TREE-NUREG-1133

for U.S. Nuclear Regulatory Commission

SCORE-EVET: A COMPUTER CODE FOR THE MULTIDIMENSIONAL TRANSIENT THERMAL-HYDRAULIC ANALYSIS OF NUCLEAR FUEL ROD ARRAYS

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February 1978

EG&G Idaho, Inc.

IDAHO NATIONAL ENGINEERING LABORATORY

DEPARTMENT OF ENERGY

IDAHO OPERATIONS OFFICE UNDER CONTRACT EY-76-C-07-1570

Printed in the United States of America
Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22161
Price: Printed Copy $11.75; Microfiche $3.00

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TREE-NUREG-1133

Reactor Behavior Program
Distributed Under Category:
NRC-4
Water Reactor Safety Research
Analysis Development

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by

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PREPARED FOR THE
U.S. NUCLEAR REGULATORY COMMISSION
AND THE
DEPARTMENT OF ENERGY
IDAHO OPERATIONS OFFICE
UNDER CONTRACT NO. EY-76-C-07-1570

ABSTRACT

The SCORE-EVET code was developed to study multidimensional transient fluid flow in nuclear reactor fuel rod arrays. The conservation equations used were derived by volume averaging the transient compressible three-dimensional local continuum equations in Cartesian coordinates. No assumptions associated with subchannel flow have been incorporated into the derivation of the conservation equations. In addition to the three-dimensional fluid flow equations, the SCORE-EVET code contains: (a) a one-dimensional steady state solution scheme to initialize the flow field, (b) steady state and transient fuel rod conduction models, and (c) comprehensive correlation packages to describe fluid-to-fuel rod interfacial energy and momentum exchange. Velocity and pressure boundary conditions can be specified as a function of time and space to model reactor transient conditions such as a hypothesized loss-of-coolant accident (LOCA) or flow blockage.

NOMENCLATURE

A_F	Cross-sectional area
AWF	Wetted surface area per unit cell volume
AWQ	Heated surface area per unit cell volume
a	Constant for friction factor
b	Constant for friction factor
c	Constant for friction factor
CEP	Convergence criteria weighting factor
CHF	Critical heat flux
C_I	Speed of sound at constant specific internal energy
C	Specific heat at constant pressure
C_{pf}	Specific heat of fuel
D	Diameter
D_{he}	Diameter, heated equivalent (4 x flow area/heated perimeter)
D_{hy}	Diameter, wetted equivalent (4 x flow area/wetted perimeter)
D_r	Diameter, fuel rod
DT	Time step
E_i	Turbulent energy transport
F	Drag force
F_i	Drag force in i^{th} direction
f	Friction factor
G	Mass flux
Gr	Grashof number
g	Gravitational acceleration (32.1740486 ft/sec^2, 9.8066500 m/s^2)
gc	Gravitational constant
g_i	Body force in i^{th} direction
H	Enthalpy
H_f	Saturated liquid enthalpy
H_{fg}	Heat of vaporization
h	Heat transfer coefficient
I	Specific internal energy

K_s	Velocity slip ratio
K_{LP}	Constant for Lombardi-Pedrocchi friction factor correlation
k	Thermal conductivity
k_f	Thermal fuel conductivity
k_T	Turbulent or eddy thermal diffusivity
L	Length
M_i	Momentum interchange
m	Mass
$\dot{m}$	Mass flow rate
MIN	Minimum
P	Pressure
P_h	Heated perimeter
P_c	Critical pressure
P_w	Wetted perimeter
Pr	Prandtl number
Q	Heat transfer rate
Q_w	Rate of solid/fluid heat supply per unit cell volume
q''	Heat flux
q'''	Volumetric energy generation rate
R	Radial dimension for fuel rod noding
Re	Reynolds number
r	Radial distance
S	Stephan-Boltzman constant (1.714×10^{-9} Btu/hr-ft^2-°R)
$S_{i,j,k}$	Excess mass or mass error
S_p	Fuel rod center-center spacing
t	Time
T	Temperature
T_s	Solid surface temperature
T_b	Bulk coolant temperature
u	Axial velocity, x-direction
V	Volume
V_f	Volume of fluid in V
v_i	Velocity component in the i^{th} direction
v	Transverse velocity, y-direction
w	Transverse velocity, z-direction

XLOSS	Form loss factor
X_{tt}	Martinelli-Lockhart parameter
x,X	Axial direction x
y,Y	Transverse direction y
z,Z	Transverse direction z
α	Void fraction
β	Coefficient of thermal expansion
$\Delta\tau$	Weighting factor increment in iteration scheme
Δt	Time increment
Δy_i	Spatial increment in the i^{th} direction
ε	Channel porosity, fluid volume per unit cell volume
μ	Mixture viscosity
μ_n	Viscosity of liquid or vapor
ξ_s	Surface roughness
ρ	Density
σ	Surface tension
$\phi_{\ell o}$	Two-phase friction multiplier
χ	Quality
χ_e	Equilibrium quality
χ_f	Flow quality
ω	Iteration weighting factor

Subscripts and Marks

a	Atmospheric
b	Bulk
Br	Barnett correlation
CHF	Critical heat flux
cw	Cold wall
cl	Cladding
cool	Coolant
down	Downstream
e	Equilibrium
f	Fuel
F	Channel cross section, or surface film conditions
flow	Flow
g	Vapor
gap	Fuel to cladding gap
he	heated equivalent
i	Direction
in	inlet
IC	Inside cladding
i,j,k	Cell index labels
I	Internal energy
L	Laminar
max	Maximum
ℓ	Liquid
ℓo	Liquid reference
OC	Outside cladding
r	Radial distance
s	Fuel rod surface
ss	Steady state
sat	Saturated conditions
T	Turbulent
up	Upstream
w	Wall conditions
x,X	With respect to x-direction
y,Y	With respect to y-direction

z,Z	With respect to z-direction
~	Fluid average
'	Fluctuating component
^	Most recent iteration
*	Multiplication

CONTENTS

FIGURES

TABLES

SCORE-EVET: A COMPUTER CODE FOR THE MULTIDIMENSIONAL TRANSIENT THERMAL-HYDRAULIC ANALYSIS OF NUCLEAR REACTOR FUEL ROD ARRAYS

I. INTRODUCTION

This document presents a description of the SCORE-EVET code numerics and organization, constitutive relationships, and user input requirements. The SCORE-EVET code is based on the three-dimensional volume-averaged equations presented in Reference 1.

Development of the SCORE-EVET code was initiated by the Atomic Energy Commission (AEC) and continued under the direction of the Nuclear Regulatory Commission (NRC). This code development effort was directed toward improved multidimensional transient computational modeling of water reactors under hypothesized accident conditions.

The approach taken in developing the SCORE-EVET code is different than that of other multidimensional codes used for reactor analysis. The SCORE-EVET conservation equations were not developed on the basis of subchannel fluid flow assumptions. The basic volume-averaged transient three-dimensional equations for flow in porous media were developed first[1]. These volume-averaged equations form the heart of the code. In SCORE-EVET these equations are solved in their general form with constitutive relationships and boundary conditions tailored to define the porous medium as a matrix of fuel rods. By retaining generality in the form of the conservation equations, a wide range of fluid flow problem configurations -- from computational regions representing a single fuel rod subchannel to multisubchannels or even regions without a fuel rod -- can be modeled without restrictive assumptions. The completeness of the conservation equations has allowed the code to be used, with modification to the constitutive relationships, to calculate three-dimensional laminar boundary layer development, flow fields in large bodies of water, and, with the addition of a turbulence model, turbulent flow in pipe expansions and tees.

The following sections of this report contain: the summary description of the code (Section II), the conservation equations and numerical algorithms for fluid and energy transport (Section III), the fuel rod thermal transport model (Section IV), a brief description of the constitutive relationships and equation of state (Section V), and the program description (Section VI).

The appendixes contain: the SCORE-EVET input data description (Appendix A), a description of the boundary condition specification options (Appendix B), a detailed description of the constitutive relationships (Appendix C), a brief description of the SCORE-EVET subroutines (Appendix D), and three sample problems (Appendix E).

II. SUMMARY DESCRIPTION OF SCORE-EVET

SCORE-EVET is a three-dimensional transient thermal-hydraulic code for transient analysis of water reactor cores under hypothesized accident conditions. The major features of this code are described below.

(1) Three-dimensional transient compressible conservation equations are used to model the flow field in fuel rod arrays

(2) Initialization of the flow field is accomplished by solving the steady state one-dimensional form of the conservation equations

(3) A comprehensive collection of constitutive relationships for fluid-solid interfacial heat transfer and momentum exchange is provided

(4) A steady state and transient fuel rod thermal transport model is included to calculate fuel rod temperature and surface heat flux

(5) Steam and water properties are accurately described for the complete range of temperatures and pressures found under hypothesized water reactor accident conditions

(6) Temporally and spatially varying pressure and velocity boundary condition specifications are allowed

(7) Printed output is available in two forms: (a) three-dimensional array output and (b) individual flow channel and fuel rod output

(8) Tape restart capability is provided.

The major assumptions and limitations associated with SCORE-EVET are given in Table I. The sections which follow describe the basic features of the SCORE-EVET code and its input. The complete description of the volume-averaging procedure used to develop the conservation equations can be found in Reference 1.

TABLE I

MAJOR ASSUMPTIONS AND LIMITATIONS
OF SCORE-EVET

Assumptions or Limitations	Equations Involved
Homogeneous compressible fluid in thermal equilibrim	All fluid equations
Geometry constant with time and x-direction	All fluid equations
Isotropic turbulent mixing	Momentum and energy equations
Volumetric heat generation neglected in the fluid	Energy equation
Fluid drag forces represented by wall friction and form drag	Momentum equation
Maximum time step limited by Courant restriction, maximum $\Delta t \leq \Delta y_i/v_i$	All fluid equations
Boundary specifications limited to the inlet and exit planes	All fluid equations
One-dimensional steady state initialization of flow field	All fluid equations
Fuel rod-to-coolant heat transfer modeled with one-dimensional steady state heat transfer and critical heat flux correlations	Energy equation
Fuel rod modeled one dimensionally	Fuel rod thermal transport equation

III. CONSERVATION EQUATIONS AND NUMERICAL ALGORITHMS FOR FLUID AND ENERGY TRANSPORT

The basis for the SCORE-EVET computer program is the numerical algorithm for the conservation equations of mass, momentum, and energy. The conservation equations were derived by volume averaging the transient compressible three-dimensional local continuum equations[1]. Using the appropriate boundary conditions and constitutive relationships, this general equation set solves for transient multidimensional homogeneous [equal phase velocity and temperature (EVET)] single- and two-phase flow in fuel rod arrays. In addition to the transient multidimensional equations, a steady state one-dimensional algorithm has been included in SCORE-EVET to provide initialization of the flow field.

The following description centers on the numerical form of the volume-averaged equations. The details of the volume-averaging procedure are given in Reference 1 and are not repeated in this document.

1. BASIC EQUATIONS

The general forms of the volume-averaged three-dimensional equations, as derived in Reference 1, are:

The conservation of mass equation is

$$\frac{\partial \varepsilon \tilde{\rho}}{\partial t} + \frac{\partial}{\partial y_k} (\varepsilon \tilde{\rho} \, \tilde{v}_k) = 0 \tag{1}$$

where ε is the porosity defined as the ratio of fluid volume to total volume (V_f/V) in a computational cell, and $\tilde{\rho}$ and $\tilde{v}_k$ are the fluid average density and velocity, respectively.

The linear momentum balance is

$$\frac{\partial(\varepsilon \tilde{\rho} \tilde{v}_i)}{\partial t} + \frac{\partial(\varepsilon \tilde{\rho} \tilde{v}_i \, \tilde{v}_k)}{\partial y_k} = - \varepsilon \frac{\partial \tilde{P}}{\partial y_i} + M_i - F_i + \varepsilon \tilde{\rho} g_i \tag{2}$$

where M_i represents the momentum interchange between adjacent fluid volumes due to viscous shear forces and velocity fluctuations, and F_i represents both form losses and fluid/solid interfacial momentum exchange. The constitutive relationships describing M_i and F_i are discussed in Appendix C.

The conservation of energy equation is

$$\frac{\partial}{\partial t}(\varepsilon\tilde{\rho}\tilde{I}) + \frac{\partial}{\partial y_k}(\varepsilon\tilde{\rho}\tilde{I}\tilde{v}_k) = \varepsilon\frac{\partial}{\partial y_k}\left(k\frac{\partial\tilde{T}}{\partial y_k}\right) + \frac{\partial}{\partial y_k}\left(\varepsilon\tilde{\rho}k_t\frac{\partial\tilde{I}}{\partial y_k}\right) - \tilde{P}\frac{\partial}{\partial y_k}(\varepsilon\tilde{v}_k) + Q_w \qquad (3)$$

where $\tilde{I}$ and $\tilde{T}$ are the fluid average specific internal energy density and temperature, respectively. The first term on the right side of Equation (3) represents the change in internal energy due to molecular heat conduction. The second term on the right side of Equation (3) represents the net change in internal energy due to the fluctuating components of velocity and energy. k_t is the turbulent thermal diffusivity coefficient and is described in Appendix C. The third term on the right represents pressure-volume work. The work due to the time rate of change of porosity $\left(\tilde{P}\frac{\partial\varepsilon}{\partial t}\right)$ has been neglected. The last term (Q_w) on the right side of Equation (3) is fluid/solid interfacial energy exchange per unit volume. In the SCORE-EVET code, Q_w can be specified as a function of space and time or it can be calculated using a fuel rod thermal model and the relationship

$$Q_w = AWQ * h(T_s - \tilde{T}_b) \qquad (4)$$

where AWQ is the ratio of heated surface area to total cell volume, h is the heat transfer coefficient, T_s is the surface temperature for the fuel rods, and $\tilde{T}_b$ is the average fluid temperature. The fuel rod thermal transport model used to calculate T_s is described in Section IV, and the constitutive relationships used to describe h are described in Appendix C.

In addition to constitutive relationships for friction, form losses, heat transfer, and turbulent exchange, closure of the equation set requires an equation of state. The form of the equation of state is

$$\tilde{\rho} = f(\tilde{P}, \tilde{I}) . \qquad (5)$$

2. NUMERICAL SCHEME

The numerical technique used to solve Equations (1) through (3) is based on the marker and cell (MAC) method for incompressible flow as modified by Hirt and Cook[2] and the implicit continuous fluid Eulerian (ICE) method for compressible flow[3]. The essential features of these two methods are: (a) the continuity equation is implicit in density and velocity, (b) the linear momentum equation is implicit in pressure, and (c) the energy equation is purely explicit.

Rearranging the momentum equation, Equation (2), and applying the continuity equation, Equation (1), yields a form of the momentum equation that is compatible with the incompressible MAC technique. The new form of Equation (2) is

$$\frac{\partial \tilde{v}_i}{\partial t} + \frac{\partial(\tilde{v}_i \tilde{v}_k)}{\partial y_k} = - \frac{\varepsilon}{(\varepsilon\tilde{\rho})} \frac{\partial \tilde{P}}{\partial y_i} + \tilde{v}_i \frac{\partial \tilde{v}_k}{\partial y_k}$$

$$+ M_i/\varepsilon\tilde{\rho} - F_i/\varepsilon\tilde{\rho} + g_i . \qquad (6)$$

The region in which computations are to be performed is divided into a set of small rectangular cells of size Δx_i, Δy_j, and Δz_k. As shown in Figure 1, velocity components are located at cell faces; and density, specific internal energy, and pressure are located at cell centers, as shown in Figure 2. Cells are labeled with an index (i, j, k) as counted from the origin in the x-, y-, z-directions, respectively. A time-dependent solution is obtained by expressing Equations (1), (3), and (6) in finite difference form using the staggered cell arrangement shown in Figure 3 and advancing the variables through a sequence of short time steps of duration Δt. The advancement for each time step is

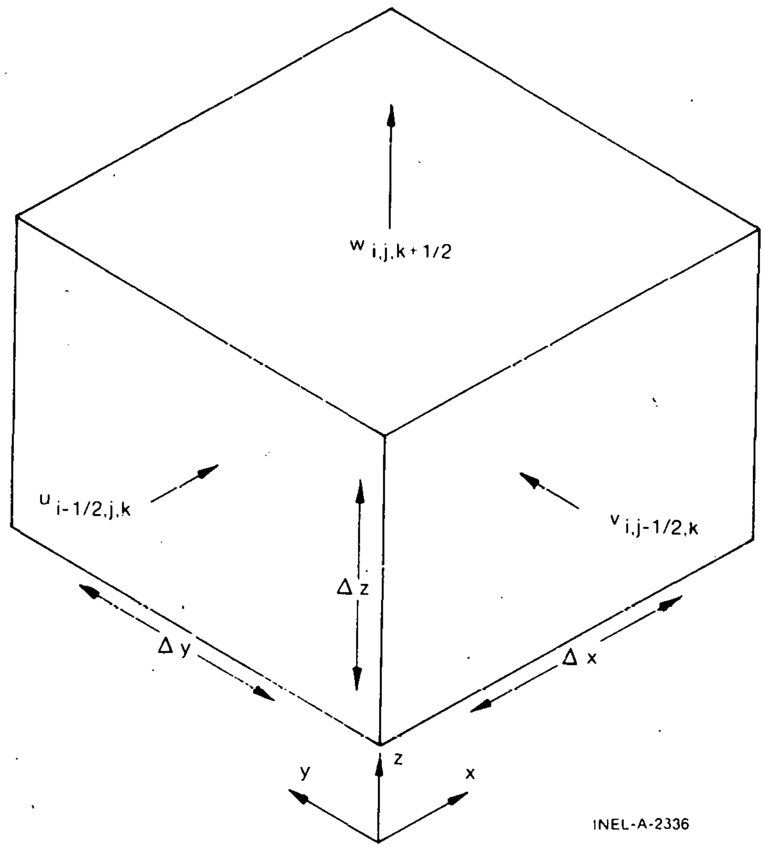


Fig. 1 The computational cell.

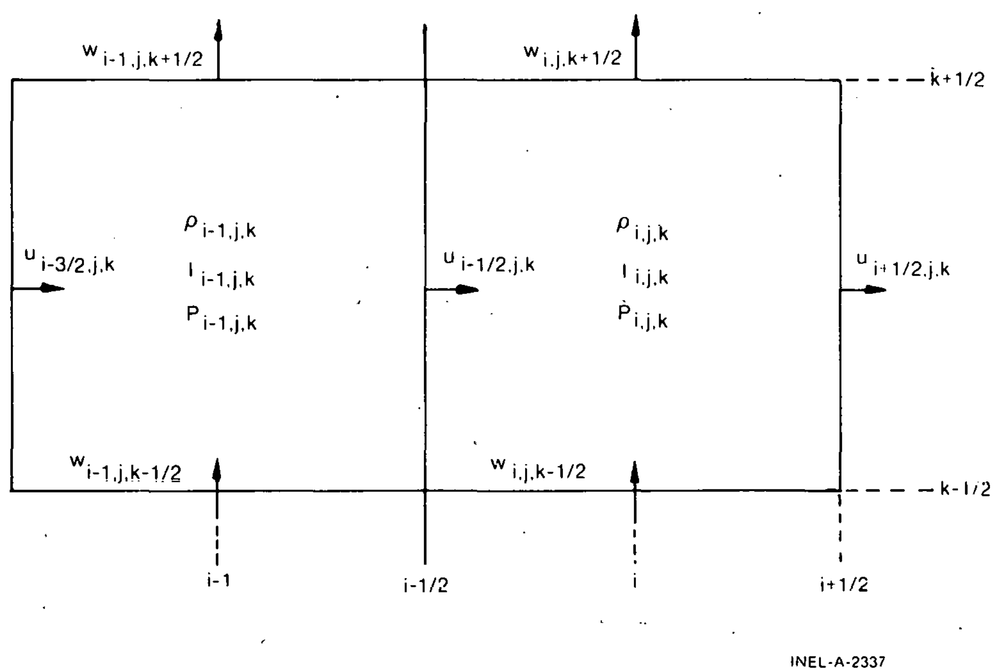


Fig. 2 Position of variables in the (i, j, k) plane.

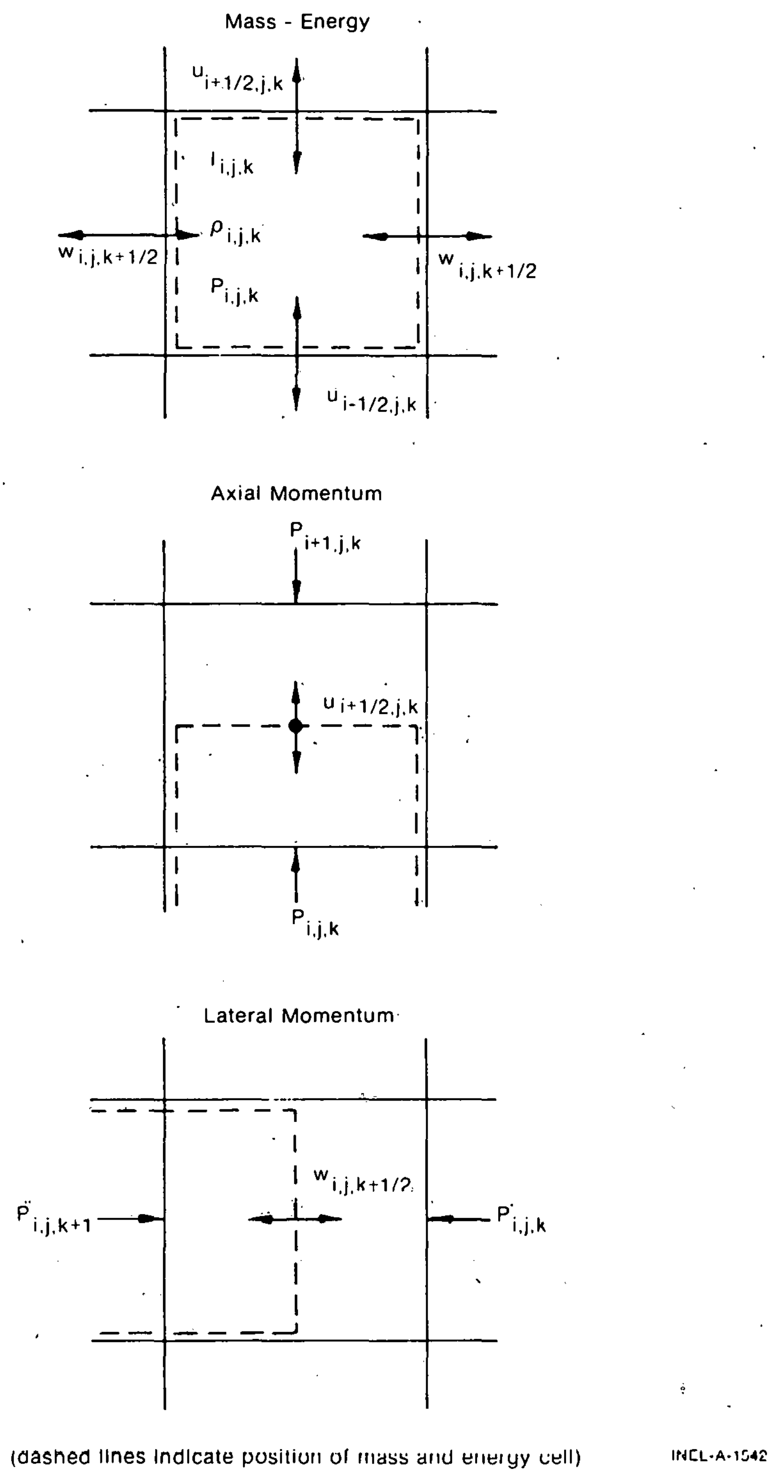


Fig. 3 Conservation cells for mass, energy, and momentum.

accomplished in two stages. In the first stage, all quantities are advanced explicitly. These quantities then provide the initial estimates for stage two in which the implicit quantities are obtained by means of a cell-by-cell iteration process. In the difference equations which follow, the fluid average symbol (~) has been omitted for convenience and the velocity components are denoted by u, v, and w.

The specific finite difference equations are:

(1) The mass conservation equation:

$$
\begin{aligned}
(\varepsilon\rho)^{n+1}_{i,j,k} = (\varepsilon\rho)_{i,j,k} + \frac{\Delta t}{2} \Bigg\{ \Bigg[& u^{n+1}_{i-1/2,j,k} \left[(\varepsilon\rho)^{n+1}_{i-1,j,k} + (\varepsilon\rho)^{n+1}_{i,j,k} \right] \\
& + \alpha_x \left| u^{n+1}_{i-1/2,j,k} \right| \left[(\varepsilon\rho)^{n+1}_{i-1,j,k} - (\varepsilon\rho)^{n+1}_{i,j,k} \right] - u^{n+1}_{i+1/2,j,k} \left[(\varepsilon\rho)^{n+1}_{i,j,k} + (\varepsilon\rho)^{n+1}_{i+1,j,k} \right] \\
& - \alpha_x \left| u^{n+1}_{i+1/2,j,k} \right| \left[(\varepsilon\rho)^{n+1}_{i,j,k} - (\varepsilon\rho)^{n+1}_{i+1,j,k} \right] \Bigg] \Bigg/ \Delta x_i + \Bigg[v^{n+1}_{i,j-1/2,k} \left[(\varepsilon\rho)^{n+1}_{i,j-1,k} \right. \\
& \left. + (\varepsilon\rho)^{n+1}_{i,j,k} \right] + \alpha_y \left| v^{n+1}_{i,j-1/2,k} \right| \left[(\varepsilon\rho)^{n+1}_{i,j-1,k} - (\varepsilon\rho)^{n+1}_{i,j,k} \right] - v^{n+1}_{i,j+1/2,k} \left[(\varepsilon\rho)^{n+1}_{i,j,k} \right. \\
& \left. + (\varepsilon\rho)^{n+1}_{i,j+1,k} \right] - \alpha_y \left| v^{n+1}_{i,j+1/2,k} \right| \left[(\varepsilon\rho)^{n+1}_{i,j,k} - (\varepsilon\rho)^{n+1}_{i,j+1,k} \right] \Bigg] \Bigg/ \Delta y_j \\
& + \Bigg[w^{n+1}_{i,j,k-1/2} \left[(\varepsilon\rho)^{n+1}_{i,j,k-1} + (\varepsilon\rho)^{n+1}_{i,j,k} \right] + \alpha_z \left| w^{n+1}_{i,j,k-1/2} \right| \left[(\varepsilon\rho)^{n+1}_{i,j,k-1} \right. \\
& \left. - (\varepsilon\rho)^{n+1}_{i,j,k} \right] - w^{n+1}_{i,j,k+1/2} \left[(\varepsilon\rho)^{n+1}_{i,j,k} + (\varepsilon\rho)^{n+1}_{i,j,k+1} \right] - \alpha_z \left| w^{n+1}_{i,j,k+1/2} \right| \left[(\varepsilon\rho)^{n+1}_{i,j,k} \right. \\
& \left. - (\varepsilon\rho)^{n+1}_{i,j,k+1} \right] \Bigg] \Bigg/ \Delta z_k \Bigg\} . \qquad (7)
\end{aligned}
$$

(2) The linear momentum equation:

$$
\begin{aligned}
u^{n+1}_{i+1/2,j,k} = u_{i+1/2,j,k} & + \frac{2\Delta t}{(\Delta x_i + \Delta x_{i+1})} \frac{\left(p^{n+1}_{i,j,k} - p^{n+1}_{i+1,j,k} \right)}{(\varepsilon\rho)_{i+1/2,j,k}} \varepsilon_{i+1/2,j,k} + \Delta t g_x \\
& - \Delta t F^x_{i+1/2,j,k} \Big/ (\varepsilon\rho)_{i+1/2,j,k} - \frac{\Delta t}{(\Delta x_i + \Delta x_{i+1})} \Big[u_{i+1,j,k} \left(u_{i+1/2,j,k} + u_{i+3/2,j,k} \right)
\end{aligned}
$$

$$+ \alpha_x |u_{i+1,j,k}| \left(u_{i+1/2,j,k} - u_{i+3/2,j,k}\right) - u_{i,j,k} \left(u_{i-1/2,j,k} + u_{i+1/2,j,k}\right) - \alpha_x |u_{i,j,k}|$$

$$\left.\left(u_{i-1/2,j,k} - u_{i+1/2,j,k}\right)\right] - \frac{\Delta t}{2\Delta y_j} \left[v_{i+1/2,j+1/2,k} \left(u_{i+1/2,j,k} + u_{i+1/2,j+1,k}\right)\right.$$

$$+ \alpha_y |v_{i+1/2,j+1/2,k}| \left(u_{i+1/2,j,k} - u_{i+1/2,j+1,k}\right) - v_{i+1/2,j-1/2,k}$$

$$\left.\left(u_{i+1/2,j-1,k} + u_{i+1/2,j,k}\right) - \alpha_y |v_{i+1/2,j-1/2,k}| \left(u_{i+1/2,j-1,k} - u_{i+1/2,j,k}\right)\right]$$

$$- \frac{\Delta t}{2\Delta z_k} \left[w_{i+1/2,j,k+1/2} \left(u_{i+1/2,j,k} + u_{i+1/2,j,k+1}\right) + \alpha_z |w_{i+1/2,j,k+1/2}|\right.$$

$$\left(u_{i+1/2,j,k} - u_{i+1/2,j,k+1}\right) - w_{i+1/2,j,k-1/2} \left(u_{i+1/2,j,k-1} + u_{i+1/2,j,k}\right) -$$

$$\left.\alpha_z |w_{i+1/2,j,k-1/2}| \left(u_{i+1/2,j,k-1} - u_{i+1/2,j,k}\right)\right] + \frac{2\Delta t}{\Delta x_i + \Delta x_{i+1}} \left[u_{i+1/2,j,k}\right.$$

$$\left.\left(u_{i+1,j,k} - u_{i,j,k}\right)\right] + \frac{\Delta t}{\Delta y_j} \left[u_{i+1/2,j,k} \left(v_{i+1/2,j+1/2,k} - v_{i+1/2,j-1/2,k}\right)\right] + \frac{\Delta t}{\Delta z_k}$$

$$\left[u_{i+1/2,j,k} \left(w_{i+1/2,j,k+1/2} - w_{i+1/2,j,k-1/2}\right)\right] + \left(\Delta t\, M^x_{i+1/2,j,k}\right) \Big/ (\varepsilon\rho)_{i+1/2,j,k} \qquad (8)$$

with similar linear momentum equations for the y- and z-directions.

(3) The energy equation:

$$(\varepsilon\rho)^{n+1}_{i,j,k}\, I^{n+1}_{i,j,k} = (\varepsilon\rho)_{i,j,k} I_{i,j,k} + \frac{\Delta T}{2} \left\{\left[u_{i-1/2,j,k} \left((\varepsilon\rho)_{i-1,j,k}\, I_{i-1,j,k}\right.\right.\right.$$

$$\left.+ (\varepsilon\rho)_{i,j,k}\, I_{i,j,k}\right) + \alpha_x |u_{i-1/2,j,k}| \left((\varepsilon\rho)_{i-1,j,k}\, I_{i-1,j,k} - (\varepsilon\rho)_{i,j,k}\, I_{i,j,k}\right)$$

$$- u_{i+1/2,j,k} \left((\varepsilon\rho)_{i,j,k}\, I_{i,j,k} + (\varepsilon\rho)_{i+1,j,k}\, I_{i+1,j,k}\right) - \alpha_x |u_{i+1/2,j,k}| \left((\varepsilon\rho)_{i,j,k}\, I_{i,j,k}\right.$$

$$\left.\left.- (\varepsilon\rho)_{i+1,j,k}\, I_{i+1,j,k}\right)\right] \Big/ \Delta x_i + \left[v_{i,j-1/2,k} \left((\varepsilon\rho)_{i,j-1,k}\, I_{i,j-1,k}\right.\right.$$

$$\left.+ (\varepsilon\rho)_{i,j,k}\, I_{i,j,k}\right) + \alpha_y |v_{i,j-1/2,k}| \left((\varepsilon\rho)_{i,j-1,k}\, I_{i,j-1,k} - (\varepsilon\rho)_{i,j,k}\, I_{i,j,k}\right)$$

$$
v_{i,j+1/2,k}\left((\varepsilon\rho)_{i,j,k}\, I_{i,j,k} + (\varepsilon\rho)_{i,j+1,k}\, I_{i,j+1,k}\right) - \alpha_y |v_{i,j+1/2,k}|
\left((\varepsilon\rho)_{i,j,k}\, I_{i,j,k} - (\varepsilon\rho)_{i,j+1,k}\, I_{i,j+1,k}\right)\Big] \Big/ \Delta y_j + \Big[w_{i,j,k-1/2} \left((\varepsilon\rho)_{i,j,k-1}\, I_{i,j,k-1}
+ (\varepsilon\rho)_{i,j,k}\, I_{i,j,k}\right) + \alpha_z |w_{i,j,k-1/2}| \left((\varepsilon\rho)_{i,j,k-1}\, I_{i,j,k-1} - (\varepsilon\rho)_{i,j,k}\, I_{i,j,k}\right)
- w_{i,j,k+1/2} \left((\varepsilon\rho)_{i,j,k}\, I_{i,j,k} + (\varepsilon\rho)_{i,j,k+1}\, I_{i,j,k+1}\right) - \alpha_z |w_{i,j,k+1/2}| \left((\varepsilon\rho)_{i,j,k}\, I_{i,j,k}
- (\varepsilon\rho)_{i,j,k+1}\, I_{i,j,k+1}\right)\Big] \Big/ \Delta z_k \Big\} - \Delta t \left[P_{i,j,k}\,\varepsilon_{i,j,k}\right] \left[\frac{u_{i+1/2,j,k} - u_{i-1/2,j,k}}{\Delta x_i}
+ \frac{v_{i,j+1/2,k} - v_{i,j-1/2,k}}{\Delta y_j} + \frac{w_{i,j,k+1/2} - w_{i,j,k-1/2}}{\Delta z_k}\right] + \Delta t (k + k_t) \Big\{\Big[2(\varepsilon\rho)_{i+1/2,j,k}
\left(I_{i+1,j,k} - I_{i,j,k}\right) \Big/ \left(\Delta x_i + \Delta x_{i+1}\right) - 2(\varepsilon\rho)_{i-1/2,j,k} \left(I_{i,j,k} - I_{i-1,j,k}\right)
\Big/ \left(\Delta x_i + \Delta x_{i-1}\right)\Big] \Big/ \Delta x_i + \Big[2(\varepsilon\rho)_{i,j+1/2,k} \left(I_{i,j+1,k} - I_{i,j,k}\right) \Big/ \left(\Delta y_j + \Delta y_{j+1}\right)
- 2(\varepsilon\rho)_{i,j-1/2,k} \left(I_{i,j,k} - I_{i,j-1,k}\right) \Big/ \left(\Delta y_j + \Delta y_{j-1}\right)\Big] \Delta y_j + \Big[2(\varepsilon\rho)_{i,j,k+1/2}
\left(I_{i,j,k+1} - I_{i,j,k}\right) \Big/ \left(\Delta z_k + \Delta z_{k+1}\right) - 2(\varepsilon\rho)_{i,j,k-1/2} \left(I_{i,j,k} - I_{i,j,k-1}\right) \Big/ \Big(\Delta z_k
+ \Delta z_{k-1}\Big)\Big] \Big/ \Delta z_k \Big\} + \Delta t\, Q^{w}_{ijk} \, . \qquad (9)
$$

The superscript $n+1$ denotes an advanced time quantity, whereas no superscript denotes the previous time values of any quantity. In Equations (7) through (9), the donor cell and centered finite differencing have been combined. α is the donor cell weighting factor such that $\alpha_i = 1$ yields full donor cell differencing, and $\alpha_i = 0$ yields centered differencing. Quantities required at positions other than where they are defined are calculated as simple averages; for example, $u_{i,j,k} = (u_{i+1/2,j,k} + u_{i-1/2,j,k})/2$. It should be noted that in the present version of the SCORE-EVET code, the porosity is not allowed to vary as a function of time and is slowly varying; that is, $\frac{\partial \varepsilon}{\partial x_i}$ terms have been neglected.

To obtain the implicit character described in Equations (7) and (8), the following cell-by-cell calculational procedure is used:

(1) The advanced-time specific internal energies (I^{n+1}) are calculated using Equation (7) explicitly (all previous time values on the right side) and Equation (9).

(2) The tentative advanced-time velocities for each cell are calculated according to Equation (8), and the corresponding equations for v and w, using the previous time pressure.

(3) The tentative advanced-time pressure is calculated such that the pressure adjustment in each cell is proportional to the excess mass $S_{i,j,k}$ that accumulates in the cell beyond that consistent with mass conservation, that is:

$$P^{n+1}_{i,j,k} = \hat{P}_{i,j,k} + \delta P_{i,j,k} \tag{10}$$

where

$$\delta P_{i,j,k} = - \Delta\tau S_{i,j,k} \tag{11}$$

and

$$S_{i,j,k} = \frac{\hat{\rho}_{i,j,k} - \rho^n_{i,j,k}}{\Delta t} + \left[\frac{\partial(\hat{\rho}\ \hat{v}_k)}{\partial x_k}\right]_{i,j,k} \tag{12}$$

where n represents the old time value.

The superscript ^ denotes the most recent tentative advanced-time quantity, and the divergence term in Equation (12) is differenced as in Equation (7). For the first iteration of any time step the tentative density ($\hat{\rho}$) is calculated as

$$\hat{\rho} = f\,(P^n,\ I^{n+1}).$$

(4) The new advanced-time velocities are then calculated from the new pressures by

$$u^{n+1}_{i+1/2,j,k} = \hat{u}_{i+1/2,j,k} + \frac{2\Delta t}{(\Delta x_i+\Delta x_{i+1})} \frac{\varepsilon_{i+1/2,j,k}\,\delta P_{i,j,k}}{\left((\varepsilon\rho)^n_{i+1/2,j,k}\right)} \tag{13}$$

$$u^{n+1}_{i-1/2,j,k} = \hat{u}_{i-1/2,j,k} - \frac{2\Delta t}{\left(\Delta x_i + \Delta x_{i-1}\right)} \frac{\varepsilon_{i-1/2jk}\,\delta P_{ijk}}{\left((\varepsilon\rho)^n_{i-1/2jk}\right)} \tag{14}$$

$$v^{n+1}_{i,j+1/2,k} = \hat{v}_{i,j+1/2,k} + \frac{2\Delta t}{\left(\Delta y_j+\Delta y_{j+1}\right)} \frac{\varepsilon_{i,j+1/2,k}\,\delta P_{i,j,k}}{\left((\varepsilon\rho)^n_{i,j+1/2,k}\right)} \tag{15}$$

$$v^{n+1}_{i,j-1/2,k} = \hat{v}_{i,j-1/2,k} - \frac{2\Delta t}{\left(\Delta y_j+\Delta y_{j-1}\right)} \frac{\varepsilon_{i,j-1/2,k}\,\delta P_{i,j,k}}{\left((\varepsilon\rho)^n_{i,j-1/2,k}\right)} \tag{16}$$

$$w^{n+1}_{i,j,k+1/2} = \hat{w}_{i,j,k+1/2} + \frac{2\Delta t}{\left(\Delta z_k+\Delta z_{k+1}\right)} \frac{\varepsilon_{i,j,k+1/2}\,\delta P_{i,j,k}}{\left((\varepsilon\rho)^n_{i,j,k+1/2}\right)} \tag{17}$$

$$w^{n+1}_{i,j,k-1/2} = \hat{w}_{i,j,k-1/2} - \frac{2\Delta t}{\left(\Delta z_k + \Delta z_{k-1}\right)} \frac{\varepsilon_{i,j,k-1/2}\,\delta P_{i,j,k}}{\left((\varepsilon\rho)^n_{i,j,k-1/2}\right)} . \tag{18}$$

Equations (10) through (18) are evaluated for each cell in turn using the previous velocity iterates on the right, front, and top faces and the new velocity iterates on the left, back, and bottom faces so that the velocity on a face is modified due to the pressure changes in the adjacent cell. The mesh is swept successively in the direction of increasing j for each (i, k) plane and in the direction of increasing k for each i column. This is a successive overrelaxation iterative procedure and is superior to simply using the previous iterates.

(5) The new tentative advanced-time densities for each cell are then calculated from the equation of state in the form $\hat{\rho} = f(\hat{P}, I)$ using the most recent value of $\hat{P}$. The user may specify the use of the linearized equation of state $\delta\rho = \delta P/C_I^2$ where C_I is the speed of sound at constant internal energy. In practice, using the linearized equation of state saves computational time with little loss of accuracy.

(6) Steps 3 through 5 are repeated until the mass error ($S_{i,j,k}$) between two consecutive iterations is below some specified tolerance. In the current version of the SCORE-EVET code, the tolerance on $S_{i,j,k}$ is specified in the following manner:

$$S_{i,j,k} \leq \text{CEP} \left[\text{Min} \left(\frac{\rho_{i,j,k}|u_{i,j,k}|}{\Delta x_i} + \frac{\rho_{i,j,k}|v_{i,j,k}|}{\Delta y_j} + \frac{\rho_{i,j,k}|w_{i,j,k}|}{\Delta z_k}\right)\right] \tag{19}$$

where the value of CEP is specified by the user (generally CEP has the value $10^{-2} \geq \text{CEP} \geq 10^{-3}$).

(7) The advanced time quantities become the previous time quantities, and Steps (1) through (6) are repeated for the next time cycle.

The value of $\Delta\tau$ in Equation (11) must be chosen so as to ensure convergence of the iteration scheme. The value of $\Delta\tau$ used in the present version of the SCORE code was derived by applying the successive overrelaxation method to the combination of the continuity equation (Equation 7), linearized momentum equations [Equations (13) through (18)], and the linearized equation of state $\delta\rho = \delta P/C_I^2$. The form of $\Delta\tau$ so derived is:

$$= \omega\left[\frac{\epsilon_{i,j,k}}{C_I^2}\left(\frac{1}{\Delta t} + \sum_{i=i,j,k}\left\{\frac{v_{i+1/2}}{2\Delta y_i}\left(1 + \frac{\alpha_i|v_{i+1/2}|}{v_{i+1/2}}\right) - \frac{v_{i-1/2}}{2\Delta y_i}\left(1 - \frac{\alpha_i|v_{i-1/2}|}{v_{i-1/2}}\right)\right\}\right) + \epsilon_{i,j,k}\,\Delta t = \sum_{i=i,j,k}\left\{\frac{2}{\Delta y_i(\Delta y_i + \Delta y_{i+1})}\left(1 + \frac{\alpha_i|v_{i+1/2}|}{v_{i+1/2}}\,\frac{(\rho_i - \rho_{i+1})}{(\rho_i + \rho_{i+1})}\right) + \frac{2}{\Delta y_i(\Delta y_i + \Delta y_{i-1})}\left(1 + \alpha_i\,\frac{|v_{i-1/2}|}{v_{i-1/2}}\,\frac{(\rho_{i-1} - \rho_i)}{(\rho_{i-1} + \rho_i)}\right)\right\}\right]^{-1} \tag{20}$$

where ω can have the values $2 > \omega > 0$. It should be noted that $\Delta\tau$, as defined by Equation (20), for an incompressible fluid and porosity of 1, reduces to the incompressible form given in Reference 2. That is, for incompressible flow in open volumes and equal cell spacing, Equation (20) becomes:

$$\Delta\tau = \frac{\omega}{2\ \Delta t \left(\frac{1}{\Delta x^2} + \frac{1}{\Delta y^2} + \frac{1}{\Delta z^2}\right)}. \tag{21}$$

General three-dimensional homogeneous compressible flow in porous media can be calculated using the equation set and the solution scheme presented. In the SCORE-EVET code, this scheme has been adapted to the solution of flow in fuel rod arrays. To adapt these numerics to flow in fuel rod arrays, the x-direction was chosen as the axial flow direction. Based on this designation, correlations for fluid/solid interfacial momentum exchange and heat transfer for fuel rods oriented in the x-direction in the coordinate system were incorporated into the code. In addition, boundary condition specifications were limited to the two y-z planes which bound the computational region in the x-direction. The constitutive relationships and boundary condition specifications allowed are described in detail in Appendixes B and C. If SCORE-EVET is used to solve for information other than flow in fuel rod arrays, only the constitutive relationships and boundary specification are changed.

3. <u>ONE-DIMENSIONAL INITIALIZATION EQUATIONS</u>

An initialization routine has been included in the SCORE-EVET code. The axial velocity (u), density, internal energy, and pressure for each computational cell are initialized by solving the steady state one-dimensional mass, momentum, and energy equations for the x-direction. The one-dimensional equations are as follows:

The mass conservation equation is

$$\frac{\partial c\rho u}{\partial x} = 0. \tag{22}$$

The linear momentum equation is

$$\varepsilon \frac{\partial p}{\partial x} = \frac{-\partial \varepsilon\rho\, u^2}{\partial x} - F_x + \varepsilon\rho g_x \;. \tag{23}$$

The energy equation is

$$\frac{\partial(\varepsilon\rho u I)}{\partial x} = Q_w - \frac{P\partial(\varepsilon u)}{\partial x} \;. \tag{24}$$

These three equations are subsets of Equations (1), (2), and (3). Turbulent momentum and energy exchange in the axial direction have been assumed small in Equations (23) and (24). The finite difference forms of the conservation equations are:

The mass conservation equation:

$$u_{i+1/2,j,k} = \frac{(\varepsilon\rho)_{i-1,j,k}\, u_{i-1/2,j,k}}{(\varepsilon\rho)_{i,j,k}} \;. \tag{25}$$

The linear momentum equation:

$$2\,\frac{(P_{i,j,k} = P_{i-1,jk})}{(\Delta x_{i,j,k} + \Delta x_{i-1,j,k})} = \frac{\Delta P_{i-1/2,j,k}}{\Delta x_{i-1/2,j,k}} = -\frac{F_{i-1/2,j,k}}{\varepsilon_{i-1/2,j,k}} + \rho_{i-1/2,j,k}\, g_x$$

$$+ 2\left(\frac{(\varepsilon\rho)_{i-1,j,k}\, u^2_{down} - (\varepsilon\rho)_{i,j,k}\, u_{up}^2}{\varepsilon_{i-1/2,j,k}\,(\Delta x_{i,j,k} + \Delta x_{i-1,j,k})}\right) \tag{26}$$

where

$$u_{down} = \frac{u_{i-1/2,j,k} + u_{i-3/2,j,k}}{2} \tag{27}$$

and

$$u_{up} = \frac{u_{i-1/2,j,k} + u_{i+1/2,j,k}}{2} \tag{28}$$

The energy equation:

$$I_{i,j,k} = I_{i-1,j,k} + \left(Q_w - P_{i,j,k} \frac{(u_{i+1/2,j,k} - u_{i-1/2,j,k})}{\Delta x_i} \varepsilon_{i,j,k} \right) \left(\frac{\Delta x_i}{(\varepsilon\rho)_{i-1,j,k} \, u_{i-1/2,j,k}} \right). \qquad (29)$$

The staggered conservation cell arrangement used for the transient three-dimensional equation is also used for the one-dimensional steady state equations (Figure 3). The user specifies the average inlet velocity, inlet internal energy, and exit pressure. Equations (25), (26), and (29) are then solved using the following procedure:

(1) All axial velocities are set at the specified inlet velocities, and all transverse velocities are set to zero

(2) The core average properties are evaluated using the equation of state, the specified inlet internal energy, and exit pressure

(3) The average $\partial P/\partial x$ for the core is evaluated using the inlet velocity, core average properties, and the constitutive relationships for friction

(4) The pressure for each cell is linearly calculated using the core average $\partial P/\partial x$, exit pressure, and the cell dimensions in the x-direction.

From this point on, an iterative procedure is used. By advancing in the positive x-direction, the tentative internal energy of each cell is calculated using Equation (29). The new internal energy and the old estimate of cell pressure are used together with the equation of state to obtain the tentative density of the cell. Equation (25) is then used to calculate the tentative cell velocity. Equation (26) is used to calculate the axial pressure drop from the center of the mass cell i,j,k to the center of the mass cell i-1,j,k. Using the specified exit pressure and the newly calculated cell axial pressure drops, the absolute pressures of all cells are reevaluated. The process is repeated six times. Experience has shown that six iterations are more than adequate for an accurate one-dimensional initialization. For one-dimensional problems, the initial conditions are exactly the steady state conditions, and a transient can be initiated from them. For two- and three-dimensional problems a run to steady state will still be required to properly initialize the crossflow velocities. However, the computer time required to run to steady state is greatly reduced.

IV. FUEL ROD THERMAL TRANSPORT

A fuel rod thermal transport model is included in the SCORE-EVET code. Under the assumption of constant thermal properties, the fuel rod model calculates fuel rod internal temperatures and surface heat flux by solving the one-dimension (radial) heat conduction equations. Both steady state and transient conduction models are included in the code. The transient solution model is addressed first.

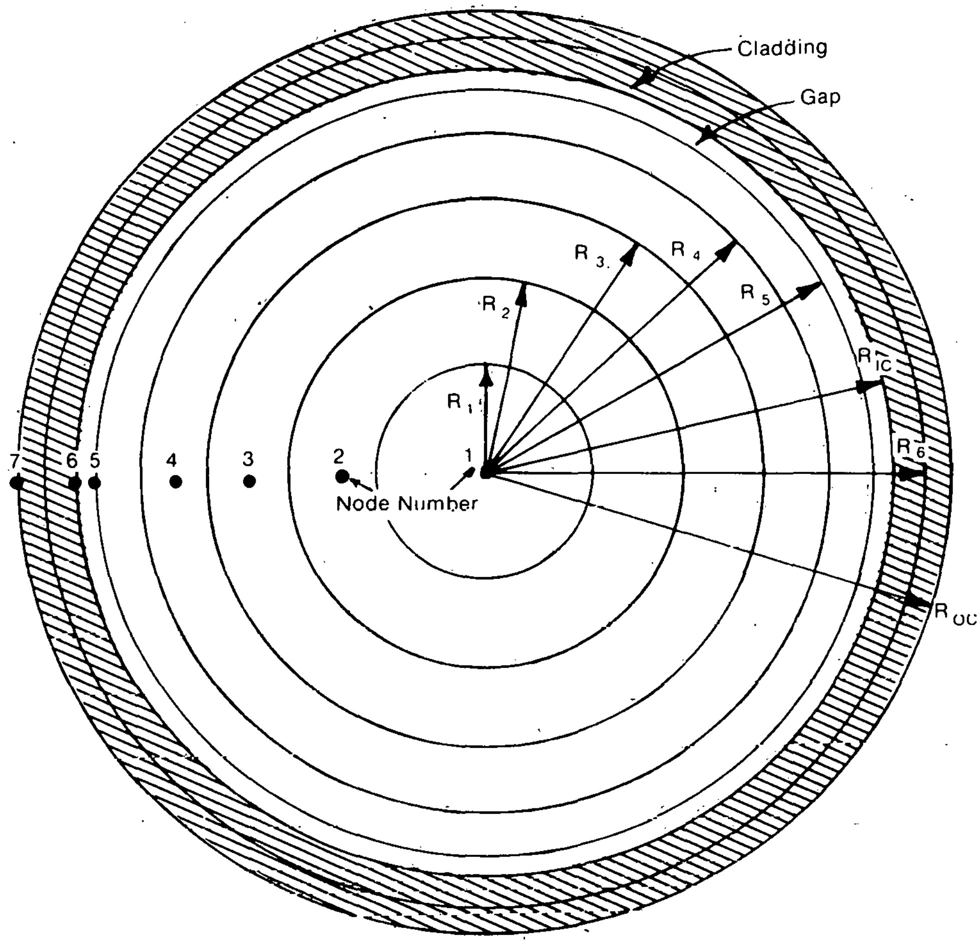
The one-dimensional transient heat conduction equation in cylindrical coordinates is:

$$\frac{\partial T}{\partial t} = \frac{k}{\rho C_p} \frac{1}{r} \left[\frac{\partial}{\partial r} \frac{r \partial T}{\partial r} \right] + \frac{q'''}{\rho C_p} \tag{30}$$

where

T = temperature
r = radial distance
q''' = volumetric heat generation (assumed independent of radius in the fuel and zero in the cladding)
C_p = specific heat (assumed independent of temperature)
ρ = density (assumed independent of temperature)
k = thermal conductivity (assumed independent of temperature).

The solution of Equation (30) is obtained by dividing the fuel and cladding into a finite number of nodes and writing Equation (30) in Crank-Nicolson implicit finite difference form[4]. In SCORE-EVET, only a fixed number and location of nodes are allowed. Currently, five nodes are allowed in the fuel (four interior to the fuel and one surface node), and two nodes in the cladding (interior and exterior surface nodes). Figure 4 shows the seven temperature node locations and the associated control volume boundaries used in SCORE-EVET to model the fuel and cladding. The nodes are numbered 1 to 7 starting at the center of the fuel rod. The Crank-Nicolson implicit finite difference forms of the conduction equations for the seven fuel rod nodes are:



$$R_1 = R_2 / 2$$

$$R_2 = R_5 / 2$$

$$R_3 = \sqrt{R_5^{2/3} + 2R_2^{2/3}}$$

$$R_4 = \sqrt{2R_5^{2/3} + R_2^{2/3}}$$

R_5 = Fuel Pellet Radius

$$R6 = \sqrt{\frac{R_{OC}{}^2 + R_{IC}{}^2}{2}}$$

INEL-A-1734

Fig. 4 SCORE-EVET fuel rod nodalization scheme.

Node 1, fuel center:

$$\rho_f C_{pf}\left(\frac{T_1^{n+1} - T_1}{\Delta t}\right) = \frac{2k_f}{R_1(R_1 + R_2)} \left(T_2^{n+1} + T_2 - T_1^{n+1} - T_1\right) + q'''^{\,n+1} \qquad (31)$$

where the subscript f refers to fuel properties.

Node 2:

$$\rho_f C_{pf}\left(\frac{T_2^{n+1} - T_2}{\Delta t}\right) = \frac{2k_f R_1}{\left(R_2^2 - R_1^2\right)\left(R_1 + R_2\right)}\left(T_1^{n+1} + T_1 - T_2^{n+1} - T_2\right)$$

$$+ \frac{2k_f R_2}{\left(R_2^2 - R_1^2\right)\left(R_3 - R_1\right)} \left(T_3^{n+1} + T_3 - T_2^{n+1} - T_2\right) + q'''^{\,n+1}. \qquad (32)$$

Node 3:

$$\rho_f C_{pf} \frac{T_3^{n+1} - T_3}{\Delta t} = \frac{2R_2 k_f}{\left(R_3^2 - R_2^2\right)\left(R_3 - R_1\right)} \left(T_2^{n+1} + T_2 - T_3^{n+1} - T_3\right)$$

$$+ \frac{2R_3 k_f}{\left(R_3^2 - R_2^2\right)\left(R_4 - R_2\right)} \left(T_4^{n+1} + T_4 - T_3^{n+1} - T_3\right) + q'''^{\,n+1}. \qquad (33)$$

Node 4:

$$\rho_f C_{pf} \left(\frac{T_4^{n+1} - T_4}{\Delta t} \right) = \frac{2R_3 k_f}{\left(R_4^2 - R_3^2\right)\left(R_4 - R_2\right)} \left(T_3^{n+1} + T_3 - T_4^{n+1} - T_4 \right)$$

$$+ \frac{2R_4 k_f}{\left(R_4^2 - R_2^3\right)\left(R_5 - R_3\right)} \left(T_5^{n+1} + T_5^{n+1} - T_4^{n+1} - T_4 \right) + q'''^{n+1}. \qquad (34)$$

Node 5, fuel pellet surface node:

$$\rho_f C_{pf} \left(\frac{T_5^{n+1} - T_5}{\Delta t} \right) = \frac{2R_4 k_f}{\left(R_5^2 - R_4^2\right)\left(R_5 - R_3\right)} \left(T_4^{n+1} + T_4 - T_5^{n+1} - T_5 \right)$$

$$+ \frac{h_{gap} R_5}{\left(R_5^2 - R_4^2\right)} \left(T_6^{n+1} + T_6 - T_5^{n+1} - T_5 \right) + q'''^{n+1} \qquad (35)$$

where h_{gap} is the fuel cladding gap conductance.

Node 6, cladding inside surface node:

$$\frac{\rho_{cl} C_{Pcl}}{\Delta t} \left(T_6^{n+1} - T_6 \right) = \frac{k_{cl} R_6}{\left(R_6^2 - R_{IC}^2\right)\left(R_{OC} - R_{IC}\right)} \left(T_7^{n+1} + T_7 - T_6^{n+1} - T_6 \right)$$

$$+ \frac{R_5 h_{gap}}{\left(R_6^2 - R_{IC}^2\right)} \left(T_5^{n+1} + T_5 - T_6^{n+1} - T_6 \right) \qquad (36)$$

where R_{IC} and R_{OC} are the cladding inside and outside radial dimensions, respectively, and the subscript cl refers to cladding materials.

Node 7, cladding outside surface nodes:

$$\frac{\rho_{c1} C_{Pc1}}{\Delta t} \left(T_7^{n+1} - T_7\right) = \frac{k_{c1} R_6}{\left(R_{OC} - R_{IC}\right)\left(R_{OC}^2 - R_6^2\right)} \left(T_6^{n+1} + T_6 - T_7^{n+1} - T_7\right)$$
$$- \frac{R_{OC}}{\left(R_{OC}^2 - R_6^2\right)} \left(q''^{n+1} + q'' \right) \qquad (37)$$

where q'' is the fuel rod surface heat flux described as

$$q'' = h_{cool} \left(T_7 - T_b\right) \qquad (38)$$

where h_{cool} is the coefficient of heat transfer between the fuel rod surface and the coolant, and T_b is the bulk coolant temperature. The superscript n+1 denotes an advanced-time quantity, whereas no superscript denotes the previous time values of any quantity. Writing the node equation in Crank-Nicolson implicit finite difference form has an advantage over other finite difference methods. The formulations above are implicit and are unconditionally stable. In addition, by using the old and new time values to calculate heat flux, the time-truncation error is now of second order in contrast to the first order error of standard implicit and explicit methods.

Equations (31) through (37) can be written in the following simplified form by combining constant coefficients and known quantities such as old time temperature and volumetric heat generation.

Node 1, fuel center:

$$B_1 T_1^{n+1} + C_1 T_2^{n+1} = D_1. \qquad (39)$$

Node 2:

$$A_2 T_1^{n+1} + B_2 T_2^{n+1} + C_2 T_3^{n+1} = D_2. \qquad (40)$$

Node 3:

$$A_3T_2^{n+1} + B_3T_3^{n+1} + C_3T_4^{n+1} = D_3. \quad (41)$$

Node 4:

$$A_4T_3^{n+1} + B_4T_4^{n+1} + C_4T_5^{n+1} = D_4. \quad (42)$$

Node 5, fuel pellet surface node:

$$A_5T_4^{n+1} + B_5T_5^{n+1} + C_5T_6^{n+1} = D_5. \quad (43)$$

Node 6, cladding inside surface node:

$$A_6T_5^{n+1} + B_6T_6^{n+1} + C_6T_7^{n+1} = D_6. \quad (44)$$

Node 7, cladding outside surface node:

$$A_7T_6^{n+1} + B_7T_7^{n+1} + q''^{n+1} = D_7. \quad (45)$$

The equations above represent a set of seven equations and seven unknowns. The solution to these equations is obtained by successive substitution of Equations (39) through (45) to obtain the following formulation for the cladding exterior surface temperature:

$$\bar{A}T_7^{n+1} + \bar{B} = q''^{n+1} = h_{cool}\left(T_7^{n+1} - T_b\right) \quad (46)$$

where $\bar{A}$ and $\bar{B}$ are constants composed of the coefficients and constants in Equations (39) through (45). Equation (46) is solved by passing the constants $\bar{A}$ and $\bar{B}$ to the heat transfer subroutine (HTCOEF). Subroutine HTCOEF determines the appropriate heat transfer coefficient based on the coolant condition, solves Equation (46) for T_7^{n+1}, and returns the surface temperature and heat flux q''^{n+1} to the conduction subroutine (RODMOD). The remaining six fuel temperatures are then calculated by six algebraic equations derived by the successive substitution of Equations (39) through (45).

The steady state temperature equations are a subset of the transient Equations (31) through (37). The seven node equations are:

Node 1, fuel center:

$$T_1 = T_2 + q''' \frac{R_1\left(R_1 + R_2\right)}{4k_f} . \tag{47}$$

Node 2:

$$T_2 = \left[\frac{\left(R_1 + R_2\right)\left(R_3 - R_1\right)}{R_1 \left(R_3 - R_1\right) + R_2 \left(R_1 + R_2\right)}\right] \left[\frac{T_1 R_1}{\left(R_1 + R_2\right)} + \frac{T_3 R_2}{\left(R_3 - R_1\right)} + \frac{q''' \left(R_2^2 - R_1^2\right)}{4k_f}\right]. \tag{48}$$

Node 3:

$$T_3 = \left[\frac{\left(R_4 - R_2\right)\left(R_3 - R_1\right)}{R_2 \left(R_4 - R_2\right) + R_3 \left(R_3 - R_1\right)}\right] \left[\frac{T_2 R_2}{\left(R_3 - R_1\right)} + \frac{T_4 R_3}{\left(R_4 - R_2\right)} + \frac{q''' \left(R_3^2 - R_2^2\right)}{4k_f}\right]. \tag{49}$$

Node 4:

$$T_4 = \left[\frac{\left(R_5 - R_3\right)\left(R_4 - R_2\right)}{R_3 \left(R_5 - R_3\right) + R_4 \left(R_4 - R_2\right)}\right] \left[\frac{T_3 R_3}{\left(R_4 - R_2\right)} + \frac{T_5 R_4}{\left(R_5 - R_3\right)} + \frac{q''' \left(R_4^2 - R_3^2\right)}{4k_f}\right]. \tag{50}$$

Node 5, fuel pellet surface node:

$$T_5 = \left[\frac{\left(R_5 - R_3\right)}{4k_f R_4 + 2R_5 h_{gap} \left(R_5 - R_3\right)}\right] \left[\frac{4T_4 R_4 k_f}{\left(R_5 - R_3\right)} + 2T_6 h_{gap} R_5 + q''' \left(R_5^2 - R_4^2\right)\right]. \tag{51}$$

Node 6, cladding inside surface node:

$$T_6 = \left[\frac{R_{OC} - R_{IC}}{R_5 h_{gap} \left(R_{OC} - R_{IC} \right) + R_6 k_{cl}} \right] \left[T_5 \; R_5 h_{gap} + \frac{T_7 \; k_{cl} R_6}{\left(R_{OC} - R_{IC} \right)} \right] . \qquad (52)$$

Node 7, cladding outside surface node:

$$T_7 = \left[\frac{\left(R_{OC} - R_{IC} \right)}{k_{cl} R_6 - R_{OC} \left(R_{OC} - R_{IC} \right)} \right] \left[\frac{k_{cl} R_6 \; T_6}{\left(R_{OC} - R_{IC} \right)} - R_{OC} \; q'' \right] . \qquad (53)$$

The equations above represent a set of seven equations and seven unknowns. A solution technique identical to that for the transient equations is used to solve the steady state equations. This is to successsively substitute Equations (47) through (53) to obtain the following cladding exterior surface temperature equation:

$$\overline{B}_{ss} = q'' = h_{cool} \left(T_7 - T_b \right) \qquad (54)$$

where $\overline{B}_{ss}$ is a constant composed of the coefficients and constants in Equations (47) to (53). The same procedure used to solve Equation (46) is used to solve Equation (54). The remaining fuel temperatures are calculated by six algebraic equations derived by the successive substitution of Equations (47) through (53).

V. CONSTITUTIVE RELATIONSHIPS AND EQUATION OF STATE

In addition to the conservation equations, constitutive relationships and equation-of-state relationships must be specified to close the set of equations to be solved. Empirical and semiempirical correlations are used to define such phenomena as turbulent mixing, fluid solid interfacial momentum exchange, and fluid solid interfacial heat transfer. Details of the constitutive relationships are given in Appendix C.

In the SCORE-EVET code, fluid-solid interfacial momentum exchange is represented by friction factors and two-phase multipliers for all three principal directions. Both laminar and turbulent friction factors are used in all three principal directions. The user can select one of five turbulent friction factors in the x-direction and one of three turbulent friction factors in the y- and z-directions. Two-phase friction multipliers are calculated by empirical and semiempirical relationships and the user can select one of the seven methods provided.

If the fuel rod thermal model is used, the fluid-solid interfacial heat transfer is calculated a slightly modified version of the heat transfer and critical heat flux (CHF) correlations developed for the RELAP4/MOD5 computer code[5]. Selection of the appropriate heat transfer correlation is based on several criteria. The first criterion is an evaluation of the physical state of the fluid to determine which regime of heat transfer is occurring (forced convection, film boiling, etc.). The second criterion is the evaluation of the CHF and the cladding temperature that would exist at this heat flux to determine whether the pre-CHF or post-CHF correlations are appropriate. The third criterion is the comparison of two or more calculated heat transfer coefficients to select the proper coefficients in regions where correlations overlap. All of the correlations are one dimensional, that is, the principal flow direction is assumed to be parallel to the fuel rod axis. No provision is currently made to calculate heat transfer based on fluid velocity components perpendicular to the fuel rod axis.

Momentum and energy exchange due to the fluctuating components of energy and velocity are described by turbulent viscosity and thermal diffusivity correlation. These viscosity and diffusivity correlations have been modeled such that the appropriate mixing effects in subchannel geometries are correctly accounted for. Momentum exchange is described by empirically calculating turbulent viscosity and using the viscous shear stress formula. Turbulent thermal diffusivity is calculated by using Reynold's analogy of mass and heat transfer to relate turbulent thermal diffusivity to turbulent viscosity. The energy exchange due to the fluctuating component of velocity and energy is then calculated by using the calculated thermal diffusivity and Fourier's law for thermal diffusion. Currently only one correlation is included in SCORE-EVET to model turbulent vicosity.

Details of the constitutive relationships to model friction factors, two-phase multiplier, heat transfer, and turbulent viscosity are given in Appendix C.

Steam and water properties are evaluated using the Idaho National Engineering Laboratory (INEL) environmental subprograms[5]. Subcooled and saturated water and saturated and superheated steam properties are provided for the complete range of pressure and temperature expected during water reactor transients. Fluid properties are evaluated at the pressure and internal energy of each individual computational cell. Additional information on the steam and water properties evaluation is given in Appendix C, Section IV.

VI. PROGRAM DESCRIPTION

The SCORE-EVET code is currently operational on the CDC-7600. Except for the steam table data, the present version of the code is contained entirely in small core memory. The organization of the code, array storage of variables, code redimensioning, and user convenient restart tape dump option are described in this section.

1. CODE ORGANIZATION

The general code organization is shown by the flow chart in Figure 5. VRM is the main subroutine. Prior to starting the transient solution, VRM calls the input subroutine VRINPO and the initialization subroutine VRS. The actual solution of the three-dimensional flow equations is performed in five steps by the following five subroutines: (a) VRBD, which sets the boundary conditions; (b) VRI, which calculates the advanced time internal energies; (c) VRFRIC, which calculates the frictional pressure drop for all computational cells; (d) VREX, which calculates the tentative advanced time velocities; and (e) VRIT, which performs the iterative solution for advanced time density, velocity, and pressure. The fuel rod thermal solution is performed (if use of the fuel rod model is specified) explicitly by subroutine RODMOD, once the advanced time coolant conditions are obtained. Printout of results is performed by subroutine VRIO. The results can be printed in two forms: (a) three-dimensional array output or (b) individual channel and fuel rod output. Subroutine VRTAP is used to read and write to magnetic tape. The user output options are described in Appendix A.

2. ARRAY STORAGE OF VARIABLES

The thermal-hydraulic and fuel rod variables are stored in two arrays, the A(N) array and the array TROD(N), respectively. Variables are stored in both arrays by the use of equivalence statements.

In array A, 13 variables are stored for each computation cell by the basic equivalence statement:

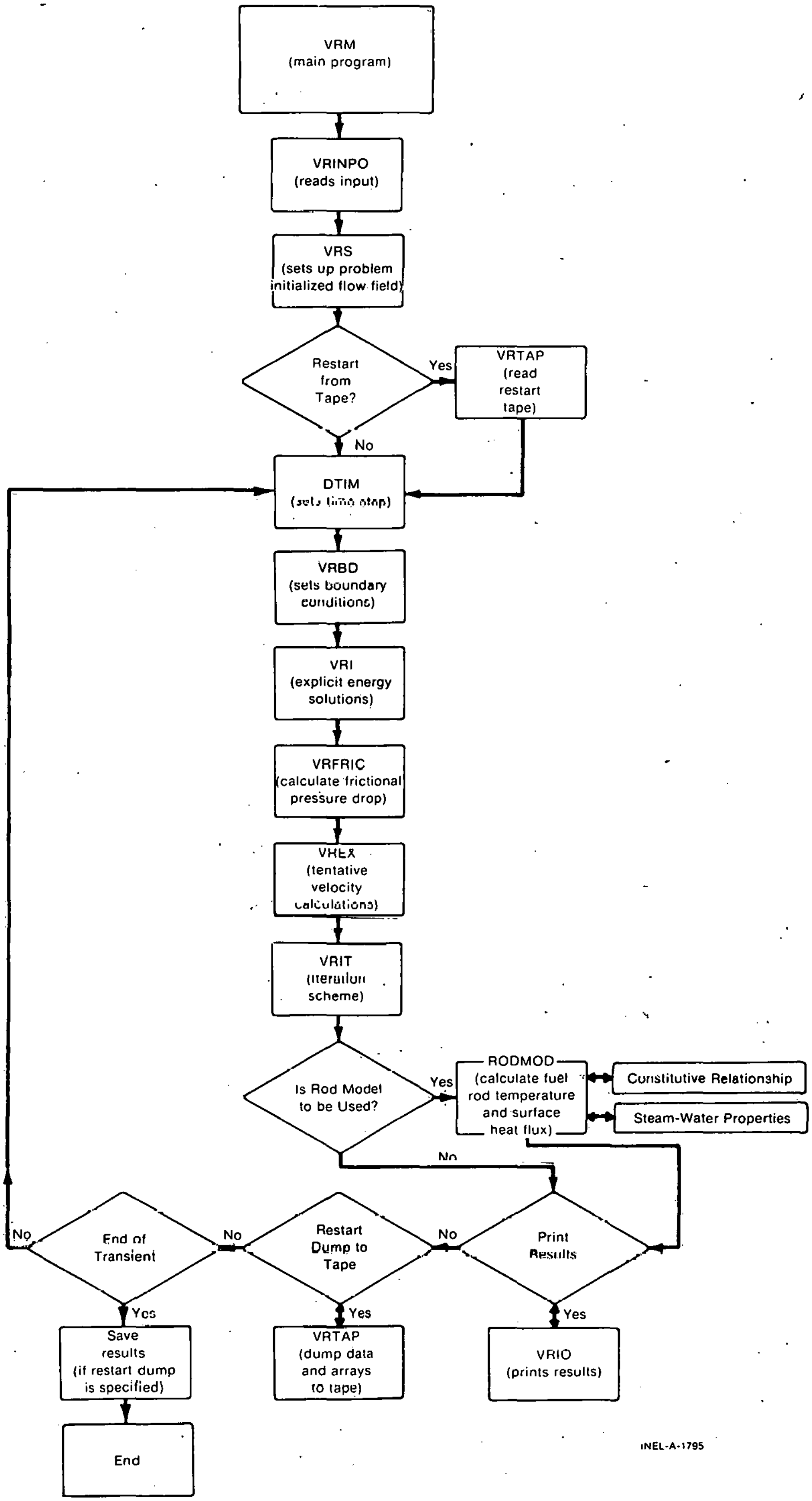


Fig. 5 SCORE-EVET flow diagram.

Equivalence	A(1)	=	U(1)	axial velocity
	A(2)	=	V(1)	y-component velocity
	A(3)	=	W(1)	z-component velocity
	A(4)	=	p(1)	pressure
	A(5)	=	RHO(1)	advanced time density
	A(6)	=	SIE(1)	internal energy
	A(7)	=	TEM(1)	temperature
	A(8)	=	RHON(1)	old time density
	A(9)	=	DUMY(1)	dummy variable
	A(10)	=	CAPP(1)	sound speed
	A(11)	=	QFLUX(1)	surface heat flux
	A(12)	=	DIA(1)	dummy variable
	A(13)	=	DIAN(1)	dummy variable.

An additional seven variables are stored in the A array at various times in the code operation. These additional storages are accomplished by the following equivalences:

Subroutine VRFRIC:

Equivalence	TEM(1)	=	FRICX(1)	axial friction pressure drop
	DIA(1)	=	FRICY(1)	y-direction frictional pressure drop
	DIAN(1)	=	FRICZ(1)	z-direction frictional pressure drop
	DUMY(1)	=	TUBMIX(1)	two-phase mixture viscosity

Subroutine VRI:

Equivalence	RHO(1)	=	TUBTHC(1)	turbulent thermal diffusivity

Subroutine VREX:

Equivalence	TEM(1)	=	FRICX(1)	
		=	DELTAV(1)	iteration factor τ
	DIA(1)	=	FRICY(1)	
	DIAN(1)	=	FRICZ(1)	
	DUMY(1)	=	TUBMIX(1)	
	DUMY(1)	=	TUBTHX(1)	turbulent viscosity

Subroutine VRIT:

Equivalence	RHO(1)	=	TUBTHC(1)
	DUMY(1)	=	TUBTHX(1).

Eight variables are stored in the TROD array for each axial level of each fuel rod by the equivalence statement:

Equivalence	TROD(1)	=	TCFURL(1)	fuel centerline temperature
	TROD(2)	=	TF2(1)	temperature of fuel Node 2
	TROD(3)	=	TF3(1)	temperature of fuel Node 3
	TROD(4)	=	TF4(1)	temperature of fuel Node 4
	TROD(5)	=	TFSURF(1)	temperature of fuel surface
	TROD(6)	=	TCISUR(1)	temperature of cladding inside surface
	TROD(7)	=	TCOSUR(1)	temperature of cladding outside surface
	TROD(8)	=	THREG(1)	heat transfer regime flag.

Presently the A array is dimensioned to 12,000 and the TROD array is dimensioned to 3,100.

3. CODE REDIMENSIONING

Problem size in the SCORE-EVET code is limited in three basic ways: (a) the total number of flow channels and fuel rods; (b) the total number of cells in the x-, y-, and z-directions; and (c) the magnitude of the A and TROD arrays. Currently no more than 64 flow channels or fuel rods can be defined no matter how few the number of axial nodes. In addition, no more than 40 cells (boundary plus real cells) can be specified in any one direction. The overall bound on problem size is determined by the dimension of the A and TROD arrays. The total number of computational cells is limited by the A array dimension in the following manner:

$$(IBR + 2) * (JBR + 3) * (KBR + 2) * 13 \leq \text{the A array dimension} \quad (55)$$

where

IBR = the number of real cells in the x-direction
KBR = the number of real cells in the z-direction
JBR = the number of real cells in the y-direction
13 = the number of variables stored per cell.

The addition of 2 to IBR and KBR accounts for two boundary cells. The addition of 3 to JBR accounts for two boundary cells and one additional storage plane, IBR by KBR, for array manipulation.

The total number of fuel rods which can be used is limited in the following manner:

$$IBR * (\text{number of rods}) * 8 \leq \text{the TROD array dimension.} \quad (56)$$

Equations (55) and (56) can be used to determine the problem size capability of the SCORE-EVET code by using the A and TROD array dimensions of 12,000 and 3,100, respectively. These equations also can be used to determine the array dimensions required to expand the capability of the present SCORE-EVET code.

To aid the user in redimensioning the code, the arrays which require redimensioning, and the common blocks in which they are contained are identified.

COMMON/BCFAF/ SIS(N), SIUP(N), SOS(N), SOUP(N)

These arrays store the channel inlet and outlet boundary condition multiplication factors. N represents the number of flow channels. Currently N equals 64.

COMMON/TIMOUT/ NCHAN(N)

This array stores the channel numbers for which results are to be printed out. N represents the total number of channels plus 2. Currently N equals 66.

COMMON/VRIMD/ DX(N1), DY(N2), DZ(N3), RDX(N1), RDY(N2), RDZ(N3), X(N1), Y(N2), Z(N3)

These arrays store the computational cell dimensions, the inverse of these dimensions, and the location of the positive face of each computational cell. N1, N2, and N3 represent the total number of real and boundary cells. N1, N2, and N3 currently equal 40.

COMMON/LOSSES/ XLOSS(N)

This array stores the axial form loss coefficients. N represents the total number of possible loss coefficients which is currently limited to the total number of real cell interfaces in the x-direction. N is currently set to 40.

COMMON/RODPR/ PCHN (N1, N2), PFACR (N2), NRC (N1, N2), PFACAX (N3).

PCHN stores the fraction of Rod N2's surface heat flux assigned to Channel N1; NRC stores the channel number of the N1 channels connected to Rod N2. PFACR stores the radial power factors. PFACAX stores the axial power factors. Currently N1 equals 4, N2 equals 64, and N3 equals 40.

COMMON/HYDRO/ AWFA(N), AWQA(N), DHEA(N), VOIDA(N), RODNUM(N)

These arrays store, respectively, the following quantities for each flow channel: wetted area per unit volume; heated area per unit volume; equivalent hydraulic diameter; equivalent heated diameter; and total number of rods. N represents the number of flow channels and is currently set to 64.

COMMON/VRDEP/ A (N)

The A array stores the thermal hydraulic quantities for each computational cell. The A array current dimension is 12,000 and can be varied according to Equation (55).

COMMON/TEDEP/ TROD(N)

This array stores the fuel rod variables for each axial node. The TROD array current dimension is 3,100 and can be varied according to Equation (56).

4. USER CONVENIENT RESTART TAPE DUMP OPTION

By the use of user input Card 8 described in Appendix A, restart dumps to tape and restart from tape are possible. The user can specify the cycle interval at which dumps to tape will be taken. If the job ends normally (reaches the specified time limit), a dump will be taken after the last calculational cycle. The following quantities and arrays are dumped to the restart tape with an unformatted write statement.

TIMET	elapsed time in seconds
DT	time step used for the cycle dumped
NCYC	calculational cycle
ITER	number of iterations taken for the cycle dumped
A (N1)	the array which stores the computational cell variables
X (N2)	the array which stores the problem dimensions in the x-direction
Y (N3)	the array which stores the problem dimensions in the y-direction
Z (N4)	the array which stores the problem dimensions in the z-direction
TROD (N5)	the array which stores the fuel rod variables.

Sufficient data are present on the restart tape to allow the user to produce plots external to the SCORE-EVET code.

VII. REFERENCES

1. W. J. Wnek et al, Transient Three-Dimensional Thermal-Hydraulic Analysis of Nuclear Reactor Fuel Rod Arrays: General Equations and Numerical Scheme, ANCR-1207 (November 1975).

2. C. W. Hirt and J. L. Cook, "Calculating Three-Dimensional Flows Around Structures and Over Rough Terrain," Journal of Computational Physics, 10 (1972) pp 197-340.

3. F. H. Harlow and A. A. Amsden, "A Numerical Fluid Dynamic Calculation Method for All Flow Speeds," Journal of Computational Physics, 8 (1971) pp 197-213.

4. J. Crank and P. Nicolson, A Practical Method for Numerical Evaluation of Solutions of Partial Differential Equations of the Heat Conduction Type, Proceedings, Cambridge Philosophical Society, 43 (1974) pp 50-64.

5. K. R. Katsma et al, RELAP4/MOD5 - A Computer Program for Transient Thermal-Hydraulic Analysis of Nuclear Reactors and Related Systems: User's Manual, Volume I, RELAP4/MOD5 Description, ANCR-NUREG-1335 (September 1976).

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APPENDIX A

JOB CONTROL AND INPUT DATA CARD DESCRIPTIONS

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APPENDIX A

JOB CONTROL AND INPUT DATA CARD DESCRIPTIONS

The job control cards for compiling and executing the SCORE-EVET code are given in Section 1 of this appendix. The input data requirements are given in Section 2.

1. CONTROL CARDS FOR THE CDC 7600 COMPUTER SYSTEM

The SCORE-EVET source is usually stored on the first file, and the object module is stored on the second file of a magnetic tape. In executing the program, it is faster to use the object module than to recompile the source program.

1.1 Control Cards to Execute SCORE-EVET from the Object Module

```
Job Card
Account Card
LABEL,TAPE1,R,L=LABEL.
STAGE,TAPE1,VSN=X1.
COPYP,TAPE1,TAPE4.
COPY,TAPE1,OLDOBJ.
RETURN,TAPE1,TAPE4.
REWIND,OLDOBJ.
ATTACH,ENVRL,ID=RJW.
ATTACH,TAPE15,ST20T,ID=RJW,MR=1.
LDSET,LIB=ENVRL/FORTRAN.
OLDOBJ,PL=XXXX.
7/8/9 in column one
```

Where the control card variables are:

X1 = the number of the SCORE-EVET tape.

XXXX = the number of printed lines that you expect.

1.2 Control Cards to Update the Source (using UPD) and Execute SCORE-EVET

```
Job Card
Account  Card
```

```
LABEL,TAPE1,R,L=LABEL.
STAGE,TAPE1,VSN=X1.
COPYP,TAPE1,TAPE4.
COPY,TAPE1,OLDOBJ.
UNLOAD,TAPE1.
REWIND,TAPE4,OLDOBJ.
ATTACH,ENVRL.
LIBRARY, ENVRL.
UPD.
RETURN,TAPE4,TAPE8.
REWIND,TAPE7.
RFL,160000.
FTN,I=TAPE7,OPT=2,R=3,A.
REDUCE.
RETURN,TAPE7.
COPYL,OLDOBJ,LGO,NEWOBJ.
RETURN,OLDOBJ,LGO.
ATTACH,TAPE15,STH2OT,ID=RJW,MR=1.
NEWOBJ,PL=XXXX.
7/8/9 in column one
```

1.3 Control Cards for SCORE-EVET to Create a Restart Tape

This card will be used when the input variables NTAP = -1 and NEWTAP = 0. The control cards will be the same as in 1.1 (execute) or 1.2 (update and execute) with the addition of the following card after the STAGE card.

```
STAGE,TAPE2,N,POST.
```

1.4 Control Cards for SCORE-EVET to Restart and Continue Taking Restart Dumps

The cards will be used when the input variables NTAP = +1 and NEWTAP = 1. The control cards will be the same as in 1.1 (execute) or 1.2 (update and execute) with the addition of the following two cards after the STAGE card.

STAGE,TAPE2,VSN=X2.
This control card reads the restart tape with number X2.
STAGE,TAPE3,N,POST.
This control card writes the restart dumps on a scratch tape.

2. DETAILED INPUT DATA CARD DESCRIPTION

The input instructions given below are ordered as the input is encountered by the code in Subroutine VRIN. The format for all card input, unless otherwise noted, is either integer 16I5 or real 6G12.5. The I format denotes that integer numbers are to be input. The integer must be right justified. The G format indicates floating-point numbers are to be read in. Under the G format, exponentials must be right adjusted. For the convenience of the user, a large part of the input data has been grouped on cards containing all integers or all real numbers.

For clarity, a few brief comments are required concerning the code input. Either all SI (System Internationals) or all English units are required on input and output. The SI and English units required are given on the card description.

When the restart option is used, the entire data deck must be submitted. Input quantities which do not refer to the problem geometry can be changed when restarting. When setting up problems, Figures A 1 through A-3 should be referred to for geometric, channel, and fuel rod numbering descriptions. The following is a detailed description of the input data cards.

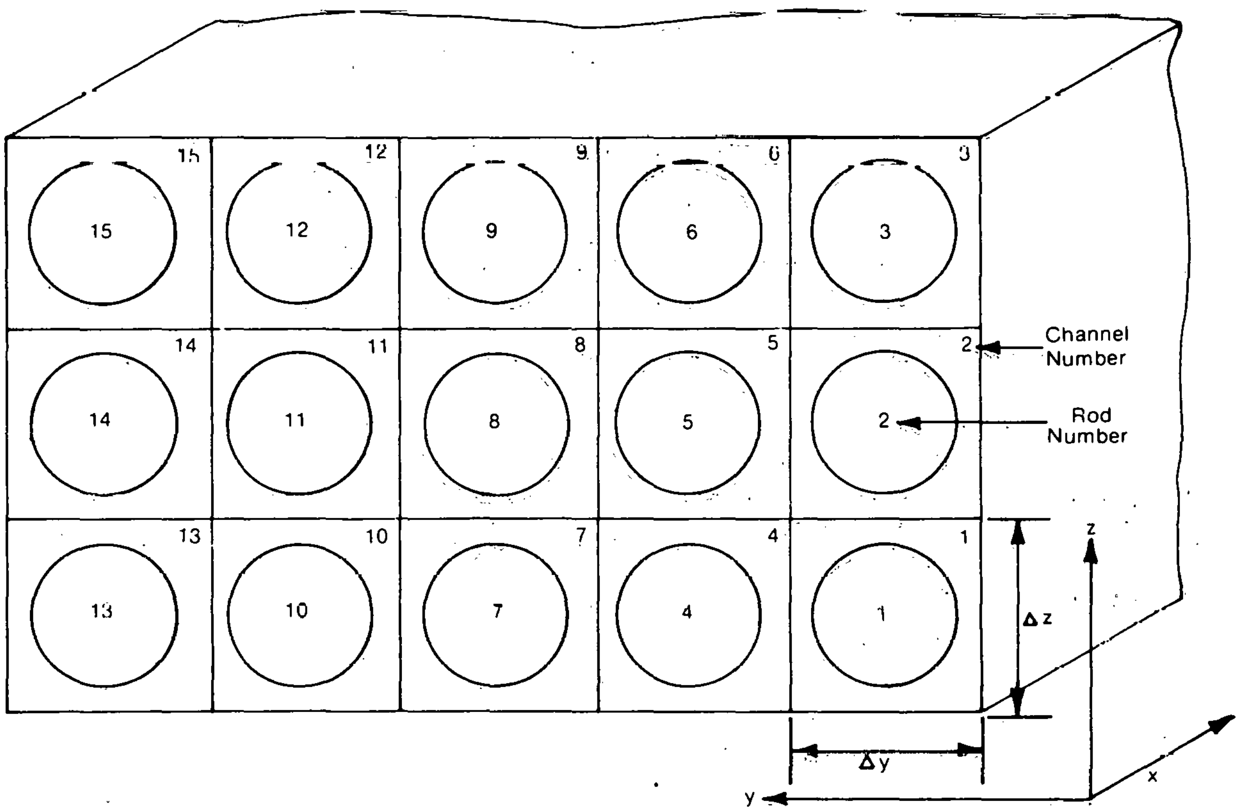


Fig. A-1 Prescribed channel numbering and typical rod numbering sequence for SCORE-EVET.

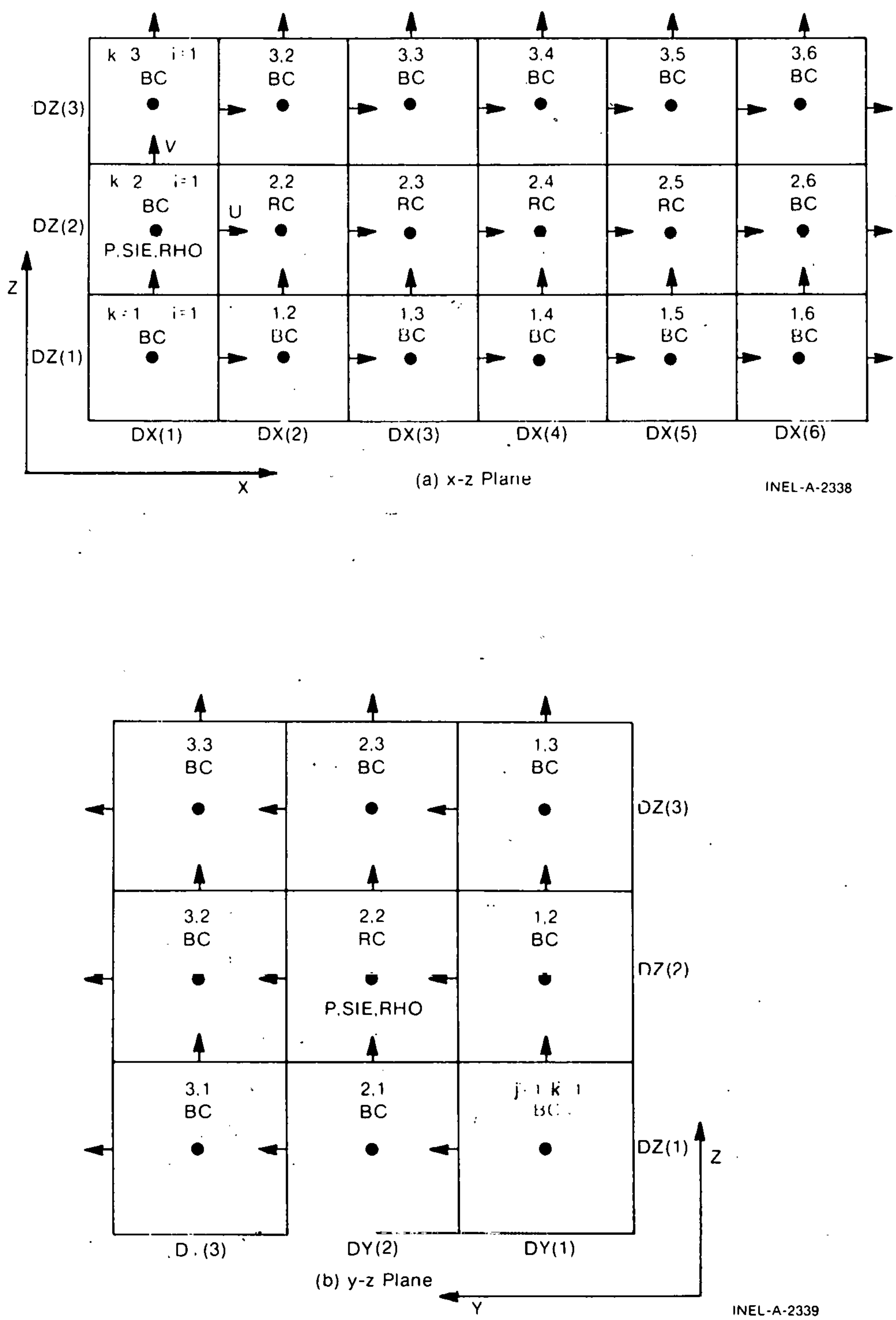
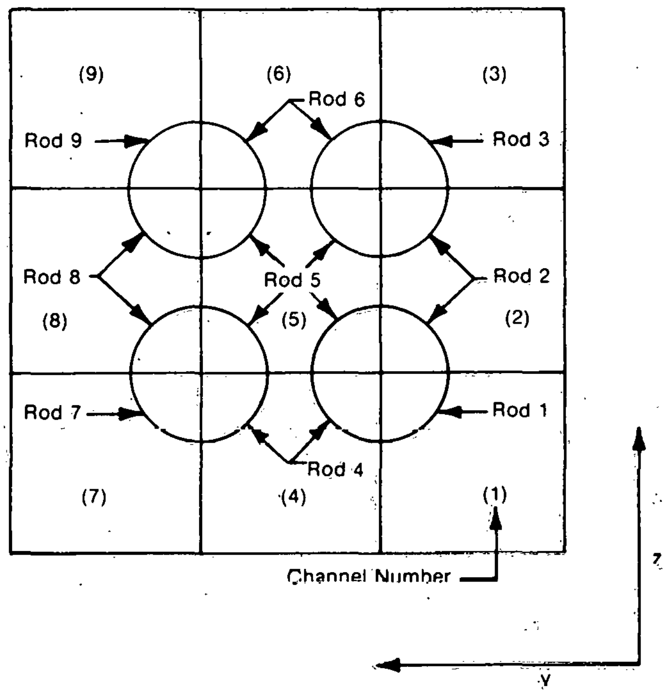
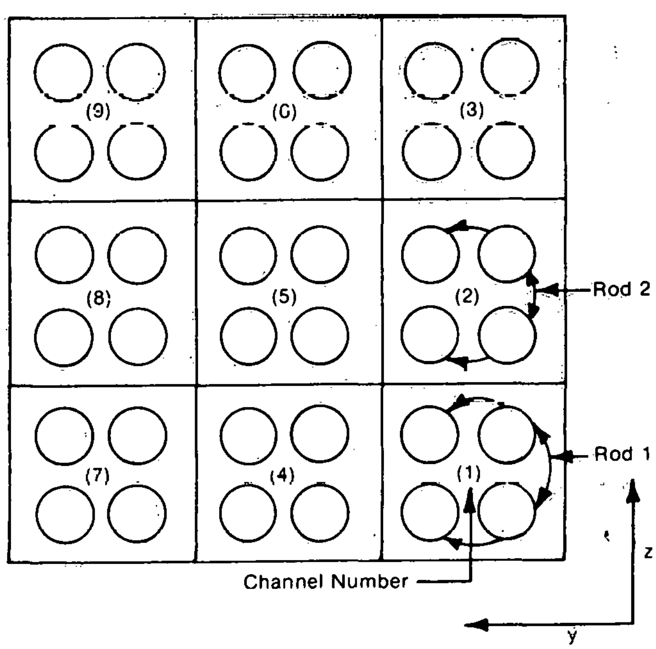


Fig. A-2 One-dimensional example of boundary and computational cell arrangement, and cell dimension specification in the x-z plane and the y-z plane.



(a) Partial fuel rods occupying a single flow channel.



(b) Multiple fuel rods occupying a single flow channel.

INEL-A-271

Fig. A-3 Typical rod numbering sequence for SCORE-EVET when partial and multiple fuel rods occupy a single flow channel.

Card 1 Title

Columns	Format	Name	Description
1-80	A	TITLE	One card TITLE of problem.

Card 2 Input and Output Units and Printed Output Form Flags

Columns	Format	Name	Description
1-5	I	IUF	IUF is the input units flag. If IUF > 0, the input is in English units. If IUF ≤ 0, the input is in SI units.
6-10	I	IOUTF	IOUTF is the output units flag. Same as above.
11-15	I	NAOC	NAOC indicates the form of the output. If NAOC < 0, only the 3-D array information is output. If NAOC = 0, the 3-D array and channel information are output. If NAOC > 0, only channel information is output. For NAOC ≥ 0, the channels for which information is to be output are described on the next card. If NAOC > 0, the 3-D array will be printed once at the beginning of each new problem.

Columns	Format	Name	Description
16-20	I	NOCH	NOCH describes the number of channels for which channel information is to be output. If NAOC < 0, NOCH is not used. For values of NAOC ≥ 0, NOCH = 0 indicates that information for all channels is to be output. If NOCH > 0, NOCH is the total number of channels for which information is to be output. For NOCH > 0, optional cards 2a are read in.

Card 2a These cards are to be read only when NOCH in the preceding card is > 0. Cards 2a will be read with format 16I5 until NOCH channel numbers have been read and stored in the array NCHAN (N). The typical channel numbering sequence is prescribed in Figure A-1. Note that the channels are numbered from the origin out the z-axis and then stepped out along the y-axis.

Columns	Format	Name	Description
1-5	I	NCHAN(1)	Channel number of first channel for which information is to be output.
"	"	"	

Card 3 Number of Computational Cells, Rod Model, Power/Time, and Time Step/Time Data

Columns	Format	Name	Description
1-5	I	IBR	Number of real fluid cells in the axial or x-direction. IBR must be ≥ 1 and ≤ 38.

Columns	Format	Name	Description
6-10	I	JBR	Number of real fluid cells in the y-direction. JBR must be ≥ 1 and ≤ 38.
11-15	I	KBR	Number of real fluid cells in the z-direction. KBR must be ≥ 1 and ≤ 38.

The total number of computational fluid cells is limited in two ways. First, (JBR)(KBR) $\leq$ 64, that is, the maximum number of cells in the y-z plane is limited to 64. Second, the limit on total number of cells is (JBR + 3)(KBR + 2)(IBR + 2) $\leq$ 923. For example, if the user desires to model a 6 by 6 array of subchannels, he will be limited to a maximum of 12 fluid cells in the axial direction (IBR = 10), plus two boundary cells.

Columns	Format	Name	Description
16-20	I	IROD	Flag which describes how the fuel rod surface heat flux will be specified. If IROD = 0, the user specifies the heat flux. If IROD = 1, a steady state fuel rod conduction model is used to calculate the surface heat flux. If IROD = 2, a transient rod conduction model is used to calculate the surface heat flux. IROD = 3, 4, or 5 are radiation heat transfer options and are currently not available.

Columns	Format	Name	Description
21-25	I	NDIAG	Diagonal symmetry flag. If NDIAG = 0, the problem does not have diagonal symmetry in the y-z plane. If NDIAG = 1, diagonal symmetry exists in the y-z plane. NDIAG = 1, should be used only when JBR = KBR.
26-30	I	NROD	Number of rods to be modeled by fuel rod conduction model, not to exceed 64. NROD is set equal to zero if IROD = 0.
31-35	I	NZPTD	Number of rod power (or surface heat flux factors)/ time data pairs to be read in. NZPTD $\leq$ 20. The data pairs are input on Card 20.
36-40	I	NZTDT	Number of time step/time data pairs to be read in NZTDT $\leq$ 20. The data pairs are input on Card 21.

Card 4 Donor Cell Weighting Factor

Columns	Format	Name	Description
1-12	G	ALX	ALX, ALY, and ALZ are coefficients which specify the method of space differencing of flux terms in the y- and z-directions for the energy, momentum and 13-continuity of mass equations. ALi = 1 gives a full donor cell differencing. $0 \leq Ali \leq 1$.
13-24	G	ALY	

Columns	Format	Name	Description
25-36	G	ALZ	

Card 5 Gravitational Force Components, Convergence Criterion and Iteration Weighting Factor

Columns	Format	Name	Description
1-12	G	GX	x, y, and z components of gravitational force per mass. For normal reactor conditions, GX = -32.2 ft/sec^2 or -9.81 m/s^2, and GY = GZ = 0.
13-24	G	GY	
25-36	G	GZ	
37-48	G	CEP	Convergence criterion for the continuity equation. $\frac{\partial\rho}{\partial t} - \frac{\partial\rho v_i}{\partial y_i} \leq \text{CEP MIN}\left[\frac{\rho\lvert u\rvert}{\Delta x} + \frac{\rho\lvert v\rvert}{\Delta Y} + \frac{\rho\lvert w\rvert}{\Delta Z}\right]$ The values of CEP generally used are $10^{-2} \geq \text{CEP} \geq 10^{-3}$.
49-60	G	WGHTP	Weight factor for iteration scheme. WGHTP may be varied (0 < WGHTP < 2) to speed up convergence. Generally, WGHTP = 1.5 is used.

Card 6 Automatic Time Step Control and Problem Time Limit

This card group provides time step control if time step/time data pairs are not used (Card group 3). The quantities read in are: DT, the initial time step; BO, the factor by which the time step may be increased every time step if the automatic time step control is used; and SACRIT, the factor by which the time step must stay below the Courant time step limitation. If the flag IDTFLG in Card group 7 is zero, the time step is held constant at the initial value read from this card. If IDTFLG is greater than zero, the time step is increased by multiplying the current time step value by BO. In this manner, the time step is allowed to increase until its value is less than or equal to the Courant limitation multiplied by SACRIT.

Columns	Format	Name	Description
1-12	G	DT	Time step (in seconds) to be used if time step/time data pairs are not to be read in, NZTDT = 0 on Card 3.
13-24	G	BO	Maximum factor by which the time step is allowed to increase when the automatic time step control is in effect (IDTFLG ≠ 0 on Card 7). New DT = old DT * BO.
25-36	G	SACRIT	Stability safety factor for automatic time step control. For implicit calculations, $MAXDT \leq SACRIT\ (MAX\ \frac{\Delta y_i}{vi})$. $(0 < SACRIT < 1.)$
37-48	G	TFIN	Problem completion time in seconds.

Card 7 Time Step Control Selection, Printout Interval, and Steam Table Flags

Columns	Format	Name	Description
1-5	I	IDTFLG	Time step selection flag. If IDTFLG = 0, DT is held constant at the input value or at the value specified by the time step/time data pairs. If IDTFLG

≠ 0, automatic time step control is used.

Columns	Format	Name	Description
6-10	I	LPR	Print control. If LPR = 1, the output is in both paper and microfilm form. If LPR = 2, output to microfilm only. If LPR = 3, output to paper only. Currently only option 3 is available.
11-15	I	NPRT	NPRT is the cycle interval at which printing occurs. If NPRT = 1, print each time cycle. If NPRT = 2, print every second cycle. If NPRT = N, print every N^{th}cycle.
16-20	I	NWPC	Number of variables stored per computational cell. Currently NWPC = 13.
21-25	I	NWPP	NWPP is the flag which indicates whether the momentum and continuity equations are to be solved explicitly or implicitly. Currently only the implicit option is available (NWPP = 0).
26-30	I	IESLFG	Steam table control during the pressure iteration. If IESLFG = 1, the full steam tables are used. If IESLFG = 2, a linearized steam table is used. IESLFG = 2 is adequate for most problems.

Columns	Format	Name	Description
	Card 8 Restart Flags		
1-5	I	NTAP	Restart flag. If NTAP = 0, the program starts at time = 0 and does not make restart dumps to tape. If NTAP = -1, the program starts at time = 0 and makes restart dumps to tape every NWTD cycle. If NTAP = 1, the program restarts from tape at cycle NRST and makes restart dumps to a new tape every NWTD cycle.
6-10	I	NWTD	Cycle interval between restart dumps. NWTD can be different from NPRT on Card 7. NWTD is left blank if NTAP = 0.
11-15	I	NEWTAP	NEWTAP is used when NTAP = ±1. If NTAP = -1, set NEWTAP = 0. If NTAP = 1, set NEWTAP = 1 so that restart dumps are taken on a new tape, unit 3. (See Section 1 for the required job control cards.) NEWTAP is left blank if NTAP = 0.
16-20	I	NRST	Cycle number from which restart is to begin. NRST is left blank if NTAP = 0.

Columns	Format	Name	Description

Card 9 3-D Array Output Control

Columns	Format	Name	Description
1-5	I	IBRST	IBRST, IBRED, and IBRIN are flags to control the limits of the 3-D array output in the i- or x-direction. Array printout will start with i level IBRST going to level IBRED, with information being printed out at each IBRINth interval.
6-10	I	IBRED	
11-15	I	IBRIN	
16-20	I	JBRST	
21-25	I	JBRED	Array output limits for the j- or y-direction.
26-30	I	JBRIN	
31-35	I	KBRST	
36-40	I	KBRED	Array output limits for the k- or z-direction.
41-45	I	KBRIN	

Card 10 Computational Cell Dimensions in the x-Direction

IBR + 2 numbers are to be read on this card.

Columns	Format	Name	Description
1-12	G	DX(1)	The array DX(I) stores the computational cell dimensions in the i- or x-direction. The user must supply the dimensions for both real and boundary cells (IBR + 2 cell dimensions) starting with the boundary cell at the inlet i = 1, proceeding
13-24	G	DX(2)	
...	...	...	

Columns	Format	Name	Description
			to the outlet at I = IBR + 2, as shown in Figure A-2. Six cell dimensions will be read from each card until IBR + 2 dimensions have been read. [DX(I) is in inches or meters.]

Card 11 Computational Cell Dimensions in the y-Direction

JBR + 2 numbers are to be read on this card.

1-12	G	DY(1)	The array DY(J) stores the computational cell dimensions in the j- or y-direction. The description is the same as Card 10.
13-24	G	DY(2)	
...	...	...	

Card 12 Computational Cell Dimensions in the z-Direction

KBR + 2 numbers are to be read on this card.

1-12	G	DZ(1)	The array DZ(K) stores the computational cell dimensions in the k- or z-direction. The description is the same as Card 10.
13-24	G	DZ(2)	
...	...	...	

Card 13 Axial Form Loss Coefficients

IBR + 1 pressure drop loss factors, XLOSS(I), for the axial or x-direction will be read in. These loss factors are to be used to account for pressure drops across inlet and outlet orifices and fuel rod spacer grids. For the pressure drop desired, the user should calculate the loss factor by:

$$XLOSS(I) = \frac{2\Delta P}{\rho u^2} .$$

The I index indicates that the loss factor is to represent a pressure drop at the interface of the I and (I + 1) cells, across the entire y-z plane. For instance, XLOSS(1) and XLOSS(IBR + 1) represent inlet and outlet loss factors. If no other losses are expected than those of the bare rods, the loss coefficients should be read in as zero.

Columns	Format	Name	Description
1-12	G	XLOSS(1)	Axial loss factor between I levels 1 and 2.
13-24	G	XLOSS(2)	Axial loss factor between I levels 2 and 3.
...	...	...	

Additional cards are read until IBR + 1 loss factors have been read.

Card 14 Boundary Quantities for Flow Field Initialization

This card is used to read in the boundary quantities required to initialize the flow field. This card must be read in even when the restart option is used.

Columns	Format	Name	Description
1-12	G	P	Core exit pressure (lbm/in.^{2} or N/m^2) used in the 1-D flow field initialization.

Columns	Format	Name	Description
13-24	G	SIE	Core inlet internal energy (Btu/lbm or J/kg) used in the 1-D flow field initialization.
25-36	G	QUAL	Core inlet quality.
37-48	G	u	Core inlet velocity (ft/sec or m/s) used in the 1-D flow field initialization.

Card 15 Fuel Rod Diameter, Spacing, and Power Specifications

1-12	G	DIAMRD	Fuel rod cladding outer diameter (in. or m).
13-24	G	SPROD	Spacing between fuel rod centers (in. or m).
25-36	G	PAVE	If IROD = 0 on Card 3, PAVE is the average surface heat flux from fuel rods or other surfaces in the problem being described (Btu/hr-ft^2 or J/s·m^2). If IROD > 0 on Card 3, PAVE is the average fuel rod linear power (kW/ft or J/s·m).

Card 16 Specification of Coolant Channel Hydraulic Parameters

One card will be read for each channel until a total (JBR)(KBR) CARDS are read. The cards must be in sequence from Channel 1 to Channel (JBR)(KBR).

Columns	Format	Name	Description
1-12	G	DHYA(N)	Equivalent hydraulic diameter of Channel N. DHYA = 4 A_f/P_w (in. or m). If the channel is devoid of solid material set DHYA(N) = 0. (A_f is the channel flow area; P_w is the wetted perimeter.)
13-24	G	DHEA(N)	Equivalent heated diameter of Channel N DHEA = $4A_f/P_h$ (in. or m). If the channel is without heated surfaces, set DHEA = 0. (P_h is the heated perimeter.)
25-36	G	VOIDA(N)	Porosity of Channel N. VOIDA(N) = V_f/V. A porosity of zero indicates that there is no fluid in the channel. (V_f is the fluid volume and V is the total cell volume.)
37-48	G	RODNUM(N)	Number of rods represented by the wetted and heated perimeters. As shown in Figure A-3 (a and b), a channel volume may contain from 1/4 rod to several rods.

Two additional channel quantities are calculated and stored for Channel N: AWF(N) and AWQ(N). AWF is the wetted surface area per total cell volume [AWF(N) = 4 VOIDA(N)/DHYA(N)]. AWQ is the heated surface area per total cell volume, [AWQ(N) = 4 VOIDA(N)/DHEA(N)]. If DHYA(N) or DHEA(N) is zero, AWF(N) and AWQ(N) are set to zero.

Columns	Format	Name	Description

Card 17a Fuel Rod Conductance Fuel and Cladding Thermal Conductivity, and Volumetric Specific Heat Specifications

This card is not included if IROD = 0 on Card 3.

1-12	G	DIAFD	Diameter of the fuel pellet (in. or m).
13-24	G	GAPT	Thickness of the gap between the fuel pellet and the inside cladding surface (in. or m).
25-36	G	GAPH	Gap conductance ($Btu/hr\text{-}ft^2\text{-}°F$ or $J/s{\cdot}m^2{\cdot}K$).
37-48	G	FUELK	Fuel thermal conductivity (Btu/hr-ft-°F or J/s·m·K).
49-60	G	CLADK	Cladding thermal conductivity (Btu/hr-ft-°F or J/s·m·K).
61-72	G	RHOCPF	Volumetric specific heat of the fuel ($Btu/ft^3\text{-}°F$ or $J/m^3{\cdot}K$).

Card 17b Fuel Rod Gap Conductance, Fuel and Cladding Thermal Conductivity, and Volumetric Specific Heat Specifications

This card is not included if IROD = 0 on Card 3.

1-12	G	RHOCPC	Volumetric specific heat of the cladding ($Btu/ft^3\text{-}°F$ or $J/m^3{\cdot}K$).

Card 17c Fuel Rod-to-Coolant Channel Connection Data

These cards describe fuel rod-to-coolant channel connections and are not included if IROD = 0 on Card 3. If IROD > 0, there should be NROD cards in this group, with rod numbers from 1 to NROD. Sequencing of the cards according to rod number is not necessary. At the present time, only one coolant channel can be associated with each rod, that is, with each fuel rod conduction solution. Each fuel rod defined can represent part of a rod, a single rod, or multiple rods in a single channel. The power factors defined in Card 18 represent the average power of the rod or rods in the channel. The heat flux from a single rod conduction solution is multiplied by AWQ to get the proper total energy to the coolant channel (AWQ is not an input quantity, but is calculated based on input). It is not necessary that a fuel rod be associated with every coolant channel. For geometries in which there is diagonal symmetry in the y-z plane and the diagonal symmetry flag NDIAG is set equal to 1, computational time can be saved by defining rods only for those channels on and above the diagonal plane. No coolant subchannel can have an identification number greater than (JBR*KBR).

Columns	Format	Name	Description
1-5	I	NURO	Rod number.
6-10	I	NRC(1,NURO)	Number of the channel connected to rod number NURO.

Card 18 Radial Power Factors

Radial power factors PFACR(N) will be read in, in sequence from 1 to N. If IROD = 0, the radial power factors represent the channel-to-channel heat flux variation. N for this case is (JBR*KBR). The radial power factors for this case must be normalized fractions of the average heat flux, PAVE, input on Card 15. If IROD > 0, the radial power factors represent the rod-to-rod linear power variation. N for this case is

NROD. The radial power factors must be normalized fractions of the average linear rod power, PAVE, input on Card 15.

Columns	Format	Name	Description
1-12	G	PFACR(1)	Radial heat flux factor for Channel 1 if IROD = 0, or the radial power factor for rod number 1 if IROD > 0.

Card 19 Axial Power Factors

Axial power factors PFACAX(I) will be read in, in sequence from 1 to IBR. Only one set of axial power factors is allowed. If IROD = 0, the specified heat flux, PFACAX(I) represents the axial variation of surface heat flux. If IROD > 0, rod conduction model, PFACAX(I) represents the axial variation of rod linear power. For both cases the following must be true.

$$\sum_{I=1}^{IBR} PFACAX(I)DX(I) \Bigg/ \sum_{I=1}^{IBR} DX(I) = 1.$$

Columns	Format	Name	Description
1-12	G	PFACAX(1)	Axial heat flux or power factor for the first axial level of real cells.

Card 20 Power Factor/Time Data Pairs

NZPTD power factor/time data pairs will be read. If NZPTD on Card 3 is zero, these cards are not included. For a given problem time, a factor by which PAVE is to be multiplied will be linearly interpolated from these data pairs. The user should choose the data pairs such that significant perturbations are represented. The pairs must be input in order of increasing time, and the times selected must contain the time for which a solution is desired. A maximum of 20 pairs is allowed.

Columns	Format	Name	Description
1-12	G	PTDAT(1)	First power factor (dimensionless).
13-24	G	PTDAT(2)	Time for the power factor above (sec).
...	...	...	
...	...	...	
49-60	G	PTDAT(5)	Third power factor.
61-72	G	PTDAT(6)	Time for the third power factor.

Card 21 Time Step/Time Data Pairs

NZTDT time step/time data pairs will be read. If NZTDT on Card 3 is zero, these cards are not included. The pairs must be input in order of increasing time, and the times selected must contain the time for which a solution is desired. A maximum of 20 pairs is allowed. The magnitude of the time steps should be selected such that: (a) pertinent phenomena such as spikes in boundary conditions, rod power, or heat flux are represented; (b) the stability limit for the time step is not exceeded (maximum time step, DT = Max. Δx_i (v_i); and (c) the solution converges within a reasonable number of iterations (generally $<$ 100 iterations).

Requirements (a) and (b) are straightforward. However, requirement (c) calls for experience in running the code. To aid the user, the input data required to run a number of different cases have been included in Appendix E.

Columns	Format	Name	Description
1-12	G	DTE(1)	First time step.
13-24	G	TIM(1)	Time to which time step DTE(1) is to be used. Time step DTE(I) is used if problem time is less than its associated TIM(I).
25-36	G	DTE(2)	Second time step.
37-48	G	TIM(2)	Time to which time step DTE(2) is to be used.

Card 22 Inlet Boundary Specification Flags

This card contains the data to load the inlet boundary flag array, IBCFAC(1,N). The flags describe how the seven boundary quantities -- axial (x) velocity component u, transverse (y) velocity component v, transverse (z) velocity component w, pressure P, internal energy SIE, density of the coolant RHO, and temperature of the coolant TEMP -- will be handled. Eight possible flags (integers 1 through 8) can be used to describe how the seven quantities above will be specified. The possible options and combination of options are described in Appendix B.

Columns	Format	Name	Description
1-5	I	N11	The boundary flag for the u component of velocity. N11 is stored in the array location IBCFAC(1,1).
6-10	I	N12	The boundary flag for the v component of velocity. N12 is stored in array location IBCFAC(1,2).

Columns	Format	Name	Description
11-15	I	N13	The boundary flag for the w component of velocity. N13 is stored in array location IBCFAC(1,3).
16-20	I	N14	The boundary flag for pressure, P. N14 is stored in the array location IBCFAC(1,4).
21-25	I	N15	The boundary flag for internal energy, SIE. N15 is stored in the array location IBCFAC(1,5).
26-30	I	N16	The boundary flag for density, RHO. N16 is stored in array location IBCFAC(1,6).
31-35	I	N17	The boundary flag for temperature, TEMP. N17 is stored in array location IBCFAC(1,6).

Card 23 Inlet Boundary Initial Conditions

The initial values for the seven inlet boundary quantities are read in on this card. These initial values are loaded into the array, FBCFAC(1,N).

Columns	Format	Name	Description
1-10	G	C11	Initial value for axial velocity u (ft/sec or m/s). C11 is not defined by the user if N11 equals 1, 6, or 7.

Columns	Format	Name	Description
11-20	G	C12	Initial value for transverse velocity v (ft/sec or m/s). C12 is defined by the user if N12 equals 2.
21-30	G	C13	Initial value for transverse velocity w (ft/sec or m/s). C13 is defined by the user if N13 equals 2.
31-40	G	C14	Initial value for pressure P (lbm/in.^{2} or N/m^2). C14 is not defined by the user equals 1, 6, or 7.
41-50	G	C15	Initial value for internal energy SIE. (Btu/lbm or J/kg). C15 is not defined by the user if N15 equals 1, 6, or 7.
51-60	G	C16	Initial value of density RHO (lbm/ft^3 or kg/m^3). C16 is defined by the user if N16 equals 2.
61-70	G	C17	Initial value of temperature TEMP (°F or K). C17 is defined by the user if N17 equals 2.

Card 24 Inlet Boundary Axial Velocity or Pressure Spatial Distribution

This optional card input, is read only if N11 or N14 equals 4 or 5.

The multiplying factors, SIUP(JBR*KBR) that vary the pressure or axial velocity at the inlet are read in. One factor is read in for each flow channel. The factors must be in order of increasing channel number. The values of SIUP are multiplied times the initial value of pressure (P) or axial velocity (u), C11 or C14, on Card 23, respectively, depending on which property is specified at the inlet boundary.

Columns	Format	Name	Description
1-12	G	SIUP(1)	Pressure or axial velocity spatial multiplying factor for Channel 1.
13-24	G	SIUP(2)	Pressure or axial velocity spatial multiplying factor for Channel 2.
...	...	...	

Card 25 Inlet Boundary Internal Energy Spatial Distribution

This optional card is read only if N15 equals 4 or 5. The multiplying factors SIS(JBR*KBR) that vary the internal energy at the inlet, are read in. One factor is read for each subchannel. The factors must be in order of increasing channel number. The values of SIS are multiplied times the initial values of internal energy (C15 on Card 23).

Columns	Format	Name	Description
1-12	G	SIS(1)	Internal energy spatial multiplying factor for Channel 1.
13-24	G	SIS(2)	Internal energy spatial multiplying factor for Channel 2.
...	...	...	

Card 26 Inlet Boundary Axial Velocity or Pressure/Time Data Pairs

This optional card input is read only if N11 or N14 equals 3 or 5 on Card 22. This card group is used to load NFTPUI pairs of multiplying factors and time into the array, TIUP(NN). These factors are used to vary the inlet pressure or axial velocity as a function of time. For a given time, a multiplication factor is interpolated from the data pairs. This factor is then multiplied times the initial value of pressure or axial velocity to provide a time varying boundary condition. The number of multiplying factor/time data pairs (NFTPUI) is read first and then the data pairs are read.

Columns	Format	Name	Description
1-5	I	NFTPUI	Number of multiplying factors/time data pairs, not to exceed 20.
13-24	G	TIUP(1)	First multiplying factor.
25-36	G	TIUP(2)	First time.
37-48	G	TIUP(3)	Second multiplying factor.
49-60	G	TIUP(4)	Second time.
61-72	G	TIUP(5)	Third multiplying factor.
...	...	...	

If NFTPUI is greater than or equal to 3, the factor/time data pairs are continued on additional cards with a 6G12.5 format.

Card 27 Inlet Boundary Internal Energy/Time Data Pairs

This optional card input is read only if N15 equals 3 or 5. This card is used to load NFTPSI pairs of multiplying factors and time into the array TIS(NN). The factors are used to vary the inlet internal energy as a function of time. For a given time, a multiplication factor is interpolated from the data pairs. The factor is then multiplied times the initial value of inlet internal energy. The number of multiplying factor/time data pairs (NFTPSI) is read first and then the data pairs are read.

Columns	Format	Name	Description
1-5	I	NFTPSI	Number of multiplying factors/ time data pairs, not to exceed 20.
13-24	G	TIS(1)	First multiplying factor.
25-36	G	TIS(2)	First time.
37-48	G	TIS(3)	Second multiplying factor.
49-60	G	TIS(4)	Second time.
61-72	G	TIS(5)	Third multiplying factor.

If NFTPSI is greater than or equal to 3, the multiplying factor/time data pairs are continued on additional cards with a 6G12.5 format.

Cards 28, 29, 30, 31, 32, and 33 define the exit boundary conditions and are identical in nature to Cards 22, 23, 24, 25, 26, and 27. The user can specify the type of exit boundary conditions, the initial magnitude of the boundary quantities, and how the boundary quantities will vary with channel number and time.

Card 28 Outlet Boundary Specification Flags

This card contains the data to load the exit boundary flag array, IBCFAC(2,N).

Columns	Format	Name	Description
1-5	I	N21	The boundary flag for the u component of exit velocity. N21 is stored in the boundary flag array location IBCFAC(2,1).
6-10	I	N22	The boundary flag for the v component of exit velocity. N22 is stored in the array location IBCFAC(2,2).
11-15	I	N23	The boundary flag for the w component of exit velocity. N23 is stored in the array location IBCFAC(2,3).
16-20	I	N24	The boundary flag for exit pressure, P. N24 is stored in the array location IBCFAC(2,4).
21-25	I	N25	The boundary flag for exit internal energy, SIE. N25 is stored in the array location IBCFAC(2,5).
26-30	I	N26	The boundary flag for exit density, RHO. N26 is stored in the array location IBCFAC(2,6).
31-35	I	N27	The boundary flag for exit temperature, TEMP. N27 is stored in the array location IBCFAC(2,7).

Card 29 Outlet Boundary Initial Conditions

The initial values for the seven exit boundary quantities are read in on this card. These initial values are loaded into the array locations FBCFAC(2,N).

Columns	Format	Name	Description
1-10	G	C21	Initial value for exit axial velocity u (ft/sec or m/s). C21 is not defined by the user if N22 equals 1, 6, or 7.
11-20	G	C22	Initial value for transverse velocity v (ft/sec or m/s). C22 is defined by the user if N22 equals 2.
21-30	G	C23	Initial value for transverse velocity w (ft/sec or m/s). C23 is defined by the user if N23 equals 2.
31-40	G	C24	Initial value for pressure, P ($lbm/in.^2$ or N/m^2). C24 is not defined by the user if N24 equals 1, 6, or 7.
41-50	G	C25	Initial value for internal energy, SIE (Btu/lbm or J/kg). C25 is not defined by the user if N25 equals 1, 6, or 7.
51-60	G	C26	Initial value of density, RHO (lbm/ft^3 or kg/m^3). C26 is defined by the user if N26 equals 2.

Columns	Format	Name	Descriptions
61-70	G	C27	Initial value of temperature, TEMP (°F or K). C27 is defined by the user if N27 equals 2.

Card 30 Outlet Boundary Axial Velocity or Pressure Spatial Distribution

This optional card input is read only if N21 or N24 equals 4 or 5. The multiplying factors SOUP(JBR*KBR) that vary the pressure or axial velocity at the exit, are read in. One factor is read in for each flow channel. The factors must be in order of increasing channel number.

Columns	Format	Name	Description
1-12	G	SOUP(1)	Pressure or axial velocity spatial multiplying factor for Channel 1.
13-24	G	SOUP(2)	Pressure of axial velocity spatial multiplying factor for Channel 2.
...	...	...	

Card 31 Outlet Boundary Initial Energy Spatial Distribution

This optional card input is read only if N25 equals 4 or 5. The multiplying factors SOS(JBR*KBR) that vary the internal energy at the exit, are read in. One factor is read in for each flow channel. The factors must be in order of increasing channel number.

Columns	Format	Name	Description
1-12	G	SOS(1)	Internal energy spatial multiplying factor for Channel 1.
13-24	G	SOS(2)	Internal energy spatial multiplying factor for Channel 2.
...	...	...	

Card 32 Outlet Boundary Axial Velocity or Pressure/Time Data Pairs

This optional card input, is read only if N21 or N24 equals 3 or 5. This card group is used to load NFTPUO pairs of multiplying factors and time into the array, TOUP(NN). The factors are used to vary the exit pressure or axial velocity as a function of time.

Columns	Format	Name	Description
1-5	I	NFTPUO	Number of multiplying factor/ time data pairs, not to exceed 20.
13-24	G	TOUP(1)	First multiplying factor.
25-36	G	TOUP(2)	First time.
37-48	G	TOUP(3)	Second multiplying factor.
49-60	G	TOUP(4)	Second time.
61-72	G	TOUP(5)	Third multiplying factor.

If NFTPUO is greater than or equal to 3, the factor/time data pairs are continued on additional cards with a 6G12.5 format.

Card 33 Outlet Boundary Internal Energy/Time Data Pairs

This optional card input is read only if N25 equals 3 or 5. This card group is used to load NFTPSO pairs of multiplying factors and time into the array, TOS(NN). The factors are used to vary the exit internal energy as a function of time.

Columns	Format	Name	Description
1-5	I	NFTPSO	Number of multiplying factors/ time data pairs, not to exceed 20.

Columns	Format	Name	Description
13-24	G	TOS(1)	First multiplying factor.
25-36	G	TOS(2)	First time.
37-48	G	TOS(3)	Second multiplying factor.
49-60	G	TOS(4)	Second time.
61-72	G	TOS(5)	Third multiplying factor.

If NFTPSO is greater than or equal to 3, the multiplying factor/time data pairs are continued on additional cards with a 6G12.5 format.

Cards 34 through 51 are used to define the friction factors, two-phase friction multiplier, reference viscosity, and heat transfer and CHF correlations to be used by the code. The various model options and correlations are described in detail in Appendix C. A summary of the model options and the correlations is given in Tables A-I and A-II, respectively.

Card 34 Correlation Model Options

With this card the user selects one of the 14 model options given in Table A-I. Model options 0 and 1 select a homogeneous fluid model with preselected laminar and turbulent friction factors. The user need only specify the heat transfer options on Card 51. Model options 2 and 3 are identical to Models 0 and 1 respectively, except that the user can specify the friction factor form. Models 4 and 5 allow the user to specify a void fraction correlation by which two-phase friction multipliers are to be calculated. Models 6 and 7 are identical to Models 4 and 5, respectively, except that the user is allowed to specify the friction factor relationships. Models 8 through 12 use preselected consistent sets of void fraction, slip, and two-phase friction multipliers. Model 13 allows the user to specify all correlations needed to calculate friction factors, two-phase multipliers, and heat transfer. The user is cautioned that only Models 0 and 1 have been thoroughly checked out.

TABLE A-I

OPTIONS DESCRIBING CONSTITUTIVE RELATIONSHIPS FOR FLUID-SOLID INTERFACIAL HEAT AND MOMENTUM EXCHANGE

Heat Transfer, Friction Factor, and Two-Phase Multiplier Name	Model Option													
	0	1	2	3	4	5	6	7	8 (ARMAND)	9 (M-N-L)[a]	10 (Beattie)	11 (Baroczy)	12 (Chisholm)	13 (User Spec)
	Correlation Option													
IRECWS	0	0	0	0	0	0	0	0	0	0	0	0	0	User Spec
IREX	4	3	4	3	5	6	5	6	1	1	1	1	1	User Spec
IREY	4	3	4	3	5	6	5	6	1	1	1	1	1	User Spec
IREZ	4	3	4	3	5	6	5	6	1	1	1	1	1	User Spec
IFXLAM	1	1	1	1	1	1	1	1	1	1	1	1	1	User Spec
IFYLAM	1	1	User Spec	User Spec	1	1	User Spec	User Spec	1	1	1	1	1	User Spec
IFZLAM	1	1	User Spec	User Spec	1	1	User Spec	User Spec	1	1	1	1	1	User Spec
IFXTUB	3	3	User Spec	User Spec	3	3	User Spec	User Spec	3	3	3	3	3	User Spec
IFYTUB	3	3	User Spec	User Spec	3	3	User Spec	User Spec	3	3	3	3	3	User Spec
IFZTUB	3	3	User Spec	User Spec	3	3	User Spec	User Spec	3	3	3	3	3	User Spec
IFLTEM	0	0	0	0	0	0	0	0	0	0	0	0	0	User Spec
IALFA	1	1	1	1	User Spec	User Spec	User Spec	User Spec	4	5	7	10	User Spec	User Spec
ITPRHO	1	1	1	1	2	2	2	2	1	1	1	1	2	User Spec
ITPMLX	5	5	5	5	5	5	5	5	1	2	3	4	2	User Spec
ITPMLY	5	5	5	5	5	5	5	5	1	2	3	4	2	User Spec
ITPMLZ	5	5	5	5	5	5	5	5	1	2	3	4	2	User Spec
ITPMTX	5	5	5	5	5	5	5	5	1	2	3	4	2	User Spec
ITPMTY	5	5	5	5	5	5	5	5	1	2	3	4	2	User Spec
ITPMTZ	5	5	5	5	5	5	5	5	1	2	3	4	2	User Spec
JCHF	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec
IHTDBF	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec
IFILMH	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec

[a] Martinelli-Nelson-Lockhart.

TABLE A-II

FRICTION FACTOR, TWO-PHASE MULTIPLIER, AND HEAT TRANSFER CORRELATIONS AND OPTIONS

Flag	Option	Description
ITPMOD	0-13	Described in Table A-I (0 is the default value).
IALFA	1 (Default Value)	Homogeneous void fraction (slip ratio, K_s = 1.0). $\alpha = \dfrac{x_e \tilde{\rho}_\ell}{x_e \tilde{\rho}_\ell + \left(1 - x_e\right)\tilde{\rho}_g}$.
	2	Slip ratio, K_s, is calculated as a polynomial function of quality. K_s = ASLP(1) + ASLP(2)x_e + ASLP(3)x_e^2 + ASLP(4)x_e^3. The void fraction is calculated as $\alpha = \dfrac{x_e \tilde{\rho}_\ell}{\tilde{\rho}_\ell K_s + x_e\left(\tilde{\rho}_\ell - \tilde{\rho}_g K_s\right)}$ where the number of coefficients NASLP to be used and the coefficients ASLP are input by the user.
	3	Void fraction is calculated as a polynomial function of quality. α = AALF(1) + AALF(2)x_e + AALF(3)x_e^2 + AALF(4)x_e^3. The slip ratio is calculated $K_s = \dfrac{x_e \tilde{\rho}_\ell - \alpha x_e \tilde{\rho}_\ell}{\alpha \tilde{\rho}_g - x_e \alpha \tilde{\rho}_g}$.
	4	Void fraction and slip ratio are calculated with the Armand correlation[A-1].
	5	Void fraction and slip ratio are calculated with the Martinelli-Nelson-Lockhart correlation[A-2].

TABLE A-II (continued)

Flag	Option	Description
IALFA	6	Void fraction and slip ratio are calculated with the Madsen correlation[A-3].
(continued)	7	Void fraction and slip ratio are calculated with the Smith correlation[A-4].
	8	Void fraction and slip ratio are calculated with the Thom correlation[A-2].
	9	Void fraction and slip ratio are calculated with the Zivi correlation[A-5].
	10	Void fraction and slip ratio are calculated with the Baroczy correlation[A-2].
	11	Void fraction and slip ratio are calculated with the Bankoff correlation[A-6].
	12	Void fraction and slip ratio are calculated with the Turner-Wallis correlation[A-2].
	13	Void fraction and slip ratio are calculated with the Von Glahn-Polcyn correlation[A-7].
	14	Void fraction and slip ratio are calculated with the Bankoff-Jones correlation[A-8,A-9].
IRECWS	0 (Default Value)	The component direction velocities u, v, w are used to calculate the x,y,z Reynolds numbers, respectively.
	1	The resultant velocity $= \sqrt{u^2+v^2+w^2}$ is used to calculate the x,y,z Reynolds numbers, respectively.

TABLE A-II (continued)

Flag	Option	Description
IREX, IREY, and IREZ	1	Reynolds number is calculated using the liquid viscosity.
	2 (Default Value)	Reynolds number is calculated using the mixture viscosity defined by $\frac{1}{\tilde{\mu}} = \frac{\chi_e}{\tilde{\mu}_g} + \frac{1-\chi_e}{\tilde{\mu}_\ell}$.
	3	Reynolds number is calculated using the mixture viscosity defined by $\tilde{\mu} = \chi_e\tilde{\mu}_g + (1-\chi_\varepsilon)\tilde{\mu}_\ell$.
	4	Reynolds number is calculated using the mixture viscosity defined by $\frac{1}{\tilde{\mu}} = \frac{\alpha}{\tilde{\mu}_g} + \frac{1-\alpha}{\tilde{\mu}_\ell}$.
	5	Reynolds number is calculated using the mixture viscosity defined by $\tilde{\mu} = \alpha\tilde{\mu}_g + (1-\alpha)\tilde{\mu}_\ell$.
	6	Reynolds number is calculated using the vapor viscosity.
IFXLAM	1 (Default Value)	x-direction laminar friction factor $f_{XL1} = 64/Re$ and $f_{XL2} = 0$.
IFYLAM and IFZLAM	1 (Default Value)	y,z-direction laminar friction factors, f_{YL1} and f_{ZL1}, using the Bergelin correlation[A-10].
	2	y,z-direction laminar friction factor $f_{YL1} = 64/Re$, $f_{ZL1} = 64/Re$, and $f_{YL2} = f_{ZL2} = 0.0$.

TABLE A-II (continued)

Flag	Option	Description
IFXTUB	1	x-direction transition - turbulent (T-T) friction factor: $f_{XT1} = C1TFX(Re)^{FREXPX}$, $f_{XT2} = C2TFX$ where C1TFX, FREXPX, and C2TFX are input by the user. A temperature correction can be applied to f_{XT2} IFLTEM = 2.
	2	x-direction T-T friction factor: $f_{XT1} = 2Log(D_{hy}/2ROUGH) + 1.74$ where ROUGH is input by the user $f_{XT2} = 0.$
	3 (Default Value)	x-direction T-T friction factor: $\frac{1}{\sqrt{f_{XT1}}} = 2Log\ (Re\sqrt{f_{XT1}})\ -0.8.$
	4	x-direction T-T friction factor: $\frac{1}{\sqrt{f_{XT1}}} = 1.74-2Log\left(\frac{2ROUGH}{D_{hy}} + \frac{18.7}{Re\sqrt{f_{XT1}}}\right)$ $f_{XT2} = 0.$
	5	x-direction T-T friction factor using the Lombardi-Pedrocchi correlation[A-11] for f_{XT1}. Note: This correlation includes the two-phase friction factor.

TABLE A-II (continued)

Flag	Option	Description
IFYTUB and IFZTUB	1	y,z-direction T-T friction factors: $f_{YT1} = C1TFY(Re)^{FREXPY}$ $f_{YT2} = C2TFY$ $f_{ZT1} = C1TFZ(Re)^{FREXPZ}$ $f_{ZT2} = C2TFZ$ where C1TFY, FREXPY, C2TFY and C1TFZ, FREXPZ, C2TFZ are input by the user. A temperature correction can be applied to f_{YT2} and f_{ZT2} if IFLTEM = 2.
	2	y,z-direction T-T friction factors: $f_{YT1} = f_{ZT1} = 2\mathrm{Log}\left(\frac{2S_p}{D_r}\right) + 1.74$ $f_{YT2} = f_{ZT2} = 0.$
	3 (Default Value)	y,z-direction T-T friction factors: $\frac{1}{\sqrt{f_{YT1}}} = 1.74 - 2\left(\mathrm{Log}\ \frac{2S_p}{D_r} + \frac{18.7}{Re\sqrt{f_{YT1}}}\right)$ $\frac{1}{\sqrt{f_{ZT1}}} = 1.74 - 2\left(\mathrm{Log}\ \frac{2S_p}{D_r} + \frac{18.7}{Re\sqrt{f_{ZT1}}}\right)$ $f_{YT2} = f_{ZT2} = 0.$

TABLE A-II (continued)

Flag	Option	Description
IFLTEM	0,1 (Default Value)	No temperature correction is applied to the friction factor.
	2	For the friction factors given by IFXTUB, IFYTUB, and IFZTUB = 1 above, a wall temperature correction of friction factor is applied as $f_{(x,y,z)T2} = C2TF_{x,y,z}[1.0 - 0.001(T_w - T_b)]$ where T_w = wall temperature T_b = bulk coolant temperature.
ITPRHO	1	Homogeneous two-phase mixture density: $\tilde{\rho} = \dfrac{\tilde{\rho}_\ell \, \tilde{\rho}_g}{x_e \tilde{\rho}_\ell + (1-x_e)\tilde{\rho}_g}$. In the present version of SCORE-EVET, only the homogeneous form of mixture density is used.
ITPMLX, ITPMLY, ITPMLZ, ITPMTX, ITPMTY, and ITPMTZ	1	Two-phase friction multiplier calculated with the Armand correlation[A-1].
	2	Two-phase friction multiplier calculated with the Martinelli-Nelson-Lockhart correlation[A-12].
	3	Two-phase friction multiplier calculated with the Beattie correlation[A-13].
	4	Two-phase friction multiplier calculated with the Baroczy correlation[A-14].

TABLE A-II (continued)

Flag	Option	Description
ITPMLX, ITPMLY, ITPMLZ, ITPMTX, ITPMTY, and ITPMTZ (continued)	5 (Default Value)	Mixture density and friction factor are used to calculate the two-phase frictional pressure drop. (a) Homogeneous flow: IALFA = 1; IREX, IREY, or IREZ = (2 or 3); IFXTUB = 1 through 4; IFYTUB or IFZTUB = 1 through 3; and ITPRHO = 1. (b) Nonhomogeneous flow: IALFA = 2 through 14; IREX, IREY, or IREZ = (4 or 5); IFXTUB = 1 through 4; IFYTUB or IFZTUB = 1 through 3; and ITPRHO = 2.
	6	Constant two-phase friction multiplier input by the user as ATPMLX, ATPMLY, ATPMLZ, ATPMTX, ATPMTY, and/or ATPMTZ, respectively.
ITPMLY, ITPMLZ, ITPMTY, and IPTMTZ	7	Transverse two-phase friction multiplier calculated with the Grant-Murray correlation[A-15]. The two-phase friction multiplier is: $\phi^2_{\ell o} = 1 + \left(\frac{\tilde{\mu}_g}{\tilde{\mu}_\ell}\right) \frac{\tilde{\rho}_\ell}{\tilde{\rho}_g} \left\{ X_e + 0.15 \left[\sqrt{X_e} - X_e^{400}\right]\right\}$ for laminar flow, and $\phi^2_{\ell o} = 1 + \left(\frac{\tilde{\mu}_g}{\tilde{\mu}_\ell}\right)^{-bT1} \frac{\tilde{\rho}_\ell}{\tilde{\rho}_g} \left\{ X_e + 0.15 \left[\sqrt{X_e} - X_e^{400}\right]\right\}$ for turbulent flow, where bT1 = FREXPY for IFYTUB = 1 bT1 = FREXPZ for IFZTUB = 1.

TABLE A-II (continued)

Flag	Option	Description
ITPMLY, ITPMLZ, ITPMTY, and ITPMTZ (continued)	7 (continued)	The following friction factor option should be used with this two-phase friction multiplier: IREY, IREZ = 1 IFYLAM, IFZLAM = 1 or 2 IFYTUB, IFZTUB = 1.
IFILMH		Transition and film boiling correlation options are:
	1	The transition or film boiling heat flux is the most conservative of the heat fluxes calculated by the: McDonough, Milich, and King[A-16] correlation (Mode 4); Groeneveld[A-17] 5.9 correlation (Mode 5); or the Dougall and Rohsenow[A-18] correlation (Mode 9).
	2	The transition or film boiling heat flux is the most conservative of the heat fluxes calculated by the: McDonough, Milich, and King[A-16] correlation (Mode 4); Groeneveld[A-17] 5.9 correlation (Mode 5); or the Dougall and Rohsenow[A-18] correlation (Mode 9).
	3 (Default Value)	The transition or film boiling heat flux is the most conservative of the heat fluxes calculated by the: McDonough, Milich, and King[A-16] correlation, or the Dougall and Rohsenow[A-18] correlation (Mode 9).
	4	The transition or film boiling heat flux is calculated by the Condie-Bengsten correlation, and the heat transfer mode is set equal to 5.

TABLE A-II (continued)

Flag	Option	Description
JCHF		Critical heat flux correlation flag. Each option provides the calculation of CHF by the following:
	0 (Default Value)	Interpolates B&W2[A-19], Barnett[A-20], and modified Barnett[A-21] based on pressure.
	1	The W3 CHF correlation[A-22] including the cold wall correction factor.
	2	The B&W2[A-19] CHF correlation (Note: Does not include a significant cold wall effect.)
	3	The Babcock & Wilcox B2[A-23] CHF correlation for high flow regime axial mass fluxes of $G \geq 1.0 \times 10^6 \frac{lb}{hr\text{-}ft^2}$. (Note: Includes a cold wall effect.)
	4	The Babcock & Wilcox B2M[A-23] CHF correlation for middle flow regime. (Note: Includes a cold wall effect.)
	5	The Babcock & Wilcox B6C[A-23] CHF correlation for high flow regime. (Note: Includes a cold wall effect.)
	6,7,8	Barnett[A-20] CHF correlation with rods represented as an equivalent annulus.
	9	Macbeth[A-24] bundle average CHF correlation at 1000 psia.
	10	Modified Barnett[A-21] CHF correlation with rods represented as an equivalent annulus.

TABLE A-II (continued)

Flag	Option	Description
JCHF (con-inued)	11	Bowring[A-25] round tube CHF correlation.
	12	GE[A-26] CHF correlation.
IHTDBG	0 (Default Value)	No printout occurs for debugging purposes.
	1	The values of variables for the heat transfer calculations are printed for debugging purposes.

Columns	Format	Name	Description
1-5	I	ITPMOD	Model options 0 through 13 as described in Table A-I.

Card 35 Laminar and Turbulent Friction Factors

This optional card input is used only if ITPMOD equals 2, 3, 6, or 7. This card is used to define the form of the laminar and turbulent friction factors in the three component directions, IFYLAM, IFZLAM, IFXTUB, IFYTUB, and IFZTUB (see Table A-II for possible options). IFXLAM is automatically specified as 1.

Columns	Format	Name	Description
1-5	I	IFYLAM	y-direction friction factor flag. (Default value: IFYLAM = 1.)
6-10	I	IFZLAM	z-direction friction factor flag. (Default value: IFZLAM = 1.)
11-15	I	IFXTUB	x-direction turbulent friction factor flag. (Default value: IFXTUB = 3.)
16-20	I	IFYTUB	y-direction turbulent friction factor flag. (Default value: IFYTUB = 3.)
21-25	I	IFZTUB	z-direction turbulent friction factor flag. (Default Value: IFZTUB = 3.)

Card 36 Laminar and Turbulent Friction Factor Formulation and Reference Velocity and Viscosity Form for Definition of Reynolds Number

This optional card input is used only if ITPMOD equals 13. See Table A-II for options which can be specified. IFXLAM is automatically specified as 1.

Columns	Format	Name	Description
1-5	I	IRECWS	Velocity flag for Reynolds number. (Default value: IRECWS = 0.)
6-10	I	IREX	Viscosity flag for Reynolds number in the x-direction. (Default value: IREX = 2.)
11-15	I	IREY	Viscosity flag for Reynolds number in the y-direction. (Default value: IREY = 2.)
16-20	I	IREZ	Viscosity flag for Reynolds number in the z-direction. (Default value: IREZ = 2.)
21-25	I	IFYLAM	y-direction laminar friction factor flags. (Default value: IFYLAM = 1.)
26-30	I	IFZLAM	z-direction laminar friction factor flags. (Default value: IFZLAM = 1.)
31-35	I	IFXTUB	x-direction turbulent friction factor flags. (Default value: IFXTUB = 3.)
36-40	I	IFYTUB	y-direction turbulent friction factor flags. (Default value; IFYTUB = 3.)
41-50	I	IFZTUB	z-direction turbulent friction factor flags. (Default value: IFZTUB = 3.)
51-55	I	IFLTEM	Friction factor wall temperature correction flag.

Card 37 Surface Roughness for Friction Factor Correlations

This optional card is used only if IFXTUB equals 2 or 4 on Card 35 or 36.

Columns	Format	Name	Description
1-12	G	ROUGH	Surface roughness (in. or m). (Default value: ROUGH = 0.0008 m, commercially smooth.)

Card 38 Correlation Constants for Friction Factor in the x-Direction

This optional card is used only if IFXTUB equals 1 on Card 35 or 36. Three constants are read in which define the friction factor in the x-direction as a function of Reynolds number.

Columns	Format	Name	Description
1-12	G	FREXPX	Exponent for Reynolds number in the x-direction. (Default value: FREXPX - -0.25.)
13-24	G	C1TFX	Coefficient for Reynolds number in the x-direction. (Default value: C1TFX = 0.3164.)
25-36	G	C2TFX	Constant. (Default value: C2TFX = 0.)

Card 39 Correlation Constants for Friction Factor in the y-Direction

This optional card is used only if IFYTUB equals 1 on Card 35 or 36. This card is used to define the friction factor in the y-direction as a function of Reynolds number.

Columns	Format	Name	Description
1-12	G	FREXPY	Exponent for Reynolds number in the y-direction. (Default value: FREXPY = -0.25)
13-24	G	C1TFY	Coefficient for Reynolds number in the y-direction. (Default value: C1TFY = 0.3164.)
25-36	G	C2TFY	Constant. (Default value: C2TFY = 0.)

Card 40 Correlation Constants for Friction Factor in the z-Direction

This optional card is used only if IFZTUB equals 1 on Card 35 or 36. This card is used to define the friction factor in the z-direction as a function of Reynolds number.

Columns	Format	Name	Description
1-12	G	FREXPZ	Exponent for Reynolds number in the z-direction. (Default value: FREXPZ = -0.25)
13-24	G	C1TFZ	Coefficient for Reynolds number in the z-direction. (Default value: C1TFZ = 0.3164.)
25-36	G	C2TFZ	Constant. (Default value: C2TFZ = 0.)

Card 41 Void Fraction Correlation

This optional card is used only if ITPMOD on Card 34 equals 4, 5, 6, 7, or 12. See Table A-II for possible options.

Columns	Format	Name	Description
1-5	I	IALFA	Void fraction correlation flag. (Default value: IALFA = 1.)

Card 42 Void Fraction and Two-Phase Friction Multiplier

This optional card is used only if ITPMOD on Card 34 equals 13. See Table A-II for options which can be specified.

Columns	Format	Name	Description
1-5	I	IALFA	Void fraction correlation flag. (Default value: IALFA = 1.)
6-10	I	ITPRHO	Specification of the form of the mixture density. Currently only the homogeneous option, ITPRHO = 1, is available. (Default value: ITPRHO = 1.)
11-15	I	ITPMLX	x-direction laminar two-phase friction multiplier flag. (Default value: ITPMLX =5.)
16-20	I	ITPMLY	y-direction laminar two-phase friction multiplier flag. (Default value: ITPMLY = 5.)
21-25	I	ITPMLZ	z-direction laminar two-phase friction multiplier flag. (Default value: ITPMLZ = 5.)
26-30	I	ITPMTX	x-direction turbulent two-phase friction multiplier flag. (Default value: ITPMTX = 5.)

Columns	Format	Name	Description
31-35	I	ITPMTY	y-direction turbulent two-phase friction multiplier flag. (Default value: ITPMTY = 5.)
36-40	I	ITPMTZ	z-direction turbulent two-phase friction multiplier flag. (Default value: ITPMTZ = 5.)

Card 43 Polynominal Form of the Void Fraction

This optional card is used only if IALFA on Card 41 or 42 equals 3. This card is used to read in polynomial coefficients to describe the void fraction (α) as a polynomial function of equilibrium quality (x_e); $\alpha = AALF(1)x_e + AALF(2)x_e + AALF(3)x_e^2 + AALF(4)x_e^3$.

Columns	Format	Name	Description
1-5	I	NAALF	Number of polynomial coefficients AALF(NAALF). (NAALF $\leq$ 3).
13-24	G	AALF(1)	First polynomial coefficient.
25-36	G	AALF(2)	Second polynomial coefficient.
37-48	G	AALF(3)	Third polynomial coefficient.
49-60	G	AALF(4)	Fourth polynominal coefficient.

Card 44 Polynomial Form of the Slip Ratio

This optional card is used only if IALFA on Cards 41 or 42 equals 2. This card is used to read in the polynomial coefficient to describe the slip ratio (K_s) as a polynomial function of equilibrium quality (x_e); $K_s = ASLP(1) + ASLP(2)x_e + ASLP(3)x_e^2 + ASLP(4)x_e^3$.

Columns	Format	Name	Description
1-5	I	NASLP	Number of polynomial coefficients ASLP(NASLP). (NASLP $\leq$ 4).
13-24	G	ASLP(1)	First polynomial coefficient.
25-36	G	ASLP(2)	Second polynomial coefficient.
37-48	G	ASLP(3)	Third polynominal coefficient.
49-60	G	ASLP(4)	Fourth polynominal coefficient.

Card 45 Constant Laminar Two-Phase Friction Multiplier in the x-Direction

This optional card is used only if ITPMLX on Card 42 is equal to 6.

Columns	Format	Name	Description
1-12	G	ATPMLX	Constant laminar two-phase friction multiplier for x-direction, $\phi^2_{\ell o}$.

Card 46 Constant Laminar Two-Phase Friction Multiplier in the y-Direction

This optional card is used only if ITPMLY on Card 42 is equal to 6.

Columns	Format	Name	Description
1-12	G	ATPMLY	Constant laminar two-phase friction multiplier for y-direction, $\phi^2_{\ell o}$.

Card 47 Constant Laminar Two-Phase Multiplier in the z-Direction

This optional card is used only if ITPMLZ on Card 42 is equal to 6.

Columns	Format	Name	Description
1-12	G	ATPMLZ	Constant laminar two-phase friction multiplier for the z-direction, $\phi^2_{\ell o}$.

Card 48 Constant Turbulent Two-Phase Multiplier in the x-Direction

This optional card is used only if ITPMTX on Card 42 is equal to 6.

Columns	Format	Name	Description
1-12	G	ATPMTX	Constant turbulent two-phase friction multiplier for the x-direction, $\phi^2_{\ell o}$.

Card 49 Constant Turbulent Two-Phase Multiplier in the y-Direction

This optional card is used only if ITPMTY on Card 42 is equal to 6.

Columns	Format	Name	Description
1-12	G	ATPMTY	Constant turbulent two-phase friction multiplier for the y-direction, $\phi^2_{\ell o}$.

Card 50 Constant Turbulent Two-Phase Multiplier in the z-Direction

This optional card is used only if ITPMTZ on Card 42 is equal to 6.

Columns	Format	Name	Description
1-12	G	ATPMTZ	Constant turbulent two-phase friction multiplier for the z-direction, $\phi^2_{\ell o}$.

Card 51 CHF and Film Boiling Heat Transfer Models

This card must be read in for all model options. The CHF correlations flag, heat transfer debug printout flag, and the film boiling heat transfer coefficient flags are read in on this card. If a blank card is used, the default options JCHF = 0, IHTDBG = 0, and IFILMH = 2 will be set.

Columns	Format	Name	Description
1-5	I	JCHF	CHF correlation flag. (Default value: JCHF = 0.)
6-10	I	IHTDBG	Heat transfer debug printout flag. (Default value: IHTDBG = 0.)
11-15	I	IFILMH	Transition and film boiling heat transfer coefficient flag. (Default value: IFILMH = 3.)

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APPENDIX B

BOUNDARY CONDITION SPECIFICATIONS

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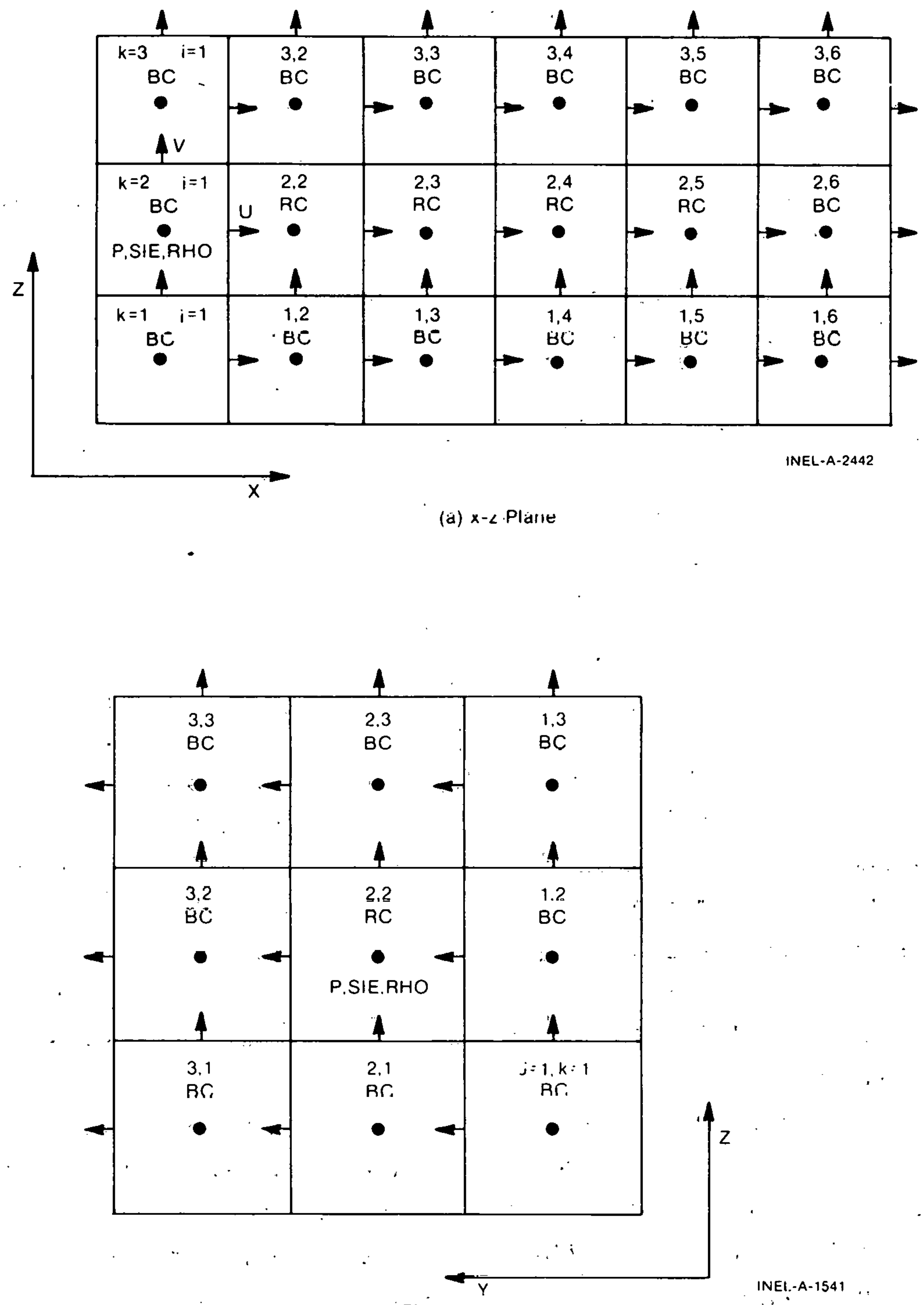
APPENDIX B

BOUNDARY CONDITION SPECIFICATIONS

As described in Section III, the SCORE-EVET code solves the 3-D transient volume-averaged equations in Cartesian coordinates. The solution of the 3-D transient equations requires initial and boundary conditions. Calculation of the initial conditions was described in Section III-2. This appendix describes the boundary conditions required in SCORE-EVET and the manner in which they are specified.

When setting up a problem, the user defines a rectangular computational region by specifying the number of computational cells and their dimensions in the x-, y-, and z-directions. In addition, the computational region is surrounded on all six of its sides by boundary cells which are also dimensioned by the user. Figure B-1 (a and b) shows the arrangement of computational (referred to as real cells = RC) and boundary cells (BC) for a 1-D problem. As shown, the thermodynamic quantities are cell centered and the velocities are face centered. Boundary conditions for a problem are: (a) thermodynamic quantities of pressure, internal energy, density, and temperature (P, SIE, RHO, and TEMP) for the boundary cells; (b) velocities normal to the interface between the real and boundary cells; and (c) the boundary cells velocities parallel to the interface plane. Boundary conditions must be set for all six sides of the computational region defined by the user. In the present version of SCORE-EVET, only the boundary conditions on the y-z plane at first and last axial levels (i = 1 and i = 6 in Figure B-1a) may be specified by the user. These two boundary planes have been designated the inlet and outlet of the computational region, respectively. The boundary conditions for the other four sides of the computational region are fixed in the code as no-flow (normal velocity is zero) adiabatic free slip (boundary cell velocities parallel to the interface plane are set equal to their neighboring real cell value) boundaries. These boundaries are, therefore, limited to representing either symmetry planes or solid walls. The distinction between a symmetry plane and a solid wall boundary is made by the user's specification of equivalent



(a) x-z Plane

(b) y-z Plane

Fig. B-1 Boundary and real cell arrangement in the x-z and the y-z plane of a hypothetical 1-D problem.

hydraulic diameter in the real cells adjacent to these boundaries. (See Appendix A, User Input Description, Card 16.)

The user specification of boundary conditions on the inlet and outlet planes will determine the direction of flow. The user may specify velocity and pressure boundary conditions such that the fluid may be entering and exiting on the same boundary plane. Boundary conditions on the inlet and outlet planes are specified by either: (a) pressure and internal energy or (b) axial velocity and internal energy. The quantities specified under these two options can be functions of both time and space. However, the user is not allowed to specify both pressure and velocity at the same time on a given boundary plane. Other thermodynamic quantities for the boundary cells can be obtained from the equation of state or extrapolated from values inside the computational region. Boundary velocities parallel to the inlet and outlet planes can be specified as constants equal to the real cell value or equal in magnitude but opposite in sign to the real cell value in the plane adjacent to the boundary. Typically, the transverse boundary cell velocities are set equal to the adjacent real cell value in magnitude and sign.

The inlet and outlet boundary conditions for the SCORE-EVET code are defined by the use of ten boundary condition storage arrays. These arrays, as noted in Appendix A, are loaded by Cards 22 through 33. The boundary condition arrays are: Array IBCFAC (i,j), the inlet and outlet boundary flags; Array FBCFAC (i,j), the initial inlet and outlet boundary quantity values; Arrays SIUP(NCHAN) and SOUP(NCHAN), the inlet and outlet spatial variation of pressure or axial velocity, respectively; Arrays SIS(NCHAN) and SOS(NCHAN), the inlet and outlet spatial variation of internal energy, respectively; Arrays TIUP(NN) and TOUP(NN) the inlet and outlet pressure or axial velocity multiplication factors/time data pairs, respectively; and Arrays TIS(NN) and TOS(NN) the internal energy multiplication factors/time data pairs, respectively.

The arrays which describe the time and space variation of the boundary quantities may or may not be read in, depending on the boundary condition flags read into array IBCFAC (i,j). The array IBCFAC (i,j) is a 2 by 7 (i = 2, j = 7) array which is used to store the integer flags that prescribe the seven inlet [IBCFAC(1,j)] and outlet [IBCFAC(2,j)] boundary quantities. The seven quantities, in the sequence in which their flags are ordered in array IBCFAC, are: IBCFAC (i,1) array location stores the axial velocity (u) boundary specification flag; IBCFAC (i,2) array location stores the transverse velocity (v) boundary specification flag; IBCFAC (i,3) array location stores the transverse velocity (w) boundary specification flag; IBCFAC (i,4) array location stores the pressure (P) boundary specification flag; IBCFAC (i,5) array location stores the internal energy (SIE) boundary specification flag; IBCFAC (i,7) array location stores the temperature (TEMP) boundary specification flag.

Eight possible boundary flags are available to describe how the above seven quantities are to be defined. The boundary flags are:

Integer Flag	Description
1	Free slip boundary condition. The velocity normal to the boundary (u) is set to zero. All other quantities in the boundary cells are set equal to those in the real cells adjacent to the boundary cells.
2	Constant (space and time) boundary conditions. The boundary quantity will be held constant at the value read into array FBCFAC (i,j).
3	Time varying boundary condition. The boundary quantity will be specified with time according to the multiplying factor/time data pairs loaded in arrays TIUP, TIS, TOUP, and TOS. For either the inlet or outlet, only three boundary quantities are allowed to use the boundary flag of 3: internal energy, axial velocity,

Integer Flag	Description
	and pressure. Of these three quantities, only the following pairs can be specified for a given problem: internal energy and axial velocity, or internal energy and pressure. The remaining quantity of the three must have a flag of 6.
4	Spatially varying boundary condition. The boundary quantity will be varied according to the channel factors loaded in arrays SIUP, SIS, SOUP, and SOS. This flag can be used only for internal energy, axial velocity, and pressure as described for Flag 3. As described for Flag 3, pressure and velocity cannot be specified by a flag of 4 at the same time on the same boundary. The quanitity not specified by a flag of 4 must have a flag of 6.
5	Spatial and time varying boundary condition. The boundary quantity will be spatially varied according to the channel factors loaded in arrays SIUP, SIS, SOUP, and SOS, and varies with time according to the multiplying factor/time data pairs loaded in TIUP, TIS, TOUP, and TOS. The use of this flag is the same as described for Flags 3 and 4.
6	Extrapolated boundary condition. The boundary quantity will not be specified explicitly, but will be defined by extrapolating its value from that of values of the same quantities inside the computational region. All quantities except pressure and axial velocity are extrapolated using the assumption that the

Integer Flag	Description
	second derivative of the quantity with respect to axial distance is zero $\frac{\partial^2 F}{\partial X^2} = 0$. The extrapolated boundary condition is used for pressure or velocity, but not both simultaneously. One of these two quantities has to be specified (Flags 2, 3, 4, and 5) and the other is extrapolated. If velocity is specified, the pressure is extrapolated, being set equal to the value of the pressure of its adjacent real cell. If the boundary cell pressure is specified, then boundary velocity is calculated. When pressure is specified, the extrapolation specification on velocity merely ensures that the calculated value of velocity is not changed.
7	No slip boundary condition. The velocity normal to the boundary (u) is set to zero. The transverse velocities (v and w) are set equal in magnitude and opposite in sign to those in the real cell adjacent to the boundary cell. All other quantities are set equal to the adjacent real cell value for the quantity.
8	Equation-of-state boundary condition. This boundary condition flag is used only for boundary cell density and temperature.

Table B-I summarizes the possible boundary condition options. Array FBCFAC (i,j) is a 2 by 7 array (i = 2, j = 7) which stores the initial values for the seven inlet [FBCFAC (1,j)] and outlet [FBCFAC (2,j)] boundary quantities. If the boundary quantities of pressure, axial velocity, or internal energy, are specified as functions of channel number (that is, the boundary specification Flag 4 is used), then the initial values stored in array FBCFAC will be multiplied by the appropriate

TABLE B-I

BOUNDARY CONDITION OPTIONS AVAILABLE
FOR THE SEVEN BOUNDARY QUANTITIES

	IBCFAC(i,1)	IBCFAC(i,2)	IBCFAC(i,3)	IBCFAC(i,4)	IBCFAC(i,5)	IBCFAC(i,6)	IBCFAC(i,7)
Boundary Condi- tion Option	Axial Velocity u	Transverse Velocity v	Transverse Velocity w	Pressure P	Internal Energy SIE	Density RHO	Temperature TEMP
1							
2							
3		X [a]	X			X	X
4		X	X			X	X
5		X	X			X	X
6							
7							
8	X	X	X	X	X		

[a] These markings indicate the option is not used.

factors read into arrays SIUP, SIS, SOUP, and SOS. If the boundary pressure, axial velocity, or internal energy are specified as functions of time (that is, boundary specification Flag 3 is used), then the initial values stored in array FBCFAC are multiplied by factors stored in the factor/time data pair arrays TIUP, TIS, TOUP, and TOS. The multiplication factor is obtained by linear interpolation using the current time and the factor/time data pairs. If the boundary quantities of pressure, axial velocity, or internal energy are specified as both a function of time and channel number (that is, the boundary specification Flag 5), then both of the above procedures are used consecutively. The user is cautioned that both inlet and outlet axial velocity can be specified simultaneously. However, this should not be done unless the fluid conditions are highly compressible, such as pure steam or high quality steam-water mixtures. Table B-II represents the typical sets of boundary condition flags used.

TABLE B-II

TYPICALLY USED BOUNDARY
CONDITION FLAGS

Axial Velocity u		Transverse Velocity v		Transverse Velocity w		Pressure P		Internal Energy SIE		Density RHO		Temperature TEMP	
In-let	Out-let	In-let	Out-let	In-let	Out-let	In-let	Out-let	In-let	Out-let	In-let	Out-let	In-let	Out-let
2	6	1	1	1	1	6	2	2	6	2	6	2	6
3,4 and 5	6	1	1	1	1	6	2,3, 4, and 5	2,3, 4, and 5	2,3, 4, and 5	8 or 6	8 or 6	8 or 6	8 or 6
6	6	1	1	1	1	2,3, 4, and 5	2,3, 4, and 5	2,3, 4, and 5	2,3, 4, and 5	8 or 6	8 or 6	8 or 6	8 or 6
6	2,3, 4, and 5	1	1	1	1	2,3, 4, and 5	6	2,3, 4, and 5	2,3, 4, and 5	8 or 6	8 or 6	8 or 6	8 or 6

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APPENDIX C

CONSTITUTIVE RELATIONSHIPS

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APPENDIX C

CONSTITUTIVE RELATIONSHIPS

The constitutive relationships discussed in this appendix are divided into four general parts. Section 1 describes formulas and options for the fluid-solid interfacial momentum exchange. Section 2 describes the formulation of the turbulent energy and momentum exchange. Section 3 describes formulas and options used to calculate the fluid-solid interfacial energy exchange. Tables C-I and C-II (see pages 116 and 117) summarize the code input flags required to specify all correlation options. Table C-I gives the model options for specifying 13 predefined flow models, and one user-specified flow model. This table contains the correlation options when specified by a given model. Table C-II provides a summary description of the friction factor, two-phase multiplier, and heat transfer correlations and options. Section 4 of this appendix describes the method used to evaluate the water properties.

1. FLUID-SOLID INTERFACIAL MOMENTUM EXCHANGE

In Section III, the fluid-solid interfacial momentum exchange was identified in the linear momentum equation as F_i. In the SCORE-EVET code, F_i is expressed in terms of the Darcy friction factor.

Two methods are provided for the SCORE-EVET user to calculate F_i. In the first method, the form of the Darcy friction factor is evaluated at liquid reference conditions, and the Two-phase multiplier is calculated using one of the six correlations available to the user. The Two-phase multiplier options are selected by use of the correlation flags ITPMLi and ITPMTi.

When using the second method to calculate F_i, nonequilibrium effects are included only by the use of the nonequilibrium void fraction to evaluate mixture viscosity. In the present version of SCORE-EVET, the mixture density is always calculated by the homomogeneous equilibrium formulation.

TABLE C-I

OPTIONS DESCRIBING CONSTITUTIVE RELATIONSHIPS FOR FLUID-SOLID INTERFACIAL HEAT AND MOMENTUM EXCHANGE

Heat Transfer, Friction Factor, and Two-Phase Multiplier Name	Model Option													
	0	1	2	3	4	5	6	7	8 (ARMAND)	9 (M-N-L)[a]	10 (Beattie)	11 (Baroczy)	12 (Chisholm)	13 (User Spec)
	Correlation Option													
IRECWS	0	0	0	0	0	0	0	0	0	0	0	0	0	User Spec
IREX	4	3	4	3	5	6	5	6	1	1	1	1	1	User Spec
IREY	4	3	4	3	5	6	5	6	1	1	1	1	1	User Spec
IREZ	4	3	4	3	5	6	5	6	1	1	1	1	1	User Spec
IFXLAM	1	1	1	1	1	1	1	1	1	1	1	1	1	User Spec
IFYLAM	1	1	User Spec	User Spec	1	1	User Spec	User Spec	1	1	1	1	1	User Spec
IFZLAM	1	1	User Spec	User Spec	1	1	User Spec	User Spec	1	1	1	1	1	User Spec
IFXTUB	3	3	User Spec	User Spec	3	3	User Spec	User Spec	3	3	3	3	3	User Spec
IFYTUB	3	3	User Spec	User Spec	3	3	User Spec	User Spec	3	3	3	3	3	User Spec
IFZTUB	3	3	User Spec	User Spec	3	3	User Spec	User Spec	3	3	3	3	3	User Spec
IFLTEM	0	0	0	0	0	0	0	0	0	0	0	0	0	User Spec
IALFA	1	1	1	1	User Spec	User Spec	User Spec	User Spec	4	5	7	10	User Spec	User Spec
ITPRHO	1	1	1	1	2	2	2	2	1	1	1	1	2	User Spec
ITPMLX	5	5	5	5	5	5	5	5	1	2	3	4	2	User Spec
ITPMLY	5	5	5	5	5	5	5	5	1	2	3	4	2	User Spec
ITPMLZ	5	5	5	5	5	5	5	5	1	2	3	4	2	User Spec
ITPMTX	5	5	5	5	5	5	5	5	1	2	3	4	2	User Spec
ITPMTY	5	5	5	5	5	5	5	5	1	2	3	4	2	User Spec
ITPMTZ	5	5	5	5	5	5	5	5	1	2	3	4	2	User Spec
JCHF	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec
IHTDBF	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec
IFILMH	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec	User Spec

[a] Martinelli-Nelson-Lockhart.

TABLE C-II

FRICTION FACTOR, TWO-PHASE MULTIPLIER, AND HEAT TRANSFER CORRELATIONS AND OPTIONS

Flag	Option	Description
ITPMOD	0-13	Described in Table C-I (0 is the default value).
IALFA	1 (Default Value)	Homogeneous void fraction (slip ratio, $K_s = 1.0$). $\alpha = \dfrac{\chi_e \tilde{\rho}_\ell}{\chi_e \tilde{\rho}_\ell + \left(1-\chi_e\right)\tilde{\rho}_g}$.
	2	Slip ratio, K_s, is calculated as a polynomial function of quality. $K_s = ASLP(1) + ASLP(2)\chi_e + ASLP(3)\chi_e^2 + ASLP(4)\chi_e^3$. The void fraction is calculated as $\alpha = \dfrac{\chi_e \tilde{\rho}_\ell}{\tilde{\rho}_g K_s + \chi_e\left(\tilde{\rho}_\ell - \tilde{\rho}_g K_s\right)}$ where the number of coefficients NASLP to be used and the coefficients ASLP are input by the user.
	3	Void fraction is calculated as a polynomial function of quality. $\alpha = AALF(1) + AALF(2)\chi_e + AALF(3)\chi_e^2 + AALF(4)\chi_e^3$. The slip ratio is calculated $K_s = \dfrac{\chi_e \tilde{\rho}_\ell - \alpha \chi_e \tilde{\rho}_\ell}{\alpha \tilde{\rho}_g - \chi_e \alpha \tilde{\rho}_g}$.
	4	Void fraction and slip ratio are calculated with the Armand correlation[C-1].
	5	Void fraction and slip ratio are calculated with the Martinelli-Nelson-Lockhart correlation[C-2].

TABLE C-II (continued)

Flag	Option	Description
IALFA	6	Void fraction and slip ratio are calculated with the Madsen correlation[C-3].
(continued)	7	Void fraction and slip ratio are calculated with the Smith correlation[C-4].
	8	Void fraction and slip ratio are calculated with the Thom correlation[C-2].
	9	Void fraction and slip ratio are calculated with the Zivi correlation[C-5].
	10	Void fraction and slip ratio are calculated with the Baroczy correlation[C-18].
	11	Void fraction and slip ratio are calculated with the Bankoff correlation[C-6].
	12	Void fraction and slip ratio are calculated with the Turner-Wallis correlation[C-2].
	13	Void fraction and slip ratio are calculated with the Von Glahn-Polcyn correlation[C-7].
	14	Void fraction and slip ratio are calculated with the Bankoff-Jones correlation[C-8,C-9].
IRECWS	0 (Default Value)	The component direction velocities u, v, w are used to calculate the x,y,z Reynolds numbers, respectively.
	1	The resultant velocity = $\sqrt{u^2+v^2+w^2}$ is used to calculate the x,y,z Reynolds numbers, respectively.

TABLE C-II (continued)

Flag	Option	Description
IREX, IREY, and IREZ	1	Reynolds number is calculated using the liquid viscosity.
	2 (Default Value)	Reynolds number is calculated using the mixture viscosity defined by $\frac{1}{\tilde{\mu}} = \frac{\chi_e}{\tilde{\mu}_g} + \frac{1-\chi_e}{\tilde{\mu}_\ell}$.
	3	Reynolds number is calculated using the mixture viscosity defined by $\tilde{\mu} = \chi_e \tilde{\mu}_g + (1-\chi_\varepsilon)\tilde{\mu}_\ell$.
	4	Reynolds number is calculated using the mixture viscosity defined by $\frac{1}{\tilde{\mu}} = \frac{\alpha}{\tilde{\mu}_g} + \frac{1-\alpha}{\tilde{\mu}_\ell}$.
	5	Reynolds number is calculated using the mixture viscosity defined by $\tilde{\mu} = \alpha\tilde{\mu}_g + (1-\alpha)\tilde{\mu}_\ell$.
	6	Reynolds number is calculated using the vapor viscosity.
IFXLAM	1 (Default Value)	x-direction laminar friction factor f_{XL1} = 64/Re and f_{XL2} = 0.
IFYLAM and IFZLAM	1 (Default Value)	y,z-direction laminar friction factors, f_{YL1} and f_{ZL1}, using the Bergelin correlation[C-10].
	2	y,z-direction laminar friction factor f_{YL1} = 64/Re, f_{ZL1} = 64/Re, and f_{YL2} = f_{ZL2} = 0.0.

TABLE C-II (continued)

Flag	Option	Description
IFXTUB	1	x-direction transition - turbulent (T-T) friction factor: $f_{XT1} = C1TFX(Re)^{FREXPX}$ $f_{XT2} = C2TFX$ where C1TFX, FREXPX, and C2TFX are input by the user. A temperature correction can be applied to f_{XT2} IFLTEM = 2.
	2	x-direction T-T friction factor: $f_{XT1} = 2Log(D_{hy}/2ROUGH) + 1.74$ where ROUGH is input by the user $f_{XT2} = 0.$
	3 (Default Value)	x-direction T-T friction factor: $\frac{1}{\sqrt{f_{XT1}}} = 2Log\,(Re\sqrt{f_{XT1}})\ -0.8.$
	4	x-direction T-T friction factor: $\frac{1}{\sqrt{f_{XT1}}} = 1.74-2Log\left(\frac{2ROUGH}{D_{hy}} + \frac{18.7}{Re\sqrt{f_{XT1}}}\right)$ $f_{XT2} = 0.$
	5	x-direction T-T friction factor using the Lombardi-Pedrocchi correlation[C-11] for f_{XT1}. Note: This correlation includes the two-phase friction factor.

TABLE C-II (continued)

Flag	Option	Description
IFYTUB and IFZTUB	1	y,z-direction T-T friction factors: $f_{YT1} = C1TFY(Re)^{FREXPY}$ $f_{YT2} = C2TFY$ $f_{ZT1} = C1TFZ(Re)^{FREXPZ}$ $f_{ZT2} = C2TFZ$ where C1TFY, FREXPY, C2TFY and C1TFZ, FREXPZ, C2TFZ are input by the user. A temperature correction can be applied to f_{YT2} and f_{ZT2} if IFLTEM = 2.
	2	y,z-direction T-T friction factors: $f_{YT1} = f_{ZT1} = 2\text{Log}\left(\frac{2S_p}{D_r}\right) + 1.74$ $f_{YT2} = f_{ZT2} = 0.$
	3 (Default Value)	y,z-direction T-T friction factors: $\frac{1}{\sqrt{f_{YT1}}} = 1.74-2\left(\text{Log}\ \frac{2S_p}{D_r} + \frac{18.7}{Re\sqrt{f_{YT1}}}\right)$ $\frac{1}{\sqrt{f_{ZT1}}} = 1.74-2\left(\text{Log}\ \frac{2S_p}{D_r} + \frac{18.7}{Re\sqrt{f_{ZT1}}}\right)$ $f_{YT2} = f_{ZT2} = 0.$

TABLE C-II (continued)

Flag	Option	Description
IFLTEM	0,1 (Default Value)	No temperature correction is applied to the friction factor.
	2	For the friction factors given by IFXTUB, IFYTUB, and IFZTUB = 1 above, a wall temperature correction of friction factor is applied as $f_{(x,y,z)T2} = C2TF_{x,y,z}[1.0 - 0.001(T_w - T_b)]$ where T_w = wall temperature T_b = bulk coolant temperature.
ITPRHO	1	Homogeneous two-phase mixture density: $\tilde{\rho} = \dfrac{\tilde{\rho}_\ell \, \tilde{\rho}_g}{x_e \tilde{\rho}_\ell + (1-x_e)\tilde{\rho}_g}$. In the present version of SCORE-EVET, only the homogeneous form of mixture density is used.
ITPMLX, ITPMLY, ITPMLZ, ITPMTX, ITPMTY, and ITPMTZ	1	Two-phase friction multiplier calculated with the Armand correlation[C-1].
	2	Two-phase friction multiplier calculated with the Martinelli-Nelson-Lockhart correlation[C-12].
	3	Two-phase friction multiplier calculated with the Beattie correlation[C-13].
	4	Two-phase friction multiplier calculated with the Baroczy correlation[C-14].

TABLE C-II (continued)

Flag	Option	Description
ITPMLX, ITPMLY, ITPMLZ, ITPMTX, ITPMTY, and ITPMTZ (continued)	5 (Default Value)	Mixture density and friction factor are used to calculate the two-phase frictional pressure drop. (a) Homogeneous flow: IALFA = 1; IREX, IREY, or IREZ = (2 to 3); IFXTUB = 1 through 4; IFYTUB or IFZTUB = 1 through 3; and ITPRHO = 1. (b) Nonhomogeneous flow: IALFA = 2 through 14; IREX, IREY, or IREZ = (4 or 5); IFXTUB = 1 through 4; IFYTUB or IFZTUB = 1 through 3; and ITPRHO = 2.
	6	Constant two-phase friction multiplier input by the user as ATPMLX, ATPMLY, ATPMLZ, ATPMTX, ATPMTY, and/or ATPMTZ, respectively.
ITPMLY, ITPMLZ, ITPMTY, and IPTMTZ	7	Transverse two-phase friction multiplier calculated with the Grant-Murray correlation[C-15]. The two-phase friction multiplier is: $\phi^2_{\ell o} = 1 + \left(\frac{\tilde{\mu}_g}{\tilde{\mu}_\ell}\right)\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g}\left\{x_e + 0.15\left[\sqrt{x_e} - x_e^{400}\right]\right\}$ for laminar flow, and $\phi^2_{\ell o} = 1 + \left(\frac{\tilde{\mu}_g}{\tilde{\mu}_\ell}\right)^{-bT1}\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g}\left\{x_e + 0.15\left[\sqrt{x_e} - x_e^{400}\right]\right\}$ for turbulent flow, where bT1 = FREXPY for IFYTUB = 1 bT1 = FREXPZ for IFZTUB = 1.

TABLE C-II (continued)

Flag	Option	Description
ITPMLY, ITPMLZ, ITPMTY, and ITPMTZ (continued)	7 (continued)	The following friction factor option should be used with this two-phase friction multiplier: IREY, IREZ = 1 IFYLAM, IFZLAM = 1 or 2 IFYTUB, IFZTUB = 1.
IFILMH		Transition and film boiling correlation options are:
	1	The transition or film boiling heat flux is the most conservative of the heat fluxes calculated by the: McDonough, Milich, and King[C-16] correlation (Mode 4); Groeneveld[C-17] 5.9 correlation (Mode 5); or the Dougall and Rohsenow[C-18] correlation (Mode 9).
	2	The transition or film boiling heat flux is the most conservative of the heat fluxes calculated by the: McDonough, Milich, and King[C-16] correlation (Mode 4); Groeneveld[C-17] 5.9 correlation (Mode 5); or the Dougall and Rohsenow[C-18] correlation (Mode 9).
	3 (Default Value)	The transition or film boiling heat flux is the most conservative of the heat fluxes calculated by the: McDonough, Milich, and King[C-16] correlation, or the Dougall and Rohsenow[C-18] correlation (Mode 9).
	4	The transition or film boiling heat flux is calculated by the Condie-Bengsten correlation, and the heat transfer mode is set equal to 5.

TABLE C-II (continued)

Flag	Option	Description
JCHF		Critical heat flux correlation flag. Each option provides the calculation of CHF by the following:
	0 (Default Value)	Interpolates B&W2[C-19], Barnett[C-20], and modified Barnett[C-21] based on pressure.
	1	The W3 CHF correlation[C-22] including the cold wall correction factor.
	2	The B&W2[C-19] CHF correlation (Note: Does not include a significant cold wall effect.)
	3	The Babcock & Wilcox B2[C-23] CHF correlation for high flow regime axial mass fluxes of $G \geq 1.0 \times 10^6 \frac{lb}{hr\text{-}ft^2}$. (Note: Includes a cold wall effect.)
	4	The Babcock & Wilcox B2M[C-23] CHF correlation for middle flow regime. (Note: Includes a cold wall effect.)
	5	The Babcock & Wilcox B6C[C-23] CHF correlation for high flow regime. (Note: Includes a cold wall effect.)
	6,7,8	Barnett[C-20] CHF correlation with rods represented as an equivalent annulus.
	9	Macbeth[C-24] bundle average CHF correlation at 1000 psia.
	10	Modified Barnett[C-21] CHF correlation with rods represented as an equivalent annulus.
	11	Bowring[C-25] round tube CHF correlation.

TABLE C-II (continued)

Flag	Option	Description
JCHF (continued)	12	GE[C-26] CHF correlations.
IHTDBG	0 (Default Value)	No printout occurs for debugging purposes.
	1	The values of variables for the heat transfer calculations are printed for debugging purposes.

$$\tilde{\rho} = \frac{\tilde{\rho}_\ell \tilde{\rho}_g}{x_e \tilde{\rho}_\ell + (1-x_e) \tilde{\rho}_g} \qquad \text{(C-1)}$$

Where x_e is the equilibrium quality defined as

$$x_e = \frac{\tilde{H} - \tilde{H}_\ell}{\tilde{H}_g - \tilde{H}_\ell} \qquad \text{(C-2)}$$

and the terms $\tilde{H}$, $\tilde{H}_\ell$, and $\tilde{H}_g$ are the mixture, liquid, and vapor enthalpies, respectively.

The second method of calculating the Two-phase frictional pressure loss can be selected by use of the input flag ITPRHO and the correlation flags ITPMLi and ITPMTi.

The void fraction α is defined by the general formulation for Two-phase flow

$$\alpha = \frac{x_f \tilde{\rho}_\ell}{\tilde{\rho}_g K_s + x_f(\tilde{\rho}_\ell - \tilde{\rho}_g K_s)} \qquad \text{(C-3)}$$

where x_f is flow quality and K_s is the ratio of the phase velocities; That is;

$$K_s = \tilde{u}_g/\tilde{u}_\ell \qquad \text{(C-4)}$$

and $\tilde{u}_g$ and $\tilde{u}_\ell$ are the average vapor and liquid velocities.

In the present version of SCORE-EVET, flow quality x_f is assumed equal to equilibrium quality x_e, and Equation (C-3) is used in the following form:

$$\alpha = \frac{x_e \tilde{\rho}_\ell}{\tilde{\rho}_g K_s + x_e(\tilde{\rho}_\ell - \tilde{\rho}_g K_s)} . \qquad \text{(C-5)}$$

In SCORE-EVET, 14 options are available for calculating void fraction. These options consist of a homogeneous model for which the phase velocities are equal and 13 nonhomogeneous models for which the void fraction is calculated using a correlation for void fraction, or using Equation (C-5) and a correlation for slip.

The flag IALFA selects the model desired. In the current version of SCORE-EVET, slip is calculated but is not used in the transport terms of the conservation equation. Void fraction is calculated to select heat transfer correlations, to use in two-phase friction mutipliers, and to calculate mixture viscosity used in friction factor correlations.

The following sections describe correlation options which can be selected for the friction factor, void fraction, two-phase friction factor multiplier, two-phase model options, and form loss factors.

1.1 Void Fraction Correlation Options

The following is a list of the void fraction options which may be selected by the code user.

IALFA = 1:

Selects the homogeneous, that is, equal phase velocity and equal phase temperature (EVET) model, where:

$$\alpha = \frac{x_e \tilde{\rho}_\ell}{x_e \tilde{\rho}_\ell + (1 - x_e) \tilde{\rho}_g} \qquad \text{(C-6)}$$

and

$$K_s = 1 \quad . \qquad \text{(C-7)}$$

IALFA = 2:

Selects a velocity slip ratio model that is a polynomial function of quality:

$$K_s = ASLP(1) + ASLP(2)\, x_e + ASLP(3)\, x_e^2 + \dots + ASLP(NASLP)\, x_e^{(NASLP-1)} \qquad (C\text{-}8)$$

where NASLP and the coefficients ASLP are input by the user (NASLP = number of ASLP coefficients, maximum = 4). The void fraction is calculated using the following form of Equation (C-5);

$$\alpha = \frac{x_e \tilde{\rho}_\ell}{\tilde{\rho}_g K_s + x_e(\tilde{\rho}_\ell - \tilde{\rho}_g K_s)} \qquad (C\text{-}9)$$

IALFA = 3:

Selects a user-input model for which the void fraction is a polynomial function of quality:

$$\alpha = AALF(1) + AALF(2)x_e + AALF(3)x_e^2 + \dots + AALF(NAALF)x_e^{(NAALF-1)} \qquad (C\text{-}10)$$

where NAALF and the coefficients AALF are input by the user (NAALF = number of AALF coefficients, maximum = 4).

The velocity slip ratio is calculated using Equation (C-5)

IALFA = 4:

Selects the Armand correlation[C-1] for which the void fraction is given by:

$$\alpha = \frac{x_e\, \tilde{\rho}_\ell (0.833 + 0.167\, x_e)}{\tilde{\rho}_g + x_e(\tilde{\rho}_\ell - \tilde{\rho}_g)} \qquad (C\text{-}11)$$

Equation (C-5) is used to calculate the slip ratio:

$$K_s = \frac{(\tilde{\rho}_\ell - \tilde{\rho}_g)x_e + \tilde{\rho}_g - x_e\,\tilde{\rho}_\ell(0.833 + 0.167x_e)}{\tilde{\rho}_g(0.833 + 0.167x_e)\,(1 - x_e)} \qquad \text{(C-12)}$$

IALFA = 5:

Selects an approximate Martinelli-Nelson-Lockhart correlation as given by Butterworth[C-2] for which the void fraction is given by:

$$\alpha = \left[1 + 0.28 \left(\frac{1 - x_e}{x_e}\right)^{0.639} \left(\frac{\tilde{\rho}_g}{\tilde{\rho}_\ell}\right)^{0.355} \left(\frac{\tilde{\mu}_g}{\tilde{\mu}_\ell}\right)^{0.071}\right]^{-1} \qquad \text{(C-13)}$$

The velocity slip ratio is calculated by substituting Equation (C-13) into Equation (C-5):

$$K_s = 0.28 \left(\frac{x_e}{1-x_e}\right)^{0.361} \left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g}\right)^{0.645} \left(\frac{\tilde{\mu}_\ell}{\tilde{\mu}_g}\right)^{0.071} \qquad \text{(C-14)}$$

IALFA = 6:

Selects the Madsen correlation[C-3] for which the void fraction is described as:

$$\alpha = \frac{1}{1 + \sqrt{\frac{\tilde{\rho}_g}{\tilde{\rho}_\ell}} \left(\frac{1 - x_e}{x_e}\right)^N} \qquad \text{(C-15)}$$

where

$$N = \frac{1/2\ \mathrm{Log}_{10}\left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g}\right) + 0.36385}{\mathrm{Log}_{10}\left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g}\right) + 0.36385} \quad \text{(C-16)}$$

The velocity slip ratio is:

$$K_s = \sqrt{\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g}} \left(\frac{1 - x_e}{x_e}\right)^M \quad \text{(C-17)}$$

where

$$M = \frac{1/2\ \mathrm{Log}_{10}\left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g}\right)}{\mathrm{Log}_{10}\left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g}\right) + 0.36385} \quad \text{(C-18)}$$

<u>IALFA = 7:</u>

Selects the Smith correlation[C-4] for which the void fraction is described as:

$$\alpha = \frac{1}{1 + \left\{0.4 + 0.6\left[\frac{x_e\tilde{\rho}_\ell + 0.4\,\tilde{\rho}_g(1 - x_e)}{x_e\tilde{\rho}_g + 0.4\tilde{\rho}_g(1 - x_e)}\right]^{1/2} \left(\frac{\tilde{\rho}_g}{\tilde{\rho}_\ell}\right)\left(\frac{1 - x_e}{x_e}\right)\right\}} \quad \text{(C-19)}$$

The velocity slip ratio is:

$$K_s = 0.4 + 0.6\left[\frac{x_e\,\tilde{\rho}_\ell + 0.4\,\tilde{\rho}_\ell(1 - x_e)}{x_e\,\tilde{\rho}_g + 0.4\,\tilde{\rho}_g\,(1 - x_e)}\right]^{1/2} \quad \text{(C-20)}$$

IALFA = 8:

Selects an approximate Thom correlation given by Butterworth[C-2] for which the void fraction is described as:

$$\alpha = \frac{1}{1 + \left(\frac{1 - x_e}{x_e}\right) \left(\frac{\tilde{\rho}_g}{\tilde{\rho}_\ell}\right)^{0.89} \left(\frac{\tilde{\mu}_\ell}{\tilde{\mu}_g}\right)^{0.18}} \quad . \qquad \text{(C-21)}$$

The velocity slip ratio is:

$$K_s = \left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g}\right)^{0.11} \left(\frac{\tilde{\mu}_\ell}{\tilde{\mu}_g}\right)^{0.18} \quad . \qquad \text{(C-22)}$$

IALFA = 9:

Selects the Zivi correlation[C-5] for which the void fraction is described by:

$$\alpha = \frac{1}{1 + \left(\frac{1 - x_e}{x_e}\right) \left(\frac{\tilde{\rho}_g}{\tilde{\rho}_\ell}\right)^{0.667}} \quad . \qquad \text{(C-23)}$$

The velocity slip ratio is:

$$K_s - \left(\frac{\tilde{\rho}_g}{\tilde{\rho}_\ell}\right)^{0.333} \quad . \qquad \text{(C-24)}$$

IALFA = 10:

Selects an approximate Baroczy correlation as given by Butterworth[C-2] for which the void fraction is:

$$\alpha = \frac{1}{1 + \left(\frac{1 - x_e}{x_e}\right)^{0.74} \left(\frac{\tilde{\rho}_g}{\tilde{\rho}_\ell}\right)^{0.65} \left(\frac{\tilde{\mu}_\ell}{\tilde{\mu}_g}\right)^{0.13}} \quad . \tag{C-25}$$

The velocity slip ratio is:

$$K_s = \left(\frac{x}{1 - x_e}\right)^{0.26} \left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g}\right)^{0.35} \left(\frac{\tilde{\mu}_\ell}{\tilde{\mu}_g}\right)^{0.13} \quad . \tag{C-26}$$

IALFA = 11:

Selects the Bankoff correlation[C-6] for which the void fraction is given as:

$$\alpha = \frac{x_e \, \tilde{\rho}_\ell \, (0.71 + 10^{-4} \, \tilde{p})}{x_e \, \rho_\ell + \rho_g \, (1 - x_e)} \quad . \tag{C-27}$$

The velocity slip ratio is:

$$K_s = \frac{(\tilde{\rho}_\ell - \tilde{\rho}_g) \, x_e + \tilde{\rho}_g - x_e \, \tilde{\rho}_\ell \, (0.71 + 10^{-4} \, \tilde{p})}{\tilde{\rho}_g (0.71 + 10^{-4} \tilde{p}) \quad (1 - x_e)} \quad . \tag{C-28}$$

IALFA = 12:

Selects the Turner-Wallis correlation as given by Butterworth[C-2] for which the void fraction is given as

$$\alpha = \frac{1}{1 + \left(\frac{1 - x_e}{x_e}\right)^{0.72} \left(\frac{\tilde{\rho}_g}{\tilde{\rho}_\ell}\right)^{0.40} \left(\frac{\tilde{\mu}_\ell}{\tilde{\mu}_g}\right)^{0.08}} \quad . \tag{C-29}$$

The velocity slip ratio is

$$K_s = \left(\frac{x_e}{1 - x_e}\right)^{0.28} \left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g}\right)^{0.60} \left(\frac{\tilde{\mu}_\ell}{\tilde{\mu}_g}\right)^{0.08} . \qquad \text{(C-30)}$$

IALFA = 13:

Selects the von Glahn-Polcyn correlation[C-7] for which the void fraction is

$$\alpha = \frac{1}{1 + (1.954 \times 10^{-6}) \left[(P + 5.8605 \times 10^4) \left(\frac{1 - x_e}{x_e}\right)\right]^{0.7}} \qquad \text{(C-31)}$$

where P is in SI units.

The velocity slip ratio is

$$K_s = \left(\frac{1 - x_e}{x_e}\right)^{0.30} \left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g}\right) (P + 5.8605 \times 10^4)^{0.7} (1.954 \quad 10^{-6}). \qquad \text{(C-32)}$$

The average mixture density is given by Equation (C-6).

IALFA = 14:

Selects the Bankoff-Jones correlation[C-8, C-9] for which the void fraction must be solved by iteration using quality and velocity slip ratio. The velocity slip ratio is:

$$K_s = \frac{(1 - \alpha)}{[0.71 + 0.29(P/P_c)] - \alpha + \left\{[1 - 0.71 - 0.29(P/P_c)] (\alpha)^{[(0.46 P + 0.18)P + 3.33]}\right\}}$$

$$\text{(C-33)}$$

where

P = pressure in psia

P_c = critical pressure in psia.

The void fraction is iterated using the nonequilibrium definition of mixture density:

$$\tilde{\rho} = \frac{\tilde{\rho}_\ell - \alpha\,(\tilde{\rho}_\ell - K_s\,\tilde{\rho}_g)}{(1-\alpha) + \alpha\,K_s} \quad . \tag{C-34}$$

First, the velocity slip ratio is set to one so that

$$\alpha = \frac{\tilde{\rho}_\ell - \tilde{\rho}}{\tilde{\rho}_\ell - \tilde{\rho}_g} \quad . \tag{C-35}$$

This α is substituted into Equation (C-33) to solve for K_s. A new mixture density is then estimated as:

$$\tilde{\rho}_n = \frac{\tilde{\rho}_\ell\,\tilde{\rho}_g\,[K_s - \chi_e(K_s - 1)]}{\tilde{\rho}_g\,K_s + \chi_e(\tilde{\rho}_\ell + \tilde{\rho}_g)}$$

Then K_s and $\tilde{\rho}_n$ are substituted into Equation (C-34), and α, K_s, and $\tilde{\rho}_n$ are solved for again. This is repeated until m-th solution results in

$$\left| \frac{\tilde{\rho}_{n+m-1} - \tilde{\rho}_{n+m}}{\tilde{\rho}_{n+m-1} + \tilde{\rho}_{n+m}} \right| \leq 10^{-6} \ .$$

1.2 Friction Factor Correlation Options

Existing literature[C-27, C-28] most often describes the Darcy friction factor for laminar flow by the formula

$$f_L = \frac{a_L}{Re} + b_L \tag{C-36}$$

where a_L is a constant coefficient, Re is the fluid Reynolds number, and b_L is a constant equivalent to a form loss coefficient. For pipes, the terms a_L and b_L are

$$a_L = 64.0$$

and (C-37)

$$b_L = 0.0 \ .$$

For turbulent flow, the Darcy friction factors are most often described by one of the following three models.

The first model for f_T is based on a model by Blasius[C-29] and is expressed as

$$f_T = a_{T1} \ Re^{b_{T1}} + c_{T1} \qquad \text{(C-38)}$$

where a_{T1} is a constant coefficient, Re is the fluid Reynolds number, b_{T1} is a constant exponent, and c_{T1} is a constant equivalent to a form loss coefficient. For smooth pipes the coefficients are:

$$a_{T1} = 0.3164$$

$$b_{T1} = -0.25 \qquad \text{(C-39)}$$

$$c_{T1} = 0.0$$

The second model for f_T is based on a formula derived by von Karman[C-28] for pipes with rough walls and is

$$\frac{1}{f_T} = a_{T2} \ \mathrm{Log}_{10} \left(\frac{D_{hy}}{2\xi_s} \right) + b_{T2} \qquad \text{(C-40)}$$

where a_{T2} and b_{T2} are constant coefficients, D_{hy} is the pipe hydraulic diameter, and ξ_s is the height of the pipe surface equivalents and roughness. For rough pipes, the coefficients are

$$a_{T2} = 2$$

and (C-41)

$$b_{T2} = 1.74.$$

The third model for f_T is that by Colebrook[C-29], which is based on Prandtl's concept of mixing length and the logarithmic fluid velocity distribution. Colebrook's formulation for pipes correlates the region from hydraulically smooth to completely rough pipes. The Colebrook equation is

$$\frac{1}{\sqrt{f_T}} = b_{T3} - 2.0 \, \text{Log}_{10} \left(\frac{2\xi_s}{D_{hy}} + \frac{a_{T3}}{\text{Re} \sqrt{f_T}} \right) \tag{C-42}$$

where a_{T3} and b_{T3} are constant coefficients, D_{hy} is the pipe hydraulic diameter, ξ_s is the height of the pipe surface equivalent sand roughness, and Re is the fluid Reynolds number. For pipes, the coefficients are

$$a_{T3} = 18.7$$

and (C-43)

$$b_{T3} = 1.74 \; .$$

Using the values for a_{T3} and b_{T3} given by Equations (C-43), Moody[C-29] converted the rough properties of commercially made pipes to surface equivalent sand roughness and plotted the friction factor versus Reynolds number for various values of $(2\xi_s/D_{hy})$. This set of curves is known as the Moody friction factor curves. For smooth surfaces ($\xi_s = 0$), Equation (C-42) reduces to:

$$\frac{1}{\sqrt{f_T}} = a_{T4} \, Log_{10}(Re \sqrt{f_T}) + b_{T4} \tag{C-44}$$

where a_{T4} and b_{T4} are constant coefficients and Re is the Reynolds number. For smooth pipes, the coefficients are

$$a_{T4} = 2.0 \tag{C-45}$$

and

$$b_{T4} = -0.8 \quad .$$

Using these coefficients, Equation (C-44) is known as Prandtl's universal law of friction for smooth pipes[C-29].

For geometries other than pipes, different values of the terms a_L, b_L, a_{T1}, b_{T1}, c_{T1}, a_{T2}, b_{T2}, a_{T3}, b_{T3}, a_{T4}, and b_{T4} are required. In addition, for other than pipe geometries, an equivalent hydraulic diameter is defined as

$$D_{hy} = \frac{4A_F}{P_W} \tag{C-46}$$

where A_F is the cross-sectional area of the fluid channel and P_W is the wetted perimeter of the channel.

In SCORE-EVET, a friction factor is calculated for each of the x-, y-, z-directions. The x-direction represents the axial direction, and the y- and z-directions represent the transverse directions through the core. For the transverse direction, a square array fuel rod arrangement is assumed. All of the friction factor models assume turbulent flow at Reynolds numbers greater than 4000. At Reynolds numbers less than or equal to 4000, the transition regime is smoothed by choosing the maximum of the laminar or turbulent friction factor.

Two options are available for choosing the velocity to be used in the Reynolds number. The options are specified by the input parameter IRECWS. The options are

IRECWS = 0: A Reynolds number is calculated for each of the x- y-, and z-directions based on the velocities in each of the x-, y-, and z-directions, respectively.

IRECWS = 1: Reynolds number is calculated using the magnitude of the resultant velocity vector. This Reynolds number is then used for the x, y, and z Reynolds number.

In SCORE-EVET, the friction factor is treated as if it were of two components. That is:

$$f = f_1 + f_2 \tag{C-47}$$

which is the same form as Equations (C-36) and (C-38), where f_1 is a function of Reynolds number and f_2 is a constant treated as a form coefficient. In the following discussions of axial and transverse friction factors, each of the friction factor models is developed in terms of the two-component friction factor given by Equation (C-47).

1.2.1 Axial Friction Factor Options. For the axial friction factor in each calculational cell, the Reynolds number is calculated for a single-phase fluid as

$$Re_x = \frac{\tilde{\rho} \left| \tilde{u}_i \right| D_{hy}}{\tilde{\mu}_n} \tag{C-48}$$

where n represents the single phase, either liquid (ℓ) or vapor (g). For two-phase fluid, a liquid reference Reynolds number is calculated by

$$Re_x = \frac{\tilde{\rho}_\ell \left| \frac{\widetilde{\rho u_i}}{\tilde{\rho}_\ell} \right| D_{hy}}{\tilde{\mu}} \tag{C-49}$$

The term $\tilde{\rho}$ is the mixture density, $\tilde{\rho}_\ell$ is the liquid density, $\tilde{u}_i$ is the velocity in the x-direction $\tilde{D}_{hy}$ is the cell hydraulic diameter, $\tilde{\mu}$ is the mixture viscosity, and μ_n is the viscosity of the liquid or vapor phase. For two-phase fluid, the value of $\tilde{\mu}$ depends on the two-phase model selected. In SCORE-EVET, there are six models available to calculate mixture viscosity. These models are selected by the option IREX, for the x component direction. The optional models are:

IREX = 1:
$$\tilde{\mu} = \tilde{\mu}_\ell \quad . \tag{C-50}$$

IREX = 2:
$$\frac{1}{\tilde{\mu}} = \frac{x_e}{\tilde{\mu}_g} + \frac{(1 - x_e)}{\tilde{\mu}_\ell} \quad . \tag{C-51}$$

IREX = 3:
$$\tilde{\mu} = x_e \tilde{\mu}_g + (1 - x_e)\tilde{\mu}_\ell \quad . \tag{C-52}$$

IREX = 4:
$$\frac{1}{\tilde{\mu}} = \frac{\alpha}{\tilde{\mu}_g} + \frac{(1 - \alpha)}{\tilde{\mu}_\ell} \quad . \tag{C-53}$$

IREX = 5:
$$\tilde{\mu} = \alpha \tilde{\mu}_g + (1 - \alpha) \tilde{\mu}_\ell \quad . \tag{C-54}$$

and IREX = 6:
$$\tilde{\mu} = \tilde{\mu}_g \quad . \tag{C-55}$$

All of the models for friction factor given by Equations (C-36) through (C-45) are included in SCORE-EVET and in addition a correlation developed by Lombardi-Pedrocchi[C-11] to calculate the pressure drop for single- and two-phase fluid flowing axially through rod bundles is included. The model to be used is selected by the input parameters IFXLAM and IFXTUB which designate the equation to use for laminar and turbulent flows respectively. For the axial laminar friction factor, Equation (C-36) is used with the constant coefficients of Equation (C-37). This is the only model for axial laminar friction factor and IFXLAM is automatically set to 1. However, provisions are made to include additional correlations if they become available.

For turbulent flow, the flag IFXTUB determines which one of the Equations (C-38) through (C-45) is to be used. The options available are:

IFXTUB = 1:

Selects Equation (C-38) as the axial friction factor model. The coefficients a_{T1}, c_{T1}, and the exponent b_{T1} are represented by input quantities C1TFX, C2TFX, and FREXPX, respectively. If C1TFX, C2TFX, and FREXPX are input as blank or zero, they default to the values given in Equation (C-39). The axial friction factor calculated is then

$$f_{XT1} = C1TFX + (Re)^{FREXPX} \quad \text{(C-56)}$$

$$f_{XT2} = C2TFX$$

where f_{XT2} is treated as a form loss coefficient within the cell.

IFXTUB = 2:

Selects Equation (C-40) as the axial friction factor model. The coefficients a_{T2} and b_{T2} are represented in the code by C1TFX and C2TFX, respectively. At present, no provision has been made to input these quantities, that is, they default to the values given in Equation (C-41). The roughness term, ξ_s, is a constant represented by the term ROUGH. If ROUGH is input as blank or zero, it will default to a value of 0.0008 metres which is equivalent to a commercially smooth pipe. The hydraulic diameter, D_{hy}, is assumed to be constant for each axial flow channel but may vary from channel to channel. Hence, the only variable is D_{hy}, and Equation (C-40) becomes

$$\frac{1}{\sqrt{f_T}} = a_{T2} \, Log_{10} \, D_{hy} + B_{T2} \quad \text{(C-57)}$$

where

$$B_{T2} = b_{T2} - a_{T2} \, Log_{10}(2 \text{ ROUGH}) \ . \quad \text{(C-58)}$$

In terms of the two-component friction factors:

$$f_{XT1} = f_T$$

and (C-59)

$$f_{XT2} = 0.$$

IFXTUB = 3:

Selects Equation (C-44) as the axial friction factor model. The coefficients a_{T1} and b_{T1} are constants represented in the code by C1TFX and C2TFX, respectively. No provisions have been made to input these quantities, so they default to the values given in Equation (C-45). The solution to Equation (C-44) for f_T is transcendental and is iteratively solved. In terms of the two-component friction factor:

$$f_{XT1} = f_T$$

and (C-60)

$$f_{XT2} = 0.$$

IFXTUB = 4:

Selects Colebrook's formula, Equation (C-42), as the axial friction factor model. The coefficients a_{T3} and b_{T3} are represented in the code by C1TFX and C2TFX. These quantities are set to the values given in Equations (C-43). The term ROUGH must be input. However, if ROUGH is input as blank or zero, it defaults to a value 0.0008 metres which is equivalent to a commercially smooth pipe.

In terms of the two-component friction factor, Equation (C-42) is represented by:

$$f_{XT1} = f_T$$

and (C-61)

$$f_{XT2} = 0.$$

IFXTUB = 5:

Selects the Lombardi and Pedrocchi correlation[C-11]. Lombardi and Pedrocchi have correlated the two-phase pressure gradient data directly without the use of single-phase friction factors and two-phase multipliers. The correlation, in SI units, is given as an expression for the friction pressure gradient directly, in the form:

$$- \left(\frac{dP}{dx}\right)_f = K_{LP} \left| G \right|^{n_{LP}} \frac{1}{(\tilde{\rho})^{0.86}} \frac{\sigma^{0.4}}{D_{hy}^{1.2}} \qquad \text{(C-62)}$$

where $\tilde{\rho}$ is the mixture density given by Equation (C-1). For rod arrays and annuli, the values 0.213 and 1.6 have been reported for the coefficients K_{LP} and n_{LP}, respectively.

An extensive amount of data has been used to determine these coefficients. Lombardi and Pedrocchi give the following ranges of conditions for the data:

Mass Flux, G_x	500 to 5000 $kg/m^2 \cdot s$
Equivalent diameter, D_{hy}	0.005 to 0.025 m
Channel length, L	0.1 to 4 m
Liquid-to-vapor density ratio, $\tilde{\rho}_\ell/\tilde{\rho}_g$	15 to 100
Surface tension, σ	20×10^{-3} to 80×10^{-3} N/m
Quality, x_e	0.10 to 0.98
Flow direction	vertical upward flow.

The liquid-to-vapor density ratio corresponds to a pressure range of 2 (10^6) N/m^2 (300 psia) to 9 (10^6) N/m^2 (1300 psia) for water. The correlation agrees well with the data on which it is based.

Using the definition of friction factor:

$$f_T = -\left(\frac{\partial P}{\partial x}\right)_f \left(\frac{2\ D_{hy}}{\tilde{\rho}\ |\tilde{u}_x|\ \tilde{u}_x}\right) \tag{C-63}$$

and the definition of mass flux then Equation (C-63) can be rewritten in friction factor form as

$$f_{XT1} = 2K_{LP}\tilde{\rho}^{(n_{LP} - 1.86)} \frac{|\tilde{u}_x|}{\tilde{u}_x}^{(n_{LP} - 1)} \frac{\sigma^{0.4}}{D_{hy}^{0.2}} \tag{C-64}$$

where f_{XT2} equals zero.

1.2.2 Transverse Friction Factor Options. For the transverse friction factor in each calculational cell, each of the transverse directions, y and z, are considered separately. For the transverse friction factor calculations, rod arrays of square pitch are assumed. The Reynolds number for each direction is based on the maximum transverse velocity through the rod array. For a single-phase fluid, the Reynolds numbers are calculated as

$$Re_y = \frac{\tilde{\rho}\ |v_{max}|}{\tilde{\mu}_n}\ D_{hy} \tag{C-65}$$

and

$$Re_z = \frac{\tilde{\rho}\ |w_{max}|}{\tilde{\mu}_n}\ D_{hy} \tag{C-66}$$

where n represents the single-phase, either liquid (ℓ) or vapor (g). For two-phase fluid, liquid reference Reynolds numbers are calculated as as

$$Re_y = \frac{\tilde{\rho}\,|v_{max}|}{\tilde{\mu}} D_{hy} \qquad \text{(C-67)}$$

and

$$Re_z = \frac{\tilde{\rho}\,|w_{max}|}{\tilde{\mu}} D_{hy} .$$

The term $\tilde{\rho}$ is the mixture density, $\tilde{\rho}_\ell$ is the liquid density, v_{max} and w_{max} are the maximum transverse component velocitiesr, D_{hy} is the cell hydraulic diameter, $\tilde{\mu}$ is the mixture viscosity, and $\tilde{\mu}_n$ is the viscosity of the liquid or vapor phase. For two-phase fluid, the value of $\tilde{\mu}$ depends on the two-phase model selected. These models are selected by setting the option IREY (for the y-direction) and IREZ (for the z-direction) to one of the six optional models as described by Equations (C-50) through (C-55) for IREX.

The terms v_{max} and w_{max} are the maximum transverse velocities in the y- and z-directions respectively, and are defined as:

$$v_{max} = \frac{v\varepsilon S_p}{(S_p - D_r)} \qquad \text{(C-68)}$$

and

$$w_{max} = \frac{w\varepsilon S_p}{(S_p - D_r)} \qquad \text{(C-69)}$$

where the term ε is the cell porsity (the ratio of cell fluid volume to cell volume), S_p is the rod spacing, and D_r is the rod diameter. Laminar and turbulent friction factor models can be specified independently for the transverse directions by the options IFYLAM and IFZLAM (for laminar friction) and IFYTUB and IFZTUB (for turbulent friction). The optional models are given in the following descriptions.

<u>IFYLAM and/or IFZLAM = 1:</u>

Selects a model of the form given by Equation (C-36), for a square pitch rod array with the coefficients a_L and b_L given by Bergelin et al[C-10]. The two component friction factors for the y- and z-directions are modeled by

$$f_{YL1} = \left[C1LFY \left(\frac{D_{hy}}{S_p}\right) \left(\frac{D_r}{S_p}\right)^{C2LFY} \right] \Big/ Re_y \qquad \text{(C-70)}$$

$$f_{YL2} = 0.0$$

$$f_{ZL1} = \left[C1LFZ \left(\frac{D_{hy}}{S_p}\right) \left(\frac{D_r}{S_p}\right)^{C2LFZ} \right] \Big/ Re_z \qquad \text{(C-71)}$$

$$f_{ZL2} = 0.0$$

where C1LFY and C1LFZ equal 280 and C2LFY and C2LFZ equal 1.6.

Reynolds numbers Re_y and Re_z are calculated with viscosity models selected by IREY and IREZ.

IFYLAM and/or IFZLAM = 2:

Selects the model of the form given by Equation (C-36) with the coefficients a_L and b_L given by Equation (C-37). Reynolds numbers Re_y and Re_z are calculated with the viscosity model selected by IREY and IREZ.

For turbulent flow, the input parameters IFYTUB and IFZTUB determine which one of the models given by Equations (C-38) through (C-45) is to be used.

IFYTUB and/or IFZTUB = 1:

Selects a model of the form given by Equation (C-38). The constants a_{T1}, b_{T1}, and c_{T1} are described by the input quantities C1TFY, C2TFY, and FREXPY, in the y-direction, and C1TFZ, C2TFZ, and FREXPZ, in the z-direction. However, if these constants are input as blank or zero, they will default to the values:

C1TFY, C2TFZ	=	0.3164
C2TFY, C2TFZ	=	0.
FREXPY, FREXPZ	=	-0.25.

The Reynolds numbers Re_y and Re_z are calculated with the viscosity model selected by IREY and IREZ.

IFYTUB and/or IFZTUB = 2:

Selects the model given by Equation (C-40) which is the same model described by IFXTUB equal to 2, except that the quantity $(D_{hy}/2\xi_s)$ is replaced by an equivalent crossflow roughness factor $(2S_p/D_r)$.

IFYTUB and/or IFZTUB = 3:

Selects the same model given by IFXTUB equal to 4, except that the quantity $(2\xi_s/D_{hy})$ is replaced by an equivalent crossflow roughness factor $(D_r/2S_p)$.

1.3 Two-phase Friction Multiplier Options

Under two-phase conditions, the frictional pressure drop F_i in SCORE-EVET is modeled in one of two ways: (a) by using liquid reference friction factor, liquid density, and a correlation for the two-phase multiplier; or (b) by using a mixture friction factor, and mixture density.

If the user elects to calculate the frictional pressure drop by use of the mixture friction factor (if friction factor is a function of Reynolds number), the friction factor is calculated by selection of one of the viscosity models, Equations (C-50) through (C-55), and mixture density, Equation (C-1). As will be shown, this option is selected by setting the two-phase multiplier flag equal to 5.

To use the correlated form of two-phase friction multiplier one of five correlation models can be selected. The liquid reference viscosity is specified automatically. Any of the axial or transverse friction factor models can be selected. However, if the axial friction factor model selected is the Lombardi-Pedrocchi correlation specified by IFXTUB = 5, then $\phi^2_{\ell o}$ is automatically set equal to one. Appropriate void fraction velocity slip ratio models are recommended in the following discussion.

The two-phase friction multiplier model can be independently selected for laminar and turbulent friction and for each of the axial and transverse directions. Selection of a model is done by specifying the correlation flags ITPMLX, ITPMLY, and ITPMLZ for laminar friction, and ITPMTX, ITPMTY, and ITPMTZ for turbulent friction in the x-, y- and z-directions, respectively. However, as will be discussed in Section 1.4, by specifying the two-phase model flag, ITPMOD, between 0 and 12, the two-phase multiplier correlation flags are automatically specified. If ITPMOD equals 13 then the user must specify the flags in the input data.

In the following description of two-phase multiplier options, the flag identifiers ITPMLi and ITPMTi will indicate that the option can be used for both laminar and turbulent flow in all three component directions except where specified.

ITPMLi and ITPMTi = 1:

Selects the Armand correlation[C-1] for which the two-phase friction multilplier is based on the void fraction and is given as:

for $\alpha \leq 0.1$.

$$\phi_{\ell o}^2 = \frac{1.73\,(1 - x_e)^2}{(1 - \alpha)^{1.64}} \tag{C-72}$$

for $0.1 < \alpha \leq 0.39$

$$\phi_{\ell o}^2 = \frac{0.478\,(1 - x_e)^2}{(1 - \alpha)^{2.2}} \tag{C-73}$$

for $0.39 < \alpha < 1.0$

$$\phi_{\ell o}^2 = \frac{(1 - x_e)^2}{(1 - \alpha)^{1.42}} . \tag{C-74}$$

The void fraction velocity slip ratio model corresponding to this two-phase friction multiplier correlation is that specified by IALFA = 4. If the user specifies the two-phase model flag ITPMOD equal to 8, ITPMLi, ITPMTi and IALFA are automatically set to the values 1, and 4, respectively. If the user specifies ITPMOD equal to 13, any of the nonhomogeneous void fraction velocity slip ratio models can be specified. However, the recommended alternatives to IALFA equal to 4 are, IALFA equals 2, 3, 6, 7, 8, 9, 11, 12, 13, or 14.

ITPMLi and ITPMTi = 2:

Selects a simple Martinelli, Nelson, and Lockhart correlation with a Chisholm low pressure model[C-12] where the two-phase friction multiplier is defined by:

$$\phi_{\ell o}^2 = (1 - x_e)^{1.75} \left\{ \left(\frac{X_{tt} + 1}{X_{tt}}\right)^{0.875} + \left(\frac{P - P_c}{P - P_a}\right) \left[\left(\frac{X_{tt} + 1}{X_{tt}}\right)^{0.875} - \left(1 + \frac{20.0}{X_{tt}} + \frac{1}{X_{tt}^2}\right)^{0.500} \right] \right\} \tag{C-75}$$

where

$$X_{tt} = \left(\frac{\tilde{\mu}_g}{\tilde{\mu}_\ell}\right)^{0.1} \sqrt{\frac{\tilde{\rho}_g}{\tilde{\rho}_\ell}} \left(\frac{1 - x_e}{x_e}\right)^{0.875} \qquad \text{(C-76)}$$

X_{tt} is the Martinelli-Lockhart parameter, P is the pressure, P_c is the critical pressure and P_a is the atmospheric pressure.

The void fraction velocity slip ratio model corresponding to this two-phase friction multiplier correlation is that specified by IAFLA = 5. If the user specifies the two-phase model flag ITPMOD equal to 9, ITPMLi, ITPMTi, and IALFA are automatically set to the values 2, and 5, respectively. If the user specifies ITPMOD equal to 13, any of the nonhomogeneous void fraction velocity slip ratio models can be specified. However, the recommended alternatives to IALFA equal to 5 are, IALFA equals 2, 3, 6, 7, 8, 9, 11, 12, 13, or 14.

ITPMLX, ITPMTX = 3:

Selects Beattie's system of correlations[C-13] for which the two-phase friction multiplier is based on the flow regime. In SCORE-EVET the flow regime is selected using a modified Bennet flow map[C-30] for vertical flow. The term IFR is used to flag the flow regime in the following manner:

if IFR = 1 the flow regime is single phase liquid
= 2 the flow regime is bubble flow
= 3 the flow regime is slug flow
= 4 the flow regime is froth flow
= 5 the flow regime is annular flow
= 6 the flow regime is single phase vapor
= 7 the flow regime is dispersed flow
= 8 the flow regime is reverse annular flow
= 9 the flow regime is stagnation (vertical)
= 10 the flow regime is separated flow (horizontal)

= 11 the flow regime is counter-current flow (liquid on wall)

= 12 the flow regime is counter-current flow (vapor on wall)

= 13 the flow regime is stagnation (horizontal).

The two-phase friction multiplier is:

for IFR = 1 or 6 (single-phase liquid or vapor, respectively):

$$\phi_{\ell o}^2 = 1.0 \qquad \text{(C-77)}$$

for IFR = 2 or 9:

$$\phi_{\ell o}^2 = \left[1 + x_e \left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g} - 1\right)\right]^{0.8} \left\{1 + x_e \left[\frac{\tilde{\rho}_\ell \,(3.5\tilde{\mu}_g + 2.0\,\tilde{\mu}_\ell)^{0.2}}{\tilde{\rho}_g\,(\tilde{\mu}_g + \tilde{\mu}_\ell)} - 1\right]\right\} \qquad \text{(C-78)}$$

for IFR = 3:

$$\phi_{\ell o}^2 = \left[1 + x_e \left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g} - 1\right)\right]^{0.8} \left[1 + x_e \left(3.5\,\frac{\tilde{\rho}_g}{\tilde{\rho}_\ell} - 1\right)\right]^{0.2} \qquad \text{(C-79)}$$

for IFR = 4 or 5:

$$\phi_{\ell o}^2 = \left[1 + x_e \left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g} - 1\right)\right]^{0.8} \left[1 + x_e \left(\frac{\tilde{\rho}_\ell\,\tilde{\mu}_g}{\tilde{\rho}_g\,\tilde{\mu}_\ell} - 1\right)\right]^{0.2} \qquad \text{(C-80)}$$

for IFR = 7:

$$\phi_{\ell o}^2 = \left(\frac{\tilde{\rho}_g}{\tilde{\rho}_\ell}\right)^{0.8} \left(\frac{\tilde{\mu}_g}{\tilde{\mu}_\ell}\right)^{0.2} \left[1 + x_e \left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g} - 1\right)\right]^{1.8} \qquad \text{(C-81)}$$

for IFR = 8:

$$\phi_{\ell o}^2 = \left[1 + x_e \left(\frac{\tilde{\rho}_g}{\tilde{\rho}_\ell} - 1\right)\right]^{0.8} \left[1 + x_e \left(\frac{\tilde{\rho}_g}{\tilde{\rho}_\ell\,\tilde{\mu}_g} - 1\right)\right]^{0.2} \qquad \text{(C-82)}$$

The void fraction velocity slip ratio model recommended for this two-phase friction multiplier correlation is that specified by IALFA = 7.

If the user specifies the two-phase model flag ITPMOD equal to 10, ITPMLi, ITPMTi, and IALFA are automatically set to the values 3 and 7, respectively.

If the user specifies ITPMOD equal to 13, any of the nonhomogeneous void fraction velocity slip ratio models can be specified. However, the recommended alternatives to IALFA equal to 7 are IALFA equals 2, 3, 6, 8, 9, 11, 12, 13, or 14.

ITPMLi and ITMPTi = 4:

Selects the Baroczy correlation[C-14] for which the two-phase friction multiplier $\phi_{\ell o}^2$ is interpolated from Baroczy's tables of two-phase multiplier versus pressure and mass flux.

The void fraction velocity slip ratio model corresponding to this two-phase friction multiplier correlation is that specified by IALFA equals 10.

If the user specifies the two-phase model flag ITPMOD equal to 11, ITPMLi, ITPMTi, and IALFA are automatically set to the values 4 and 10, respectively.

If the user specifies ITPMOD equal to 13 any of the nonhomogeneous void fraction velocity slip ratio models can be specified. However, the recommended alternatives to IALFA equals 10 are IALFA = 2, 3, 6, 7, 8, 9, 11, 12, 13, and 14.

ITPMLi and ITPMTi = 5:

When using this option, the two-phase friction factor f_w^i is calculated directly using either a homogeneous or nonhomogeneous definition for the mixture viscosity.

For homogeneous flow, the user should select the following void fraction, mixture viscosity, and friction factor options.

IALFA = 1
IREX, IREY and IREZ = 2 or 3
IFXLAM = 1
IFYLAM and IFZLAM = 1 or 2
IFXTUB = 1 through 4
IFYTUB and IFZTUB = 1, 2, or 3.

For nonhomogeneous flow, the user should select the following void fraction, mixture viscosity, and friction factor options.

IALFA = 2 through 14
IREX, IREY and IREZ = 4 or 5
IFXLAM = 1
IFYLAM and IFZLAM = 1 or 2
IFXTUB = 1 through 4
IFYTUB and IFZTUB = 1, 2, or 3.

<u>ITPMLi and ITPMTi = 6:</u>

Selects a constant two-phase friction multiplier for which the constants are input by the user as

$$\phi_{\ell o}^2 = \text{ATPMTi} \qquad \text{(C-83)}$$

for turbulent flow, or

$$\phi_{\ell o}^2 = \text{ATPMLi} \qquad \text{(C-84)}$$

for laminar flow.

The constants ATPMTi and ATPMLi (where i represents the component directions x, y, or z) are read in by additional card input (see Appendix A).

<u>ITPMLY, ITPMTY, ITPMLZ, and ITPMTZ = 7:</u>
(This option is not available for ITPMLX and ITPMTX.)

Selects the Grant-Murray correlation[C-15] for which the transverse two-phase friction multiplier is given as

$$\phi_{\ell o}^{2} = 1 + \left(\frac{\tilde{\mu}_g}{\tilde{\mu}_\ell}\right)^{-b_{T1}} \left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g}\right) \left\{ x_e + 0.15 \left[\sqrt{x_e} - x_e\right] \right\}^{4.0} \qquad \text{(C-85)}$$

for turbulent flow, and

$$\phi_{\ell o}^{2} = 1 + \left(\frac{\mu_g}{\mu_\ell}\right) \left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g}\right) \left\{ x_e + 0.15 \left[\sqrt{x_e} - x_e\right] \right\}^{4.0} \qquad \text{(C-86)}$$

for laminar flow, where

b_{T1} = FREXPX for IFYTUB = 1

b_{T1} = FREXPZ for IFZTUB = 1.

IFYTUB and IFZTUB must be specified as one.

1.4 Two-phase Model Option

The user does not have to select each individual friction factor, viscosity, or two-phase multiplier option. Fourteen two-phase model options can be selected by the input parameters ITPMOD. The first 13 models require only minimum input by the user. The last model option requires that the user specify all input quantities described in the preceding sections. The model options selected by ITPMOD and the correlation options are described in Table C-I. Table C-II defines the specific options selected by each of the models. Model options 0 and 1 select a homogeneous fluid model with preselected laminar and turbulent friction factors. The user need only specify the heat transfer options. Model options 2 and 3 are identical to Model options 0 and 1 respectively, except that the user can specify the friction factor form. Models 4 and 5 allow the user to specify a void fraction correlation by which two-phase friction multipliers are to be calculated. Models 6 and 7 are identical to Models 4 and 5, respectively, except that the user is allowed to specify the friction factor relationships. Models 8 through 12 use preselected consistent sets of void fraction, slip, and two-phase friction multipliers. Model 13 allows the user to specify all correlations needed to calculate friction factors, two phase multipliers and heat transfer. The user is cautioned that only Models 0 and 1 have been thoroughly checked out.

1.5 Form Loss Coefficients

As shown in Section 1.2, a friction factor of the form

$$f = f_1 + f_2 \qquad \text{(C-87)}$$

can be selected, where f_1 is a function of Reynolds number and f_2 is a constant. The constant f_2 can be treated as a form loss coefficient and can be used as such by user specification of the constants C2TFX, C2TFY, and C2TFZ. Additional input (XLoss(I) on Card 13) is available if the user wishes to specify an axial form loss coefficient independent of the friction factor. For the pressure drop desired, the user should calculate the loss factor by:

$$XLOSS(I) = \frac{2\Delta P}{\tilde{\rho}\ u^2} \qquad \text{(C-88)}$$

where ΔP is the pressure drop which the user desires to simulate.

The I index indicates that XLOSS is the loss coefficient at the interface of the I and I+1 cells, across the entire y-z plane. For instance, XLOSS(1) and XLOSS(IBR+1) represent inlet and outlet loss factors. If no losses are expected other than those of the bare rods, the form loss coefficients should be input as zero.

2. TURBULENT ENERGY AND MOMENTUM EXCHANGE

In the derivation of the volume-averaged equations[C-31], energy and momentum transport was identified with nonuniform fluctuating components of velocity (v') and internal energy (I'). The energy transport was described by

$$E_i = \frac{\partial}{\partial y_i} \left(\varepsilon \tilde{\rho}\, v_i' \, I' \right) \tag{C-89}$$

where ' indicates the fluctuating component of the quantity. This energy transport was treated as that due to turbulence in Reference C-32 and was described by a turbulent transport coefficient in the following manner:

$$\varepsilon \tilde{\rho} v_i' I' = \varepsilon \tilde{\rho} k_T \frac{\partial \tilde{I}}{\partial y_i} \tag{C-90}$$

where k_T is the turbulent thermal transport coefficient.

The contribution to momentum transport due to spatially nonuniform velocity fluctuations was identified as

$$M_i = \frac{\partial}{\partial y_k} \varepsilon \rho \, \widetilde{v_i v_k'} \, . \tag{C-91}$$

This term, which is analogous to Reynolds stress terms when time averaging is employed, was assumed to have the form of an additional stress which acts as an effective increase in the viscosity of the fluid. Therefore, the average of the product of the fluctuating terms v_i' and v_k' is written as

$$\varepsilon \rho v_i' v_k' = \varepsilon \left[-\frac{2}{3} \mu_T \frac{\partial \tilde{v}_s}{\partial y_s} \delta_{i,k} + \mu_T \left(\frac{\partial \tilde{v}_i}{\partial y_k} + \frac{\partial \tilde{v}_k}{\partial y_i} \right) \right] \tag{C-92}$$

where μ_T is the turbulent viscosity.

In SCORE-EVET, μ_T is described by Moyer's[C-32] model which relates turbulent viscosity to Reynolds number and friction factor in the following manner:

$$\frac{\mu_T}{\tilde{\mu}} = 0.05 \text{ Re} \sqrt{\frac{f_T}{2}} \qquad \text{(C-93)}$$

where $\tilde{\mu}$ is the fluid average viscosity. Using Reynolds analogy, the ratio of turbulent viscosity to turbulent thermal transport coefficient is assumed proportional to Prandtl number. The turbulent thermal transport coefficient is therefore described by

$$\frac{k_T}{k/\rho C_p} = 0.05 \text{ Re} \sqrt{\frac{f_T}{2}} \qquad \text{(C-94)}$$

where k is the molecular thermal conductivity of the fluid. In the present version of the code, the turbulent viscosity and thermal transport coefficients are assumed to be isotropic, that is, equal in magnitude in all three principal directions. The friction factor used is that for the axial direction.

3. FLUID-SOLID INTERFACIAL ENERGY EXCHANGE

As shown in Section III, the fluid-solid interfacial energy exchange is described by the quantity Q_w in the energy equation [Equation (3)]. In turn, Q_w is defined by the relationship of Equation (4):

$$Q_w = AWQ * h\ (T_s - \tilde{T}_b)$$

where AWQ is the ratio of heated surface area to total cell volume, h is the heat transfer coefficient, T_s is the surface temperature for the fuel rods, and $\tilde{T}_b$ is the average fluid temperature. In SCORE-EVET, h is described by a linked set of correlations similar to those in RELAP4[C-33].

The heat transfer correlations are linked together by defining heat transfer regimes as illustrated in Figure C-1. Each of the heat transfer regimes is designated by a heat transfer mode number. For example, heat transfer Mode 1 corresponds to the subcooled forced convection heat transfer regime of line A-B in Figure C-1.

Figure C-1 shows Regime A-B (labeled as subcooled forced convection, Mode 1) to be characterized by a coolant bulk temperature low enough so that boiling does not occur. If the surface temperature is less than saturation temperature, boiling is not possible and the Dittus-Boelter subcooled forced convection correlation[C-34] is used. Point B in Figure C-1 shows the beginning of the nucleate boiling regime. In some cases the coolant may still be subcooled, but the surface temperature may be high enough for some boiling to occur. When the surface temperature is greater than the saturation temperature, the regime on either side of point B is possible. For this condition, both the Dittus-Boelter correlation and the Thom correlation[C-35] are evaluated and the surface temperatures are calculated. The lower of the two surface temperatures is selected with the corresponding heat transfer mode number assigned.

Regime B-C in Figure C-1 is defined by two modes: nucleate boiling (Mode 2) and forced convection vaporization (Mode 3). If the void fraction, α, is less than 0.80, the Thom nucleate boiling correlation is used. For a void fraction above 0.90, the Schrock-Grossman forced convection vaporization correlation[C-36] is used. For void fractions between 0.80 and 0.90, an interpolation is performed, based on void fraction, between the correlation limits to provide a smooth transition from nucleate boiling (Mode 2) to forced convection vaporization (Mode 3). The Schrock-Grossman correlation is applied until the quality (x_e) reaches 0.950. At a quality above 0.999, the Dittus-Boelter correlation for single-phase forced convection to superheated steam (Mode 8) is used. For quality between 0.950 and 0.999, an interpolation is performed, based on quality, to smooth the transition from forced convection vaporization (Mode 3) to forced convection to superheated steam (Mode 8).

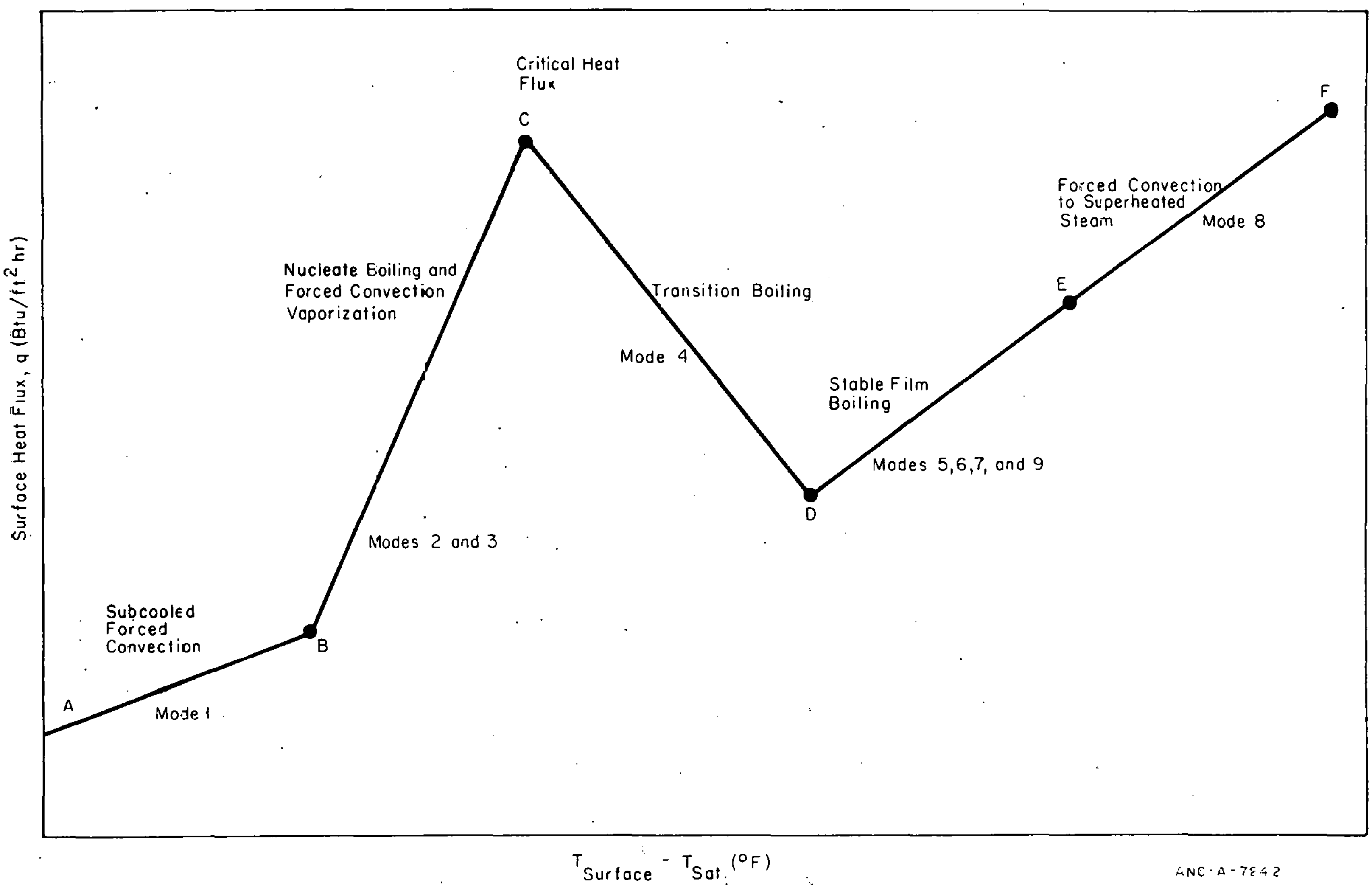

Fig. C-1 Heat transfer regimes.

The critical heat flux (CHF, shown as point C in Figure C-1) is evaluated at the fuel rod surface in each calculational cell for each time step. If the heat flux exceeds the calculated CHF, the correlations for the transition regime [Regime C-D of Figure C-1, (Mode 4)] and the stable film boiling regime [Regime D-E of Figure C-1, (Modes 5, 6, 7 or 9)] are evaluated.

The linked set of post-CHF correlations to be used is selected by specifying the parameter IFILMH in the input. The optional choices available are IFILMH equals 1, 2, 3, or 4. However, if IFILMH is input as blank or zero it will default to IFILMH equals 3. The post-CHF correlations are discussed in the following.

If IFILMH equals 1 or 2, the Groeneveld[C-17] 5.9 or 5.7 correlation, respectively, is selected for Mode 5. The McDonough, Milich, and King correlation[C-16] (Mode 4) and the selected Groeneveld correlation (Mode 5) are evaluated. If the pressure is less than 500 psia, the Dougall-Rohsenow correlation[C-18] (Mode 9) is also evaluated. The minimum heat flux calculated by the Groeneveld and Dougall-Rohsenow correlations is then chosen as the film boiling heat flux and compared to that calculated by the McDonough, Milich, and King correlation. The maximum of these two heat fluxes is selected and the selection giving the maximum heat flux determines the heat transfer mode. If the pressure is greater than 500 psia, the Dougall-Rohsenow correlation is not evaluated and the heat flux and heat transfer modes are determined by comparing the results of the selected Groeneveld correlation and the McDonough, Milich, and King correlation. These results determine the post-CHF heat flux and heat transfer mode if the mass flux is greater than or equal to 200,000 lbm/ft^2-hr (high flow condition). If the mass flux is less than 200,000 lbm/ft^2-hr (low flow condition) then either the modified Bromley correlation[C-33] (Mode 6) or the free-convection plus-radiation correlation[C-33] (Mode 7) are evaluated. If the void fraction is less than 0.6, then the modified Bromley correlation is used. If the void fraction is greater than or equal to 0.6, the free-convection-plus-radiation correlation is used. The resulting heat flux is then compared to that chosen from the results of the Groeneveld, the McDonough, and King, and the Dougall-Rohsenow correlations and the maximum chosen as the post-CHF heat flux and heat transfer mode.

If IFILMH equals 3, the McDonough, Milich, and King and the Dougall-Rohsenow correlations are evaluated, and the maximum heat flux and heat transfer mode are selected. If the high flow condition exists, these results are the post-CHF heat flux and heat transfer mode. If the low flow conditions exist, the selected heat flux is compared, as previously described, to the heat flux calculated by either the modified Bromley or the free convection and radiation correlations, and the maximum is chosen.

The Groeneveld and Dougall-Rohsenow correlations are not valid below a quality of 0.100. Both correlations underpredict experimental data at low qualities. The data in this range indicate a tendency to rewet the surface with resulting heat transfer coefficients which are much higher than film boiling. Therefore, for calculated qualities of less than 0.100 the Groeneveld and the Dougall-Rohsenow correlations are evaluated with quality fixed at a value of 0.100.

If IFILMH equals 4, the Condie-Bengsten correlation is evaluated and the heat transfer mode is set to 5. If the high flow conditions exist, these results are the post-CHF heat flux and heat transfer mode. If the low flow conditions exist, the selected heat flux is compared, as previously described, to the heat flux calculated by either the modified Bromley or the free convection and radiation correlations.

The pre-CHF, post-CHF, and CHF heat transfer correlations are presented next.

3.1 Pre-CHF Heat Transfer Correlations

The heat transfer correlations describing the pre-CHF regimes and the experimental conditions for which the correlations were developed are presented in the following.

Mode 1 - Forced Convection in Subcooled Liquid

Dittus and Boelter[C-34]

$$h = 0.023 \left(\frac{k_\ell}{D_{hy}}\right) (Pr_f)^{0.4} \left(\frac{\tilde{G}_x D_{hy}}{\tilde{\mu}_\ell}\right)^{0.8}, \text{ evaluated at } T_b. \qquad \text{(C-95)}$$

The data base is for turbulent flow of water in circular tubes and the following parametric ranges:

$L/D > 60$

$0.7 < Pr < 100$

$Re > 10^4.$

Mode 2 - Nucleate Boiling

Thom[C-35]

$$q'' = \left(\frac{\Delta T_{sat} e^{P/1260}}{0.072}\right)^2. \qquad \text{(C-96)}$$

The data base is for vertical upflow of water and the following parametric ranges:

Round tube: 0.5-in. diameter, 60-in. length

Annulus: 0.7-in. ID, 0.9-in. OD, 12-in. length

Pressure: 750 to 2000 psia

Mass Flux: 0.77×10^6 to 2.80×10^6 lbm/hr-ft^2

Heat flux: to 0.5×10^6 Btu/ft^2-hr.

Mode 3 - Forced Convection Vaporization

Schrock and Grossman[C-36]

$$h = (2.50)\ (0.023) \left(\frac{\overline{k}_\ell}{D_{hy}}\right) (Pr_\ell)^{0.4} \left[\frac{\tilde{G}_x D_{hy}\ \ (1-x_e)}{\tilde{\mu}_\ell}\right]^{0.8} \left(\frac{1}{X_{tt}}\right)^{0.75} \qquad \text{(C-97)}$$

evaluated at T_b, where

$$\frac{1}{X_{tt}} = \left(\frac{x_e}{1-x_\varepsilon}\right)^{0.9} \quad \left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g}\right)^{0.5} \quad \left(\frac{\tilde{\mu}_g}{\tilde{\mu}_\ell}\right)^{0.1} .$$

The data base is for water in round tubes and the following parametric ranges:

Diameter:	0.1162 to 0.4317 in.
Length:	15 to 40 in.
Pressure:	42 to 505 psia
Mass fluxes:	0.175×10^6 to 3.28×10^6 lbm/ft^2-hr
Heat flux:	0.06×10^6 to 1.45×10^6 Btu/ft^2-hr
Exit quality:	0.05 to 0.57.

3.2 Post-CHF Heat Transfer Correlations

The heat transfer correlations describing the post-CHF regimes and the experimental conditions are as follows.

Transition Boiling

If IFILMH equals 1, 2, or 3, the McDonough, Milich, and King[C-16] correlation (Mode 4) is evaluated, which is:

$$q'' = q''_{CHF} - h(T_w - T_{w,CHF}) \tag{C-98}$$

where h is dependent on pressure as follows:

P	h
2000	979.2
1200	1180.8
800	1501.2

The data base is for vertical upflow of water in round tubes and the following parametric ranges:

Diameter: 0.152 in.

Length: 12.5 in.

Mass flux: 0.2×10^6 to 1.4×10^6 lbm/ft^2-hr

Wall temperature: $T_w < 1030°F$

Pressure: 800, 1200, and 2000 psia.

Transition and Stable Film Boiling

If IFILMH equals 4, the Condie-Bengsten correlation is evaluated for either the transition or the stable film boiling regimes, and the mode is set equal to 5. The correlation is

$$h = 42011.23 \text{ Exp } [-0.5 \, (T_w - T_{sat})]$$

$$+ 659.91 \, \frac{k_g^{0.2007} \, Pr_w^{3.6155} \, Re_g^{[0.0483+0.7441 Log_e(x_e+1)]}}{\tilde{D}_{hy}^{0.2771} \quad (x_e+1)^{10.8450}} \tag{C-99}$$

$$- 16.04 \text{ Exp } (Pr_w \quad P/1000)$$

where

Pr_w = Prandtl number for vapor at the fuel rod surface temperature and coolant pressure

Re_g = Reynolds number for the vapor at the mixture temperature and pressure.

The parametric ranges are as follows:

Quality: 0.01 to 1.00

Pressure: 200 to 3115 psia

Mass Flux: 0.05×10^6 to 4.0×10^6 lbm/hr-ft^2

ΔT: 2 to 1000°F

T_w: 500 to 1800°F .

RMS Error = 36%

Stable Film Boiling

If IFILMH equals 1 or 2, the Groeneveld[C-17] correlation (Mode 5) is evaluated. The Groeneveld equation is

$$h = a \left(\frac{k_g}{D_{hy}}\right) Pr_w^c \left\{ Re_g \left[x_\varepsilon + \frac{\tilde{\rho}_g}{\tilde{\rho}_\ell} (1-x_e)\right]\right\}^b Y^d \qquad \text{(C-100)}$$

where

$$Y = 1.0 - 0.1 \left[(1-\tilde{x}_e)\left(\frac{\tilde{\rho}_\ell}{\tilde{\rho}_g} - 1\right)\right]^{0.4}$$ or 0.1, whichever is greater

and where

Pr_w = Prandtl number for vapor at the fuel rod surface temperature and coolant pressure

Re_g = Reynolds number for the vapor at the coolant temperature and pressure.

If IFILMH is equal to 0, the Groeneveld 5.9 version of Equation (C-100) is selected, for which

$$a = 3.270 \times 10^{-3}$$

$$b = 0.901$$

$$c = 1.320$$

$$d = -1.500.$$

If IFILMH is equal to 1, the Groeneveld 5.7 version of Equation (C-100) is selected, for which

$$a = 5.200 \times 10^{-2}$$

$$b = 0.688$$

$$c = 1.260$$

$$d = 1.060.$$

Both k_g and μ_g are evaluated at T_b, and Pr is evaluated at T_w.

The data base is for vertical and horizontal flow of water in round tubes and annuli and the following parametric ranges:

Diameter: 0.06 to 1.00 in.

Pressure: 500 to 3100 psia

Mass flux: 0.2×10^6 to 3.0×10^6 lbm/hr-ft^2

Quality: 10 to 90%

Heat flux: 35,000 to 700,000 Btu/ft^2-hr

Laminar Pool Film Boiling

The modified Bromley[C-33] correlation (Mode 6) is evaluated if

$$|\tilde{G}_x| \leqq 0.2 \times 10^6 \text{ lbm/hr-ft}^2, \ \alpha < 0.6.$$

The correlation is

$$h = 0.62 \left[\frac{k_g H_{fg} \tilde{\rho}_g g (\tilde{\rho}_\ell - \rho_g)}{\tilde{\mu}_g \Delta T L} \right] \qquad \text{(C-101)}$$

where

$$L = 2\pi \quad \frac{gc\sigma}{g(\tilde{\rho}_\ell - \tilde{\rho}_g)}$$

g = acceleration of gravity (32.174 ft/sec^2)

gc = gravitational constant (32.174 lbm-ft/lbf-sec^2).

Free Convection Plus Radiation[C-33]

The free convection and radiation correlation (Mode 7) is evaluated if

$$|\tilde{G}_x| \leqq 0.2 \times 10^6 \text{ lbm/hr-ft}^2$$

and $\alpha \geqq 0.6$.

The correlation is

$$h = h_c + h_r \tag{C-102}$$

where

$$h_c = 0.4\ (Gr + Pr_F)^{0.2} \tag{C-103}$$

$$Pr_F = \frac{\tilde{C}_{pF}\tilde{\mu}_F}{\tilde{k}_F}$$

and where F indicates the properties are evaluated at the film temperature

$$T_F = \frac{1}{2}\ (T_w + T_{sat}) \tag{C-104}$$

and where

$$Gr = \frac{L^3 g\beta_g \Delta T \tilde{\rho}_g^{\ 2}}{\tilde{\mu}_g^{\ 2}}$$

$$L = \frac{D_{hy}}{2}$$

$$h_r = 0.23\ \frac{S(T_w^4 - T_{sat}^4)}{\Delta T} \tag{C-105}$$

where T_w, T_{sat} are in °R, S is the Stephan-Boltzman constant, and β_g is the coefficient of thermal expansion for the vapor.

Forced Convection To Superheated Vapor

The Dittus and Boelter[C-37] correlation (Mode 8) is

$$h = 0.023\ \left(\frac{k_g}{D_{hy}}\right)\ (Pr_g)^{0.4}\ \left(\frac{G_x D_{hy}}{\tilde{\mu}_g}\right)^{0.8} \tag{C-106}$$

evaluated at T_b.

The data base is for turbulent flow of steam in circular tubes[C-38], and the following parametric ranges:

Length:	36 in.
Diameter:	0.5 in.
L/D:	> 26
Pressure:	25 to 75 psia
Inlet temperature:	300 to 1100°F
Wall temperature:	to 1800°F
Heat flux:	2400 to 31,000 Btu/ft^2-hr

Low Pressure Flow Film Boiling

The Dougall and Rohsenow[C-18] correlation (Mode 9) is evaluated when IFILMH = 1, 2, or 3 and is given by

$$h = 0.023 \left(\frac{k_g}{D_{hy}}\right) (Pr_g)^{0.4} \left[\left(\frac{\tilde{G}_x D_{hy}}{\tilde{\mu}_g}\right)\left(x_e + \frac{\rho_g}{\rho_\ell} (1 - x_e)\right)\right]^{0.8} . \tag{C-107}$$

The data base is for vertical upflow of freon-113 in round tubes and the following parametric ranges:

Diameter:	0.408 and 0.108 in.
Length:	15 in.
Pressure:	2 to 9 psig
Mass flux:	3.32 x 10^5 to 8.18 x 10^5 lbm/ft^2-hr

Heat flux: 14,400 to 41,800 Btu/ft^2-hr

Quality: up to 50%

The equation is approximated in the coding by

$$h = 0.023 \left(\frac{k_g}{D_{hy}}\right) (Pr_g)^{0.4} \left[\left(\frac{\tilde{G}_x D_{hy}}{\tilde{\mu}_g}\right) \left(x_e + \frac{\tilde{\rho}_g}{\tilde{\rho}_f} (1-x_e)\right)\right]^{0.8} . \quad \text{(C-108)}$$

3.3. Critical Heat Flux Correlations

Fourteen options are available for selecting CHF correlations. The options are selected by specifying the correlation flag JCHF in the input data. If JCHF is blank or zero, a value of JCHF equal to 0 is automatically specified.

The inlet enthalphy is used in some of the CHF correlations and it is dependent on the flow direction. The inlet enthalpy, H_{in}, is determined in the following manner:

Flow at Major Inlet	Flow at Major Outlet	H_{in}
≥ 0	≥ 0	H at normal inlet
≤ 0	<0	H at normal outlet
All other cases		H of core volume.

For the correlations, if the term $H_f - H_{in}$ is negative, it is set to 0.

A summary of the CHF correlations and the JCHF options are as follows.

JCHF = 0:

Selects a linked set of three CHF correlations which cover the full range of pressure[C-33] encountered during a PWR LOCA. The correlations are linked based on the coolant pressure. If the coolant pressure is within the range of validity for a correlation, then that correlation is used to calculate CHF. If the coolant pressure is between the ranges of validity for two of the correlations an interpolation based on pressure is performed to calculate CHF. The three CHF correlations are the B&W-2[C-19], the Barnett[C-20], and the Modified Barnett[C-21] as described for JCHF equal to 2, 7, and 10, respectively. The correlation selection is based on the following pressure ranges:

$P \geq 1500$ psia	B&W-2
$1500 > P > 1300$ psia	Interpolation between B&W-2 and Barnett
$1300 \geq P \geq 1000$ psia	Barnett
$1000 > P > 725$ psia	Interpolation between Barnett and Modified Barnett
$725 \geq P$	Modified Barnett

For a pressure between 725 and 1000 lb/in.^{2} or between 1300 and 1500 lb/in.^{2}, the two relevant correlations are evaluated at that pressure and the corresponding enthalpy, H_f. The two flux values are then weighted to give

$$q''_{CHF} = \frac{(P_{up} - P)\, q_{CHF_{down}} + (P - P_{down})\, q_{CHF_{up}}}{P_{up} - P_{down}} \qquad (C\text{-}109)$$

where P = pressure, and down and up represent the low and high ends of the interpolation range, respectively. A minimum CHF of 90,000 Btu/ft^2-hr is set if the predicted value falls below this number.

If the axial mass flux, $\tilde{G}_x$, is less than 200,000 lbm/ft^2-hr, CHF is interpolated, based on $\tilde{G}_x$, between the minimum CHF and the calculated CHF, and the greater value of the minimum CHF or the interpolated CHF is chosen.

JCHF = 1:

Selects the W3 correlation[C-22] given by

$$\frac{q''_{CHF}}{10^6} = F_{cw}\Bigg\{(2.022 - 0.4302 \times 10^{3}P) + (0.1722 - 0.0984 \times 10^{-3}P)$$

$$\mathrm{Exp}\left[x_{CHF}(18.177 - 4.129 \times 10^{-3}P)\right] \left[1.157 - 0.869\ x_{CHF}\right] \Bigg[\Big(0.1484$$

$$+ 0.1729 x_{CHF}|x_{CHF}| - 1.596 x_{CHF}\Big)\frac{\tilde{G}_x}{10^6} + 1.037\Bigg]\Bigg[0.2664$$

$$+ 0.8357\ \mathrm{Exp}(-3.151\ D_{he})\Bigg] \left[0.8258 + 7.940 \times 10^{-4}(H_f - H_{in})\right]\Bigg\} \qquad \text{(C-110)}$$

where the cold wall factor, F_{cw} is:

$$F_{cw} = 1 - \left(1 - \frac{D_{hy}}{D_{he}}\right)\Bigg[13.76 - 1.372\ \mathrm{Exp}\left(1.78\ x_{CHF}\right)$$

$$- 4.732\left(\frac{|\tilde{G}_x|}{10^6}\right)^{-5.35 \times 10^{-2}} - 6.19 \times 10^2 \left(\frac{P}{1000}\right)^{0.14}$$

$$- 8.509\ D_{hy}^{0.107}\Bigg] \qquad \text{(C-111)}$$

where

$$x_{CHF} = \frac{H - H_f}{H_{fg}}$$

P = pressure (lbf/in.^{2})

$\tilde{G}_x$ = axial mass flux (lbm/hr-ft^2)

D_{he} = heated equivalent diameter ($4A_F$/heated perimeter) (in.)

H_{in} = inlet enthalpy (Btu/lbm)

H_f = saturated liquid enthalpy (Btu/lbm)

D_{hy} = hydraulic diameter ($4A_F$/wetted perimeter) (in.)

The correlation is reported to be valid over the following ranges:

$1000 \leq p \leq 2300$ psia

$0.2 \leq D_{hy} \leq 0.7$ in.

$-0.25 \leq x_{CHF} \leq 0.15$

$10.0 \leq L \leq 144.0$ in.

$10^6 \leq \tilde{G}_x \leq 5 \times 10^6$ lbm/hr-ft^2.

JCHF = 2:

Selects the B&W-2 CHF correlation[C-19] given by

$$\frac{q''_{CHF}}{10^6} = \left(1.15509 - 0.40703 D_{hy}\right)\left[\left(0.3702 \times 10^8 |\tilde{G}_x|\right)^{\left\{0.8304 + 0.68479 \frac{(P-2000)}{1000}\right\}} - 0.15208 |G_x| \, x_{CHF} \, H_{fg}\right] \Big/ \left(0.30545 \times 10^{-5} \, |\tilde{G}_x|\right)^{\left\{0.7486 + 0.20729 (P-2000)\right\}} \qquad \text{(C-112)}$$

where D_{hy} = hydraulic diameter ($4A_F$/wetted perimeter) (in.)

$\tilde{G}_x$ = mass flux (lbm/hr-ft^2)

P = pressure (lbm/in.^{2})

$$x_{CHF} = \frac{H - H_f}{H_{fg}} \quad .$$

The correlation does not include a cold wall factor and is reported to be valid over the following range of conditions:

Equivalent diameter:	0.2 to 0.5 in.
Length:	72 in.
Pressure:	2,000 to 2,400 psia
Mass flux:	0.75×10^6 to 4.0×10^6 lbm/ft^2-hr
Burnout quality:	-0.03 to 0.20.

JCHF - 3:

Selects the Babcock & Wilcox high flow regime B2 CHF correlation [C-23] given by

$$\frac{q''_{CHF}}{10^6} = \frac{14.3 \left(|\tilde{G}_z|/0.867 \times 10^6\right)^{\left[1.09+0.417\frac{(P-2000)}{1000}\right]} + 0.133 \left|\frac{\tilde{G}_x}{10^6}\right| (H_f - H_{in})}{7.4 \left(|\tilde{G}_x|/0.268 \times 10^6\right)^{\left[0.828 + 0.393\frac{(P-2000)}{1000}\right]} + 0.133 \frac{4L}{D_{hy}}} \qquad \text{(C-113)}$$

where $\tilde{G}_x$ = mass flux (lbm/hr-ft^2)

P = pressure (lbf/in.^{2})

H_f = saturated liquid enthalphy (Btu/lbm)

H_{in} = inlet enthalpy (Btu/lbm)

L = test section length (in.)

D_{he} = heated equivalent diameter ($4A_F$/heated perimeter) (in.)

The correlation is reported to be valid over the same region as the B&W-2 correlation.

JCHF = 4:

Selects the Babcock & Wilcox middle flow regime B2M CHF correlation[C-23] given by

$$\frac{q''_{CHF}}{10^6} = \frac{0.8284\left|\frac{\tilde{G}_x}{10^6}\right|^{-0.2261}\left[1.5353 - \mathrm{Exp}\left(\frac{1.178P-3005.3}{1000}\right)\right]}{1 + \left[2.6028 - \mathrm{Exp}\left(\frac{1.084P-7252.0}{1000}\right)\right]\frac{4L}{\left(\left|\frac{\tilde{G}_x}{10^6}\right| D_{he} H_{fg}\right)}}$$

$$+ \frac{2.6028 - \mathrm{Exp}\left(\frac{1.084P-2572.0}{1000}\right)\frac{H_f - H_{in}}{H_{fg}}}{1 + \left[2.6028 - \mathrm{Exp}\left(\frac{1.084P-7252.0}{1000}\right)\right]\frac{4L}{\left(\left|\frac{\tilde{G}_x}{10^6}\right| D_{he} H_{fg}\right)}} \qquad \text{(C-114)}$$

where $\tilde{G}_x$ = mass flux (lbm/hr-ft^2)

P = pressure (lbf/in.^{2})

H_f = saturated liquid enthalpy (Btu/lbm)

H_{in} = inlet enthalpy (Btu/lbm)

H_{fg} = heat of vaporization (Btu/lbm)

L = length of the test section (in.)

D_{he} = heated equivalent diameter ($4A_F$/heated perimeter) (in.).

The correlation is reported to be valid over the following ranges:

P (psia)	$G/10^6$ (lbm/ft^2-hr)	$\Delta H_{in} = H_f - H_{in}$ (Btu/lbm)
2400	$0.404 \leq G/10^6 \leq 0.845$	$36.8 \leq \Delta H_{in} \leq 305.2$
2200	$0.293 \leq G/10^6 \leq 1.096$	$24.5 \leq \Delta H_{in} \leq 317.1$
2000	$0.513 \leq G/10^6 \leq 1.014$	$45.1 \leq \Delta H_{in} \leq 285.5$
1500	$0.473 \leq G/10^6 \leq 2.023$	$15.4 \leq \Delta H_{in} \leq 284.0.$

JCHF = 5:

Selects the Babcock & Wilcox high flow regime B6C CHF correlation[C-23] given by

$$\frac{q''_{CHF}}{10^6} = \frac{13.85 \left|\frac{\tilde{G}_x}{10^6}\right|^{\left[0.33 \frac{P-2000}{1000}\right]} + 0.1086 \left|\frac{\tilde{G}_x}{10^6}\right| (H_f - H_{in})}{7.246 \left|\frac{G_x}{10^6}\right|^{\left[0.8212 + 0.36 \frac{P-2000}{1000}\right]} + 0.1086 \left(\frac{4L}{D_{he}}\right)} \quad \text{(C-115)}$$

where $\tilde{G}_x$ = mass flux (lbm/ft^2-hr)

P = pressure (lbf/in.^{2})

H_f = saturated liquid enthalpy (Btu/lbm)

H_{in} = inlet enthalpy (Btu/lbm)

L = test section length (in.)

D_{he} = heated equivalent diameter ($4A_F$/heated perimeter) (in.).

The correlation is reported to be valid over the same ranges as those for the B&W-2 correlation.

JCHF = 6, 7, 8:

Select the Barnett CHF correlation[C-20] for all rods in the cell at equal power. This correlation is given by

$$\frac{q''_{CHF}}{10^6} = \frac{67.45 \; D_{heBr}^{0.68} \left|\frac{\tilde{G}_x}{10^6}\right|^{0.192} \left[1-0.744 \; \mathrm{Exp}\left(-6.512 D_{hyBr}\left|\frac{\tilde{G}_x}{10^6}\right|\right)\right] \frac{H_{fg}}{H_{fg}(p=1000)}}{185.0 \; D_{hyBr}^{1.415} \left|\frac{\tilde{G}_x}{10^6}\right|^{0.212} + L}$$

$$+ \frac{0.2587 \; D_{heBr}^{1.261} \left|\frac{\tilde{G}_x}{10^6}\right|^{0.817} (H_f - H_{in})}{185.0 \; D_{hyBr}^{1.415} \left|\frac{\tilde{G}_x}{10^6}\right|^{0.212} + L} \qquad \text{(C-116)}$$

where $D_{heBr} = (D_0^2 - D_r^2)/D_r$

$D_{hyBr} = D_0 - D_r$

$D_0 = D_r(D_r + D_{he})$

D_r = rod diameter (in.)

D_{he} = heated equivalent diameter ($4A_F$/heated perimeter) (in.)

$\tilde{G}_x$ = mass flux (lbm/hr-ft^2)

H_{fg} = heat of vaporization (Btu/lbm)

H_f = saturated liquid enthalpy (Btu/lbm)

H_{in} = inlet enthalpy

L = test section length.

The correlation is reported to be valid over the following ranges:

Equivalent diameters:	$0.258 \text{ in.} < D_{he} < 3.792 \text{ in.}$
	$0.127 \text{ in.} < D_{hy} < 0.875 \text{ in.}$
Length:	24 to 180 in.
Pressure:	1000 psi
Mass flux:	0.14×10^6 to $6.20 \times$ lbm/ft^2-hr
Inlet subcooling:	0 to 412 Btu/lbm.

<u>JCHF = 9</u>:

Selects the Macbeth[C-24] bundle average CHF correlation given by

$$\frac{q''_{CHF}}{10^6} = \frac{67.6 \ D_{he}^{0.83} \left|\frac{\tilde{G}_x}{10^6}\right|^{0.57} + 0.25 \ D_{he} \left|\frac{\tilde{G}_x}{10^6}\right| (H_f - H_{in})}{47.3 \ D_{he}^{0.57} \left|\frac{\tilde{G}_x}{10^6}\right|^{0.27} + L} \tag{C-117}$$

where q''_{CHF} = Btu/hr-ft^2

D_{he} = heated equivalent diameter ($4A_F$ / heated perimeter) (in.)

$\tilde{G}_x$ = mass flux (lbm/hr-ft^2)

H_f = saturated liquid enthalpy (Btu/lbm)

H_{in} = inlet enthalpy (Btu/lbm)

L = test section length (in.).

The correlation is reported to be valid over the following ranges:

$P = 1000$ psia

$0.5 \leq \tilde{G}/10^6 \leq 4.0$ lbm/hr-ft^2

$0.113 \leq D_{he} \leq 0.902$ in.

$0.079 \leq D_{hy} \leq 0.543$ in.

$18.0 \leq L \leq 76.0$ in.

<u>JCHF = 10</u>:

Selects the Modified Barnett[C-21] CHF correlation given by

$$\frac{q''_{CHF}}{10^6} = \left\{ \frac{73.21\ D_{heBr}^{0.0523} \left|\frac{\tilde{G}_x}{10^6}\right|^{0.663} + \left[1 - 0.315\ \mathrm{Exp}\left(-11.34 D_{hyBr} \left|\frac{\tilde{G}_x}{10^6}\right|\right)\right]}{45.55\ D_{hyBr}^{0.0817} \left|\frac{\tilde{G}_x}{10^6}\right|^{0.587} + L} \right\}$$

$$\frac{H_{fg}\ (P{=}100)}{H_{fg}} + \frac{0.104 D_{heBr}^{1.445} \left|\frac{\tilde{G}_x}{10^6}\right|^{0.691} (H_f - H_{in})}{45.55\ D_{hyBr}^{0.0817} \left|\frac{\tilde{G}_x}{10^6}\right|^{0.586} + L} \qquad \text{(C-118)}$$

where q''_{CHF} = Btu/ft^2-hr

D_{heBr} = $(D_0^2 - D_r^2)/D_r$

D_{hyBr} = $D_0 - D_r$

D_0 = $D_r(D_r + D_{he})$

D_r = fuel rod diameter

G mass flux (lbm/ft^2-hr)

H_{fg} = heat of vaporization (Btu/lbm)

H_f = saturated liquid enthalpy (Btu/lbm)

H_{in} = inlet enthalpy (Btu/lbm)

L = test section length (in.).

The correlation is reported to be valid over the following ranges:

Rod diameter: 0.395 to 0.543 in.

Length:	32.9 to 174.8 in.
Pressure:	150 to 725 psia
Mass Flux:	0.03×10^6 to 1.7×10^6 lbm/ft^2-hr
Inlet subcooling:	6 to 373 Btu/lbm.

JCHF = 1:

Selects the Bowring[C-25] round tube CHF correlation given by

$$q''_{CHF} = \frac{\dfrac{2.317\left(0.25\left|\dfrac{\tilde{G}_x}{10^6}\right| D_{he}\right) H_{fg} F_1}{1 + 3.092\left|\dfrac{\tilde{G}_x}{10^6}\right| F_a \quad D_{he}} + 0.25\left|\dfrac{\tilde{G}_x}{10^6}\right| D_{he} \left(H_f - H_{in}\right)}{\dfrac{417.6 \; 0.25\left|\dfrac{\tilde{G}_x}{10^6}\right| D_{he} F_3}{1 + 0.347\left|\dfrac{\tilde{G}_x}{10^6}\right| \dfrac{(2-Pr)}{2} \quad F_4} + L} \tag{C-119}$$

where $Pr = P/1000$

P = pressure (lbf/in^2)

and if $Pr = 1$

$F_1 = 1$

$F_2 = 1$

$F_3 = 1$

$F_4 = 1$

if Pr < 1

$$F_1 = \{Pr^{18.942} \exp[20.89(1 - Pr)] + 0.917\}/(1.917)$$

$$F_2 = F_1(1 + 0.309)/\{Pr^{1.316} \exp[2.444(1 - Pr)] + 0.309\}$$

$$F_3 = \{Pr^{17.023} \exp[16.658(1 - Pr)] + 0.667\}/(1.667)$$

$$F_4 = F_3 \, Pr^{1.649}$$

if Pr > 1

$$F_1 = Pr^{-0.368} \exp[0.648(1 - Pr)]$$

$$F_2 = F_1/\{Pr^{-0.448} \exp[0.245(1 - Pr)]\}$$

$$F_3 = Pr^{0.219}$$

$$F_4 = F_3 \, Pr^{1.649}$$

and where

q''_{CHF} = Btu/hr-ft^2

$\tilde{G}$ = mass flux (lbm/hr ft^2)

D_{he} = heated equivalent diameter ($4A_f$/heated perimeter) (in.)

H_f = saturated liquid enthalpy (Btu/lbm)

H_{in} = inlet enthalpy (Btu/lbm)

L = test section length (in.).

The correlation is reported to be valid over the following ranges:

$$34.0 \leq P \leq 2750 \text{ psia}$$
$$0.08 \leq D_{he} \leq 1.76 \text{ in.}$$
$$6.0 \leq L \leq 144.0 \text{ in.}$$
$$0.1 \leq \tilde{G}_x/10^6 \leq 13.7 \text{ lbm/hr-ft}^2$$

<u>JCHF = 13</u>:

Selects the GE transient[C-26] CHF correlation given by

$$\frac{q''_{CHF}}{10^6} = 0.84\, x_{CHF} \qquad \text{(C-120)}$$

if $|\tilde{G}_x| \leq 678.115 \text{ kg/m}^2\cdot\text{s}$

or $$\frac{q''_{CHF}}{10^6} = 0.8 - x_{CHF}$$

if $|\tilde{G}_x| > 678.115 \text{ kg/m}^2\cdot\text{s}$.

where

q''_{CHF} = $\text{J/m}^2\cdot\text{s}$

$\tilde{G}_x$ = mass flux ($\text{kg/m}^2\cdot\text{s}$)

x_{CHF} = quality $(h - h_f)/h_{fg}$

H = enthalpy (J/kg)

H_f = saturated liquid enthalpy (J/kg)

H_{fg} = heat of vaporization (J/kg).

4. WATER PROPERTIES

SCORE-EVET uses the INEL environmental subprograms for the calculation of steam and water properties[C-33] which are based on the cell bulk pressure and internal energy. The properties are calculated based on the following assumption. If the bulk pressure and internal energy are such that the bulk fluid is subcooled or saturated liquid, then the bulk properties and liquid properties are equated to the subcooled or saturated liquid properties. If vapor is present, saturated vapor at the bulk pressure is assumed. The thermodynamic equilibrium quality is assumed to be zero.

If the bulk pressure and internal energy are such that the bulk fluid is saturated, then the bulk properties are equated to the mixed saturated liquid and vapor properties where the thermodynamic equilibrium quality is

$$x_e = \frac{H - H_f}{H_{fg}} \qquad \text{(C-121)}$$

at the bulk pressure. The liquid and vapor properties are equated to the saturated liquid and vapor properties, respectively.

If the bulk pressure and internal energy are such that the bulk fluid is superheated or saturated vapor, then the bulk properties and vapor properties are equated to the superheated or saturated vapor properties. If liquid is present, saturated liquid at the bulk pressure is assumed. The thermodynamic equilibrium quality is assumed to be 1.

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APPENDIX D

SUBROUTINE DESCRIPTION

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APPENDIX - D

SUBROUTINE DESCRIPTION

A brief description of each of the SCORE-EVET program subroutines follows. The subroutines are listed according to the routine name beginning with the main driver routine.

VRM. . . . . . Main driver routine, calls the computational and input-output routines.

BETAKP . . . . Calculates the saturated pressure given the temperature.

BETAKT . . . . Calculates the saturated temperature given the pressure.

COMPU. . . . . Calculates water mixture, liquid, and vapor thermodynamic properties.

DATD . . . . . Block data for the Baroczy two-phase friction multiplier correlation.

DTIM . . . . . Calculates the time step.

FRICT. . . . . Calculates the axial and transverse friction pressure gradients for a single cell.

HEAD . . . . . Prints the page headings and number.

HAMHFG . . . . Calculates the Keenan and Keyes heat of vaporization.

HAMHF. . . . . Calculates the Keenan and Keyes saturated liquid enthalpy.

HAMHG. . . . . Calculates the Keenan and Keyes saturated vapor enthalpy.

HTCOEF. . . . Links and calls the heat transfer correlations.

LAMBDA . . . . Dummy routine. Reserved for turbulent thermal coefficient correlations.

MOVEN. . . . . Moves arrays.

MOXIN. . . . . Dummy routine. Reserved for the SCORE-MOXY linkup.

MOXOUT . . . . Dummy routine. Reserved for the SCORE-MOXY linkup.

MOXY . . . . . Dummy routine. Reserved for the SCORE-MOXY linkup.

PCHF . . . . . Links and calls the CHF correlations.

POLATE . . . . Performs one-dimensional interpolations.

POLCOF . . . . Calculates coefficients for the n-th derivative of polynomials.

POL2 . . . . . Performs two-dimensional interpolations.

PROFAC . . . . Dummy routine. Reserved for CHF nonuniform heat flux factor correlations.

QDOT . . . . . Contains the heat transfer correlations.

RODMOD . . . . Calculates fuel rod heat conduction.

SALFA. . . . . Contains the void-fraction correlations.

SBWPAR . . . . Contains the axial friction factor correlations.

SBWTRA . . . . Contains the transverse friction factor correlations.

SSCHF. . . . . Contains the CHF correlations.

SFR. . . . . . Calculates the flow regime for the Beattie two-phase friction multiplier correlation.

SCON . . . . . Calculates the water liquid and vapor thermal conductivities.

SSLIP. . . . . Contains the velocity slip ratio correlations.

SSIG . . . . . Calculates the water surface tension.

SUBID. . . . . Identifies and logs the subroutines called.

SUMPOL . . . . Evaluates polynomials or their n^{th} derivative.

STPMPX . . . . Contains the axial two-phase friction multiplier correlations.

STPMTR . . . . Contains the transverse two-phase friction multiplier correlations.

TFFM . . . . . Calculates the Baroczy two-phase friction multiplier.

VISCOG . . . . Calculates the water vapor viscosity.

VISCOL . . . . Calculates the water liquid viscosity.

VRBD. . . . . . Calculates SCORE-EVET boundary conditions.

VREX . . . . . Performs the SCORE-EVET explicit calculations.

VRFR . . . . . Calculates the cell array axial and transverse friction pressure gradients.

VRI. . . . . . Performs the SCORE-EVET energy calculations.

VRIN . . . . . Controls the input of data and its printout.

VIRO . . . . . Contains the printout of calculational results.

VRIT . . . . . Performs the SCORE-EVET iteration procedure.

VROB . . . . . Dummy routine. Reserved for cell obstacle calculations.

VRS. . . . . . Calculates initial values for the calculational arrays.

VRTAP. . . . . Controls the input and output of data for restart tapes.

XMUTUB . . . . Dummy routine. Reserved for turbulent mixing correlations.

ZCLOK. . . . . Block data for subroutine timing and timer editing.

ZTEDIT . . . . Edits the subroutine timers.

APPENDIX E

SAMPLE PROBLEMS

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APPENDIX E

SAMPLE PROBLEMS

In this appendix, three sample problems are presented which illustrate the use of SCORE-EVET and some of the options available to the user. The first two problems are multichannel, multifuel-rod problems illustrating channel and fuel rod numbering when diagonal symmetry is used, and illustrating the specification of temporally and spatially varying boundary conditions. The third problem illustrates the one-dimensional representation of a multichannel geometry.

1. SAMPLE PROBLEM NUMBER 1: A 7 BY 7 BWR FUEL ASSEMBLY; STEADY STATE AND BLOWDOWN TRANSIENT

Sample Problem Number 1 consists of a three-dimensional transient problem illustrating the use of the diagonal symmetry feature, the rod conduction model, and the time varying inlet and outlet boundary conditions. The problem simulates a 12-ft long, 7 by 7 BWR fuel assembly undergoing a blowdown transient.

The geometry of the fuel assembly is shown in Figure E-1. The fuel assembly consists of 49 fuel rods, each 12-ft long and of 0.563-in. diameter, arranged in a 7 by 7 square matrix with a rod-to-rod pitch of 0.738 in. (0.175-in. gap spacing). The rod bundle is contained within a canister 5.278-in. square. For calculational purposes, the fuel rod array is divided transversely into 49 calculational subchannels with a fuel rod contained within each subchannel, and axially into three 48-in. calculational intervals. The transverse dimensions of the flow channels are shown in Figure E-1 and are listed in the following input printout.

The fuel rod power conditions simulate a BWR operating at a steady state average power of 12 kW/ft with a transient power decay initiated at 1 second. The rod-to-average transverse power distribution is shown

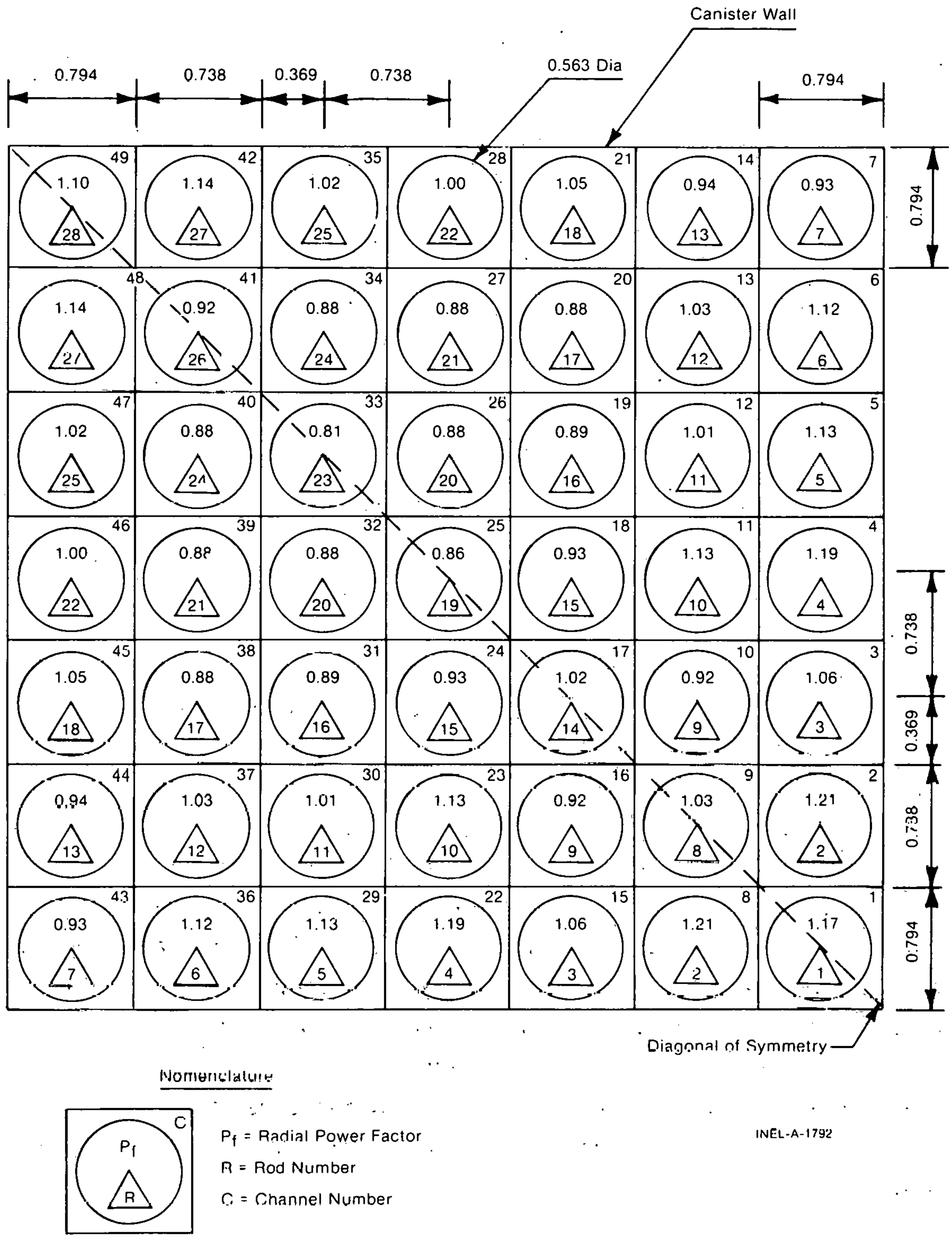

Fig. E-1 Layout of the 7 by 7 BWR Sample Problem Number 1 (symmetric fuel rods have been identically numbered).

in Figure E-1 and listed in Table E-I. The peak-to-average axial power distribution and the power-time distribution also are listed in the following input printout.

BWR coolant conditions are simulated with an initial internal energy of 522.8 Btu/lbm, and axial velocity of 6.962 ft/sec at the inlet and an initial pressure of 1043.0 psia at the outlet. A uniform transverse distribution of these parameters is assumed. The problem is conducted holding the coolant conditions constant for 1 second to provide steady state initialization, after which a transient is initiated simulating BWR blowdown conditions. The inlet internal energy and axial velocity and the outlet pressure versus time conditions are listed in the following input printout.

The input data required to perform the calculations are presented in Table E-I. Following the input printout the calculational results are presented in the output printout. Because of the excessive length of the printed output, output are shown only for times of zero, one, and four seconds.

TABLE E-I

SAMPLE PROBLEM 1

```
SCORE-EVET       BENEDETTI-KISER-LORDS    MOD 1   VER 2
 EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

                                        ****************************************
                                        ****                                ****
                                        ****   INPUT IS IN ENGLISH UNITS    ****
                                        ****                                ****
                                        ****************************************
 IUF =  1
 ICUTF =  1
 NAOC =  1
 NOCH = 28
 CHANNEL NOS =   1   2   3   4   5   6   7   9  10  11  12  13  14  17  18  19  20  21  25  26  27  28  33  34
 CHANNEL NOS =  35  41  42  49
 IBR =      3
 JBR =      7
 KBR =      7
 IROD =     1
 NDIAG =    1
 NROD =    28
 NZPTD =    15
 NZTDT =    10
 ALX =  1.00
 ALY =  1.00
 ALZ =  1.00
 GX = -32.2
 GY =  0.
 GZ =  0.
 CEP =  .400E-02
 WGHTP =  1.50
 DT =  .300E-02
 B0 =  1.20
 SACRIT =  .800
 TFIN =  4.00
 IDTFLG =     0
 LPR =      3
 NPRT =   100
 NWPC =    13
 NWPP =     0
 IESFLG =     2
 NTAP =     0
 NWTD =   100
 NEWTAP =     0
 NRST =   700
 I,J,K PRINT LIMITS ARE    1    5    1    1    9    1    1    9    1
```

TABLE E-I (continued)

```
SCORE-EVET      BENEDETTI-KISER-LORDS    MOD 1   VER 2
 EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT


  X CELL DIMENSIONS
  .50000       48.000       48.000       48.000       .50000

  Y CELL DIMENSIONS
  .79400       .79400       .73800       .73800       .73800       .73800       .73800       .79400       .79400

  Z CELL DIMENSIONS
  .79400       .79400       .73800       .73800       .73800       .73800       .73800       .79400       .79400
 LOSS COEFFICIENTS
                                 0.          0.          0.          0.
 P(1) =  .104E+04
 SIE(1) =  523.
 QUAL =  0.
 U(1) =  6.96
 DIAMRD =  .563
 SPROD =  .738
 PAVE =  12.0
```

CHANNEL 1	DHY =	.45450	DHE =	.86270	AWF =	5.3251	AWQ =	2.8054	VOID =	.60506	RODNUM=	1.0000
CHANNEL 2	DHY =	.52600	DHE =	.76213	AWF =	4.3734	AWQ =	3.0184	VOID =	.57510	RODNUM=	1.0000
CHANNEL 3	DHY =	.52600	DHE =	.76213	AWF =	4.3734	AWQ =	3.0184	VOID =	.57510	RODNUM=	1.0000
CHANNEL 4	DHY =	.52600	DHE =	.76213	AWF =	4.3734	AWQ =	3.0184	VOID =	.57510	RODNUM=	1.0000
CHANNEL 5	DHY =	.52600	DHE =	.76213	AWF =	4.3734	AWQ =	3.0184	VOID =	.57510	RODNUM=	1.0000
CHANNEL 6	DHY =	.52600	DHE =	.76213	AWF =	4.3734	AWQ =	3.0184	VOID =	.57510	RODNUM=	1.0000
CHANNEL 7	DHY =	.45450	DHE =	.86270	AWF =	5.3251	AWQ =	2.8054	VOID =	.60506	RODNUM=	1.0000
CHANNEL 8	DHY =	.52600	DHE =	.76213	AWF =	4.3734	AWQ =	3.0184	VOID =	.57510	RODNUM=	1.0000
CHANNEL 9	DHY =	.66870	DHE =	.66870	AWF =	3.2475	AWQ =	3.2475	VOID =	.54290	RODNUM=	1.0000
CHANNEL 10	DHY =	.66870	DHE =	.66870	AWF =	3.2475	AWQ =	3.2475	VOID =	.54290	RODNUM=	1.0000
CHANNEL 11	DHY =	.66870	DHE =	.66870	AWF =	3.2475	AWQ =	3.2475	VOID =	.54290	RODNUM=	1.0000
CHANNEL 12	DHY =	.66870	DHE =	.66870	AWF =	3.2475	AWQ =	3.2475	VOID =	.54290	RODNUM=	1.0000
CHANNEL 13	DHY =	.66870	DHE =	.66870	AWF =	3.2475	AWQ =	3.2475	VOID =	.54290	RODNUM=	1.0000

TABLE E-I (continued)

CHANNEL 14	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 15	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 16	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 17	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 18	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 19	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 20	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 21	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 22	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 23	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 24	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 25	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 26	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 27	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 28	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 29	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 30	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 31	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 32	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 33	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 34	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 35	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 36	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 37	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 38	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 39	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 40	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 41	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 42	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 43	DHY = .45450	DHE = .86270	AWF = 5.3251	AWQ = 2.8054	VOID = .60506	RODNUM= 1.0000
CHANNEL 44	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 45	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 46	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 47	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 48	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 49	DHY = .45450	DHE = .86270	AWF = 5.3251	AWQ = 2.8054	VOID = .60506	RODNUM= 1.0000

TABLE E-I (continued)

```
DIAFD =   .507
GAPT =  .800E-02
GAPH =  1000
FUELK =   2.00
CLADK =   7.00
RHOCPF =   53.0
RHOCPC =   32.0
ROD NUMBER  1   NRC=  1
ROD NUMBER  2   NRC=  2
ROD NUMBER  3   NRC=  3
ROD NUMBER  4   NRC=  4
ROD NUMBER  5   NRC=  5
ROD NUMBER  6   NRC=  6
ROD NUMBER  7   NRC=  7
ROD NUMBER  8   NRC=  9
ROD NUMBER  9   NRC= 10
ROD NUMBER 10   NRC= 11
ROD NUMBER 11   NRC= 12
ROD NUMBER 12   NRC= 13
ROD NUMBER 13   NRC= 14
ROD NUMBER 14   NRC= 17
ROD NUMBER 15   NRC= 18
ROD NUMBER 16   NRC= 19
ROD NUMBER 17   NRC= 20
ROD NUMBER 18   NRC= 21
ROD NUMBER 19   NRC= 25
ROD NUMBER 20   NRC= 26
ROD NUMBER 21   NRC= 27
ROD NUMBER 22   NRC= 28
ROD NUMBER 23   NRC= 33
ROD NUMBER 24   NRC= 34
ROD NUMBER 25   NRC= 35
ROD NUMBER 26   NRC= 41
ROD NUMBER 27   NRC= 42
ROD NUMBER 28   NRC= 49
```

TABLE E-I (continued)

```
SCORE-EVET       BENEDETTI-KISER-LORDS     MOD 1   VER 2
 EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

 RADIAL POWER FACTORS--BY CHANNEL IF IROD = 0 ---BY ROD IF IROD = 1 OR 2
                          1.17       1.21       1.06       1.19       1.13       1.12        .930       1.03        .920       1.13
                          1.01       1.03       .940       1.02       .930       .890        .880       1.05        .860       .880
                          .880       1.00       .810       .880       1.02       .920        1.14       1.10
 AXIAL POWER FACTORS FOR THE REAL CELLS
                          .781       1.44       .781
 POWER-TIME INPUT
                          1.00       0.         1.00       1.00       .940       1.10        .815       1.22        .558       1.43
                          .458       1.63       .348       1.81       .296       2.02        .123       3.01        8.920E-02  4.01
                          8.090E-02  5.00       7.590E-02  6.00       7.340E-02  7.00        7.100E-02  8.00        6.910E-02  11.0
 DELTA T-TIME INPUT
                          1.000E-03 1.000E-02 1.000E-03 2.000E-02 2.000E-03 .180        2.000E-03  .300        1.000E-03  .400
                          2.000E-03  .994       2.000E-04  1.01       1.000E-03  2.00        5.000E-04  6.00        1.000E-03  11.0


                                   U          V          W          P          SIE          RHO          TEMP

 INLET BOUNDARY FLAGS              3          1          1          6          3            8            6

 INLET BOUNDARY CONDITIONS     6.96200    0.         0.         0.         522.800      0.           0.

 NFTPUI =  10
FACTORS FOR INLET VELOCITY  OR PRESSURE AS A FUNCTION OF TIME
   1.000000   0.000000   1.000000   1.000000   .759000   1.500000   .304000   2.000000   .432000   2.500000
    .367000   3.500000   .310000    4.000000   .252000   5.000000   .222000   6.000000   .227000   11.000000

 NFTPSI =  10
FACTORS FOR INTERNAL ENERGY AS A FUNCTION OF TIME
   1.000000   0.000000   1.000000   1.000000   1.000100   1.500000   1.000200   2.000000   1.000400   3.500000
   1.000900   3.500000   1.001200   4.000000   1.001900   5.000000   1.002800   6.000000   1.003800   11.000000


                                   U          V          W          P          SIE          RHO          TEMP

 OUTLET BOUNDARY FLAGS             6          1          1          3          6            6            6

 OUTLET BOUNDARY CONDITIONS        0.         0.         0.         1043.00    0.           0.           0.

 NFTPUO =  10
FACTORS FOR OUTLET VELOCITY OR PRESSURE AS A FUNCTION OF TIME
   1.000000   0.000000   1.000000   1.000000   .994000   1.500000   .983000   2.000000   .971200   2.500000
    .950200   3.500000   .941500    4.000000   .926500   5.000000   .913000   6.000000   .911100   11.000000
```

TABLE E-I (continued)

```
    TWO-PHASE FRICTION MODEL FLAG, ITPMOD =   0

**** INPUT OF CRITICAL HEAT FLUX CORRELATION FLAGS ****

    JCHF =  0 NSW = 0 IHTDBG = 0 IFILMH = 0 IPOOLH = 0 IHTCAL = 0

    **** ACTUAL FRICTION FACTOR FLAGS USED ****

    IRECWS = 0   IREX = 2   IREY = 2   IREZ = 2
    IFXLAM = 1 IFYLAM = 1 IFZLAM = 1
    IFXTUB = 3 IFYTUB = 3 IFZTUB = 3
    IFLTEM = 0

    **** ACTUAL TWO-PHASE CORRELATION FLAGS USED ****

     IALFA =  1 ITPRHO = 1
    ITPMLX =  5 ITPMLY =  5 ITPMLZ =  5
    ITPMTX =  5 ITPMTY =  5 ITPMTZ =  5

    **** ACTUAL HEAT TRANSFER FLAGS USED ****

    JCHF =  0         IHTDBG = 0 IFILMH = 2


MINIMUM DIMENSIONING FOR THE A(ARRAY)  5850
```

TABLE E-I (continued).

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

CYCLE = 0 TIME = 0. ITERATIONS = 0 DELTA TIME = .30000E-02 POWER AVERAGE = 12.000 KW/FT.

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
1	1	1	6.96200	0.	0.	1049.45	47.1952	522.800	550.633	0.
2	1	1	6.96200	0.	0.	1049.45	47.1952	522.800	550.633	0.
3	1	1	6.96200	0.	0.	1049.80	47.1954	522.800	550.682	0.
4	1	1	6.96200	0.	0.	1049.14	47.1951	522.800	550.590	0.
5	1	1	6.96200	0.	0.	1049.71	47.1954	522.800	550.670	0.
6	1	1	6.96200	0.	0.	1049.45	47.1952	522.800	550.633	0.
7	1	1	6.96200	0.	0.	1049.40	47.1952	522.800	550.627	0.
8	1	1	6.96200	0.	0.	1048.47	47.1948	522.800	550.500	0.
9	1	1	6.96200	0.	0.	1048.47	47.1948	522.800	550.500	0.
1	2	1	12.2046	0.	0.	1049.45	26.9205	567.467	550.478	3.837677E-02
2	2	1	12.2046	0.	0.	1049.45	26.9205	567.467	550.478	3.837677E-02
3	2	1	13.8667	0.	0.	1049.80	23.6937	574.634	550.519	5.101959E-02
4	2	1	12.4655	0.	0.	1049.14	26.3570	568.533	550.441	4.034737E-02
5	2	1	13.6800	0.	0.	1049.71	24.0171	573.821	550.509	4.959651E-02
6	2	1	13.1197	0.	0.	1049.45	25.0428	571.380	550.477	4.532751E-02
7	2	1	13.0263	0.	0.	1049.40	25.2224	570.974	550.472	4.461604E-02
8	2	1	10.2228	0.	0.	1048.47	32.1392	558.842	550.364	2.330643E-02
9	2	1	10.2228	0.	0.	1048.47	32.1392	558.842	550.364	2.330643E-02
1	3	1	30.3573	0.	0.	1048.12	10.8229	644.820	550.322	.176006
2	3	1	30.3573	0.	0.	1048.12	10.8229	644.820	550.322	.176006
3	3	1	35.1087	0.	0.	1048.41	9.35820	665.191	550.356	.212109
4	3	1	31.0831	0.	0.	1047.87	10.5702	647.864	550.293	.181460
5	3	1	34.5722	0.	0.	1048.34	9.50343	662.881	550.348	.208022
6	3	1	32.9622	0.	0.	1048.12	9.96761	655.950	550.322	.195762
7	3	1	32.6938	0.	0.	1048.08	10.0494	654.794	550.318	.193719
8	3	1	24.6635	0.	0.	1047.31	13.3215	620.327	550.228	.132707
9	3	1	24.6635	0.	0.	1047.31	13.3215	620.327	550.228	.132707
1	4	1	40.3331	0.	0.	1045.29	8.14601	686.713	549.991	.250877
2	4	1	40.3331	0.	0.	1045.29	8.14601	686.713	549.991	.250877
3	4	1	46.7775	0.	0.	1045.48	7.02376	714.238	550.013	.299659
4	4	1	41.3038	0.	0.	1045.22	7.95458	690.832	549.983	.258195
5	4	1	46.0478	0.	0.	1045.45	7.13506	711.117	550.009	.294131
6	4	1	43.8585	0.	0.	1045.34	7.49122	701.755	549.997	.277545
7	4	1	43.4936	0.	0.	1045.32	7.55408	700.194	549.995	.274780
8	4	1	32.5926	0.	0.	1044.90	10.0806	653.628	549.946	.192279
9	4	1	32.5926	0.	0.	1044.90	10.0806	653.628	549.946	.192279
1	5	1	40.3331	0.	0.	1043.00	5.46912	728.606	549.659	.325748
2	5	1	40.3331	0.	0.	1043.00	5.46912	728.606	549.659	.325748
3	5	1	46.7775	0.	0.	1043.00	4.68933	763.285	549.671	.387210
4	5	1	41.3038	0.	0.	1043.00	5.33896	733.801	549.673	.334930
5	5	1	46.0478	0.	0.	1043.00	4.76669	759.354	549.671	.380239
6	5	1	43.8585	0.	0.	1043.00	5.01484	747.560	549.672	.359327
7	5	1	43.4936	0.	0.	1043.00	5.05872	745.594	549.672	.355842
8	5	1	32.5926	0.	0.	1043.00	6.83979	686.928	549.664	.251852
9	5	1	32.5926	0.	0.	1043.00	6.83979	686.928	549.664	.251852
1	1	2	6.96200	0.	0.	1049.45	47.1952	522.800	550.633	0.
2	1	2	6.96200	0.	0.	1049.45	47.1952	522.800	550.633	0.
3	1	2	6.96200	0.	0.	1049.80	47.1954	522.800	550.682	0.
4	1	2	6.96200	0.	0.	1049.14	47.1951	522.800	550.590	0.
5	1	2	6.96200	0.	0.	1049.71	47.1954	522.800	550.670	0.
6	1	2	6.96200	0.	0.	1049.45	47.1952	522.800	550.633	0.
7	1	2	6.96200	0.	0.	1049.40	47.1952	522.800	550.627	0.
8	1	2	6.96200	0.	0.	1048.47	47.1948	522.800	550.500	0.

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
9	1	2	6.96200	0.	0.	1048.47	47.1948	522.800	550.500	0.
1	2	2	12.2046	0.	0.	1049.45	26.9205	567.467	550.478	3.837677E-02
2	2	2	12.2046	0.	0.	1049.45	26.9205	567.467	550.478	3.837677E-02
3	2	2	13.8667	0.	0.	1049.80	23.6937	574.634	550.519	5.101959E-02
4	2	2	12.4655	0.	0.	1049.14	26.3570	568.533	550.441	4.034737E-02
5	2	2	13.6800	0.	0.	1049.71	24.0171	573.821	550.509	4.959651E-02
6	2	2	13.1197	0.	0.	1049.45	25.0428	571.380	550.477	4.532751E-02
7	2	2	13.0263	0.	0.	1049.40	25.2224	570.974	550.472	4.461604E-02
8	2	2	10.2228	0.	0.	1048.47	32.1392	558.842	550.364	2.330643E-02
9	2	2	10.2228	0.	0.	1048.47	32.1392	558.842	550.364	2.330643E-02
1	3	2	30.3573	0.	0.	1048.12	10.8229	644.820	550.322	.176006
2	3	2	30.3573	0.	0.	1048.12	10.8229	644.820	550.322	.176006
3	3	2	35.1087	0.	0.	1048.41	9.35820	665.191	550.356	.212109
4	3	2	31.0831	0.	0.	1047.87	10.5702	647.864	550.293	.181460
5	3	2	34.5722	0.	0.	1048.34	9.50343	662.881	550.348	.208022
6	3	2	32.9622	0.	0.	1048.12	9.96761	655.950	550.322	.195762
7	3	2	32.6938	0.	0.	1048.08	10.0494	654.794	550.318	.193719
8	3	2	24.6635	0.	0.	1047.31	13.3215	620.327	550.228	.132707
9	3	2	24.6635	0.	0.	1047.31	13.3215	620.327	550.228	.132707
1	4	2	40.3331	0.	0.	1045.29	8.14601	686.713	549.991	.250877
2	4	2	40.3331	0.	0.	1045.29	8.14601	686.713	549.991	.250877
3	4	2	46.7775	0.	0.	1045.48	7.02376	714.238	550.013	.299659
4	4	2	41.3038	0.	0.	1045.22	7.95458	690.832	549.983	.258195
5	4	2	46.0478	0.	0.	1045.45	7.13506	711.117	550.009	.294131
6	4	2	43.8585	0.	0.	1045.34	7.49122	701.755	549.997	.277545
7	4	2	43.4936	0.	0.	1045.32	7.55408	700.194	549.995	.274780
8	4	2	32.5926	0.	0.	1044.90	10.0806	653.628	549.946	.192279
9	4	2	32.5926	0.	0.	1044.90	10.0806	653.628	549.946	.192279
1	5	2	40.3331	0.	0.	1043.00	5.46912	728.606	549.659	.325748
2	5	2	40.3331	0.	0.	1043.00	5.46912	728.606	549.659	.325748
3	5	2	46.7775	0.	0.	1043.00	4.68933	763.285	549.671	.387210
4	5	2	41.3038	0.	0.	1043.00	5.33896	733.801	549.673	.334930
5	5	2	46.0478	0.	0.	1043.00	4.76669	759.354	549.671	.380239
6	5	2	43.8585	0.	0.	1043.00	5.01484	747.560	549.672	.359327
7	5	2	43.4936	0.	0.	1043.00	5.05872	745.594	549.672	.355842
8	5	2	32.5926	0.	0.	1043.00	6.83979	686.928	549.664	.251852
9	5	2	32.5926	0.	0.	1043.00	6.83979	686.928	549.664	.251852
1	1	3	6.96200	0.	0.	1049.80	47.1954	522.800	550.682	0.
2	1	3	6.96200	0.	0.	1049.80	47.1954	522.800	550.682	0.
3	1	3	6.96200	0.	0.	1049.02	47.1951	522.800	550.573	0.
4	1	3	6.96200	0.	0.	1048.52	47.1948	522.800	550.504	0.
5	1	3	6.96200	0.	0.	1049.48	47.1953	522.800	550.638	0.
6	1	3	6.96200	0.	0.	1048.93	47.1950	522.800	550.561	0.
7	1	3	6.96200	0.	0.	1049.02	47.1951	522.800	550.573	0.
8	1	3	6.96200	0.	0.	1048.62	47.1949	522.800	550.518	0.
9	1	3	6.96200	0.	0.	1048.62	47.1949	522.800	550.518	0.
1	2	3	13.8667	0.	0.	1049.80	23.6937	574.634	550.519	5.101959E-02
2	2	3	13.8667	0.	0.	1049.80	23.6937	574.634	550.519	5.101959E-02
3	2	3	13.5512	0.	0.	1049.02	24.2453	573.156	550.427	4.858550E-02
4	2	3	12.3775	0.	0.	1048.52	26.5444	568.057	550.369	3.965621E-02
5	2	3	14.6172	0.	0.	1049.48	22.4773	577.791	550.481	5.670394E-02
6	2	3	13.3379	0.	0.	1048.93	24.6331	572.229	550.416	4.696193E-02
7	2	3	13.5512	0.	0.	1049.02	24.2453	573.156	550.427	4.858550E-02
8	2	3	11.3431	0.	0.	1048.62	28.9650	563.652	550.380	3.181049E-02
9	2	3	11.3431	0.	0.	1048.62	28.9650	563.652	550.380	3.181049E-02

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
1	3	3	35.1087	0.	0.	1048.41	9.35820	665.191	550.356	.212109
2	3	3	35.1087	0.	0.	1048.41	9.35820	665.191	550.356	.212109
3	3	3	34.1670	0.	0.	1047.77	9.61612	661.014	550.281	.204820
4	3	3	30.7983	0.	0.	1047.36	10.6679	646.533	550.233	.179201
5	3	3	37.2273	0.	0.	1048.14	8.82563	674.179	550.325	.228115
6	3	3	33.5547	0.	0.	1047.69	9.79159	658.381	550.272	.200162
7	3	3	34.1670	0.	0.	1047.77	9.61612	661.014	550.281	.204820
8	3	3	27.8597	0.	0.	1047.44	11.7932	634.002	550.243	.156947
9	3	3	27.8597	0.	0.	1047.44	11.7932	634.002	550.243	.156947
1	4	3	46.7775	0.	0.	1045.48	7.02376	714.238	550.013	.299659
2	4	3	46.7775	0.	0.	1045.48	7.02376	714.238	550.013	.299659
3	4	3	45.4725	0.	0.	1045.25	7.22534	708.608	549.986	.289715
4	4	3	40.8955	0.	0.	1045.04	8.03399	689.045	549.962	.255058
5	4	3	49.6318	0.	0.	1045.43	6.61984	726.392	550.008	.321224
6	4	3	44.6404	0.	0.	1045.21	7.36001	705.051	549.981	.283414
7	4	3	45.4725	0.	0.	1045.25	7.22534	708.608	549.986	.289715
8	4	3	36.9228	0.	0.	1045.01	8.89841	672.107	549.958	.225027
9	4	3	36.9228	0.	0.	1045.01	8.89841	672.107	549.958	.225027
1	5	3	46.7775	0.	0.	1043.00	4.68933	763.285	549.671	.387210
2	5	3	46.7775	0.	0.	1043.00	4.68933	763.285	549.671	.387210
3	5	3	45.4725	0.	0.	1043.00	4.83457	756.202	549.690	.374610
4	5	3	40.8955	0.	0.	1043.00	5.40006	731.557	549.690	.330915
5	5	3	49.6318	0.	0.	1043.00	4.41404	778.605	549.690	.414333
6	5	3	44.6404	0.	0.	1043.00	4.92844	751.721	549.690	.366665
7	5	3	45.4725	0.	0.	1043.00	4.83457	756.202	549.690	.374610
8	5	3	36.9228	0.	0.	1043.00	6.00364	710.212	549.674	.293107
9	5	3	36.9228	0.	0.	1043.00	6.00364	710.212	549.674	.293107
1	1	4	6.96200	0.	0.	1049.14	47.1951	522.800	550.590	0.
2	1	4	6.96203	0.	0.	1049.14	47.1951	522.800	550.590	0.
3	1	4	6.96203	0.	0.	1048.52	47.1948	522.800	550.504	0.
4	1	4	6.96203	0.	0.	1048.97	47.1950	522.800	550.567	0.
5	1	4	6.96203	0.	0.	1048.56	47.1949	522.800	550.510	0.
6	1	4	6.96203	0.	0.	1048.38	47.1948	522.800	550.485	0.
7	1	4	6.96203	0.	0.	1048.34	47.1943	522.800	550.479	0.
8	1	4	6.96203	0.	0.	1049.10	47.1951	522.800	550.584	0.
9	1	4	6.96200	0.	0.	1049.10	47.1951	522.800	550.584	0.
1	2	4	12.4655	0.	0.	1049.14	26.3570	568.533	550.441	4.034737E-02
2	2	4	12.4655	0.	0.	1049.14	26.3570	568.533	550.441	4.034737E-02
3	2	4	12.3775	0.	0.	1048.52	26.5444	568.057	550.369	3.965621E-02
4	2	4	13.4446	0.	0.	1048.97	24.4376	572.693	550.422	4.777371E-02
5	2	4	12.4843	0.	0.	1048.56	26.3174	568.521	550.374	4.046794E-02
6	2	4	12.0572	0.	0.	1048.38	27.2497	566.667	550.353	3.722102E-02
7	2	4	11.9504	0.	0.	1048.34	27.4932	566.203	550.347	3.640929E-02
8	2	4	12.3721	0.	0.	1049.10	26.5561	568.126	550.436	3.963595E-02
9	2	4	12.3721	0.	0.	1049.10	26.5561	568.126	550.436	3.963595E-02
1	3	4	31.0831	0.	0.	1047.87	10.5702	647.864	550.293	.181460
2	3	4	31.0831	0.	0.	1047.87	10.5702	647.864	550.293	.181460
3	3	4	30.7983	0.	0.	1047.36	10.6679	646.533	550.233	.179201
4	3	4	33.8609	0.	0.	1047.73	9.70306	659.698	550.277	.202491
5	3	4	31.1047	0.	0.	1047.40	10.5629	647.849	550.238	.181530
6	3	4	29.8791	0.	0.	1047.25	10.9961	642.583	550.220	.172215
7	3	4	29.5727	0.	0.	1047.21	11.1101	641.267	550.216	.169887
8	3	4	30.8145	0.	0.	1047.83	10.6623	646.708	550.289	.179417
9	3	4	30.8145	0.	0.	1047.83	10.6623	646.708	550.289	.179417
1	4	4	41.3033	0.	0.	1045.22	7.95458	690.832	549.983	.258195

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
2	4	4	41.3038	0.	0.	1045.22	7.95458	690.832	549.983	.258195
3	4	4	40.8955	0.	0.	1045.04	8.03399	689.045	549.962	.255058
4	4	4	45.0564	0.	0.	1045.23	7.29205	706.830	549.983	.286564
5	4	4	41.3116	0.	0.	1045.06	7.95306	690.823	549.964	.258208
6	4	4	39.6469	0.	0.	1044.99	8.28701	683.709	549.955	.245606
7	4	4	39.2307	0.	0.	1044.97	8.37493	681.931	549.953	.242456
8	4	4	40.9388	0.	0.	1045.20	8.02550	689.272	549.981	.255431
9	4	4	40.9388	0.	0.	1045.20	8.02550	689.272	549.981	.255431
1	5	4	41.3038	0.	0.	1043.00	5.33896	733.801	549.673	.334930
2	5	4	41.3038	0.	0.	1043.00	5.33896	733.801	549.673	.334930
3	5	4	40.8955	0.	0.	1043.00	5.40006	731.557	549.690	.330915
4	5	4	45.0564	0.	0.	1043.00	4.88105	753.961	549.690	.370637
5	5	4	41.3116	0.	0.	1043.00	5.34327	733.797	549.690	.334887
6	5	4	39.6469	0.	0.	1043.00	5.57790	724.835	549.690	.318998
7	5	4	39.2307	0.	0.	1043.00	5.63980	722.595	549.690	.315026
8	5	4	40.9388	0.	0.	1043.00	5.38869	731.835	549.673	.331445
9	5	4	40.9388	0.	0.	1043.00	5.38869	731.835	549.673	.331445
1	1	5	6.96200	0.	0.	1049.71	47.1954	522.800	550.670	0.
2	1	5	6.96200	0.	0.	1049.71	47.1954	522.800	550.670	0.
3	1	5	6.96200	0.	0.	1049.48	47.1953	522.800	550.638	0.
4	1	5	6.96200	0.	0.	1048.56	47.1949	522.800	550.510	0.
5	1	5	6.96200	0.	0.	1048.25	47.1947	522.800	550.467	0.
6	1	5	6.96200	0.	0.	1048.34	47.1948	522.800	550.479	0.
7	1	5	6.96200	0.	0.	1048.34	47.1948	522.800	550.479	0.
8	1	5	6.96200	0.	0.	1048.88	47.1950	522.800	550.554	0.
9	1	5	6.96200	0.	0.	1048.88	47.1950	522.800	550.554	0.
1	2	5	13.6800	0.	0.	1049.71	24.0171	573.821	550.509	4.959651E-02
2	2	5	13.6800	0.	0.	1049.71	24.0171	573.821	550.509	4.959651E-02
3	2	5	14.6172	0.	0.	1049.48	22.4773	577.791	550.481	5.670394E-02
4	2	5	12.4843	0.	0.	1048.56	26.3174	568.521	550.374	4.046794E-02
5	2	5	11.7367	0.	0.	1048.25	27.9937	565.276	550.337	3.478583E-02
6	2	5	11.9504	0.	0.	1048.34	27.4932	566.203	550.347	3.640929E-02
7	2	5	11.9504	0.	0.	1048.34	27.4932	566.203	550.347	3.640929E-02
8	2	5	11.9045	0.	0.	1048.88	27.5991	566.092	550.411	3.607890E-02
9	2	5	11.9045	0.	0.	1048.88	27.5991	566.092	550.411	3.607890E-02
1	3	5	34.5722	0.	0.	1048.34	9.50343	662.881	550.348	.208022
2	3	5	34.5722	0.	0.	1048.34	9.50343	662.881	550.348	.208022
3	3	5	37.2273	0.	0.	1048.14	8.82563	674.179	550.325	.228115
4	3	5	31.1047	0.	0.	1047.40	10.5629	647.849	550.238	.181530
5	3	5	28.9597	0.	0.	1047.14	11.3452	638.634	550.207	.165229
6	3	5	29.5727	0.	0.	1047.21	11.1101	641.267	550.216	.169887
7	3	5	29.5727	0.	0.	1047.21	11.1101	641.267	550.216	.169887
8	3	5	29.4717	0.	0.	1047.65	11.1481	640.933	550.268	.169203
9	3	5	29.4717	0.	0.	1047.65	11.1481	640.933	550.268	.169203
1	4	5	46.0478	0.	0.	1045.45	7.13506	711.117	550.009	.294131
2	4	5	46.0478	0.	0.	1045.45	7.13506	711.117	550.009	.294131
3	4	5	49.6318	0.	0.	1045.43	6.61984	726.392	550.008	.321224
4	4	5	41.3116	0.	0.	1045.06	7.95306	690.823	549.964	.258208
5	4	5	38.3982	0.	0.	1044.93	8.55650	678.374	549.949	.236155
6	4	5	39.2307	0.	0.	1044.97	8.37493	681.931	549.953	.242456
7	4	5	39.2307	0.	0.	1044.97	8.37493	681.931	549.953	.242456
8	4	5	39.1135	0.	0.	1045.12	8.40001	681.469	549.970	.241611
9	4	5	39.1135	0.	0.	1045.12	8.40001	681.469	549.970	.241611
1	5	5	46.0478	0.	0.	1043.00	4.76669	759.354	549.671	.380239
2	5	5	46.0478	0.	0.	1043.00	4.76669	759.354	549.671	.380239

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LCRDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
3	5	5	49.6318	0.	0.	1043.00	4.41404	778.605	549.690	.414333
4	5	5	41.3116	0.	0.	1043.00	5.34327	733.797	549.690	.334887
5	5	5	38.3982	0.	0.	1043.00	5.76780	718.114	549.690	.307081
6	5	5	39.2307	0.	0.	1043.00	5.63980	722.595	549.690	.315026
7	5	5	39.2307	0.	0.	1043.00	5.63980	722.595	549.690	.315026
8	5	5	39.1135	0.	0.	1043.00	5.65191	722.006	549.673	.314018
9	5	5	39.1135	0.	0.	1043.00	5.65191	722.006	549.673	.314018
1	1	6	6.96200	0.	0.	1049.45	47.1952	522.800	550.633	0.
2	1	6	6.96200	0.	0.	1049.45	47.1952	522.800	550.633	0.
3	1	6	6.96200	0.	0.	1048.93	47.1950	522.800	550.561	0.
4	1	6	6.96200	0.	0.	1048.38	47.1948	522.800	550.485	0.
5	1	6	6.96200	0.	0.	1048.34	47.1948	522.800	550.479	0.
6	1	6	6.96200	0.	0.	1048.03	47.1946	522.800	550.436	0.
7	1	6	6.96200	0.	0.	1048.34	47.1948	522.800	550.479	0.
8	1	6	6.96200	0.	0.	1048.96	47.1950	522.800	550.566	0.
9	1	6	6.96200	0.	0.	1048.96	47.1950	522.800	550.566	0.
1	2	6	13.1197	0.	0.	1049.45	25.0428	571.380	550.477	4.532751E-02
2	2	6	13.1197	0.	0.	1049.45	25.0428	571.380	550.477	4.532751E-02
3	2	6	13.3379	0.	0.	1048.93	24.6331	572.229	550.416	4.696193E-02
4	2	6	12.0572	0.	0.	1048.38	27.2497	566.667	550.353	3.722102E-02
5	2	6	11.9504	0.	0.	1048.34	27.4932	566.203	550.347	3.640929E-02
6	2	6	11.2024	0.	0.	1048.03	29.3289	562.959	550.311	3.072709E-02
7	2	6	11.9504	0.	0.	1048.34	27.4932	566.203	550.347	3.640929E-02
8	2	6	12.0916	0.	0.	1048.96	27.1722	566.906	550.421	3.750171E-02
9	2	6	12.0916	0.	0.	1048.96	27.1722	566.906	550.421	3.750171E-02
1	3	6	32.9622	0.	0.	1048.12	9.96761	655.950	550.322	.195762
2	3	6	32.9622	0.	0.	1048.12	9.96761	655.950	550.322	.195762
3	3	6	33.5547	0.	0.	1047.69	9.79159	658.381	550.272	.200162
4	3	6	29.8791	0.	0.	1047.25	10.9961	642.583	550.220	.172215
5	3	6	29.5727	0.	0.	1047.21	11.1101	641.267	550.216	.169887
6	3	6	27.4270	0.	0.	1046.96	11.9792	632.051	550.186	.153587
7	3	6	29.5727	0.	0.	1047.21	11.1101	641.267	550.216	.169887
8	3	6	30.0089	0.	0.	1047.72	10.9486	643.243	550.276	.173289
9	3	6	30.0089	0.	0.	1047.72	10.9486	643.243	550.276	.173289
1	4	6	43.8585	0.	0.	1045.34	7.49122	701.755	549.997	.277545
2	4	6	43.8585	0.	0.	1045.34	7.49122	701.755	549.997	.277545
3	4	6	44.6404	0.	0.	1045.21	7.36001	705.051	549.981	.283414
4	4	6	39.6469	0.	0.	1044.99	8.28701	683.709	549.955	.245606
5	4	6	39.2307	0.	0.	1044.97	8.37493	681.931	549.953	.242456
6	4	6	36.3166	0.	0.	1044.84	9.04693	669.481	549.938	.220404
7	4	6	39.2307	0.	0.	1044.97	8.37493	681.931	549.953	.242456
8	4	6	39.8437	0.	0.	1045.15	8.24608	684.590	549.975	.247139
9	4	6	39.8437	0.	0.	1045.15	8.24608	684.590	549.975	.247139
1	5	6	43.8585	0.	0.	1043.00	5.01484	747.560	549.672	.359327
2	5	6	43.8585	0.	0.	1043.00	5.01484	747.560	549.672	.359327
3	5	6	44.6404	0.	0.	1043.00	4.92844	751.721	549.690	.366665
4	5	6	39.6469	0.	0.	1043.00	5.57790	724.835	549.690	.318998
5	5	6	39.2307	0.	0.	1043.00	5.63980	722.595	549.690	.315026
6	5	6	36.3166	0.	0.	1043.00	6.11462	706.911	549.690	.287220
7	5	6	39.2307	0.	0.	1043.00	5.63980	722.595	549.690	.315026
8	5	6	39.8437	0.	0.	1043.00	5.54361	725.938	549.673	.320989
9	5	6	39.8437	0.	0.	1043.00	5.54361	725.938	549.673	.320989
1	1	7	6.96200	0.	0.	1049.40	47.1952	522.800	550.627	0.
2	1	7	6.96200	0.	0.	1049.40	47.1952	522.800	550.627	0.
3	1	7	6.96200	0.	0.	1049.02	47.1951	522.800	550.573	0.

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
4	1	7	6.96200	0.	0.	1048.34	47.1948	522.800	550.479	0.
5	1	7	6.96200	0.	0.	1048.34	47.1948	522.800	550.479	0.
6	1	7	6.96200	0.	0.	1048.34	47.1948	522.800	550.479	0.
7	1	7	6.96200	0.	0.	1048.52	47.1948	522.800	550.504	0.
8	1	7	6.96200	0.	0.	1049.49	47.1953	522.800	550.639	0.
9	1	7	6.96200	0.	0.	1049.49	47.1953	522.800	550.639	0.
1	2	7	13.0263	0.	0.	1049.40	25.2224	570.974	550.472	4.461604E-02
2	2	7	13.0263	0.	0.	1049.40	25.2224	570.974	550.472	4.461604E-02
3	2	7	13.5512	0.	0.	1049.02	24.2453	573.156	550.427	4.858550E-02
4	2	7	11.9504	0.	0.	1048.34	27.4932	566.203	550.347	3.640929E-02
5	2	7	11.9504	0.	0.	1048.34	27.4932	566.203	550.347	3.640929E-02
6	2	7	11.9504	0.	0.	1048.34	27.4932	566.203	550.347	3.640929E-02
7	2	7	12.3775	0.	0.	1048.52	26.5444	568.057	550.369	3.965621E-02
8	2	7	13.2131	0.	0.	1049.49	24.8658	571.787	550.483	4.603898E-02
9	2	7	13.2131	0.	0.	1049.49	24.8658	571.787	550.483	4.603898E-02
1	3	7	32.6938	0.	0.	1048.08	10.0494	654.794	550.318	.193719
2	3	7	32.6938	0.	0.	1048.08	10.0494	654.794	550.318	.193719
3	3	7	34.1670	0.	0.	1047.77	9.61612	661.014	550.281	.204820
4	3	7	29.5727	0.	0.	1047.21	11.1101	641.267	550.216	.169887
5	3	7	29.5727	0.	0.	1047.21	11.1101	641.267	550.216	.169887
6	3	7	29.5727	0.	0.	1047.21	11.1101	641.267	550.216	.169887
7	3	7	30.7983	0.	0.	1047.36	10.6679	646.533	550.233	.179201
8	3	7	33.2305	0.	0.	1048.16	9.88711	657.105	550.326	.197805
9	3	7	33.2305	0.	0.	1048.16	9.88711	657.105	550.326	.197805
1	4	7	43.4936	0.	0.	1045.32	7.55408	700.194	549.995	.274780
2	4	7	43.4936	0.	0.	1045.32	7.55408	700.194	549.995	.274780
3	4	7	45.4725	0.	0.	1045.25	7.22534	708.608	549.986	.289715
4	4	7	39.2307	0.	0.	1044.97	8.37493	681.931	549.953	.242456
5	4	7	39.2307	0.	0.	1044.97	8.37493	681.931	549.953	.242456
6	4	7	39.2307	0.	0.	1044.97	8.37493	681.931	549.953	.242456
7	4	7	40.8955	0.	0.	1045.04	8.03399	689.045	549.962	.255058
8	4	7	44.2234	0.	0.	1045.36	7.42941	703.315	549.999	.280309
9	4	7	44.2234	0.	0.	1045.36	7.42941	703.315	549.999	.280309
1	5	7	43.4936	0.	0.	1043.00	5.05872	745.594	549.672	.355842
2	5	7	43.4936	0.	0.	1043.00	5.05872	745.594	549.672	.355842
3	5	7	45.4725	0.	0.	1043.00	4.83457	756.202	549.690	.374610
4	5	7	39.2307	0.	0.	1043.00	5.63980	722.595	549.690	.315026
5	5	7	39.2307	0.	0.	1043.00	5.63980	722.595	549.690	.315026
6	5	7	39.2307	0.	0.	1043.00	5.63980	722.595	549.690	.315026
7	5	7	40.8955	0.	0.	1043.00	5.40006	731.557	549.690	.330915
8	5	7	44.2234	0.	0.	1043.00	4.97171	749.526	549.672	.362813
9	5	7	44.2234	0.	0.	1043.00	4.97171	749.526	549.672	.362813
1	1	8	6.96200	0.	0.	1048.47	47.1948	522.800	550.500	0.
2	1	8	6.96200	0.	0.	1048.47	47.1948	522.800	550.500	0.
3	1	8	6.96200	0.	0.	1048.62	47.1949	522.800	550.518	0.
4	1	8	6.96200	0.	0.	1049.10	47.1951	522.800	550.584	0.
5	1	8	6.96200	0.	0.	1048.88	47.1950	522.800	550.554	0.
6	1	8	6.96200	0.	0.	1048.96	47.1950	522.800	550.566	0.
7	1	8	6.96200	0.	0.	1049.49	47.1953	522.800	550.639	0.
8	1	8	6.96200	0.	0.	1049.16	47.1951	522.800	550.594	0.
9	1	8	6.96200	0.	0.	1049.16	47.1951	522.800	550.594	0.
1	2	8	10.2228	0.	0.	1048.47	32.1392	558.842	550.364	2.330643E-02
2	2	8	10.2228	0.	0.	1048.47	32.1392	558.842	550.364	2.330643E-02
3	2	8	11.3431	0.	0.	1048.62	28.9650	563.652	550.380	3.181049E-02
4	2	8	12.3721	0.	0.	1049.10	26.5561	568.126	550.436	3.963595E-02

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
5	2	8	11.9045	0.	0.	1048.88	27.5991	566.092	550.411	3.607890E-02
6	2	8	12.0916	0.	0.	1048.96	27.1722	566.906	550.421	3.750171E-02
7	2	8	13.2131	0.	0.	1049.49	24.8658	571.787	550.483	4.603898E-02
8	2	8	11.6270	0.	0.	1049.16	28.2577	564.951	550.444	3.398125E-02
9	2	8	11.6270	0.	0.	1049.16	28.2577	564.951	550.444	3.398125E-02
1	3	8	24.6635	0.	0.	1047.31	13.3215	620.327	550.228	.132707
2	3	8	24.6635	0.	0.	1047.31	13.3215	620.327	550.228	.132707
3	3	8	27.8597	0.	0.	1047.44	11.7932	634.002	550.243	.156947
4	3	8	30.8145	0.	0.	1047.83	10.6623	646.708	550.289	.179417
5	3	8	29.4717	0.	0.	1047.65	11.1481	640.933	550.268	.169203
6	3	8	30.0089	0.	0.	1047.72	10.9486	643.243	550.276	.173289
7	3	8	33.2305	0.	0.	1048.16	9.88711	657.105	550.326	.197805
8	3	8	28.6975	0.	0.	1047.88	11.4489	637.676	550.295	.163376
9	3	8	28.6975	0.	0.	1047.88	11.4489	637.676	550.295	.163376
1	4	8	32.5926	0.	0.	1044.90	10.0806	653.628	549.946	.192279
2	4	8	32.5926	0.	0.	1044.90	10.0806	653.628	549.946	.192279
3	4	8	36.9228	0.	0.	1045.01	8.89841	672.107	549.958	.225027
4	4	8	40.9388	0.	0.	1045.20	8.02550	689.272	549.981	.255431
5	4	8	39.1135	0.	0.	1045.12	8.40001	681.469	549.970	.241611
6	4	8	39.8437	0.	0.	1045.15	8.24608	684.590	549.975	.247139
7	4	8	44.2234	0.	0.	1045.36	7.42941	703.315	549.999	.280309
8	4	8	38.0761	0.	0.	1045.18	8.62888	677.063	549.978	.233786
9	4	8	38.0761	0.	0.	1045.18	8.62888	677.063	549.978	.233786
1	5	8	32.5926	0.	0.	1043.00	6.83979	686.928	549.664	.251852
2	5	8	32.5926	0.	0.	1043.00	6.83979	686.928	549.664	.251852
3	5	8	36.9228	0.	0.	1043.00	6.00364	710.212	549.674	.293107
4	5	8	40.9388	0.	0.	1043.00	5.38869	731.835	549.673	.331445
5	5	8	39.1135	0.	0.	1043.00	5.65191	722.006	549.673	.314018
6	5	8	39.8437	0.	0.	1043.00	5.54361	725.938	549.673	.320989
7	5	8	44.2234	0.	0.	1043.00	4.97171	749.526	549.672	.362813
8	5	8	38.0761	0.	0.	1043.00	5.80890	716.450	549.661	.304195
9	5	8	38.0761	0.	0.	1043.00	5.80890	716.450	549.661	.304195
1	1	9	6.96200	0.	0.	1048.47	47.1948	522.800	550.500	0.
2	1	9	6.96200	0.	0.	1048.47	47.1948	522.800	550.500	0.
3	1	9	6.96200	0.	0.	1048.62	47.1949	522.800	550.518	0.
4	1	9	6.96200	0.	0.	1049.10	47.1951	522.800	550.584	0.
5	1	9	6.96200	0.	0.	1048.88	47.1950	522.800	550.554	0.
6	1	9	6.96200	0.	0.	1048.96	47.1950	522.800	550.566	0.
7	1	9	6.96200	0.	0.	1049.49	47.1953	522.800	550.639	0.
8	1	9	6.96200	0.	0.	1049.16	47.1951	522.800	550.594	0.
9	1	9	6.96200	0.	0.	1049.16	47.1951	522.800	550.594	0.
1	2	9	10.2228	0.	0.	1048.47	32.1392	558.842	550.364	2.330643E-02
2	2	9	10.2228	0.	0.	1048.47	32.1392	558.842	550.364	2.330643E-02
3	2	9	11.3431	0.	0.	1048.62	28.9650	563.652	550.380	3.181049E-02
4	2	9	12.3721	0.	0.	1049.10	26.5561	568.126	550.436	3.963595E-02
5	2	9	11.9045	0.	0.	1048.88	27.5991	566.092	550.411	3.607890E-02
6	2	9	12.0916	0.	0.	1048.96	27.1722	566.906	550.421	3.750171E-02
7	2	9	13.2131	0.	0.	1049.49	24.8658	571.787	550.483	4.603898E-02
8	2	9	11.6270	0.	0.	1049.16	28.2577	564.951	550.444	3.398125E-02
9	2	9	11.6270	0.	0.	1049.16	28.2577	564.951	550.444	3.398125E-02
1	3	9	24.6635	0.	0.	1047.31	13.3215	620.327	550.228	.132707
2	3	9	24.6635	0.	0.	1047.31	13.3215	620.327	550.228	.132707
3	3	9	27.8597	0.	0.	1047.44	11.7932	634.002	550.243	.156947
4	3	9	30.8145	0.	0.	1047.83	10.6623	646.708	550.289	.179417
5	3	9	29.4717	0.	0.	1047.65	11.1481	640.933	550.268	.169203

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
6	3	9	30.0089	0.	0.	1047.72	10.9486	643.243	550.276	.173289
7	3	9	33.2305	0.	0.	1048.16	9.88711	657.105	550.326	.197805
8	3	9	28.6975	0.	0.	1047.88	11.4489	637.676	550.295	.163376
9	3	9	28.6975	0.	0.	1047.88	11.4489	637.676	550.295	.163376
1	4	9	32.5926	0.	0.	1044.90	10.0806	653.628	549.946	.192279
2	4	9	32.5926	0.	0.	1044.90	10.0806	653.628	549.946	.192279
3	4	9	36.9228	0.	0.	1045.01	8.89841	672.107	549.958	.225027
4	4	9	40.9388	0.	0.	1045.20	8.02550	689.272	549.981	.255431
5	4	9	39.1135	0.	0.	1045.12	8.40001	681.469	549.970	.241611
6	4	9	39.8437	0.	0.	1045.15	8.24608	684.590	549.975	.247139
7	4	9	44.2234	0.	0.	1045.36	7.42941	703.315	549.999	.280309
8	4	9	38.0761	0.	0.	1045.18	8.62888	677.063	549.978	.233786
9	4	9	38.0761	0.	0.	1045.18	8.62888	677.063	549.978	.233786
[illegible]	5	9	32.5926	0.	0.	1043.00	6.83979	686.928	549.664	.251852
2	5	9	32.5926	0.	0.	1043.00	6.83979	686.928	549.664	.251852
3	5	9	36.9223	0.	0.	1043.00	6.00364	710.212	549.674	.293107
4	5	9	40.9388	0.	0.	1043.00	5.38869	731.835	549.673	.331445
5	5	9	39.1135	0.	0.	1043.00	5.65191	722.006	549.673	.314018
6	5	9	39.8437	0.	0.	1043.00	5.54361	725.938	549.673	.320989
7	5	9	44.2234	0.	0.	1043.00	4.97171	749.526	549.672	.362813
8	5	9	33.0761	0.	0.	1043.00	5.80890	716.450	549.661	.304195
9	5	9	38.0761	0.	0.	1043.00	5.80890	716.450	549.661	.304195

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

X	DX INCHES	DY INCHES	DZ INCHES	X INCHES	Y INCHES	Z INCHES
1	.50000	.79400	.79400	0.	0.	0.
2	48.000	.79400	.79400	48.000	.79400	.79400
3	48.000	.73800	.73800	96.000	1.5320	1.5320
4	48.000	.73800	.73800	144.00	2.2700	2.2700
5	.50000	.73800	.73800	144.50	3.0080	3.0080
6	0.	.73800	.73800	0.	3.7460	3.7460
7	0.	.73800	.73800	0.	4.4840	4.4840
8	0.	.79400	.79400	0.	5.2760	5.2760
9	0.	.79400	.79400	0.	6.0720	6.0720

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 1 CYCLE C TIMET C. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1049.452	47.19524	522.8000	550.6335	0.	328.5733	0.
2	12.20459	1049.452	26.92053	567.4666	550.4779	3.8376768E-02	328.5540	253844.7
3	30.35733	1048.121	10.82289	644.8199	550.3224	.1760064	328.5540	468036.3
4	40.33315	1045.288	8.146005	686.7127	549.9909	.2508775	328.5540	253844.7
5	40.33315	1043.000	5.469123	728.6056	549.6594	.3257485	220.5869	0.

***CHANNEL 2 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1049.804	47.19539	522.8000	550.6821	0.	328.5743	0.
2	13.86675	1049.804	23.69366	574.6344	550.5191	5.1019594E-02	328.5540	262523.2
3	35.10868	1048.409	9.358200	665.1908	550.3561	.2121092	328.5540	484037.6
4	46.77749	1045.481	7.023764	714.2377	550.0134	.2996594	328.5540	262523.2
5	46.77749	1043.000	4.689327	763.2846	549.6707	.3872096	219.3550	0.

***CHANNEL 3 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1049.139	47.19511	522.8000	550.5901	0.	328.5723	0.
2	12.46555	1049.139	26.35696	568.5330	550.4414	4.0347374E-02	328.5540	229979.0
3	31.08306	1047.867	10.57020	647.8635	550.2927	.1814601	328.5540	424032.9
4	41.30378	1045.219	7.954575	690.8320	549.9827	.2581952	328.5540	229979.0
5	41.30378	1043.000	5.338955	733.8005	549.6727	.3349302	220.5190	0.

***CHANNEL 4 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1049.715	47.19535	522.8000	550.6697	0.	328.5741	0.
2	13.68003	1049.715	24.01705	573.8209	550.5087	4.9596511E-02	328.5540	258183.9
3	34.57216	1048.337	9.503429	662.8805	550.3476	.2080222	328.5540	476037.0
4	46.04782	1045.446	7.135061	711.1170	550.0093	.2941306	328.5540	258183.9
5	46.04782	1043.000	4.766694	759.3535	549.6710	.3802391	219.4959	0.

***CHANNEL 5 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1049.448	47.19524	522.8000	550.6328	0.	328.5733	0.
2	13.11968	1049.448	25.04283	571.3803	550.4775	4.5327506E-02	328.5540	245166.3
3	32.96217	1048.120	9.967608	655.9496	550.3222	.1957620	328.5540	452035.1
4	43.85852	1045.341	7.491224	701.7548	549.9970	.2775447	328.5540	245166.3
5	43.85852	1043.000	5.014840	747.5600	549.6718	.3593273	219.9435	0.

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 6 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1049.404	47.19522	522.8000	550.6266	0.	328.5731	0.
2	13.02626	1049.404	25.22244	570.9736	550.4723	4.4616036E-02	328.5540	242996.6
3	32.69378	1048.084	10.04943	654.7945	550.3180	.1937187	328.5540	448034.8
4	43.49360	1045.324	7.554078	700.1944	549.9950	.2747604	328.5540	242996.6
5	43.49360	1043.000	5.058722	745.5944	549.6719	.3558420	220.0220	0.

***CHANNEL 7 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1048.474	47.19462	522.8000	550.4996	0.	328.5704	0.
2	10.22284	1048.474	32.13922	558.8416	550.3637	2.3306432E-02	328.5540	201774.0
3	24.66347	1047.313	13.32148	620.3270	550.2279	.1327070	328.5540	372028.9
4	32.59259	1044.905	10.08064	653.6276	549.9459	.1922794	328.5540	201774.0
5	32.59259	1043.000	6.839787	686.9282	549.6639	.2518518	222.9264	0.

***CHANNEL 9 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1049.318	47.19506	522.8000	550.5733	0.	328.5720	0.
2	13.55124	1049.318	24.24531	573.1561	550.4271	4.8585500E-02	328.5540	223470.1
3	34.16701	1047.768	9.616118	661.0143	550.2810	.2048204	328.5540	412032.0
4	45.47245	1045.245	7.225342	708.6081	549.9856	.2897150	328.5540	223470.1
5	45.47245	1043.000	4.834566	756.2019	549.6903	.3746096	219.8396	0.

***CHANNEL 10 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1048.517	47.19484	522.8000	550.5038	0.	328.5705	0.
2	12.37751	1048.517	26.54444	568.0574	550.3685	3.9656206E-02	328.5540	199604.4
3	30.79830	1047.359	10.66793	646.5328	550.2332	.1792013	328.5540	368028.6
4	40.89548	1045.041	8.033994	689.0448	549.9617	.2550580	328.5540	199604.4
5	40.89548	1043.000	5.400062	731.5569	549.6902	.3309146	220.8381	0.

***CHANNEL 11 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1049.481	47.19525	522.8000	550.6376	0.	328.5734	0.
2	14.61717	1049.481	22.47726	577.7913	550.4812	5.6703942E-02	328.5540	245166.3
3	37.22726	1048.143	8.825630	674.1792	550.3249	.2281152	328.5540	452035.1
4	49.63175	1045.432	6.619835	726.3922	550.0075	.3212239	328.5540	245166.3
5	49.63175	1043.000	4.414041	778.6051	549.6902	.4143325	219.0766	0.

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 12 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1048.926	47.19502	522.8000	550.5605	0.	328.5717	0.
2	13.33793	1048.926	24.63306	572.2290	550.4164	4.6961934E-02	328.5540	219130.9
3	33.55471	1047.694	9.791591	658.3813	550.2723	.2001620	328.5540	404031.4
4	44.64041	1045.208	7.360013	705.0512	549.9813	.2834135	328.5540	219130.9
5	44.64041	1043.000	4.928435	751.7211	549.6903	.3666651	220.0074	0.

***CHANNEL 13 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1049.018	47.19506	522.8000	550.5733	0.	328.5720	0.
2	13.55124	1049.018	24.24531	573.1561	550.4271	4.8585500E-02	328.5540	223470.1
3	34.16701	1047.768	9.616118	661.0143	550.2810	.2048204	328.5540	412032.0
4	45.47245	1045.245	7.225342	708.6081	549.9856	.2897150	328.5540	223470.1
5	45.47245	1043.000	4.834566	756.2019	549.6903	.3746096	219.8396	0.

***CHANNEL 14 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1048.617	47.19488	522.8000	550.5182	0.	328.5708	0.
2	11.34314	1048.617	28.96499	563.6520	550.3804	3.1810491E-02	328.5540	203943.6
3	27.85968	1047.438	11.79317	634.0015	550.2425	.1569470	328.5540	376029.2
4	36.92280	1045.011	8.898406	672.1065	549.9583	.2250267	328.5540	203943.6
5	36.92280	1043.000	6.003638	710.2116	549.6741	.2931065	221.6711	0.

***CHANNEL 17 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1048.972	47.19504	522.8000	550.5669	0.	328.5718	0.
2	13.44459	1048.972	24.43764	572.6926	550.4218	4.7773713E-02	328.5540	221300.5
3	33.86087	1047.731	9.703058	659.6978	550.2766	.2024912	328.5540	408031.7
4	45.05644	1045.227	7.292055	706.8297	549.9835	.2865643	328.5540	221300.5
5	45.05644	1043.000	4.881051	753.9615	549.6903	.3706373	219.9228	0.

***CHANNEL 18 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1048.562	47.19486	522.8000	550.5101	0.	328.5706	0.
2	12.48427	1048.562	26.31745	568.5209	550.3738	4.0467936E-02	328.5540	201774.0
3	31.10466	1047.396	10.56286	647.8493	550.2375	.1815301	328.5540	372028.9
4	41.31164	1045.059	7.953062	690.8233	549.9639	.2582085	328.5540	201774.0
5	41.31164	1043.000	5.343266	733.7974	549.6902	.3348868	220.7391	0.

TABLE E-I (continued)

SCORE-EVET   BENEDETTI-KISER-LORDS   MOD 1   VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 19   CYCLE 0   TIMET 0.   ITER 0   DELTA TIME .30000E-02   POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1048.382	47.19478	522.8000	550.4852	0.	328.5701	0.
2	12.05717	1048.382	27.24968	556.6669	550.3527	3.7221022E-02	328.5540	193095.5
3	29.87911	1047.249	10.99611	642.5832	550.2202	.1722152	328.5540	356027.6
4	39.64689	1044.985	8.287006	633.7093	549.9552	.2456065	328.5540	193095.5
5	39.64689	1043.000	5.577902	724.8353	549.6901	.3189978	221.1465	0.

***CHANNEL 20   CYCLE 0   TIMET 0.   ITER 0   DELTA TIME .30000E-02   POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1048.337	47.19476	522.8000	550.4790	0.	328.5699	0.
2	11.95037	1048.337	27.49322	566.2034	550.3475	3.6409294E-02	328.5540	190925.9
3	29.57267	1047.212	11.11006	641.2667	550.2159	.1698866	328.5540	352027.3
4	39.23066	1044.967	8.374929	681.9307	549.9530	.2424560	328.5540	190925.9
5	39.23066	1043.000	5.639803	722.5948	549.6901	.3150255	221.2532	0.

***CHANNEL 21   CYCLE 0   TIMET 0.   ITER 0   DELTA TIME .30000E-02   POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1049.095	47.19509	522.8000	550.5840	0.	328.5722	0.
2	12.37207	1049.095	26.55612	568.1263	550.4363	3.9635952E-02	328.5540	227809.4
3	30.81455	1047.832	10.66230	646.7084	550.2885	.1794172	328.5540	420032.6
4	40.93877	1045.202	8.025499	689.2716	549.9807	.2554311	328.5540	227809.4
5	40.93877	1043.000	5.388694	731.8348	549.6728	.3314449	220.6065	0.

***CHANNEL 25   CYCLE 0   TIMET 0.   ITER 0   DELTA TIME .30000E-02   POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1048.248	47.19473	522.8000	550.4667	0.	328.5697	0.
2	11.73673	1048.248	27.99357	565.2764	550.3370	3.4785831E-02	328.5540	186586.7
3	28.95973	1047.139	11.34521	638.6336	550.2074	.1652294	328.5540	344026.7
4	38.39816	1044.930	8.556503	678.3736	549.9487	.2361552	328.5540	186586.7
5	38.39816	1043.000	5.767801	718.1136	549.6900	.3070810	221.4730	0.

***CHANNEL 26   CYCLE 0   TIMET 0.   ITER 0   DELTA TIME .30000E-02   POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1048.337	47.19476	522.8000	550.4790	0.	328.5699	0.
2	11.95037	1048.337	27.49322	566.2034	550.3475	3.6409294E-02	328.5540	190925.9
3	29.57267	1047.212	11.11006	541.2667	550.2159	.1698866	328.5540	352027.3
4	39.23066	1044.967	8.374929	581.9307	549.9530	.2424560	328.5540	190925.9
5	39.23066	1043.000	5.639803	722.5948	549.6901	.3150255	221.2532	0.

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 27 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U	PRESSURE	DENSITY	ENERGY	TEMP	QUAL	MASS FLUX	HEAT FLUX
	FT/SEC	PSI	LBM/FT3	BTU/LBM	DEG F		LBM/FT2*SEC	BTU/FT2.HR.
1	6.962000	1048.337	47.19476	522.8000	550.4790	0.	328.5699	0.
2	11.95037	1048.337	27.49322	566.2034	550.3475	3.6409294E-02	328.5540	190925.9
3	29.57267	1047.212	11.11006	641.2667	550.2159	.1698866	328.5540	352027.3
4	39.23066	1044.967	6.374929	681.9307	549.9530	.2424560	328.5540	190925.9
5	39.23066	1043.000	5.639803	722.5948	549.6901	.3150255	221.2532	0.

***CHANNEL 28 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U	PRESSURE	DENSITY	ENERGY	TEMP	QUAL	MASS FLUX	HEAT FLUX
	FT/SEC	PSI	LBM/FT3	BTU/LBM	DEG F		LBM/FT2*SEC	BTU/FT2.HR.
1	6.962000	1048.877	47.19500	522.8000	550.5539	0.	328.5716	0.
2	11.90451	1048.877	27.59911	566.0925	550.4107	3.6078900E-02	328.5540	216961.3
3	29.47170	1047.652	11.14812	640.9326	550.2675	.1692029	328.5540	400031.1
4	39.11351	1045.115	8.400013	681.4694	549.9705	.2416106	328.5540	216961.3
5	39.11351	1043.000	5.651905	722.0062	549.6734	.3140184	221.0659	0.

***CHANNEL 33 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U	PRESSURE	DENSITY	ENERGY	TEMP	QUAL	MASS FLUX	HEAT FLUX
	FT/SEC	PSI	LBM/FT3	BTU/LBM	DEG F		LBM/FT2*SEC	BTU/FT2.HR.
1	6.962000	1048.026	47.19463	522.8000	550.4364	0.	328.5690	0.
2	11.20241	1048.026	29.32886	562.9588	550.3112	3.0727090E-02	328.5540	175738.6
3	27.42697	1046.956	11.97923	632.0510	550.1860	.1535873	328.5540	324025.2
4	36.31665	1044.838	9.046926	669.4808	549.9379	.2204035	328.5540	175738.6
5	36.31665	1043.000	6.114622	706.9105	549.6899	.2872198	222.0626	0.

***CHANNEL 34 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U	PRESSURE	DENSITY	ENERGY	TEMP	QUAL	MASS FLUX	HEAT FLUX
	FT/SEC	PSI	LBM/FT3	BTU/LBM	DEG F		LBM/FT2*SEC	BTU/FT2.HR.
1	6.962000	1048.337	47.19475	522.8000	550.4790	0.	328.5699	0.
2	11.95037	1048.337	27.49322	566.2034	550.3475	3.6409294E-02	328.5540	190925.9
3	29.57267	1047.212	11.11005	641.2667	550.2159	.1698866	328.5540	352027.3
4	39.23066	1044.967	8.374929	681.9307	549.9530	.2424560	328.5540	190925.9
5	39.23066	1043.000	5.639803	722.5948	549.6901	.3150255	221.2532	0.

***CHANNEL 35 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U	PRESSURE	DENSITY	ENERGY	TEMP	QUAL	MASS FLUX	HEAT FLUX
	FT/SEC	PSI	LBM/FT3	BTU/LBM	DEG F		LBM/FT2*SEC	BTU/FT2.HR.
1	6.962000	1048.964	47.19503	522.8000	550.5659	0.	328.5718	0.
2	12.09156	1048.964	27.17217	566.9060	550.4209	3.7501711E-02	328.5540	221300.5
3	30.00889	1047.724	10.94856	643.2429	550.2759	.1732885	328.5540	408031.7
4	39.84365	1045.150	8.246082	684.5903	549.9746	.2471388	328.5540	221300.5
5	39.84365	1043.000	5.543607	725.9377	549.6732	.3209890	220.8776	0.

TABLE E-I (continued)

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SCORE-EVET       BENEDETTI-KISER-LORDS     MOD 1    VER 2
 EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT
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***CHANNEL 41 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1048.517	47.19484	532.8000	550.5038	0.	328.5705	0.
2	12.37751	1048.517	26.54444	558.0574	550.3685	3.9656206E-02	328.5540	199604.4
3	30.79830	1047.359	10.66793	646.5328	550.2332	.1792013	328.5540	368028.6
4	40.89548	1045.041	8.033994	689.0448	549.9617	.2550580	328.5540	199604.4
5	40.89548	1043.000	5.400062	731.5569	549.6902	.3309146	220.8381	0.

***CHANNEL 42 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1049.493	47.19526	532.8000	550.6389	0.	328.5734	0.
2	13.21309	1049.493	24.86579	571.7871	550.4827	4.6038983E-02	328.5540	247335.9
3	33.23055	1048.156	9.887108	637.1048	550.3265	.1978052	328.5540	456035.4
4	44.22344	1045.359	7.429409	703.3152	549.9991	.2803089	328.5540	247335.9
5	44.22344	1043.000	4.971711	749.5256	549.6717	.3628126	219.8662	0.

***CHANNEL 49 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .30000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.962000	1049.162	47.19512	532.8000	550.5937	0.	328.5724	0.
2	11.62705	1049.162	28.25773	554.9509	550.4442	3.3981251E-02	328.5540	238657.4
3	28.69753	1047.383	11.44886	637.6762	550.2946	.1633757	328.5540	440034.2
4	38.07610	1045.176	8.628879	677.0632	549.9777	.2337855	328.5540	238657.4
5	38.07610	1043.000	5.808895	716.4502	549.6608	.3041954	221.1801	0.

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

FUEL ROD 1 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 1, 0, 0, 0,

	..........R A D I A L	P O S I T I O N S..........						
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2288.9	2009.7	1669.5	1284.2	906.6	628.9	566.3	2
2	3752.1	3237.5	2610.1	1899.7	1203.5	691.5	576.0	2
3	2300.4	2021.3	1681.0	1295.7	918.1	640.4	577.8	2

FUEL ROD 2 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 2, 0, 0, 0,

	..........R A D I A L	P O S I T I O N S..........						
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2348.0	2059.4	1707.5	1309.0	918.5	631.3	566.6	2
2	5044.1	4511.9	3863.1	3128.4	2408.3	1878.8	1759.4	9
3	2362.5	2073.8	1721.9	1323.4	932.9	645.7	581.0	2

FUEL ROD 3 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 3, 0, 0, 0,

	..........R A D I A L	P O S I T I O N S..........						
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2126.1	1873.2	1565.0	1215.9	873.8	622.2	565.5	2
2	3455.8	2989.5	2421.2	1777.5	1146.8	682.9	578.3	2
3	2137.0	1884.1	1575.8	1226.8	884.7	633.1	576.3	2

FUEL ROD 4 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 4, 0, 0, 0,

	..........R A D I A L	P O S I T I O N S..........						
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2318.5	2034.6	1688.5	1296.6	912.5	630.1	566.4	2
2	4984.2	4460.7	3822.7	3100.1	2392.0	1871.2	1753.8	9
3	2332.4	2048.5	1702.5	1310.6	926.5	644.1	580.4	2

FUEL ROD 5 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 5, 0, 0, 0,

	..........R A D I A L	P O S I T I O N S..........						
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2229.7	1960.1	1631.5	1259.4	894.7	626.5	566.0	2
2	3655.7	3158.6	2552.7	1866.6	1194.2	699.7	588.2	2
3	2242.3	1972.7	1644.1	1272.0	907.3	639.1	578.6	2

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

FUEL ROD 6 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 6, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2214.9	1947.7	1622.0	1253.1	891.7	625.9	565.9	2
2	3627.2	3134.5	2534.0	1853.9	1187.4	697.3	586.8	2
3	2227.3	1960.1	1634.4	1265.5	904.1	638.2	578.3	2

FUEL ROD 7 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 7, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1933.7	1711.3	1441.4	1135.1	834.9	614.2	564.4	2
2	3094.0	2684.9	2186.2	1621.5	1068.1	661.1	569.4	2
3	1937.3	1715.[illegible]	1445.0	1138.7	838.6	617.8	563.1	2

FUEL ROD 8 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 9, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2081.7	1836.0	1536.4	1197.2	864.8	620.4	565.2	2
2	3386.8	2933.7	2381.4	1756.0	1143.1	692.4	590.7	2
3	2094.0	1848.3	1548.8	1209.6	877.1	632.7	577.6	2

FUEL ROD 9 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 10, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1918.9	1699.4	1431.9	1128.9	832.0	613.6	564.4	2
2	3072.3	2667.6	2174.3	1615.7	1068.2	665.6	574.9	2
3	1928.5	1709.0	1441.4	1138.5	841.5	623.2	573.9	2

FUEL ROD 10 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 11, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2229.7	1960.1	1631.5	1259.4	894.7	626.5	566.0	2
2	4750.2	4253.1	3647.2	2961.1	2288.7	1794.2	1682.6	9
3	2243.8	1974.2	1645.6	1273.5	908.8	640.6	580.1	3

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

FUEL ROD 11 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 12, 0, 0, 0,

	R A D I A L P O S I T I O N S						
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2052.1	1811.2	1517.4	1184.8	858.9	619.1	565.1	2
2	3329.8	2885.5	2344.0	1730.7	1129.7	687.7	588.0	2
3	2064.0	1823.0	1529.3	1196.7	870.7	631.0	576.9	2

FUEL ROD 12 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 13, 0, 0, 0,

	R A D I A L P O S I T I O N S							
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2081.7	1836.0	1536.4	1197.2	864.8	620.4	565.2	2
2	3386.8	2933.7	2381.4	1756.0	1143.1	692.4	590.7	2
3	2094.0	1848.3	1548.8	1209.6	877.1	632.7	577.6	2

FUEL ROD 13 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 14, 0, 0, 0,

	R A D I A L P O S I T I O N S							
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1948.5	1724.2	1450.9	1141.3	837.9	614.8	564.5	2
2	3121.2	2707.7	2203.7	1633.0	1073.6	662.2	569.5	2
3	1955.9	1731.7	1458.3	1148.7	845.4	622.3	572.0	2

FUEL ROD 14 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 17, 0, 0, 0,

	R A D I A L P O S I T I O N S							
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2066.9	1823.6	1526.9	1191.0	861.8	619.7	565.2	2
2	3358.3	2909.6	2362.7	1743.4	1136.4	690.0	589.4	2
3	2079.0	1835.7	1539.0	1203.1	873.9	631.8	577.3	2

FUEL ROD 15 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 18, 0, 0, 0,

	R A D I A L P O S I T I O N S							
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1933.7	1711.8	1441.4	1135.1	835.0	614.2	564.4	2
2	3101.0	2691.9	2193.3	1628.6	1075.2	668.2	576.4	2
3	1943.5	1721.7	1451.2	1144.9	844.8	624.1	574.3	2

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

FUEL ROD 16 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 19, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	....	R A D I A L	P O S I T I O N S	....				
1	1874.5	1662.1	1403.3	1110.2	823.0	611.8	564.1	2
2	2986.1	2594.5	2117.4	1577.0	1047.4	657.9	570.1	2
3	1883.2	1670.9	1412.1	1119.0	831.7	620.5	572.9	2

FUEL ROD 17 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 20, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	....	R A D I A L	P O S I T I O N S	....				
1	1859.7	1649.7	1393.8	1104.0	820.0	611.1	564.0	2
2	2957.7	2570.5	2098.8	1564.4	1040.8	655.7	568.8	2
3	1868.1	1658.2	1402.3	1112.5	828.4	619.6	572.5	2

FUEL ROD 18 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 21, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	....	R A D I A L	P O S I T I O N S	....				
1	2111.3	1860.3	1555.5	1209.7	870.8	621.6	565.4	2
2	3427.2	2965.3	2402.3	1764.7	1139.9	680.4	576.8	2
3	2121.9	1871.4	1566.1	1220.3	881.4	632.2	576.0	2

FUEL ROD 19 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 25, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	....	R A D I A L	P O S I T I O N S	....				
1	1830.1	1624.9	1374.8	1091.6	814.0	609.9	563.9	2
2	2903.2	2524.9	2063.8	1541.6	1029.8	653.5	568.6	2
3	1837.9	1632.7	1382.6	1099.4	821.9	617.7	571.7	2

FUEL ROD 20 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 26, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	....	R A D I A L	P O S I T I O N S	....				
1	1859.7	1649.7	1393.8	1104.0	820.0	611.1	564.0	2
2	2957.7	2570.5	2098.8	1564.4	1040.8	655.7	568.8	2
3	1868.1	1658.2	1402.3	1112.5	828.4	619.6	572.5	2

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

FUEL ROD 21 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 27, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S	....			
1	1859.7	1649.7	1393.8	1104.0	820.0	611.1	564.0	2
2	2957.7	2570.6	2098.8	1564.4	1040.8	655.7	568.8	2
3	1868.1	1658.2	1402.3	1112.5	828.4	619.6	572.5	2

FUEL ROD 22 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 28, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S	....			
1	2037.3	1798.7	1507.9	1178.6	855.9	618.5	565.0	2
2	3284.7	2844.8	2308.7	1701.5	1106.4	668.8	570.1	2
3	2046.5	1808.0	1517.2	1187.8	865.1	627.8	574.2	2

FUEL ROD 23 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 33, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S	....			
1	1756.0	1562.8	1327.2	1060.5	799.1	606.8	563.4	2
2	2766.9	2410.6	1976.3	1484.4	1002.4	648.0	568.0	2
3	1762.3	1569.0	1333.5	1066.7	805.3	613.0	569.7	2

FUEL ROD 24 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 34, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S	....			
1	1859.7	1649.7	1393.8	1104.0	820.0	611.1	564.0	2
2	2957.7	2570.6	2098.8	1564.4	1040.8	655.7	568.8	2
3	1868.1	1658.2	1402.3	1112.5	828.4	619.6	572.5	2

FUEL ROD 25 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 35, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S	....			
1	2066.9	1823.6	1526.9	1191.0	861.8	619.7	565.2	2
2	3341.2	2892.5	2345.6	1726.2	1119.3	672.9	572.2	2
3	2076.7	1833.4	1536.7	1200.8	871.6	629.5	575.0	2

TABLE E-I (continued)

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SCORE-EVET        BENEDETTI-KISER-LORDS     MOD 1    VER 2
 EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT
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FUEL ROD 26 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 41, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	R A D I A L		P O S I T I O N S					
1	1918.9	1699.4	1431.9	1128.9	832.0	613.6	564.4	2
2	3072.3	2667.6	2174.3	1615.7	1068.2	665.6	574.9	2
3	1928.5	1709.0	1441.4	1138.5	841.5	623.2	573.9	2

FUEL ROD 27 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 42, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	R A D I A L		P O S I T I O N S					
1	2244.5	1972.5	1641.0	1265.6	897.6	627.1	566.1	2
2	3684.2	3182.7	2571.5	1879.3	1200.9	702.0	589.5	2
3	2257.3	1985.4	1653.8	1278.4	910.5	639.9	578.9	2

FUEL ROD 28 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 49, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	R A D I A L		P O S I T I O N S					
1	2185.3	1922.9	1603.0	1240.7	885.7	624.6	565.7	2
2	3557.2	3073.3	2483.5	1815.6	1161.0	679.6	571.1	2
3	2194.8	1932.4	1612.5	1250.3	895.2	634.2	575.3	2

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 1 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

K	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	11.81116	1047.493	26.35115	568.2828	550.2491	4.0307170E-02	311.2376	253307.2
3	29.58014	1046.454	10.23104	651.9417	550.1275	.1889802	302.6355	467045.2
4	39.43916	1044.440	7.549224	700.0752	549.8915	.2747218	297.7351	253307.2
5	39.43916	1042.955	4.867413	748.2088	549.6555	.3604635	191.9667	0.

***CHANNEL 2 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

K	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	13.01227	1047.493	24.08214	573.2997	550.2491	4.9210544E-02	313.3633	261967.2
3	32.04695	1046.454	9.361316	664.6722	550.1275	.2115651	300.0016	483012.6
4	42.49585	1044.440	7.040086	713.4828	549.8915	.2984930	299.1744	261967.2
5	42.49585	1042.955	4.718856	762.2933	549.6555	.3854208	200.5318	0.

***CHANNEL 3 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

K	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	12.57125	1047.493	25.74701	569.5322	550.2491	4.2524497E-02	323.6720	229492.0
3	31.23133	1046.454	10.18112	652.6134	550.1275	.1901719	317.9701	423135.0
4	41.54391	1044.440	7.551706	700.0143	549.8915	.2746138	313.7274	229492.0
5	41.54391	1042.955	4.922289	747.4151	549.6555	.3590557	204.4911	0.

***CHANNEL 4 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

K	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	13.10693	1047.493	24.08835	573.2847	550.2491	4.9183897E-02	315.7244	257637.2
3	32.21101	1046.454	9.405848	663.9631	550.1275	.2103072	302.9718	475028.9
4	42.70910	1044.440	7.054710	713.0706	549.8915	.2977623	301.3003	257637.2
5	42.70910	1042.955	4.703573	762.1781	549.6555	.3852174	200.8854	0.

***CHANNEL 5 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

K	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	12.83749	1047.493	24.86277	571.4704	550.2491	4.5964065E-02	319.1756	244647.1
3	31.68818	1046.454	9.759159	658.5672	550.1275	.2007343	309.2500	451077.8
4	42.05507	1044.440	7.299642	706.4140	549.8915	.2859602	306.9870	244647.1
5	42.05507	1042.955	4.840125	754.2607	549.6555	.3711861	203.5518	0.

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 6 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	12.44620	1047.493	25.52699	570.0019	550.2491	4.3358074E-02	317.7140	242482.1
3	30.81868	1046.454	10.07100	654.1191	550.1275	.1928430	310.3750	447086.0
4	40.86332	1044.440	7.627377	698.1756	549.8915	.2713539	311.6799	242482.1
5	40.86332	1042.955	5.183750	742.2322	549.6555	.3498648	211.8252	0.

***CHANNEL 7 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	10.31680	1047.493	31.01626	560.2739	550.2492	2.6094237E-02	319.9886	201346.7
3	26.57152	1045.454	12.45763	627.4505	550.1275	.1455309	331.0183	371241.1
4	35.50586	1044.440	9.314056	664.9471	549.8915	.2124407	330.7036	201346.7
5	35.50586	1042.955	6.170480	702.4436	549.6555	.2793504	219.0682	0.

***CHANNEL 9 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	13.60010	1047.493	24.41800	572.4983	550.2491	4.7788342E-02	332.0872	222996.9
3	33.52152	1046.454	9.751117	658.6856	550.1275	.2009445	326.3723	411159.5
4	44.44907	1044.440	7.329479	705.6334	549.8915	.2845764	325.7885	222996.9
5	44.44907	1042.955	4.907840	752.5813	549.6555	.3682083	218.1489	0.

***CHANNEL 10 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	13.29564	1047.493	25.71381	569.6026	550.2491	4.2649351E-02	341.8815	199181.7
3	32.97366	1046.454	10.40975	649.5892	550.1275	.1848068	343.2475	367249.2
4	43.80737	1044.440	7.741636	695.4674	549.8915	.2665524	339.1407	199181.7
5	43.80737	1042.955	5.073525	741.3456	549.6555	.3482980	222.2578	0.

***CHANNEL 11 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	13.96910	1047.493	23.35954	575.1021	550.2491	5.2409084E-02	326.3118	244647.1
3	34.09652	1045.454	9.320912	665.3213	550.1275	.2127167	317.8107	451077.8
4	45.05178	1044.439	7.129849	710.9799	549.8915	.2940555	321.2124	244647.1
5	45.05178	1042.955	4.938787	756.6384	549.6555	.3753942	222.5011	0.

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 12 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	13.54347	1047.493	24.70810	571.8237	550.2491	4.6591011E-02	334.6335	218666.9
3	33.32533	1046.454	9.932441	656.0610	550.1275	.1962882	331.0019	403175.8
4	44.13236	1044.440	7.509066	701.0667	549.8915	.2764797	331.3928	218666.9
5	44.13236	1042.955	5.085690	746.0724	549.6555	.3566711	224.4435	0.

***CHANNEL 13 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	13.22392	1047.493	25.02505	571.0820	550.2491	4.5274872E-02	331.0615	222996.9
3	32.62404	1046.454	10.06929	654.1427	550.1275	.1928849	328.5011	411159.5
4	43.17646	1044.439	7.695162	696.5593	549.8915	.2684882	332.2498	222996.9
5	43.17646	1042.955	5.321030	738.9759	549.6555	.3440914	229.7432	0.

***CHANNEL 14 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	11.39758	1047.493	28.64810	564.0135	550.2492	3.2730695E-02	326.5190	203511.7
3	28.90202	1046.454	11.51369	636.6766	550.1275	.1618987	332.7691	375232.9
4	38.48518	1044.440	8.659578	676.3038	549.8915	.2325758	333.2654	203511.7
5	38.48518	1042.955	5.805462	715.9310	549.6555	.3032529	223.4242	0.

***CHANNEL 17 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	13.46098	1047.493	24.93085	571.3163	550.2491	4.5690567E-02	335.5937	220831.9
3	33.14771	1046.454	10.12225	653.4143	550.1275	.1915928	335.5293	407167.6
4	43.90074	1044.440	7.689076	696.7032	549.8915	.2687434	337.5561	220831.9
5	43.90074	1042.955	5.255905	739.9921	549.6555	.3458940	230.7381	0.

***CHANNEL 18 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	13.20243	1047.493	25.91725	569.1742	550.2491	4.1889226E-02	342.1705	201346.7
3	32.64024	1046.454	10.57887	647.4362	550.1275	.1809871	345.2970	371241.1
4	43.26122	1044.440	7.989632	689.8559	549.8915	.2566034	345.6412	201346.7
5	43.26122	1042.955	5.400390	732.2757	549.6555	.3322197	233.6275	0.

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 19 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	12.86589	1047.493	26.78517	567.4200	550.2491	3.8776009E-02	344.6150	192686.6
3	32.00367	1046.454	11.00518	642.3027	550.1275	.1718799	352.2062	355273.7
4	42.47204	1044.440	8.298694	683.3321	549.8915	.2450368	352.4625	192686.6
5	42.47204	1042.955	5.592206	724.3615	549.6555	.3181938	237.5124	0.

***CHANNEL 20 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	12.67962	1047.493	27.02045	566.9638	550.2491	3.7966521E-02	342.6091	190521.6
3	31.64366	1046.454	11.07972	641.4457	550.1275	.1703595	350.6029	351281.9
4	42.01645	1044.439	8.354165	682.2123	549.8915	.2430514	351.0124	190521.6
5	42.01645	1042.955	5.628609	722.9789	549.6555	.3157434	236.4942	0.

***CHANNEL 21 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	11.95402	1047.493	26.82491	567.3424	550.2492	3.8638286E-02	320.6654	227326.9
3	29.88080	1046.454	10.70802	645.8376	550.1275	.1781515	319.9643	419143.1
4	39.68004	1044.440	8.126890	686.8974	549.8915	.2513580	322.4753	227326.9
5	39.68004	1042.955	5.545755	727.9570	549.6555	.3245645	220.0558	0.

***CHANNEL 25 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	12.64648	1047.493	27.41465	566.2171	550.2491	3.6641393E-02	346.6988	186191.6
3	31.56965	1046.454	11.33135	638.6359	550.1275	.1653747	357.7267	343298.2
4	41.91786	1044.440	8.549994	678.3752	549.8915	.2362484	358.3975	186191.6
5	41.91786	1042.955	5.768639	718.1145	549.6555	.3071220	241.8090	0.

***CHANNEL 26 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	12.50948	1047.493	27.46643	566.1207	550.2491	3.6470155E-02	343.5908	190521.6
3	31.26747	1046.454	11.38105	638.0955	550.1275	.1644162	355.8558	351281.9
4	41.50845	1044.440	8.649275	676.4963	549.8915	.2329171	359.0130	190521.6
5	41.50845	1042.955	5.917497	714.8969	549.6555	.3014160	245.6251	0.

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 27 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	12.47627	1047.493	27.38809	566.2668	550.2491	3.6729485E-02	341.7012	190521.6
3	31.22565	1046.454	11.28226	639.1743	550.1275	.1663298	352.2958	351281.9
4	41.47251	1044.439	8.549841	678.3781	549.8915	.2362536	354.5833	190521.6
5	41.47251	1042.955	5.817426	717.5820	549.6555	.3061774	241.2632	0.

***CHANNEL 28 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	11.83760	1047.493	27.36060	566.3183	550.2492	3.6820841E-02	323.8838	216501.8
3	29.66799	1046.454	10.98032	642.5911	550.1275	.1723915	325.7641	399183.9
4	39.44902	1044.440	8.278346	683.7467	549.8915	.2457718	326.5726	216501.8
5	39.44902	1042.955	5.576368	724.9022	549.6555	.3191521	219.9822	0.

***CHANNEL 33 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	12.22011	1047.493	28.49651	564.2741	550.2491	3.3193067E-02	348.2306	175366.5
3	30.76470	1046.454	11.87738	632.9483	550.1275	.1552844	365.4040	323339.0
4	40.92071	1044.440	8.954003	670.9894	549.8915	.2231535	366.4041	175366.5
5	40.92071	1042.955	6.030628	709.0305	549.6555	.2910227	246.7776	0.

***CHANNEL 34 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	12.48519	1047.493	27.35976	566.3198	550.2492	3.6823638E-02	341.5917	190521.6
3	31.24593	1046.454	11.26537	639.3605	550.1275	.1666602	351.9971	351281.9
4	41.50557	1044.439	8.530841	678.7427	549.8915	.2369000	354.0774	190521.6
5	41.50557	1042.955	5.796309	718.1249	549.6555	.3071398	240.5791	0.

***CHANNEL 35 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	12.00881	1047.493	26.90805	567.1808	550.2492	3.8351482E-02	323.1335	220831.9
3	29.99554	1046.454	10.76061	645.1980	550.1275	.1770164	322.7704	407167.6
4	39.86604	1044.440	8.104208	687.3794	549.8915	.2522125	323.0826	220831.9
5	39.86604	1042.955	5.447802	729.5608	549.6555	.3274087	217.1823	0.

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 41 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	12.80336	1047.493	26.36424	568.2160	550.2492	4.0188674E-02	337.8068	199181.7
3	31.87433	1046.454	10.72273	645.6582	550.1275	.1778328	341.7799	367249.2
4	42.30631	1044.439	8.099780	687.4738	549.8915	.2523799	342.6718	199181.7
5	42.30631	1042.955	5.476826	729.2894	549.6555	.3269269	231.7043	0.

***CHANNEL 42 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	12.46829	1047.493	25.33430	570.4200	550.2492	4.4100012E-02	315.8754	246812.1
3	30.87941	1046.454	9.964117	655.6123	550.1275	.1954922	307.6860	455069.7
4	40.94271	1044.440	7.556917	699.8865	549.8915	.2743872	309.4007	246812.1
5	40.94271	1042.955	5.149717	744.1606	549.6555	.3532822	210.8434	0.

***CHANNEL 49 CYCLE 600 TIMET 1.0036 ITER 4 DELTA TIME .20000E-03 POWER AVERAGE 11.975 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.949920	1047.493	47.19438	522.8004	550.3708	0.	327.9972	0.
2	11.29912	1047.493	27.67671	565.7326	550.2492	3.5781390E-02	312.7224	238152.0
3	28.52076	1046.454	10.86056	643.9991	550.1275	.1748894	309.7513	439102.3
4	38.04300	1044.440	8.069721	688.1174	549.8915	.2535211	306.9964	238152.0
5	38.04300	1042.955	5.278884	732.2358	549.6555	.3321527	200.8246	0.

TABLE E-I (continued)

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SCORE-EVET      BENEDETTI-KISER-LORDS     MOD 1    VER 2
 EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT
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FUEL ROD 1 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 1, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2285.0	2006.4	1666.9	1282.4	905.6	628.5	566.0	2
2	3755.3	3241.7	2615.7	1906.8	1212.0	701.1	585.9	2
3	2299.7	2021.1	1681.6	1297.1	920.3	643.2	580.7	2

FUEL ROD 2 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 2, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2344.0	2056.0	1704.8	1307.2	917.5	630.9	566.3	2
2	5121.0	4589.9	3942.5	3209.3	2490.8	1962.4	1843.3	9
3	2360.8	2072.7	1721.6	1323.9	934.2	647.7	583.0	2

FUEL ROD 3 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 3, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2122.6	1870.3	1562.7	1214.3	872.9	621.9	565.3	2
2	3455.2	2989.9	2422.7	1780.5	1151.0	688.2	583.8	2
3	2134.9	1882.6	1575.0	1226.6	885.3	634.2	577.6	2

FUEL ROD 4 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 4, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2314.5	2031.2	1685.9	1294.8	911.6	629.7	566.2	2
2	5039.7	4517.3	3880.6	3159.6	2452.9	1933.3	1816.1	9
3	2330.7	2047.4	1702.0	1311.0	927.7	645.9	582.3	2

FUEL ROD 5 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 5, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2225.9	1956.9	1629.0	1257.7	893.7	626.1	565.8	2
2	3652.8	3156.8	2552.2	1867.5	1196.5	703.0	591.8	2
3	2240.3	1971.2	1643.3	1272.0	908.1	640.4	580.1	2

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LOROS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

FUEL ROD 6 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 6, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2211.2	1944.5	1619.5	1251.5	890.8	625.5	565.7	2
2	3621.1	3129.5	2530.2	1851.6	1186.5	697.4	587.1	2
3	2224.6	1958.0	1632.9	1264.9	904.2	638.9	579.1	2

FUEL ROD 7 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 7, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1930.7	1709.3	1439.4	1133.8	834.3	614.0	564.3	2
2	3088.5	2680.3	2182.7	1619.2	1066.9	660.8	569.2	2
3	1936.6	1715.2	1445.3	1139.7	840.2	619.9	570.3	2

FUEL ROD 8 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 9, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2078.3	1833.1	1534.2	1195.7	864.0	620.1	565.1	2
2	3379.0	2926.9	2375.8	1751.7	1140.1	690.3	588.9	2
3	2090.7	1845.5	1546.6	1208.2	876.4	632.5	577.5	2

FUEL ROD 9 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 10, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1915.9	1696.9	1429.9	1127.6	831.3	613.4	564.2	2
2	3069.7	2665.9	2173.7	1616.2	1069.9	668.2	577.6	2
3	1925.3	1706.3	1439.3	1137.0	840.7	622.8	573.7	2

FUEL ROD 10 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 11, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2225.9	1956.9	1629.0	1257.7	893.7	626.1	565.8	2
2	4814.4	4318.4	3713.8	3029.1	2358.1	1864.6	1753.4	9
3	2240.7	1971.7	1643.8	1272.4	908.5	640.9	580.5	2

TABLE E-I (continued)

SCORE-EVET   BENEDETTI-KISER-LORDS   MOD 1   VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

FUEL ROD 11 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 12, 0, 0, 0,

AXIAL LEVEL	........................R A D I A L P O S I T I O N S........................							HEAT TRANS MODE
	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	
1	2048.8	1808.3	1515.3	1183.3	858.1	618.9	564.9	2
2	3321.9	2878.5	2338.1	1726.1	1126.4	685.3	585.9	2
3	2060.3	1819.9	1526.8	1194.9	869.6	630.4	576.5	2

FUEL ROD 12 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 13, 0, 0, 0,

AXIAL LEVEL	........................R A D I A L P O S I T I O N S........................							HEAT TRANS MODE
	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	
1	2078.3	1833.1	1534.2	1195.7	864.0	620.1	565.1	2
2	3375.0	2922.9	2371.6	1747.7	1136.1	686.3	584.9	2
3	2090.0	1844.8	1545.9	1207.4	875.7	631.7	576.7	2

FUEL ROD 13 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 14, 0, 0, 0,

AXIAL LEVEL	........................R A D I A L P O S I T I O N S........................							HEAT TRANS MODE
	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	
1	1945.4	1721.7	1448.9	1140.0	837.2	614.6	564.4	2
2	3115.7	2703.1	2200.1	1630.6	1072.4	661.9	569.3	2
3	1953.2	1729.5	1456.7	1147.8	845.0	622.4	572.2	2

FUEL ROD 14 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 17, 0, 0, 0,

AXIAL LEVEL	........................R A D I A L P O S I T I O N S........................							HEAT TRANS MODE
	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	
1	2063.6	1820.7	1524.7	1189.5	861.0	619.5	565.0	2
2	3346.7	2898.9	2353.2	1735.2	1129.5	684.0	583.6	2
3	2074.8	1831.9	1535.9	1200.7	872.2	630.7	576.2	2

FUEL ROD 15 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 18, 0, 0, 0,

AXIAL LEVEL	........................R A D I A L P O S I T I O N S........................							HEAT TRANS MODE
	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	
1	1930.7	1709.3	1439.4	1133.8	834.3	614.0	564.3	2
2	3094.9	2686.7	2189.1	1625.6	1073.4	667.3	575.7	2
3	1939.7	1718.3	1448.4	1142.8	843.2	623.0	573.3	2

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LOROS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

FUEL ROD 16 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 19, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1871.6	1659.7	1401.4	1109.0	822.3	611.5	564.0	2
2	2980.7	2590.0	2113.8	1574.5	1046.1	657.4	569.8	2
3	1879.3	1667.5	1409.2	1116.7	830.1	619.3	571.8	2

FUEL ROD 17 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 20, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1856.8	1647.3	1392.0	1102.8	819.4	610.9	563.9	2
2	2952.5	2566.3	2095.4	1562.2	1039.7	655.4	568.7	2
3	1864.4	1654.9	1399.5	1110.4	826.9	618.5	571.5	2

FUEL ROD 18 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 21, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2107.8	1857.9	1553.2	1208.1	870.0	621.3	565.2	2
2	3420.5	2959.6	2397.8	1761.6	1138.1	679.5	576.1	2
3	2118.7	1868.7	1564.0	1218.9	880.8	632.1	576.0	2

FUEL ROD 19 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 25, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1827.3	1622.5	1373.0	1090.4	813.4	609.7	563.8	2
2	2898.2	2520.7	2060.5	1539.4	1028.8	653.2	568.5	2
3	1834.1	1629.3	1379.8	1097.1	820.2	616.5	570.6	2

FUEL ROD 20 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 26, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1856.8	1647.3	1392.0	1102.8	819.4	610.9	563.9	2
2	2952.5	2566.3	2095.4	1562.2	1039.7	655.4	568.7	2
3	1863.7	1654.2	1398.8	1109.6	826.2	617.8	570.8	2

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

FUEL ROD 21 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 27, 0, 0, 0,

	......................R A D I A L	P O S I T I O N S	....	....	....	....	....	
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1856.8	1647.3	1392.0	1102.8	819.4	610.9	563.9	2
2	2952.5	2566.3	2095.4	1562.2	1039.7	655.4	568.7	2
3	1864.0	1654.5	1399.1	1109.9	826.5	618.1	571.1	2

FUEL ROD 22 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 28, 0, 0, 0,

	......................R A D I A L	P O S I T I O N S	....	....	....	....	....	
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2034.0	1796.0	1505.8	1177.1	855.1	618.2	564.8	2
2	3280.3	2841.3	2306.3	1700.4	1106.6	669.9	571.4	2
3	2043.6	1805.6	1515.4	1186.7	864.7	627.8	574.4	2

FUEL ROD 23 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 33, 0, 0, 0,

	......................R A D I A L	P O S I T I O N S	....	....	....	....	....	
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1753.4	1560.6	1325.5	1059.4	798.5	606.6	563.4	2
2	2762.2	2406.6	1973.2	1482.4	1001.4	647.7	568.0	2
3	1758.8	1565.9	1330.9	1064.7	803.8	612.0	568.7	2

FUEL ROD 24 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 34, 0, 0, 0,

	......................R A D I A L	P O S I T I O N S	....	....	....	....	....	
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1856.8	1647.3	1392.0	1102.8	819.4	610.9	563.9	2
2	2952.5	2566.3	2095.4	1562.2	1039.7	655.4	568.7	2
3	1864.0	1654.5	1399.2	1110.0	826.6	618.2	571.2	2

FUEL ROD 25 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 35, 0, 0, 0,

	......................R A D I A L	P O S I T I O N S	....	....	....	....	....	
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2063.6	1820.7	1524.7	1189.5	861.0	619.5	565.0	2
2	3337.9	2890.2	2344.4	1726.4	1120.7	675.3	574.9	2
3	2073.9	1831.1	1535.1	1199.9	871.4	629.8	575.3	2

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

FUEL ROD 26 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 41, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	..................R A D I A L			P O S I T I O N S..................				
1	1915.9	1696.9	1429.9	1127.6	831.3	613.4	564.2	2
2	3066.0	2662.1	2169.9	1612.5	1066.2	664.4	573.8	2
3	1924.7	1705.7	1438.7	1136.4	840.1	622.2	573.1	2

FUEL ROD 27 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 42, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	..................R A D I A L			P O S I T I O N S..................				
1	2240.7	1969.3	1638.5	1263.9	896.7	626.7	565.8	2
2	3677.5	3177.1	2567.1	1876.4	1199.4	701.6	589.3	2
3	2254.7	1983.3	1652.5	1277.9	910.7	640.7	579.8	2

FUEL ROD 28 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 49, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	..................R A D I A L			P O S I T I O N S..................				
1	2181.7	1919.8	1600.6	1239.1	884.8	624.3	565.5	2
2	3554.3	3071.4	2482.9	1816.4	1163.2	682.8	574.5	2
3	2193.6	1931.7	1612.5	1251.1	896.8	636.3	577.5	2

DUMP TAKEN AT TIME .10036E+01 AND CYCLE 605

TABLE E-I (continued)

SCORE-EVET   BENEDETTI-KISER-LORDS   MOD 1   VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 1   CYCLE 5600   TIMET 3.9987   ITER 26   DELTA TIME .50000E-03   POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3565	47.13472	523.4270	542.6633	0.	101.7757	0.
2	2.539348	983.3565	37.37608	543.0890	542.5634	1.2088969E-02	94.91087	22739.90
3	4.289386	982.5434	18.60609	578.7826	542.4636	7.4402500E-02	79.80870	41927.60
4	5.354746	982.0320	12.86042	610.5384	542.4007	.1297688	68.86426	22739.90
5	5.354746	981.8000	7.114740	642.2943	542.3379	.1851351	38.09762	0.

***CHANNEL 2   CYCLE 5600   TIMET 3.9987   ITER 26   DELTA TIME .50000E-03   POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3560	47.13472	523.4270	542.6632	0.	101.7757	0.
2	3.027074	983.3560	36.02607	544.4203	542.5634	1.4406082E-02	109.0536	23517.33
3	4.602057	982.5429	18.64499	578.6337	542.4635	7.4143551E-02	85.80532	43361.03
4	5.662423	982.0316	12.92432	610.0284	542.4007	.1286816	73.18295	23517.33
5	5.662423	981.8000	7.203642	641.4231	542.3378	.1836197	40.79007	0.

***CHANNEL 3   CYCLE 5600   TIMET 3.9987   ITER 26   DELTA TIME .50000E-03   POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3560	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.759360	983.3560	36.91289	543.5348	542.5634	1.2864869E-02	101.8560	20601.96
3	4.390408	982.5429	18.98166	577.3714	542.4635	7.1947210E-02	83.33721	37985.69
4	5.468528	982.0316	13.17426	608.0814	542.4007	.1254945	72.04379	20601.96
5	5.468528	981.8000	7.366855	638.7914	542.3378	.1790417	40.28585	0.

***CHANNEL 4   CYCLE 5600   TIMET 3.9987   ITER 26   DELTA TIME .50000E-03   POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3560	47.13472	523.4270	542.6632	0.	101.7757	0.
2	3.030493	983.3560	36.03258	544.4137	542.5634	1.4394491E-02	109.1965	23128.62
3	4.562943	982.5429	18.76321	578.1853	542.4635	7.3363368E-02	85.61544	42644.31
4	5.622762	982.0316	13.00567	609.3864	542.4007	.1277649	73.12778	23128.62
5	5.622762	981.8000	7.248128	640.5876	542.3378	.1821664	40.75450	0.

***CHANNEL 5   CYCLE 5600   TIMET 3.9987   ITER 26   DELTA TIME .50000E-03   POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3560	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.844755	983.3560	36.69124	543.7521	542.5634	1.3243101E-02	104.3776	21962.47
3	4.514275	982.5429	18.78137	578.1169	542.4635	7.3244351E-02	84.78427	40494.18
4	5.591412	982.0316	13.03888	609.1267	542.4007	.1273130	72.90574	21962.47
5	5.591412	981.8000	7.296387	640.1365	542.3378	.1813816	40.79710	0.

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 5 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3560	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.575748	983.3560	37.66357	542.8178	542.5634	1.1616984E-02	97.01188	21768.11
3	4.600496	982.5429	18.40813	579.5494	542.4635	7.5736922E-02	84.68656	40135.83
4	5.692358	982.0316	12.87803	510.3973	542.4007	.1295233	73.30636	21768.11
5	5.692358	981.8000	7.347924	541.2451	542.3378	.1833098	41.82701	0.

***CHANNEL 7 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3565	47.13472	523.4270	542.6633	0.	101.7757	0.
2	1.674060	983.3565	40.62494	540.2477	542.5634	7.1439809E-03	68.00857	18075.31
3	4.568473	982.5433	17.45660	583.4789	542.4636	8.2573812E-02	79.74999	33327.07
4	5.568114	982.0320	12.65555	612.2080	542.4007	.1326733	70.46756	18075.31
5	5.568114	981.8000	7.854503	640.9371	542.3379	.1827728	43.73477	0.

***CHANNEL 9 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3554	47.13472	523.4270	542.6632	0.	101.7757	0.
2	3.114357	983.3554	36.23817	544.2045	542.5633	1.4030609E-02	112.8586	20018.89
3	4.724776	982.5424	19.09559	576.9541	542.4634	7.1221422E-02	90.22238	36910.63
4	5.835238	982.0310	13.30724	507.0751	542.4006	.1237441	77.65089	20018.89
5	5.835238	981.8000	7.518882	537.1961	542.3378	.1762668	43.87447	0.

***CHANNEL 10 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3554	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.912721	983.3554	36.87589	543.5708	542.5633	1.2927687E-02	107.4092	17880.95
3	4.565803	982.5423	19.37657	575.9465	542.4634	6.9468101E-02	88.46959	32968.71
4	5.692365	982.0310	13.51757	605.5242	542.4006	.1210460	76.94693	17880.95
5	5.692365	981.3000	7.658569	635.1020	542.3378	.1726240	43.59537	0.

***CHANNEL 11 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3554	47.13472	523.4270	542.6632	0.	101.7757	0.
2	3.231552	983.3554	35.84312	544.6084	542.5633	1.4733519E-02	115.8289	21962.47
3	4.827134	982.5423	18.88831	577.7167	542.4634	7.2548274E-02	91.17642	40494.18
4	5.919564	982.0310	13.22156	607.7210	542.4006	.1248678	78.26586	21962.47
5	5.919564	981.8000	7.554801	637.7254	542.3378	.1771873	44.72113	0.

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 12 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3554	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.987460	983.3554	36.67531	543.7677	542.5633	1.3270443E-02	109.5660	19630.17
3	4.723924	982.5423	19.04481	577.1394	542.4634	7.1543818E-02	89.96623	36193.91
4	5.842093	982.0310	13.32841	606.9168	542.4006	.1234686	77.86580	19630.17
5	5.842093	981.8000	7.612010	636.6942	542.3378	.1753935	44.47007	0.

***CHANNEL 13 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3554	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.818904	983.3554	37.16473	543.2909	542.5633	1.2440611E-02	104.7638	20018.89
3	4.786501	982.5423	18.73868	578.2777	542.4634	7.3524384E-02	89.69272	36910.63
4	5.917703	982.0310	13.16843	608.1258	542.4006	.1255719	77.92686	20018.89
5	5.917703	981.8000	7.598177	637.9739	542.3378	.1776194	44.96376	0.

***CHANNEL 14 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3560	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.106842	983.3560	39.18043	541.4527	542.5634	9.2413661E-03	82.54698	18269.66
3	4.537369	982.5429	18.23806	580.2217	542.4635	7.6906570E-02	82.75280	33685.42
4	5.612260	982.0316	12.97312	609.6423	542.4007	.1282100	72.80852	18269.66
5	5.612260	981.8000	7.708179	639.0630	542.3378	.1795135	43.26031	0.

***CHANNEL 17 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3554	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.936745	983.3554	36.72111	543.7226	542.5633	1.3191852E-02	107.8405	19824.53
3	4.622306	982.5423	19.13575	576.8083	542.4634	7.0967685E-02	88.45127	36552.27
4	5.731040	982.0310	13.44246	606.0725	542.4006	.1219999	77.03925	19824.53
5	5.731040	981.8000	7.749154	635.3367	542.3378	.1730320	44.41077	0.

***CHANNEL 18 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3554	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.739736	983.3554	37.41524	543.0517	542.5633	1.2024249E-02	102.5079	18075.31
3	4.566823	982.5423	19.18819	576.6188	542.4634	7.0637942E-02	87.62905	33327.07
4	5.685904	982.0310	13.50804	605.5934	542.4006	.1211664	76.80543	18075.31
5	5.685904	981.8000	7.827898	634.5680	542.3378	.1716949	44.50868	0.

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 19 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3554	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.568037	983.3554	37.88135	542.6150	542.5633	1.1264204E-02	97.28072	17297.87
3	4.524594	982.5423	19.14282	575.7827	542.4634	7.0923127E-02	86.61346	31893.65
4	5.655629	982.0310	13.52083	605.5006	542.4006	.1210049	76.46880	17297.87
5	5.655629	981.8000	7.898842	634.2184	542.3378	.1710865	44.67292	0.

***CHANNEL 20 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3554	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.515124	983.3554	38.04010	542.4687	542.5633	1.1009603E-02	95.67556	17103.52
3	4.569952	982.5423	19.00840	577.2729	542.4634	7.1776004E-02	86.86750	31535.29
4	5.712330	982.0310	13.41982	606.2389	542.4006	.1222894	76.65844	17103.52
5	5.712330	981.8000	7.831236	635.2050	542.3378	.1728028	44.73461	0.

***CHANNEL 21 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3560	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.425023	983.3560	37.99125	542.5136	542.5634	1.1087732E-02	92.12963	20407.60
3	4.490976	982.5429	18.45713	579.3581	542.4635	7.5403981E-02	82.89052	37627.34
4	5.568986	982.0316	12.99782	609.4480	542.4007	.1278719	72.38470	20407.60
5	5.568986	981.8000	7.538519	639.5379	542.3378	.1803359	41.98191	0.

***CHANNEL 25 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3554	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.439873	983.3554	38.23177	542.2937	542.5633	1.0705016E-02	93.28068	16714.80
3	4.478701	982.5423	19.10364	576.9249	542.4634	7.1170466E-02	85.55950	30818.58
4	5.604435	982.0310	13.55252	605.2712	542.4006	.1206056	75.95420	16714.80
5	5.604435	981.8000	8.001391	633.6175	542.3378	.1700412	44.84328	0.

***CHANNEL 26 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3554	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.399120	983.3554	38.30626	542.2261	542.5633	1.0587473E-02	91.90130	17103.52
3	4.520915	982.5423	18.92182	577.5923	542.4634	7.2331819E-02	85.54394	31535.29
4	5.643907	982.0310	13.47611	605.8261	542.4006	.1215712	76.05792	17103.52
5	5.643907	981.8000	8.030402	634.0598	542.3378	.1708105	45.32284	0.

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 27 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3554	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.435597	983.3554	38.22815	542.2970	542.5633	1.0710745E-02	93.10837	17103.52
3	4.563297	982.5423	18.88509	577.7287	542.4634	7.2569135E-02	86.17828	31535.29
4	5.695258	982.0310	13.40094	606.3782	542.4006	.1225316	76.32182	17103.52
5	5.695258	981.8000	7.916791	635.0276	542.3378	.1724941	45.08817	0.

***CHANNEL 28 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3560	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.356364	983.3560	38.19559	542.3267	542.5634	1.0762287E-02	90.00269	19435.81
3	4.417924	982.5429	18.55807	578.9670	542.4635	7.4723560E-02	81.98814	35835.56
4	5.497944	982.0316	13.07323	608.8594	542.4007	.1268479	71.87589	19435.81
5	5.497944	981.8000	7.588394	638.7517	542.3378	.1789723	41.72056	0.

***CHANNEL 33 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3554	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.244320	983.3554	38.60207	541.7832	542.5633	9.8165470E-03	87.08426	15743.01
3	4.488328	982.5423	18.91977	577.5999	542.4634	7.2345042E-02	84.91814	29026.80
4	5.616314	982.0310	13.51769	605.5234	542.4006	.1210445	75.91958	15743.01
5	5.616314	981.8000	8.115606	633.4468	542.3378	.1697440	45.57979	0.

***CHANNEL 34 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3554	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.453466	983.3554	38.17556	542.3448	542.5633	1.0794024E-02	93.66245	17103.52
3	4.564045	982.5423	18.90675	577.6482	542.4634	7.2429052E-02	86.29129	31535.29
4	5.698320	982.0310	13.40171	606.3725	542.4006	.1225217	76.36725	17103.52
5	5.698320	981.8000	7.896674	635.0967	542.3378	.1726143	44.99777	0.

***CHANNEL 35 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3560	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.445537	983.3560	37.91310	542.5857	542.5634	1.1213112E-02	92.71792	19824.53
3	4.421293	982.5429	18.62800	578.6986	542.4635	7.4256511E-02	82.35985	36552.27
4	5.504964	982.0316	13.07303	608.8609	542.4007	.1268506	71.96658	19824.53
5	5.504964	981.8000	7.518064	639.0232	542.3378	.1794448	41.38668	0.

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LOROS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

***CHANNEL 41 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3554	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.669305	983.3554	37.55571	542.9189	542.5633	1.1793215E-02	100.2476	17880.95
3	4.631518	982.5423	18.97107	577.4103	542.4634	7.2015054E-02	87.86485	32968.71
4	5.772426	982.0310	13.32366	606.9523	542.4006	.1235303	76.90986	17880.95
5	5.772426	981.3000	7.676257	636.4942	542.3378	.1750456	44.31063	0.

***CHANNEL 42 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3560	47.13472	523.4270	542.6632	0.	101.7757	0.
2	2.732804	983.3560	36.98794	543.4618	542.5634	1.2737842E-02	101.0808	22156.83
3	4.557999	982.5429	18.52282	579.1031	542.4635	7.4960321E-02	84.42700	40852.54
4	5.635836	982.0316	12.91720	610.0849	542.4007	.1289800	72.79921	22156.83
5	5.635836	981.3000	7.311576	641.0668	542.3378	.1829997	41.20684	0.

***CHANNEL 49 CYCLE 5600 TIMET 3.9987 ITER 26 DELTA TIME .50000E-03 POWER AVERAGE 1.0750 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	2.159252	983.3565	47.13472	523.4270	542.6633	0.	101.7757	0.
2	2.265883	983.3565	38.32331	542.2109	542.5634	1.0560626E-02	86.83613	21379.39
3	4.308432	982.5433	18.35543	579.7565	542.4636	7.6097085E-02	79.08313	39419.11
4	5.369477	982.0320	12.82316	610.8381	542.4007	.1302901	68.85367	21379.39
5	5.369477	981.6000	7.290886	641.9196	542.3379	.1844831	39.14825	0.

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

FUEL ROD 1 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 1, 0, C, 0,

AXIAL LEVEL	FUEL 0.000C0 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S.......				
1	701.9	676.8	646.4	611.9	578.0	553.1	547.5	2
2	833.7	787.6	731.4	667.8	605.4	559.6	549.2	2
3	701.7	676.7	646.2	611.7	577.9	553.0	547.4	2

FUEL ROD 2 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 2, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S.......				
1	707.2	681.4	649.8	614.1	579.2	553.4	547.6	2
2	843.6	795.9	737.8	672.0	607.5	560.0	549.3	2
3	707.1	681.2	649.7	614.0	579.0	553.3	547.5	2

FUEL ROD 3 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 3, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S.......				
1	687.1	664.5	636.8	605.6	574.9	552.4	547.3	2
2	806.7	764.9	714.0	656.3	599.8	558.3	548.9	2
3	686.9	664.3	636.7	605.4	574.8	552.2	547.1	2

FUEL ROD 4 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 4, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S.......				
1	704.5	679.1	648.1	613.0	578.6	553.3	547.6	2
2	838.7	791.8	734.6	669.9	606.5	559.8	549.3	2
3	704.4	678.9	647.9	612.8	578.4	553.1	547.4	2

FUEL ROD 5 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 5, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S.......				
1	696.5	672.3	642.9	609.6	576.9	552.9	547.5	2
2	823.9	779.4	725.1	663.6	603.4	559.1	549.1	2
3	696.3	672.2	642.7	609.4	576.7	552.7	547.3	2

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

FUEL ROD 6 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 6, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S..........		....	....	
1	695.2	671.2	642.0	609.0	576.6	552.6	547.4	2
2	821.4	777.3	723.5	662.6	602.9	559.0	549.1	2
3	695.0	671.1	641.9	608.8	576.5	552.6	547.3	2

FUEL ROD 7 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 7, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S..........		....	....	
1	669.7	649.8	625.6	598.1	571.2	551.5	547.0	2
2	774.6	738.0	693.3	642.7	593.2	556.7	548.5	2
3	669.5	649.6	625.4	598.0	571.1	551.3	546.8	2

FUEL ROD 8 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 9, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S..........		....	....	
1	683.1	661.1	634.2	603.8	574.1	552.2	547.2	2
2	799.3	758.7	709.2	653.2	598.3	557.9	548.8	2
3	682.9	660.9	634.1	603.7	573.9	552.0	547.1	2

FUEL ROD 9 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 10, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S..........		....	....	
1	668.3	648.7	624.7	597.5	570.9	551.4	547.0	2
2	772.2	735.9	691.7	641.7	592.7	556.6	548.5	2
3	668.2	648.5	624.5	597.4	570.8	551.2	546.8	2

FUEL ROD 10 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 11, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S..........		....	....	
1	696.5	672.3	642.9	609.6	576.9	552.9	547.5	2
2	823.9	779.4	725.1	663.6	603.4	559.1	549.1	2
3	696.3	672.2	642.7	609.4	576.7	552.7	547.3	2

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

FUEL ROD 11 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 12, 0, 0, 0,

	........................R A D I A L		P O S I T I O N S	....	....	....	
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	680.4	658.8	632.5	602.7	573.5	552.0	547.2	2
2	794.4	754.6	706.0	651.1	597.3	557.7	548.7	2
3	680.2	658.7	632.3	602.5	573.3	551.9	547.0	2

FUEL ROD 12 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 13, 0, 0, 0,

	........................R A D I A L		P O S I T I O N S	....	....	....	
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	683.1	661.1	634.2	603.8	574.1	552.2	547.2	2
2	799.3	758.7	709.2	653.2	598.3	557.9	548.8	2
3	682.9	660.9	634.1	603.7	573.9	552.0	547.1	2

FUEL ROD 13 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 14, 0, 0, 0,

	........................R A D I A L		P O S I T I O N S	....	....	....	
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	671.0	650.9	626.4	598.7	571.5	551.5	547.0	2
2	777.1	740.1	694.9	643.8	593.7	556.8	548.5	2
3	670.8	650.8	626.3	598.5	571.4	551.4	546.9	2

FUEL ROD 14 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 17, 0, 0, 0,

	........................R A D I A L		P O S I T I O N S	....	....	....	
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	681.7	659.9	633.4	603.3	573.8	552.1	547.2	2
2	795.8	756.6	707.6	652.2	597.8	557.8	548.8	2
3	681.6	659.8	633.2	603.1	573.6	551.9	547.1	2

FUEL ROD 15 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 18, 0, 0, 0,

	........................R A D I A L		P O S I T I O N S	....	....	....	
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	669.7	649.8	625.6	598.1	571.2	551.5	547.0	2
2	774.6	738.0	693.3	642.7	593.2	556.7	548.5	2
3	669.5	649.6	625.4	598.0	571.1	551.3	546.8	2

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

FUEL ROD 16 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 19, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	664.3	645.3	622.1	595.8	570.1	551.2	546.9	2
2	764.8	729.7	687.0	638.6	591.1	556.2	548.4	2
3	664.1	645.1	621.9	595.7	569.9	551.0	546.7	2

FUEL ROD 17 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 20, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	662.9	644.1	621.2	595.3	569.8	551.1	546.9	2
2	762.3	727.6	685.4	637.5	590.6	556.1	548.3	2
3	662.8	644.0	621.1	595.1	569.6	550.9	546.7	2

FUEL ROD 18 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 21, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	685.8	663.3	636.0	605.0	574.6	552.3	547.3	2
2	804.2	762.8	712.4	655.3	599.3	558.1	548.9	2
3	685.6	663.2	635.8	604.8	574.5	552.2	547.1	2

FUEL ROD 19 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 25, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	660.3	641.9	619.5	594.1	569.2	551.0	546.8	2
2	757.4	723.5	682.2	635.4	589.6	555.9	548.3	2
3	660.1	641.7	619.3	593.9	569.1	550.8	546.7	2

FUEL ROD 20 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 26, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	662.9	644.1	621.2	595.3	569.8	551.1	546.9	2
2	762.3	727.6	685.4	637.5	590.6	556.1	548.3	2
3	662.8	644.0	621.1	595.1	569.6	550.9	546.7	2

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

FUEL ROD 26 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 41, 0, 0, 0,

	........................R A D I A L	P O S I T I O N S	....	....	....	....	....	
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	668.3	648.7	624.7	597.5	570.9	551.4	547.0	2
2	772.2	735.9	691.7	641.7	592.7	556.6	548.5	2
3	668.2	648.5	624.5	597.4	570.8	551.2	546.8	2

FUEL ROD 27 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 42, 0, 0, 0,

	........................R A D I A L	P O S I T I O N S	....	....	....	....	....	
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	697.8	673.5	643.8	610.1	577.2	552.9	547.5	2
2	826.4	781.4	726.7	664.7	603.9	559.2	549.1	2
3	697.7	673.3	643.6	610.0	577.0	552.8	547.3	2

FUEL ROD 28 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 49, 0, 0, 0,

	........................R A D I A L	P O S I T I O N S	....	....	....	....	....	
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	692.5	669.0	640.3	607.9	576.0	552.7	547.4	2
2	816.5	773.2	720.3	660.5	601.9	558.7	549.0	2
3	692.3	668.8	640.1	607.7	575.9	552.5	547.2	2

DUMP TAKEN AT TIME .39987E+01 AND CYCLE 5600

TABLE E-I (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 1, 3-D 7X7 BWR CLUSTER, UNIFORM INLET VELOCITY, SS + TRANSIENT

FUEL ROD 21 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 27, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	662.9	644.1	621.2	595.3	569.8	551.1	546.9	2
2	762.3	727.6	685.4	637.5	590.6	556.1	548.3	2
3	662.8	644.0	621.1	595.1	569.6	550.9	546.7	2

FUEL ROD 22 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 28, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	679.1	657.7	631.6	602.1	573.2	552.0	547.2	2
2	791.9	752.5	704.5	650.1	596.8	557.6	548.7	2
3	678.9	657.5	631.5	602.0	573.1	551.8	547.0	2

FUEL ROD 23 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 33, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	653.5	636.2	615.1	591.2	567.8	550.6	546.7	2
2	745.1	713.1	674.2	630.2	587.0	555.2	548.1	2
3	653.4	636.1	615.0	591.1	567.6	550.4	546.5	2

FUEL ROD 24 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 34, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	662.9	644.1	621.2	595.3	569.8	551.1	546.9	2
2	762.3	727.6	685.4	637.5	590.6	556.1	548.3	2
3	662.8	644.0	621.1	595.1	569.6	550.9	546.7	2

FUEL ROD 25 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 35, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	681.7	659.9	633.4	603.3	573.8	552.1	547.2	2
2	796.8	755.6	707.6	652.2	597.8	557.8	548.8	2
3	681.6	659.8	633.2	603.1	573.6	551.9	547.1	2

2. SAMPLE PROBLEM NUMBER 2: A THREE-DIMENSIONAL REPRESENTATION OF A 7 BY 7 BWR FUEL ASSEMBLY AT STEADY STATE

Sample Problem Number 2 consists of a three-dimensional steady state problem illustrating the use of the diagonal symmetry feature, the rod conduction model, and the spatially varying inlet velocity boundary conditions. The problem simulates a 12-ft long, 7 by 7 BWR fuel assembly at steady state. The geometry of the fuel assembly is identical to that of Sample Problem Number 1 as is shown in Figure E-1.

The fuel rod power conditions simulate a BWR operating at a steady state average power of 12 kW/ft. The rod-to-average transverse power distribution is shown in Figure E-1 and listed in the following input printout. The peak-to-average axial power distribution also is listed in the following input printout.

Steady state BWR coolant conditions are simulated with a uniformly distributed internal energy of 522.8 Btu/lbm at the inlet and a pressure of 1043.0 psia at the outlet. The coolant axial velocity at the inlet is nonuniformly distributed, with an average value of 6.962 ft/sec. The channel-to-average inlet velocity multipliers are shown in Figure E-2 and are listed in the following input printout. The problem is conducted holding the coolant conditions constant for 1 second to achieve steady state conditions.

The input data required to perform the calculations are presented in Table E-II. Following the input printout the calculational results for times of zero and 1 second only are presented.

49 0.5676	42 0.7841	35 0.8232	28 0.8264	21 0.8232	14 0.7841	7 0.5676
48 0.7841	41 1.0280	34 1.0656	27 1.0693	20 1.0656	13 1.0280	6 0.7841
47 0.8232	40 1.0656	33 1.1010	26 1.1047	19 1.1010	12 1.0656	5 0.8232
46 0.8264	39 1.0693	32 1.1047	25 1.1084	18 1.1047	11 1.0693	4 0.8264
45 0.8232	38 1.0656	31 1.1010	24 1.1047	17 1.1010	10 1.0656	3 0.8232
44 0.7841	37 1.0280	30 1.0656	23 1.0693	16 1.0656	9 1.0280	2 0.7841
43 0.5676	36 0.7841	29 0.8232	22 0.8264	15 0.8232	8 0.7841	1 0.5676

Diagonal of Symmetry

Nomenclature

C
U_f

U_f = Inlet Velocity Multiplication Factor

C = Channel Number

INEL-A-1793

Fig. E-2 7 by BWR channel inlet velocity multiplication factors for Sample Problem Number 2.

TABLE E-II

SAMPLE PROBLEM 2

```
SCORE-EVET        BENEDETTI-KISER-LORDS     MOD 1    VER 2
 EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

                                             ****************************************
                                             ****                                ****
                                             ****   INPUT IS IN ENGLISH UNITS    ****
                                             ****                                ****
                                             ****************************************
 IUF =  1
 IOUTF =  1
 NADC =  1
 NOCH = 28
 CHANNEL NOS =   1   2   3   4   5   6   7   9  10  11  12  13  14  17  18  19  20  21  25  26  27  28  33  34
 CHANNEL NOS =  35  41  42  49
 IBR =      3
 JBR =      7
 KBR =      7
 IROD =     1
 NDIAG =    1
 NROD =     28
 NZPTD =      0
 NZTDT =      0
 ALX =  1.00
 ALY =  1.00
 ALZ =  1.00
 GX = -32.0
 GY =  0.
 GZ =  0.
 CEP =  .400E-02
 WGHTP =  1.50
 DT =  .100E-02
 B0 =  1.20
 SACRIT =  .800
 TFIN =  1.00
 IDTFLG =      0
 LPR =      3
 NPRT =   100
 NWPC =    13
 NWPP =     0
 IESFLG =     2
 NTAP =     0
 NWTD =   100
 NEWTAP =     0
 NRST =     0
 I,J,K PRINT LIMITS ARE    1    5    1    1    9    1    1    9    1
```

TABLE E-II (continued)

```
SCORE-EVET        BENEDETTI-KISER-LORDS     MOD 1    VER 2
 EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

  X CELL DIMENSIONS
 .50000       48.000       48.000       48.000       .50000

  Y CELL DIMENSIONS
 .79400       .79400       .73800       .73800       .73800       .73800       .73800       .79400       .79400

  Z CELL DIMENSIONS
 .79400       .79400       .73800       .73800       .73800       .73800       .73800       .79400       .79400
 LOSS COEFFICIENTS
                              0.           0.           0.           0.
 P(1) =  .104E+04
 SIE(1) =  523.
 QUAL =  0.
 U(1) =  6.96
 DIAMRD =  .563
 SPROD =  .738
 PAVE =  12.0
```

CHANNEL	1	DHY =	.45450	DHE =	.86270	AWF =	5.3251	AWQ =	2.8054	VOID =	.60506	RODNUM= 1.0000
CHANNEL	2	DHY =	.52600	DHE =	.76213	AWF =	4.3734	AWQ =	3.0184	VOID =	.57510	RODNUM= 1.0000
CHANNEL	3	DHY =	.52600	DHE =	.76213	AWF =	4.3734	AWQ =	3.0184	VOID =	.57510	RODNUM= 1.0000
CHANNEL	4	DHY =	.52600	DHE =	.76213	AWF =	4.3734	AWQ =	3.0184	VOID =	.57510	RODNUM= 1.0000
CHANNEL	5	DHY =	.52600	DHE =	.76213	AWF =	4.3734	AWQ =	3.0184	VOID =	.57510	RODNUM= 1.0000
CHANNEL	6	DHY =	.52600	DHE =	.76213	AWF =	4.3734	AWQ =	3.0184	VOID =	.57510	RODNUM= 1.0000
CHANNEL	7	DHY =	.45450	DHE =	.86270	AWF =	5.3251	AWQ =	2.8054	VOID =	.60506	RODNUM= 1.0000
CHANNEL	8	DHY =	.52600	DHE =	.76213	AWF =	4.3734	AWQ =	3.0184	VOID =	.57510	RODNUM= 1.0000
CHANNEL	9	DHY =	.66870	DHE =	.66870	AWF =	3.2475	AWQ =	3.2475	VOID =	.54290	RODNUM= 1.0000
CHANNEL	10	DHY =	.66870	DHE =	.66870	AWF =	3.2475	AWQ =	3.2475	VOID =	.54290	RODNUM= 1.0000
CHANNEL	11	DHY =	.66870	DHE =	.66870	AWF =	3.2475	AWQ =	3.2475	VOID =	.54290	RODNUM= 1.0000
CHANNEL	12	DHY =	.66870	DHE =	.66870	AWF =	3.2475	AWQ =	3.2475	VOID =	.54290	RODNUM= 1.0000
CHANNEL	13	DHY =	.66870	DHE =	.66870	AWF =	3.2475	AWQ =	3.2475	VOID =	.54290	RODNUM= 1.0000

TABLE E-II (continued)

CHANNEL 14	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 15	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 16	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 17	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 18	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 19	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 20	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 21	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 22	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 23	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 24	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 25	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 26	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 27	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 28	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 29	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 30	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 31	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 32	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 33	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 34	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 35	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 36	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 37	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 38	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 39	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 40	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 41	DHY = .66870	DHE = .66870	AWF = 3.2475	AWQ = 3.2475	VOID = .54290	RODNUM= 1.0000
CHANNEL 42	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 43	DHY = .45450	DHE = .86270	AWF = 5.3251	AWQ = 2.8054	VOID = .60506	RODNUM= 1.0000
CHANNEL 44	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 45	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 46	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 47	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 48	DHY = .52600	DHE = .76213	AWF = 4.3734	AWQ = 3.0184	VOID = .57510	RODNUM= 1.0000
CHANNEL 49	DHY = .45450	DHE = .86270	AWF = 5.3251	AWQ = 2.8054	VOID = .60506	RODNUM= 1.0000

TABLE E-II (continued)

```
DIAFD =  .507
GAPT =  .800E-02
GAPH =  1000
FUELK =  2.00
CLADK =  7.00
RHOCPF =  53.0
RHOCPC =  32.0
ROD NUMBER  1  NRC=  1
ROD NUMBER  2  NRC=  2
ROD NUMBER  3  NRC=  3
ROD NUMBER  4  NRC=  4
ROD NUMBER  5  NRC=  5
ROD NUMBER  6  NRC=  6
ROD NUMBER  7  NRC=  7
ROD NUMBER  8  NRC=  9
ROD NUMBER  9  NRC= 10
ROD NUMBER 10  NRC= 11
ROD NUMBER 11  NRC= 12
ROD NUMBER 12  NRC= 13
ROD NUMBER 13  NRC= 14
ROD NUMBER 14  NRC= 17
ROD NUMBER 15  NRC= 18
ROD NUMBER 16  NRC= 19
ROD NUMBER 17  NRC= 20
ROD NUMBER 18  NRC= 21
ROD NUMBER 19  NRC= 25
ROD NUMBER 20  NRC= 26
ROD NUMBER 21  NRC= 27
ROD NUMBER 22  NRC= 28
ROD NUMBER 23  NRC= 33
ROD NUMBER 24  NRC= 34
ROD NUMBER 25  NRC= 35
ROD NUMBER 26  NRC= 41
ROD NUMBER 27  NRC= 42
ROD NUMBER 28  NRC= 49
```

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

RADIAL POWER FACTORS--BY CHANNEL IF IROD = 0 ---BY ROD IF IROD = 1 OR 2

1.17	1.21	1.06	1.19	1.13	1.12	.930	1.03	.920	1.13
1.01	1.03	.940	1.02	.930	.890	.880	1.05	.860	.880
.880	1.00	.810	.880	1.02	.920	1.14	1.10		

AXIAL POWER FACTORS FOR THE REAL CELLS

.781	1.44	.781

	U	V	W	P	SIE	RHO	TEMP
INLET BOUNDARY FLAGS	4	1	1	5	2	8	6
INLET BOUNDARY CONDITIONS	6.96200	0.	0.	0.	522.800	0.	0.

FACTORS FOR INLET VELOCITY OR PRESSURE AS A FUNCTION OF SPACE

.567600	.784100	.823200	.826400	.823200	.784100	.567600	.784100	1.028000	1.065600
1.069300	1.065600	1.028000	.784100	.823200	1.065600	1.101000	1.104700	1.101000	1.065600
.823200	.826400	1.069300	1.104700	1.108400	1.104700	1.069300	.826400	.823200	1.065600
1.101000	1.134700	1.101000	1.065600	.823200	.784100	1.028000	1.065600	1.069300	1.065600
1.028000	.784100	.567600	.784100	.823200	.826400	.823200	.784100	.567600	

	U	V	W	P	SIE	RHO	TEMP
OUTLET BOUNDARY FLAGS	6	1	1	2	6	6	6
OUTLET BOUNDARY CONDITIONS	0.	0.	0.	1043.00	0.	0.	0.

TABLE E-II (continued)

```
     TWO-PHASE FRICTION MODEL FLAG, ITPMOD =    0

**** INPUT OF CRITICAL HEAT FLUX CORRELATION FLAGS ****

     JCHF =  0 NSW = 0 IHTDBG = 0 IFILMH = 0 IPOOLH = 0 IHTCAL = 0

     **** ACTUAL FRICTION FACTOR FLAGS USED ****

     IRECWS = 0   IREX = 2   IREY = 2   IREZ = 2
     IFXLAM = 1 IFYLAM = 1 IFZLAM = 1
     IFXTUB = 3 IFYTUB = 3 IFZTUB = 3
     IFLTEM = 0

     **** ACTUAL TWO-PHASE CORRELATION FLAGS USED ****

      IALFA =  1 ITPRHO = 1
     ITPMLX =  5 ITPMLY =  5 ITPMLZ =  5
     ITPMTX =  5 ITPMTY =  5 ITPMTZ =  5

     **** ACTUAL HEAT TRANSFER FLAGS USED ****

     JCHF =  0          IHTDBG = 0 IFILMH = 2


MINIMUM DIMENSIONING FOR THE A(ARRAY)  5850
```

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

CYCLE = 0 TIME = 0. ITERATIONS = 0 DELTA TIME = .10000E-02 POWER AVERAGE = 12.000 KW/FT.

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
1	1	1	3.95163	0.	0.	1049.45	47.1952	522.800	550.633	0.
2	1	1	3.95163	0.	0.	1049.45	47.1952	522.800	550.633	0.
3	1	1	5.45890	0.	0.	1049.80	47.1954	522.800	550.682	0.
4	1	1	5.73112	0.	0.	1049.14	47.1951	522.800	550.589	0.
5	1	1	5.75340	0.	0.	1049.71	47.1954	522.800	550.669	0.
6	1	1	5.73112	0.	0.	1049.44	47.1952	522.800	550.632	0.
7	1	1	5.45890	0.	0.	1049.40	47.1952	522.800	550.626	0.
8	1	1	3.95163	0.	0.	1048.47	47.1948	522.800	550.499	0.
9	1	1	3.95163	0.	0.	1048.47	47.1948	522.800	550.499	0.
1	2	1	12.2047	0.	0.	1049.45	26.9203	567.467	550.478	3.837758E-02
2	2	1	12.2047	0.	0.	1049.45	26.9203	567.467	550.478	3.837758E-02
3	2	1	13.8669	0.	0.	1049.80	23.6935	574.634	550.519	5.102029E-02
4	2	1	12.4657	0.	0.	1049.14	26.3567	568.533	550.441	4.034817E-02
5	2	1	13.6801	0.	0.	1049.71	24.0169	573.821	550.508	4.959722E-02
6	2	1	13.1198	0.	0.	1049.44	25.0426	571.380	550.477	4.532825E-02
7	2	1	13.0264	0.	0.	1049.40	25.2222	570.974	550.472	4.461679E-02
8	2	1	10.2230	0.	0.	1048.47	32.1388	558.842	550.363	2.330746E-02
9	2	1	10.2230	0.	0.	1048.47	32.1388	558.842	550.363	2.330746E-02
1	3	1	30.3574	0.	0.	1048.12	10.8229	644.820	550.322	.176007
2	3	1	30.3574	0.	0.	1048.12	10.8229	644.820	550.322	.176007
3	3	1	35.1088	0.	0.	1048.41	9.35818	665.191	550.356	.212110
4	3	1	31.0832	0.	0.	1047.87	10.5702	647.864	550.292	.181460
5	3	1	34.5722	0.	0.	1048.34	9.50340	662.880	550.347	.208022
6	3	1	32.9623	0.	0.	1048.12	9.96758	655.950	550.322	.195762
7	3	1	32.6939	0.	0.	1048.08	10.0494	654.794	550.318	.193719
8	3	1	24.6636	0.	C.	1047.31	13.3214	620.327	550.228	.132707
9	3	1	24.6636	0.	0.	1047.31	13.3214	620.327	550.228	.132707
1	4	1	40.3332	0.	0.	1045.29	8.14600	686.713	549.991	.250878
2	4	1	40.3332	0.	0.	1045.29	8.14600	686.713	549.991	.250878
3	4	1	46.7775	0.	0.	1045.48	7.02376	714.238	550.013	.299660
4	4	1	41.3038	0.	0.	1045.22	7.95457	690.832	549.983	.258195
5	4	1	46.0479	0.	0.	1045.45	7.13505	711.117	550.009	.294131
6	4	1	43.8586	0.	0.	1045.34	7.49122	701.755	549.997	.277545
7	4	1	43.4936	0.	0.	1045.32	7.55407	700.194	549.995	.274781
8	4	1	32.5926	0.	0.	1044.90	10.0806	653.628	549.946	.192280
9	4	1	32.5926	0.	0.	1044.90	10.0806	653.628	549.946	.192280
1	5	1	40.3332	0.	0.	1043.00	5.46914	728.606	549.659	.325748
2	5	1	40.3332	0.	0.	1043.00	5.46914	728.606	549.659	.325748
3	5	1	46.7775	0.	0.	1043.00	4.68934	763.285	549.671	.387210
4	5	1	41.3038	0.	0.	1043.00	5.33897	733.801	549.673	.334930
5	5	1	46.0479	0.	0.	1043.00	4.76671	759.354	549.671	.380239
6	5	1	43.8586	0.	0.	1043.00	5.01485	747.560	549.672	.359327
7	5	1	43.4936	0.	0.	1043.00	5.05874	745.594	549.672	.355842
8	5	1	32.5926	0.	0.	1043.00	6.83982	686.928	549.664	.251852
9	5	1	32.5926	0.	0.	1043.00	6.83982	686.928	549.664	.251852
1	1	2	3.95163	0.	0.	1049.45	47.1952	522.800	550.633	0.
2	1	2	3.95163	0.	0.	1049.45	47.1952	522.800	550.633	0.
3	1	2	5.45890	0.	0.	1049.80	47.1954	522.800	550.682	0.
4	1	2	5.73112	0.	0.	1049.14	47.1951	522.800	550.589	0.
5	1	2	5.75340	0.	0.	1049.71	47.1954	522.800	550.669	0.
6	1	2	5.73112	0.	0.	1049.44	47.1952	522.800	550.632	0.
7	1	2	5.45890	0.	0.	1049.40	47.1952	522.800	550.626	0.
8	1	2	3.95163	0.	0.	1048.47	47.1948	522.800	550.499	0.

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
9	1	2	3.95163	0.	0.	1048.47	47.1948	522.800	550.499	0.
1	2	2	12.2047	0.	0.	1049.45	26.9203	567.467	550.478	3.837758E-02
2	2	2	12.2047	0.	0.	1049.45	26.9203	567.467	550.478	3.837758E-02
3	2	2	13.8669	0.	0.	1049.80	23.6935	574.634	550.519	5.102029E-02
4	2	2	12.4657	0.	0.	1049.14	26.3567	568.533	550.441	4.034817E-02
5	2	2	13.6801	0.	0.	1049.71	24.0169	573.821	550.508	4.959722E-02
6	2	2	13.1198	0.	0.	1049.44	25.0426	571.380	550.477	4.532825E-02
7	2	2	13.0264	0.	0.	1049.40	25.2222	570.974	550.472	4.461679E-02
8	2	2	10.2230	0.	0.	1048.47	32.1388	558.842	550.363	2.330746E-02
9	2	2	10.2230	0.	0.	1048.47	32.1388	558.842	550.363	2.330746E-02
1	3	2	30.3574	0.	0.	1048.12	10.8229	644.820	550.322	.176007
2	3	2	30.3574	0.	0.	1048.12	10.8229	644.820	550.322	.176007
3	3	2	35.1038	0.	0.	1048.41	9.35818	665.191	550.356	.212110
4	3	2	31.0832	0.	0.	1047.87	10.5702	647.864	550.292	.181460
5	3	2	34.5722	0.	0.	1048.34	9.50340	662.880	550.347	.208022
6	3	2	32.9623	0.	0.	1048.12	9.96758	655.950	550.322	.195762
7	3	2	32.6939	0.	0.	1048.08	10.0494	654.794	550.318	.193719
8	3	2	24.6636	0.	0.	1047.31	13.3214	620.327	550.228	.132707
9	3	2	24.6636	0.	0.	1047.31	13.3214	620.327	550.228	.132707
1	4	2	40.3332	0.	0.	1045.29	8.14600	686.713	549.991	.250878
2	4	2	40.3332	0.	0.	1045.29	8.14600	686.713	549.991	.250878
3	4	2	46.7775	0.	0.	1045.48	7.02376	714.238	550.013	.299660
4	4	2	41.3038	0.	0.	1045.22	7.95457	690.832	549.983	.258195
5	4	2	46.0479	0.	0.	1045.45	7.13505	711.117	550.009	.294131
6	4	2	43.8586	0.	0.	1045.34	7.49122	701.755	549.997	.277545
7	4	2	43.4936	0.	0.	1045.32	7.55407	700.194	549.995	.274781
8	4	2	32.5926	0.	0.	1044.90	10.0806	653.628	549.946	.192280
9	4	2	32.5926	0.	0.	1044.90	10.0806	653.628	549.946	.192280
1	5	2	40.3332	0.	0.	1043.00	5.46914	728.606	549.659	.325748
2	5	2	40.3332	0.	0.	1043.00	5.46914	728.606	549.659	.325748
3	5	2	46.7775	0.	0.	1043.00	4.68934	763.285	549.671	.387210
4	5	2	41.3038	0.	0.	1043.00	5.33897	733.801	549.673	.334930
5	5	2	46.0479	0.	0.	1043.00	4.76671	759.354	549.671	.380239
6	5	2	43.8536	0.	0.	1043.00	5.01485	747.560	549.672	.359327
7	5	2	43.4936	0.	0.	1043.00	5.05874	745.594	549.672	.355842
8	5	2	32.5926	0.	0.	1043.00	6.83982	636.928	549.664	.251852
9	5	2	32.5926	0.	0.	1043.00	6.83982	636.928	549.664	.251852
1	1	3	5.45890	0.	0.	1049.80	47.1954	522.800	550.682	0.
2	1	3	5.45890	0.	0.	1049.80	47.1954	522.800	550.682	0.
3	1	3	7.15694	0.	0.	1049.01	47.1951	522.800	550.573	0.
4	1	3	7.41871	0.	0.	1048.51	47.1948	522.800	550.503	0.
5	1	3	7.44447	0.	0.	1049.48	47.1953	522.800	550.637	0.
6	1	3	7.41871	0.	0.	1048.92	47.1950	522.800	550.560	0.
7	1	3	7.15694	0.	0.	1049.01	47.1951	522.800	550.573	0.
8	1	3	5.45890	0.	0.	1048.61	47.1949	522.800	550.517	0.
9	1	3	5.45890	0.	0.	1048.61	47.1949	522.800	550.517	0.
1	2	3	13.8669	0.	0.	1049.80	23.6935	574.634	550.519	5.102029E-02
2	2	3	13.8669	0.	0.	1049.80	23.6935	574.634	550.519	5.102029E-02
3	2	3	13.5514	0.	0.	1049.01	24.2451	573.156	550.427	4.858622E-02
4	2	3	12.3776	0.	0.	1048.51	26.5442	568.057	550.368	3.965701E-02
5	2	3	14.6173	0.	0.	1049.48	22.4771	577.791	550.481	5.670459E-02
6	2	3	13.3380	0.	0.	1048.92	24.6328	572.229	550.416	4.696267E-02
7	2	3	13.5514	0.	0.	1049.01	24.2451	573.156	550.427	4.858622E-02
8	2	3	11.3433	0.	0.	1048.61	28.9647	563.652	550.380	3.181139E-02
9	2	3	11.3433	0.	0.	1048.61	28.9647	563.652	550.380	3.181139E-02

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
1	3	3	35.1088	0.	0.	1048.41	9.35818	665.191	550.356	.212110
2	3	3	35.1088	0.	0.	1048.41	9.35818	665.191	550.356	.212110
3	3	3	34.1671	0.	0.	1047.77	9.61609	661.014	550.281	.204821
4	3	3	30.7984	0.	0.	1047.36	10.6679	646.533	550.233	.179202
5	3	3	37.2274	0.	0.	1048.14	8.82561	674.179	550.325	.228116
6	3	3	33.5548	0.	0.	1047.69	9.79156	658.381	550.272	.200162
7	3	3	34.1671	0.	0.	1047.77	9.61609	661.014	550.281	.204821
8	3	3	27.8598	0.	0.	1047.44	11.7931	634.001	550.242	.156947
9	3	3	27.8598	0.	0.	1047.44	11.7931	634.001	550.242	.156947
1	4	3	46.7775	0.	0.	1045.48	7.02376	714.238	550.013	.299660
2	4	3	46.7775	0.	0.	1045.48	7.02376	714.238	550.013	.299660
3	4	3	45.4725	0.	0.	1045.24	7.22533	708.608	549.986	.289715
4	4	3	40.8955	0.	0.	1045.04	8.03399	689.045	549.962	.255058
5	4	3	49.6318	0.	0.	1045.43	6.61983	726.392	550.007	.321224
6	4	3	44.6405	0.	0.	1045.21	7.36001	705.051	549.981	.283414
7	4	3	45.4725	0.	0.	1045.24	7.22533	708.608	549.986	.289715
8	4	3	36.9228	0.	0.	1045.01	8.89839	672.107	549.958	.225027
9	4	3	36.9228	0.	0.	1045.01	8.89839	672.107	549.958	.225027
1	5	3	46.7775	0.	0.	1043.00	4.68934	763.285	549.671	.387210
2	5	3	46.7775	0.	0.	1043.00	4.68934	763.285	549.671	.387210
3	5	3	45.4725	0.	0.	1043.00	4.83458	756.202	549.690	.374610
4	5	3	40.8955	0.	0.	1043.00	5.40008	731.557	549.690	.330915
5	5	3	49.6318	0.	0.	1043.00	4.41405	778.605	549.690	.414333
6	5	3	44.6405	0.	0.	1043.00	4.92845	751.721	549.690	.366665
7	5	3	45.4725	0.	0.	1043.00	4.83458	756.202	549.690	.374610
8	5	3	36.9228	0.	0.	1043.00	6.00366	710.212	549.674	.293106
9	5	3	36.9228	0.	0.	1043.00	6.00366	710.212	549.674	.293106
1	1	4	5.73112	0.	0.	1049.14	47.1951	522.800	550.589	0.
2	1	4	5.73112	0.	0.	1049.14	47.1951	522.800	550.589	0.
3	1	4	7.41871	0.	0.	1048.51	47.1948	522.800	550.503	0.
4	1	4	7.66516	0.	0.	1048.97	47.1950	522.800	550.566	0.
5	1	4	7.69092	0.	0.	1048.56	47.1949	522.800	550.509	0.
6	1	4	7.66516	0.	0.	1048.38	47.1948	522.800	550.485	0.
7	1	4	7.41871	0.	0.	1048.33	47.1948	522.800	550.478	0.
8	1	4	5.73112	0.	0.	1049.09	47.1951	522.800	550.583	0.
9	1	4	5.73112	0.	0.	1049.09	47.1951	522.800	550.583	0.
1	2	4	12.4657	0.	0.	1049.14	26.3567	568.533	550.441	4.034817E-02
2	2	4	12.4657	0.	0.	1049.14	26.3567	568.533	550.441	4.034817E-02
3	2	4	12.3776	0.	0.	1048.51	26.5442	568.057	550.368	3.965701E-02
4	2	4	13.4447	0.	0.	1048.97	24.4374	572.693	550.421	4.777444E-02
5	2	4	12.4844	0.	0.	1048.56	26.3172	568.521	550.373	4.046873E-02
6	2	4	12.0573	0.	0.	1048.38	27.2494	566.667	550.352	3.722186E-02
7	2	4	11.9505	0.	0.	1048.33	27.4929	566.203	550.347	3.641014E-02
8	2	4	12.3722	0.	0.	1049.09	26.5559	568.126	550.436	3.963676E-02
9	2	4	12.3722	0.	0.	1049.09	26.5559	568.126	550.436	3.963676E-02
1	3	4	31.0832	0.	0.	1047.87	10.5702	647.864	550.292	.181460
2	3	4	31.0832	0.	0.	1047.87	10.5702	647.864	550.292	.181460
3	3	4	30.7984	0.	0.	1047.36	10.6679	646.533	550.233	.179202
4	3	4	33.8610	0.	0.	1047.73	9.70303	659.698	550.276	.202492
5	3	4	31.1048	0.	0.	1047.39	10.5628	647.849	550.237	.181530
6	3	4	29.8792	0.	0.	1047.25	10.9961	642.583	550.220	.172216
7	3	4	29.5728	0.	0.	1047.21	11.1100	641.267	550.216	.169887
8	3	4	30.8146	0.	0.	1047.83	10.6623	646.708	550.288	.179418
9	3	4	30.8146	0.	0.	1047.83	10.6623	646.708	550.288	.179418
1	4	4	41.3038	0.	0.	1045.22	7.95457	690.832	549.983	.258195

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LCRDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
2	4	4	41.3038	0.	0.	1045.22	7.95457	690.832	549.983	.258195
3	4	4	40.8955	0.	0.	1045.04	8.03399	689.045	549.962	.255058
4	4	4	45.0565	0.	0.	1045.23	7.29205	706.830	549.983	.286564
5	4	4	41.3117	0.	0.	1045.06	7.95305	690.823	549.964	.258209
6	4	4	39.6469	0.	0.	1044.98	8.28700	683.709	549.955	.245607
7	4	4	39.2307	0.	0.	1044.97	8.37492	681.931	549.953	.242456
8	4	4	40.9388	0.	0.	1045.20	8.02549	689.272	549.981	.255431
9	4	4	40.9388	0.	0.	1045.20	8.02549	689.272	549.981	.255431
1	5	4	41.3038	0.	0.	1043.00	5.33897	733.801	549.673	.334930
2	5	4	41.3038	0.	0.	1043.00	5.33897	733.801	549.673	.334930
3	5	4	40.8955	0.	0.	1043.00	5.40008	731.557	549.690	.330915
4	5	4	45.0565	0.	0.	1043.00	4.88106	753.962	549.690	.370637
5	5	4	41.3117	0.	0.	1043.00	5.34328	733.797	549.690	.334887
6	5	4	39.6469	0.	0.	1043.00	5.57792	724.835	549.690	.318998
7	5	4	39.2307	0.	0.	1043.00	5.63982	722.595	549.690	.315025
8	5	4	40.9388	0.	0.	1043.00	5.38871	731.835	549.673	.331445
9	5	4	40.9388	0.	0.	1043.00	5.38871	731.835	549.673	.331445
1	1	5	5.75340	0.	0.	1049.71	47.1954	522.800	550.669	0.
2	1	5	5.75340	0.	0.	1049.71	47.1954	522.800	550.669	0.
3	1	5	7.44447	0.	0.	1049.48	47.1953	522.800	550.637	0.
4	1	5	7.69092	0.	0.	1048.56	47.1949	522.800	550.509	0.
5	1	5	7.71668	0.	0.	1048.24	47.1947	522.800	550.466	0.
6	1	5	7.69092	0.	0.	1048.33	47.1948	522.800	550.478	0.
7	1	5	7.44447	0.	0.	1048.33	47.1948	522.800	550.478	0.
8	1	5	5.75340	0.	0.	1048.87	47.1950	522.800	550.553	0.
9	1	5	5.75340	0.	0.	1048.87	47.1950	522.800	550.553	0.
1	2	5	13.6801	0.	0.	1049.71	24.0169	573.821	550.508	4.959722E-02
2	2	5	13.6801	0.	0.	1049.71	24.0169	573.821	550.508	4.959722E-02
3	2	5	14.6173	0.	0.	1049.48	22.4771	577.791	550.481	5.670459E-02
4	2	5	12.4844	0.	0.	1048.56	26.3172	568.521	550.373	4.046873E-02
5	2	5	11.7369	0.	0.	1048.24	27.9934	565.276	550.337	3.478670E-02
6	2	5	11.9505	0.	0.	1048.33	27.4929	566.203	550.347	3.641014E-02
7	2	5	11.9505	0.	0.	1048.33	27.4929	566.203	550.347	3.641014E-02
8	2	5	11.9046	0.	0.	1048.87	27.5988	566.092	550.410	3.607975E-02
9	2	5	11.9046	0.	0.	1048.87	27.5988	566.092	550.410	3.607975E-02
1	3	5	34.5722	0.	0.	1048.34	9.50340	662.880	550.347	.208022
2	3	5	34.5722	0.	0.	1048.34	9.50340	662.880	550.347	.208022
3	3	5	37.2274	0.	0.	1048.14	8.82561	674.179	550.325	.228116
4	3	5	31.1048	0.	0.	1047.39	10.5628	647.849	550.237	.181530
5	3	5	28.9598	0.	0.	1047.14	11.3452	638.634	550.207	.165230
6	3	5	29.5728	0.	0.	1047.21	11.1100	641.267	550.216	.169887
7	3	5	29.5728	0.	0.	1047.21	11.1100	641.267	550.216	.169887
8	3	5	29.4718	0.	0.	1047.65	11.1481	640.933	550.267	.169203
9	3	5	29.4718	0.	0.	1047.65	11.1481	640.933	550.267	.169203
1	4	5	46.0479	0.	0.	1045.45	7.13505	711.117	550.009	.294131
2	4	5	46.0479	0.	0.	1045.45	7.13505	711.117	550.009	.294131
3	4	5	49.6318	0.	0.	1045.43	6.61983	726.392	550.007	.321224
4	4	5	41.3117	0.	0.	1045.06	7.95305	690.823	549.964	.258209
5	4	5	38.3982	0.	0.	1044.93	8.55649	678.374	549.949	.236155
6	4	5	39.2307	0.	0.	1044.97	8.37492	681.931	549.953	.242456
7	4	5	39.2307	0.	0.	1044.97	8.37492	681.931	549.953	.242456
8	4	5	39.1136	0.	0.	1045.11	8.40000	681.469	549.970	.241611
9	4	5	39.1136	0.	0.	1045.11	8.40000	681.469	549.970	.241611
1	5	5	46.0479	0.	0.	1043.00	4.76671	759.354	549.671	.380239
2	5	5	46.0479	0.	0.	1043.00	4.76671	759.354	549.671	.380239

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
3	5	5	49.6318	0.	0.	1043.00	4.41405	778.605	549.690	.414333
4	5	5	41.3117	0.	0.	1043.00	5.34328	733.797	549.690	.334887
5	5	5	38.3982	0.	0.	1043.00	5.76782	718.114	549.690	.307081
6	5	5	39.2307	0.	0.	1043.00	5.63982	722.595	549.690	.315025
7	5	5	39.2307	0.	0.	1043.00	5.63982	722.595	549.690	.315025
8	5	5	39.1136	0.	0.	1043.00	5.65192	722.006	549.674	.314018
9	5	5	39.1136	0.	0.	1043.00	5.65192	722.006	549.674	.314018
1	1	6	5.73112	0.	0.	1049.44	47.1952	522.800	550.632	0.
2	1	6	5.73112	0.	0.	1049.44	47.1952	522.800	550.632	0.
3	1	6	7.41871	0.	0.	1048.92	47.1950	522.800	550.560	0.
4	1	6	7.66516	0.	0.	1048.38	47.1948	522.800	550.485	0.
5	1	6	7.69092	0.	0.	1048.33	47.1948	522.800	550.478	0.
6	1	6	7.66516	0.	0.	1048.02	47.1946	522.800	550.436	0.
7	1	6	7.41871	0.	0.	1048.33	47.1948	522.800	550.478	0.
8	1	6	5.73112	0.	0.	1048.96	47.1950	522.800	550.565	0.
9	1	6	5.73112	0.	0.	1048.96	47.1950	522.800	550.565	0.
1	2	6	13.1198	0.	0.	1049.44	25.0426	571.380	550.477	4.532825E-02
2	2	6	13.1198	0.	0.	1049.44	25.0426	571.380	550.477	4.532825E-02
3	2	6	13.3380	0.	0.	1048.92	24.6328	572.229	550.416	4.696267E-02
4	2	6	12.0573	0.	0.	1048.38	27.2494	566.667	550.352	3.722186E-02
5	2	6	11.9505	0.	0.	1048.33	27.4929	566.203	550.347	3.641014E-02
6	2	6	11.2026	0.	0.	1048.02	29.3285	562.959	550.311	3.072801E-02
7	2	6	11.9505	0.	0.	1048.33	27.4929	566.203	550.347	3.641014E-02
8	2	6	12.0917	0.	0.	1048.96	27.1719	566.906	550.420	3.750254E-02
9	2	6	12.0917	0.	0.	1048.96	27.1719	566.906	550.420	3.750254E-02
1	3	6	32.9623	0.	0.	1048.12	9.96758	655.950	550.322	.195762
2	3	6	32.9623	0.	0.	1048.12	9.96758	655.950	550.322	.195762
3	3	6	33.5548	0.	0.	1047.69	9.79156	658.381	550.272	.200162
4	3	6	29.8792	0.	0.	1047.25	10.9961	642.583	550.220	.172216
5	3	6	29.5728	0.	0.	1047.21	11.1100	641.267	550.216	.169887
6	3	6	27.4271	0.	0.	1046.95	11.9792	632.051	550.186	.153588
7	3	6	29.5728	0.	0.	1047.21	11.1100	641.267	550.216	.169887
8	3	6	30.0090	0.	0.	1047.72	10.9485	643.243	550.276	.173289
9	3	6	30.0090	0.	0.	1047.72	10.9485	643.243	550.276	.173289
1	4	6	43.8586	0.	0.	1045.34	7.49122	701.755	549.997	.277545
2	4	6	43.8586	0.	0.	1045.34	7.49122	701.755	549.997	.277545
3	4	6	44.6405	0.	0.	1045.21	7.36001	705.051	549.981	.283414
4	4	6	39.6469	0.	0.	1044.98	8.28700	683.709	549.955	.245607
5	4	6	39.2307	0.	0.	1044.97	8.37492	681.931	549.953	.242456
6	4	6	36.3167	0.	0.	1044.84	9.04691	669.481	549.938	.220404
7	4	6	39.2307	0.	0.	1044.97	8.37492	681.931	549.953	.242456
8	4	6	39.8437	0.	0.	1045.15	8.24607	684.590	549.974	.247139
9	4	6	39.8437	0.	0.	1045.15	8.24607	684.590	549.974	.247139
1	5	6	43.8586	0.	0.	1043.00	5.01485	747.560	549.672	.359327
2	5	6	43.8586	0.	0.	1043.00	5.01485	747.560	549.672	.359327
3	5	6	44.6405	0.	0.	1043.00	4.92845	751.721	549.690	.366665
4	5	6	39.6469	0.	0.	1043.00	5.57792	724.835	549.690	.318998
5	5	6	39.2307	0.	0.	1043.00	5.63982	722.595	549.690	.315025
6	5	6	36.3167	0.	0.	1043.00	6.11464	706.911	549.690	.287220
7	5	6	39.2307	0.	0.	1043.00	5.63982	722.595	549.690	.315025
8	5	6	39.8437	0.	0.	1043.00	5.54362	725.938	549.673	.320989
9	5	6	39.8437	0.	0.	1043.00	5.54362	725.938	549.673	.320989
1	1	7	5.45890	0.	0.	1049.40	47.1952	522.800	550.626	0.
2	1	7	5.45890	0.	0.	1049.40	47.1952	522.800	550.626	0.
3	1	7	7.15694	0.	0.	1049.01	47.1951	522.800	550.573	0.

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
4	1	7	7.41871	0.	0.	1048.33	47.1948	522.800	550.478	0.
5	1	7	7.44447	0.	0.	1048.33	47.1948	522.800	550.478	0.
6	1	7	7.41871	0.	0.	1048.33	47.1948	522.800	550.478	0.
7	1	7	7.15694	0.	0.	1048.51	47.1948	522.800	550.503	0.
8	1	7	5.45890	0.	0.	1049.49	47.1953	522.800	550.638	0.
9	1	7	5.45890	0.	0.	1049.49	47.1953	522.800	550.638	0.
1	2	7	13.0264	0.	0.	1049.40	25.2222	570.974	550.472	4.461679E-02
2	2	7	13.0264	0.	0.	1049.40	25.2222	570.974	550.472	4.461679E-02
3	2	7	13.5514	0.	0.	1049.01	24.2451	573.156	550.427	4.858622E-02
4	2	7	11.9505	0.	0.	1048.33	27.4929	566.203	550.347	3.641014E-02
5	2	7	11.9505	0.	0.	1048.33	27.4929	566.203	550.347	3.641014E-02
6	2	7	11.9505	0.	0.	1048.33	27.4929	566.203	550.347	3.641014E-02
7	2	7	12.3776	0.	0.	1048.51	26.5442	568.057	550.368	3.965701E-02
8	2	7	13.2132	0.	0.	1049.49	24.8656	571.787	550.482	4.603972E-02
9	2	7	13.2132	0.	0.	1049.49	24.8656	571.787	550.482	4.603972E-02
1	3	7	32.6939	0.	0.	1048.08	10.0494	654.794	550.318	.193719
2	3	7	32.6939	0.	0.	1048.08	10.0494	654.794	550.318	.193719
3	3	7	34.1671	0.	0.	1047.77	9.61609	661.014	550.281	.204821
4	3	7	29.5728	0.	0.	1047.21	11.1100	641.267	550.216	.169887
5	3	7	29.5728	0.	0.	1047.21	11.1100	641.267	550.216	.169887
6	3	7	29.5728	0.	0.	1047.21	11.1100	641.267	550.216	.169887
7	3	7	30.7984	0.	0.	1047.36	10.6679	646.533	550.233	.179202
8	3	7	33.2306	0.	0.	1048.15	9.88708	657.105	550.326	.197806
9	3	7	33.2306	0.	0.	1048.15	9.88708	657.105	550.326	.197806
1	4	7	43.4936	0.	0.	1045.32	7.55407	700.194	549.995	.274781
2	4	7	43.4936	0.	0.	1045.32	7.55407	700.194	549.995	.274781
3	4	7	45.4725	0.	0.	1045.24	7.22533	708.608	549.986	.289715
4	4	7	39.2307	0.	0.	1044.97	8.37492	681.931	549.953	.242456
5	4	7	39.2307	0.	0.	1044.97	8.37492	681.931	549.953	.242456
6	4	7	39.2307	0.	0.	1044.97	8.37492	681.931	549.953	.242456
7	4	7	40.8955	0.	0.	1045.04	8.03399	689.045	549.962	.255058
8	4	7	44.2235	0.	0.	1045.36	7.42940	703.315	549.999	.280309
9	4	7	44.2235	0.	0.	1045.36	7.42940	703.315	549.999	.280309
1	5	7	43.4936	0.	0.	1043.00	5.05874	745.594	549.672	.355842
2	5	7	43.4936	0.	0.	1043.00	5.05874	745.594	549.672	.355842
3	5	7	45.4725	0.	0.	1043.00	4.83458	756.202	549.690	.374610
4	5	7	39.2307	0.	0.	1043.00	5.63982	722.595	549.690	.315025
5	5	7	39.2307	0.	0.	1043.00	5.63982	722.595	549.690	.315025
6	5	7	39.2307	0.	0.	1043.00	5.63982	722.595	549.690	.315025
7	5	7	40.8955	0.	0.	1043.00	5.40008	731.557	549.690	.330915
8	5	7	44.2235	0.	0.	1043.00	4.97172	749.526	549.672	.362813
9	5	7	44.2235	0.	0.	1043.00	4.97172	749.526	549.672	.362813
1	1	8	3.95163	0.	0.	1048.47	47.1948	522.800	550.499	0.
2	1	8	3.95163	0.	0.	1048.47	47.1948	522.800	550.499	0.
3	1	8	5.45890	0.	0.	1048.61	47.1949	522.800	550.517	0.
4	1	8	5.73112	0.	0.	1049.09	47.1951	522.800	550.583	0.
5	1	8	5.75340	0.	0.	1048.87	47.1950	522.800	550.553	0.
6	1	8	5.73112	0.	0.	1048.96	47.1950	522.800	550.565	0.
7	1	8	5.45890	0.	0.	1049.49	47.1953	522.800	550.638	0.
8	1	8	3.95163	0.	0.	1049.16	47.1951	522.800	550.593	0.
9	1	8	3.95163	0.	0.	1049.16	47.1951	522.800	550.593	0.
1	2	8	10.2230	0.	0.	1048.47	32.1388	558.842	550.363	2.330746E-02
2	2	8	10.2230	0.	0.	1048.47	32.1388	558.842	550.363	2.330746E-02
3	2	8	11.3433	0.	0.	1048.61	28.9647	563.652	550.380	3.181139E-02
4	2	8	12.3722	0.	0.	1049.09	26.5559	568.126	550.436	3.963676E-02

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
5	2	8	11.9046	0.	0.	1048.87	27.5988	566.092	550.410	3.607975E-02
6	2	8	12.0917	0.	0.	1048.96	27.1719	566.906	550.420	3.750254E-02
7	2	8	13.2132	0.	0.	1049.49	24.8656	571.787	550.482	4.603972E-02
8	2	8	11.6272	0.	0.	1049.16	28.2574	564.951	550.444	3.398212E-02
9	2	8	11.6272	0.	0.	1049.16	28.2574	564.951	550.444	3.398212E-02
1	3	8	24.6636	0.	0.	1047.31	13.3214	620.327	550.228	.132707
2	3	8	24.6636	0.	0.	1047.31	13.3214	620.327	550.228	.132707
3	3	8	27.8598	0.	0.	1047.44	11.7931	634.001	550.242	.156947
4	3	8	30.8146	0.	0.	1047.83	10.6623	646.708	550.288	.179418
5	3	8	29.4718	0.	0.	1047.65	11.1481	640.933	550.267	.169203
6	3	8	30.0090	0.	0.	1047.72	10.9485	643.243	550.276	.173289
7	3	8	33.2306	0.	0.	1048.15	9.88708	657.105	550.326	.197806
8	3	8	28.6976	0.	0.	1047.88	11.4488	637.676	550.294	.163376
9	3	8	28.6976	0.	0.	1047.88	11.4488	637.676	550.294	.163376
1	4	8	32.5926	0.	0.	1044.90	10.0806	653.628	549.946	.192280
2	4	8	32.5926	0.	0.	1044.90	10.0806	653.628	549.946	.192280
3	4	8	36.9228	0.	0.	1045.01	8.89839	672.107	549.958	.225027
4	4	8	40.9388	0.	0.	1045.20	8.02549	689.272	549.981	.255431
5	4	8	39.1136	0.	0.	1045.11	8.40000	681.469	549.970	.241611
6	4	8	39.8437	0.	0.	1045.15	8.24607	684.590	549.974	.247139
7	4	8	44.2235	0.	0.	1045.36	7.42940	703.315	549.999	.280309
8	4	8	38.0761	0.	0.	1045.18	8.62887	677.063	549.978	.233786
9	4	8	38.0761	0.	0.	1045.18	8.62887	677.063	549.978	.233786
1	5	8	32.5926	0.	0.	1043.00	6.83982	686.928	549.664	.251852
2	5	8	32.5926	0.	0.	1043.00	6.83982	686.928	549.664	.251852
3	5	8	36.9228	0.	0.	1043.00	6.00366	710.212	549.674	.293106
4	5	8	40.9388	0.	0.	1043.00	5.38871	731.835	549.673	.331445
5	5	8	39.1136	0.	0.	1043.00	5.65192	722.006	549.674	.314018
6	5	8	39.8437	0.	0.	1043.00	5.54362	725.938	549.673	.320989
7	5	8	44.2235	0.	0.	1043.00	4.97172	749.526	549.672	.362813
8	5	8	38.0761	0.	0.	1043.00	5.80891	716.450	549.661	.304195
9	5	8	38.0761	0.	0.	1043.00	5.80891	716.450	549.661	.304195
1	1	9	3.95163	0.	0.	1048.47	47.1948	522.800	550.499	0.
2	1	9	3.95163	0.	0.	1048.47	47.1948	522.800	550.499	0.
3	1	9	5.45890	0.	0.	1048.61	47.1949	522.800	550.517	0.
4	1	9	5.73112	0.	0.	1049.09	47.1951	522.800	550.583	0.
5	1	9	5.75340	0.	0.	1048.87	47.1950	522.800	550.553	0.
6	1	9	5.73112	0.	0.	1048.96	47.1950	522.800	550.565	0.
7	1	9	5.45890	0.	0.	1049.49	47.1953	522.800	550.638	0.
8	1	9	3.95163	0.	0.	1049.16	47.1951	522.800	550.593	0.
9	1	9	3.95163	0.	0.	1049.16	47.1951	522.800	550.593	0.
1	2	9	10.2230	0.	0.	1048.47	32.1388	558.842	550.363	2.330746E-02
2	2	9	10.2230	0.	0.	1048.47	32.1388	558.842	550.363	2.330746E-02
3	2	9	11.3433	0.	0.	1048.61	28.9647	563.652	550.380	3.181139E-02
4	2	9	12.3722	0.	0.	1049.09	26.5559	568.126	550.436	3.963676E-02
5	2	9	11.9046	0.	0.	1048.87	27.5988	566.092	550.410	3.607975E-02
6	2	9	12.0917	0.	0.	1048.96	27.1719	566.906	550.420	3.750254E-02
7	2	9	13.2132	0.	0.	1049.49	24.8656	571.787	550.482	4.603972E-02
8	2	9	11.6272	0.	0.	1049.16	28.2574	564.951	550.444	3.398212E-02
9	2	9	11.6272	0.	0.	1049.16	28.2574	564.951	550.444	3.398212E-02
1	3	9	24.6636	0.	0.	1047.31	13.3214	620.327	550.228	.132707
2	3	9	24.6636	0.	0.	1047.31	13.3214	620.327	550.228	.132707
3	3	9	27.8598	0.	0.	1047.44	11.7931	634.001	550.242	.156947
4	3	9	30.8146	0.	0.	1047.83	10.6623	646.708	550.288	.179418
5	3	9	29.4718	0.	0.	1047.65	11.1481	640.933	550.267	.169203

TABLE E-II (continued)

SCORE-EVET   BENEDETTI-KISER-LORDS   MOD 1   VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
6	3	9	30.0090	0.	0.	1047.72	10.9485	643.243	550.276	.173289
7	3	9	33.2306	0.	0.	1048.15	9.88708	657.105	550.326	.197806
8	3	9	28.6976	0.	0.	1047.88	11.4488	637.676	550.294	.163376
9	3	9	28.6976	0.	0.	1047.88	11.4488	637.676	550.294	.163376
1	4	9	32.5926	0.	0.	1044.90	10.0806	653.628	549.946	.192280
2	4	9	32.5926	0.	0.	1044.90	10.0806	653.628	549.946	.192280
3	4	9	36.9228	0.	0.	1045.01	8.89839	672.107	549.958	.225027
4	4	9	40.9388	0.	0.	1045.20	8.02549	689.272	549.981	.255431
5	4	9	39.1136	0.	0.	1045.11	8.40000	681.469	549.970	.241611
6	4	9	39.8437	0.	0.	1045.15	8.24607	684.590	549.974	.247139
7	4	9	44.2235	0.	0.	1045.36	7.42940	703.315	549.999	.280309
8	4	9	38.0761	0.	0.	1045.18	8.62887	677.063	549.978	.233786
9	4	9	38.0761	0.	0.	1045.18	8.62887	677.063	549.978	.233786
1	5	9	32.5926	0.	0.	1043.00	6.83982	686.928	549.664	.251852
2	5	9	32.5926	0.	0.	1043.00	6.83982	686.928	549.664	.251852
3	5	9	36.9228	0.	0.	1043.00	6.00366	710.212	549.674	.293106
4	5	9	40.9388	0.	0.	1043.00	5.38871	731.835	549.673	.331445
5	5	9	39.1136	0.	0.	1043.00	5.65192	722.006	549.674	.314018
6	5	9	39.8437	0.	0.	1043.00	5.54362	725.938	549.673	.320989
7	5	9	44.2235	0.	0.	1043.00	4.97172	749.526	549.672	.362813
8	5	9	38.0761	0.	0.	1043.00	5.80891	716.450	549.661	.304195
9	5	9	38.0761	0.	0.	1043.00	5.80891	716.450	549.661	.304195

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

X	DX INCHES	DY INCHES	DZ INCHES	X INCHES	Y INCHES	Z INCHES
1	.50000	.79400	.79400	0.	0.	0.
2	48.000	.79400	.79400	48.000	.79400	.79400
3	48.000	.73800	.73800	96.000	1.5320	1.5320
4	48.000	.73800	.73800	144.00	2.2700	2.2700
5	.50000	.73800	.73800	144.50	3.0080	3.0080
6	0.	.73800	.73800	0.	3.7460	3.7460
7	0.	.73800	.73800	0.	4.4840	4.4840
8	0.	.79400	.79400	0.	5.2780	5.2780
9	0.	.79400	.79400	0.	6.0720	6.0720

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

***CHANNEL 1 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	3.951631	1049.448	47.19524	522.8000	550.6328	0.	186.4982	0.
2	12.20471	1049.448	26.92026	567.4665	550.4775	3.8377584E-02	328.5540	253844.7
3	30.35743	104[illegible].119	10.82285	644.8199	550.3222	.1760068	328.5540	468036.3
4	40.33319	1045.288	8.145996	686.7128	549.9908	.2508776	328.5540	253844.7
5	40.33319	1043.000	5.469139	728.6056	549.6594	.3257484	220.5879	0.

***CHANNEL 2 CYCLE 0. TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	5.458904	1049.801	47.19539	522.8000	550.6815	0.	257.6351	0.
2	13.86686	1049.801	23.69347	574.6344	550.5187	5.1020286E-02	328.5540	262523.2
3	35.10877	1046.408	9.358176	665.1908	550.3559	.2121095	328.5540	484037.6
4	46.77753	1045.480	7.023757	714.2377	550.0133	.2996596	328.5540	262523.2
5	46.77753	1043.000	4.689339	763.2847	549.6708	.3872096	219.3557	0.

***CHANNEL 3 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	5.731118	1049.136	47.19511	522.8000	550.5894	0.	270.4807	0.
2	12.46567	1049.136	26.35670	568.5330	550.4410	4.0348170E-02	328.5540	229979.0
3	31.08316	1047.866	10.57016	647.8635	550.2925	.1814605	328.5540	424032.9
4	41.30383	1045.219	7.954566	690.8321	549.9826	.2581954	328.5540	229979.0
5	41.30383	1043.000	5.338971	733.8006	549.6728	.3349302	220.5199	0.

***CHANNEL 4 CYCLE 0. TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	5.753397	1049.712	47.19535	522.8000	550.6691	0.	271.5336	0.
2	13.68014	1049.712	24.01685	575.8208	550.5083	4.9597216E-02	328.5540	258183.9
3	34.57225	1048.335	9.503403	662.8805	550.3474	.2080225	328.5540	476037.0
4	46.04786	1045.445	7.135054	711.1170	550.0092	.2941308	328.5540	258183.9
5	46.04786	1043.000	4.766706	759.3536	549.6710	.3802391	219.4966	0.

***CHANNEL 5 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	5.731118	1049.445	47.19524	522.8000	550.6322	0.	270.4815	0.
2	13.11980	1049.445	25.04261	57[illegible].3803	550.4771	4.5328251E-02	328.5540	245166.3
3	32.96227	104[illegible].118	9.967579	655.9496	550.3220	.1957623	328.5540	452035.1
4	43.85857	1045.341	7.491216	70[illegible].7549	549.9969	.2775448	328.5540	245166.3
5	43.85857	1043.000	5.014854	747.5601	549.6719	.3593273	219.9443	0.

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

***CHANNEL 6 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	5.458904	1049.400	47.19522	522.8000	550.6260	0.	257.6342	0.
2	13.02638	1049.400	25.22221	570.9735	550.4719	4.4616788E-02	328.5540	242996.6
3	32.69388	1048.082	10.04940	654.7945	550.3178	.1937191	328.5540	448034.8
4	43.49364	1045.323	7.554070	700.1945	549.9949	.2747805	328.5540	242996.6
5	43.49364	1043.000	5.058735	745.5945	549.6720	.3558420	220.0228	0.

***CHANNEL 7 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	3.951631	1048.470	47.19482	522.8000	550.4988	0.	186.4965	0.
2	10.22298	1048.470	32.13876	558.8415	550.3632	2.3307463E-02	328.5540	201774.0
3	24.66358	1047.310	13.32142	620.3270	550.2276	.1327075	328.5540	372028.9
4	32.59264	1044.904	10.08062	653.6276	549.9458	.1922796	328.5540	201774.0
5	32.59264	1043.000	6.839816	686.9283	549.6640	.2518517	222.9277	0.

***CHANNEL 9 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.156936	1049.015	47.19505	522.8000	550.5727	0.	337.7720	0.
2	13.55136	1049.015	24.24510	573.1560	550.4268	4.8586216E-02	328.5540	223470.1
3	34.16711	1047.766	9.616091	661.0143	550.2808	.2048208	328.5540	412032.0
4	45.47250	1045.245	7.225335	708.6081	549.9856	.2897152	328.5540	223470.1
5	45.47250	1043.000	4.834578	756.2019	549.6904	.3746096	219.8403	0.

***CHANNEL 10 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.418707	1048.513	47.19484	522.8000	550.5032	0.	350.1247	0.
2	12.37763	1048.513	26.54417	568.0573	550.3681	3.9657012E-02	328.5540	199604.4
3	30.79840	1047.357	10.66789	646.5327	550.2330	.1792017	328.5540	368028.6
4	40.89552	1045.040	8.033985	689.0449	549.9616	.2550581	328.5540	199604.4
5	40.89552	1043.000	5.400078	731.5570	549.6903	.3309145	220.8390	0.

***CHANNEL 11 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.444467	1049.478	47.19525	522.8000	550.6371	0.	351.3435	0.
2	14.61728	1049.478	22.47709	577.7912	550.4809	5.6704591E-02	328.5540	245166.3
3	37.22735	1048.141	8.825608	674.1792	550.3247	.2281155	328.5540	452035.1
4	49.63180	1045.431	6.619829	726.3922	550.0075	.3212240	328.5540	245166.3
5	49.63180	1043.000	4.414050	778.6052	549.6903	.4143325	219.0772	0.

TABLE E-II (continued)

SCORE-EVET   BENEDETTI-KISER-LORDS   MOD 1   VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

***CHANNEL 12   CYCLE 0   TIMET 0.   ITER 0   DELTA TIME .10000E-02   POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.418707	1048.923	47.19501	522.8000	550.5600	0.	350.1260	0.
2	13.33805	1048.923	24.63234	572.2290	550.4160	4.6962665E-02	328.5540	219130.9
3	33.55481	1047.692	9.791564	658.3813	550.2721	.2001623	328.5540	404031.4
4	44.64046	1045.207	7.360006	705.0512	549.9812	.2834137	328.5540	219130.9
5	44.64046	1043.000	4.928448	751.7211	549.6904	.3666650	220.0082	0.

***CHANNEL 13   CYCLE 0   TIMET 0.   ITER 0   DELTA TIME .10000E-02   POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.156936	1049.015	47.19505	522.8000	550.5727	0.	337.7720	0.
2	13.55136	1049.015	24.24510	573.1560	550.4268	4.8586216E-02	328.5540	223470.1
3	34.16711	1047.766	9.616091	561.0143	550.2808	.2043208	328.5540	412032.0
4	45.47250	1045.245	7.225335	708.6081	549.9856	.2897152	328.5540	223470.1
5	45.47250	1043.000	4.834578	756.2019	549.6904	.3745096	219.8403	0.

***CHANNEL 14   CYCLE 0   TIMET 0.   ITER 0   DELTA TIME .10000E-02   POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	5.458904	1048.613	47.19488	522.8000	550.5175	0.	257.6323	0.
2	11.34327	1048.613	28.96465	565.6519	550.3799	3.1811392E-02	328.5540	203943.6
3	27.85978	1047.435	11.79313	634.0015	550.2423	.1569474	328.5540	376029.2
4	36.92264	1045.010	8.898394	672.1066	549.9582	.2250269	328.5540	203943.6
5	36.92264	1043.000	6.003659	710.2117	549.6742	.2931065	221.6722	0.

***CHANNEL 17   CYCLE 0   TIMET 0.   ITER 0   DELTA TIME .10000E-02   POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.665162	1048.969	47.19503	522.8000	550.5663	0.	361.7576	0.
2	13.44471	1048.969	24.43742	572.6925	550.4214	4.7774437E-02	328.5540	221300.5
3	33.86097	1047.729	9.703031	659.6978	550.2764	.2024915	328.5540	408031.7
4	45.05649	1045.226	7.292047	706.8297	549.9834	.2865644	328.5540	221300.5
5	45.05649	1043.000	4.881063	753.9615	549.6904	.3706373	219.9236	0.

***CHANNEL 18   CYCLE 0   TIMET 0.   ITER 0   DELTA TIME .10000E-02   POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.690921	1048.558	47.19486	522.8000	550.5094	0.	362.9719	0.
2	12.48439	1048.558	26.31719	568.5209	550.3734	4.0468734E-02	328.5540	201774.0
3	31.10475	1047.394	10.56282	647.8493	550.2373	.1815305	328.5540	372028.9
4	41.31169	1045.059	7.953053	690.8234	549.9638	.2582086	328.5540	201774.0
5	41.31169	1043.000	5.343282	733.7975	549.6903	.3348868	220.7400	0.

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

***CHANNEL 19 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.665162	1048.378	47.19478	522.8000	550.4845	0.	361.7556	0.
2	12.05730	1048.378	27.24940	566.6668	550.3523	3.7221856E-02	328.5540	193095.5
3	29.87921	1047.247	10.99607	642.5832	550.2200	.1722156	328.5540	356027.6
4	39.64694	1044.985	8.286996	683.7093	549.9551	.2456067	328.5540	193095.5
5	39.64694	1043.000	5.577919	724.8354	549.6902	.3189977	221.1474	0.

***CHANNEL 20 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.418707	1048.333	47.19476	522.8000	550.4784	0.	350.1241	0.
2	11.95049	1048.333	27.49292	566.2033	550.3470	3.6410138E-02	328.5540	190925.9
3	29.57277	1047.210	11.11002	641.2667	550.2157	.1698870	328.5540	352027.3
4	39.23071	1044.966	8.374919	681.9307	549.9529	.2424562	328.5540	190925.9
5	39.23071	1043.000	5.639320	722.5948	549.6902	.3150255	221.2542	0.

***CHANNEL 21 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	5.731118	1049.092	47.19509	522.8000	550.5834	0.	270.4806	0.
2	12.37219	1049.092	26.55585	568.1262	550.4358	3.9636756E-02	328.5540	227809.4
3	30.81464	1047.830	10.66227	646.7084	550.2883	.1794175	328.5540	420032.6
4	40.93881	1045.201	8.025490	689.2716	549.9806	.2554312	328.5540	227809.4
5	40.93881	1043.000	5.388710	731.8349	549.6729	.3314449	220.6074	0.

***CHANNEL 25 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.716681	1048.244	47.19472	522.8000	550.4661	0.	364.1866	0.
2	11.73686	1048.244	27.99336	565.2763	550.3366	3.4786695E-02	328.5540	186586.7
3	28.95983	1047.137	11.34517	638.6336	550.2071	.1652298	328.5540	344026.7
4	38.39821	1044.929	8.556493	678.3736	549.9486	.2361554	328.5540	186586.7
5	38.39821	1043.000	5.767820	718.1137	549.6901	.3070810	221.4740	0.

***CHANNEL 26 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.690921	1048.333	47.19476	522.8000	550.4784	0.	362.9712	0.
2	11.95049	1048.333	27.49292	566.2033	550.3470	3.6410138E-02	328.5540	190925.9
3	29.57277	1047.210	11.11002	641.2667	550.2157	.1698870	328.5540	352027.3
4	39.23071	1044.966	8.374919	681.9307	549.9529	.2424562	328.5540	190925.9
5	39.23071	1043.000	5.639820	722.5948	549.6902	.3150255	221.2542	0.

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

***CHANNEL 27 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.444467	1048.333	47.19476	522.8000	550.4784	0.	351.3398	0.
2	11.95049	1048.333	27.49292	566.2033	550.3470	3.6410138E-02	328.5540	190925.9
3	29.57277	1047.210	11.11002	641.2667	550.2157	.1698870	328.5540	352027.3
4	39.23071	1044.966	8.374919	681.9307	549.9529	.2424562	328.5540	190925.9
5	39.23071	1043.000	5.639820	722.5948	549.6902	.3150255	221.2542	0.

***CHANNEL 28 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	5.753397	1048.873	47.19499	522.8000	550.5532	0.	271.5315	0.
2	11.90454	1048.873	27.59882	565.0924	550.4103	3.6079746E-02	328.5540	216961.3
3	29.47130	1047.650	11.14808	640.9325	550.2673	.1692033	328.5540	400031.1
4	39.11356	1045.114	8.400003	681.4694	549.9704	.2416108	328.5540	216961.3
5	39.11356	1043.000	5.651923	722.0063	549.6735	.3140184	221.0668	0.

***CHANNEL 33 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.665162	1048.022	47.19463	522.8000	550.4356	0.	361.7545	0.
2	11.20255	1048.022	29.32850	562.9588	550.3107	3.0728009E-02	328.5540	175738.6
3	27.42708	1046.954	11.97918	632.0510	550.1858	.1535877	328.5540	324025.2
4	36.31670	1044.837	9.046914	669.4808	549.9379	.2204037	328.5540	175738.6
5	36.31670	1043.000	6.114643	706.9106	549.6899	.2872198	222.0636	0.

***CHANNEL 34 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.418707	1048.333	47.19476	522.8000	550.4784	0.	350.1241	0.
2	11.95049	1048.333	27.49292	566.2033	550.3470	3.6410138E-02	328.5540	190925.9
3	29.57277	1047.210	11.11002	641.2667	550.2157	.1698870	328.5540	352027.3
4	39.23071	1044.966	8.374919	681.9307	549.9529	.2424562	328.5540	190925.9
5	39.23071	1043.000	5.639820	722.5948	549.6902	.3150255	221.2542	0.

***CHANNEL 35 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	5.731118	1048.960	47.19503	522.8000	550.5652	0.	270.4803	0.
2	12.09169	1048.960	27.17189	566.9059	550.4205	3.7502540E-02	328.5540	221300.5
3	30.00899	1047.722	10.94852	643.2429	550.2757	.1732889	328.5540	408031.7
4	39.84370	1045.149	8.246072	684.5903	549.9745	.2471389	328.5540	221300.5
5	39.84370	1043.000	5.543625	725.9378	549.6733	.3209890	220.8785	0.

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

***CHANNEL 41 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U	PRESSURE	DENSITY	ENERGY	TEMP	QUAL	MASS FLUX	HEAT FLUX
	FT/SEC	PSI	LBM/FT3	BTU/LBM	DEG F		LBM/FT2*SEC	BTU/FT2.HR.
1	7.156936	1048.513	47.19484	522.8000	550.5032	0.	337.7704	0.
2	12.37763	1048.513	26.54417	568.0573	550.3681	3.9657012E-02	328.5540	199604.4
3	30.79840	1047.357	10.66789	646.5327	550.2330	.1792017	328.5540	368028.6
4	40.89552	1045.040	8.033985	689.0449	549.9616	.2550581	328.5540	199604.4
5	40.89552	1043.000	5.400078	731.5570	549.6903	.3309145	220.8390	0.

***CHANNEL 42 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U	PRESSURE	DENSITY	ENERGY	TEMP	QUAL	MASS FLUX	HEAT FLUX
	FT/SEC	PSI	LBM/FT3	BTU/LBM	DEG F		LBM/FT2*SEC	BTU/FT2.HR.
1	5.458904	1049.489	47.19526	522.8000	550.6383	0.	257.6344	0.
2	13.21321	1049.489	24.86557	571.7870	550.4823	4.6039721E-02	328.5540	247335.9
3	33.23064	1048.154	9.887080	657.1048	550.3263	.1978056	328.5540	456035.4
4	44.22348	1045.358	7.429402	703.3152	549.9990	.2803091	328.5540	247335.9
5	44.22348	1043.000	4.971724	749.5257	549.6717	.3628126	219.8670	0.

***CHANNEL 49 CYCLE 0 TIMET 0. ITER 0 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U	PRESSURE	DENSITY	ENERGY	TEMP	QUAL	MASS FLUX	HEAT FLUX
	FT/SEC	PSI	LBM/FT3	BTU/LBM	DEG F		LBM/FT2*SEC	BTU/FT2.HR.
1	3.951631	1049.158	47.19512	522.8000	550.5930	0.	186.4977	0.
2	11.62718	1049.158	28.25741	564.9508	550.4437	3.3982122E-02	328.5540	238657.4
3	28.69763	1047.881	11.44382	637.6762	550.2944	.1633761	328.5540	440034.2
4	38.07614	1045.175	8.628368	677.0632	549.9776	.2337857	328.5540	238657.4
5	38.07614	1043.000	5.808914	716.4503	549.6609	.3041953	221.1811	0.

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

FUEL ROD 1 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 1, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2288.9	2009.7	1669.5	1284.2	906.6	628.9	565.2	2
2	3752.1	3237.5	2610.1	1899.7	1203.5	691.5	575.0	2
3	2300.4	2021.3	1681.0	1295.7	918.1	640.4	577.8	2

FUEL ROD 2 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 2, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2348.0	2059.4	1707.5	1309.0	918.5	631.3	566.6	2
2	5044.1	4511.9	3863.1	3128.4	2408.3	1878.8	1759.4	9
3	2362.5	2073.8	1721.9	1323.4	932.9	645.7	581.0	2

FUEL ROD 3 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 3, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2126.1	1873.2	1565.0	1215.9	873.8	622.2	565.5	2
2	3455.8	2989.5	2421.2	1777.5	1146.8	682.9	578.3	2
3	2137.0	1884.1	1575.8	1226.8	884.7	633.1	576.3	2

FUEL ROD 4 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 4, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2318.5	2034.6	1688.5	1296.6	912.5	630.1	566.4	2
2	4984.2	4460.7	3822.7	3100.1	2392.0	1871.2	1753.8	9
3	2332.4	2048.5	1702.5	1310.6	926.5	644.1	580.4	2

FUEL ROD 5 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 5, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2229.7	1960.1	1631.5	1259.4	894.7	626.5	566.0	2
2	3655.7	3158.6	2552.7	1866.6	1194.2	699.7	588.2	2
3	2242.3	1972.7	1644.1	1272.0	907.3	639.1	578.6	2

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

FUEL ROD 6 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 6, 0, 0, 0,

	RADIAL POSITIONS							
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2214.9	1947.7	1622.0	1253.1	891.7	625.9	565.9	2
2	3627.2	3134.5	2534.0	1853.9	1187.4	697.3	586.8	2
3	2227.3	1960.1	1634.4	1265.5	904.1	638.2	578.3	2

FUEL ROD 7 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 7, 0, 0, 0,

	RADIAL POSITIONS							
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1933.7	1711.8	1441.4	1135.1	834.9	614.2	564.4	2
2	3094.0	2684.9	2186.2	1621.5	1068.1	661.1	569.4	2
3	1937.3	1715.4	1445.0	1138.7	838.6	617.8	568.1	2

FUEL ROD 8 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 9, 0, 0, 0,

	RADIAL POSITIONS							
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2081.7	1836.0	1536.4	1197.2	864.8	620.4	565.2	2
2	3386.8	2933.7	2381.4	1756.0	1143.1	692.4	590.7	2
3	2094.0	1848.3	1548.8	1209.6	877.1	632.7	577.6	2

FUEL ROD 9 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 10, 0, 0, 0,

	RADIAL POSITIONS							
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1918.9	1699.4	1431.9	1128.9	832.0	613.6	564.4	2
2	3072.3	2667.6	2174.3	1615.7	1068.2	665.6	574.9	2
3	1928.5	1709.0	1441.4	1138.5	841.5	623.2	573.9	2

FUEL ROD 10 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 11, 0, 0, 0,

	RADIAL POSITIONS							
AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2229.7	1960.1	1631.5	1259.4	894.7	626.5	566.0	2
2	4750.2	4253.1	3647.2	2961.1	2288.7	1794.2	1682.6	9
3	2243.8	1974.2	1645.6	1273.5	908.8	640.6	580.1	3

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

FUEL ROD 11 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 12, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	......	......	R A D I A L	P O S I T I O N S	......	......	......	
1	2052.1	1811.2	1517.4	1184.8	858.9	619.1	565.1	2
2	3329.8	2885.5	2344.0	1730.7	1129.7	687.7	588.0	2
3	2064.0	1823.0	1529.3	1196.7	870.7	631.0	576.9	2

FUEL ROD 12 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 13, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	......	......	R A D I A L	P O S I T I O N S	......	......	......	
1	2081.7	1836.0	1536.4	1197.2	864.8	620.4	565.2	2
2	3386.8	2933.7	2381.4	1756.0	1143.1	692.4	590.7	2
3	2094.0	1848.3	1548.8	1209.6	877.1	632.7	577.6	2

FUEL ROD 13 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 14, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	......	......	R A D I A L	P O S I T I O N S	......	......	......	
1	1948.5	1724.2	1450.9	1141.3	837.9	614.8	564.5	2
2	3121.2	2707.7	2203.7	1633.0	1073.6	662.2	569.5	2
3	1955.9	1731.7	1458.3	1148.7	845.4	622.3	572.0	2

FUEL ROD 14 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 17, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	......	......	R A D I A L	P O S I T I O N S	......	......	......	
1	2066.9	1823.6	1526.9	1191.0	861.8	619.7	565.2	2
2	3358.3	2909.6	2362.7	1743.4	1136.4	690.0	589.4	2
3	2079.0	1835.7	1539.0	1203.1	873.9	631.8	577.3	2

FUEL ROD 15 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 18, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	......	......	R A D I A L	P O S I T I O N S	......	......	......	
1	1933.7	1711.8	1441.4	1135.1	835.0	614.2	564.4	2
2	3101.0	2691.9	2193.3	1628.6	1075.2	668.2	576.4	2
3	1943.5	1721.7	1451.2	1144.9	844.8	624.1	574.3	2

TABLE E-II (continued)

SCORE-EVET   BENEDETTI-KISER-LORDS   MOD 1   VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

FUEL ROD 16 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 19, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S..........				
1	1874.5	1662.1	1403.3	1110.2	823.0	611.8	564.1	2
2	2986.1	2594.6	2117.4	1577.0	1047.4	657.9	570.1	2
3	1883.2	1670.9	1412.1	1119.0	831.7	620.5	572.9	2

FUEL ROD 17 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 20, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S..........				
1	1859.7	1649.7	1393.8	1104.0	820.0	611.1	564.0	2
2	2957.7	2570.6	2098.8	1564.4	1040.8	655.7	568.8	2
3	1868.1	1658.2	1402.3	1112.5	828.4	619.6	572.5	2

FUEL ROD 18 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 21, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S..........				
1	2111.3	1860.8	1555.5	1209.7	870.8	621.6	565.4	2
2	3427.2	2965.3	2402.3	1764.7	1139.9	680.4	576.8	2
3	2121.9	1871.4	1566.1	1220.3	881.4	632.2	576.0	2

FUEL ROD 19 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 25, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S..........				
1	1830.1	1624.9	1374.8	1091.6	814.0	609.9	563.9	2
2	2903.2	2524.9	2063.8	1541.6	1029.8	653.5	568.6	2
3	1837.9	1632.7	1382.6	1099.4	821.9	617.7	571.7	2

FUEL ROD 20 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 26, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S..........				
1	1859.7	1649.7	1393.8	1104.0	820.0	611.1	564.0	2
2	2957.7	2570.6	2098.8	1564.4	1040.8	655.7	568.8	2
3	1868.1	1658.2	1402.3	1112.5	828.4	619.6	572.5	2

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LOROS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

FUEL ROD 21 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 27, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	......................R A D I A L			P O S I T I O N S	....			
1	1859.7	1649.7	1393.8	1104.0	820.0	611.1	564.0	2
2	2957.7	2570.6	2098.8	1564.4	1040.8	655.7	568.8	2
3	1868.1	1658.2	1402.3	1112.5	828.4	619.6	572.5	2

FUEL ROD 22 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 28, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	......................R A D I A L			P O S I T I O N S	....			
1	2037.3	1798.7	1507.9	1178.6	855.9	618.5	565.0	2
2	3284.7	2844.8	2308.7	1701.5	1106.4	668.8	570.1	2
3	2046.5	1808.0	1517.2	1187.8	865.1	627.8	574.2	2

FUEL ROD 23 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 33, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	......................R A D I A L			P O S I T I O N S	....			
1	1756.0	1562.3	1327.2	1060.5	799.1	606.8	563.4	2
2	2766.9	2410.5	1976.3	1484.4	1002.4	648.0	568.0	2
3	1762.3	1569.0	1333.5	1066.7	805.3	613.0	569.7	2

FUEL ROD 24 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 34, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	......................R A D I A L			P O S I T I O N S	....			
1	1859.7	1649.7	1393.8	1104.0	820.0	611.1	564.0	2
2	2957.7	2570.6	2098.8	1564.4	1040.8	655.7	568.8	2
3	1868.1	1658.2	1402.3	1112.5	828.4	619.6	572.5	2

FUEL ROD 25 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 35, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	......................R A D I A L			P O S I T I O N S	....			
1	2066.9	1823.6	1526.9	1191.0	861.8	619.7	565.2	2
2	3341.2	2892.5	2345.6	1726.2	1119.3	672.9	572.2	2
3	2076.7	1833.4	1536.7	1200.8	871.6	629.5	575.0	2

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

FUEL ROD 26 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 41, 0, 0, 0,

R A D I A L P O S I T I O N S

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1918.9	1699.4	1431.9	1128.9	832.0	613.6	564.4	2
2	3072.3	2667.6	2174.3	1615.7	1068.2	665.6	574.9	2
3	1928.5	1709.0	1441.4	1138.5	841.5	623.2	573.9	2

FUEL ROD 27 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 42, 0, 0, 0,

R A D I A L P O S I T I O N S

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2244.5	1972.5	1641.0	1265.6	897.6	627.1	566.1	2
2	3684.2	3182.7	2571.5	1879.3	1200.9	702.0	589.5	2
3	2257.3	1985.4	1653.8	1278.4	910.5	639.9	578.9	2

FUEL ROD 28 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 49, 0, 0, 0,

R A D I A L P O S I T I O N S

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2185.3	1922.9	1603.0	1240.7	885.7	624.6	565.7	2
2	3557.2	3073.3	2483.5	1815.6	1161.0	679.6	571.1	2
3	2194.8	1932.4	1612.5	1250.3	895.2	634.2	575.3	2

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

***CHANNEL 6 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	5.458904	1047.481	47.19440	522.8000	550.3674	0.	257.6297	0.
2	12.78529	1047.481	21.37673	580.6716	550.2477	6.2295867E-02	273.3076	242996.6
3	31.64907	1046.458	8.649311	677.0011	550.1280	.2334368	273.7427	448034.8
4	41.89417	1044.446	6.647049	725.2395	549.8922	.3193363	278.4726	242996.6
5	41.89417	1043.000	4.644788	773.4778	549.6564	.4052357	194.5896	0.

***CHANNEL 7 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	3.951631	1047.481	47.19440	522.8000	550.3674	0.	186.4949	0.
2	11.65049	1047.481	21.45794	580.4231	550.2477	6.1854982E-02	249.9956	201774.0
3	28.60035	1046.458	9.544151	661.8043	550.1280	.2064765	272.9660	372028.9
4	37.81730	1044.446	7.432625	702.9852	549.8922	.2798801	281.0818	201774.0
5	37.81730	1043.000	5.321100	744.1661	549.6564	.3532838	201.2296	0.

***CHANNEL 9 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.156936	1047.481	47.19440	522.8000	550.3674	0.	337.7673	0.
2	13.20067	1047.481	24.17447	573.0752	550.2477	4.8815045E-02	319.1193	223470.1
3	33.21581	1046.458	9.299259	665.6726	550.1280	.2133391	308.8824	412032.0
4	44.26517	1044.446	6.873040	713.3162	549.8922	.3070616	304.2363	223470.1
5	44.26517	1043.000	4.446821	770.9599	549.6564	.4007841	196.8393	0.

***CHANNEL 10 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.418707	1047.481	47.19440	522.8000	550.3674	0.	350.1214	0.
2	12.60808	1047.481	26.35813	563.2668	550.2477	4.0281725E-02	332.3254	199604.4
3	32.05474	1046.458	10.20829	652.2479	550.1280	.1895227	327.2241	368028.6
4	42.85809	1044.446	7.461779	702.2495	549.8922	.2785757	319.7976	199604.4
5	42.85809	1043.000	4.715265	752.2511	549.6564	.3676288	202.0873	0.

***CHANNEL 11 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.444457	1047.481	47.19440	522.8000	550.3674	0.	351.3371	0.
2	13.14334	1047.481	24.26817	572.8511	550.2477	4.8417348E-02	318.9649	245166.3
3	32.99861	1046.458	9.226370	665.8636	550.1280	.2154520	304.4573	452035.1
4	43.87554	1044.446	6.944709	715.2148	549.8922	.3033357	304.7028	245166.3
5	43.87554	1043.000	4.663048	765.5660	549.6564	.3912195	204.5937	0.

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

***CHANNEL 12 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.418707	1047.481	47.19440	522.8000	550.3674	0.	350.1214	0.
2	12.81013	1047.481	25.44267	570.1821	550.2477	4.3680846E-02	325.9239	219130.9
3	32.35386	1046.458	9.769088	658.4222	550.1280	.2004763	316.0677	404031.4
4	43.11298	1044.446	7.262511	707.3959	549.8922	.2877002	313.1085	219130.9
5	43.11298	1043.000	4.755933	756.3697	549.6564	.3749241	205.0425	0.

***CHANNEL 13 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.156936	1047.481	47.19440	522.8000	550.3674	0.	337.7673	0.
2	12.80386	1047.481	24.76047	571.7016	550.2477	4.6377306E-02	317.0296	223470.1
3	32.22131	1046.458	9.602974	660.9046	550.1280	.2048803	309.4204	412032.0
4	42.84757	1044.446	7.228055	708.3146	549.8922	.2893289	309.7046	223470.1
5	42.84757	1043.000	4.853136	755.7246	549.6564	.3737776	207.9451	0.

***CHANNEL 14 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	5.458904	1047.481	47.19440	522.8000	550.3674	0.	257.6297	0.
2	11.82753	1047.481	23.82721	573.9211	550.2477	5.0316230E-02	281.8171	203943.6
3	29.72149	1046.458	9.856181	657.1541	550.1280	.1982266	292.9403	376029.2
4	39.48508	1044.446	7.507400	701.1097	549.8922	.2765549	296.4302	203943.6
5	39.48508	1043.000	5.158619	745.0653	549.6564	.3548832	203.6885	0.

***CHANNEL 17 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.665162	1047.481	47.19440	522.8000	550.3674	0.	361.7527	0.
2	12.45865	1047.481	26.61375	567.7555	550.2477	3.9374363E-02	331.5713	221300.5
3	31.61926	1046.458	10.24140	651.8039	550.1280	.1887350	323.8256	408031.7
4	42.19220	1044.446	7.641294	697.8431	549.8922	.2707633	322.4030	221300.5
5	42.19220	1043.000	5.041184	743.8823	549.6564	.3527916	212.6986	0.

***CHANNEL 18 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.690921	1047.481	47.19440	522.8000	550.3674	0.	362.9684	0.
2	12.13038	1047.481	27.87144	565.3764	550.2477	3.5152385E-02	338.0913	201774.0
3	30.95244	1046.458	10.78058	644.9577	550.1280	.1765892	333.6851	372028.9
4	41.34882	1044.446	7.998233	689.6692	549.8922	.2562712	330.7175	201774.0
5	41.34882	1043.000	5.215891	734.3807	549.6564	.3359531	215.6709	0.

TABLE E-II (continued)

SCORE-EVET   BENEDETTI-KISER-LORDS   MOD 1   VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

***CHANNEL 19   CYCLE 1000   TIMET 1.0000   ITER 2   DELTA TIME .10000E-02   POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.665162	1047.481	47.19440	522.8000	550.3674	0.	361.7527	0.
2	11.88977	1047.481	28.57014	564.1453	550.2477	3.2967519E-02	339.6924	193095.5
3	30.46113	1046.458	11.14237	640.7352	550.1280	.1690982	339.4093	356027.6
4	40.73917	1044.446	8.248341	684.3633	549.8922	.2468639	336.0306	193095.5
5	40.73917	1043.000	5.354309	727.9913	549.6564	.3246296	218.1301	0.

***CHANNEL 20   CYCLE 1000   TIMET 1.0000   ITER 2   DELTA TIME .10000E-02   POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.418707	1047.481	47.19440	522.8000	550.3674	0.	350.1214	0.
2	11.98670	1047.481	27.76385	555.5715	550.2477	3.5498605E-02	332.7969	190925.9
3	30.64985	1046.458	10.88659	643.6914	550.1280	.1743426	333.6723	352027.3
4	40.96062	1044.446	8.066622	688.1857	549.8922	.2536409	330.4139	190925.9
5	40.96062	1043.000	5.246657	732.6799	549.6564	.3329392	214.9063	0.

***CHANNEL 21   CYCLE 1000   TIMET 1.0000   ITER 2   DELTA TIME .10000E-02   POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	5.731118	1047.481	47.19440	522.8000	550.3674	0.	270.4767	0.
2	11.96577	1047.481	23.53275	574.6580	550.2477	5.1623837E-02	281.5873	227809.4
3	30.07376	1046.458	9.525021	662.0994	550.1280	.2069939	286.5008	420032.6
4	39.92397	1044.446	7.311579	706.1026	549.8922	.2854072	291.9073	227809.4
5	39.92397	1043.000	5.093137	750.1059	549.6564	.3638145	203.5379	0.

***CHANNEL 25   CYCLE 1000   TIMET 1.0000   ITER 2   DELTA TIME .10000E-02   POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.716681	1047.481	47.19440	522.8000	550.3674	0.	364.1841	0.
2	11.58919	1047.481	29.54831	562.5195	550.2477	3.0082347E-02	342.4409	186586.7
3	29.79904	1046.458	11.58419	635.9365	550.1280	.1605848	345.1978	344026.7
4	39.87468	1044.446	8.596252	677.4959	549.8922	.2346883	342.7728	186586.7
5	39.87468	1043.000	5.608313	719.0553	549.6564	.3087917	223.6297	0.

***CHANNEL 26   CYCLE 1000   TIMET 1.0000   ITER 2   DELTA TIME .10000E-02   POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.690921	1047.481	47.19440	522.8000	550.3674	0.	362.9684	0.
2	11.52555	1047.481	29.42834	562.7131	550.2477	3.0425882E-02	339.1777	190925.9
3	29.62997	1046.458	11.57484	636.0343	550.1280	.1607583	342.9621	352027.3
4	39.63282	1044.446	8.643428	676.6073	549.8922	.2331128	342.5635	190925.9
5	39.63282	1043.000	5.712019	717.1803	549.6564	.3054672	226.3834	0.

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

***CHANNEL 27 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.444467	1047.481	47.19440	522.8000	550.3674	0.	351.3371	0.
2	11.75274	1047.481	28.28222	564.6452	550.2477	3.3854801E-02	332.3934	190925.9
3	30.11909	1046.456	11.14028	640.7588	550.1280	.1691400	335.5352	352027.3
4	40.25288	1044.446	8.305545	683.1946	549.8922	.2447919	334.3221	190925.9
5	40.25288	1043.000	5.470807	725.6304	549.6565	.3204438	220.2157	0.

***CHANNEL 28 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	5.753397	1047.481	47.19440	522.8000	550.3674	0.	271.5281	0.
2	11.76589	1047.481	24.18900	573.0404	550.2477	4.8753180E-02	284.6052	216961.3
3	29.72969	1046.458	9.811535	657.8013	550.1280	.1993748	291.6939	400031.1
4	39.52124	1044.446	7.488477	701.5808	549.8922	.2773902	295.9539	216961.3
5	39.52124	1043.000	5.165418	745.3603	549.6564	.3554055	204.1437	0.

***CHANNEL 33 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.665162	1047.481	47.19440	522.8000	550.3674	0.	361.7527	0.
2	11.32256	1047.481	30.30132	561.3394	550.2477	2.7988166E-02	343.0885	175738.6
3	29.26814	1046.458	12.00610	631.6837	550.1280	.1530400	351.3962	324025.2
4	39.22344	1044.446	8.883847	672.2253	549.8922	.2253435	348.4550	175738.6
5	39.22344	1043.000	5.761595	712.7668	549.6565	.2976470	225.9896	0.

***CHANNEL 34 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.418707	1047.481	47.19440	522.8000	550.3674	0.	350.1214	0.
2	11.80075	1047.481	28.14296	564.8907	550.2477	3.4290456E-02	332.1081	190925.9
3	30.24657	1046.458	11.08200	641.4207	550.1280	.1703143	335.1923	352027.3
4	40.43203	1044.446	8.244934	684.4334	549.8922	.2469882	333.3594	190925.9
5	40.43203	1043.000	5.407871	727.4461	549.6565	.3236622	218.6512	0.

***CHANNEL 35 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	5.731118	1047.481	47.19440	522.8000	550.3674	0.	270.4767	0.
2	11.97105	1047.481	23.69584	574.2476	550.2477	5.0895612E-02	283.6640	221300.5
3	30.16452	1046.458	9.577806	661.2882	550.1280	.2055608	288.9099	408031.7
4	40.08846	1044.446	7.295919	706.5135	549.8922	.2861356	292.4822	221300.5
5	40.08846	1043.000	5.014033	751.7388	549.6564	.3667105	201.0049	0.

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

***CHANNEL 41 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	7.156936	1047.481	47.19440	522.8000	550.3674	0.	337.7673	0.
2	12.37227	1047.481	26.15451	568.6812	550.2477	4.1017206E-02	323.5906	199604.4
3	31.43171	1046.458	10.23827	651.8458	550.1280	.1888092	321.8064	368028.6
4	41.92543	1044.446	7.611491	698.5603	549.8922	.2720348	319.1150	199604.4
5	41.92543	1043.000	4.984710	745.2747	549.6564	.3552603	208.9861	0.

***CHANNEL 42 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	5.458904	1047.481	47.19440	522.8000	550.3674	0.	257.6297	0.
2	12.80355	1047.481	21.29031	580.9380	550.2477	6.2768647E-02	272.5916	247335.9
3	31.71330	1046.458	8.578307	678.3427	550.1280	.2358169	272.0464	456035.4
4	41.96709	1044.446	6.604507	726.5957	549.8922	.3217409	277.1719	247335.9
5	41.96709	1043.000	4.630708	774.8487	549.6564	.4076649	194.3373	0.

***CHANNEL 49 CYCLE 1000 TIMET 1.0000 ITER 2 DELTA TIME .10000E-02 POWER AVERAGE 12.000 KW/FT.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	3.951631	1047.481	47.19440	522.8000	550.3674	0.	186.4949	0.
2	12.81030	1047.481	18.94208	589.1081	550.2477	7.7267627E-02	242.6538	238657.4
3	30.90913	1046.458	8.245677	684.9353	550.1280	.2475128	254.8667	440034.2
4	40.77220	1044.446	6.413664	732.9013	549.8922	.3329205	261.4992	238657.4
5	40.77220	1043.000	4.581652	780.8673	549.6564	.4183283	186.8040	0.

TABLE E-II (continued)

SCORE-EVET 3ENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

FUEL ROD 1 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 1, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S......				
1	2238.6	2009.5	1669.3	1284.0	906.4	628.7	566.0	2
2	4931.0	4416.3	3789.0	3078.6	2382.3	1870.3	1754.9	9
3	2305.4	2026.3	1686.0	1300.7	923.1	645.4	582.8	3

FUEL ROD 2 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 2, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S......				
1	2347.8	2059.1	1707.3	1308.8	918.3	631.1	566.3	2
2	5097.9	4565.6	3916.8	3182.1	2462.1	1932.6	1813.2	9
3	2365.5	2076.9	1725.0	1326.5	936.0	648.8	584.0	3

FUEL ROD 3 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 3, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S......				
1	2125.9	1873.0	1564.8	1215.7	873.6	622.0	565.3	2
2	3478.5	3012.2	2443.8	1800.2	1169.4	705.6	601.0	2
3	2141.1	1888.2	1580.0	1230.9	888.8	637.2	580.5	2

FUEL ROD 4 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 4, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S......				
1	2318.2	2034.3	1688.3	1296.4	912.3	629.9	566.2	2
2	5045.2	4521.7	3883.7	3161.1	2453.0	1932.2	1814.8	9
3	2335.9	2052.0	1705.9	1314.1	930.0	647.5	583.9	3

FUEL ROD 5 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 5, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S......				
1	2229.5	1959.9	1631.3	1259.2	894.5	626.3	565.8	2
2	4832.8	4335.7	3729.8	3043.7	2371.3	1876.8	1765.2	9
3	2246.1	1976.5	1647.9	1275.8	911.1	642.9	582.4	3

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

FUEL ROD 6 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 6, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S......				
1	2214.7	1947.5	1621.8	1252.9	891.5	625.7	565.7	2
2	4803.5	4310.8	3710.3	3030.2	2363.7	1873.6	1763.1	9
3	2231.4	1964.2	1638.5	1269.6	908.2	642.3	582.4	3

FUEL ROD 7 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 7, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S......				
1	1933.6	1711.7	1441.3	1135.0	834.8	614.1	564.3	2
2	3114.3	2705.2	2206.6	1641.9	1088.5	681.5	589.7	2
3	1945.1	1723.2	1452.7	1146.5	846.3	625.6	575.8	2

FUEL ROD 8 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 9, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S......				
1	2081.5	1835.8	1536.3	1197.1	864.7	620.2	565.1	2
2	3391.8	2938.7	2386.4	1761.0	1148.1	697.3	595.7	2
3	2095.8	1850.1	1550.6	1211.4	878.9	634.5	579.4	2

FUEL ROD 9 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 10, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S......				
1	1918.8	1699.3	1431.7	1128.8	831.9	613.5	564.3	2
2	3078.0	2673.3	2180.0	1621.4	1073.9	671.3	580.6	2
3	1929.5	1710.0	1442.5	1139.5	842.6	624.2	575.0	2

FUEL ROD 10 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 11, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S......				
1	2229.5	1959.9	1631.3	1259.2	894.5	626.3	565.8	2
2	4863.5	4366.4	3760.9	3074.4	2402.0	1907.5	1796.0	9
3	2245.8	1976.2	1647.6	1275.5	910.8	642.6	582.1	2

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

FUEL ROD 11 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 12, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	......................R A D I A L			P O S I T I O N S......				
1	2052.0	1811.0	1517.3	1184.7	858.7	619.0	564.9	2
2	3330.7	2886.4	2344.9	1731.6	1130.6	688.6	588.9	2
3	2065.0	1824.0	1530.3	1197.7	871.7	632.0	577.9	2

FUEL ROD 12 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 13, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	......................R A D I A L			P O S I T I O N S......				
1	2081.5	1835.8	1536.3	1197.1	864.7	620.2	565.1	2
2	3388.1	2935.1	2382.8	1757.4	1144.4	693.7	592.1	2
3	2095.2	1849.5	1549.9	1210.7	878.3	633.8	578.7	2

FUEL ROD 13 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 14, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	......................R A D I A L			P O S I T I O N S......				
1	1948.4	1724.1	1450.8	1141.2	837.8	614.7	564.4	2
2	3137.7	2724.2	2220.2	1649.5	1090.1	678.7	586.0	2
3	1959.7	1735.4	1462.1	1152.5	849.1	626.0	575.7	2

FUEL ROD 14 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 17, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	......................R A D I A L			P O S I T I O N S......				
1	2066.8	1823.4	1526.8	1190.9	861.7	619.6	565.0	2
2	3351.6	2902.9	2356.0	1736.7	1129.7	683.4	582.7	2
3	2079.0	1835.6	1539.0	1203.1	873.9	631.8	577.2	2

FUEL ROD 15 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 18, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	......................R A D I A L			P O S I T I O N S......				
1	1933.6	1711.7	1441.3	1135.0	834.8	614.1	564.3	2
2	3098.0	2688.9	2190.3	1625.6	1072.1	665.2	573.4	2
3	1943.3	1721.5	1451.0	1144.8	844.6	623.9	574.1	2

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-CORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

FUEL ROD 16 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 19, 0, 0, 0,

AXIAL LEVEL	......R A D I A L FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	P O S I T I O N S FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1874.4	1662.1	1403.2	1110.1	822.9	611.7	564.0	2
2	2984.9	2593.4	2116.2	1575.8	1046.2	656.7	568.9	2
3	1882.9	1670.6	1411.8	1118.7	831.4	620.2	572.6	2

FUEL ROD 17 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 20, 0, 0, 0,

AXIAL LEVEL	......R A D I A L FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	P O S I T I O N S FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1859.6	1649.5	1393.7	1103.9	819.9	611.0	563.9	2
2	2960.1	2573.1	2101.2	1566.9	1043.2	658.1	571.3	2
3	1868.5	1658.5	1402.6	1112.8	828.8	619.9	572.8	2

FUEL ROD 18 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 21, 0, 0, 0,

AXIAL LEVEL	......R A D I A L FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	P O S I T I O N S FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	2111.1	1860.5	1555.3	1209.5	870.6	621.4	565.2	2
2	3444.5	2982.6	2419.6	1782.1	1157.2	697.7	594.1	2
3	2125.1	1874.6	1569.2	1223.4	884.5	635.3	579.1	2

FUEL ROD 19 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 25, 0, 0, 0,

AXIAL LEVEL	......R A D I A L FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	P O S I T I O N S FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1830.0	1624.8	1374.7	1091.5	813.9	609.8	563.8	2
2	2903.1	2524.8	2063.7	1541.5	1029.7	653.4	568.5	2
3	1837.3	1632.1	1382.0	1098.8	821.3	617.1	571.1	2

FUEL ROD 20 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 26, 0, 0, 0,

AXIAL LEVEL	......R A D I A L FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	P O S I T I O N S FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
1	1859.6	1649.6	1393.7	1103.9	819.9	611.0	563.9	2
2	2957.6	2570.5	2098.7	1564.4	1040.7	655.6	568.7	2
3	1867.1	1657.1	1401.2	1111.4	827.4	618.6	571.5	2

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

FUEL ROD 21 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 27, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S........				
1	1859.6	1649.6	1393.7	1103.9	819.9	611.0	563.9	2
2	2957.6	2570.5	2098.7	1564.4	1040.7	655.6	568.7	2
3	1868.0	1658.0	1402.1	1112.3	828.3	619.4	572.3	2

FUEL ROD 22 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 28, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S........				
1	2037.2	1798.6	1507.8	1178.5	855.7	618.4	564.9	2
2	3303.1	2863.2	2327.0	1719.8	1124.8	687.2	588.5	2
3	2049.7	1811.1	1520.3	1191.0	868.2	630.9	577.4	2

FUEL ROD 23 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 33, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S........				
1	1756.0	1562.7	1327.2	1060.4	799.0	606.7	563.4	2
2	2766.8	2410.5	1976.2	1484.4	1002.4	647.9	568.0	2
3	1762.0	1568.7	1333.2	1066.4	805.0	612.8	569.4	2

FUEL ROD 24 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 34, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S........				
1	1859.6	1649.6	1393.7	1103.9	819.9	611.0	563.9	2
2	2957.6	2570.5	2098.7	1564.4	1040.7	655.6	568.7	2
3	1868.1	1658.2	1402.2	1112.4	828.4	619.6	572.5	2

FUEL ROD 25 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 35, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	........................R A D I A L			P O S I T I O N S........				
1	2066.8	1823.4	1526.8	1190.9	861.7	619.6	565.0	2
2	3361.2	2912.5	2365.6	1746.2	1139.2	692.9	592.2	2
3	2080.1	1836.7	1540.1	1204.2	875.0	632.9	578.3	2

TABLE E-II (continued)

SCORE-EVET BENEDETTI-KISER--ORDS MOD 1 VER 2
EXAMPLE 2, 3-D 7X7 BWR CLUSTER, NON-UNIFORM INLET VELOCITY, STEADY STATE

FUEL ROD 26 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 41, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	....................R A D I A L		P O S I T I O N S	....				
1	1918.8	1699.3	1431.7	1128.6	831.9	613.5	564.3	2
2	3077.9	2673.2	2179.9	1621.5	1073.8	671.2	580.4	2
3	1929.4	1709.9	1442.4	1139.4	842.5	624.1	574.9	2

FUEL ROD 27 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 42, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	....................R A D I A L		P O S I T I O N S	....				
1	2244.3	1972.3	1640.8	1265.4	897.4	626.9	565.8	2
2	4877.6	4376.1	3764.9	3072.7	2394.3	1895.4	1762.9	9
3	2261.4	1989.4	1657.9	1282.5	914.5	644.0	582.9	3

FUEL ROD 28 TEMPERATURE DISTRIBUTION (DEGREES F) WHICH IS IN CHANNEL(S) 49, 0, 0, 0,

AXIAL LEVEL	FUEL 0.00000 IN	FUEL .09506 IN	FUEL .15300 IN	FUEL .24263 IN	FUEL .25350 IN	CLADDING .26150 IN	CLADDING .28150 IN	HEAT TRANS MODE
	....................R A D I A L		P O S I T I O N S	....				
1	2185.1	1922.7	1602.8	1240.5	885.5	624.4	565.6	2
2	3599.1	3115.3	2525.5	1857.5	1203.0	721.6	613.1	2
3	2201.2	1938.7	1618.9	1256.5	901.6	640.5	581.6	3

PMAX = 588.049 PCHECK = -.502689 CCHECK = 2.14635 ITER = 3

PMAX = 588.035 PCHECK = -.533557 CCHECK = 2.23006 ITER = 3

PMAX = 588.022 PCHECK = -.608171 CCHECK = 1.86495 ITER = 4

3. SAMPLE PROBLEM NUMBER 3: A ONE-DIMENSIONAL REPRESENTATION OF A 5 BY 5 TEST ASSEMBLY: STEADY STATE AND HOT LEG BLOWDOWN TRANSIENT

Sample Problem Number 3 consists of a one-dimensional transient problem illustrating the use of the heat flux specification option and the time varying inlet and outlet pressure boundary conditions. The problem simulates a 5.5-ft-long, 5 by 5 fuel rod test assembly undergoing a hot leg blowdown transient.

The geometry of the fuel assembly is shown in Figure E-3. The fuel assembly consists of 25 fuel rods, each 5.5-ft long and 0.422 in. in diameter arranged in a 5 by 5 square matrix with a rod-to-rod pitch of 0.570 in. (0.148-in.-gap spacing). The rod bundle is contained within a canister 2.850-in. square. For this sample problem the fuel rod array is represented as a single average calculational channel 2.850-in. square and divided into 13 unequal axial lengths as listed in the following input printout.

The specified heat flux simulated PWR fuel rods operating at an initial steady state average heat flux of $2 * 10^5$ Btu/hr-ft^2, with transient heat decay initiated at 1 second to simulate a loss-of-coolant accident (LOCA). The peak-to-average axial heat flux distribution and the heat flux time distribution are listed in the following input printout.

PWR coolant conditions are simulated with an initial internal energy of 534.5 Btu/lbm, an axial velocity of 6.72 ft/sec at the inlet, and an initial pressure of 2265.0 psia at the outlet. The problem is conducted holding the coolant conditions constant for 1 second to provide steady state initialization, after which time a transient is initiated simulating PWR blowdown conditions.

The input data required to perform the calculations are presented in Table E-III. Following the input printout the calculational results are presented in the output printout. Calculational results for times 0, 1.011, 1.471, 2.071, 2.571, 3.071, 3.571, and 3.971 seconds are presented.

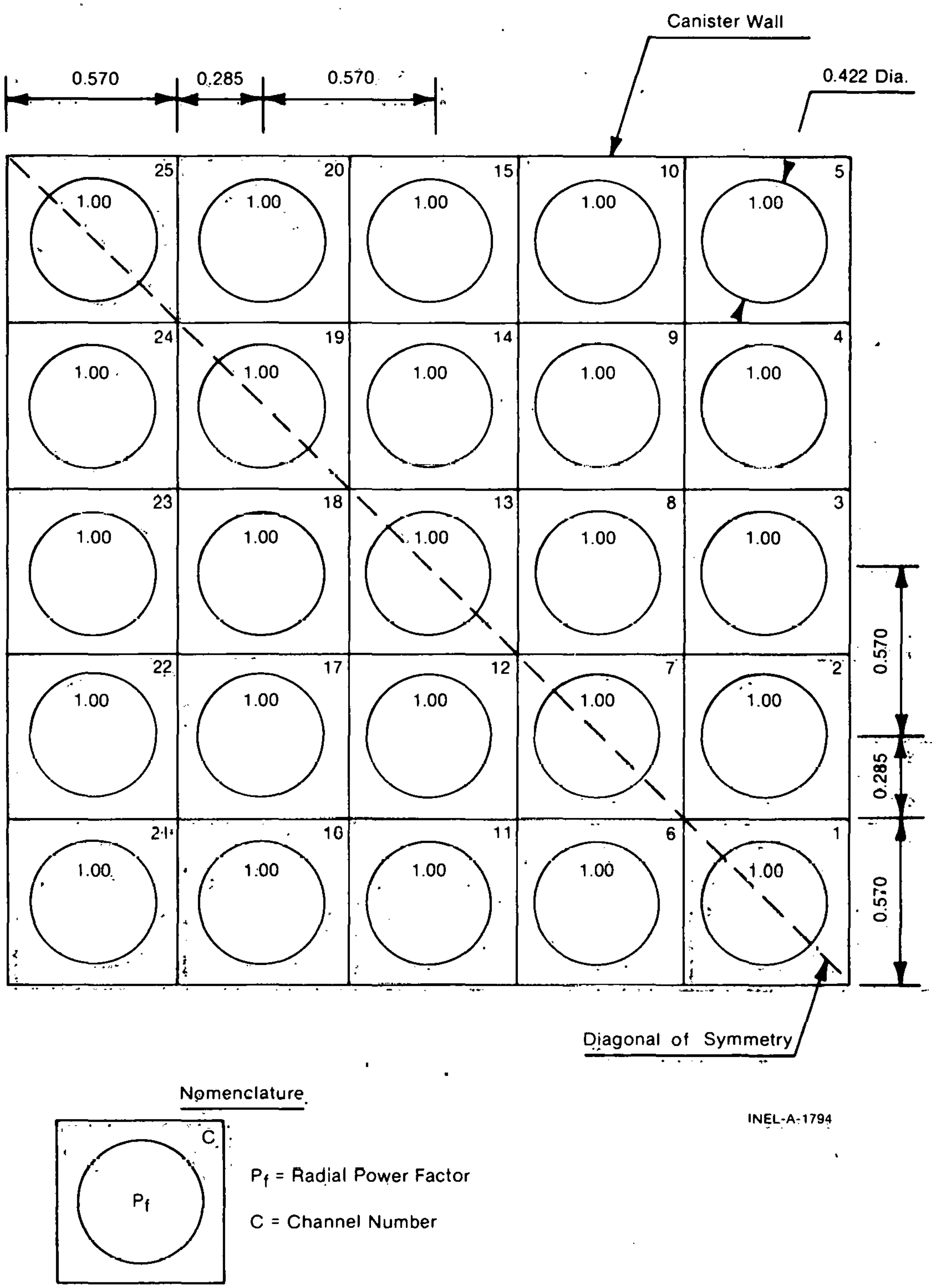

Fig. E-3 Layout of the 5 by 5 PWR, Sample Problem Number 3.

TABLE E-III

SAMPLE PROBLEM 3

```
SCORE-EVET        BENEDETTI-KISER-LORDS     MOD 1    VER 2
EXAMPLE 4, 1-D 5X5 PWR CLUSTER, SS + TRANSIENT

                                             ****************************************
                                             ****                                ****
                                             ****    INPUT IS IN ENGLISH UNITS   ****
                                             ****                                ****
                                             ****************************************
 IUF =  1
 IOUTF =  1
 NAOC =  1
 NOCH =  0
 IBR =     13
 JBR =      1
 KBR =      1
 IROD =     3
 NDIAG =    1
 NROD =      0
 NZPTD =       8
 NZTDT =       6
 ALX =  1.00
 ALY =  1.00
 ALZ =  1.00
 GX = -32.2
 GY =  0.
 GZ =  0.
 CEP =  .448E-04
 WGHTP =  1.50
 DT =  .100E-03
 BO =  1.20
 SACRIT =  .800
 TFIN =  4.00
 IDTFLG =       0
 LPR =     3
 NPRT =    20
 NWPC =    13
 NWPP =     0
 IESFLG =       2
 NTAP =     0
 NWTD =    20
 NEWTAP =      0
 NRST =     0
 I,J,K PRINT LIMITS ARE     1   15    1    1    3    1    1    3    1
```

TABLE E-III (continued)

```
SCORE-EVET      BENEDETTI-KESER-LORDS    MOD 1    VER 2
EXAMPLE 4, 1-D 5X5 PWR CLUSTER, SS + TRANSIENT

 X CELL DIMENSIONS
 .50000      6.0000      5.0000      5.0000      5.0000      5.0000      5.0000      5.0000      5.0000      7.0000
 4.0000      4.0000      5.0000      5.0000      5.0000

 Y CELL DIMENSIONS
 .57000      2.8500      .57000

 Z CELL DIMENSIONS
 .57000      2.8500      .57000
LOSS COEFFICIENTS
                       0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
                       0.          0.          0.          0.
P(1) =  .225E+04
SIE(1) =  541.
QUAL =  0.
U(1) =  6.72
DIAMRD =  .422
SPROD =  .570
PAVE =  .172E+06
CHANNEL  1 DHY =  .41540    DHE =  .55827    AWF =  5.4640    AWQ =  4.0805    VOID =  .56951    RODNUM=  0.
```

TABLE E-III (continued)

```
SCORE-EVET       BENEDETTI-KISER-LORDS     MOD 1    VER 2
EXAMPLE 4, 1-D 5X5 PWR CLUSTER, SS + TRANSIENT

RADIAL POWER FACTORS--BY CHANNEL IF IROD = 0 ---BY ROD IF IROD = 1 OR 2
                         1.00
AXIAL POWER FACTORS FOR THE REAL CELLS
                         .750        .750       .825        1.10        1.20        1.23        1.23        1.00        .750        .500
                         .451        .400       .150
POWER-TIME INPUT
                         1.00        0.         1.00        1.00        1.36        1.25        1.24        1.50        1.07        2.00
                         .946        2.60       .844        3.20        .576        6.00
DELTA T-TIME INPUT
                        1.000E-03  1.000E-02  1.000E-03  2.000E-02  1.000E-02   1.00      1.000E-03   1.17      5.000E-03   1.35
                        5.000E-03   4.50

                                             U            V            W            P            SIE          RHO          TEMP
INLET BOUNDARY FLAGS                         3            1            1            6            3            8            6
INLET BOUNDARY CONDITIONS              6.72000      0.           0.           0.           534.500      0.           0.

NFTPUI =     6
FACTORS FOR INLET VELOCITY  OR PRESSURE AS A FUNCTION OF TIME
   1.000000    0.000000    1.000000    1.000000     .476200    1.600000     .464300    1.900000     .640000    3.300000
    .667000    4.100000

NFTPSI =     5
FACTORS FOR INTERNAL ENERGY AS A FUNCTION OF TIME
   1.000000    0.000000    1.000000    1.000000    1.006000    1.050000    1.004600    1.100000    1.006500    5.400000

                                             U            V            W            P            SIE          RHO          TEMP
OUTLET BOUNDARY FLAGS                        6            1            1            3            6            6            6
OUTLET BOUNDARY CONDITIONS                   0.           0.           0.           2250.78      0.           0.           0.

NFTPUO =     8
FACTORS FOR OUTLET VELOCITY OR PRESSURE AS A FUNCTION OF TIME
   1.000000    0.000000    1.000000    1.000000     .972200    1.052200     .695300    1.104400     .622900    1.156500
    .617660    1.521700     .609200    1.867000     .491800    4.496000
```

TABLE E-III (continued)

```
     TWO-PHASE FRICTION MODEL FLAG, ITPMOD =    0

     **** ACTUAL FRICTION FACTOR FLAGS USED ****

     IRECWS = 0    IREX = 2    IREY = 2    IREZ = 2
     IFXLAM = 1 IFYLAM = 1 IFZLAM = 1
     IFXTUB = 3 IFYTUB = 3 IFZTUB = 3
     IFLTEM = 0

     **** ACTUAL TWO-PHASE CORRELATION FLAGS USED ****

      IALFA =   1 ITPRHO = 1
     ITPMLX =   5 ITPMLY =   5 ITPMLZ =   5
     ITPMTX =   5 ITPMTY =   5 ITPMTZ =   5

MINIMUM DIMENSIONING FOR THE A(ARRAY)  2340
```

TABLE E-III (continued)

SCORE-EVET   BENEDETTI-KISER-LORDS   MOD 1   VER 2
EXAMPLE 4, 1-D 5X5 PWR CLUSTER, SS + TRANSIENT

CYCLE = 0   TIME = 0.   ITERATIONS = 0   DELTA TIME = .10000E-03   POWER AVERAGE = .17172E+06BTU/FT2.HR.

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
1	1	1	6.72000	0.	0.	2253.10	47.0685	534.500	553.036	0.
2	1	1	6.72000	0.	0.	2253.10	47.0685	534.500	553.036	0.
3	1	1	6.72000	0.	0.	2253.10	47.0685	534.500	553.036	0.
1	2	1	6.75590	0.	0.	2253.10	46.4793	546.108	556.269	0.
2	2	1	6.75590	0.	0.	2253.10	46.4793	546.108	556.269	0.
3	2	1	6.75590	0.	0.	2253.10	46.4793	546.108	556.269	0.
1	3	1	6.78769	0.	0.	2252.90	46.2617	550.147	559.503	0.
2	3	1	6.78769	0.	0.	2252.90	46.2617	550.147	559.503	0.
3	3	1	6.78769	0.	0.	2252.90	46.2617	550.147	559.503	0.
1	4	1	6.82448	0.	0.	2252.72	46.0123	554.588	563.059	0.
2	4	1	6.82448	0.	0.	2252.72	46.0123	554.588	563.059	0.
3	4	1	6.82448	0.	0.	2252.72	46.0123	554.588	563.059	0.
1	5	1	6.87360	0.	0.	2252.55	45.6834	560.509	567.740	0.
2	5	1	6.87360	0.	0.	2252.55	45.6834	560.509	567.740	0.
3	5	1	6.87360	0.	0.	2252.55	45.6834	560.509	567.740	0.
1	6	1	6.92465	0.	0.	2252.37	45.3466	566.972	572.704	0.
2	6	1	6.92465	0.	0.	2252.37	45.3466	566.972	572.704	0.
3	6	1	6.92465	0.	0.	2252.37	45.3466	566.972	572.704	0.
1	7	1	6.98217	0.	0.	2252.19	44.9731	573.589	577.786	0.
2	7	1	6.98217	0.	0.	2252.19	44.9731	573.589	577.786	0.
3	7	1	6.98217	0.	0.	2252.19	44.9731	573.589	577.786	0.
1	8	1	7.04465	0.	0.	2252.01	44.5742	580.173	582.842	0.
2	8	1	7.04465	0.	0.	2252.01	44.5742	580.173	582.842	0.
3	8	1	7.04465	0.	0.	2252.01	44.5742	580.173	582.842	0.
1	9	1	7.09229	0.	0.	2251.83	44.2748	585.552	586.837	0.
2	9	1	7.09229	0.	0.	2251.83	44.2748	585.552	586.837	0.
3	9	1	7.09229	0.	0.	2251.83	44.2748	585.552	586.837	0.
1	10	1	7.14262	0.	0.	2251.62	43.9628	591.199	590.949	0.
2	10	1	7.14262	0.	0.	2251.62	43.9628	591.199	590.949	0.
3	10	1	7.14262	0.	0.	2251.62	43.9628	591.199	590.949	0.
1	11	1	7.16308	0.	0.	2251.42	43.8372	593.349	592.514	0.
2	11	1	7.16308	0.	0.	2251.42	43.8372	593.349	592.514	0.
3	11	1	7.16308	0.	0.	2251.42	43.8372	593.349	592.514	0.
1	12	1	7.18215	0.	0.	2251.28	43.7209	595.287	593.925	0.
2	12	1	7.18215	0.	0.	2251.28	43.7209	595.287	593.925	0.
3	12	1	7.18215	0.	0.	2251.28	43.7209	595.287	593.925	0.
1	13	1	7.20395	0.	0.	2251.13	43.5886	597.435	595.489	0.
2	13	1	7.20395	0.	0.	2251.13	43.5886	597.435	595.489	0.
3	13	1	7.20395	0.	0.	2251.13	43.5886	597.435	595.489	0.
1	14	1	7.21232	0.	0.	2250.95	43.5380	598.240	596.074	0.
2	14	1	7.21232	0.	0.	2250.95	43.5380	598.240	596.074	0.
3	14	1	7.21232	0.	0.	2250.95	43.5380	598.240	596.074	0.
1	15	1	7.21232	0.	0.	2250.78	43.4874	599.045	596.659	0.
2	15	1	7.21232	0.	0.	2250.78	43.4874	599.045	596.659	0.
3	15	1	7.21232	0.	0.	2250.78	43.4874	599.045	596.659	0.
1	1	2	6.72000	0.	0.	2253.10	47.0685	534.500	553.036	0.
2	1	2	6.72000	0.	0.	2253.10	47.0685	534.500	553.036	0.
3	1	2	6.72000	0.	0.	2253.10	47.0685	534.500	553.036	0.
1	2	2	6.75590	0.	0.	2253.10	46.4793	546.108	556.269	0.
2	2	2	6.75590	0.	0.	2253.10	46.4793	546.108	556.269	0.
3	2	2	6.75590	0.	0.	2253.10	46.4793	546.108	556.269	0.
1	3	2	6.78769	0.	0.	2252.90	46.2617	550.147	559.503	0.
2	3	2	6.78769	0.	0.	2252.90	46.2617	550.147	559.503	0.

TABLE E-III (continued)

SCORE-EVET BENEDETTI-KISER--ORDS MOD 1 VER 2
EXAMPLE 4, 1-D 5X5 PWR CLUSTER, SS + TRANSIENT

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
3	3	2	6.78769	0.	0.	2252.90	46.2617	550.147	559.503	0.
1	4	2	6.82448	0.	0.	2252.72	46.0123	554.588	563.059	0.
2	4	2	6.82448	0.	0.	2252.72	46.0123	554.588	563.059	0.
3	4	2	6.82448	0.	0.	2252.72	46.0123	554.588	563.059	0.
1	5	2	6.87360	0.	0.	2252.55	45.6834	560.509	567.740	0.
2	5	2	6.87360	0.	0.	2252.55	45.6834	560.509	567.740	0.
3	5	2	6.87360	0.	0.	2252.55	45.6834	560.509	567.740	0.
1	6	2	6.92465	0.	0.	2252.37	45.3466	566.972	572.704	0.
2	6	2	6.92465	0.	0.	2252.37	45.3466	566.972	572.704	0.
3	6	2	6.92465	0.	0.	2252.37	45.3466	566.972	572.704	0.
1	7	2	6.98217	0.	0.	2252.19	44.9731	573.589	577.786	0.
2	7	2	6.98217	0.	0.	2252.19	44.9731	573.589	577.786	0.
3	7	2	6.98217	0.	0.	2252.19	44.9731	573.589	577.786	0.
1	8	2	7.04465	0.	0.	2252.01	44.5742	580.173	582.842	0.
2	8	2	7.04465	0.	0.	2252.01	44.5742	580.173	582.842	0.
3	8	2	7.04465	0.	0.	2252.01	44.5742	580.173	582.842	0.
1	9	2	7.09229	0.	0.	2251.83	44.2748	585.552	586.837	0.
2	9	2	7.09229	0.	0.	2251.83	44.2748	585.552	586.837	0.
3	9	2	7.09229	0.	0.	2251.83	44.2748	585.552	586.837	0.
1	10	2	7.14262	0.	0.	2251.62	43.9628	591.199	590.949	0.
2	10	2	7.14262	0.	0.	2251.62	43.9628	591.199	590.949	0.
3	10	2	7.14262	0.	0.	2251.62	43.9628	591.199	590.949	0.
1	11	2	7.16308	0.	0.	2251.42	43.8372	593.349	592.514	0.
2	11	2	7.16308	0.	0.	2251.42	43.8372	593.349	592.514	0.
3	11	2	7.16308	0.	0.	2251.42	43.8372	593.349	592.514	0.
1	12	2	7.18215	0.	0.	2251.28	43.7209	595.287	593.925	0.
2	12	2	7.18215	0.	0.	2251.28	43.7209	595.287	593.925	0.
3	12	2	7.18215	0.	0.	2251.28	43.7209	595.287	593.925	0.
1	13	2	7.20395	0.	0.	2251.13	43.5886	597.435	595.489	0.
2	13	2	7.20395	0.	0.	2251.13	43.5886	597.435	595.489	0.
3	13	2	7.20395	0.	0.	2251.13	43.5886	597.435	595.489	0.
1	14	2	7.21232	0.	0.	2250.95	43.5380	598.240	596.074	0.
2	14	2	7.21232	0.	0.	2250.95	43.5380	598.240	596.074	0.
3	14	2	7.21232	0.	0.	2250.95	43.5380	598.240	596.074	0.
1	15	2	7.21232	0.	0.	2250.78	43.4874	599.045	596.659	0.
2	15	2	7.21232	0.	0.	2250.78	43.4874	599.045	596.659	0.
3	15	2	7.21232	0.	0.	2250.78	43.4874	599.045	596.659	0.
1	1	3	6.72000	0.	0.	2253.10	47.0685	534.500	553.036	0.
2	1	3	6.72000	0.	0.	2253.10	47.0685	534.500	553.036	0.
3	1	3	6.72000	0.	0.	2253.10	47.0685	534.500	553.036	0.
1	2	3	6.75590	0.	0.	2253.10	46.4793	546.108	556.269	0.
2	2	3	6.75590	0.	0.	2253.10	46.4793	546.108	556.269	0.
3	2	3	6.75590	0.	0.	2253.10	46.4793	546.108	556.269	0.
1	3	3	6.78769	0.	0.	2252.90	46.2617	550.147	559.503	0.
2	3	3	6.78769	0.	0.	2252.90	46.2617	550.147	559.503	0.
3	3	3	6.78769	0.	0.	2252.90	46.2617	550.147	559.503	0.
1	4	3	6.82448	0.	0.	2252.72	46.0123	554.588	563.059	0.
2	4	3	6.82448	0.	0.	2252.72	46.0123	554.588	563.059	0.
3	4	3	6.82448	0.	0.	2252.72	46.0123	554.588	563.059	0.
1	5	3	6.87360	0.	0.	2252.55	45.6834	560.509	567.740	0.
2	5	3	6.87360	0.	0.	2252.55	45.6834	560.509	567.740	0.
3	5	3	6.87360	0.	0.	2252.55	45.6834	560.509	567.740	0.
1	6	3	6.92465	0.	0.	2252.37	45.3466	566.972	572.704	0.
2	6	3	6.92465	0.	0.	2252.37	45.3466	566.972	572.704	0.
3	6	3	6.92465	0.	0.	2252.37	45.3466	566.972	572.704	0.

TABLE E-III (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 4, 1-D 5X5 PWR CLUSTER, SS + TRANSIENT

K	I	J	U FT/SEC	V FT/SEC	W FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL
1	7	3	6.98217	0.	0.	2252.19	44.9731	573.589	577.786	0.
2	7	3	6.98217	0.	0.	2252.19	44.9731	573.589	577.786	0.
3	7	3	6.98217	0.	0.	2252.19	44.9731	573.589	577.786	0.
1	8	3	7.04465	0.	0.	2252.01	44.5742	580.173	582.842	0.
2	8	3	7.04465	0.	0.	2252.01	44.5742	580.173	582.842	0.
3	8	3	7.04465	0.	0.	2252.01	44.5742	580.173	582.842	0.
1	9	3	7.09229	0.	0.	2251.83	44.2748	585.552	586.837	0.
2	9	3	7.09229	0.	0.	2251.83	44.2748	585.552	586.837	0.
3	9	3	7.09229	0.	0.	2251.83	44.2748	585.552	586.837	0.
1	10	3	7.14262	0.	0.	2251.62	43.9628	591.199	590.949	0.
2	10	3	7.14262	0.	0.	2251.62	43.9628	591.199	590.949	0.
3	10	3	7.14262	0.	0.	2251.62	43.9628	591.199	590.949	0.
1	11	3	7.16308	0.	0.	2251.42	43.8372	593.349	592.514	0.
2	11	3	7.16308	0.	0.	2251.42	43.8372	593.349	592.514	0.
3	11	3	7.16308	0.	0.	2251.42	43.8372	593.349	592.514	0.
1	12	3	7.18215	0.	0.	2251.28	43.7209	595.287	593.925	0.
2	12	3	7.18215	0.	0.	2251.28	43.7209	595.287	593.925	0.
3	12	3	7.18215	0.	0.	2251.28	43.7209	595.287	593.925	0.
1	13	3	7.20395	0.	0.	2251.13	43.5886	597.435	595.489	0.
2	13	3	7.20395	0.	0.	2251.13	43.5886	597.435	595.489	0.
3	13	3	7.20395	0.	0.	2251.13	43.5886	597.435	595.489	0.
1	14	3	7.21232	0.	0.	2250.95	43.5380	598.240	596.074	0.
2	14	3	7.21232	0.	0.	2250.95	43.5380	598.240	596.074	0.
3	14	3	7.21232	0.	0.	2250.95	43.5380	598.240	596.074	0.
1	15	3	7.21232	0.	0.	2250.78	43.4874	599.045	596.659	0.
2	15	3	7.21232	0.	0.	2250.78	43.4874	599.045	596.659	0.
3	15	3	7.21232	0.	0.	2250.78	43.4874	599.045	596.659	0.

TABLE E-III (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 4, 1-D 5X5 PWR CLUSTER, SS + TRANSIENT

X	DX INCHES	DY INCHES	DZ INCHES	X INCHES	Y INCHES	Z INCHES
1	.50000	.57000	.57000	0.	0.	0.
2	6.0000	2.8500	2.8500	6.0000	2.8500	2.8500
3	5.0000	.57000	.57000	11.000	3.4200	3.4200
4	5.0000	0.	0.	16.000	0.	0.
5	5.0000	0.	0.	21.000	0.	0.
6	5.0000	0.	0.	26.000	0.	0.
7	5.0000	0.	0.	31.000	0.	0.
8	5.0000	0.	0.	36.000	0.	0.
9	5.0000	0.	0.	41.000	0.	0.
10	7.0000	0.	0.	48.000	0.	0.
11	4.0000	0.	0.	52.000	0.	0.
12	4.0000	0.	0.	56.000	0.	0.
13	5.0000	0.	0.	61.000	0.	0.
14	5.0000	0.	0.	66.000	0.	0.
15	5.0000	0.	0.	71.000	0.	0.

TABLE E-III (continued)

SCORE-EVET,   BENEDETTI-KISER-LORDS   MOD 1   VER 2
EXAMPLE 4, 1-D 5X5 PWR CLUSTER, SS + TRANSIENT

***CHANNEL 1   CYCLE 0   TIMET 0.   ITER 0   DELTA TIME .10000E-03   POWER AVERAGE .17172E+06BTU/FT2.HR.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/=T3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.720000	2253.103	47.06851	534.5000	553.0355	0.	316.3004	0.
2	6.755901	2253.103	46.47934	546.1082	556.2694	0.	314.0098	128790.0
3	6.787689	2252.905	46.26167	550.1475	559.5034	0.	314.0098	128790.0
4	6.824478	2252.725	46.01228	554.5883	563.0589	0.	314.0098	141669.0
5	6.873604	2252.545	45.68343	560.5094	567.7399	0.	314.0098	188892.0
6	6.924655	2252.366	45.34664	566.9720	572.7036	0.	314.0098	206064.0
7	6.982167	2252.187	44.97312	573.5894	577.7861	0.	314.0098	211215.6
8	7.044648	2252.008	44.57424	580.1730	582.8425	0.	314.0098	210357.0
9	7.092286	2251.830	44.27484	585.5518	586.8366	0.	314.0098	171720.0
10	7.142619	2251.619	43.96284	591.1991	590.9492	0.	314.0098	128790.0
11	7.163084	2251.425	43.83724	593.3488	592.5139	0.	314.0098	85860.00
12	7.182147	2251.285	43.72089	595.2870	593.9249	0.	314.0098	77445.72
13	7.203951	2251.128	43.58856	597.4349	595.4885	0.	314.0098	68688.00
14	7.212319	2250.954	43.53799	598.2401	596.0739	0.	314.0098	25758.00
15	7.212319	2250.780	43.48741	599.0453	596.6593	0.	313.6451	0.

TABLE E-III (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 4, 1-D 5X5 PWR CLUSTER, SS + TRANSIENT

***CHANNEL 1 CYCLE 120 TIMET 1.0110 ITER 56 DELTA TIME .10000E-02 POWER AVERAGE .17442E+06BTU/FT2.HR.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	6.655468	2239.779	47.02435	535.2055	547.7100	0.	312.9690	0.
2	6.696052	2239.779	46.81408	539.4158	550.8511	0.	313.4695	130818.7
3	6.730314	2239.605	46.61743	543.3411	553.9921	0.	313.7499	130818.7
4	6.769499	2239.444	46.38595	547.7541	557.5235	0.	314.0097	143900.6
5	6.823319	2239.282	46.06078	553.6383	562.2324	0.	314.2874	191867.4
6	6.883391	2239.117	45.69951	560.0531	567.3235	0.	314.5676	209309.9
7	6.941593	2238.951	45.35854	566.6340	572.3744	0.	314.8606	214542.7
8	7.005067	2238.783	44.99035	573.1863	577.4033	0.	315.1605	213670.5
9	7.061941	2238.615	44.66920	578.5416	581.5132	0.	315.4512	174424.9
10	7.123347	2238.415	44.33610	584.2357	585.8022	0.	315.8214	130818.7
11	7.146598	2238.224	44.21921	586.4536	587.4152	0.	316.0170	87212.47
12	7.168722	2238.086	44.10744	588.5053	588.9074	0.	316.1940	78665.64
13	7.194721	2237.935	43.97351	590.8841	590.6376	0.	316.3771	69769.97
14	7.208517	2237.765	43.90716	592.0326	591.4723	0.	316.5055	26163.74
15	7.208517	2237.594	43.84080	593.1811	592.3071	0.	316.0271	0.

TABLE E-III (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 4, 1-D 5X5 PWR CLUSTER, SS + TRANSIENT

***CHANNEL 1 CYCLE 340 TIMET 1.4710 ITER 53 DELTA TIME .50000E-02 POWER AVERAGE .21452E+06BTU/FT2.HR.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	3.956850	1393.488	46.58570	537.0463	547.0599	0.	184.3326	0.
2	4.004551	1393.488	46.09279	546.2869	552.4186	0.	184.5809	160893.2
3	4.046059	1393.347	45.71589	553.2427	557.7773	0.	184.9692	160893.2
4	4.096454	1393.220	45.30601	560.2232	563.1550	0.	185.5940	176982.5
5	4.160848	1393.094	44.79597	569.2601	569.9164	0.	186.3892	235976.7
6	4.236714	1392.968	44.27160	578.3698	576.5623	0.	187.5661	257429.2
7	4.325741	1392.843	43.72139	586.8967	582.7828	0.	189.1274	263864.9
8	5.235792	1392.721	40.94674	594.4171	586.3641	4.9199764E-03	214.3887	262792.3
9	6.335305	1392.567	37.16968	598.8677	586.3496	1.3762740E-02	235.4812	214524.3
10	7.503665	1392.398	34.88714	602.0164	586.3336	2.0032810E-02	261.7814	160893.2
11	7.963903	1392.239	34.73524	602.2221	586.3187	2.0478308E-02	276.6281	107262.2
12	8.379261	1392.147	34.74570	602.1949	586.3100	2.0446873E-02	291.1433	96750.46
13	8.839331	1392.051	34.85551	602.0197	586.3010	2.0123407E-02	308.0994	85809.72
14	9.039642	1391.944	35.87872	600.5334	586.2909	1.7209595E-02	324.3307	32178.65
15	9.039642	1391.854	36.90192	599.0471	586.2809	1.4295784E-02	333.5801	0.

TABLE E-III (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 4, 1-D 5X5 PWR CLUSTER, SS - TRANSIENT

***CHANNEL 1 CYCLE 460 TIMET 2.0710 ITER 44 DELTA TIME .50000E-02 POWER AVERAGE .18076E+06BTU/FT2.HR.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	3.264311	1354.213	46.56179	537.1880	546.5262	0.	151.9921	0.
2	3.304873	1354.213	45.96820	548.3204	553.7994	0.	151.9191	135573.3
3	3.341328	1354.049	45.43544	557.7803	561.0727	0.	151.8147	135573.3
4	3.384122	1353.901	44.83906	563.0375	568.8203	0.	151.7408	149130.7
5	3.442609	1353.755	44.06359	581.3158	578.4913	0.	151.6964	198840.9
6	4.232938	1353.622	36.91711	594.3907	582.6436	1.4406475E-02	156.2697	216917.4
7	5.435528	1353.486	29.47627	605.3826	582.6305	3.7868422E-02	160.2191	222340.3
8	6.621067	1353.351	24.75511	617.7268	582.6176	6.0062511E-02	163.9053	221436.5
9	7.597947	1353.222	22.05734	625.3841	582.6051	7.7004811E-02	167.5905	180764.5
10	8.644253	1353.083	20.02355	634.4490	582.5917	9.2790242E-02	173.0886	135573.3
11	9.062856	1352.945	19.46890	636.9262	582.5785	9.7659021E-02	176.4439	90382.23
12	9.445071	1352.856	19.06227	638.8363	582.5699	.1014091	180.0445	81524.77
13	9.876500	1352.758	18.73192	640.4454	582.5605	.1045731	185.0058	72305.79
14	10.08518	1352.646	18.90343	639.5780	582.5497	.1029027	190.6445	27114.67
15	10.08518	1352.540	19.07494	638.7106	582.5388	.1012323	192.3743	0.

TABLE E-III (continued)

SCORE-EVET   BENEDETTI-KISER-LORDS   MOD 1   VER 2
EXAMPLE 4, 1-D 5X5 PWR CLUSTER, SS + TRANSIENT

***CHANNEL 1   CYCLE 560   TIMET 2.5710   ITER 44   DELTA TIME .50000E-02   POWER AVERAGE .16344E+06BTU/FT2.HR.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	3.685991	1303.501	46.53440	537.3061	545.9517	0.	171.5253	0.
2	3.723039	1303.501	46.05142	546.2871	551.9973	0.	171.4512	122576.3
3	3.754620	1303.333	45.62262	554.1719	558.0429	0.	171.2956	122576.3
4	3.793519	1303.182	45.08231	563.1841	564.9530	0.	171.0206	134833.9
5	3.843536	1303.033	44.39750	575.3065	573.8524	0.	170.6434	179778.6
6	4.533327	1302.896	37.31324	587.5584	577.6922	1.3423419E-02	169.1531	196122.1
7	5.666045	1302.761	29.56945	599.4589	577.6788	3.6340908E-02	167.5418	201025.1
8	6.780780	1302.628	24.49518	611.3358	577.6657	5.9210325E-02	166.0965	200207.9
9	7.698757	1302.503	21.41681	621.2801	577.6533	7.8360168E-02	164.8828	163435.1
10	8.680539	1302.373	18.85397	632.0351	577.6404	9.9068364E-02	163.6626	122576.3
11	9.073016	1302.248	17.97880	636.3979	577.6280	.1074838	163.1219	81717.53
12	9.430529	1302.168	17.25643	640.3372	577.6201	.1150746	162.7372	73709.21
13	9.832577	1302.083	16.52701	644.6642	577.6116	.1234117	162.5031	65374.02
14	10.02465	1301.987	16.21391	646.6313	577.6022	.1272135	162.5387	24515.26
15	10.02465	1301.899	15.90081	648.5985	577.5927	.1310153	159.3999	0.

TABLE E-III (continued)

SCORE-EVET BENEDETTI-KISER--ORDS MOD 1 VER 2
EXAMPLE 4, 1-D 5X5 PWR CLUSTER, SS + TRANSIENT

***CHANNEL 1 CYCLE 660 TIMET 3.0710 ITER 39 DELTA TIME .500006-02 POWER AVERAGE .14865E+06BTU/FT2.HR.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	4.107671	1252.976	46.50684	537.4242	545.6953	0.	191.0348	0.
2	4.142066	1252.976	46.10985	544.6754	550.5239	0.	190.9900	111490.0
3	4.169868	1252.804	45.77735	550.9910	555.3525	0.	190.8855	111490.0
4	4.203509	1252.650	45.36483	553.1921	560.8581	0.	190.6915	122639.0
5	4.251880	1252.496	44.78493	567.9257	568.2074	0.	190.4202	163518.7
6	4.749430	1252.351	39.94147	573.1281	572.6097	7.8718269E-03	189.7012	178384.0
7	5.834704	1252.208	32.25193	587.8994	572.5951	2.6398391E-02	188.1805	182843.6
8	6.900875	1252.061	27.01128	597.7442	572.5801	4.5063444E-02	186.4015	182100.4
9	7.779928	1251.922	23.72315	606.1382	572.5659	6.0979562E-02	184.5644	148653.4
10	8.721980	1251.778	20.87042	615.5634	572.5512	7.8846553E-02	182.0314	111490.0
11	9.101060	1251.640	19.84497	619.6008	572.5371	8.6516764E-02	180.6102	74326.68
12	9.446400	1251.552	18.97232	623.3863	572.5281	9.3698560E-02	179.2201	67042.67
13	9.834864	1251.458	18.05211	627.7753	572.5185	.1020231	177.5400	59461.35
14	10.02473	1251.354	17.54860	630.3633	572.5079	.1069420	175.9200	22298.01
15	10.02473	1251.259	17.04510	632.9513	572.4973	.1118608	170.8725	0.

TABLE E-III (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 4, 1-D 5X5 PWR CLUSTER, SS + TRANSIENT

***CHANNEL 1 CYCLE 760 TIMET 3.5710 ITER 37 DELTA TIME .50000E-02 POWER AVERAGE .13879E+06BTU/FT2.HR.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY BTU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	4.362263	1202.462	46.47903	537.5423	545.5458	0.	202.7537	0.
2	4.395085	1202.462	46.13237	543.7377	549.5684	0.	202.7557	104095.3
3	4.420549	1202.291	45.86055	549.0148	553.5910	0.	202.7288	104095.3
4	4.450979	1202.136	45.53150	554.9467	558.1127	0.	202.6598	114504.9
5	4.495474	1201.982	45.05016	562.9486	564.2126	0.	202.5218	152673.1
6	5.106729	1201.836	40.16193	571.2325	567.3713	7.5896764E-03	205.0961	166552.5
7	6.170818	1201.682	33.40495	579.1794	567.3550	2.2424687E-02	206.1359	170716.3
8	7.216303	1201.522	28.59339	587.1254	567.3383	3.7257536E-02	206.3386	170022.4
9	8.080164	1201.370	25.50251	593.8071	567.3222	4.9733886E-02	206.0645	138793.8
10	9.009090	1201.209	22.76838	601.2295	567.3052	6.3589507E-02	205.1224	104095.3
11	9.385788	1201.053	21.78370	604.3445	567.2888	6.9424514E-02	204.4572	69396.88
12	9.729406	1200.954	20.93495	607.2715	567.2784	7.4895901E-02	203.6846	62595.99
13	10.11676	1200.847	20.02447	610.6881	567.2671	8.1280127E-02	202.5826	55517.51
14	10.31162	1200.728	19.52865	612.6731	567.2546	8.5001972E-02	201.3720	20819.06
15	10.31162	1200.616	19.03283	614.6581	567.2420	8.8723818E-02	196.2593	0.

TABLE E-III (continued)

SCORE-EVET BENEDETTI-KISER-LORDS MOD 1 VER 2
EXAMPLE 4, 1-D 5X5 PWR CLUSTER, SS + TRANSIEN-

***CHANNEL 1 CYCLE 840 TIMET 3.9710 ITER 37 DELTA TIME .50000E-02 POWER AVERAGE .13223E+06BTU/FT2.HR.

X	U FT/SEC	PRESSURE PSI	DENSITY LBM/FT3	ENERGY ETU/LBM	TEMP DEG F	QUAL	MASS FLUX LBM/FT2*SEC	HEAT FLUX BTU/FT2.HR.
1	4.452983	1162.010	46.45657	537.6368	545.3954	0.	206.8703	0.
2	4.484848	1162.010	46.12784	543.4099	549.1286	0.	206.8764	99173.70
3	4.509277	1161.837	45.87436	548.3030	552.8617	0.	206.8602	99173.70
4	4.538275	1161.682	45.57196	553.7581	557.0237	0.	206.8181	109091.1
5	4.580346	1161.527	45.13542	561.0699	562.6028	0.	206.7359	145454.8
6	5.558083	1161.384	37.84648	568.1858	563.0540	1.1995123E-02	210.3539	158677.9
7	6.607549	1161.217	32.17337	575.3160	563.0359	2.5145714E-02	212.5871	162644.9
8	7.639637	1161.056	28.01308	582.3791	563.0184	3.8170290E-02	214.0097	161983.7
9	8.493911	1160.399	25.30764	588.2135	563.0015	4.8933621E-02	214.9609	132231.6
10	9.414972	1160.732	22.91323	594.5253	562.9834	6.0575905E-02	215.7274	99173.70
11	9.790250	1160.569	22.06726	597.0674	562.9658	6.5286451E-02	216.0440	66115.80
12	10.13304	1160.464	21.34129	599.4161	562.9545	6.9628019E-02	216.2520	59636.45
13	10.52023	1160.351	20.56610	602.1078	562.9422	7.4601562E-02	216.3601	52892.64
14	10.71860	1160.224	20.18477	603.4965	562.9285	7.7182942E-02	216.3524	19834.74
15	10.71860	1160.106	19.80345	604.8852	562.9147	7.9764321E-02	212.2652	0.

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