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COMPUTER MODEL OF AN
AVIATION GAS
TURBINE TEST FACILITY

by

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Computer Model of an
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Turbine Test Facility

by

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ABSTRACT

A computer model of an aviation gas turbine test facility was developed and analyzed to compare computer generated gas pressures, temperatures, and velocities to those of an actual, operational test facility. The computer model simulated the Royal Danish Air Force Test Facility at the Skrydstrup Air Force Base, Denmark. The Parabolic, Hyperbolic, or Elliptic Numerical Integration Code Series (PHOENICS) was used. The Computer Model output compared well with actual data obtained from the Denmark test facility. Tabular Data and Figures are presented.

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I. INTRODUCTION

A. BACKGROUND

The United States Navy desires to provide standardized test facilities for the testing of its aviation gas turbine jet engines (Ref 1).

Today's high performance and high technology jet engines require accurate, consistent, and controlled testing to assess performance throughout the jet engine's entire operational range Modern day test facilities must incorporate state of the art equipment and instrumentation such that jet engines may be tested in or out of the aircraft, around the clock, and year round.

B. NATURE OF THE PROBLEM

Presently, 75 Navy and Marine Corp activities worldwide operate 81 Jet Engine Test Facilities (Ref 1). Of these, 60 are fully operational and 51 are over 25 years old. Immediate problem areas which hinder operational needs include: structural degradation, obsolescence, noise, and air pollution.

1. Structural Degradation

High jet engine exhaust gas temperatures and water impingement on diffusers and interior concrete walls have caused cracking and spalling of test facility interiors.

Concrete reinforcing rods exposed to a hot, moist environment will corrode and thereby reduce structural integrity. Noise reduction baffles and exhaust gas turning vanes are being damaged by flying concrete debris. Replacement of baffling and turning vanes is required as often as every three years. The maintenance requirements navy wide has significantly increased the workload and operational costs of the Navy Public Works Department.

2. <u>Obsolescence</u>

Several of the test facilities require major modernization or even complete replacement due to current aircraft designs and test requirements. Examples of modernization include improved engine handling systems and engine thrust stands. Increased access to engine components and test points greatly improves testing efficiency. Additionally, with today's high technology engines, state of the art data acquisition systems are required.

3. <u>Noise</u>

Most of the older test facilities use water for exhaust gas cooling. The water and the high exhaust gas temperature deteriorates the acoutic baffling silencing capabilities. The increased noise level degrades the work environment. Worker efficiency is reduced and the high test facility interior sound levels are being suspected of contributing to engine deterioration. State of the art engines using thinner, lighter materials are more sensitive to acoustic fatigue (Ref 1).

4. Air Pollution

Today's high power and high mass flow engines constitute a major problem to the environment. Visible particulate matter is emitted in excess of allowable environmental pollution standards. By Executive Order Number 11282, May 26, 1966 (Ref 2), Jet Engine Test Facilities must meet local laws concerning the environment. Judicial action by the state of California against Jet Engine Test Facilities within California (Ref 3) has identified a need to address pollution control measures during the design, construction, and operation of Jet Engine Test Facilities.

C. TYPES OF TEST FACILITIES

The Navy operates five types of Jet Engine Test Facilities (Ref. 1). Each facility utilizes some form of hold down device for the engine or the aircraft and instrumentation to monitor the performance of the engine. Each facility must be designed such that several engine types may be tested (e.g., turboprop, turbofan, turboshaft, turbojet). The types of facilities are:

1. Run-up Pad

The simplest test facility is the run-up (power check) pad. Normally, the engine is tested while installed in the aircraft. Therefore, the aircraft acts as the hold-down device. The run-up pad is usually located in remote locations due to high noise levels encountered during testing.

2. <u>Sound Suppressors</u>

These are usually equipment packages which are used to reduce inlet and exhaust noise from a tied down aircraft. The sound suppressors may be used to augment or to substitute for the run-up pads.

3. <u>Open Test Stand</u>

This is an outdoor test facility which supports and constrains the engine during test. Due to noise levels, the open test stand must be located in a remote area. Portable sensors and instrumentation are utilized to monitor engine performance.

4. <u>Hush House</u>

This is a total aircraft enclosure. It permits round the clock and year round testing. Normally on twin engine aircraft, only one engine may be tested in full after burner. The other engine is held at idle.

5. <u>Fully Enclosed Test Cell</u>

This test facility is normally capable of testing several types and sizes of jet engines. The engines may be in or out of the aircraft. The facility is normally equipped with all the necessary instrumentation and data gathering equipment required to perform routine or complex testing after jet engine rework or overhaul. Testing may be performed round the clock and year round.

The type of test facility to utilize at an activity is dependent upon several factors. Availability of military construction funds, required control of noise and emissions (environmental concern), amount of maintenance testing, and military and civilian manpower requirements are all key factors.

D. RESEARCH GOAL

To provide quality jet engine testing, to comply with local environmental standards, and to ensure fleet readiness, the Navy embarked on a comprehensive program in 1984 to upgrade and to modernize as necessary all jet engine test facilities under its cognizance. To this end, it was necessary to review existing jet engine test procedures and to examine jet engine test facilities to determine which facilities met desired criteria. Additionally, the Navy decided to explore the feasibility of the computer modeling of aviation gas turbine jet engine test facilities. It was felt that if a computer model could accurately represent an actual operational test facility then a computer model could also be used to predict the operation of future proposed test facilities. The purpose of this research was to computer model the Royal Danish Test Facility and to compare computer generated temperatures, pressures, and velocities with actual data obtained in the field and to investigate techniques necessary to make computer simulations of flow and temperature fields useful for predictive purposes.

II. TEST FACILITY OPERATION

The basic geometry of the Denmark test facility is shown in Figure C.1. For simplicity all storage areas, engine preparation rooms, and control modules are not included. The test facility is basically comprised of the primary air inlet, a test bay, an exhaust duct (also called an augmentor tube), secondary air inlets, and an exhaust stack. Turning vanes, which are not shown, are located in the exhaust duct to exhaust stack transition region. This feature better utilizes the total exhaust stack cross section with an attendant reduction in exhaust gas noise (Ref 4). Baffles (not shown) are located at three places: At the top of the exhaust stack, within the secondary air inlets, and within the primary air inlet (test bay doors). The baffles also provide noise reduction (Ref 4).

During a jet engine test, the engine is aligned with the centerline of the exhaust duct. This can be accomplished either with the engine in the aircraft or with the engine supported in a test stand. With proper alignment, a near uniform flow profile develops (Ref 3) inside the augmentor tube. Primary air is drawn in through the primary air inlet (test bay door/baffle configuration). For a F-100 Engine, at full throttle and after burner on, the primary air mass flow rate is 260 kg/sec of which

100 kg/sec is the mass flow rate through the engine (Ref. 4). As the exhaust gas enters the augmentor tube, air from within the test bay is entrained into the augmentor tube. The exhaust gas moving through the augmentor tube also entrains air coming through the secondary air inlets. The secondary air mass flow rate is 340 kg/sec (Ref. 4). Both the entrained primary and secondary air play an important role in the test facility operation. Hot and noisy jet engine gases must be treated prior to leaving the test facility in order to comply with environmental standards. To treat jet engine exhaust, its temperature, noise level, and particulate density must be lowered.

The ratio of total "cooling" air (primary and secondary) mass flow rate to the engine mass flow rate is called the Augmentation Ratio. The Augmentation Ratio is a key to successful test facility operation. With appropriate primary air and secondary air mass flow rates, the exhaust gas is sufficiently cooled which helps prolong duct/stack life and the exhaust gas is sufficiently diluted such that proper pollution levels are obtained (Ref. 2). The Augmentation Ratio of the Denmark Test Facility is 5:1.

With a computer model that can accurately predict test facility operation, design personnel will have the ability to easily change model parameters such as engine location or structural dimensions and to observe their effect on test facility operation. For example by changing the secondary air inlet configuration, the augmentation ratio is changed. This in turn has an effect over exhaust gas cooling. Additionally, design engineers may wish to experiment with various exhaust stack heights or exhaust duct openings. A mere changing of a few lines of computer model source code accomplishes this. In all, a computer model could save significant time and money in the design of future jet engine test facilities.

III. DESCRIPTION OF PHOENICS

A. WHAT IS PHOENICS

PHOENICS is a general-purpose, computer-code system for simulating fluid flow, heat transfer, and chemical reaction processes in engineering equipment or the environment. PHOENICS is an acronym for Parabolic, Hyperbolic, or Elliptic Numerical Integration Code Series. Typical applications of PHOENICS include: Thermal hydraulics of nuclear reactors and other power plants; external hydrodynamics and aerodynamics of cars, ships, buildings, etc; air movement within an enclosed space, both under normal conditions and in the presence of a fire; flows in pumps and turbomachinery. PHOENICS was developed by D. Brian Spalding of CHAM Ltd and of Imperial College of London, England. Information regarding the history and development of PHOENICS is contained in the user's guide (Ref 5).

B. HOW PHOENICS WORKS

The PHOENICS computer code consists of two separate computer programs: EARTH and Q1. The EARTH program resides in the computer mainframe as an object code and cannot be accessed by the user. The user couples his problem (defined by the user) to the EARTH code. The EARTH program contains the main flow simulating software and various coding sequences which simulate the Laws of Physics as applied to the conservation principles: energy, mass, momentum. The Q1 program defines the problem and differs from one flow simulation program to the next. The Q1 program represents the user's decision as to what problem is to be simulated. The Q1 program activates the EARTH program which solves the problem.

The PHOENICS code is capable of describing flow simulations in terms of distributions in time and space. The distributions involve assigning numerical values for all dependent variables to an orderly array of cells located in the physical domain of the problem. Temperature, pressure, concentration, KE (Turbulence Kinetic Energy), and EP (Kinetic Energy Dissipation Rate) values are located at a cell's center while velocity values are located at the positive faces of the cells. A cell configuration in the X-Y plane is illustrated in Figure C.2. Temperatures, pressures, and concentrations would be located at N, S, E, W, and G for example while velocities would be at N', S', E', and W'. A similar procedure is utilized for the Z (low-to-high) direction. This convention is called the "STAGGERED GRID" arrangement. If the flow simulation is time dependent, the distributions are obtained for each variable at a succession of times instants. The Denmark test facility model flow simulation is for steady state conditions.

In general, a PHOENICS flow simulation is four dimensional: 1 time and three space coordinates. For ease of reference to the user, PHOENICS measures time in the past-to-future direction; X coordinates in the west-to-east direction, Y coordinates in the south-to-north direction, and Z coordinates in the low-to-high direction. This concept is illustrated in Figure C.3. Although Figure C.3 represents a Cartesian configuration, individual cells may vary in shape and size as determined by a user defined code. This option, called BFC, was not utilized in this investigation. The Denmark test facility model is a Cartesian configuration of cells which vary in size.

PHOENICS calculates the dependant variables over the complete set of cells, which defines the operational (e.g., system, physical) domain, with linear algebraic equations that represent the conservation laws. Here the partial differential equations are those governing the conservation of energy, momentum, and mass and the linear algebraic equations are obtained by the finite volume method. The finite volume method is a method having some features from the finite differencing method and the finite element method. The conservation partial differential equations will not be discussed here; except to say that the original non linear, coupled conservation partial differential equations are linearized. Interested readers are directed to the PHOENICS User's Manual (Ref. 5) for detailed information.

PHOENICS utilizes an iterative process involving a multi-stage sequence of dependent variable value adjustments. The process is repeated several times until the left and right imbalance (called a residual) of each equation is reduced to a negligible amount. A variety of iterative procedures are available to the user. The "SLAB-SWEEP" iterative process feature of PHOENICS for equation imbalance reduction was chosen for the Denmark test facility model. Slabs are arrays of cells having the same Z (low-to-high) coordinate. PHOENICS conducts many mathematical operations over a slab in an attempt to reduce dependent variable imbalances among cells within the slab prior to moving on to the next slab. The adjustment operations are referred to as "SLABWISE SOLUTIONS". The operations begin at the lowest numbered slab and continue sequentially to the highest numbered slab. A sweep is a completed set of slabwise operations. The equations for dependent variable values at one slab are coupled to values of other dependent variables at neighbor slabs. For this reason numerous sweeps are normally required until all dependent variable imbalances are negligible. This is a necessary but not a sufficient condition for problem convergence.

C. PHOENICS INPUT LANGUAGE

The source code used in a PHOENICS Q1 program is arranged in a 24 group data structure. Figure C.4 lists the group categories of the data structure. The developers of the PHOENICS code suggest this ordering of the groups normally conforms to a well thought out flow simulation problem description. However, any group ordering the user desires will be acceptable to PHOENICS. It is the PHOENICS defined variables and keywords plus the user defined variables that actually trigger desired PHOENICS responses as opposed to a particular group ordering. A detailed description of group functions is explained in the PHOENICS User's Manual (Ref. 5).

D. MODEL GEOMETRY

PHOENICS utilizes three distinct procedures for defining a flow simulation operational domain (grid): Cylindrical-polar, Body-fitted, and Cartesian coordinate systems.

1. Cylindrical-Polar Coordinate System

The cylindrical-polar grid arrangement consists of planes with constant Z coordinates that are perpendicular to an axis of rotation, planes with a constant X coordinate (usually called the Theta coordinate) that intersect with the axis of rotation giving the X coordinate a representation in radians, and concentric cylindrical surfaces with a constant Y radial coordinate.

2. <u>Body-Fitted Coordinate System</u>

This arrangement is best thought of as starting with an orthogonal group of cells made of clay. The cells are then squeezed, bent, twisted, and stretched into the desired shape for the fluid flow simulation operational domain. Each cell although distorted in shape and size still remains in contact with its original neighbors.

3. <u>Cartesian Coordinate System</u>

The Cartesian grid arrangement is composed of cells in a mutually perpendicular X, Y and Z coordinate system. As such the cell faces form planes that intersect at right angles. The spacing between the cell faces (planes) is user defined.

Due to the regularity of a Cartesian coordinate system, the information required to specify the geometry is rather modest. The PHOENICS variables NX, NY, and NZ specify the number of cells the operational domain is to have in the X, Y, and Z directions respectively. The PHOENICS variables XULAST, YVLAST, and ZWLAST specify the domain lengths in the X, Y, and Z directions. The "METHOD-OF-PAIRS" is a PHOENICS coding sequence to specify the number of cells per length of domain in the X, Y, and Z directions. XFRAC, YFRAC, and ZFRAC are PHOENICS variables for arrays used in the method-of-pairs coding sequence.

The odd indexed array elements, for example, XFRAC(1), XFRAC(3), XFRAC(5), etc., specify the number of cells in a particular length of operational domain while the even indexed array elements XFRAC(2), XFRAC(4), and XFRAC(6) specifies the length of each cell. A negative argument for the first element in each array tells PHOENICS that the method-of-pairs is being utilized. For example, "XFRAC(1) =-2.0;XFRAC(2)=0.1" tells PHOENICS the method-of-pairs is to be used and that the first cell group in the X direction is to have two cells and the length of each cell is 0.1 meter. "XFRAC(9)=4.0;XFRAC(10)=0.15" specifies the number of cells and lengths of each cell in the "FIFTH" X direction cell group.

E. POROSITY AND BLOCKAGE

In any flow simulation problem there exists walls, submerged bodies, or some form of obstruction to fluid flow. For example, in Hagen-Poiseuille pipe flow the fluid is confined to the interior of the pipe. Additionally, due to wall friction the fluid's velocity at the wall is zero. In a PHOENICS flow simulation problem, obstructions to fluid flow must also be introduced. In a jet engine test facility model one must be concerned with obstructions to flow as a result of walls, floors, baffle material, turning vanes, and the jet engine itself. To account for the physical obstructions, PHOENICS makes use of the command

"CONPOR(R.R, TYPE,XF,XL,YF,YL,ZF,ZL)". The real number "R.R" normally has a value from 0.0 to 1.0. This value tells PHOENICS how much obstruction to flow is to be introduced by a surface or volume. For maximum obstruction (blocked flow), "R.R" would be 0.0. The "TYPE" argument specifies a surface or volume. For example a surface might be the inside of the test bay ceiling. A volume might be the geometric body of the jet engine. For a surface obstruction the "TYPE" Arguments "WEST, EAST, SOUTH, NORTH, LOW, OR HIGH" (the faces of an individual cell) are used. For a volume obstruction the type "CELL" is used. The arguments "XF, XL, YF, YL, ZF, and ZL" identify the first and last cells of the obstruction domain in the X, Y, and Z directions respectively. For example "CONPOR(0.0, HIGH, 1,3,1,1,3,3)" tells PHOENICS to introduce complete obstruction to flow through the "HIGH" (Z direction) surfaces of the group of cells starting at IX=1, IY=1, and IZ=3, and ending at cells IX=3, IY=1, and IZ=3 respectively. Each cell has an IX, IY, and IZ identity. Figure C.5 illustrates "HIGH" surface obstruction to flow. The cross-hatched surface blocks Z direction flow. "CONPOR (0.0,CELL,1,3,1,1,1,3)" would introduce maximum obstruction to flow through the surfaces of the volume defined by these coordinates. In Figure C.5, the "CELL" volume outlined with bold lines prevents fluid flow perpendicular to any of its surfaces.

PHOENICS also has the ability to introduce wall or surface "FRICTION" which brings about zero magnitude velocity components on a cell's surface and calculates the friction coefficient. For the above "HIGH" example, the magnitude of flow in the Z direction was set to zero on the surfaces of several cells. To also set the X and Y velocity components to zero on the same "HIGH" surfaces, the CONPOR command requires a slight modification. Utilizing a "NEGATIVE" argument with the CONPOR command accomplishes the desired action. For example "CONPOR(0.0,HIGH,1,3,1,1,3,-3)" causes the X, Y, and Z velocity components on the "HIGH" surfaces of that particular group of cells to be zeroed. Through the use of the negative argument convention, velocity components on the external surfaces of a volume (cell) can be zeroed, and friction introduced into the model.

F. SOURCE AND BOUNDARY CONDITIONS

In any PHOENICS flow simulation problem description, the user's Q1 program must introduce source and boundary conditions to the EARTH program. Through the use of PHOENICS keywords, source and boundary conditions may be identified as energy, momentum, or mass flow. Energy sources are identified with the enthalpy variable "H", momentum by the velocity variables "U, V, or W", and mass flow utilizes the pressure variable "P". By using the notation "H1" a fluid's first phase enthalpy would be identified while "H2" would refer to second phase enthalpy for a two phase flow simulation. Information about inflow and outflow of any variable in the system domain is conveyed to the EARTH Program by way of the PHOENICS combination "PATCH-COVAL" statements. The PATCH command is used to specify the location at which a source or boundary condition is to be applied and to also specify the "TYPE" factor or what the PATCH command is to do to the system domain. The COVAL command is used to specify the coefficient and value which combine to determine the magnitude of the dependent variable over a PATCH. For example, "PATCH(JETOUT,LOW,1,1,5,6,8,8,1,1); COVAL(JETOUT,P1,FIXFLU,100.0); COVAL(JETOUT,W1,ONLYMS,500.0);COVAL(JETOUT,H1,ONLYMS, 200000.0)" specifies a 100 kg/sec, steady-state, fixed-flux mass source. The mass source, named JETOUT, begins at the low faces of the cells IX=1, IY=5, and IZ=8 and ends at IX=1, IY=6, and IZ=8. The mass source has a Z direction velocity of 500 m/sec and an enthalpy of 200,000 J/kg. The COVAL coefficient "ONLYMS" specifies that only convection flow effects are influential in the transport of enthalpy from the cell faces to the cell centers. That is, diffusive effects are zero. Appendix 2 of the PHOENICS User's Manual (Ref. 5) lists the various "TYPES", "COEFFICIENTS", and "VALUES" that may be used with the combination "PATCH-COVAL" statements.

G. INITIAL CONDITIONS

In order to obtain the solution of a steady state problem, PHOENICS starts the iterative solution with an initial field of the dependent variables. The default initial fields for all dependent variables is zero over the entire physical domain. However, convergence to the true solution can be speeded up by the user specifying initial field conditions via "FIINIT" (Field Initialization) statements over the entire operational domain or "PATCH-INIT" statements over subdomains of the system. For example "FIINIT(H1)=AMOUNT" initialize a first phase enthalpy field to a user-defined value "AMOUNT". "PATCH(GASIN,INIVAL,XF,XL,YF,YL,ZF,ZL,TF,TL);INIT(GASIN,P1, COEFFICIENT, VALUE)" initializes a first phase pressure field for the user-defined PATCH "GASIN". XF,XL,YF,YL,ZF, and ZL define the geometric region of the PATCH called "GASIN".

H. MAXIMUM/MINIMUM VALUES

At the beginning of a flow simulation problem iterative process, a poorly defined dependent variable field value may have an adverse affect on problem convergence. At times, dependent variables "STRAY" outside of a physically meaningful range and cause numerical divergence. To help minimize divergence of the solution PHOENICS utilizes the "VARMIN" and VARMAX" commands. These commands are used to set upper and lower bounds on any dependent variables. "VARMIN"(VI)=SLOW;VARMAX(W1)=FAST" sets a lower limit of "SLOW" to V1 and an upper limit of "FAST" to W1.

I. UNDER-RELAXATION FACTORS

A feature of PHOENICS which greatly assists problem convergence is the application of "UNDER-RELAXATION" factors to flow simulation dependent variables. This practice is most useful on an operational domain comprised of ill-proportioned cells (very large cells adjacent to very small cells). During program execution, EARTH'S dependent variable correction equations may develop enormously large coefficients between adjacent cells. The coefficient disparity often contributes to solution divergence. With selective "UNDER-RELAXATION" applied to a flow simulation program, PHOENICS introducers "FALSE-TIME-STEP" values to select dependant variables thereby preventing large dependent variable changes in magnitude per sweep. The "FALSE-TIME-STEP" brings equation coefficients closer together "LESS ABRUPTLY" which promotes problem convergence. "UNDER-RELAXATION" for pressure, velocity, and enthalpy components is frequently required for steady state problems.

J. PROGRAM RUN PROCEDURES

The Denmark test facility model was analyzed on the Naval Postgraduate School IBM-3033 mainframe computer system. Program run procedures involve interactive terminal sessions and a batch submission. The necessary flow simulation Q1 program and Job Control Language (JCL) programs reside in the User's mainframe storage area. All flow simulation programs are submitted for execution by means of "EXEC" (execute) and JCL files. The EXEC files are activated by the keywords "COPYQ1", "RUNSAT", and "RUNEAR".

The COPYQ1 EXEC file queries the user as to the name and file type of the flow simulation Q1 program source code. Afterwards the COPYQ1 EXEC file stores the source code and appropriate JCL in a temporary file. At this point, the user must ensure the above transfer of data was successful. This is accomplished through the user's "VIRTUAL READER" file. An inspection of this file will reveal various condition codes which indicate the status of data transfer. Figure C.6 is an example of COPYQ1 EXEC and JCL files.

The "RUNSAT" EXEC file extracts from the user's mainframe storage area JCL which enables a Q1 program to EARTH program communications link. This JCL is also stored in a temporary file. Again a virtual reader file inspection must be made to ensure that a successful data transfer was achieved. Figures C.7 and C.8 are examples of RUNSAT EXEC and JCL files.

Finally after successful COPYQ1 and RUNSAT data transfers, the flow simulation problem is ready for execution. The "RUNEAR" EXEC file is called, Necessary mainframe storage is allocated and the PHOENICS system is activated. Figure C.9 is an example of RUNEAR EXEC and JCL files. Upon program completion, PHOENICS output is sent to the user's virtual reader file. After the PHOENICS output is analyzed, the user may discard the information or utilize a PHOENICS restart which allows the problem to continue from where it last ended. Upon completion of a PHOENICS run, output is stored on disk file "DF09". To access this file and to continue the problem the PHOENICS code "RESTRT(A,B,....,Z)" must be utilized in the Q1 program. "A,B,...,Z" represent the dependent variables which are to continue from their last value when the program ended. If the user desires all dependent variables to restart from their last values then "RESTRT(ALL)" can be used in the Q1 program.

IV. MODELING THE DENMARK TEST FACILITY

A. MODEL DESCRIPTION

The Denmark test facility model utilizes a Cartesian grid arrangement. Figure C.10 is a schematic diagram of the test facility in the Y-Z pane (side view). Figure C.11 is the X-Z plane (top view) representation. The PHOENICS code allows for a plane of symmetry. For the Denmark test facility model the vertical Y-Z plane is one of symmetry. Therefore, in Figure C.11 only half of the Denmark test facility is represented, In this figure the jet engine is slightly off-of-center from the Z axis for clarity only.

To facilitate the Denmark test facility model geometry specifications, the system domain was divided into user defined zones. Each zone comprises a particular section of the Denmark test facility model. For example in Figure C.12, "YLBL1" is a user defined variable which specified the length of the first zone in the Y direction. This particular zone represents the length in the Y direction from the ground or floor of the Denmark test facility up 2.0 meters. "ZLEXT2" represents the length in the Z direction of the atmosphere behind the test facility, and so on. Figure C.12 is a schematic diagram of the system domain zones which make up the vertical Y-Z plane while C.13 illustrates the zones in the horizontal X-Z plane.

The zone concept has proven to be very flexible. The number of cells in each zone may be specified by a user defined variable. For example, "XNCBL1" specifies the number of cells in the X direction for the length of operational domain "XLBL1". "ZNCEX2" specifies the number of cells in the Z direction for the length of operational domain "ZLEXT2" and so on. Grid refinement for a particular zone can be accomplished without any difficulty by changing one variable in the Q1 code. Figure C.14 is the method-of-pairs coding sequence which specifies the operational domain zones and numbers of cells used in the Denmark test facility model. Figure C.15 is an example of the EARTH output for the Q1 code in Appendix A.

Program run time, program cost and EARTH output are directly affected by the number of cells in the model of the physical domain. By increasing the number of cells in the X, Y, or Z direction zones, the EARTH program requires more "SLAB-WISE" Computations thereby increasing computer CPU requirements and costs. By increasing the number of cells in the X or Y directions (i.e., NX or NY), the number of cells and therefore the number of calculations is increased. For example for a fixed NY, SAY 16, an increase of 1 cell in the X direction will result in 7 (number of dependent variables) times 16 = 102 additional equations (and unknowns). An increase of an additional cell in the Z direction will result in 7 times NX times NY additional equations. For example for NX=9 and NY=16, increasing NZ from 28 to 29 will result in an additional 1,008 equations. Therefore, deciding to use a "COURSE" or "FINE" model of the physical domain is determined by the user's time and financial constraints and the desired information from the flow simulation program. The Denmark test facility model has NX=9, NY=16 and NZ=28 for a grand total of 4,032 cells. Since each cell has 7 dependent variables, 28,224 linear algebraic equations must be solved iteratively to achieve problem convergence. This is a big job even for an IBM mainframe computer.

For the purpose of this research, the Denmark test facility was modeled with a "COARSE" grid with the intent of achieving problem convergence prior to using a "fine" grid. Due to time constaints only one grid was used in this research. Therefore, problem convergence could not be identified as "GRID INDEPENDENT".

Although the Denmark test facility model grid is considered "COARSE", many of the cells vary in size. The number and size of cells for a particular region of the grid was chosen based upon the expected activity in a region. For example, at the primary air inlet, one would expect primary cooling air to be entering at a relatively low velocity and in a laminar and uniform flow. Then as the primary air approaches the jet engine intake, fluid velocities should be increasing in magnitude and changing in direction. At the outlet of the jet engine there exists a very hot and a very fast fluid flow mixing with entrained primary cooling air. In this particular region with a lot or activity, a less "COARSE" grid is more desirable in order to incorporate the mixing process into the model. As the exhaust gas enters the augmentor tube it mixes with the cooler entrained secondary air. Again, a less "COARSE" grid is necessary to better analyze the activity involved.

Figure C.16 is a schematic diagram of the system domain grid for the X-Z plane while Figure C.17 represents the Y-Z plane. The two figures illustrate a less "COARSE" grid arrangement at the jet engine exhaust, augmentor tube inlet, and secondary air inlet. Again, grid refinement for any physical domain zone is accomplished by changing one user defined variable in the Q1 code.

Although the Denmark test facility was modeled as a three-dimensional structure. The body fitted coordinate option of PHOENICS was not utilized. As such, the cylindrical jet engine, the augmentor tube, and the exhaust stack turning vanes were modeled as rectangular cubes. The jet engine was specified as a solid block with a hot mass source at one end and a mass sink at the other end. The jet engine was modeled with CONPOR and PATCH-COVAL statements.

The Denmark test facility walls, floor, and ceilings were modeled utilizing CONPOR and PATCH-COVAL statements. The CONPOR statements were given a zero porosity value thereby preventing mass transfer across any solid structure. PATCH-COVAL statements were necessary for the walls, floor, and ceilings in order to introduce appropriate friction and set fluid velocity components to zero magnitude at the structure surfaces.

B. MODEL BOUNDARY CONDITIONS AND TURBULENCE MODELS

Boundary conditions for the Denmark test facility openings to the atmosphere were specified with PATCH-COVAL statements. Ambient pressure was set to 101,325 Pascals while ambient temperature was set to 295 K.

To incorporate turbulence into the flow simulation problem, this research utilized the PHOENICS K-E turbulence model. The K-E model introduces the KE (turbulence kinetic energy) and EP (kinetic energy dissipation rate) dependent variables into the problem. Turbulence modeling is not an exact science and the choice of the K-E model for this research was arbitrary. The PHOENICS user's manual (Ref. 5) explains in detail the K-E turbulence model and three other turbulence models available to the PHOENICS user.

Readers may refer to Appendix A, the annotated Q1 code, which explains in detail the user defined variables for the

Denmark test facility model. Columns 1 and 2 are reserved for the beginning of executable statements, while non-executable statements (comments) begin in column 3 or beyond.

V. ANALYSIS OF RESULTS

A. OBTAINING A FINAL SOLUTION

The original purpose of this research was to computer model the Royal Danish Air Force Gas Turbine Test Facility using the PHOENICS code. The computer model would then be used to compare field data obtained from the test facility with computer generated pressures, temperatures, and velocities. If the computer generated output compared well with the field data, one might suggest that the computer model was successful. However, if field data from a test facility was non-existent or perhaps very limited how then could the success of a computer model be measured?

The field data from the Denmark test facility was limited in scope. Besides the mass flow described in Chapter II, the only other field data available are the test bay pressure and the velocity and temperature of the engine exhaust at one point in the augmentor tube and at one point in the exhaust stack. Since the field data from the Denmark test facility was limited, a comprehensive comparison of field data with numerical results was not possible. To investigate the EARTH output (numerical results) and conclude that the numerical results were representative of the test facility, this study examined the EARTH output from three viewpoints: common sense approach, conservation equation balances, and problem convergence.

B. COMMON SENSE APPROACH

The Denmark test facility was modeled with five major regions or zones. Within each zone a common sense approach to what one would expect the gas pressure, temperature, and velocity conditions to be was taken. The five major model zones are: primary air inlet, test bay, secondary air inlet, augmentor tube, and exhaust stack. The EARTH output presented in Appendix B is the numerical results of only 5 slabs in the major model zones.

1. Primary Air Inlet

The primary air inlet is comprised of the following cells: IX=1 to IX=8, IY=1 to IY=12, and IZ=2. Cool ambient air (295 K) is drawn into the test facility through the primary air inlet (test facility doors). Pressure drops at the test facility doors were very small with a maximum drop of about 12 Pascals. Air flow through the primary air inlet was predominantly in the Z-direction (W). Velocities ranged from 1 to 2 m/sec with an average of about 1.7 m/sec. The horizontal X-direction velocity (U) and the vertical Y-direction velocity (V) components were negligible.

With an average gas density of about 1.2 kg/m^3 at the test facility doors, a primary air mass flow rate of about 135 kg/sec was calculated. Recall from chapter IV that the Q1 program modeled only one half of the test facility due to the Y-Z plane of symmetry. Therefore, the 135 kg/sec primary air mass flow rate is for one half of the structure. The calculated primary air mass flow rate for the entire structure would be about 270 kg/sec. Of this amount, about 170 kg/sec would be primary cooling air and the remaining 100 kg/sec flows through the engine. From this point on, references to mass flow rates will be for the entire test facility. The temperature at the test facility doors remained at about 295 K. At the test facility doors, one would not expect much activity and a laminar flow. The KE and EP turbulence dependant variables were negligible which indicated laminar flow.

2. Test Bay

The test bay comprises cells IX=1 to IX=8, IY=1 to IY=12, and IZ=2 to IZ=9. The jet engine which was modeled as a 2000 K, 100 kg/sec sink-source is located at cells IX=1, IY=5 to IY=6, and IZ=6 to IZ=7. At 2000 K, the density of the engine exhaust gas was 0.18 kg/m^3. The jet engine provides the excitation which draws ambient air in through the primary air inlet, entrains primary cooling air into the augmentor tube from the test bay and entrains secondary cooling air into the augmentor tube from the secondary air inlets. As primary air moved through the test bay from the primary air inlet to the sink side of the jet engine, its pressure and velocity changed. At the two cells (IX=1, IY=5 to IY=6, and IZ=5) before the engine inlet, about 1.5 meters upstream of the inlet, primary air pressure dropped about 40 Pascals. The primary air W-velocity component was about 3 m/sec at IZ=4, about 3 meters upstream of the engine inlet. The horizontal U-velocity component was about -4.5 m/sec which indicated that air was being drawn into the engine from the side walls of the test bay. The vertical V-velocity component was about -4 m/sec above the engine and about 4 m/sec below the engine. This indicated that air was being drawn down from the test bay ceiling into the engine and at the same time being drawn up from the test bay floor. The turbulent parameters KE and EP were very small indicating laminar behavior at the engine inlet. The temperature at the engine inlet remained at about 295 K.

At the discharge side of the engine (cells IX=1, IY=5 to IY=6, and IZ=8), significant activity was observed. The pressure increased about 2100 Pascals. In adjacent cells above/below and longside the engine at IZ=8, the pressure dropped about 410 Pascals. The pressure difference among the cells caused an expanding or diverging effect if the jet engine exhaust gas. The U-velocity component of the gas was about 30 m/sec while the V-velocity component was about 50 m/sec. The jet engine exhaust gas expanded out towards the rear wall of the test facility as opposed to going directly into the augmentor tube. However, due to the large magnitude of the W-velocity component, about 430 m/sec, the resultant direction of the engine exhaust was primarily into the augmentor tube. Hot, fast moving gas at the engine outlet mixed with the cool, slow moving entrained primary cooling air. Due to this mixing, small turbulence resulted. this premise is supported by the magnitude of the KE and EP parameters in the region. KE had a maximum value of about 110 J/kg, while EP had a maximum value of about 5400 J/kg/sec. Due to this mixing of engine exhaust and primary cooling air, over a distance of about 1.5 meters, the exhaust gas was cooled from 2000 K to about 1830 K prior to entering the augmentor tube (IZ=10). Over the same 1.5 meter distance, the exhaust gas W-velocity component decreased from about 430 m/sec to about 400 m/sec.

The investigation of the test bay was localized to a small region around the jet engine. For the most part the activity in the rest of the test bay was uneventful (i.e. no turbulence and insignificant pressure, temperature, or velocity changes).

The above observations in the test bay and at the inlet and outlet ends of the jet engine are realistic. One would expect primary air velocity components and pressure to change somewhat prior to going into the engine and more significantly at the engine outlet. Additionally, due to the primary air being drawn into the engine a low pressure area at the inlet makes good sense. While at the outlet side of the engine a high pressure is expected. At the engine outlet one would expect that the hot, fast engine exhaust colliding and mixing with the cool, slow entrained primary cooling air would result in some turbulence.

3. Secondary Air Inlet

As was mentioned earlier in chapter II, the secondary cooling air plays a significant role in the operation of a jet engine test facility. The secondary cooling air serves the purpose of providing additional cool (ambient) air for mixing with the hot engine exhaust. For the Denmark test facility the largest mass flow rate occurs through the secondary air inlets. The test facility data indicated a mass flow rate of about 340 kg/sec. In the structure model, secondary cooling air enters the augmentor tube at cells IX=5, IY=1 to IY=10, and IZ=10 to IZ=12. The secondary cooling air had an average U-velocity component of about -14 m/sec, which indicated that secondary cooling air was being drawn into the augmentor tube from outside the structure.

A maximum pressure drop of about 480 Pascals at the secondary air inlet was in consonance with the relatively high U-velocity component. With an average air density of about 1.0 kg/m^3 at the secondary air inlet, a mass flow rate of about 420 kg/sec was calculated. Although the secondary air inlet had a significant pressure drop and a relatively large U-velocity component (about -14 m/sec) it did not demonstrate turbulent behavior based upon the relatively low KE and EP parameters. The temperature at the secondary air inlet indicated a temperature rise of about 15 K. The results showed that warm air from the exhaust stack was flowing into the secondary air inlet region.

With a primary cooling air mass flow rate of about 170 kg/sec and a secondary cooling air mass flow rate of about 420 kg/sec, an Augmentation Ratio of about 5.9:1 was calculated.

4. Augmentor Tube

Three regions of the augmentor tube were chosen for investigation: The region IZ=10 to IZ=16, the slab IZ=20, and the slab IZ=22. At the beginning of the augmentor tube, IZ=10 to IZ=16, a large mass of primary and secondary cooling air collided and mixed with the hot, fast exhaust gas. As a result, significant turbulence occurred. A maximum KE value of about 7,100 J/kg was observed while maximum EP was about 500,000 J/kg/sec. In the 8.5 meters that the engine exhaust traveled, it cooled from 2000 K to about 920 K. The engine exhaust W-velocity component decreased from about 430 m/sec to about 125 m/sec. The U and V-velocity components were considered negligible. Figures C.18 and C.19 are PHOENICS enthalpy (H1) and velocity (W1) profiles for the cells IX=1, IY=1 to IY=10, and IZ=16. The reader is reminded at this point that an enthalpy value divided by a specific heat value of about 1000 J/(kg K) will give a good temperature approximation within a cell. The profiles indicated minimum temperature and W-velocity values at the bottom (IY=1) and top (IY=10) of the augmentor tube and maximum temperature and W-velocity values at the centerline of the augmentor tube. These temperature and W-velocity distributions make good sense. Since the location IY=5 is at the height of the engine outlet, one would expect the engine exhaust to be hotter and to be moving faster here than at the top/bottom of the augmentor tube. Figures C.20 and C.21 are temperature and W-velocity profiles for the cells at IX=1 to IX=5, IY=5, and IZ=16. Although these profiles are at the same slab location (IZ=16) as figures C.18 and C.19, the examination of the variables is from the center of the augmentor tube to the side wall. These distributions indicated maximum values of the variables occurred at the center of the augmentor tube and minimum values at the side walls. These profiles also make good sense. In the cells at the augmentor wall (IX=5, IY=1 to IY=10, and IZ=16), the secondary cooling air entering the augmentor tube has only mixed with the engine exhaust for about a 3 meter distance down the augmentor tube.

At augmentor tube location IZ=20 (about 22 meters downstream of the engine outlet), the total mass flow was examined. The W-velocity component ranged from about 25 m/sec to 75 m/sec with an average of about 45 m/sec. The U and V-velocity components were considered to be negligible. With an average gas density of about 0.6 kg/m^3, the total mass flow rate was about 700 kg/sec. At augmentor tube location IZ=20, there was still some turbulence, which indicated continued mixing of the primary/secondary cooling air and the engine exhaust. The maximum KE value was about 740 J/kg while EP maximum was about 10,400 J/kg/sec. The temperature ranged from about 520 K to about 635 K with an average of about 550 K. Figures C.22 and C.23 are temperature and W-velocity profiles for the cells at IX=1, IY=1 to IY=10, and IZ=20. Figures C.24 and C.25 are temperature and W-velocity profiles for the cells at IX=1 to IX=5, IY=5, and IZ=20. A more uniform distribution of temperature and W-velocity was observed across the slab at IZ=20 than at slab IZ=16. This is reasonable since the total mass of primary and secondary cooling air and engine exhaust has mixed for a distance of about 22 meters downstream of the engine outlet.

In the augmentor tube/exhaust stack transition region (IZ=22), the test facility field data indicated the W-velocity component on a centerline with the jet engine was about 60 m/sec and the average temperature was about

650 to 675 K. The numerical results indicated a W-velocity component of about 63 m/sec and a temperature of about 615 K. In a distance of about 4 meters from IZ=20 to IZ=22, turbulence decreased by about 50 percent. KE was about 400 J/kg while EP was about 4,500 J/kg/sec.

5. Exhaust Stack

Field data from the Denmark test facility indicated a temperature rise of about 20 K from the bottom of the exhaust stack to the area under the exhaust stack baffle material. In the numerical model a temperature drop of about 50 K was observed. The Denmark test facility was modeled without baffle material at the top of the stack. Gas velocities at the top of the computer model stack were for the most part in the V-direction. The V-velocity ranged from about 10 to 45 m/sec with an average of about 20 m/sec. Turbulence at the top of the exhaust stack was considered to be negligible. Average temperature at the top of the exhaust stack was about 550 K. Figures C.26, C.27, C.28, and C.29 are temperature and V-velocity profiles for the top (IY=13) of the exhaust stack. Figures C.26 and C.27 are for the cells IX=1, IY=13, and IZ=21 to IZ=26 (along the Z axis). Figure C.26 indicated highest temperature values towards the rear (IZ=25) of the exhaust stack. Additionally, Figure C.27 indicated that the V-velocity fluctuated (low to high to low ...) from IZ=21 to IZ=26. It is suggested that the manner in which the turning vanes were computer modeled caused a lack of uniformity in the temperature and V-velocity distribution for this stack region.

Figures C.28 and C.29 are the temperature and V-velocity distributions for the cells at IX=1 to IX=5, IY=13, and IZ=23 (from the center of the exhaust stack out to the side wall). These figures indicated fairly uniform temperature and V-velocity profiles throughout the cells in this region.

C. COMPUTER DATA AND FIELD DATA COMPARISON

The difference between field data results and numerical results can be attributed to several things: baffle material (not included in the numerical model), turning vanes (crudely modeled as rectangular cubes), turbulence model (modeling is not an exact science), and model grid (grid independence not verified).

The computer model total mass flow rate of about 700 kg/sec is about 15 percent larger than the 600 kg/sec total mass flow rate of the Denmark test facility. It is suggested that not including the baffle material, in the computer model primary and secondary air inlets and the exhaust stack, resulted in larger numerical mass flow rates than the test facility mass flow rates. Test facility baffle information was not available for this research.

Field data indicated a maximum pressure drop in the test bay of about 500 Pascals. The computer model calculated a maximum pressure drop of about 410 Pascals in the cells adjacent to the jet engine outlet.

As was mentioned earlier, the exhaust gas temperature and W-velocity component in the augmentor tube/exhaust stack transition region compared very well with the field data.

D. CONSERVATION EQUATION BALANCES

The PHOENICS output code enables the investigator to determine the degree conservation of mass has been achieved. The PHOENICS output symbol for a mass flow source is "R1". By an algebraic summing of the mass flow sources, a conservation of mass flow calculation can be made. For a total accounting of all the mass flow sources in a computer model, the algebraic sum of the sources should be zero. For the Denmark test facility this sum was equal to 0.02 kg/sec. If this amount is compared to the 100 kg/sec mass flow through the jet engine there is a 0.02 percent error. Compared to the 700 kg/sec mass flow calculated for the augmentor tube the percent of error is reduced to 0.003. Based on this analysis, a mass balance or a continuity of flow exists in the Denmark test facility model. A mass balance or a continuity of flow is a necessary but not sufficient condition for problem convergence.

E. CONVERGENCE

Chapter III described the iterative process which adjusts the values of the dependent variables during the solution process. During the process, imbalances occurred between the left and right hand side of the dependent variable discretized algebraic equations. These imbalances are called residuals. Problem convergence would be obtained when all residuals were zero (i.e. the dependent variable discretized algebraic equations were in balance). The residual goes to zero as the number of sweeps goes to infinity. With numerical solutions, users must employ a variety of methods to determine problem convergence since residuals can not decrease to zero, as a practical matter.

With the PHOENICS output (Appendix B), this research utilized a local and a global analysis of the dependent variables to determine problem convergence. A local or "spot value" analysis can be accomplished with the PHOENICS output by designating cells to be monitored. Since the test facility field data referenced the exhaust gas temperature and velocity for a location in the augmentor tube/exhaust stack transition region, the computer model spot checked the dependent variable values at the same location (the cell at IX=1, IY=5, and IX=22). From the initial program run to the final sweep (about 10,000), the spot values were closely monitored and compared. Local convergence at this cell occurred when little or no change in the dependent variable values was observed from sweep to sweep. Local or spot value convergence of dependent variables for one cell is a necessary but not sufficient condition for problem convergence. For this reason, the results at "ALL" cells were spot checked during the solution process.

During the problem solution process, the PHOENICS code sums the dependent variable whole-field residuals. An examination of the whole-field sums provides a means of global investigation to determine problem convergence. If whole-field residuals decrease towards zero, with increasing iterations, problem convergence is suggested. However, if the residuals increase, with increasing iterations, problem divergence is occurring and some adjustment of the PHOENICS relaxation parameters is required. Global analysis is also accomplished by examination of the energy balance of the system. The dependent energy variable enthalpy (H1) residual is first divided by 1,000,000. This result is then divided by the absolute value of the sum of the enthalpy (H1) net sources. If the quotient decreases to less than about 0.05 (5 percent error), problem convergence is suggested. If the quotient continues to increase, problem divergence is occuring and PHOENICS relaxation adjustment is again required.

F. SUMMARY

Although there was limited test facility field data to compare with numerical results, it is suggested that the computer modeling of the Denmark gas turbine test facility with PHOENICS code was successful. The field test data compared well with the numerical results. During the common sense examination, the conditions that existed in the five major regions of investigation made good sense and were indicative of what one might expect in a gas turbine test facility. The total mass flow continuity check indicated less than 0.003 percent error. Finally, local and global convergence was indicated. A system energy balance was within a 5 percent error.

VI. RECOMMENDATIONS

A. INTRODUCTION

It is believed the PHOENICS code is a useful tool for the solution of gas turbine flow simulation problems. However, since the Denmark test facility has not "FINELY" modeled the following computer model enhancements are suggested: BFC, PHOTON, alternate turbulence models, grid refinement, and baffle modeling.

B. BFC

Body fitted coordinates (BFC) are necessary to incorporate the cylindrical and curved surfaces of the jet engine, augmentor tube, and turning vanes. With the proper geometric shapes in the test facility model, mass flow in the augmentor tube inlet, the secondary air inlets, and the exhaust stack will be more representative of the actual test facility.

C. PHOTON

The implementation of the PHOENICS PHOTON option will greatly enhance numerical results investigation. A two or three dimensional representation of a dependent variable field is much more useful than a cell by cell examination of numbers.

D. ALTERNATE TURBULENCE MODELS

One or more of the alternate PHOENICS turbulence models should be implemented and investigated. Since it was suggested that turbulence modeling is not an exact science, verifying the effect of the turbulence model on the solution is crucial. It may be that the turbulence model selected does not greatly effect the solution.

E. GRID REFINEMENT

Increasing the number of cells (grid refinement) in the system will enhance the problem solution process. During the slab-sweep iterative process, the dependent variable discretized algebraic equations will be solved in a "LESS ABRUPT" manner which will promote problem convergence. Grid refinement is also necessary to verify the solution is grid independent.

F. BAFFLE MODELING

Finally, by utilizing additional PHOENICS CONPOR commands, baffle material could be modeled into the primary/secondary air inlets and the exhaust stack. By experimenting with different values of porosity, the total mass flow rate of the computer model could more closely represent the total mass flow rate of the actual test facility.

APPENDIX A

Q1 CODE

```
TALK=F;RUN(1,1)
    *                                                                   *
    *                                                                   *
    *********************************************************************
    *                                                                   *
    *    DENMARK JET-ENGINE TEST FACILITY COMPUTER MODEL                *
    *********************************************************************
    *                                                                   *
    *          NON-PHOENICS USER-DEFINED VARIABLES                      *
    *                                                                   *
    *    XLBL1         THE FOLLOWING VARIABLES ARE USED TO DESCRIBE THE *
    *    XLMID1        PHYSICAL CHARACTERISTICS OF THE DENMARK TEST     *
    *    XLMID2        FACILITY.  THE FIRST LETTER OF THE VARIABLE      *
    *    XLMID3        SPECIFIES THE DIRECTION IN THE COORDINATE        *
    *    XLBL2         SYSTEM.                                          *
    *    XLBL3         THE FOLLOWING CONVENTIONS ARE USED TO DESCRIBE   *
    *    XLEXT1        A PARTICULAR ZONE OF THE MODEL:                  *
    *    XLEXT2             L    LENGTH IN A COORDINATE DIRECTION       *
    *    XNCBL1             MID  MIDDLE OF SAY THE AUGMENTOR TUBE       *
    *    XNCMD1             BL   BOUNDARY LAYER                         *
    *    XNCMD2             EXT  EXTERIOR ZONE OF STRUCTURE             *
    *    XNCMD3             NC   NUMBER OF CELLS IN A DIRECTION         *
    *    XNCBL2             INT  INTERNAL ZONE OF STRUCTURE             *
    *    XNCBL3                                                         *
    *    XNCEX1        EXAMPLE:  XLBL1    THE LENGTH OF THE FIRST       *
    *    XNCEX2                           ZONE IN THE X DIRECTION.      *
    *    YLMID                                                          *
    *    YLBL1                                                          *
    *    YLBL2                   YNCEX2   THE NUMBER OF CELLS FOR THE   *
    *    YLEXT1                           SECOND EXTERNAL ZONE IN THE Y *
    *    YLEXT2                           DIRECTION.                    *
    *    YLBL3                                                          *
    *    YLEXT3                  ZLINT5   THE LENGTH OF THE FIFTH       *
    *    YLBL4                            INTERNAL ZONE IN THE Z        *
    *    YNCMID                           DIRECTION.                    *
    *    YNCBL1                                                         *
    *    YNCBL2                                                         *
    *    YNCEX1                                                         *
    *    YNCEX2                                                         *
    *    YNCBL3                                                         *
    *    YNCEX3                                                         *
    *    YNCBL4                                                         *
    *    ZLEXT1                                                         *
    *    ZLINT1                                                         *
    *    ZLINT2                                                         *
    *    ZLINT3                                                         *
    *    ZLINT4                                                         *
    *    ZLINT5                                                         *
    *    ZLINT6                                                         *
    *    ZLEXT2                                                         *
    *    ZNCEX1                                                         *
    *    ZNCIN1                                                         *
    *    ZNCIN2                                                         *
    *    ZNCIN3                                                         *
    *    ZNCIN4                                                         *
```

```
    *    ZNCIN5                                                              *
    *    ZNCIN6                                                              *
    *    ZNCEX2                                                              *
    *                                                                        *
    *                                                                        *
    *    TMPJET          TEMPERATURE OF JET EXHAUST (K)                      *
    *    CPJET           SPECIFIC HEAT OF JET EXHAUST (J/KG*K)               *
    *    PRSJET          PRESSURE OF JET EXHAUST (N/M**2)                    *
    *    GASCON          GAS CONSTANT OF JET EXHAUST (N*M/KG*K)              *
    *    MASJET          MASS FLOW RATE OF JET EXHAUST (KG/SEC)              *
    *    VELJET          VELOCITY OF JET EXHAUST (M/SEC)                     *
    *    RHOJET          DENSITY OF JET EXHAUST (KG/M**3)                    *
    *                                                                        *
    *    TMPAMB          AMBIENT AIR TEMPERATURE (K)                         *
    *    PRSAMB          AMBIENT AIR PRESSURE (N/M**2)                       *
    *    CPAMB           SPECIFIC HEAT AMBIENT AIR (J/KG*K)                  *
    *                                                                        *
    *                                                                        *
    *                                                                        *
    *                                                                        *
    **************************************************************************
    *                                                                        *
    *                                                                        *
    *                                                                        *
    **************************************************************************
    **************************************************************************
    *                                                                        *
    *    VARIABLE DECLARATIONS                                               *
    *                                                                        *
    **************************************************************************
    *                                                                        *
    *    PHOENICS ALLOWS 45 USER DEFINED REAL-NUMBER VARIABLES               *
    *                                                                        *
REAL(XLBL1,XLMID1,XLMID2,XLMID3,XLBL2,XLBL3,XLEXT1,XLEXT2)
REAL(YLMID,YLBL1,YLBL2,YLEXT1,YLEXT2,YLBL3,YLEXT3,YLBL4)
REAL(ZLEXT1,ZLINT1,ZLINT2,ZLINT3,ZLINT4,ZLINT5,ZLINT6,ZLEXT2)
REAL(TMPJET,CPJET,PRSJET,GASCON,MASJET,VELJET,RHOJET)
REAL(TMPAMB,PRSAMB,CPAMB,DELT,FACT)
REAL(KEINJ,EPINJ,KEINA,EPINA)
    *                                                                        *
    *    PHOENICS ALLOWS 45 USER DEFINED INTEGER VARIABLES                   *
    *                                                                        *
INTEGER(XNCBL1,XNCMD1,XNCMD2,XNCMD3,XNCBL2,XNCBL3,XNCEX1,XNCEX2)
INTEGER(YNCMID,YNCBL1,YNCBL2,YNCEX1,YNCEX2,YNCBL3,YNCEX3,YNCBL4)
INTEGER(ZNCEX1,ZNCIN1,ZNCIN2,ZNCIN3,ZNCIN4,ZNCIN5,ZNCIN6,ZNCEX2)
    *                                                                        *
    *                                                                        *
    *                                                                        *
    **************************************************************************
    **************************************************************************
    *                                                                        *
    *    INITIALIZATION OF USER-DEFINED VARIABLES                            *
    *                                                                        *
    **************************************************************************
    *                                                                        *
```

```
    *    X DIRECTION LENGTHS (METERS)                                    *
    *                                                                    *
XLBL1=0.5
XLMID1=0.5
XLMID2=0.5
XLMID3=0.5
XLBL2=0.5
XLBL3=5.4
XLEXT1=2.0
    *                                                                    *
    *    NUMBER OF CELLS IN X DIRECTION                                  *
    *                                                                    *
XNCBL1=1
XNCMD1=1
XNCMD2=1
XNCMD3=1
XNCBL2=1
XNCBL3=3
XNCEX1=1
    *                                                                    *
    *    Y DIRECTION LENGTHS (METERS)                                    *
    *                                                                    *
YLBL1=2.0
YLMID=1.0
YLBL2=2.0
YLEXT1=3.85
YLEXT2=2.15
YLBL3=6.0
    *                                                                    *
    *    NUMBER OF CELLS IN THE Y DIRECTION                              *
    *                                                                    *
YNCBL1=4
YNCMID=2
YNCBL2=4
YNCEX1=2
YNCEX2=1
YNCBL3=3
    *                                                                    *
    *    Z DIRECTION LENGTHS (METERS)                                    *
    *                                                                    *
ZLEXT1=2.0
ZLINT1=23.5
ZLINT2=3.2
ZLINT3=1.5
ZLINT4=6.0
ZLINT5=16.3
ZLINT6=8.4
ZLEXT2=4.0
    *                                                                    *
    *    NUMBER OF CELLS IN THE Z DIRECTION                              *
    *                                                                    *
ZNCEX1=1
ZNCIN1=5
ZNCIN2=1
ZNCIN3=2
```

```
ZNCIN4=6
ZNCIN5=5
ZNCIN6=6
ZNCEX2=2
    *                                                                  *
    *                                                                  *
    *                                                                  *
    ********************************************************************
    ********************************************************************
    *                                                                  *
    *    GROUP 1.  RUN TITLE AND OTHER PRELIMINARIES                   *
    *                                                                  *
    ********************************************************************
    *                                                                  *
TEXT(DENMARK JET-ENGINE TEST FACILITY MODEL)
    *                                                                  *
    *                                                                  *
    *                                                                  *
    ********************************************************************
    ********************************************************************
    *                                                                  *
    *    GROUP 2.  TRANSCIENCE; TIME-STEP SPECIFICATION                *
    *                                                                  *
    *              DEFAULT TAKEN: STEADY STATE                         *
    *                                                                  *
    *                                                                  *
    *                                                                  *
    ********************************************************************
    ********************************************************************
    *                                                                  *
    *    GROUP 3.  X-DIRECTION GRID SPECIFICATION                      *
    *                                                                  *
    ********************************************************************
    *                                                                  *
    *    NX = THE NUMBER OF CELLS IN THE X DIRECTION (INTEGER)         *
    *    XULAST = DISTANCE IN THE X DIRECTION (METERS)                 *
    *                                                                  *
NX=XNCBL1+XNCMD1+XNCMD2+XNCMD3+XNCBL2+XNCBL3+XNCEX1
    *
XULAST=XLBL1+XLMID1+XLMID2+XLMID3+XLBL2+XLBL3+XLEXT1
    *                                                                  *
    *   THE METHOD-OF-PAIRS HAS BEEN USED TO DEFINE THE NUMBER         *
    *   AND SIZE OF CELLS.  THE XFRAC,YFRAC, AND ZFRAC SPECIFY THE X,Y,*
    *   AND Z COORDINATES RESPECTIVELY.  THE ODD INDEX SPECIFIES THE   *
    *   NUMBER OF CELLS IN A DIRECTION AND THE EVEN INDEX SPECIFIES THE*
    *   SIZE OF EACH CELL. THE NEGATIVE QUANTITY FOR THE FIRST ODD     *
    *   INDEX IN EACH GROUP IS THE RESERVED WORD WHICH SPECIFIES       *
    *   "METHOD-OF-PAIRS"                                              *
    *                                                                  *
XFRAC(1)=-XNCBL1;     XFRAC(2)=XLBL1/(XNCBL1*XULAST)
XFRAC(3)=XNCMD1;      XFRAC(4)=XLMID1/(XNCMD1*XULAST)
XFRAC(5)=XNCMD2;      XFRAC(6)=XLMID2/(XNCMD2*XULAST)
XFRAC(7)=XNCMD3;      XFRAC(8)=XLMID3/(XNCMD3*XULAST)
XFRAC(9)=XNCBL2;      XFRAC(10)=XLBL2/(XNCBL2*XULAST)
XFRAC(11)=XNCBL3;     XFRAC(12)=XLBL3/(XNCBL3*XULAST)
```

```
XFRAC(13)=XNCEX1;      XFRAC(14)=XLEXT1/(XNCEX1*XULAST)
    *                                                                  *
    *                                                                  *
    *                                                                  *
    ********************************************************************
    ********************************************************************
    *                                                                  *
    *    GROUP 4.  Y-DIRECTION GRID SPECIFICATION                      *
    *                                                                  *
    ********************************************************************
    *                                                                  *
    *    NY = THE NUMBER OF CELLS IN THE Y DIRECTION (INTEGER)         *
    *    YVLAST = DISTANCE IN THE Y DIRECTION (METERS)                 *
    *                                                                  *
NY=YNCMID+YNCBL1+YNCBL2+YNCEX1+YNCEX2+YNCBL3
YVLAST=YLMID+YLBL1+YLBL2+YLEXT1+YLEXT2+YLBL3
    *                                                                  *
    *    METHOD OF PAIRS                                               *
    *                                                                  *
YFRAC(1)=-YNCBL1;      YFRAC(2)=YLBL1/(YNCBL1*YVLAST)
YFRAC(3)=YNCMID;       YFRAC(4)=YLMID/(YNCMID*YVLAST)
YFRAC(5)=YNCBL2;       YFRAC(6)=YLBL2/(YNCBL2*YVLAST)
YFRAC(7)=YNCEX1;       YFRAC(8)=YLEXT1/(YNCEX1*YVLAST)
YFRAC(9)=YNCEX2;       YFRAC(10)=YLEXT2/(YNCEX2*YVLAST)
YFRAC(11)=YNCBL3;      YFRAC(12)=YLBL3/(YNCBL3*YVLAST)
    *                                                                  *
    *                                                                  *
    *                                                                  *
    ********************************************************************
    ********************************************************************
    *                                                                  *
    *    GROUP 5.  Z-DIRECTION GRID SPECIFICATION                      *
    *                                                                  *
    ********************************************************************
    *                                                                  *
    *    NZ = THE NUMBER OF CELLS IN THE Z DIRECTION (INTEGER)         *
    *    ZWLAST = DISTANCE IN THE Z DIRECTION (METERS)                 *
    *                                                                  *
NZ=ZNCEX1+ZNCIN1+ZNCIN2+ZNCIN3+ZNCIN4+ZNCIN5+ZNCIN6+ZNCEX2
ZWLAST=ZLEXT1+ZLINT1+ZLINT2+ZLINT3+ZLINT4+ZLINT5+ZLINT6+ZLEXT2
ZFRAC(1)=-ZNCEX1;      ZFRAC(2)=ZLEXT1/(ZNCEX1*ZWLAST)
ZFRAC(3)=ZNCIN1;       ZFRAC(4)=ZLINT1/(ZNCIN1*ZWLAST)
ZFRAC(5)=ZNCIN2,       ZFRAC(6)=ZLINT2/(ZNCIN2*ZWLAST)
ZFRAC(7)=ZNCIN3;       ZFRAC(8)=ZLINT3/(ZNCIN3*ZWLAST)
ZFRAC(9)=ZNCIN4;       ZFRAC(10)=ZLINT4/(ZNCIN4*ZWLAST)
ZFRAC(11)=ZNCIN5;      ZFRAC(12)=ZLINT5/(ZNCIN5*ZWLAST)
ZFRAC(13)=ZNCIN6;      ZFRAC(14)=ZLINT6/(ZNCIN6*ZWLAST)
ZFRAC(15)=ZNCEX2;      ZFRAC(16)=ZLEXT2/(ZNCEX2*ZWLAST)
    *                                                                  *
    *                                                                  *
    *                                                                  *
    ********************************************************************
    ********************************************************************
    *                                                                  *
    *    GROUP 6.  BODY-FITTED COORDINATES OR GRID DIRECTION           *
```

```
    *              (NOT IN USE)                                        *
    ********************************************************************
    *                                                                  *
    *                                                                  *
    *                                                                  *
    ********************************************************************
    ********************************************************************
    *                                                                  *
    *    GROUP 7.  VARIABLES STORED, SOLVED AND NAMED                  *
    *                                                                  *
    ********************************************************************
    *                                                                  *
SOLVE(P1,H1,U1,V1,W1)
SOLUTN(P1,Y,Y,Y,N,N,N)
STORE(RHO1,TMP1)
    *                                                                  *
    *                                                                  *
    *                                                                  *
    ********************************************************************
    ********************************************************************
    *                                                                  *
    *    GROUP 8.  TERMS (IN DIFFERENTIAL EQUATION) AND DEVICES        *
    *                                                                  *
    ********************************************************************
    *                                                                  *
    *              DEFAULT TAKEN                                       *
    *                                                                  *
    *                                                                  *
    *                                                                  *
    ********************************************************************
    ********************************************************************
    *                                                                  *
    *    GROUP 9.  PROPERTIES OF THE MEDIUM (OR MEDIA)                 *
    *                                                                  *
    ********************************************************************
    *                                                                  *
TMP1A=TINY
TMPAMB=295.
PRSAMB=0.
CPAMB=1004.
TMP1B=1.0/CPAMB
TMP1=GRND2
TMPJET=2000.
CPJET=1004.
PRSJET=0.
GASCON=287.
RHO1B=1./GASCON
MASJET=100.
PRESS0=101325.
RHOJET=(PRESS0+PRSJET)/(GASCON*TMPJET)
VELJET=MASJET/RHOJET
RHO1=GRND5
ENUL=1.0E-05
DRH1DP=GRND5
TURMOD(KEMODL)
```

```
STORE(VIST)
KEINJ=0.5*(0.005*VELJET)**2
EPINJ=0.09*KEINJ**1.5/(0.05*0.5)
KEINA=0.5*(0.005*1.0)**2
EPINA=0.09*KEINA**1.5/(0.1)
    *                                                                 *
    *                                                                 *
    *******************************************************************
    *******************************************************************
    *                                                                 *
    *    GROUP 10. INTERPHASE-TRANSFER PROCESSES AND PROPERTIES       *
    *                                                                 *
    *******************************************************************
    *              DEFAULT TAKEN                                      *
    *                                                                 *
    *******************************************************************
    *******************************************************************
    *                                                                 *
    *    GROUP 11. INITIALIZATION OF VARIABLE OR POROSITY FIELDS      *
    *                                                                 *
    *******************************************************************
    *                                                                 *
FIINIT(H1)=CPAMB*TMPAMB
FIINIT(TMP1)=TMPAMB
FIINIT(DEN1)=1.0
FIINIT(P1)=0.0
FIINIT(U1)=0.0
FIINIT(V1)=0.0
FIINIT(W1)=0.0
FIINIT(KE)=KEINA
FIINIT(EP)=EPINA
    *                                                                 *
    *                                                                 *
    *                                                                 *
    *    BLOCKING OUT THE MASS OF THE JET ENGINE                      *
    *                                                                 *
CONPOR(0.0,CELL,1,1,5,6,6,7)
    *                                                                 *
    *    WALL,FLOOR, AND CEILING BOUNDARY CONDITIONS.  RESTRICTING FLOW*
    *    ACROSS A BOUNDARY BY USING CONPOR VALUES FROM 0.0 (NO FLOW) TO*
    *    1.0 (MAX FLOW).  BOUNDARY FRICTION TO FLOW IS ALSO IMPLEMENTED*
    *    USING A NEGATIVE BOUNDARY COORDINATE. THIS CONVENTION CAUSES  *
    *    FLOW PARALLEL TO THAT BOUNDARY FACE TO HAVE FRICTION. BOUNDARY*
    *    CONDITIONS WILL BE DESCRIBED BY COMMENT AND PLANE.            *
    *                                                                 *
    *                                                                 *
    *    TEST FACILITY FOUNDATION AND GROUND OUTSIDE STRUCTURE        *
    *                                                                 *
CONPOR(0.0,SOUTH,1,NX,1,1,1,NZ)
PATCH(FLOR,SWALL,1,NX,1,1,1,NZ,1,1)
COVAL(FLOR,U1,GRND2,0.0)
COVAL(FLOR,W1,GRND2,0.0)
COVAL(FLOR,KE,GRND2,GRND2)
COVAL(FLOR,EP,GRND2,GRND2)
    *                                                                 *
```

```
    *    JET-ENGINE TEST BAY                                                *
    *                                                                       *
    *    BAY SIDE WALL (Y-Z)                                                *
    *                                                                       *
CONPOR(0.0,WEST,9,9,1,12,2,9)
    *                                                                       *
    *    BAY CEILING (X-Z)                                                  *
    *                                                                       *
CONPOR(0.0,SOUTH,1,8,13,13,2,9)
    *                                                                       *
    *    BAY WALL REAR (X-Y) 2 SECTIONS                                     *
    *                                                                       *
CONPOR(0.0,LOW,6,8,1,12,-10,10)
CONPOR(0.0,LOW,1,5,11,12,-10,10)
    *                                                                       *
    *    EXHAUST DUCT INLET TUBE                                            *
    *                                                                       *
CONPOR(0.0,NORTH,1,2,3,3,10,14)
PATCH(TUB1,NWALL,1,2,3,3,10,14,1,1)
COVAL(TUB1,U1,GRND2,0.0)
COVAL(TUB1,W1,GRND2,0.0)
COVAL(TUB1,KE,GRND2,GRND2)
COVAL(TUB1,EP,GRND2,GRND2)
CONPOR(0.0,SOUTH,1,2,8,8,10,14)
PATCH(TUB2,SWALL,1,2,8,8,10,14,1,1)
COVAL(TUB2,U1,GRND2,0.0)
COVAL(TUB2,W1,GRND2,0.0)
COVAL(TUB2,KE,GRND2,GRND2)
COVAL(TUB2,EP,GRND2,GRND2)
CONPOR(0.0,WEST,3,3,4,7,10,14)
PATCH(TUB3,WWALL,3,3,4,7,10,14,1,1)
COVAL(TUB3,V1,GRND2,0.0)
COVAL(TUB3,W1,GRND2,0.0)
COVAL(TUB3,KE,GRND2,GRND2)
COVAL(TUB3,EP,GRND2,GRND2)
CONPOR(0.0,LOW,1,5,1,3,10,10)
CONPOR(0.0,LOW,1,5,8,10,10,10)
CONPOR(0.0,LOW,3,5,4,7,10,10)
    *                                                                       *
    *    SECONDARY-AIR INLET WALL (X-Y)                                     *
    *                                                                       *
CONPOR(0.0,LOW,6,7,1,10,12,12)
PATCH(SAIW,LWALL,6,7,1,10,12,12,1,1)
COVAL(SAIW,U1,GRND2,0.0)
COVAL(SAIW,V1,GRND2,0.0)
COVAL(SAIW,KE,GRND2,GRND2)
COVAL(SAIW,EP,GRND2,GRND2)
    *                                                                       *
    *    SECONDARY-AIR INLET AND PARTIAL EXHAUST DUCT CEILING (X-Z)         *
    *                                                                       *
CONPOR(0.0,SOUTH,1,7,11,11,10,12)
PATCH(SAIWPE,SWALL,1,7,11,11,10,12,1,1)
COVAL(SAIWPE,U1,GRND2,0.0)
COVAL(SAIWPE,W1,GRND2,0.0)
COVAL(SAIWPE,KE,GRND2,GRND2)
```

```
COVAL(SAIWPE,EP,GRND2,GRND2)
    *                                                                   *
    *    EXHAUST DUCT CEILING (X-Z)                                      *
    *                                                                   *
CONPOR(0.0,SOUTH,1,5,11,11,13,20)
PATCH(EDC,SWALL,1,5,11,11,13,20,1,1)
COVAL(EDC,U1,GRND2,0.0)
COVAL(EDC,W1,GRND2,0.0)
COVAL(EDC,KE,GRND2,GRND2)
COVAL(EDC,EP,GRND2,GRND2)
    *                                                                   *
    *    EXHAUST-DUCT WALL (Y-Z)                                         *
    *                                                                   *
CONPOR(0.0,WEST,6,6,1,10,13,20)
PATCH(EDWXZ,WWALL,6,6,1,10,13,20,1,1)
COVAL(EDWXZ,V1,GRND2,0.0)
COVAL(EDWXZ,W1,GRND2,0.0)
COVAL(EDWXZ,KE,GRND2,GRND2)
COVAL(EDWXZ,EP,GRND2,GRND2)
    *                                                                   *
    *    EXHAUST-STACK WALLS (X-Y) TWO SECTIONS                          *
    *                                                                   *
CONPOR(0.0,HIGH,1,5,11,13,20,20)
PATCH(ESWXY1,HWALL,1,5,11,13,20,20,1,1)
COVAL(ESWXY1,U1,GRND2,0.0)
COVAL(ESWXY1,V1,GRND2,0.0)
COVAL(ESWXY1,KE,GRND2,GRND2)
COVAL(ESWXY1,EP,GRND2,GRND2)
CONPOR(0.0,LOW,1,5,1,13,27,27)
PATCH(ESWXY2,LWALL,1,5,1,13,27,27,1,1)
COVAL(ESWXY2,U1,GRND2,0.0)
COVAL(ESWXY2,V1,GRND2,0.0)
COVAL(ESWXY2,KE,GRND2,GRND2)
COVAL(ESWXY2,EP,GRND2,GRND2)
    *                                                                   *
    *    EXHAUST-STACK WALL (Y-Z)                                        *
    *                                                                   *
CONPOR(0.0,WEST,6,6,1,13,21,26)
PATCH(ESWXZ,WWALL,6,6,1,13,21,26,1,1)
COVAL(ESWXZ,V1,GRND2,0.0)
COVAL(ESWXZ,W1,GRND2,0.0)
COVAL(ESWXZ,KE,GRND2,GRND2)
COVAL(ESWXZ,EP,GRND2,GRND2)
    *                                                                   *
    *    TURNING VANES                                                   *
    *                                                                   *
CONPOR(0.0,SOUTH,1,5,-7,7,21,22)
CONPOR(0.0,SOUTH,1,5,-3,3,23,24)
CONPOR(0.0,LOW,1,5,7,10,-23,23)
CONPOR(0.0,LOW,1,5,3,6,-25,25)
    *********************************************************************
    *********************************************************************
    *                                                                   *
    *    GROUP 12. CONVECTION AND DIFFUSION ADJUSTMENTS                  *
    *                                                                   *
```

```
    ******************************************************************
    *                                                                *
    *              DEFAULT TAKEN                                     *
    *                                                                *
    ******************************************************************
    ******************************************************************
    *                                                                *
    *    GROUP 13. BOUNDARY CONDITIONS AND SPECIAL SOURCES           *
    *                                                                *
    ******************************************************************
    *                                                                *
    *    JET-ENGINE MASS SOURCE                                      *
    *                                                                *
PATCH(JETIN,HIGH,1,1,5,6,5,5,1,1)
COVAL(JETIN,P1,FIXFLU,-MASJET*1.)
COVAL(JETIN,H1,ONLYMS,SAME)
PATCH(JETOUT,LOW,1,1,5,6,8,8,1,1)
COVAL(JETOUT,P1,FIXFLU,MASJET*1.)
COVAL(JETOUT,W1,ONLYMS,VELJET)
COVAL(JETOUT,H1,ONLYMS,CPJET*TMPJET)
COVAL(JETOUT,KE,ONLYMS,KEINJ)
COVAL(JETOUT,EP,ONLYMS,EPINJ)
    *                                                                *
    *    ATMOSPHERIC BOUNDARY CONDITIONS                             *
    *                                                                *
    *    LAST CELL SURFACE IN X DIRECTION                            *
    *                                                                *
PATCH(XSKY,EAST,NX,NX,1,NY,1,NZ,1,1)
COVAL(XSKY,P1,0.1,0.0)
COVAL(XSKY,H1,ONLYMS,CPAMB*TMPAMB)
COVAL(XSKY,KE,ONLYMS,KEINA)
COVAL(XSKY,EP,ONLYMS,EPINA)
    *                                                                *
    *    LAST CELL SURFACE IN THE Y DIRECTION                        *
    *                                                                *
PATCH(YSKY,NORTH,1,NX,NY,NY,1,NZ,1,1)
COVAL(YSKY,P1,0.1,0.0)
COVAL(YSKY,H1,ONLYMS,CPAMB*TMPAMB)
COVAL(YSKY,KE,ONLYMS,KEINA)
COVAL(YSKY,EP,ONLYMS,EPINA)
    *                                                                *
    *    FIRST CELL SURFACE IN THE Z DIRECTION                       *
    *                                                                *
PATCH(ZSKY1,LOW,1,NX,1,NY,1,1,1,1)
COVAL(ZSKY1,P1,0.1,0.0)
COVAL(ZSKY1,H1,ONLYMS,CPAMB*TMPAMB)
COVAL(ZSKY1,KE,ONLYMS,KEINA)
COVAL(ZSKY1,EP,ONLYMS,EPINA)
    *                                                                *
    *    LAST CELL SURFACE IN THE Z DIRECTION                        *
    *                                                                *
PATCH(ZSKY2,HIGH,1,NX,1,NY,NZ,NZ,1,1)
COVAL(ZSKY2,P1,0.1,0.0)
COVAL(ZSKY2,H1,ONLYMS,CPAMB*TMPAMB)
COVAL(ZSKY2,KE,ONLYMS,KEINA)
```

```
COVAL(ZSKY2,EP,ONLYMS,EPINA)
    ********************************************************************
    ********************************************************************
    *                                                                  *
    *    GROUP 14. DOWNSTREAM PRESSURE FOR PARAB=T                     *
    *                                                                  *
    ********************************************************************
    *                                                                  *
    *              DEFAULT TAKEN                                       *
    *                                                                  *
    ********************************************************************
    ********************************************************************
    *                                                                  *
    *    GROUP 15. TERMINATION OF SWEEPS                               *
    *                                                                  *
    ********************************************************************
    *                                                                  *
RESTRT(ALL)
FSWEEP=1
LSWEEP=2
    *                                                                  *
    *                                                                  *
    *                                                                  *
    ********************************************************************
    ********************************************************************
    *                                                                  *
    *    GROUP 16. TERMINATION OF ITERATIONS                           *
    *                                                                  *
    ********************************************************************
    *                                                                  *
    *              DEFAULT TAKEN                                       *
    *                                                                  *
    ********************************************************************
    ********************************************************************
    *                                                                  *
    *    GROUP 17. UNDERRELAXATION DEVICES                             *
    *                                                                  *
    ********************************************************************
    *                                                                  *
DELT=50./(NZ*0.2*VELJET)
    FACT=0.25
    SHIFTED TO FACT=0.5 AT 1550 SWEEPS
FACT=0.5
RELAX(P1,LINRLX,0.3)
RELAX(U1,FALSDT,FACT*DELT)
RELAX(V1,FALSDT,FACT*DELT)
RELAX(W1,FALSDT,FACT*DELT)
RELAX(KE,FALSDT,FACT*DELT)
RELAX(EP,FALSDT,FACT*DELT)
    REMOVED THE 2.5 FROM H1 RELAX AT 5000 SWEEPS
RELAX(H1,FALSDT,FACT*DELT*1.0)
    *                                                                  *
    *                                                                  *
    *                                                                  *
    ********************************************************************
```

```
    ******************************************************************
    *                                                                *
    *    GROUP 18. LIMITS ON VARIABLES OR INCREMENTS TO THEM         *
    *                                                                *
    ******************************************************************
    *                                                                *
VARMIN(P1)=-2*PRESSO
VARMIN(H1)=CPAMB*TMPAMB
VARMIN(U1)=-VELJET
VARMIN(V1)=-VELJET
VARMIN(W1)=-VELJET
VARMIN(TMP1)=TMPAMB
VARMIN(RHO1)=0.1
VARMAX(P1)=2*PRESSO
VARMAX(H1)=CPJET*TMPJET
VARMAX(U1)=VELJET
VARMAX(V1)=VELJET
VARMAX(W1)=VELJET
VARMAX(TMP1)=TMPJET
VARMAX(RHO1)=2.0
    *                                                                *
    *                                                                *
    *                                                                *
    ******************************************************************
    ******************************************************************
    *                                                                *
    *    GROUP 19. DATA COMMUNICATED BY SATELLITE TO GROUND          *
    *                                                                *
    ******************************************************************
    *                                                                *
    *              DEFAULT TAKEN                                     *
    *                                                                *
    ******************************************************************
    ******************************************************************
    *                                                                *
    *    GROUP 20. PRELIMINARY PRINTOUT                              *
    *                                                                *
    ******************************************************************
    *                                                                *
    *                                                                *
    *              DEFAULT TAKEN                                     *
    *                                                                *
    ******************************************************************
    ******************************************************************
    *                                                                *
    *    GROUP 21. PRINTOUT OF VARIABLES                             *
    *                                                                *
    ******************************************************************
    *                                                                *
    *              DEFAULT TAKEN                                     *
    *                                                                *
    ******************************************************************
    ******************************************************************
    *                                                                *
    *    GROUP 22. SPOT-VALUE PRINTOUT                               *
```

```
IXMON=1
IYMON=5
IZMON=22
TSTSWP=10
    *                                                                    *
    *                                                                    *
    *                                                                    *
    **********************************************************************
    **********************************************************************
    *                                                                    *
    *    GROUP 23. FIELD PRINTOUT AND PLOT CONTROL                       *
    *                                                                    *
    **********************************************************************
    *                                                                    *
PATCH(PLOT5,PROFIL,1,1,5,5,1,NZ,1,1)
PLOT(PLOT5,P1,-3000.0,2500.0)
PATCH(PLOT3,PROFIL,1,1,5,5,1,NZ,1,1)
PLOT(PLOT3,U1,-20.0,50.0)
PATCH(PLOT4,PROFIL,1,1,5,5,1,NZ,1,1)
PLOT(PLOT4,V1,-40.0,60.0)
PATCH(PLOT2,PROFIL,1,1,5,5,1,NZ,1,1)
PLOT(PLOT2,W1,-15.0,500.0)
PATCH(PLOT1,PROFIL,1,1,5,5,1,NZ,1,1)
PLOT(PLOT1,H1,275000.0,2100000.0)
PATCH(PLOT6,PROFIL,1,1,1,10,20,20,1,1)
PLOT(PLOT6,H1,300000.0,1000000.0)
PATCH(PLOT7,PROFIL,1,1,1,10,20,20,1,1)
PLOT(PLOT7,W1,20.0,175.0)
PATCH(PLOT8,PROFIL,1,5,5,5,20,20,1,1)
PLOT(PLOT8,H1,300000.0,1000000.0)
PATCH(PLOT9,PROFIL,1,5,5,5,20,20,1,1)
PLOT(PLOT9,W1,20.0,175.0)
PATCH(PLOT10,PROFIL,1,1,1,10,16,16,1,1)
PLOT(PLOT10,H1,300000.0,1000000.0)
PATCH(PLOT11,PROFIL,1,1,1,10,16,16,1,1)
PLOT(PLOT11,W1,20.0,175.0)
PATCH(PLOT12,PROFIL,1,5,5,5,16,16,1,1)
PLOT(PLOT12,H1,300000.0,1000000.0)
PATCH(PLOT13,PROFIL,1,5,5,5,16,16,1,1)
PLOT(PLOT13,W1,20.0,175.0)
PATCH(PLOT14,PROFIL,1,1,13,13,21,26,1,1)
PLOT(PLOT14,H1,500000.0,600000.0)
PATCH(PLOT15,PROFIL,1,1,13,13,21,26,1,1)
PLOT(PLOT15,V1,10.0,45.0)
PATCH(PLOT16,PROFIL,1,5,13,13,23,23,1,1)
PLOT(PLOT16,H1,500000.0,600000.0)
PATCH(PLOT17,PROFIL,1,5,13,13,23,23,1,1)
PLOT(PLOT17,V1,10.0,45.0)
NUMCLS=10*NXPRIN
NPLT=10
ITABL=3
IPROF=3
LUPR3=6
    *                                                                    *
    *                                                                    *
    **********************************************************************
    **********************************************************************
    *                                                                    *
    *    GROUP 24. DUMPS FOR RESTARTS                                    *
    *                                                                    *
    **********************************************************************
STOP
```

APPENDIX B

EARTH OUTPUT

```
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= 16  -1.341E+00  -1.359E+00  -1.359E+00  -1.358E+00  -1.358E+00  -1.356E+00  -1.349E+00  -1.336E+00  -1.298E+00
IY= 15  -1.362E+00  -1.384E+00  -1.383E+00  -1.382E+00  -1.381E+00  -1.379E+00  -1.372E+00  -1.362E+00  -1.334E+00
IY= 14  -1.363E+00  -1.385E+00  -1.385E+00  -1.385E+00  -1.384E+00  -1.382E+00  -1.378E+00  -1.373E+00  -1.343E+00
IY= 13  -1.348E+00  -1.371E+00  -1.371E+00  -1.371E+00  -1.371E+00  -1.370E+00  -1.369E+00  -1.372E+00  -1.344E+00
IY= 12  -9.602E+00  -9.609E+00  -9.610E+00  -9.610E+00  -9.610E+00  -9.608E+00  -9.608E+00  -9.610E+00  -1.316E+00
IY= 11  -9.610E+00  -9.632E+00  -9.630E+00  -9.626E+00  -9.622E+00  -9.610E+00  -9.600E+00  -9.602E+00  -1.325E+00
IY= 10  -9.647E+00  -9.689E+00  -9.681E+00  -9.668E+00  -9.653E+00  -9.624E+00  -9.598E+00  -9.594E+00  -1.330E+00
IY=  9  -9.676E+00  -9.727E+00  -9.712E+00  -9.692E+00  -9.671E+00  -9.631E+00  -9.598E+00  -9.591E+00  -1.332E+00
IY=  8  -9.714E+00  -9.774E+00  -9.748E+00  -9.718E+00  -9.690E+00  -9.639E+00  -9.597E+00  -9.588E+00  -1.333E+00
IY=  7  -9.772E+00  -9.832E+00  -9.786E+00  -9.744E+00  -9.707E+00  -9.645E+00  -9.597E+00  -9.584E+00  -1.335E+00
IY=  6  -9.875E+00  -9.889E+00  -9.814E+00  -9.761E+00  -9.719E+00  -9.650E+00  -9.596E+00  -9.581E+00  -1.336E+00
IY=  5  -9.874E+00  -9.886E+00  -9.814E+00  -9.763E+00  -9.722E+00  -9.652E+00  -9.595E+00  -9.577E+00  -1.337E+00
IY=  4  -9.786E+00  -9.835E+00  -9.792E+00  -9.752E+00  -9.717E+00  -9.652E+00  -9.594E+00  -9.574E+00  -1.337E+00
IY=  3  -9.750E+00  -9.791E+00  -9.766E+00  -9.738E+00  -9.709E+00  -9.650E+00  -9.592E+00  -9.570E+00  -1.337E+00
IY=  2  -9.743E+00  -9.763E+00  -9.747E+00  -9.727E+00  -9.702E+00  -9.646E+00  -9.589E+00  -9.567E+00  -1.335E+00
IY=  1  -9.756E+00  -9.756E+00  -9.744E+00  -9.723E+00  -9.697E+00  -9.638E+00  -9.584E+00  -9.568E+00  -1.325E+00
 IX=        1           2           3           4           5           6           7           8           9
FIELD VALUES OF U1
IY= 16  -7.477E-03  -1.463E-02  -2.182E-02  -2.904E-02  -3.627E-02  -6.230E-02  -8.748E-02  -1.079E-01
IY= 15  -7.862E-03  -1.566E-02  -2.340E-02  -3.107E-02  -3.866E-02  -6.517E-02  -8.890E-02  -1.064E-01
IY= 14  -7.389E-03  -1.473E-02  -2.199E-02  -2.913E-02  -3.612E-02  -5.975E-02  -7.986E-02  -9.660E-02
IY= 13  -6.759E-03  -1.346E-02  -2.003E-02  -2.642E-02  -3.256E-02  -5.224E-02  -6.590E-02  -7.405E-02
IY= 12  -1.692E-03  -3.608E-03  -5.371E-03  -6.671E-03  -7.308E-03  -3.603E-03   2.951E-03  -2.663E-08
IY= 11  -7.279E-03  -1.447E-02  -2.052E-02  -2.475E-02  -2.690E-02  -1.858E-02  -2.089E-03  -6.837E-07
IY= 10  -1.588E-02  -3.068E-02  -4.160E-02  -4.783E-02  -4.975E-02  -3.161E-02  -5.712E-03  -2.351E-07
IY=  9  -2.129E-02  -4.014E-02  -5.294E-02  -5.940E-02  -6.052E-02  -3.701E-02  -6.906E-03  -2.542E-07
IY=  8  -2.936E-02  -5.271E-02  -6.654E-02  -7.217E-02  -7.163E-02  -4.188E-02  -7.584E-03  -2.672E-07
IY=  7  -4.181E-02  -6.857E-02  -8.144E-02  -8.494E-02  -8.202E-02  -4.578E-02  -7.563E-03  -2.726E-07
IY=  6  -5.865E-02  -8.471E-02  -9.444E-02  -9.543E-02  -9.029E-02  -4.837E-02  -6.651E-03  -2.691E-07
IY=  5  -6.259E-02  -9.001E-02  -1.001E-01  -1.010E-01  -9.534E-02  -4.942E-02  -4.647E-03  -2.553E-07
IY=  4  -5.194E-02  -8.345E-02  -9.806E-02  -1.017E-01  -9.735E-02  -4.897E-02  -1.330E-03  -2.300E-07
IY=  3  -4.412E-02  -7.575E-02  -9.375E-02  -1.004E-01  -9.798E-02  -4.729E-02   3.592E-03  -1.915E-07
IY=  2  -4.093E-02  -7.144E-02  -9.186E-02  -1.009E-01  -9.964E-02  -4.480E-02   1.068E-02  -1.347E-07
IY=  1  -3.290E-02  -7.271E-02  -1.000E-01  -1.111E-01  -1.072E-01  -4.083E-02   2.611E-02   3.096E-11
 IX=        1           2           3           4           5           6           7           8
```

FIELD VALUES OF V1

IY= 15	-9.775E-02	-9.812E-02	-9.855E-02	-9.906E-02	-9.966E-02	-1.013E-01	-1.054E-01	-1.100E-01	-1.092E-01
IY= 14	-7.665E-02	-7.690E-02	-7.735E-02	-7.799E-02	-7.880E-02	-8.105E-02	-8.651E-02	-9.132E-02	-8.683E-02
IY= 13	-4.447E-02	-4.465E-02	-4.498E-02	-4.546E-02	-4.610E-02	-4.790E-02	-5.260E-02	-5.771E-02	-5.573E-02
IY= 12	-3.061E-07	-3.045E-07	-2.974E-07	-2.839E-07	-2.621E-07	-6.575E-07	-3.976E-07	-4.953E-08	-2.545E-02
IY= 11	8.259E-04	9.697E-05	-2.401E-05	3.514E-04	1.059E-03	3.098E-03	5.879E-03	8.968E-03	-4.359E-02
IY= 10	-4.324E-02	-4.362E-02	-4.164E-02	-3.817E-02	-3.402E-02	-2.425E-02	-1.042E-02	3.435E-03	-4.551E-02
IY= 9	-5.643E-02	-5.618E-02	-5.253E-02	-4.735E-02	-4.194E-02	-3.037E-02	-1.425E-02	2.289E-03	-4.408E-02
IY= 8	-6.729E-02	-6.581E-02	-6.003E-02	-5.328E-02	-4.705E-02	-3.499E-02	-1.741E-02	1.496E-03	-4.191E-02
IY= 7	-7.296E-02	-6.879E-02	-6.074E-02	-5.338E-02	-4.755E-02	-3.734E-02	-1.954E-02	1.191E-03	-3.906E-02
IY= 6	-6.627E-02	-5.833E-02	-5.049E-02	-4.548E-02	-4.226E-02	-3.702E-02	-2.042E-02	1.409E-03	-3.557E-02
IY= 5	-2.569E-02	-2.596E-02	-2.774E-02	-3.000E-02	-3.191E-02	-3.420E-02	-1.999E-02	2.073E-03	-3.150E-02
IY= 4	1.679E-02	8.325E-03	-3.223E-03	-1.285E-02	-1.992E-02	-2.955E-02	-1.836E-02	2.988E-03	-2.686E-02
IY= 3	2.598E-02	2.291E-02	1.141E-02	-5.976E-04	-1.016E-02	-2.385E-02	-1.566E-02	3.847E-03	-2.160E-02
IY= 2	2.015E-02	2.403E-02	1.592E-02	5.036E-03	-4.210E-03	-1.745E-02	-1.202E-02	4.232E-03	-1.563E-02
IY= 1	7.473E-03	1.827E-02	1.288E-02	4.984E-03	-1.583E-03	-1.008E-02	-7.344E-03	3.566E-03	-8.777E-03
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF W1

IY= 16	9.417E-02	9.384E-02	9.323E-02	9.232E-02	9.107E-02	8.736E-02	7.522E-02	5.118E-02	6.990E-06
IY= 15	1.056E-01	1.053E-01	1.048E-01	1.040E-01	1.030E-01	1.000E-01	9.097E-02	7.572E-02	5.282E-02
IY= 14	1.103E-01	1.101E-01	1.097E-01	1.092E-01	1.085E-01	1.065E-01	1.009E-01	9.211E-02	7.896E-02
IY= 13	1.117E-01	1.115E-01	1.112E-01	1.108E-01	1.103E-01	1.089E-01	1.052E-01	1.001E-01	9.495E-02
IY= 12	1.302E+00	1.300E+00	1.293E+00	1.282E+00	1.266E+00	1.224E+00	1.137E+00	1.077E+00	1.104E-01
IY= 11	1.470E+00	1.467E+00	1.454E+00	1.434E+00	1.409E+00	1.342E+00	1.217E+00	1.132E+00	1.229E-01
IY= 10	1.700E+00	1.692E+00	1.661E+00	1.618E+00	1.569E+00	1.460E+00	1.286E+00	1.173E+00	1.306E-01
IY= 9	1.843E+00	1.826E+00	1.778E+00	1.716E+00	1.650E+00	1.515E+00	1.315E+00	1.190E+00	1.338E-01
IY= 8	2.033E+00	1.997E+00	1.915E+00	1.824E+00	1.736E+00	1.569E+00	1.343E+00	1.203E+00	1.372E-01
IY= 7	2.328E+00	2.215E+00	2.067E+00	1.934E+00	1.819E+00	1.621E+00	1.367E+00	1.213E+00	1.406E-01
IY= 6	2.858E+00	2.467E+00	2.205E+00	2.030E+00	1.891E+00	1.667E+00	1.388E+00	1.219E+00	1.442E-01
IY= 5	2.955E+00	2.539E+00	2.266E+00	2.084E+00	1.938E+00	1.704E+00	1.405E+00	1.219E+00	1.482E-01
IY= 4	2.572E+00	2.424E+00	2.247E+00	2.094E+00	1.959E+00	1.733E+00	1.417E+00	1.214E+00	1.529E-01
IY= 3	2.380E+00	2.321E+00	2.208E+00	2.085E+00	1.965E+00	1.755E+00	1.424E+00	1.202E+00	1.584E-01
IY= 2	2.301E+00	2.262E+00	2.177E+00	2.072E+00	1.961E+00	1.771E+00	1.427E+00	1.182E+00	1.648E-01
IY= 1	2.281E+00	2.241E+00	2.162E+00	2.060E+00	1.938E+00	1.786E+00	1.428E+00	1.137E+00	1.763E-01
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF KE

IY= 16	3.816E-01	3.805E-01	3.782E-01	3.749E-01	3.704E-01	3.579E-01	3.257E-01	2.829E-01	2.284E-01
IY= 15	4.911E-01	4.898E-01	4.873E-01	4.835E-01	4.785E-01	4.646E-01	4.294E-01	3.836E-01	3.232E-01
IY= 14	6.518E-01	6.502E-01	6.471E-01	6.426E-01	6.367E-01	6.202E-01	5.824E-01	5.422E-01	4.983E-01
IY= 13	9.007E-01	8.984E-01	8.939E-01	8.873E-01	8.788E-01	8.556E-01	8.101E-01	7.925E-01	8.821E-01
IY= 12	1.294E+00	1.295E+00	1.296E+00	1.299E+00	1.302E+00	1.314E+00	1.373E+00	1.518E+00	1.751E+00
IY= 11	1.063E+00	1.065E+00	1.066E+00	1.068E+00	1.073E+00	1.088E+00	1.171E+00	1.353E+00	2.175E+00
IY= 10	1.016E+00	1.014E+00	1.006E+00	9.962E-01	9.895E-01	9.863E-01	1.062E+00	1.252E+00	2.211E+00
IY= 9	1.012E+00	1.005E+00	9.875E-01	9.689E-01	9.550E-01	9.411E-01	1.014E+00	1.206E+00	2.199E+00
IY= 8	1.027E+00	1.009E+00	9.750E-01	9.416E-01	9.178E-01	8.921E-01	9.604E-01	1.152E+00	2.156E+00
IY= 7	1.068E+00	1.025E+00	9.612E-01	9.076E-01	8.727E-01	8.367E-01	9.008E-01	1.090E+00	2.080E+00
IY= 6	1.103E+00	1.030E+00	9.268E-01	8.549E-01	8.127E-01	7.722E-01	8.329E-01	1.016E+00	1.967E+00
IY= 5	9.959E-01	9.256E-01	8.346E-01	7.696E-01	7.315E-01	6.963E-01	7.539E-01	9.275E-01	1.812E+00
IY= 4	7.988E-01	7.577E-01	6.996E-01	6.559E-01	6.295E-01	6.063E-01	6.602E-01	8.190E-01	1.607E+00
IY= 3	5.928E-01	5.746E-01	5.461E-01	5.226E-01	5.081E-01	4.976E-01	5.449E-01	6.809E-01	1.337E+00
IY= 2	3.935E-01	3.853E-01	3.733E-01	3.633E-01	3.574E-01	3.556E-01	3.900E-01	4.896E-01	9.579E-01
IY= 1	3.273E-02	3.170E-02	2.973E-02	2.724E-02	2.440E-02	2.100E-02	1.399E-02	9.262E-03	3.296E-04
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF EP

IY= 16	1.225E-02	1.221E-02	1.213E-02	1.201E-02	1.185E-02	1.142E-02	1.032E-02	8.856E-03	6.946E-03
IY= 15	1.838E-02	1.833E-02	1.824E-02	1.810E-02	1.791E-02	1.740E-02	1.621E-02	1.477E-02	1.268E-02
IY= 14	2.980E-02	2.973E-02	2.959E-02	2.940E-02	2.916E-02	2.853E-02	2.749E-02	2.736E-02	2.806E-02
IY= 13	5.161E-02	5.147E-02	5.121E-02	5.085E-02	5.040E-02	4.927E-02	4.830E-02	5.279E-02	7.432E-02
IY= 12	1.077E-01	1.079E-01	1.084E-01	1.090E-01	1.099E-01	1.127E-01	1.233E-01	1.480E-01	2.160E-01
IY= 11	8.134E-02	8.165E-02	8.210E-02	8.277E-02	8.379E-02	8.719E-02	1.007E-01	1.302E-01	2.933E-01
IY= 10	8.222E-02	8.192E-02	8.088E-02	7.979E-02	7.924E-02	7.992E-02	9.228E-02	1.228E-01	3.076E-01
IY= 9	8.580E-02	8.469E-02	8.211E-02	7.950E-02	7.779E-02	7.688E-02	8.853E-02	1.193E-01	3.091E-01
IY= 8	9.378E-02	9.061E-02	8.490E-02	7.971E-02	7.635E-02	7.356E-02	8.438E-02	1.150E-01	3.057E-01
IY= 7	1.079E-01	9.992E-02	8.841E-02	7.946E-02	7.417E-02	6.963E-02	7.959E-02	1.097E-01	2.968E-01
IY= 6	1.237E-01	1.088E-01	8.932E-02	7.681E-02	7.015E-02	6.477E-02	7.394E-02	1.031E-01	2.820E-01
IY= 5	1.119E-01	9.773E-02	8.063E-02	6.939E-02	6.340E-02	5.872E-02	6.719E-02	9.478E-02	2.604E-01
IY= 4	8.376E-02	7.597E-02	6.556E-02	5.828E-02	5.426E-02	5.135E-02	5.903E-02	8.422E-02	2.311E-01
IY= 3	5.733E-02	5.416E-02	4.936E-02	4.565E-02	4.356E-02	4.242E-02	4.890E-02	7.044E-02	1.920E-01
IY= 2	3.679E-02	3.549E-02	3.355E-02	3.197E-02	3.108E-02	3.094E-02	3.530E-02	5.099E-02	1.373E-01
IY= 1	8.944E-03	8.526E-03	7.743E-03	6.793E-03	5.759E-03	4.599E-03	2.499E-03	1.347E-03	9.041E-06
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF H1

IY= 16	2.965E+05	2.965E+05	2.965E+05	2.965E+05	2.965E+05	2.964E+05	2.964E+05	2.964E+05	2.963E+05
IY= 15	2.965E+05	2.965E+05	2.965E+05	2.965E+05	2.965E+05	2.965E+05	2.965E+05	2.964E+05	2.964E+05
IY= 14	2.965E+05	2.965E+05	2.965E+05	2.965E+05	2.965E+05	2.965E+05	2.965E+05	2.965E+05	2.964E+05
IY= 13	2.966E+05	2.966E+05	2.966E+05	2.965E+05	2.965E+05	2.965E+05	2.965E+05	2.965E+05	2.964E+05
IY= 12	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.963E+05
IY= 11	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.963E+05
IY= 10	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.963E+05
IY= 9	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.963E+05
IY= 8	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.963E+05
IY= 7	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.963E+05
IY= 6	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.963E+05
IY= 5	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.963E+05
IY= 4	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.963E+05
IY= 3	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05
IY= 2	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05
IY= 1	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05	2.962E+05
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF TMP1

IY= 16	2.953E+02	2.953E+02	2.953E+02	2.953E+02	2.953E+02	2.953E+02	2.952E+02	2.952E+02	2.952E+02
IY= 15	2.953E+02	2.953E+02	2.953E+02	2.953E+02	2.953E+02	2.953E+02	2.953E+02	2.952E+02	2.952E+02
IY= 14	2.954E+02	2.954E+02	2.954E+02	2.954E+02	2.953E+02	2.953E+02	2.953E+02	2.953E+02	2.952E+02
IY= 13	2.954E+02	2.954E+02	2.954E+02	2.954E+02	2.954E+02	2.954E+02	2.953E+02	2.953E+02	2.952E+02
IY= 12	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.951E+02
IY= 11	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.951E+02
IY= 10	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.951E+02
IY= 9	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.951E+02
IY= 8	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.951E+02
IY= 7	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.951E+02
IY= 6	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.951E+02
IY= 5	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.951E+02
IY= 4	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.951E+02
IY= 3	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.951E+02
IY= 2	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.951E+02
IY= 1	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.950E+02	2.951E+02
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF RHO1

IY= 16	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00
IY= 15	1.195E+00	1.195E+00	1.195E+00	1.195E+00	1.195E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00
IY= 14	1.195E+00	1.195E+00	1.195E+00	1.195E+00	1.195E+00	1.195E+00	1.195E+00	1.196E+00	1.196E+00
IY= 13	1.195E+00	1.195E+00	1.195E+00	1.195E+00	1.195E+00	1.195E+00	1.195E+00	1.196E+00	1.196E+00
IY= 12	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00
IY= 11	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00
IY= 10	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00
IY= 9	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.197E+00	1.197E+00	1.197E+00	1.196E+00	1.196E+00
IY= 8	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.196E+00
IY= 7	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.196E+00
IY= 6	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.196E+00
IY= 5	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.196E+00
IY= 4	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.196E+00
IY= 3	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.196E+00
IY= 2	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00
IY= 1	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00	1.197E+00
IX=	1	2	3	4	5	6	7	8	9

TIME STP= 1 SWEEP NO= 400 ZSLAB NO= 8 ITERN NO= 1
FLOW FIELD AT ITHYD= 1, IZ= 8, ISWEEP= 400, ISTEP= 1
FIELD VALUES OF P1

IY= 16	-1.620E+00	-1.652E+00	-1.647E+00	-1.641E+00	-1.632E+00	-1.608E+00	-1.531E+00	-1.437E+00	-1.462E+00
IY= 15	-1.668E+00	-1.710E+00	-1.705E+00	-1.696E+00	-1.686E+00	-1.657E+00	-1.571E+00	-1.481E+00	-1.524E+00
IY= 14	-1.795E+00	-1.839E+00	-1.833E+00	-1.826E+00	-1.816E+00	-1.789E+00	-1.709E+00	-1.638E+00	-1.667E+00
IY= 13	-1.888E+00	-1.919E+00	-1.918E+00	-1.917E+00	-1.916E+00	-1.911E+00	-1.881E+00	-1.835E+00	-2.019E+00
IY= 12	-8.411E+00	-8.477E+00	-8.475E+00	-8.477E+00	-8.477E+00	-8.476E+00	-8.445E+00	-8.448E+00	-2.748E+00
IY= 11	-8.679E+00	-8.832E+00	-8.876E+00	-8.855E+00	-8.802E+00	-8.666E+00	-8.490E+00	-8.455E+00	-3.717E+00
IY= 10	-1.002E+01	-1.356E+01	-1.303E+01	-1.106E+01	-1.007E+01	-9.133E+00	-8.584E+00	-8.479E+00	-4.632E+00
IY= 9	-1.535E+01	-2.550E+01	-1.992E+01	-1.388E+01	-1.136E+01	-9.409E+00	-8.630E+00	-8.485E+00	-5.054E+00
IY= 8	-4.557E+01	-6.763E+01	-3.372E+01	-1.818E+01	-1.291E+01	-9.645E+00	-8.669E+00	-8.487E+00	-5.436E+00
IY= 7	-4.007E+02	-1.950E+02	-4.925E+01	-1.795E+01	-1.310E+01	-9.705E+00	-8.691E+00	-8.482E+00	-5.742E+00
IY= 6	2.081E+03	-2.344E+02	-1.720E+01	-8.993E+00	-1.067E+01	-9.575E+00	-8.691E+00	-8.471E+00	-5.957E+00
IY= 5	2.080E+03	-2.405E+02	-1.556E+01	-8.675E+00	-1.040E+01	-9.489E+00	-8.678E+00	-8.454E+00	-6.105E+00
IY= 4	-4.129E+02	-1.912E+02	-5.682E+01	-1.978E+01	-1.338E+01	-9.511E+00	-8.658E+00	-8.435E+00	-6.210E+00
IY= 3	-3.349E+01	-6.215E+01	-3.312E+01	-1.913E+01	-1.357E+01	-9.459E+00	-8.638E+00	-8.412E+00	-6.289E+00
IY= 2	-7.653E+00	-2.176E+01	-2.096E+01	-1.722E+01	-1.347E+01	-9.494E+00	-8.631E+00	-8.388E+00	-6.325E+00
IY= 1	-6.805E+00	-1.244E+01	-1.542E+01	-1.569E+01	-1.357E+01	-9.670E+00	-8.654E+00	-8.393E+00	-6.251E+00
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF U1

IY= 16	-1.795E-02	-3.492E-02	-5.163E-02	-6.808E-02	-8.427E-02	-1.373E-01	-1.484E-01	-2.134E-02
IY= 15	-1.923E-02	-3.795E-02	-5.617E-02	-7.388E-02	-9.104E-02	-1.447E-01	-1.489E-01	-3.808E-02
IY= 14	-1.652E-02	-3.264E-02	-4.827E-02	-6.326E-02	-7.746E-02	-1.187E-01	-1.126E-01	-3.681E-02
IY= 13	-1.020E-02	-2.017E-02	-2.980E-02	-3.896E-02	-4.748E-02	-7.033E-02	-5.300E-02	5.234E-02
IY= 12	-4.640E-02	-8.519E-02	-1.232E-01	-1.575E-01	-1.838E-01	-2.059E-01	-1.225E-01	1.140E-07
IY= 11	-1.064E-02	-9.944E-02	-2.178E-01	-3.163E-01	-3.823E-01	-3.587E-01	-1.907E-01	2.670E-07
IY= 10	1.009E+00	-2.130E-01	-8.196E-01	-9.102E-01	-8.865E-01	-5.597E-01	-2.662E-01	9.397E-08
IY= 9	2.030E+00	-1.467E+00	-1.960E+00	-1.588E+00	-1.284E+00	-6.723E-01	-3.040E-01	9.894E-08
IY= 8	1.338E+00	-4.971E+00	-3.842E+00	-2.399E+00	-1.703E+00	-7.840E-01	-3.402E-01	1.018E-07
IY= 7	-1.315E+01	-1.145E+01	-4.844E+00	-2.532E+00	-1.897E+00	-8.727E-01	-3.713E-01	1.019E-07
IY= 6	3.231E+01	6.887E+00	1.248E+00	-1.417E+00	-1.764E+00	-9.267E-01	-3.944E-01	9.855E-08
IY= 5	3.205E+01	7.149E+00	1.433E+00	-1.248E+00	-1.776E+00	-9.533E-01	-4.080E-01	9.067E-08
IY= 4	-1.273E+01	-1.135E+01	-4.911E+00	-2.921E+00	-2.084E+00	-9.508E-01	-4.076E-01	7.863E-08
IY= 3	1.159E+00	-5.640E+00	-4.735E+00	-3.163E+00	-2.122E+00	-9.091E-01	-3.882E-01	6.663E-08
IY= 2	1.855E+00	-2.031E+00	-3.095E+00	-2.765E+00	-2.036E+00	-8.620E-01	-3.545E-01	5.383E-08
IY= 1	1.334E+00	-7.075E-01	-2.338E+00	-2.721E+00	-2.321E+00	-1.018E+00	-3.457E-01	1.970E-10
IX=	1	2	3	4	5	6	7	8

FIELD VALUES OF V1

IY= 15	-2.277E-01	-2.289E-01	-2.300E-01	-2.312E-01	-2.326E-01	-2.362E-01	-2.470E-01	-2.655E-01	-2.260E-01
IY= 14	-2.756E-01	-2.768E-01	-2.793E-01	-2.830E-01	-2.878E-01	-3.018E-01	-3.408E-01	-3.872E-01	-3.602E-01
IY= 13	-2.345E-01	-2.355E-01	-2.386E-01	-2.437E-01	-2.507E-01	-2.709E-01	-3.235E-01	-3.909E-01	-5.013E-01
IY= 12	2.976E-07	2.978E-07	2.847E-07	2.398E-07	2.024E-07	3.281E-07	2.983E-08	-7.149E-07	-6.930E-01
IY= 11	-4.962E-01	-5.000E-01	-4.929E-01	-4.666E-01	-4.261E-01	-3.346E-01	-1.842E-01	-1.200E-01	-8.842E-01
IY= 10	-1.491E+00	-1.783E+00	-1.761E+00	-1.477E+00	-1.175E+00	-6.897E-01	-3.057E-01	-1.824E-01	-9.568E-01
IY= 9	4.586E-02	-3.248E+00	-2.998E+00	-2.021E+00	-1.398E+00	-7.193E-01	-3.068E-01	-1.789E-01	-9.199E-01
IY= 8	4.532E+00	-5.597E+00	-4.100E+00	-2.255E+00	-1.369E+00	-6.803E-01	-2.897E-01	-1.649E-01	-8.519E-01
IY= 7	1.370E+01	-9.883E+00	-3.589E+00	-1.215E+00	-8.550E-01	-5.586E-01	-2.544E-01	-1.406E-01	-7.588E-01
IY= 6	4.882E+01	-5.138E+00	3.176E+00	1.375E+00	-1.934E-01	-3.955E-01	-2.056E-01	-1.069E-01	-6.498E-01
IY= 5	-6.813E-03	-9.001E-01	-5.479E-01	-4.055E-01	-3.183E-01	-2.710E-01	-1.506E-01	-6.627E-02	-5.354E-01
IY= 4	-4.899E+01	4.085E+00	-4.556E+00	-2.397E+00	-7.029E-01	-1.784E-01	-9.685E-02	-2.228E-02	-4.233E-01
IY= 3	-1.357E+01	8.428E+00	1.451E+00	-5.460E-01	-1.706E-01	-8.059E-02	-5.306E-02	1.999E-02	-3.152E-01
IY= 2	-4.767E+00	4.236E+00	2.129E+00	3.798E-01	9.939E-02	-6.312E-02	-3.120E-02	4.956E-02	-2.101E-01
IY= 1	-1.419E+00	1.942E+00	1.566E+00	3.630E-01	-2.391E-02	-1.381E-01	-3.726E-02	4.941E-02	-1.041E-01
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF W1

IY= 16	3.395E-01	3.355E-01	3.280E-01	3.170E-01	3.023E-01	2.593E-01	1.283E-01	-6.797E-02	6.965E-07
IY= 15	4.576E-01	4.539E-01	4.464E-01	4.349E-01	4.194E-01	3.741E-01	2.399E-01	6.402E-02	9.430E-02
IY= 14	6.050E-01	6.024E-01	5.965E-01	5.873E-01	5.749E-01	5.388E-01	4.342E-01	3.054E-01	2.598E-01
IY= 13	7.567E-01	7.553E-01	7.531E-01	7.499E-01	7.456E-01	7.328E-01	6.887E-01	6.196E-01	4.953E-01
IY= 12	1.525E-01	1.354E-01	1.336E-01	1.352E-01	1.356E-01	1.312E-01	1.133E-01	9.383E-02	7.209E-01
IY= 11	-5.609E-02	-5.113E-02	6.347E-03	8.565E-02	1.403E-01	1.719E-01	1.379E-01	1.080E-01	1.178E+00
IY= 10	2.153E+00	4.613E-01	-2.623E-01	-9.484E-02	1.432E-01	2.221E-01	1.516E-01	1.105E-01	1.552E+00
IY= 9	9.140E+00	3.982E+00	2.301E-01	-1.052E-01	2.227E-01	2.443E-01	1.541E-01	1.097E-01	1.749E+00
IY= 8	2.229E+01	6.913E+00	6.991E-01	4.396E-01	4.726E-01	2.668E-01	1.520E-01	1.064E-01	1.929E+00
IY= 7	8.545E+01	1.006E+01	3.638E+00	1.761E+00	8.353E-01	2.934E-01	1.450E-01	9.995E-02	2.080E+00
IY= 6	4.335E+02	5.768E+01	1.150E+01	3.648E+00	1.178E+00	3.071E-01	1.329E-01	8.949E-02	2.198E+00
IY= 5	4.336E+02	5.993E+01	1.231E+01	3.658E+00	1.062E+00	2.564E-01	1.135E-01	7.430E-02	2.286E+00
IY= 4	8.639E+01	1.103E+01	4.397E+00	1.453E+00	3.023E-01	1.318E-01	8.598E-02	5.446E-02	2.356E+00
IY= 3	2.274E+01	8.079E+00	1.835E+00	3.057E-01	-4.377E-01	-2.130E-02	5.080E-02	2.415E-02	2.414E+00
IY= 2	1.044E+01	5.462E+00	2.375E+00	6.229E-01	-5.643E-01	-1.386E-01	7.817E-03	-2.623E-02	2.463E+00
IY= 1	4.389E+00	2.043E+00	1.467E+00	1.100E+00	1.787E-01	1.601E-01	5.099E-03	-1.205E-01	2.492E+00
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF KE

IY= 16	2.941E-01	2.934E-01	2.918E-01	2.894E-01	2.862E-01	2.773E-01	2.554E-01	2.346E-01	1.403E-01
IY= 15	3.797E-01	3.792E-01	3.780E-01	3.762E-01	3.738E-01	3.669E-01	3.486E-01	3.221E-01	2.269E-01
IY= 14	4.777E-01	4.773E-01	4.766E-01	4.756E-01	4.743E-01	4.705E-01	4.566E-01	4.259E-01	3.327E-01
IY= 13	5.798E-01	5.791E-01	5.793E-01	5.803E-01	5.820E-01	5.870E-01	5.951E-01	5.983E-01	5.236E-01
IY= 12	9.116E-01	8.999E-01	8.772E-01	8.455E-01	8.074E-01	7.197E-01	6.102E-01	5.823E-01	7.969E-01
IY= 11	1.564E+00	1.474E+00	1.377E+00	1.257E+00	1.115E+00	8.589E-01	6.492E-01	6.093E-01	1.248E+00
IY= 10	3.029E+00	2.935E+00	2.867E+00	2.359E+00	1.774E+00	1.071E+00	6.896E-01	6.349E-01	1.902E+00
IY= 9	9.829E+00	4.386E+00	5.215E+00	3.823E+00	2.401E+00	1.196E+00	7.047E-01	6.454E-01	2.212E+00
IY= 8	3.172E+01	1.029E+01	1.244E+01	6.036E+00	3.018E+00	1.287E+00	7.100E-01	6.521E-01	2.401E+00
IY= 7	9.106E+01	3.406E+01	1.113E+01	5.278E+00	3.324E+00	1.315E+00	7.034E-01	6.519E-01	2.415E+00
IY= 6	1.524E+01	1.068E+02	2.281E+01	4.168E+00	3.731E+00	1.284E+00	6.832E-01	6.411E-01	2.237E+00
IY= 5	1.521E+01	9.779E+01	2.175E+01	4.512E+00	3.906E+00	1.235E+00	6.474E-01	6.162E-01	1.925E+00
IY= 4	8.406E+01	2.630E+01	7.888E+00	3.446E+00	3.208E+00	1.190E+00	5.938E-01	5.734E-01	1.561E+00
IY= 3	2.904E+01	8.297E+00	8.048E+00	3.311E+00	2.361E+00	1.145E+00	5.199E-01	5.051E-01	1.199E+00
IY= 2	8.272E+00	2.644E+00	2.626E+00	1.833E+00	1.475E+00	1.019E+00	4.111E-01	3.875E-01	8.315E-01
IY= 1	1.170E-01	2.734E-02	2.851E-02	4.623E-02	3.943E-02	1.872E-02	3.683E-03	4.520E-04	3.845E-02
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF EP

IY= 16	9.380E-03	9.415E-03	9.480E-03	9.581E-03	9.729E-03	1.022E-02	1.239E-02	1.765E-02	6.666E-03
IY= 15	1.278E-02	1.284E-02	1.294E-02	1.309E-02	1.330E-02	1.396E-02	1.629E-02	1.991E-02	1.049E-02
IY= 14	1.733E-02	1.738E-02	1.750E-02	1.767E-02	1.792E-02	1.864E-02	2.053E-02	2.192E-02	1.499E-02
IY= 13	2.313E-02	2.315E-02	2.330E-02	2.360E-02	2.403E-02	2.530E-02	2.862E-02	3.241E-02	2.783E-02
IY= 12	9.087E-02	8.895E-02	8.513E-02	7.984E-02	7.363E-02	5.989E-02	4.485E-02	4.190E-02	6.355E-02
IY= 11	2.869E-01	2.558E-01	2.235E-01	1.857E-01	1.458E-01	8.513E-02	5.080E-02	4.637E-02	1.419E-01
IY= 10	7.755E+00	3.302E+00	1.724E+00	7.846E-01	4.088E-01	1.303E-01	5.786E-02	5.208E-02	3.026E-01
IY= 9	1.590E+02	2.513E+01	4.629E+00	1.999E+00	7.137E-01	1.633E-01	6.126E-02	5.502E-02	3.807E-01
IY= 8	9.714E+02	7.324E+01	2.006E+01	4.958E+00	9.919E-01	1.909E-01	6.418E-02	5.802E-02	4.211E-01
IY= 7	4.608E+03	4.568E+02	1.045E+02	1.408E+01	1.280E+00	2.037E-01	6.580E-02	6.065E-02	4.153E-01
IY= 6	1.811E+03	5.215E+03	6.243E+02	4.512E+01	1.672E+00	2.029E-01	6.577E-02	6.247E-02	3.682E-01
IY= 5	1.790E+03	4.718E+03	5.814E+02	4.904E+01	1.973E+00	2.040E-01	6.407E-02	6.303E-02	2.983E-01
IY= 4	4.318E+03	3.511E+02	9.962E+01	1.417E+01	1.604E+00	2.174E-01	6.061E-02	6.190E-02	2.369E-01
IY= 3	8.926E+02	6.374E+01	1.586E+01	3.837E+00	1.191E+00	2.468E-01	5.558E-02	5.814E-02	1.862E-01
IY= 2	1.353E+02	1.835E+01	2.320E+00	1.152E+00	8.372E-01	2.651E-01	4.763E-02	4.812E-02	1.336E-01
IY= 1	6.043E-02	6.831E-03	7.271E-03	1.502E-02	1.183E-02	3.868E-03	3.377E-04	1.452E-05	1.139E-02
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF H1

IY= 16	2.991E+05	2.991E+05	2.992E+05	2.993E+05	2.995E+05	3.001E+05	3.022E+05	3.053E+05	2.998E+05
IY= 15	2.995E+05	2.995E+05	2.997E+05	2.998E+05	3.000E+05	3.007E+05	3.026E+05	3.049E+05	3.009E+05
IY= 14	2.995E+05	2.996E+05	2.996E+05	2.998E+05	2.999E+05	3.004E+05	3.016E+05	3.026E+05	3.006E+05
IY= 13	2.994E+05	2.994E+05	2.995E+05	2.995E+05	2.996E+05	2.999E+05	3.005E+05	3.008E+05	2.997E+05
IY= 12	2.963E+05	2.963E+05	2.963E+05	2.963E+05	2.963E+05	2.963E+05	2.963E+05	2.963E+05	2.985E+05
IY= 11	2.978E+05	2.972E+05	2.968E+05	2.965E+05	2.964E+05	2.963E+05	2.963E+05	2.963E+05	2.974E+05
IY= 10	3.026E+05	2.985E+05	2.979E+05	2.968E+05	2.964E+05	2.963E+05	2.963E+05	2.964E+05	2.970E+05
IY= 9	3.793E+05	3.145E+05	2.983E+05	2.969E+05	2.964E+05	2.963E+05	2.964E+05	2.964E+05	2.969E+05
IY= 8	4.956E+05	3.156E+05	2.978E+05	2.969E+05	2.965E+05	2.964E+05	2.964E+05	2.965E+05	2.967E+05
IY= 7	7.594E+05	3.162E+05	3.239E+05	3.032E+05	2.967E+05	2.965E+05	2.966E+05	2.967E+05	2.966E+05
IY= 6	2.008E+06	7.624E+05	4.440E+05	3.285E+05	2.975E+05	2.968E+05	2.968E+05	2.970E+05	2.965E+05
IY= 5	2.008E+06	7.530E+05	4.343E+05	3.299E+05	2.982E+05	2.973E+05	2.972E+05	2.976E+05	2.964E+05
IY= 4	7.580E+05	3.197E+05	3.355E+05	3.091E+05	2.988E+05	2.983E+05	2.978E+05	2.986E+05	2.964E+05
IY= 3	4.865E+05	3.129E+05	2.997E+05	3.011E+05	3.007E+05	2.996E+05	2.986E+05	2.999E+05	2.963E+05
IY= 2	3.623E+05	3.124E+05	2.990E+05	3.006E+05	3.021E+05	3.007E+05	2.994E+05	3.014E+05	2.963E+05
IY= 1	3.154E+05	3.041E+05	2.978E+05	2.983E+05	2.988E+05	2.990E+05	2.994E+05	3.035E+05	2.963E+05
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF TMP1

IY= 16	2.979E+02	2.979E+02	2.980E+02	2.981E+02	2.983E+02	2.989E+02	3.009E+02	3.041E+02	2.986E+02
IY= 15	2.983E+02	2.984E+02	2.985E+02	2.986E+02	2.988E+02	2.995E+02	3.014E+02	3.037E+02	2.997E+02
IY= 14	2.983E+02	2.984E+02	2.984E+02	2.986E+02	2.987E+02	2.992E+02	3.004E+02	3.014E+02	2.994E+02
IY= 13	2.982E+02	2.982E+02	2.983E+02	2.984E+02	2.985E+02	2.987E+02	2.993E+02	2.996E+02	2.985E+02
IY= 12	2.952E+02	2.951E+02	2.951E+02	2.951E+02	2.951E+02	2.951E+02	2.951E+02	2.951E+02	2.973E+02
IY= 11	2.966E+02	2.960E+02	2.956E+02	2.953E+02	2.952E+02	2.951E+02	2.951E+02	2.951E+02	2.962E+02
IY= 10	3.014E+02	2.974E+02	2.968E+02	2.956E+02	2.953E+02	2.951E+02	2.951E+02	2.952E+02	2.958E+02
IY= 9	3.778E+02	3.133E+02	2.972E+02	2.957E+02	2.953E+02	2.952E+02	2.952E+02	2.952E+02	2.957E+02
IY= 8	4.936E+02	3.143E+02	2.966E+02	2.957E+02	2.953E+02	2.952E+02	2.953E+02	2.953E+02	2.955E+02
IY= 7	7.563E+02	3.150E+02	3.226E+02	3.019E+02	2.955E+02	2.953E+02	2.954E+02	2.955E+02	2.954E+02
IY= 6	2.000E+03	7.593E+02	4.422E+02	3.272E+02	2.963E+02	2.956E+02	2.956E+02	2.959E+02	2.953E+02
IY= 5	2.000E+03	7.500E+02	4.326E+02	3.285E+02	2.970E+02	2.961E+02	2.960E+02	2.964E+02	2.953E+02
IY= 4	7.550E+02	3.164E+02	3.341E+02	3.079E+02	2.976E+02	2.971E+02	2.966E+02	2.974E+02	2.952E+02
IY= 3	4.846E+02	3.117E+02	2.985E+02	2.999E+02	2.995E+02	2.984E+02	2.974E+02	2.987E+02	2.952E+02
IY= 2	3.608E+02	3.111E+02	2.978E+02	2.994E+02	3.009E+02	2.995E+02	2.982E+02	3.002E+02	2.951E+02
IY= 1	3.142E+02	3.028E+02	2.966E+02	2.971E+02	2.976E+02	2.978E+02	2.982E+02	3.023E+02	2.951E+02
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF RHO1

	1	2	3	4	5	6	7	8	9
IY= 16	1.185E+00	1.185E+00	1.185E+00	1.184E+00	1.183E+00	1.181E+00	1.173E+00	1.161E+00	1.182E+00
IY= 15	1.184E+00	1.183E+00	1.183E+00	1.182E+00	1.181E+00	1.179E+00	1.171E+00	1.163E+00	1.178E+00
IY= 14	1.183E+00	1.183E+00	1.183E+00	1.182E+00	1.182E+00	1.180E+00	1.175E+00	1.171E+00	1.179E+00
IY= 13	1.184E+00	1.184E+00	1.184E+00	1.183E+00	1.183E+00	1.182E+00	1.180E+00	1.179E+00	1.183E+00
IY= 12	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.187E+00
IY= 11	1.190E+00	1.192E+00	1.194E+00	1.195E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.192E+00
IY= 10	1.171E+00	1.187E+00	1.190E+00	1.194E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.193E+00
IY= 9	9.344E-01	1.127E+00	1.183E+00	1.194E+00	1.196E+00	1.196E+00	1.196E+00	1.196E+00	1.194E+00
IY= 8	7.149E-01	1.122E+00	1.190E+00	1.194E+00	1.195E+00	1.196E+00	1.196E+00	1.195E+00	1.195E+00
IY= 7	4.649E-01	1.119E+00	1.094E+00	1.169E+00	1.194E+00	1.195E+00	1.195E+00	1.195E+00	1.195E+00
IY= 6	1.801E-01	4.639E-01	7.982E-01	1.079E+00	1.191E+00	1.194E+00	1.194E+00	1.193E+00	1.195E+00
IY= 5	1.801E-01	4.696E-01	8.160E-01	1.074E+00	1.188E+00	1.192E+00	1.193E+00	1.191E+00	1.196E+00
IY= 4	4.657E-01	1.107E+00	1.056E+00	1.146E+00	1.186E+00	1.188E+00	1.190E+00	1.187E+00	1.196E+00
IY= 3	7.283E-01	1.132E+00	1.182E+00	1.177E+00	1.178E+00	1.183E+00	1.187E+00	1.182E+00	1.196E+00
IY= 2	9.784E-01	1.134E+00	1.185E+00	1.179E+00	1.173E+00	1.179E+00	1.184E+00	1.176E+00	1.196E+00
IY= 1	1.124E+00	1.166E+00	1.190E+00	1.188E+00	1.186E+00	1.186E+00	1.184E+00	1.168E+00	1.196E+00
IX=	1	2	3	4	5	6	7	8	9

TIME STP= 1 SWEEP NO= 400 ZSLAB NO= 11 ITERN NO= 1
FLOW FIELD AT ITHYD= 1, IZ= 11, ISWEEP= 400, ISTEP= 1

FIELD VALUES OF P1

IX=	1	2	3	4	5	6	7	8	9
IY= 16	-1.688E+00	-1.701E+00	-1.698E+00	-1.695E+00	-1.692E+00	-1.677E+00	-1.621E+00	-1.536E+00	-1.529E+00
IY= 15	-1.784E+00	-1.816E+00	-1.810E+00	-1.803E+00	-1.794E+00	-1.769E+00	-1.674E+00	-1.572E+00	-1.594E+00
IY= 14	-2.003E+00	-2.049E+00	-2.042E+00	-2.033E+00	-2.022E+00	-1.992E+00	-1.893E+00	-1.797E+00	-1.808E+00
IY= 13	-2.415E+00	-2.438E+00	-2.441E+00	-2.446E+00	-2.453E+00	-2.473E+00	-2.454E+00	-2.432E+00	-2.280E+00
IY= 12	-3.111E+00	-3.038E+00	-3.068E+00	-3.108E+00	-3.158E+00	-3.317E+00	-3.657E+00	-4.411E+00	-3.296E+00
IY= 11	-2.763E+00	-2.774E+00	-2.827E+00	-2.914E+00	-3.033E+00	-3.313E+00	-3.844E+00	-8.727E+00	-4.878E+00
IY= 10	-1.479E+02	-1.895E+02	-1.965E+02	-2.029E+02	-1.960E+02	-1.643E+02	-1.902E+02	-3.420E+01	-7.248E+00
IY= 9	-1.613E+02	-1.974E+02	-1.971E+02	-2.007E+02	-1.894E+02	-1.635E+02	-1.742E+02	-3.499E+01	-8.269E+00
IY= 8	-1.791E+02	-2.239E+02	-1.875E+02	-1.866E+02	-1.746E+02	-1.595E+02	-1.615E+02	-3.436E+01	-8.889E+00
IY= 7	-2.179E+03	-2.216E+03	-1.167E+02	-1.555E+02	-1.550E+02	-1.538E+02	-1.528E+02	-3.439E+01	-9.191E+00
IY= 6	-2.221E+03	-2.225E+03	-9.522E+01	-1.387E+02	-1.423E+02	-1.484E+02	-1.469E+02	-3.436E+01	-9.258E+00
IY= 5	-2.219E+03	-2.222E+03	-9.066E+01	-1.332E+02	-1.383E+02	-1.443E+02	-1.428E+02	-3.426E+01	-9.148E+00
IY= 4	-2.174E+03	-2.211E+03	-9.741E+01	-1.374E+02	-1.420E+02	-1.419E+02	-1.402E+02	-3.413E+01	-8.894E+00
IY= 3	-1.173E+02	-1.527E+02	-1.457E+02	-1.563E+02	-1.513E+02	-1.408E+02	-1.385E+02	-3.398E+01	-8.504E+00
IY= 2	-1.067E+02	-1.356E+02	-1.534E+02	-1.653E+02	-1.575E+02	-1.403E+02	-1.374E+02	-3.380E+01	-7.958E+00
IY= 1	-1.003E+02	-1.289E+02	-1.523E+02	-1.673E+02	-1.598E+02	-1.400E+02	-1.367E+02	-3.341E+01	-7.240E+00

FIELD VALUES OF U1

IX=	1	2	3	4	5	6	7	8
IY= 16	-1.377E-02	-2.612E-02	-3.726E-02	-4.718E-02	-5.601E-02	-6.620E-02	1.863E-02	5.434E-02
IY= 15	-2.234E-02	-4.326E-02	-6.343E-02	-8.304E-02	-1.024E-01	-1.580E-01	-1.006E-01	3.224E-02
IY= 14	-2.305E-02	-4.489E-02	-6.626E-02	-8.748E-02	-1.089E-01	-1.774E-01	-1.565E-01	-1.581E-02
IY= 13	-8.557E-03	-1.668E-02	-2.537E-02	-3.524E-02	-4.661E-02	-9.688E-02	-1.055E-01	-9.563E-02
IY= 12	3.760E-02	7.081E-02	1.001E-01	1.253E-01	1.463E-01	1.505E-01	1.368E-01	-4.662E-01
IY= 11	1.238E-01	2.494E-01	3.723E-01	4.864E-01	5.796E-01	6.284E-01	1.474E+00	-1.124E+00
IY= 10	-4.995E+00	-8.370E+00	-9.994E+00	-1.107E+01	-1.086E+01	-7.822E+00	-7.821E+00	-2.427E+00
IY= 9	-5.060E+00	-8.947E+00	-1.032E+01	-1.158E+01	-1.142E+01	-9.790E+00	-1.121E+01	-3.655E+00
IY= 8	-3.650E+00	-9.258E+00	-1.001E+01	-1.172E+01	-1.178E+01	-1.121E+01	-1.209E+01	-4.518E+00
IY= 7	4.950E+00	3.501E-06	-7.484E+00	-1.095E+01	-1.168E+01	-1.182E+01	-1.208E+01	-5.084E+00
IY= 6	-2.517E-01	3.286E-07	-6.670E+00	-1.050E+01	-1.151E+01	-1.195E+01	-1.184E+01	-5.422E+00
IY= 5	-2.736E-01	2.753E-07	-6.748E+00	-1.052E+01	-1.151E+01	-1.189E+01	-1.158E+01	-5.599E+00
IY= 4	4.868E+00	3.845E-06	-7.526E+00	-1.104E+01	-1.176E+01	-1.176E+01	-1.135E+01	-5.664E+00
IY= 3	-3.517E+00	-8.485E+00	-1.008E+01	-1.208E+01	-1.218E+01	-1.163E+01	-1.114E+01	-5.660E+00
IY= 2	-5.077E+00	-9.095E+00	-1.114E+01	-1.269E+01	-1.250E+01	-1.147E+01	-1.095E+01	-5.612E+00
IY= 1	-5.436E+00	-9.143E+00	-1.144E+01	-1.287E+01	-1.255E+01	-1.114E+01	-1.073E+01	-5.457E+00

FIELD VALUES OF V1

IY= 15	-3.843E-01	-3.870E-01	-3.890E-01	-3.906E-01	-3.924E-01	-3.991E-01	-4.501E-01	-5.387E-01	-3.161E-01
IY= 14	-5.235E-01	-5.269E-01	-5.321E-01	-5.393E-01	-5.489E-01	-5.774E-01	-6.692E-01	-7.813E-01	-5.670E-01
IY= 13	-6.304E-01	-6.337E-01	-6.428E-01	-6.573E-01	-6.770E-01	-7.344E-01	-8.807E-01	-1.022E+00	-8.317E-01
IY= 12	-8.068E-01	-8.112E-01	-8.289E-01	-8.585E-01	-8.994E-01	-1.022E+00	-1.310E+00	-1.629E+00	-1.226E+00
IY= 11	-4.665E-01	-4.881E-01	-5.196E-01	-5.626E-01	-6.157E-01	-7.960E-01	-1.240E+00	-2.433E+00	-1.548E+00
IY= 10	-7.511E-07	2.079E-06	4.627E-06	3.506E-06	2.176E-06	2.511E-06	-4.468E-06	-6.029E+00	-2.075E+00
IY= 9	-3.793E-01	1.024E+00	2.297E+00	1.694E+00	1.113E+00	4.722E-01	-5.512E-02	-5.215E+00	-2.088E+00
IY= 8	-8.719E-01	1.441E+00	4.661E+00	2.891E+00	1.759E+00	7.241E-01	-4.165E-01	-4.091E+00	-1.936E+00
IY= 7	5.117E-06	1.948E-05	7.615E+00	3.498E+00	1.971E+00	7.822E-01	-6.114E-01	-3.101E+00	-1.687E+00
IY= 6	6.948E+00	-9.277E-01	4.158E+00	2.452E+00	1.472E+00	6.566E-01	-6.533E-01	-2.333E+00	-1.390E+00
IY= 5	1.273E-01	4.451E-02	1.639E+00	1.100E+00	7.104E-01	4.170E-01	-6.144E-01	-1.745E+00	-1.076E+00
IY= 4	-6.756E+00	9.669E-01	-9.804E-01	-2.059E-01	-2.745E-02	1.595E-01	-5.337E-01	-1.283E+00	-7.676E-01
IY= 3	-3.934E-06	-1.077E-05	-4.504E+00	-1.335E+00	-5.333E-01	-2.795E-02	-4.235E-01	-9.003E-01	-4.761E-01
IY= 2	1.197E+00	-6.664E-01	-2.473E+00	-1.127E+00	-5.179E-01	-9.703E-02	-2.887E-01	-5.664E-01	-2.099E-01
IY= 1	7.884E-01	-4.812E-01	-1.082E+00	-6.075E-01	-3.062E-01	-8.809E-02	-1.425E-01	-2.661E-01	3.978E-03
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF W1

IY= 16	1.914E-01	1.802E-01	1.668E-01	1.501E-01	1.284E-01	5.620E-02	-2.615E-01	-6.759E-01	3.501E-07
IY= 15	4.371E-01	4.271E-01	4.129E-01	3.929E-01	3.654E-01	2.792E-01	-4.700E-02	-4.743E-01	2.485E-03
IY= 14	6.527E-01	6.455E-01	6.334E-01	6.155E-01	5.905E-01	5.125E-01	2.401E-01	-1.158E-01	1.273E-01
IY= 13	7.760E-01	7.733E-01	7.677E-01	7.588E-01	7.454E-01	6.988E-01	5.012E-01	2.271E-01	2.722E-01
IY= 12	2.370E-01	2.378E-01	2.397E-01	2.423E-01	2.450E-01	2.499E-01	6.330E-02	-2.241E-01	2.206E-01
IY= 11	-1.429E-01	-1.250E-01	-8.494E-02	-1.998E-02	7.703E-02	4.605E-01	-1.887E-02	-1.008E+00	1.185E-01
IY= 10	1.751E+01	1.646E+01	1.432E+01	1.037E+01	4.594E+00	-3.011E+00	-3.334E+00	-2.427E+00	-4.176E-02
IY= 9	1.744E+01	1.617E+01	1.370E+01	9.388E+00	3.301E+00	-4.609E+00	-3.500E+00	-3.490E+00	-2.135E-01
IY= 8	1.760E+01	1.574E+01	1.339E+01	8.767E+00	2.525E+00	-5.448E+00	-3.509E+00	-4.199E+00	-3.927E-01
IY= 7	1.444E+02	7.069E+01	1.408E+01	8.815E+00	2.389E+00	-5.659E+00	-3.433E+00	-4.650E+00	-5.649E-01
IY= 6	3.664E+02	1.158E+02	1.444E+01	8.973E+00	2.472E+00	-5.591E+00	-3.338E+00	-4.913E+00	-7.232E-01
IY= 5	3.679E+02	1.163E+02	1.444E+01	9.004E+00	2.525E+00	-5.457E+00	-3.256E+00	-5.083E+00	-8.668E-01
IY= 4	1.447E+02	7.079E+01	1.413E+01	8.847E+00	2.466E+00	-5.358E+00	-3.205E+00	-5.211E+00	-1.002E+00
IY= 3	1.832E+01	1.617E+01	1.326E+01	8.475E+00	2.305E+00	-5.323E+00	-3.198E+00	-5.323E+00	-1.137E+00
IY= 2	1.794E+01	1.583E+01	1.277E+01	8.191E+00	2.154E+00	-5.332E+00	-3.239E+00	-5.429E+00	-1.298E+00
IY= 1	1.782E+01	1.571E+01	1.262E+01	8.116E+00	2.124E+00	-5.307E+00	-3.325E+00	-5.574E+00	-1.632E+00
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF KE

IY= 16	3.102E-01	3.103E-01	3.087E-01	3.055E-01	3.014E-01	2.925E-01	3.423E-01	5.252E-01	1.560E-01
IY= 15	4.019E-01	4.024E-01	4.015E-01	3.994E-01	3.965E-01	3.899E-01	4.099E-01	5.126E-01	2.434E-01
IY= 14	4.989E-01	5.003E-01	5.015E-01	5.028E-01	5.041E-01	5.073E-01	5.114E-01	5.163E-01	3.073E-01
IY= 13	5.879E-01	5.909E-01	5.970E-01	6.061E-01	6.178E-01	6.498E-01	7.099E-01	7.190E-01	5.166E-01
IY= 12	7.670E-01	7.758E-01	7.945E-01	8.220E-01	8.559E-01	9.482E-01	1.125E+00	1.164E+00	1.107E+00
IY= 11	2.794E-04	3.811E-04	7.315E-04	1.232E-03	1.856E-03	3.470E-03	6.281E-03	3.077E+00	4.130E+00
IY= 10	1.381E+02	1.229E+02	1.001E+02	7.614E+01	5.147E+01	3.732E+01	1.570E+01	5.340E+00	1.068E+01
IY= 9	1.130E+02	9.795E+01	8.414E+01	6.997E+01	4.662E+01	3.495E+01	1.625E+01	9.298E+00	1.569E+01
IY= 8	1.437E+00	1.298E+00	5.797E+01	6.931E+01	4.466E+01	3.463E+01	1.838E+01	1.325E+01	1.823E+01
IY= 7	2.777E+03	1.373E+03	1.063E+00	7.551E+01	4.499E+01	3.508E+01	2.032E+01	1.538E+01	1.885E+01
IY= 6	1.834E+03	5.464E+03	9.959E-01	7.518E+01	4.498E+01	3.498E+01	2.115E+01	1.582E+01	1.842E+01
IY= 5	1.761E+03	5.405E+03	9.610E-01	7.162E+01	4.292E+01	3.380E+01	2.077E+01	1.523E+01	1.743E+01
IY= 4	2.695E+03	1.328E+03	9.546E-01	6.488E+01	3.933E+01	3.143E+01	1.931E+01	1.395E+01	1.592E+01
IY= 3	1.539E+00	1.332E+00	4.719E+01	5.126E+01	3.381E+01	2.753E+01	1.671E+01	1.196E+01	1.369E+01
IY= 2	4.714E+01	4.583E+01	4.394E+01	3.566E+01	2.525E+01	2.085E+01	1.245E+01	8.914E+00	1.019E+01
IY= 1	1.536E+00	1.343E+00	1.198E+00	9.817E-01	7.784E-01	7.892E-01	6.243E-01	4.727E-01	1.738E-01
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF EP

IY= 16	1.923E-02	1.964E-02	2.021E-02	2.097E-02	2.205E-02	2.588E-02	5.003E-02	1.035E-01	1.957E-02
IY= 15	2.063E-02	2.101E-02	2.158E-02	2.241E-02	2.363E-02	2.770E-02	4.825E-02	8.783E-02	2.622E-02
IY= 14	2.331E-02	2.369E-02	2.435E-02	2.531E-02	2.667E-02	3.083E-02	4.596E-02	6.833E-02	2.662E-02
IY= 13	2.667E-02	2.710E-02	2.800E-02	2.942E-02	3.140E-02	3.732E-02	5.454E-02	7.152E-02	4.105E-02
IY= 12	4.936E-02	5.050E-02	5.299E-02	5.682E-02	6.195E-02	7.734E-02	1.191E-01	1.494E-01	1.489E-01
IY= 11	1.833E-06	2.920E-06	7.764E-06	1.698E-05	3.138E-05	8.020E-05	1.953E-04	1.679E+00	2.294E+00
IY= 10	4.370E+02	3.473E+02	2.326E+02	1.472E+02	8.637E+01	5.879E+01	1.880E+01	4.149E+00	1.023E+01
IY= 9	3.587E+02	2.692E+02	1.840E+02	1.315E+02	7.568E+01	5.276E+01	1.961E+01	1.013E+01	1.987E+01
IY= 8	2.603E+00	2.235E+00	1.208E+02	1.391E+02	7.272E+01	5.228E+01	2.329E+01	1.641E+01	2.508E+01
IY= 7	2.434E+05	6.878E+04	1.657E+00	1.655E+02	7.439E+01	5.364E+01	2.673E+01	2.008E+01	2.617E+01
IY= 6	2.076E+05	4.543E+05	1.502E+00	1.664E+02	7.452E+01	5.364E+01	2.799E+01	2.057E+01	2.508E+01
IY= 5	1.983E+05	4.496E+05	1.423E+00	1.563E+02	7.106E+01	5.152E+01	2.718E+01	1.933E+01	2.309E+01
IY= 4	2.374E+05	6.660E+04	1.409E+00	1.387E+02	6.460E+01	4.759E+01	2.481E+01	1.721E+01	2.059E+01
IY= 3	2.884E+00	2.323E+00	1.036E+02	1.014E+02	5.504E+01	4.166E+01	2.111E+01	1.438E+01	1.740E+01
IY= 2	1.573E+02	1.229E+02	9.520E+01	6.668E+01	4.106E+01	3.178E+01	1.555E+01	1.050E+01	1.271E+01
IY= 1	2.875E+00	2.350E+00	1.981E+00	1.470E+00	1.038E+00	1.059E+00	7.452E-01	4.911E-01	1.095E-01
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF H1

IY= 16	3.038E+05	3.040E+05	3.044E+05	3.051E+05	3.061E+05	3.093E+05	3.233E+05	3.387E+05	3.089E+05
IY= 15	3.038E+05	3.040E+05	3.045E+05	3.052E+05	3.062E+05	3.096E+05	3.234E+05	3.395E+05	3.124E+05
IY= 14	3.032E+05	3.033E+05	3.037E+05	3.043E+05	3.051E+05	3.076E+05	3.166E+05	3.279E+05	3.100E+05
IY= 13	3.027E+05	3.028E+05	3.030E+05	3.034E+05	3.039E+05	3.053E+05	3.101E+05	3.150E+05	3.067E+05
IY= 12	3.053E+05	3.054E+05	3.056E+05	3.060E+05	3.065E+05	3.080E+05	3.122E+05	3.144E+05	3.047E+05
IY= 11	3.066E+05	3.065E+05	3.065E+05	3.065E+05	3.066E+05	3.074E+05	3.107E+05	3.137E+05	3.021E+05
IY= 10	3.104E+05	3.106E+05	3.110E+05	3.114E+05	3.118E+05	3.121E+05	3.132E+05	3.143E+05	3.015E+05
IY= 9	3.103E+05	3.106E+05	3.111E+05	3.115E+05	3.120E+05	3.124E+05	3.136E+05	3.149E+05	3.012E+05
IY= 8	3.102E+05	3.106E+05	3.112E+05	3.118E+05	3.123E+05	3.127E+05	3.139E+05	3.154E+05	3.010E+05
IY= 7	8.208E+05	4.852E+05	3.112E+05	3.119E+05	3.125E+05	3.129E+05	3.142E+05	3.158E+05	3.011E+05
IY= 6	1.727E+06	6.835E+05	3.112E+05	3.120E+05	3.127E+05	3.130E+05	3.144E+05	3.161E+05	3.013E+05
IY= 5	1.734E+06	6.865E+05	3.112E+05	3.121E+05	3.127E+05	3.132E+05	3.146E+05	3.164E+05	3.016E+05
IY= 4	8.209E+05	4.851E+05	3.113E+05	3.123E+05	3.129E+05	3.134E+05	3.148E+05	3.166E+05	3.020E+05
IY= 3	3.097E+05	3.107E+05	3.116E+05	3.125E+05	3.132E+05	3.138E+05	3.152E+05	3.169E+05	3.025E+05
IY= 2	3.098E+05	3.109E+05	3.119E+05	3.129E+05	3.137E+05	3.143E+05	3.158E+05	3.172E+05	3.031E+05
IY= 1	3.097E+05	3.111E+05	3.124E+05	3.138E+05	3.149E+05	3.157E+05	3.172E+05	3.178E+05	3.043E+05
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF TMP1

IY= 16	3.026E+02	3.028E+02	3.032E+02	3.039E+02	3.048E+02	3.080E+02	3.221E+02	3.373E+02	3.077E+02
IY= 15	3.026E+02	3.028E+02	3.033E+02	3.040E+02	3.050E+02	3.084E+02	3.222E+02	3.381E+02	3.111E+02
IY= 14	3.019E+02	3.021E+02	3.025E+02	3.030E+02	3.038E+02	3.063E+02	3.154E+02	3.266E+02	3.088E+02
IY= 13	3.015E+02	3.016E+02	3.018E+02	3.022E+02	3.027E+02	3.041E+02	3.089E+02	3.137E+02	3.055E+02
IY= 12	3.040E+02	3.042E+02	3.044E+02	3.048E+02	3.053E+02	3.068E+02	3.110E+02	3.132E+02	3.035E+02
IY= 11	3.053E+02	3.053E+02	3.053E+02	3.053E+02	3.054E+02	3.062E+02	3.095E+02	3.125E+02	3.009E+02
IY= 10	3.091E+02	3.094E+02	3.097E+02	3.101E+02	3.105E+02	3.109E+02	3.119E+02	3.130E+02	3.003E+02
IY= 9	3.091E+02	3.094E+02	3.098E+02	3.103E+02	3.108E+02	3.111E+02	3.123E+02	3.136E+02	3.000E+02
IY= 8	3.090E+02	3.094E+02	3.099E+02	3.105E+02	3.111E+02	3.114E+02	3.127E+02	3.141E+02	2.998E+02
IY= 7	8.175E+02	4.833E+02	3.100E+02	3.107E+02	3.113E+02	3.116E+02	3.129E+02	3.145E+02	2.999E+02
IY= 6	1.720E+03	6.808E+02	3.100E+02	3.108E+02	3.114E+02	3.118E+02	3.131E+02	3.148E+02	3.001E+02
IY= 5	1.727E+03	6.838E+02	3.100E+02	3.109E+02	3.115E+02	3.119E+02	3.133E+02	3.151E+02	3.004E+02
IY= 4	8.176E+02	4.832E+02	3.101E+02	3.110E+02	3.117E+02	3.122E+02	3.136E+02	3.154E+02	3.008E+02
IY= 3	3.085E+02	3.095E+02	3.104E+02	3.113E+02	3.120E+02	3.125E+02	3.139E+02	3.157E+02	3.013E+02
IY= 2	3.086E+02	3.097E+02	3.107E+02	3.117E+02	3.125E+02	3.131E+02	3.145E+02	3.160E+02	3.019E+02
IY= 1	3.085E+02	3.099E+02	3.112E+02	3.125E+02	3.136E+02	3.145E+02	3.159E+02	3.166E+02	3.031E+02
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF RHO1

IY= 16	1.167E+00	1.166E+00	1.164E+00	1.162E+00	1.158E+00	1.146E+00	1.096E+00	1.047E+00	1.147E+00
IY= 15	1.167E+00	1.166E+00	1.164E+00	1.161E+00	1.157E+00	1.145E+00	1.096E+00	1.044E+00	1.135E+00
IY= 14	1.169E+00	1.169E+00	1.167E+00	1.165E+00	1.162E+00	1.152E+00	1.119E+00	1.081E+00	1.143E+00
IY= 13	1.171E+00	1.171E+00	1.170E+00	1.168E+00	1.166E+00	1.161E+00	1.143E+00	1.125E+00	1.156E+00
IY= 12	1.161E+00	1.161E+00	1.160E+00	1.158E+00	1.157E+00	1.151E+00	1.135E+00	1.127E+00	1.163E+00
IY= 11	1.156E+00	1.156E+00	1.156E+00	1.156E+00	1.156E+00	1.153E+00	1.141E+00	1.130E+00	1.173E+00
IY= 10	1.140E+00	1.139E+00	1.138E+00	1.136E+00	1.135E+00	1.134E+00	1.130E+00	1.128E+00	1.176E+00
IY= 9	1.140E+00	1.139E+00	1.137E+00	1.136E+00	1.134E+00	1.133E+00	1.128E+00	1.125E+00	1.177E+00
IY= 8	1.141E+00	1.139E+00	1.137E+00	1.135E+00	1.133E+00	1.132E+00	1.127E+00	1.124E+00	1.177E+00
IY= 7	4.226E-01	7.146E-01	1.138E+00	1.135E+00	1.132E+00	1.131E+00	1.127E+00	1.122E+00	1.177E+00
IY= 6	2.008E-01	5.072E-01	1.138E+00	1.134E+00	1.132E+00	1.131E+00	1.126E+00	1.121E+00	1.176E+00
IY= 5	1.999E-01	5.050E-01	1.138E+00	1.134E+00	1.132E+00	1.130E+00	1.125E+00	1.120E+00	1.175E+00
IY= 4	4.225E-01	7.148E-01	1.137E+00	1.134E+00	1.131E+00	1.129E+00	1.124E+00	1.119E+00	1.173E+00
IY= 3	1.143E+00	1.139E+00	1.136E+00	1.132E+00	1.130E+00	1.128E+00	1.123E+00	1.118E+00	1.171E+00
IY= 2	1.143E+00	1.139E+00	1.135E+00	1.131E+00	1.128E+00	1.126E+00	1.121E+00	1.117E+00	1.169E+00
IY= 1	1.142E+00	1.138E+00	1.133E+00	1.128E+00	1.124E+00	1.121E+00	1.116E+00	1.115E+00	1.165E+00
IX=	1	2	3	4	5	6	7	8	9

TIME STP=   1 SWEEP NO=   400 ZSLAB NO=   20 ITERN NO=   1
FLOW FIELD AT ITHYD= 1, IZ= 20, ISWEEP= 400, ISTEP=   1
FIELD VALUES OF P1

IY= 16	1.089E+01	1.200E+01	1.092E+01	9.312E+00	7.088E+00	3.617E+00	-4.193E-01	-2.346E-01	4.426E+00
IY= 15	-1.480E+00	-1.352E+00	-1.805E+00	-2.467E+00	-3.261E+00	-4.370E+00	-6.235E+00	-4.984E+00	5.058E-01
IY= 14	-4.564E+00	-4.686E+00	-4.866E+00	-5.126E+00	-5.419E+00	-5.749E+00	-6.481E+00	-5.894E+00	-3.127E+00
IY= 13	-4.206E+00	-4.258E+00	-4.355E+00	-4.480E+00	-4.587E+00	-4.791E+00	-4.997E+00	-4.602E+00	-3.615E+00
IY= 12	-3.142E+00	-3.190E+00	-3.269E+00	-3.374E+00	-3.488E+00	-3.519E+00	-3.423E+00	-3.095E+00	-2.810E+00
IY= 11	-3.091E+00	-3.122E+00	-3.209E+00	-3.392E+00	-3.718E+00	-2.716E+00	-2.275E+00	-2.011E+00	-1.998E+00
IY= 10	1.433E+02	1.456E+02	1.475E+02	1.490E+02	1.506E+02	-1.818E+00	-1.641E+00	-1.504E+00	-1.460E+00
IY= 9	1.451E+02	1.476E+02	1.493E+02	1.506E+02	1.521E+02	-1.471E+00	-1.440E+00	-1.341E+00	-1.328E+00
IY= 8	1.520E+02	1.548E+02	1.560E+02	1.568E+02	1.583E+02	-1.216E+00	-1.271E+00	-1.209E+00	-1.221E+00
IY= 7	1.577E+02	1.607E+02	1.613E+02	1.615E+02	1.628E+02	-1.025E+00	-1.132E+00	-1.100E+00	-1.127E+00
IY= 6	1.566E+02	1.603E+02	1.615E+02	1.620E+02	1.636E+02	-8.791E-01	-1.020E+00	-1.011E+00	-1.047E+00
IY= 5	1.576E+02	1.608E+02	1.611E+02	1.611E+02	1.625E+02	-7.675E-01	-9.305E-01	-9.376E-01	-9.779E-01
IY= 4	1.575E+02	1.604E+02	1.604E+02	1.603E+02	1.616E+02	-6.825E-01	-8.609E-01	-8.774E-01	-9.184E-01
IY= 3	1.568E+02	1.593E+02	1.594E+02	1.594E+02	1.605E+02	-6.199E-01	-8.099E-01	-8.292E-01	-8.655E-01
IY= 2	1.567E+02	1.583E+02	1.587E+02	1.590E+02	1.599E+02	-5.788E-01	-7.783E-01	-7.900E-01	-8.161E-01
IY= 1	1.587E+02	1.594E+02	1.600E+02	1.606E+02	1.610E+02	-5.677E-01	-7.786E-01	-7.472E-01	-7.334E-01
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF U1

IY= 16	6.850E-01	1.316E+00	1.982E+00	2.700E+00	3.483E+00	4.880E+00	5.224E+00	4.204E+00
IY= 15	2.136E-01	4.340E-01	6.489E-01	8.322E-01	9.351E-01	1.468E+00	1.650E+00	9.726E-01
IY= 14	-3.598E-02	-6.289E-02	-8.164E-02	-9.965E-02	-1.369E-01	1.112E-02	-1.384E-01	-3.939E-01
IY= 13	-1.570E-01	-3.218E-01	-4.928E-01	-6.440E-01	-7.238E-01	-7.763E-01	-8.759E-01	-8.149E-01
IY= 12	-2.228E-01	-4.541E-01	-6.837E-01	-8.884E-01	-1.042E+00	-1.091E+00	-1.066E+00	-8.441E-01
IY= 11	-7.147E-02	-2.574E-01	-5.125E-01	-8.221E-01	-1.188E+00	-1.079E+00	-9.889E-01	-7.242E-01
IY= 10	1.210E-01	2.116E-01	2.189E-01	1.343E-01	2.282E-08	-7.343E-01	-8.710E-01	-6.804E-01
IY= 9	1.823E-01	3.071E-01	3.110E-01	1.901E-01	1.229E-06	-6.637E-01	-8.209E-01	-6.506E-01
IY= 8	3.005E-01	4.834E-01	4.735E-01	2.845E-01	1.779E-06	-5.995E-01	-7.731E-01	-6.177E-01
IY= 7	4.398E-01	6.812E-01	6.498E-01	3.852E-01	2.334E-06	-5.506E-01	-7.310E-01	-5.847E-01
IY= 6	5.205E-01	7.944E-01	7.502E-01	4.436E-01	2.621E-06	-5.172E-01	-6.980E-01	-5.546E-01
IY= 5	5.775E-01	8.690E-01	8.120E-01	4.781E-01	2.756E-06	-4.979E-01	-6.764E-01	-5.302E-01
IY= 4	5.513E-01	8.376E-01	7.911E-01	4.706E-01	2.603E-06	-4.916E-01	-6.672E-01	-5.145E-01
IY= 3	4.887E-01	7.441E-01	7.157E-01	4.356E-01	2.199E-06	-4.980E-01	-6.699E-01	-5.104E-01
IY= 2	4.366E-01	6.554E-01	6.447E-01	4.064E-01	1.618E-06	-5.151E-01	-6.851E-01	-5.198E-01
IY= 1	3.006E-01	6.132E-01	6.694E-01	4.069E-01	4.090E-08	-5.516E-01	-7.282E-01	-5.577E-01
IX=	1	2	3	4	5	6	7	8

FIELD VALUES OF V1

IY= 15	3.587E+00	3.545E+00	3.552E+00	3.552E+00	3.522E+00	1.691E+00	2.765E-01	-1.059E+00	-3.038E+00
IY= 14	3.505E+00	3.503E+00	3.498E+00	3.394E+00	3.088E+00	1.667E+00	6.675E-01	-1.306E+00	-3.655E+00
IY= 13	2.698E+00	2.754E+00	2.781E+00	2.684E+00	2.346E+00	1.682E+00	6.801E-01	-1.203E+00	-3.256E+00
IY= 12	1.606E+00	1.687E+00	1.727E+00	1.719E+00	1.662E+00	1.549E+00	5.577E-01	-9.780E-01	-2.527E+00
IY= 11	5.446E-01	7.123E-01	8.452E-01	9.712E-01	1.121E+00	1.329E+00	4.461E-01	-7.277E-01	-1.845E+00
IY= 10	7.749E-06	7.875E-06	8.025E-06	8.246E-06	1.358E-05	1.361E+00	4.352E-01	-4.522E-01	-1.247E+00
IY= 9	9.510E-01	9.521E-01	9.211E-01	8.801E-01	8.585E-01	1.153E+00	3.877E-01	-3.955E-01	-1.087E+00
IY= 8	1.456E+00	1.449E+00	1.383E+00	1.304E+00	1.262E+00	9.757E-01	3.396E-01	-3.458E-01	-9.382E-01
IY= 7	1.320E+00	1.311E+00	1.245E+00	1.172E+00	1.134E+00	8.239E-01	2.916E-01	-2.991E-01	-7.975E-01
IY= 6	5.813E-01	6.012E-01	6.040E-01	6.044E-01	6.079E-01	6.912E-01	2.452E-01	-2.545E-01	-6.651E-01
IY= 5	3.855E-02	3.541E-02	3.257E-02	4.272E-02	5.562E-02	5.715E-01	2.013E-01	-2.110E-01	-5.413E-01
IY= 4	-5.228E-01	-5.010E-01	-4.420E-01	-3.778E-01	-3.433E-01	4.596E-01	1.598E-01	-1.679E-01	-4.256E-01
IY= 3	-8.361E-01	-8.294E-01	-7.386E-01	-6.334E-01	-5.855E-01	3.510E-01	1.199E-01	-1.249E-01	-3.167E-01
IY= 2	-7.923E-01	-8.475E-01	-7.660E-01	-6.521E-01	-6.165E-01	2.412E-01	8.117E-02	-8.213E-02	-2.122E-01
IY= 1	-4.685E-01	-6.103E-01	-5.414E-01	-4.340E-01	-4.358E-01	1.264E-01	4.241E-02	-4.005E-02	-1.087E-01
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF W1

IY= 16	-5.300E+00	-5.259E+00	-5.132E+00	-4.934E+00	-4.710E+00	-4.255E+00	-3.659E+00	-3.321E+00	-7.911E-05
IY= 15	-1.364E+00	-1.329E+00	-1.236E+00	-1.084E+00	-8.822E-01	-1.551E-01	9.119E-01	3.410E-01	1.955E-01
IY= 14	2.327E-03	1.462E-02	8.633E-03	3.048E-02	1.341E-01	8.965E-01	1.546E+00	9.561E-01	3.564E-01
IY= 13	-1.400E-06	-1.386E-06	-1.329E-06	-1.228E-06	3.099E-06	4.817E-01	8.133E-01	7.215E-01	3.636E-01
IY= 12	2.879E-09	1.663E-09	5.579E-10	-1.081E-10	-1.859E-06	-3.561E-01	1.263E-01	3.877E-01	2.972E-01
IY= 11	5.770E-10	1.199E-10	-3.886E-10	-1.195E-09	-5.163E-06	-7.430E-01	-2.798E-01	9.594E-02	1.883E-01
IY= 10	4.621E+01	4.414E+01	4.101E+01	3.823E+01	3.670E+01	-1.083E+00	-4.629E-01	-5.674E-02	1.067E-01
IY= 9	4.783E+01	4.505E+01	4.098E+01	3.751E+01	3.565E+01	-1.109E+00	-5.371E-01	-1.420E-01	4.516E-02
IY= 8	5.300E+01	4.885E+01	4.300E+01	3.818E+01	3.570E+01	-1.149E+00	-6.187E-01	-2.379E-01	-2.977E-02
IY= 7	6.111E+01	5.511E+01	4.690E+01	4.034E+01	3.705E+01	-1.195E+00	-7.067E-01	-3.457E-01	-1.210E-01
IY= 6	7.204E+01	6.365E+01	5.254E+01	4.332E+01	3.950E+01	-1.245E+00	-7.995E-01	-4.656E-01	-2.304E-01
IY= 5	7.285E+01	6.476E+01	5.392E+01	4.524E+01	4.084E+01	-1.295E+00	-8.950E-01	-5.956E-01	-3.571E-01
IY= 4	6.665E+01	6.015E+01	5.106E+01	4.351E+01	3.959E+01	-1.345E+00	-9.904E-01	-7.313E-01	-4.973E-01
IY= 3	5.791E+01	5.314E+01	4.611E+01	3.999E+01	3.671E+01	-1.393E+00	-1.083E+00	-8.663E-01	-6.441E-01
IY= 2	4.999E+01	4.636E+01	4.072E+01	3.561E+01	3.280E+01	-1.438E+00	-1.169E+00	-9.938E-01	-7.887E-01
IY= 1	4.169E+01	3.854E+01	3.324E+01	2.837E+01	2.564E+01	-1.478E+00	-1.279E+00	-1.159E+00	-9.895E-01
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF KE

IY= 16	2.889E+01	2.906E+01	2.924E+01	2.927E+01	2.911E+01	2.334E+01	1.947E+01	1.792E+01	1.664E+01
IY= 15	1.497E+01	1.516E+01	1.504E+01	1.447E+01	1.339E+01	7.366E+00	5.369E+00	7.580E+00	1.088E+01
IY= 14	9.052E+00	9.535E+00	9.666E+00	9.314E+00	8.151E+00	4.536E+00	3.302E+00	5.240E+00	7.735E+00
IY= 13	2.153E-02	2.294E-02	2.403E-02	2.370E-02	2.079E-02	4.963E+00	3.400E+00	4.307E+00	5.612E+00
IY= 12	6.218E-03	7.847E-03	9.792E-03	1.182E-02	1.378E-02	3.754E+00	2.870E+00	3.524E+00	4.207E+00
IY= 11	2.839E-04	5.828E-04	1.446E-03	3.213E-03	6.281E-03	1.975E+00	2.371E+00	2.726E+00	3.083E+00
IY= 10	4.524E+02	4.300E+02	4.081E+02	3.990E+02	4.191E+02	1.463E-02	1.949E+00	2.292E+00	2.582E+00
IY= 9	4.709E+02	4.454E+02	4.169E+02	4.023E+02	4.211E+02	1.273E-02	1.780E+00	2.085E+00	2.311E+00
IY= 8	5.687E+02	5.244E+02	4.703E+02	4.336E+02	4.447E+02	1.157E-02	1.607E+00	1.886E+00	2.063E+00
IY= 7	6.860E+02	6.240E+02	5.424E+02	4.780E+02	4.791E+02	1.093E-02	1.437E+00	1.695E+00	1.837E+00
IY= 6	7.437E+02	6.818E+02	5.902E+02	5.082E+02	5.029E+02	1.066E-02	1.270E+00	1.511E+00	1.629E+00
IY= 5	7.351E+02	6.754E+02	5.855E+02	5.028E+02	4.972E+02	1.064E-02	1.105E+00	1.329E+00	1.431E+00
IY= 4	6.681E+02	6.112E+02	5.311E+02	4.611E+02	4.586E+02	1.079E-02	9.378E-01	1.142E+00	1.235E+00
IY= 3	5.369E+02	4.950E+02	4.364E+02	3.868E+02	3.886E+02	1.106E-02	7.555E-01	9.350E-01	1.022E+00
IY= 2	3.683E+02	3.453E+02	3.110E+02	2.813E+02	2.855E+02	1.142E-02	5.303E-01	6.727E-01	7.517E-01
IY= 1	6.815E+00	5.891E+00	4.480E+00	3.341E+00	2.770E+00	1.364E-02	1.403E-02	1.222E-02	9.245E-03
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF EP

IY= 16	4.277E+01	4.366E+01	4.477E+01	4.558E+01	4.582E+01	3.160E+01	2.297E+01	1.876E+01	1.434E+01
IY= 15	2.083E+01	2.166E+01	2.193E+01	2.129E+01	1.960E+01	6.891E+00	3.522E+00	5.049E+00	7.495E+00
IY= 14	1.330E+01	1.463E+01	1.528E+01	1.490E+01	1.247E+01	2.417E+00	1.060E+00	2.548E+00	4.491E+00
IY= 13	7.318E-04	8.050E-04	8.633E-04	8.455E-04	6.944E-04	1.924E+00	9.710E-01	1.695E+00	2.765E+00
IY= 12	1.136E-04	1.611E-04	2.245E-04	2.978E-04	3.749E-04	1.300E+00	7.686E-01	1.190E+00	1.758E+00
IY= 11	1.492E-06	4.390E-06	1.716E-05	5.683E-05	1.553E-04	6.385E-01	5.565E-01	7.658E-01	1.074E+00
IY= 10	3.184E+03	2.825E+03	2.421E+03	2.154E+03	2.241E+03	7.429E-04	4.132E-01	5.887E-01	8.311E-01
IY= 9	3.828E+03	3.337E+03	2.740E+03	2.323E+03	2.361E+03	6.026E-04	3.603E-01	5.048E-01	6.856E-01
IY= 8	6.008E+03	5.002E+03	3.782E+03	2.892E+03	2.772E+03	5.220E-04	3.096E-01	4.289E-01	5.639E-01
IY= 7	8.856E+03	7.230E+03	5.208E+03	3.661E+03	3.321E+03	4.796E-04	2.632E-01	3.616E-01	4.624E-01
IY= 6	1.046E+04	8.685E+03	6.239E+03	4.221E+03	3.725E+03	4.620E-04	2.219E-01	3.026E-01	3.779E-01
IY= 5	1.038E+04	8.655E+03	6.246E+03	4.225E+03	3.733E+03	4.607E-04	1.852E-01	2.514E-01	3.074E-01
IY= 4	8.823E+03	7.298E+03	5.316E+03	3.702E+03	3.336E+03	4.707E-04	1.518E-01	2.059E-01	2.481E-01
IY= 3	6.117E+03	5.154E+03	3.892E+03	2.859E+03	2.662E+03	4.884E-04	1.193E-01	1.626E-01	1.952E-01
IY= 2	3.578E+03	3.124E+03	2.481E+03	1.924E+03	1.852E+03	5.123E-04	8.266E-02	1.149E-01	1.399E-01
IY= 1	2.688E+01	2.160E+01	1.433E+01	9.228E+00	6.966E+00	1.538E-03	2.510E-03	2.041E-03	1.343E-03
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF H1

IY= 16	4.768E+05	4.765E+05	4.755E+05	4.742E+05	4.728E+05	4.657E+05	4.642E+05	4.667E+05	4.667E+05
IY= 15	4.339E+05	4.336E+05	4.328E+05	4.313E+05	4.291E+05	4.169E+05	4.206E+05	4.392E+05	4.589E+05
IY= 14	4.140E+05	4.146E+05	4.149E+05	4.145E+05	4.125E+05	4.058E+05	4.139E+05	4.335E+05	4.414E+05
IY= 13	3.979E+05	4.002E+05	4.019E+05	4.034E+05	4.053E+05	4.071E+05	4.149E+05	4.255E+05	4.221E+05
IY= 12	3.983E+05	4.008E+05	4.016E+05	4.024E+05	4.032E+05	4.042E+05	4.095E+05	4.146E+05	4.074E+05
IY= 11	3.961E+05	3.996E+05	3.996E+05	3.996E+05	3.997E+05	3.997E+05	4.018E+05	4.028E+05	3.953E+05
IY= 10	5.315E+05	5.292E+05	5.258E+05	5.230E+05	5.215E+05	3.965E+05	3.979E+05	3.975E+05	3.902E+05
IY= 9	5.448E+05	5.404E+05	5.342E+05	5.292E+05	5.266E+05	3.957E+05	3.966E+05	3.951E+05	3.873E+05
IY= 8	5.716E+05	5.627E+05	5.504E+05	5.406E+05	5.357E+05	3.949E+05	3.954E+05	3.929E+05	3.847E+05
IY= 7	6.059E+05	5.906E+05	5.701E+05	5.541E+05	5.463E+05	3.942E+05	3.943E+05	3.911E+05	3.824E+05
IY= 6	6.333E+05	6.125E+05	5.854E+05	5.647E+05	5.547E+05	3.936E+05	3.934E+05	3.895E+05	3.805E+05
IY= 5	6.378E+05	6.167E+05	5.892E+05	5.681E+05	5.578E+05	3.929E+05	3.926E+05	3.883E+05	3.790E+05
IY= 4	6.172E+05	6.014E+05	5.801E+05	5.634E+05	5.551E+05	3.923E+05	3.919E+05	3.874E+05	3.780E+05
IY= 3	5.851E+05	5.761E+05	5.635E+05	5.534E+05	5.483E+05	3.917E+05	3.913E+05	3.869E+05	3.775E+05
IY= 2	5.534E+05	5.503E+05	5.454E+05	5.418E+05	5.403E+05	3.912E+05	3.907E+05	3.865E+05	3.775E+05
IY= 1	5.117E+05	5.162E+05	5.209E+05	5.271E+05	5.314E+05	3.905E+05	3.901E+05	3.862E+05	3.782E+05
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF TMP1

IY= 16	4.749E+02	4.746E+02	4.736E+02	4.723E+02	4.709E+02	4.639E+02	4.624E+02	4.648E+02	4.648E+02
IY= 15	4.322E+02	4.319E+02	4.311E+02	4.296E+02	4.274E+02	4.153E+02	4.189E+02	4.374E+02	4.571E+02
IY= 14	4.124E+02	4.129E+02	4.133E+02	4.128E+02	4.109E+02	4.041E+02	4.122E+02	4.318E+02	4.397E+02
IY= 13	3.963E+02	3.986E+02	4.003E+02	4.018E+02	4.036E+02	4.055E+02	4.132E+02	4.238E+02	4.204E+02
IY= 12	3.967E+02	3.992E+02	4.000E+02	4.007E+02	4.016E+02	4.026E+02	4.078E+02	4.129E+02	4.058E+02
IY= 11	3.945E+02	3.980E+02	3.980E+02	3.981E+02	3.981E+02	3.981E+02	4.002E+02	4.012E+02	3.937E+02
IY= 10	5.294E+02	5.270E+02	5.237E+02	5.209E+02	5.194E+02	3.949E+02	3.963E+02	3.959E+02	3.886E+02
IY= 9	5.426E+02	5.382E+02	5.321E+02	5.271E+02	5.245E+02	3.941E+02	3.950E+02	3.935E+02	3.858E+02
IY= 8	5.693E+02	5.604E+02	5.482E+02	5.384E+02	5.336E+02	3.934E+02	3.938E+02	3.914E+02	3.832E+02
IY= 7	6.035E+02	5.883E+02	5.678E+02	5.519E+02	5.441E+02	3.927E+02	3.927E+02	3.895E+02	3.809E+02
IY= 6	6.307E+02	6.101E+02	5.831E+02	5.625E+02	5.525E+02	3.920E+02	3.918E+02	3.879E+02	3.790E+02
IY= 5	6.352E+02	6.142E+02	5.868E+02	5.658E+02	5.556E+02	3.914E+02	3.910E+02	3.867E+02	3.775E+02
IY= 4	6.148E+02	5.990E+02	5.778E+02	5.611E+02	5.529E+02	3.908E+02	3.903E+02	3.859E+02	3.765E+02
IY= 3	5.828E+02	5.738E+02	5.613E+02	5.511E+02	5.461E+02	3.902E+02	3.897E+02	3.853E+02	3.760E+02
IY= 2	5.512E+02	5.481E+02	5.433E+02	5.397E+02	5.381E+02	3.896E+02	3.892E+02	3.850E+02	3.760E+02
IY= 1	5.096E+02	5.142E+02	5.188E+02	5.250E+02	5.293E+02	3.889E+02	3.885E+02	3.847E+02	3.767E+02
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF RHO1

IY= 16	7.434E-01	7.440E-01	7.455E-01	7.476E-01	7.498E-01	7.611E-01	7.636E-01	7.595E-01	7.596E-01
IY= 15	8.169E-01	8.174E-01	8.189E-01	8.218E-01	8.260E-01	8.501E-01	8.427E-01	8.071E-01	7.724E-01
IY= 14	8.561E-01	8.549E-01	8.543E-01	8.552E-01	8.592E-01	8.735E-01	8.564E-01	8.176E-01	8.030E-01
IY= 13	8.908E-01	8.857E-01	8.820E-01	8.786E-01	8.746E-01	8.705E-01	8.544E-01	8.330E-01	8.397E-01
IY= 12	8.900E-01	8.844E-01	8.826E-01	8.809E-01	8.791E-01	8.769E-01	8.656E-01	8.550E-01	8.700E-01
IY= 11	8.948E-01	8.871E-01	8.870E-01	8.869E-01	8.869E-01	8.869E-01	8.821E-01	8.800E-01	8.967E-01
IY= 10	6.678E-01	6.708E-01	6.751E-01	6.788E-01	6.807E-01	8.940E-01	8.908E-01	8.917E-01	9.084E-01
IY= 9	6.516E-01	6.569E-01	6.645E-01	6.709E-01	6.741E-01	8.958E-01	8.937E-01	8.971E-01	9.151E-01
IY= 8	6.211E-01	6.309E-01	6.450E-01	6.567E-01	6.627E-01	8.975E-01	8.965E-01	9.021E-01	9.214E-01
IY= 7	5.859E-01	6.011E-01	6.227E-01	6.407E-01	6.499E-01	8.991E-01	8.989E-01	9.064E-01	9.269E-01
IY= 6	5.606E-01	5.796E-01	6.064E-01	6.287E-01	6.401E-01	9.006E-01	9.011E-01	9.101E-01	9.316E-01
IY= 5	5.566E-01	5.757E-01	6.026E-01	6.250E-01	6.365E-01	9.021E-01	9.029E-01	9.129E-01	9.352E-01
IY= 4	5.752E-01	5.903E-01	6.120E-01	6.302E-01	6.396E-01	9.035E-01	9.045E-01	9.150E-01	9.378E-01
IY= 3	6.067E-01	6.162E-01	6.300E-01	6.416E-01	6.475E-01	9.048E-01	9.059E-01	9.162E-01	9.390E-01
IY= 2	6.415E-01	6.451E-01	6.509E-01	6.552E-01	6.571E-01	9.062E-01	9.071E-01	9.171E-01	9.389E-01
IY= 1	6.938E-01	6.877E-01	6.815E-01	6.735E-01	6.680E-01	9.077E-01	9.087E-01	9.178E-01	9.372E-01
IX=	1	2	3	4	5	6	7	8	9

TIME STP= 1 SWEEP NO= 400 ZSLAB NO= 23 ITERN NO= 1
FLOW FIELD AT ITHYD= 1, IZ= 23, ISWEEP= 400, ISTEP= 1

FIELD VALUES OF P1

IY= 16	9.770E+01	9.880E+01	9.732E+01	9.268E+01	8.094E+01	5.101E+01	1.504E+01	3.473E+00	1.170E+01
IY= 15	3.940E+01	3.877E+01	3.550E+01	2.962E+01	2.040E+01	4.458E+00	-9.028E+00	-9.583E+00	-4.440E-01
IY= 14	1.061E+01	9.313E+00	7.878E+00	5.056E+00	2.328E-01	-8.845E+00	-9.766E+00	-8.621E+00	-4.542E+00
IY= 13	2.075E+00	8.626E-01	2.087E+00	3.885E+00	4.700E+00	-8.046E+00	-6.249E+00	-5.161E+00	-4.166E+00
IY= 12	-3.090E+00	-4.568E+00	-3.299E+00	-1.189E+00	-6.718E-01	-2.872E+00	-3.018E+00	-2.688E+00	-2.768E+00
IY= 11	-4.727E+01	-4.817E+01	-4.358E+01	-3.717E+01	-3.439E+01	-1.143E+00	-1.414E+00	-1.381E+00	-1.712E+00
IY= 10	-1.633E+02	-1.649E+02	-1.529E+02	-1.419E+02	-1.376E+02	-5.969E-01	-8.295E-01	-8.108E-01	-9.732E-01
IY= 9	-1.955E+02	-1.974E+02	-1.875E+02	-1.758E+02	-1.728E+02	-3.767E-01	-6.272E-01	-6.072E-01	-7.817E-01
IY= 8	-2.588E+02	-2.583E+02	-2.451E+02	-2.280E+02	-2.200E+02	-1.868E-01	-4.460E-01	-4.263E-01	-5.979E-01
IY= 7	-3.981E+02	-3.839E+02	-3.526E+02	-3.180E+02	-2.985E+02	-2.072E-02	-2.836E-01	-2.574E-01	-4.174E-01
IY= 6	-6.131E+01	-5.253E+01	-3.544E+01	-1.531E+01	-2.385E+00	1.265E-01	-1.380E-01	-9.713E-02	-2.387E-01
IY= 5	2.548E+02	2.583E+02	2.645E+02	2.750E+02	2.835E+02	2.582E-01	-7.613E-03	5.622E-02	-6.147E-02
IY= 4	4.414E+02	4.426E+02	4.431E+02	4.475E+02	4.528E+02	3.753E-01	1.074E-01	2.026E-01	1.122E-01
IY= 3	5.264E+02	5.251E+02	5.200E+02	5.185E+02	5.206E+02	4.755E-01	2.053E-01	3.408E-01	2.800E-01
IY= 2	-1.744E+01	-1.544E+01	-1.194E+01	-8.558E+00	-6.641E+00	5.532E-01	2.838E-01	4.684E-01	4.457E-01
IY= 1	9.394E+00	1.104E+01	1.364E+01	1.608E+01	1.748E+01	5.919E-01	3.522E-01	6.350E-01	7.136E-01
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF U1

IY= 16	5.562E-01	1.312E+00	2.535E+00	4.383E+00	6.981E+00	8.466E+00	8.685E+00	7.214E+00
IY= 15	2.649E-01	7.120E-01	1.424E+00	2.393E+00	3.436E+00	2.271E+00	1.128E+00	6.059E-01
IY= 14	-3.024E-01	-3.659E-01	-1.138E-01	4.674E-01	1.218E+00	-1.654E+00	-1.868E+00	-1.237E+00
IY= 13	-7.030E-01	-1.134E+00	-1.197E+00	-8.215E-01	-1.470E-06	-2.367E+00	-2.063E+00	-1.472E+00
IY= 12	-8.514E-01	-1.368E+00	-1.438E+00	-9.453E-01	-3.857E-06	-1.305E+00	-1.622E+00	-1.239E+00
IY= 11	-1.272E+00	-2.047E+00	-2.118E+00	-1.370E+00	-5.855E-06	-8.792E-01	-1.193E+00	-9.265E-01
IY= 10	-2.771E+00	-3.996E+00	-3.660E+00	-2.239E+00	-3.294E-06	-7.829E-01	-1.085E+00	-8.622E-01
IY= 9	-2.124E+00	-3.305E+00	-3.281E+00	-2.039E+00	-3.188E-06	-7.475E-01	-1.035E+00	-8.169E-01
IY= 8	-1.590E+00	-2.723E+00	-2.896E+00	-1.884E+00	-3.049E-06	-7.157E-01	-9.937E-01	-7.757E-01
IY= 7	-1.083E+00	-1.935E+00	-2.153E+00	-1.444E+00	-2.398E-06	-6.945E-01	-9.635E-01	-7.413E-01
IY= 6	-1.543E-02	-2.384E-01	-5.095E-01	-4.542E-01	-7.802E-07	-6.870E-01	-9.473E-01	-7.173E-01
IY= 5	2.895E-01	2.505E-01	-2.864E-02	-1.657E-01	-4.497E-07	-6.951E-01	-9.475E-01	-7.073E-01
IY= 4	4.384E-01	5.259E-01	2.660E-01	1.874E-02	2.440E-08	-7.195E-01	-9.654E-01	-7.132E-01
IY= 3	5.644E-01	7.482E-01	5.050E-01	1.723E-01	4.345E-07	-7.589E-01	-9.998E-01	-7.365E-01
IY= 2	1.399E-01	1.459E-01	1.174E-01	7.967E-02	4.080E-09	-8.137E-01	-1.049E+00	-7.766E-01
IY= 1	3.664E-02	1.282E-01	1.433E-01	7.441E-02	4.206E-09	-9.204E-01	-1.147E+00	-8.733E-01
IX=	1	2	3	4	5	6	7	8

FIELD VALUES OF V1

IY= 15	1.851E+01	1.913E+01	2.020E+01	2.135E+01	2.209E+01	9.452E+00	3.362E+00	1.514E-01	-4.007E+00
IY= 14	2.167E+01	2.243E+01	2.374E+01	2.502E+01	2.534E+01	8.707E+00	2.084E+00	-8.371E-01	-4.561E+00
IY= 13	2.223E+01	2.306E+01	2.449E+01	2.592E+01	2.641E+01	5.232E+00	7.523E-01	-1.115E+00	-3.906E+00
IY= 12	2.080E+01	2.154E+01	2.292E+01	2.447E+01	2.552E+01	2.452E+00	5.615E-01	-1.157E+00	-3.045E+00
IY= 11	1.755E+01	1.826E+01	1.959E+01	2.126E+01	2.242E+01	1.329E+00	1.186E-01	-1.135E+00	-2.379E+00
IY= 10	9.764E+00	1.109E+01	1.324E+01	1.561E+01	1.712E+01	8.005E-01	-1.175E-01	-1.009E+00	-1.869E+00
IY= 9	1.025E+01	1.253E+01	1.532E+01	1.763E+01	1.907E+01	7.009E-01	-1.522E-01	-9.655E-01	-1.726E+00
IY= 8	1.319E+01	1.560E+01	1.834E+01	2.045E+01	2.164E+01	6.154E-01	-1.753E-01	-9.155E-01	-1.586E+00
IY= 7	1.893E+01	2.070E+01	2.274E+01	2.431E+01	2.520E+01	5.418E-01	-1.875E-01	-8.536E-01	-1.444E+00
IY= 6	2.856E+01	2.902E+01	2.945E+01	2.976E+01	2.998E+01	4.766E-01	-1.890E-01	-7.781E-01	-1.297E+00
IY= 5	1.920E+01	1.969E+01	2.026E+01	2.072E+01	2.100E+01	4.154E-01	-1.798E-01	-6.876E-01	-1.141E+00
IY= 4	1.170E+01	1.208E+01	1.259E+01	1.304E+01	1.332E+01	3.539E-01	-1.602E-01	-5.806E-01	-9.689E-01
IY= 3	5.444E+00	5.669E+00	5.996E+00	6.308E+00	6.502E+00	2.876E-01	-1.307E-01	-4.566E-01	-7.752E-01
IY= 2	-2.331E-05	-2.147E-05	-1.731E-05	-1.271E-05	-9.849E-06	2.120E-01	-9.194E-02	-3.164E-01	-5.540E-01
IY= 1	-8.160E-02	-1.824E-01	-1.689E-01	-1.363E-01	-1.563E-01	1.216E-01	-4.777E-02	-1.635E-01	-3.024E-01
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF W1

IY= 16	-3.035E-02	-2.840E-01	-7.430E-01	-1.242E+00	-1.535E+00	-1.169E+00	-7.444E-01	-5.637E-01	-7.070E-06
IY= 15	1.590E+00	1.201E+00	5.749E-01	-1.227E-01	-6.051E-01	1.526E-01	3.991E-01	-4.393E-02	9.114E-02
IY= 14	2.265E+00	1.661E+00	7.360E-01	-2.773E-01	-9.487E-01	1.041E-01	-1.435E-01	-2.710E-01	-5.112E-02
IY= 13	2.902E+00	2.086E+00	8.311E-01	-5.710E-01	-1.585E+00	9.387E-03	-9.977E-02	-2.398E-01	-1.215E-01
IY= 12	4.123E+00	3.087E+00	1.449E+00	-4.263E-01	-1.821E+00	-7.486E-02	-7.811E-02	-1.910E-01	-1.352E-01
IY= 11	5.635E+00	4.378E+00	2.367E+00	-1.811E-02	-1.834E+00	-1.306E-01	-9.277E-02	-1.627E-01	-1.293E-01
IY= 10	8.939E+00	7.418E+00	4.919E+00	1.758E+00	-7.032E-01	-2.495E-01	-1.477E-01	-1.897E-01	-1.454E-01
IY= 9	1.385E+01	1.178E+01	8.404E+00	4.522E+00	1.653E+00	-2.789E-01	-1.787E-01	-2.122E-01	-1.659E-01
IY= 8	2.014E+01	1.730E+01	1.284E+01	8.093E+00	4.829E+00	-3.119E-01	-2.149E-01	-2.431E-01	-1.954E-01
IY= 7	2.982E+01	2.574E+01	1.964E+01	1.362E+01	9.751E+00	-3.478E-01	-2.565E-01	-2.842E-01	-2.370E-01
IY= 6	4.693E+01	4.055E+01	3.156E+01	2.337E+01	1.846E+01	-3.856E-01	-3.033E-01	-3.366E-01	-2.942E-01
IY= 5	4.076E+01	3.573E+01	2.837E+01	2.138E+01	1.706E+01	-4.245E-01	-3.549E-01	-3.999E-01	-3.683E-01
IY= 4	3.615E+01	3.204E+01	2.583E+01	1.971E+01	1.581E+01	-4.641E-01	-4.106E-01	-4.716E-01	-4.566E-01
IY= 3	3.275E+01	2.944E+01	2.423E+01	1.884E+01	1.527E+01	-5.049E-01	-4.704E-01	-5.488E-01	-5.522E-01
IY= 2	5.394E+01	5.094E+01	4.628E+01	4.202E+01	3.963E+01	-5.492E-01	-5.379E-01	-6.302E-01	-6.474E-01
IY= 1	5.012E+01	4.772E+01	4.379E+01	4.027E+01	3.837E+01	-6.050E-01	-6.406E-01	-7.530E-01	-7.905E-01
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF KE

IY= 16	5.031E+01	5.175E+01	5.451E+01	5.800E+01	6.241E+01	4.336E+01	2.795E+01	2.176E+01	1.728E+01
IY= 15	5.645E+01	5.785E+01	6.010E+01	6.253E+01	6.573E+01	3.601E+01	1.373E+01	8.294E+00	1.127E+01
IY= 14	6.392E+01	6.558E+01	6.819E+01	7.137E+01	7.573E+01	2.578E+01	5.738E+00	5.894E+00	8.079E+00
IY= 13	7.482E+01	7.679E+01	8.003E+01	8.477E+01	9.365E+01	6.844E-02	4.760E+00	4.966E+00	5.928E+00
IY= 12	9.221E+01	9.498E+01	9.921E+01	1.045E+02	1.131E+02	1.862E-02	3.609E+00	3.954E+00	4.452E+00
IY= 11	1.220E+02	1.267E+02	1.334E+02	1.402E+02	1.478E+02	6.593E-03	2.550E+00	2.929E+00	3.283E+00
IY= 10	2.387E+02	2.397E+02	2.410E+02	2.434E+02	2.485E+02	3.782E-03	2.119E+00	2.519E+00	2.916E+00
IY= 9	2.835E+02	2.772E+02	2.727E+02	2.743E+02	2.827E+02	3.144E-03	1.941E+00	2.300E+00	2.644E+00
IY= 8	3.370E+02	3.137E+02	3.001E+02	2.999E+02	3.143E+02	2.699E-03	1.776E+00	2.099E+00	2.402E+00
IY= 7	3.642E+02	3.287E+02	3.148E+02	3.165E+02	3.377E+02	2.403E-03	1.623E+00	1.915E+00	2.186E+00
IY= 6	2.385E+02	2.448E+02	2.654E+02	2.913E+02	3.303E+02	2.215E-03	1.478E+00	1.749E+00	1.996E+00
IY= 5	4.415E+02	4.412E+02	4.360E+02	4.422E+02	4.741E+02	2.102E-03	1.339E+00	1.595E+00	1.830E+00
IY= 4	4.214E+02	4.184E+02	4.154E+02	4.246E+02	4.542E+02	2.045E-03	1.194E+00	1.445E+00	1.676E+00
IY= 3	3.776E+02	3.767E+02	3.830E+02	4.014E+02	4.340E+02	2.039E-03	1.020E+00	1.267E+00	1.503E+00
IY= 2	1.099E+01	9.882E+00	8.269E+00	6.914E+00	6.204E+00	2.109E-03	7.651E-01	9.896E-01	1.221E+00
IY= 1	9.589E+00	8.754E+00	7.465E+00	6.390E+00	5.843E+00	3.443E-03	1.046E-02	1.115E-02	9.874E-03
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF EP

IY= 16	9.987E+01	1.053E+02	1.158E+02	1.298E+02	1.504E+02	8.817E+01	4.696E+01	3.114E+01	2.036E+01
IY= 15	1.265E+02	1.328E+02	1.434E+02	1.563E+02	1.764E+02	7.603E+01	1.952E+01	7.298E+00	1.042E+01
IY= 14	1.631E+02	1.709E+02	1.841E+02	2.020E+02	2.332E+02	5.839E+01	2.898E+00	3.628E+00	6.224E+00
IY= 13	2.219E+02	2.312E+02	2.476E+02	2.723E+02	3.223E+02	7.514E-03	2.078E+00	2.580E+00	3.817E+00
IY= 12	3.306E+02	3.426E+02	3.633E+02	3.923E+02	4.462E+02	1.066E-03	1.324E+00	1.747E+00	2.396E+00
IY= 11	5.449E+02	5.639E+02	5.933E+02	6.283E+02	6.812E+02	2.246E-04	7.688E-01	1.080E+00	1.455E+00
IY= 10	1.465E+03	1.426E+03	1.370E+03	1.348E+03	1.391E+03	9.760E-05	5.867E-01	8.619E-01	1.208E+00
IY= 9	2.167E+03	1.960E+03	1.759E+03	1.673E+03	1.734E+03	7.398E-05	5.113E-01	7.374E-01	1.011E+00
IY= 8	3.064E+03	2.562E+03	2.176E+03	2.006E+03	2.101E+03	5.885E-05	4.440E-01	6.297E-01	8.479E-01
IY= 7	3.809E+03	3.018E+03	2.520E+03	2.292E+03	2.440E+03	4.945E-05	3.848E-01	5.376E-01	7.134E-01
IY= 6	2.272E+03	2.173E+03	2.136E+03	2.156E+03	2.476E+03	4.375E-05	3.332E-01	4.599E-01	6.029E-01
IY= 5	4.228E+03	3.971E+03	3.491E+03	3.185E+03	3.383E+03	4.045E-05	2.886E-01	3.953E-01	5.135E-01
IY= 4	3.680E+03	3.426E+03	3.051E+03	2.842E+03	3.023E+03	3.880E-05	2.487E-01	3.414E-01	4.420E-01
IY= 3	2.970E+03	2.794E+03	2.603E+03	2.549E+03	2.774E+03	3.864E-05	2.086E-01	2.912E-01	3.815E-01
IY= 2	5.503E+01	4.693E+01	3.592E+01	2.746E+01	2.335E+01	4.066E-05	1.568E-01	2.278E-01	3.105E-01
IY= 1	4.486E+01	3.913E+01	3.081E+01	2.440E+01	2.134E+01	1.950E-04	1.616E-03	1.779E-03	1.482E-03
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF H1

IY= 16	5.631E+05	5.628E+05	5.620E+05	5.606E+05	5.584E+05	5.073E+05	4.896E+05	4.857E+05	4.857E+05
IY= 15	5.626E+05	5.623E+05	5.613E+05	5.591E+05	5.551E+05	4.739E+05	4.518E+05	4.544E+05	4.757E+05
IY= 14	5.636E+05	5.632E+05	5.621E+05	5.595E+05	5.523E+05	4.475E+05	4.337E+05	4.473E+05	4.531E+05
IY= 13	5.654E+05	5.648E+05	5.639E+05	5.629E+05	5.621E+05	4.193E+05	4.268E+05	4.341E+05	4.317E+05
IY= 12	5.684E+05	5.670E+05	5.653E+05	5.637E+05	5.625E+05	4.113E+05	4.176E+05	4.223E+05	4.174E+05
IY= 11	5.742E+05	5.718E+05	5.685E+05	5.656E+05	5.636E+05	4.052E+05	4.099E+05	4.124E+05	4.067E+05
IY= 10	5.986E+05	5.909E+05	5.808E+05	5.732E+05	5.693E+05	4.006E+05	4.063E+05	4.086E+05	4.042E+05
IY= 9	6.042E+05	5.947E+05	5.821E+05	5.725E+05	5.678E+05	3.991E+05	4.046E+05	4.065E+05	4.022E+05
IY= 8	6.106E+05	5.986E+05	5.831E+05	5.717E+05	5.662E+05	3.976E+05	4.028E+05	4.045E+05	4.005E+05
IY= 7	6.152E+05	6.014E+05	5.837E+05	5.707E+05	5.644E+05	3.962E+05	4.010E+05	4.025E+05	3.990E+05
IY= 6	6.190E+05	6.039E+05	5.846E+05	5.702E+05	5.633E+05	3.947E+05	3.992E+05	4.004E+05	3.977E+05
IY= 5	6.087E+05	5.975E+05	5.826E+05	5.711E+05	5.653E+05	3.933E+05	3.973E+05	3.984E+05	3.966E+05
IY= 4	5.971E+05	5.883E+05	5.774E+05	5.683E+05	5.637E+05	3.920E+05	3.955E+05	3.964E+05	3.953E+05
IY= 3	5.863E+05	5.804E+05	5.721E+05	5.653E+05	5.617E+05	3.908E+05	3.938E+05	3.945E+05	3.939E+05
IY= 2	5.620E+05	5.592E+05	5.547E+05	5.509E+05	5.489E+05	3.896E+05	3.923E+05	3.927E+05	3.924E+05
IY= 1	5.298E+05	5.327E+05	5.352E+05	5.381E+05	5.401E+05	3.883E+05	3.902E+05	3.903E+05	3.902E+05
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF TMP1

IY= 16	5.609E+02	5.606E+02	5.598E+02	5.583E+02	5.562E+02	5.053E+02	4.876E+02	4.837E+02	4.838E+02
IY= 15	5.604E+02	5.600E+02	5.590E+02	5.568E+02	5.529E+02	4.720E+02	4.500E+02	4.526E+02	4.738E+02
IY= 14	5.613E+02	5.609E+02	5.599E+02	5.573E+02	5.501E+02	4.457E+02	4.319E+02	4.455E+02	4.513E+02
IY= 13	5.631E+02	5.625E+02	5.617E+02	5.607E+02	5.598E+02	4.177E+02	4.251E+02	4.323E+02	4.300E+02
IY= 12	5.661E+02	5.648E+02	5.631E+02	5.615E+02	5.602E+02	4.096E+02	4.159E+02	4.206E+02	4.157E+02
IY= 11	5.719E+02	5.695E+02	5.662E+02	5.633E+02	5.614E+02	4.036E+02	4.083E+02	4.107E+02	4.051E+02
IY= 10	5.963E+02	5.885E+02	5.785E+02	5.709E+02	5.670E+02	3.990E+02	4.047E+02	4.070E+02	4.026E+02
IY= 9	6.018E+02	5.923E+02	5.798E+02	5.702E+02	5.656E+02	3.975E+02	4.030E+02	4.049E+02	4.006E+02
IY= 8	6.082E+02	5.962E+02	5.806E+02	5.694E+02	5.639E+02	3.960E+02	4.012E+02	4.029E+02	3.989E+02
IY= 7	6.128E+02	5.990E+02	5.814E+02	5.684E+02	5.622E+02	3.946E+02	3.994E+02	4.008E+02	3.974E+02
IY= 6	6.165E+02	6.015E+02	5.823E+02	5.679E+02	5.611E+02	3.932E+02	3.976E+02	3.988E+02	3.962E+02
IY= 5	6.062E+02	5.951E+02	5.803E+02	5.688E+02	5.631E+02	3.918E+02	3.957E+02	3.968E+02	3.950E+02
IY= 4	5.947E+02	5.865E+02	5.751E+02	5.661E+02	5.615E+02	3.905E+02	3.939E+02	3.948E+02	3.937E+02
IY= 3	5.839E+02	5.781E+02	5.699E+02	5.630E+02	5.594E+02	3.893E+02	3.922E+02	3.929E+02	3.923E+02
IY= 2	5.598E+02	5.570E+02	5.525E+02	5.487E+02	5.468E+02	3.881E+02	3.907E+02	3.911E+02	3.909E+02
IY= 1	5.277E+02	5.306E+02	5.330E+02	5.360E+02	5.379E+02	3.868E+02	3.886E+02	3.887E+02	3.886E+02
IX=	1	2	3	4	5	6	7	8	9

FIELD VALUES OF RHO1

IY= 16	6.300E-01	6.304E-01	6.313E-01	6.329E-01	6.353E-01	6.991E-01	7.241E-01	7.298E-01	7.299E-01
IY= 15	6.302E-01	6.306E-01	6.318E-01	6.342E-01	6.387E-01	7.480E-01	7.845E-01	7.800E-01	7.452E-01
IY= 14	6.290E-01	6.295E-01	6.307E-01	6.335E-01	6.417E-01	7.921E-01	8.173E-01	7.924E-01	7.823E-01
IY= 13	6.269E-01	6.276E-01	6.286E-01	6.297E-01	6.306E-01	8.452E-01	8.304E-01	8.166E-01	8.210E-01
IY= 12	6.236E-01	6.251E-01	6.270E-01	6.288E-01	6.302E-01	8.618E-01	8.488E-01	8.393E-01	8.492E-01
IY= 11	6.170E-01	6.196E-01	6.233E-01	6.265E-01	6.287E-01	8.747E-01	8.648E-01	8.596E-01	8.715E-01
IY= 10	5.912E-01	5.989E-01	6.093E-01	6.175E-01	6.218E-01	8.849E-01	8.724E-01	8.674E-01	8.770E-01
IY= 9	5.855E-01	5.949E-01	6.078E-01	6.180E-01	6.232E-01	8.881E-01	8.761E-01	8.719E-01	8.812E-01
IY= 8	5.790E-01	5.906E-01	6.064E-01	6.186E-01	6.247E-01	8.914E-01	8.799E-01	8.763E-01	8.850E-01
IY= 7	5.739E-01	5.871E-01	6.051E-01	6.192E-01	6.261E-01	8.947E-01	8.839E-01	8.808E-01	8.883E-01
IY= 6	5.723E-01	5.866E-01	6.061E-01	6.216E-01	6.292E-01	8.980E-01	8.880E-01	8.852E-01	8.912E-01
IY= 5	5.838E-01	5.948E-01	6.100E-01	6.224E-01	6.287E-01	9.011E-01	8.921E-01	8.896E-01	8.938E-01
IY= 4	5.962E-01	6.046E-01	6.165E-01	6.264E-01	6.316E-01	9.041E-01	8.962E-01	8.942E-01	8.967E-01
IY= 3	6.078E-01	6.139E-01	6.227E-01	6.303E-01	6.343E-01	9.070E-01	9.001E-01	8.986E-01	8.999E-01
IY= 2	6.306E-01	6.337E-01	6.389E-01	6.434E-01	6.457E-01	9.097E-01	9.036E-01	9.027E-01	9.033E-01
IY= 1	6.691E-01	6.655E-01	6.624E-01	6.588E-01	6.564E-01	9.129E-01	9.084E-01	9.082E-01	9.084E-01
IX=	1	2	3	4	5	6	7	8	9

APPENDIX C

FIGURES

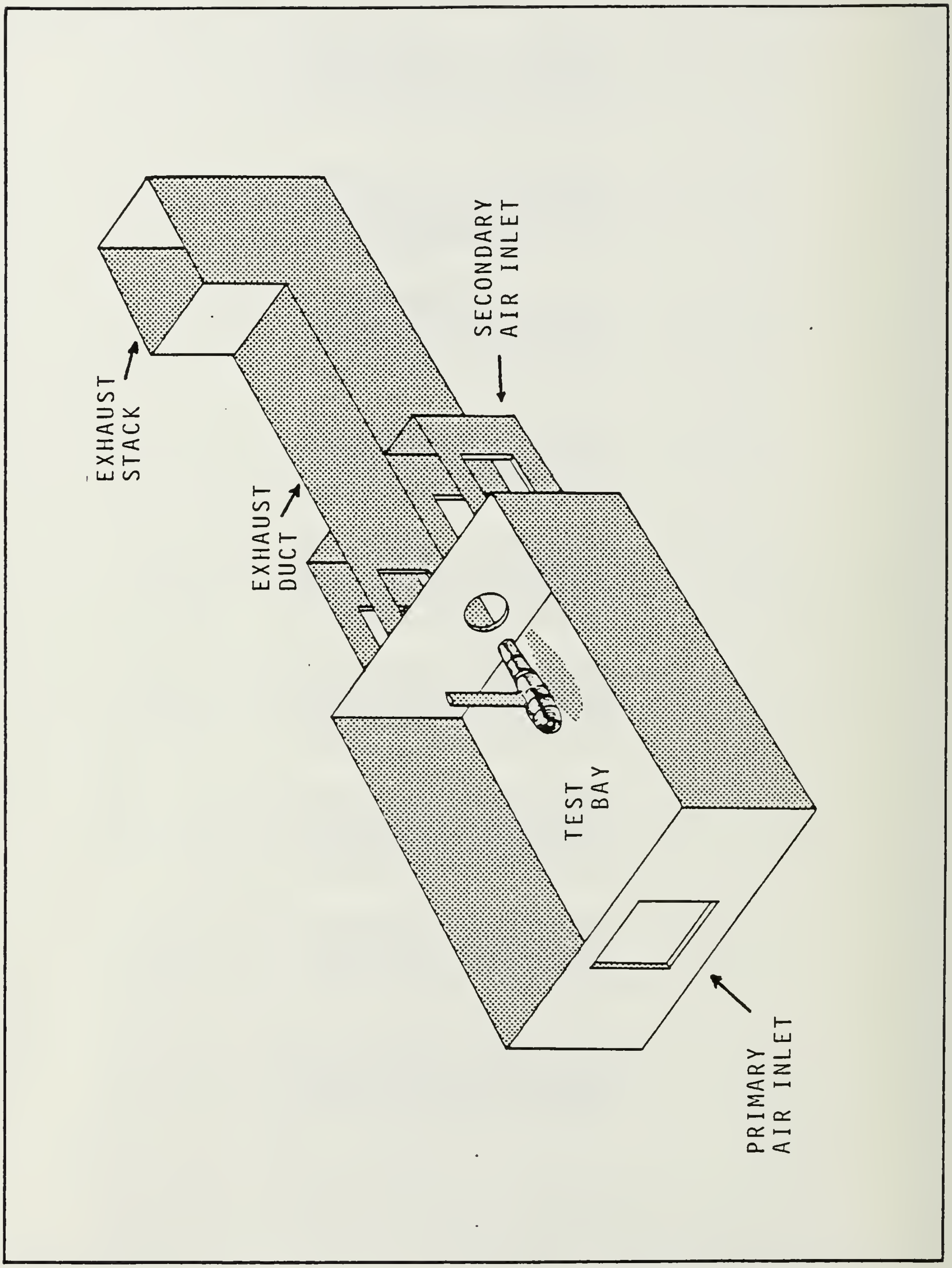


Figure C.1. Denmark Jet-Engine Test Facility

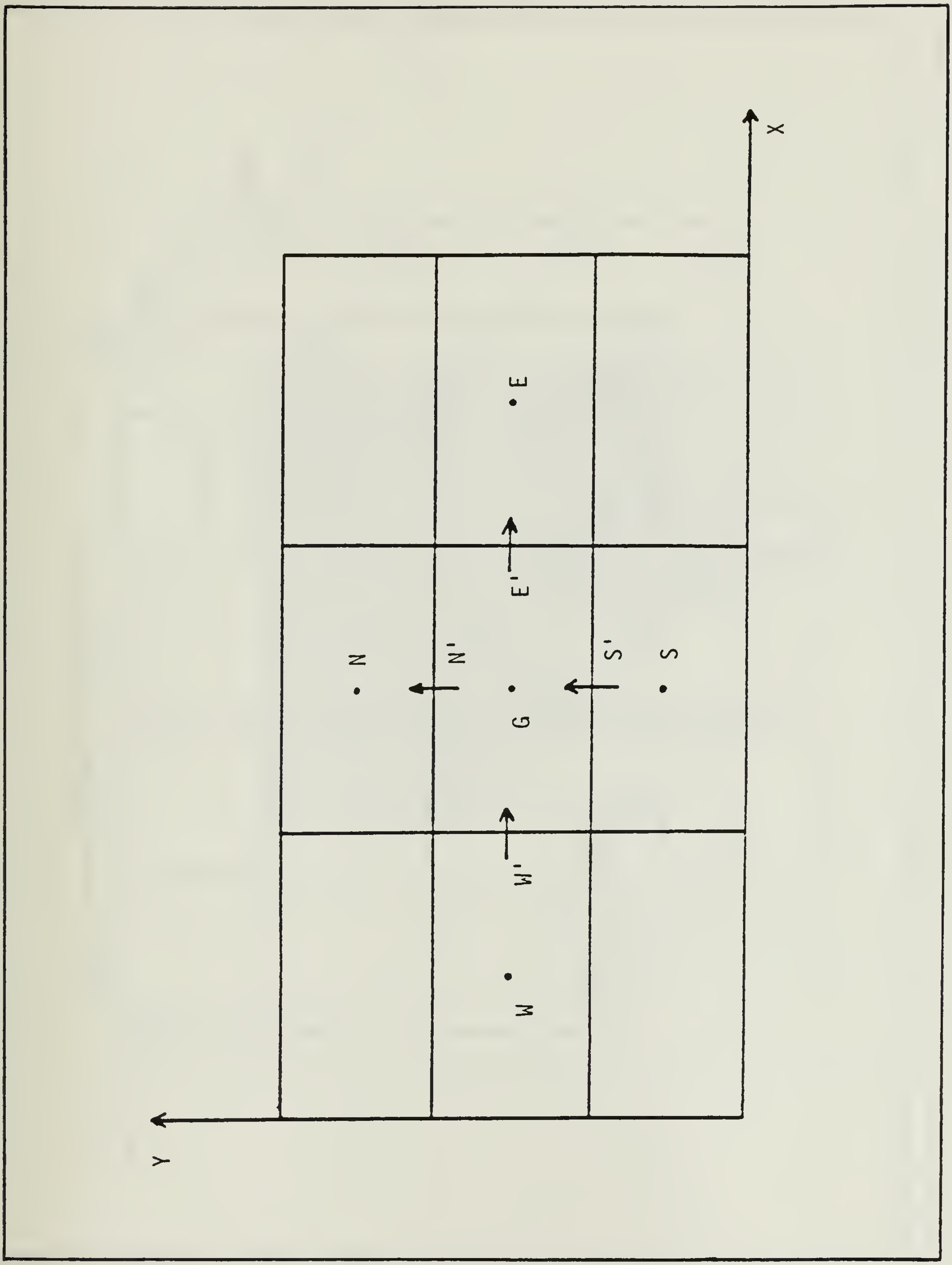


Figure C.2. Staggered-Grid Cell Configuration

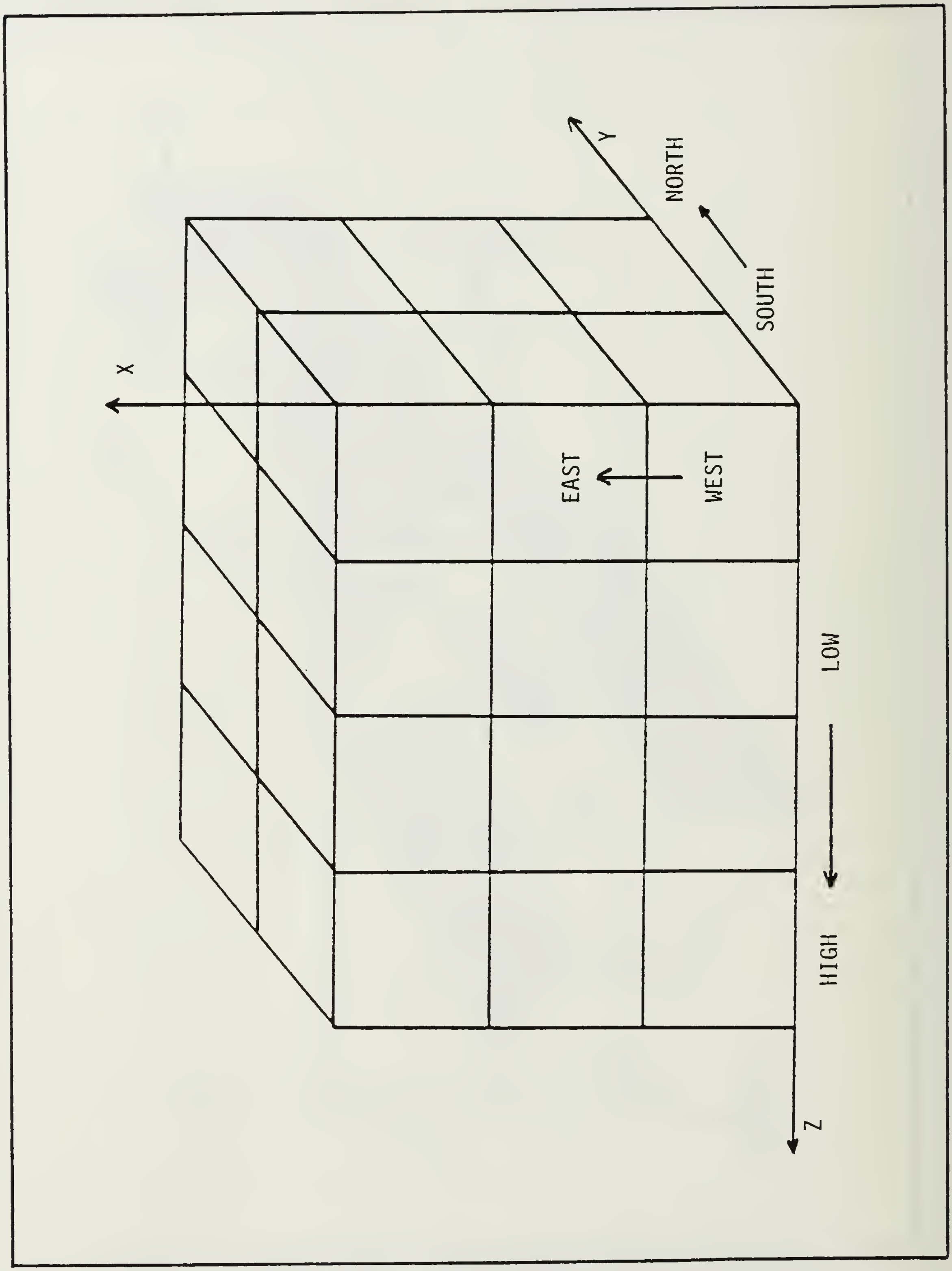


Figure C.3. Cartesian Cell Configuration

GROUP	TITLE
1	RUN TITLE AND OTHER PRELIMINARIES
2	TRANSIENCE: TIME-STEP SPECIFICATIONS
3	X-DIRECTION GRID SPECIFICATION
4	Y-DIRECTION GRID SPECIFICATIONS
5	Z-DIRECTION GRID SPECIFICATIONS
6	BODY-FITTED COORDINATES OR GRID DISTORTION
7	VARIABLES STORED, SOLVED AND NAMED
8	TERMS (IN DIFFERENTIAL EQUATIONS) AND DEVICES
9	PROPERTIES OF THE MEDIUM (OR MEDIA)
10	INTERPHASE-TRANSFER PROCESSES AND PROPERTIES
11	INITIALIZATION OF VARIABLE OR POROSITY FIELDS
12	CONVECTION AND DIFFUSION ADJUSTMENTS
13	BOUNDARY CONDITIONS AND SPECIAL SOURCES
14	DOWNSTREAM PRESSURE FOR PARAB=T
15	TERMINATION OF SWEEPS
16	TERMINATION OF ITERATIONS
17	UNDERRELAXATION DEVICES
18	LIMITS ON VARIABLES OR INCREMENTS TO THEM
19	DATA COMMUNICATED BY SATELLITE TO GROUND
20	PRELIMINARY PRINTOUT
21	PRINTOUT OF VARIABLES
22	SPOT-VALUE PRINTOUT
23	FIELD PRINTOUT AND PLOT CONTROL
24	DUMPS FOR RESTARTS

Figure C.4. PHOENICS Data Group Catagories

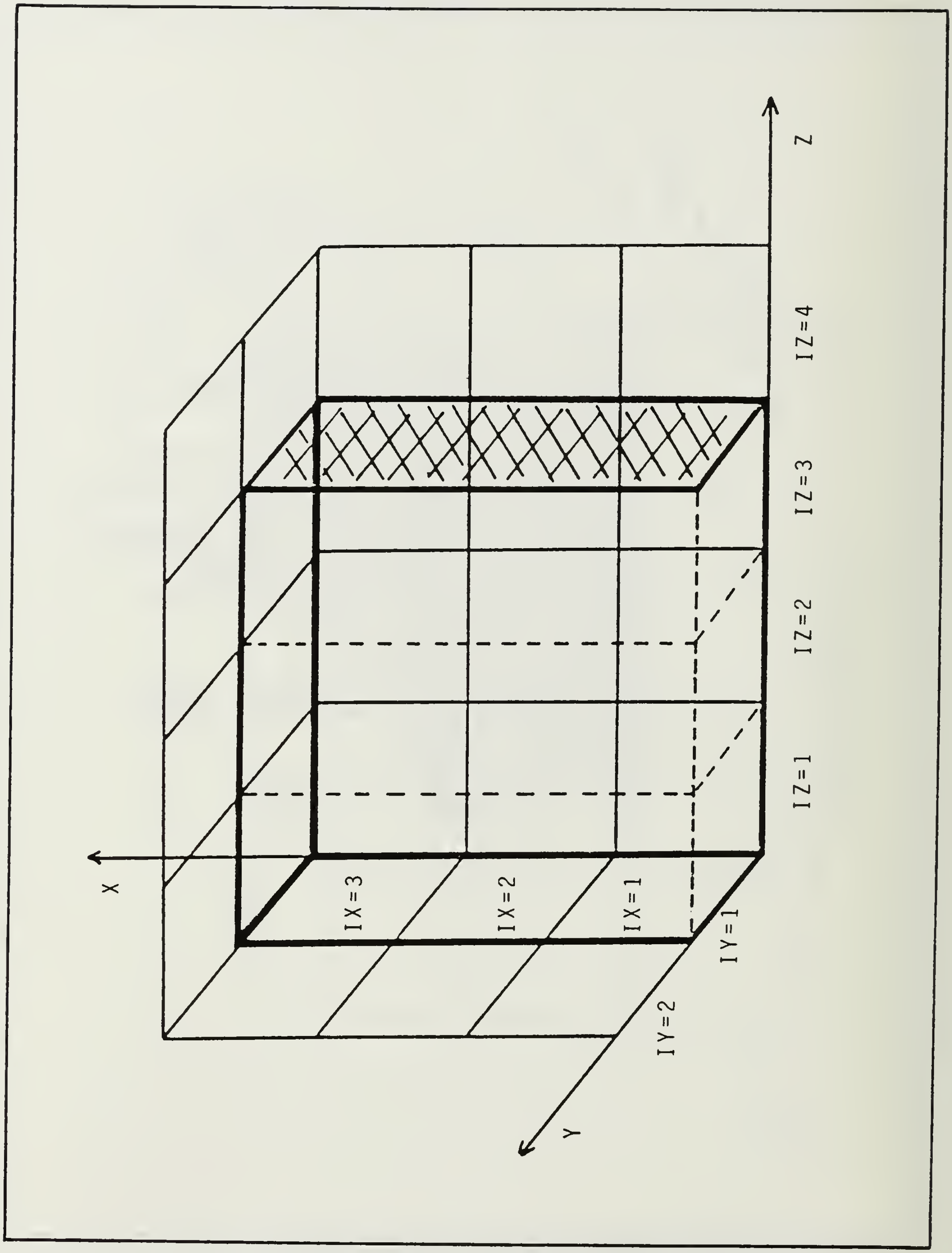


Figure C.5. CONPOR Porosity And Blockage

```
FILE: COPYQ1   EXEC     A1

&TRACE
-START
&TYPE WHAT ARE THE FILENAME AND FILETYPE OF THE Q1 FILE YOU WANT
&TYPE TO STORE ON MVS?  USE ENTER TO EXIT.
&READ VAR &Q1 &Q2
   &IF /&Q1 EQ / &EXIT
   STATE &Q1 &Q2 A
   &IF &RC EQ 0    &GOTO -NEXT
   &TYPE FILE &Q1 &Q2 A DOES NOT EXIST. USE ENTER TO EXIT.
      &READ VAR &
      &IF /& EQ / &EXIT
   &GOTO -START
-NEXT
   STATE COPYQ1 JCL A
      &IF &RC EQ 0 &GOTO -COPY
      &TYPE TEMPLATE FILE COPYQ1 JCL A DOES NOT EXIST ;
      &TYPE SEE LAB MANAGER.
      &EXIT -2
-COPY
   &ERROR &EXIT -1
   COPYFILE COPYQ1 JCL A TEMP1 JCL A (REPL
   & = &CONCAT OF /YOURQ1FILENAME/ &Q1 /
   &STACK TOP
   &STACK CLOCATE/YOURQ1FILENAME/
   &STACK CHANGE & 1 1
   &STACK CLOCATE/SYSUT1/
   &STACK GET &Q1 &Q2 A
   &STACK TOP
   &STACK FILE
   XEDIT TEMP1 JCL A
   EXEC SUBMIT TEMP1 JCL A
   CONWAIT
   DESBUF
&EXIT
```

```
FILE: COPYQ1   JCL      A1

//CXHUSH JOB (4555,9999),'COPYTMVS',CLASS=A
// EXEC PGM=IEBGENER
//SYSPRINT DD SYSOUT=A
//SYSIN DD DUMMY
//SYSUT2 DD DSN=MSS.S4555.PHOENICS.SRC(YOURQ1FILENAME),DISP=SHR
//SYSUT1 DD *
/*
//
```

Figure C.6 COPYQ1 EXEC And JCL Files

```
FILE: RUNSAT   EXEC     A1


&TRACE
-START
&TYPE WHAT IS THE FILENAME OF THE Q1 FILE YOU WANT TO RUN (SATELITE)?
&TYPE USE ENTER TO EXIT.
&READ VAR &Q1
   &IF /&Q1 EQ / &EXIT
*  STATE &Q1 DATA A
*  &IF &RC EQ 0    &GOTO -NEXT
*  &TYPE FILE &Q1 DATA A DOES NOT EXIST. USE ENTER TO EXIT.
*     &READ VAR &
*     &IF /& EQ / &EXIT
*  &GOTO -START
-NEXT
   STATE RUNSAT JCL A
      &IF &RC EQ 0 &GOTO -COPY
      &TYPE TEMPLATE FILE RUNSAT JCL A DOES NOT EXIST ;
      &TYPE SEE LAB MANAGER.
      &EXIT -2
-COPY
   &ERROR &EXIT -1
   COPYFILE RUNSAT JCL A TEMP2 JCL A (REPL
   & = &CONCAT OF / YOURQ1FILENAME / &Q1 /
   &STACK TOP
   &STACK CHANGE & * 1
   &STACK FILE
   XEDIT TEMP2 JCL A
   EXEC SUBMIT TEMP2 JCL A
   CONWAIT
   DESBUF
&EXIT
```

Figure C.7 RUNSAT EXEC File

```
FILE: RUNSAT   JCL      A1

//RXHUSH JOB (4555,9999),'*CHAM',CLASS=A,REGION=1024K
//G02 EXEC PGM=SATLITP
//STEPLIB DD DSN=MSS.PHOENICS.LOAD,DISP=SHR
//LIST1 DD DSN=MSS.PHOENICS.LIST1.DIR,DISP=(OLD)
//LIST2 DD DSN=MSS.PHOENICS.LIST2.DIR,DISP=(OLD)
//LIST3 DD DSN=MSS.PHOENICS.LIST3.DIR,DISP=(OLD)
//LIST4 DD DSN=MSS.PHOENICS.LIST4.DIR,DISP=(OLD)
//Q1 DD DSN=MSS.S4555.PHOENICS.SRC(YOURQ1FILENAME),DISP=(OLD)
//PHHELP DD DSN=MSS.PHOENICS.PHHELP.DATA,DISP=(OLD)
//SCRL     DD DSN=MSS.PHOENICS.SCRL,DISP=(NEW,PASS),
//         DCB=(RECFM=F,LRECL=80,BLKSIZE=80),
//         SPACE=(TRK,(12,3)),UNIT=SYSDA
//COPY     DD DSN=MSS.PHOENICS.COPY,DISP=(NEW,PASS),
//         DCB=(RECFM=F,LRECL=80,BLKSIZE=6320),
//         SPACE=(TRK,(12,3)),UNIT=SYSDA
//FT09F001 DD SYSOUT=*
//FT06F001 DD SYSOUT=*
//FT14F001 DD SYSOUT=*
//G512 DD DSN=MSS.PHOENICS.G512,DISP=(OLD)
//G513 DD DSN=MSS.PHOENICS.G513,DISP=(OLD)
//G514 DD DSN=MSS.PHOENICS.G514,DISP=(OLD)
//G515 DD DSN=MSS.PHOENICS.G515,DISP=(OLD)
//G516 DD DSN=MSS.PHOENICS.G516,DISP=(OLD)
//G518 DD DSN=MSS.PHOENICS.G518,DISP=(OLD)
//G526 DD DSN=MSS.PHOENICS.G526,DISP=(OLD)
//G520 DD DSN=MSS.PHOENICS.G520,DISP=(OLD)
//G521 DD DSN=MSS.PHOENICS.G521,DISP=(OLD)
//G522 DD DSN=MSS.PHOENICS.G522,DISP=(OLD)
//G523 DD DSN=MSS.PHOENICS.G523,DISP=(OLD)
//G524 DD DSN=MSS.PHOENICS.G524,DISP=(OLD)
//G527 DD DSN=MSS.PHOENICS.G527,DISP=(OLD)
//G528 DD DSN=MSS.PHOENICS.G528,DISP=(OLD)
//G529 DD DSN=MSS.PHOENICS.G529,DISP=(OLD)
//G530 DD DSN=MSS.PHOENICS.G530,DISP=(OLD)
//G531 DD DSN=MSS.PHOENICS.G531,DISP=(OLD)
//G735 DD DSN=MSS.PHOENICS.G735,DISP=(OLD)
//G736 DD DSN=MSS.PHOENICS.G736,DISP=(OLD)
//G737 DD DSN=MSS.PHOENICS.G737,DISP=(OLD)
//DF10     DD DSN=MSS.S4555.PHOENICS.DF10,
//         DISP=SHR
//DF12     DD DSN=MSS.S4555.PHOENICS.DF12,DISP=SHR
//
```

Figure C.8. RUNSAT JCL File

```
FILE: RUNEAR   EXEC     A1

&TRACE
EXEC SUBMIT RUNEAR JCL A
```

```
FILE: RUNEAR   JCL      A1

//EXHUSH  JOB (4555,9999),'CHAM',CLASS=G,REGION=2048K
//*MAIN ORG=NPGVM1.4555P,LINES=(12)
//G02 EXEC PGM=EARTHP
//STEPLIB DD DSN=MSS.PHOENICS.LOAD,DISP=SHR
//DSTL     DD DUMMY
//DF09      DD DSN=MSS.S4555.PHOENICS.DF09,DISP=SHR
//DF01     DD DSN=&&DF01,DISP=(NEW,PASS),
//         DCB=(RECFM=VBS,LRECL=19000,BLKSIZE=19006),
//         SPACE=(TRK,(25,3)),UNIT=SYSDA
//DF02     DD DSN=&&DF02,DISP=(NEW,PASS),
//         DCB=(RECFM=VBS,LRECL=19000,BLKSIZE=19006),
//         SPACE=(TRK,(25,3)),UNIT=SYSDA
//DF03     DD DSN=&&DF03,DISP=(NEW,PASS),
//         DCB=(RECFM=VBS,LRECL=19000,BLKSIZE=19006),
//         SPACE=(TRK,(25,3)),UNIT=SYSDA
//DF04     DD DSN=&&DF04,DISP=(NEW,PASS),
//         DCB=(RECFM=VBS,LRECL=19000,BLKSIZE=19006),
//         SPACE=(TRK,(25,3)),UNIT=SYSDA
//DF05     DD DSN=&&DF05,DISP=(NEW,PASS),
//         DCB=(RECFM=VBS,LRECL=19000,BLKSIZE=19006),
//         SPACE=(TRK,(25,3)),UNIT=SYSDA
//DF07     DD DSN=&&DF07,DISP=(NEW,PASS),
//         DCB=(RECFM=VBS,LRECL=19000,BLKSIZE=19006),
//         SPACE=(TRK,(25,3)),UNIT=SYSDA
//DF08     DD DSN=&&DF08,DISP=(NEW,PASS),
//         DCB=(RECFM=VBS,LRECL=19000,BLKSIZE=19006),
//         SPACE=(TRK,(25,3)),UNIT=SYSDA
//DF15     DD DSN=&&DF15,DISP=(NEW,PASS),
//         DCB=(RECFM=VBS,LRECL=19000,BLKSIZE=19006),
//         SPACE=(TRK,(25,3)),UNIT=SYSDA
//DF16     DD DSN=MSS.S4555.PHOENICS.DF16,DISP=SHR
//DF10   DD DSN=MSS.S4555.PHOENICS.DF10,DISP=(OLD)
//DF12   DD DSN=MSS.S4555.PHOENICS.DF12,DISP=(OLD)
//FT14F001   DD SYSOUT=*
//FT06F001   DD SYSOUT=*
//
```

Figure C.9 RUNEAR EXEC And JCL Files

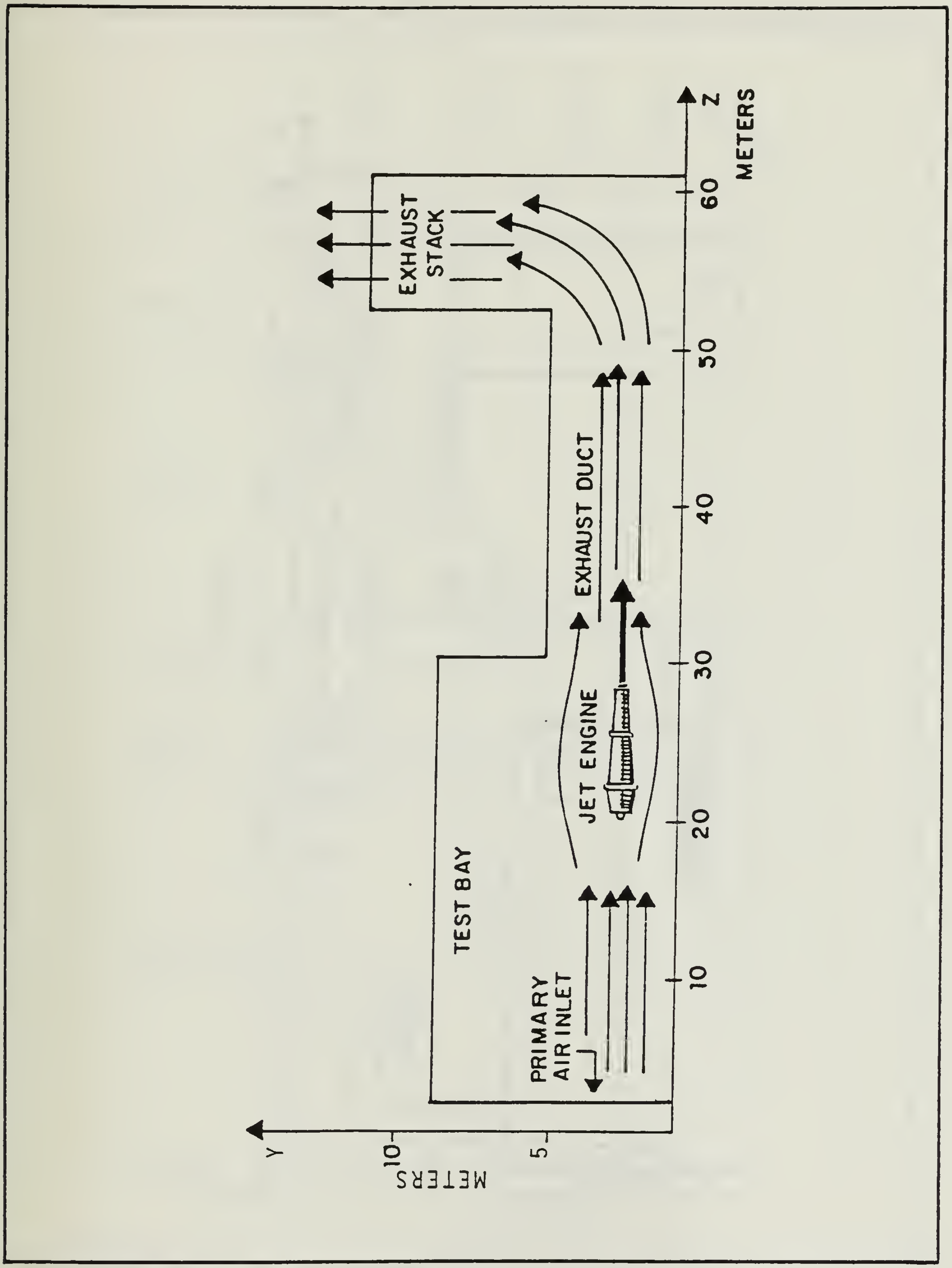


Figure C.10. Test Facility Side View (Y-Z Plane)

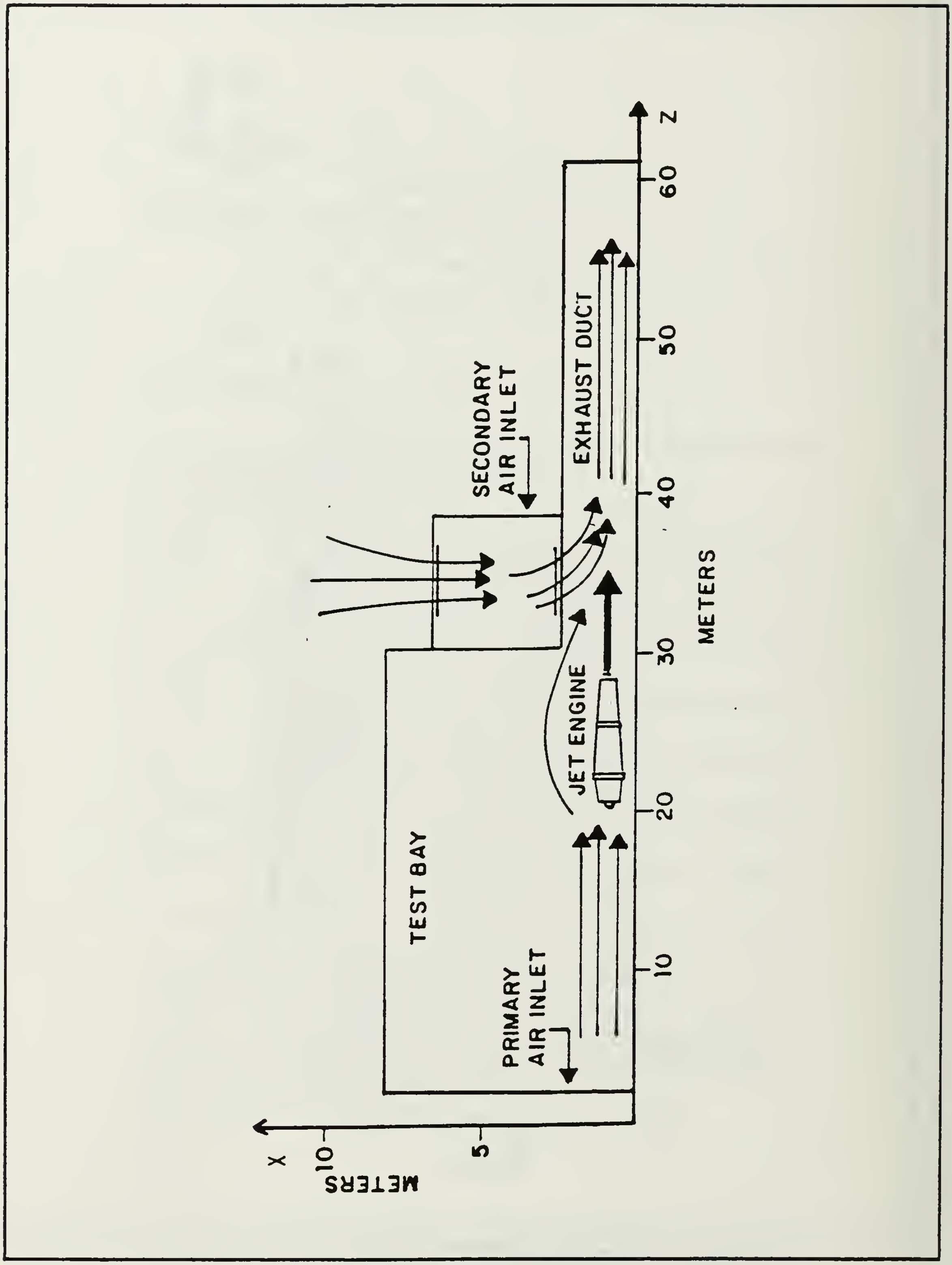


Figure C.11. Test Facility Top View (X-Z Plane)

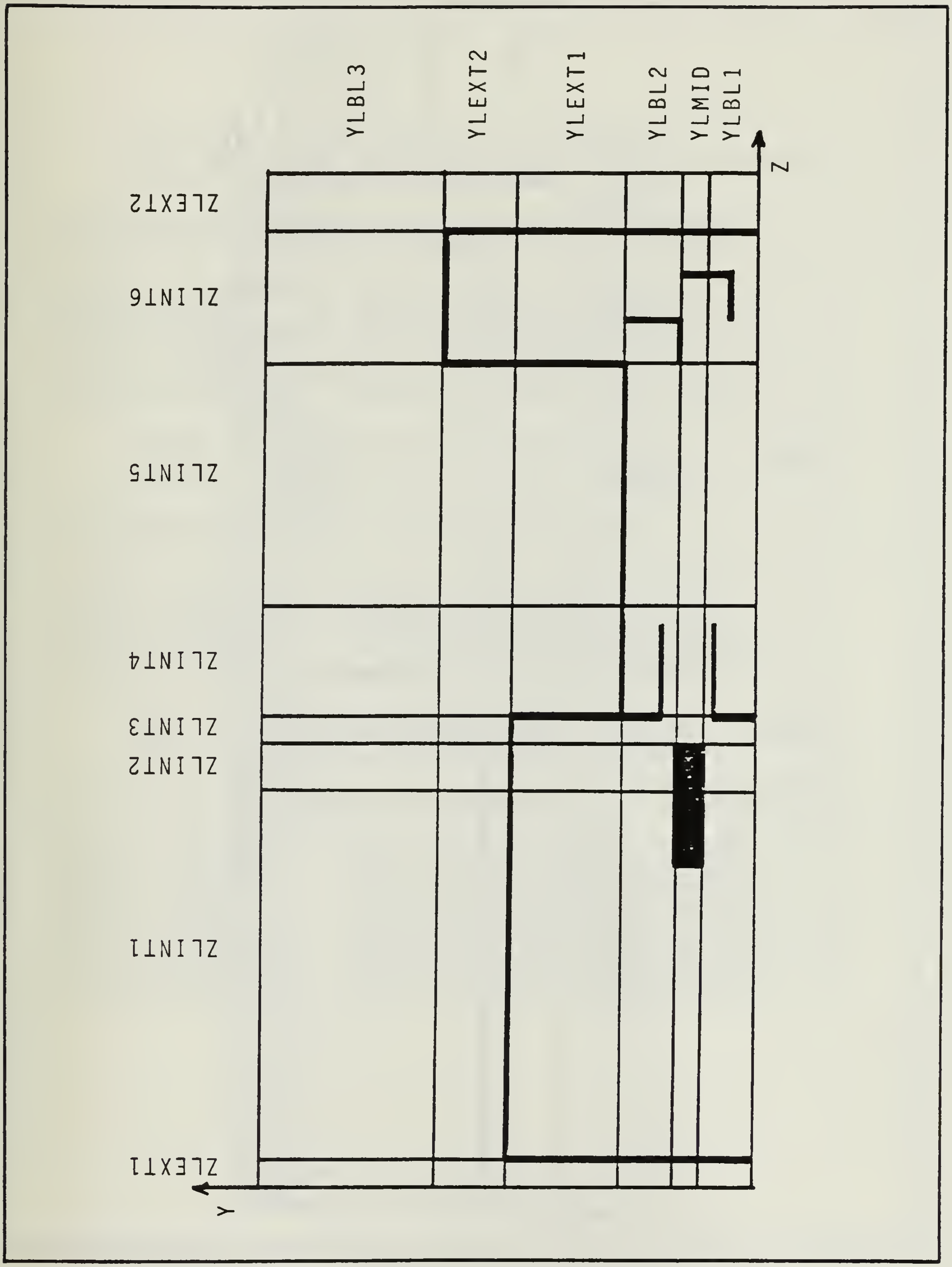


Figure C.12. Vertical Y-Z Plane Zones

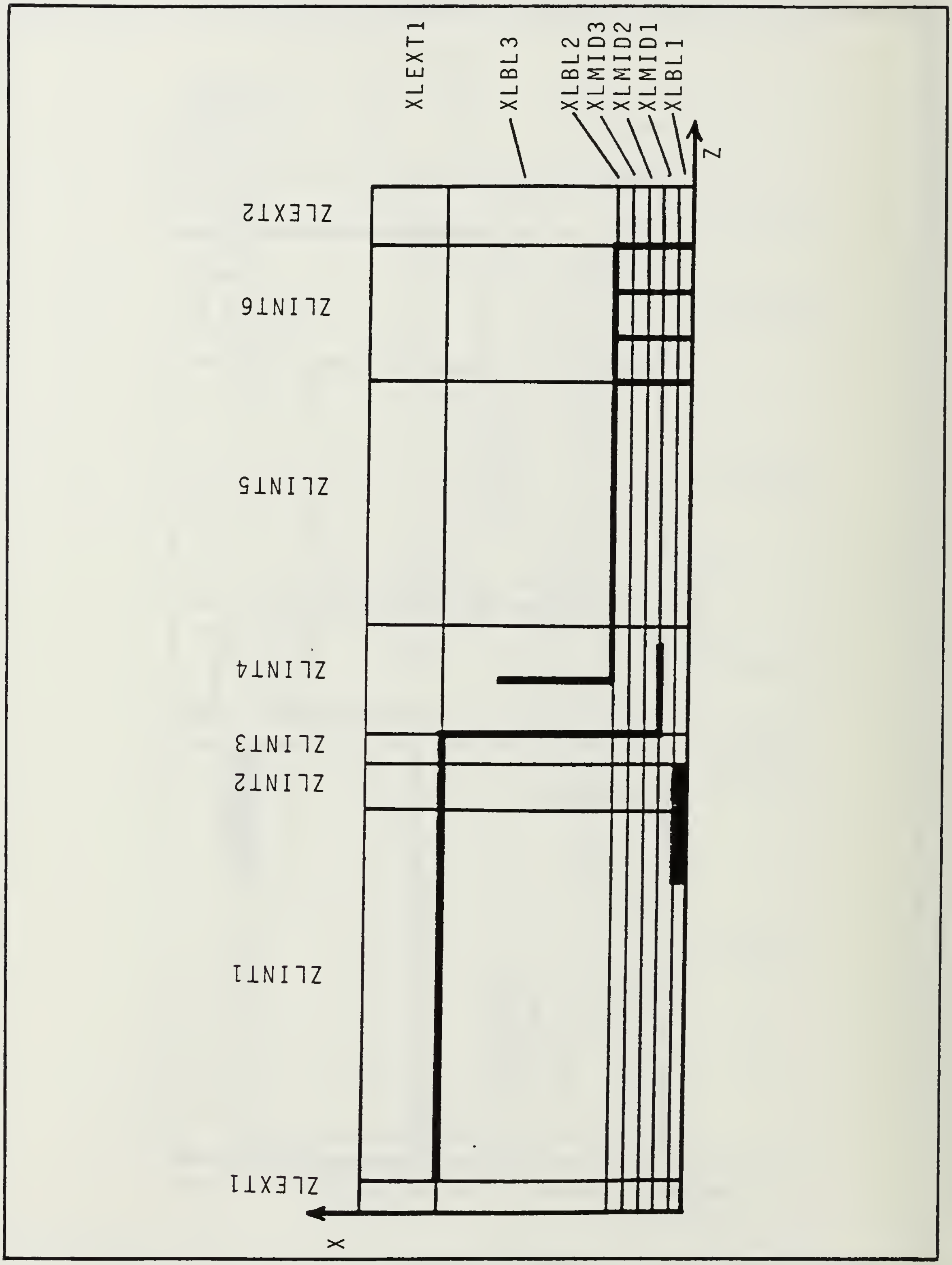


Figure C.13. Horizontal X-Z Plane Zones

```
    * GROUP 3.  X-DIRECTION GRID SPECIFICATION
    * NX = THE NUMBER OF CELLS IN THE X DIRECTION (INTEGER)
    * XULAST = DISTANCE IN THE X DOMAIN (METERS)
    *
NX=XNCBL1+XNCMD1+XNCMD2+XNCMD3+XNCBL2+XNCBL3+XNCEX1
XULAST=XLBL1+XLMID1+XLMID2+XLMID3+XLBL2+XLBL3+XLEXT1
    *
XFRAC(1)=-XNCBL1;      XFRAC(2)=XLBL1/(XNCBL1*XULAST)
XFRAC(3)=XNCMD1;       XFRAC(4)=XLMID1/(XNCMD1*XULAST)
XFRAC(5)=XNCMD2;       XFRAC(6)=XLMID2/(XNCMD2*XULAST)
XFRAC(7)=XNCMD3;       XFRAC(8)=XLMID3/(XNCMD3*XULAST)
XFRAC(9)=XNCBL2;       XFRAC(10)=XLBL2/(XNCBL2*XULAST)
XFRAC(11)=XNCBL3;      XFRAC(12)=XLBL3/(XNCBL3*XULAST)
XFRAC(13)=XNCEX1;      XFRAC(14)=XLEXT1/(XNCEX1*XULAST)
    *
    * GROUP 4.  Y-DIRECTION GRID SPECIFICATION
    * NY = THE NUMBER OF CELLS IN THE Y DIRECTION (INTEGER)
    * YVLAST = DISTANCE IN THE Y DOMAIN (METERS)
    *
NY=YNCMID+YNCBL1+YNCBL2+YNCEX1+YNCEX2+YNCBL3
YVLAST=YLMID+YLBL1+YLBL2+YLEXT1+YLEXT2+YLBL3
    *
YFRAC(1)=-YNCBL1;      YFRAC(2)=YLBL1/(YNCBL1*YVLAST)
YFRAC(3)=YNCMID;       YFRAC(4)=YLMID/(YNCMID*YVLAST)
YFRAC(5)=YNCBL2;       YFRAC(6)=YLBL2/(YNCBL2*YVLAST)
YFRAC(7)=YNCEX1;       YFRAC(8)=YLEXT1/(YNCEX1*YVLAST)
YFRAC(9)=YNCEX2;       YFRAC(10)=YLEXT2/(YNCEX2*YVLAST)
YFRAC(11)=YNCBL3;      YFRAC(12)=YLBL3/(YNCBL3*YVLAST)
    *
    * GROUP 5.  Z-DIRECTION GRID SPECIFICATION
    * NZ = THE NUMBER OF CELLS IN THE Z DIRECTION (INTEGER)
    * ZWLAST = DISTANCE IN THE Z DOMAIN (METERS)
    *
NZ=ZNCEX1+ZNCIN1+ZNCIN2+ZNCIN3+ZNCIN4+ZNCIN5+ZNCIN6+ZNCEX2
ZWLAST=ZLEXT1+ZLINT1+ZLINT2+ZLINT3+ZLINT4+ZLINT5+ZLINT6+ZLEXT2
    *
ZFRAC(1)=-ZNCEX1;      ZFRAC(2)=ZLEXT1/(ZNCEX1*ZWLAST)
ZFRAC(3)=ZNCIN1;       ZFRAC(4)=ZLINT1/(ZNCIN1*ZWLAST)
ZFRAC(5)=ZNCIN2,       ZFRAC(6)=ZLINT2/(ZNCIN2*ZWLAST)
ZFRAC(7)=ZNCIN3;       ZFRAC(8)=ZLINT3/(ZNCIN3*ZWLAST)
ZFRAC(9)=ZNCIN4;       ZFRAC(10)=ZLINT4/(ZNCIN4*ZWLAST)
ZFRAC(11)=ZNCIN5;      ZFRAC(12)=ZLINT5/(ZNCIN5*ZWLAST)
ZFRAC(13)=ZNCIN6;      ZFRAC(14)=ZLINT6/(ZNCIN6*ZWLAST)
ZFRAC(15)=ZNCEX2;      ZFRAC(16)=ZLEXT2/(ZNCEX2*ZWLAST)
```

Figure C.14. Q1 MEthod-Of-Pairs Coding Sequence

```
************************************************************
 GROUP 3. X-DIRECTION GRID SPACING
CARTES   =     T
NX       =      9
XULAST   = 9.900E+00
  METHOD OF PAIRS USED FOR GRID SETTING
XFRAC (  1) = -1.000E+00 ;XFRAC (  2) =  5.051E-02
XFRAC (  3) =  1.000E+00 ;XFRAC (  4) =  5.051E-02
XFRAC (  5) =  1.000E+00 ;XFRAC (  6) =  5.051E-02
XFRAC (  7) =  1.000E+00 ;XFRAC (  8) =  5.051E-02
XFRAC (  9) =  1.000E+00 ;XFRAC ( 10) =  5.051E-02
XFRAC ( 11) =  3.000E+00 ;XFRAC ( 12) =  1.818E-01
XFRAC ( 13) =  1.000E+00 ;XFRAC ( 14) =  2.020E-01
************************************************************
 GROUP 4. Y-DIRECTION GRID SPACING
NY       =     16
YVLAST   = 1.700E+01
  METHOD OF PAIRS USED FOR GRID SETTING
YFRAC (  1) = -4.000E+00 ;YFRAC (  2) =  2.941E-02
YFRAC (  3) =  2.000E+00 ;YFRAC (  4) =  2.941E-02
YFRAC (  5) =  4.000E+00 ;YFRAC (  6) =  2.941E-02
YFRAC (  7) =  2.000E+00 ;YFRAC (  8) =  1.132E-01
YFRAC (  9) =  1.000E+00 ;YFRAC ( 10) =  1.265E-01
YFRAC ( 11) =  3.000E+00 ;YFRAC ( 12) =  1.176E-01
************************************************************
 GROUP 5. Z-DIRECTION GRID SPACING
PARAB    =     F
NZ       =     28
ZWLAST   = 6.490E+01
  METHOD OF PAIRS USED FOR GRID SETTING
ZFRAC (  1) = -1.000E+00 ;ZFRAC (  2) =  3.082E-02
ZFRAC (  3) =  5.000E+00 ;ZFRAC (  4) =  7.242E-02
ZFRAC (  5) =  1.000E+00 ;ZFRAC (  6) =  4.931E-02
ZFRAC (  7) =  2.000E+00 ;ZFRAC (  8) =  1.156E-02
ZFRAC (  9) =  6.000E+00 ;ZFRAC ( 10) =  1.541E-02
ZFRAC ( 11) =  5.000E+00 ;ZFRAC ( 12) =  5.023E-02
ZFRAC ( 13) =  6.000E+00 ;ZFRAC ( 14) =  2.157E-02
ZFRAC ( 15) =  2.000E+00 ;ZFRAC ( 16) =  3.082E-02
************************************************************
```

Figure C.15. EARTH Method-Of-Pairs Output

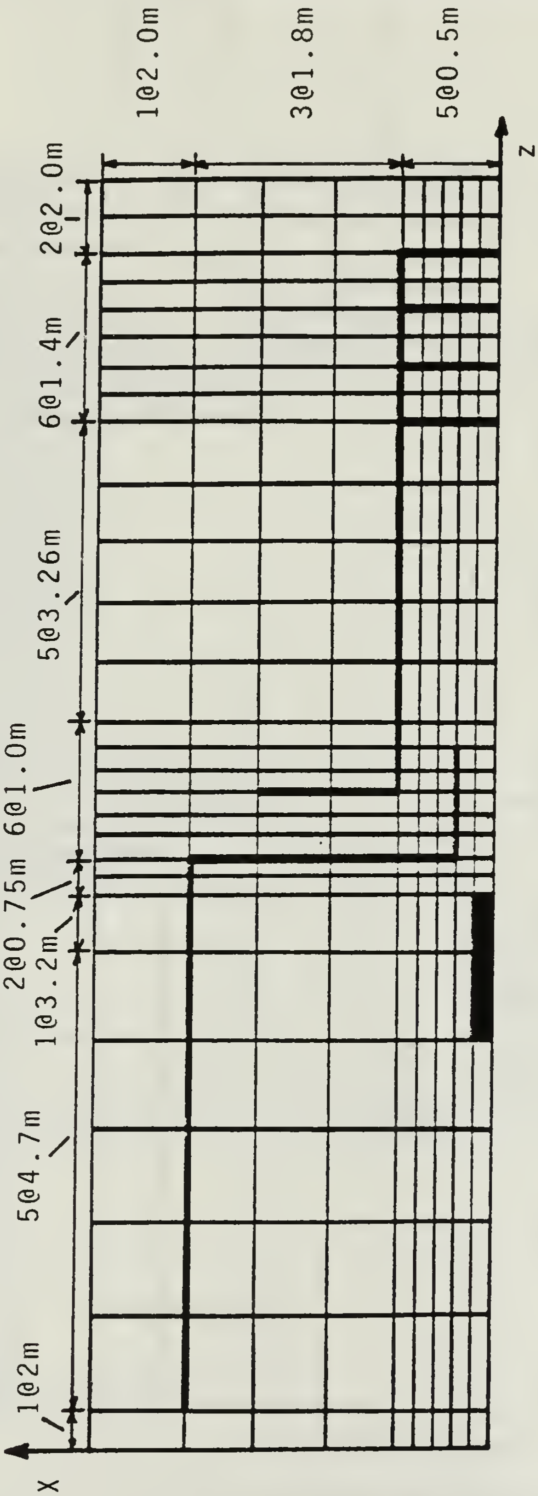


Figure C.16. System Domain Grid (X-Z Plane)

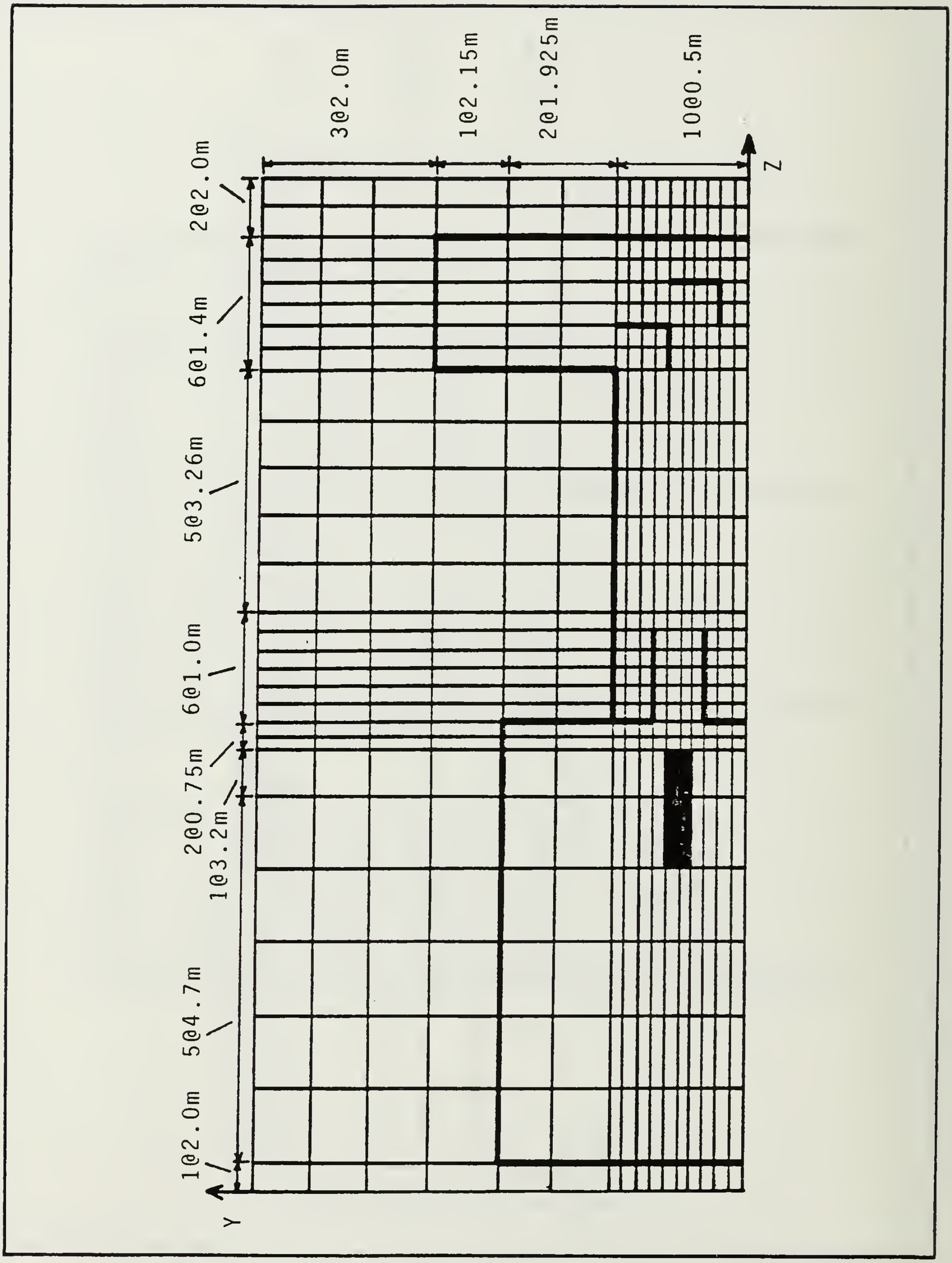


Figure C.17. System Domain Grid (Y-Z Plane)

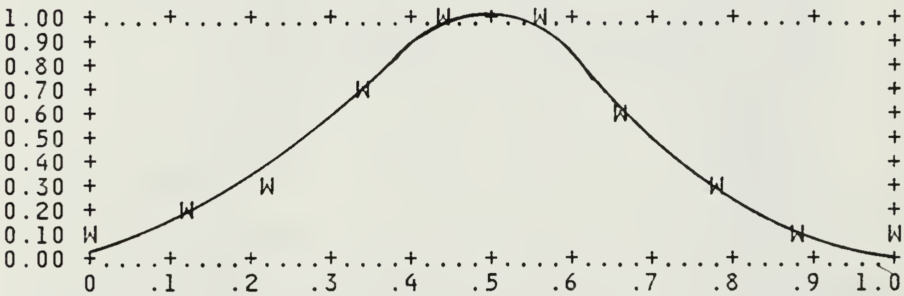
```
PATCH(PLOT10  ,PROFIL,    1,    1,    1,  10,   16,   16,    1,    1)
PLOT(PLOT10  ,H1   , 3.000E+05, 1.000E+06)
TABULATION OF ABSCISSA AND ORDINATES...
       Y           H1
  2.500E-01  3.454E+05
  7.500E-01  4.154E+05
  1.250E+00  5.411E+05
  1.750E+00  7.754E+05
  2.250E+00  9.650E+05
  2.750E+00  9.599E+05
  3.250E+00  7.667E+05
  3.750E+00  5.340E+05
  4.250E+00  4.097E+05
  4.750E+00  3.613E+05
  VARIABLE         H1
    MINVAL=  3.000E+05
    MAXVAL=  1.000E+06

    CELLAV=  6.074E+05

1.00 +....+....+....+....+.H..+....+....+....+....+....+
0.90 +                            H                    +
0.80 +                                                 +
0.70 +                 H              H                +
0.60 +                                                 +
0.50 +                                                 +
0.40 +                                                 +
0.30 +           H                          H          +
0.20 +     H                                     H     +
0.10 H                                                 H
0.00 +....+....+....+....+....+....+....+....+....+....+
     0   .1   .2   .3   .4   .5   .6   .7   .8   .9  1.0
THE ABSCISSA IS       Y   .  MIN= 2.50E-01 MAX= 4.75E+00
************************************************************
```

Figure C.18. H vs Y-Axis at IY=1 to IY=10
For IX=1 And IZ=16

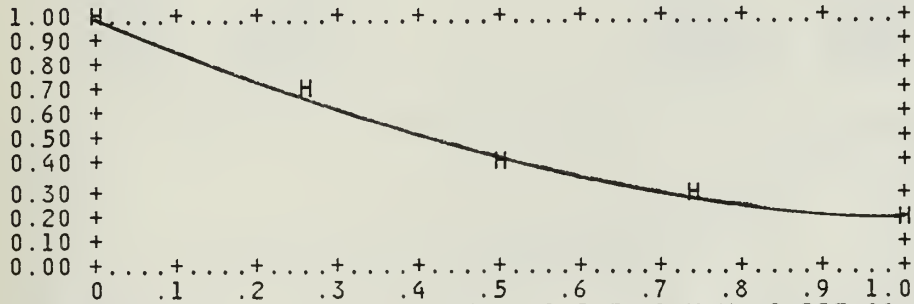
```
PATCH(PLOT11  ,PROFIL,   1,   1,   1,  10,  16,  16,   1,   1)
PLOT(PLOT11  ,W1  , 2.000E+01, 1.750E+02)
TABULATION OF ABSCISSA AND ORDINATES...
      Y           W1
  2.500E-01  2.923E+01
  7.500E-01  4.467E+01
  1.250E+00  7.167E+01
  1.750E+00  1.226E+02
  2.250E+00  1.696E+02
  2.750E+00  1.684E+02
  3.250E+00  1.203E+02
  3.750E+00  6.873E+01
  4.250E+00  4.100E+01
  4.750E+00  2.919E+01
  VARIABLE        W1
    MINVAL=  2.000E+01
    MAXVAL=  1.750E+02
    CELLAV=  8.653E+01
```




```
THE ABSCISSA IS       Y  .  MIN= 2.50E-01 MAX= 4.75E+00
*************************************************************
```

Figure C.19. W vs Y-Axis At IY=1 To IY=10
For IX=1 And IZ=16

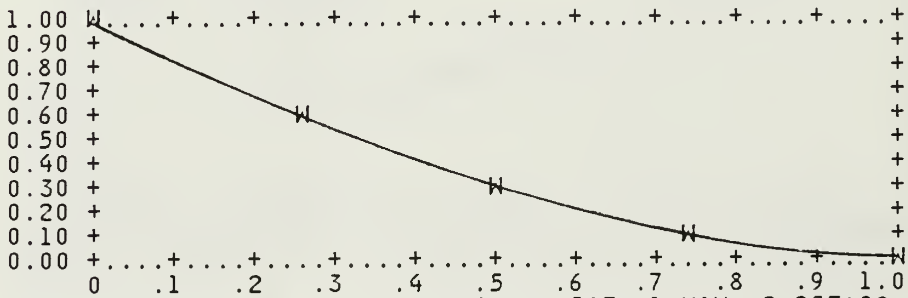
```
PATCH(PLOT12  ,PROFIL,   1,    5,    5,    5,  16,  16,    1,    1)
PLOT(PLOT12  ,H1  , 3.000E+05, 1.000E+06)
TABULATION OF ABSCISSA AND ORDINATES...
       X          H1
  2.500E-01  9.650E+05
  7.500E-01  7.746E+05
  1.250E+00  5.784E+05
  1.750E+00  4.848E+05
  2.250E+00  4.530E+05
  VARIABLE        H1
    MINVAL=  3.000E+05
    MAXVAL=  1.000E+06
    CELLAV=  6.512E+05
```




```
THE ABSCISSA IS        X   .  MIN= 2.50E-01 MAX= 2.25E+00
************************************************************
```

Figure C.20. H vs X-Axis At IX=1 To IX=5
For IY=5 And IZ=16

```
PATCH(PLOT13  ,PROFIL,    1,    5,    5,    5,   16,   16,    1,    1)
PLOT(PLOT13  ,W1  , 2.000E+01, 1.750E+02)
TABULATION OF ABSCISSA AND ORDINATES...
       X            W1
  2.500E-01  1.696E+02
  7.500E-01  1.196E+02
  1.250E+00  6.867E+01
  1.750E+00  3.822E+01
  2.250E+00  2.315E+01
  VARIABLE          W1
    MINVAL=  2.000E+01
    MAXVAL=  1.750E+02
    CELLAV=  8.384E+01
```




```
THE ABSCISSA IS       X   .  MIN= 2.50E-01 MAX= 2.25E+00
************************************************************
```

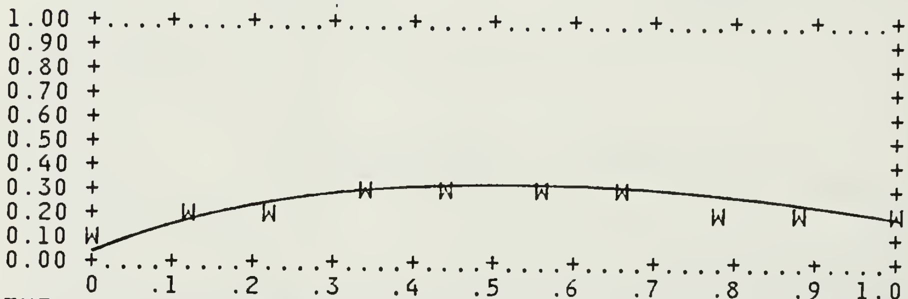
Figure C.21. W vs X-Axis At IX=1 To IX=5
For IY=5 And IZ=16

```
************************************************************
PATCH(PLOT6    ,PROFIL,   1,    1,    1,   10,   20,   20,    1,    1)
PLOT(PLOT6    ,H1   , 3.000E+05, 1.000E+06)
TABULATION OF ABSCISSA AND ORDINATES...
        Y           H1
  2.500E-01  5.117E+05
  7.500E-01  5.534E+05
  1.250E+00  5.850E+05
  1.750E+00  6.171E+05
  2.250E+00  6.376E+05
  2.750E+00  6.331E+05
  3.250E+00  6.057E+05
  3.750E+00  5.715E+05
  4.250E+00  5.447E+05
  4.750E+00  5.315E+05
  VARIABLE          H1
    MINVAL=  3.000E+05
    MAXVAL=  1.000E+06
    CELLAV=  5.791E+05

1.00 +....+....+....+....+....+....+....+....+....+....+
0.90 +                                                  +
0.80 +                                                  +
0.70 +                                                  +
0.60 +                                                  +
0.50 +                H    H     H                      +
0.40 +     H    H                     H     H           +
0.30 H                                           H      H
0.20 +                                                  +
0.10 +                                                  +
0.00 +....+....+....+....+....+....+....+....+....+....+
     0   .1   .2   .3   .4   .5   .6   .7   .8   .9  1.0
THE ABSCISSA IS       Y  .  MIN= 2.50E-01 MAX= 4.75E+00
************************************************************
```

Figure C.22. H vs Y-Axis At IY=1 To IY=10
For IX=1 And IZ=20

```
PATCH(PLOT7    ,PROFIL,    1,    1,    1,  10,   20,   20,    1,    1)
PLOT(PLOT7    ,W1   , 2.000E+01, 1.750E+02)
TABULATION OF ABSCISSA AND ORDINATES...
        Y              W1
   2.500E-01   4.170E+01
   7.500E-01   5.000E+01
   1.250E+00   5.790E+01
   1.750E+00   6.663E+01
   2.250E+00   7.281E+01
   2.750E+00   7.200E+01
   3.250E+00   6.108E+01
   3.750E+00   5.297E+01
   4.250E+00   4.782E+01
   4.750E+00   4.620E+01
   VARIABLE          W1
     MINVAL=   2.000E+01
     MAXVAL=   1.750E+02
     CELLAV=   5.691E+01
```




```
THE ABSCISSA IS        Y   .   MIN= 2.50E-01 MAX= 4.75E+00
************************************************************
```

Figure C.23. W vs Y-Axis At IY=1 To IY=10
For IX=1 And IZ=20

```
PATCH(PLOT8   ,PROFIL,   1,   5,   5,   5,  20,  20,   1,   1)
PLOT(PLOT8   ,H1   , 3.000E+05, 1.000E+06)
TABULATION OF ABSCISSA AND ORDINATES...
        X          H1
  2.500E-01  6.376E+05
  7.500E-01  6.165E+05
  1.250E+00  5.890E+05
  1.750E+00  5.679E+05
  2.250E+00  5.577E+05
  VARIABLE         H1
    MINVAL=  3.000E+05
    MAXVAL=  1.000E+06
    CELLAV=  5.937E+05

1.00 +....+....+....+....+....+....+....+....+....+....+
0.90 +                                                  +
0.80 +                                                  +
0.70 +                                                  +
0.60 +                                                  +
0.50 H------------H                                     +
0.40 +                        H           H             H
0.30 +                                                  +
0.20 +                                                  +
0.10 +                                                  +
0.00 +....+....+....+....+....+....+....+....+....+....+
     0   .1   .2   .3   .4   .5   .6   .7   .8   .9  1.0
THE ABSCISSA IS      X   .  MIN= 2.50E-01 MAX= 2.25E+00
*************************************************************
```

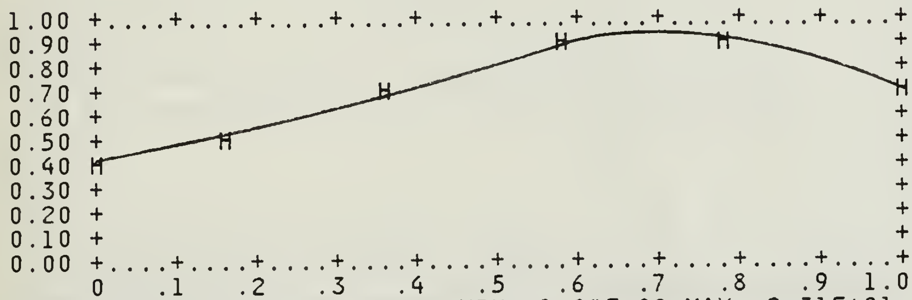
Figure C.24. H vs X-Axis At IX=1 TO IX=5
For IY=5 And IZ=20

```
PATCH(PLOT9   ,PROFIL,   1,    5,    5,    5,   20,   20,    1,    1)
PLOT(PLOT9   ,W1  , 2.000E+01, 1.750E+02)
TABULATION OF ABSCISSA AND ORDINATES...
        X          W1
  2.500E-01  7.281E+01
  7.500E-01  6.474E+01
  1.250E+00  5.391E+01
  1.750E+00  4.524E+01
  2.250E+00  4.084E+01
  VARIABLE         W1
    MINVAL=  2.000E+01
    MAXVAL=  1.750E+02
    CELLAV=  5.551E+01

1.00 +....+....+....+....+....+....+....+....+....+....+
0.90 +                                                  +
0.80 +                                                  +
0.70 +                                                  +
0.60 +                                                  +
0.50 +                                                  +
0.40 +                                                  +
0.30 W            W                                     +
0.20 +                        W           W             +
0.10 +                                                  W
0.00 +....+....+....+....+....+....+....+....+....+....+
     0   .1   .2   .3   .4   .5   .6   .7   .8   .9  1.0
THE ABSCISSA IS       X  .  MIN= 2.50E-01 MAX= 2.25E+00
************************************************************
```

Figure C.25. W vs X-Axis At IX=1 To IX=5
For IY=5 And IZ=20

```
PATCH(PLOT14   ,PROFIL,    1,    1,   13,   13,   21,   26,    1,    1)
PLOT(PLOT14   ,H1   , 5.000E+05, 6.000E+05)
TABULATION OF ABSCISSA AND ORDINATES...
        Z          H1
  1.000E+00  5.429E+05
  4.350E+00  5.535E+05
  9.050E+00  5.653E+05
  1.375E+01  5.895E+05
  1.845E+01  5.905E+05
  2.315E+01  5.681E+05
  VARIABLE         H1
    MINVAL=  5.000E+05
    MAXVAL=  6.000E+05
    CELLAV=  5.683E+05
```




```
THE ABSCISSA IS       Z  .  MIN= 1.00E+00 MAX= 2.31E+01
************************************************************
```

Figure C.26. H vs Z-Axis At IZ=21 To IZ=26
For IX=1 And IY=13

```
PATCH(PLOT15  ,PROFIL,   1,   1,  13,  13,  21,  26,   1,   1)
PLOT(PLOT15  ,V1  , 1.000E+01, 4.500E+01)
TABULATION OF ABSCISSA AND ORDINATES...
        Z          V1
  1.000E+00  1.286E+01
  4.350E+00  2.973E+01
  9.050E+00  2.223E+01
  1.375E+01  3.062E+01
  1.845E+01  2.919E+01
  2.315E+01  2.821E+01
  VARIABLE         V1
    MINVAL=  1.000E+01
    MAXVAL=  4.500E+01
    CELLAV=  2.547E+01
1.00 +....+....+....+....+....+....+....+....+....+....+
0.90 +                                                  +
0.80 +                                                  +
0.70 +                                                  +
0.60 +       V                    V                     +
0.50 +                                      V           V
0.40 +                                                  +
0.30 +                 V                                +
0.20 +                                                  +
0.10 V                                                  +
0.00 +....+....+....+....+....+....+....+....+....+....+
     0   .1   .2   .3   .4   .5   .6   .7   .8   .9  1.0
THE ABSCISSA IS      Z   .  MIN= 1.00E+00 MAX= 2.31E+01
************************************************************
```

Figure C.27. V vs Z-Axis At IZ=21 To IZ=26
For IX=1 And IY=13

```
PATCH(PLOT16  ,PROFIL,   1,   5,  13,  13,  23,  23,   1,   1)
PLOT(PLOT16  ,H1   , 5.000E+05, 6.000E+05)
TABULATION OF ABSCISSA AND ORDINATES...
        X          H1
  2.500E-01  5.653E+05
  7.500E-01  5.647E+05
  1.250E+00  5.638E+05
  1.750E+00  5.628E+05
  2.250E+00  5.620E+05
  VARIABLE         H1
    MINVAL=  5.000E+05
    MAXVAL=  6.000E+05
    CELLAV=  5.637E+05

1.00 +....+....+....+....+....+....+....+....+....+....+
0.90 +                                                  +
0.80 +                                                  +
0.70 H                                                  +
0.60 +            H            H            H           H
0.50 +                                                  +
0.40 +                                                  +
0.30 +                                                  +
0.20 +                                                  +
0.10 +                                                  +
0.00 +....+....+....+....+....+....+....+....+....+....+
     0   .1   .2   .3   .4   .5   .6   .7   .8   .9  1.0
THE ABSCISSA IS       X   .  MIN= 2.50E-01 MAX= 2.25E+00
*************************************************************
```

Figure C.28. H vs X-Axis At IX=1 To IX=5
For IY=13 And IZ=23

```
PATCH(PLOT17  ,PROFIL,   1,    5,   13,   13,   23,   23,    1,    1)
PLOT(PLOT17  ,V1  , 1.000E+01, 4.500E+01)
TABULATION OF ABSCISSA AND ORDINATES...
       X            V1
  2.500E-01  2.223E+01
  7.500E-01  2.306E+01
  1.250E+00  2.448E+01
  1.750E+00  2.591E+01
  2.250E+00  2.641E+01
  VARIABLE          V1
    MINVAL=  1.000E+01
    MAXVAL=  4.500E+01
    CELLAV=  2.442E+01

1.00 +....+....+....+....+....+....+....+....+....+....+
0.90 +                                                  +
0.80 +                                                  +
0.70 +                                                  +
0.60 +                                                  +
0.50 +                                            V     V
0.40 +            V           V                         +
0.30 V                                                  +
0.20 +                                                  +
0.10 +                                                  +
0.00 +....+....+....+....+....+....+....+....+....+....+
     0   .1   .2   .3   .4   .5   .6   .7   .8   .9  1.0
THE ABSCISSA IS       X  .  MIN= 2.50E-01 MAX= 2.25E+00
************************************************************
```

Figure C.29. V vs X-Axis At IX=1 to IX=5
For IY=13 And IZ=23

LIST OF REFERENCES

1. Brunner, D. D., Naval Civil Engineering Laboratory, Port Hueneme, Project Master Plan for Aviation Gas Turbine Engine Test Facilities, March 1984.

2. Bailey, D. L., Tower, P. W., and Fuhs, A. E., Advisory Group for Aerospace Research and Development Report Number 125, Polution Control of Airport Engine Test Facilities, April 1973.

3. Walters, J. J. and Netzer, D. W., A Validation of Mathematical Models for Turbo Jet Test Cells, Engineer's Thesis, Naval Postgraduate School, Monterey, California, June 1978.

4. Brink-Johnsen, B., Titech Company, OSLO, Norway Letter Serial TS/BBJ/ABV, to the Naval Civil Engineering Laboratory, Port Hueneme, Computerized Jet Engine Test Cell and Aircraft Trim Facility, 16 September 1985.

5. Rosten, H. I. and Spalding, D. B., Cham of North America, Incorporated, Huntville, Alabama, PHOENICS Beginner's Guide and User's Manual, October 1976.

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