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DISCRETE ELEMENT WELD MODEL, PHASE II

FINAL REPORT

by

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PREFACE

This is the final report for the project "Discrete Element Weld Model, Phase II" conducted by CHAM of North America, Inc. under NASA contract No. NAS8-36716.

The authors acknowledge the contributions of Dr. Arthur Nunes (NASA MSFC) by useful discussions relating to the practical aspects of the welding problem, and Dr. Vaughan Voller (University of Minnesota) by discussions of numerical methodologies for phase change problems.

ABSTRACT

A numerical method has been developed for analyzing Tungsten Inert Gas (TIG) welding process. The phenomena being modeled include melting under the arc and the flow in the melt under the action of buoyancy, surface tension, and electromagnetic forces. The latter entails the calculation of the electric potential and the computation of electric current and magnetic field therefrom. Melting may occur at a single temperature or over a temperature range, and the electrical and thermal conductivities can be a function of temperature.

Results of sample calculations are presented and discussed at length. A major research contribution of the present study has been the development of numerical methodology for the calculation of phase change problems in a fixed grid framework.

The model has been implemented on CHAM's general purpose computer code PHOENICS. The inputs to the computer model include:

a) Geometric parameters:
   - Physical dimensions of the computational domain which includes plate width and thickness

b) Material properties:
   - Thermal conductivity which could be a function of temperature
   - Electrical conductivity which could also be a function of temperature
   - Specific heat
   - Latent heat of fusion
   - Density
   - Surface tension, and its variation with temperature
   - Liquidus and solidus temperatures

c) Weld process parameters:
   - Current density distribution
   - Potential

- Weld speed
- Acceleration of gravity
- Surface heat losses specified in terms of thermophysical properties of the ambient air

The outputs of the computer model include:

a) Scalar fields of:
   - Pressure
   - Temperature and enthalpy
   - Electric potential
   - Thermal conductivity
   - Electrical conductivity

b) Vector fields of:
   - Fluid velocity
   - Electric current
   - Magnetic field

The output is produced as numbers in a tabulated manner. In addition, all output is stored in a formatted file which can be read by the CHAM graphics package (GRAFFIC) for making contour/vector plots. Both PHOENICS and GRAFFIC are available to NASA MSFC on its computer network.

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Section 1
INTRODUCTION

The science of welding is an important research area because of its industrial importance and the growing need of automation. Though the mathematical equations governing the basic phenomena have been known, their complex nature has prevented predictions for practical problems. However, due to the advances in the field of computational fluid dynamics over the past decade, the situation is changing; now, it is possible to use numerical methods to solve the complex, interlinked, and highly non-linear equations governing a welding process. The work described in this report is an example of such an effort. The welding process being investigated is called TIG (Tungsten Inert Gas) or GTA (Gas Tungsten Arc). The configuration is described schematically in Figure 1.

The TIG process involves a source of heat (arc) moving laterally over the joint in the surface to be welded. As a consequence of intense heating, the material under the arc melts giving rise to liquid puddle; and, as the arc moves away, the melt re-solidifies, resulting in the welding of the joint. Thus, in a stationary coordinate system, the melt puddle moves with the arc. The quality of the weld depends on the size and shape of the puddle, which, in turn, depends upon the nature of the fluid motion inside the melt. This fluid motion is caused by the action of buoyancy, surface tension (Marangoni), arc shear, and electromagnetic stirring (Lorentz) forces. Thus, a quantitative prediction of the TIG process must take account of all of these processes.

As phase I of this study, Martin Marietta Corporation [1]* have assembled the differential equations which govern various mechanisms in the TIG process. The objective of the present study, phase II, has been to develop a methodology for the numerical solution of these equations.

A comprehensive literature survey related to TIG modeling has been presented in [1]. Hence, the review here will be brief. References [2 - 15] include

*Number in square brackets indicate references cited in Section 7.

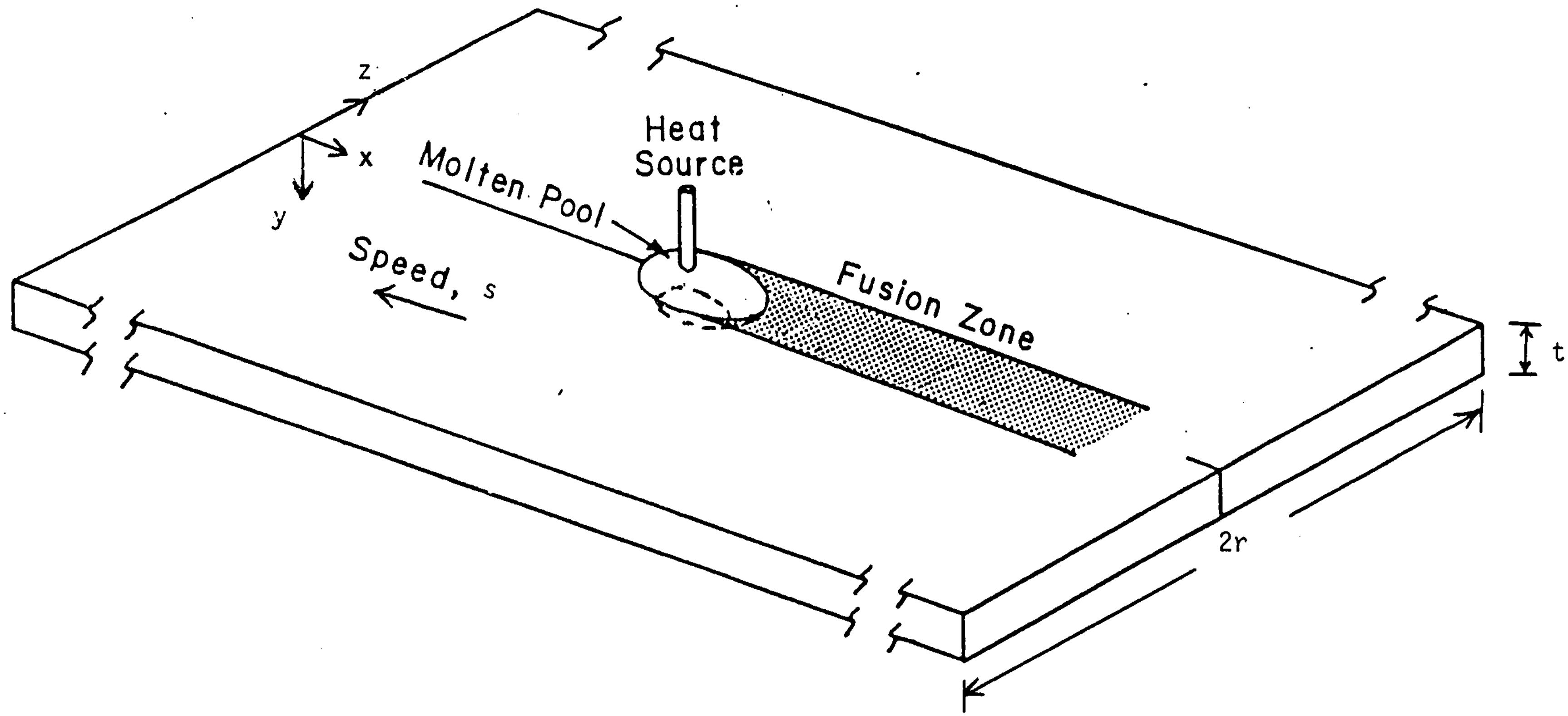

Figure 1. Schematics of a GTA Welding Process

some key papers. Of these, references [11] and [12] contain a broad experimental and theoretical background of the relevant physics. Earliest attempts to model the problem involved solution to the heat conduction equation with a moving point source [15]. Convection in the puddle was accounted for by an enhanced value of the thermal conductivity in the liquid region [4, 5, 6, 10]. The latent heat effects were not included in these studies. In a series of papers, Kuo et al [8, 9] have analyzed the problem using the enthalpy method taking into account the effects of latent heat and variable properties. Excellent puddle contour agreement has been obtained but, the weak link is the artificially enhanced thermal conductivity in the liquid region. Procedures for obtaining weld pool shapes from an interface heat balance have been carried out by Malmuth [14]. Also, there are some complimentary theoretical predictions for the flow in the weld puddle. However, in these, the shape of the puddle is assumed known, and the convective velocities are driven by idealized distribution of electric and magnetic fields. A recent example of this approach are the calculations by Atthey [13].

In terms of completeness and detail, the very recent works of Kuo and Wang [2, 3] comes closest to the present study. The key difference lies in the fact that Kuo and Wang [2, 3] employ a two-dimensional axisymmetric solution for the calculation of the electromagnetic forces. In the present study, all three components of the magnetic field are evaluated, and complete account is taken of the nonlinear coupling that could arise when the electrical conductivity depends upon the temperature.

Section 2
MATHEMATICAL FORMULATION

2.1 Coordinate System

Viewed in the stationary coordinates, the problem is inherently unsteady. However, if the coordinate system is attached to the moving arc, then the problem becomes steady. In the present study, the latter approach was used. Thus, the weld pool and the arc remain fixed in space while the weld material enters and leaves the computational domain. Strictly, for such a steady state to exist, the weld plate should be infinitely long in the direction of the arc motion. While the assumption of a very long weld plate is satisfactory, computationally, however, one must have a finite size of the domain in the x-direction. Thus, the domain size ℓ in the arc direction is arbitrary as long as it is large enough to ensure that a further increase in ℓ does not significantly affect the solution of the melt puddle.

2.2 Simulation of the Solid-Liquid System

In Martin Marietta's report [1], a distinction is retained between the liquid puddle and the solid regions. In the present work, no such distinction is made. The entire material is regarded as a continuum, and the solid portion is modeled as a fluid of infinitely large viscosity. The large viscosity prevents any shear in the solid so that the velocity becomes uniform there. Since it is not known apriori as to which portion of the computational domain is solid or liquid, the viscosity is adjusted iteratively from the examination of the prevailing temperature solution. All other thermophysical properties of the media can vary and are iteratively updated.

The following two features are important for a proper treatment of large discontinuities in properties of the solid and liquid region: (i) use of a control volume type finite difference approach; and (ii) more importantly, use of harmonic average of exchange coefficients to compute diffusive fluxes at the faces of the control volumes. Details of these practices may be found in the textbook [16] and a related publication [17] by Patankar.

2.3 Governing Equations

With this understanding of the preceding subsection, and the nomenclature listed in Section 8, the governing equations are [1]:

Continuity:

$$\frac{\partial}{\partial x}(\rho u) + \frac{\partial}{\partial y}(\rho v) + \frac{\partial(\rho w)}{\partial z} = 0 \tag{1}$$

Momentum:

$$\frac{\partial}{\partial x}[\rho uu] + \frac{\partial}{\partial y}[\rho vu] + \frac{\partial}{\partial z}[\rho wu] = G_x + F_x - \frac{\partial p}{\partial x} + \frac{\partial}{\partial x}[\mu \frac{\partial u}{\partial x}] + \frac{\partial}{\partial y}[\mu \frac{\partial u}{\partial y}] + \frac{\partial}{\partial z}[\mu \frac{\partial u}{\partial z}] \tag{2}$$

$$\frac{\partial}{\partial x}[\rho uv] + \frac{\partial}{\partial y}[\rho vv] + \frac{\partial}{\partial z}[\rho wv] = G_y + F_y - \frac{\partial p}{\partial y} + \frac{\partial}{\partial x}[\mu \frac{\partial v}{\partial x}] + \frac{\partial}{\partial y}[\mu \frac{\partial v}{\partial y}] + \frac{\partial}{\partial z}[\mu \frac{\partial v}{\partial z}] \tag{3}$$

$$\frac{\partial}{\partial x}[\rho uw] + \frac{\partial}{\partial y}[\rho vw] + \frac{\partial}{\partial z}[\rho ww] = G_z + F_z - \frac{\partial p}{\partial z} + \frac{\partial}{\partial x}[\mu \frac{\partial w}{\partial x}] + \frac{\partial}{\partial y}[\mu \frac{\partial w}{\partial y}] + \frac{\partial}{\partial z}[\mu \frac{\partial w}{\partial z}] \tag{4}$$

Enthalpy:

$$\frac{\partial}{\partial x}[\rho uh] + \frac{\partial}{\partial y}[\rho vh] + \frac{\partial}{\partial z}[\rho wh] = S_h + \frac{\partial}{\partial x}[\frac{k}{c_p} \frac{\partial h}{\partial x}] + \frac{\partial}{\partial y}[\frac{k}{c_p} \frac{\partial h}{\partial y}] + \frac{\partial}{\partial z}[\frac{k}{c_p} \frac{\partial h}{\partial z}] \tag{5}$$

Electric Potential:

$$\frac{\partial}{\partial x}[\sigma \frac{\partial \phi}{\partial x}] + \frac{\partial}{\partial y}[\sigma \frac{\partial \phi}{\partial y}] + \frac{\partial}{\partial z}[\sigma \frac{\partial \phi}{\partial z}] = 0 \tag{6}$$

In the present study, the specific heat c_p is taken to be a constant. The density ρ is also taken to be a constant except for the calculation of buoyancy force components (G_x, G_y, G_z) where the Boussinesq approximation is employed [1]. Thus, in the coordinate system shown in Figure 1:

$$G_x = 0 \tag{7}$$

$$G_y = \frac{\rho g \beta}{c_p} (h - h_{ref}) \tag{8}$$

$$G_z = 0 \tag{9}$$

The electromagnetic $\vec{F} = F_x \hat{i} + F_y \hat{j} + F_z \hat{k}$ is given by:

$$\vec{F} = \vec{J} \times \vec{B} \tag{10}$$

Where $\vec{J}$ represents the electric current density given by:

$$\vec{J} = - \sigma \vec{\nabla} \phi \tag{11}$$

and $\vec{B}$ is the magnetic induction computed using the Biot-Savart law [1].

$$\vec{B}(\vec{r}) = \frac{\mu_o}{4\pi} \int_{vol} \frac{\vec{J}(\vec{r}\,') \times (\vec{r} - \vec{r}\,')}{|\vec{r} - \vec{r}|^3} dv' \tag{12}$$

The term S_h in the enthalpy equation is related to the efflux of latent heat energy; details of this term will be discussed in Section 3.2 dealing with the proposed methodology for solution of phase change problems on a fixed grid system. Since the fluid velocity in the puddle is quite small, viscous dissipation and compression work terms are neglected in the enthalpy equation.

2.4 Boundary Conditions

To complete the problem, boundary conditions are needed for all the variables. The conditions used in the present study are:

Inlet Plane: $x = 0$

Assuming arc velocity $= -s\hat{i}$

$$\left\{ \begin{array}{ll} u = s & (13) \\ v = 0 & (14) \\ w = 0 & (15) \\ h = c_p T_{in} & (16) \\ \frac{\partial \phi}{\partial x} = 0 & (17) \end{array} \right.$$

Where T_{in} represents the temperature of the material entering the calculation domain. If the computational domain is extended sufficiently far in front of the arc, then $T_{in} \approx T_{air}$, the ambient air temperture. However, since the thermal conductivity of the weld material is quite high, one may need to go quite far in front of the arc before $T_{in} \approx T_{air}$ approximation is valid. Therefore, option has been left open for the user to provide T_{in} as he/she may deem fit+.

Exit Plane: $x = \ell$

At the exit plane, the solid (re-solidified) material leaves the computational domain. A procedure to delink the effect of conditions downstream of the exit plane on happening within the computational domain would be to use the "outflow" boundary treatment described by Patankar [16] and recommended in the Phase I report [1]. The mathematical statement of this treatment is:

$$\frac{\partial h}{\partial x} = 0 \quad (19)$$

$$\frac{\partial \phi}{\partial x} = 0 \quad (20)$$

As for the velocity components, the boundary condition in this solid region would be the same as at $x = 0$, namely

$$u = s \quad (21)$$
$$v = 0 \quad (22)$$
$$w = 0 \quad (23)$$

+At times, an experimental value may be the best one to use.

Symmetry Surface: $z = 0$

The conditions are:

$$w = 0 \tag{24}$$

$$\partial u/\partial z = 0 \tag{25}$$

$$\partial v/\partial z = 0 \tag{26}$$

$$\partial h/\partial z = 0 \tag{27}$$

$$\partial \phi/\partial z = 0 \tag{28}$$

Bottom Surface of the Plate: $y = t$

$$v = 0 \tag{29}$$

$$\partial u/\partial y = 0 \tag{30}$$

$$\partial w/\partial y = 0 \tag{31}$$

$$\partial \phi/\partial y = 0 \tag{32}$$

$$-\frac{k}{c_p}\frac{\partial h}{\partial y} = \frac{h_t}{c_p}[h - c_p\, T_{air}] \tag{33}$$

For the region near the bottom surface which is solid, the b.c. $\frac{\partial u}{\partial y} = \frac{\partial w}{\partial y} = 0$ will be equivalent to $u = u_s$, $w = 0$. As suggested in [1], the bottom surface is assumed insulated to any electric current. The convective boundary condition on the energy equation is to allow for natural convection heat loss to the ambient air. Thus, h_t is a heat transfer coefficient between the plate surface and the ambient air. Following [18] define a characteristic length:

$$d = \frac{\ell \times 2r}{2[\ell + 2r]} \tag{34}$$

which, for a large ℓ, would give $d \simeq r$. Define a Rayleigh number Ra_d as:

$$Ra_d = \frac{g\, \beta_{air}\, d^3\, Pr_{air}}{\nu_{air}^2}\left(\frac{h_s}{c_p} - T_{air}\right) \tag{35}$$

where h_s/c_p is the temperature of the plate surface.

A suitable correlation for the heat transfer coefficient h_t is:

$$Nu_d = h_t \frac{d}{k_{air}} = m \; Ra_d^n \tag{36}$$

where $m = 0.27$ (37)

$n = 0.25$ (38)

Due to the presence of the surface enthalpy h_s in the definition of the Rayleigh number, the boundary condition is non-linear. However, this poses no difficulty since the entire problem is non-linear and is to be solved iteratively. Thus, the latest h values are used to iteratively update h_s.

<u>Top Surface: y = 0</u>

$$v = 0 \tag{39}$$

$$-\mu \frac{\partial u}{\partial y} = \frac{d\gamma}{dT} \cdot \frac{\partial T}{\partial x} = \frac{1}{c_p} \frac{\partial \gamma}{\partial T} \frac{\partial h}{\partial x} \tag{40}$$

$$-\mu \frac{\partial w}{\partial y} = \frac{d\gamma}{dT} \cdot \frac{\partial T}{\partial z} = \frac{1}{c_p} \frac{\partial \gamma}{\partial T} \frac{\partial h}{\partial z} \tag{41}$$

$$- \frac{k}{c_p} \frac{\partial h}{\partial y} = q_s - \frac{h_t}{c_p} (h_s - c_p \; T_{air}) \tag{42}$$

$$-\sigma \frac{\partial \phi}{\partial y} = j_s \tag{43}$$

The top surface of the plate is assumed to be planar. The quantity γ represents the surface tension, and $d\gamma/dT$ represents the surface tension variation with temperature. Thus, boundary conditions (40) and (41) are included to account for the Marangoni forces. The gradients of h are iteratively updated from the most current available solution for h.

q_s in equation (42) represents heat source due to the arc. Assuming a gaussian distribution, q_s is given by:

$$q_s = \frac{3 \; \eta \; V \; I}{\pi \; a^2} \; \exp \left[\frac{(x - x_o)^2 + z^2}{-a^2/3} \right] \tag{44}$$

The second term on the r.h.s. of (42) represents heat loss by natural convection to the ambient. The heat transfer coefficient h_t is obtained from equations (34 - 36) except that for the top surface [18]:

$$m = 0.54;\ n = 0.25 \text{ for } Ra_d < 10^7 \tag{45}$$

$$m = 0.15;\ n = 0.33 \text{ for } Ra_d > 10^7 \tag{46}$$

The electric current due to the arc J_s is given by:

$$J_s = \frac{3I}{\pi b^2} \exp\left[\frac{(x - x_o)^2 + z^2}{-b^2/3}\right] \tag{47}$$

<u>End Surface: z = r</u>

$$w = 0 \tag{48}$$

$$\frac{\partial u}{\partial z} = 0 \tag{49}$$

$$\frac{\partial v}{\partial z} = 0 \tag{50}$$

$$-\sigma \frac{\partial \phi}{\partial z} = \frac{1}{\ell t} \int_{x=0}^{\ell} \int_{z=0}^{r} j_s \, dx \, dz \tag{51}$$

$$\frac{\partial h}{\partial z} = 0 \tag{52}$$

Thus, the incoming electric current is assumed to exit from the end surface uniformly. The surface is assumed to be insulated to the flow of heat.

Section 3
NUMERICAL METHODLOLOGY

3.1 The Finite Difference Methodology

The numerical model described in the previous section has been implemented on CHAM's general-purpose flow analysis code, PHOENICS [19]. PHOENICS employs a fully conservative control-volume-finite-difference formulation. Thus, as described by Patankar [16], the computational domain is divided into a family of non-overlapping parallelipiped control volumes (see Figure 2). At the center of each control volume is a grid node, and the purpose of the computation is to predict value of all variables at the grid nodes. The governing differential equations are discretized by integrating them over control volumes and expressing the convective and diffusive fluxes in terms of values of the variables at the grid nodes. This process results into a system of algebraic equations in which the unknowns are the values of the variable at the grid nodes. These algebraic equations are then solved using a variety of procedures.

Pressure and all other variables are stored at the center of control volumes. However, velocity components are staggered in their respective directions and stored at the surface of the main control volumes. The coupling between velocity and pressure (momentum and continuity) is handled iteratively using variants of the SIMPLE algorithm [16].

Since the entire problem is non-linear, an iterative solution scheme is used. Thus, one variable is solved for at a time using the most currently available values of all other variables. Thermophysical properties, like thermal or electric conductivity, which may depend upon field variables like temperature, are iteratively updated.

3.2 Methodology for Handling the Phase Change

Voller [20] has discussed various computational procedures for solving phase change problem. He has also suggested an attractive procedure for solving phase change problems using a fixed-grid-control-volume formulation like the

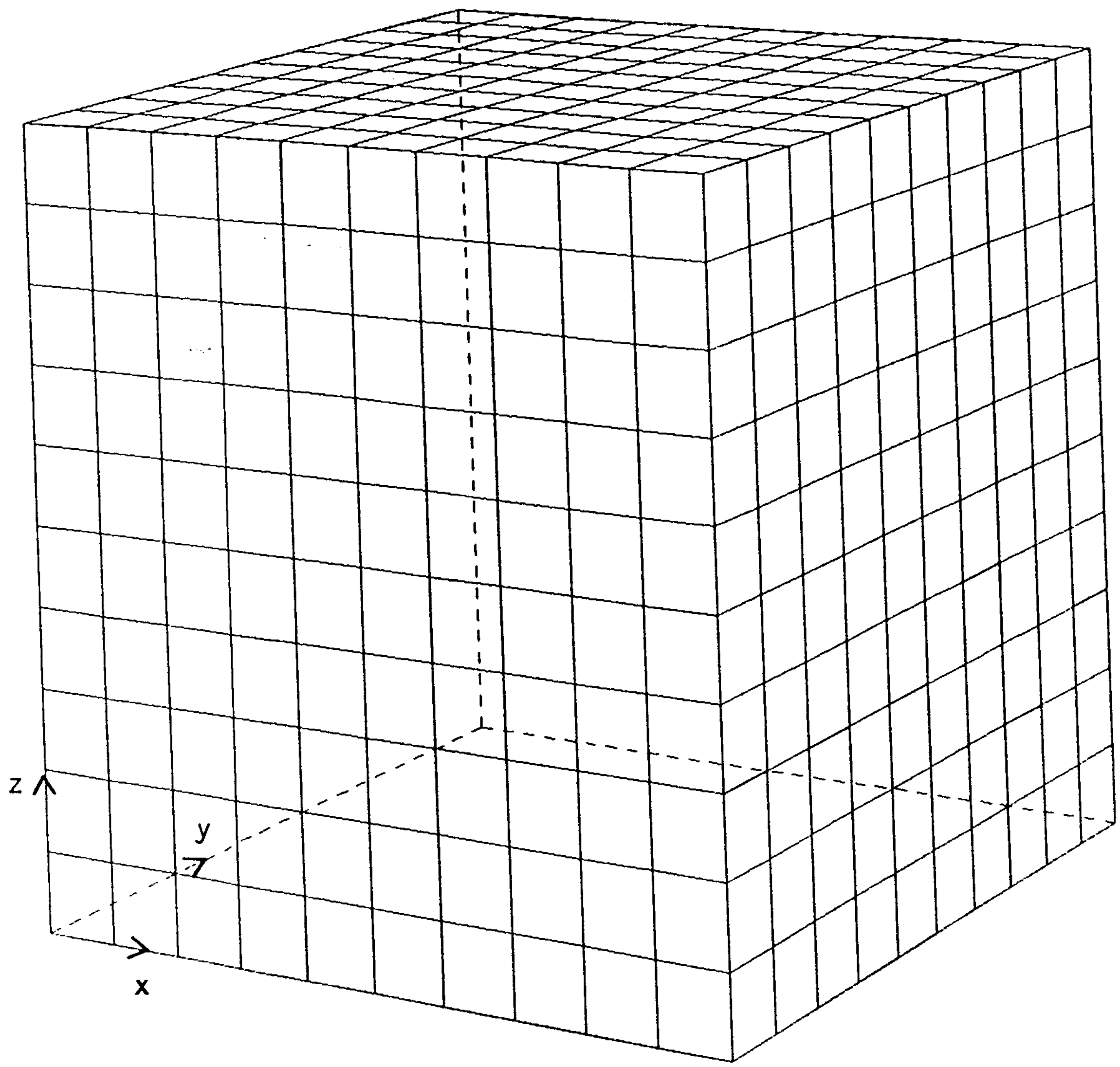

Figure 2. Discretization of the Domain into Control Volumes

one employed in PHOENICS. In the present study, Voller's method has been extended to solve the problem at hand. Details of this procedure will now be described.

The total enthalpy H is considered to be the sum of sensible ($h = c_p T$) and latent heat (ΔH) components. That is,

$$H = h + \Delta H \tag{53}$$

where ΔH is bounded in the range

$$0 < \Delta H < L \tag{54}$$

L being the latent heat of phase change. The value of ΔH in a cell indicates the following:

$$\Delta H = 0 \quad \rightarrow \text{all solid} \tag{55}$$

$$\Delta H = L \quad \rightarrow \text{all liquid} \tag{56}$$

$$0 < \Delta H < L \quad \rightarrow \text{solid fraction: } 1 - \frac{\Delta H}{L} \quad \text{liquid fraction: } \frac{\Delta H}{L} \tag{57}$$

Whereas the sensible heat h can be transferred both by convection and diffusion, the latent heat ΔH participates only in convection. Thus, the eqution for conservation of enthalpy is:

$$\frac{\partial}{\partial x}[\rho u\ (h + \Delta H)] + \frac{\partial}{\partial y}[\rho v\ (h + \Delta H)] + \frac{\partial}{\partial z}[\rho w\ (h + \Delta H)]$$

$$= \frac{\partial}{\partial x}\left[\frac{k}{c_p}\frac{\partial h}{\partial x}\right] + \frac{\partial}{\partial y}\left[\frac{k}{c_p}\frac{\partial h}{\partial y}\right] + \frac{\partial}{\partial z}\left[\frac{k}{c_p}\frac{\partial h}{\partial z}\right] \tag{58}$$

which can be rewritten as:

$$\frac{\partial}{\partial x}[\rho uh] + \frac{\partial}{\partial y}[\rho vh] + \frac{\partial}{\partial z}[\rho wh] = S_h + \frac{\partial}{\partial x}\left[\frac{k}{c_p}\frac{\partial h}{\partial x}\right] + \frac{\partial}{\partial y}\left[\frac{k}{c_p}\frac{\partial h}{\partial y}\right] + \frac{\partial}{\partial z}\left[\frac{k}{c_p}\frac{\partial h}{\partial z}\right] \tag{59}$$

where $$S_h = -\frac{\partial}{\partial x}[\rho u\ \Delta H] - \frac{\partial}{\partial y}[\rho v\ \Delta H] - \frac{\partial}{\partial z}[\rho w\ \Delta H] \tag{60}$$

Thus, the consequence of latent heat ΔH is to create a source term in the equation for the sensible enthalpy. Note that this term will be zero when there is no phase change since then ΔH is uniform. S_h may be regarded as the net efflux of latent heat at a point.

Consider the control cell shown in Figure 3. While discretizing the enthalpy equation for the node P, the integrated form of source term S_h would be:

$$\begin{aligned}\text{source of } \Delta H = \; & \Delta y\, \Delta z\, [(\rho u)_w\, (\Delta H)_w - (\rho u)_e\, (\Delta H)_e] \\ + \; & \Delta x\, \Delta z\, [(\rho v)_s\, (\Delta H)_s - (\rho v)_n\, (\Delta H)_n] \\ + \; & \Delta x\, \Delta y\, [(\rho w)_b\, (\Delta H)_b - (\rho w)_t\, (\Delta H)_t] \end{aligned} \tag{61}$$

where the subscripts w, e, s, n, b and t refer to the different faces of the control volume.

The next task is to relate the value of (ΔH) at the control volume faces to the values at the grid nodes. In this regard, the donor cell upwinding, technique [16] is most appropriate. Thus,

$$\Delta H_w = \begin{cases} \Delta H_W \text{ if } u_w > 0 \\ \Delta H_P \text{ if } u_w < 0 \end{cases} \tag{62}$$

and likewise for ΔH at e, s, n, b and t.

Given a distribution of ΔH, the enthalpy equation (59) can be solved to determine h. Hence the remaining issue is that of obtaining ΔH from the computed h solution. At this stage the nature of phase change comes into the picture.

Let T_s^* and T_ℓ^* be the solidus and liquidus temperatures respectively. Define a phase change temperature T_c^* as:

$$T_c^* = 1/2\ (T_s^* + T_\ell^*) \tag{63}$$

and the phase change temperature interval ε as:

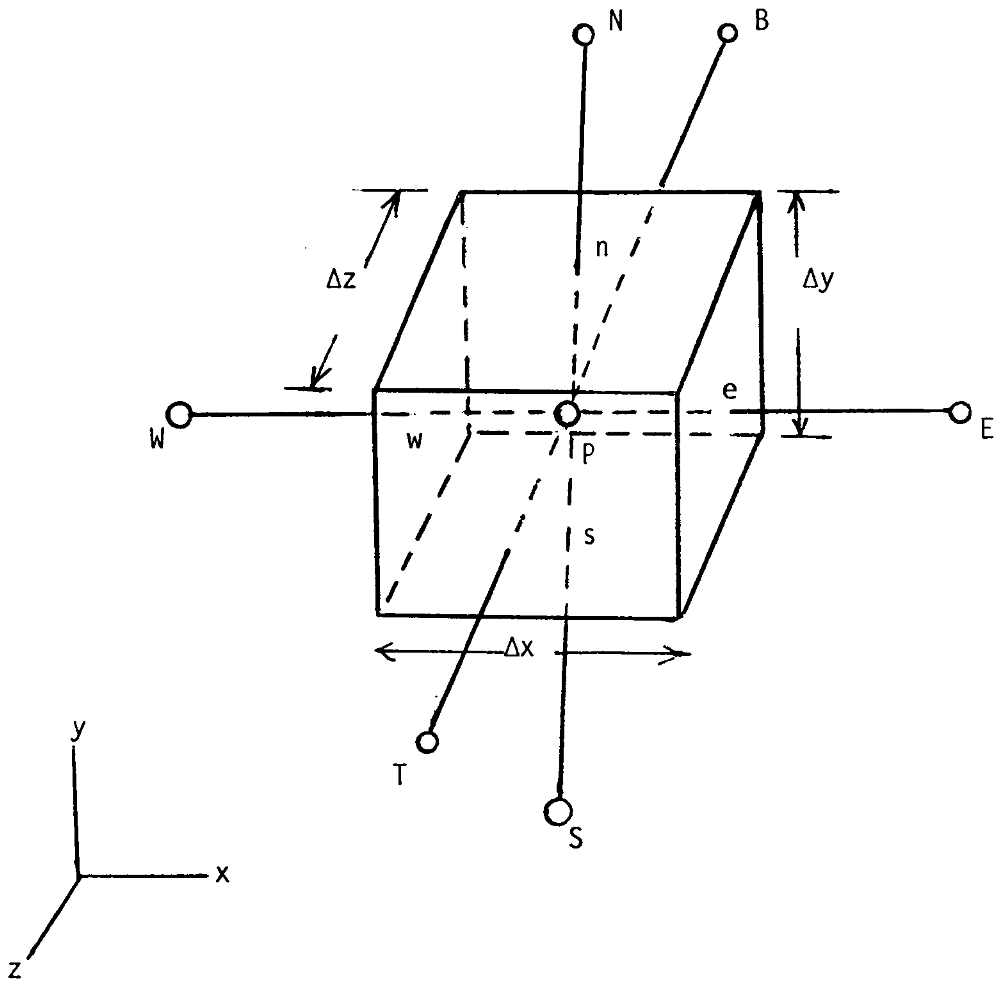

Figure 3. A typical grid node P and its associated control volume. E, W, N, S, B and T are neighbors of P; e, w, n, s, b, t designate the control volume faces.

$$\varepsilon = 1/2\ (T_\ell^* - T_s^*) \tag{64}$$

As is customary, in the following, the temperature will be scaled with respect to T_c^*. Thus, $h = 0$ corresponds to $T = T_c^*$.

In general, h and ΔH could be related in a complex manner on the range $-\varepsilon\ c_p < h < \varepsilon\ c_p$ (see Figure 4). In the present study, a simple linear relationship between the two has been assumed; thus:

$$\Delta H = 0 \qquad \text{for } h < -\varepsilon\ c_p \tag{65}$$

$$\Delta H = L \qquad \text{for } h > \varepsilon\ c_p \tag{66}$$

$$\Delta H = L \cdot \frac{[h + \varepsilon\ c_p]}{[2\ \varepsilon\ c_p]} \qquad \text{for } -\varepsilon\ c_p < h < \varepsilon\ c_p \tag{67}$$

The equation is pictorially represented in Figure 4.

The iterative procedure used for updating ΔH from the current h values has evolved from the work of Voller [20] and the more recent study of Voller and Prakash [21]. Thus, let a superscript k refer to an iteration number k. With a distribution $(\Delta H)^k$, let the h obtained by solving Equation (59) be represented by h^k. Then for the (k+1) iteration, ΔH at each point is obtained from:

$$(\Delta H)^{k+1} = (\Delta H)^k + h^k - \frac{c_p \cdot \varepsilon}{L}[2\ (\Delta H)^k - L] \tag{68}$$

with the bounds

$$0 \leqslant \Delta H^{k+1} \leqslant L \tag{69}$$

It is clear from equation (68) that once the solution has converged, ΔH and h will satisfy the governing relation (65 - 67).

The isothermal phase change case can be simulated by setting the solidus and liquidus temperatures equal. Then, $\varepsilon = 0$, and equation 68 gives:

$$(\Delta H)^{k+1} = (\Delta H)^k + h^k \tag{70}$$

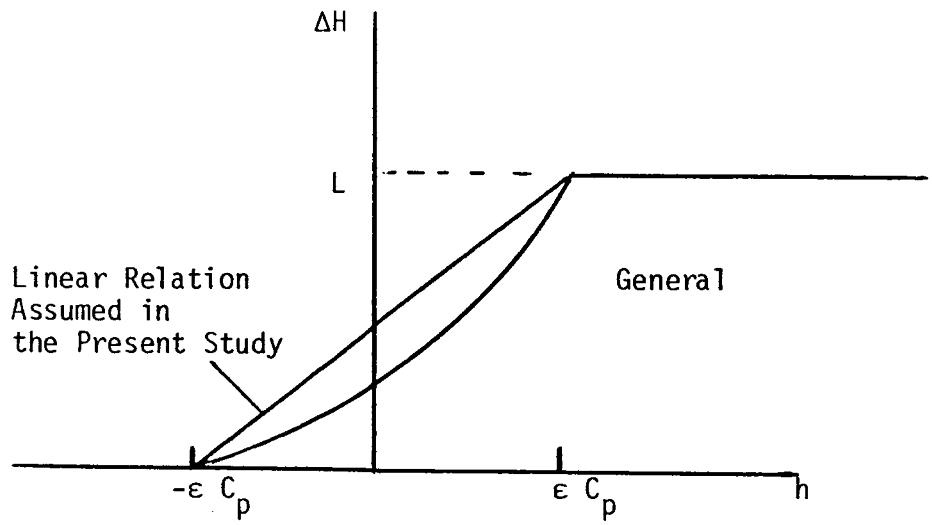

Figure 4. Phase Change Characteristics

$$0 < \Delta H^{k+1} < L \tag{71}$$

which is the same equation as developed first by Voller [20]. Physically, equation (70) is the requirement that $h = 0$ [i.e. the temperature is equal to the phase change temperature] for a partially melted cell.

3.3 Modeling of the Mushy Region

The behavior of a fluid in the mushy region ($T_s^* < T < T_\ell^*$) can be a subject of independent research; important aspects to be considered would include the morphology of the dendritic solid-fluid interface. Needless to say that such an effort would require close validation with experimental data. Due to these difficulties, most analytical attempts for solving phase change problems have sought to ignore the detailed modeling of the mushy region. Generally, a 'numeric fix' is employed which ensures proper behavior at the two extremes, viz-a-viz, the solid must immobolize while the liquid must be free to flow.

Voller [20] has summarized a number of procedures for modeling the mushy region. The most commonly used method [2, 3] is to let the fluid viscosity increase monotonically from the liquid value μ_ℓ to a large value μ_s in the solid over the temperature range $T_\ell^* \rightarrow T_s^*$. Alternately [20] one could provide momentum sink terms which increase as the solid is approached. Voller and Prakash [21] regard the mushy region as a porous media and employ the Ergun equation [22] in a Darcy law framework.

In the present study, a rather simple minded approach has been adopted. Thus, the viscosity μ is set to a large value μ_s for temperture $T < T_c^*$ while the liquid value μ_ℓ is used for $T > T_c^*$. As already mentioned, PHOENICS uses the harmonic averaging technique to compute interface diffusion fluxes [16, 17] so that large discontinuities in the value of μ can be handled in a manner that ensures proper evaluation of interface shear/heat flux etc.

Section 4
PROGRAM DETAILS

4.1 General Comments

As already mentioned, the model has been implemented on the PHOENICS code which is available on the NASA-MSFC computer network. The code is well documented [19] and it is assumed that the reader has some familiarity with the code and that he/she knows how to execute it on his/her system.

PHOENICS consists of a problem independent part EARTH which remains fixed. Any particular problem is specified via an input file Q1 and a routine GROUND. This section describes the Q1 and the GROUND files which were developed to implement the weld problem.

Ease of use has been kept in focus while preparing the Q1 and the GROUND files. Indeed, all of the important input quantities are separated in clearly cordoned areas so that for most of the day-to-day parametric studies a user has to merely change the necessary numbers.

All coding in standard FORTRAN IV.

4.2 The Grid Layout

As shown in Figure 2, the computational domain is discretized into a family of control volumes. Further details of the domain discretization for the present problem are shown in Figure 5.

The coordinate system is attached to the left-front-top corner. The center of the arc is supposed to be located at:

x = LX1 + (LX2)/3
z = 0
y = 0

The computational domain extends a distance:

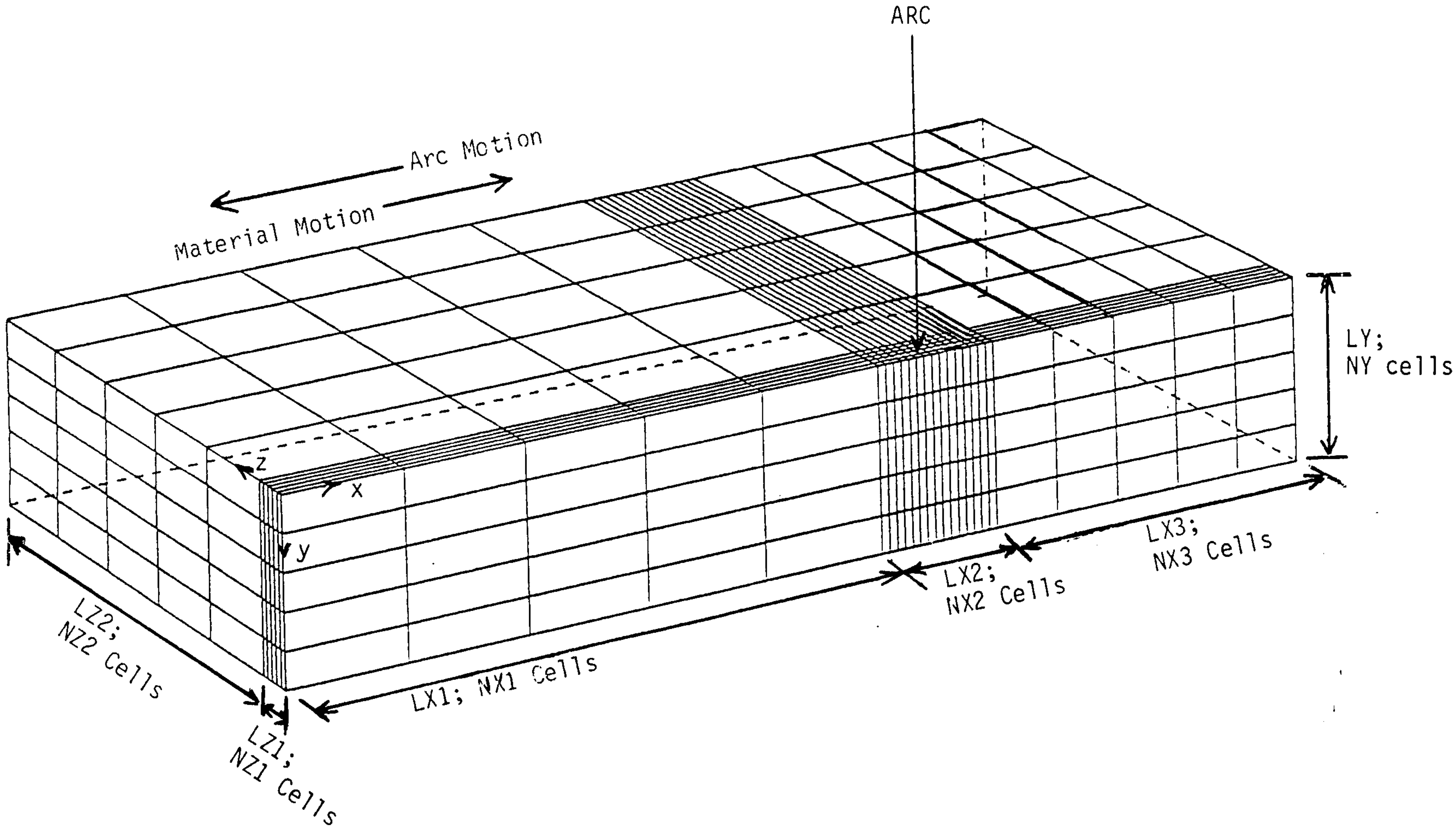

Figure 5. Grid Layout. The center of the arc is at z=0, x = LX1 + (LX2)/3. NX2 should be divisible by 3.

2 (LX2)/3 + LX3

behind the arc in the x direction. The distance LX2 may be regarded as the "fine-grid" region under the arc.

In a likewise manner, the grid in the z direction is kept finer near the arc. Thus LZ1 is a small "fine-grid" distance followed by LZ2 where a coarse grid is used. Of course, LZ1 + LZ2 must equal the half width r of the weld plate.

In the vertical, y direction, LY represents the plate thickness t.

A non-uniform grid, with finer grid under the arc, can be affected by the proper choice of various distances and the number of cells in different sections. The latter are specified by:

NX1,NX2,NX3	:	Number of cells in the x-direction in lengths LX1, LX2 and LX3, respectively. The integer number NX2 should be divisible by 3.
NZ1,NZ2	:	Number of cells in the z-direction in lengths LZ1, LZ2, respectively.
NY	:	Number of cells in the y-direction.

4.3 The Slab by Slab Solution Procedure/Notes on the Magnetic Field Calculation

PHOENICS solves any problem in a slab by slab fashion in the z-direction. One pass through all the NZ slabs in the computational domain constitute a SWEEP. The total number of sweeps is provided by the user via a PHOENICS variable LSWEEP.

It was established through some trial runs that the computation of the magnetic field $\vec{B}$ with the Biot-Savart law is very time consuming. Hence the following practice has been adopted.

- For the first NLOR sweeps (NLOR specified by the user), the problem is solved without taking account of the magnetic forces.

- At the end of the NLORth sweep, the magnetic field $\vec{B}$ is computed once-for-all with the then available electric current density $\vec{J}$.

- From sweeps (NLOR+1) $\rightarrow$ LSWEEP the Lorentz forces is included in the problem. Though the magnetic field is being kept fixed, the current density $\vec{J}$ is still updated.

It should be noted that if the electric conductivity, σ, is a constant, then the above procedure is entirely satisfactory. Only when σ depends on the temperature, so that the electrical problem is coupled with the thermofluid problem, does one loose the very secondary effect of changes in $\vec{B}$ over the sweeps (NLOR + 1) $\rightarrow$ LSWEEP. Considering that this secondary effect is insignificant and that the computational time saving is enormous, the above practice is highly recommended.

4.4 The Input File Q1

Most of the problem specification is provided via the input file Q1. A listing of the Q1 file is provided in Appendix 1. As described in [19], the Q1 file is divided into 24 groups for a clean organization of the data. A brief description of various groups follows.

Real/Integer Decleration

The top few lines contain the real/integer decleration of variales for local use in the Q1 file using the PIL (PHOENICS Instruction Language).

Input Block

For the convenience of the user, all input data has been cordoned at the top in an area marked INPUT BLOCK. A description is provided of different variables, and a system of units is listed. For most of the day-to-day work, a user would only have to change the appropriate numbers in the input block; the coding in the remaining groups has been kept general enough so that no changes are necessary unless a special need arises.

As will be noted, the thermal and electrical conductivities of the weld material are not specified in the input block. Since these properties can be functions of temperature, coding for them is provided separately in the GROUND routine; details will be discussed in the next section.

Miscellaneous Calculation

Following the input block, some miscellaneous calculations are made. TPC refers to the phase change temperature and EPSIL = c_p ε. The enthalpy h is scaled to make the phase change temperature equal to zero; thus, TPC is being subtracted from other input temperatures.

Group 1

A suitable title is being provided which appears at the top of the outputs.

Group 2

Since the present problem is steady, nothing needs to be done in this group.

Group 3 - 5

The method of pairs [19] is being used to deploy the grid pattern described in Section 4.2.

Group 6

Not needed.

Group 7

A decleration is being made regarding the variables to be solved for. Thus the pressure (P1), the velocity components (U1, V1, W1), the sensible enthalpy (H1) and the electrical potential (C2 or EPOT) are being solved for. As already mentioned, the sensible enthalpy is being scaled to make the phase change temperature zero. Various Ys and Ns in the SOLUTN command indicate various solution options [19]. Thus, the last Y in the SOLUTN commend for (U1, V1, W1, H1 and C2) indicates use of harmonic averaging of exchange coefficients to obtain diffusion flux.

Besides the variables solved for, a number of auxiliary arrays are being stored for printout purposes. Thus, the latent heat ΔH is stored in PHOENICS array C1, the components of the electrical current flux in arrays C3 → C5, the magnetic induction in arrays C6 → C8, and the thermal and electric conductivity in arrays C9 and C10, respectively. In addition, the temperature T and the material kinematic viscosity ν are also being stored in arrays TMP1 and ENUL, respectively. The temperature TMP1 is in actual units, i.e.:

$$TMP1 = \frac{H1}{c_p} + TPC$$

In other words, TMP1 is not being scaled with respect to TPC.

Group 8

Since the electric potential is governed by the Laplace equation, the convection terms are being deactivated. In addition, in built source terms for the enthalpy equation are being switched off. These source terms relate to viscous dissipation, etc.

Group 9

The thermophysical properties are being specified. Those, which depend upon the temperature, will be provided in the GROUND routine.

Group 10

Not needed.

Group 11

Variables are being initialized to start the iterative solution procedure.

Group 12

Not needed.

Group 13

In PHOENICS, boundary conditions are handled by appropriate simulation of sources and sinks [19]. All boundary conditions are provided in this section.

The patches INLET and OUTLET refer to plane x=0 and $x=\ell$ respectively (Figure 1). At the patch ZEROP, reference values of the pressure and the electric potential are being prescribed. At one point in the solid, the fluid velocity is being fixed via the patch FIXVEL; the large viscosity will then propagate this value at other points in the solid. The patch HEAT is used to prescribe the heat and current flux at the plane y=0. The outflow of electric current through the plane z=r is provided via the patch JZOUT. The patch SPECIAL is employed for the provision of latent heat related source term S_h in the enthalpy equation. The buoyancy, Marangoni and electromagnetic forces are provided via the patches BUOY, MRNGN and LORENTZ respectively. Finally, the heat loss through the upper and lower surfaces are provided in patches HTLOSUPS and HTLOSLOS, respectively.

Group 14

Not needed.

Groups 15 - 18

To monitor and control the convergence behavior of the iterative solution procedure, PHOENICS allows the use of various underrelaxing devices and traps on the minimum and maximum values, etc. Details may be found in [19]. For the sample run, the velocities are being underrelaxed using the inertial underrelaxation factor FALSDT = 10^{-4}.

Whenever a solution tends to diverge a user may need to reduce the values underrelaxation parameters. To gain experience, some runs with various underrelaxation parameters is necessary.

Group 19

The necessary integer and real variables are being transferred to the GROUND station.

Groups 20 - 23

Since the output of this three dimensional problem can be rather bulky, a user may need to make a judicious choice of various print control parameters. Thus ECHO = T or F will decide whether or not the Q1 file will be reproduced at the top of the output. As the iterations proceed, values of all the variables at the cell IXMON, IYMON and IZMON are printed out; if the solution is well converged, then these values must change by a smaller and smaller amount with repeated sweeps. The variable NPLT controls the frequency (in terms of number of sweeps) with which the monitoring values are printed.

To monitor the solution as the sweeps are progressing, residue of the finite difference equations of the variables being solved are printed out every TSTSWPth sweep. These residuals are normalized by rather small numbers, so that large values should not cause any alarm; for a well converging solution, it is only necessary that these residuals decrease by a few orders of magnitude, regardless of their absolute values.

NUMCLS sets the number of columns in the output. ITABL = 3 produces the table and line-plot of the residuals and the monitoring values with sweep number.

The field printout is produced for cells IX = IXPRF → IXPRL at intervals of NXPRIN. Similarly in the y and z directions.

A typical output would contain, in order:

- the Q1 file settings if ECHO = T
- residuals every TSTSWPth sweep
- field printout over the range IXPRF → IXPRL; IYPRF → IYPRL; IZPRF → IZPRL
- Table and plot of monitoring values with sweep number
- Table and plot of residuals

Group 24

The results are being saved in a file called ARCA for post processing by the GRAPHICS package [23]. The values stored in ARCA are for the entire field, not just the printout window set by IXPRF, IXPRL, etc.

4.4 The GROUND Routine

As explained in [19], the GROUND routine is also divided into 24 groups for tidy organization of the input. The listing of the GROUND routine for the present problem is provided in Appendix 2. For most of the day-to-day work, the user would not need to make any changes in GROUND.

Dimensions

Near the top of the GROUND routine, dimensions are declared of local array variables. A user must ensure that NXD, NYD and NZD defined via the PARAMETER statement are equal to the total number of computational cells in the x, y and z directions, respectively.

Group 1

The integer and reals variable transferred from the Q1 file are being recovered in easily recognizable names.

Groups 2 - 8

Nothing is being done.

Group 9

The material viscosity and the electrical and thermal conductivity values are being updated using the prevailing temperature find.

Groups 10 - 12

Nothing is being done.

Group 13

The boundary condition which depends on variables being solved for in a non-linear way are being updated.

Groups 14 - 18

Nothing is being done here.

Group 19

Some constants are being calculated in Section 1. In Section 3, the required geometrical information is being accessed from EARTH. Section 6 is used to update the value of latent heat ΔH every sweep; this is followed by the calculation of electric current flux and the magnetic field.

Groups 20 - 24

Nothing is being done.

The Functions GTHCND; GELCND

The functions GTHCND and GELCND calculate the thermal and the electrical conductivity as a function of temperature respectively. A table of the temperature versus the conductivity values is rovided via the data statements. For any input temperature, the routine calculates the conductivity value by a local interpolation of the data. The quantity N, specified via the parameter statement, identifies the number of data points in the table. If it is intended that the conductivity be uniform, then all the conductivity values in the data list should be set equal.

Section 5
RESULTS OF A SAMPLE RUN

The Q1 and the GROUND files in Appendices 1 and 2 contain the data for the sample run. The property data has been taken from the report of Martin Marietta [1] with some guidance from the work of Kuo and Wang [2, 3]. The listing of the output file is included in Appendix 3. The results have also been post processed using CHAM's graphic package PHOTON [23], and are presented in Figures 6 - 9. In order to avoid the output from becoming too bulky, the results have been "windowed" over the region of molten puddle; thus, the printout is obtained for IX = 6 → 20; IZ = 1 → 5; IY = 1 → 5 only. In the same spirit, the graphical results in Figures (6 → 8) have been magnified, but focused over the puddle region only.

We present here results of only one sample case which takes into account all the generalities of the model. The reader is referred to our earlier monthly progress reports [24 - 25] where a number of limiting situations were discussed such as buoyancy acting alone, Marangoni force acting alone, Lorentz force acting alone, two of these acting in different pairs, etc. In these reports, comparisons were also made with the results of [2, 3] and [26].

5.1 The Flow Field

Figure 6 presents the velocity vector plots as viewed from the side; i.e. on vertical plans of constant z. Figures 7(a) and 7(b) present the vector flow field as viewed from top, i.e. on horizontal planes of constant y.

As discussed in [24 - 25],

- Buoyancy forces create an upward motion under the arc (hot fluid rising up) and a downward flow away from arc (cold fluid settling down).

- Marangoni forces create the flow in the same direction as buoyancy since the fluid is hottest (least surface tension) under the arc and colder (greater surface tension) away from the arc.

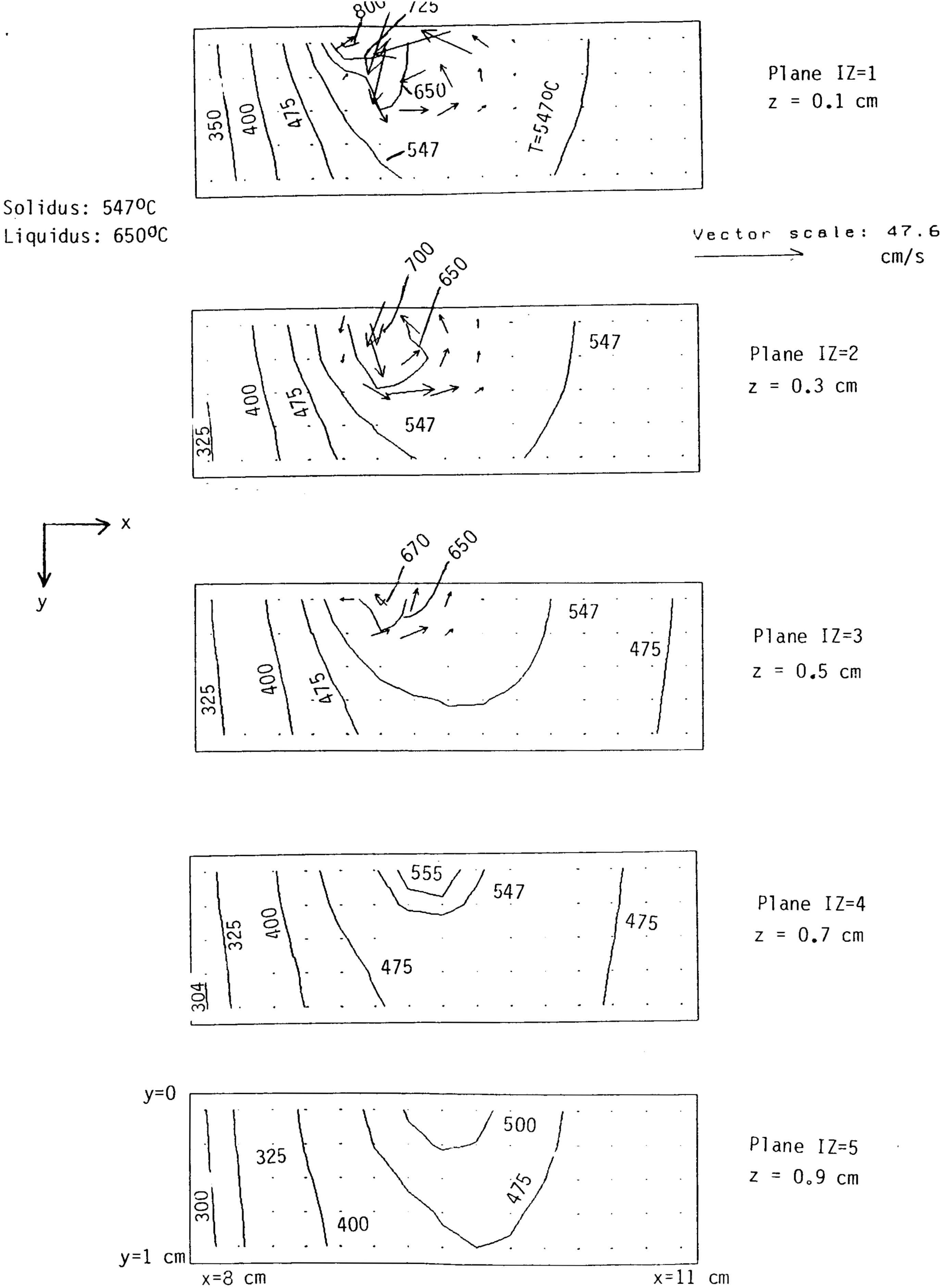

Figure 6. Isotherm and Velocity vector plots on vertical plane of constant z. Arc center at x = 9 cm; y = 0; z = 0.

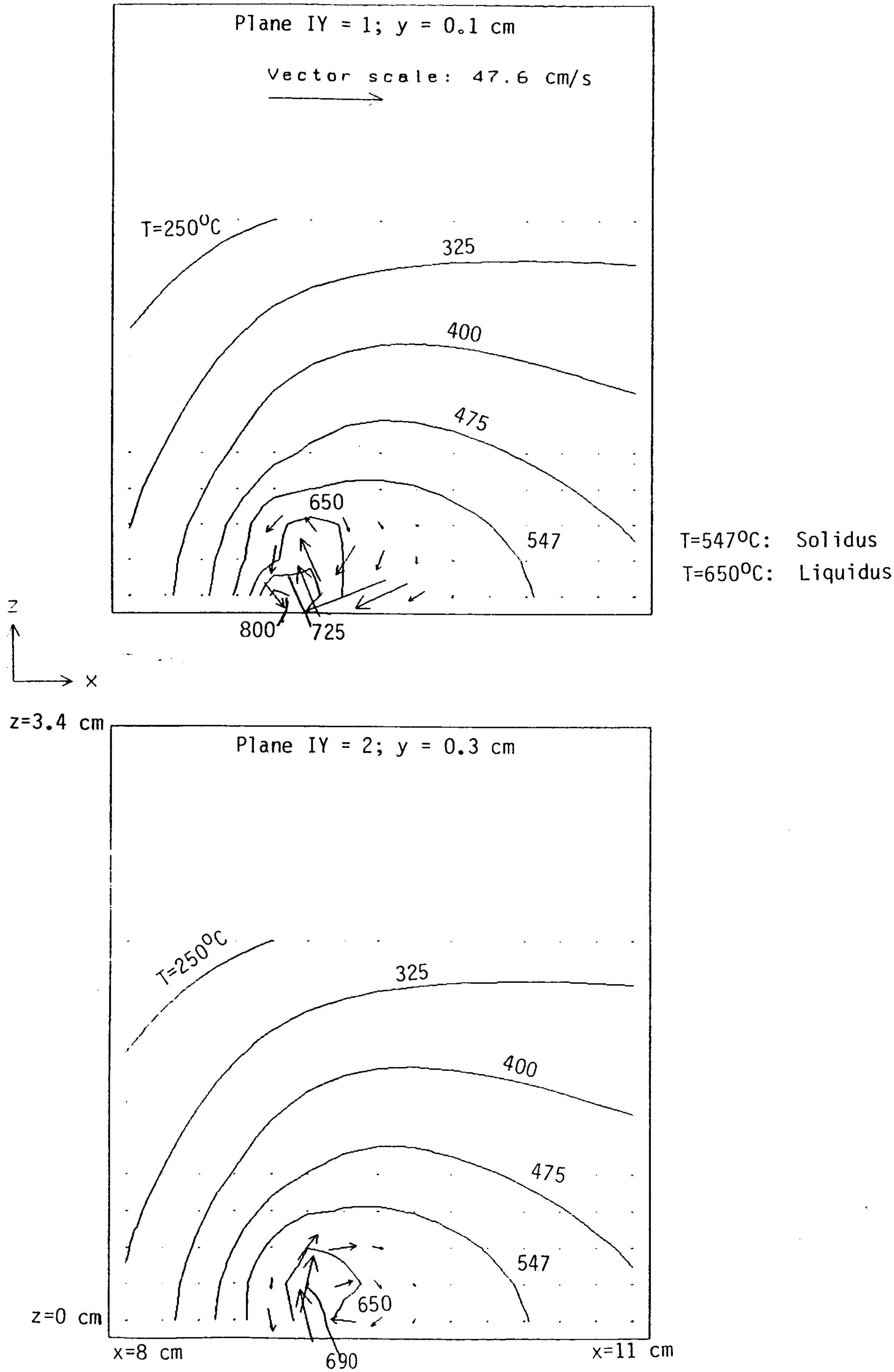

Figure 7(a). Isotherms and velocity vector plots on horizontal planes of constant y. Arc center at x = 9 cm; y = 0; z = 0.

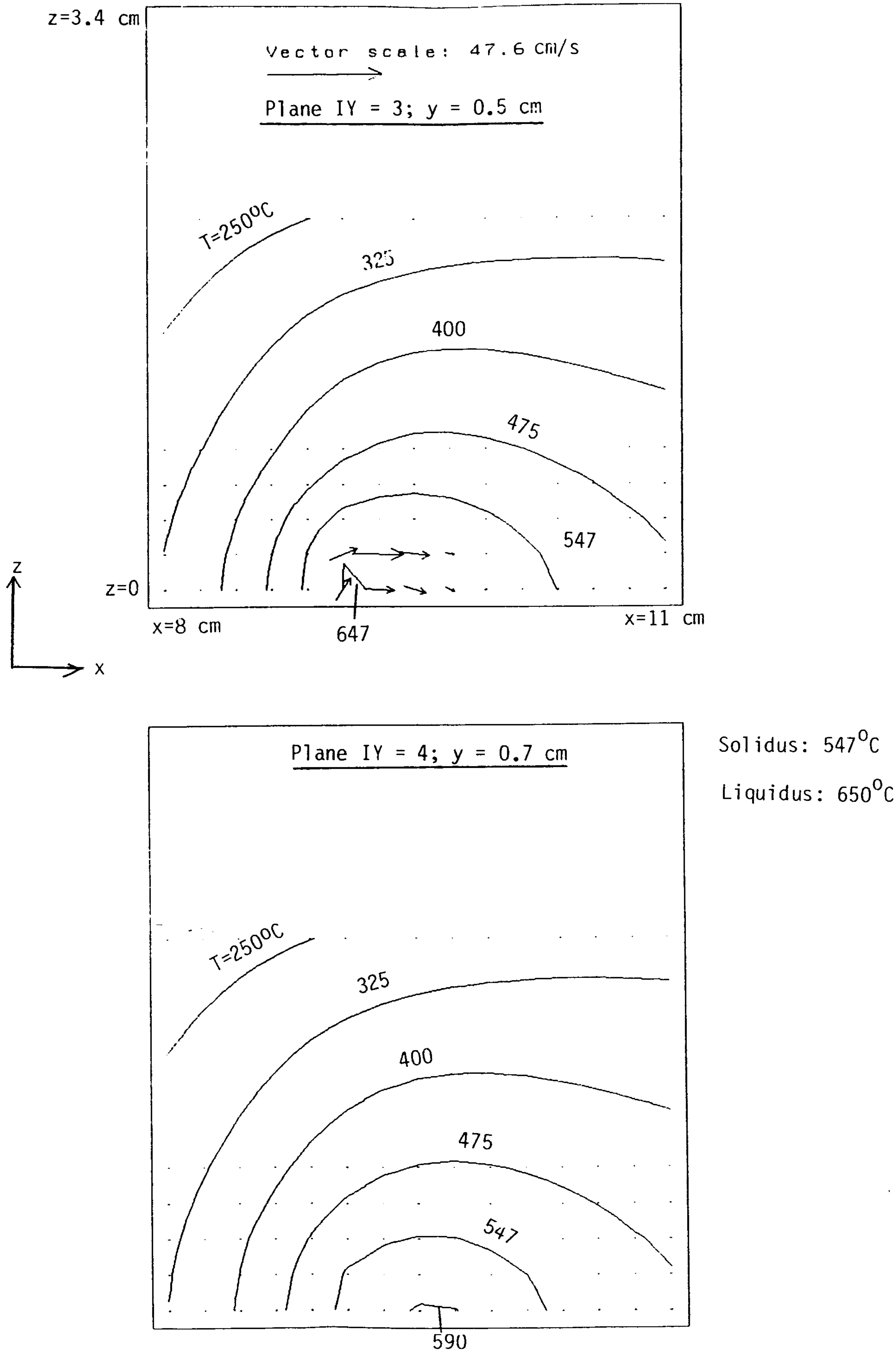

Figure 7(b). Isotherms and velocity vector plots on horizontal planes of constant y. Arc center at x = 9 cm; y = 0; z = 0.

- Electromagnetic, i.e. Lorentz forces, work the other way; i.e. Lorentz forces produce an downward motion under the arc.

As a consequence, when all three forces are present simultaneously, the flow can show a mixed behavior depending upon the net force at each point. For the case of Figures 6 - 7 this mixed behavior is clearly demonstrated; generally, though, the flow appears to be downwards under the arc. Maximum flow velocities were ~ 30 cm/sec.

The velocities must decrease as one proceeds away from the arc; this is clearly shown in Figures 6 - 7 where the velocity vectors reduce to dots (small magnitude) at large IY and large IZ.

5.2 The Temperature Field

Isotherms, i.e. contours of constant temperature, are also plotted in Figures 6 - 7. The important isotherms to be noted are the ones corresponding the liquidus temperature $T_\ell^* = 650^0C$ and the solidus temperature $T_s^* = 547^oC$. The region $T_s^* < T < T_\ell^*$ can be regarded as the mushy zone. As was discussed in Section 3.3, in the present study, the liquid is allowed to flow freely for $T > T_c^* = \frac{1}{2}(T_\ell^* + T_s^*) = 598.5^0C$ while it is totally immobolized (large μ) for $T < T_c^*$. Regarding T_c^* as the boundary of the mushy region, the maximum extent of the melt region may be estimated to be ~ 1.2 cm in the x direction, ~ 0.75 cm in the y direction, and ~ 0.3 cm in the z direction.

5.3 The Electric Field and Current

Via patch ZEROP [see Q1 listing in Appendix 1, Group 13], the reference value of the electric potential is being set to zero at a location IX = NX/2; IY = NY/2 and IZ = 1. Contours of electric potential are presented in Figures 8 and 9. Also included are contour lines of the electric flux component.

As expected, the gradients of the electric potential are larger under the arc where the current flow is the highest. This in in evidence in Figure 8(a) and in the top panel in Figure 9. In regions away from the arc, like Figure 8b

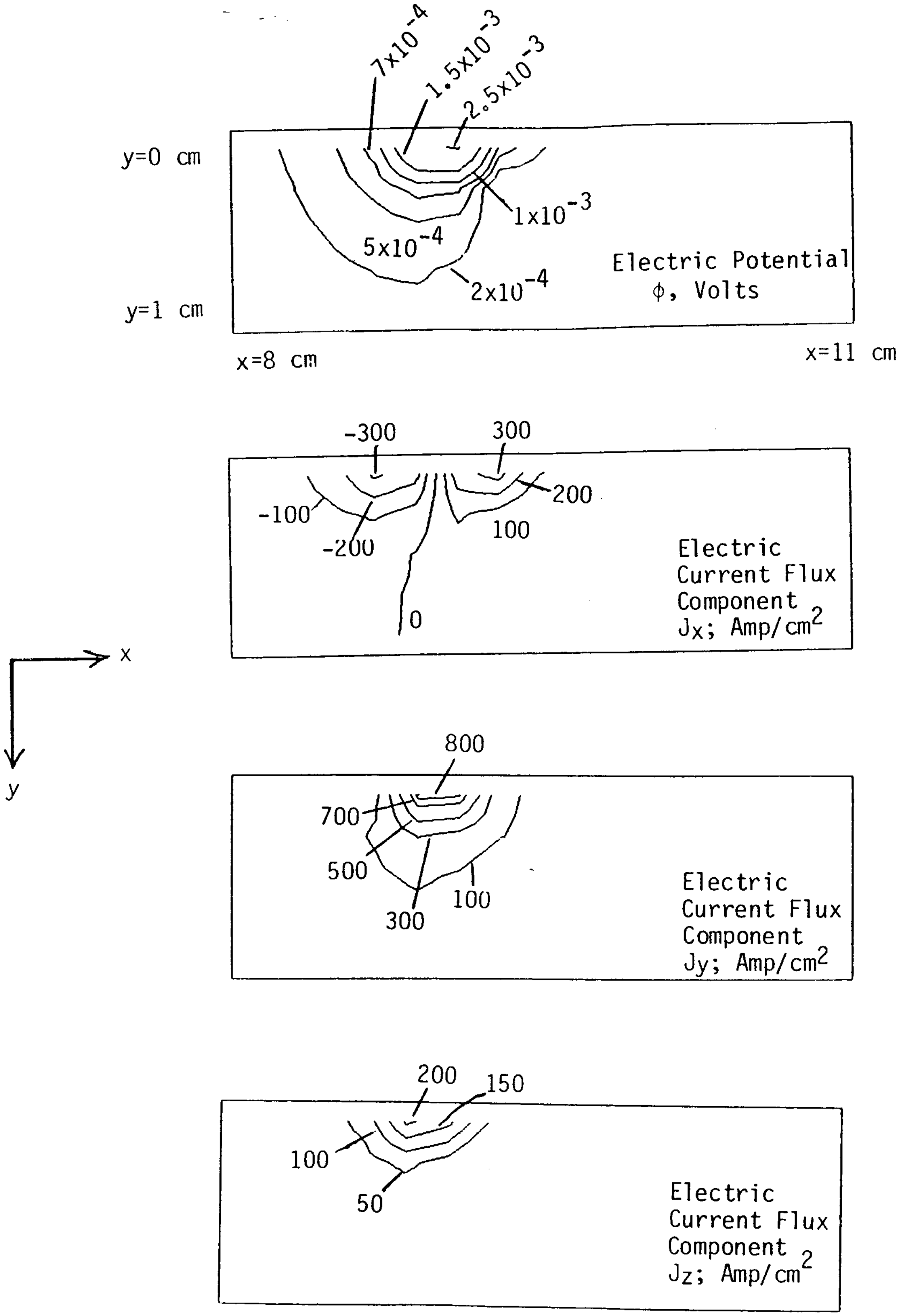

Figure 8(a). Electric field at plane IZ=1; z=0.1 cm.
Arc center at x = 9 cm; y = 0; z = 0.

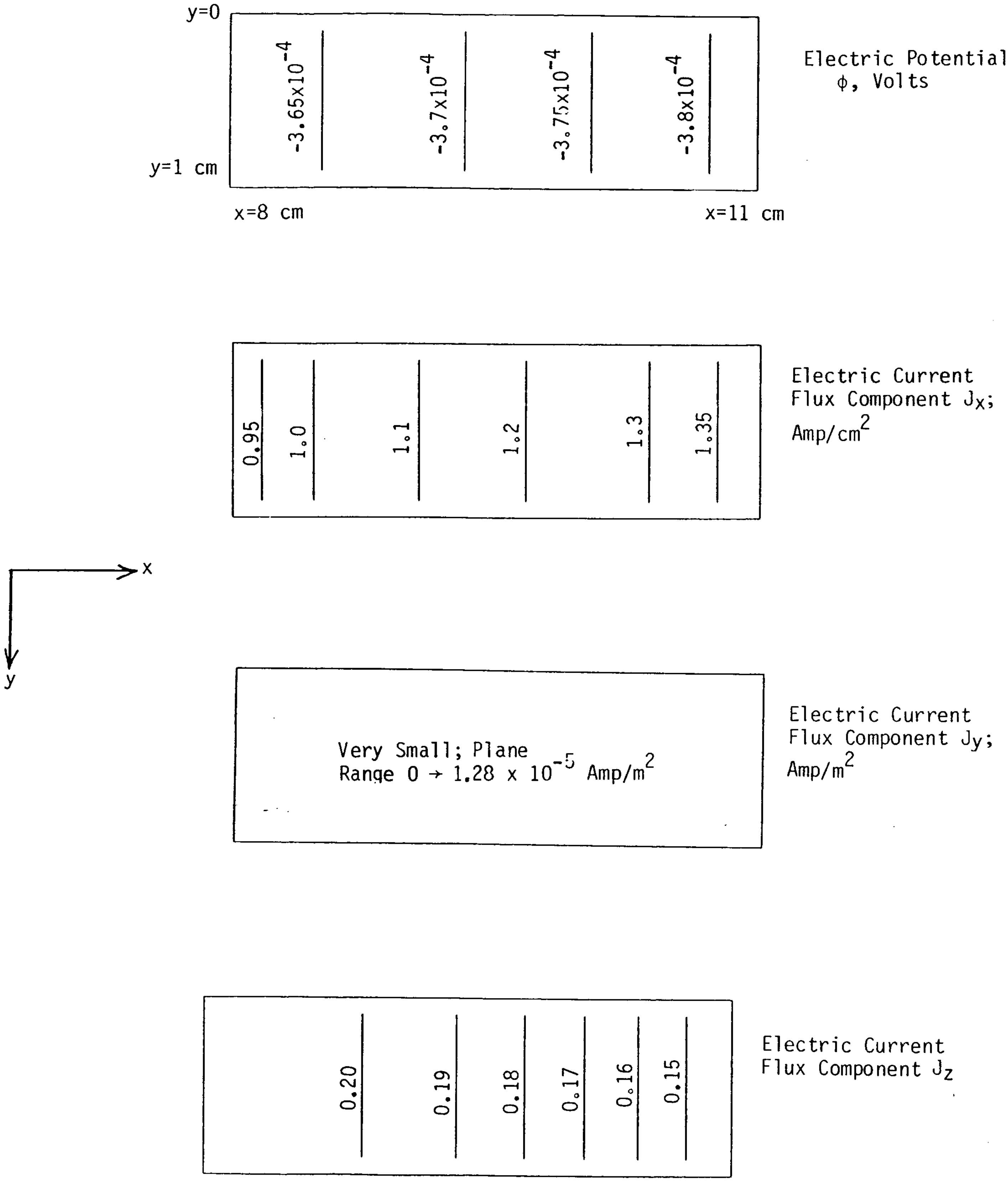

Figure 8(b). Electric field at plane IZ=10; z=11.8 cm.
Arc center at x = 9 cm; y = 0; z = 0.

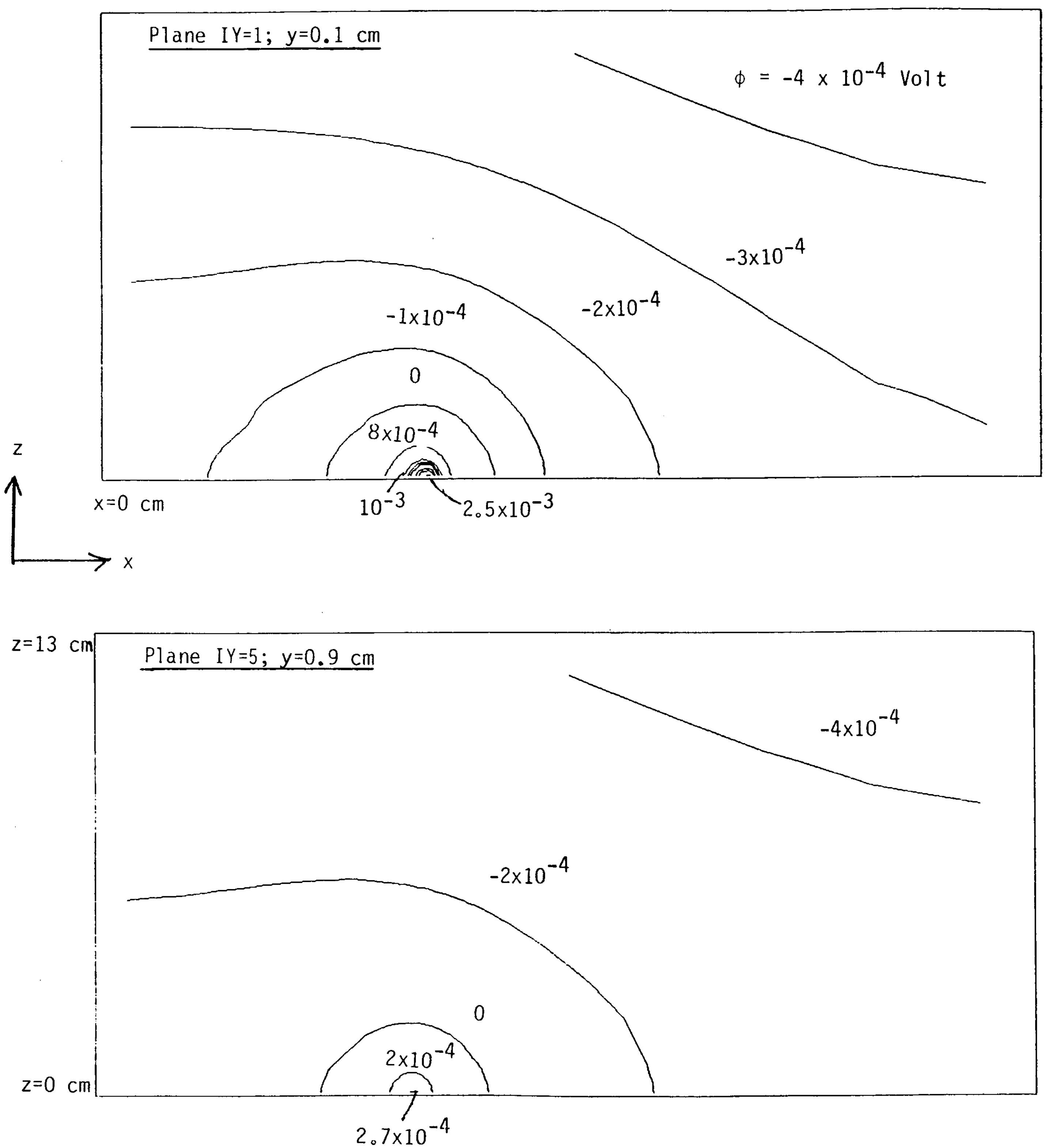

Figure 9. Electric field at the horizontal planes of constant y.
Arc center at x = 9 cm; y = 0; z = 0.

and the lower panel in Figure 9, the variation in the potential is much smaller and so is the magnitude of the flux component.

5.4 Other Field Variables

Other field variables, including the electrical and thermal conductivity which can be function of temperature, are tabulated in the results included in Appendix 3. As will be noted, both the thermal conductivity (THCN) and the electrical conductivity (ELCN) vary significantly in the puddle region. The values are, of course, constrained within the limits of the data reported in [1].

Section 6

CONCLUDING REMARKS

6.1 Summary

The equations governing the TIG (or GTA) welding process have been solved numerically using a finite difference approach. The methodology has been implemented on CHAM's PHOENICS code which is available to NASA MSFC on its computer network.

Most of the essential features of the TIG modeling have been accounted for. These include melting under the arc, and the computation of the motion in the weld puddle due to the action of buoyancy, surface tension (Marangoni), and electromagnetic (Lorentz) forces. Results of a sample calculation are discussed at length.

The coding is in standard Fortran. The input data block has been clearly delineated for ease of change by the user.

6.2 Suggestions for Further Work

Following is a list of suggestions for further work on the proposed model. Such work would be best done at CHAM if appropriate resources are provided; alternately, it could be done in-house at NASA under close collaboration with CHAM.

(1) The model must now be subjected to an extensive parametric study. This should be preceded by a rigorous grid refinement exercise to identify the number and distribution of grid nodes which produces results of acceptable engineering accuracy.

(2) It would be appropriate to examine alternate ways of determining the magnetic field $\vec{B}$. As has been discussed, the use of Biot ~ Savart law is computationally very demanding. Thus, it might be appropriate to use the two-dimensional axisymmetric expressions employed by Kuo and Wang [2, 3]. This does not, however, mean that the electric flux $\vec{J}$ should also be

computed as in [2, 3]; i.e. one could use $\vec{B}$ from [2, 3] but still compute $\vec{J}$ with proper account of dependence of the electrical conductivity on the temperature, etc.

(3) A closer study of various models for flow in the mushy region would be a very valuable exercise. Nothing is available in the literature on this topic, so that a serious study could produce original ideas.

(4) Extension to transient problems would be an important next step.

Section 7
REFERENCES

1. S.C. Traugott, Discrete Element Weld Model, Phase I: General Model of a Weld Puddle Without a Cavity, Final report by Martin Marietta Corporation, prepared for NASA, Contract No. NAS8-35773, 1985.

2. S. Kou and Y.H. Wang, "Computer Simulation of Convection in Moving Arc Weld Pools", Metallurgical Transactions, in press, 1986.

3. S. Kou and Y.H. Wang, "Weld Pool Convection and Its Effect", Welding Journal, Volume 65, No. 3, 1986, pp 63s - 70s.

4. N.S. Tsai and T.W. Eagar, "Changes of Weld Pool Shape by Variations in the Distribution of Heat Source in Arc Welding", in Modeling of Casting and Welding Processes, II, The Metallurgical Society of AIME, 1984, pp 317-328.

5. C.L. Tsai, "Finite Source Theory", in Modeling of Casting and Welding Processes II, The Metallurgical Society of AIME, 1984, pp 329 - 334.

6. C.A. Hou and C.L. Tsai, "Theoretical Analysis of Weld Pool Behavior in the Pulsed Current GTAW Process", in Transport Phenomenon in Materials Processing, Proc. of ASME Winter Annual Meeting, Boston, 1983, pp 117-127.

7. A.C. Nunes, Jr., "An Extended Rosenthal Weld Model", Welding Journal, Vol. 62, No. 6, 1983, pp 165s-1705.

8. S. Kou and Y. Le, "Three-Dimensional Heat Flow and Solidification During the Autogeneous GTA Welding of Aluminum Plates", Metallurgical Transactions, Volume 14A, 1983, pp 2245 - 2253.

9. S. Kou, "Welding, Glazing and Heat Treating - A Dimensional Analysis of Heat Flow", Metallurgical Transactions, Volume 13A, 1982, pp 363-371.

10. G.M. Ecer, M. Downs, H.D. Brody and A. Gokhale, "Heat Flow Simulation of

Pulsed Current Gas Tungsten Arc Welding", in Modeling of Casting and Welding Processes, The Metallurgical Society of AIME, 1981, pp 139-160.

11. W. Lucas, Arc Physics and Weld Pool Behavior, in two volumes, The Welding Institute, Abington Hall, Abington/Cambridge, 1980, 1981.

12. K. Masubuchi, Analysis of Welded Structures, Pergamon Press, 1980.

13. D.R. Atthey, "A Mathematical Model for Fluid Flow in a Weld Pool at High Currents", J. Fluid Mechanics, Volume 98, No. 4, 1980, pp 787-801.

14. N.D. Malmuth, "Temperature Field of a Moving Point Source with Change of State", Int. J. Heat Mass Transfer, Volume 19, No. 4, 1976, pp 344-354.

15. D. Rosenthal, "The Theory of Moving Sources of Heat and Its Application to Metal Treatments", Trans. ASME, Volume 68, 1946, pp 849-866.

16. S.V. Patankar, Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation, McGraw-Hill, New York, 1980.

17. S.V. Patankar, "A Numerical Method for Conduction in Composite Materials, Flow in Irregular Geometrics, and Conjugate Heat Transfer", Proceedings of 6th International Heat Transfer Conference, Toronto, 3, 1978, pp 279-285.

18. F. Incropera and D.P. DeWitt, Fundamentals of Heat Transfer, John Wiley & Sons, New York, 1981.

19. H.I. Rosten and D.B. Spalding, PHOENICS - Beginner's Guide and User Manual, CHAM TR/100, 1986.

20. V.R. Voller, N.C. Markatos and M. Cross, "Techniques for Accounting for the Moving Interface in Convection/Diffusion Phase Change", in Numerical Methods in Thermal Problems, Volume 4, Editors R.W. Lewis and K. Morgan, Pineridge Press, Swansea, U.K., 1985, pp 595-609.

21. V.R. Voller and C. Prakash, "A Fixed Grid Numerical Modeling Methodology

for Convection/Diffusion Mushy Region Phase Change Problems", Int. J. Heat Mass Transfer, in review, 1986.

22. J. Szekely, Fluid Flow Phenomena in Metals Processing, Academic Press, 1979.

23. M.R. Malin, GRAFFIC: An Instruction Manual, CHAM TR/71a, 1983. Also see: D.B. Spalding, H.I. Rosten, D.R. Glynn and J.P. Edwards, Lecture Panels for Use of Body-Fitted Coordinates in PHOENICS, CHAM TR/126, 1986.

24. M. Samonds, C. Prakash and A.K. Singhal, "Discrete Element Weld Model, Phase II Progress Report for May 1986", CHAM 4036/2, June 1986.

25. M. Samonds, C. Prakash and A.K. Singhal, "Discrete Element Weld Model, Phase II Progress Report for June 1986", CHAM 4036/3, July 1986.

26. G.M. Oreper and J. Szekely, "Heat and Fluid Phenomena in Weld Pools", J. Fluid Mechanics, Volume 147, 1984, pp 53 - 79.

Section 8
NOMENCLATURE

a	Heat radius of the arc, Egn. (44)
b	Electric current radius of the arc, Egn. (45)
$\vec{B}$	$(B_x \hat{i} + B_y \hat{j} + B_z \hat{k})$, the magnetic field
c_p	Specific heat of the weld material
d	Characteristic length, Egn. (34)
$\vec{F}$	$(F_x \hat{i} + F_y \hat{j} + F_z \hat{k})$, the electromagnetic force in the puddle
g	Acceleration due to gravity
$\vec{G}$	$(G_x \hat{i} + G_y \hat{j} + G_z \hat{k})$, buoyancy force in the puddle
h	Sensible enthalpy $(= c_p T)$
h_{ref}	Reference enthalpy
ΔH	Latent heat energy related with phase change
H	Total enthalpy $(= h + \Delta H)$
$\hat{i}$	Unit vector along the x-direction
I	Arc current
$\hat{j}$	Unit vector along the y-direction
$\vec{J}$	$(J_x \hat{i} + J_y \hat{j} + J_z \hat{k})$, the electric current flux
J_s	The electric current flux due to the arc at the plate surface
$\hat{k}$	Unit vector along the z-direction
k	Thermal conductivity of the weld material
k_{air}	Thermal conductivity of the ambient air
ℓ	Extent of the computational domain in the arc (x) direction
L	Latent heat of phase change
m	Constant in the Nusselt number ~ Rayleigh number relation, Egn. (36)
n	Constant in the Nusselt number ~ Rayleigh number relation, Egn. (36)
Pr_{air}	Prandtl number for ambient air

q_s	Heat flux due to the arc at the plate surface
r	Half of plate width; width = 2r; Figure 1
s	Arc speed
S_h	Source term in the equation for sensible enthalpy to account for latent heat effects, Egns. (59 - 60)
t	Weld plate thickness, Figure 1
T	Temperature
T_{air}	Ambient air temperature
T_{in}	Weld plate temperature at the inlet plane
T_ℓ^*	Liquidus temperature
T_s^*	Solidus temperature
T_c^*	$(T_s^* + T_\ell^*)/2$, the phase change temperature
u	Velocity component in the x-direction
v	Velocity component in the y-direction
V	Arc voltage
w	Velocity component in the z-direction
x	Coordinate along the direction of arc motion
x_o	The x coordinates of the arc center
Δx	Width of a computational cell in the x-direction, Figure 3
y	Coordinate along plate depth
Δy	Width of a computational cell in the y-direction, Figure 3
z	Coordinate along plate width
Δz	Width of a computational cell in the z-direction, Figure 3

Greek

β	Volumetric thermal expansion coefficient of the weld melt
β_{air}	Volumetric thermal expansion coefficient of the ambient air
γ	Surface tension of the weld melt

ε	Half of the phase change temperature range = 1/2 $(T_\ell^* - T_s^*)$
η	Arc efficiency, Egn. (44)
μ	Viscosity of the weld material
μ_o	Permeability of free space
ν	Kinematic viscosity of the weld material
ν_{air}	Kinematic viscosity of ambient air
ρ	Density of the weld material
ρ_{air}	Density of the ambient air
σ	Electrical conductivity
ϕ	Electric potential

Subscripts

w,s,n,e,b,t	Location of different control volume faces, Figure 3

APPENDIX 1

Listing of the Q1 File

```
TALK=F,RUN(1,1)
REAL(LX1,LX2,LX3,CP,LZ1,LZ2,SPEED,TIN,TPC,HIN,LENUL,LATHT,GDEN)
REAL(ABUOY,AGRAV,TREF,DGAMDT,VOLTS,AMPS,EFF,HRAD,JRAD,LY,PRMB)
REAL(TSLDS,TLQDS,EPSIL)
REAL(GTAIR,GBTAIR,GENAIR,GPRAIR,GKAIR)
INTEGER(NX1,NX2,NX3,NZ1,NZ2,NXFF,NXFL,NLOR)
   ***********************************************************
   *                                                         *
   *            THE  MAIN  INPUT  BLOCK                      *
   *---------------------------------------------------------*
   *     VARIABLE          DESCRIPTION              UNITS    *
   *     --------          -----------              -----    *
   *       NX1        No. of cells in distance               *
   *                  LX1.(See Fig.5 in report)              *
   *       NX2        No. of cells in distance               *
   *                  LX2; NX2 should be divisible           *
   *                  by 3                                   *
   *       NX3        No. of cells in distance               *
   *                  LX3                                    *
   *       LX1        Computational domain length    cm      *
   *                  in front of the arc.(See               *
   *                  Fig.5 in the report)                   *
   *       LX2        Computational domain length    cm      *
   *                  in the x direction under the           *
   *                  arc                                    *
   *       LX3        Computational domain length    cm      *
   *                  behind the arc                         *
   *       NY         No. of cells in the y direc-           *
   *                  tion; the direction normal             *
   *                  to weld surface.(See Fig.5)            *
   *       LY         Thickness of the weld plate     cm     *
   *       NZ1        No. of cells in distance LZ1           *
   *                  in the z direction                     *
   *       LZ1        Fine grid distance near arc     cm     *
   *                  in the z direction. (See Fig.5)        *
   *       NZ2        No. of cells in distance LZ2           *
   *       LZ2        Distance in the z direction;    cm     *
   *                  along the width of the weld            *
   *       NLOR       The sweep number at which              *
   *                  the magnetic field is computed         *
   *                  and Lorentz forces turned on           *
   *       LSWEEP     Total number of sweeps to be           *
   *                  performed                              *
   *       CP         Specific heat of the material  J/(gm-C) *
   *                  being welded                           *
   *       SPEED      Arc speed                       cm/s   *
   *       LATHT      Latent heat of phase change     J/gm   *
   *       TSLDS      Solidus temperature             C      *
```

```
   *       TLQDS        Liquidus temperature             C            *
   *       TIN          Weld material temperature        C            *
   *                    at inlet to the calculation                   *
   *                    domain                                        *
   *       LENUL        Kinematic viscosity of the melt   (cm**2)/s   *
   *       GDEN         Density of the weld material     gm/(cm**3)   *
   *       ABUOY        Volumetric expansion coeff.      1/C          *
   *                    for the melt                                  *
   *       AGRAV        Acceleration due to gravity      cm/(s**2)    *
   *       TREF         Reference tempertaure in the     C            *
   *                    calculation of buoyancy force                 *
   *                    in the melt                                   *
   *       DGAMDT       Rate of change of surface       dynes/(cm-C)*
   *                    tension of the melt with                      *
   *                    temperature                                   *
   *       VOLTS        Arc voltage                     Volts         *
   *       AMPS         Arc amperage                    Amps          *
   *       EFF          Arc efficiency                                *
   *       HRAD         The constant 'a' in the gaussian  cm          *
   *                    heat flux distribution under arc              *
   *       JRAD         The constant 'b' in the gaussian  cm          *
   *                    electric current distribution                 *
   *                    under the arc                                 *
   *       PRMB         Magnetic permeability      dynes/(cm**2)      *
   *                    constant                                      *
   *       GTAIR        Ambient air temperature           C           *
   *       GBTAIR       Volumetric expansion coeff        1/C         *
   *                    for air                                       *
   *       GENAIR       Kinematic viscosity of air        (cm**2)/s   *
   *       GPRAIR       Prandtl no. for air                           *
   *       GKAIR        Thermal conductivity for air      W/cm-C      *
NX1=5,NX2=15,NX3=5
LX1=8.,LX2=3.,LX3=15.
NY=5,LY=1.
NZ1=5,NZ2=5,LZ1=1.,LZ2=12.
NLOR=200,LSWEEP=400
CP=1.005,SPEED=0.34,LATHT=3.95E2
TSLDS=547.,TLQDS=650.,TIN=100.,LENUL=3.57E-3,GDEN=2.8
ABUOY=1.E-4,AGRAV=981.,TREF=600.,DGAMDT=-.35
VOLTS=15.,AMPS=200.,EFF=.76,HRAD=.2,JRAD=.2,PRMB=.126
GTAIR=20.,GBTAIR=3.E-3,GENAIR=.1589,GPRAIR=0.7,GKAIR=2.63E-4
   *********************************************************************
TPC=0.5*(TSLDS+TLQDS)
EPSIL=0.5*(TLQDS-TSLDS)*CP
TREF=TREF-TPC
HIN=(TIN-TPC)*CP
NXFF=NX1+1
NXFL=NX1+NX2
    GROUP 1. Run title
```

```
TEXT(NASA ARC WELDING SIMULATION)
    GROUP 2. Transience; time-step specification
    GROUP 3. X-direction grid specification
NX=NX1+NX2+NX3
XULAST=LX1+LX2+LX3
XFRAC(1)=-NX1,XFRAC(2)=LX1/(NX1*XULAST)
XFRAC(3)=NX2,XFRAC(4)=LX2/(NX2*XULAST)
XFRAC(5)=NX3,XFRAC(6)=LX3/(NX3*XULAST)
    GROUP 4. Y-direction grid specification
GRDPWR(Y,NY,LY,1.)
    GROUP 5. Z-direction grid specification
NZ=NZ1+NZ2
ZWLAST=LZ1+LZ2
ZFRAC(1)=-NZ1,ZFRAC(2)=LZ1/(NZ1*ZWLAST)
ZFRAC(3)=NZ2,ZFRAC(4)=LZ2/(NZ2*ZWLAST)
    GROUP 6. Body-fitted coordinates or grid distortion
    GROUP 7. Variables stored, solved & named
SOLUTN(P1,Y,Y,N,N,N,N)
SOLUTN(U1,Y,Y,N,N,N,Y)
SOLUTN(V1,Y,Y,N,N,N,Y)
SOLUTN(W1,Y,Y,N,N,N,Y)
SOLUTN(H1,Y,Y,N,N,N,Y)
SOLUTN(C2,Y,Y,N,N,N,Y)
OUTPUT(H1,Y,N,N,Y,Y,Y)
OUTPUT(U1,Y,N,N,Y,Y,Y)
OUTPUT(V1,Y,N,N,Y,Y,Y)
OUTPUT(W1,Y,N,N,Y,Y,Y)
OUTPUT(P1,Y,N,N,Y,Y,Y)
OUTPUT(C2,Y,N,N,Y,Y,Y)
STORE(C1,C3,C4,C5,C6,C7,C8,C9,C10,TMP1,ENUL)
NAME(C1)=DELH;NAME(C2)=EPOT
NAME(C3)=JX;NAME(C4)=JY;NAME(C5)=JZ
NAME(C6)=BX;NAME(C7)=BY;NAME(C8)=BZ
NAME(C9)=THCN;NAME(C10)=ELCN
    GROUP 8. Terms (in differential equations) & devices
TERMS(EPOT,N,N,Y,N,Y,N)
TERMS(H1,N,Y,Y,N,Y,N)
    GROUP 9. Properties of the medium (or media)
ENUL=GRND
RHO1=GDEN
PRNDTL(H1)=-GRND
PRNDTL(EPOT)=-GRND
TMP1=GRND2
TMP1A=TPC
TMP1B=1./CP
    GROUP 10. Inter-phase-transfer processes and properties
    GROUP 11. Initialization of variable or porosity fields
FIINIT(P1)=0.0
FIINIT(U1)=SPEED
```

```
FIINIT(V1)=0.0
FIINIT(W1)=0.0
FIINIT(H1)=HIN
FIINIT(DELH)=0.0
    GROUP 12. Convection and diffusion adjustments
    GROUP 13. Boundary conditions and special sources
PATCH(INLET,WEST,1,1,1,NY,1,NZ,1,1)
COVAL(INLET,P1,FIXFLU,SPEED*RHO1)
COVAL(INLET,U1,ONLYMS,SPEED)
COVAL(INLET,H1,ONLYMS,HIN)
COVAL(INLET,EPOT,ONLYMS,SAME)
PATCH(OUTLET,EAST,NX,NX,1,NY,1,NZ,1,1)
COVAL(OUTLET,P1,FIXFLU,-SPEED*RHO1)
PATCH(ZEROP,CELL,NX/2,NX/2,NY/2,NY/2,1,1,1,1)
COVAL(ZEROP,P1,FIXP,0.0)
COVAL(ZEROP,EPOT,FIXVAL,0.)
PATCH(FIXVEL,CELL,1,1,1,1,1,1,1,1)
COVAL(FIXVEL,U1,FIXVAL,SPEED)
COVAL(FIXVEL,V1,FIXVAL,0.)
COVAL(FIXVEL,W1,FIXVAL,0.)
PATCH(HEAT,SOUTH,NXFF,NXFL,1,1,1,NZ1,1,1)
COVAL(HEAT,H1,FIXFLU,GRND)
COVAL(HEAT,EPOT,FIXFLU,GRND)
PATCH(JZOUT,HIGH,1,NX,1,NY,NZ,NZ,1,1)
COVAL(JZOUT,EPOT,FIXFLU,GRND)
PATCH(SPECIAL,CELL,1,NX,1,NY,1,NZ,1,1)
COVAL(SPECIAL,H1,FIXFLU,GRND)
PATCH(BUOY,PHASEM,1,NX,1,NY,1,NZ,1,1)
COVAL(BUOY,V1,FIXFLU,GRND)
PATCH(MRNGN,SOUTH,1,NX-1,1,1,1,NZ-1,1,1)
COVAL(MRNGN,U1,FIXFLU,GRND)
COVAL(MRNGN,W1,FIXFLU,GRND)
PATCH(LORENTZ,VOLUME,NXFF,NXFL,1,NY,1,NZ1,1,1)
COVAL(LORENTZ,U1,FIXFLU,GRND)
COVAL(LORENTZ,V1,FIXFLU,GRND)
COVAL(LORENTZ,W1,FIXFLU,GRND)
PATCH(HTLOSUPS,SOUTH,1,NX,1,1,1,NZ,1,1)
COVAL(HTLOSUPS,H1,GRND,CP*(GTAIR-TPC))
PATCH(HTLOSLOS,NORTH,1,NX,NY,NY,1,NZ,1,1)
COVAL(HTLOSLOS,H1,GRND,CP*(GTAIR-TPC))
    GROUP 14. Downstream pressure for PARAB=.TRUE.
    GROUP 15. Termination of sweeps
    GROUP 16. Termination of iterations
    GROUP 17. Under-relaxation devices
RELAX(H1,LINRLX,1.0)
RELAX(EPOT,LINRLX,1.0)
RELAX(U1,FALSDT,.0001)
RELAX(V1,FALSDT,.0001)
RELAX(W1,FALSDT,.0001)
```

```
    GROUP 18. Limits on variables or increments to them
    GROUP 19. Special calls from EARTH to GROUND
IG(1)=NXFF,IG(2)=NXFL,IG(3)=NZ1,IG(4)=NLOR
RG(1)=LATHT,RG(2)=SPEED,RG(3)=LENUL,RG(4)=DGAMDT,RG(5)=CP
RG(6)=ABUOY*AGRAV*TREF,RG(7)=-ABUOY*AGRAV/CP
RG(8)=VOLTS,RG(9)=AMPS,RG(10)=EFF,RG(11)=HRAD,RG(12)=JRAD
RG(13)=LY*XULAST,RG(14)=PRMB,RG(15)=EPSIL
RG(16)=GTAIR,RG(17)=GBTAIR,RG(18)=GENAIR,RG(19)=GPRAIR
RG(20)=GKAIR,RG(21)=AGRAV,RG(22)=XULAST,RG(23)=ZWLAST
RG(24)=TPC
    GROUP 20. Preliminary print-out
ECHO=F
    GROUP 21. Print-out of variables
    GROUP 22. Spot-value print-out
IXMON=(NXFF+NXFL)/2
IYMON=1
IZMON=1
TSTSWP=10000
    GROUP 23. Field print-out and plot control
NPLT=10
NUMCLS=5
ITABL=3
IPROF=3
IXPRF=6
IXPRL=20
NXPRIN=1
IYPRF=1
IYPRL=NY
NYPRIN=1
IZPRF=1
IZPRL=5
NZPRIN=1
    GROUP 24. Dumps for restarts
SAVE=T
NSAVE=ARCA
STOP
```

APPENDIX 2

Listing of the GROUND Routine

```
      PROGRAM MAIN
C THIS IS THE MAIN PROGRAM OF EARTH
C FILE NAME GROUND.FTN--------------------------------16 July 1986
C
C   (C) COPYRIGHT 1984, LAST REVISION 1986.
C   CONCENTRATION HEAT AND MOMENTUM LTD. ALL RIGHTS RESERVED.
C   This subroutine and the remainder of the PHOENICS code are
C   proprietary software owned by Concentration Heat and Momentum
C   Limited, 40 High Street, Wimbledon, London SW19 5AU, England.
C
C
C     PROGRAM MAIN
C
C 1   The following two COMMON's, which appear identically in the
C     satellite MAIN program, allow up to 25 dependent variables to
C     be solved for (or their storage spaces to be occupied by
C     other variables, such as density). If a larger number is
C     required, the 25's should be replaced, in the next 8 lines,
C     by the required larger number; and the 100 in COMMON/F01/
C     should be replaced by 4 times the required number. Numbers
C     less than 25 are not permitted.
C
      COMMON/LGE1/L1(25)/LGE2/L2(25)/LGE3/L3(25)/LGE4/L4(25)
     1/LDB1/L5(25)/IDA1/I1(25)/IDA2/I2(25)/IDA3/I3(25)/IDA4/I4(25)
     1/IDA5/I5(25)/IDA6/I6(25)/GI1/I7(25)/GI2/I8(25)/HDA1/IH1(25)
     1/GH1/IH2(25)/RDA1/R1(25)/RDA2/R2(25)/RDA3/R3(25)/RDA4/R4(25)
     1/RDA5/R5(25)/RDA6/R6(25)/RDA7/R7(25)/RDA8/R8(25)/RDA9/R9(25)
     1/RDA10/R10(25)/RDA11/R11(25)
     1/GR1/R12(25)/GR2/R13(25)/GR3/R14(25)/GR4/R15(25)
     1/IPIP1/IP1(25)/HPIP2/IHP2(25)/RPIP1/RVAL(25)/LPIP1/LVAL(25)
     1/IFPL/IPL0(25)/RFPL1/ORPRIN(25)/RFPL2/ORMAX(25)
     1/RFPL3/ORMIN(25)/RFPL4/CELAV(25)
      LOGICAL L1,L2,L3,L4,L5,DBGFIL,LVAL
      CHARACTER*4 IH1,IH2,IHP2,NSDA
C
      COMMON/F01/I9(100)
      COMMON/DISC/DBGFIL
      EXTERNAL WAYOUT
C
C 2   Set dimensions of data-for-GROUND arrays here. WARNING: the
C     corresponding arrays in the MAIN program of the satellite
C     (see SATLIT) must have the same dimensions.
      COMMON/LGRND/LG(20)/IGRND/IG(20)/RGRND/RG(100)/CGRND/CG(10)
      LOGICAL LG
      CHARACTER*4 CG
C
C 3   Set dimensions of data-for-GREX1 arrays here. WARNING: the
C     corresponding arrays in the MAIN program of the satellite
```

```
C     (see SATLIT) must have the same dimensions.
      COMMON/LSG/LSGD(20)/ISG/ISGD(20)/RSG/RSGD(100)/CSG/CSGD(10)
      LOGICAL LSGD
      CHARACTER*4 CSGD
C
C 4   Set dimension of patch-name array here. WARNING: the array
C     NAMPAT in the MAIN program of the satellite must have the
C     dimension.
      COMMON/NPAT/NAMPAT(100)
      CHARACTER*8 NAMPAT
C
C     Declare local CHARACTER variables.
      CHARACTER NDUM4*4,NDUM6*6,NDUM15*15
C
C 5   The numbers in the next two statements (which must be ident-
C     ical) indicate how much computer memory is to be set aside
C     for storing the main and auxiliary variables. The user may
C     alter them if he wishes, to accord with the number of
C     grid nodes and dependent variables he is concerned with.
      COMMON F(200000)
      NFDIM=200000
C
C 6   Logical-unit numbers and file names, not to be changed.
      DBGFIL=.FALSE.
      CALL DSCEAR(14,LUPR3,'  ',15,NDUM15,-11,16)
      CALL DSCEAR(6,LUDUM,'  ',4,NDUM4,9,33)
      CALL DSCEAR(-10,LUSDA,'  ',4,NSDA,0,0)
      CALL DSCEAR(-14,LUPR1,'  ',15,NDUM15,0,0)
      CALL DSCEAR(21,LUDST,'  ',4,NDUM4,9,33)
C
C     User may here change message transmitted to logical unit
C     LUPR3
      CALL WRIT40('GROUND STATION IS GROUND.FTN 11 JULY 86 ')
      CALL MAIN1(NFDIM,LUPR1,LUPR3,LUSDA,NSDA)
      CALL WAYOUT(0)
      STOP
      END
C****************************************************************
      SUBROUTINE GROSTA
C (C) COPYRIGHT 1984, LAST REVISION 1986.
C  CONCENTRATION HEAT AND MOMENTUM LTD. ALL RIGHTS RESERVED.
#include "satear"
#include "grdloc"
#include "grdear"
C.... This subroutine directs control to the GROUNDs selected by
C     the satellite settings of USEGRX, NAMGRD & USEGRD.
C           Subroutine GREX1 contains much standard material, eg.
C     options for fluid properties, several turbulence models,
C     wall functions, etc.
```

```
C
          IF(USEGRX) CALL GREX1
C
C.... ESTER is for electrolytic-smelter modelling of the Hall-cell
C     and Soderberg types used in the reduction of aluminium.
C
          IF(NAMGRD.EQ.'ESTR') CALL ESTRGR
C
C.... SCRS contains the simple-chemical-reaction-model of
C     combustion, the theoretical basis of which is found in the
C     book "Combustion & Mass Transfer" by D B Spalding (1979)
C     This ground also contains geometrical features of a
C     simplified can combustor.
C
          IF(NAMGRD.EQ.'SCRS') CALL SCRSGR
C
C.... A more advanced model of a combustor is given in COMBGR.
C
          IF(NAMGRD.EQ.'COMB') CALL COMBGR
C
C.... WJETGR shows how to represent non-isotropic effects in the
C     turbulence of a wall jet.
C
          IF(NAMGRD.EQ.'WJET') CALL WJETGR
C
C.... TRACGR contains software for tracking fluid interfaces by
C     means of a set of imaginary particles which follow the motion
C
          IF(NAMGRD.EQ.'TRAC') CALL TRACGR
C
C.... PARTGR is used to solve for the motion of particles slipping
C     relative to the host fluid. A spectrum of particle sizes can
C     can be represented. Each particle is characterized by a size,
C     an interphase friction coefficient, an evaporation rate & a
C     temperature.
C
          IF(NAMGRD.EQ.'PART') CALL PARTGR
C
C.... RADIGR provides the coding sequences required to activate
C     the so-called six-flux radiation model.
C
          IF(NAMGRD.EQ.'RADI') CALL RADIGR
C
C.... GAUSGR provides the Gauss-Seidel solver as an alternative
C     to the whole-field linear equation solver provided in EARTH.
C
          IF(NAMGRD.EQ.'GAUS') CALL GAUSGR
C
C.... NOZLGR provides initial conditions & special print out for
```

```
C     a convergent-divergent nozzle case for which body-fitted
C     coordinates are used.
C
          IF(NAMGRD.EQ.'NOZL') CALL NOZLGR
C
C.... AEROGR provides inlet boundary conditions & initial conditions
C     for a one-half C grid for an aerofoil.
C
          IF(NAMGRD.EQ.'AERO') CALL AEROGR
C
C.... POLRGR specifies uniform flow boundary conditions into
C     a polar domain of 360 degree extent.
C
          IF(NAMGRD.EQ.'POLR') CALL POLRGR
C
C.... BTSTGR contains the sequenses used in conjunction with
C     the BFC test battery.
C
          IF(NAMGRD.EQ.'BTST') CALL BTSTGR
C
C.... TESTGR contains test battery sequences used in conjunction
C     with the test-battery SATLIT subroutine, TESTST.
C
          IF(NAMGRD.EQ.'TEST') CALL TESTGR
C
C.... SPECGR is a generic "special" GROUND the name of which can
C     be used by anyone for their own purposes.
C
          IF(NAMGRD.EQ.'SPEC') CALL SPECGR
C
C.... The model ground is for the insertion of new user sequences.
C
          IF(USEGRD) CALL GROUND
C
C.... The data echo is now called at the preliminary print stage.
C
          IF(IGR.NE.20) RETURN
          IF(.NOT.ECHO) GO TO 20
      CALL DATPRN(Y,Y,Y,Y,  Y,Y,Y,Y,  Y,Y,Y,N,  Y,Y,Y,Y,
     1          Y,Y,Y,Y,  Y,Y,Y,Y)
      RETURN
   20 CALL DATPRN(Y,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N,N)
      RETURN
      END
C*****************************************************************
      SUBROUTINE GROUND
#include "satear"
#include "grdloc"
#include "grdear"
```

```
      INTEGER HIGH,OLD,AUX
      LOGICAL STORE,SOLVE,PRINT
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX USER SECTION STARTS:
C
C 1   Set dimensions of satellite-to-GROUND data arrays to those
C     of the satellite.
      COMMON/LGRND/LG(20)/IGRND/IG(20)/RGRND/RG(100)/CGRND/CG(10)
      LOGICAL LG
      CHARACTER*4 CG
C
      PARAMETER(NXD=25,NYD=5,NZD=10)
      PARAMETER(NXZ=NXD*NZD,NXYZ=3*NXD*NYD*NZD)
C
C 2   User dimensions own arrays here, for example:
C     DIMENSION UUH(10,10),UUC(10,10),UUX(10,10),UUZ(10)
C
      DIMENSION GH1(NYD,NXD),GDELH(NYD,NXD),GDELHB(NYD,NXD)
      DIMENSION GAX(NYD,NXD),GAY(NYD,NXD),GAZ(NYD,NXD)
      DIMENSION GU1(NYD,NXD),GV1(NYD,NXD),GW1(NYD,NXD),GW1L(NYD,NXD)
      DIMENSION GDELHT(NYD,NXD),ARRAY(NYD,NXD),GENUL(NYD,NXD),
     1GH1H(NYD,NXD),GDX(NYD,NXD),GXU2D(NYD,NXD),GPX(4),GPZ(4),
     2GH1L(NYD,NXD),GTMP(NYD,NXD),GTHKND(NYD,NXD),GELKND(NYD,NXD)
      DIMENSION AHEAT(NXD,NZD),ACUR(NXD,NZD),GDY(NYD,NXD),GXG2D(NYD,
     1NXD),GYG2D(NYD,NXD),GVOL(NYD,NXD),GJX(NYD,NXD),GJY(NYD,NXD),
     2GJZ(NYD,NXD),GZGNZ(NZD),GBX(NXD,NYD,NZD),GBY(NXD,NYD,NZD),
     3GBZ(NXD,NYD,NZD),GC2(NYD,NXD),GC2L(NYD,NXD),GC2H(NYD,NXD),
     4GNORTH(NYD,NXD),GDZWNZ(NZD)
      DIMENSION GDYV2D(NYD,NXD),GDXU2D(NYD,NXD)
C
C 3   User places his data statements here, for example:
C     DATA NXDIM,NYDIM/10,10/
C
      DATA ACUR/NXZ*0./,GBX,GBY,GBZ/NXYZ*0./,AHEAT/NXZ*0./
C
C 4   Index functions for GROUND-EARTH variable references.
      LOW(I)=NPHI+I
      HIGH(I)=2*NPHI+I
      OLD(I)=3*NPHI+I
      IN(I)=4*NPHI+I
      STORE(I)=MOD(ISLN(I),2).EQ.0
      SOLVE(I)=MOD(ISLN(I),3).EQ.0
      PRINT(I)=MOD(IPRN(I),2).EQ.0
C
C 5   Insert own coding below as desired, guided by GREX1 examples.
C     Note that the satellite-to-GREX1 special data in the labelled
C     COMMONs /RSG/, /ISG/, /LSG/ and /CSG/ can be included and
C     used below but the user must check GREX1 for any conflicting
C     uses. The same comment applies to the EARTH-spare working
C     arrays EASP1, EASP2,....EASP10. If the call to GREX1 has been
```

```
C     deactivated then they can all be used without reservation.
C
      IXL=IABS(IXL)
          IF(IGR.EQ.13) GO TO 13
          IF(IGR.EQ.19) GO TO 19
      GO TO (1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,
     122,23,24),IGR
C*******************************************************************
C
C--- GROUP 1. Run title
C
    1 GO TO (1001,1002),ISC
 1001 CONTINUE
      CALL MAKE(DXG2D)
      CALL MAKE(DYG2D)
      CALL MAKE(XG2D)
      CALL MAKE(YG2D)
      CALL MAKE(XU2D)
      CALL MAKE(DYV2D)
      CALL MAKE(DXU2D)
      RETURN
 1002 CONTINUE
      GLATHT=RG(1)
      GSPEED=RG(2)
      GNL=RG(3)
      GGAMDT=RG(4)
      GCP=RG(5)
      GVOLTS=RG(8)
      GAMPS=RG(9)
      GEFF=RG(10)
      GHRAD=RG(11)
      GJRAD=RG(12)
      GATOT=RG(13)
      GPRMB=RG(14)
      GEPSIL=RG(15)
      GTAIR=RG(16)
      GBTAIR=RG(17)
      GENAIR=RG(18)
      GPRAIR=RG(19)
      GKAIR=RG(20)
      GGRAV=RG(21)
      GEL1=RG(22)
      GEL2=2.*RG(23)
      GTPC=RG(24)
      JNXFF=IG(1)
      JNXFL=IG(2)
      JNZ1=IG(3)
      JLOR=IG(4)
      GPI=ACOS(-1.)
```

```
      GP=.5773502692
      GPX(1)=GP
      GPX(2)=-GP
      GPX(3)=-GP
      GPX(4)=GP
      GPZ(1)=GP
      GPZ(2)=GP
      GPZ(3)=-GP
      GPZ(4)=-GP
      GEL=GEL1*GEL2/(2.*(GEL1+GEL2))
      GCONSH=GGRAV*GBTAIR*GEL**3*GPRAIR/GENAIR**2
      RETURN
C*****************************************************************
C
C--- GROUP 2. Transience; time-step specification
C
    2 CONTINUE
      RETURN
C*****************************************************************
C
C--- GROUP 3. X-direction grid specification
C
    3 CONTINUE
      RETURN
C*****************************************************************
C
C--- GROUP 4. Y-direction grid specification
C
    4 CONTINUE
      RETURN
C*****************************************************************
C
C--- GROUP 5. Z-direction grid specification
C
    5 CONTINUE
      RETURN
C*****************************************************************
C
C--- GROUP 6. Body-fitted coordinates or grid distortion
C
    6 CONTINUE
      RETURN
C*****************************************************************
C
C--- GROUP 7. Variables stored, solved & named
    7 CONTINUE
      RETURN
C*****************************************************************
C
```

```
C--- GROUP 8. Terms (in differential equations) & devices
C
    8 GO TO (81,82,83,84,85,86,87,88,89,810,811,812,813,814,815)
     1,ISC
   81 CONTINUE
C--- for U1AD.LE.GRND--- phase 1 additional velocity (VELAD).
      RETURN
   82 CONTINUE
C--- for U2AD.LE.GRND--- phase 2 additional velocity (VELAD).
      RETURN
   83 CONTINUE
C--- for V1AD.LE.GRND--- phase 1 additional velocity (VELAD).
      RETURN
   84 CONTINUE
C--- for V2AD.LE.GRND--- phase 2 additional velocity (VELAD).
      RETURN
   85 CONTINUE
C--- for W1AD.LE.GRND--- phase 1 additional velocity (VELAD).
      RETURN
   86 CONTINUE
C--- for W2AD.LE.GRND--- phase 2 additional velocity (VELAD).
      RETURN
C    * ------------------- SECTION 7 ---- VOLUMETRIC SOURCE FOR GALA
   87 CONTINUE
      RETURN
C    * ------------------- SECTION 8 --- CONVECTION FLUXES
   88 CONTINUE
      RETURN
C    * ------------------ SECTION 9 --- DIFFUSION COEFFICIENTS
   89 CONTINUE
      RETURN
C    * ------------------ SECTION 10 --- CONVECTION NEIGHBOURS
  810 CONTINUE
      RETURN
C    * ------------------ SECTION 11 --- DIFFUSION NEIGHBOURS
  811 CONTINUE
      RETURN
C    * ------------------ SECTION 12 --- LINEARISED SOURCES
  812 CONTINUE
      RETURN
C    * ------------------ SECTION 13 --- CORRECTION COEFFICIENTS
  813 CONTINUE
      RETURN
C    * ------------------ SECTION 14 --- USER'S SOLVER
  814 CONTINUE
      RETURN
C    * ------------------ SECTION 15 --- CHANGE SOLUTION
  815 CONTINUE
      RETURN
```

```
C   * Make all other group-8 changes in group 19.
C*****************************************************************
C
C--- GROUP 9. Properties of the medium (or media)
C
    9 GO TO (91,92,93,94,95,96,97,98,99,900,901,902,903),ISC
C*****************************************************************
  900 CONTINUE
C--- for TMP1.LE.GRND--------- phase-1 temperature Index AUX(TEMP1)
      RETURN
  901 CONTINUE
C--- for TMP2.LE.GRND--------- phase-2 temperature Index AUX(TEMP2)
      RETURN
  902 CONTINUE
C--- for EL1.LE.GRND--------- phase-1 length scale Index AUX(LEN1)
      RETURN
  903 CONTINUE
C--- for EL2.LE.GRND--------- phase-2 length scale Index AUX(LEN2)
      RETURN
   91 CONTINUE
C--- for RHO1.LE.GRND--- density for phase 1 Index AUX(DEN1).
      RETURN
   92 CONTINUE
C--- for DRH1DP.LE.GRND--- D(LN(DEN))/DP for phase 1 (D1DP).
      RETURN
   93 CONTINUE
C--- for RHO2.LE.GRND--- density for phase 2 Index AUX(DEN2).
      RETURN
   94 CONTINUE
C--- for DRH2DP.LE.GRND--- D(LN(DEN))/DP for phase 2 (D2DP).
      RETURN
   95 CONTINUE
C--- for ENUT.LE.GRND--- reference turbulent kinematic viscosity.
      RETURN
   96 CONTINUE
C--- for ENUL.LE.GRND--- reference laminar kinematic viscosity.
      CALL GETYX(H1,GH1,NYD,NXD)
      DO 965 JY=1,NY
      DO 965 JX=1,NX
      IF(GH1(JY,JX)) 961,961,962
  961 GENUL(JY,JX)=1.E6
      GO TO 965
  962 GENUL(JY,JX)=GNL
  965 CONTINUE
      CALL SETYX(AUX(VISL),GENUL,NYD,NXD)
      RETURN
   97 CONTINUE
C--- for PRNDTL( ).LE.GRND--- laminar PRANDTL nos., or diffusivity.
      IF(INDVAR.NE.H1) GO TO 967
```

```
      CALL GETYX(AUX(TEMP1),GTMP,NYD,NXD)
      DO 966 JY=1,NY
      DO 966 JX=1,NX
      GTHKND(JY,JX)=GTHCND(GTMP(JY,JX))
      ARRAY(JY,JX)=GTHKND(JY,JX)/GCP/RHO1
  966 CONTINUE
      CALL SETYX(LAMPR,ARRAY,NYD,NXD)
      CALL SETYX(C9,GTHKND,NYD,NXD)
  967 IF(INDVAR.NE.C2) GO TO 968
      CALL GETYX(AUX(TEMP1),GTMP,NYD,NXD)
      DO 969 JY=1,NY
      DO 969 JX=1,NX
      GELKND(JY,JX)=GELCND(GTMP(JY,JX))
      ARRAY(JY,JX)=GELKND(JY,JX)/RHO1
  969 CONTINUE
      CALL SETYX(LAMPR,ARRAY,NYD,NXD)
      CALL SETYX(C10,GELKND,NYD,NXD)
  968 CONTINUE
      RETURN
   98 CONTINUE
C--- for PHINT( ).LE.GRND--- interface value of first phase(FII1).
      RETURN
   99 CONTINUE
C--- for PHINT( ).LE.GRND--- interface value of second phase(FII2)
      RETURN
C*****************************************************************
C
C--- GROUP 10. Inter-phase-transfer processes and properties
C
   10 GO TO (101,102,103,104),ISC
  101 CONTINUE
C--- for CFIPS.LE.GRND--- inter-phase friction coeff. AUX(INTFRC).
      RETURN
  102 CONTINUE
C--- for CMDOT.EQ.GRND- inter-phase mass transfer Index AUX(INTMDT).
      RETURN
  103 CONTINUE
C--- for CINT( ).EQ.GRND--- phase1-to-interface transfer
C                                              coefficients (COI1)
      RETURN
  104 CONTINUE
C--- for CINT( ).EQ.GRND--- phase2-to-interface transfer
C                                              coefficients (COI2)
      RETURN
C*****************************************************************
C
C--- GROUP 11. Initialization of variable or porosity fields
C
   11 CONTINUE
```

```
      RETURN
C*****************************************************************
C
C--- GROUP 12. Convection and diffusion adjustments
C
   12 CONTINUE
      RETURN
C*****************************************************************
C
C--- GROUP 13. Boundary conditions and special sources
C
   13 CONTINUE
      GO TO (130,131,132,133,134,135,136,137,138,139,1310,
     11311,1312,1313,1314,1315,1316,1317,1318,1319,1320,1321),ISC
  130 CONTINUE
C-------------------------------- coefficient = GRND
      IF(NPATCH.NE.'HTLOSUPS') GO TO 1004
      IF(INDVAR.NE.H1) GO TO 1004
      CALL GETYX(AUX(TEMP1),GTMP,NYD,NXD)
      CALL GETYX(C9,GTHKND,NYD,NXD)
      DO 1005 JX=1,NX
      DO 1005 JY=1,NY
      ARRAY(JY,JX)=0.0
 1005 CONTINUE
      DO 1006 JX=1,NX
      GDEL=GDYV2D(1,JX)
      GRAL=GCONSH*ABS(GTMP(1,JX)-GTAIR)
      GCONA=0.54
      GCONB=0.25
      IF(GRAL.GT.1.E7) GCONA=0.15
      IF(GRAL.GT.1.E7) GCONB=0.33
      GNUSLT=GCONA*GRAL**GCONB
      GHTC=GKAIR*GNUSLT/GEL
      GK1=GTHKND(1,JX)
      ARRAY(1,JX)=GHTC*GK1/(GK1+GHTC*GDEL)
      ARRAY(1,JX)=ARRAY(1,JX)/GCP
 1006 CONTINUE
      CALL SETYX(CO,ARRAY,NYD,NXD)
 1004 IF(NPATCH.NE.'HTLOSLOS') GO TO 1008
      IF(INDVAR.NE.H1) GO TO 1008
      CALL GETYX(AUX(TEMP1),GTMP,NYD,NXD)
      CALL GETYX(C9,GTHKND,NYD,NXD)
      DO 1009 JX=1,NX
      DO 1009 JY=1,NY
      ARRAY(JY,JX)=0.0
 1009 CONTINUE
      DO 1010 JX=1,NX
      GDEL=GDYV2D(NY,JX)
      GRAL=GCONSH*ABS(GTMP(NY,JX)-GTAIR)
```

```
      GCONA=0.27
      GCONB=.25
      GNUSLT=GCONA*GRAL**GCONB
      GHTC=GKAIR*GNUSLT/GEL
      GK1=GTHKND(NY,JX)
      ARRAY(NY,JX)=GK1*GHTC/(GK1+GHTC*GDEL)
      ARRAY(NY,JX)=ARRAY(NY,JX)/GCP
 1010 CONTINUE
      CALL SETYX(CO,ARRAY,NYD,NXD)
 1008 CONTINUE
      RETURN
  131 CONTINUE
C---------------------------------- coefficient = GRND1
      RETURN
  132 CONTINUE
C---------------------------------- coefficient = GRND2
      RETURN
  133 CONTINUE
C---------------------------------- coefficient = GRND3
      RETURN
  134 CONTINUE
C---------------------------------- coefficient = GRND4
      RETURN
  135 CONTINUE
C---------------------------------- coefficient = GRND5
      RETURN
  136 CONTINUE
C---------------------------------- coefficient = GRND6
      RETURN
  137 CONTINUE
C---------------------------------- coefficient = GRND7
      RETURN
  138 CONTINUE
C---------------------------------- coefficient = GRND8
      RETURN
  139 CONTINUE
C---------------------------------- coefficient = GRND9
      RETURN
 1310 CONTINUE
C---------------------------------- coefficient = GRND10
      RETURN
 1311 CONTINUE
C------------------------------------------ value = GRND
      IF(INDVAR.NE.H1) GO TO 1351
      IF(NPATCH.NE.'SPECIAL') GO TO 1351
      CALL GETYX(C1,GDELH,NYD,NXD)
      CALL GETYX(AEAST,GAX,NYD,NXD)
      CALL GETYX(ANORTH,GAY,NYD,NXD)
      CALL GETYX(AHIGH,GAZ,NYD,NXD)
```

```
      CALL GETYX(U1,GU1,NYD,NXD)
      CALL GETYX(V1,GV1,NYD,NXD)
      CALL GETYX(W1,GW1,NYD,NXD)
      CALL GETYX(LOW(W1),GW1L,NYD,NXD)
      CALL GETYX(LOW(C1),GDELHB,NYD,NXD)
      CALL GETYX(HIGH(C1),GDELHT,NYD,NXD)
      DO 1350 JX=1,NX
      DO 1350 JY=1,NY
      GDELHW=GDELH(JY,JX-1)
      IF(JX.EQ.1) GDELHW=0.
      GDELHE=GDELH(JY,JX+1)
      IF(JX.EQ.NX) GDELHE=0.
      GDELHS=GDELH(JY-1,JX)
      IF(JY.EQ.1) GDELHS=0.
      GDELHN=GDELH(JY+1,JX)
      IF(JY.EQ.NY) GDELHN=0.
      GDELHL=GDELHB(JY,JX)
      IF(IZ.EQ.1) GDELHL=0.
      GDELHH=GDELHT(JY,JX)
      IF(IZ.EQ.NZ) GDELHH=0.
      GU1W=GU1(JY,JX-1)
      IF(JX.EQ.1) GU1W=0.
      GV1S=GV1(JY-1,JX)
      IF(JY.EQ.1) GV1S=0.
      GW1LO=GW1L(JY,JX)
      IF(IZ.EQ.1) GW1LO=0.
      UFLUX=RHO1*GU1(JY,JX)*GAX(JY,JX)
      HFE=AMAX1(UFLUX,0.)*GDELH(JY,JX)-
     &    AMAX1(-UFLUX,0.)*GDELHE
      UFLUX=RHO1*GU1W*GAX(JY,JX)
      HFW=AMAX1(UFLUX,0.)*GDELHW-
     &    AMAX1(-UFLUX,0.)*GDELH(JY,JX)
      VFLUX=RHO1*GV1(JY,JX)*GAY(JY,JX)
      HFN=AMAX1(VFLUX,0.)*GDELH(JY,JX)-
     &    AMAX1(-VFLUX,0.)*GDELHN
      VFLUX=RHO1*GV1S*GAY(JY,JX)
      HFS=AMAX1(VFLUX,0.)*GDELHS-
     &    AMAX1(-VFLUX,0.)*GDELH(JY,JX)
      WFLUX=RHO1*GW1(JY,JX)*GAZ(JY,JX)
      HFH=AMAX1(WFLUX,0.)*GDELH(JY,JX)-
     &    AMAX1(-WFLUX,0.)*GDELHH
      WFLUX=RHO1*GW1LO*GAZ(JY,JX)
      HFL=AMAX1(WFLUX,0.)*GDELHL-
     &    AMAX1(-WFLUX,0.)*GDELH(JY,JX)
 1350 ARRAY(JY,JX)=HFW-HFE+HFS-HFN+HFL-HFH
      CALL SETYX(VAL,ARRAY,NYD,NXD)
 1351 IF(INDVAR.NE.U1) GO TO 1356
      IF(NPATCH.NE.'MRNGN') GO TO 1356
      CALL GETYX(H1,GH1,NYD,NXD)
```

```
      DO 1355 JX=1,NX-1
      ARRAY(1,JX)=0.0
      HE=GH1(1,JX+1)
      HP=GH1(1,JX)
      IF(HE.LT.0..AND.HP.LT.0.) GO TO 1355
      ARRAY(1,JX)=GGAMDT*(HE-HP)/(GDX(1,JX)*GCP)
 1355 CONTINUE
      CALL SETYX(VAL,ARRAY,NYD,NXD)
 1356 IF(INDVAR.NE.W1) GO TO 1361
      IF(NPATCH.NE.'MRNGN') GO TO 1361
      CALL GETYX(H1,GH1,NYD,NXD)
      CALL GETYX(HIGH(H1),GH1H,NYD,NXD)
      DO 1360 JX=1,NX
      ARRAY(1,JX)=0.0
      HH=GH1H(1,JX)
      HP=GH1(1,JX)
      IF(HH.LT.0..AND.HP.LT.0.) GO TO 1360
      ARRAY(1,JX)=GGAMDT*(HH-HP)/(DZG*GCP)
 1360 CONTINUE
      CALL SETYX(VAL,ARRAY,NYD,NXD)
 1361 IF(INDVAR.NE.V1) GO TO 1371
      IF(NPATCH.NE.'BUOY') GO TO 1371
      CALL GETYX(H1,GH1,NYD,NXD)
      DO 1370 JX=1,NX
      DO 1370 JY=1,NY
      ARRAY(JY,JX)=0.
      IF(GH1(JY,JX).LE.0.) GO TO 1370
      ARRAY(JY,JX)=RG(6)+RG(7)*GH1(JY,JX)
 1370 CONTINUE
      CALL SETYX(VAL,ARRAY,NYD,NXD)
 1371 IF(NPATCH.NE.'HEAT') GO TO 1385
      IF(INDVAR.NE.H1.AND.INDVAR.NE.C2) GO TO 1385
      IF(IZ.GT.JNZ1) GO TO 1385
      IF(ISWEEP.GT.1) GO TO 1381
      CALL GETYX(ANORTH,GNORTH,NYD,NXD)
      IF(INDVAR.EQ.H1) THEN
      GRAD=GHRAD
      ELSE
      GRAD=GJRAD
      ENDIF
      JX0=(JNXFL-JNXFF+1)/3+JNXFF-1
      X0=GXU2D(1,JX0)
      DO 1380 JX=JNXFF,JNXFL
      A=GXU2D(1,JX-1)
      B=GXU2D(1,JX)
      IF(ABS(((A+B)/2.)-X0).GT.3.*GRAD) GO TO 1380
      IF((ZW-DZ/2.).GT.3.*GRAD) GO TO 1380
      QSUM=0.
      DO 1375 K=1,4
```

```
      QX=((A+B-2.*X0+GPX(K)*(B-A))/2.)**2
      QZ=((2.*ZW-DZ+GPZ(K)*DZ)/2.)**2
      QT=-3.*(QX+QZ)/GRAD**2
 1375 QSUM=QSUM+EXP(QT)/4.
      IF(INDVAR.EQ.H1) THEN
      AHEAT(JX,IZ)=GPOW*QSUM
      GHTOT=GHTOT+GPOW*QSUM*GNORTH(1,JX)
      ELSE
      ACUR(JX,IZ)=GCUR*QSUM
      GJTOT=GJTOT+GCUR*QSUM*GNORTH(1,JX)
      ENDIF
 1380 CONTINUE
 1381 IF(INDVAR.EQ.H1) THEN
      DO 1382 JX=JNXFF,JNXFL
 1382 ARRAY(1,JX)=AHEAT(JX,IZ)
      ELSE
      DO 1383 JX=JNXFF,JNXFL
 1383 ARRAY(1,JX)=ACUR(JX,IZ)
      ENDIF
      CALL SETYX(VAL,ARRAY,NYD,NXD)
 1385 CONTINUE
      IF(NPATCH.NE.'JZOUT') GO TO 1387
      IF(INDVAR.NE.C2) GO TO 1387
      DO 1386 JX=1,NX
      DO 1386 JY=1,NY
 1386 ARRAY(JY,JX)=-GJTOT/GATOT
      CALL SETYX(VAL,ARRAY,NYD,NXD)
 1387 CONTINUE
      IF(NPATCH.NE.'LORENTZ') GO TO 1394
      IF((INDVAR.NE.U1).AND.(INDVAR.NE.V1).AND.(INDVAR.NE.W1)) GO TO 13
      IF(IZ.GT.JNZ1) GO TO 1394
      IF(ISWEEP.LE.JLOR) GO TO 1391
      CALL GETYX(C3,GJX,NYD,NXD)
      CALL GETYX(C4,GJY,NYD,NXD)
      CALL GETYX(C5,GJZ,NYD,NXD)
      IF(INDVAR.EQ.U1) THEN
      DO 1388 JX=JNXFF,JNXFL
      DO 1388 JY=1,NY
      ARRAY(JY,JX)=GJY(JY,JX)*GBZ(JX,JY,IZ)-GJZ(JY,JX)*GBY(JX,JY,IZ)
 1388 CONTINUE
      GO TO 1393
      ELSE IF(INDVAR.EQ.V1) THEN
      DO 1389 JX=JNXFF,JNXFL
      DO 1389 JY=1,NY
      ARRAY(JY,JX)=GJZ(JY,JX)*GBX(JX,JY,IZ)-GJX(JY,JX)*GBZ(JX,JY,IZ)
 1389 CONTINUE
      GO TO 1393
      ELSE IF(INDVAR.EQ.W1) THEN
      DO 1390 JX=JNXFF,JNXFL
```

```
      DO 1390 JY=1,NY
      ARRAY(JY,JX)=GJX(JY,JX)*GBY(JX,JY,IZ)-GJY(JY,JX)*GBX(JX,JY,IZ)
 1390 CONTINUE
      GO TO 1393
      ENDIF
 1391 DO 1392 JX=JNXFF,JNXFL
      DO 1392 JY=1,NY
 1392 ARRAY(JY,JX)=0.
 1393 CALL SETYX(VAL,ARRAY,NYD,NXD)
 1394 CONTINUE
      RETURN
 1312 CONTINUE
C-------------------------------------- value = GRND1
      RETURN
 1313 CONTINUE
C-------------------------------------- value = GRND2
      RETURN
 1314 CONTINUE
C-------------------------------------- value = GRND3
      RETURN
 1315 CONTINUE
C-------------------------------------- value = GRND4
      RETURN
 1316 CONTINUE
C-------------------------------------- value = GRND5
      RETURN
 1317 CONTINUE
C-------------------------------------- value = GRND6
      RETURN
 1318 CONTINUE
C-------------------------------------- value = GRND7
      RETURN
 1319 CONTINUE
C-------------------------------------- value = GRND8
      RETURN
 1320 CONTINUE
C-------------------------------------- value = GRND9
      RETURN
 1321 CONTINUE
C-------------------------------------- value = GRND10
      RETURN
C***************************************************************
C
C--- GROUP 14. Downstream pressure for PARAB=.TRUE.
C
   14 CONTINUE
      RETURN
C***************************************************************
C
```

```
C--- GROUP 15. Termination of sweeps
C
   15 CONTINUE
C    * Make changes for this group only in group 19.
      RETURN
C*****************************************************************
C
C--- GROUP 16. Termination of iterations
C
   16 CONTINUE
C    * Make changes for this group only in group 19.
      RETURN
C*****************************************************************
C
C--- GROUP 17. Under-relaxation devices
C
   17 CONTINUE
C    * Make changes for this group only in group 19.
      RETURN
C*****************************************************************
C
C--- GROUP 18. Limits on variables or increments to them
C
   18 CONTINUE
C    * Make changes for this group only in group 19.
      RETURN
C*****************************************************************
C
C--- GROUP 19. Special calls to GROUND from EARTH
C
   19 GO TO (191,192,193,194,195,196,197,198),ISC
  191 CONTINUE
C    * ------------------- SECTION 1 ---- START OF TIME STEP.
      GJTOT=0.
      GHTOT=0.
      GPOW=3.*GEFF*GVOLTS*GAMPS/(GPI*GHRAD**2)
      GCUR=3.*GAMPS/(GPI*GJRAD**2)
      RETURN
  192 CONTINUE
C    * ------------------- SECTION 2 ---- START OF SWEEP.
      RETURN
  193 CONTINUE
C    * ------------------- SECTION 3 ---- START OF IZ SLAB.
      IF(ISWEEP.NE.1) GO TO 199
      IF(IZSTEP.NE.1) GO TO 199
      CALL GETYX(DXG2D,GDX,NYD,NXD)
      CALL GETYX(DYG2D,GDY,NYD,NXD)
      CALL GETYX(XG2D,GXG2D,NYD,NXD)
      CALL GETYX(YG2D,GYG2D,NYD,NXD)
```

```
      CALL GETZ(ZGNZ,GZGNZ,NZD)
      CALL GETZ(DZWNZ,GDZWNZ,NZD)
      CALL GETYX(XU2D,GXU2D,NYD,NXD)
      CALL GETYX(DYV2D,GDYV2D,NYD,NXD)
      CALL GETYX(DXU2D,GDXU2D,NYD,NXD)
  199 CONTINUE
      CALL GETYX(VOL,GVOL,NYD,NXD)
      RETURN
  194 CONTINUE
C    * ------------------- SECTION 4 ---- START OF ITERATION.
      RETURN
  195 CONTINUE
C    * ------------------- SECTION 5 ---- FINISH OF ITERATION.
      RETURN
  196 CONTINUE
C    * ------------------- SECTION 6 ---- FINISH OF IZ SLAB.
      CALL GETYX(H1,GH1,NYD,NXD)
      CALL GETYX(C1,GDELH,NYD,NXD)
      DO 1930 JX=1,NX
      DO 1930 JY=1,NY
      GDELH(JY,JX)=GDELH(JY,JX)+GH1(JY,JX)
     1            -GEPSIL*(2.*GDELH(JY,JX)-GLATHT)/GLATHT
      IF(GDELH(JY,JX).LT.0.0) GDELH(JY,JX)=0.0
      IF(GDELH(JY,JX).GT.GLATHT) GDELH(JY,JX)=GLATHT
 1930 CONTINUE
      CALL SETYX(C1,GDELH,NYD,NXD)
      CALL GETYX(C2,GC2,NYD,NXD)
      CALL GETYX(C10,GH1,NYD,NXD)
      IF(IZ.NE.1) THEN
      CALL GETYX(LOW(C2),GC2L,NYD,NXD)
      CALL GETYX(LOW(C10),GH1L,NYD,NXD)
      ENDIF
      IF(IZ.NE.NZ) THEN
      CALL GETYX(HIGH(C2),GC2H,NYD,NXD)
      CALL GETYX(HIGH(C10),GH1H,NYD,NXD)
      ENDIF
      DO 1931 JX=1,NX
      DO 1931 JY=1,NY
      GJX1=0.0
      GJX2=0.0
      IF(JX.NE.NX) THEN
      GDEL1=GDXU2D(JY,JX)
      GCND1=GH1(JY,JX)
      GDEL2=GDXU2D(JY,JX+1)
      GCND2=GH1(JY,JX+1)
      GECOND=(GDEL1+GDEL2)*GCND1*GCND2/(GCND1*GDEL2+GCND2*GDEL1)
      GJX2=-GECOND*(GC2(JY,JX+1)-GC2(JY,JX))/GDX(JY,JX)
      ENDIF
      IF(JX.NE.1) THEN
```

```
      GDEL1=GDXU2D(JY,JX-1)
      GCND1=GH1(JY,JX-1)
      GDEL2=GDXU2D(JY,JX)
      GCND2=GH1(JY,JX)
      GECOND=(GDEL1+GDEL2)*GCND1*GCND2/(GCND1*GDEL2+GCND2*GDEL1)
      GJX1=-GECOND*(GC2(JY,JX)-GC2(JY,JX-1))/GDX(JY,JX-1)
      ENDIF
      GJX(JY,JX)=(GJX2+GJX1)/2.
      GJY1=0.0
      GJY2=0.0
      IF(JY.NE.NY) THEN
      GDEL1=GDYV2D(JY,JX)
      GCND1=GH1(JY,JX)
      GDEL2=GDYV2D(JY+1,JX)
      GCND2=GH1(JY+1,JX)
      GECOND=(GDEL1+GDEL2)*GCND1*GCND2/(GCND1*GDEL2+GCND2*GDEL1)
      GJY2=-GECOND*(GC2(JY+1,JX)-GC2(JY,JX))/GDY(JY,JX)
      ENDIF
      IF(JY.NE.1) THEN
      GDEL1=GDYV2D(JY-1,JX)
      GCND1=GH1(JY-1,JX)
      GDEL2=GDYV2D(JY,JX)
      GCND2=GH1(JY,JX)
      GECOND=(GDEL1+GDEL2)*GCND1*GCND2/(GCND1*GDEL2+GCND2*GDEL1)
      GJY1=-GECOND*(GC2(JY,JX)-GC2(JY-1,JX))/GDY(JY-1,JX)
      ENDIF
      IF(JY.EQ.1) GJY1=ACUR(JX,IZ)
      GJY(JY,JX)=(GJY2+GJY1)/2.
      GJZ1=0.0
      GJZ2=0.0
      IF(IZ.NE.NZ) THEN
      GDEL1=GDZWNZ(IZ)
      GCND1=GH1(JY,JX)
      GDEL2=GDZWNZ(IZ+1)
      GCND2=GH1H(JY,JX)
      GECOND=(GDEL1+GDEL2)*GCND1*GCND2/(GCND1*GDEL2+GCND2*GDEL1)
      GJZ2=-GECOND*(GC2H(JY,JX)-GC2(JY,JX))/DZG
      ENDIF
      IF(IZ.EQ.NZ) GJZ2=-GJTOT/GATOT
      IF(IZ.NE.1) THEN
      GDEL1=GDZWNZ(IZ-1)
      GCND1=GH1L(JY,JX)
      GDEL2=GDZWNZ(IZ)
      GCND2=GH1(JY,JX)
      GECOND=(GDEL1+GDEL2)*GCND1*GCND2/(GCND1*GDEL2+GCND2*GDEL1)
      GJZ1=-GECOND*(GC2(JY,JX)-GC2L(JY,JX))/DZGL
      ENDIF
      GJZ(JY,JX)=(GJZ2+GJZ1)/2.
 1931 CONTINUE
```

```
      CALL SETYX(C3,GJX,NYD,NXD)
      CALL SETYX(C4,GJY,NYD,NXD)
      CALL SETYX(C5,GJZ,NYD,NXD)
      IF(ISWEEP.NE.JLOR) GO TO 1934
      DO 1933 KZ=1,NZ
      DO 1933 KY=1,NY
      DO 1933 KX=1,NX
      X1=GXG2D(KY,KX)
      Y1=GYG2D(KY,KX)
      Z1=GZGNZ(KZ)
      Z2=GZGNZ(IZ)
      DO 1932 JX=1,NX
      DO 1932 JY=1,NY
      X2=GXG2D(JY,JX)
      Y2=GYG2D(JY,JX)
      R=((X1-X2)**2+(Y1-Y2)**2+(Z1-Z2)**2)**.5
      ROP=((X1-X2)**2+(Y1-Y2)**2+(Z1+Z2)**2)**.5
      IF(R.EQ.0.) GO TO 1937
      GBX(KX,KY,KZ)=GBX(KX,KY,KZ)+(GJY(JY,JX)*(Z1-Z2)-GJZ(JY,JX)*
     1(Y1-Y2))*GVOL(JY,JX)/R**3
      GBY(KX,KY,KZ)=GBY(KX,KY,KZ)+(GJZ(JY,JX)*(X1-X2)-GJX(JY,JX)*
     1(Z1-Z2))*GVOL(JY,JX)/R**3
      GBZ(KX,KY,KZ)=GBZ(KX,KY,KZ)+(GJX(JY,JX)*(Y1-Y2)-GJY(JY,JX)*
     1(X1-X2))*GVOL(JY,JX)/R**3
 1937 CONTINUE
      GBX(KX,KY,KZ)=GBX(KX,KY,KZ)+(GJY(JY,JX)*(Z1+Z2)+GJZ(JY,JX)*
     1(Y1-Y2))*GVOL(JY,JX)/ROP**3
      GBY(KX,KY,KZ)=GBY(KX,KY,KZ)+(-GJZ(JY,JX)*(X1-X2)-GJX(JY,JX)*
     1(Z1+Z2))*GVOL(JY,JX)/ROP**3
      GBZ(KX,KY,KZ)=GBZ(KX,KY,KZ)+(GJX(JY,JX)*(Y1-Y2)-GJY(JY,JX)*
     1(X1-X2))*GVOL(JY,JX)/ROP**3
 1932 CONTINUE
 1933 CONTINUE
 1934 IF(ISWEEP.NE.JLOR+1) GO TO 1935
      DO 1936 JX=1,NX
      DO 1936 JY=1,NY
      GJX(JY,JX)=GBX(JX,JY,IZ)
      GJY(JY,JX)=GBY(JX,JY,IZ)
      GJZ(JY,JX)=GBZ(JX,JY,IZ)
 1936 CONTINUE
      CALL SETYX(C6,GJX,NYD,NXD)
      CALL SETYX(C7,GJY,NYD,NXD)
      CALL SETYX(C8,GJZ,NYD,NXD)
 1935 CONTINUE
      RETURN
  197 CONTINUE
C   * -------------------- SECTION 7 ---- FINISH OF SWEEP.
      IF(ISWEEP.NE.JLOR) RETURN
      FACT=GPRMB/(4.*GPI)
```

```
      DO 1971 KZ=1,NZ
      DO 1971 KY=1,NY
      DO 1971 KX=1,NX
      GBX(KX,KY,KZ)=GBX(KX,KY,KZ)*FACT
      GBY(KX,KY,KZ)=GBY(KX,KY,KZ)*FACT
      GBZ(KX,KY,KZ)=GBZ(KX,KY,KZ)*FACT
 1971 CONTINUE
      RETURN
  198 CONTINUE
C   * ------------------- SECTION 8 ---- FINISH OF TIME STEP.
      RETURN
C*************************************************************
C
C--- GROUP 20. Preliminary print-out
C
   20 CONTINUE
      RETURN
C*************************************************************
C
C--- GROUP 21. Print-out of variables
C
   21 CONTINUE
C   * Make changes for this group only in group 19.
      RETURN
C*************************************************************
C
C--- GROUP 22. Spot-value print-out
   22 CONTINUE
C   * Make changes for this group only in group 19.
      RETURN
C*************************************************************
C
C--- GROUP 23. Field print-out and plot control
   23 CONTINUE
      RETURN
C*************************************************************
C
C--- GROUP 24. Dumps for restarts
C
   24 CONTINUE
      RETURN
      END
      FUNCTION GTHCND(GTEMP)
      PARAMETER(N=9)
      DIMENSION T(N),C(N)
      DATA T/27.,127.,227.,327.,427.,660.,665.,1027.,1227./
      DATA C/1.70,1.75,1.85,1.80,1.75,1.70,0.93,1.00,1.10/
      IF(GTEMP.LE.T(1)) GTHCND=C(1)
      IF(GTEMP.LE.T(1)) RETURN
```

```
      IF(GTEMP.GE.T(N)) GTHCND=C(N)
      IF(GTEMP.GE.T(N)) RETURN
      DO 10 I=2,N
      IM=I-1
      IF(GTEMP.GE.T(IM).AND.GTEMP.LE.T(I))
     1GTHCND=C(IM)+(GTEMP-T(IM))*(C(I)-C(IM))/(T(I)-T(IM))
   10 CONTINUE
      RETURN
      END
      FUNCTION GELCND(GTEMP)
      PARAMETER(N=9)
      DIMENSION T(N),C(N)
      DATA T/27.,327.,527.,627.,660.,665.,800.,1000.,1200./
      DATA C/1.89E5,1.37E5,1.18E5,1.00E5,9.00E4,4.17E4,3.77E4,3.45E4,
     13.13E4/
      IF(GTEMP.LE.T(1)) GELCND=C(1)
      IF(GTEMP.LE.T(1)) RETURN
      IF(GTEMP.GE.T(N)) GELCND=C(N)
      IF(GTEMP.GE.T(N)) RETURN
      DO 10 I=2,N
      IM=I-1
      IF(GTEMP.GE.T(IM).AND.GTEMP.LE.T(I))
     1GELCND=C(IM)+(GTEMP-T(IM))*(C(I)-C(IM))/(T(I)-T(IM))
   10 CONTINUE
      RETURN
      END
```

APPENDIX 3

Listing of the OUTPUT File

```
GROUND STATION IS GROUND.FTN 11 JULY 86
************************************************************


  -----------------------------------------------------------
       CCCC HHH          PHOENICS  VERSION 1.3, 03 SEPT 1986
    CCCCCCCC HHHHH       (C) COPYRIGHT 1984
   CCCCCCC HHHHHHHHHH    CONCENTRATION HEAT AND MOMENTUM LTD
  CCCCCCC HHHHHHHHHHHH   ALL RIGHTS RESERVED.
  CCCCCC HHHHHHHHHHHHH   CHAM LTD, BAKERY HOUSE, 40 HIGH ST
  CCCCCCC HHHHHHHHHHHH   WIMBLEDON, LONDON, SW19 5AU
   CCCCCCC HHHHHHHHHH    TEL: 01-947-7651; TELEX: 928517
    CCCCCCCC HHHHH       FACSIMILE: 01-879-3497
       CCCC HHH          THE OPTION LEVEL IS   -18
  -----------------------------------------------------------

  THIS CODE MAY ONLY BE USED UNDER THE TERMS AND CONDITIONS
  OF A LICENCE AGREEMENT WITH CHAM LTD.

  REPLICATION OF THIS CODE IS PROHIBITED UNLESS
  SPECIFICALLY AUTHORISED IN WRITING BY CHAM LTD.

************************************************************

GREX1 OF 15/07/86 HAS BEEN CALLED
FORMATTED SATLIT DATA READ FROM DF10 FOR IRUN=  1
***------ STORAGE INFORMATION ------***
F DIMNSN=200000 OCCUPIED= 29622 ESTIMATED MINIMUM DIMNSN= 14747
DEP VRBL= 21250 OLD VRBL=      0 3D COEFF=      0 3D DVDPS=      0

************************************************************
 GROUP 1. RUN TITLE & NUMBER
************************************************************
************************************************************

TEXT(NASA ARC WELDING SIMULATION             )

************************************************************
************************************************************

IRUNN     =      1

*** GRID-GEOMETRY INFORMATION ***
X-COORDINATES OF THE CELL CENTRES
   8.100E+00   8.300E+00   8.500E+00   8.700E+00   8.900E+00
   9.100E+00   9.300E+00   9.500E+00   9.700E+00   9.900E+00
   1.010E+01   1.030E+01   1.050E+01   1.070E+01   1.090E+01
Y-COORDINATES OF THE CELL CENTRES
```

```
   1.000E-01   3.000E-01   5.000E-01   7.000E-01   9.000E-01

Z-COORDINATES OF THE CELL CENTRES
   1.000E-01   3.000E-01   5.000E-01   7.000E-01   9.000E-01


--- INTEGRATION OF EQUATIONS BEGINS ---


************************************************************
TIME STP=      1 SWEEP NO=   400 ZSLAB NO=     1 ITERN NO=     1


FLOW FIELD AT ITHYD=  1, IZ=  1, ISWEEP= 400, ISTEP=   1
FIELD VALUES OF P1
IY=  5  -3.227E+02  -4.799E+02  -6.692E+02  -7.480E+02  -3.838E+02
IY=  4  -3.216E+02  -4.673E+02  -5.954E+02  -4.156E+02   8.961E+02
IY=  3  -3.266E+02  -4.492E+02  -4.648E+02   1.855E+02   3.402E+03
IY=  2  -3.454E+02  -4.802E+02  -5.315E+02  -7.908E+00   2.839E+03
IY=  1  -3.566E+02  -5.348E+02  -7.821E+02  -1.150E+03   1.574E+03
 IX=        6           7           8           9          10
IY=  5   8.186E+02   2.037E+03   1.949E+03   1.809E+03   2.917E+02
IY=  4   4.810E+03   2.294E+03   1.784E+03   1.602E+03   1.440E+03
IY=  3   3.237E+03   9.587E+02   9.050E+02   1.174E+03   1.202E+03
IY=  2   3.742E+03  -2.564E-02   1.148E+01   6.385E+02   8.383E+02
IY=  1   4.240E+03  -1.348E+03  -6.057E+02   3.156E+02   6.118E+02
 IX=       11          12          13          14          15
IY=  5  -3.087E+02  -3.684E+02  -2.680E+02  -1.605E+02  -9.050E+01
IY=  4   1.461E+01  -2.619E+02  -2.293E+02  -1.454E+02  -8.340E+01
IY=  3   6.652E+01  -2.289E+02  -2.234E+02  -1.507E+02  -9.133E+01
IY=  2   7.223E+01  -2.157E+02  -2.248E+02  -1.583E+02  -1.001E+02
IY=  1   4.928E+02  -1.024E+02  -1.871E+02  -1.434E+02  -9.267E+01
 IX=       16          17          18          19          20
FIELD VALUES OF U1
IY=  5   3.384E-01   3.381E-01   3.377E-01   3.371E-01   3.366E-01
IY=  4   3.384E-01   3.380E-01   3.374E-01   3.361E-01   3.339E-01
IY=  3   3.383E-01   3.378E-01   3.367E-01   3.340E-01   7.180E+00
IY=  2   3.382E-01   3.377E-01   3.366E-01   3.344E-01   9.500E+00
IY=  1   3.382E-01   3.376E-01   3.366E-01   3.347E-01   1.053E+01
 IX=        6           7           8           9          10
IY=  5   3.373E-01   4.672E+00   3.665E+00   3.434E-01   3.427E-01
IY=  4   2.721E+01   1.910E+01   9.333E+00   4.090E+00   3.441E-01
IY=  3   1.679E+01   1.879E+01   8.872E+00   3.372E+00   3.440E-01
IY=  2  -1.974E+00  -4.431E+00  -3.586E+00  -1.175E+00   3.440E-01
IY=  1  -3.272E+01  -3.403E+01  -1.463E+01  -4.884E+00   3.442E-01
 IX=       11          12          13          14          15
IY=  5   3.418E-01   3.413E-01   3.410E-01   3.409E-01   3.408E-01
IY=  4   3.421E-01   3.414E-01   3.410E-01   3.409E-01   3.408E-01
```

IY=	3	3.422E-01	3.414E-01	3.411E-01	3.409E-01	3.408E-01
IY=	2	3.423E-01	3.415E-01	3.411E-01	3.409E-01	3.408E-01
IY=	1	3.423E-01	3.415E-01	3.411E-01	3.409E-01	3.408E-01
IX=		16	17	18	19	20

FIELD VALUES OF V1

IY=	4	1.874E-04	2.915E-04	5.160E-04	1.018E-03	2.265E-03
IY=	3	2.692E-04	4.145E-04	7.226E-04	1.431E-03	3.752E-03
IY=	2	2.624E-04	3.845E-04	5.768E-04	7.282E-04	6.858E+00
IY=	1	1.783E-04	2.554E-04	3.648E-04	4.093E-04	2.167E+01
IX=		6	7	8	9	10
IY=	4	5.193E-03	4.341E+00	-9.998E-01	-3.315E+00	2.313E-03
IY=	3	2.689E+01	3.852E+00	-7.094E+00	-7.459E+00	-3.738E+00
IY=	2	5.157E+01	1.259E+01	-1.493E+01	-1.215E+01	-6.759E+00
IY=	1	5.415E+01	1.508E+01	-1.377E+01	-9.352E+00	-5.234E+00
IX=		11	12	13	14	15
IY=	4	6.342E-04	2.344E-04	1.063E-04	5.798E-05	3.862E-05
IY=	3	2.927E-04	1.996E-04	1.210E-04	7.578E-05	5.346E-05
IY=	2	1.906E-04	1.493E-04	1.028E-04	6.979E-05	5.128E-05
IY=	1	1.629E-04	1.016E-04	6.803E-05	4.690E-05	3.497E-05
IX=		16	17	18	19	20

FIELD VALUES OF W1

IY=	5	3.940E-04	5.676E-04	9.232E-04	1.604E-03	2.805E-03
IY=	4	3.162E-04	4.751E-04	8.475E-04	1.703E-03	3.699E-03
IY=	3	2.974E-04	4.729E-04	9.163E-04	2.024E-03	8.232E-03
IY=	2	2.742E-04	4.478E-04	8.721E-04	1.838E-03	5.641E+00
IY=	1	1.952E-04	3.381E-04	6.968E-04	1.484E-03	-3.186E+01
IX=		6	7	8	9	10
IY=	5	4.444E-03	6.214E-03	7.409E-03	7.309E-03	3.006E-03
IY=	4	1.038E-02	7.613E+00	3.675E+00	1.099E+00	6.195E-03
IY=	3	1.508E+01	6.739E+00	2.075E+00	8.047E-01	6.185E-03
IY=	2	1.405E+01	5.179E+00	3.197E-01	3.905E-01	6.266E-03
IY=	1	-1.090E+01	-1.377E+01	-5.633E+00	-3.933E-01	6.776E-03
IX=		11	12	13	14	15
IY=	5	1.511E-03	7.460E-04	3.787E-04	2.098E-04	1.395E-04
IY=	4	1.603E-03	7.316E-04	3.491E-04	1.843E-04	1.192E-04
IY=	3	1.625E-03	7.474E-04	3.491E-04	1.776E-04	1.112E-04
IY=	2	1.652E-03	7.621E-04	3.504E-04	1.727E-04	1.046E-04
IY=	1	1.684E-03	7.503E-04	3.304E-04	1.537E-04	8.821E-05
IX=		16	17	18	19	20

FIELD VALUES OF ENUL

IY=	5	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY=	4	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY=	3	1.000E+06	1.000E+06	1.000E+06	1.000E+06	3.570E-03
IY=	2	1.000E+06	1.000E+06	1.000E+06	1.000E+06	3.570E-03
IY=	1	1.000E+06	1.000E+06	1.000E+06	1.000E+06	3.570E-03
IX=		6	7	8	9	10
IY=	5	1.000E+06	3.570E-03	3.570E-03	3.570E-03	1.000E+06
IY=	4	3.570E-03	3.570E-03	3.570E-03	3.570E-03	3.570E-03
IY=	3	3.570E-03	3.570E-03	3.570E-03	3.570E-03	3.570E-03

IY= 2	3.570E-03	3.570E-03	3.570E-03	3.570E-03	3.570E-03
IY= 1	3.570E-03	3.570E-03	3.570E-03	3.570E-03	3.570E-03
IX=	11	12	13	14	15
IY= 5	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 4	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 3	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 2	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 1	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IX=	16	17	18	19	20

FIELD VALUES OF H1

IY= 5	-2.765E+02	-2.386E+02	-1.930E+02	-1.392E+02	-7.964E+01
IY= 4	-2.749E+02	-2.356E+02	-1.866E+02	-1.254E+02	-4.945E+01
IY= 3	-2.722E+02	-2.307E+02	-1.763E+02	-1.016E+02	1.308E+01
IY= 2	-2.697E+02	-2.262E+02	-1.673E+02	-8.411E+01	3.884E+01
IY= 1	-2.681E+02	-2.235E+02	-1.620E+02	-7.309E+01	4.423E+01
IX=	6	7	8	9	10
IY= 5	-2.338E+01	2.021E+01	1.805E+01	1.303E+01	-1.736E+00
IY= 4	3.538E+01	3.523E+01	3.363E+01	2.701E+01	1.605E+01
IY= 3	4.157E+01	3.505E+01	3.431E+01	3.018E+01	1.825E+01
IY= 2	4.558E+01	2.648E+01	3.241E+01	2.778E+01	1.474E+01
IY= 1	4.775E+01	2.474E+01	2.537E+01	2.105E+01	1.012E+01
IX=	11	12	13	14	15
IY= 5	-2.256E+01	-4.522E+01	-6.950E+01	-9.011E+01	-1.055E+02
IY= 4	-1.576E+01	-4.221E+01	-6.793E+01	-8.941E+01	-1.051E+02
IY= 3	-1.296E+01	-4.006E+01	-6.639E+01	-8.857E+01	-1.046E+02
IY= 2	-1.332E+01	-3.942E+01	-6.556E+01	-8.799E+01	-1.041E+02
IY= 1	-1.472E+01	-3.961E+01	-6.536E+01	-8.776E+01	-1.039E+02
IX=	16	17	18	19	20

FIELD VALUES OF TMP1

IY= 5	3.234E+02	3.611E+02	4.065E+02	4.600E+02	5.193E+02
IY= 4	3.250E+02	3.641E+02	4.128E+02	4.738E+02	5.493E+02
IY= 3	3.276E+02	3.689E+02	4.230E+02	4.974E+02	6.115E+02
IY= 2	3.302E+02	3.735E+02	4.320E+02	5.148E+02	6.372E+02
IY= 1	3.317E+02	3.761E+02	4.373E+02	5.258E+02	6.425E+02
IX=	6	7	8	9	10
IY= 5	5.752E+02	6.186E+02	6.165E+02	6.115E+02	5.968E+02
IY= 4	6.337E+02	6.336E+02	6.320E+02	6.254E+02	6.145E+02
IY= 3	6.399E+02	6.334E+02	6.326E+02	6.285E+02	6.167E+02
IY= 2	6.439E+02	6.248E+02	6.307E+02	6.261E+02	6.132E+02
IY= 1	6.460E+02	6.231E+02	6.237E+02	6.194E+02	6.086E+02
IX=	11	12	13	14	15
IY= 5	5.761E+02	5.535E+02	5.293E+02	5.088E+02	4.935E+02
IY= 4	5.828E+02	5.565E+02	5.309E+02	5.095E+02	4.939E+02
IY= 3	5.856E+02	5.586E+02	5.324E+02	5.104E+02	4.945E+02
IY= 2	5.852E+02	5.593E+02	5.333E+02	5.109E+02	4.949E+02
IY= 1	5.839E+02	5.591E+02	5.335E+02	5.112E+02	4.951E+02
IX=	16	17	18	19	20

FIELD VALUES OF DELH

IY= 5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

IY= 4	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.715E+00
IY= 3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.430E+02
IY= 2	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.370E+02
IY= 1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.555E+02
IX=	6	7	8	9	10
IY= 5	1.076E+02	2.738E+02	2.657E+02	2.466E+02	1.905E+02
IY= 4	3.300E+02	3.295E+02	3.243E+02	2.997E+02	2.575E+02
IY= 3	3.514E+02	3.291E+02	3.275E+02	3.126E+02	2.667E+02
IY= 2	3.663E+02	2.990E+02	3.218E+02	3.039E+02	2.532E+02
IY= 1	3.742E+02	2.939E+02	2.957E+02	2.779E+02	2.355E+02
IX=	11	12	13	14	15
IY= 5	1.116E+02	2.591E+01	0.000E+00	0.000E+00	0.000E+00
IY= 4	1.374E+02	3.733E+01	0.000E+00	0.000E+00	0.000E+00
IY= 3	1.483E+02	4.561E+01	0.000E+00	0.000E+00	0.000E+00
IY= 2	1.469E+02	4.805E+01	0.000E+00	0.000E+00	0.000E+00
IY= 1	1.415E+02	4.732E+01	0.000E+00	0.000E+00	0.000E+00
IX=	16	17	18	19	20

FIELD VALUES OF EPOT

IY= 5	2.028E-04	2.322E-04	2.595E-04	2.789E-04	2.821E-04
IY= 4	2.111E-04	2.452E-04	2.807E-04	3.109E-04	3.212E-04
IY= 3	2.261E-04	2.701E-04	3.252E-04	3.872E-04	4.309E-04
IY= 2	2.437E-04	3.024E-04	3.929E-04	5.335E-04	7.226E-04
IY= 1	2.567E-04	3.293E-04	4.640E-04	7.568E-04	1.561E-03
IX=	6	7	8	9	10
IY= 5	2.621E-04	2.249E-04	1.901E-04	1.590E-04	1.308E-04
IY= 4	2.914E-04	2.282E-04	1.913E-04	1.608E-04	1.324E-04
IY= 3	3.738E-04	2.061E-04	1.874E-04	1.641E-04	1.359E-04
IY= 2	6.105E-04	3.630E-09	1.767E-04	1.730E-04	1.423E-04
IY= 1	1.513E-03	5.627E-04	3.056E-04	2.065E-04	1.524E-04
IX=	11	12	13	14	15
IY= 5	1.052E-04	8.254E-05	6.251E-05	4.484E-05	2.914E-05
IY= 4	1.063E-04	8.320E-05	6.290E-05	4.507E-05	2.930E-05
IY= 3	1.086E-04	8.452E-05	6.363E-05	4.548E-05	2.956E-05
IY= 2	1.120E-04	8.623E-05	6.449E-05	4.594E-05	2.985E-05
IY= 1	1.156E-04	8.764E-05	6.511E-05	4.625E-05	3.003E-05
IX=	16	17	18	19	20

FIELD VALUES OF JX

IY= 5	-2.067E+01	-1.896E+01	-1.517E+01	-7.144E+00	4.771E+00
IY= 4	-2.292E+01	-2.318E+01	-2.115E+01	-1.254E+01	4.826E+00
IY= 3	-2.744E+01	-3.281E+01	-3.718E+01	-3.129E+01	2.074E+00
IY= 2	-3.376E+01	-4.904E+01	-7.233E+01	-9.370E+01	-2.389E+01
IY= 1	-3.950E+01	-6.790E+01	-1.329E+02	-3.032E+02	-2.021E+02
IX=	6	7	8	9	10
IY= 5	1.551E+01	1.865E+01	1.680E+01	1.530E+01	1.420E+01
IY= 4	2.333E+01	2.458E+01	1.665E+01	1.476E+01	1.404E+01
IY= 3	5.487E+01	4.528E+01	1.029E+01	1.285E+01	1.423E+01
IY= 2	1.758E+02	1.050E+02	-4.317E+01	8.662E+00	1.570E+01
IY= 1	2.441E+02	2.970E+02	8.962E+01	3.883E+01	2.353E+01
IX=	11	12	13	14	15

IY= 5	1.315E+01	1.208E+01	1.102E+01	9.970E+00	9.178E+00
IY= 4	1.321E+01	1.220E+01	1.111E+01	1.003E+01	9.206E+00
IY= 3	1.373E+01	1.260E+01	1.135E+01	1.015E+01	9.257E+00
IY= 2	1.501E+01	1.330E+01	1.170E+01	1.032E+01	9.318E+00
IY= 1	1.737E+01	1.412E+01	1.202E+01	1.045E+01	9.362E+00
IX=	16	17	18	19	20

FIELD VALUES OF JY

IY= 5	2.852E+00	4.345E+00	6.842E+00	9.879E+00	1.134E+01
IY= 4	7.998E+00	1.264E+01	2.112E+01	3.309E+01	4.091E+01
IY= 3	1.118E+01	1.900E+01	3.580E+01	6.687E+01	1.024E+02
IY= 2	1.046E+01	1.962E+01	4.404E+01	1.100E+02	2.760E+02
IY= 1	4.423E+00	8.917E+00	2.253E+01	7.392E+01	8.355E+02
IX=	6	7	8	9	10
IY= 5	7.582E+00	8.304E-01	2.860E-01	4.473E-01	4.110E-01
IY= 4	2.753E+01	-4.654E+00	-6.783E-01	1.270E+00	1.303E+00
IY= 3	7.652E+01	-5.664E+01	-3.620E+00	3.032E+00	2.531E+00
IY= 2	2.710E+02	9.027E+01	2.947E+01	1.064E+01	4.233E+00
IY= 1	8.468E+02	1.490E+02	3.213E+01	8.427E+00	2.594E+00
IX=	11	12	13	14	15
IY= 5	2.884E-01	1.872E-01	1.144E-01	6.951E-02	4.732E-02
IY= 4	9.088E-01	5.581E-01	3.263E-01	1.920E-01	1.279E-01
IY= 3	1.539E+00	8.502E-01	4.620E-01	2.584E-01	1.665E-01
IY= 2	1.871E+00	8.758E-01	4.330E-01	2.284E-01	1.420E-01
IY= 1	9.525E-01	3.965E-01	1.828E-01	9.251E-02	5.615E-02
IX=	16	17	18	19	20

FIELD VALUES OF JZ

IY= 5	2.733E+00	3.323E+00	4.046E+00	4.693E+00	4.710E+00
IY= 4	3.118E+00	4.010E+00	5.340E+00	6.876E+00	7.414E+00
IY= 3	3.878E+00	5.500E+00	8.555E+00	1.335E+01	1.708E+01
IY= 2	4.889E+00	7.804E+00	1.474E+01	3.003E+01	5.266E+01
IY= 1	5.740E+00	1.018E+01	2.334E+01	6.569E+01	2.038E+02
IX=	6	7	8	9	10
IY= 5	3.530E+00	1.780E+00	1.196E+00	1.035E+00	9.273E-01
IY= 4	4.782E+00	1.360E-01	3.041E-01	7.424E-01	8.518E-01
IY= 3	1.006E+01	-9.449E+00	-2.860E+00	2.359E-02	7.405E-01
IY= 2	3.567E+01	-6.725E+01	-1.017E+01	-6.578E-01	7.994E-01
IY= 1	1.973E+02	3.397E+01	7.507E+00	2.739E+00	1.541E+00
IX=	11	12	13	14	15
IY= 5	8.209E-01	7.233E-01	6.463E-01	5.837E-01	5.266E-01
IY= 4	8.001E-01	7.223E-01	6.485E-01	5.852E-01	5.280E-01
IY= 3	8.039E-01	7.374E-01	6.580E-01	5.899E-01	5.311E-01
IY= 2	8.808E-01	7.775E-01	6.756E-01	5.972E-01	5.352E-01
IY= 1	1.068E+00	8.321E-01	6.934E-01	6.036E-01	5.383E-01
IX=	16	17	18	19	20

FIELD VALUES OF BX

IY= 5	7.675E-01	1.218E+00	1.841E+00	2.551E+00	2.985E+00
IY= 4	1.319E+00	2.225E+00	3.612E+00	5.493E+00	6.964E+00
IY= 3	1.699E+00	3.036E+00	5.424E+00	9.601E+00	1.449E+01
IY= 2	1.794E+00	3.355E+00	6.634E+00	1.412E+01	2.546E+01

IY=	1	1.689E+00	3.200E+00	6.731E+00	1.687E+01	3.802E+01
IX=		6	7	8	9	10
IY=	5	2.667E+00	1.762E+00	1.067E+00	6.640E-01	4.185E-01
IY=	4	6.199E+00	3.496E+00	1.877E+00	1.098E+00	6.552E-01
IY=	3	1.342E+01	6.631E+00	3.127E+00	1.639E+00	8.882E-01
IY=	2	2.477E+01	1.178E+01	4.806E+00	2.204E+00	1.077E+00
IY=	1	3.774E+01	1.566E+01	5.638E+00	2.393E+00	1.147E+00
IX=		11	12	13	14	15
IY=	5	2.655E-01	1.708E-01	1.125E-01	7.671E-02	5.730E-02
IY=	4	3.990E-01	2.518E-01	1.665E-01	1.157E-01	8.465E-02
IY=	3	5.069E-01	3.087E-01	2.006E-01	1.382E-01	9.968E-02
IY=	2	5.839E-01	3.498E-01	2.268E-01	1.565E-01	1.123E-01
IY=	1	6.259E-01	3.842E-01	2.570E-01	1.826E-01	1.322E-01
IX=		16	17	18	19	20

FIELD VALUES OF BY

IY=	5	1.566E+00	1.861E+00	1.670E+00	1.021E+00	-3.155E-02
IY=	4	2.167E+00	2.771E+00	2.747E+00	1.923E+00	1.629E-01
IY=	3	2.680E+00	3.782E+00	4.351E+00	3.798E+00	1.017E+00
IY=	2	3.043E+00	4.740E+00	6.325E+00	7.092E+00	3.215E+00
IY=	1	2.748E+00	4.494E+00	6.443E+00	7.536E+00	4.062E+00
IX=		6	7	8	9	10
IY=	5	-1.102E+00	-1.714E+00	-1.805E+00	-1.666E+00	-1.492E+00
IY=	4	-1.754E+00	-2.667E+00	-2.535E+00	-2.152E+00	-1.873E+00
IY=	3	-2.536E+00	-3.834E+00	-3.063E+00	-2.275E+00	-1.957E+00
IY=	2	-3.211E+00	-5.152E+00	-3.474E+00	-2.228E+00	-1.900E+00
IY=	1	-2.445E+00	-5.305E+00	-3.959E+00	-2.295E+00	-1.650E+00
IX=		11	12	13	14	15
IY=	5	-1.324E+00	-1.166E+00	-1.015E+00	-8.572E-01	-6.298E-01
IY=	4	-1.648E+00	-1.447E+00	-1.257E+00	-1.058E+00	-7.714E-01
IY=	3	-1.717E+00	-1.505E+00	-1.307E+00	-1.100E+00	-8.016E-01
IY=	2	-1.644E+00	-1.435E+00	-1.247E+00	-1.052E+00	-7.688E-01
IY=	1	-1.343E+00	-1.158E+00	-1.005E+00	-8.500E-01	-6.269E-01
IX=		16	17	18	19	20

FIELD VALUES OF BZ

IY=	5	7.672E-01	6.594E-01	8.979E-01	8.899E-01	-8.580E-02
IY=	4	3.971E+00	4.284E+00	4.741E+00	4.247E+00	3.295E-01
IY=	3	6.971E+00	8.166E+00	9.956E+00	1.097E+01	3.141E+00
IY=	2	1.021E+01	1.331E+01	1.872E+01	2.738E+01	1.352E+01
IY=	1	1.409E+01	2.035E+01	3.130E+01	5.505E+01	3.434E+01
IX=		6	7	8	9	10
IY=	5	-1.774E+00	-2.350E+00	-1.879E+00	-1.484E+00	-1.052E+00
IY=	4	-6.439E+00	-8.536E+00	-6.626E+00	-5.481E+00	-4.194E+00
IY=	3	-1.417E+01	-1.910E+01	-1.309E+01	-9.941E+00	-7.113E+00
IY=	2	-2.551E+01	-3.491E+01	-2.013E+01	-1.352E+01	-9.570E+00
IY=	1	-3.938E+01	-5.607E+01	-2.835E+01	-1.702E+01	-1.177E+01
IX=		11	12	13	14	15
IY=	5	-6.503E-01	-3.443E-01	-1.554E-01	-9.119E-02	-1.995E-01
IY=	4	-3.112E+00	-2.311E+00	-1.753E+00	-1.389E+00	-1.178E+00
IY=	3	-5.192E+00	-3.904E+00	-3.015E+00	-2.388E+00	-1.933E+00

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IY=  2  -6.982E+00  -5.305E+00  -4.151E+00  -3.305E+00  -2.634E+00
IY=  1  -8.679E+00  -6.736E+00  -5.392E+00  -4.366E+00  -3.456E+00
 IX=     16          17          18          19          20
FIELD VALUES OF THCN
IY=  5   1.802E+00   1.783E+00   1.760E+00   1.743E+00   1.730E+00
IY=  4   1.801E+00   1.781E+00   1.757E+00   1.740E+00   1.724E+00
IY=  3   1.800E+00   1.779E+00   1.752E+00   1.735E+00   1.711E+00
IY=  2   1.798E+00   1.777E+00   1.749E+00   1.731E+00   1.706E+00
IY=  1   1.798E+00   1.775E+00   1.748E+00   1.729E+00   1.705E+00
 IX=      6           7           8           9          10
IY=  5   1.718E+00   1.709E+00   1.709E+00   1.710E+00   1.714E+00
IY=  4   1.706E+00   1.706E+00   1.706E+00   1.708E+00   1.710E+00
IY=  3   1.705E+00   1.706E+00   1.706E+00   1.707E+00   1.709E+00
IY=  2   1.704E+00   1.708E+00   1.706E+00   1.707E+00   1.710E+00
IY=  1   1.704E+00   1.708E+00   1.708E+00   1.709E+00   1.711E+00
 IX=     11          12          13          14          15
IY=  5   1.718E+00   1.723E+00   1.728E+00   1.732E+00   1.736E+00
IY=  4   1.717E+00   1.722E+00   1.728E+00   1.732E+00   1.736E+00
IY=  3   1.716E+00   1.722E+00   1.727E+00   1.732E+00   1.736E+00
IY=  2   1.716E+00   1.722E+00   1.727E+00   1.732E+00   1.735E+00
IY=  1   1.716E+00   1.722E+00   1.727E+00   1.732E+00   1.735E+00
 IX=     16          17          18          19          20
FIELD VALUES OF ELCN
IY=  5   1.376E+05   1.338E+05   1.294E+05   1.244E+05   1.188E+05
IY=  4   1.373E+05   1.335E+05   1.289E+05   1.231E+05   1.141E+05
IY=  3   1.369E+05   1.330E+05   1.279E+05   1.208E+05   1.030E+05
IY=  2   1.367E+05   1.326E+05   1.270E+05   1.193E+05   9.808E+04
IY=  1   1.366E+05   1.323E+05   1.266E+05   1.183E+05   9.677E+04
 IX=      6           7           8           9          10
IY=  5   1.094E+05   1.016E+05   1.020E+05   1.028E+05   1.055E+05
IY=  4   9.842E+04   9.846E+04   9.879E+04   1.004E+05   1.023E+05
IY=  3   9.692E+04   9.855E+04   9.859E+04   9.965E+04   1.019E+05
IY=  2   9.579E+04   1.004E+05   9.894E+04   1.002E+05   1.025E+05
IY=  1   9.519E+04   1.006E+05   1.005E+05   1.014E+05   1.033E+05
 IX=     11          12          13          14          15
IY=  5   1.092E+05   1.132E+05   1.176E+05   1.197E+05   1.212E+05
IY=  4   1.080E+05   1.127E+05   1.173E+05   1.197E+05   1.211E+05
IY=  3   1.075E+05   1.123E+05   1.170E+05   1.196E+05   1.211E+05
IY=  2   1.075E+05   1.122E+05   1.169E+05   1.195E+05   1.210E+05
IY=  1   1.078E+05   1.122E+05   1.168E+05   1.195E+05   1.210E+05
 IX=     16          17          18          19          20

*************************************************************
TIME STP=     1 SWEEP NO=   400 ZSLAB NO=     2 ITERN NO=     1


FLOW FIELD AT ITHYD=  1, IZ=  2, ISWEEP= 400, ISTEP=   1
FIELD VALUES OF P1
IY=  5   1.053E+02   1.104E+02   1.408E+02   2.192E+02   3.698E+02
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IY= 4	1.062E+02	1.068E+02	1.334E+02	2.422E+02	6.140E+02
IY= 3	9.963E+01	9.756E+01	1.324E+02	3.307E+02	1.323E+03
IY= 2	8.376E+01	6.236E+01	6.762E+01	2.547E+02	4.137E+02
IY= 1	7.428E+01	1.739E+01	-3.513E+00	1.126E+03	-3.329E+03
IX=	6	7	8	9	10
IY= 5	5.877E+02	9.118E+02	9.417E+02	7.232E+02	1.166E+02
IY= 4	1.732E+03	1.712E+03	1.657E+03	1.541E+03	7.269E+02
IY= 3	2.604E+03	1.410E+03	1.181E+03	1.221E+03	7.947E+02
IY= 2	2.564E+02	-9.103E+00	2.507E+02	6.413E+02	5.151E+02
IY= 1	-2.545E+03	-1.269E+03	-2.248E+02	3.166E+02	-4.608E+02
IX=	11	12	13	14	15
IY= 5	1.325E+01	3.306E+01	6.421E+01	8.774E+01	1.019E+02
IY= 4	1.339E+02	8.057E+01	9.151E+01	1.050E+02	1.141E+02
IY= 3	1.735E+02	1.030E+02	1.048E+02	1.133E+02	1.199E+02
IY= 2	1.540E+02	1.133E+02	1.158E+02	1.215E+02	1.259E+02
IY= 1	7.406E+01	1.298E+02	1.414E+02	1.405E+02	1.395E+02
IX=	16	17	18	19	20

FIELD VALUES OF U1

IY= 5	3.383E-01	3.380E-01	3.377E-01	3.374E-01	3.375E-01
IY= 4	3.383E-01	3.380E-01	3.375E-01	3.370E-01	3.367E-01
IY= 3	3.383E-01	3.378E-01	3.372E-01	3.362E-01	3.377E-01
IY= 2	3.382E-01	3.377E-01	3.368E-01	3.352E-01	-7.760E-01
IY= 1	3.382E-01	3.377E-01	3.369E-01	3.359E-01	-2.478E+01
IX=	6	7	8	9	10
IY= 5	3.384E-01	3.392E-01	3.404E-01	3.421E-01	3.421E-01
IY= 4	3.386E-01	6.279E+00	3.923E+00	3.426E-01	3.428E-01
IY= 3	1.924E+01	1.405E+01	5.845E+00	3.424E-01	3.429E-01
IY= 2	5.460E+00	1.523E+00	-2.470E+00	3.423E-01	3.429E-01
IY= 1	-2.010E+01	-1.300E+01	-7.800E+00	3.426E-01	3.431E-01
IX=	11	12	13	14	15
IY= 5	3.417E-01	3.414E-01	3.411E-01	3.409E-01	3.408E-01
IY= 4	3.419E-01	3.414E-01	3.411E-01	3.409E-01	3.408E-01
IY= 3	3.420E-01	3.414E-01	3.411E-01	3.409E-01	3.408E-01
IY= 2	3.420E-01	3.415E-01	3.411E-01	3.409E-01	3.408E-01
IY= 1	3.421E-01	3.415E-01	3.411E-01	3.409E-01	3.408E-01
IX=	16	17	18	19	20

FIELD VALUES OF V1

IY= 4	1.385E-04	2.175E-04	3.796E-04	6.949E-04	1.272E-03
IY= 3	2.092E-04	3.214E-04	5.413E-04	9.612E-04	1.880E-03
IY= 2	2.044E-04	3.051E-04	4.891E-04	8.314E-04	1.739E-03
IY= 1	1.305E-04	1.861E-04	2.554E-04	2.273E-04	-6.744E+00
IX=	6	7	8	9	10
IY= 4	1.921E-03	5.457E-04	8.151E-04	1.146E-03	1.070E-03
IY= 3	9.601E-04	-1.668E+00	-6.024E+00	-4.671E+00	3.714E-04
IY= 2	3.831E+00	-1.359E+01	-1.630E+01	-1.097E+01	2.211E-04
IY= 1	7.730E+00	-1.429E+01	-1.311E+01	-8.543E+00	2.633E-04
IX=	11	12	13	14	15
IY= 4	3.747E-04	1.614E-04	7.939E-05	4.410E-05	2.911E-05
IY= 3	2.636E-04	1.666E-04	1.007E-04	6.233E-05	4.322E-05

IY= 2	1.875E-04	1.355E-04	8.984E-05	5.906E-05	4.232E-05
IY= 1	1.445E-04	9.077E-05	5.859E-05	3.865E-05	2.785E-05
IX=	16	17	18	19	20

FIELD VALUES OF W1

IY= 5	7.991E-04	1.090E-03	1.621E-03	2.491E-03	3.742E-03
IY= 4	7.103E-04	9.820E-04	1.514E-03	2.497E-03	4.248E-03
IY= 3	6.679E-04	9.456E-04	1.523E-03	2.711E-03	5.606E-03
IY= 2	6.209E-04	8.877E-04	1.429E-03	2.411E-03	5.102E-03
IY= 1	5.311E-04	7.627E-04	1.227E-03	1.993E-03	4.235E-03
IX=	6	7	8	9	10
IY= 5	5.069E-03	5.671E-03	6.371E-03	6.038E-03	3.833E-03
IY= 4	6.731E-03	4.157E-03	5.380E-03	5.841E-03	4.663E-03
IY= 3	4.307E-03	3.046E-03	4.148E-03	5.330E-03	4.826E-03
IY= 2	1.171E+01	8.420E+00	7.502E+00	5.288E-03	4.941E-03
IY= 1	-2.332E+01	-6.579E+00	2.277E+00	5.992E-03	5.197E-03
IX=	11	12	13	14	15
IY= 5	2.272E-03	1.328E-03	7.909E-04	5.036E-04	3.679E-04
IY= 4	2.359E-03	1.302E-03	7.551E-04	4.741E-04	3.444E-04
IY= 3	2.424E-03	1.317E-03	7.502E-04	4.623E-04	3.316E-04
IY= 2	2.480E-03	1.336E-03	7.495E-04	4.533E-04	3.207E-04
IY= 1	2.525E-03	1.328E-03	7.289E-04	4.321E-04	3.017E-04
IX=	16	17	18	19	20

FIELD VALUES OF ENUL

IY= 5	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 4	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 3	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 2	1.000E+06	1.000E+06	1.000E+06	1.000E+06	3.570E-03
IY= 1	1.000E+06	1.000E+06	1.000E+06	1.000E+06	3.570E-03
IX=	6	7	8	9	10
IY= 5	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 4	1.000E+06	3.570E-03	3.570E-03	3.570E-03	1.000E+06
IY= 3	3.570E-03	3.570E-03	3.570E-03	3.570E-03	1.000E+06
IY= 2	3.570E-03	3.570E-03	3.570E-03	3.570E-03	1.000E+06
IY= 1	3.570E-03	3.570E-03	3.570E-03	3.570E-03	1.000E+06
IX=	11	12	13	14	15
IY= 5	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 4	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 3	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 2	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 1	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IX=	16	17	18	19	20

FIELD VALUES OF H1

IY= 5	-2.808E+02	-2.445E+02	-2.015E+02	-1.521E+02	-9.947E+01
IY= 4	-2.793E+02	-2.418E+02	-1.962E+02	-1.416E+02	-7.974E+01
IY= 3	-2.769E+02	-2.376E+02	-1.876E+02	-1.233E+02	-4.206E+01
IY= 2	-2.746E+02	-2.334E+02	-1.791E+02	-1.041E+02	1.282E+01
IY= 1	-2.733E+02	-2.311E+02	-1.749E+02	-9.780E+01	1.023E+01
IX=	6	7	8	9	10
IY= 5	-5.148E+01	-1.903E+01	-8.662E+00	-9.995E+00	-2.166E+01

IY= 4	-2.190E+01	2.224E+01	2.119E+01	1.262E+01	-1.131E+01
IY= 3	3.328E+01	3.145E+01	2.734E+01	1.788E+01	-6.633E+00
IY= 2	3.581E+01	3.106E+01	2.623E+01	1.612E+01	-6.116E+00
IY= 1	1.391E+01	2.301E+01	2.096E+01	1.308E+01	-7.292E+00
IX=	11	12	13	14	15
IY= 5	-3.868E+01	-5.871E+01	-8.008E+01	-9.802E+01	-1.121E+02
IY= 4	-3.379E+01	-5.613E+01	-7.890E+01	-9.743E+01	-1.118E+02
IY= 3	-3.037E+01	-5.373E+01	-7.757E+01	-9.667E+01	-1.113E+02
IY= 2	-2.916E+01	-5.248E+01	-7.670E+01	-9.609E+01	-1.109E+02
IY= 1	-2.927E+01	-5.218E+01	-7.637E+01	-9.583E+01	-1.107E+02
IX=	16	17	18	19	20

FIELD VALUES OF TMP1

IY= 5	3.191E+02	3.553E+02	3.980E+02	4.471E+02	4.995E+02
IY= 4	3.206E+02	3.579E+02	4.033E+02	4.576E+02	5.192E+02
IY= 3	3.229E+02	3.621E+02	4.119E+02	4.759E+02	5.567E+02
IY= 2	3.252E+02	3.662E+02	4.202E+02	4.949E+02	6.113E+02
IY= 1	3.266E+02	3.686E+02	4.244E+02	5.012E+02	6.087E+02
IX=	6	7	8	9	10
IY= 5	5.473E+02	5.796E+02	5.899E+02	5.886E+02	5.770E+02
IY= 4	5.767E+02	6.206E+02	6.196E+02	6.111E+02	5.872E+02
IY= 3	6.316E+02	6.298E+02	6.257E+02	6.163E+02	5.919E+02
IY= 2	6.341E+02	6.294E+02	6.246E+02	6.145E+02	5.924E+02
IY= 1	6.123E+02	6.214E+02	6.194E+02	6.115E+02	5.912E+02
IX=	11	12	13	14	15
IY= 5	5.600E+02	5.401E+02	5.188E+02	5.010E+02	4.869E+02
IY= 4	5.649E+02	5.427E+02	5.200E+02	5.016E+02	4.873E+02
IY= 3	5.683E+02	5.450E+02	5.213E+02	5.023E+02	4.878E+02
IY= 2	5.695E+02	5.463E+02	5.222E+02	5.029E+02	4.882E+02
IY= 1	5.694E+02	5.466E+02	5.225E+02	5.031E+02	4.884E+02
IX=	16	17	18	19	20

FIELD VALUES OF DELH

IY= 5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 4	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.402E+01
IY= 2	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.400E+02
IY= 1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.419E+02
IX=	6	7	8	9	10
IY= 5	3.847E-01	1.237E+02	1.635E+02	1.587E+02	1.147E+02
IY= 4	1.114E+02	2.779E+02	2.756E+02	2.436E+02	1.538E+02
IY= 3	3.157E+02	3.114E+02	2.988E+02	2.648E+02	1.720E+02
IY= 2	3.250E+02	3.109E+02	2.954E+02	2.584E+02	1.741E+02
IY= 1	2.613E+02	2.856E+02	2.767E+02	2.471E+02	1.696E+02
IX=	11	12	13	14	15
IY= 5	5.035E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 4	6.891E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 3	8.210E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 2	8.674E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 1	8.632E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IX=	16	17	18	19	20

FIELD VALUES OF EPOT

IY= 5	1.943E-04	2.218E-04	2.465E-04	2.635E-04	2.659E-04
IY= 4	2.015E-04	2.327E-04	2.636E-04	2.882E-04	2.952E-04
IY= 3	2.142E-04	2.531E-04	2.980E-04	3.428E-04	3.665E-04
IY= 2	2.289E-04	2.783E-04	3.460E-04	4.322E-04	5.107E-04
IY= 1	2.393E-04	2.980E-04	3.898E-04	5.355E-04	7.439E-04
IX=	6	7	8	9	10
IY= 5	2.490E-04	2.176E-04	1.850E-04	1.546E-04	1.268E-04
IY= 4	2.724E-04	2.272E-04	1.896E-04	1.574E-04	1.286E-04
IY= 3	3.319E-04	2.438E-04	1.985E-04	1.636E-04	1.326E-04
IY= 2	4.620E-04	2.688E-04	2.170E-04	1.752E-04	1.388E-04
IY= 1	7.128E-04	4.272E-04	2.753E-04	1.953E-04	1.460E-04
IX=	11	12	13	14	15
IY= 5	1.018E-04	7.955E-05	5.987E-05	4.244E-05	2.695E-05
IY= 4	1.029E-04	8.020E-05	6.025E-05	4.266E-05	2.710E-05
IY= 3	1.052E-04	8.146E-05	6.093E-05	4.306E-05	2.736E-05
IY= 2	1.083E-04	8.303E-05	6.173E-05	4.349E-05	2.763E-05
IY= 1	1.112E-04	8.425E-05	6.229E-05	4.378E-05	2.780E-05
IX=	16	17	18	19	20

FIELD VALUES OF JX

IY= 5	-1.956E+01	-1.754E+01	-1.364E+01	-6.196E+00	4.252E+00
IY= 4	-2.141E+01	-2.082E+01	-1.804E+01	-9.933E+00	4.366E+00
IY= 3	-2.500E+01	-2.791E+01	-2.880E+01	-2.107E+01	2.077E+00
IY= 2	-2.973E+01	-3.878E+01	-4.888E+01	-4.890E+01	-9.974E+00
IY= 1	-3.369E+01	-4.972E+01	-7.522E+01	-1.040E+02	-5.061E+01
IX=	6	7	8	9	10
IY= 5	1.373E+01	1.751E+01	1.690E+01	1.562E+01	1.441E+01
IY= 4	1.834E+01	2.142E+01	1.776E+01	1.576E+01	1.457E+01
IY= 3	3.093E+01	3.316E+01	2.011E+01	1.687E+01	1.548E+01
IY= 2	6.004E+01	6.086E+01	2.355E+01	2.008E+01	1.770E+01
IY= 1	8.128E+01	1.118E+02	5.905E+01	3.334E+01	2.231E+01
IX=	11	12	13	14	15
IY= 5	1.325E+01	1.210E+01	1.098E+01	9.902E+00	9.093E+00
IY= 4	1.344E+01	1.226E+01	1.109E+01	9.965E+00	9.120E+00
IY= 3	1.409E+01	1.267E+01	1.132E+01	1.009E+01	9.170E+00
IY= 2	1.534E+01	1.331E+01	1.164E+01	1.024E+01	9.227E+00
IY= 1	1.700E+01	1.396E+01	1.191E+01	1.035E+01	9.268E+00
IX=	16	17	18	19	20

FIELD VALUES OF JY

IY= 5	2.476E+00	3.667E+00	5.568E+00	7.732E+00	8.740E+00
IY= 4	6.878E+00	1.049E+01	1.668E+01	2.456E+01	2.936E+01
IY= 3	9.441E+00	1.524E+01	2.649E+01	4.406E+01	5.959E+01
IY= 2	8.619E+00	1.498E+01	2.944E+01	5.862E+01	9.966E+01
IY= 1	3.579E+00	6.567E+00	1.406E+01	3.149E+01	6.826E+01
IX=	6	7	8	9	10
IY= 5	6.556E+00	2.519E+00	1.176E+00	7.320E-01	4.838E-01
IY= 4	2.199E+01	6.644E+00	3.399E+00	2.302E+00	1.528E+00
IY= 3	4.765E+01	1.035E+01	6.886E+00	4.524E+00	2.693E+00
IY= 2	9.548E+01	4.607E+01	1.941E+01	8.117E+00	3.583E+00

IY= 1	7.083E+01	3.994E+01	1.475E+01	5.163E+00	1.933E+00
IX=	11	12	13	14	15
IY= 5	3.101E-01	1.892E-01	1.125E-01	6.821E-02	4.598E-02
IY= 4	9.417E-01	5.508E-01	3.165E-01	1.866E-01	1.237E-01
IY= 3	1.498E+00	8.098E-01	4.393E-01	2.476E-01	1.599E-01
IY= 2	1.656E+00	7.979E-01	4.026E-01	2.159E-01	1.355E-01
IY= 1	7.889E-01	3.497E-01	1.673E-01	8.663E-02	5.331E-02
IX=	16	17	18	19	20

FIELD VALUES OF JZ

IY= 5	7.993E+00	9.493E+00	1.126E+01	1.271E+01	1.270E+01
IY= 4	8.934E+00	1.111E+01	1.418E+01	1.744E+01	1.843E+01
IY= 3	1.075E+01	1.451E+01	2.107E+01	3.036E+01	3.666E+01
IY= 2	1.309E+01	1.949E+01	3.326E+01	5.980E+01	9.320E+01
IY= 1	1.498E+01	2.426E+01	4.836E+01	1.135E+02	2.895E+02
IX=	6	7	8	9	10
IY= 5	1.013E+01	6.278E+00	4.462E+00	3.666E+00	3.172E+00
IY= 4	1.331E+01	4.441E+00	3.228E+00	3.210E+00	3.049E+00
IY= 3	2.438E+01	-6.066E+00	-5.552E-01	2.394E+00	2.984E+00
IY= 2	6.658E+01	-6.582E+01	-7.729E+00	2.236E+00	3.363E+00
IY= 1	2.747E+02	6.257E+01	1.851E+01	8.103E+00	4.822E+00
IX=	11	12	13	14	15
IY= 5	2.786E+00	2.470E+00	2.230E+00	2.032E+00	1.855E+00
IY= 4	2.761E+00	2.475E+00	2.238E+00	2.038E+00	1.859E+00
IY= 3	2.817E+00	2.523E+00	2.264E+00	2.052E+00	1.868E+00
IY= 2	3.046E+00	2.630E+00	2.310E+00	2.072E+00	1.879E+00
IY= 1	3.454E+00	2.757E+00	2.353E+00	2.089E+00	1.888E+00
IX=	16	17	18	19	20

FIELD VALUES OF BX

IY= 5	1.892E+00	2.853E+00	4.123E+00	5.497E+00	6.307E+00
IY= 4	2.877E+00	4.641E+00	7.236E+00	1.055E+01	1.302E+01
IY= 3	3.648E+00	6.220E+00	1.057E+01	1.748E+01	2.446E+01
IY= 2	3.937E+00	6.975E+00	1.286E+01	2.465E+01	4.057E+01
IY= 1	3.724E+00	6.632E+00	1.266E+01	2.694E+01	5.247E+01
IX=	6	7	8	9	10
IY= 5	5.755E+00	4.127E+00	2.725E+00	1.798E+00	1.190E+00
IY= 4	1.180E+01	7.407E+00	4.414E+00	2.728E+00	1.703E+00
IY= 3	2.280E+01	1.266E+01	6.839E+00	3.871E+00	2.240E+00
IY= 2	3.955E+01	2.136E+01	1.004E+01	5.032E+00	2.680E+00
IY= 1	5.214E+01	2.593E+01	1.122E+01	5.351E+00	2.800E+00
IX=	11	12	13	14	15
IY= 5	7.928E-01	5.361E-01	3.711E-01	2.653E-01	2.005E-01
IY= 4	1.082E+00	7.085E-01	4.816E-01	3.407E-01	2.515E-01
IY= 3	1.350E+00	8.562E-01	5.721E-01	4.006E-01	2.917E-01
IY= 2	1.546E+00	9.638E-01	6.408E-01	4.482E-01	3.245E-01
IY= 1	1.617E+00	1.019E+00	6.877E-01	4.874E-01	3.537E-01
IX=	16	17	18	19	20

FIELD VALUES OF BY

IY= 5	2.822E+00	3.216E+00	2.909E+00	1.841E+00	9.978E-02
IY= 4	3.869E+00	4.747E+00	4.714E+00	3.377E+00	5.059E-01

IY= 3	4.764E+00	6.408E+00	7.280E+00	6.313E+00	1.867E+00
IY= 2	5.324E+00	7.838E+00	1.022E+01	1.086E+01	4.828E+00
IY= 1	4.819E+00	7.388E+00	1.037E+01	1.233E+01	6.751E+00
IX=	6	7	8	9	10
IY= 5	-1.697E+00	-2.761E+00	-2.986E+00	-2.819E+00	-2.560E+00
IY= 4	-2.697E+00	-4.261E+00	-4.145E+00	-3.637E+00	-3.212E+00
IY= 3	-3.989E+00	-6.083E+00	-4.898E+00	-3.902E+00	-3.397E+00
IY= 2	-5.230E+00	-8.076E+00	-5.289E+00	-3.863E+00	-3.299E+00
IY= 1	-4.574E+00	-8.944E+00	-6.247E+00	-3.888E+00	-2.869E+00
IX=	11	12	13	14	15
IY= 5	-2.291E+00	-2.027E+00	-1.764E+00	-1.482E+00	-1.112E+00
IY= 4	-2.845E+00	-2.504E+00	-2.172E+00	-1.818E+00	-1.350E+00
IY= 3	-2.993E+00	-2.626E+00	-2.275E+00	-1.902E+00	-1.410E+00
IY= 2	-2.864E+00	-2.497E+00	-2.162E+00	-1.810E+00	-1.347E+00
IY= 1	-2.363E+00	-2.033E+00	-1.756E+00	-1.474E+00	-1.109E+00
IX=	16	17	18	19	20

FIELD VALUES OF BZ

IY= 5	1.353E+00	1.377E+00	1.373E+00	9.717E-01	-1.757E-01
IY= 4	3.549E+00	3.901E+00	4.024E+00	3.137E+00	9.540E-02
IY= 3	5.969E+00	6.993E+00	7.897E+00	7.268E+00	1.588E+00
IY= 2	8.506E+00	1.074E+01	1.348E+01	1.499E+01	5.876E+00
IY= 1	1.078E+01	1.445E+01	1.938E+01	2.407E+01	1.206E+01
IX=	6	7	8	9	10
IY= 5	-1.708E+00	-2.513E+00	-2.460E+00	-2.145E+00	-1.728E+00
IY= 4	-4.266E+00	-6.291E+00	-5.798E+00	-4.922E+00	-3.912E+00
IY= 3	-7.966E+00	-1.206E+01	-1.027E+01	-8.147E+00	-6.190E+00
IY= 2	-1.236E+01	-1.936E+01	-1.499E+01	-1.101E+01	-8.159E+00
IY= 1	-1.527E+01	-2.545E+01	-1.869E+01	-1.305E+01	-9.526E+00
IX=	11	12	13	14	15
IY= 5	-1.316E+00	-9.777E-01	-7.368E-01	-6.000E-01	-5.797E-01
IY= 4	-3.020E+00	-2.327E+00	-1.820E+00	-1.468E+00	-1.241E+00
IY= 3	-4.703E+00	-3.629E+00	-2.855E+00	-2.290E+00	-1.872E+00
IY= 2	-6.159E+00	-4.772E+00	-3.781E+00	-3.039E+00	-2.453E+00
IY= 1	-7.227E+00	-5.671E+00	-4.555E+00	-3.696E+00	-2.969E+00
IX=	16	17	18	19	20

FIELD VALUES OF THCN

IY= 5	1.804E+00	1.786E+00	1.764E+00	1.746E+00	1.734E+00
IY= 4	1.803E+00	1.785E+00	1.762E+00	1.743E+00	1.730E+00
IY= 3	1.802E+00	1.782E+00	1.758E+00	1.740E+00	1.722E+00
IY= 2	1.801E+00	1.780E+00	1.753E+00	1.736E+00	1.711E+00
IY= 1	1.800E+00	1.779E+00	1.751E+00	1.734E+00	1.711E+00
IX=	6	7	8	9	10
IY= 5	1.724E+00	1.717E+00	1.715E+00	1.715E+00	1.718E+00
IY= 4	1.718E+00	1.709E+00	1.709E+00	1.711E+00	1.716E+00
IY= 3	1.707E+00	1.707E+00	1.708E+00	1.709E+00	1.715E+00
IY= 2	1.707E+00	1.707E+00	1.708E+00	1.710E+00	1.715E+00
IY= 1	1.709E+00	1.708E+00	1.709E+00	1.710E+00	1.715E+00
IX=	11	12	13	14	15
IY= 5	1.721E+00	1.726E+00	1.730E+00	1.734E+00	1.737E+00

IY= 4	1.720E+00	1.725E+00	1.730E+00	1.734E+00	1.737E+00
IY= 3	1.720E+00	1.725E+00	1.730E+00	1.734E+00	1.737E+00
IY= 2	1.719E+00	1.724E+00	1.730E+00	1.734E+00	1.737E+00
IY= 1	1.719E+00	1.724E+00	1.729E+00	1.734E+00	1.737E+00
IX=	16	17	18	19	20

FIELD VALUES OF ELCN

IY= 5	1.384E+05	1.343E+05	1.303E+05	1.256E+05	1.206E+05
IY= 4	1.381E+05	1.341E+05	1.298E+05	1.246E+05	1.188E+05
IY= 3	1.377E+05	1.337E+05	1.289E+05	1.229E+05	1.129E+05
IY= 2	1.373E+05	1.333E+05	1.282E+05	1.211E+05	1.034E+05
IY= 1	1.371E+05	1.331E+05	1.278E+05	1.205E+05	1.030E+05
IX=	6	7	8	9	10
IY= 5	1.144E+05	1.086E+05	1.067E+05	1.070E+05	1.090E+05
IY= 4	1.093E+05	1.015E+05	1.015E+05	1.029E+05	1.072E+05
IY= 3	9.992E+04	1.001E+05	1.005E+05	1.020E+05	1.063E+05
IY= 2	9.930E+04	1.001E+05	1.007E+05	1.023E+05	1.062E+05
IY= 1	1.019E+05	1.011E+05	1.015E+05	1.028E+05	1.064E+05
IX=	11	12	13	14	15
IY= 5	1.121E+05	1.156E+05	1.188E+05	1.205E+05	1.218E+05
IY= 4	1.112E+05	1.152E+05	1.187E+05	1.204E+05	1.218E+05
IY= 3	1.106E+05	1.147E+05	1.185E+05	1.203E+05	1.217E+05
IY= 2	1.104E+05	1.145E+05	1.185E+05	1.203E+05	1.217E+05
IY= 1	1.104E+05	1.145E+05	1.184E+05	1.203E+05	1.217E+05
IX=	16	17	18	19	20

****
TIME STP= 1 SWEEP NO= 400 ZSLAB NO= 3 ITERN NO= 1

FLOW FIELD AT ITHYD= 1, IZ= 3, ISWEEP= 400, ISTEP= 1

FIELD VALUES OF P1

IY= 5	4.721E+02	4.977E+02	5.610E+02	6.765E+02	8.391E+02
IY= 4	4.869E+02	5.221E+02	6.091E+02	7.752E+02	1.029E+03
IY= 3	4.982E+02	5.534E+02	6.938E+02	9.477E+02	1.228E+03
IY= 2	5.139E+02	5.994E+02	8.184E+02	1.089E+03	1.379E+02
IY= 1	5.437E+02	6.696E+02	1.015E+03	1.402E+03	-1.828E+03
IX=	6	7	8	9	10
IY= 5	9.904E+02	1.003E+03	9.141E+02	7.660E+02	5.230E+02
IY= 4	1.324E+03	1.129E+03	9.844E+02	8.726E+02	6.444E+02
IY= 3	1.609E+03	1.364E+03	1.113E+03	9.652E+02	7.468E+02
IY= 2	-4.660E+02	-3.794E+02	-2.410E+02	5.570E+02	7.544E+02
IY= 1	-1.494E+03	-8.076E+02	-3.606E+02	2.615E+02	6.713E+02
IX=	11	12	13	14	15
IY= 5	4.283E+02	4.118E+02	4.199E+02	4.315E+02	4.401E+02
IY= 4	5.043E+02	4.581E+02	4.478E+02	4.486E+02	4.516E+02
IY= 3	5.656E+02	4.922E+02	4.675E+02	4.609E+02	4.604E+02
IY= 2	6.219E+02	5.305E+02	4.897E+02	4.743E+02	4.697E+02
IY= 1	7.331E+02	6.021E+02	5.285E+02	4.958E+02	4.833E+02
IX=	16	17	18	19	20

FIELD VALUES OF U1

IY= 5	3.384E-01	3.381E-01	3.379E-01	3.378E-01	3.381E-01
IY= 4	3.384E-01	3.381E-01	3.378E-01	3.377E-01	3.380E-01
IY= 3	3.383E-01	3.380E-01	3.377E-01	3.375E-01	3.387E-01
IY= 2	3.383E-01	3.380E-01	3.377E-01	3.375E-01	3.387E-01
IY= 1	3.383E-01	3.380E-01	3.377E-01	3.376E-01	3.384E-01
IX=	6	7	8	9	10
IY= 5	3.389E-01	3.394E-01	3.403E-01	3.414E-01	3.417E-01
IY= 4	3.393E-01	3.395E-01	3.402E-01	3.412E-01	3.418E-01
IY= 3	3.393E-01	3.395E-01	3.401E-01	3.411E-01	3.419E-01
IY= 2	9.385E-01	-1.050E+00	3.401E-01	3.412E-01	3.420E-01
IY= 1	-1.187E+01	-8.045E+00	3.406E-01	3.414E-01	3.421E-01
IX=	11	12	13	14	15
IY= 5	3.416E-01	3.413E-01	3.411E-01	3.409E-01	3.408E-01
IY= 4	3.416E-01	3.413E-01	3.411E-01	3.409E-01	3.408E-01
IY= 3	3.417E-01	3.414E-01	3.411E-01	3.409E-01	3.408E-01
IY= 2	3.417E-01	3.414E-01	3.411E-01	3.409E-01	3.408E-01
IY= 1	3.418E-01	3.414E-01	3.411E-01	3.409E-01	3.408E-01
IX=	16	17	18	19	20

FIELD VALUES OF V1

IY= 4	8.117E-05	1.257E-04	2.106E-04	3.563E-04	5.551E-04
IY= 3	1.282E-04	1.911E-04	2.996E-04	4.643E-04	6.504E-04
IY= 2	1.241E-04	1.758E-04	2.442E-04	2.920E-04	3.218E-04
IY= 1	7.552E-05	1.031E-04	1.294E-04	1.212E-04	1.212E-04
IX=	6	7	8	9	10
IY= 4	5.456E-04	-1.686E-04	-1.339E-04	1.021E-04	3.430E-04
IY= 3	-1.008E-04	-2.897E-04	-3.132E-04	-1.652E-05	2.176E-04
IY= 2	-1.976E-04	-2.891E-04	-3.947E-04	5.814E-05	1.758E-04
IY= 1	-1.111E+01	-1.041E+01	-6.111E+00	2.489E-04	1.801E-04
IX=	11	12	13	14	15
IY= 4	1.903E-04	9.784E-05	5.246E-05	3.030E-05	2.018E-05
IY= 3	1.830E-04	1.207E-04	7.455E-05	4.639E-05	3.198E-05
IY= 2	1.538E-04	1.090E-04	7.111E-05	4.584E-05	3.218E-05
IY= 1	1.165E-04	7.445E-05	4.693E-05	2.989E-05	2.090E-05
IX=	16	17	18	19	20

FIELD VALUES OF W1

IY= 5	1.076E-03	1.406E-03	1.948E-03	2.730E-03	3.677E-03
IY= 4	9.925E-04	1.302E-03	1.829E-03	2.642E-03	3.717E-03
IY= 3	9.326E-04	1.234E-03	1.766E-03	2.625E-03	3.826E-03
IY= 2	8.693E-04	1.150E-03	1.633E-03	2.368E-03	3.490E-03
IY= 1	7.855E-04	1.034E-03	1.459E-03	2.090E-03	3.125E-03
IX=	6	7	8	9	10
IY= 5	4.457E-03	4.668E-03	4.963E-03	4.723E-03	3.630E-03
IY= 4	4.503E-03	3.887E-03	4.315E-03	4.448E-03	3.730E-03
IY= 3	3.594E-03	3.115E-03	3.602E-03	4.160E-03	3.773E-03
IY= 2	1.550E-03	1.312E-03	1.700E-03	4.219E-03	3.866E-03
IY= 1	1.642E-03	1.693E-03	2.264E-03	4.568E-03	4.000E-03
IX=	11	12	13	14	15
IY= 5	2.483E-03	1.628E-03	1.068E-03	7.354E-04	5.626E-04

IY=	4	2.485E-03	1.595E-03	1.035E-03	7.077E-04	5.401E-04
IY=	3	2.523E-03	1.602E-03	1.025E-03	6.928E-04	5.248E-04
IY=	2	2.574E-03	1.617E-03	1.021E-03	6.810E-04	5.113E-04
IY=	1	2.603E-03	1.608E-03	1.002E-03	6.604E-04	4.927E-04
IX=		16	17	18	19	20

FIELD VALUES OF ENUL

IY=	5	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY=	4	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY=	3	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY=	2	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY=	1	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IX=		6	7	8	9	10
IY=	5	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY=	4	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY=	3	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY=	2	3.570E-03	3.570E-03	3.570E-03	1.000E+06	1.000E+06
IY=	1	3.570E-03	3.570E-03	3.570E-03	1.000E+06	1.000E+06
IX=		11	12	13	14	15
IY=	5	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY=	4	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY=	3	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY=	2	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY=	1	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IX=		16	17	18	19	20

FIELD VALUES OF H1

IY=	5	-2.887E+02	-2.549E+02	-2.160E+02	-1.728E+02	-1.283E+02
IY=	4	-2.874E+02	-2.528E+02	-2.122E+02	-1.657E+02	-1.165E+02
IY=	3	-2.855E+02	-2.495E+02	-2.059E+02	-1.536E+02	-9.461E+01
IY=	2	-2.836E+02	-2.462E+02	-1.996E+02	-1.409E+02	-6.692E+01
IY=	1	-2.825E+02	-2.444E+02	-1.963E+02	-1.358E+02	-6.259E+01
IX=		6	7	8	9	10
IY=	5	-8.866E+01	-6.104E+01	-4.847E+01	-4.659E+01	-5.301E+01
IY=	4	-7.245E+01	-4.486E+01	-3.572E+01	-3.696E+01	-4.716E+01
IY=	3	-4.114E+01	-2.369E+01	-1.940E+01	-2.720E+01	-4.127E+01
IY=	2	2.142E+01	2.108E+01	1.566E+01	-1.597E+01	-3.648E+01
IY=	1	1.123E+01	1.360E+01	1.069E+01	-1.524E+01	-3.533E+01
IX=		11	12	13	14	15
IY=	5	-6.584E+01	-8.127E+01	-9.741E+01	-1.121E+02	-1.244E+02
IY=	4	-6.241E+01	-7.955E+01	-9.653E+01	-1.116E+02	-1.241E+02
IY=	3	-5.856E+01	-7.749E+01	-9.539E+01	-1.110E+02	-1.237E+02
IY=	2	-5.573E+01	-7.596E+01	-9.450E+01	-1.104E+02	-1.233E+02
IY=	1	-5.471E+01	-7.531E+01	-9.408E+01	-1.101E+02	-1.231E+02
IX=		16	17	18	19	20

FIELD VALUES OF TMP1

IY=	5	3.113E+02	3.449E+02	3.836E+02	4.266E+02	4.709E+02
IY=	4	3.125E+02	3.469E+02	3.874E+02	4.336E+02	4.826E+02
IY=	3	3.144E+02	3.502E+02	3.937E+02	4.456E+02	5.044E+02
IY=	2	3.163E+02	3.535E+02	3.999E+02	4.583E+02	5.319E+02
IY=	1	3.175E+02	3.554E+02	4.032E+02	4.634E+02	5.362E+02

IX=		6	7	8	9	10
IY=	5	5.103E+02	5.378E+02	5.503E+02	5.521E+02	5.458E+02
IY=	4	5.264E+02	5.539E+02	5.630E+02	5.617E+02	5.516E+02
IY=	3	5.576E+02	5.749E+02	5.792E+02	5.714E+02	5.574E+02
IY=	2	6.198E+02	6.195E+02	6.141E+02	5.826E+02	5.622E+02
IY=	1	6.097E+02	6.120E+02	6.091E+02	5.833E+02	5.633E+02
IX=		11	12	13	14	15
IY=	5	5.330E+02	5.176E+02	5.016E+02	4.870E+02	4.747E+02
IY=	4	5.364E+02	5.193E+02	5.024E+02	4.874E+02	4.750E+02
IY=	3	5.402E+02	5.214E+02	5.036E+02	4.881E+02	4.755E+02
IY=	2	5.430E+02	5.229E+02	5.045E+02	4.886E+02	4.758E+02
IY=	1	5.441E+02	5.236E+02	5.049E+02	4.889E+02	4.760E+02
IX=		16	17	18	19	20

FIELD VALUES OF DELH

IY=	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY=	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY=	3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY=	2	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY=	1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IX=		6	7	8	9	10
IY=	5	0.000E+00	0.000E+00	1.202E+01	1.952E+01	0.000E+00
IY=	4	0.000E+00	2.466E+01	6.014E+01	5.592E+01	1.761E+01
IY=	3	3.616E+01	1.038E+02	1.217E+02	9.321E+01	4.015E+01
IY=	2	2.662E+02	2.701E+02	2.532E+02	1.358E+02	5.844E+01
IY=	1	2.360E+02	2.464E+02	2.366E+02	1.390E+02	6.288E+01
IX=		11	12	13	14	15
IY=	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY=	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY=	3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY=	2	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY=	1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IX=		16	17	18	19	20

FIELD VALUES OF EPOT

IY=	5	1.792E-04	2.035E-04	2.245E-04	2.381E-04	2.397E-04
IY=	4	1.847E-04	2.116E-04	2.365E-04	2.546E-04	2.586E-04
IY=	3	1.944E-04	2.262E-04	2.594E-04	2.880E-04	2.992E-04
IY=	2	2.051E-04	2.434E-04	2.886E-04	3.352E-04	3.638E-04
IY=	1	2.125E-04	2.559E-04	3.121E-04	3.791E-04	4.363E-04
IX=		6	7	8	9	10
IY=	5	2.264E-04	2.016E-04	1.731E-04	1.450E-04	1.188E-04
IY=	4	2.424E-04	2.111E-04	1.785E-04	1.482E-04	1.206E-04
IY=	3	2.775E-04	2.306E-04	1.895E-04	1.546E-04	1.243E-04
IY=	2	3.386E-04	2.628E-04	2.073E-04	1.641E-04	1.293E-04
IY=	1	4.160E-04	3.148E-04	2.322E-04	1.748E-04	1.339E-04
IX=		11	12	13	14	15
IY=	5	9.493E-05	7.358E-05	5.456E-05	3.765E-05	2.261E-05
IY=	4	9.601E-05	7.420E-05	5.492E-05	3.786E-05	2.275E-05
IY=	3	9.806E-05	7.533E-05	5.555E-05	3.822E-05	2.298E-05
IY=	2	1.006E-04	7.665E-05	5.625E-05	3.861E-05	2.323E-05

IY= 1	1.027E-04	7.762E-05	5.672E-05	3.886E-05	2.339E-05
IX=	16	17	18	19	20

FIELD VALUES OF JX

IY= 5	-1.773E+01	-1.536E+01	-1.145E+01	-4.924E+00	3.576E+00
IY= 4	-1.905E+01	-1.753E+01	-1.416E+01	-7.072E+00	3.646E+00
IY= 3	-2.152E+01	-2.192E+01	-2.017E+01	-1.260E+01	2.821E+00
IY= 2	-2.455E+01	-2.800E+01	-2.977E+01	-2.358E+01	-1.924E+00
IY= 1	-2.690E+01	-3.335E+01	-3.986E+01	-3.864E+01	-1.176E+01
IX=	6	7	8	9	10
IY= 5	1.137E+01	1.549E+01	1.616E+01	1.547E+01	1.439E+01
IY= 4	1.392E+01	1.821E+01	1.763E+01	1.623E+01	1.483E+01
IY= 3	1.933E+01	2.427E+01	2.076E+01	1.796E+01	1.589E+01
IY= 2	2.613E+01	3.349E+01	2.553E+01	2.090E+01	1.766E+01
IY= 1	3.173E+01	4.748E+01	3.646E+01	2.636E+01	2.005E+01
IX=	11	12	13	14	15
IY= 5	1.319E+01	1.198E+01	1.081E+01	9.724E+00	8.910E+00
IY= 4	1.348E+01	1.217E+01	1.092E+01	9.785E+00	8.936E+00
IY= 3	1.413E+01	1.255E+01	1.114E+01	9.898E+00	8.981E+00
IY= 2	1.512E+01	1.308E+01	1.141E+01	1.003E+01	9.032E+00
IY= 1	1.615E+01	1.354E+01	1.162E+01	1.013E+01	9.067E+00
IX=	16	17	18	19	20

FIELD VALUES OF JY

IY= 5	1.933E+00	2.745E+00	3.964E+00	5.243E+00	5.793E+00
IY= 4	5.302E+00	7.689E+00	1.146E+01	1.577E+01	1.810E+01
IY= 3	7.108E+00	1.072E+01	1.699E+01	2.529E+01	3.157E+01
IY= 2	6.300E+00	9.989E+00	1.715E+01	2.848E+01	4.053E+01
IY= 1	2.561E+00	4.210E+00	7.652E+00	1.371E+01	2.127E+01
IX=	6	7	8	9	10
IY= 5	4.761E+00	2.729E+00	1.514E+00	8.830E-01	5.285E-01
IY= 4	1.492E+01	8.162E+00	4.535E+00	2.651E+00	1.566E+00
IY= 3	2.654E+01	1.393E+01	7.704E+00	4.357E+00	2.437E+00
IY= 2	3.622E+01	2.179E+01	1.111E+01	5.500E+00	2.694E+00
IY= 1	1.984E+01	1.330E+01	6.430E+00	2.911E+00	1.295E+00
IX=	11	12	13	14	15
IY= 5	3.146E-01	1.838E-01	1.074E-01	6.428E-02	4.312E-02
IY= 4	9.103E-01	5.188E-01	2.958E-01	1.738E-01	1.153E-01
IY= 3	1.338E+00	7.273E-01	3.977E-01	2.267E-01	1.476E-01
IY= 2	1.338E+00	6.784E-01	3.526E-01	1.941E-01	1.238E-01
IY= 1	5.954E-01	2.861E-01	1.433E-01	7.699E-02	4.843E-02
IX=	16	17	18	19	20

FIELD VALUES OF JZ

IY= 5	1.188E+01	1.374E+01	1.582E+01	1.736E+01	1.727E+01
IY= 4	1.295E+01	1.549E+01	1.876E+01	2.180E+01	2.248E+01
IY= 3	1.495E+01	1.896E+01	2.515E+01	3.252E+01	3.640E+01
IY= 2	1.740E+01	2.365E+01	3.504E+01	5.225E+01	6.733E+01
IY= 1	1.927E+01	2.766E+01	4.513E+01	7.804E+01	1.252E+02
IX=	6	7	8	9	10
IY= 5	1.473E+01	1.088E+01	8.249E+00	6.658E+00	5.614E+00
IY= 4	1.830E+01	1.126E+01	8.064E+00	6.549E+00	5.599E+00

IY= 3	2.821E+01	1.176E+01	7.963E+00	6.717E+00	5.793E+00
IY= 2	5.318E+01	1.291E+01	9.490E+00	7.947E+00	6.456E+00
IY= 1	1.128E+02	4.906E+01	2.180E+01	1.178E+01	7.656E+00
IX=	11	12	13	14	15
IY= 5	4.864E+00	4.290E+00	3.845E+00	3.481E+00	3.173E+00
IY= 4	4.882E+00	4.311E+00	3.860E+00	3.491E+00	3.180E+00
IY= 3	5.012E+00	4.386E+00	3.899E+00	3.513E+00	3.193E+00
IY= 2	5.316E+00	4.521E+00	3.959E+00	3.541E+00	3.209E+00
IY= 1	5.708E+00	4.658E+00	4.010E+00	3.562E+00	3.220E+00
IX=	16	17	18	19	20

FIELD VALUES OF BX

IY= 5	2.247E+00	3.151E+00	4.252E+00	5.319E+00	5.899E+00
IY= 4	3.113E+00	4.605E+00	6.572E+00	8.708E+00	1.005E+01
IY= 3	3.842E+00	5.940E+00	8.992E+00	1.279E+01	1.563E+01
IY= 2	4.252E+00	6.770E+00	1.077E+01	1.639E+01	2.126E+01
IY= 1	4.271E+00	6.835E+00	1.106E+01	1.739E+01	2.332E+01
IX=	6	7	8	9	10
IY= 5	5.593E+00	4.553E+00	3.368E+00	2.390E+00	1.671E+00
IY= 4	9.519E+00	7.389E+00	5.122E+00	3.426E+00	2.279E+00
IY= 3	1.499E+01	1.119E+01	7.262E+00	4.558E+00	2.880E+00
IY= 2	2.077E+01	1.504E+01	9.240E+00	5.494E+00	3.334E+00
IY= 1	2.297E+01	1.639E+01	9.860E+00	5.770E+00	3.477E+00
IX=	11	12	13	14	15
IY= 5	1.167E+00	8.217E-01	5.882E-01	4.316E-01	3.301E-01
IY= 4	1.532E+00	1.050E+00	7.393E-01	5.359E-01	4.015E-01
IY= 3	1.865E+00	1.249E+00	8.663E-01	6.215E-01	4.596E-01
IY= 2	2.106E+00	1.393E+00	9.612E-01	6.880E-01	5.059E-01
IY= 1	2.199E+00	1.464E+00	1.020E+00	7.368E-01	5.426E-01
IX=	16	17	18	19	20

FIELD VALUES OF BY

IY= 5	2.210E+00	2.351E+00	2.109E+00	1.403E+00	3.235E-01
IY= 4	2.909E+00	3.295E+00	3.165E+00	2.276E+00	6.589E-01
IY= 3	3.484E+00	4.214E+00	4.397E+00	3.519E+00	1.331E+00
IY= 2	3.733E+00	4.781E+00	5.384E+00	4.771E+00	2.229E+00
IY= 1	3.406E+00	4.442E+00	5.178E+00	4.811E+00	2.565E+00
IX=	6	7	8	9	10
IY= 5	-7.964E-01	-1.585E+00	-1.928E+00	-1.965E+00	-1.867E+00
IY= 4	-1.093E+00	-2.233E+00	-2.587E+00	-2.508E+00	-2.313E+00
IY= 3	-1.233E+00	-2.777E+00	-3.057E+00	-2.795E+00	-2.505E+00
IY= 2	-1.085E+00	-3.049E+00	-3.274E+00	-2.826E+00	-2.445E+00
IY= 1	-6.622E-01	-2.732E+00	-2.996E+00	-2.522E+00	-2.106E+00
IX=	11	12	13	14	15
IY= 5	-1.716E+00	-1.542E+00	-1.350E+00	-1.135E+00	-8.853E-01
IY= 4	-2.094E+00	-1.864E+00	-1.622E+00	-1.353E+00	-1.040E+00
IY= 3	-2.237E+00	-1.978E+00	-1.714E+00	-1.426E+00	-1.092E+00
IY= 2	-2.145E+00	-1.882E+00	-1.627E+00	-1.354E+00	-1.040E+00
IY= 1	-1.812E+00	-1.578E+00	-1.363E+00	-1.139E+00	-8.873E-01
IX=	16	17	18	19	20

FIELD VALUES OF BZ

IY=	5	1.482E+00	1.514E+00	1.358E+00	8.251E-01	-1.687E-01
IY=	4	2.995E+00	3.196E+00	3.026E+00	2.059E+00	-3.917E-03
IY=	3	4.718E+00	5.269E+00	5.347E+00	4.096E+00	6.336E-01
IY=	2	6.427E+00	7.517E+00	8.155E+00	6.961E+00	1.967E+00
IY=	1	7.723E+00	9.305E+00	1.046E+01	9.465E+00	3.505E+00
IX=		6	7	8	9	10
IY=	5	-1.330E+00	-2.113E+00	-2.337E+00	-2.208E+00	-1.916E+00
IY=	4	-2.523E+00	-4.114E+00	-4.403E+00	-4.017E+00	-3.395E+00
IY=	3	-3.943E+00	-6.694E+00	-6.918E+00	-6.055E+00	-4.967E+00
IY=	2	-5.201E+00	-9.332E+00	-9.349E+00	-7.883E+00	-6.326E+00
IY=	1	-5.467E+00	-1.067E+01	-1.070E+01	-8.937E+00	-7.154E+00
IX=		11	12	13	14	15
IY=	5	-1.586E+00	-1.287E+00	-1.050E+00	-8.833E-01	-7.897E-01
IY=	4	-2.769E+00	-2.235E+00	-1.814E+00	-1.498E+00	-1.271E+00
IY=	3	-3.989E+00	-3.200E+00	-2.590E+00	-2.121E+00	-1.760E+00
IY=	2	-5.038E+00	-4.041E+00	-3.276E+00	-2.680E+00	-2.204E+00
IY=	1	-5.722E+00	-4.626E+00	-3.783E+00	-3.114E+00	-2.556E+00
IX=		16	17	18	19	20

FIELD VALUES OF THCN

IY=	5	1.808E+00	1.791E+00	1.772E+00	1.750E+00	1.741E+00
IY=	4	1.807E+00	1.790E+00	1.770E+00	1.749E+00	1.738E+00
IY=	3	1.806E+00	1.788E+00	1.767E+00	1.746E+00	1.734E+00
IY=	2	1.805E+00	1.787E+00	1.764E+00	1.743E+00	1.728E+00
IY=	1	1.805E+00	1.786E+00	1.762E+00	1.742E+00	1.727E+00
IX=		6	7	8	9	10
IY=	5	1.732E+00	1.726E+00	1.724E+00	1.723E+00	1.725E+00
IY=	4	1.729E+00	1.723E+00	1.721E+00	1.721E+00	1.723E+00
IY=	3	1.722E+00	1.719E+00	1.718E+00	1.719E+00	1.722E+00
IY=	2	1.710E+00	1.710E+00	1.710E+00	1.717E+00	1.721E+00
IY=	1	1.711E+00	1.711E+00	1.711E+00	1.717E+00	1.721E+00
IX=		11	12	13	14	15
IY=	5	1.727E+00	1.731E+00	1.734E+00	1.737E+00	1.740E+00
IY=	4	1.727E+00	1.730E+00	1.734E+00	1.737E+00	1.740E+00
IY=	3	1.726E+00	1.730E+00	1.734E+00	1.737E+00	1.740E+00
IY=	2	1.725E+00	1.729E+00	1.733E+00	1.737E+00	1.740E+00
IY=	1	1.725E+00	1.729E+00	1.733E+00	1.737E+00	1.739E+00
IX=		16	17	18	19	20

FIELD VALUES OF ELCN

IY=	5	1.397E+05	1.353E+05	1.316E+05	1.275E+05	1.233E+05
IY=	4	1.395E+05	1.351E+05	1.313E+05	1.269E+05	1.223E+05
IY=	3	1.392E+05	1.348E+05	1.307E+05	1.258E+05	1.202E+05
IY=	2	1.388E+05	1.345E+05	1.301E+05	1.246E+05	1.174E+05
IY=	1	1.387E+05	1.343E+05	1.298E+05	1.241E+05	1.164E+05
IX=		6	7	8	9	10
IY=	5	1.196E+05	1.161E+05	1.139E+05	1.135E+05	1.146E+05
IY=	4	1.181E+05	1.133E+05	1.116E+05	1.118E+05	1.136E+05
IY=	3	1.129E+05	1.097E+05	1.088E+05	1.101E+05	1.125E+05
IY=	2	1.025E+05	1.021E+05	1.027E+05	1.081E+05	1.117E+05
IY=	1	1.036E+05	1.030E+05	1.034E+05	1.079E+05	1.115E+05

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 IX=       11            12            13            14            15
IY=  5   1.169E+05     1.189E+05     1.204E+05     1.218E+05     1.230E+05
IY=  4   1.163E+05     1.187E+05     1.203E+05     1.218E+05     1.229E+05
IY=  3   1.156E+05     1.185E+05     1.202E+05     1.217E+05     1.229E+05
IY=  2   1.151E+05     1.184E+05     1.201E+05     1.216E+05     1.229E+05
IY=  1   1.149E+05     1.183E+05     1.201E+05     1.216E+05     1.228E+05
 IX=       16            17            18            19            20

***********************************************************
TIME STP=     1 SWEEP NO=   400 ZSLAB NO=     4 ITERN NO=     1


FLOW FIELD AT ITHYD=  1, IZ=  4, ISWEEP= 400, ISTEP=   1
FIELD VALUES OF P1
IY=  5   6.772E+02     7.029E+02     7.482E+02     8.131E+02     8.900E+02
IY=  4   6.975E+02     7.306E+02     7.844E+02     8.514E+02     9.198E+02
IY=  3   7.059E+02     7.401E+02     7.818E+02     7.790E+02     6.597E+02
IY=  2   7.183E+02     7.554E+02     7.739E+02     5.964E+02    -1.562E+02
IY=  1   7.502E+02     8.082E+02     8.593E+02     6.628E+02    -3.554E+02
 IX=        6             7             8             9            10
IY=  5   9.584E+02     9.648E+02     9.208E+02     8.451E+02     7.398E+02
IY=  4   1.007E+03     1.027E+03     9.976E+02     9.389E+02     8.318E+02
IY=  3   6.384E+02     7.629E+02     8.046E+02     8.653E+02     8.377E+02
IY=  2  -6.761E+02    -2.912E+02    -6.304E+01     5.975E+02     7.979E+02
IY=  1  -1.679E+02     1.387E+02     1.507E+02     7.660E+02     9.119E+02
 IX=       11            12            13            14            15
IY=  5   6.720E+02     6.419E+02     6.319E+02     6.299E+02     6.300E+02
IY=  4   7.408E+02     6.876E+02     6.605E+02     6.475E+02     6.420E+02
IY=  3   7.688E+02     7.149E+02     6.818E+02     6.634E+02     6.543E+02
IY=  2   7.926E+02     7.450E+02     7.055E+02     6.805E+02     6.673E+02
IY=  1   8.908E+02     8.090E+02     7.428E+02     7.019E+02     6.811E+02
 IX=       16            17            18            19            20
FIELD VALUES OF U1
IY=  5   3.384E-01     3.383E-01     3.382E-01     3.382E-01     3.386E-01
IY=  4   3.385E-01     3.383E-01     3.382E-01     3.382E-01     3.386E-01
IY=  3   3.385E-01     3.383E-01     3.382E-01     3.382E-01     3.389E-01
IY=  2   3.385E-01     3.383E-01     3.382E-01     3.383E-01     3.392E-01
IY=  1   3.385E-01     3.383E-01     3.382E-01     3.383E-01     3.391E-01
 IX=        6             7             8             9            10
IY=  5   3.392E-01     3.396E-01     3.402E-01     3.409E-01     3.413E-01
IY=  4   3.393E-01     3.396E-01     3.402E-01     3.409E-01     3.413E-01
IY=  3   3.394E-01     3.396E-01     3.400E-01     3.408E-01     3.413E-01
IY=  2   3.394E-01     3.396E-01     3.397E-01     3.408E-01     3.414E-01
IY=  1   3.393E-01     3.396E-01     3.398E-01     3.408E-01     3.414E-01
 IX=       11            12            13            14            15
IY=  5   3.414E-01     3.412E-01     3.411E-01     3.409E-01     3.407E-01
IY=  4   3.414E-01     3.412E-01     3.411E-01     3.409E-01     3.407E-01
IY=  3   3.414E-01     3.413E-01     3.411E-01     3.409E-01     3.407E-01
IY=  2   3.414E-01     3.413E-01     3.411E-01     3.409E-01     3.407E-01
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IY= 1	3.415E-01	3.413E-01	3.411E-01	3.409E-01	3.407E-01
IX=	16	17	18	19	20

FIELD VALUES OF V1

IY= 4	3.174E-05	4.773E-05	7.421E-05	1.085E-04	1.210E-04
IY= 3	5.454E-05	7.687E-05	1.065E-04	1.299E-04	9.197E-05
IY= 2	5.187E-05	6.707E-05	7.493E-05	4.989E-05	-4.261E-05
IY= 1	2.870E-05	3.509E-05	3.292E-05	7.965E-06	-3.693E-05
IX=	6	7	8	9	10
IY= 4	1.228E-06	-2.474E-04	-2.307E-04	-7.280E-05	7.237E-05
IY= 3	-2.359E-04	-3.648E-04	-3.287E-04	-9.926E-05	6.711E-05
IY= 2	-4.544E-04	-5.243E-04	-4.682E-04	-4.055E-05	8.332E-05
IY= 1	-1.052E-04	-9.715E-05	-4.072E-05	8.222E-05	9.445E-05
IX=	11	12	13	14	15
IY= 4	7.362E-05	5.013E-05	3.105E-05	1.910E-05	1.295E-05
IY= 3	9.335E-05	7.353E-05	4.925E-05	3.163E-05	2.188E-05
IY= 2	9.533E-05	7.426E-05	5.029E-05	3.260E-05	2.267E-05
IY= 1	7.477E-05	5.195E-05	3.359E-05	2.126E-05	1.456E-05
IX=	16	17	18	19	20

FIELD VALUES OF W1

IY= 5	1.219E-03	1.521E-03	1.966E-03	2.539E-03	3.142E-03
IY= 4	1.152E-03	1.436E-03	1.862E-03	2.425E-03	3.023E-03
IY= 3	1.088E-03	1.356E-03	1.763E-03	2.302E-03	2.833E-03
IY= 2	1.022E-03	1.268E-03	1.633E-03	2.092E-03	2.481E-03
IY= 1	9.550E-04	1.178E-03	1.506E-03	1.914E-03	2.266E-03
IX=	6	7	8	9	10
IY= 5	3.565E-03	3.690E-03	3.797E-03	3.643E-03	3.070E-03
IY= 4	3.353E-03	3.277E-03	3.436E-03	3.452E-03	3.027E-03
IY= 3	2.788E-03	2.668E-03	2.915E-03	3.229E-03	2.992E-03
IY= 2	1.856E-03	1.740E-03	2.097E-03	3.101E-03	3.003E-03
IY= 1	1.703E-03	1.701E-03	2.143E-03	3.183E-03	3.045E-03
IX=	11	12	13	14	15
IY= 5	2.339E-03	1.696E-03	1.221E-03	9.078E-04	7.288E-04
IY= 4	2.309E-03	1.665E-03	1.193E-03	8.851E-04	7.101E-04
IY= 3	2.308E-03	1.659E-03	1.180E-03	8.695E-04	6.949E-04
IY= 2	2.326E-03	1.661E-03	1.171E-03	8.562E-04	6.809E-04
IY= 1	2.332E-03	1.649E-03	1.154E-03	8.382E-04	6.646E-04
IX=	16	17	18	19	20

FIELD VALUES OF ENUL

IY= 5	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 4	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 3	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 2	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 1	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IX=	6	7	8	9	10
IY= 5	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 4	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 3	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 2	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 1	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06

IX=	11	12	13	14	15
IY= 5	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 4	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 3	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 2	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 1	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IX=	16	17	18	19	20

FIELD VALUES OF H1

IY= 5	-2.991E+02	-2.683E+02	-2.338E+02	-1.965E+02	-1.590E+02
IY= 4	-2.981E+02	-2.668E+02	-2.312E+02	-1.920E+02	-1.522E+02
IY= 3	-2.966E+02	-2.643E+02	-2.268E+02	-1.846E+02	-1.403E+02
IY= 2	-2.951E+02	-2.619E+02	-2.226E+02	-1.770E+02	-1.272E+02
IY= 1	-2.942E+02	-2.605E+02	-2.202E+02	-1.732E+02	-1.224E+02
IX=	6	7	8	9	10
IY= 5	-1.259E+02	-1.018E+02	-8.825E+01	-8.398E+01	-8.703E+01
IY= 4	-1.172E+02	-9.331E+01	-8.131E+01	-7.890E+01	-8.373E+01
IY= 3	-1.015E+02	-7.960E+01	-7.049E+01	-7.178E+01	-7.930E+01
IY= 2	-8.126E+01	-6.215E+01	-5.695E+01	-6.447E+01	-7.530E+01
IY= 1	-7.750E+01	-5.869E+01	-5.396E+01	-6.194E+01	-7.357E+01
IX=	11	12	13	14	15
IY= 5	-9.531E+01	-1.065E+02	-1.187E+02	-1.305E+02	-1.410E+02
IY= 4	-9.328E+01	-1.053E+02	-1.181E+02	-1.301E+02	-1.407E+02
IY= 3	-9.053E+01	-1.037E+02	-1.171E+02	-1.296E+02	-1.403E+02
IY= 2	-8.818E+01	-1.023E+02	-1.163E+02	-1.291E+02	-1.400E+02
IY= 1	-8.704E+01	-1.016E+02	-1.159E+02	-1.288E+02	-1.398E+02
IX=	16	17	18	19	20

FIELD VALUES OF TMP1

IY= 5	3.009E+02	3.315E+02	3.659E+02	4.030E+02	4.403E+02
IY= 4	3.019E+02	3.330E+02	3.685E+02	4.074E+02	4.470E+02
IY= 3	3.034E+02	3.355E+02	3.728E+02	4.149E+02	4.589E+02
IY= 2	3.049E+02	3.379E+02	3.770E+02	4.224E+02	4.720E+02
IY= 1	3.057E+02	3.393E+02	3.794E+02	4.261E+02	4.767E+02
IX=	6	7	8	9	10
IY= 5	4.732E+02	4.973E+02	5.107E+02	5.149E+02	5.119E+02
IY= 4	4.819E+02	5.057E+02	5.176E+02	5.200E+02	5.152E+02
IY= 3	4.975E+02	5.193E+02	5.284E+02	5.271E+02	5.196E+02
IY= 2	5.176E+02	5.367E+02	5.418E+02	5.344E+02	5.236E+02
IY= 1	5.214E+02	5.401E+02	5.448E+02	5.369E+02	5.253E+02
IX=	11	12	13	14	15
IY= 5	5.037E+02	4.925E+02	4.804E+02	4.686E+02	4.582E+02
IY= 4	5.057E+02	4.937E+02	4.810E+02	4.690E+02	4.585E+02
IY= 3	5.084E+02	4.953E+02	4.820E+02	4.696E+02	4.589E+02
IY= 2	5.108E+02	4.967E+02	4.828E+02	4.701E+02	4.592E+02
IY= 1	5.119E+02	4.974E+02	4.832E+02	4.703E+02	4.594E+02
IX=	16	17	18	19	20

FIELD VALUES OF DELH

IY= 5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 4	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

IY= 2	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IX=	6	7	8	9	10
IY= 5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 4	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 2	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IX=	11	12	13	14	15
IY= 5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 4	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 2	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IY= 1	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
IX=	16	17	18	19	20

FIELD VALUES OF EPOT

IY= 5	1.598E-04	1.807E-04	1.980E-04	2.087E-04	2.096E-04
IY= 4	1.639E-04	1.864E-04	2.060E-04	2.191E-04	2.212E-04
IY= 3	1.708E-04	1.963E-04	2.205E-04	2.387E-04	2.438E-04
IY= 2	1.783E-04	2.075E-04	2.376E-04	2.633E-04	2.742E-04
IY= 1	1.833E-04	2.152E-04	2.501E-04	2.829E-04	3.010E-04
IX=	6	7	8	9	10
IY= 5	1.991E-04	1.796E-04	1.556E-04	1.307E-04	1.068E-04
IY= 4	2.094E-04	1.868E-04	1.602E-04	1.336E-04	1.085E-04
IY= 3	2.298E-04	2.009E-04	1.691E-04	1.389E-04	1.116E-04
IY= 2	2.580E-04	2.203E-04	1.809E-04	1.456E-04	1.153E-04
IY= 1	2.850E-04	2.400E-04	1.922E-04	1.515E-04	1.183E-04
IX=	11	12	13	14	15
IY= 5	8.470E-05	6.466E-05	4.666E-05	3.057E-05	1.620E-05
IY= 4	8.567E-05	6.522E-05	4.698E-05	3.076E-05	1.632E-05
IY= 3	8.743E-05	6.619E-05	4.753E-05	3.108E-05	1.653E-05
IY= 2	8.945E-05	6.728E-05	4.812E-05	3.141E-05	1.675E-05
IY= 1	9.093E-05	6.803E-05	4.851E-05	3.163E-05	1.689E-05
IX=	16	17	18	19	20

FIELD VALUES OF JX

IY= 5	-1.563E+01	-1.309E+01	-9.367E+00	-3.798E+00	2.980E+00
IY= 4	-1.652E+01	-1.442E+01	-1.091E+01	-4.950E+00	2.977E+00
IY= 3	-1.812E+01	-1.697E+01	-1.406E+01	-7.558E+00	2.670E+00
IY= 2	-1.997E+01	-2.019E+01	-1.847E+01	-1.181E+01	1.428E+00
IY= 1	-2.130E+01	-2.272E+01	-2.237E+01	-1.636E+01	-8.903E-01
IX=	6	7	8	9	10
IY= 5	9.230E+00	1.317E+01	1.463E+01	1.456E+01	1.376E+01
IY= 4	1.049E+01	1.481E+01	1.587E+01	1.537E+01	1.427E+01
IY= 3	1.296E+01	1.809E+01	1.833E+01	1.697E+01	1.527E+01
IY= 2	1.601E+01	2.256E+01	2.166E+01	1.914E+01	1.659E+01
IY= 1	1.805E+01	2.702E+01	2.555E+01	2.151E+01	1.785E+01
IX=	11	12	13	14	15
IY= 5	1.268E+01	1.153E+01	1.043E+01	9.406E+00	8.623E+00
IY= 4	1.299E+01	1.172E+01	1.054E+01	9.462E+00	8.646E+00

IY= 3	1.359E+01	1.206E+01	1.073E+01	9.562E+00	8.687E+00
IY= 2	1.435E+01	1.248E+01	1.095E+01	9.673E+00	8.730E+00
IY= 1	1.499E+01	1.280E+01	1.111E+01	9.749E+00	8.760E+00
IX=	16	17	18	19	20

FIELD VALUES OF JY

IY= 5	1.433E+00	1.946E+00	2.670E+00	3.371E+00	3.650E+00
IY= 4	3.881E+00	5.346E+00	7.488E+00	9.691E+00	1.073E+01
IY= 3	5.090E+00	7.192E+00	1.047E+01	1.422E+01	1.653E+01
IY= 2	4.395E+00	6.405E+00	9.797E+00	1.419E+01	1.771E+01
IY= 1	1.754E+00	2.613E+00	4.142E+00	6.285E+00	8.271E+00
IX=	6	7	8	9	10
IY= 5	3.167E+00	2.186E+00	1.376E+00	8.371E-01	4.995E-01
IY= 4	9.362E+00	6.393E+00	3.991E+00	2.405E+00	1.417E+00
IY= 3	1.470E+01	9.920E+00	6.066E+00	3.553E+00	2.025E+00
IY= 2	1.654E+01	1.143E+01	6.718E+00	3.695E+00	1.976E+00
IY= 1	8.037E+00	5.714E+00	3.267E+00	1.710E+00	8.686E-01
IX=	11	12	13	14	15
IY= 5	2.925E-01	1.692E-01	9.776E-02	5.829E-02	3.910E-02
IY= 4	8.169E-01	4.651E-01	2.650E-01	1.562E-01	1.040E-01
IY= 3	1.131E+00	6.248E-01	3.471E-01	2.007E-01	1.320E-01
IY= 2	1.047E+00	5.551E-01	2.991E-01	1.691E-01	1.097E-01
IY= 1	4.404E-01	2.263E-01	1.192E-01	6.636E-02	4.266E-02
IX=	16	17	18	19	20

FIELD VALUES OF JZ

IY= 5	1.428E+01	1.605E+01	1.788E+01	1.910E+01	1.894E+01
IY= 4	1.514E+01	1.739E+01	2.000E+01	2.210E+01	2.234E+01
IY= 3	1.672E+01	1.993E+01	2.427E+01	2.862E+01	3.033E+01
IY= 2	1.856E+01	2.311E+01	3.018E+01	3.882E+01	4.454E+01
IY= 1	1.989E+01	2.560E+01	3.539E+01	4.934E+01	6.241E+01
IX=	6	7	8	9	10
IY= 5	1.698E+01	1.398E+01	1.138E+01	9.436E+00	8.005E+00
IY= 4	1.960E+01	1.508E+01	1.179E+01	9.619E+00	8.105E+00
IY= 3	2.585E+01	1.768E+01	1.291E+01	1.019E+01	8.413E+00
IY= 2	3.778E+01	2.283E+01	1.532E+01	1.140E+01	9.006E+00
IY= 1	5.615E+01	3.458E+01	2.049E+01	1.339E+01	9.750E+00
IX=	11	12	13	14	15
IY= 5	6.930E+00	6.094E+00	5.427E+00	4.889E+00	4.451E+00
IY= 4	6.988E+00	6.130E+00	5.449E+00	4.902E+00	4.460E+00
IY= 3	7.150E+00	6.216E+00	5.495E+00	4.927E+00	4.475E+00
IY= 2	7.422E+00	6.342E+00	5.555E+00	4.957E+00	4.493E+00
IY= 1	7.701E+00	6.452E+00	5.601E+00	4.978E+00	4.505E+00
IX=	16	17	18	19	20

FIELD VALUES OF BX

IY= 5	2.312E+00	3.046E+00	3.876E+00	4.618E+00	5.006E+00
IY= 4	3.056E+00	4.189E+00	5.531E+00	6.818E+00	7.552E+00
IY= 3	3.679E+00	5.205E+00	7.128E+00	9.121E+00	1.038E+01
IY= 2	4.069E+00	5.877E+00	8.270E+00	1.091E+01	1.273E+01
IY= 1	4.175E+00	6.055E+00	8.581E+00	1.146E+01	1.350E+01
IX=	6	7	8	9	10

IY= 5	4.846E+00	4.204E+00	3.354E+00	2.542E+00	1.877E+00
IY= 4	7.308E+00	6.191E+00	4.756E+00	3.463E+00	2.467E+00
IY= 3	1.010E+01	8.394E+00	6.227E+00	4.366E+00	3.010E+00
IY= 2	1.247E+01	1.022E+01	7.393E+00	5.044E+00	3.402E+00
IY= 1	1.325E+01	1.080E+01	7.751E+00	5.263E+00	3.546E+00
IX=	11	12	13	14	15
IY= 5	1.372E+00	1.005E+00	7.427E-01	5.588E-01	4.348E-01
IY= 4	1.754E+00	1.258E+00	9.172E-01	6.828E-01	5.214E-01
IY= 3	2.086E+00	1.471E+00	1.060E+00	7.817E-01	5.898E-01
IY= 2	2.324E+00	1.624E+00	1.166E+00	8.577E-01	6.436E-01
IY= 1	2.429E+00	1.708E+00	1.236E+00	9.159E-01	6.876E-01
IX=	16	17	18	19	20

FIELD VALUES OF BY

IY= 5	1.847E+00	1.842E+00	1.605E+00	1.096E+00	3.797E-01
IY= 4	2.291E+00	2.396E+00	2.189E+00	1.572E+00	6.057E-01
IY= 3	2.635E+00	2.878E+00	2.767E+00	2.115E+00	9.373E-01
IY= 2	2.751E+00	3.113E+00	3.124E+00	2.528E+00	1.279E+00
IY= 1	2.563E+00	2.926E+00	2.990E+00	2.498E+00	1.405E+00
IX=	6	7	8	9	10
IY= 5	-3.687E-01	-9.603E-01	-1.307E+00	-1.441E+00	-1.442E+00
IY= 4	-4.335E-01	-1.230E+00	-1.650E+00	-1.769E+00	-1.732E+00
IY= 3	-3.873E-01	-1.385E+00	-1.861E+00	-1.948E+00	-1.869E+00
IY= 2	-2.106E-01	-1.350E+00	-1.868E+00	-1.931E+00	-1.823E+00
IY= 1	2.215E-02	-1.095E+00	-1.615E+00	-1.693E+00	-1.593E+00
IX=	11	12	13	14	15
IY= 5	-1.371E+00	-1.260E+00	-1.122E+00	-9.629E-01	-7.840E-01
IY= 4	-1.621E+00	-1.474E+00	-1.302E+00	-1.106E+00	-8.862E-01
IY= 3	-1.728E+00	-1.559E+00	-1.370E+00	-1.159E+00	-9.244E-01
IY= 2	-1.668E+00	-1.496E+00	-1.312E+00	-1.111E+00	-8.885E-01
IY= 1	-1.450E+00	-1.298E+00	-1.140E+00	-9.716E-01	-7.884E-01
IX=	16	17	18	19	20

FIELD VALUES OF BZ

IY= 5	1.336E+00	1.310E+00	1.102E+00	6.218E-01	-1.232E-01
IY= 4	2.399E+00	2.429E+00	2.135E+00	1.329E+00	-1.460E-02
IY= 3	3.559E+00	3.717E+00	3.428E+00	2.328E+00	2.842E-01
IY= 2	4.655E+00	5.003E+00	4.807E+00	3.505E+00	7.872E-01
IY= 1	5.463E+00	5.970E+00	5.856E+00	4.443E+00	1.313E+00
IX=	6	7	8	9	10
IY= 5	-9.473E-01	-1.577E+00	-1.877E+00	-1.897E+00	-1.752E+00
IY= 4	-1.533E+00	-2.649E+00	-3.109E+00	-3.068E+00	-2.770E+00
IY= 3	-2.114E+00	-3.835E+00	-4.453E+00	-4.298E+00	-3.806E+00
IY= 2	-2.523E+00	-4.865E+00	-5.628E+00	-5.353E+00	-4.683E+00
IY= 1	-2.570E+00	-5.332E+00	-6.246E+00	-5.955E+00	-5.222E+00
IX=	11	12	13	14	15
IY= 5	-1.538E+00	-1.316E+00	-1.121E+00	-9.655E-01	-8.565E-01
IY= 4	-2.389E+00	-2.019E+00	-1.699E+00	-1.440E+00	-1.237E+00
IY= 3	-3.239E+00	-2.716E+00	-2.271E+00	-1.907E+00	-1.613E+00
IY= 2	-3.962E+00	-3.315E+00	-2.771E+00	-2.322E+00	-1.951E+00
IY= 1	-4.438E+00	-3.736E+00	-3.142E+00	-2.644E+00	-2.220E+00

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 IX=      16             17             18             19             20
FIELD VALUES OF THCN
IY=  5    1.813E+00      1.798E+00      1.781E+00      1.762E+00      1.747E+00
IY=  4    1.813E+00      1.797E+00      1.779E+00      1.760E+00      1.746E+00
IY=  3    1.812E+00      1.796E+00      1.777E+00      1.756E+00      1.743E+00
IY=  2    1.811E+00      1.795E+00      1.775E+00      1.752E+00      1.740E+00
IY=  1    1.811E+00      1.794E+00      1.774E+00      1.750E+00      1.739E+00
 IX=       6              7              8              9             10
IY=  5    1.740E+00      1.735E+00      1.732E+00      1.731E+00      1.732E+00
IY=  4    1.738E+00      1.733E+00      1.731E+00      1.730E+00      1.731E+00
IY=  3    1.735E+00      1.730E+00      1.728E+00      1.729E+00      1.730E+00
IY=  2    1.731E+00      1.727E+00      1.725E+00      1.727E+00      1.729E+00
IY=  1    1.730E+00      1.726E+00      1.725E+00      1.726E+00      1.729E+00
 IX=      11             12             13             14             15
IY=  5    1.734E+00      1.736E+00      1.739E+00      1.741E+00      1.743E+00
IY=  4    1.733E+00      1.736E+00      1.738E+00      1.741E+00      1.743E+00
IY=  3    1.733E+00      1.735E+00      1.738E+00      1.741E+00      1.743E+00
IY=  2    1.732E+00      1.735E+00      1.738E+00      1.741E+00      1.743E+00
IY=  1    1.732E+00      1.735E+00      1.738E+00      1.741E+00      1.743E+00
 IX=      16             17             18             19             20
FIELD VALUES OF ELCN
IY=  5    1.415E+05      1.366E+05      1.333E+05      1.298E+05      1.262E+05
IY=  4    1.414E+05      1.364E+05      1.331E+05      1.294E+05      1.256E+05
IY=  3    1.411E+05      1.362E+05      1.327E+05      1.287E+05      1.245E+05
IY=  2    1.408E+05      1.360E+05      1.322E+05      1.280E+05      1.233E+05
IY=  1    1.407E+05      1.358E+05      1.320E+05      1.276E+05      1.228E+05
 IX=       6              7              8              9             10
IY=  5    1.231E+05      1.208E+05      1.196E+05      1.192E+05      1.194E+05
IY=  4    1.223E+05      1.201E+05      1.189E+05      1.187E+05      1.191E+05
IY=  3    1.209E+05      1.188E+05      1.178E+05      1.180E+05      1.187E+05
IY=  2    1.190E+05      1.165E+05      1.154E+05      1.167E+05      1.183E+05
IY=  1    1.186E+05      1.158E+05      1.149E+05      1.162E+05      1.182E+05
 IX=      11             12             13             14             15
IY=  5    1.202E+05      1.213E+05      1.224E+05      1.235E+05      1.245E+05
IY=  4    1.200E+05      1.212E+05      1.224E+05      1.235E+05      1.245E+05
IY=  3    1.198E+05      1.210E+05      1.223E+05      1.235E+05      1.245E+05
IY=  2    1.195E+05      1.209E+05      1.222E+05      1.234E+05      1.244E+05
IY=  1    1.194E+05      1.208E+05      1.222E+05      1.234E+05      1.244E+05
 IX=      16             17             18             19             20

*************************************************************
TIME STP=     1 SWEEP NO=   400 ZSLAB NO=      5 ITERN NO=      1


FLOW FIELD AT ITHYD=  1, IZ=  5, ISWEEP= 400, ISTEP=   1
FIELD VALUES OF P1
IY=  5    9.272E+02      9.559E+02      9.799E+02      9.938E+02      1.001E+03
IY=  4    9.546E+02      9.867E+02      1.008E+03      1.007E+03      9.931E+02
IY=  3    9.530E+02      9.658E+02      9.330E+02      8.213E+02      6.506E+02
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IY=  2    9.558E+02    9.499E+02    8.564E+02    5.965E+02    1.723E+02
IY=  1    9.950E+02    1.002E+03    9.216E+02    6.553E+02    1.971E+02
 IX=      6            7            8            9            10
IY=  5    1.014E+03    1.024E+03    1.027E+03    1.018E+03    9.862E+02
IY=  4    1.011E+03    1.056E+03    1.095E+03    1.112E+03    1.084E+03
IY=  3    5.844E+02    6.753E+02    8.092E+02    9.640E+02    1.041E+03
IY=  2   -3.393E+01    1.197E+02    3.744E+02    7.596E+02    9.857E+02
IY=  1    1.044E+02    2.657E+02    5.031E+02    9.044E+02    1.123E+03
 IX=      11           12           13           14           15
IY=  5    9.469E+02    9.106E+02    8.810E+02    8.592E+02    8.450E+02
IY=  4    1.030E+03    9.723E+02    9.233E+02    8.874E+02    8.652E+02
IY=  3    1.041E+03    1.003E+03    9.551E+02    9.150E+02    8.882E+02
IY=  2    1.055E+03    1.037E+03    9.900E+02    9.443E+02    9.123E+02
IY=  1    1.168E+03    1.117E+03    1.042E+03    9.769E+02    9.347E+02
 IX=      16           17           18           19           20
FIELD VALUES OF U1
IY=  5    3.386E-01    3.385E-01    3.384E-01    3.386E-01    3.389E-01
IY=  4    3.386E-01    3.385E-01    3.384E-01    3.386E-01    3.389E-01
IY=  3    3.386E-01    3.385E-01    3.385E-01    3.386E-01    3.391E-01
IY=  2    3.386E-01    3.385E-01    3.385E-01    3.387E-01    3.392E-01
IY=  1    3.386E-01    3.385E-01    3.385E-01    3.387E-01    3.392E-01
 IX=      6            7            8            9            10
IY=  5    3.393E-01    3.397E-01    3.402E-01    3.407E-01    3.411E-01
IY=  4    3.394E-01    3.397E-01    3.401E-01    3.407E-01    3.411E-01
IY=  3    3.394E-01    3.396E-01    3.400E-01    3.406E-01    3.410E-01
IY=  2    3.394E-01    3.396E-01    3.398E-01    3.405E-01    3.410E-01
IY=  1    3.394E-01    3.396E-01    3.398E-01    3.405E-01    3.411E-01
 IX=      11           12           13           14           15
IY=  5    3.412E-01    3.411E-01    3.410E-01    3.409E-01    3.407E-01
IY=  4    3.412E-01    3.411E-01    3.410E-01    3.408E-01    3.407E-01
IY=  3    3.412E-01    3.411E-01    3.410E-01    3.409E-01    3.407E-01
IY=  2    3.412E-01    3.412E-01    3.410E-01    3.409E-01    3.407E-01
IY=  1    3.412E-01    3.412E-01    3.410E-01    3.409E-01    3.407E-01
 IX=      16           17           18           19           20
FIELD VALUES OF V1
IY=  4    4.069E-06    5.325E-06    4.039E-06   -7.452E-06   -4.906E-05
IY=  3    1.042E-05    1.121E-05    3.647E-06   -2.767E-05   -1.147E-04
IY=  2    8.503E-06    5.139E-06   -1.311E-05   -6.387E-05   -1.731E-04
IY=  1    1.895E-06   -2.327E-06   -1.749E-05   -5.155E-05   -1.063E-04
 IX=      6            7            8            9            10
IY=  4   -1.486E-04   -2.450E-04   -2.210E-04   -1.120E-04   -1.257E-05
IY=  3   -2.978E-04   -3.804E-04   -3.258E-04   -1.499E-04   -1.362E-05
IY=  2   -3.835E-04   -4.386E-04   -3.591E-04   -1.187E-04    7.716E-06
IY=  1   -1.708E-04   -1.725E-04   -1.177E-04   -1.782E-05    3.038E-05
 IX=      11           12           13           14           15
IY=  4    2.190E-05    2.474E-05    1.867E-05    1.250E-05    8.693E-06
IY=  3    3.738E-05    4.218E-05    3.235E-05    2.196E-05    1.541E-05
IY=  2    4.723E-05    4.684E-05    3.483E-05    2.336E-05    1.632E-05
IY=  1    3.994E-05    3.331E-05    2.328E-05    1.512E-05    1.035E-05
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IX=	16	17	18	19	20
FIELD VALUES OF W1					
IY= 5	1.184E-03	1.399E-03	1.678E-03	2.001E-03	2.309E-03
IY= 4	1.149E-03	1.355E-03	1.623E-03	1.933E-03	2.221E-03
IY= 3	1.106E-03	1.300E-03	1.550E-03	1.831E-03	2.064E-03
IY= 2	1.063E-03	1.241E-03	1.467E-03	1.707E-03	1.866E-03
IY= 1	1.028E-03	1.196E-03	1.405E-03	1.621E-03	1.756E-03
IX=	6	7	8	9	10
IY= 5	2.520E-03	2.607E-03	2.639E-03	2.546E-03	2.274E-03
IY= 4	2.387E-03	2.432E-03	2.486E-03	2.456E-03	2.237E-03
IY= 3	2.116E-03	2.134E-03	2.236E-03	2.326E-03	2.190E-03
IY= 2	1.776E-03	1.781E-03	1.947E-03	2.217E-03	2.159E-03
IY= 1	1.654E-03	1.683E-03	1.886E-03	2.201E-03	2.156E-03
IX=	11	12	13	14	15
IY= 5	1.897E-03	1.524E-03	1.215E-03	9.884E-04	8.402E-04
IY= 4	1.876E-03	1.508E-03	1.202E-03	9.767E-04	8.302E-04
IY= 3	1.859E-03	1.496E-03	1.190E-03	9.652E-04	8.195E-04
IY= 2	1.849E-03	1.488E-03	1.180E-03	9.547E-04	8.093E-04
IY= 1	1.845E-03	1.480E-03	1.171E-03	9.448E-04	8.002E-04
IX=	16	17	18	19	20
FIELD VALUES OF ENUL					
IY= 5	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 4	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 3	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 2	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 1	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IX=	6	7	8	9	10
IY= 5	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 4	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 3	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 2	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 1	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IX=	11	12	13	14	15
IY= 5	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 4	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 3	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 2	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IY= 1	1.000E+06	1.000E+06	1.000E+06	1.000E+06	1.000E+06
IX=	16	17	18	19	20
FIELD VALUES OF H1					
IY= 5	-3.110E+02	-2.833E+02	-2.527E+02	-2.201E+02	-1.879E+02
IY= 4	-3.103E+02	-2.821E+02	-2.508E+02	-2.171E+02	-1.836E+02
IY= 3	-3.091E+02	-2.803E+02	-2.477E+02	-2.122E+02	-1.764E+02
IY= 2	-3.079E+02	-2.784E+02	-2.447E+02	-2.073E+02	-1.690E+02
IY= 1	-3.072E+02	-2.774E+02	-2.429E+02	-2.046E+02	-1.654E+02
IX=	6	7	8	9	10
IY= 5	-1.594E+02	-1.378E+02	-1.245E+02	-1.188E+02	-1.196E+02
IY= 4	-1.542E+02	-1.326E+02	-1.201E+02	-1.156E+02	-1.174E+02
IY= 3	-1.452E+02	-1.241E+02	-1.130E+02	-1.106E+02	-1.141E+02

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IY=  2  -1.356E+02  -1.150E+02  -1.057E+02  -1.057E+02  -1.110E+02
IY=  1  -1.315E+02  -1.111E+02  -1.025E+02  -1.033E+02  -1.094E+02
 IX=     11          12          13          14          15
IY=  5  -1.249E+02  -1.330E+02  -1.424E+02  -1.519E+02  -1.606E+02
IY=  4  -1.235E+02  -1.321E+02  -1.419E+02  -1.516E+02  -1.604E+02
IY=  3  -1.214E+02  -1.309E+02  -1.411E+02  -1.511E+02  -1.601E+02
IY=  2  -1.195E+02  -1.297E+02  -1.404E+02  -1.507E+02  -1.598E+02
IY=  1  -1.185E+02  -1.291E+02  -1.401E+02  -1.504E+02  -1.596E+02
 IX=     16          17          18          19          20
FIELD VALUES OF TMP1
IY=  5   2.890E+02   3.166E+02   3.471E+02   3.795E+02   4.115E+02
IY=  4   2.897E+02   3.178E+02   3.490E+02   3.824E+02   4.158E+02
IY=  3   2.909E+02   3.196E+02   3.520E+02   3.873E+02   4.230E+02
IY=  2   2.921E+02   3.214E+02   3.551E+02   3.922E+02   4.303E+02
IY=  1   2.928E+02   3.225E+02   3.568E+02   3.949E+02   4.340E+02
 IX=      6           7           8           9          10
IY=  5   4.399E+02   4.614E+02   4.747E+02   4.802E+02   4.795E+02
IY=  4   4.451E+02   4.665E+02   4.790E+02   4.835E+02   4.817E+02
IY=  3   4.540E+02   4.750E+02   4.860E+02   4.885E+02   4.850E+02
IY=  2   4.636E+02   4.841E+02   4.934E+02   4.934E+02   4.881E+02
IY=  1   4.676E+02   4.879E+02   4.966E+02   4.957E+02   4.897E+02
 IX=     11          12          13          14          15
IY=  5   4.743E+02   4.662E+02   4.568E+02   4.474E+02   4.387E+02
IY=  4   4.757E+02   4.670E+02   4.573E+02   4.477E+02   4.389E+02
IY=  3   4.777E+02   4.683E+02   4.581E+02   4.482E+02   4.392E+02
IY=  2   4.796E+02   4.694E+02   4.588E+02   4.486E+02   4.395E+02
IY=  1   4.806E+02   4.701E+02   4.591E+02   4.488E+02   4.397E+02
 IX=     16          17          18          19          20
FIELD VALUES OF DELH
IY=  5   0.000E+00   0.000E+00   0.000E+00   0.000E+00   0.000E+00
IY=  4   0.000E+00   0.000E+00   0.000E+00   0.000E+00   0.000E+00
IY=  3   0.000E+00   0.000E+00   0.000E+00   0.000E+00   0.000E+00
IY=  2   0.000E+00   0.000E+00   0.000E+00   0.000E+00   0.000E+00
IY=  1   0.000E+00   0.000E+00   0.000E+00   0.000E+00   0.000E+00
 IX=      6           7           8           9          10
IY=  5   0.000E+00   0.000E+00   0.000E+00   0.000E+00   0.000E+00
IY=  4   0.000E+00   0.000E+00   0.000E+00   0.000E+00   0.000E+00
IY=  3   0.000E+00   0.000E+00   0.000E+00   0.000E+00   0.000E+00
IY=  2   0.000E+00   0.000E+00   0.000E+00   0.000E+00   0.000E+00
IY=  1   0.000E+00   0.000E+00   0.000E+00   0.000E+00   0.000E+00
 IX=     11          12          13          14          15
IY=  5   0.000E+00   0.000E+00   0.000E+00   0.000E+00   0.000E+00
IY=  4   0.000E+00   0.000E+00   0.000E+00   0.000E+00   0.000E+00
IY=  3   0.000E+00   0.000E+00   0.000E+00   0.000E+00   0.000E+00
IY=  2   0.000E+00   0.000E+00   0.000E+00   0.000E+00   0.000E+00
IY=  1   0.000E+00   0.000E+00   0.000E+00   0.000E+00   0.000E+00
 IX=     16          17          18          19          20
FIELD VALUES OF EPOT
IY=  5   1.384E-04   1.561E-04   1.704E-04   1.788E-04   1.793E-04
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IY= 4	1.414E-04	1.602E-04	1.760E-04	1.858E-04	1.869E-04
IY= 3	1.465E-04	1.673E-04	1.858E-04	1.984E-04	2.009E-04
IY= 2	1.520E-04	1.750E-04	1.967E-04	2.130E-04	2.179E-04
IY= 1	1.555E-04	1.801E-04	2.043E-04	2.235E-04	2.308E-04
IX=	6	7	8	9	10
IY= 5	1.707E-04	1.547E-04	1.345E-04	1.128E-04	9.146E-05
IY= 4	1.777E-04	1.601E-04	1.381E-04	1.151E-04	9.287E-05
IY= 3	1.907E-04	1.700E-04	1.448E-04	1.193E-04	9.538E-05
IY= 2	2.066E-04	1.821E-04	1.529E-04	1.242E-04	9.823E-05
IY= 1	2.193E-04	1.919E-04	1.592E-04	1.279E-04	1.003E-04
IX=	11	12	13	14	15
IY= 5	7.142E-05	5.305E-05	3.640E-05	2.140E-05	7.882E-06
IY= 4	7.225E-05	5.353E-05	3.668E-05	2.156E-05	7.992E-06
IY= 3	7.370E-05	5.435E-05	3.715E-05	2.183E-05	8.172E-06
IY= 2	7.531E-05	5.524E-05	3.764E-05	2.211E-05	8.358E-06
IY= 1	7.641E-05	5.583E-05	3.796E-05	2.230E-05	8.475E-06
IX=	16	17	18	19	20

FIELD VALUES OF JX

IY= 5	-1.362E+01	-1.114E+01	-7.734E+00	-2.968E+00	2.596E+00
IY= 4	-1.425E+01	-1.201E+01	-8.685E+00	-3.644E+00	2.576E+00
IY= 3	-1.534E+01	-1.360E+01	-1.050E+01	-5.036E+00	2.411E+00
IY= 2	-1.655E+01	-1.548E+01	-1.281E+01	-7.001E+00	1.930E+00
IY= 1	-1.739E+01	-1.685E+01	-1.462E+01	-8.748E+00	1.240E+00
IX=	6	7	8	9	10
IY= 5	7.738E+00	1.127E+01	1.292E+01	1.319E+01	1.268E+01
IY= 4	8.425E+00	1.226E+01	1.381E+01	1.384E+01	1.312E+01
IY= 3	9.667E+00	1.413E+01	1.548E+01	1.506E+01	1.392E+01
IY= 2	1.110E+01	1.648E+01	1.759E+01	1.658E+01	1.489E+01
IY= 1	1.203E+01	1.837E+01	1.940E+01	1.784E+01	1.566E+01
IX=	11	12	13	14	15
IY= 5	1.182E+01	1.084E+01	9.864E+00	8.951E+00	8.235E+00
IY= 4	1.209E+01	1.100E+01	9.958E+00	9.001E+00	8.256E+00
IY= 3	1.259E+01	1.129E+01	1.012E+01	9.086E+00	8.291E+00
IY= 2	1.317E+01	1.163E+01	1.031E+01	9.179E+00	8.328E+00
IY= 1	1.360E+01	1.186E+01	1.043E+01	9.241E+00	8.353E+00
IX=	16	17	18	19	20

FIELD VALUES OF JY

IY= 5	1.088E+00	1.435E+00	1.888E+00	2.305E+00	2.464E+00
IY= 4	2.925E+00	3.890E+00	5.189E+00	6.434E+00	6.970E+00
IY= 3	3.778E+00	5.106E+00	6.985E+00	8.917E+00	9.926E+00
IY= 2	3.206E+00	4.415E+00	6.225E+00	8.245E+00	9.534E+00
IY= 1	1.264E+00	1.763E+00	2.541E+00	3.457E+00	4.114E+00
IX=	6	7	8	9	10
IY= 5	2.209E+00	1.664E+00	1.124E+00	7.120E-01	4.329E-01
IY= 4	6.280E+00	4.715E+00	3.164E+00	1.988E+00	1.198E+00
IY= 3	9.060E+00	6.775E+00	4.487E+00	2.768E+00	1.634E+00
IY= 2	8.921E+00	6.711E+00	4.364E+00	2.610E+00	1.491E+00
IY= 1	3.932E+00	2.987E+00	1.917E+00	1.118E+00	6.214E-01
IX=	11	12	13	14	15

IY= 5	2.558E-01	1.484E-01	8.587E-02	5.131E-02	3.449E-02
IY= 4	7.005E-01	4.024E-01	2.306E-01	1.367E-01	9.145E-02
IY= 3	9.367E-01	5.279E-01	2.977E-01	1.741E-01	1.154E-01
IY= 2	8.296E-01	4.562E-01	2.523E-01	1.454E-01	9.544E-02
IY= 1	3.376E-01	1.822E-01	9.936E-02	5.666E-02	3.697E-02
IX=	16	17	18	19	20

FIELD VALUES OF JZ

IY= 5	1.589E+01	1.749E+01	1.892E+01	1.976E+01	1.960E+01
IY= 4	1.642E+01	1.826E+01	2.003E+01	2.124E+01	2.124E+01
IY= 3	1.735E+01	1.963E+01	2.214E+01	2.418E+01	2.465E+01
IY= 2	1.838E+01	2.124E+01	2.477E+01	2.818E+01	2.972E+01
IY= 1	1.909E+01	2.240E+01	2.683E+01	3.168E+01	3.473E+01
IX=	6	7	8	9	10
IY= 5	1.831E+01	1.625E+01	1.409E+01	1.215E+01	1.051E+01
IY= 4	1.967E+01	1.707E+01	1.454E+01	1.240E+01	1.065E+01
IY= 3	2.256E+01	1.880E+01	1.550E+01	1.293E+01	1.094E+01
IY= 2	2.705E+01	2.150E+01	1.695E+01	1.369E+01	1.133E+01
IY= 1	3.205E+01	2.493E+01	1.874E+01	1.451E+01	1.170E+01
IX=	11	12	13	14	15
IY= 5	9.141E+00	8.024E+00	7.118E+00	6.389E+00	5.810E+00
IY= 4	9.220E+00	8.069E+00	7.144E+00	6.405E+00	5.820E+00
IY= 3	9.377E+00	8.154E+00	7.190E+00	6.431E+00	5.837E+00
IY= 2	9.580E+00	8.257E+00	7.243E+00	6.460E+00	5.855E+00
IY= 1	9.746E+00	8.334E+00	7.280E+00	6.479E+00	5.867E+00
IX=	16	17	18	19	20

FIELD VALUES OF BX

IY= 5	2.231E+00	2.794E+00	3.389E+00	3.887E+00	4.140E+00
IY= 4	2.831E+00	3.653E+00	4.539E+00	5.312E+00	5.723E+00
IY= 3	3.324E+00	4.383E+00	5.569E+00	6.650E+00	7.262E+00
IY= 2	3.638E+00	4.863E+00	6.272E+00	7.603E+00	8.392E+00
IY= 1	3.744E+00	5.019E+00	6.493E+00	7.906E+00	8.758E+00
IX=	6	7	8	9	10
IY= 5	4.050E+00	3.647E+00	3.065E+00	2.453E+00	1.905E+00
IY= 4	5.594E+00	4.968E+00	4.080E+00	3.180E+00	2.409E+00
IY= 3	7.112E+00	6.250E+00	5.036E+00	3.839E+00	2.847E+00
IY= 2	8.241E+00	7.195E+00	5.726E+00	4.304E+00	3.153E+00
IY= 1	8.602E+00	7.493E+00	5.948E+00	4.467E+00	3.276E+00
IX=	11	12	13	14	15
IY= 5	1.457E+00	1.110E+00	8.488E-01	6.565E-01	5.201E-01
IY= 4	1.804E+00	1.352E+00	1.021E+00	7.821E-01	6.097E-01
IY= 3	2.096E+00	1.550E+00	1.160E+00	8.806E-01	6.795E-01
IY= 2	2.300E+00	1.691E+00	1.261E+00	9.553E-01	7.334E-01
IY= 1	2.398E+00	1.772E+00	1.329E+00	1.012E+00	7.771E-01
IX=	16	17	18	19	20

FIELD VALUES OF BY

IY= 5	1.600E+00	1.529E+00	1.289E+00	8.829E-01	3.573E-01
IY= 4	1.900E+00	1.876E+00	1.633E+00	1.153E+00	4.940E-01
IY= 3	2.112E+00	2.144E+00	1.926E+00	1.415E+00	6.610E-01
IY= 2	2.170E+00	2.252E+00	2.075E+00	1.580E+00	8.056E-01

IY= 1	2.041E+00	2.127E+00	1.985E+00	1.549E+00	8.510E-01
IX=	6	7	8	9	10
IY= 5	-1.886E-01	-6.484E-01	-9.608E-01	-1.125E+00	-1.177E+00
IY= 4	-2.046E-01	-7.862E-01	-1.163E+00	-1.343E+00	-1.384E+00
IY= 3	-1.586E-01	-8.390E-01	-1.265E+00	-1.449E+00	-1.477E+00
IY= 2	-6.133E-02	-7.890E-01	-1.237E+00	-1.421E+00	-1.440E+00
IY= 1	4.885E-02	-6.392E-01	-1.067E+00	-1.245E+00	-1.267E+00
IX=	11	12	13	14	15
IY= 5	-1.155E+00	-1.088E+00	-9.909E-01	-8.733E-01	-7.346E-01
IY= 4	-1.341E+00	-1.251E+00	-1.129E+00	-9.851E-01	-8.156E-01
IY= 3	-1.418E+00	-1.314E+00	-1.180E+00	-1.025E+00	-8.449E-01
IY= 2	-1.376E+00	-1.270E+00	-1.139E+00	-9.902E-01	-8.183E-01
IY= 1	-1.212E+00	-1.120E+00	-1.008E+00	-8.824E-01	-7.395E-01
IX=	16	17	18	19	20

FIELD VALUES OF BZ

IY= 5	1.131E+00	1.060E+00	8.467E-01	4.548E-01	-8.816E-02
IY= 4	1.861E+00	1.789E+00	1.482E+00	8.690E-01	-1.317E-02
IY= 3	2.622E+00	2.576E+00	2.207E+00	1.388E+00	1.452E-01
IY= 2	3.319E+00	3.321E+00	2.924E+00	1.940E+00	3.756E-01
IY= 1	3.838E+00	3.883E+00	3.468E+00	2.374E+00	6.016E-01
IX=	6	7	8	9	10
IY= 5	-6.718E-01	-1.152E+00	-1.442E+00	-1.540E+00	-1.502E+00
IY= 4	-9.699E-01	-1.738E+00	-2.167E+00	-2.281E+00	-2.185E+00
IY= 3	-1.227E+00	-2.315E+00	-2.891E+00	-3.011E+00	-2.850E+00
IY= 2	-1.383E+00	-2.770E+00	-3.485E+00	-3.614E+00	-3.401E+00
IY= 1	-1.406E+00	-2.993E+00	-3.814E+00	-3.974E+00	-3.752E+00
IX=	11	12	13	14	15
IY= 5	-1.386E+00	-1.240E+00	-1.094E+00	-9.651E-01	-8.622E-01
IY= 4	-1.984E+00	-1.752E+00	-1.527E+00	-1.328E+00	-1.161E+00
IY= 3	-2.562E+00	-2.244E+00	-1.942E+00	-1.676E+00	-1.448E+00
IY= 2	-3.046E+00	-2.662E+00	-2.301E+00	-1.980E+00	-1.703E+00
IY= 1	-3.373E+00	-2.961E+00	-2.571E+00	-2.220E+00	-1.907E+00
IX=	16	17	18	19	20

FIELD VALUES OF THCN

IY= 5	1.819E+00	1.805E+00	1.790E+00	1.774E+00	1.758E+00
IY= 4	1.819E+00	1.805E+00	1.789E+00	1.772E+00	1.756E+00
IY= 3	1.818E+00	1.804E+00	1.787E+00	1.770E+00	1.752E+00
IY= 2	1.817E+00	1.803E+00	1.786E+00	1.767E+00	1.749E+00
IY= 1	1.817E+00	1.802E+00	1.785E+00	1.766E+00	1.749E+00
IX=	6	7	8	9	10
IY= 5	1.747E+00	1.743E+00	1.740E+00	1.739E+00	1.739E+00
IY= 4	1.746E+00	1.742E+00	1.739E+00	1.738E+00	1.738E+00
IY= 3	1.744E+00	1.740E+00	1.737E+00	1.737E+00	1.738E+00
IY= 2	1.742E+00	1.738E+00	1.736E+00	1.736E+00	1.737E+00
IY= 1	1.741E+00	1.737E+00	1.735E+00	1.735E+00	1.737E+00
IX=	11	12	13	14	15
IY= 5	1.740E+00	1.742E+00	1.744E+00	1.746E+00	1.747E+00
IY= 4	1.740E+00	1.741E+00	1.743E+00	1.746E+00	1.747E+00
IY= 3	1.739E+00	1.741E+00	1.743E+00	1.745E+00	1.747E+00

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IY=  2    1.739E+00    1.741E+00    1.743E+00    1.745E+00    1.747E+00
IY=  1    1.738E+00    1.741E+00    1.743E+00    1.745E+00    1.747E+00
 IX=      16           17           18           19           20
FIELD VALUES OF ELCN
IY=  5    1.436E+05    1.388E+05    1.351E+05    1.320E+05    1.290E+05
IY=  4    1.435E+05    1.386E+05    1.349E+05    1.317E+05    1.286E+05
IY=  3    1.432E+05    1.383E+05    1.346E+05    1.313E+05    1.279E+05
IY=  2    1.430E+05    1.380E+05    1.343E+05    1.308E+05    1.272E+05
IY=  1    1.429E+05    1.378E+05    1.342E+05    1.306E+05    1.269E+05
 IX=       6            7            8            9           10
IY=  5    1.263E+05    1.242E+05    1.230E+05    1.225E+05    1.225E+05
IY=  4    1.258E+05    1.238E+05    1.226E+05    1.221E+05    1.223E+05
IY=  3    1.250E+05    1.230E+05    1.219E+05    1.217E+05    1.220E+05
IY=  2    1.241E+05    1.221E+05    1.212E+05    1.212E+05    1.217E+05
IY=  1    1.237E+05    1.218E+05    1.209E+05    1.210E+05    1.216E+05
 IX=      11           12           13           14           15
IY=  5    1.230E+05    1.238E+05    1.247E+05    1.256E+05    1.264E+05
IY=  4    1.229E+05    1.237E+05    1.246E+05    1.255E+05    1.264E+05
IY=  3    1.227E+05    1.236E+05    1.245E+05    1.255E+05    1.263E+05
IY=  2    1.225E+05    1.235E+05    1.245E+05    1.254E+05    1.263E+05
IY=  1    1.224E+05    1.234E+05    1.244E+05    1.254E+05    1.263E+05
 IX=      16           17           18           19           20

 *******************************************************
TIME STP=     1 SWEEP NO=   400 ZSLAB NO=    10 ITERN NO=     1

WHOLE-FIELD RESIDUALS BEFORE SOLUTIONS
WHOLE-FIELD SUM OF ABS(VOL.FLOW RESIDUALS)=  7.700E+04
WHOLE-FIELD SUM OF ABS(RESIDUALS) OF U1   =  7.427E+10
WHOLE-FIELD SUM OF ABS(RESIDUALS) OF V1   =  3.257E+10
WHOLE-FIELD SUM OF ABS(RESIDUALS) OF W1   =  2.760E+11
WHOLE-FIELD SUM OF ABS(RESIDUALS) OF H1   =  2.230E+08
WHOLE-FIELD SUM OF ABS(RESIDUALS) OF EPOT =  7.428E+07
* SUMS HAVE BEEN DIVIDED BY RESREF(NAME)

NET SOURCE OF U1   AT PATCH NAMED: INLET     = 4.208E+00
NET SOURCE OF U1   AT PATCH NAMED: FIXVEL    = 2.980E+02
NET SOURCE OF U1   AT PATCH NAMED: MRNGN     =-1.367E+01
NET SOURCE OF U1   AT PATCH NAMED: LORENTZ   =-1.565E+02
NET SOURCE OF V1   AT PATCH NAMED: FIXVEL    = 1.280E+02
NET SOURCE OF V1   AT PATCH NAMED: BUOY      =-2.447E+00
NET SOURCE OF V1   AT PATCH NAMED: LORENTZ   = 1.654E+03
NET SOURCE OF W1   AT PATCH NAMED: FIXVEL    =-1.783E+02
NET SOURCE OF W1   AT PATCH NAMED: MRNGN     = 3.141E+01
NET SOURCE OF W1   AT PATCH NAMED: LORENTZ   =-1.223E+03
NET SOURCE OF R1   AT PATCH NAMED: INLET     = 1.238E+01
NET SOURCE OF R1   AT PATCH NAMED: OUTLET    =-1.238E+01
NET SOURCE OF R1   AT PATCH NAMED: ZEROP     = 3.001E-05
NET SOURCE OF H1   AT PATCH NAMED: INLET     =-6.200E+03
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NET SOURCE OF H1   AT PATCH NAMED: HEAT     = 1.181E+03
NET SOURCE OF H1   AT PATCH NAMED: SPECIAL  = 1.248E+01
NET SOURCE OF H1   AT PATCH NAMED: HTLOSUPS =-4.681E+01
NET SOURCE OF H1   AT PATCH NAMED: HTLOSLOS =-2.334E+01
NET SOURCE OF EPOT AT PATCH NAMED: INLET    = 0.000E+00
NET SOURCE OF EPOT AT PATCH NAMED: ZEROP    =-3.624E+01
NET SOURCE OF EPOT AT PATCH NAMED: HEAT     = 1.036E+02
NET SOURCE OF EPOT AT PATCH NAMED: JZOUT    =-1.036E+02

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SPOT VALUES VS. SWEEP (/ITHYD IF PARAB)
   IXMON=    13    IYMON=     1    IZMON=     1

TABULATION OF ABSCISSA AND ORDINATES...
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ISWP	P1	U1	V1	W1	H1
1.000E+01	1.300E+02	3.462E-01	6.108E-03	8.609E-03	-1.810E+02
2.000E+01	8.664E+01	3.391E-01	-2.653E-04	-4.789E-04	-8.376E+01
3.000E+01	3.084E+02	3.765E-01	3.824E-02	5.121E-02	2.397E+00
4.000E+01	1.241E+03	3.300E-01	-1.043E-02	-1.966E-02	8.626E+01
5.000E+01	4.023E+02	3.543E-01	2.200E-01	-1.692E-02	1.503E+02
6.000E+01	2.765E+02	4.611E-01	5.347E-01	-5.074E-02	1.907E+02
7.000E+01	4.546E+02	3.075E-01	8.779E-01	5.891E-02	2.340E+02
8.000E+01	3.593E+02	4.699E-01	1.045E+00	1.851E-01	2.967E+02
9.000E+01	2.513E+02	6.454E-01	1.052E+00	2.823E-01	3.234E+02
1.000E+02	1.473E+02	8.818E-01	1.030E+00	3.834E-01	3.327E+02
1.100E+02	2.120E+02	1.107E+00	9.958E-01	4.871E-01	3.459E+02
1.200E+02	1.522E+02	1.334E+00	9.506E-01	5.652E-01	3.527E+02
1.300E+02	4.343E+01	1.593E+00	8.634E-01	6.610E-01	3.644E+02
1.400E+02	8.267E+01	1.815E+00	7.551E-01	7.736E-01	3.586E+02
1.500E+02	1.198E+02	2.008E+00	6.675E-01	8.448E-01	3.554E+02
1.600E+02	5.852E+01	2.202E+00	5.582E-01	9.332E-01	3.507E+02
1.700E+02	1.610E+02	2.405E+00	3.141E-01	1.064E+00	3.375E+02
1.800E+02	8.790E+01	2.550E+00	2.174E-01	1.129E+00	3.356E+02
1.900E+02	1.746E+01	2.733E+00	9.167E-02	1.199E+00	3.302E+02
2.000E+02	5.724E+01	2.899E+00	-3.376E-02	1.274E+00	3.125E+02
2.100E+02	-2.499E+03	2.117E+00	-7.788E-01	6.316E-01	3.197E+02
2.200E+02	-2.810E+03	1.866E+00	-1.694E+00	6.395E-01	2.616E+02
2.300E+02	-2.266E+03	1.432E+00	-2.957E+00	4.345E-01	9.179E+01
2.400E+02	-1.719E+03	6.366E-01	-3.909E+00	-1.871E-01	7.647E+01
2.500E+02	-2.274E+03	-3.198E-01	-5.040E+00	-5.931E-01	7.419E+01
2.600E+02	-2.127E+03	-1.163E+00	-6.103E+00	-1.070E+00	5.834E+01
2.700E+02	-2.160E+03	-2.214E+00	-6.963E+00	-1.733E+00	5.107E+01
2.800E+02	-2.246E+03	-3.343E+00	-7.832E+00	-2.335E+00	4.777E+01
2.900E+02	-2.107E+03	-4.397E+00	-8.699E+00	-2.851E+00	4.431E+01
3.000E+02	-1.963E+03	-5.526E+00	-9.598E+00	-3.394E+00	4.214E+01
3.100E+02	-1.843E+03	-6.659E+00	-1.042E+01	-3.876E+00	3.981E+01
3.200E+02	-1.745E+03	-7.728E+00	-1.115E+01	-4.257E+00	3.701E+01
3.300E+02	-1.455E+03	-8.723E+00	-1.179E+01	-4.571E+00	3.414E+01
3.400E+02	-1.195E+03	-9.656E+00	-1.229E+01	-4.803E+00	3.311E+01

3.500E+02	-1.059E+03	-1.057E+01	-1.271E+01	-4.992E+00	3.267E+01
3.600E+02	-9.661E+02	-1.142E+01	-1.305E+01	-5.135E+00	3.037E+01
3.700E+02	-8.375E+02	-1.223E+01	-1.332E+01	-5.273E+00	2.731E+01
3.800E+02	-7.365E+02	-1.308E+01	-1.355E+01	-5.419E+00	2.940E+01
3.900E+02	-6.793E+02	-1.388E+01	-1.369E+01	-5.540E+00	2.618E+01
4.000E+02	-6.057E+02	-1.463E+01	-1.377E+01	-5.633E+00	2.537E+01

ISWP	EPOT
1.000E+01	1.651E-04
2.000E+01	2.163E-04
3.000E+01	2.624E-04
4.000E+01	3.530E-04
5.000E+01	3.840E-04
6.000E+01	4.040E-04
7.000E+01	4.349E-04
8.000E+01	4.807E-04
9.000E+01	5.079E-04
1.000E+02	5.147E-04
1.100E+02	5.203E-04
1.200E+02	5.232E-04
1.300E+02	5.338E-04
1.400E+02	5.344E-04
1.500E+02	5.350E-04
1.600E+02	5.354E-04
1.700E+02	5.343E-04
1.800E+02	5.350E-04
1.900E+02	5.380E-04
2.000E+02	5.080E-04
2.100E+02	4.921E-04
2.200E+02	4.963E-04
2.300E+02	4.740E-04
2.400E+02	4.846E-04
2.500E+02	4.828E-04
2.600E+02	4.534E-04
2.700E+02	4.841E-04
2.800E+02	4.773E-04
2.900E+02	4.754E-04
3.000E+02	3.924E-04
3.100E+02	3.643E-04
3.200E+02	3.556E-04
3.300E+02	3.367E-04
3.400E+02	3.291E-04
3.500E+02	3.256E-04
3.600E+02	3.126E-04
3.700E+02	3.186E-04
3.800E+02	3.143E-04
3.900E+02	3.095E-04
4.000E+02	3.056E-04

VARIABLE	P1	U1	V1	W1	H1
MINVAL=	-2.810E+03	-1.463E+01	-1.377E+01	-5.633E+00	-1.810E+02

```
  MAXVAL=  1.241E+03  2.899E+00  1.052E+00  1.274E+00  3.644E+02
  CELLAV= -7.161E+02 -2.358E+00 -4.228E+00 -1.254E+00  1.544E+02
VARIABLE        EPOT
  MINVAL=  1.651E-04
  MAXVAL=  5.380E-04
  CELLAV=  4.251E-04

1.00 +...P+V.VVV.VEEE.EEE+EEEW+U...+....+....+....+....+
0.90 VV VVVU UHE EWWW WW   HHE EEWE E E                 +
0.80 WW WWWW HEP                HEW UE  EE              +
0.70 PP     H E   PPPP PPP PPPP   VV WWU                +
0.60 +     EE                        V W UUE            +
0.50 +    E                       HH HVV W UE EE   PPP PP
0.40 +                               HH HHHH HHE EEEE EE
0.30 +   E                         P       VWW PUU      +
0.20 +H                               PP   PPV WW   UU  +
0.10 +E                         P P  P    P      VW WWWU +
0.00 E....+....+....+....+....+.P..+....+....+....VVW.WW
     0    .1   .2   .3   .4   .5   .6   .7   .8   .9  1.0
THE ABSCISSA IS      ISWP.  MIN= 1.00E+01 MAX= 4.00E+02
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RESIDUALS VS. SWEEP (/ITHYD IF PARAB)

TABULATION OF ABSCISSA AND ORDINATES...

ISWP	P1	U1	V1	W1	H1
1.000E+01	2.999E+04	1.592E+11	1.278E+11	2.073E+11	2.316E+09
2.000E+01	2.544E+04	1.951E+11	1.293E+11	2.619E+11	2.301E+09
3.000E+01	1.298E+05	3.100E+11	2.733E+11	5.982E+11	2.103E+09
4.000E+01	5.186E+04	1.625E+11	1.157E+11	3.793E+11	1.980E+09
5.000E+01	1.021E+05	3.738E+11	3.153E+11	6.085E+11	1.797E+09
6.000E+01	1.186E+05	4.038E+11	3.336E+11	6.218E+11	1.778E+09
7.000E+01	8.071E+04	3.799E+11	3.078E+11	6.136E+11	1.641E+09
8.000E+01	6.410E+04	2.362E+11	1.946E+11	4.042E+11	1.592E+09
9.000E+01	4.403E+04	1.200E+11	9.309E+10	2.098E+11	1.521E+09
1.000E+02	3.998E+04	8.400E+10	6.936E+10	2.159E+11	1.476E+09
1.100E+02	3.011E+04	1.053E+11	8.018E+10	2.086E+11	1.181E+09
1.200E+02	3.223E+04	6.569E+10	4.763E+10	1.295E+11	1.044E+09
1.300E+02	3.744E+04	1.978E+11	1.438E+11	2.250E+11	9.623E+08
1.400E+02	3.286E+04	1.124E+11	8.625E+10	1.778E+11	8.914E+08
1.500E+02	2.187E+04	9.148E+10	8.840E+10	2.099E+11	8.034E+08
1.600E+02	3.460E+04	7.195E+10	5.648E+10	1.206E+11	7.162E+08
1.700E+02	4.516E+04	1.226E+11	1.014E+11	2.427E+11	6.662E+08
1.800E+02	3.305E+04	6.510E+10	5.669E+10	1.303E+11	5.930E+08
1.900E+02	3.033E+04	1.062E+11	9.172E+10	1.805E+11	5.285E+08
2.000E+02	2.885E+04	6.604E+10	6.130E+10	1.355E+11	4.841E+08
2.100E+02	1.552E+06	7.559E+12	6.490E+12	1.075E+13	1.697E+09

2.200E+02	3.696E+05	9.953E+11	1.053E+12	2.312E+12	8.166E+08
2.300E+02	5.970E+05	1.984E+12	1.624E+12	3.140E+12	8.947E+08
2.400E+02	2.057E+05	9.565E+11	6.522E+11	1.719E+12	6.699E+08
2.500E+02	1.977E+05	6.449E+11	3.678E+11	1.207E+12	4.103E+08
2.600E+02	1.724E+05	6.273E+11	2.630E+11	9.690E+11	4.260E+08
2.700E+02	8.586E+04	2.585E+11	1.296E+11	5.668E+11	3.576E+08
2.800E+02	5.614E+04	1.549E+11	8.887E+10	4.523E+11	2.980E+08
2.900E+02	1.123E+05	1.894E+11	7.693E+10	4.055E+11	3.126E+08
3.000E+02	1.100E+05	2.244E+11	9.819E+10	3.911E+11	2.726E+08
3.100E+02	6.123E+04	1.399E+11	6.781E+10	3.118E+11	2.399E+08
3.200E+02	9.802E+04	1.350E+11	4.068E+10	3.071E+11	2.160E+08
3.300E+02	1.682E+05	2.871E+11	1.240E+11	4.695E+11	2.211E+08
3.400E+02	1.551E+05	2.854E+11	9.984E+10	5.263E+11	1.672E+08
3.500E+02	1.092E+05	1.496E+11	4.506E+10	3.922E+11	1.557E+08
3.600E+02	1.188E+05	1.104E+11	5.584E+10	3.401E+11	1.443E+08
3.700E+02	1.568E+05	3.040E+11	1.486E+11	6.478E+11	1.331E+08
3.800E+02	9.581E+04	1.064E+11	3.409E+10	3.673E+11	1.026E+08
3.900E+02	7.460E+04	7.690E+10	3.154E+10	2.731E+11	1.351E+08
4.000E+02	7.700E+04	7.427E+10	3.257E+10	2.760E+11	2.230E+08

ISWP	EPOT
1.000E+01	2.665E+08
2.000E+01	2.305E+08
3.000E+01	1.765E+08
4.000E+01	1.669E+08
5.000E+01	1.409E+08
6.000E+01	1.216E+08
7.000E+01	1.118E+08
8.000E+01	1.173E+08
9.000E+01	1.161E+08
1.000E+02	1.097E+08
1.100E+02	7.653E+07
1.200E+02	6.935E+07
1.300E+02	6.488E+07
1.400E+02	6.097E+07
1.500E+02	5.804E+07
1.600E+02	5.598E+07
1.700E+02	5.449E+07
1.800E+02	5.442E+07
1.900E+02	5.370E+07
2.000E+02	5.768E+07
2.100E+02	6.821E+07
2.200E+02	8.626E+07
2.300E+02	6.015E+07
2.400E+02	5.575E+07
2.500E+02	5.297E+07
2.600E+02	4.984E+07
2.700E+02	5.203E+07
2.800E+02	5.335E+07
2.900E+02	4.941E+07

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  3.000E+02  6.589E+07
  3.100E+02  6.721E+07
  3.200E+02  6.683E+07
  3.300E+02  7.162E+07
  3.400E+02  6.746E+07
  3.500E+02  6.633E+07
  3.600E+02  7.466E+07
  3.700E+02  7.522E+07
  3.800E+02  7.337E+07
  3.900E+02  7.351E+07
  4.000E+02  7.428E+07
  VARIABLE          P1          U1          V1          W1          H1
    MINVAL=  9.993E+00   2.490E+01   2.417E+01   2.552E+01   1.845E+01
    MAXVAL=  1.426E+01   2.965E+01   2.950E+01   3.001E+01   2.156E+01
  VARIABLE        EPOT
    MINVAL=  1.772E+01
    MAXVAL=  1.940E+01

1.00 EH.H.+....+....+....+....+W...+....+....+....+....+
0.90 +E  HHH HHH H             H                       +
0.80 +  E         H              P                     +
0.70 +   E         HH HH        HH                     +
0.60 +    E             H HH    U H                    +
0.50 +     E EEE E          HH    P WH        PP   P   +
0.40 +  W WW W                      HVH  HP  P   PPW   +
0.30 VV UW   PW   E V           E     W HWHH  WW W VP PP
0.20 UW  V     V  VEE VV  W V  E        VVEE EEE EEEE EE
0.10 W         W WWVW EEE EEWE   EE        V     HHHU H+
0.00 +P...+....+...W+..PW+.WEW+....+EEE.EE...V....+.H.VV
     0   .1   .2   .3   .4   .5   .6   .7   .8   .9  1.0
THE ABSCISSA IS       ISWP.  MIN= 1.00E+01 MAX= 4.00E+02
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DATA FOR RE-STARTS AND PLOTTING SAVED ON ARCA
RUN NO.   1  ENDED AT ISWEEP=    400  AND ISTEP=      1

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SATLIT RUN NUMBER =    1
RUN COMPLETED AT 14:28:58 ON TUESDAY,27 JANUARY 1987
MACHINE-CLOCK TIME OF RUN =     2256 SECONDS.
TIME/(VARIABLES*CELLS*TSTEPS*SWEEPS*ITS) = 7.520E-04
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 NORMAL STOP REACHED IN PROGRAM
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