	0.0	-1.9540-02	8	0
10.100	9.6810-01	-6.6580-03	1.0030+01	9.9270-01	-1.4520-01	1.2560-01	0.0	0.0	0.0	-1.9560-02	8	0
10.110	9.6800-01	-6.6590-03	1.0040+01	9.9260-01	-1.4530-01	1.2580-01	0.0	0.0	0.0	-1.9590-02	8	0
10.120	9.6790-01	-6.6600-03	1.0050+01	9.9260-01	-1.4550-01	1.2590-01	0.0	0.0	0.0	-1.9620-02	8	0
10.130	9.6790-01	-6.6610-03	1.0050+01	9.9260-01	-1.4570-01	1.2600-01	0.0	0.0	0.0	-1.9650-02	8	0
10.140	9.6780-01	-6.6620-03	1.0060+01	9.9260-01	-1.4580-01	1.2620-01	0.0	0.0	0.0	-1.9670-02	8	0
10.150	9.6770-01	-6.6630-03	1.0070+01	9.9250-01	-1.4600-01	1.2630-01	0.0	0.0	0.0	-1.9700-02	8	0
10.160	9.6770-01	-6.6640-03	1.0080+01	9.9250-01	-1.4610-01	1.2640-01	0.0	0.0	0.0	-1.9730-02	8	0
10.170	9.6760-01	-6.6650-03	1.0090+01	9.9250-01	-1.4630-01	1.2650-01	0.0	0.0	0.0	-1.9750-02	8	0
10.180	9.6750-01	-6.6660-03	1.0100+01	9.9250-01	-1.4650-01	1.2670-01	0.0	0.0	0.0	-1.9780-02	8	0
10.190	9.6750-01	-6.6670-03	1.0110+01	9.9240-01	-1.4660-01	1.2680-01	0.0	0.0	0.0	-1.9810-02	8	0
10.200	9.6740-01	-6.6680-03	1.0120+01	9.9240-01	-1.4680-01	1.2690-01	0.0	0.0	0.0	-1.9840-02	8	0
10.210	9.6730-01	-6.6690-03	1.0130+01	9.9240-01	-1.4690-01	1.2710-01	0.0	0.0	0.0	-1.9860-02	8	0
10.220	9.6730-01	-6.6700-03	1.0140+01	9.9240-01	-1.4710-01	1.2720-01	0.0	0.0	0.0	-1.9890-02	8	0
10.230	9.6720-01	-6.6700-03	1.0150+01	9.9230-01	-1.4730-01	1.2730-01	0.0	0.0	0.0	-1.9920-02	8	0
10.240	9.6710-01	-6.6710-03	1.0160+01	9.9230-01	-1.4740-01	1.2750-01	0.0	0.0	0.0	-1.9940-02	8	0
10.250	9.6710-01	-6.6720-03	1.0170+01	9.9230-01	-1.4760-01	1.2760-01	0.0	0.0	0.0	-1.9970-02	8	0
10.260	9.6700-01	-6.6730-03	1.0180+01	9.9230-01	-1.4770-01	1.2770-01	0.0	0.0	0.0	-2.0000-02	8	0
10.270	9.6690-01	-6.6740-03	1.0190+01	9.9220-01	-1.4790-01	1.2790-01	0.0	0.0	0.0	-2.0020-02	8	0
10.280	9.6690-01	-6.6750-03	1.0200+01	9.9220-01	-1.4810-01	1.2800-01	0.0	0.0	0.0	-2.0050-02	8	0
10.290	9.6680-01	-6.6760-03	1.0210+01	9.9220-01	-1.4820-01	1.2810-01	0.0	0.0	0.0	-2.0080-02	8	0
10.300	9.6670-01	-6.6770-03	1.0220+01	9.9220-01	-1.4840-01	1.2830-01	0.0	0.0	0.0	-2.0100-02	8	0
10.310	9.6670-01	-6.6780-03	1.0230+01	9.9210-01	-1.4850-01	1.2840-01	0.0	0.0	0.0	-2.0130-02	8	0
10.320	9.6660-01	-6.6790-03	1.0240+01	9.9210-01	-1.4870-01	1.2850-01	0.0	0.0	0.0	-2.0160-02	8	0
10.330	9.6650-01	-6.6800-03	1.0250+01	9.9210-01	-1.4880-01	1.2870-01	0.0	0.0	0.0	-2.0190-02	8	0
10.340	9.6650-01	-6.6810-03	1.0260+01	9.9210-01	-1.4900-01	1.2880-01	0.0	0.0	0.0	-2.0210-02	8	0
10.350	9.6640-01	-6.6820-03	1.0270+01	9.9210-01	-1.4920-01	1.2890-01	0.0	0.0	0.0	-2.0240-02	8	0
10.360	9.6630-01	-6.6820-03	1.0280+01	9.9200-01	-1.4930-01	1.2910-01	0.0	0.0	0.0	-2.0270-02	8	0
10.370	9.6630-01	-6.6830-03	1.0290+01	9.9200-01	-1.4950-01	1.2920-01	0.0	0.0	0.0	-2.0290-02	8	0
10.380	9.6620-01	-6.6840-03	1.0300+01	9.9200-01	-1.4960-01	1.2930-01	0.0	0.0	0.0	-2.0320-02	8	0
10.390	9.6610-01	-6.6850-03	1.0310+01	9.9200-01	-1.4980-01	1.2950-01	0.0	0.0	0.0	-2.0350-02	8	0
10.400	9.6610-01	-6.6860-03	1.0320+01	9.9190-01	-1.5000-01	1.2960-01	0.0	0.0	0.0	-2.0370-02	8	0
10.410	9.6600-01	-6.6870-03	1.0330+01	9.9190-01	-1.5010-01	1.2970-01	0.0	0.0	0.0	-2.0400-02	8	0
10.420	9.6590-01	-6.6880-03	1.0340+01	9.9190-01	-1.5030-01	1.2980-01	0.0	0.0	0.0	-2.0430-02	8	0
10.430	9.6590-01	-6.6890-03	1.0350+01	9.9190-01	-1.5040-01	1.3000-01	0.0	0.0	0.0	-2.0450-02	8	0
10.440	9.6580-01	-6.6900-03	1.0350+01	9.9180-01	-1.5060-01	1.3010-01	0.0	0.0	0.0	-2.0480-02	8	0
10.450	9.6570-01	-6.6900-03	1.0360+01	9.9180-01	-1.5070-01	1.3020-01	0.0	0.0	0.0	-2.0510-02	8	0
10.460	9.6570-01	-6.6910-03	1.0370+01	9.9180-01	-1.5090-01	1.3040-01	0.0	0.0	0.0	-2.0530-02	8	0
10.470	9.6560-01	-6.6920-03	1.0380+01	9.9180-01	-1.5110-01	1.3050-01	0.0	0.0	0.0	-2.0560-02	8	0
10.480	9.6550-01	-6.6930-03	1.0390+01	9.9170-01	-1.5120-01	1.3060-01	0.0	0.0	0.0	-2.0580-02	8	0

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 50

TIME	POWER	PDOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
10.490	9.6550-01	-6.6940-03	1.0400+01	9.9170-01	-1.5140-01	1.3080-01	0.0	0.0	-2.0610-02	8	0
10.500	9.6540-01	-6.6950-03	1.0410+01	9.9170-01	-1.5150-01	1.3090-01	0.0	0.0	-2.0640-02	8	0
10.510	9.6530-01	-6.6960-03	1.0420+01	9.9170-01	-1.5170-01	1.3100-01	0.0	0.0	-2.0660-02	8	0
10.520	9.6530-01	-6.6970-03	1.0430+01	9.9160-01	-1.5180-01	1.3120-01	0.0	0.0	-2.0690-02	8	0
10.530	9.6520-01	-6.6970-03	1.0440+01	9.9160-01	-1.5200-01	1.3130-01	0.0	0.0	-2.0720-02	8	0
10.540	9.6510-01	-6.6980-03	1.0450+01	9.9160-01	-1.5220-01	1.3140-01	0.0	0.0	-2.0740-02	8	0
10.550	9.6510-01	-6.6990-03	1.0460+01	9.9160-01	-1.5230-01	1.3160-01	0.0	0.0	-2.0770-02	8	0
10.560	9.6500-01	-6.7000-03	1.0470+01	9.9150-01	-1.5250-01	1.3170-01	0.0	0.0	-2.0800-02	8	0
10.570	9.6490-01	-6.7010-03	1.0480+01	9.9150-01	-1.5260-01	1.3180-01	0.0	0.0	-2.0820-02	8	0
10.580	9.6490-01	-6.7020-03	1.0490+01	9.9150-01	-1.5280-01	1.3190-01	0.0	0.0	-2.0850-02	8	0
10.590	9.6480-01	-6.7030-03	1.0500+01	9.9140-01	-1.5290-01	1.3210-01	0.0	0.0	-2.0870-02	8	0
10.600	9.6470-01	-6.7030-03	1.0510+01	9.9140-01	-1.5310-01	1.3220-01	0.0	0.0	-2.0900-02	8	0
10.610	9.6470-01	-6.7040-03	1.0520+01	9.9140-01	-1.5330-01	1.3230-01	0.0	0.0	-2.0930-02	8	0
10.620	9.6460-01	-6.7050-03	1.0530+01	9.9140-01	-1.5340-01	1.3250-01	0.0	0.0	-2.0950-02	8	0
10.630	9.6450-01	-6.7060-03	1.0540+01	9.9130-01	-1.5360-01	1.3260-01	0.0	0.0	-2.0980-02	8	0
10.640	9.6450-01	-6.7070-03	1.0550+01	9.9130-01	-1.5370-01	1.3270-01	0.0	0.0	-2.1010-02	8	0
10.650	9.6440-01	-6.7080-03	1.0560+01	9.9130-01	-1.5390-01	1.3290-01	0.0	0.0	-2.1030-02	8	0
10.660	9.6430-01	-6.7090-03	1.0570+01	9.9130-01	-1.5400-01	1.3300-01	0.0	0.0	-2.1060-02	8	0
10.670	9.6430-01	-6.7090-03	1.0580+01	9.9120-01	-1.5420-01	1.3310-01	0.0	0.0	-2.1080-02	8	0
10.680	9.6420-01	-6.7100-03	1.0590+01	9.9120-01	-1.5440-01	1.3320-01	0.0	0.0	-2.1110-02	8	0
10.690	9.6410-01	-6.7110-03	1.0600+01	9.9120-01	-1.5450-01	1.3340-01	0.0	0.0	-2.1140-02	8	0
10.700	9.6410-01	-6.7120-03	1.0610+01	9.9120-01	-1.5470-01	1.3350-01	0.0	0.0	-2.1160-02	8	0
10.710	9.6400-01	-6.7130-03	1.0620+01	9.9110-01	-1.5480-01	1.3360-01	0.0	0.0	-2.1190-02	8	0
10.720	9.6390-01	-6.7130-03	1.0620+01	9.9110-01	-1.5500-01	1.3380-01	0.0	0.0	-2.1210-02	8	0
10.730	9.6390-01	-6.7140-03	1.0630+01	9.9110-01	-1.5510-01	1.3390-01	0.0	0.0	-2.1240-02	8	0
10.740	9.6380-01	-6.7150-03	1.0640+01	9.9110-01	-1.5530-01	1.3400-01	0.0	0.0	-2.1270-02	8	0
10.750	9.6370-01	-6.7160-03	1.0650+01	9.9100-01	-1.5550-01	1.3420-01	0.0	0.0	-2.1290-02	8	0
10.760	9.6370-01	-6.7170-03	1.0660+01	9.9100-01	-1.5560-01	1.3430-01	0.0	0.0	-2.1320-02	8	0
10.770	9.6360-01	-6.7180-03	1.0670+01	9.9100-01	-1.5580-01	1.3440-01	0.0	0.0	-2.1340-02	8	0
10.780	9.6350-01	-6.7180-03	1.0680+01	9.9100-01	-1.5590-01	1.3450-01	0.0	0.0	-2.1370-02	8	0
10.790	9.6350-01	-6.7190-03	1.0690+01	9.9090-01	-1.5610-01	1.3470-01	0.0	0.0	-2.1400-02	8	0
10.800	9.6340-01	-6.7200-03	1.0700+01	9.9090-01	-1.5620-01	1.3480-01	0.0	0.0	-2.1420-02	8	0
10.810	9.6330-01	-6.7210-03	1.0710+01	9.9090-01	-1.5640-01	1.3490-01	0.0	0.0	-2.1450-02	8	0
10.820	9.6320-01	-6.7220-03	1.0720+01	9.9090-01	-1.5650-01	1.3510-01	0.0	0.0	-2.1470-02	8	0
10.830	9.6320-01	-6.7220-03	1.0730+01	9.9080-01	-1.5670-01	1.3520-01	0.0	0.0	-2.1500-02	8	0
10.840	9.6310-01	-6.7230-03	1.0740+01	9.9080-01	-1.5690-01	1.3530-01	0.0	0.0	-2.1530-02	8	0
10.850	9.6300-01	-6.7240-03	1.0750+01	9.9080-01	-1.5700-01	1.3550-01	0.0	0.0	-2.1550-02	8	0
10.860	9.6300-01	-6.7250-03	1.0760+01	9.9080-01	-1.5720-01	1.3560-01	0.0	0.0	-2.1580-02	8	0
10.870	9.6290-01	-6.7260-03	1.0770+01	9.9070-01	-1.5730-01	1.3570-01	0.0	0.0	-2.1600-02	8	0
10.880	9.6280-01	-6.7260-03	1.0780+01	9.9070-01	-1.5750-01	1.3580-01	0.0	0.0	-2.1630-02	8	0
10.890	9.6280-01	-6.7270-03	1.0790+01	9.9070-01	-1.5760-01	1.3600-01	0.0	0.0	-2.1650-02	8	0
10.900	9.6270-01	-6.7280-03	1.0800+01	9.9070-01	-1.5780-01	1.3610-01	0.0	0.0	-2.1680-02	8	0
10.910	9.6260-01	-6.7290-03	1.0810+01	9.9060-01	-1.5790-01	1.3620-01	0.0	0.0	-2.1710-02	8	0
10.920	9.6260-01	-6.7300-03	1.0820+01	9.9060-01	-1.5810-01	1.3640-01	0.0	0.0	-2.1730-02	8	0
10.930	9.6250-01	-6.7300-03	1.0830+01	9.9060-01	-1.5820-01	1.3650-01	0.0	0.0	-2.1760-02	8	0
10.940	9.6240-01	-6.7310-03	1.0840+01	9.9060-01	-1.5840-01	1.3660-01	0.0	0.0	-2.1780-02	8	0
10.950	9.6240-01	-6.7320-03	1.0850+01	9.9050-01	-1.5860-01	1.3680-01	0.0	0.0	-2.1810-02	8	0
10.960	9.6230-01	-6.7330-03	1.0860+01	9.9050-01	-1.5870-01	1.3690-01	0.0	0.0	-2.1830-02	8	0
10.970	9.6220-01	-6.7340-03	1.0870+01	9.9050-01	-1.5890-01	1.3700-01	0.0	0.0	-2.1860-02	8	0
10.980	9.6220-01	-6.7340-03	1.0880+01	9.9050-01	-1.5900-01	1.3710-01	0.0	0.0	-2.1880-02	8	0
10.990	9.6210-01	-6.7350-03	1.0880+01	9.9040-01	-1.5920-01	1.3730-01	0.0	0.0	-2.1910-02	8	0
11.000	9.6200-01	-6.7360-03	1.0890+01	9.9040-01	-1.5930-01	1.3740-01	0.0	0.0	-2.1940-02	8	0
11.010	9.6200-01	-6.7370-03	1.0900+01	9.9040-01	-1.5950-01	1.3750-01	0.0	0.0	-2.1960-02	8	0
11.020	9.6190-01	-6.7370-03	1.0910+01	9.9040-01	-1.5960-01	1.3770-01	0.0	0.0	-2.1990-02	8	0
11.030	9.6180-01	-6.7380-03	1.0920+01	9.9030-01	-1.5980-01	1.3780-01	0.0	0.0	-2.2010-02	8	0

TIME	POWER	POOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IFHI	IREA
11.040	9.6180-01	-6.7390-03	1.0930+01	9.9030-01	-1.5990-01	1.3790-01	0.0	0.0	-2.2040-02	8	0
11.050	9.6170-01	-6.7400-03	1.0940+01	9.9030-01	-1.6010-01	1.3800-01	0.0	0.0	-2.2050-02	8	0
11.060	9.6160-01	-6.7400-03	1.0950+01	9.9020-01	-1.6030-01	1.3820-01	0.0	0.0	-2.2070-02	8	0
11.070	9.6160-01	-6.7410-03	1.0960+01	9.9020-01	-1.6040-01	1.3830-01	0.0	0.0	-2.2110-02	8	0

*****QSET FACTORS *****

FUEL BASED

COOLANT BASED

CHANNEL 1

AXIAL LOCATION	QSET FACTOR
158.412	0.33470-06
150.237	0.33890-06
142.062	0.36430-06
133.887	0.83100-07
126.181	0.28120-06
118.942	0.28310-06
111.704	0.28440-06
104.465	0.28520-06
97.227	0.28590-06
89.988	0.28640-06
82.750	0.28690-06
75.512	0.28730-06
68.273	0.28760-06
61.035	0.28790-06
53.796	0.28830-06
46.558	0.28860-06
39.319	0.28890-06
29.750	0.29940-06
17.850	0.29960-06
5.950	0.29980-06

*****QSET FACTORS *****

FUEL BASED

AXIAL LOCATION	QSET FACTOR
158.412	0.22760-06
150.237	0.23040-06
142.062	0.35360-06
133.887	-0.11200-05
126.181	0.30330-06
118.942	0.29050-06
111.704	0.29540-06
104.465	0.29340-06
97.227	0.29150-06
89.988	0.29030-06
82.750	0.28990-06
75.512	0.28920-06
68.273	0.28850-06
61.035	0.28820-06
53.796	0.28780-06
46.558	0.28750-06
39.319	0.28730-06
29.750	0.28670-06
17.850	0.28620-06
5.950	0.28530-06

COOLANT BASED

CHANNEL 2

AXIAL LOCATION	QSET FACTOR
158.412	0.33500-06
150.237	0.34180-06
142.062	0.41340-06
133.887	0.25180-06
126.181	0.28100-06
118.942	0.28300-06
111.704	0.28430-06
104.465	0.28510-06
97.227	0.28580-06
89.988	0.28640-06
82.750	0.28680-06
75.512	0.28720-06
68.273	0.28760-06
61.035	0.28790-06
53.796	0.28820-06
46.558	0.28850-06
39.319	0.28880-06
29.750	0.29940-06
17.850	0.29960-06
5.950	0.29980-06

AXIAL LOCATION	QSET FACTOR
158.412	0.19650-06
150.237	0.21710-06
142.062	0.53000-06
133.887	-0.20590-06
126.181	0.30560-06
118.942	0.30000-06
111.704	0.29660-06
104.465	0.29440-06
97.227	0.29290-06
89.988	0.29170-06
82.750	0.29020-06
75.512	0.29010-06
68.273	0.28950-06
61.035	0.28910-06
53.796	0.28850-06
46.558	0.28860-06
39.319	0.28860-06
29.750	0.28670-06
17.850	0.28620-06
5.950	0.28530-06

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 52

*****QSET FACTORS *****

FUEL BASED

CHANNEL 3

AXIAL LOCATION	QSET FACTOR
158.412	0.33480-06
150.237	0.33950-06
142.062	0.37080-06
133.887	0.17640-06
126.181	0.28120-06
118.942	0.28310-06
111.704	0.28430-06
104.465	0.28520-06
97.227	0.28590-06
89.988	0.28640-06
82.750	0.28690-06
75.512	0.28730-06
68.273	0.28760-06
61.035	0.28790-06
53.796	0.28820-06
46.558	0.28850-06
39.319	0.28880-06
29.750	0.29940-06
17.850	0.29960-06
5.950	0.29980-06

*****QSET FACTORS *****

FUEL BASED

CHANNEL 4

AXIAL LOCATION	QSET FACTOR
158.412	0.33500-06
150.237	0.34080-06
142.062	0.39050-06
133.887	0.23510-06
126.181	0.28050-06
118.942	0.28260-06
111.704	0.28390-06
104.465	0.28490-06
97.227	0.28560-06
89.988	0.28620-06
82.750	0.28670-06
75.512	0.28710-06
68.273	0.28740-06
61.035	0.28780-06
53.796	0.28810-06
46.558	0.28840-06
39.319	0.28870-06
29.750	0.29940-06
17.850	0.29960-06
5.950	0.29980-06

COOLANT BASED

AXIAL LOCATION	QSET FACTOR
158.412	0.22110-06
150.237	0.23410-06
142.062	0.38680-06
133.887	-0.61560-06
126.181	0.30400-06
118.942	0.29880-06
111.704	0.29570-06
104.465	0.29360-06
97.227	0.29210-06
89.988	0.29100-06
82.750	0.29010-06
75.512	0.28940-06
68.273	0.28880-06
61.035	0.28840-06
53.796	0.28800-06
46.558	0.28770-06
39.319	0.28760-06
29.750	0.28670-06
17.850	0.28620-06
5.950	0.28580-06

COOLANT BASED

AXIAL LOCATION	QSET FACTOR
158.412	0.20810-06
150.237	0.22480-06
142.062	0.45520-06
133.887	-0.29460-06
126.181	0.30710-06
118.942	0.30100-06
111.704	0.29740-06
104.465	0.29500-06
97.227	0.29330-06
89.988	0.29210-06
82.750	0.29110-06
75.512	0.29030-06
68.273	0.28970-06
61.035	0.28930-06
53.796	0.28890-06
46.558	0.28870-06
39.319	0.28870-06
29.750	0.28670-06
17.850	0.28630-06
5.950	0.28580-06

*****QSET FACTORS *****

FUEL BASED

CHANNEL 5

AXIAL LOCATION	QSET FACTOR
158.412	0.3346D-06
150.237	0.3377D-06
142.062	0.3532D-06
133.887	0.5980D-06
126.181	0.2807D-06
118.942	0.2827D-06
111.704	0.2840D-06
104.465	0.2850D-06
97.227	0.2857D-06
89.988	0.2863D-06
82.750	0.2868D-06
75.512	0.2872D-06
68.273	0.2875D-06
61.035	0.2879D-06
53.796	0.2882D-06
46.558	0.2885D-06
39.319	0.2889D-06
29.750	0.2994D-06
17.850	0.2996D-06
5.950	0.2998D-06

*****QSET FACTORS *****

FUEL BASED

CHANNEL 6

AXIAL LOCATION	QSET FACTOR
158.412	0.3347D-06
150.237	0.3389D-06
142.062	0.3640D-06
133.887	0.7092D-07
126.181	0.2801D-06
118.942	0.2823D-06
111.704	0.2837D-06
104.465	0.2847D-06
97.227	0.2855D-06
89.988	0.2861D-06
82.750	0.2866D-06
75.512	0.2870D-06
68.273	0.2874D-06
61.035	0.2878D-06
53.796	0.2881D-06
46.558	0.2884D-06
39.319	0.2888D-06
29.750	0.2993D-06
17.850	0.2996D-06
5.950	0.2998D-06

COOLANT BASED

AXIAL LOCATION	QSET FACTOR
158.412	0.2436D-06
150.237	0.2480D-06
142.062	0.3237D-06
133.887	0.1664D-05
126.181	0.3045D-06
118.942	0.2991D-06
111.704	0.2958D-06
104.465	0.2935D-06
97.227	0.2921D-06
89.988	0.2909D-06
82.750	0.2900D-06
75.512	0.2892D-06
68.273	0.2886D-06
61.035	0.2881D-06
53.796	0.2876D-06
46.558	0.2872D-06
39.319	0.2870D-06
29.750	0.2867D-06
17.850	0.2863D-06
5.950	0.2858D-06

COOLANT BASED

AXIAL LOCATION	QSET FACTOR
158.412	0.2304D-06
150.237	0.2394D-06
142.062	0.3610D-06
133.887	-0.1175D-05
126.181	0.3071D-06
118.942	0.3010D-06
111.704	0.2973D-06
104.465	0.2949D-06
97.227	0.2932D-06
89.988	0.2919D-06
82.750	0.2909D-06
75.512	0.2901D-06
68.273	0.2894D-06
61.035	0.2889D-06
53.796	0.2884D-06
46.558	0.2881D-06
39.319	0.2879D-06
29.750	0.2868D-06
17.850	0.2863D-06
5.950	0.2858D-06

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 54

*****QSET FACTORS *****

FUEL BASED

CHANNEL 7

AXIAL LOCATION	QSET FACTOR
158.412	0.33460-06
150.237	0.33810-06
142.062	0.35600-06
133.887	0.12000-05
126.181	0.27900-06
118.942	0.28150-06
111.704	0.28310-06
104.465	0.28420-06
97.227	0.28500-06
89.988	0.28570-06
82.750	0.28630-06
75.512	0.28680-06
68.273	0.28720-06
61.035	0.28760-06
53.796	0.28800-06
46.558	0.28840-06
39.319	0.28880-06
29.750	0.29930-06
17.850	0.29950-06
5.950	0.29980-06

*****QSET FACTORS *****

FUEL BASED

CHANNEL 8

AXIAL LOCATION	QSET FACTOR
158.412	0.33370-06
150.237	0.33610-06
142.062	0.34650-06
133.887	0.40970-06
126.181	0.28150-06
118.942	0.28330-06
111.704	0.28450-06
104.465	0.28540-06
97.227	0.28600-06
89.988	0.28650-06
82.750	0.28700-06
75.512	0.28730-06
68.273	0.28770-06
61.035	0.28800-06
53.796	0.28830-06
46.558	0.28860-06
39.319	0.28890-06
29.750	0.29940-06
17.850	0.29960-06
5.950	0.29980-06

COOLANT BASED

AXIAL LOCATION	QSET FACTOR
158.412	0.24340-06
150.237	0.24680-06
142.062	0.33170-06
133.887	0.48340-05
126.181	0.31010-06
118.942	0.30300-06
111.704	0.29880-06
104.465	0.29610-06
97.227	0.29410-06
89.988	0.29260-06
82.750	0.29150-06
75.512	0.29060-06
68.273	0.28950-06
61.035	0.28920-06
53.796	0.28870-06
46.558	0.28830-06
39.319	0.28800-06
29.750	0.28700-06
17.850	0.28640-06
5.950	0.28590-06

COOLANT BASED

AXIAL LOCATION	QSET FACTOR
158.412	0.25250-06
150.237	0.25390-06
142.062	0.30470-06
133.887	0.66570-06
126.181	0.30190-06
118.942	0.29720-06
111.704	0.29440-06
104.465	0.29250-06
97.227	0.29110-06
89.988	0.29000-06
82.750	0.28920-06
75.512	0.28850-06
68.273	0.28790-06
61.035	0.28740-06
53.796	0.28700-06
46.558	0.28660-06
39.319	0.28620-06
29.750	0.28660-06
17.850	0.28620-06
5.950	0.28530-06

*****QSET FACTORS *****

FUEL BASED

CHANNEL 9

AXIAL LOCATION	QSET FACTOR
158.412	0.33370-06
150.237	0.33660-06
142.062	0.34980-06
133.887	0.47830-06
126.181	0.28080-06
118.942	0.28280-06
111.704	0.28410-06
104.465	0.28500-06
97.227	0.28570-06
89.988	0.28630-06
82.750	0.28680-06
75.512	0.28720-06
68.273	0.28760-06
61.035	0.28790-06
53.796	0.28820-06
46.558	0.28850-06
39.319	0.28890-06
29.750	0.29940-06
17.850	0.29960-06
5.950	0.29980-06

*****QSET FACTORS *****

FUEL BASED

CHANNEL 10

AXIAL LOCATION	QSET FACTOR
158.412	0.33350-06
150.237	0.33520-06
142.062	0.34150-06
133.887	0.36420-06
126.181	0.27850-06
118.942	0.28110-06
111.704	0.28270-06
104.465	0.28390-06
97.227	0.28480-06
89.988	0.28550-06
82.750	0.28610-06
75.512	0.28660-06
68.273	0.28710-06
61.035	0.28750-06
53.796	0.28800-06
46.558	0.28840-06
39.319	0.28880-06
29.750	0.29920-06
17.850	0.29950-06
5.950	0.29980-06

COOLANT BASED

AXIAL LOCATION	QSET FACTOR
158.412	0.24790-06
150.237	0.25080-06
142.062	0.31610-06
133.887	0.10410-05
126.181	0.30400-06
118.942	0.29870-06
111.704	0.29550-06
104.465	0.29340-06
97.227	0.29190-06
89.988	0.29070-06
82.750	0.28980-06
75.512	0.28910-06
68.273	0.28840-06
61.035	0.28790-06
53.796	0.28740-06
46.558	0.28710-06
39.319	0.28670-06
29.750	0.28670-06
17.850	0.28630-06
5.950	0.28580-06

COOLANT BASED

AXIAL LOCATION	QSET FACTOR
158.412	0.27220-06
150.237	0.26350-06
142.062	0.23450-06
133.887	0.40150-06
126.181	0.31010-06
118.942	0.30280-06
111.704	0.29860-06
104.465	0.29570-06
97.227	0.29370-06
89.988	0.29220-06
82.750	0.29100-06
75.512	0.29000-06
68.273	0.28910-06
61.035	0.28840-06
53.796	0.28780-06
46.558	0.28720-06
39.319	0.28670-06
29.750	0.28710-06
17.850	0.28650-06
5.950	0.28590-06

TIME	POWER	POOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 56

CHANNEL 8 VOIDING TIME= 0.110800+02

TEMPERATURE PROFILES AT VOIDING

Z	TCOOL	TCLAD	TF1	TFAVE	TF0	ENERGY
158.41250	924.62278	924.62736	890.39930	842.97384	795.86693	0.557410-06
150.23750	935.02960	935.15331	901.98302	856.00595	810.32701	0.150500-04
142.06250	945.27499	945.84771	918.90028	881.57034	844.53066	0.696770-04
133.88750	954.56185	956.13338	944.06142	927.43923	911.12146	0.191190-03
126.18077	950.04257	964.70869	1157.72696	1427.28453	1697.98315	0.178430-02
118.94231	936.87072	955.21052	1206.68670	1557.68443	1909.92728	0.223120-02
111.70385	909.63950	931.18431	1234.66264	1658.12349	2032.93526	0.262110-02
104.46538	872.16332	896.36255	1243.86671	1728.68318	2214.94407	0.294410-02
97.22692	827.02818	853.26342	1235.59289	1768.94473	2303.81325	0.319180-02
89.98846	776.34252	803.94334	1210.94987	1778.69188	2347.99569	0.335790-02
82.75000	722.01256	750.27361	1171.14158	1758.19574	2346.82579	0.343820-02
75.51154	665.84495	694.04401	1117.57855	1708.33643	2300.65095	0.343070-02
68.27308	609.57738	636.99383	1051.91385	1630.64577	2210.88081	0.333550-02
61.03462	554.87596	580.80916	976.04016	1527.30373	2079.98286	0.315500-02
53.79615	503.31632	527.10356	892.06363	1401.10279	1911.43730	0.289400-02
46.55769	456.35631	477.38970	802.26221	1255.38767	1709.65795	0.255890-02
39.31923	415.30288	433.04491	709.03133	1093.97330	1479.88259	0.215850-02
29.75000	393.68382	395.38331	421.53516	457.98441	494.49936	0.206760-03
17.85000	389.43297	390.22282	402.44733	419.48538	436.55398	0.960930-04
5.95000	387.88469	388.03670	390.40294	393.70095	397.00485	0.184930-04

TIME	POWER	POOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
11.080	9.6150-01	-6.7420-03	1.0970+01	9.9020-01	-1.6060-01	1.3840-01	0.0	0.0	-2.2140-02	8	0

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 1					
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	923.561	923.569	889.450	842.172	795.209
150.237	933.914	934.139	902.458	858.565	814.969
142.062	943.892	944.931	924.678	896.731	869.088
133.887	952.103	954.954	961.184	970.224	979.612
126.181	946.221	961.172	1149.313	1412.865	1677.536
118.942	933.309	952.006	1197.304	1540.684	1835.285
111.704	906.617	928.581	1224.726	1639.135	2054.868
104.465	869.883	894.553	1233.748	1708.297	2134.263
97.227	825.641	852.387	1225.638	1747.762	2271.373
89.988	775.959	804.097	1201.483	1757.316	2314.681
82.750	722.705	751.516	1162.462	1737.226	2313.534
75.512	667.649	696.397	1109.960	1688.353	2268.273
68.273	612.495	640.445	1045.595	1612.201	2180.280
61.035	558.877	585.314	971.223	1510.905	2051.974
53.796	508.338	532.588	888.909	1387.202	1856.765
46.558	462.307	483.750	800.836	1244.371	1688.980
39.319	422.067	440.154	709.500	1036.153	1463.753
29.750	398.077	401.160	446.647	510.211	573.890
17.850	390.664	392.097	413.360	443.073	472.839
5.950	387.964	388.240	392.356	398.107	403.869

VDTIME	11.240	ZVOIDU	133.863	RHO-D	-0.9555D-02	G	145.735
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.1304D-01	H	29.142
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	566.405
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.3482D-02	HV	1000.000
		ZHFL	79.750			PHV	1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 2					
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	858.415	858.427	828.502	787.033	745.837
150.237	867.474	867.778	841.547	805.219	769.154
142.062	875.962	877.371	867.032	852.893	839.037
133.887	881.992	885.859	911.841	948.441	985.397
126.181	875.290	888.119	1049.013	1274.401	1500.749
118.942	864.211	880.254	1090.193	1384.030	1679.014
111.704	841.307	860.154	1113.724	1468.559	1824.531
104.465	809.786	830.955	1121.465	1527.906	1935.563
97.227	771.823	794.773	1114.506	1561.770	2010.310
89.988	729.191	753.336	1093.779	1569.968	2047.472
82.750	683.494	708.216	1060.296	1552.729	2046.488
75.512	636.252	660.920	1015.245	1510.793	2007.651
68.273	588.926	612.909	960.014	1445.447	1932.145
61.035	542.916	565.602	896.197	1358.527	1822.048
53.796	499.550	520.358	825.565	1252.380	1680.285
46.558	460.052	478.451	750.033	1129.819	1510.569
39.319	425.522	441.042	671.617	994.054	1317.306
29.750	401.751	405.933	467.645	553.882	640.274
17.850	391.694	393.637	422.485	462.796	503.179
5.950	388.030	388.404	393.988	401.791	409.608

VDTIME	13.490	ZVOIDU	133.863	RHO-D	-0.1539D-01	G	145.735
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.2258D-01	H	29.142
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	566.405
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.7184D-02	HV	1000.000
		ZHFL	79.750			PHV	1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 58

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 3					
AXIAL LOCATION (CH)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	880.219	880.228	848.878	805.438	762.287
150.237	889.727	889.957	861.189	821.335	781.755
142.062	898.837	899.901	882.919	859.515	836.394
133.887	906.125	909.043	919.266	933.856	948.779
126.181	900.381	914.057	1086.020	1326.911	1568.825
118.942	888.572	905.673	1129.915	1443.820	1758.842
111.704	864.158	884.248	1154.996	1533.868	1913.951
104.465	830.559	853.124	1163.248	1597.128	2032.303
97.227	790.094	814.557	1155.830	1633.224	2111.978
89.988	744.652	770.388	1133.737	1641.963	2151.589
82.750	695.943	722.295	1098.047	1623.587	2150.540
75.512	645.586	671.880	1050.026	1578.886	2109.143
68.273	595.140	620.704	991.154	1509.233	2028.660
61.035	546.098	570.279	923.130	1416.583	1911.304
53.796	499.872	522.052	847.842	1303.438	1760.196
46.558	457.771	477.383	767.331	1172.798	1579.292
39.319	420.964	437.508	683.746	1028.083	1373.289
29.750	398.324	401.480	448.057	513.144	578.347
17.850	390.733	392.200	413.973	444.397	474.876
5.950	387.969	388.251	392.465	398.354	404.254
VOTIME	12.770	ZVOIDU	133.863	RHO-D -0.1499D-01	G 145.735
FRTIME	1000.000	ZVOIDL	133.863	RHO-C 0.2043D-01	H 29.142
TFMOV	1000.000	ZDOU	133.863	RHO-CL 0.0	P/H 566.405
PHIXV	1000.000	ZDOL	133.863	RHO-F 0.0	GV 1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET 0.5434D-02	HV 1000.000
		ZHFL	79.750		PWV 1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CHANNEL 4 CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	856.309	856.319	826.549	785.311	744.362
150.237	866.024	866.292	839.630	802.716	766.078
142.062	875.223	876.463	863.644	846.053	828.752
133.887	882.123	885.525	904.530	931.392	953.608
126.181	874.434	886.502	1035.995	1245.462	1455.872
118.942	864.324	879.415	1075.029	1348.902	1623.792
111.704	841.987	859.715	1096.428	1427.705	1760.074
104.465	810.761	830.673	1102.241	1482.204	1863.327
97.227	772.896	794.483	1093.682	1512.240	1932.011
89.988	730.214	752.925	1071.774	1517.774	1965.019
82.750	684.354	707.609	1037.592	1499.131	1961.923
75.512	636.866	660.070	992.364	1457.108	1923.088
68.273	589.236	611.795	937.501	1393.011	1849.714
61.035	542.886	564.225	874.600	1308.655	1743.832
53.796	499.162	518.736	805.419	1206.332	1608.271
46.558	459.310	476.617	731.846	1088.765	1446.591
39.319	424.442	439.041	655.852	959.042	1242.997
29.750	400.975	404.654	458.890	534.679	610.605
17.850	391.478	393.187	418.551	453.993	489.499
5.950	388.017	388.346	393.257	400.121	406.996

VDTIME	13.560	ZVOIDU	133.863	RHO-D	-0.20000-01	G	135.629
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.27980-01	M	27.121
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/W	608.608
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.79840-02	HV	1000.000
		ZHFL	79.750			PWV	1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 60

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CHANNEL 5 CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	893.561	893.567	861.376	816.789	772.519
150.237	904.099	904.257	873.533	830.973	788.712
142.062	914.394	915.128	892.218	850.558	829.193
133.887	923.392	925.405	920.950	915.055	909.481
126.181	917.052	930.452	1097.175	1330.780	1565.431
118.942	905.826	922.582	1140.518	1445.638	1751.836
111.704	881.023	900.708	1164.279	1533.139	1903.212
104.465	846.351	868.461	1170.733	1593.653	2017.862
97.227	804.305	828.276	1161.230	1627.005	2094.127
89.988	756.912	782.130	1136.904	1633.150	2130.778
82.750	705.991	731.812	1098.949	1612.449	2127.341
75.512	653.261	679.025	1048.728	1565.787	2034.219
68.273	600.373	625.422	987.809	1494.616	2002.746
61.035	548.907	572.601	917.965	1400.948	1835.176
53.796	500.357	522.091	841.148	1287.331	1734.652
46.558	456.105	475.323	759.454	1156.787	1555.125
39.319	417.389	433.600	675.072	1012.744	1351.267
29.750	395.588	397.766	429.863	474.715	519.649
17.850	389.967	390.979	405.990	426.965	447.977
5.950	387.919	388.114	391.021	395.083	399.152
VDTIME	12.510	ZVOIDU	133.863	RHO-D -0.20360-01	G 135.629
FRTIME	1000.000	ZVOIDL	133.863	RHO-C 0.25660-01	H 27.121
TFMOV	1000.000	ZDOU	133.863	RHO-CL 0.0	P/H 608.608
PHIXV	1000.000	ZDOL	133.863	RHO-F 0.0	GV 1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-HET 0.52980-02	WV 1000.000
		ZHFL	79.750		PWV 1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CHANNEL 6 CLADDING TEMPERATURE (C)	FUEL BORY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	857.513	857.520	827.675	786.350	745.328
150.237	867.831	868.027	840.210	801.697	763.471
142.062	877.795	878.705	860.789	836.092	811.688
133.887	886.023	888.520	893.704	901.268	909.163
126.181	878.226	889.965	1034.261	1236.485	1439.658
118.942	868.710	883.390	1072.537	1337.385	1603.246
111.704	846.432	863.677	1092.843	1413.583	1735.404
104.465	814.888	834.257	1097.409	1465.614	1834.963
97.227	776.426	797.426	1087.564	1493.461	1900.549
89.988	732.943	755.035	1064.418	1497.187	1931.175
82.750	686.134	708.755	1029.113	1477.197	1926.504
75.512	637.600	660.172	982.930	1434.343	1836.961
68.273	588.874	610.818	927.324	1369.970	1813.778
61.035	541.421	562.179	863.924	1285.913	1708.994
53.796	496.628	515.668	794.514	1184.467	1575.418
46.558	455.775	472.611	720.995	1068.340	1416.567
39.319	420.012	434.213	645.344	940.539	1236.580
29.750	397.989	400.689	440.451	496.016	551.680
17.850	390.641	391.896	410.497	436.491	462.530
5.950	387.963	388.204	391.808	396.843	401.887

VDTIME	13.530	ZVOIDU	133.863	RHO-D	-0.17280-01	G	128.531
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.19630-01	H	25.702
TFNOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	642.218
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZMFU	79.750	RHO-NET	0.23520-02	HV	1000.000
		ZHFL	79.750			P/W	1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 62

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CH)	COOLANT TEMPERATURE (C)	CHANNEL 7 CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	876.290	876.296	845.333	802.488	759.989
150.237	888.401	888.570	859.087	818.292	777.826
142.062	900.221	901.005	879.793	850.534	821.604
133.887	910.411	912.564	911.013	909.207	907.759
126.181	900.026	911.161	1044.921	1232.476	1421.007
118.942	891.967	905.890	1082.144	1329.015	1576.906
111.704	869.801	886.159	1100.450	1400.431	1701.483
104.465	837.419	855.791	1102.487	1447.715	1794.062
97.227	797.416	817.334	1089.863	1471.161	1853.615
89.988	751.866	772.821	1063.889	1471.066	1879.418
82.750	702.616	724.072	1025.868	1448.010	1871.325
75.512	651.394	672.803	977.215	1402.982	1829.902
68.273	599.851	620.665	919.493	1337.426	1756.466
61.035	549.564	569.252	854.423	1253.238	1653.091
53.796	502.022	520.081	783.859	1152.743	1522.574
46.558	458.601	474.570	709.756	1038.647	1368.373
39.319	420.534	434.004	634.123	913.969	1194.522
29.750	397.659	399.987	434.206	482.022	529.926
17.850	390.551	391.633	407.653	430.040	452.467
5.950	387.957	388.165	391.271	395.611	399.959

VTIME	13.190	ZVOIDU	133.863	RHO-D	-0.20440-01	G	114.333
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.23690-01	H	22.862
TFHOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	721.972
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.32450-02	HV	1000.000
		ZHFL	79.750			PHV	1000.000

*****RADIAL,TEMPERATURE EDITS*****

EDITS FOR CHANNEL 8

AXIAL
LOCATION
(CH)

LOCATION (CH)	TAVG	TCLAD	TFUEL OUTER	TFUEL AVG	TFUEL CENTER	RH	THM	TFR
158.412	924.623	924.627	890.399	842.974	795.867	0.0	0.0	0.843340+03
150.237	935.030	935.153	901.983	856.006	810.327	0.0	0.0	0.856380+03
142.062	945.275	945.848	918.900	881.570	844.531	0.0	0.0	0.881950+03
133.887	954.562	956.133	944.061	927.439	911.121	0.0	0.0	0.927830+03
126.181	950.043	964.709	1157.727	1427.285	1697.983	0.0	0.0	0.142760+04
118.942	936.871	955.211	1206.687	1557.684	1909.927	0.0	0.0	0.155800+04
111.704	909.640	931.184	1234.663	1658.123	2082.935	0.0	0.0	0.165840+04
104.465	872.163	896.363	1243.867	1728.683	2214.944	0.0	0.0	0.172900+04
97.227	827.028	853.263	1235.593	1768.945	2303.813	0.0	0.0	0.176920+04
89.988	776.343	803.943	1210.950	1778.692	2347.996	0.0	0.0	0.177890+04
82.750	722.013	750.274	1171.142	1758.196	2346.826	0.0	0.0	0.175840+04
75.512	665.845	694.044	1117.579	1708.336	2300.651	0.0	0.0	0.170850+04
68.273	609.577	636.994	1051.914	1630.646	2210.881	0.0	0.0	0.163070+04
61.035	554.876	580.809	976.040	1527.304	2079.983	0.0	0.0	0.152740+04
53.796	503.316	527.104	892.064	1401.103	1911.437	0.0	0.0	0.140110+04
46.558	456.356	477.390	802.262	1255.388	1709.658	0.0	0.0	0.125540+04
39.319	415.303	433.045	709.031	1093.973	1479.883	0.0	0.0	0.109400+04
29.750	393.684	395.383	421.535	457.984	494.499	0.0	0.0	0.457990+03
17.850	389.433	390.223	402.447	419.485	436.554	0.0	0.0	0.419490+03
5.950	387.885	388.037	390.403	393.701	397.005	0.0	0.0	0.393700+03

VDTIME	11.080	ZVOIDU	133.863	RHO-D	-0.74800-02	G	145.735
FRTIME	11.580	ZVOIDL	133.863	RHO-C	0.83040-02	H	29.142
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	566.405
PHIXV	0.961	ZDOL	133.863	RHO-F	0.0	GV	145.735
PINTGV	10.971	ZMFU	79.750	RHO-NET	0.82450-03	MV	29.142
		ZMFL	79.750			PMV	566.405

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 64

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 9					
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	853.788	853.793	824.128	783.040	742.245
150.237	863.503	863.635	835.132	795.648	756.439
142.062	873.025	873.641	851.624	821.184	791.015
133.887	881.471	883.160	876.554	867.628	858.991
126.181	875.825	888.208	1042.347	1258.318	1475.256
118.942	865.451	880.936	1082.400	1364.459	1647.560
111.704	842.531	860.721	1104.357	1445.318	1787.400
104.465	810.488	830.920	1110.320	1501.239	1893.347
97.227	771.632	793.783	1101.537	1532.058	1963.823
89.988	727.834	751.138	1079.055	1537.734	1997.691
82.750	680.775	704.636	1043.978	1518.602	1994.512
75.512	632.045	655.854	997.566	1475.480	1954.661
68.273	583.168	606.316	941.269	1409.708	1879.369
61.035	535.606	557.502	876.723	1323.147	1770.722
53.796	490.738	510.822	805.734	1218.151	1631.619
46.558	449.843	467.602	730.239	1097.513	1465.717
39.319	414.063	429.043	652.259	964.401	1277.329
29.750	394.330	396.156	423.080	460.703	498.395
17.850	389.615	390.463	403.054	420.649	438.275
5.950	387.896	388.060	390.498	393.905	397.318
VOTIME	13.510	ZVOIDU	133.863	RHO-D -0.1537D-01	6 135.622
FRTIME	1000.000	ZVOIDL	133.863	RHO-C 0.5151D-02	W 27.119
TFMOV	1000.000	ZDOU	133.863	RHO-CL 0.0	P/W 608.643
PHIXV	1000.000	ZDOL	133.863	RHO-F 0.0	GV 1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET -0.1022D-01	HV 1000.000
		ZHFL	79.750		PHV 1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 10					
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLAODING TEMPERATURE (C)	FUEL BDY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	870.156	870.159	839.632	797.419	755.575
150.237	883.257	883.336	852.892	810.777	769.011
142.062	896.341	896.707	869.507	831.903	794.637
133.887	908.731	909.735	891.087	865.413	840.077
126.181	897.808	908.300	1032.528	1206.791	1382.035
118.942	891.169	904.289	1068.506	1298.578	1529.658
111.704	869.684	885.097	1085.205	1365.377	1646.596
104.465	837.457	854.769	1085.530	1408.495	1732.542
97.227	797.220	815.988	1071.262	1428.447	1786.741
89.988	751.141	770.886	1043.838	1425.694	1808.672
82.750	701.140	721.358	1004.655	1400.937	1798.335
75.512	649.009	669.183	955.198	1355.246	1756.385
68.273	596.456	616.070	897.083	1290.108	1634.179
61.035	545.110	563.662	832.064	1207.431	1583.779
53.796	496.506	513.523	762.014	1109.521	1457.920
46.558	452.065	467.112	688.890	999.029	1309.955
39.319	413.058	425.751	614.688	878.895	1143.768
29.750	392.790	393.876	409.810	432.076	454.383
17.850	389.185	389.690	397.155	407.586	418.036
5.950	387.869	387.966	389.414	391.438	393.465

VDTIME	13.250	ZVOIDU	133.863	RHO-D	-0.19700-01	6	104.987
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	-0.28030-01	W	20.994
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/W	786.238
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	-0.47730-01	HV	1000.000
		ZHFL	79.750			PWV	1000.000

TIME	POWER	POOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
11.090	9.6140-01	-7.4530-03	1.0980+01	9.9020-01	-1.6070-01	1.3850-01	0.0	0.0	0.0	-2.2170-02	8 0

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 66

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 1					
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	923.811	923.820	889.770	842.538	795.568
150.237	934.170	934.394	902.785	858.939	815.337
142.062	944.152	945.191	925.011	897.112	869.462
133.887	952.367	955.218	961.522	970.608	979.989
126.181	946.482	961.433	1149.638	1413.222	1677.867
118.942	933.575	952.272	1197.621	1541.022	1885.595
111.704	906.881	928.845	1225.027	1639.447	2055.149
104.465	870.138	894.808	1234.027	1708.578	2184.511
97.227	825.883	852.629	1225.892	1748.007	2271.584
89.988	776.183	804.321	1201.707	1757.524	2314.853
82.750	722.908	751.719	1162.656	1737.395	2313.668
75.512	667.828	696.576	1110.121	1688.485	2268.369
68.273	612.649	640.599	1045.724	1612.296	2180.341
61.035	559.003	585.441	971.321	1510.966	2052.003
53.796	508.435	532.686	888.976	1387.233	1885.766
46.558	462.378	483.821	800.925	1244.377	1688.959
39.319	422.111	440.198	709.516	1086.137	1463.716
29.750	398.109	401.192	446.662	510.213	573.889
17.850	390.678	392.111	413.366	443.072	472.837
5.950	387.967	388.242	392.357	398.107	403.868

VDTIME	11.240	ZVOIDU	133.863	RHO-D	-0.95640-02	G	145.735
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.13050-01	H	29.142
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	823.315
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.34840-02	HV	1000.000
		ZHFL	79.750			PHV	1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 2					
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	858.624	858.636	828.779	787.354	746.152
150.237	867.687	867.991	841.830	805.548	769.476
142.062	876.178	877.588	867.320	853.227	839.364
133.887	882.211	886.078	912.131	948.775	985.723
126.181	875.506	888.336	1049.293	1274.713	1501.039
118.942	864.431	880.475	1090.466	1384.376	1679.287
111.704	841.525	860.372	1113.982	1468.832	1824.778
104.465	809.997	831.166	1121.706	1528.153	1935.781
97.227	772.022	794.972	1114.724	1561.986	2010.497
89.988	729.376	753.520	1093.972	1570.152	2047.626
82.750	683.661	708.383	1060.463	1552.880	2046.609
75.512	636.398	661.066	1015.384	1510.911	2007.739
68.273	589.050	613.033	960.125	1445.534	1932.203
61.035	543.017	565.703	896.281	1358.585	1822.078
53.796	499.627	520.435	825.623	1252.412	1680.292
46.558	460.105	478.505	750.068	1129.829	1510.557
39.319	425.552	441.072	671.631	994.047	1317.280
29.750	401.794	405.976	467.666	553.884	640.273
17.850	391.713	393.656	422.493	462.795	503.177
5.950	388.034	388.408	393.990	401.791	409.607
VDTIME	13.490	ZVOIDU	133.863	RHO-D -0.15410-01	G 145.735
FRTIME	1000.000	ZVOIDL	133.863	RHO-C 0.22590-01	W 29.142
TFMOV	1000.000	ZDOU	133.863	RHO-CL 0.0	P/W 722.721
PHIXV	1000.000	ZDOL	133.863	RHO-F 0.0	GV 1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET 0.71870-02	WV 1000.000
		ZHFL	79.750		PHV 1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 68

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	CHANNEL 3 FUEL EDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	880.447	880.455	849.172	805.775	762.616
150.237	889.959	890.189	861.489	821.679	782.093
142.062	899.074	900.137	883.225	859.865	836.737
133.887	906.365	909.283	919.574	934.209	949.124
126.181	900.619	914.294	1086.317	1327.238	1569.129
118.942	888.814	905.915	1130.205	1444.131	1759.127
111.704	864.397	884.487	1155.272	1534.155	1914.210
104.465	830.791	853.355	1163.504	1597.386	2032.531
97.227	790.313	814.776	1156.063	1633.449	2112.172
89.988	744.855	770.591	1133.943	1642.154	2151.748
82.750	696.127	722.479	1098.224	1623.743	2150.664
75.512	645.748	672.042	1050.173	1579.007	2109.232
68.273	595.278	620.843	991.272	1509.321	2028.717
61.035	546.211	570.393	923.219	1416.640	1911.332
53.796	499.960	522.141	847.903	1303.467	1760.199
46.558	457.833	477.446	767.367	1172.804	1579.275
39.319	421.003	437.546	683.760	1028.071	1373.256
29.750	398.357	401.513	448.073	513.145	578.346
17.850	390.748	392.214	413.979	444.396	474.874
5.950	387.971	388.253	392.466	398.354	404.254

VDTIME	12.770	ZVOIDU	133.863	RHO-D	-0.15010-01	G	145.735
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.20450-01	H	29.142
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	756.607
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.54370-02	HV	1000.000
		ZHFL	79.750			P/W	1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 4					
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	856.517	856.527	826.825	785.631	744.675
150.237	866.236	866.504	839.912	803.044	766.399
142.062	875.439	876.679	863.931	846.386	829.079
133.887	882.342	885.744	904.820	931.728	958.935
126.181	874.650	886.718	1036.274	1245.775	1456.163
118.942	864.543	879.634	1075.302	1349.201	1624.067
111.704	842.204	859.932	1096.688	1427.982	1760.326
104.465	810.971	830.883	1102.482	1482.454	1863.551
97.227	773.094	794.681	1093.901	1512.460	1932.203
89.988	730.397	753.108	1071.968	1517.962	1965.178
82.750	684.519	707.773	1037.760	1499.285	1962.049
75.512	637.010	660.214	992.503	1457.230	1923.181
68.273	589.358	611.917	937.612	1393.102	1849.777
61.035	542.985	564.323	874.684	1308.716	1743.867
53.796	499.237	518.810	805.477	1206.367	1608.282
46.558	459.361	476.668	731.881	1088.777	1446.582
39.319	424.471	439.070	655.866	959.036	1262.974
29.750	401.014	404.693	458.909	534.682	610.605
17.850	391.494	393.204	418.558	453.993	489.497
5.950	388.020	388.349	393.258	400.120	406.996
VDTIME	13.560	ZVOIDU	133.863	RHO-D -0.20010-01	G 135.629
FRTIME	1000.000	ZVOIDL	133.863	RHO-C 0.28000-01	H 27.121
TFMOV	1000.000	ZDOU	133.863	RHO-CL 0.0	P/W 727.577
PHIXV	1000.000	ZDOL	133.863	RHO-F 0.0	GV 1000.000
PINTGV	1000.000	ZMFU	79.750	RHO-NET 0.79870-02	HV 1000.000
		ZHFL	79.750		FWV 1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 70

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CH)	COOLANT TEMPERATURE (C)	CHANNEL 5 CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	893.800	893.805	861.679	817.134	772.856
150.237	904.342	904.501	873.843	831.327	789.059
142.062	914.643	915.376	892.535	860.919	829.547
133.887	923.644	925.658	921.272	915.422	909.840
126.181	917.301	930.701	1097.485	1331.120	1565.747
118.942	906.080	922.836	1140.821	1445.962	1752.184
111.704	881.275	900.959	1164.567	1533.439	1903.483
104.465	846.594	868.704	1171.001	1593.923	2018.102
97.227	804.536	828.506	1161.473	1627.242	2094.333
89.988	757.125	782.343	1137.119	1633.351	2130.947
82.750	706.184	732.005	1099.134	1612.613	2127.473
75.512	653.431	679.196	1048.882	1565.915	2084.315
68.273	600.518	625.568	987.933	1494.708	2002.808
61.035	549.026	572.721	918.058	1401.008	1835.208
53.796	500.450	522.184	841.212	1287.361	1734.656
46.558	456.172	475.390	759.492	1156.792	1555.108
39.319	417.431	433.642	675.086	1012.730	1351.232
29.750	395.611	397.788	429.874	474.717	519.648
17.850	389.977	389.989	405.994	426.964	447.976
5.950	387.921	388.116	391.021	395.082	399.151

VDTIME	12.510	ZVOIDU	133.863	RHO-D	-0.20380-01	G	135.629
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.25680-01	H	27.121
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/W	786.215
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PIHTGV	1000.000	ZHFU	79.750	RHO-NET	0.53000-02	HV	1000.000
		ZHFL	79.750			P/W	1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 6					
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BODY TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	857.726	857.733	827.954	786.670	745.641
150.237	868.049	868.246	840.495	802.025	763.793
142.062	878.018	878.927	861.080	836.427	812.016
133.887	886.250	888.746	894.000	901.608	909.496
126.181	878.449	890.188	1034.545	1236.801	1439.952
118.942	868.937	883.617	1072.815	1337.688	1603.526
111.704	846.656	863.901	1093.108	1413.864	1735.660
104.465	815.104	834.474	1097.655	1465.868	1835.191
97.227	776.631	797.630	1087.788	1493.685	1910.745
89.988	733.131	755.224	1064.617	1497.378	1731.338
82.750	686.304	708.925	1029.284	1477.354	1926.634
75.512	637.749	660.321	983.073	1434.467	1837.057
68.273	589.000	610.945	927.438	1370.062	1813.843
61.035	541.524	562.281	864.010	1285.974	1709.030
53.796	496.706	515.746	794.573	1184.501	1575.429
46.558	455.830	472.666	721.030	1068.351	1416.557
39.319	420.044	434.245	645.357	940.581	1236.554
29.750	398.017	400.717	440.465	496.018	551.680
17.850	390.654	391.908	410.503	436.490	462.529
5.950	387.965	388.206	391.808	396.843	401.887
VDTIME	13.530	ZVOIDU	133.863	RHO-D -0.1729D-01	G 128.531
FRTIME	1000.000	ZVOIDL	133.863	RHO-C 0.1964D-01	W 25.702
TFMOV	1000.000	ZDOU	133.863	RHO-CL 0.0	P/W 736.301
PHIXV	1000.000	ZDOL	133.863	RHO-F 0.0	GV 1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET 0.2352D-02	HV 1000.000
		ZHFL	79.750		PHV 1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 72

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 7							
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)		
158.412	876.511	876.517	845.621	802.820	766.313		
150.237	888.627	888.796	859.384	818.634	778.160		
142.062	900.452	901.237	880.097	850.885	821.948		
133.887	910.647	912.800	911.323	909.565	908.109		
126.181	900.257	911.392	1045.219	1232.809	1421.318		
118.942	892.202	906.126	1082.436	1329.335	1577.203		
111.704	870.034	886.391	1100.729	1400.730	1701.757		
104.465	837.643	856.015	1102.747	1447.987	1794.308		
97.227	797.627	817.545	1090.099	1471.402	1853.829		
89.988	752.061	773.016	1064.099	1471.272	1879.597		
82.750	702.791	724.247	1026.049	1448.181	1871.470		
75.512	651.546	672.955	977.365	1403.118	1830.011		
68.273	599.979	620.794	919.613	1337.528	1756.542		
61.035	549.668	569.356	854.514	1253.307	1653.136		
53.796	502.101	520.160	783.922	1152.783	1522.592		
46.558	458.656	474.624	709.793	1033.661	1368.368		
39.319	420.565	434.035	634.137	913.963	1194.499		
29.750	397.684	400.012	434.218	482.025	529.927		
17.850	390.562	391.644	407.658	430.040	452.466		
5.950	387.959	388.167	391.272	395.611	399.959		
VDTIME	13.190	ZVOIDU	133.863	RHO-D	-0.20460-01	6	114.333
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.23710-01	H	22.862
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	781.982
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.32430-02	HV	1000.000
		ZHFL	79.750			PHV	1000.000

*****RADIAL,TEMPERATURE EDITS*****

EDITS FOR CHANNEL 8

AXIAL LOCATION (CM)	TAVG	TCLAD	TFUEL OUTER	TFUEL AVG	TFUEL CENTER	RM	THM	TFR
158.412	924.213	924.218	890.449	843.341	798.226	0.0	0.0	0.84371D+03
150.237	934.632	934.756	902.041	856.381	810.695	0.0	0.0	0.85676D+03
142.062	944.952	945.525	918.986	881.953	844.907	0.0	0.0	0.88234D+03
133.887	954.418	955.989	944.207	927.827	911.503	0.0	0.0	0.92822D+03
126.181	950.380	965.046	1157.839	1427.639	1658.317	0.0	0.0	0.14280D+04
118.942	937.213	955.552	1206.729	1558.020	1910.241	0.0	0.0	0.15534D+04
111.704	909.976	931.521	1234.635	1658.431	2083.220	0.0	0.0	0.16537D+04
104.465	872.488	896.687	1243.771	1728.958	2215.195	0.0	0.0	0.17292D+04
97.227	827.334	853.570	1235.435	1769.183	2304.026	0.0	0.0	0.17694D+04
89.988	776.625	804.226	1210.737	1778.891	2348.170	0.0	0.0	0.17791D+04
82.750	722.268	750.529	1170.883	1758.356	2346.960	0.0	0.0	0.17535D+04
75.512	666.069	694.268	1117.286	1708.458	2300.747	0.0	0.0	0.17086D+04
68.273	609.768	637.185	1051.598	1630.730	2210.941	0.0	0.0	0.16303D+04
61.035	555.033	580.966	975.714	1527.354	2080.011	0.0	0.0	0.15274D+04
53.796	503.438	527.225	891.740	1401.123	1911.437	0.0	0.0	0.14011D+04
46.558	456.444	477.478	801.955	1255.382	1709.634	0.0	0.0	0.12554D+04
39.319	415.358	433.100	708.752	1093.948	1479.842	0.0	0.0	0.10939D+04
29.750	393.691	395.391	421.511	457.985	494.499	0.0	0.0	0.45799D+03
17.850	389.436	390.226	402.435	419.485	436.553	0.0	0.0	0.41948D+03
5.950	387.885	388.037	390.400	393.701	397.005	0.0	0.0	0.39370D+03

VDTIME	11.080	ZVOIDU	133.863	RHO-D	-0.7486D-02	G	145.735
FRTIME	11.580	ZVOIDL	133.863	RHO-C	0.8321D-02	H	29.142
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/W	566.405
PRIXV	0.961	ZDOL	133.863	RHO-F	0.0	GV	145.735
PINTGV	10.971	ZHFU	79.750	RHO-NET	0.8345D-03	HV	29.142
		ZHFL	79.750			PHV	566.405

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 74

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CHANNEL 9 CLADDING TEMPERATURE (C)	FUEL BDY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	854.016	854.021	824.411	783.358	742.556
150.237	863.735	863.868	835.422	795.974	756.758
142.062	873.263	873.878	851.920	821.517	791.341
133.887	881.713	883.402	876.854	867.966	859.322
126.181	876.056	888.439	1042.633	1258.631	1475.547
118.942	865.686	881.171	1032.679	1364.757	1647.835
111.704	842.763	860.954	1104.623	1445.594	1737.650
104.465	810.712	831.144	1110.567	1501.487	1893.569
97.227	771.844	793.995	1101.760	1532.275	1964.012
89.988	728.030	751.334	1079.253	1537.919	1997.846
82.750	680.952	704.813	1044.148	1518.753	1994.633
75.512	632.200	656.009	997.708	1475.597	1954.749
68.273	583.301	606.449	941.382	1409.793	1879.426
61.035	535.715	557.611	876.808	1323.202	1770.750
53.796	490.823	510.907	805.793	1218.178	1631.623
46.558	449.903	467.662	730.272	1097.517	1465.700
39.319	414.101	429.081	652.271	964.387	1277.297
29.750	394.349	396.175	423.089	460.705	498.395
17.850	389.623	390.472	403.058	420.649	438.274
5.950	387.898	388.061	390.499	393.905	397.318

VDTIME	13.510	ZVDTDU	133.863	RHO-D	-0.15380-01	G	135.622
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.51560-02	H	27.119
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	724.475
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFL	79.750	RHO-NET	-0.10230-01	HV	1000.000
			79.750			PWV	1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CHANNEL 10		FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
		CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)		
158.412	870.394	870.397	839.925	797.746	755.893
150.237	883.500	883.579	853.194	811.115	769.341
142.062	896.590	896.956	869.817	832.252	794.978
133.887	908.985	909.989	891.405	865.771	840.427
126.181	898.047	908.539	1032.829	1207.124	1382.346
118.942	891.412	904.532	1068.803	1298.900	1529.957
111.704	869.924	885.337	1085.488	1365.679	1646.874
104.465	837.688	855.000	1085.794	1408.769	1732.792
97.227	797.437	816.205	1071.502	1428.690	1786.959
89.988	751.341	771.086	1044.051	1425.903	1808.855
82.750	701.319	721.537	1004.839	1401.110	1798.482
75.512	649.166	669.339	955.351	1355.382	1756.497
68.273	596.589	616.202	897.205	1290.209	1684.257
61.035	545.217	563.769	832.155	1207.500	1583.825
53.796	496.588	513.605	762.077	1109.559	1457.938
46.558	452.123	467.170	688.926	999.041	1309.949
39.319	413.093	425.785	614.700	878.885	1143.742
29.750	392.802	393.888	409.816	432.078	454.384
17.850	389.190	389.695	397.157	407.586	418.036
5.950	387.870	387.967	389.415	391.438	393.465

VDTIME	13.250	ZVOIDU	133.863	RHO-D	-0.19720-01	G	104.987
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	-0.28050-01	H	20.994
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	786.179
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZMFU	79.750	RHO-NET	-0.47770-01	HV	1000.000
		ZMFL	79.750			PHV	1000.000

TIME	POWER	PDOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL	PROGRAMMED	NET REAC	IPHI	IREA
11.100	9.6140-01	-7.1160-03	1.0990+01	9.8940-01	-1.6090-01	1.3870-01	0.0	0.0	0.0	-2.2200-02	8	0
11.110	9.6130-01	-6.3170-03	1.1000+01	9.8910-01	-1.6100-01	1.3880-01	0.0	0.0	0.0	-2.2220-02	8	0
11.120	9.6120-01	-5.7550-03	1.1010+01	9.8870-01	-1.6120-01	1.3890-01	0.0	0.0	0.0	-2.2240-02	8	0
11.130	9.6120-01	-4.8000-03	1.1020+01	9.8830-01	-1.6130-01	1.3910-01	0.0	0.0	0.0	-2.2250-02	8	0
11.140	9.6110-01	-4.2590-03	1.1030+01	9.8800-01	-1.6150-01	1.3920-01	0.0	0.0	0.0	-2.2250-02	8	0
11.150	9.6110-01	-3.6800-03	1.1040+01	9.8760-01	-1.6160-01	1.3940-01	0.0	0.0	0.0	-2.2250-02	8	0
11.160	9.6110-01	-3.0880-03	1.1050+01	9.8730-01	-1.6180-01	1.3960-01	0.0	0.0	0.0	-2.2240-02	8	0
11.170	9.6100-01	-2.5000-03	1.1060+01	9.8690-01	-1.6190-01	1.3970-01	0.0	0.0	0.0	-2.2220-02	8	0
11.180	9.5800-01	-4.5810-01	1.1070+01	9.8650-01	-1.6190-01	1.3650-01	0.0	0.0	0.0	-2.5370-02	8	0
11.190	9.4410-01	-1.9220+00	1.1080+01	9.8600-01	-1.6190-01	1.2130-01	0.0	0.0	0.0	-4.0670-02	8	0
11.200	9.4920-01	1.4440+00	1.1090+01	9.8530-01	-1.6210-01	1.2760-01	0.0	0.0	0.0	-3.4590-02	8	0
11.210	9.4740-01	-5.0700-01	1.1100+01	9.8500-01	-1.6220-01	1.2570-01	0.0	0.0	0.0	-3.6570-02	8	0
11.220	9.4090-01	-8.9360-01	1.1110+01	9.8440-01	-1.6210-01	1.1840-01	0.0	0.0	0.0	-4.3700-02	8	0
11.230	9.4050-01	2.6430-01	1.1110+01	9.8370-01	-1.6210-01	1.1830-01	0.0	0.0	0.0	-4.3860-02	8	0

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 76

CHANNEL 1 VOIDING TIME= 0.112400+02

TEMPERATURE PROFILES AT VOIDING

Z	TCOOL	TCLAD	TF1	TFAVE	TFO	ENERGY
158.41250	927.51570	927.52352	894.46881	847.94207	800.99633	0.985600-06
150.23750	937.94575	938.15673	907.57905	864.45917	820.89003	0.266110-04
142.06250	947.99720	948.97394	929.88369	902.71765	875.10052	0.123200-03
133.88750	956.26893	958.94912	966.43524	976.23713	985.63610	0.338060-03
126.18077	950.34264	964.40149	1154.24003	1418.21696	1632.61548	0.177330-02
118.94231	937.45132	955.03173	1202.05395	1545.69397	1889.96667	0.221750-02
111.70385	910.66435	931.31706	1229.18093	1643.68129	2059.02915	0.260500-02
104.46538	873.74498	896.94221	1237.82314	1712.30238	2187.83008	0.292590-02
97.22692	829.24397	854.39290	1229.27216	1751.17701	2274.30544	0.317210-02
89.98846	779.24113	805.69910	1204.63388	1760.11784	2316.96605	0.333720-02
82.75000	725.61727	752.70813	1165.10573	1739.41238	2315.18312	0.341710-02
75.51154	670.15555	697.18698	1112.08667	1689.94318	2269.31830	0.340960-02
68.27308	614.57164	640.85287	1047.21269	1613.22999	2180.77227	0.331490-02
61.03462	560.51112	585.37052	972.35380	1511.42617	2051.98045	0.313560-02
53.79615	509.53059	532.33288	889.58816	1387.28363	1886.36866	0.287610-02
46.55769	463.07019	483.23266	801.16078	1244.09339	1688.27528	0.254320-02
39.31923	422.41928	439.42667	709.42911	1085.60482	1462.84367	0.214520-02
29.75000	398.41812	401.31653	446.79920	510.20043	573.81708	0.365580-03
17.85000	390.78334	392.13040	413.40148	443.04607	472.78412	0.169910-03
5.95000	387.97336	388.23260	392.35522	398.09745	403.85437	0.326990-04

TIME	POWER	PDOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
11.240	9.4030-01	-9.9090-03	1.1120+01	9.8320-01	-1.6220-01	1.1820-01	0.0	0.0	-4.3950-02	8	0
11.250	9.4030-01	9.7720-03	1.1130+01	9.8260-01	-1.6220-01	1.1850-01	0.0	0.0	-4.3790-02	8	0
11.260	9.4030-01	2.2680-03	1.1140+01	9.8210-01	-1.6230-01	1.1870-01	0.0	0.0	-4.3620-02	8	0
11.270	9.4030-01	3.8330-03	1.1150+01	9.8150-01	-1.6240-01	1.1900-01	0.0	0.0	-4.3430-02	8	0
11.280	9.4040-01	5.3910-03	1.1160+01	9.8100-01	-1.6250-01	1.1930-01	0.0	0.0	-4.3220-02	8	0
11.290	9.4040-01	6.4090-03	1.1170+01	9.8050-01	-1.6260-01	1.1960-01	0.0	0.0	-4.3010-02	8	0
11.300	9.4050-01	7.1370-03	1.1180+01	9.7990-01	-1.6270-01	1.1990-01	0.0	0.0	-4.2790-02	8	0
11.310	9.4580-01	7.8250-01	1.1190+01	9.7950-01	-1.6250-01	1.2580-01	0.0	0.0	-3.6760-02	8	0
11.320	9.4600-01	-2.3000-01	1.1200+01	9.7910-01	-1.6260-01	1.2610-01	0.0	0.0	-3.6550-02	8	0
11.330	9.4610-01	2.2440-03	1.1210+01	9.7860-01	-1.6280-01	1.2640-01	0.0	0.0	-3.6320-02	8	0
11.340	9.4450-01	-2.4220-01	1.1220+01	9.7820-01	-1.6250-01	1.2480-01	0.0	0.0	-3.7690-02	8	0
11.350	9.3690-01	-1.0510+00	1.1230+01	9.7770-01	-1.6250-01	1.1610-01	0.0	0.0	-4.6340-02	8	0
11.360	9.3850-01	6.1160-01	1.1240+01	9.7700-01	-1.6270-01	1.1840-01	0.0	0.0	-4.4210-02	8	0
11.370	9.3790-01	-1.6680-01	1.1250+01	9.7660-01	-1.6270-01	1.1790-01	0.0	0.0	-4.4810-02	8	0
11.380	9.3680-01	-1.3040-01	1.1260+01	9.7610-01	-1.6250-01	1.1670-01	0.0	0.0	-4.5850-02	8	0
11.390	9.3770-01	1.7580-01	1.1270+01	9.7550-01	-1.6250-01	1.1780-01	0.0	0.0	-4.4740-02	8	0
11.400	9.3840-01	7.4080-02	1.1270+01	9.7510-01	-1.6260-01	1.1880-01	0.0	0.0	-4.3760-02	8	0
11.410	9.3860-01	-1.4590-02	1.1280+01	9.7460-01	-1.6270-01	1.1920-01	0.0	0.0	-4.3450-02	8	0
11.420	9.3870-01	1.5260-02	1.1290+01	9.7410-01	-1.6280-01	1.1960-01	0.0	0.0	-4.3140-02	8	0
11.430	9.3890-01	1.7170-02	1.1300+01	9.7360-01	-1.6290-01	1.2000-01	0.0	0.0	-4.2820-02	8	0
11.440	9.3910-01	1.7260-02	1.1310+01	9.7320-01	-1.6300-01	1.2050-01	0.0	0.0	-4.2500-02	8	0
11.450	9.5050-01	1.7030+00	1.1320+01	9.7280-01	-1.6280-01	1.3320-01	0.0	0.0	-2.9630-02	8	0
11.460	9.5090-01	-5.0200-01	1.1330+01	9.7260-01	-1.6300-01	1.3360-01	0.0	0.0	-2.9350-02	8	0
11.470	9.5110-01	3.3390-04	1.1340+01	9.7230-01	-1.6310-01	1.3400-01	0.0	0.0	-2.9080-02	8	0
11.480	9.6040-01	1.3930+00	1.1350+01	9.7200-01	-1.6300-01	1.4410-01	0.0	0.0	-1.8830-02	8	0
11.490	9.6090-01	-4.0480-01	1.1360+01	9.7190-01	-1.6320-01	1.4460-01	0.0	0.0	-1.8610-02	8	0
11.500	9.6100-01	3.0480-03	1.1370+01	9.7170-01	-1.6340-01	1.4500-01	0.0	0.0	-1.8410-02	8	0
11.510	9.6120-01	2.1090-02	1.1380+01	9.7150-01	-1.6360-01	1.4530-01	0.0	0.0	-1.8200-02	8	0

TIME	POWER	PDOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL	PROGRAMMED	NET REAC	IPHI	IREA
11.520	9.6140-01	1.8790-02	1.1390+01	9.7130-01	-1.6370-01	1.4570-01	0.0	0.0	0.0	-1.8000-02	8	0
11.530	9.6160-01	1.7360-02	1.1400+01	9.7110-01	-1.6390-01	1.4610-01	0.0	0.0	0.0	-1.7820-02	8	0
11.540	9.6170-01	1.5510-02	1.1410+01	9.7090-01	-1.6410-01	1.4650-01	0.0	0.0	0.0	-1.7650-02	8	0
11.550	9.6190-01	1.5840-02	1.1420+01	9.7070-01	-1.6430-01	1.4690-01	0.0	0.0	0.0	-1.7480-02	8	0
11.560	9.6210-01	1.5590-02	1.1430+01	9.7050-01	-1.6450-01	1.4720-01	0.0	0.0	0.0	-1.7320-02	8	0
11.570	9.6220-01	1.5310-02	1.1440+01	9.7030-01	-1.6470-01	1.4760-01	0.0	0.0	0.0	-1.7160-02	8	0
11.580	9.6240-01	1.5040-02	1.1450+01	9.7020-01	-1.6490-01	1.4800-01	0.0	0.0	0.0	-1.7000-02	8	0
11.590	9.6250-01	1.4790-02	1.1460+01	9.7000-01	-1.6520-01	1.4830-01	0.0	0.0	0.0	-1.6840-02	8	0
11.600	9.6270-01	1.4530-02	1.1470+01	9.6980-01	-1.6540-01	1.4870-01	0.0	0.0	J.0	-1.6690-02	8	0
11.610	9.9650-01	5.0710+00	1.1480+01	9.6980-01	-1.6500-01	1.8350-01	0.0	0.0	0.0	1.8510-02	8	0
11.620	9.9760-01	-1.5360+00	1.1490+01	9.7040-01	-1.6530-01	1.8390-01	0.0	0.0	0.0	1.8540-02	10	0
11.630	9.9760-01	-4.1720-02	1.1500+01	9.7050-01	-1.6560-01	1.8420-01	0.0	0.0	0.0	1.8560-02	8	0
11.640	9.9780-01	2.5990-02	1.1510+01	9.7070-01	-1.6600-01	1.8450-01	0.0	0.0	0.0	1.8550-02	8	0
11.650	9.9800-01	1.4330-02	1.1520+01	9.7080-01	-1.6630-01	1.8480-01	0.0	0.0	0.0	1.8530-02	8	0
11.660	9.9810-01	1.5050-02	1.1530+01	9.7100-01	-1.6660-01	1.8510-01	0.0	0.0	0.0	1.8490-02	8	0
11.670	9.9830-01	1.4750-02	1.1540+01	9.7120-01	-1.6700-01	1.8540-01	0.0	0.0	0.0	1.8460-02	8	0
11.680	9.9840-01	1.4330-02	1.1550+01	9.7130-01	-1.6730-01	1.8570-01	0.0	0.0	0.0	1.8420-02	8	0
11.690	9.9860-01	1.3910-02	1.1560+01	9.7150-01	-1.6760-01	1.8600-01	0.0	0.0	0.0	1.8390-02	8	0
11.700	9.9870-01	1.3500-02	1.1570+01	9.7170-01	-1.6790-01	1.8630-01	0.0	0.0	0.0	1.8350-02	8	0
11.710	9.9880-01	1.3120-02	1.1580+01	9.7180-01	-1.6830-01	1.8660-01	0.0	0.0	0.0	1.8310-02	8	0
11.720	9.9900-01	1.2740-02	1.1590+01	9.7200-01	-1.6860-01	1.8690-01	0.0	0.0	0.0	1.8270-02	8	0
11.730	9.9910-01	1.2370-02	1.1600+01	9.7220-01	-1.6890-01	1.8720-01	0.0	0.0	0.0	1.8230-02	8	0
11.740	9.9920-01	1.2000-02	1.1610+01	9.7240-01	-1.6930-01	1.8750-01	0.0	0.0	0.0	1.8190-02	8	0
11.750	9.9930-01	1.1640-02	1.1620+01	9.7250-01	-1.6960-01	1.8770-01	0.0	0.0	0.0	1.8140-02	8	0
11.760	9.9950-01	1.1290-02	1.1630+01	9.7270-01	-1.6990-01	1.8800-01	0.0	0.0	0.0	1.8100-02	8	0
11.770	9.9960-01	1.0940-02	1.1640+01	9.7290-01	-1.7030-01	1.8830-01	0.0	0.0	0.0	1.8050-02	8	0
11.780	1.0460+00	7.0300+00	1.1650+01	9.7320-01	-1.7000-01	2.3280-01	0.0	0.0	0.0	6.2790-02	8	0
11.790	1.0480+00	-2.1400+00	1.1660+01	9.7440-01	-1.7050-01	2.3300-01	0.0	0.0	0.0	6.2550-02	10	0
11.800	1.0480+00	-7.5030-02	1.1670+01	9.7480-01	-1.7100-01	2.3330-01	0.0	0.0	0.0	6.2300-02	8	0
11.810	1.0480+00	2.3400-02	1.1680+01	9.7540-01	-1.7150-01	2.3350-01	0.0	0.0	0.0	6.2040-02	8	0
11.820	1.0480+00	1.2120-02	1.1690+01	9.7600-01	-1.7200-01	2.3370-01	0.0	0.0	0.0	6.1770-02	8	0
11.830	1.0480+00	1.2040-02	1.1700+01	9.7660-01	-1.7250-01	2.3400-01	0.0	0.0	0.0	6.1510-02	8	0
11.840	1.0480+00	1.1410-02	1.1710+01	9.7720-01	-1.7290-01	2.3420-01	0.0	0.0	0.0	6.1250-02	8	0
11.850	1.0480+00	1.0850-02	1.1720+01	9.7770-01	-1.7340-01	2.3440-01	0.0	0.0	0.0	6.0980-02	8	0
11.860	1.0490+00	1.0320-02	1.1730+01	9.7830-01	-1.7390-01	2.3460-01	0.0	0.0	0.0	6.0720-02	8	0
11.870	1.0490+00	9.7930-03	1.1740+01	9.7890-01	-1.7440-01	2.3490-01	0.0	0.0	0.0	6.0460-02	8	0
11.880	1.0490+00	9.2840-03	1.1750+01	9.7940-01	-1.7490-01	2.3510-01	0.0	0.0	0.0	6.0200-02	8	0
11.890	1.0490+00	8.7990-03	1.1760+01	9.8000-01	-1.7540-01	2.3530-01	0.0	0.0	0.0	5.9940-02	8	0
11.900	1.0490+00	8.3220-03	1.1770+01	9.8050-01	-1.7580-01	2.3550-01	0.0	0.0	0.0	5.9680-02	8	0

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 78

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CH)	COOLANT TEMPERATURE (C)	CHANNEL 1 CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	952.664	922.695	901.365	866.195	825.609
150.237	955.107	934.673	915.577	883.535	846.089
142.062	957.550	946.812	939.009	922.683	900.917
133.887	959.993	959.779	977.820	997.611	1012.028
126.181	962.296	976.367	1173.485	1443.609	1708.901
118.942	964.458	982.989	1231.531	1575.035	1915.359
111.704	966.621	983.216	1276.393	1679.019	2082.300
104.465	968.784	992.917	1307.759	1754.189	2207.885
97.227	970.947	997.026	1324.174	1798.354	2290.384
89.988	974.110	1000.568	1323.780	1809.214	2329.241
82.750	936.139	963.230	1289.261	1786.095	2324.993
75.512	874.233	901.265	1231.521	1733.490	2276.763
68.273	810.183	836.465	1160.776	1653.270	2135.888
61.035	745.493	770.352	1078.853	1547.636	2054.886
53.796	681.599	704.401	987.800	1419.388	1887.259
46.558	619.839	640.001	839.839	1271.863	1687.418
39.319	561.410	578.417	787.309	1108.855	1460.570
29.750	508.791	511.689	507.780	527.043	571.022
17.850	463.114	464.462	453.194	453.800	470.729
5.950	414.208	414.467	406.736	401.913	403.051
VOTIME	11.240	ZVOIDU	210.519	RHO-D -0.97140-02	G 145.735
FRTIME	11.740	ZVOIDL	95.535	RHO-C 0.61780-01	H 29.142
TFNOV	1000.000	ZDOU	175.519	RHO-CL 0.0	P/W 805.224
PHIXV	0.940	ZDOL	113.035	RHO-F 0.0	GV 145.735
PINTGV	11.124	ZMFU	79.750	RHO-NET 0.52070-01	WV 29.142
		ZMFL	79.750		PHV 805.224

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CHANNEL 2 CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	874.590	874.601	848.929	811.388	772.116
150.237	883.960	884.264	862.424	830.154	796.080
142.062	892.739	894.149	888.389	878.441	866.579
133.887	898.977	902.844	933.665	974.579	1013.417
126.181	892.044	904.874	1071.150	1300.719	1527.924
118.942	880.310	896.353	1111.870	1409.940	1705.463
111.704	856.317	875.164	1134.394	1493.322	1849.586
104.465	823.413	844.582	1140.730	1551.099	1958.748
97.227	783.866	806.816	1132.065	1583.029	2031.276
89.988	739.528	763.673	1109.414	1539.022	2065.973
82.750	692.072	716.794	1073.863	1569.387	2062.371
75.512	643.082	667.750	1026.671	1524.947	2020.851
68.273	594.082	618.066	969.298	1457.067	1942.680
61.035	546.536	569.222	903.407	1367.657	1830.013
53.796	501.828	522.636	830.837	1259.142	1685.851
46.558	461.246	479.645	753.573	1134.405	1513.974
39.319	425.953	441.473	673.703	996.728	1318.848
29.750	402.546	406.728	468.794	555.099	641.137
17.850	391.909	393.853	422.860	463.205	503.433
5.950	388.044	388.418	394.030	401.839	409.628

VDTIME	13.490	ZVOIDU	133.863	RHO-D	-0.1691D-01	G	145.735
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.2347D-01	H	29.142
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/W	783.469
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PHXGV	1000.000	ZHFL	79.750	RHO-NET	0.6552D-02	HV	1000.000
						PHV	1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 80

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 3					
AXIAL LOCATION (CH)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	897.672	897.681	870.572	831.030	789.760
150.237	907.517	907.747	883.354	847.530	809.906
142.062	916.950	918.014	905.581	856.341	805.203
133.887	924.496	927.415	942.413	961.297	978.142
126.181	918.549	932.225	1109.643	1354.711	1597.373
118.942	906.015	923.116	1153.032	1471.127	1786.615
111.704	880.414	900.503	1177.026	1560.002	1940.240
104.465	845.314	867.879	1183.766	1621.534	2055.599
97.227	803.134	827.597	1174.515	1655.615	2133.909
89.988	755.847	781.583	1150.354	1661.997	2170.894
82.750	705.234	731.586	1112.444	1641.063	2167.056
75.512	652.986	679.280	1062.123	1593.688	2122.799
68.273	600.727	626.291	1000.951	1521.327	2031.475
61.035	550.016	574.198	930.698	1426.016	1919.382
53.796	502.332	524.512	853.325	1310.340	1765.717
46.558	459.049	478.661	770.950	1177.372	1532.510
39.319	421.413	437.957	685.801	1030.611	1374.520
29.750	398.924	402.080	448.924	514.062	578.998
17.850	390.896	392.363	414.256	444.706	475.068
5.950	387.979	388.261	392.497	398.391	404.269
VDTIME	12.770	ZVOIDU	133.863	RHO-D -0.16540-01	G 145.735
FRTIME	1000.000	ZVOIDL	133.863	RHO-C 0.21260-01	H 29.142
TFH0V	1000.000	ZDOU	133.863	RHO-CL 0.0	P/H 825.437
PHIXV	1000.000	ZDOL	133.863	RHO-F 0.0	GV 1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET 0.47290-02	HV 1000.000
		ZHFL	79.750		PHV 1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CHANNEL 4 CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)		
158.412	872.556	872.566	846.954	809.548	770.463		
150.237	882.608	882.876	860.517	827.575	792.876		
142.062	892.127	893.367	885.040	871.562	856.221		
133.887	899.266	902.668	926.416	957.524	986.616		
126.181	891.310	903.378	1058.143	1271.727	1483.017		
118.942	880.591	895.681	1096.751	1374.748	1650.274		
111.704	857.191	874.919	1117.159	1452.473	1785.204		
104.465	824.593	844.505	1121.570	1505.407	1826.611		
97.227	785.144	806.732	1111.300	1533.507	1953.086		
89.988	740.747	763.458	1087.456	1536.826	1983.630		
82.750	693.110	716.354	1051.189	1515.775	1977.909		
75.512	643.849	667.052	1003.800	1471.233	1936.378		
68.273	594.515	617.074	946.774	1404.585	1860.320		
61.035	546.593	567.932	881.776	1317.724	1751.848		
53.796	501.491	521.064	810.638	1213.017	1613.863		
46.558	460.520	477.827	735.312	1093.260	1449.997		
39.319	424.866	439.465	657.852	961.614	1264.515		
29.750	401.730	405.409	459.956	535.804	611.415		
17.850	391.682	393.392	418.897	454.369	489.737		
5.950	388.029	388.358	393.295	400.164	407.015		
VDTIME	13.560	ZVOIDU	133.863	RHO-D	-0.22000-01	G	135.629
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.29100-01	H	27.121
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	793.767
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZMFU	79.750	RHO-NET	0.70960-02	HV	1000.000
		ZHFL	79.750			PHV	1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 82

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CHANNEL 5 CLADDING TEMPERATURE (C)	FUEL BDY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	911.941	911.947	883.910	843.123	800.656
150.237	922.862	923.020	896.592	857.975	817.606
142.062	933.531	934.265	915.821	898.248	858.830
133.887	942.856	944.869	945.086	943.421	939.789
126.181	936.285	949.685	1121.815	1359.547	1594.912
118.942	924.342	941.099	1164.662	1473.933	1780.633
111.704	898.320	918.005	1187.301	1560.231	1930.457
104.465	862.083	884.193	1192.175	1619.001	2043.058
97.227	818.239	842.210	1180.749	1650.196	2116.873
89.988	768.899	794.117	1154.248	1653.874	2150.789
82.750	715.960	741.781	1113.953	1630.492	2144.438
75.512	661.216	686.981	1061.307	1581.024	2099.324
68.273	606.388	631.438	997.957	1507.011	2013.871
61.035	553.126	576.821	925.753	1410.550	1893.427
53.796	502.995	524.729	846.728	1294.272	1740.213
46.558	457.455	476.672	763.058	1161.282	1558.259
39.319	417.833	434.043	677.022	1015.089	1352.302
29.750	396.035	398.212	430.493	475.381	520.128
17.850	390.089	391.101	406.194	427.187	448.118
5.950	387.927	388.121	391.043	395.108	399.163

VOTIME	12.510	ZVOIDU	133.863	RHO-D	-0.22450-01	G	135.629
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.26750-01	H	27.121
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	857.738
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.43070-02	HV	1000.000
		ZHFL	79.750			PHV	1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

		CHANNEL 6				
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)	
158.412	874.238	874.245	848.380	810.704	771.431	
150.237	884.924	885.120	861.429	826.710	790.318	
142.062	895.242	896.152	832.543	861.787	839.260	
133.887	903.764	906.260	915.976	927.622	937.363	
126.181	895.689	907.428	1056.836	1263.029	1467.009	
118.942	885.575	900.255	1094.699	1363.532	1629.975	
111.704	862.221	879.466	1114.002	1438.647	1760.788	
104.465	829.275	848.644	1117.135	1489.039	1858.488	
97.227	789.187	810.187	1105.537	1514.961	1921.835	
89.988	743.935	766.027	1080.402	1516.424	1949.954	
82.750	695.287	717.908	1042.953	1493.970	1942.606	
75.512	644.913	667.484	994.546	1443.536	1900.308	
68.273	594.411	616.355	936.710	1381.551	1824.380	
61.035	545.312	566.069	871.146	1294.926	1716.942	
53.796	499.068	518.108	799.712	1191.035	1580.881	
46.558	457.032	473.868	724.382	1072.662	1419.785	
39.319	420.436	434.637	647.219	942.939	1237.854	
29.750	398.575	401.274	441.265	496.873	552.305	
17.850	390.800	392.055	410.760	436.775	462.714	
5.950	387.973	388.214	391.836	396.875	401.901	
VDTIME	13.530	ZVOIDU	133.863	RHO-D	-0.19030-01	G 128.531
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.20440-01	H 25.702
TFMOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H 803.284
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	6V 1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.14060-02	HV 1000.000
		ZHFL	79.750			PHV 1000.000

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 84

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 7					
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	893.865	893.871	866.935	827.769	787.009
150.237	906.411	906.580	831.298	844.353	805.728
142.062	918.656	919.441	902.630	877.395	850.374
133.887	929.213	931.366	934.454	936.841	937.305
126.181	918.455	929.589	1068.557	1260.184	1449.597
118.942	909.863	923.787	1105.422	1356.390	1604.968
111.704	886.629	902.986	1122.717	1426.716	1728.217
104.465	852.808	871.181	1123.270	1472.356	1818.895
97.227	811.111	831.029	1108.808	1493.737	1876.129
89.958	763.702	784.656	1080.738	1491.262	1899.311
82.750	712.503	733.959	1040.450	1465.607	1888.406
75.512	659.317	680.726	989.438	1417.855	1844.077
68.273	605.868	626.682	929.346	1349.535	1767.735
61.035	553.801	573.490	861.973	1262.629	1661.546
53.796	504.679	522.739	789.251	1159.546	1528.384
46.558	459.958	475.926	713.217	1043.071	1371.788
39.319	420.971	434.441	635.974	916.306	1195.857
29.750	398.230	400.558	434.973	482.825	530.525
17.850	390.706	391.788	407.899	430.304	452.642
5.950	387.967	388.175	391.297	395.640	399.973

VDTIME	13.190	ZVOIDU	133.863	RHO-D	-0.2251D-01	G	114.333
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	0.2469D-01	H	22.862
TFMGV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	853.120
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	0.2182D-02	HV	1000.000
		ZHFL	79.750			PHV	1000.000

*****RADIAL TEMPERATURE EDITS*****

EDITS FOR CHANNEL 8

AXIAL LOCATION (CM)	TAVG	TCLAD	TFUEL OUTER	TFUEL AVG	TFUEL CENTER	RH	THM	TFR
158.412	952.664	919.046	899.006	865.394	826.122	0.0	0.0	0.865610+03
158.237	955.107	931.087	911.906	879.465	841.340	0.0	0.0	0.879700+03
142.062	957.550	942.566	929.618	905.824	876.298	0.0	0.0	0.906070+03
133.887	959.993	954.960	956.450	952.862	943.606	0.0	0.0	0.953130+03
126.181	962.296	981.281	1181.654	1457.548	1729.842	0.0	0.0	0.145300+04
118.942	964.458	989.501	1242.222	1592.616	1940.894	0.0	0.0	0.159320+04
111.784	966.621	995.829	1289.763	1700.460	2111.855	0.0	0.0	0.170120+04
104.465	968.784	993.738	1321.015	1779.713	2240.601	0.0	0.0	0.178060+04
97.227	970.947	997.917	1340.696	1828.173	2324.993	0.0	0.0	0.182920+04
89.988	973.110	1001.432	1344.341	1843.629	2363.890	0.0	0.0	0.184490+04
82.750	976.273	1004.534	1329.812	1823.786	2358.010	0.0	0.0	0.182540+04
75.512	921.658	949.857	1274.189	1769.840	2308.742	0.0	0.0	0.177140+04
68.273	855.567	882.983	1201.280	1687.513	2215.997	0.0	0.0	0.168900+04
61.035	788.274	814.207	1116.579	1579.083	2082.321	0.0	0.0	0.158050+04
53.796	721.158	744.946	1022.124	1447.387	1911.287	0.0	0.0	0.144870+04
46.538	655.510	676.544	920.138	1295.819	1707.398	0.0	0.0	0.129750+04
39.319	592.486	610.228	812.968	1128.234	1475.968	0.0	0.0	0.112920+04
29.750	534.540	536.240	503.240	433.851	491.103	0.0	0.0	0.424500+03
17.850	482.323	483.113	456.175	436.317	434.175	0.0	0.0	0.436740+03
5.950	421.769	421.921	409.955	399.775	396.105	0.0	0.0	0.399930+03

VDTIME	11.080	ZVOIDU	223.645	RHO-D	-0.80930-02	G	145.735
FRTIME	11.580	ZVOIDL	88.972	RHO-C	0.52170-01	W	29.142
TFMOV	1000.000	ZDOU	188.645	RHO-CL	0.0	P/W	566.405
PHIXV	0.961	ZDOL	106.472	RHO-F	0.0	SV	145.735
PINTGV	10.971	ZHFU	79.750	RHO-NET	0.44080-01	WV	29.142
		ZHFL	79.750			FW	566.405

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 86

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CHANNEL 9 CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	870.796	870.801	844.935	807.318	768.166
150.237	880.865	880.998	856.424	820.542	783.058
142.062	890.735	891.351	873.415	846.711	818.321
133.887	899.489	901.178	898.837	893.777	886.924
126.181	893.629	906.012	1065.111	1284.860	1502.437
118.942	882.563	898.047	1104.688	1390.558	1674.063
111.704	858.488	876.679	1125.591	1470.300	1812.516
104.465	824.978	845.410	1130.081	1524.604	1916.570
97.227	784.443	806.594	1119.509	1553.426	1934.781
89.988	738.833	762.137	1095.011	1556.820	2016.122
82.750	689.903	713.765	1057.767	1535.208	2010.251
75.512	639.310	663.119	1009.113	1489.492	1967.634
68.273	588.645	611.793	950.570	1421.094	1839.589
61.035	539.431	561.327	883.850	1331.953	1778.284
53.796	493.115	513.199	810.827	1224.501	1636.696
46.558	451.045	468.804	733.515	1101.606	1468.550
39.319	414.447	429.427	654.018	966.512	1278.222
29.750	394.700	396.526	423.606	461.261	498.797
17.850	389.715	390.564	403.225	420.835	433.393
5.950	387.903	388.066	390.517	393.927	397.328

VTIME	13.510	ZVOIDU	133.863	RHO-D	-0.16940-01	G	135.622
FRIME	1000.000	ZVOIDL	133.863	RHO-C	0.53120-02	H	27.119
TFHOV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	790.382
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	-0.11630-01	HV	1000.000
		ZHFL	79.750			PWV	1000.000

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CHANNEL 10		FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
		CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)		
158.412	888.213	888.216	861.353	822.452	782.121
150.237	901.803	901.882	875.281	836.659	796.520
142.062	915.376	915.742	892.576	853.650	823.110
133.887	928.229	929.233	914.830	893.014	869.474
126.181	916.887	927.379	1056.478	1234.506	1410.487
118.942	909.739	922.859	1092.131	1326.017	1557.675
111.704	887.173	902.586	1107.815	1391.744	1673.333
104.465	853.476	870.788	1106.630	1433.208	1757.395
97.227	811.495	830.263	1090.482	1451.067	1809.266
89.988	763.494	783.239	1060.908	1445.893	1828.552
82.750	711.474	731.691	1019.396	1418.488	1815.363
75.512	657.301	677.475	967.513	1370.016	1770.457
68.273	602.758	622.371	906.957	1302.055	1695.288
61.035	549.544	568.096	839.563	1216.600	1592.011
53.796	499.269	516.286	767.283	1116.040	1463.446
46.558	453.441	468.488	692.159	1003.112	1313.025
39.319	413.453	426.146	616.293	880.838	1144.697
29.750	393.077	394.163	410.190	432.473	454.685
17.850	389.263	389.768	397.276	407.716	418.124
5.950	387.874	387.971	389.427	391.452	393.472

VDTIME	13.250	ZVOIDU	133.863	RHO-D	-0.2167D-01	G	104.987
FRTIME	1000.000	ZVOIDL	133.863	RHO-C	-0.2943D-01	H	20.994
TFMDV	1000.000	ZDOU	133.863	RHO-CL	0.0	P/H	857.700
PHIXV	1000.000	ZDOL	133.863	RHO-F	0.0	GV	1000.000
PINTGV	1000.000	ZHFU	79.750	RHO-NET	-0.5110D-01	HV	1000.000
		ZHFL	79.750			PHV	1000.000

TIME	POWER	PDOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL	PROGRAMMED	NET REAC	IPHI	IREA
11.910	1.049D+00	7.833D-03	1.178D+01	9.811D-01	-1.763D-01	2.358D-01	0.0	0.0	0.0	5.943D-02	8	0
11.920	1.049D+00	7.361D-03	1.179D+01	9.816D-01	-1.768D-01	2.360D-01	0.0	0.0	0.0	5.917D-02	8	0
11.930	1.049D+00	6.900D-03	1.180D+01	9.822D-01	-1.773D-01	2.362D-01	0.0	0.0	0.0	5.891D-02	8	0
11.940	1.049D+00	6.449D-03	1.181D+01	9.827D-01	-1.778D-01	2.364D-01	0.0	0.0	0.0	5.866D-02	8	0
11.950	1.049D+00	5.839D-03	1.182D+01	9.832D-01	-1.782D-01	2.366D-01	0.0	0.0	0.0	5.840D-02	8	0
11.960	1.079D+00	4.477D+00	1.184D+01	9.839D-01	-1.784D-01	2.631D-01	0.0	0.0	0.0	8.468D-02	8	0
11.970	1.080D+00	-1.369D+00	1.185D+01	9.850D-01	-1.790D-01	2.633D-01	0.0	0.0	0.0	8.430D-02	8	0
11.980	1.108D+00	4.225D+00	1.186D+01	9.858D-01	-1.793D-01	2.872D-01	0.0	0.0	0.0	1.079D-01	8	0
11.990	1.109D+00	-1.294D+00	1.187D+01	9.871D-01	-1.799D-01	2.874D-01	0.0	0.0	0.0	1.075D-01	8	0
12.000	1.109D+00	-4.478D-02	1.188D+01	9.880D-01	-1.806D-01	2.876D-01	0.0	0.0	0.0	1.070D-01	8	0
12.010	1.109D+00	1.454D-02	1.189D+01	9.890D-01	-1.813D-01	2.878D-01	0.0	0.0	0.0	1.065D-01	8	0
12.020	1.109D+00	5.196D-03	1.190D+01	9.900D-01	-1.819D-01	2.879D-01	0.0	0.0	0.0	1.060D-01	8	0
12.030	1.109D+00	5.488D-03	1.191D+01	9.910D-01	-1.826D-01	2.881D-01	0.0	0.0	0.0	1.055D-01	8	0
12.040	1.109D+00	4.802D-03	1.192D+01	9.920D-01	-1.832D-01	2.883D-01	0.0	0.0	0.0	1.050D-01	8	0
12.050	1.110D+00	4.144D-03	1.194D+01	9.929D-01	-1.839D-01	2.884D-01	0.0	0.0	0.0	1.045D-01	8	0
12.060	1.110D+00	3.505D-03	1.195D+01	9.939D-01	-1.845D-01	2.886D-01	0.0	0.0	0.0	1.041D-01	8	0
12.070	1.110D+00	2.852D-03	1.196D+01	9.948D-01	-1.852D-01	2.888D-01	0.0	0.0	0.0	1.036D-01	8	0
12.080	1.110D+00	2.226D-03	1.197D+01	9.958D-01	-1.859D-01	2.890D-01	0.0	0.0	0.0	1.031D-01	8	0

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 88

TIME	POWER	POOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
12.090	1.1100+00	1.6200-03	1.1980+01	9.9670-01	-1.8650-01	2.8910-01	0.0	0.0	1.0260-01	8	0
12.100	1.1100+00	1.0290-03	1.1990+01	9.9760-01	-1.8710-01	2.8930-01	0.0	0.0	1.0220-01	8	0
12.110	1.1100+00	4.5660-04	1.2000+01	9.9850-01	-1.8780-01	2.8950-01	0.0	0.0	1.0170-01	8	0
12.120	1.1100+00	-9.1050-05	1.2010+01	9.9940-01	-1.8840-01	2.8960-01	0.0	0.0	1.0120-01	8	0
12.130	1.1100+00	-6.2760-04	1.2020+01	1.0000+00	-1.8910-01	2.8980-01	0.0	0.0	1.0080-01	8	0
12.140	1.1100+00	-1.1500-03	1.2040+01	1.0010+00	-1.8970-01	2.9000-01	0.0	0.0	1.0030-01	8	0
12.150	1.1450+00	5.3100+00	1.2050+01	1.0020+00	-1.9000-01	3.1820-01	0.0	0.0	1.2820-01	8	0
12.160	1.1460+00	-1.6290+00	1.2060+01	1.0040+00	-1.9080-01	3.1840-01	0.0	0.0	1.2760-01	8	0
12.170	1.1460+00	-7.0880-02	1.2070+01	1.0050+00	-1.9150-01	3.1850-01	0.0	0.0	1.2700-01	8	0
12.180	1.1460+00	6.8550-03	1.2080+01	1.0060+00	-1.9220-01	3.1870-01	0.0	0.0	1.2640-01	8	0
12.190	1.1460+00	-2.7160-03	1.2090+01	1.0070+00	-1.9300-01	3.1890-01	0.0	0.0	1.2590-01	8	0
12.200	1.1760+00	4.5990+00	1.2100+01	1.0080+00	-1.9350-01	3.4200-01	0.0	0.0	1.4850-01	8	0
12.210	1.1770+00	-1.4100+00	1.2120+01	1.0100+00	-1.9430-01	3.4210-01	0.0	0.0	1.4780-01	8	0
12.220	1.1770+00	-6.0900-02	1.2130+01	1.0110+00	-1.9510-01	3.4230-01	0.0	0.0	1.4720-01	8	0
12.230	1.1770+00	6.0700-03	1.2140+01	1.0130+00	-1.9600-01	3.4240-01	0.0	0.0	1.4650-01	8	0
12.240	1.1770+00	-2.4140-03	1.2150+01	1.0140+00	-1.9680-01	3.4260-01	0.0	0.0	1.4590-01	8	0
12.250	1.1770+00	-2.8130-03	1.2160+01	1.0150+00	-1.9760-01	3.4270-01	0.0	0.0	1.4510-01	8	0
12.260	1.1770+00	-3.5890-03	1.2180+01	1.0170+00	-1.9840-01	3.4290-01	0.0	0.0	1.4450-01	8	0
12.270	1.1770+00	-6.6060-03	1.2190+01	1.0180+00	-1.9920-01	3.4300-01	0.0	0.0	1.4390-01	8	0
12.280	1.1770+00	-7.4790-03	1.2200+01	1.0190+00	-2.0010-01	3.4320-01	0.0	0.0	1.4310-01	8	0
12.290	1.1770+00	-7.8070-03	1.2210+01	1.0200+00	-2.0090-01	3.4330-01	0.0	0.0	1.4240-01	8	0
12.300	1.1770+00	-8.2430-03	1.2220+01	1.0220+00	-2.0170-01	3.4340-01	0.0	0.0	1.4180-01	8	0
12.310	1.1770+00	-8.9250-03	1.2230+01	1.0230+00	-2.0250-01	3.4360-01	0.0	0.0	1.4110-01	8	0
12.320	1.1770+00	-9.5260-03	1.2250+01	1.0240+00	-2.0330-01	3.4370-01	0.0	0.0	1.4040-01	8	0
12.330	1.1770+00	-1.0110-02	1.2260+01	1.0250+00	-2.0410-01	3.4390-01	0.0	0.0	1.3980-01	8	0
12.340	1.1760+00	-1.0670-02	1.2270+01	1.0270+00	-2.0490-01	3.4400-01	0.0	0.0	1.3910-01	8	0
12.350	1.1760+00	-1.1220-02	1.2280+01	1.0280+00	-2.0570-01	3.4410-01	0.0	0.0	1.3850-01	8	0
12.360	1.1760+00	-1.1750-02	1.2290+01	1.0290+00	-2.0640-01	3.4430-01	0.0	0.0	1.3780-01	8	0
12.370	1.2140+00	5.7160+00	1.2310+01	1.0300+00	-2.0690-01	3.7180-01	0.0	0.0	1.6490-01	8	0
12.380	1.2150+00	-1.7610+00	1.2320+01	1.0320+00	-2.0780-01	3.7190-01	0.0	0.0	1.6410-01	8	0
12.390	1.2150+00	-8.5820-02	1.2330+01	1.0340+00	-2.0870-01	3.7210-01	0.0	0.0	1.6340-01	8	0
12.400	1.2150+00	-7.6940-04	1.2340+01	1.0350+00	-2.0960-01	3.7220-01	0.0	0.0	1.6260-01	8	0
12.410	1.2150+00	-1.5450-02	1.2350+01	1.0360+00	-2.1050-01	3.7240-01	0.0	0.0	1.6190-01	8	0
12.420	1.2150+00	-1.4300-02	1.2370+01	1.0380+00	-2.1140-01	3.7250-01	0.0	0.0	1.6110-01	8	0
12.430	1.2140+00	-1.4930-02	1.2380+01	1.0390+00	-2.1230-01	3.7260-01	0.0	0.0	1.6030-01	8	0
12.440	1.2140+00	-1.5580-02	1.2390+01	1.0410+00	-2.1320-01	3.7270-01	0.0	0.0	1.5960-01	8	0
12.450	1.2430+00	4.3720+00	1.2400+01	1.0420+00	-2.1370-01	3.9280-01	0.0	0.0	1.7900-01	8	0
12.460	1.2440+00	-1.3570+00	1.2420+01	1.0440+00	-2.1470-01	3.9290-01	0.0	0.0	1.7820-01	8	0
12.470	1.2440+00	-7.3130-02	1.2430+01	1.0450+00	-2.1570-01	3.9300-01	0.0	0.0	1.7740-01	8	0
12.480	1.2440+00	-8.6100-03	1.2440+01	1.0470+00	-2.1660-01	3.9320-01	0.0	0.0	1.7650-01	8	0
12.490	1.2430+00	-1.6690-02	1.2450+01	1.0490+00	-2.1760-01	3.9330-01	0.0	0.0	1.7570-01	8	0
12.500	1.2430+00	-1.7000-02	1.2460+01	1.0500+00	-2.1860-01	3.9340-01	0.0	0.0	1.7490-01	8	0

CHANNEL 5 VOIDING TIME= 0.125100+02

TEMPERATURE PROFILES AT VOIDING

Z	TCDL	TCLAD	TF1	TFAVE	TF0	ENERGY
158.41250	927.17751	927.18481	900.07951	861.04474	820.78162	0.780910-06
150.23750	938.41559	938.61261	913.24627	876.56716	838.53800	0.210850-04
142.06250	949.39528	950.30743	933.29836	908.15862	881.35576	0.976140-04
133.88750	958.99096	961.49390	963.92149	965.69792	965.18184	0.267850-03
126.18077	952.22952	968.88720	1149.75357	1399.20343	1641.27369	0.178260-02
118.94231	939.60462	960.43483	1194.68428	1518.19060	1832.77302	0.722920-02
111.70385	912.55292	937.02336	1218.66062	1607.95742	1987.02784	0.261870-02
104.46538	875.07069	902.55601	1224.20035	1669.09107	2102.72216	0.294140-02
97.22692	829.84731	859.64511	1212.80385	1701.54230	2178.27940	0.318830-02
89.98846	779.05612	810.40493	1185.72863	1705.37322	2212.58231	0.335430-02
82.75000	724.64664	756.74534	1144.28634	1681.05845	2205.27643	0.343510-02
75.51154	668.45506	700.48335	1089.96125	1629.61291	2156.90746	0.342750-02
68.27308	612.23839	643.37780	1024.44945	1552.63715	2068.97191	0.333240-02
61.03462	557.67318	587.12793	949.65752	1452.31559	1943.91446	0.315210-02
53.79615	506.33549	533.35287	867.67696	1331.38312	1785.08609	0.289130-02
46.55769	459.66784	483.55741	780.74137	1193.06787	1596.67049	0.255660-02
39.31923	418.92965	439.08092	691.16531	1041.01230	1383.58379	0.215650-02
29.75000	396.30950	399.01622	432.55854	479.07783	524.59081	0.289660-03
17.85000	398.17272	391.43069	407.10554	428.84912	450.12870	0.134620-03
5.95000	387.93281	388.17490	391.20852	395.41722	399.53707	0.259030-04

TIME	POWER	FOOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
12.510	1.2430+00	-1.7700-02	1.2480+01	1.0520+00	-2.1950-01	3.9360-01	0.0	0.0	1.7670-01	8	0
12.520	1.2430+00	-1.9410-02	1.2490+01	1.0530+00	-2.2040-01	3.9370-01	0.0	0.0	1.7330-01	8	0
12.530	1.2430+00	-1.4720-02	1.2500+01	1.0550+00	-2.2140-01	3.9390-01	0.0	0.0	1.7250-01	8	0
12.540	1.2430+00	-1.2020-02	1.2510+01	1.0560+00	-2.2230-01	3.9410-01	0.0	0.0	1.7170-01	8	0
12.550	1.2430+00	-9.4350-03	1.2530+01	1.0580+00	-2.2330-01	3.9430-01	0.0	0.0	1.7100-01	8	0
12.560	1.2420+00	-6.8280-03	1.2540+01	1.0590+00	-2.2420-01	3.9450-01	0.0	0.0	1.7030-01	8	0
12.570	1.2410+00	-1.6610-01	1.2550+01	1.0610+00	-2.2510-01	3.9400-01	0.0	0.0	1.6990-01	8	0
12.580	1.2360+00	-7.4330-01	1.2560+01	1.0620+00	-2.2580-01	3.9040-01	0.0	0.0	1.6460-01	8	0
12.590	1.2360+00	2.6180-01	1.2580+01	1.0630+00	-2.2670-01	3.9030-01	0.0	0.0	1.6410-01	8	0
12.600	1.2120+00	-3.5360+00	1.2590+01	1.0650+00	-2.2680-01	3.7330-01	0.0	0.0	1.4700-01	8	0
12.610	1.2050+00	1.4280-01	1.2600+01	1.0660+00	-2.2750-01	3.6930-01	0.0	0.0	1.4180-01	8	0
12.620	1.2370+00	5.1220+00	1.2610+01	1.0670+00	-2.2780-01	3.9130-01	0.0	0.0	1.6400-01	8	0
12.630	1.2480+00	-4.1690-02	1.2630+01	1.0690+00	-2.2900-01	3.9890-01	0.0	0.0	1.6980-01	8	0
12.640	1.2350+00	-2.4510+00	1.2640+01	1.0700+00	-2.2920-01	3.8950-01	0.0	0.0	1.6030-01	8	0
12.650	1.2360+00	8.2970-01	1.2650+01	1.0710+00	-2.2990-01	3.9030-01	0.0	0.0	1.6080-01	8	0
12.660	1.2380+00	2.1300-01	1.2660+01	1.0730+00	-2.3060-01	3.9210-01	0.0	0.0	1.6150-01	8	0
12.670	1.2400+00	1.8950-01	1.2680+01	1.0740+00	-2.3130-01	3.9350-01	0.0	0.0	1.6220-01	8	0
12.680	1.2400+00	-4.5130-02	1.2690+01	1.0750+00	-2.3220-01	3.9400-01	0.0	0.0	1.6180-01	8	0
12.690	1.2400+00	2.7840-02	1.2700+01	1.0770+00	-2.3310-01	3.9460-01	0.0	0.0	1.6150-01	8	0
12.700	1.2410+00	3.4680-02	1.2710+01	1.0780+00	-2.3400-01	3.9510-01	0.0	0.0	1.6110-01	8	0
12.710	1.2410+00	3.5330-02	1.2720+01	1.0790+00	-2.3480-01	3.9570-01	0.0	0.0	1.6080-01	8	0
12.720	1.2410+00	3.3930-02	1.2740+01	1.0810+00	-2.3570-01	3.9620-01	0.0	0.0	1.6050-01	8	0
12.730	1.2420+00	3.1540-02	1.2750+01	1.0820+00	-2.3660-01	3.9680-01	0.0	0.0	1.6020-01	8	0
12.740	1.2640+00	3.3580+00	1.2760+01	1.0830+00	-2.3720-01	4.1220-01	0.0	0.0	1.7510-01	8	0
12.750	1.2650+00	-9.9190-01	1.2770+01	1.0850+00	-2.3810-01	4.1230-01	0.0	0.0	1.7470-01	8	0
12.760	1.2970+00	4.7010+00	1.2790+01	1.0860+00	-2.3820-01	4.3290-01	0.0	0.0	1.9470-01	8	0

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 90

CHANNEL 3 VOIDING TIME= 0.127700+02

TEMPERATURE PROFILES AT VOIDING

Z	TCOOL	TCLAD	TF1	TFAVE	TFO	ENERGY
158.41250	919.76632	919.77736	893.34268	855.71216	817.32059	0.116140-05
150.23750	930.03798	930.33623	906.86416	873.29218	838.79320	0.313570-04
142.06250	939.87961	941.26043	930.56783	914.64335	897.26527	0.145170-03
133.88750	947.75257	951.54153	970.05322	994.51325	1016.39788	0.398350-03
126.18077	941.54791	959.30126	1150.25530	1413.47030	1667.85559	0.186650-02
118.94231	928.27389	950.47424	1197.03661	1537.28234	1866.73777	0.233400-02
111.70385	901.44135	927.52135	1223.35229	1631.39007	2027.96318	0.274190-02
104.46538	864.78251	894.07570	1231.42007	1697.54265	2149.84996	0.307970-02
97.22692	820.81853	852.57632	1222.53969	1733.95468	2230.55779	0.333880-02
89.98846	771.59733	805.00815	1197.81913	1741.01226	2268.77253	0.351260-02
82.75000	718.96372	753.17374	1158.45172	1719.05746	2263.99701	0.359660-02
75.51154	664.65994	698.79493	1105.82591	1669.00902	2216.68216	0.358870-02
68.27308	610.35549	643.54313	1041.56057	1592.40453	2128.27563	0.348910-02
61.03462	557.64414	589.03631	967.50180	1491.39680	2001.21771	0.330040-02
53.79615	508.02438	536.81885	885.69671	1368.71907	1838.89798	0.302730-02
46.55769	462.87075	488.33169	798.35139	1227.62603	1645.57972	0.267680-02
39.31923	423.40059	444.87733	707.77635	1071.81354	1426.29622	0.225790-02
29.75000	399.55134	403.64879	453.41528	522.29619	589.32729	0.430780-03
17.85000	391.08427	392.98859	416.24057	448.42413	479.74755	0.200210-03
5.95000	387.99168	388.35817	392.85759	399.08506	405.14647	0.385300-04

TIME	POWER	PDOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IFHI	IREA
12.770	1.2980+00	-1.3930+00	1.2800+01	1.0880+00	-2.3970-01	4.3340-01	0.0	0.0	1.9420-01	8	0
12.780	1.2980+00	-2.8590-02	1.2810+01	1.0900+00	-2.4010-01	4.3400-01	0.0	0.0	1.9370-01	8	0
12.790	1.2990+00	4.7690-02	1.2830+01	1.0910+00	-2.4130-01	4.3450-01	0.0	0.0	1.9320-01	8	0
12.800	1.2990+00	4.1710-02	1.2840+01	1.0930+00	-2.4240-01	4.3510-01	0.0	0.0	1.9280-01	8	0
12.810	1.3000+00	3.5760-02	1.2850+01	1.0950+00	-2.4340-01	4.3570-01	0.0	0.0	1.9230-01	8	0
12.820	1.3000+00	3.7710-02	1.2870+01	1.0960+00	-2.4440-01	4.3630-01	0.0	0.0	1.9180-01	8	0
12.830	1.3000+00	4.0650-02	1.2880+01	1.0980+00	-2.4550-01	4.3690-01	0.0	0.0	1.9140-01	8	0
12.840	1.3010+00	4.2720-02	1.2890+01	1.0990+00	-2.4650-01	4.3750-01	0.0	0.0	1.9100-01	8	0
12.850	1.3010+00	4.4770-02	1.2910+01	1.1010+00	-2.4760-01	4.3810-01	0.0	0.0	1.9060-01	8	0
12.860	1.3020+00	4.6840-02	1.2920+01	1.1020+00	-2.4860-01	4.3870-01	0.0	0.0	1.9020-01	8	0
12.870	1.3020+00	4.9410-02	1.2930+01	1.1040+00	-2.4960-01	4.3950-01	0.0	0.0	1.8980-01	8	0
12.880	1.3030+00	5.2190-02	1.2940+01	1.1060+00	-2.5070-01	4.4020-01	0.0	0.0	1.8950-01	8	0
12.890	1.3030+00	5.4090-02	1.2960+01	1.1070+00	-2.5170-01	4.4090-01	0.0	0.0	1.8920-01	8	0
12.900	1.3630+00	8.9450+00	1.2970+01	1.1090+00	-2.5170-01	4.7660-01	0.0	0.0	2.2490-01	8	0
12.910	1.4000+00	2.5780+00	1.2990+01	1.1110+00	-2.5260-01	4.9670-01	0.0	0.0	2.4410-01	8	0
12.920	1.4020+00	-1.6360+00	1.3000+01	1.1140+00	-2.5390-01	4.9740-01	0.0	0.0	2.4350-01	8	0
12.930	1.4020+00	1.3880-02	1.3010+01	1.1160+00	-2.5520-01	4.9820-01	0.0	0.0	2.4290-01	8	0
12.940	1.3950+00	-1.0480+00	1.3030+01	1.1180+00	-2.5610-01	4.9460-01	0.0	0.0	2.3850-01	8	0
12.950	1.3660+00	-4.1450+00	1.3040+01	1.1200+00	-2.5710-01	4.7750-01	0.0	0.0	2.2030-01	10	0
12.960	1.3720+00	2.6850+00	1.3050+01	1.1210+00	-2.5850-01	4.8240-01	0.0	0.0	2.2380-01	8	0
12.970	1.3640+00	-1.6050+00	1.3070+01	1.1230+00	-2.5920-01	4.7710-01	0.0	0.0	2.1790-01	8	0
12.980	1.3670+00	8.8440-01	1.3080+01	1.1250+00	-2.6050-01	4.7930-01	0.0	0.0	2.1910-01	8	0
12.990	1.3700+00	3.9010-01	1.3100+01	1.1270+00	-2.6130-01	4.8160-01	0.0	0.0	2.2030-01	8	0
13.000	1.3710+00	-2.0300-03	1.3110+01	1.1290+00	-2.6250-01	4.8270-01	0.0	0.0	2.2020-01	8	0
13.010	1.3720+00	4.6790-02	1.3120+01	1.1300+00	-2.6370-01	4.8350-01	0.0	0.0	2.1960-01	8	0
13.020	1.3730+00	6.9100-02	1.3140+01	1.1320+00	-2.6490-01	4.8430-01	0.0	0.0	2.1940-01	8	0
13.030	1.3740+00	6.8320-02	1.3150+01	1.1340+00	-2.6610-01	4.8510-01	0.0	0.0	2.1910-01	8	0
13.040	1.3740+00	6.7230-02	1.3160+01	1.1360+00	-2.6730-01	4.8600-01	0.0	0.0	2.1870-01	8	0

TIME	POWER	POOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
13.050	1.3750+00	6.6260-02	1.3180+01	1.1380+00	-2.6350-01	4.8680-01	0.0	0.0	2.1830-01	8	0
13.060	1.4050+00	4.5190+00	1.3190+01	1.1400+00	-2.6900-01	5.0390-01	0.0	0.0	2.3190-01	8	0
13.070	1.5010+00	1.2860+01	1.3210+01	1.1420+00	-2.6920-01	5.5280-01	0.0	0.0	2.8350-01	8	0
13.080	1.5230+00	-1.5220+00	1.3220+01	1.1450+00	-2.7050-01	5.6200-01	0.0	0.0	2.9160-01	10	0
13.090	1.5240+00	-9.8850-01	1.3240+01	1.1480+00	-2.7210-01	5.6270-01	0.0	0.0	2.9070-01	8	0
13.100	1.5240+00	4.3930-02	1.3250+01	1.1500+00	-2.7370-01	5.6350-01	0.0	0.0	2.8930-01	8	0
13.110	1.5250+00	5.7500-02	1.3270+01	1.1530+00	-2.7530-01	5.6420-01	0.0	0.0	2.8890-01	8	0
13.120	1.5250+00	5.2600-02	1.3280+01	1.1550+00	-2.7690-01	5.6490-01	0.0	0.0	2.8800-01	8	0
13.130	1.5260+00	5.1120-02	1.3300+01	1.1580+00	-2.7850-01	5.6560-01	0.0	0.0	2.8710-01	8	0
13.140	1.5260+00	5.0390-02	1.3310+01	1.1610+00	-2.8010-01	5.6640-01	0.0	0.0	2.8620-01	8	0
13.150	1.5270+00	4.8460-02	1.3330+01	1.1630+00	-2.8170-01	5.6710-01	0.0	0.0	2.8540-01	8	0
13.160	1.5270+00	4.6850-02	1.3350+01	1.1660+00	-2.8330-01	5.6780-01	0.0	0.0	2.8450-01	8	0
13.170	1.5280+00	4.3540-02	1.3360+01	1.1680+00	-2.8490-01	5.6850-01	0.0	0.0	2.8370-01	8	0
13.180	1.5280+00	4.3540-02	1.3380+01	1.1710+00	-2.8650-01	5.6930-01	0.0	0.0	2.8280-01	8	0

CHANNEL 7 VOIDING TIME= 0.131900+02

TEMPERATURE PROFILES AT VOIDING

Z	TCOOL	TCLAD	TF1	TFAVE	TF0	ENERGY
158.41250	929.72141	929.73140	902.36706	864.37741	826.56265	0.896060-06
150.23750	943.15639	943.42598	918.03945	882.76087	847.47500	0.241940-04
142.06250	956.26918	957.51729	941.70378	919.66105	896.98575	0.112010-03
133.88750	967.57430	970.99910	977.48264	986.30805	993.14073	0.307350-03
126.18077	956.05323	973.76783	1131.56027	1350.09004	1557.87122	0.153980-02
118.94231	947.08083	969.23271	1174.19352	1458.24344	1728.97210	0.198800-02
111.70385	922.45286	948.47594	1195.43105	1537.83090	1864.67704	0.233540-02
104.46538	886.51933	915.74858	1198.25801	1590.07540	1964.50174	0.262310-02
97.22692	842.17042	873.85889	1184.47521	1615.37457	2027.48518	0.284330-02
89.98846	791.70682	825.04471	1155.54602	1614.11215	2052.96472	0.299180-02
82.75000	737.16836	771.30371	1112.92588	1586.98643	2040.90250	0.306340-02
75.51154	680.46214	714.52262	1058.19616	1535.15038	1992.03118	0.305670-02
68.27308	623.40566	656.52086	993.11114	1460.26321	1907.90970	0.297180-02
61.03462	567.72973	599.05338	919.60058	1364.49238	1790.92461	0.281110-02
53.79615	515.06062	543.79225	839.74643	1250.48337	1644.25296	0.257840-02
46.55769	466.88946	492.29482	755.74154	1121.30511	1471.79506	0.227990-02
39.31923	424.52931	445.95917	669.83161	980.37350	1278.08038	0.192320-02
29.75000	399.27872	402.98237	441.28655	494.41558	545.32531	0.332370-03
17.85000	391.02322	392.74452	410.67359	435.53526	459.35803	0.154470-03
5.95000	387.98927	388.32053	391.79739	396.61655	401.23347	0.297280-04

TIME	POWER	POOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
13.190	1.5910+00	9.4050+00	1.3390+01	1.1730+00	-2.8740-01	5.9810-01	0.0	0.0	3.1080-01	8	0
13.200	1.5890+00	-3.4510+00	1.3410+01	1.1770+00	-2.8910-01	5.9690-01	0.0	0.0	3.0780-01	10	0
13.210	1.5820+00	-8.5930-01	1.3420+01	1.1790+00	-2.9030-01	5.9470-01	0.0	0.0	3.0350-01	8	0
13.220	1.5730+00	-1.0980+00	1.3440+01	1.1820+00	-2.9240-01	5.9100-01	0.0	0.0	2.9850-01	8	0
13.230	1.6180+00	7.2300+00	1.3460+01	1.1850+00	-2.9380-01	6.1140-01	0.0	0.0	3.1750-01	8	0
13.240	1.6960+00	9.4540+00	1.3470+01	1.1880+00	-2.9380-01	6.4170-01	0.0	0.0	3.4790-01	8	0

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 92

CHANNEL 10 VOIDING TIME= 0.132500+02

TEMPERATURE PROFILES AT VOIDING

Z	TPOOL	TCLAD	TF1	TFAVE	TFO	ENERGY
158.41250	926.46286	926.46783	898.86702	860.73763	822.97556	0.421030-06
150.23750	941.09179	941.22577	914.07331	876.54050	839.27243	0.113680-04
142.06250	955.70272	956.32299	933.18448	901.19869	869.14756	0.526290-04
133.88750	969.53791	971.23991	958.09679	939.96253	921.05343	0.144410-03
126.18077	957.32888	975.11423	1123.13151	1328.77480	1523.42295	0.150910-02
118.94231	949.85655	972.09691	1164.87228	1432.82180	1687.10237	0.183710-02
111.70385	925.83069	951.95771	1184.66584	1508.21575	1815.77283	0.221690-02
104.46538	889.86253	919.20852	1185.79608	1556.52826	1909.35114	0.249000-02
97.22692	845.00473	876.81977	1170.26068	1578.39972	1967.16704	0.269950-02
89.98846	793.67288	827.14391	1139.66494	1574.39196	1988.77369	0.284000-02
82.75000	737.99723	772.26891	1095.57233	1545.33475	1974.28924	0.290790-02
75.51154	679.96180	714.15931	1039.64810	1492.47416	1924.54922	0.290160-02
68.27308	621.45232	654.69778	973.71081	1417.52810	1841.16553	0.282100-02
61.03462	564.26058	595.70933	899.73668	1322.69040	1726.52936	0.266840-02
53.79615	510.06677	538.91115	819.83591	1210.60155	1583.77859	0.244760-02
46.55769	460.39212	485.89895	736.20778	1084.29407	1416.72792	0.216420-02
39.31923	416.55495	438.07041	651.06985	947.11210	1229.78278	0.182560-02
29.75000	393.64913	395.48971	413.46974	438.46533	462.32384	0.156170-03
17.85010	389.43733	390.29275	398.71433	410.41787	421.58860	0.725820-04
5.95000	387.88628	388.05091	389.68539	391.95554	394.12179	0.139680-04

TIME	POWER	PDDT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
13.250	1.6950+00	-4.0480+00	1.3490+01	1.1920+00	-2.9590-01	6.4110-01	0.0	0.0	3.4520-01	8	0
13.260	1.6830+00	-1.8290+00	1.3510+01	1.1950+00	-2.9770-01	6.3680-01	0.0	0.0	3.3900-01	8	0
13.270	1.6670+00	-1.7760+00	1.3520+01	1.1980+00	-2.9950-01	6.3080-01	0.0	0.0	3.3130-01	8	0
13.280	1.6790+00	2.5950+00	1.3540+01	1.2010+00	-3.0160-01	6.3670-01	0.0	0.0	3.3510-01	8	0
13.290	1.6600+00	-3.3490+00	1.3560+01	1.2040+00	-3.0230-01	6.2890-01	0.0	0.0	3.2610-01	8	0
13.300	1.5920+00	-9.2900+00	1.3570+01	1.2070+00	-3.0340-01	5.9920-01	0.0	0.0	2.9580-01	8	0
13.310	1.5510+00	-2.7730+00	1.3590+01	1.2090+00	-3.0470-01	5.8100-01	0.0	0.0	2.7630-01	8	0
13.320	1.5320+00	-7.6470-01	1.3600+01	1.2110+00	-3.0610-01	5.7290-01	0.0	0.0	2.6680-01	8	0
13.330	1.5900+00	9.5900+00	1.3620+01	1.2140+00	-3.0640-01	5.9970-01	0.0	0.0	2.9340-01	8	0
13.340	1.5690+00	-5.9450+00	1.3630+01	1.2170+00	-3.0770-01	5.8980-01	0.0	0.0	2.8210-01	10	0
13.350	1.5470+00	-2.3570+00	1.3650+01	1.2190+00	-3.0900-01	5.8000-01	0.0	0.0	2.7090-01	8	0
13.360	1.5400+00	1.3380-01	1.3670+01	1.2210+00	-3.1050-01	5.7760-01	0.0	0.0	2.6710-01	8	0
13.370	1.5400+00	3.4720-01	1.3680+01	1.2230+00	-3.1190-01	5.7830-01	0.0	0.0	2.6640-01	8	0
13.380	1.5410+00	2.5030-02	1.3700+01	1.2260+00	-3.1340-01	5.7910-01	0.0	0.0	2.6570-01	8	0
13.390	1.5790+00	5.7780+00	1.3710+01	1.2280+00	-3.1390-01	5.9710-01	0.0	0.0	2.8330-01	8	0
13.400	1.5810+00	-1.7250+00	1.3730+01	1.2310+00	-3.1540-01	5.9790-01	0.0	0.0	2.8240-01	8	0
13.410	1.5810+00	-6.7040-02	1.3740+01	1.2330+00	-3.1700-01	5.9860-01	0.0	0.0	2.8160-01	8	0
13.420	1.7270+00	2.2000+01	1.3760+01	1.2360+00	-3.1720-01	6.6050-01	0.0	0.0	3.4330-01	10	0
13.430	1.7320+00	-6.5610+00	1.3780+01	1.2400+00	-3.1920-01	6.6120-01	0.0	0.0	3.4200-01	10	0
13.440	1.6610+00	-1.0980+01	1.3800+01	1.2430+00	-3.2020-01	6.3230-01	0.0	0.0	3.1200-01	8	0
13.450	1.6590+00	3.2980+00	1.3810+01	1.2450+00	-3.2200-01	6.3300-01	0.0	0.0	3.1100-01	8	0
13.460	1.6590+00	1.1860-01	1.3830+01	1.2480+00	-3.2370-01	6.3360-01	0.0	0.0	3.0990-01	8	0
13.470	1.6590+00	-3.4990-02	1.3840+01	1.2510+00	-3.2550-01	6.3430-01	0.0	0.0	3.0880-01	8	0
13.480	1.7800+00	1.8210+01	1.3860+01	1.2540+00	-3.2600-01	6.8200-01	0.0	0.0	3.5510-01	10	0

CHANNEL 2 VOIDING TIME= 0.134900+02

TEMPERATURE PROFILES AT VOIDING

Z	TCOOL	TCLAD	TF1	TFAVE	TF0	ENERGY
158.41250	920.87006	920.89018	892.87653	855.06783	818.51354	0.105860-05
150.23750	931.13036	931.67342	908.26034	876.80144	846.20900	0.450530-04
142.06250	940.74478	943.25896	938.84615	933.60992	927.75156	0.208580-03
133.88750	947.57537	954.47427	993.15246	1047.38379	1097.66627	0.572340-03
126.18077	939.98357	962.87189	1160.67361	1434.55130	1692.36801	0.189390-02
118.94231	922.11129	957.06635	1211.86143	1564.75945	1897.60389	0.237450-02
111.70385	903.42045	937.04382	1242.32937	1665.21919	2064.55339	0.278950-02
104.46538	868.52549	906.29142	1254.12465	1735.97973	2191.35649	0.313310-02
97.22692	826.19626	867.13965	1248.41523	1776.59647	2276.02995	0.339670-02
89.98846	778.41478	821.48932	1226.20490	1786.82959	2317.14780	0.357350-02
82.75000	726.97405	771.07896	1188.60704	1766.92680	2314.13170	0.365900-02
75.51154	673.57729	717.58547	1136.95375	1717.74405	2267.38252	0.365100-02
68.27308	619.86802	662.65483	1072.83144	1540.78813	2178.32927	0.354970-02
61.03462	567.42823	607.90025	998.07831	1538.21315	2049.42497	0.335760-02
53.79615	517.76092	554.88389	914.75894	1412.78542	1884.10234	0.307980-02
46.55769	472.26366	505.08890	825.12320	1267.82386	1686.69640	0.272320-02
39.31923	432.19222	459.88088	731.55050	1107.11886	1462.33807	0.229710-02
29.75000	404.87935	412.33996	485.06151	585.60240	680.67357	0.618940-03
17.85000	392.61104	396.07842	430.09468	477.09683	521.52731	0.287660-03
5.95000	388.09274	388.76004	395.35289	404.45568	413.05601	0.553600-04

TIME	POWER	PDOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
13.498	1.7840+00	-5.5140+00	1.3880+01	1.2580+00	-3.2800-01	6.8260-01	0.0	0.0	3.5460-01	10	0
13.500	1.7830+00	-3.8820-01	1.3900+01	1.2610+00	-3.3010-01	6.8310-01	0.0	0.0	3.5300-01	8	0

9/10/79 1911.300 PAGE 94

CHANNEL 9 VOIDING TIME= 0.135100+02

TEMPERATURE PROFILES AT VOIDING

Z	TCOOL	TCLAD	TF1	TFAVE	TF0	ENERGY
158.41250	918.41279	918.42156	890.06212	851.83492	814.93293	0.73063D-06
150.23750	929.47450	929.71141	902.98754	867.01403	832.19834	0.197270-02
142.86250	940.31793	941.41472	922.64655	897.63640	873.12394	0.913280-04
133.88750	949.93498	952.94457	952.71233	953.24484	952.79165	0.250600-03
126.18077	943.97468	965.56329	1156.05879	1419.46879	1667.06563	0.183740-02
118.94231	932.50355	960.09657	1205.92608	1545.94355	1866.18864	0.229760-02
111.70385	907.21296	939.62805	1234.53768	1642.48518	2027.20798	0.269920-02
104.46538	871.48936	907.89816	1244.21974	1709.48593	2148.61553	0.303170-02
97.22692	827.92143	867.39349	1236.32161	1746.69031	2228.67768	0.328680-02
89.98846	778.60006	820.12668	1211.97815	1754.03727	2266.15478	0.345790-02
82.75010	725.40566	767.92543	1172.40558	1731.88069	2260.60676	0.354090-02
75.51154	670.11574	712.54245	1119.01810	1681.17254	2212.53090	0.353280-02
68.27308	614.44044	655.68967	1053.46704	1603.48149	2123.41356	0.343480-02
61.03462	560.01910	599.03673	977.63914	1500.99664	1995.72733	0.324900-02
53.79615	508.40137	544.19032	893.62991	1376.49256	1832.88327	0.298010-02
46.55769	461.01408	492.65972	803.69855	1233.26858	1639.17925	0.263510-02
39.31923	419.10642	445.80007	710.20069	1075.06351	1419.64519	0.222270-02
29.75000	395.80767	399.06229	430.95655	474.99278	516.58472	0.271010-03
17.85000	390.04933	391.56194	406.48724	427.08213	446.52717	0.125950-03
5.95000	387.92612	388.21722	391.11144	395.10183	398.86736	0.242400-04

37.75000 337.72012 338.21721 374.11114 375.10102 376.00100 376.12100 37

TIME	POWER	PDOT	ENERGY	BETAS	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
13.510	1.7820+00	-3.9060-02	1.3920+01	1.2650+00	-3.3220-01	6.8360-01	0.0	0.0	3.5140-01	8	0
13.520	1.7810+00	-8.4630-02	1.3930+01	1.2680+00	-3.3430-01	6.8410-01	0.0	0.0	3.4980-01	8	0

[illegible]

CHANNEL 6 VOIDING TIME= 0.135300+02

TEMPERATURE PROFILES AT VOIDING

Z	TCOOL	TCLAD	TF1	TFAVE	TF0	ENERGY
158.41250	922.34326	922.35622	894.02173	855.82023	818.93228	0.108270-05
150.23750	934.08551	934.43538	908.80686	874.32716	840.90234	0.292330-04
142.06250	945.42476	947.04454	933.51717	915.68930	897.91214	0.135340-03
133.88750	954.78885	959.23353	973.53607	994.00489	1012.27477	0.371370-03
126.18077	945.91512	966.81565	1147.00749	1395.81136	1629.29564	0.174630-02
118.94231	936.05736	962.19322	1195.02922	1516.64083	1819.10775	0.218380-02
111.70385	911.60546	942.30873	1221.88842	1608.13870	1971.88893	0.256540-02
104.46538	876.51803	911.00410	1230.06349	1670.89539	2086.42688	0.288140-02
97.22692	833.43876	870.82633	1221.00702	1704.84837	2161.21451	0.312390-02
89.98846	784.49356	823.82719	1195.92721	1710.03845	2195.7985	0.328650-02
82.75000	731.58711	771.86163	1156.08960	1686.91588	2187.516	0.336510-02
75.51154	676.51622	716.70241	1102.93838	1636.47098	2140.21599	0.335770-02
68.27308	621.00609	660.07699	1038.13759	1560.28118	2053.33369	0.326450-02
61.03462	566.71056	603.66770	963.57081	1460.51015	1929.77389	0.308790-02
53.79615	515.19377	549.09272	881.31629	1339.87459	1772.85549	0.283240-02
46.55769	467.89990	497.87437	793.60432	1201.58617	1586.71762	0.250450-02
39.31923	426.10599	451.38997	702.75573	1049.27070	1376.21855	0.211260-02
29.75000	400.33054	405.13710	452.47822	517.76164	579.35438	0.401610-03
17.85000	391.33169	393.56558	415.72762	446.26993	475.07550	0.186650-03
5.95000	388.01004	388.43995	392.73938	398.65949	404.23972	0.359210-04

TIME	POWER	PDOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAL	FUEL PROGRAMMED	NET REAC	IPHI	IREA
13.530	1.7800+00	-7.0320-02	1.3950+01	1.2710+00	-3.3640-01	6.8470-01	0.0	0.0	3.4830-01	8	0
13.540	1.8770+00	1.4460+01	1.3970+01	1.2750+00	-3.3730-01	7.1870-01	0.0	0.0	3.8130-01	8	0
13.550	1.8790+00	-4.4460+00	1.3990+01	1.2790+00	-3.3970-01	7.1920-01	0.0	0.0	3.7960-01	10	0

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 96

CHANNEL 4 VOIDING TIME= 0.135600+02

TEMPERATURE PROFILES AT VOIDING

Z	TCOOL	TCLAD	TF1	TFVE	TF0	ENERGY
158.41250	921.59044	921.60906	893.26419	855.18628	818.55576	0.148160-05
150.23750	932.65894	933.16184	908.80760	876.24226	844.75469	0.400020-04
142.06250	943.14023	945.46844	937.95816	928.64635	918.98051	0.185190-03
133.88750	951.00116	957.38977	988.23417	1031.86347	1071.93239	0.508170-03
126.18077	942.24087	964.90189	1151.89070	1411.07386	1653.83874	0.180250-02
118.94231	931.91737	960.25469	1201.51009	1535.98482	1849.93670	0.225410-02
111.70385	907.55128	940.84074	1230.23531	1631.48251	2008.60234	0.764800-02
104.46538	872.92153	910.31242	1240.32833	1697.89916	2128.33038	0.297400-02
97.22692	830.56110	871.09789	1233.09794	1734.99052	2207.40020	0.322440-02
89.98846	782.51744	825.16421	1209.64759	1742.66265	2244.58012	0.339230-02
82.75000	730.63365	774.30056	1171.16318	1721.26510	2239.42666	0.347340-02
75.51154	676.65495	720.22608	1119.02840	1671.72162	2192.41960	0.346530-02
68.27308	622.26213	664.62403	1054.66332	1595.56501	2105.01272	0.336960-02
61.03462	569.07120	609.14130	980.52331	1494.94517	1979.63109	0.318730-02
53.79615	518.61597	555.37028	898.07428	1372.59031	1819.62877	0.292360-02
46.55769	472.32073	504.61999	809.75166	1231.74970	1629.21420	0.258510-02
39.31923	431.46140	458.87508	717.90363	1076.11369	1413.34721	0.218060-02
29.75000	404.10842	411.01719	475.81236	565.43578	649.79684	0.549550-03
17.85000	392.40055	395.61145	425.93793	467.85684	507.29947	0.255410-03
5.95000	388.07982	388.69776	394.57961	402.70263	410.34131	0.491530-04

TIME	POWER	POOT	ENRGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
13.560	1.8780+00	-2.9410-01	1.4010+01	1.2830+00	-3.4200-01	7.1990-01	0.0	0.0	3.7790-01	8	0
13.570	1.8770+00	-7.2420-02	1.4030+01	1.2870+00	-3.4430-01	7.2050-01	0.0	0.0	3.7620-01	8	0
13.580	1.8760+00	-6.2490-02	1.4050+01	1.2900+00	-3.4660-01	7.2120-01	0.0	0.0	3.7460-01	8	0
13.590	1.8060+00	-1.0540+01	1.4060+01	1.2940+00	-3.4770-01	6.9590-01	0.0	0.0	3.4320-01	8	0
13.600	1.8040+00	3.1990+00	1.4080+01	1.2970+00	-3.4980-01	6.9670-01	0.0	0.0	3.4650-01	8	0
13.610	1.9830+00	2.7100+01	1.4100+01	1.3000+00	-3.5060-01	7.5710-01	0.0	0.0	4.0650-01	10	0
13.620	2.0110+00	-4.8140+00	1.4120+01	1.3060+00	-3.5270-01	7.6410-01	0.0	0.0	4.1140-01	10	0
13.630	2.1910+00	2.5590+01	1.4150+01	1.3100+00	-3.5440-01	8.1400-01	0.0	0.0	4.5960-01	10	0
13.640	2.1610+00	-1.3480+01	1.4170+01	1.3170+00	-3.5640-01	8.0530-01	0.0	0.0	4.4890-01	10	9
13.650	2.0090+00	-2.1350+01	1.4190+01	1.3210+00	-3.5740-01	7.6190-01	0.0	0.0	4.0460-01	10	0
13.660	1.9530+00	-8.2340-01	1.4210+01	1.3240+00	-3.6000-01	7.4610-01	0.0	0.0	3.8610-01	8	0
13.670	1.8750+00	-8.7950+00	1.4220+01	1.3270+00	-3.6090-01	7.2010-01	0.0	0.0	3.5920-01	8	0
13.680	1.8400+00	-1.4260+00	1.4240+01	1.3300+00	-3.6160-01	7.0780-01	0.0	0.0	3.4620-01	8	0
13.690	1.8380+00	1.4810+00	1.4260+01	1.3330+00	-3.6320-01	7.0790-01	0.0	0.0	3.4470-01	8	0
13.700	1.9840+00	2.2020+01	1.4280+01	1.3370+00	-3.6390-01	7.5700-01	0.0	0.0	3.9320-01	10	0
13.710	1.9750+00	-8.7180+00	1.4300+01	1.3420+00	-3.6560-01	7.5330-01	0.0	0.0	3.8760-01	10	0
13.720	1.9230+00	-7.3280+00	1.4320+01	1.3460+00	-3.6790-01	7.3710-01	0.0	0.0	3.6920-01	10	0
13.730	1.9000+00	-8.5430-01	1.4340+01	1.3490+00	-3.6920-01	7.2980-01	0.0	0.0	3.6060-01	8	0
13.740	1.9630+00	1.0570+01	1.4360+01	1.3520+00	-3.7030-01	7.5090-01	0.0	0.0	3.8060-01	8	0
13.750	1.9710+00	-1.9400+00	1.4380+01	1.3570+00	-3.7170-01	7.5290-01	0.0	0.0	3.8120-01	8	0
13.760	1.9560+00	-2.5940+00	1.4400+01	1.3600+00	-3.7180-01	7.4690-01	0.0	0.0	3.7520-01	8	0
13.770	1.9580+00	1.0390+00	1.4420+01	1.3640+00	-3.7410-01	7.4890-01	0.0	0.0	3.7470-01	8	0
13.780	1.9610+00	2.7780-01	1.4440+01	1.3680+00	-3.7650-01	7.5070-01	0.0	0.0	3.7430-01	8	0
13.790	1.9630+00	2.1650-01	1.4460+01	1.3720+00	-3.7880-01	7.5260-01	0.0	0.0	3.7380-01	8	0
13.800	2.2100+00	3.6900+01	1.4480+01	1.3760+00	-3.7910-01	8.2360-01	0.0	0.0	4.4450-01	10	0
13.810	2.4520+00	2.4040+01	1.4510+01	1.3830+00	-3.8080-01	8.7780-01	0.0	0.0	4.9710-01	10	0
13.820	2.4610+00	-1.0800+01	1.4530+01	1.3900+00	-3.8430-01	8.7960-01	0.0	0.0	4.9530-01	10	0
13.830	2.4610+00	-3.7580-01	1.4560+01	1.3960+00	-3.8790-01	8.8140-01	0.0	0.0	4.9350-01	8	0

TIME	POWER	POOT	ENERGY	BETAG	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
13.840	2.6230+00	2.4230+01	1.4580+01	1.4020+00	-3.9070-01	9.1440-01	0.0	0.0	5.2370-01	8	0
13.850	2.7050+00	4.1900+00	1.4610+01	1.4100+00	-3.9350-01	9.2880-01	0.0	0.0	5.3520-01	8	0
13.860	3.3090+00	8.6450+01	1.4650+01	1.4180+00	-3.9580-01	1.0170+00	0.0	0.0	6.2080-01	10	0
13.870	3.3320+00	-2.6700+01	1.4680+01	1.4320+00	-4.0140-01	1.0180+00	0.0	0.0	6.1690-01	11	0
13.880	3.3210+00	-2.7370+00	1.4710+01	1.4410+00	-4.0690-01	1.0200+00	0.0	0.0	6.1320-01	8	0
13.890	3.6760+00	5.3790+01	1.4750+01	1.4510+00	-4.1170-01	1.0610+00	0.0	0.0	6.4920-01	10	0
13.900	3.6760+00	-1.7870+01	1.4790+01	1.4650+00	-4.1800-01	1.0630+00	0.0	0.0	6.4460-01	10	0

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 1					
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	952.664	886.061	885.379	880.708	872.316
150.237	955.107	905.696	907.070	905.044	899.076
142.062	957.550	950.865	960.083	968.593	972.754
133.887	959.993	1038.465	1065.162	1097.274	1124.261
126.181	962.296	1371.000	1514.544	1837.925	2075.803
118.942	964.458	1500.929	1593.359	1987.924	2342.994
111.704	966.621	1676.310	1756.281	2143.101	2541.194
104.465	968.784	1763.140	1845.777	2257.439	2692.698
97.227	970.947	1755.722	1856.591	2328.283	2767.000
89.988	973.110	1696.663	1828.777	2374.177	2767.000
82.750	975.273	1530.559	1718.446	2389.751	2767.000
75.512	977.436	1371.000	1651.863	2366.395	2767.000
68.273	979.599	1323.826	1719.380	2260.684	2767.000
61.035	981.762	1020.302	1516.538	2124.823	2649.208
53.796	983.925	1013.802	1446.655	1976.682	2432.965
46.558	986.088	946.403	1320.622	1777.931	2170.566
39.319	866.193	883.200	1181.614	1550.117	1870.872
29.750	790.119	793.018	772.947	741.671	707.114
17.850	665.450	666.797	635.058	592.068	550.360
5.950	494.005	494.264	475.349	450.765	427.981

VDTIME	11.240	ZVOIDU	311.515	RHO-D	-0.26390-01	G	145.735
FRTIME	11.740	ZVOIDL	45.037	RHO-C	0.21070+00	H	29.142
TFMOV	1000.000	ZDOU	276.515	RHO-CL	0.0	P/W	805.224
PHIXV	0.940	ZDOL	62.537	RHO-F	0.0	GV	145.735
PIHTGV	11.124	ZHFL	79.750	RHO-NET	0.18430+00	WV	29.142
			79.750			PHV	805.224

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 98

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CHANNEL 2 CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	952.664	909.596	893.160	864.732	830.801
150.237	955.107	923.366	911.277	883.882	860.953
142.062	957.550	940.363	948.926	953.665	951.200
133.887	959.993	961.307	1017.632	1034.670	1140.182
126.181	962.296	990.115	1228.823	1531.547	1804.029
118.942	964.458	998.955	1299.525	1683.944	2033.525
111.704	966.621	1006.943	1354.343	1804.688	2220.798
104.465	968.784	1013.931	1392.052	1891.851	2364.017
97.227	962.209	1003.153	1404.461	1943.375	2461.429
89.988	910.032	953.107	1383.834	1959.814	2510.963
82.750	853.576	897.681	1345.207	1942.045	2511.479
75.512	794.476	838.484	1289.848	1890.863	2463.298
68.273	734.313	777.100	1219.339	1807.814	2367.899
61.035	674.604	715.076	1135.569	1695.192	2227.904
53.796	616.782	653.905	1040.712	1556.003	2047.041
46.558	562.164	594.989	937.172	1393.838	1830.048
39.319	511.919	539.608	827.528	1213.078	1582.567
29.750	475.922	483.383	535.410	618.426	711.887
17.850	439.426	442.894	460.212	493.385	535.575
5.950	405.223	405.890	405.123	408.232	415.519

VDTIME	13.490	ZVOIDU	196.780	RHO-D	-0.40640-01	G	145.735
FRTIME	13.990	ZVOIDL	102.405	RHO-C	0.69630-01	H	29.142
TFMOV	1000.000	ZDOU	161.780	RHO-CL	0.0	P/H	1341.086
PHIXV	1.784	ZDOL	119.905	RHO-F	0.0	GV	145.735
PINTGV	13.881	ZMFU	79.750	RHO-NET	0.28990-01	HV	29.142
		ZMFL	79.750			PHV	1341.086

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 3						
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)	
158.412	952.664	897.630	891.124	874.498	850.389	
150.237	955.107	913.274	909.284	896.241	875.719	
142.062	957.550	937.973	945.751	949.598	946.446	
133.887	959.993	977.540	1012.246	1054.904	1091.809	
126.181	962.296	1136.978	1333.367	1610.176	1839.858	
118.942	964.458	1184.222	1430.780	1780.178	2135.056	
111.704	966.621	1223.164	1510.882	1919.804	2336.320	
104.465	968.784	1233.995	1560.774	2022.896	2491.325	
97.227	970.947	1123.903	1531.795	2077.655	2600.420	
89.988	973.110	1019.444	1498.435	2106.186	2653.557	
82.750	975.273	1022.683	1494.047	2099.062	2651.600	
75.512	977.436	1024.745	1468.310	2050.963	2597.553	
68.273	955.073	988.261	1404.873	1961.904	2494.848	
61.035	886.385	917.778	1311.451	1839.092	2345.252	
53.796	817.005	845.800	1204.577	1687.225	2152.073	
46.558	747.824	773.285	1086.497	1510.086	1920.375	
39.319	679.613	701.089	959.654	1312.049	1656.177	
29.750	622.686	626.783	609.184	608.685	632.235	
17.850	540.422	542.327	516.467	498.649	499.085	
5.950	443.292	443.658	428.387	414.685	408.579	
VDTIME	12.770	ZVOIDU	253.538	RHO-D	-0.40440-01	6 145.735
FRTIME	13.270	ZVOIDL	74.026	RHO-C	0.25160+00	H 29.142
TFMOV	1000.000	ZDOU	218.538	RHO-CL	0.0	P/H 1021.638
PHIXV	1.298	ZDOL	91.526	RHO-F	0.0	GV 145.735
PINTGV	12.801	ZHFU	79.750	RHO-NET	0.21120+00	HV 29.142
		ZHFL	79.750			PHV 1021.638

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 100

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CHANNEL 4 CLADDING TEMPERATURE (C)	FUEL BDY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	952.664	911.515	893.564	863.594	828.693
150.237	955.167	925.506	911.286	886.522	856.829
142.062	957.550	942.622	946.260	945.135	937.809
133.887	959.993	963.181	1008.360	1061.752	1105.516
126.181	962.296	989.323	1210.447	1491.849	1746.214
118.942	964.458	997.969	1276.840	1635.034	1962.433
111.704	966.621	1005.789	1327.203	1746.922	2138.023
104.465	969.794	1007.175	1358.269	1825.997	2271.723
97.227	930.119	970.706	1357.098	1871.597	2361.623
89.988	878.443	921.093	1335.123	1854.509	2405.762
82.750	822.456	866.123	1295.926	1854.961	2403.512
75.512	763.917	807.488	1240.849	1813.825	2355.294
68.273	704.481	746.843	1171.521	1732.672	2262.601
61.035	645.730	685.800	1089.855	1623.772	2128.000
53.796	589.156	625.910	998.019	1490.055	1955.085
46.558	536.135	568.634	898.391	1335.051	1748.402
39.319	487.885	515.299	793.501	1162.797	1513.331
29.750	455.220	462.129	512.519	589.862	674.250
17.850	426.030	429.241	447.644	479.776	518.371
5.950	400.372	400.990	401.513	405.358	412.319

VDTIME	13.560	ZVOIOU	188.456	RHO-D	-0.54060-01	G	135.629
FRTIME	14.060	ZVOIDL	106.566	RHO-C	0.77030-01	H	27.121
TFHOV	1000.000	ZDOU	153.456	RHO-CL	0.0	P/W	1421.056
PHIXV	1.878	ZDOL	124.066	RHO-F	0.0	GV	135.629
PINTGV	14.009	ZHFU	79.750	RHO-NET	0.22970-01	HV	27.121
		ZHFL	79.750			PIV	1421.056

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CHANNEL 5 CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	952.664	902.362	897.646	883.495	861.773
150.237	955.107	918.697	915.420	903.132	883.128
142.062	957.550	943.182	946.849	944.793	935.567
133.887	959.993	981.631	1001.243	1023.020	1039.217
126.181	962.296	1222.833	1387.652	1628.723	1880.965
118.942	964.458	1293.739	1500.166	1803.478	2122.163
111.704	966.621	1350.809	1592.087	1946.963	2320.163
104.465	968.784	1359.140	1638.062	2045.926	2472.593
97.227	970.947	1271.869	1610.841	2091.282	2579.342
89.988	973.110	1120.912	1544.660	2105.525	2636.181
82.750	975.273	1021.393	1498.147	2098.548	2634.339
75.512	977.436	1023.457	1477.000	2054.877	2577.996
68.273	979.599	1024.382	1433.158	1969.518	2472.048
61.035	928.946	958.401	1340.612	1845.278	2321.475
53.796	856.767	883.784	1231.266	1691.887	2128.435
46.558	784.174	808.064	1110.496	1513.541	1897.778
39.319	711.814	731.966	980.653	1314.559	1635.484
29.750	651.881	654.588	612.520	576.288	562.503
17.850	562.365	563.623	525.088	488.244	468.307
5.950	452.047	452.289	433.878	415.166	403.424
VOTIME	12.510	ZVOIDU	265.448	RHO-D -0.50310-01	6 135.629
FRTIME	13.010	ZVOIDL	68.070	RHO-C 0.36210+00	W 27.121
TFMOV	1000.000	ZDOU	230.448	RHO-CL 0.0	P/W 1016.567
PHIXV	1.243	ZDOL	85.570	RHO-F 0.0	GV 135.629
PINTGV	12.477	ZHFU	79.750	RHO-NET 0.31180+00	HV 27.121
		ZHFL	79.750		PHV 1016.567

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 102

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CHANNEL 6 CLADDING TEMPERATURE (C)	FUEL BDY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	952.664	912.327	894.603	864.835	830.022
150.237	955.107	927.342	911.646	884.985	853.555
142.062	957.550	943.479	940.775	931.237	915.932
133.887	959.993	961.465	989.459	1019.964	1041.926
126.181	962.296	986.078	1203.774	1478.978	1725.730
118.942	964.458	993.177	1268.090	1618.669	1936.356
111.704	966.621	1003.163	1318.530	1727.776	2106.373
104.465	968.784	1009.686	1350.820	1804.170	2235.031
97.227	942.165	979.552	1350.988	1846.981	2320.862
89.988	889.434	928.768	1327.286	1857.466	2361.944
82.750	832.248	872.523	1286.586	1836.141	2357.687
75.512	772.367	812.553	1230.288	1783.948	2308.581
68.273	711.478	750.549	1160.061	1702.500	2216.163
61.035	651.197	688.154	1077.844	1594.087	2083.006
53.796	593.041	626.940	985.816	1461.634	1912.683
46.558	538.404	568.379	886.351	1308.638	1709.680
39.319	488.504	513.788	781.948	1139.078	1479.290
29.750	456.824	461.630	489.200	538.264	597.938
17.850	428.468	430.701	438.007	456.528	483.379
5.950	401.556	401.986	400.107	401.085	405.661

VDTIME	13.530	ZVOIDU	192.659	RHO-D	-0.45990-01	G	128.531
FRTIME	14.030	ZVOIDL	104.465	RHO-C	0.45160-01	H	25.702
TFMOV	1000.000	ZDOU	157.659	RHO-CL	0.0	P/W	1363.518
PHIXV	1.780	ZDOL	121.965	RHO-F	0.0	GV	128.531
PINTGV	13.953	ZHFU	79.750	RHO-NET	-0.82310-03	HV	25.702
		ZHFL	79.750			PHV	1363.518

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 7					
AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	952.664	920.473	905.891	879.823	848.026
150.237	955.107	938.655	925.173	900.931	871.254
142.062	957.550	956.581	954.130	944.295	928.043
133.887	959.993	973.739	998.608	1023.861	1039.675
126.181	962.296	980.668	1197.180	1466.263	1702.423
118.942	964.458	988.755	1261.065	1601.818	1903.486
111.704	966.621	1000.371	1314.020	1709.835	2063.964
104.465	968.784	1006.538	1349.428	1786.695	2182.940
97.227	970.947	1011.772	1368.543	1831.279	2259.102
89.988	974.110	1007.448	1365.866	1841.332	2292.316
82.750	940.959	975.095	1333.054	1816.295	2233.472
75.512	876.521	910.582	1272.728	1760.892	2232.070
68.273	810.274	843.389	1198.663	1677.453	2139.469
61.035	743.795	775.119	1112.807	1568.313	2008.293
53.796	678.568	707.300	1017.325	1436.399	1842.100
46.558	615.945	641.350	914.553	1285.165	1645.306
39.319	557.097	578.527	806.927	1118.505	1423.072
29.750	516.099	519.802	517.130	532.786	567.823
17.850	468.332	470.053	458.577	456.723	469.023
5.950	416.337	416.668	408.443	402.693	402.666
VOTIME	13.190	ZVOIDU	219.671	RHO-D -0.50270-01	6 114.333
FRTIME	13.690	ZVOIDL	90.959	RHO-C 0.16370+00	W 22.862
TFMOV	1000.000	ZDOU	184.671	RHO-CL 0.0	P/W 1294.001
PHIXV	1.591	ZDOL	108.459	RHO-F 0.0	6V 114.333
PINTGV	13.392	ZMFU	79.750	RHO-NET 0.11340+00	WV 22.862
		ZHFL	79.750		PMV 1294.001

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 104

*****RADIAL,TEMPERATURE EDITS*****

EDITS FOR CHANNEL 8

AXIAL LOCATION (CM)	TAVG	TCLAD	TFUEL OUTER	TFUEL AVG	TFUEL CENTER	RM		THM	TFR
158.412	952.664	881.397	880.824	876.755	869.418	0.0	0.0		0.876760+03
150.237	955.107	897.250	897.838	895.187	889.066	0.0	0.0		0.895260+03
142.062	957.550	928.076	933.124	936.341	935.734	0.0	0.0		0.936650+03
133.887	959.993	984.594	999.581	1015.970	1027.842	0.0	0.0		0.101680+04
126.181	962.296	1371.000	1497.077	1855.714	2114.614	0.0	0.0		0.186100+04
118.942	964.458	1586.070	1663.625	2022.244	2375.279	0.0	0.0		0.202970+04
111.704	966.621	1752.918	1826.405	2190.690	2574.156	0.0	0.0		0.219930+04
104.465	968.784	1847.111	1924.059	2312.696	2728.620	0.0	0.0		0.232200+04
97.227	970.947	1854.204	1952.898	2397.407	2767.000	0.068	0.275630+00		0.237630+04
89.988	973.110	1815.100	1935.279	2431.640	2767.000	0.096	0.387470+00		0.238130+04
82.750	975.273	1685.877	1838.019	2422.613	2767.000	0.109	0.440800+00		0.234770+04
75.512	977.436	1396.640	1638.572	2408.444	2767.000	0.112	0.453930+00		0.232060+04
68.273	979.599	1371.000	1738.765	2324.396	2767.000	0.053	0.256250+00		0.230230+04
61.035	981.762	1042.647	1542.011	2160.811	2701.862	0.0	0.0		0.217180+04
53.796	983.925	997.147	1451.566	2006.409	2482.238	0.0	0.0		0.201660+04
46.558	986.088	922.398	1320.813	1803.949	2214.484	0.0	0.0		0.181300+04
39.319	850.848	868.590	1185.294	1573.173	1907.172	0.0	0.0		0.158100+04
29.750	778.806	780.506	740.489	680.651	616.793	0.0	0.0		0.682160+03
17.850	660.435	661.225	621.984	567.057	511.938	0.0	0.0		0.567980+03
5.950	492.788	492.940	473.617	447.540	422.338	0.0	0.0		0.447840+03

VOTIME	11.080	ZVOIDU	315.140	RHO-D	-6.23360-01	G	145.735
FRTIME	11.580	ZVOIDL	43.224	RHO-C	0.14510+00	H	29.142
TFMOV	1000.000	ZDOU	280.140	RHO-CL	0.0	P/H	566.405
PHIXV	1.961	ZDDL	60.724	RHO-F	0.0	GV	145.735
PINTGV	10.971	ZHFU	79.750	RHO-NET	0.12180+00	HV	29.142
		ZHFL	79.750			PWV	566.405

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

AXIAL LOCATION (CM)	COOLANT TEMPERATURE (C)	CHANNEL 9 CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	952.664	907.217	890.249	861.152	826.626
150.237	955.107	920.903	904.951	877.569	845.058
142.062	957.550	935.809	928.120	911.770	889.797
133.887	959.993	952.036	964.613	974.813	977.669
126.181	962.296	989.020	1218.957	1510.155	1771.818
118.942	964.458	996.005	1286.395	1657.162	1993.639
111.704	966.621	1005.337	1339.455	1772.825	2173.514
104.465	968.784	1012.127	1374.477	1854.885	2310.268
97.227	948.929	988.401	1379.146	1901.888	2402.334
89.988	895.515	937.041	1356.293	1914.998	2447.605
82.750	837.680	880.200	1315.776	1894.803	2445.284
75.512	777.154	819.581	1258.955	1842.193	2395.798
68.273	715.601	756.850	1187.484	1758.775	2300.677
61.035	654.611	693.629	1103.306	1646.872	2162.558
53.796	595.680	631.468	1008.620	1509.482	1985.127
46.558	540.173	571.819	905.839	1350.214	1773.048
39.319	489.274	515.967	797.507	1173.188	1531.838
29.750	459.578	462.833	468.610	491.389	528.888
17.850	431.892	433.404	429.903	435.602	451.883
5.950	403.146	403.437	399.102	397.285	399.698
VDTIME	13.510	ZVOIDU	194.454	RHO-D -0.40940-01	6 135.622
FRTIME	14.010	ZVOIDL	103.568	RHO-C -0.37100-01	H 27.119
TFMOV	1000.000	ZDOU	159.454	RHO-CL 0.0	P/H 1342.777
PHIXV	1.782	ZDOL	121.068	RHO-F 0.0	GV 135.622
PINTGV	13.917	ZIFU	79.750	RHO-NET -0.78050-01	HV 27.119
		ZHFL	79.750		PHV 1342.777

SACO 1.0

10 CHANNEL SACO 1.0 EXAMPLE PROBLEM -- 10/79

9/10/79 1911.300 PAGE 106

***** COOLANT, CLAD AND FUEL TEMPERATURE EDIT *****

CHANNEL 10					
AXIAL LOCATION (CH)	COOLANT TEMPERATURE (C)	CLADDING TEMPERATURE (C)	FUEL BDRY. TEMPERATURE (C)	FUEL AVE. TEMPERATURE (C)	FUEL CENTER TEMPERATURE (C)
158.412	952.664	917.319	902.117	875.216	842.616
150.237	955.107	936.084	920.166	892.783	860.222
142.062	957.550	954.704	942.755	920.813	893.598
133.887	959.993	973.820	973.157	965.997	952.603
126.181	962.296	981.958	1183.305	1433.328	1652.522
118.942	964.458	986.212	1241.519	1560.667	1842.841
111.704	966.621	999.972	1292.430	1661.987	1993.159
104.465	968.784	1006.092	1324.416	1732.080	2103.387
97.227	970.947	1011.290	1339.923	1770.322	2172.719
89.988	972.843	1006.314	1333.100	1774.548	2201.622
82.750	911.163	945.434	1286.891	1746.744	2190.162
75.512	846.040	880.237	1225.890	1690.666	2138.077
68.273	779.245	812.492	1151.889	1608.084	2047.060
61.035	712.467	743.915	1066.903	1501.349	1919.717
53.796	647.288	676.134	973.136	1373.359	1759.526
46.558	585.140	610.647	872.932	1227.493	1570.760
39.319	527.241	548.757	768.695	1067.519	1358.383
29.750	492.245	494.086	472.030	461.322	470.673
17.850	454.500	455.355	436.327	423.644	424.821
5.950	411.659	411.823	403.014	396.041	394.381

VDTIME	13.250	ZVOIDU	213.320	RHO-D	-0.45540-01	G	104.987
FRTIME	13.750	ZVOIDL	94.134	RHO-C	-0.22530+00	H	20.994
TFHOV	1000.000	ZDOU	178.320	RHO-CL	0.0	P/H	1386.151
PHIXV	1.695	ZDOL	111.634	RHO-F	0.0	GV	104.987
PINTGV	13.490	ZHFU	79.750	RHO-NET	-0.27080+00	HV	20.994
		ZHFL	79.750			PHV	1386.151

TIME	POWER	PDOT	ENERGY	BETAS	DOPPLER	COOLANT	CLAD	FUEL PROGRAMMED	NET REAC	IPHI	IREA
13.910	3.6600+00	-2.3390+00	1.4820+01	1.4760+00	-4.2420-01	1.0640+00	0.0	0.0	6.4010-01	8	0

APPENDIX E

Sample Plotting Input/Output

This appendix illustrates the plotting capabilities generated for verification studies with SACO. Subroutines were generated to write the information for the steady-state power and reactivity-worth curves for the transient channel-dependent reactivity and temperature-versus-time information. Also generated were core reactivity, power, and energy-versus-time plots, the fuel, cladding, and coolant-temperature-versus-axial-position plots, and the voiding and dryout interface-versus-time plots.

The reactivity, power, energy-versus-time, and temperature information have been plotted with analogous SAS3A-calculated information to provide an indication of one mode of verification used to qualify the SACO code.

Fig. E.1

Reactivity vs Time. Comparison between SACO and SAS

Fig. E.2

Normalized Reactor Power vs Time. Comparison between SACO and SAS

Fig. E.3. Normalized Transient Energy vs Time. Comparison between SACO and SAS

Fig. E.4. Temperature Comparison between SACO and SAS, ~0.1 s; Channel 8

Fig. E.5. Temperature Comparison between SACO and SAS, 2 s; Channel 8

Fig. E.6. Temperature Comparison between SACO and SAS, 4 s; Channel 8

Fig. E.7. Temperature Comparison between SACO and SAS, 6 s, Channel 8

Fig. E.8. Temperature Comparison between SACO and SAS, 8 s, Channel 8

Fig. E.9. Temperature Comparison between SACO and SAS, 10 s, Channel 8

Fig. E.10. Temperature Comparison between SACO and SAS, 11.28 s, Channel 8

Fig. E.11. Temperature Comparison between SACO and SAS, 11.68 s; Channel 8

Fig. E.12. Temperature Comparison between SACO and SAS, 12.07 s; Channel 8

Fig. E.13. Temperature Comparison between SACO and SAS, 12.86 s; Channel 8

Fig. E.14. Temperature Comparison between SACO and SAS, 13.22 s; Channel 8

Fig. E.15. Temperature Comparison between SACO and SAS, 13.58 s; Channel 8

Fig. E.16. Temperature Comparison between SACO and SAS, 13.9 s; Channel 8

Fig. E.17. Voiding and Dryout Profiles, Channel 8

Fig. E.18. Axial Power Profile, Channels 1-5

Fig. E.19. Axial Power Profile, Channels 6-10

Fig. E.20. Fuel-reactivity-worth
Curves, Channels 1-5 Fig. E.21. Fuel-reactivity-worth
Curves, Channels 6-10

Fig. E.22. Steel-reactivity Worth, Channels 1-5

Fig. E.23. Steel-reactivity Worth, Channels 6-10

Fig. E.24. Sodium-voiding-reactivity Worth, Channels 1-5

Fig. E.25. Sodium-voiding-reactivity Worth, Channels 6-10

Fig. E.26. Doppler-reactivity-worth Curves (Sodium In), Channels 1-5

Fig. E.27. Doppler-reactivity-worth Curves (Sodium in), Channels 6-10

Fig. E.28. Net Reactivity vs Time, Channels 1-5

Fig. E.29. Net Reactivity vs Time, Channels 6-10

Fig. E.30. Doppler Reactivity vs Time, Channels 1-5

Fig. E.31. Doppler Reactivity vs Time, Channels 6-10

Fig. E.32. Void Reactivity vs Time, Channels 1-5

Fig. E.33. Void Reactivity vs Time, Channels 6-10

Fig. E.34. Temperature vs Time

APPENDIX F

Heat-transfer Properties and Lumped Parameters

Figure F.1* illustrates the lumped-parameter formalism used to describe heat transfer in the lumped-parameter or 1-D models of SACO. The derivations and relevant input parameters are described here. The relevant subroutine is PROMM.

Fig. F.1. Coordinate System and Notation

In Fig. F.1, the plane $z = 0$ denotes the bottom of a fuel pin. No void fraction is considered in the fuel region and the line $r = 0$ denotes the center of the fuel region. The gap heat-transfer coefficient, h_{gap} , is defined to account for the thermal resistance at the boundary between the fuel and cladding regions, and the gap distance is ignored. Constant thermal conductivities are assumed, and axial conduction is neglected. At any given axial position, z , the steady-state conduction equations for fuel and cladding can be written as

$$\frac{k_F}{r} \frac{\partial}{\partial r} \left[r \frac{\partial T_F(r)}{\partial r} \right] + \frac{P(z)}{\pi R_F^2} = 0, \quad 0 \leq r \leq R_F \quad (F.1)$$

$$\frac{k_{cl}}{r} \frac{\partial}{\partial r} \left[r \frac{\partial T_{cl}(r)}{\partial r} \right] = 0, \quad R_F \leq r \leq R_{cl} \quad (F.2)$$

with the boundary conditions

$$k_{cl} \frac{\partial T_{cl}}{\partial r} = -h(T_{cl} - T_c) \text{ at } r = R_c \quad (F.3)$$

*Much of this discussion follows that of Ref. 8.

and

$$-k_F \frac{\partial T_F}{\partial r} = -k_{cl} \frac{\partial T_{cl}}{\partial r} = h_{gap}(T_F - T_{cl}) \text{ at } r = R_F, \quad (F.4)$$

where

h is the coolant heat-transfer coefficient,

T is the temperature,

k is the thermal conductivity,

$P(z)$ is the linear power density,

and the subscripts F , cl , and c denote fuel, cladding, and coolant, respectively.

The steady-state fuel and cladding temperatures are obtained by solving this system of equations to yield

$$T_F = T_c + \frac{P(z)}{2\pi} \left[\frac{1}{hR_{cl}} + \frac{1}{h_{gap}R_F} + \frac{1}{2k_F} \left(1 - \frac{r^2}{R_F^2} \right) + \frac{1}{k_{cl}} \ln \frac{R_{cl}}{R_F} \right] \quad (F.5)$$

and

$$T_{cl} = T_c + \frac{P(z)}{2\pi} \left(\frac{1}{hR_c} + \frac{1}{k_{cl}} \ln \frac{R_{cl}}{r} \right). \quad (F.6)$$

The average fuel and cladding temperatures can be reformulated from Eqs. F.5 and F.6 as follows:

$$\langle T_F \rangle = \frac{1}{\pi R_F^2} \int_0^{R_F} T_F 2\pi r \, dr = T_c + \frac{P(z)}{2\pi} \left(\frac{1}{4k_F} + \frac{1}{hR_{cl}} + \frac{1}{h_{gap}R_F} + \frac{1}{k_{cl}} \ln \frac{R_{cl}}{R_F} \right), \quad (F.7)$$

and

$$\begin{aligned} \langle T_{cl} \rangle &= \frac{1}{\pi(R_{cl}^2 - R_F^2)} \int_{R_F}^{R_{cl}} T_{cl} 2\pi r \, dr = T_c + \frac{P(z)}{2\pi} \left(\frac{1}{hR_{cl}} + \frac{1}{2k_{cl}} \right. \\ &\quad \left. - \frac{R_F^2}{R_{cl}^2 - R_F^2} \frac{1}{k_{cl}} \ln \frac{R_{cl}}{R_F} \right) \approx T_c + \frac{P(z)}{2\pi} \left(\frac{1}{hR_{cl}} + \frac{1}{2k_{cl}} \ln \frac{R_{cl}}{R_F} \right), \end{aligned} \quad (F.8)$$

where $\langle \rangle$ denotes the average temperature. This last form can be justified by series developments when $R_{cl} - R_F < R_F$.

In the text of Sec. III.A, the lumped heat-transfer parameters can be shown to correspond to the above equations according to

$$h'_{cl-c} \equiv 2\pi R_F h_{cl-c} = 2\pi \left(\frac{1}{h R_{cl}} + \frac{1}{2k_{cl}} \ln \frac{R_{cl}}{R_F} \right)^{-1} \quad (F.9)$$

and

$$h'_{F-d} \equiv 2\pi R_F h_{F-cl} = 2\pi \left(\frac{1}{4k_F} + \frac{1}{2k_{cl}} \ln \frac{R_{cl}}{R_F} + \frac{1}{h_{gap} R_F} \right)^{-1}. \quad (F.10)$$

The values for h_{gap} and h in SACO are defined by the input variables HGAP and HCOL, the values for k_F and k_{cl} by input variables AKF and AKCL, respectively, and the radii R_F and R_{cl} by input variables RF and RCLD, respectively. These input variables are indicated in the input listing of Appendix B.

ACKNOWLEDGMENTS

We gratefully acknowledge helpful discussions with the rest of the Accident Analysis Staff.

REFERENCES

1. M. G. Stevenson et al., "Current Status and Experimental Basis of the SAS LMFBR Accident-Analysis Code Systems," *Proc. Fast Reactor Safety Meeting*, CONF-740401-P3, pp. 1303-1321 (1974).
2. C. Mueller, J. E. Cahalan, and J. M. Kyser, *A Closed-Form Methodology for LMFBR Accident Analysis*, Trans. Am. Nucl. Soc. 23, 336 (1976).
3. C. Mueller, *An Integral Model for Predicting Voiding-Phase Conditions During an LMFBR LOF Transient*, Trans. Am. Nucl. Soc. 24, 281 (1976).
4. J. E. Cahalan et al., *The SAS3D LMFBR Accident-analysis Computer Code*, ANL report (to be published).
5. J. K. Vaurio and C. Mueller, "A Probabilistic/Deterministic Procedure for Analyzing LMFBR Core Disruptive Accidents," *Proc. Int. Meeting on Fast Reactor Safety and Related Physics*, Chicago (Oct 1976).
6. J. K. Vaurio and C. Mueller, *Probabilistic Analysis of Liquid-metal Fast Breeder Reactor Accident Consequences with Response Surface Techniques*, Nucl. Sci. Eng. 65, 401-413 (1978).
7. W. L. Woodruff, *Two-Dimensional Variational Estimates of Reactivity Worths and Mutual Interactions of Perturbations*, Trans. Am. Nucl. Soc. 22, 248 (1975).
8. W. L. Chen, M. Ishii, and M. A. Grolmes, *Thermal Transient Analysis of a Fuel Pin Band on the Average Properties and Lumped Parameter Techniques*, Trans. Am. Nucl. Soc. 22, 396 (1975).
9. F. E. Dunn et al., *The SAS2A LMFBR Accident-analysis Computer Code*, ANL-8138 (Oct 1974).
10. J. J. Kaganove, *Numerical Solution of the One-group, Space-independent Reactor Kinetics Equation for Neutron Density Given the Excess Reactivity*, ANL-6132 (Feb 1960).
11. M. A. Grolmes, *Heat-Capacity Effects in Sodium Boiling*, Trans. Am. Nucl. Soc. 22, 407 (1975).
12. L. W. Deitrich and R. W. Ostensen, ANL, personal communication (1977).
13. G. H. Golden and J. V. Tokar, *Thermophysical Properties of Sodium*, ANL-7323 (Aug 1967).
14. Report ANCR-1263 (NRC-5), Aerojet Nuclear Company, Feb 1976.
15. D. D. Freeman et al., *The FREADM-1 Code, A Fast Reactor Excursion Accident-Dynamics Model*, GEAP-13608 (1972).
16. A. E. Waltar et al., *MELT-II--A Two-Dimensional Neutronics-Heat-Transfer Program for Fast Reactor Safety Analysis*, HEDL-TME 72-43 (1972).
17. W. R. Bohl, "Fuel-Coolant-Interaction, Cladding and Fuel-Motion Model Development," *Reactor Development Program Progress Report: May-June 1976*, ANL-RDP-51, p. 7.3.

18. H. K. Fauske, *Some Comments on Cladding and Early Fuel Relocation in LMFBR Core Disruptive Accidents*, Trans. Am. Nucl. Soc. 21, 322 (1975).
19. W. R. Bohl et al., ANL, personal communication (1975).
20. W. R. Bohl and R. J. Henninger, *Some Comments on CRBRP LOF Analysis Using SAS3A*, Trans. Am. Nucl. Soc. 22, 401 (1975).
21. ANL-75-31, *Physics of Reactor Safety, Quarterly Report, January-March 1975*, p. 12.
22. S. J. Hakim and R. J. Henninger, *TRANSIT: A Computer Code For a Mechanistic Analysis of the Transition Phase of an FBR Accident*, Trans. Am. Nucl. Soc. 24, 261 (1976),
23. J. F. Jackson and R. B. Nicholson, *VENUS-II: An LMFBR Disassembly Program*, ANL-7951 (Sept 1972).
24. J. F. Jackson et al., "Trends in LMFBR Hypothetical Accident Analysis," in *Proc. Fast Reactor Safety Meeting*, CONF-740401-P3, pp. 1241-1264 (1974).
25. J. K. Vaurio and C. Mueller, *PROSA-1: A Probabilistic Response-Surface Analysis Code*, ANL-78-56 (June 1978).
26. J. K. Vaurio and C. Mueller, *A Fast Integral Model for the Transient Analysis of a Melting Fuel Pin*, Trans. Am. Nucl. Soc. 28, 473 (1978).