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G.J. Moridis and K. Pruess

November 1992

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**TOUGH Simulations of Updegraff's
Set of Fluid and Heat Flow Problems**

by

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November 1992

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ABSTRACT

The TOUGH code [Pruess, 1987] for two-phase flow of water, air, and heat in permeable media has been exercised on a suite of test problems originally selected and simulated by C. D. Updegraff [1989]. These include five "verification" problems for which analytical or numerical solutions are available, and three "validation" problems that model laboratory fluid and heat flow experiments. All problems could be run without any code modifications (*). Good and efficient numerical performance, as well as accurate results were obtained throughout. Additional code verification and validation problems from the literature are briefly summarized, and suggestions are given for proper applications of TOUGH and related codes.

(*) To model the infiltration experiment of Vauclin *et al.* [1979], the relative permeability function measured in the experiment had to be added to TOUGH.

TABLE OF CONTENTS

LIST OF FIGURES	vi
LIST OF TABLES	ix
1. INTRODUCTION	1
1.1 Background	1
1.2. The critique of TOUGH	1
1.3 Purpose	2
1.4 Organization and Approach	2
2. 1-D HORIZONTAL INFILTRATION (VERIFICATION PROBLEM 1)	4
2.1 Description	4
2.2 Updegraff's approach & results	4
2.3 Modification of approach and data inputs	4
2.4 Discussion of the TOUGH output from the modified input files	8
3. 1-D COUPLED HEAT AND MASS TRANSPORT (VERIFICATION PROBLEM 2)	9
3.1 Description	9
3.2 Updegraff's approach & results	9
3.3 Modification of approach and data inputs	13
3.4 Discussion of the TOUGH output from the modified input files	13
4. RADIAL HEAT TRANSPORT (VERIFICATION PROBLEM 3)	16
4.1 Description	16
4.2 Updegraff's approach & results	16
4.3 Modification of approach and data inputs	23
4.4 Discussion of the TOUGH output from the modified input files	23
5. FLOW TO A GEOTHERMAL WELL AND HEAT PIPE (VERIFICATION PROBLEMS 4&5)	31
5.1 Description	31
5.2 Updegraff's approach & results	31
6. TWO-DIMENSIONAL INFILTRATION EXPERIMENT (VALIDATION PROBLEM 1)	37
6.1 Description	37
6.2 Updegraff's approach & results	37
6.3 Modification of approach and data inputs	41
6.4 Discussion of the TOUGH output from the modified input files	42

7. CONVECTION CELL EXPERIMENT (VALIDATION PROBLEM 2)	53
7.1 Description	53
7.2 Updegraff's approach & results	53
7.3 Modification of approach and data inputs	59
7.4 Discussion of the TOUGH output from the modified input files	60
8. TWO-PHASE FLOW EXPERIMENT (VALIDATION PROBLEM 3)	66
8.1 Description	66
8.2 Updegraff's approach & results	66
8.3 Modification of approach and data inputs	69
8.4 Discussion of the TOUGH output from the modified input files	71
9. FURTHER CODE VERIFICATIONS AND VALIDATIONS	73
9.1 The MULKOM/TOUGH family of codes	73
9.2 Summary of verifications and validations	73
10. CONCLUSIONS AND DISCUSSION	75
ACKNOWLEDGEMENTS	76
REFERENCES	77
APPENDIX	
Local Truncation Error in the Integral Finite Difference Method	81
REPORT DISTRIBUTION	84

LIST OF FIGURES

Figure 1.	A schematic of the one-dimensional horizontal infiltration problem (from <i>Updegraff</i> [1989]).	5
Figure 2.	TOUGH grid for the one-dimensional horizontal infiltration problem (from <i>Updegraff</i> [1989]).	6
Figure 3.	Comparison of the analytical and the TOUGH solutions to the Verification Problem 1.	7
Figure 4.	The one-dimensional heat transport problem in Verification Problem 2 (from <i>Updegraff</i> [1989]).	10
Figure 5.	The TOUGH grid used by <i>Updegraff</i> [1989] in the simulation of the Verification Problem 2.	11
Figure 6.	Comparison of the TOUGH and the analytical solutions using <i>Updegraff's</i> [1989] data in Verification Problem 2. The corrected analytical solution is also shown.	12
Figure 7.	Comparison of the analytical solution to the TOUGH solutions in Verification Problem 2.	14
Figure 8.	The radial heat transport problem in Verification Problem 2 (from <i>Updegraff</i> [1989]).	17
Figure 9.	The TOUGH grid used by <i>Updegraff</i> [1989] in the simulation of the Verification Problem 3.	18
Figure 10.	The TOUGH solution reported by <i>Updegraff</i> [1989] in the simulation of the Verification Problem 3.	20
Figure 11.	The NORIA solution reported by <i>Updegraff</i> [1989] in the simulation of the Verification Problem 3.	21
Figure 12.	The PETROS solution reported by <i>Updegraff</i> [1989] in the simulation of the Verification Problem 3.	22
Figure 13.	Comparison of the TOUGH and the analytical solutions using <i>Updegraff's</i> [1989] data in Verification Problem 3. The corrected analytical solution is also shown.	25
Figure 14.	Comparison of the analytical and the TOUGH solutions at $t = 10^6$ sec.	27
Figure 15.	Comparison of the analytical and the TOUGH solutions at $t = 10^9$ sec.	28
Figure 16.	The analytical and numerical similarity solutions to the Verification Problem 3.	29

Figure 17.	The analytical and numerical similarity solutions to the Verification Problem 3 (detail).	30
Figure 18.	A schematic of the radial boiling front problem (from <i>Updegraff</i> [1989]).	32
Figure 19.	A schematic of the heat pipe problem (from <i>Updegraff</i> [1989]).	33
Figure 20.	Comparison of the TOUGH and the Garg [1980] solutions for the Verification Problem 4 (from <i>Updegraff</i> [1989]).	34
Figure 21.	Comparison of the TOUGH and the <i>Udell and Fitch</i> [1985] steady-state solutions for the Verification Problem 5 (from <i>Updegraff</i> [1989]).	35
Figure 22.	The two-dimensional infiltration system in Validation Problem 1 (from <i>Updegraff</i> [1989]).	38
Figure 23.	TOUGH grid used by Updegraff for the simulation of Validation Problem 1 (from <i>Updegraff</i> [1989]).	39
Figure 24(a).	TOUGH predictions and experimental measurements at $x = 0.19\text{ m}$ in Validation Problem 1.	43
Figure 24(b).	TOUGH predictions and experimental measurements at $x = 0.49\text{ m}$ in Validation Problem 1.	44
Figure 24(c).	TOUGH predictions and experimental measurements at $x = 0.79\text{ m}$ in Validation Problem 1.	45
Figure 24(d).	TOUGH predictions and experimental measurements at $x = 1.09\text{ m}$ in Validation Problem 1.	46
Figure 24(e).	TOUGH predictions and experimental measurements at $x = 1.39\text{ m}$ in Validation Problem 1.	47
Figure 24(f).	TOUGH predictions and experimental measurements at $x = 1.69\text{ m}$ in Validation Problem 1.	48
Figure 24(g).	TOUGH predictions and experimental measurements at $x = 1.99\text{ m}$ in Validation Problem 1.	49
Figure 25.	Comparison of TOUGH predictions and experimental data of water pressure in Validation Problem 1.	51
Figure 26.	Schematic of the convection cell apparatus (from <i>Reda</i> [1984]).	54
Figure 27.	The convection cell experiment in Validation Problem 2 (from <i>Updegraff</i> [1989]).	55
Figure 28.	The TOUGH grid used by Updegraff in the simulation of Validation Problem 2 (from <i>Updegraff</i> [1989]).	56

Figure 29.	Comparison of Updegraff's TOUGH results with experimental data in Validation Problem 2 (from <i>Updegraff</i> [1989]).....	57
Figure 30(a).	Comparison of TOUGH predictions with experimental data at the heater bottom ($z/\Delta r = 2$) and top ($z/\Delta r = 3$). The bars attached to the TOUGH curves indicate the predicted temperature in the first radial element (i.e. on the surface of the heating element).	62
Figure 30(b).	Comparison of TOUGH predictions with experimental data at $z/\Delta r = 3.5$ and $z/\Delta r = 3.75$	63
Figure 31.	Temperature sensitivity to z at the heater bottom ($z/\Delta r = 2$) and top ($z/\Delta r = 3$).	65
Figure 32.	A schematic of the two-phase flow problem (Validation Problem 3, from <i>Updegraff</i> [1989]).	67
Figure 33.	TOUGH grid used by Updegraff for the simulation of Validation Problem 3 (from <i>Updegraff</i> [1989]).....	68
Figure 34.	Comparison of TOUGH predictions and experimental data in Validation Problem 3	72
Figure 35.	A flow domain V with sub-domain V_n	83
Figure 36.	One-dimensional block-centered grid.	83

LIST OF TABLES

TABLE 1.	Grid discretization for the TOUGH simulation of Verification Problem 3.	24
TABLE 2.	Specifications of the refined 2-D x - z grid in Validation Problem 1.....	42
TABLE 3.	Specifications of the refined 2-d r - z grid in Validation Problem 2.....	59

1. INTRODUCTION

1.1 Background

Under the sponsorship of the U.S. Nuclear Regulatory Commission, Sandia National Laboratories (SNL) is developing a performance assessment methodology for the analysis of long-term disposal of High-level Radioactive Waste (HRW) in unsaturated welded tuff (the only potential host rock presently under consideration by the U.S. Department of Energy). As part of this effort, a comparison study of three simulation codes modeling strongly coupled mass and heat flow in unsaturated porous media was conducted [Updegraff and Bonano, 1988; Updegraff, 1989].

The three codes evaluated were: (a) TOUGH, developed by *Pruess* [1987] at Lawrence Berkeley Laboratory (LBL); (b) NORIA, developed by *Bixler* [1985] at SNL; and (c) PETROS, developed by *Hadley* [1985] at SNL. These codes were tested against one- and two-dimensional flow problems for which analytical solutions, numerical solutions or experimental results are available. The problems were selected to test the capabilities of the codes for a wide variety of flow problems representing different levels of complexity and numerical difficulty, ranging from simple, uncoupled processes (such as one-dimensional infiltration) to strongly coupled processes (such as two-dimensional heat-driven flow and vaporization).

The SNL report [Updegraff, 1989] stated that all three codes were cumbersome to use because of limitations in the selection of time-step size, the treatment of boundary conditions, and the handling of evaporation and condensation. The report remarked that *"...each code exhibits one weakness or another, whether it be boundary conditions (TOUGH, PETROS), core storage (TOUGH), or computational time (NORIA). In addition, none of the codes can directly handle fractures, a feature of welded tuff formations."* Based on these conclusions, Updegraff [1989] recommended that a new code be developed combining the strengths of each of the tested codes without suffering from their individual weaknesses.

1.2. The critique of TOUGH

In his final review of the performance of TOUGH, Updegraff [1989] concluded that:

- (a) TOUGH was capable of solving most of the problems, produced some type of solution in all cases, and was ranked as the best of the three codes tested.
- (b) The problems in which TOUGH produced an erroneous solution were characterized by an inability to converge on the dependent variables, resulting in extremely small time-steps and (consequently) long execution times and inefficient runs. In such cases the simulation period was cut short.
- (c) It exhibited significant numerical dispersion in heat transport problems.
- (d) It had large core storage requirements.
- (e) The execution time requirements covered a wide range.

- (f) The available options for the treatment of boundary conditions in TOUGH were inadequate, and may limit the range of applications of the code. This was considered as "TOUGH's greatest weakness".
- (g) The type of data inputs required by TOUGH make its use cumbersome, especially in multi-dimensional simulations. On the other hand, this formulation is an asset since it allows complete flexibility and a seamless application in one-, two-, or three-dimensional problems.
- (h) TOUGH solves three strongly non-linear Partial Differential Equations (PDE's) where the dependent variables are the gas or liquid phase pressure, air mass fraction, and temperature. However, it does not account for Knudsen diffusion or thermodiffusion which may be important in welded tuffs.
- (i) Faster and less memory-intensive matrix solvers (such as conjugate gradients) are needed.

1.3 Purpose

The purpose of this study is to address the issues raised by *Updegraff* [1989] in the SNL Report. We demonstrate that:

- (a) The difficulties encountered and described by *Updegraff* [1989] can be overcome by careful consideration of the physical processes modeled. Close attention must be paid to issues of space and time discretization, interface weighting procedures, and implementation of boundary conditions.
- (b) TOUGH is capable of handling all the test problems and obtaining correct answers by suitable preparation of input data, without any code modification.
- (c) In all test problems TOUGH produces very efficient runs (in terms of number of time steps) which cover the entire desired simulation periods.

Moreover, by re-examining *Updegraff's* test problems we hope to demonstrate a set of sound simulation principles and practices to be used in the application of TOUGH. We also give a brief summary of verification and validation problems which have been presented in the literature for the MULKOM/TOUGH family of numerical simulation programs.

1.4 Organization and Approach

All the test problems examined in the SNL study are re-investigated. These problems include five verification problems (for which either analytical or numerical solutions exist) and three validation problems (for which experimental results are available). Verification is shown by the proximity of the TOUGH-produced solutions to the known analytical and/or numerical solution. Validation is indicated by the ability of the TOUGH solutions to reproduce experimentally observed data. All calculations reported here were performed on an IBM RS/6000 workstation using double-precision (64-bit) arithmetic.

The review and discussion of each of the eight test problems occupies the next seven sections, in each of which the following approach is used:

- (a) A short description of the problem is presented.
- (b) The inputs and approach used by *Updegraff* [1989] are discussed, making use of a complete set of Updegraff's TOUGH input files that were supplied for this purpose by S. Webb(*) of Sandia National Laboratories. Using the *Updegraff* [1989] input data, a TOUGH run is made to attempt to reproduce his results and use it as a reference.
- (c) The necessary changes (if any) to the data inputs and approach are listed and explained.
- (d) TOUGH is run using the new/modified input data set. The new simulation results are discussed, and, where appropriate, relevant comments of *Updegraff's* [1989] are addressed.

A computer diskette (PC type of format) with all the input files used in our simulations is included in this report. To make the input files more easily readable we have added column counters to the keywords. We also use the single-record data block "START" as a convenient means for providing informal comments. An explanation of the files and their content is found in the text file "ReadMe" also included in the same disk. These input files can serve as references and as building blocks for other TOUGH applications. The diskette also includes a listing of subroutine RELP of TOUGH with the *Vauclin* [1979] relative permeability function added.

(*) Stephen Webb (private communication to the authors) indicated that several of the input files originally given to him by D. Updegraff did not reproduce the results in *Updegraff* [1989]. S. Webb then obtained the original TOUGH outputs from D. Updegraff, and made an effort to modify the input files to reproduce those outputs. It is these modified files that formed the starting point for the present study.

2. 1-D HORIZONTAL INFILTRATION (VERIFICATION PROBLEM 1)

2.1 Description

The first test problem was a horizontal infiltration problem originally solved by Philip [1955]. The problem was described by Ross *et al.* [1982], and was featured as Sample Problem No. 2 in the TOUGH User's Guide [Pruess, 1987]. A semi-infinite horizontal tube filled with a homogeneous soil is partially saturated with water. The soil porosity is $\phi = 0.45$, and the initial moisture content is $\theta = 0.2$, corresponding to a liquid saturation of $S = \theta/\phi = 0.44$. The liquid saturation at the $x=0$ boundary is held constant at $S = 1$ for $t > 0$. Due to a capillary pressure differential, water infiltrates into the horizontal system. Air is considered a passive phase, and its effects are neglected. A schematic of the problem along with pertinent information on the properties of the porous medium appears in Figure 1.

TOUGH predictions are obtained for $t = 864 \text{ sec}$, $t = 5184 \text{ sec}$, and $t = 9504 \text{ sec}$, at which Ross *et al.* [1982] specify exact solutions. The simulated length was limited to $L = 0.2 \text{ m}$ because the solution of Philip [1955] indicated that it is sufficient to produce a semi-infinite behavior.

2.2 Updegraff's approach & results

Figure 2 shows the space discretization used by Updegraff [1989]. The second row of gridblocks (R1 to R40) was used to allow for gas escape, thus avoiding pressure buildup and deviation from the conditions of a passive air phase assumed in the development of the analytical solution. A very large volume ($5.0 \times 10^{50} \text{ m}^3$) was assigned to the element LB1, thus maintaining stable its initial liquid saturation $S = 1$.

The input file supplied by S. Webb is essentially identical to the input file for sample problem 2 from the TOUGH report [Pruess, 1987]. Results of the run (using the original input data set) for $t = 864 \text{ sec}$, 5184 sec , and 9504 sec are shown in Figure 3. This run duplicated Updegraff's solution and confirmed his observations that (a) a very good agreement with the exact solution is observed for a saturation $S > 0.7$, (b) below this limit the simulation results exceed the exact solution by less than 5%, and (c) in general a good agreement between the numerical and analytical solutions exists.

2.3 Modification of approach and data inputs

We created two modified data sets. The first modification involved the removal of the second row of gridblocks (R1 to R40), thus reducing the size of the problem by 50%. This action was prompted by the expectation that the desired constant air pressure could be approximated without special "guard" blocks. Everything else remained as in the original Updegraff file, in which an option MOP(11) = 0 was used (signifying an upstream weighting of mobilities, permeabilities, and thermal properties).

The second modified data set differed from the first in the value of MOP(11), which was 1 in this case. This indicates a midpoint weighting, and has some interesting implications. From the strict point of view of error analysis, midpoint weighting is $O(\Delta x^2)$ and $O(\Delta t)$ accurate, and thus seemingly superior to the upstream weighting scheme which is only $O(\Delta x)$ and $O(\Delta t)$ accurate. However, this apparent superiority is not unconditional, and if the midpoint weighting scheme is not used judiciously, it may produce solutions

INITIAL CONDITION

$$\Theta = 0.20 \dots$$

Figure 1. A schematic of the one-dimensional horizontal infiltration problem (from Updegraff [1989]).

INITIAL CONDITION: $\Theta = 0.20 \dots$

Figure 2. TOUGH grid for the one-dimensional horizontal infiltration problem (from Updegraff [1989]).

Figure 3. Comparison of the analytical and the TOUGH solutions to the Verification Problem 1.

which may be mathematically correct but physically unrealistic. These potential problems stem from the fact that the unconstrained implementation of such a scheme may violate the second law of thermodynamics by allowing mass and energy to flow from a lower to a higher level. When certain conditions of monotonicity [vanLeer, 1977] are met, the midpoint scheme can be used and results in a more accurate solution. The verification problem under investigation meets strict monotonicity criteria (with a maximum $S = 1$ at $x = 0$ and monotonously decreasing saturations with increasing x), and as such is ideally suited to the implementation of a midpoint weighting scheme. Caution should always be exercised when such a scheme is used in two dimensional systems (especially in cases with strong curvature of the flow lines). While the midpoint weighting scheme is more accurate, the upstream weighting scheme is far more robust, enables the simulation of complex mass and energy flow patterns without violating the second law of thermodynamics, and should be always preferred unless the monotonicity of the problem under consideration is indisputable.

2.4 Discussion of the TOUGH output from the modified input files

The results of the TOUGH simulation obtained with the two modified data files are also shown in Figure 3. Each of the three runs required 28 time steps to reach the maximum simulation time of $t_{max} = 9504 \text{ sec}$. It can be seen that:

- (a) The elimination of the second row of gridblocks (and the corresponding reduction of the size of the problem by half) does not adversely affect the solutions.
- (b) The use of the midpoint weighting scheme in the second modified input file further improves the accuracy of the solution, providing an excellent match for larger times. This eliminates the discrepancy of less than 5% mentioned by Updegraff. At $t = 864 \text{ sec}$ this solution lags slightly behind the other solutions, but is always more accurate near the tail end of the saturation curve.
- (c) All three numerical solutions indicate an efficient simulation (in terms of time steps required to reach t_{max}) and provide an excellent agreement with the exact solution.

3. 1-D COUPLED HEAT AND MASS TRANSPORT (VERIFICATION PROBLEM 2)

3.1 Description

The analytical solution to the second verification problem of one-dimensional heat and mass transport was developed by Avdonin [1964]. A description of the problem and a solution were presented by Ross *et al.* [1982]. Cold water is injected into a semi-infinite, high-temperature aquifer at a specified constant mass flow rate. The overburden and underburden are impermeable to mass and heat flow, acting as no-flow and adiabatic boundaries and reducing the equation governing heat transport to that of convection-diffusion. A schematic of the problem along with other pertinent information appears in Figure 4.

The TOUGH predictions are compared to the analytical solution at $t = t_{max} = 130,000$ sec after the initiation of the cold water injection. The simulated length used by Updegraff was $L = 50$ m because previous modeling studies [Ward *et al.*, 1984] had demonstrated that this length suffices to approximate the semi-infinite behavior of the aquifer.

3.2 Updegraff's approach & results

Figure 5 shows the space discretization used by Updegraff [1989]. It consisted of 500 equally spaced gridblocks, and two boundary gridblocks. The space and time discretization were based on criteria established by Reeves *et al.* [1986]. A very large volume (10^{50} m³) was assigned to the boundary gridblocks LB1 and RB1, thus ensuring constant boundary pressures and temperatures during the simulation. An initial pressure distribution varying linearly between 5.05×10^6 Pa (at the left-hand boundary) and 5.0×10^6 Pa (at the right-hand boundary) was imposed on the gridblocks of the simulated domain. Instead of direct injection into the gridblock at $x = 0$, the prescribed pressure differential on the boundaries created an influx which resulted in an equivalent system. For this flux to equal the desired injection rate of 10 kg/sec at the conditions of average pressure and temperature, Updegraff [1989] specified a permeability of 1.74×10^{-9} m².

Using the water property values listed in Updegraff [1989], application of Darcy's law between the boundaries results in a permeability of 1.7357×10^{-11} m², i.e. two orders of magnitude lower than the reported value. This was the value used in the original data set (supplied by S. Webb), so we presumed that this discrepancy was due to a typographical error in the report. Figure 6 shows the analytical solution and the TOUGH results at $t = 1.3 \times 10^5$ sec obtained using the original data set. Updegraff [1989] concluded that although there seems to be an agreement between the analytical and the TOUGH solutions, some numerical dispersion exists.

Examination of the report and of the input file revealed a serious problem. The water properties used in TOUGH at a pressure of 5.025×10^6 Pa (the average pressure) and a temperature of $T = 165$ °C (the average temperature) are different from the ones used by Updegraff. More specifically, the water density and specific heat are $\rho_w = 905.24$ kg/m³ and $c_w = 4336.88$ J/kg-°C respectively [International Formulation Committee, 1967], as opposed to the values of $\rho_w = 919$ kg/m³ and $c_w = 4185$ J/kg-°C used by Updegraff. Although these differences are not large, they are not insignificant and have a sizable impact on the solution. The error in these inputs has three serious implications.

Figure 4. The one-dimensional heat transport problem in Verification Problem 2 (from Updegraff [1989]).

Figure 5. The TOUGH grid used by Updegraff [1989] in the simulation of the Verification Problem 2.

Figure 6. Comparison of the TOUGH and the analytical solutions using *Updegraff's* [1989] data in Verification Problem 2. The corrected analytical solution is also shown.

The first implication is an erroneous analytical solution. Figure 6 shows the corrected analytical solution, in which the front has advanced about 1 m further than predicted from the incorrect water properties. The second implication is the corresponding error in the calculation of permeability, which is calculated as $1.8138 \times 10^{-11} \text{ m}^2$ using the corrected water properties. The last (and potentially most important) implication is that the comparison between the original analytical solution and Updegraff's TOUGH solution may be meaningless because TOUGH uses water properties calculated internally from steam table equations [International Formulation Committee, 1967]. Use of incorrect property data creates a direct conflict with these "hardwired" temperature- and pressure-dependent properties, resulting in comparisons of essentially dissimilar problems.

3.3 Modification of approach and data inputs

We created three modified data sets. A grid of $L = 40 \text{ m}$ length was used in all cases, so that the problem could be run without increasing the array dimensions in TOUGH. The first modified data set involved the correction of the property values in the original data file. The value of permeability was changed to $1.8138 \times 10^{-11} \text{ m}^2$. The soil density and soil specific heat in the original data set ($2,900 \text{ kg/m}^3$ and $739.8 \text{ J/kg-}^\circ\text{C}$) were close to the values recalculated from given properties for full water saturation ($2,898.68 \text{ kg/m}^3$ and $739.35 \text{ J/kg-}^\circ\text{C}$). A $\text{MOP}(11) = 0$ was used in this data set, signifying an upstream weighting of mobilities, permeabilities, and thermal properties.

The second modified data set differed from the first in the value of $\text{MOP}(11)$, which was 1 in this case, i.e. a midpoint weighting scheme was used. Due to the prevailing conditions of strict monotonicity (discussed in detail in section 2.3), such a weighting scheme is permissible and produces a more accurate solution. The second and third modified data set differed in the boundary conditions and the treatment of sources/sinks. Water was injected at a rate of 10 kg/sec directly into the first gridblock, instead of imposing a rate by means of boundary pressures. An initial temperature of 160°C and a specific heat of $1040 \text{ J/kg-}^\circ\text{C}$ were assigned to the first gridblock, thus effecting a constant injection of 160°C water. The use of direct injection eliminated the need for a large INCON data block, reducing the size of the input data file by 90%.

Strictly speaking, constant rate injection into a flow system initially at uniform pressure will result in a transient change of flow rates away from the injection point, rather than giving steady-state mass flow throughout. However, because of the large permeability ($k = 1.8138 \times 10^{-11} \text{ m}^2$) and the small compressibility ($c_w = 6.7 \times 10^{-10} \text{ Pa}^{-1}$) of liquid water, the pressure diffusivity at these conditions (a pressure of $5.05 \times 10^6 \text{ Pa}$ and a temperature of $T = 165^\circ\text{C}$) is very large,

$$D = k/(\phi \mu c_w) = 790 \text{ m}^2/\text{sec}$$

so that the region with practically steady flow $x \approx (Dt)^{0.5}$ expands rapidly and runs well ahead of the thermal front.

3.4 Discussion of the TOUGH output from the modified input files

The corrected analytical and the TOUGH solutions (obtained with the modified input files) appear in Figure 7. As in Updegraff [1989], due to the time-step constraint of

Figure 7. Comparison of the analytical solution to the TOUGH solutions in Verification Problem 2.

$\Delta t \leq 100 \text{ sec}$, the runs required 1300 time steps to reach the maximum simulation time of $t_{\max} = 130,000 \text{ sec}$. It can be seen that:

- (a) With upstream weighting, TOUGH properly predicts the midpoint of the front, but there is a certain amount of numerical dispersion which results in a broadening of the front. This broadening is due to the numerical dispersion caused by the higher truncation error of the upstream scheme (discussed in section 2.3). On the other hand, upstream weighting does not violate the second law of thermodynamics, is far more stable in more difficult situations and with longer time steps, and unless strict monotonicity criteria are satisfied, should be the preferable weighting scheme. The larger truncation error is the necessary price to pay for a far more robust numerical scheme.
As Updegraff [1989] indicated, a more accurate solution can be obtained using finer time and/or space discretization. However, the additional storage and execution time requirements have to be weighed against the incremental improvement in accuracy.
- (b) The solution obtained using the midpoint weighting scheme (in the second modified input file) is more accurate and in excellent agreement with the analytical solution. This was expected because of the smaller truncation error of this scheme.
- (c) Direct injection into the aquifer is preferable to assigning constant boundary pressures because it reduces the size of the input file by 90%.

4. RADIAL HEAT TRANSPORT (VERIFICATION PROBLEM 3)

4.1 Description

The radial heat transport in the third verification test problem was originally solved analytically by *Avdonin* [1964], and was later described by *Ross et al.* [1982]. Cold water is injected into a semi-infinite, high-temperature aquifer. This problem is very similar to the one-dimensional heat transport described in Section 3, from which it differs in the coordinate system (radial coordinates, as opposed to cartesian coordinates). The overburden and underburden are impermeable to mass and heat flow, acting as no-flow and adiabatic boundaries and reducing the equation governing heat transport to that of convection-diffusion. Figure 8 shows a diagram of the problem and other pertinent information.

The properties and conditions are as in Verification Problem 2. The radius of the aquifer is 1000 m (sufficient to approximate the semi-infinite behavior), at which a constant temperature (equal to the initial temperature of $170\text{ }^{\circ}\text{C}$) is imposed. The TOUGH predictions of the temperature distribution are sought at $t = t_{\max} = 10^9\text{ sec}$ (i.e. 32 years) after the initiation of the cold water injection for comparison to the analytical solution.

4.2 Updegraff's approach & results

Updegraff [1989] discretized the space domain in 252 unequally-sized gridblocks, which included two boundary gridblocks. A schematic of this grid appears in Figure 9. The space discretization was based on an algorithm developed by *Reeves et al.* [1986] for the SWIFTII code. A very large volume (10^{50} m^3) was assigned to the boundary gridblocks IB1 and OB1, thus ensuring constant boundary pressures and temperatures during the duration of the simulation. The IB1 and OB1 boundaries were assigned pressures of $5.05 \times 10^6\text{ Pa}$ and $5.0 \times 10^6\text{ Pa}$, and temperatures of $160\text{ }^{\circ}\text{C}$ and $170\text{ }^{\circ}\text{C}$ respectively. The initial pressure distribution was determined using a logarithmic pressure function [*Updegraff*, 1989]. Instead of a direct injection, the prescribed pressure differential on the boundaries created an influx which resulted in an equivalent system. For this flux to equal the injection rate of 10 kg/sec at the conditions of average pressure and temperature, *Updegraff* [1989] calculated a permeability of $6.36 \times 10^{-11}\text{ m}^2$.

Constraining the computation to ≤ 3000 time steps, *Updegraff* [1989] could only simulate the first $1.5 \times 10^6\text{ sec}$ of this problem. He did not elaborate whether the inability to proceed past this point was due to obviously erroneous answers or extremely small time steps (which could make further simulation impractical). Based on this performance, he concluded that TOUGH was unlikely to simulate the required period of $t_{\max} = 10^9\text{ sec}$ within a reasonable time frame, and compared the numerical and the analytical solutions at $t = 10^6\text{ sec}$. His comparison indicated that the TOUGH solution showed limited numerical dispersion, and lagged behind the analytical solution by about 5% of the distance traveled by the front (as predicted by the analytical solution). He speculated that this discrepancy was caused by the temperature dependence of the water viscosity and density in TOUGH, which is not accounted for in the analytical solution.

Examination of the report and input file revealed a series of problems of varying significance. More specifically:

Figure 8. The radial heat transport problem in Verification Problem 2 (from *Uptegraff* [1989]).

Figure 9. The TOUGH grid used by *Updegraff* [1989] in the simulation of the Verification Problem 3.

- (a) A wrong permeability was listed in the report (as in the previous problem, section 3.2) Using the water property values listed in Updegraff [1989], application of Darcy's law between the boundaries results in a permeability of $6.499 \times 10^{-13} \text{ m}^2$, i.e. two orders of magnitude lower than the reported value. The fact that the original input file (supplied by S. Webb) used a value of $6.36 \times 10^{-13} \text{ m}^2$ led us to believe that this discrepancy was due to a typographical error in the report.
- (b) The Updegraff report compared the performance of TOUGH, NORIA, and PETROS at $t = 10^6 \text{ sec}$ against the analytical solution (Figures 10, 11, and 12). Comparison of these graphs indicate that the analytical solution shown in the TOUGH graph (Figure 10) bears no resemblance to the analytical solution in the NORIA and PETROS graphs (Figures 11 and 12) at the same time. The obvious conclusion is that the solutions in Figure 10 do not correspond to the stated time of $t = 10^6 \text{ sec}$ but to some other unknown time, raising questions about the applicability or validity of Updegraff's observations and comments.
- (c) The same discrepancy as observed in the Verification Problem 2 (subsection 3.2) between the water properties used by Updegraff and their correct values (as provided by the *International Formulation Committee* [1967] incorporated in TOUGH) exists in the Verification Problem 3. The water density and specific heat at the average pressure of $5.025 \times 10^6 \text{ Pa}$ and the average temperature of $T = 165^\circ \text{C}$ are $\rho_w = 905.24 \text{ kg/m}^3$ and $c_w = 4336.88 \text{ J/kg-}^\circ\text{C}$ respectively, as compared to values of $\rho_w = 919 \text{ kg/m}^3$ and $c_w = 4185 \text{ J/kg-}^\circ\text{C}$ used by Updegraff. The corrected permeability is then calculated as $6.6646 \times 10^{-13} \text{ m}^2$.
 These differences have a significant impact on the solution and the results drawn thereof for the same reasons as discussed in detail in the subsection 3.2 of the Verification Problem 2. More specifically, these inaccurate data (i) produce an incorrect analytical solution and thus an unreliable reference basis, (ii) result in an incorrect calculation of the permeability and in accordingly inaccurate determination of the front position in the numerical predictions, and (iii) are likely to cause a conflict with the correct water property data "hardwired" in TOUGH and thus undermine the validity of any conclusions (since they are inevitably based on essentially dissimilar problem specifications).
- (d) A serious problem was detected in the space discretization of the radial direction r . The first 0.09 m immediately next to the well bore (i.e. the region between $r = 0.01 \text{ m}$ and $r = 0.10 \text{ m}$) was discretized into 50 gridblocks, all of which had Δr 's in the 10^{-4} to 10^{-2} m range.

Such a fine discretization can produce severe loss of accuracy when calculating interblock flows from small differences in the pressure of adjacent gridblocks, and it increases the size of the system of linear equations to be solved. This approach makes the numerical aspects of the problem unnecessarily difficult, without resolving additional physics.

In an effort to duplicate Updegraff's results we made a single run using the original data input file supplied by S. Webb. Figure 13 shows the simulation results from this TOUGH run, the analytical solution based on the water properties used by Updegraff [1989], as well as the corrected analytical solution.

Because the TOUGH solution reported by Updegraff [1989] could not be used as a basis of reference for the aforementioned reasons, there is no certainty that this run reproduced his observations if the maximum time he was capable of simulating was indeed

Figure 10. The TOUGH solution reported by *Updegraff* [1989] in the simulation of the Verification Problem 3.

Figure 11. The NORIA solution reported by *Updegraff* [1989] in the simulation of the Verification Problem 3.

Figure 12. The PETROS solution reported by *Updegraff* [1989] in the simulation of the Verification Problem 3.

1.5×10^6 sec. Our run proceeded smoothly until a $t = 1.5886 \times 10^8$ sec, exceeding Updegraff's reported time by a factor of 100. The cause of the inability to reach the desired observation time of $t_{max} = 10^9$ sec was traced to the shortcomings of the exceedingly fine space discretization (described in detail above). After $t = 1.5886 \times 10^8$ sec convergence is obtained at unchanged primary variables (ITER = 1), resulting in an advancement of time without a corresponding advancement of the front and a numerical solution lagging behind the correct solution.

4.3 Modification of approach and data inputs

We evaluated the ability of TOUGH to yield an accurate solution at two times: $t = 10^6$ sec (used for comparisons by Updegraff) and $t = t_{max} = 10^9$ sec (specified by the problem). Four very similar data sets were created for the purpose, all of which shared the same space discretization. The number of gridblocks was reduced from 252 in Updegraff [1989] to 127, which considerably decreased the execution time. Table 1 lists the specifications of the refined grid, which for simplicity and convenience was generated with the MESHAVER facility built into the TOUGH2 code [Pruess, 1991]. A very large volume (10^{38} m^3) was assigned to the single boundary gridblock in the radial direction (127th), thus ensuring constant boundary pressures and temperatures during the duration of the simulation.

As discussed in the previous problem, water at a temperature of 160°C and a rate of 10 kg/sec is injected directly into the first gridblock located next to the wellbore. We believe that this is a markedly better approach than creating influx in response to boundary pressure differentials because it is more physically correct, less cumbersome to implement, and significantly simplifies and reduces the size of the input file. With flow rate directly specified through a mass source, the problem becomes insensitive to the precise value of permeability; we used a value of $k = 6.6646 \times 10^{-13} \text{ m}^2$. The soil density and soil specific heat were the same as in the Verification Problem 2 ($2,898.68 \text{ kg/m}^3$ and $739.35 \text{ J/kg}^\circ\text{C}$).

The first two input files were used to simulate the desired period of 10^9 sec. They only differed in the value of MOP(11) (= 0 in the first and 1 in the second), and returned numerical solutions using both an upstream (preferable) and the midpoint (allowed due to strict monotonicity) weighting schemes. The maximum allowed time step size in both files was $\Delta t = 10^6$ sec, i.e. 1/1000th of the maximum.

The third and fourth input files were necessitated by the realization that the simulation time of 10^6 sec (at which comparisons of the numerical and analytical solutions are to be made) is reached after only 27 time steps (as opposed to the 3000 reported by Updegraff) in the first two runs. Such a time discretization is perfectly acceptable for the solution at 10^9 sec, but is coarse and provides an insufficiently detailed solution at 10^6 sec. Therefore, the third and fourth input files were created, differing from the first and second in the maximum simulation time (10^6 sec) and the maximum allowable Δt (10^3 sec, i.e. 1/1000th of the maximum).

4.4 Discussion of the TOUGH output from the modified input files

Our four input files produced very efficient runs which did not suffer from any of the shortcomings reported by Updegraff [1989]. The numerical simulations based on the first and second input files both reached 10^6 sec in 27 time steps and $t_{max} = 10^9$ sec in 1031 time steps. The finer time discretization in the third and fourth input files required

TABLE 1. Grid discretization for the TOUGH simulation of Verification Problem 3.

Block	Δr (m)	Block	Δr (m)	Block	Δr (m)	Block	Δr (m)	Block	Δr (m)	Block	Δr (m)
1	1.00E-04 †	22	4.4060E-02	43	1.9416E-01	64	8.5540E-01	85	3.7700E+00	106	1.6610E+01
2	1.0732E-02	23	4.7280E-02	44	2.0840E-01	65	9.1800E-01	86	4.0460E+00	107	1.7824E+01
3	1.1518E-02	24	5.0740E-02	45	2.2360E-01	66	9.8520E-01	87	4.3420E+00	108	1.9128E+01
4	1.2360E-02	25	5.4460E-02	46	2.4000E-01	67	1.0574E+00	88	4.6580E+00	109	2.0520E+01
5	1.3264E-02	26	5.8440E-02	47	2.5760E-01	68	1.1348E+00	89	5.0000E+00	110	2.2040E+01
6	1.4234E-02	27	6.2720E-02	48	2.7640E-01	69	1.2178E+00	90	5.3660E+00	111	2.3640E+01
7	1.5276E-02	28	6.7320E-02	49	2.9660E-01	70	1.3068E+00	91	5.7580E+00	112	2.5380E+01
8	1.6394E-02	29	7.2240E-02	50	3.1820E-01	71	1.4024E+00	92	6.1800E+00	113	2.7220E+01
9	1.7594E-02	30	7.7520E-02	51	3.4160E-01	72	1.5052E+00	93	6.6320E+00	114	2.9220E+01
10	1.8882E-02	31	8.3200E-02	52	3.6660E-01	73	1.6152E+00	94	7.1180E+00	115	3.1360E+01
11	2.0260E-02	32	8.9280E-02	53	3.9340E-01	74	1.7334E+00	95	7.6380E+00	116	3.3660E+01
12	2.1740E-02	33	9.5820E-02	54	4.2220E-01	75	1.8602E+00	96	8.1960E+00	117	3.6120E+01
13	2.3340E-02	34	1.0282E-01	55	4.5300E-01	76	1.9964E+00	97	8.7960E+00	118	3.8760E+01
14	2.5040E-02	35	1.1036E-01	56	4.8620E-01	77	2.1420E+00	98	9.4400E+00	119	4.1600E+01
15	2.6880E-02	36	1.1842E-01	57	5.2180E-01	78	2.3000E+00	99	1.0132E+01	120	4.4640E+01
16	2.8840E-02	37	1.2710E-01	58	5.6000E-01	79	2.4680E+00	100	1.0872E+01	121	4.7900E+01
17	3.0960E-02	38	1.3640E-01	59	6.0100E-01	80	2.6480E+00	101	1.1668E+01	122	5.1420E+01
18	3.3220E-02	39	1.4638E-01	60	6.4500E-01	81	2.8420E+00	102	1.2522E+01	123	5.5180E+01
19	3.5640E-02	40	1.5708E-01	61	6.9220E-01	82	3.0500E+00	103	1.3438E+01	124	5.9220E+01
20	3.8260E-02	41	1.6858E-01	62	7.4280E-01	83	3.2720E+00	104	1.4422E+01	125	6.3540E+01
21	4.1060E-02	42	1.8092E-01	63	7.9720E-01	84	3.5120E+00	105	1.5476E+01	126	6.8200E+01
										127	1.0000E+00*

(*): Assigned a large volume ($10^{38} m^3$).

(†): Assigned a large heat capacity ($10^{50} J/kg ^\circ C$) to enforce injection at constant temperature.

Figure 13. Comparison of the TOUGH and the analytical solutions using *Updegraff's* [1989] data in Verification Problem 3. The corrected analytical solution is also shown.

1009 time steps to reach the desired observation time of 10^6 sec.

Figure 14 shows the corrected analytical solution and four TOUGH solutions (corresponding to the two time discretizations and the two weighting schemes) at $t = 10^6$ sec. Figure 15 shows the corrected analytical solution and two TOUGH solutions (corresponding to the two weighting schemes) at $t = 10^9$ sec.

Before discussing these results further, we wish to point out that the problem at hand has a "similarity solution" in terms of the variable r^2/t [O'Sullivan, 1981; Dougherty and Pruess, 1990; 1992]. The temperature changes in space and time are coupled in such a way that they depend solely on r^2/t , rather than on r and t separately. In Figure 16 we plot the analytical solution, the two TOUGH solutions at $t = 10^6$ sec (with the fine time discretization), and the two TOUGH solutions at $t = 10^9$ sec versus the similarity variable r^2/t . Figure 17 demonstrates the same similarity solution, but offers much finer detail by focusing on the portion of the r^2/t axis where most of the changes occur. It also includes the TOUGH solutions with the coarse time discretization at $t = 10^6$ sec. An examination of the simulation results and Figures 14 through 17 reveals that:

- (a) TOUGH is capable of an efficient simulation of the radial heat transport problem. All the simulations reached the desired maximum simulation times without any oscillations. The maximum timestep was not limited by code-imposed internal criteria but by restricting the maximum allowable size to a 1/1000th of the maximum (10^6 sec in the first two and 10^3 sec in the remaining two runs). The number of time steps to reach 10^6 and 10^9 sec was 27 and 1031.
- (b) The TOUGH results are consistent with the r^2/t invariance that is known to exist in this problem. At $t_{max} = 10^9$ sec the two TOUGH solutions (corresponding to the two weighting schemes) virtually coincide with the analytical solution. The midpoint-weighted solution is slightly more accurate, but the difference from the upstream-weighted solution is almost imperceptible.
- (c) Similar observations are made for the solutions at $t = 10^6$ sec. When the time discretization is fine, a very good agreement between the analytical solution and the two TOUGH solutions is observed. This degree of match is satisfactory for most practical applications. The small degree of numerical diffusion is due mostly to errors associated with the coarse time discretization. The solution based on midpoint weighting is consistently more accurate than the upstream-based solution, but the difference is not significant.

These results directly negate Updegraff's [1989] statements that "TOUGH could only simulate the first 1.5×10^6 sec ..." and that "PETROS...was the only code to solve the radial heat transport problem".

Figure 14. Comparison of the analytical and the TOUGH solutions at $t = 10^6$ sec.

Figure 15. Comparison of the analytical and the TOUGH solutions at $t = 10^9$ sec.

Figure 16. The analytical and numerical similarity solutions to the Verification Problem 3.

Figure 17. The analytical and numerical similarity solutions to the Verification Problem 3 (detail).

5. FLOW TO A GEOTHERMAL WELL AND HEAT PIPE (VERIFICATION PROBLEMS 4 & 5)

5.1 Description

Verification Problem 4 is the radial boiling front problem described and solved by *Garg* [1980], and also included in the TOUGH User's Guide [*Pruess*, 1987] as Sample Problem No. 4. In this problem water and/or steam is produced from a well in the center of an infinite cylindrical hot water aquifer. Figure 18 shows a schematic of the problem and lists pertinent parameter values. Water boils in response to a decrease in pressure brought about by the water removal at the well, and the resulting flash front advances away from the well and into the aquifer over time. The problem to be solved is that of one-component, two-phase flow and heat transport. The semi-analytical solution of *Garg* [1980] predicts the wellbore pressure over a period of time.

Verification Problem 5 is a heat pipe problem described and simulated by *Udell and Fitch* [1985], and included in the TOUGH User's Guide [*Pruess*, 1987] as Sample Problem No. 6. A one-dimensional horizontal layer of porous medium filled with water and a two component gas (air and water vapor) is subjected to a heat flux at the right end. A schematic of the problem and relevant information is shown in Figure 19. Due to the heat flux, (a) the right end dries, (b) moisture is collected at the left end, (c) near the saturated left end the temperature increases strongly while (d) it approaches a constant value at the right end, and (e) the mass fraction of air in the gaseous phase decreases rapidly to zero as it approaches the left end of the porous medium. It should be noted that the fluid properties used in the *Udell and Fitch* [1985] solution were considered constants, i.e. independent of pressure and temperature.

These two problems are used to investigate the performance of numerical codes in the simulation of fully coupled two-phase flow, heat transport, and phase changes (evaporation). In Verification Problem 4, the TOUGH predictions of the wellbore pressure over a period of 9.0×10^5 sec are compared to the semi-analytical solution of *Garg* [1980]. In Verification Problem 5, the semi-analytical and the TOUGH predictions of temperature, saturation, and air mole fraction are compared at steady state.

5.2 Updegraff's approach & results

The input files used by *Updegraff* [1989] were identical in all aspects to the ones in the TOUGH User's Guide [*Pruess*, 1987]. The results of the Updegraff simulations (which we repeated to confirm the identity) are therefore identical to the ones reported in the TOUGH User's Guide. TOUGH was the only code among the three tested (TOUGH, NORIA, and PETROS) to successfully simulate both these problems.

An excellent agreement is observed between the TOUGH and *Garg's* [1980] solution in the Verification Problem 4 (Figure 20). In Verification Problem 5, the TOUGH solutions of temperature and mole fraction (Figure 21) are in excellent quantitative agreement with the *Udell and Fitch* [1985] predictions, while a similar qualitative behavior (but some quantitative differences) are observed in the prediction of saturation. These differences stem from the fact that TOUGH does not resort to the simplifications involved in the derivation of the semi-analytical solution, thus producing a solution which is more physically accurate than the one predicted by *Udell and Fitch* [1985]. *Updegraff* [1989] correctly attributed the differences in the predictions to the fact that gas and liquid properties in TOUGH were fully pressure- and temperature-dependent but were considered constant

Figure 18. A schematic of the radial boiling front problem (from Updegraff [1989]).

Figure 19. A schematic of the heat pipe problem (from Updegraff [1989]).

Figure 20. Comparison of the TOUGH and the *Garg* [1980] solutions for the Verification Problem 4 (from *Updegraff* [1989]).

Figure 21. Comparison of the TOUGH and the *Udell and Fitch* [1985] steady-state solutions for the Verification Problem 5 (from *Updegraff* [1989]).

in the *Udell and Fitch* [1985] solution. This discrepancy in the saturation predictions was addressed by *Doughty and Pruess* [1987], who (as a further check) modified TOUGH to implement the same simplifying assumptions used in the reference solution and reported an excellent agreement of the solutions.

The above brief discussion of Verification Problems 4 and 5 was included here for completeness. No issues were identified that would have necessitated any revisions in the TOUGH solutions as originally reported [*Pruess*, 1987].

6. TWO-DIMENSIONAL INFILTRATION EXPERIMENT (VALIDATION PROBLEM 1)

6.1 Description

Experimental measurements and a numerical solution to the problem of two-dimensional infiltration were provided by *Vauclin et al.* [1979]. Water infiltrates at a rate of $4.111 \times 10^{-5} \text{ m/sec}$ over a length of 0.5 m of the vertical slab of soil depicted in Figure 22 which, due to symmetry, represents only the right half of the problem. The water table stands at 0.65 m from the bottom. The bottom boundary and the left boundary (line of symmetry) are considered impermeable to flow. Below $z = 0.65 \text{ m}$ the right boundary is a constant pressure boundary with a water saturation of 1 in the bottom; above $z = 0.65 \text{ m}$ it is a seepage surface, i.e. a mixed type of boundary condition which sets the water flux equal to zero when the medium is unsaturated and has a head equal to the hydraulic head when the medium is saturated. This problem is used to test the ability of TOUGH to simulate two-dimensional two-phase flow.

The TOUGH evaluation process compares the volumetric moisture content distributions with depth z at distances of $x = 0.19, 0.49, 0.79, 1.09, 1.39, \text{ and } 1.99 \text{ m}$ from the line of symmetry. The TOUGH predictions are compared to the experimental measurements at $t = 1800, 3600, 5400, 7200, 10800, 14400, 18000, 21000, \text{ and } 28800 \text{ sec}$ after the initiation of infiltration.

6.2 Updegraff's approach & results

Figure 23 shows the space discretization used by *Updegraff* [1989]. It consisted of 194 gridblocks which included 120 gridblocks with dimensions $0.25 \text{ m} \times 0.135 \text{ m} \times 1 \text{ m}$, 48 gridblocks with dimensions $0.25 \text{ m} \times 0.1625 \text{ m} \times 1 \text{ m}$, and 26 boundary gridblocks. The top layer (O) and the right column (13) of gridblocks were used as the boundary gridblocks. The gridblocks O1 and O2 were extremely thin and controlled infiltration into the slab. A very large volume (10^{50} m^3) was assigned to all the other boundary gridblocks, thus effecting (a) constant pressure and temperature, and (b) zero infiltration boundary conditions to gridblocks O3 to O13. The lack of boundary gridblocks along the bottom and the left end of the slab corresponds to zero mass and heat fluxes along these boundaries. The water content distribution in the boundary gridblocks in column 13 was determined from their distance from the water table and the capillary pressure curve which pertained to the particular soil of the experiment [*Vauclin et al.*, 1979], and defined an equilibrium (i.e. zero vertical flux) system.

Infiltration into the slab was simulated by injecting water into gridblocks O1 and O2 at a mass rate of 0.01028 kg/sec (each), which corresponds to the infiltration rate of $4.111 \times 10^{-5} \text{ m/sec}$. Gridblocks in rows A through D were assigned an initial pressure equal to the hydrostatic and an initial liquid saturation equal to 1. Gridblocks in rows E through N were assigned an initial pressure equal to atmospheric (101300 Pa) and a saturation calculated from their elevation above the water table and the relationship between the capillary pressure and saturation. This saturation and pressure distribution resulted in an initial state of equilibrium i.e. zero water flux in the vertical direction. A liquid saturation of 0 and an atmospheric pressure was assigned to gridblocks O3 through O12. In describing the handling of the boundary conditions, *Updegraff* [1989] remarked that "...a seepage-face boundary condition should be applied to the right-side grid blocks above the water table, but TOUGH does not have this capability."

Figure 22. The two-dimensional infiltration system in Validation Problem 1 (from Updegraff [1989]).

Figure 23. TOUGH grid used by Updegraff for the simulation of Validation Problem 1 (from Updegraff [1989]).

Of the 28800 sec total desired simulation time, Updegraff [1989] was able to simulate a period of only 6722 sec. TOUGH required only 39 time steps for the first 6300 sec. Thereafter, the size of time steps became very small, requiring 231 time-steps to cover the next 422 sec. Based on this deteriorating performance, he concluded that TOUGH was unlikely to simulate the required period of $t_{max} = 28800 \text{ sec}$ (8 hours) within a reasonable time frame, and terminated the simulation. The limited time range of the simulation enabled him to compare the numerical solutions and the experimental observations of the water content distribution up to a time of 5400 sec (1.5 hr).

The comparison set included three curves at $x = 0.19 \text{ m}$ and $x = 0.49 \text{ m}$ (at 0.5, 1, and 1.5 hrs) and a single curve at $x = 0.79 \text{ m}$ and 1.5 hrs. The agreement between experiment and simulation was quite good at $x = 0.19 \text{ m}$. Updegraff attributed existing discrepancies to heterogeneities, a conclusion further supported by the observation of similar behavior at the $x = 0.49 \text{ m}$ axis. He rated the agreement at $x = 0.49 \text{ m}$ as poor, and attributed it to (a) the coarse grid and (b) errors caused by interpolation near the boundaries of relatively large gridblocks in an area of steep saturation fronts. It is curious that although Updegraff identified these reasons as potential causes of the perceived poor performance of TOUGH, he made no attempt to investigate whether addressing them would alleviate or eliminate the deviations between experiment and simulation. Finally, at $x = 0.79 \text{ m}$ and $t = 1.5 \text{ hr}$ Updegraff reported a good qualitative agreement but a quantitative discrepancy between the observed and the predicted water content distributions. He indicated that in order to determine conclusively the cause of the discrepancy, simulation results at longer times were needed.

Examination of the report and input file revealed a number of problems which either prevented the completion of the simulation runs or affected their quality. More specifically:

- (a) The option MOP(11) = 1 was used in Updegraff's simulation, indicating a midpoint weighting scheme for interface mobilities. As discussed earlier, for problems with smooth saturation distributions and no phase change this is more accurate than upstream weighting, but it may violate the second law of thermodynamics and lead to physically unrealistic answers if improperly applied.

The use of midpoint weighting is inappropriate for this problem because (i) in problems with propagating phase fronts a fully upstream weighting scheme must be used [Aziz and Settari, 1979] and (ii) the conditions of strict monotonicity which must be satisfied for the valid application of this scheme are much harder to establish or verify in two dimensions. Midpoint averaging can produce a large mobility for a phase that is present at a very low saturation, resulting in an unstable situation. We found that use of MOP(11) = 0 (the default option in TOUGH) alleviates the problem.

- (b) The implementation of the permeability vs. saturation relationship of Vauclin *et al.* [1979] in TOUGH was done in a manner that produced a discontinuity of the gas relative permeability at a gas saturation of $S_g = 10^{-4}$. For an S_g approaching 10^{-4} the gas relative permeability tended to 3.65×10^{-4} , but $k_{rg} = 0$ for an $S_g = 10^{-4}$.

This violated the basic requirement of TOUGH that all parameters appearing in the governing equations must be continuous functions of the primary variables, a requirement dictated by the fully implicit formulation in TOUGH and the use of Newton-Raphson iteration for the solution of the resulting strongly non-linear equations. The discontinuity in Updegraff's implementation yielded erroneous saturation derivatives in the Jacobian matrix which prevented the convergence of the solution and led to successive reductions in the size of the timestep. The problem is eliminated by removing the code statement that produces the discontinuity.

These first two problems were the reasons for Updegraff's inability to proceed past the first 6722 *sec* in the simulation. The following two problems affected the quality of the output, but did not obstruct the simulation process.

- (c) An examination of the space discretization revealed that a rather coarse grid was used and that the selection of the gridblock size (uniform in the x -direction, locally uniform in the two sub-regions in the z -direction) reflected ease of input generation rather than an effort to obtain sufficiently detailed information at the prescribed locations.

Consequently, the water content distributions along z at the desired x locations had to be calculated by interpolating between gridblock centers over significant distances. This was a cumbersome procedure which could potentially introduce significant errors in the calculations (especially when interpolating across steep fronts with highly non-linear spatial variation of water content).

- (d) Contrary to Updegraff's statement, TOUGH can easily model seepage faces. For his space discretization in Figure 23, this can be accomplished by (i) specifying the boundary blocks E13 through N13 as single-phase gas in pressure equilibrium with the rest of the system, and (ii) assigning these gridblocks to a domain with zero capillary pressure.

In our attempt to duplicate Updegraff's results we made two basic runs. The first run used the original data input file supplied by S. Webb, and reproduced the results and difficulties observed and reported by Updegraff [1989]. The input file in the second run differed in the value of MOP(11), which was set to the default zero for upstream weighting. We also removed the discontinuity that had been present in the coding of the relative permeability function of Vauclin *et al.* [1979].

The implementation of these two simple changes eliminated the difficulties observed in the first run and produced a very efficient TOUGH run, which covered the desired simulation period of 28,800 *sec* in 64 time steps without any problems related to phase appearance or disappearance. The same run showed that the mass flux through the top boundary (i.e. row O) was practically insignificant, which indicated that row O could be removed from the simulated domain, thus reducing the size of the problem without affecting the quality of the simulation. We did not compare these simulation results to the experimental observations of Vauclin *et al.* [1979] because we deemed the Updegraff space discretization rather coarse for the requirements of the problem.

6.3 Modification of approach and data inputs

For our simulation we created a new data set. The number of gridblocks was increased from 194 (15x13 in x,z) in Updegraff [1989] to 378 (21x18 in x,z). The new discretization appears in Table 2, and does not require interpolation for the determination of the water content distributions at $x = 0.19, 0.79, 1.09, 1.39$, and 1.99 *m* from the line of symmetry, as there are gridblocks centered at these locations. Interpolation is only required at the $x = 0.49$ *m* axis, but the discretization in the vicinity of this location is quite fine. Although it is not necessary, for simplicity we used the MESHMAKER facility of TOUGH2 [Pruess, 1991], to generate the grid. A very large volume (10^{29} *m*³) was assigned to the right-hand boundary gridblocks (column 21), thus ensuring constant boundary pressures, saturations, and temperatures during the duration of the simulation.

TABLE 2. Specifications of the refined 2-D x - z grid in Validation Problem 1.
(left to right, top to bottom)

Δx (m)	0.115	0.15	0.155	0.09	0.08
	0.14	0.15	0.15	0.15	0.15
	0.15	0.15	0.15	0.15	0.15
	0.16	0.18	0.20	0.20	0.20
	1.00E-04				
Δz (m)	0.10	0.10	0.10	0.10	0.10
	0.10	0.10	0.10	0.10	0.10
	0.10	0.10	0.10	0.05	0.05
	0.10	0.20	0.30		

An upstream weighting scheme (i.e. MOP(11) = 0) was used in this simulation. For the reasons discussed in the previous Subsection (6.2), a no-flow top boundary was used and water was injected directly into the four gridblocks A111 through A114 by specifying appropriate sources.

Initial pressures and saturations were hand-calculated and assigned using (i) the hydrostatic pressure distribution below the watertable, and (ii) the capillary pressure vs. water content relationship in *Vauclin et al.* [1979]. Note that the initial equilibrium state could have been also generated with a TOUGH run. A seepage face was assigned to the right-hand boundary gridblocks above the water table by using the procedures described in detail in item (d) in Subsection 6.2. The maximum allowed time step size was $\Delta t = 900 \text{ sec}$ (vs. 1,800 sec used by Updegraff).

6.4 Discussion of the TOUGH output from the modified input files

Our input file produced a very efficient run which did not encounter any of the shortcomings which hampered the *Updegraff* [1989] run. Figures 24(a) through 24(g) show the TOUGH predictions and the experimental observations at the desired locations and times. An examination of the experimental data and simulation results reveals the following:

- (a) There seems to exist considerable heterogeneity in the soil slab. This is evidenced by: (i) the initial water content distributions measured by *Vauclin et al.* [1979] at $x = 0.19, 0.49, 0.79, 1.09, 1.39, 1.69$ and 1.99 m show wide variability; (ii) initial volumetric water contents θ above the water table exceed the reported saturation value $\theta_s = 0.30$ (used in the simulations) at a significant number of locations; (iii) θ 's exceed the maximum value of 0.256 (i.e. $S_l = 0.853$, attainable directly below the infiltration surface) in the $x = 0.49 \text{ m}$ curves; and (iv) the shapes of the θ profiles are quite jagged, as opposed to the smooth curves that would result under homogeneous and isotropic conditions.

In light of our current understanding of the difficulties of packing even the smallest of containers (let alone a $3\text{m} \times 2\text{m}$ sand box) with a uniform distribution of sand, such heterogeneity is entirely expected and must be considered in the evaluation of the performance of the TOUGH model.

- (b) TOUGH is capable of an efficient simulation of the two-dimensional infiltration (two-phase) problem. The simulation reached the desired maximum simulation

Figure 24(a). TOUGH predictions and experimental measurements at $x = 0.19 \text{ m}$ in Validation Problem 1.

Figure 24(b). TOUGH predictions and experimental measurements at $x = 0.49 \text{ m}$ in Validation Problem 1.

Figure 24(c). TOUGH predictions and experimental measurements at $x = 0.79 \text{ m}$ in Validation Problem 1.

Figure 24(d). TOUGH predictions and experimental measurements at $x = 1.09 \text{ m}$ in Validation Problem 1.

Figure 24(e). TOUGH predictions and experimental measurements at $x = 1.39$ m in Validation Problem 1.

Figure 24(f). TOUGH predictions and experimental measurements at $x = 1.69 \text{ m}$ in Validation Problem 1.

Figure 24(g). TOUGH predictions and experimental measurements at $x = 1.99$ m in Validation Problem 1.

times without any oscillations or any adverse reactions related to phase appearance or disappearance. The maximum timestep was not limited by code-imposed internal criteria but by the restriction on the maximum allowable size to 900 sec. The number of time steps to reach the desired simulation time of 28,800 sec was 144.

- (c) TOUGH predictions agree well with the numerical simulation results given by *Vauclin et al.* [1979].
- (d) Comparison of the experimental results and the TOUGH predictions in Figures 24(a) through 24(g) shows a very good overall agreement. The shape and the advance of the numerically predicted wetting fronts at all axes are consistent with expectations, and considering the heterogeneity of the system, they are deemed to accurately reproduce the experimental observations.

Observed discrepancies are attributed to two factors: (a) the heterogeneity in the soil and (b) the assumption of homogeneous and isotropic soil in the numerical simulation. The heterogeneity of the soil was briefly alluded to by *Vauclin et al.* [1979]; its effects are demonstrated by the jagged appearance of the water content profiles, the non-monotonic shape of curves, and the existence of points where the volumetric water contents are significantly larger than $0.3 \text{ m}^3/\text{m}^3$, i.e. the stated porosity of the medium. Since no information is available on the soil heterogeneity, it is unaccounted for in the simulations, in which isotropic and homogeneous conditions are assumed in accordance to the approach of *Vauclin et al.* [1979]. These assumptions produce the smooth numerical profiles in Figures 24(a) through 24(g).

A measure of the degree of heterogeneity is given by the deviation of the theoretically predicted distribution from the experimentally observed moisture profiles at the 7 observation axes. The discrepancies are especially pronounced at the $x = 0.79 \text{ m}$ and $x = 1.09 \text{ m}$ axes.

Another indication of heterogeneity is evident in Figure 24(b), where at $x = 0.49 \text{ m}$ (a) there are points with water contents exceeding those at the infiltration surface, and (b) there is no marked difference from the saturation profile at $x = 0.19 \text{ m}$ (especially at $t = 0.5 \text{ hrs}$) despite the fact that these points lie next to dry soil and are expected to show markedly lower water contents. This shows an inconsistency in behavior which is not observed in the numerical results. There is a very good agreement between prediction and observation at $x = 0.19 \text{ m}$, which would normally lead us to anticipate a similar agreement at $x = 0.49 \text{ m}$. The numerical profile at $x = 0.49 \text{ m}$ conforms with our expectations (i.e. shows a similar pattern but lower saturations at the same times), but differs from the observations which exhibit marginal differences and occasionally higher saturations, which is most likely explained by heterogeneity.

Based on these results, we believe that existing discrepancies between experiment and prediction are due to the media heterogeneities for which no detailed data are available, and do not indicate limitations of TOUGH to address the complexity of the problem.

- (e) Further support for our arguments is provided by Figure 25, which compares the experimental data to the TOUGH predictions of the evolution of water pressure heads at two points (1st point: $x = 0.11 \text{ m}$, $z = 0.11 \text{ m}$, and 2nd point: $x = 1.61 \text{ m}$, $z = 82 \text{ m}$) with time. These experimental data are available in the original paper by *Vauclin et al.* [1979].

At the 1st point (which lies under the infiltration area) and at $t = 0 \text{ hrs}$, a head of -0.9 m was observed, which is significantly different from the expected value of -1.24 m (determined from the geometry of the system and the initial

Figure 25. Comparison of TOUGH predictions and experimental data of water pressure in Validation Problem 1.

position of the water table). After the beginning of infiltration, a steady-state is reached within 1/2 hr with an observed water head of -0.11 m . The predicted water head for the steady-state is -0.21145 m , i.e. almost 100% higher (in an absolute sense). From the water head vs. water content relationship of this particular soil, the volumetric water content which corresponds to the steady-state water head of -0.11 m is $0.292\text{ m}^3/\text{m}^3$ ($S_w = 0.975$). This is significantly larger than any water content measurement under the infiltration surface (the maximum of which was $0.27\text{ m}^3/\text{m}^3$ in Figure 24(b)), and can only be explained by heterogeneity. On the other hand, the volumetric water content corresponding to the numerically obtained head of -0.212 m is 0.256 ($S_w = 0.853$), which is in excellent agreement with the maximum water content of $0.26\text{ m}^3/\text{m}^3$ measured immediately below the infiltration surface (Figures 24(a) and 24(b)).

At the 2nd point (which lies outside the infiltration area), there is an excellent agreement between the initial measured and computed head. Comparison of the evolution of water head over time demonstrates a reasonably good agreement between experiments and predictions. The two curves have the same shapes, exhibit the same behavior, lie very close to each other, and exhibit a small discrepancy. The numerical results over-predict (in an absolute sense) water head, a tendency which is most obvious at steady-state. This discrepancy can be easily caused by a small variation in porosity, as is indicated by the fact that at $x = 1.69\text{ m}$ (quite close to this point) the saturated water content exceeds the value of 0.30 quoted by *Vauclin et al.* [1979]. Such a higher saturated water content (i.e. porosity) could produce a behavior consistent with the observations.

7. CONVECTION CELL EXPERIMENT (VALIDATION PROBLEM 2)

7.1 Description

The second validation problem is a laboratory convection cell experiment described, performed, and modeled by Reda [1984]. Figure 26 shows a schematic of the experiment. A porous medium consisting of glass beads with an average diameter of 0.65 mm fills the annular region between the two vertical concentric cylinders. Application of heat generates a thermal buoyancy force, giving rise to the development of convection cells. Figure 27 provides information on the system geometry, properties, as well as initial and boundary conditions. This problem is used to test the ability of TOUGH to simulate transient two-dimensional simultaneous heat and mass flow.

To evaluate TOUGH, numerical predictions are compared to measurements of the thermal response of the surface of the inner cylinder at the elevations $z = 0.4192, 0.6288, 0.7336, \text{ and } 0.7860\text{ m}$ (i.e. $z/\Delta r = 2, 3, 3.5, \text{ and } 3.75$). These comparisons are made over a period of 10^5 seconds for a power level of 278.3 W/m .

7.2 Updegraff's approach & results

The grid used in the Updegraff [1989] simulation appears in Figure 28. It consisted of 462 gridblocks, and included 62 boundary gridblocks. The heater was represented by gridblocks T0 to EE0, which controlled the heat flux into the system. A very large volume (10^{50} m^3) was assigned to gridblocks OO1 through OO10 (domain "BOUND") to maintain a constant temperature of 21.5°C and a pressure of $200,000\text{ Pa}$. Gridblocks A11 through NN11 were designated as domain "TCOND"; they were assigned a very small volume (10^{-10} m^3) and a very large specific heat ($10^{50}\text{ J/kg-}^\circ\text{C}$) in order to model zero mass flux and constant temperature boundary conditions. Zero mass and heat flux boundaries were assigned along the bottom and the left side of the grid. An initial temperature of 21.5°C and a hydrostatic initial pressure distribution (based on a $200,000\text{ Pa}$ pressure at the NN-OO interface) were assigned to the gridblocks of the system.

Updegraff's attempt to simulate this experiment with TOUGH failed, and he concluded that "... TOUGH could not simulate the convection cell behavior of the experiment". The results of his simulation are compared to the experimental data in Figure 29, and seem to indicate that (a) TOUGH consistently and significantly over-predicts temperatures (by 15 to 30°C), while (b) not exhibiting sufficient temperature differentials between the top and the bottom of the heating elements (less than 10°C , when the observed difference was 30°C).

The reasons for Updegraff's failure to successfully simulate this experiment were traced to inadequate and/or inappropriate data inputs. Examination of the report and the data input file identified the following sources of error:

- (a) The discretization in the radial direction was excessively coarse for the requirements of this problem, and appeared to have been designed for maximum ease of implementation rather than for an accurate description of the temperature profile. Due to essentially cylindrical geometry, large temperature gradients are expected near the heater, and convective effects would be concentrated within a short distance from the heater.

Figure 26. Schematic of the convection cell apparatus (from Reda [1984]).

Figure 27. The convection cell experiment in Validation Problem 2 (from Updegraff [1989]).

Figure 28. The TOUGH grid used by Updegraff in the simulation of Validation Problem 2 (from Updegraff [1989]).

Figure 29. Comparison of Updegraff's TOUGH results with experimental data in Validation Problem 2 (from Updegraff [1989]).

This expectation was confirmed by the data and the analysis presented in the original report on the experiment [Reda, 1984]. Reda's finite element simulation employed a grid which was fine near the heater and grew progressively coarser away from the heater and towards the outer boundary. Moreover, Reda [1984] stated that the packing of the spherical particles (i.e. the glass beads used in his experiment) against the straight surface of the heater led to important flow channeling effects due to porosity and permeability enhancement. Reda modeled such effects by linearly increasing permeability from k_0 to $2k_0$ as the radial distance from the inner boundary decreases from $5d = 3.25 \text{ mm}$ to 0 mm (where k_0 is the unenhanced "background" permeability, $d = 0.65 \text{ mm}$ is the average bead size in the experiment). Thus, this important permeability enhancement is localized in the critical region near the heater, where thermal buoyancy effects are most pronounced.

The entire region with an enhanced permeability is limited to a $\Delta r = 5d = 3.25 \text{ mm}$ beyond the inner radius r_i . Compared to this size, the radial increment Δr used by Updegraff to describe this region (i.e. the first gridblock in r) was 20.96 mm . This was 6.45 times larger than the permeability enhancement zone, completely overwhelming its effects, and introducing very large discretization errors. The coarseness of the grid is the reason for the unacceptably large discrepancies between Updegraff's TOUGH predictions and the experimental data.

- (b) The assignment of small volumes to the outer boundary (column 11) gridblocks in Updegraff's simulations is a rather awkward way to approximate the actual "no-mass-flow" boundary conditions. This approach results in a boundary with permeable connections to the flow domain, which, while small in magnitude, are not negligible and may have a noticeable impact on predicted convection behavior. Assigning a permeability of zero to these boundary gridblocks enforces strict "no-mass-flow" conditions, while being more physically correct and numerically less troublesome (TOUGH2 users are cautioned to be mindful of choices for interface permeability weighting when implementing impermeable boundaries).
- (c) Permeability enhancement in the immediate vicinity of the heater was not accounted for in Updegraff's simulations. As we will later show (Subsection 7.4), the inclusion of permeability enhancement has a marked effect on predictions.
- (d) The heater domain in Updegraff's simulation (column 0) was assigned porous medium properties, with (a) a porosity of 0.34 , (b) zero permeability in the r - and z -directions, (c) zero medium compressibility, and (d) a specific heat equal to that of the porous medium. These assumptions resulted in enormous pressures in the heater gridblocks because, due to zero permeabilities, they had no outlet and no compressibility other than that of water.
- (e) Although a medium density and specific heat of $2,500 \text{ kg/m}^3$ and $740 \text{ J/kg-}^\circ\text{C}$ are quoted in the Updegraff report, there was a discrepancy in the input files provided to us, in which these values were 2200 kg/m^3 and $753 \text{ J/kg-}^\circ\text{C}$ respectively.

In our attempt to duplicate Updegraff's runs, we made a single run in which we used the input data file provided by S. Webb. This simulation was found to reproduce the results reported by Updegraff [1989] within the precision discernible from Figure 29. As compared to the experimental data, this TOUGH simulation predicted much higher temperatures (15 to 30°C higher) and much weaker and delayed convective effects. An additional problem was spotted in the selection of the location of the grid points at which the comparisons were made. Updegraff used information from the heater gridblocks,

which, in light of the treatment described in item (d) and its poor representation of the physics of this domain, makes the validity of these results questionable.

7.3 Modification of approach and data inputs

For our simulation we created two new data sets. The strong variation of temperature in the immediate vicinity of the heater, combined with the need to include permeability-enhancement effects in our simulations, necessitated a new grid with a sufficiently fine discretization in the all-important region near the heater. For simplicity we used the MESHMAKER facility of TOUGH2 [Pruess, 1991] to generate the grid. The grid specifications are given in Table 3.

The first radial grid block extends to 9.5 mm, i.e. the radius of the heater (as well as of the nylon rods placed above and below). The next 5 radial gridblocks have a radial increment $\Delta r = 0.65$ mm each, corresponding to the mean glass bead size. Besides providing the desired fine spatial resolution near the heater, these blocks are also used to represent the enhanced permeability in the 5d zone affected by wall effects. The next 4 gridblocks have progressively large Δr 's and reach $r = 0.05$ m. These are followed by 5 more blocks with logarithmically increasing spacing, and a boundary gridblock with a $\Delta r = 10^{-5}$ m. This discretization results in 16 gridblocks in r (as opposed to 11 in Updegraff). Layer thickness in the region of the heater was chosen as $\Delta z = 0.02096$ m, as in Updegraff's simulation. Above and below the 12 grid layers representing the heater region there are 3 layers with the same $\Delta z = 0.02096$ m, followed by a coarser discretization. The top layer with a $\Delta z = 10^{-5}$ m is used to represent the top boundary conditions.

We use nine different sub-domains of porous media in the simulation. Sub-domain "SOIL1" remains as in Updegraff, and represents the unenhanced "background" permeability of $k_0 = 6.1 \times 10^{-10}$ m². Soil types "SOIL2" through "SOIL6" represent the five sub-domains with channeling-induced enhanced permeability in the vicinity of the heater. Following Reda [1984], permeability in these domains is linearly interpolated between k_0 and $2k_0$ over the $\Delta r = 3.25$ mm region starting at the internal radius $r_i = 9.5$ mm. The soil density and specific heat of the six domains "SOIL1" through "SOIL6" are 2500 kg/m³ and 740 J/kg-°C respectively. These values are taken from Updegraff [1989], and differ from the values we found in the input values (see item (e) in Subsection 7.2). It should be noted that these values appear to be relatively low for the porous medium (i.e. glass beads) used in the experiment. However, we decided to use them since the original paper by Reda [1984] makes no mention of the values of these quantities.

TABLE 3. Specifications of the refined 2-d r - z grid in Validation Problem 2.

Interface radii (m)	0.0000	0.0095	0.0102	0.0108	0.0115
	0.0121	0.0128	0.0150	0.0200	0.0300
	0.0500	0.0736	0.1015	0.1344	0.1732
	0.2191	0.21911			
Layer thickness (m)	0.0734	0.0734	0.0734	0.0734	0.0419
	0.0210	0.0210	0.0210	0.0210	0.0210
	0.0210	0.0210	0.0210	0.0210	0.0210
	0.0210	0.0210	0.0210	0.0210	0.0210
	0.0210	0.0210	0.0210	0.0419	0.0419
	0.0419	0.00001			

Domain "BOUND" is used to represent the top permeable boundary of the model and has the same properties as "SOIL1", with the exception of specific heat which is $10^4 \text{ J/kg-}^\circ\text{C}$ for this domain. This value is chosen to exclude the large volume blocks in domain BOUND from the mass and energy balances.

The gridblocks at the outer radial boundary belong to the domain "TCOND", which has a very low porosity (10^{-5}), zero permeability and a very high specific heat ($10^{54} \text{ J/kg-}^\circ\text{C}$). This forces strict "no mass-flow" boundaries while maintaining a constant temperature. The gridblocks assigned to the heater belong to the domain "HEATR", which is characterized by a very low porosity (10^{-5}), zero permeability to impose a "no-mass-flow" boundary, and the properties of cast iron (as opposed to those of the porous medium used by Updegraff), i.e. a density of 7400 kg/m^3 , a specific heat of $569.4 \text{ J/kg-}^\circ\text{C}$, and a thermal conductivity of $50.2 \text{ W/m-}^\circ\text{C}$ [Carslaw and Jaeger, 1959]. However, the use of cast iron is not expected to have a significant effect on the simulation, and is implemented in the spirit of conceptual consistency. An important aspect is the inclusion of a large compressibility (10^{-5} Pa^{-1}) for the tiny pore space in the "HEATR" domain. This feature prevents the build-up of excessive pore pressures in this domain due to thermal expansion of liquid water. Alternatively, the "HEATR" domain could have been initialized as containing gas, which at ambient temperature has a large compressibility of approximately 10^{-5} Pa^{-1} .

The initial pressure and temperature conditions for the TOUGH run are $2.0 \times 10^5 \text{ Pa}$ and 21.5°C respectively. No separate initial step of gravity equilibration was deemed necessary because it was determined that this process occurs extremely fast. More specifically, the pressure diffusivity $D = k/(c\phi\mu)$ is of order $10^3 \text{ m}^2/\text{sec}$, so that pressure equilibration would require only a fraction of a second.

The first data set accounted for permeability enhancement and had variable permeabilities in the domains "SOIL1" through "SOIL6". The second data set was used to investigate some of the results that appeared in a revised version of Reda's 1984 paper. In the revised paper [Reda, 1986] Reda stated that *"variable-porosity (flow channeling) effects ... adjacent to solid boundaries were found to have a negligible influence on the thermal field adjacent to such boundaries under conditions of Darcy flow..."*. Following up on this, we conducted a separate simulation in which the permeability throughout the glass bead pack (domains "SOIL1" through "SOIL6") was set to the constant value of "background" permeability $k_0 = 6.1 \times 10^{-10} \text{ m}^2$. Everything else in this second data set remained as in the first input data set.

7.4 Discussion of the TOUGH output from the modified input files

We evaluated the performance of TOUGH by comparing the simulation results to the experimental measurements made by Reda [1984] at the locations $r = r_i$ and $z/\Delta r = 2, 3, 3.5$, and 3.75 over time. The point at $z/\Delta r = 2$ marks the bottom of the heater and lies at the interface between layers of equal thickness (layers J and K); similarly, the point at $z/\Delta r = 3$ marks the top of the heater and lies at the interface between layers of equal thickness (layers 9 and A). The points at $z/\Delta r = 3.5$ and $z/\Delta r = 3.75$ lie above the top of the heater. Temperature predictions at these points are obtained by interpolation. The maximum simulation time was $t_{\max} = 10^5 \text{ sec}$. The evolution of temperature over time at the prescribed locations is presented in Figures 30(a) and 30(b). An examination of the simulation results and Figures 30(a) and 30(b) reveals that:

- (a) Both input files produced very efficient runs. The first run (input data set with permeability enhancement) covered the desired simulation period in 40 time steps; the second run (without permeability enhancement) covered t_{max} in 32 time steps.

- (b) Figure 30(a) shows the experimental measurements and the numerical predictions of the temporal variation of temperature at the bottom and the top of the heater. The numerical results with and without permeability enhancement are shown here. A very good agreement between experiment and prediction is observed for the period of transient convection, as well as for the eventual steady-state.

The numerical results in Figure 30(a) are obtained at the center of the second gridblock at $r = 9.825 \text{ mm}$, i.e. 0.325 mm away from the inner radius r_i . Although this seems to practically coincide with the inner radius, our simulation indicates an extreme sensitivity of temperature to the radial distance r in the immediate vicinity of the inner radius. The temperature at r_i is also shown in Figure 30(a) as the upper limit of the range of the temperature at the points in the graphs. It can be seen that within 1 mm the temperature drops by as much as 2°C . The very strong dependence of temperature on the radial distance suggests that the predicted surface temperature lies between the two temperatures at $r_i = 9.5 \text{ mm}$. and $r = 9.825 \text{ mm}$.

- (c) Comparison between predictions and observations and experiments at the points $r = r_i$ and $z/\Delta r = 3.5$, and 3.75 (i.e. above the top of the heater) in Figure 30(b) shows reasonable agreement. A far less dramatic dependence of temperature on radial distance r is expected at these two elevations z because they do not lie immediately next to the heater. A test run over the first 5000 sec using smaller time steps and a finer grid in the z direction gave significantly improved results, but at the expense of larger execution times.

- (d) Contrary to Reda's [1986] assertions, we found a significant difference between the runs with and without permeability enhancement. Temperatures predicted without permeability enhancement are consistently higher both at the bottom and the top of the heater. This temperature differential is small initially, but keeps increasing during the transient period and stabilizes as the steady-state is approached at $3 - 3.1^\circ\text{C}$. The temperature differential appears earlier and is more pronounced at the top of the heater. This indicates that without flow channeling there is a somewhat slower initiation of convection, and a weaker convection process at later times when steady-state is approached.

A closer investigation of Reda's publications on the subject reveals that his simulation results which supposedly do not include permeability enhancement effects [Reda, 1986] seem to be identical to those when permeability enhancement is included [Reda, 1984]. We find this hard to accept because our simulations indicate that permeability enhancement effects are significant, and predict measurable temperature differentials which should have been easily discernible on Reda's figures if they had been accounted for.

At the heater bottom ($z/\Delta r = 2$), the two runs produce practically the same results in the earlier part of the transient period, which agree very well with the laboratory observations; as steady-state is approached the run without permeability enhancement seems to agree better with the experimental data. At the heater top flow channeling produces results which agree better with the experimental data, but a better agreement between the results of the run without permeability enhancement is observed as steady-state is approached.

- (e) However, it must be pointed out that despite its apparent better agreement with measurements (at least near steady-state), it is simply inappropriate to state that

Figure 30(a). Comparison of TOUGH predictions with experimental data at the heater bottom ($z/\Delta r = 2$) and top ($z/\Delta r = 3$). The bars attached to the TOUGH curves indicate the predicted temperature in the first radial element (i.e. on the surface of the heating element).

Figure 30(b). Comparison of TOUGH predictions with experimental data at $z/\Delta r = 3.5$ and $z/\Delta r = 3.75$.

neglecting channeling effects produces more accurate results because of extremely steep temperature gradients in the vicinity of the heater. This hyper-sensitivity has been demonstrated and discussed in item (b) above.

Figure 31 shows the temperature predictions 0.01048 m above and below the bottom ($z/\Delta r = 2$) and the top ($z/\Delta r = 3$) of the heater. While this sensitivity is not as dramatic as the sensitivity to r (where temperature changes by several degrees within fractions of a mm), it is nevertheless important.

As was discussed earlier, the points $z/\Delta r = 2$ and $z/\Delta r = 3$ lie at the interface (and not the centers) of gridblocks (layers) of equal thickness of 0.2096 m . Predictions at these points are obtained by averaging the predictions at the overlaying and underlying gridblocks. The differential in the predictions at the centers of these gridblocks gives the measure of temperature sensitivity to the vertical distance z .

Figure 31 shows the TOUGH results at the centers of the gridblocks immediately above and below the top and the bottom of the heater, as well as the corresponding averaged temperatures at the interfaces (marking the top and the bottom of the heater). All predictions are made at the centers of the second radial gridblocks, i.e. at $r = 9.825\text{ mm}$, as opposed to the first (heater) gridblock, for reasons explained in the preceding item (b). A dramatic dependence of temperature on the vertical distance z is evident at the top of the heater, where a temperature differential of $7.35\text{ }^{\circ}\text{C}$ is evidenced within a vertical distance of 0.02096 m . The temperature variation with z at the bottom of the heater is significant ($2.07\text{ }^{\circ}\text{C}$ within 0.02096 m), but far less dramatic than at the top.

It is obvious that even minute (i.e. sub-millimeter) changes in the position of the measuring device (sampling point) can effect sizable temperature differentials. This observation from our simulations adds further perspective on the comparison between experimental and numerical results.

Figure 31. Temperature sensitivity to z at the heater bottom ($z/\Delta r = 2$) and top ($z/\Delta r = 3$).

8. TWO-PHASE FLOW EXPERIMENT (VALIDATION PROBLEM 3)

8.1 Description

The third validation problem sought to model flashing (vaporizing) flow from a synthetic sandstone core. The experiment was performed and modeled by *Kruger and Ramey* [1974]. *Faust and Mercer* [1979] later independently modeled the experiment. This problem is used to test the ability of TOUGH to simulate simultaneous heat and mass flow, as well as phase change (vaporization of water). Figure 32 shows a schematic of the experiment, as well as pertinent material property, boundary condition, and initial condition information. The saturated core cylinder in Figure 32 is placed in an oven and heated to 198.9°C . While the left boundary is insulated to prevent mass and energy flux, the right end of the core is a "time-variable-pressure" boundary with a pressure decline described by the equation (cited after *Updegraff* [1989])

$$P_r = P_0 + P_1 t + P_2 t^2$$

with $P_0 = 1,840,965.0$, $P_1 = -11,395.51972$, and $P_2 = 21.4064213$. Prior to emplacement in the oven, the saturated core is brought to an initial pressure of $1,840,965$ Pa, and heated in such a way as to effect a linear temperature variation between the left end (where the temperature is $T = 192.0^{\circ}\text{C}$) and the right end (where $T = 184.0^{\circ}\text{C}$).

The relative permeability curves in this experiment were described by Corey's equations [*Kruger and Ramey*, 1974]. To evaluate TOUGH, numerical predictions are compared to the measured temperature distribution along the length of the core cylinder at a time $t = 300$ sec.

8.2 Updegraff's approach & results

The grid used by *Updegraff* [1989] to simulate this experiment appears in Figure 33. It consists of 100 gridblocks labeled A0 through A99, each 5.969 mm wide, as well as a boundary gridblock (labeled YY1) for the right end boundary. The lack of a boundary gridblock on the left end of the core automatically imposes zero mass and energy flux at this end. A very large volume (10^{50} m^3) was assigned to gridblock YY1 on the right-hand boundary to maintain a constant temperature, pressure, and gas saturation boundary conditions. The temperature, pressure and gas saturation assigned to YY1 were a constant 20°C , $101,330$ Pa, and 1 respectively. The initial conditions assigned to the core were a pressure of $1,840,965$ Pa, a liquid saturation of 1, as well as a linear temperature distribution between 192°C at the left end and 184°C at the right end.

The modeled system is significantly different from the experiment described above. The boundary conditions of Updegraff's approach do not even approximate the ones described in the *Kruger and Ramey* [1974] experiment. The results of a simulation using Updegraff's input file (which we reproduced with an input file supplied by S. Webb) showed a similar temperature trend as in the experiment, but they consistently under-predicted temperatures along the length of the core by $4\text{-}15^{\circ}\text{C}$. Such discrepancies were entirely expected in light of the large differences between the experimental and the simulated conditions, and were attributed by Updegraff to three reasons, all related to boundary conditions.

Figure 32. A schematic of the two-phase flow problem (from Updegraff [1989]).

Figure 33. TOUGH grid used by Updegraff for the simulation of Validation Problem 3 (from *Updegraff* [1989]).

The first reason was the failure to include the constant-temperature boundary condition on the periphery of the core imposed by its placement inside the oven. Updegraff stated that *"attempts to include a constant temperature boundary condition at the outside edge of the core failed because extremely small time steps were required and, consequently, the solution progressed very slowly making the computer cost prohibitive."*

The second problem surmised by Updegraff was related to the very large volume at the right-end boundary, which *"...was inconsistent with the zero temperature gradient boundary condition."* Being unable to describe this condition, he arbitrarily set the temperature at this boundary to 20 °C. He further indicated that attempts to force a "zero-heat" flux condition by setting the thermal conductivity of the YY1 boundary to zero failed because this approach required a large number of small time steps.

The third problem according to Updegraff [1989] was that *"...TOUGH cannot directly handle a transient pressure boundary condition."* To deal with this perceived problem, he suggested a series of restarts with an adjusted boundary pressure after each time step, but he correctly indicated that such an approach, although more accurate, would be cumbersome and time consuming.

A close examination of the report and the input data files failed to detect an obvious, "smoking-gun" type of problem that could cause the discrepancies reported by Updegraff. Small inconsistencies were spotted. For example, the initial pressure of the core (as reported by Faust and Mercer [1979]) was 2.17×10^6 Pa, and not 1,840,965 Pa as indicated in the report; however, the original input file supplied by S. Webb had an initial pressure of 2.17×10^6 Pa.

Further investigation into the matter determined the source of the problems in the treatment of the boundary conditions, and more specifically in the unacceptably inaccurate approximations and simplifications which Updegraff introduced in the belief that TOUGH could not address this type of problem. Contrary to his assertions, TOUGH can very easily handle all the boundary conditions present in the experiment, including the transient pressure boundaries. A detailed explanation of our approach to successfully simulate the experiment is presented in the following Sub-section 8.3.

8.3 Modification of approach and data inputs

We created two new data sets for our simulation, in which we maintained the space discretization of Updegraff's, as well as the right-hand side boundary gridblock. In the first data set the properties of the core domain remain as in Updegraff. The boundary gridblock YY1 had the same density and permeability as the core, a porosity of 0.1, a zero thermal conductivity to enforce a "no-heat-flux" condition, and a very large specific heat (10^{30} J/kg-°C). As in Updegraff, a Corey-type curve described the relative permeabilities in the core, while a zero capillary pressure was assigned to both the core and YY1. A very large volume (10^{51} m³) was assigned to YY1, as well as liquid and gas relative permeabilities of 1.

To simulate the "constant-temperature" boundary imposed by the insertion of the core into the oven, we added a second set of gridblocks (B0 through B99), which formed a ring surrounding the cylindrical core (gridblocks A0 through A99) and had the same space discretization. This new domain had the same density, porosity, and thermal conductivity as the core (allowing the flow of heat from the oven into the core), zero permeability (thus preventing any mass flow), and a large specific heat (10^6 J/kg-°C). To maintain a constant

temperature, a very large volume (10^{30} m^3) was assigned to each of the gridblocks of this domain. The addition of this new domain was not unimportant because conduction into the core was calculated to be significant. More specifically, the thermal diffusivity for heat conduction (neglecting fluid contributions) is obtained as

$$D_H = K_H / [(1-\phi)\rho C] = 2.1 / [(1-0.36) \times 2650 \times 1010] = 1.226 \times 10^{-6} \text{ m}^2/\text{s},$$

from which for $t = 100 \text{ sec}$ we calculate a thermal penetration of

$$x(t=100) = (D_H t)^{0.5} = 1.11 \times 10^{-2} \text{ m}.$$

This is a significant quantity when compared to the core radius of $2.54 \times 10^{-2} \text{ m}$.

The addition of the "ring" boundary created in essence a two-dimensional problem. The center of the gridblocks (A and B) in the x -direction (along the length of the core) was located in the geometric center of the gridblocks. In the radial direction the centers of the B gridblocks were placed at a distance of $5 \times 10^{-3} \text{ m}$ from the interface with the A gridblocks; the A gridblock centers were placed at a distance of $r(1-1/\sqrt{2}) = 7.44 \text{ mm}$ from the interface, i.e. at a radius which divided the cylinder volume in half. The initial conditions in the core and the YY1 boundary remain as in Updegraff, while an initial temperature of 198.9°C (i.e. the oven temperature) is assigned to the ring.

The introduction of transient-pressure boundary conditions was accomplished by exploiting the simplicity of the pressure-density relationship of ideal gases. The air component in TOUGH is treated as an ideal gas. By introducing a large boundary block in air-only, single-phase gas conditions, and subjecting it to suitable time-dependent rates of air injection or withdrawal, very general time-dependent pressure conditions can be realized. The ideal gas law written for a mass m of air is

$$m = M V (R T)^{-1} P = F P, \text{ where } F = M V (R T)^{-1},$$

$M = 28.96 \text{ kg/kmole}$ is the molecular weight of air, V is its volume, $R = 8314.56 \text{ J/kmole}^\circ\text{C}$ is the universal gas constant, T is the temperature, and P is the gas pressure. The evolution of pressure at the right hand boundary is described by a quadratic equation (see Sub-section 8.1), which combined with the equation of air mass yields:

$$m = F(P_0 + P_1 t + P_2 t^2) = m_0 + m_1 t + m_2 t^2,$$

where P_0, P_1, P_2 are the polynomial coefficients in the boundary pressure equation. A time-dependent change in mass m corresponds to an injection or production rate Q , and is given by

$$Q = dm/dt = F dP/dt = m_1 + 2 m_2 t.$$

Thus, a time-dependent pressure condition can be translated into a time-dependent rate condition by simple differentiation. This way, the TOUGH facility to specify time-dependent generation can be utilized to achieve any desired time-dependent pressure conditions. Applying these equations to the boundary gridblock YY1 where $V = 10^{50} \text{ m}^3$, $T = 20^\circ \text{C} = 293.17^\circ \text{K}$, yields

$$m_1 = -1.35395 \times 10^{49} \text{ kg/sec and } m_2 = 2.54339 \times 10^{46} \text{ kg/sec}^2$$

This indicates that the transient-pressure boundary condition is easily transformed into a simple case of combined injection/production, in which gas is (a) removed from the gridblock YY1 at a constant rate of -1.35395×10^{49} kg/sec, and (b) is injected into YY1 at a linearly increasing rate which starts at 0 kg/sec at $t = 0$ and increases to $2 \text{ m}_2 t = 1.526036 \times 10^{49}$ kg/sec at $t = 300 \text{ sec}$.

The second data set was identical to the first, but did not include the steady-temperature "ring" boundary. The purpose of this run was to determine the effect of heat conduction from the oven into the core.

8.4 Discussion of the TOUGH output from the modified input files

We made two TOUGH runs using the new data files. With the treatment of the boundaries described in the previous Sub-section (8.3), we eliminated all of the problems encountered by Updegraff. We evaluated the TOUGH simulations by comparison with the laboratory measurements of *Kruger and Ramey* [1974]. Figure 34 shows the numerical and experimental results. Based on the simulation performance, the following conclusions are reached:

- (a) TOUGH was able to simulate this problem of coupled mass and heat transport with multi-phase flow and phase change. Using the approach described in Sub-section 8.3, the problems encountered by Updegraff were avoided.
- (b) The TOUGH simulation was very efficient, and required only 152 and 159 time steps (in the first and second run respectively) to reach the desired maximum simulation time of 300 sec. This number of time steps is deemed very reasonable considering the complexity of the processes involved in this simulation (i.e. phase appearance and disappearance).
- (c) As is shown in Figure 34, the effect of heat conduction from the oven into the core is not insignificant. When the boundary "ring" is not included, TOUGH underpredicts temperatures (especially near the left boundary). The experimental data lie in the narrow band between the two TOUGH curves. Note that inclusion of a ring of elements will give a somewhat crude approximation of axial heat transfer. A more accurate model would use a fully two-dimensional r - x grid, but this was not considered necessary in the present problem.
- (d) Figure 34 reveals a satisfactory agreement between the experimental data and the TOUGH numerical predictions. The observed discrepancies are not considered significant; they may reflect that experimentally achieved boundary conditions at the core outlet may be more complex than presumed in the somewhat idealized one-dimensional model.

Figure 34. Comparison of TOUGH predictions and experimental data in Validation Problem 3.

9. FURTHER CODE VERIFICATIONS AND VALIDATIONS

9.1 The MULKOM/TOUGH family of codes

In the present context it is of interest to briefly summarize other verification and validation problems that have been run with the MULKOM/TOUGH family of multiphase flow codes. Before doing so a few remarks about the interrelationships between these codes are in order.

The "ancestor" to TOUGH is a code known as MULKOM which first became operational in the early 80's [Pruess, 1983]. MULKOM was built on the recognition that the governing equations for non-isothermal, multi-phase, multi-component flow are the same, regardless of the nature and number of fluid components present. Accordingly, MULKOM featured a modular architecture, in which a central module for flow and transport could be interfaced with several different fluid property modules to model systems with different fluid mixtures. The development of MULKOM was driven by research applications primarily in geothermal reservoir engineering, and later also in nuclear waste-related studies. The coding of MULKOM was never finalized; rather, it consisted of a continually evolving collection of program modules for specialized applications, with only sketchy documentation. The needs of nuclear-waste oriented applications then prompted an effort to finalize and document a specialized version of MULKOM for nonisothermal two-phase flows of water and air, which in 1987 was released under the name TOUGH (for Transport Of Unsaturated Ground-water and Heat; [Pruess, 1987]). A number of enhanced versions of TOUGH have subsequently been developed at the Lawrence Berkeley Laboratory, as well as in other places [Pruess, 1990]. The methodological choices made in the development of MULKOM and their relationship to an earlier code SHAFT79 [Pruess and Schroeder, 1980] have been discussed in a laboratory report [Pruess, 1988].

With its "hardwiring" of the two fluid components water and air, TOUGH traded-in some of MULKOM's flexibility against greater robustness and ease of use. The recently released TOUGH2 code [Pruess, 1991; ESTSC, 1992] is an upwardly-compatible successor to TOUGH. It is actually subroutine-for-subroutine very similar to TOUGH, but offers added new features (internal mesh generation, embedded fractured-media capability with the "MINC" method of "*Multiple Interacting Continua*", version control), and it provides the full multi-component, multi-phase flexibility previously only available in the undocumented MULKOM collection of research modules. The name "MULKOM" is now used to refer to the particular modular architecture of these codes, while actual coding implementations are referred to as TOUGH and TOUGH2.

Throughout the development of the MULKOM/TOUGH codes an effort was made to maintain continuity in numerical performance, i.e., different code variations were always exercised on several earlier benchmark problems to guard against occurrence of coding errors. Therefore, verification or validation exercises performed with any one member of the MULKOM/TOUGH family are significant in establishing credibility for all the other members as well. Accordingly, our summary of verification and validation work will cover all of the MULKOM/TOUGH variations developed at LBL.

9.2 Summary of verifications and validations

An early comparative evaluation of geothermal reservoir simulation codes under the auspices of DOE established important benchmarks for subsequent code developments [Stanford, 1980]. MULKOM was extensively cross-checked against the SHAFT79 solutions developed for the DOE code comparison study. An analytical solution obtained by Lauwerier

[1955] for non-isothermal flow in a homogeneous reservoir with conductive heat exchange to caprock and baserock was closely matched by a MULKOM simulation [Pruess and Bodvarsson, 1984].

Using the method of "multiple interacting continua" (MINC), Pruess and Narasimhan [1985] demonstrated excellent agreement between MULKOM simulations and the Warren and Root [1963] double-porosity solution for isothermal single-phase flow in a naturally fractured reservoir. Pruess *et al.* [1987] developed an analytical solution for the propagation of a boiling front during water injection into a depleted vapor zone in one-dimensional radial flow geometry. Numerical simulations with MULKOM closely matched the analytically predicted vaporization fraction, pressures and temperatures at the boiling front, and the time-dependent front location. Verma *et al.* [1985] numerically simulated a laboratory two-phase flow experiment for measuring steam-water relative permeability, obtaining good agreement with experimental data. Lam *et al.* [1988] successfully used MULKOM and the MINC method to model laboratory heat sweep experiments in a pressure vessel containing a configuration of regularly-shaped granite blocks.

McKibbin and Pruess [1989] presented analytical solutions for steady-state geothermal heat pipes with CO₂, which closely agreed with results of MULKOM simulations. Wu *et al.* [1990] developed a Buckley-Leverett type solution for immiscible displacement in composite porous media. Satisfactory agreement was obtained with numerical simulations using MULKOM-GWF, a specialized version of MULKOM for three-phase flow of gas, water, and foam [Pruess and Wu, 1988]. Doughty and Pruess [1990] investigated thermohydrologic conditions near heat-generating high-level nuclear waste packages. For the idealized problem of an infinite linear string of waste packages in a homogeneous porous medium with single-component water they obtained a semi-analytical similarity solution which was closely matched by numerical simulations with TOUGH.

Bodvarsson *et al.* [1990] reported three-dimensional well-by-well numerical simulations with MULKOM of the Olkaria, Kenya, geothermal reservoir. Using actual well performance data (flow rates and enthalpies) for the period from 1977 to 1983 to calibrate the reservoir model, performance predictions were developed that matched observed behavior of most wells from 1984 to 1987. A number of successful simulations of field observations and laboratory experiments, as well as code verifications, were presented at the TOUGH workshop [Pruess, 1990]. Wu *et al.* [1991] developed an analytical solution for immiscible displacement of non-Newtonian fluids, which was closely matched by numerical simulations with MULKOM-GWF.

Falta *et al.* [1991; 1992a; b] developed an enhanced version of TOUGH for three-phase three-component flow of water, air, and volatile organic compounds, known as "STMVOC". They modeled steam injection experiments in one-dimensional laboratory cores performed by Hunt *et al.* [1988], and successfully predicted the migration of the steam condensation front, as well as profiles of temperature and pressure, and the removal of trichloroethylene from the column over time. Doughty and Pruess [1992] extended their earlier work on a similarity solution for fluid and heat flow near a linear heat source to a pore fluid consisting of water and air. The only simplifications made in their treatment involved flow geometry. The process complexities of highly non-linear fully transient two-phase two-component fluid and heat flow with phase change were rigorously accounted for, making this the most difficult solvable two-phase fluid and heat flow problem presently available. Numerical simulations with TOUGH2 showed excellent agreement with the semi-analytical similarity solution.

10. CONCLUSIONS AND DISCUSSION

TOUGH has performed well on a series of fluid and heat flow problems that involved one- and two-dimensional flows, with varying degrees of non-linearity, coupling between fluid and heat flows, and complexity of boundary conditions. These results, as well as additional verification and validation problems for the MULKOM/TOUGH codes reported elsewhere (see Section 9), substantiate the accuracy of the physics model employed in the code, and the mathematical and numerical approaches used. As the number of successfully executed verification and validation problems increases, the likelihood that significant coding errors may still be present is diminished. However, we wish to emphasize that we know of no test or procedure that will establish absence of coding errors with certainty.

The two-phase two-component fluid and heat flow capability offered by TOUGH, and the flexibility of the space discretization by means of integral finite differences, make possible applications to a great diversity of flow problems on different space and time scales [Pruess, 1990]. Key to successful application of TOUGH is a careful consideration of the physical processes that are involved in a given flow problem. In particular, space discretization, time stepping, and interface weighting procedures need to be carefully selected so that accurate results may be obtained. Application of TOUGH (or, for that matter, of any other two-phase fluid and heat flow code) without due attention to these issues may result in poor (inefficient) performance, inaccurate results, or both.

In the appendix we show that, for regular grid systems referred to global coordinates, the integral finite difference method used in TOUGH is mathematically equivalent to conventional (Taylor-series based) finite difference formulations, in which derivatives in the governing partial differential equations are approximated as finite differences. This mathematical equivalence makes established techniques for estimating space and time discretization errors applicable to integral finite difference simulations [Peaceman, 1977]. Theoretical estimates of these errors may not always be easy to make. However, discretization errors in practical applications can always be checked by re-running a simulation with finer space and time discretizations.

An important aspect of discretization is the interface and time weighting procedure. TOUGH was designed for robustness and stability in difficult non-linear problems with phase change and propagating phase fronts. The appropriate weighting procedures for such problems are fully upstream weighting in space, and "fully implicit" first-order backward finite differences in time. Users should be cautioned that for simpler sub-classes of problems - such as non-isothermal single phase flows - these default choices are not necessarily optimal in terms of accuracy and efficiency.

Some of the problems and limitations in TOUGH with regard to ease of use and description of physical processes that were noted by Updegraff [1989] were overcome with the recently released successor code, TOUGH2 [Pruess, 1991; ESTSC, 1992]. TOUGH2 is upward compatible with TOUGH, with additional capabilities and user-friendly features; these include an internal version control system, more convenient facilities for specifying boundary conditions, and internal mesh processing and generating capabilities (used for mesh generation in Verification Problem 3 and Validation Problems 1 and 2). TOUGH2 offers a multiple interacting continua capability (MINC) for fractured media simulations, a simplified description of Knudsen diffusion by means of a Klinkenberg factor for permeability, and an ability to handle different fluid mixtures.

Further enhancements of process description, such as a capability for multi-component dispersion and diffusion in multi-phase flow, will be included in future releases

of TOUGH2. We also expect to release a set of efficient conjugate gradient solvers for use with TOUGH2 which, compared with the presently employed direct solution technique, will drastically shorten execution times for large 3-D problems.

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APPENDIX: Local Truncation Error in the Integral Finite Difference Method

Consider heat conduction in a homogeneous isotropic solid. The heat content (internal energy) per unit volume is

$$M = \rho c T \dots\dots\dots (A.1)$$

where ρ and c are, respectively, the density and the specific heat of the medium, and T is the temperature. Heat flux is given by

$$\bar{F} = -K \nabla T \dots\dots\dots (A.1)$$

where K is the thermal conductivity. The rate at which the heat content of a sub-domain with volume V_n changes is given by the total rate of heat flow across the closed surface Γ_n around V_n (see Figure 35)

$$\frac{d}{dt} \int_{V_n} M dV = \int_{\Gamma_n} \bar{F} \cdot \bar{n} d\Gamma \dots\dots\dots (A.3)$$

Here $\bar{n}$ denotes the inward unit normal vector, and for simplicity we have neglected sinks and sources in V_n . Applying Gauss' divergence theorem to the right hand side and placing the time derivative on the left hand side inside the integral, we obtain the partial differential equation for heat conduction [Carslaw and Jaeger, 1959] as

$$\frac{\partial T}{\partial t} = D \Delta T \dots\dots\dots (A.4)$$

where $D = K/\rho c$ is the thermal diffusivity, assumed here for simplicity to be constant, independent of temperature. The integral finite difference approximation to Eq. (A.3) is written

$$V_n \frac{dM_n}{dt} = \sum_m A_{nm} F_{nm} \dots\dots\dots (A.5)$$

where A_{nm} denotes surface segments between V_n and neighboring subdomains V_m . For a one-dimensional domain V partitioned into rectangular gridblocks V_n (see Figure 36), the first-order finite difference approximation to the flux term in Eq. (A.5) becomes

$$F_{nm} = K \frac{T_m - T_n}{\Delta x} \dots\dots\dots (A.6)$$

Introducing also a first-order finite approximation of the time derivative,

$$\frac{dM_n}{dt} \approx \rho c \frac{T_n^{k+1} - T_n^k}{\Delta t} \dots\dots\dots (A.7)$$

Eq. (A.5) becomes

$$T_n^{k+1} - T_n^k = D \frac{\Delta t}{\Delta x} \left(\frac{T_{n+1}^{k+1} - T_n^{k+1}}{\Delta x} + \frac{T_{n-1}^{k+1} - T_n^{k+1}}{\Delta x} \right) = D \frac{\Delta t}{\Delta x^2} (T_{n+1}^{k+1} - 2T_n^{k+1} + T_{n-1}^{k+1}) \dots\dots(A.8)$$

Here we have indicated "fully implicit" time differencing by evaluating temperatures in the flux terms at the new time level $k+1$. Eq. (A.8) is identical to the "conventional" finite difference approximation of Eq. (A.4) [Peaceman, 1977]. Completely analogous but notationally more complicated derivations can be made when Eq. (A.3) is interpreted as general balance equations for multi-phase fluid and heat flows of multi-component mixtures. The mathematical identity between integral and conventional finite difference formulations holds not only for one-dimensional grid systems, but also for two- and three-dimensional regular grids referred to a global coordinate system.

For the one-dimensional heat conduction equation, the discretization error from replacing time and space derivatives by the finite difference equations (A.7) and (A.8) can be identified as [Peaceman, 1977]

$$\varepsilon = \frac{\Delta x^2}{12} \frac{\partial^4 T}{\partial x^4} - \frac{\Delta t}{2D} \frac{\partial^2 T}{\partial t^2} \dots\dots\dots(A.9)$$

where the derivatives are taken at an interior point of the discretization interval ($t^k, t^{k+1} = t^k + Dt$), ($x_n - Dx, x_n + Dx$).

Figure 35. A flow domain V with sub-domain V_n .

Figure 36. One-dimensional block-centered grid.

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This diskette contains the files used for the simulation of Updegraff's problems. A list of the names of the data input files and a brief explanation follow:

- (1) File "ver1a": Verification Problem #1
1-d infiltration (Philip, 1955)
Data file as in TOUGH's User Guide (Pruess, 1987)
Upstream weighting and a second row of cells
- (2) File "ver1b": Verification Problem #1
Modified
Upstream weighting and removal of second row of cells
- (3) File "ver1c": Verification Problem #1
Modified
Midpoint weighting and removal of second row of cells
- (4) File "ver2a": Verification Problem #2
1-d heat transport (Avdonin, 1964)
Upstream weighting and fluid injection
- (5) File "ver2b": Verification Problem #2
1-d heat transport (Avdonin, 1964)
Midpoint weighting and fluid injection
- (6) File "ver3a": Verification Problem #3
1-d radial heat transport (Avdonin, 1964)
Upstream weighting and fluid injection
Includes the MESHMAKER data input file (appended at the end of the regular data file) for grid generation using the MESHMAKER facility of TOUGH2.
- (7) File "ver3b": Verification Problem #3
1-d radial heat transport (Avdonin, 1964)
Midpoint weighting and fluid injection
Includes the MESHMAKER data input file (appended at the end of the regular data file) for grid generation using the MESHMAKER facility of TOUGH2.
- (8) File "ver4": Verification Problem #4
Flow to a geothermal well (Garg, 1980)
Data file as in TOUGH's User Guide (Pruess, 1987)
- (9) File "ver5": Verification Problem #5
Heat pipe problem (Udell and Fitch, 1985)
Data file as in TOUGH's User Guide (Pruess, 1987)
- (10) File "val1": Validation Problem #1
2-d infiltration (Vauclin et al., 1979)
Includes the MESHMAKER data input file (appended at the end of the regular data file) for grid generation using the MESHMAKER facility of TOUGH2.
- (11) File "val2a": Validation Problem #2
2-d convection cell in r-z (Reda, 1984)
Flow channeling effects included
Includes the MESHMAKER data input file (appended at the end of the regular data file) for grid generation using the MESHMAKER facility of TOUGH2.
- (12) File "val2b": Validation Problem #2
2-d convection cell in r-z (Reda, 1984)
Flow channeling effects neglected
Includes the MESHMAKER data input file (appended at the end of the regular data file) for grid generation using the MESHMAKER facility of TOUGH2.
- (13) File "val3a": Validation Problem #3
Heat and mass flow with phase change (Kruger and Ramey, 1974)

Boundary ring included
(14) File "val3b": Validation Problem #2
Heat and mass flow with phase change (Kruger and Ramey, 1974)
Boundary ring omitted

Moreover, this diskette includes the file RELP, which is the relative permeability subroutine. The addition of Vauclin's equation for Validation Problem 1 is clearly marked.

```

C*****
C-----THIS ROUTINE COMPUTES RELATIVE PERMEABILITIES FOR LIQUID
C      AND GASEOUS PHASES.
C
C      COMMON/P3/DELX(1)
C      COMMON/RPCAP/IRP(27),RP(7,27),ICP(27),CP(7,27),IRPD,RPD(7),
1     ICPD,CPD(7)
C
C      SL=1.-SG
C      GO TO (10,11,12,12,13,14,15,16,17),IRP(NMAT)
10  CONTINUE
C-----LINEAR FUNCTIONS.
C
C      CHECK IF INCREMENT NEEDS TO BE ADJUSTED AT LOWER LIQUID CUTOFF.
C      IF (K.NE.3) GO TO 20
C      IF ((SL-RP(1,NMAT))*(1.-SG0-RP(1,NMAT)).GE.0.) GO TO 20
C      ADJUST INCREMENT.
C      DELX(NLOC+2)=-DELX(NLOC+2)
C      SG=SG0+DELX(NLOC+2)
C      SL=1.-SG
20  CONTINUE
C      REPL=(SL-RP(1,NMAT))/(RP(3,NMAT)-RP(1,NMAT))
C      IF (SL.GE.RP(3,NMAT)) REPL=1.
C      IF (SL.LE.RP(1,NMAT)) REPL=0.
C      REPG=(SG-RP(2,NMAT))/(RP(4,NMAT)-RP(2,NMAT))
C      IF (SG.GE.RP(4,NMAT)) REPG=1.
C      IF (SG.LE.RP(2,NMAT)) REPG=0.
C      RETURN
C
11  CONTINUE
C-----RELATIVE PERMEABILITY OF PICKENS ET AL.
C
C      REPG=1.
C      REPL=(1.-SG)**RP(1,NMAT)
C
C      RETURN
C
12  CONTINUE
C-----COREY'S OR GRANT'S CURVES.
C
C      SSTAR=(SL-RP(1,NMAT))/(1.-RP(1,NMAT)-RP(2,NMAT))
C      REPL=SSTAR**4
C      REPG=(1.-SSTAR**2)*(1.-SSTAR)**2
C      IF (SG.GE.RP(2,NMAT)) GO TO 50
C      REPG=0.
C      REPL=1.
C      GO TO 102
50  IF (SG.LT.(1.-RP(1,NMAT))) GO TO 102
C      REPL=0.
C      REPG=1.

```

```

102 CONTINUE
    IF (IRP(NMAT).EQ.4) REPG=1.-REPL
    RETURN
C
    13 CONTINUE
C-----BOTH PHASES ARE PERFECTLY MOBILE.
C
    REPL=1.
    REPG=1.
C
    RETURN
    14 CONTINUE
C-----RELATIVE PERMEABILITIES OF FATT AND KLIKOFF (1959), AS REPORTED
C    BY K. UDELL (BERKELEY, 1982).
C
    SS=0.
    IF (SL.GT.RP(1,NMAT)) SS=(SL-RP(1,NMAT))/(1.-RP(1,NMAT))
    REPL=SS**3
    REPG=(1.-SS)**3
    RETURN
C
C
    15 CONTINUE
C-----RELATIVE PERMEABILITY OF VAN GENUCHTEN, SOIL SCI. SOC. AM. J. 44,
C    PP. 892-898, 1980.
C
    IF (SL.GE.RP(3,NMAT)) GO TO 150
    SS=(SL-RP(2,NMAT))/(RP(3,NMAT)-RP(2,NMAT))
    REPL=0.
    IF (SS.GT.0.)
    1    REPL=SQRT(SS)*(1.-(1.-SS**(1./RP(1,NMAT)))*RP(1,NMAT))**2
    REPG=1.-REPL
    RETURN
C
    150 REPL=1.
    REPG=0.
    RETURN
C
    16 CONTINUE
C    RELATIVE PERMEABILITIES AS MEASURED BY VERMA ET AL. IN
C    LABORATORY FLOW EXPERIMENTS FOR STEAM-WATER MIXTURES
C
    SS=(SL-RP(1,NMAT))/(RP(2,NMAT)-RP(1,NMAT))
    IF(SS.GT.1.) SS=1.
    IF(SS.LT.0.) SS=0.
    REPL=SS**3
    REPG=RP(3,NMAT)+RP(4,NMAT)*SS+RP(5,NMAT)*SS*SS
    IF(REPG.GT.1.) REPG=1.
    IF(REPG.LT.0.) REPG=0.
    RETURN
C
C*****
C    ADDITION OF VAUCLIN'S FUNCTION
C*****
C
    17 CONTINUE

```


val1 ... Validation Problem No.1.

START 2-d infiltration - Vauclin et al. (1979)

START 2nd modification; upstream weighting + injection

START 7-10-92: George's latest data file

START grid generation using MESHMAKER from TOUGH2

ROCKS-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

SOIL 2 2242.857 0.3 9.95E-12 9.95E-12 9.95E-12 1.0 700.0

0.0 0.0 1.0 1.0

9 28.768353 0.0 1.7241379 0.0

3 3783.0145 0.0 2.9

BOUN 2 2242.857 0.3 9.95E-12 9.95E-12 9.95E-12 1.0 700.0

0.0 0.0 1.0 1.0

1 1.0 -0.1 1.1 0.0

1 0.0 0.0 1.0

SAT 2 2242.857 0.3 9.95E-12 9.95E-12 9.95E-12 1.0 700.0

0.0 0.0 1.0 1.0

9 28.768353 0.0 1.7241379 0.0

3 3783.0145 0.0 2.9

START-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

PARAM-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

8 19999360050001000001 0001 0 40 2.13E-5 1.8

0. 28800. .1 900.A11 1 9.807 2. 1.

5.E-7 1. 0.1 1. 1. 1.E-8

101330. 1. 20.

TIMES-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

1 16 1800. 1800.

1800.

ELEME-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

A11 1 SOIL .1150E-01 .1150E+00 .5750E-01 .5000E+00-.5000E-01

A21 1 SOIL .1150E-01 .0000E+00 .5750E-01 .5000E+00-.1500E+00

A31 1 SOIL .1150E-01 .0000E+00 .5750E-01 .5000E+00-.2500E+00

A41 1 SOIL .1150E-01 .0000E+00 .5750E-01 .5000E+00-.3500E+00

A51 1 SOIL .1150E-01 .0000E+00 .5750E-01 .5000E+00-.4500E+00

A61 1 SOIL .1150E-01 .0000E+00 .5750E-01 .5000E+00-.5500E+00

A71 1 SOIL .1150E-01 .0000E+00 .5750E-01 .5000E+00-.6500E+00

A81 1 SOIL .1150E-01 .0000E+00 .5750E-01 .5000E+00-.7500E+00

A91 1 SOIL .1150E-01 .0000E+00 .5750E-01 .5000E+00-.8500E+00

AA1 1 SOIL .1150E-01 .0000E+00 .5750E-01 .5000E+00-.9500E+00

AB1 1 SOIL .1150E-01 .0000E+00 .5750E-01 .5000E+00-.1050E+01

AC1 1 SOIL .1150E-01 .0000E+00 .5750E-01 .5000E+00-.1150E+01

AD1 1 SOIL .1150E-01 .0000E+00 .5750E-01 .5000E+00-.1250E+01

AE1 1 SOIL .5750E-02 .0000E+00 .5750E-01 .5000E+00-.1325E+01

AF1 1 SOIL .5750E-02 .0000E+00 .5750E-01 .5000E+00-.1375E+01

AG1 1 SOIL .1150E-01 .0000E+00 .5750E-01 .5000E+00-.1450E+01

AH1 1 SOIL .2300E-01 .0000E+00 .5750E-01 .5000E+00-.1600E+01

AI1 1 SOIL .3450E-01 .1150E+00 .5750E-01 .5000E+00-.1850E+01

A11 2 SOIL .1500E-01 .1500E+00 .1900E+00 .5000E+00-.5000E-01

A21 2 SOIL .1500E-01 .0000E+00 .1900E+00 .5000E+00-.1500E+00

A31 2 SOIL .1500E-01 .0000E+00 .1900E+00 .5000E+00-.2500E+00

A41 2 SOIL .1500E-01 .0000E+00 .1900E+00 .5000E+00-.3500E+00

A51 2 SOIL .1500E-01 .0000E+00 .1900E+00 .5000E+00-.4500E+00

A61 2 SOIL .1500E-01 .0000E+00 .1900E+00 .5000E+00-.5500E+00

A71 2 SOIL .1500E-01 .0000E+00 .1900E+00 .5000E+00-.6500E+00

A81 2 SOIL .1500E-01 .0000E+00 .1900E+00 .5000E+00-.7500E+00

A91 2 SOIL .1500E-01 .0000E+00 .1900E+00 .5000E+00-.8500E+00

AA1 2 SOIL .1500E-01 .0000E+00 .1900E+00 .5000E+00-.9500E+00

AB1	2	SOIL	.1500E-01	.0000E+00	.1900E+00	.5000E+00-.1050E+01
AC1	2	SOIL	.1500E-01	.0000E+00	.1900E+00	.5000E+00-.1150E+01
AD1	2	SOIL	.1500E-01	.0000E+00	.1900E+00	.5000E+00-.1250E+01
AE1	2	SOIL	.7500E-02	.0000E+00	.1900E+00	.5000E+00-.1325E+01
AF1	2	SOIL	.7500E-02	.0000E+00	.1900E+00	.5000E+00-.1375E+01
AG1	2	SOIL	.1500E-01	.0000E+00	.1900E+00	.5000E+00-.1450E+01
AH1	2	SOIL	.3000E-01	.0000E+00	.1900E+00	.5000E+00-.1600E+01
AI1	2	SOIL	.4500E-01	.1500E+00	.1900E+00	.5000E+00-.1850E+01
A11	3	SOIL	.1500E-01	.1500E+00	.3400E+00	.5000E+00-.5000E-01
A21	3	SOIL	.1500E-01	.0000E+00	.3400E+00	.5000E+00-.1500E+00
A31	3	SOIL	.1500E-01	.0000E+00	.3400E+00	.5000E+00-.2500E+00
A41	3	SOIL	.1500E-01	.0000E+00	.3400E+00	.5000E+00-.3500E+00
A51	3	SOIL	.1500E-01	.0000E+00	.3400E+00	.5000E+00-.4500E+00
A61	3	SOIL	.1500E-01	.0000E+00	.3400E+00	.5000E+00-.5500E+00
A71	3	SOIL	.1500E-01	.0000E+00	.3400E+00	.5000E+00-.6500E+00
A81	3	SOIL	.1500E-01	.0000E+00	.3400E+00	.5000E+00-.7500E+00
A91	3	SOIL	.1500E-01	.0000E+00	.3400E+00	.5000E+00-.8500E+00
AA1	3	SOIL	.1500E-01	.0000E+00	.3400E+00	.5000E+00-.9500E+00
AB1	3	SOIL	.1500E-01	.0000E+00	.3400E+00	.5000E+00-.1050E+01
AC1	3	SOIL	.1500E-01	.0000E+00	.3400E+00	.5000E+00-.1150E+01
AD1	3	SOIL	.1500E-01	.0000E+00	.3400E+00	.5000E+00-.1250E+01
AE1	3	SOIL	.7500E-02	.0000E+00	.3400E+00	.5000E+00-.1325E+01
AF1	3	SOIL	.7500E-02	.0000E+00	.3400E+00	.5000E+00-.1375E+01
AG1	3	SOIL	.1500E-01	.0000E+00	.3400E+00	.5000E+00-.1450E+01
AH1	3	SOIL	.3000E-01	.0000E+00	.3400E+00	.5000E+00-.1600E+01
AI1	3	SOIL	.4500E-01	.1500E+00	.3400E+00	.5000E+00-.1850E+01
A11	4	SOIL	.8500E-02	.8500E-01	.4575E+00	.5000E+00-.5000E-01
A21	4	SOIL	.8500E-02	.0000E+00	.4575E+00	.5000E+00-.1500E+00
A31	4	SOIL	.8500E-02	.0000E+00	.4575E+00	.5000E+00-.2500E+00
A41	4	SOIL	.8500E-02	.0000E+00	.4575E+00	.5000E+00-.3500E+00
A51	4	SOIL	.8500E-02	.0000E+00	.4575E+00	.5000E+00-.4500E+00
A61	4	SOIL	.8500E-02	.0000E+00	.4575E+00	.5000E+00-.5500E+00
A71	4	SOIL	.8500E-02	.0000E+00	.4575E+00	.5000E+00-.6500E+00
A81	4	SOIL	.8500E-02	.0000E+00	.4575E+00	.5000E+00-.7500E+00
A91	4	SOIL	.8500E-02	.0000E+00	.4575E+00	.5000E+00-.8500E+00
AA1	4	SOIL	.8500E-02	.0000E+00	.4575E+00	.5000E+00-.9500E+00
AB1	4	SOIL	.8500E-02	.0000E+00	.4575E+00	.5000E+00-.1050E+01
AC1	4	SOIL	.8500E-02	.0000E+00	.4575E+00	.5000E+00-.1150E+01
AD1	4	SOIL	.8500E-02	.0000E+00	.4575E+00	.5000E+00-.1250E+01
AE1	4	SOIL	.4250E-02	.0000E+00	.4575E+00	.5000E+00-.1325E+01
AF1	4	SOIL	.4250E-02	.0000E+00	.4575E+00	.5000E+00-.1375E+01
AG1	4	SOIL	.8500E-02	.0000E+00	.4575E+00	.5000E+00-.1450E+01
AH1	4	SOIL	.1700E-01	.0000E+00	.4575E+00	.5000E+00-.1600E+01
AI1	4	SOIL	.2550E-01	.8500E-01	.4575E+00	.5000E+00-.1850E+01
A11	5	SOIL	.7500E-02	.7500E-01	.5375E+00	.5000E+00-.5000E-01
A21	5	SOIL	.7500E-02	.0000E+00	.5375E+00	.5000E+00-.1500E+00
A31	5	SOIL	.7500E-02	.0000E+00	.5375E+00	.5000E+00-.2500E+00
A41	5	SOIL	.7500E-02	.0000E+00	.5375E+00	.5000E+00-.3500E+00
A51	5					

AE1	5	SOIL	.3750E-02	.0000E+00	.5375E+00	.5000E+00-.1325E+01
AF1	5	SOIL	.3750E-02	.0000E+00	.5375E+00	.5000E+00-.1375E+01
AG1	5	SOIL	.7500E-02	.0000E+00	.5375E+00	.5000E+00-.1450E+01
AH1	5	SOIL	.1500E-01	.0000E+00	.5375E+00	.5000E+00-.1600E+01
AI1	5	SOIL	.2250E-01	.7500E-01	.5375E+00	.5000E+00-.1850E+01
A11	6	SOIL	.1400E-01	.1400E+00	.6450E+00	.5000E+00-.5000E-01
A21	6	SOIL	.1400E-01	.0000E+00	.6450E+00	.5000E+00-.1500E+00
A31	6	SOIL	.1400E-01	.0000E+00	.6450E+00	.5000E+00-.2500E+00
A41	6	SOIL	.1400E-01	.0000E+00	.6450E+00	.5000E+00-.3500E+00
A51	6	SOIL	.1400E-01	.0000E+00	.6450E+00	.5000E+00-.4500E+00
A61	6	SOIL	.1400E-01	.0000E+00	.6450E+00	.5000E+00-.5500E+00
A71	6	SOIL	.1400E-01	.0000E+00	.6450E+00	.5000E+00-.6500E+00
A81	6	SOIL	.1400E-01	.0000E+00	.6450E+00	.5000E+00-.7500E+00
A91	6	SOIL	.1400E-01	.0000E+00	.6450E+00	.5000E+00-.8500E+00
AA1	6	SOIL	.1400E-01	.0000E+00	.6450E+00	.5000E+00-.9500E+00
AB1	6	SOIL	.1400E-01	.0000E+00	.6450E+00	.5000E+00-.1050E+01
AC1	6	SOIL	.1400E-01	.0000E+00	.6450E+00	.5000E+00-.1150E+01
AD1	6	SOIL	.1400E-01	.0000E+00	.6450E+00	.5000E+00-.1250E+01
AE1	6	SOIL	.7000E-02	.0000E+00	.6450E+00	.5000E+00-.1325E+01
AF1	6	SOIL	.7000E-02	.0000E+00	.6450E+00	.5000E+00-.1375E+01
AG1	6	SOIL	.1400E-01	.0000E+00	.6450E+00	.5000E+00-.1450E+01
AH1	6	SOIL	.2800E-01	.0000E+00	.6450E+00	.5000E+00-.1600E+01
AI1	6	SOIL	.4200E-01	.1400E+00	.6450E+00	.5000E+00-.1850E+01
A11	7	SOIL	.1500E-01	.1500E+00	.7900E+00	.5000E+00-.5000E-01
A21	7	SOIL	.1500E-01	.0000E+00	.7900E+00	.5000E+00-.1500E+00
A31	7	SOIL	.1500E-01	.0000E+00	.7900E+00	.5000E+00-.2500E+00
A41	7	SOIL	.1500E-01	.0000E+00	.7900E+00	.5000E+00-.3500E+00
A51	7	SOIL	.1500E-01	.0000E+00	.7900E+00	.5000E+00-.4500E+00
A61	7	SOIL	.1500E-01	.0000E+00	.7900E+00	.5000E+00-.5500E+00
A71	7	SOIL	.1500E-01	.0000E+00	.7900E+00	.5000E+00-.6500E+00
A81	7	SOIL	.1500E-01	.0000E+00	.7900E+00	.5000E+00-.7500E+00
A91	7	SOIL	.1500E-01	.0000E+00	.7900E+00	.5000E+00-.8500E+00
AA1	7	SOIL	.1500E-01	.0000E+00	.7900E+00	.5000E+00-.9500E+00
AB1	7	SOIL	.1500E-01	.0000E+00	.7900E+00	.5000E+00-.1050E+01
AC1	7	SOIL	.1500E-01	.0000E+00	.7900E+00	.5000E+00-.1150E+01
AD1	7	SOIL	.1500E-01	.0000E+00	.7900E+00	.5000E+00-.1250E+01
AE1	7	SOIL	.7500E-02	.0000E+00	.7900E+00	.5000E+00-.1325E+01
AF1	7	SOIL	.7500E-02	.0000E+00	.7900E+00	.5000E+00-.1375E+01
AG1	7	SOIL	.1500E-01	.0000E+00	.7900E+00	.5000E+00-.1450E+01
AH1	7	SOIL	.3000E-01	.0000E+00	.7900E+00	.5000E+00-.1600E+01
AI1	7	SOIL	.4500E-01	.1500E+00	.7900E+00	.5000E+00-.1850E+01
A11	8	SOIL	.1500E-01	.1500E+00	.9400E+00	.5000E+00-.5000E-01
A21	8	SOIL	.1500E-01	.0000E+00	.9400E+00	.5000E+00-.1500E+00
A31	8	SOIL	.1500E-01	.0000E+00	.9400E+00	.5000E+00-.2500E+00
A41	8	SOIL	.1500E-01	.0000E+00	.9400E+00	.5000E+00-.3500E+00
A51	8	SOIL	.1500E-01	.0000E+00	.9400E+00	.5000E+00-.4500E+00
A61	8	SOIL	.1500E-01	.0000E+00	.9400E+00	.5000E+00-.5500E+00
A71	8	SOIL	.1500E-01	.0000E+00	.9400E+00	.5000E+00-.6500E+00
A81	8					

[illegible]

A5115	SOIL	.1500E-01	.0000E+00	.1990E+01	.5000E+00-.4500E+00
A6115	SOIL	.1500E-01	.0000E+00	.1990E+01	.5000E+00-.5500E+00
A7115	SOIL	.1500E-01	.0000E+00	.1990E+01	.5000E+00-.6500E+00
A8115	SOIL	.1500E-01	.0000E+00	.1990E+01	.5000E+00-.7500E+00
A9115	SOIL	.1500E-01	.0000E+00	.1990E+01	.5000E+00-.8500E+00
AA115	SOIL	.1500E-01	.0000E+00	.1990E+01	.5000E+00-.9500E+00
AB115	SOIL	.1500E-01	.0000E+00	.1990E+01	.5000E+00-1.050E+01
AC115	SOIL	.1500E-01	.0000E+00	.1990E+01	.5000E+00-1.150E+01
AD115	SOIL	.1500E-01	.0000E+00	.1990E+01	.5000E+00-1.250E+01
AE115	SOIL	.7500E-02	.0000E+00	.1990E+01	.5000E+00-1.325E+01
AF115	SOIL	.7500E-02	.0000E+00	.1990E+01	.5000E+00-1.375E+01
AG115	SOIL	.1500E-01	.0000E+00	.1990E+01	.5000E+00-1.450E+01
AH115	SOIL	.3000E-01	.0000E+00	.1990E+01	.5000E+00-1.600E+01
AI115	SOIL	.4500E-01	.1500E+00	.1990E+01	.5000E+00-1.850E+01
A1116	SOIL	.1550E-01	.1550E+00	.2142E+01	.5000E+00-.5000E-01
A2116	SOIL	.1550E-01	.0000E+00	.2142E+01	.5000E+00-.1500E+00
A3116	SOIL	.1550E-01	.0000E+00	.2142E+01	.5000E+00-.2500E+00
A4116	SOIL	.1550E-01	.0000E+00	.2142E+01	.5000E+00-.3500E+00
A5116	SOIL	.1550E-01	.0000E+00	.2142E+01	.5000E+00-.4500E+00
A6116	SOIL	.1550E-01	.0000E+00	.2142E+01	.5000E+00-.5500E+00
A7116	SOIL	.1550E-01	.0000E+00	.2142E+01	.5000E+00-.6500E+00
A8116	SOIL	.1550E-01	.0000E+00	.2142E+01	.5000E+00-.7500E+00
A9116	SOIL	.1550E-01	.0000E+00	.2142E+01	.5000E+00-.8500E+00
AA116	SOIL	.1550E-01	.0000E+00	.2142E+01	.5000E+00-.9500E+00
AB116	SOIL	.1550E-01	.0000E+00	.2142E+01	.5000E+00-1.050E+01
AC116	SOIL	.1550E-01	.0000E+00	.2142E+01	.5000E+00-1.150E+01
AD116	SOIL	.1550E-01	.0000E+00	.2142E+01	.5000E+00-1.250E+01
AE116	SOIL	.7750E-02	.0000E+00	.2142E+01	.5000E+00-1.325E+01
AF116	SOIL	.7750E-02	.0000E+00	.2142E+01	.5000E+00-1.375E+01
AG116	SOIL	.1550E-01	.0000E+00	.2142E+01	.5000E+00-1.450E+01
AH116	SOIL	.3100E-01	.0000E+00	.2142E+01	.5000E+00-1.600E+01
AI116	SOIL	.4650E-01	.1550E+00	.2142E+01	.5000E+00-1.850E+01
A1117	SOIL	.1800E-01	.1800E+00	.2310E+01	.5000E+00-.5000E-01
A2117	SOIL	.1800E-01	.0000E+00	.2310E+01	.5000E+00-.1500E+00
A3117	SOIL	.1800E-01	.0000E+00	.2310E+01	.5000E+00-.2500E+00
A4117	SOIL	.1800E-01	.0000E+00	.2310E+01	.5000E+00-.3500E+00
A5117	SOIL	.1800E-01	.0000E+00	.2310E+01	.5000E+00-.4500E+00
A6117	SOIL	.1800E-01	.0000E+00	.2310E+01	.5000E+00-.5500E+00
A7117	SOIL	.1800E-01	.0000E+00	.2310E+01	.5000E+00-.6500E+00
A8117	SOIL	.1800E-01	.0000E+00	.2310E+01	.5000E+00-.7500E+00
A9117	SOIL	.1800E-01	.0000E+00	.2310E+01	.5000E+00-.8500E+00
AA117	SOIL	.1800E-01	.0000E+00	.2310E+01	.5000E+00-.9500E+00
AB117	SOIL	.1800E-01	.0000E+00	.2310E+01	.5000E+00-1.050E+01
AC117	SOIL	.1800E-01	.0000E+00	.2310E+01	.5000E+00-1.150E+01
AD117	SOIL	.1800E-01	.0000E+00	.2310E+01	.5000E+00-1.250E+01
AE117	SOIL	.9000E-02	.0000E+00	.2310E+01	.5000E+00-1.325E+01
AF117	SOIL	.9000E-02	.0000E+00	.2310E+01	.5000E+00-1.375E+01
AG117	SOIL	.1800E-01	.0000E+00	.2310E+01	.5000E+00-1.450E+01
AH117	SOIL	.3600E-01	.0000E+00	.2310E+01	.5000E+00-1.600E+01
AI117	SOIL	.5400E-01	.1800E+00	.2310E+01	.5000E+00-1.850E+01
A1118	SOIL	.			

A8118	SOIL	.2000E-01	.0000E+00	.2500E+01	.5000E+00-.7500E+00
A9118	SOIL	.2000E-01	.0000E+00	.2500E+01	.5000E+00-.8500E+00
AA118	SOIL	.2000E-01	.0000E+00	.2500E+01	.5000E+00-.9500E+00
AB118	SOIL	.2000E-01	.0000E+00	.2500E+01	.5000E+00-1.050E+01
AC118	SOIL	.2000E-01	.0000E+00	.2500E+01	.5000E+00-1.150E+01
AD118	SOIL	.2000E-01	.0000E+00	.2500E+01	.5000E+00-1.250E+01
AE118	SOIL	.1000E-01	.0000E+00	.2500E+01	.5000E+00-1.325E+01
AF118	SOIL	.1000E-01	.0000E+00	.2500E+01	.5000E+00-1.375E+01
AG118	SOIL	.2000E-01	.0000E+00	.2500E+01	.5000E+00-1.450E+01
AH118	SOIL	.4000E-01	.0000E+00	.2500E+01	.5000E+00-1.600E+01
AI118	SOIL	.6000E-01	.2000E+00	.2500E+01	.5000E+00-1.850E+01
A1119	SOIL	.2000E-01	.2000E+00	.2700E+01	.5000E+00-.5000E-01
A2119	SOIL	.2000E-01	.0000E+00	.2700E+01	.5000E+00-.1500E+00
A3119	SOIL	.2000E-01	.0000E+00	.2700E+01	.5000E+00-.2500E+00
A4119	SOIL	.2000E-01	.0000E+00	.2700E+01	.5000E+00-.3500E+00
A5119	SOIL	.2000E-01	.0000E+00	.2700E+01	.5000E+00-.4500E+00
A6119	SOIL	.2000E-01	.0000E+00	.2700E+01	.5000E+00-.5500E+00
A7119	SOIL	.2000E-01	.0000E+00	.2700E+01	.5000E+00-.6500E+00
A8119	SOIL	.2000E-01	.0000E+00	.2700E+01	.5000E+00-.7500E+00
A9119	SOIL	.2000E-01	.0000E+00	.2700E+01	.5000E+00-.8500E+00
AA119	SOIL	.2000E-01	.0000E+00	.2700E+01	.5000E+00-.9500E+00
AB119	SOIL	.2000E-01	.0000E+00	.2700E+01	.5000E+00-1.050E+01
AC119	SOIL	.2000E-01	.0000E+00	.2700E+01	.5000E+00-1.150E+01
AD119	SOIL	.2000E-01	.0000E+00	.2700E+01	.5000E+00-1.250E+01
AE119	SOIL	.1000E-01	.0000E+00	.2700E+01	.5000E+00-1.325E+01
AF119	SOIL	.1000E-01	.0000E+00	.2700E+01	.5000E+00-1.375E+01
AG119	SOIL	.2000E-01	.0000E+00	.2700E+01	.5000E+00-1.450E+01
AH119	SOIL	.4000E-01	.0000E+00	.2700E+01	.5000E+00-1.600E+01
AI119	SOIL	.6000E-01	.2000E+00	.2700E+01	.5000E+00-1.850E+01
A1120	SOIL	.2000E-01	.2000E+00	.2900E+01	.5000E+00-.5000E-01
A2120	SOIL	.2000E-01	.0000E+00	.2900E+01	.5000E+00-.1500E+00
A3120	SOIL	.2000E-01	.0000E+00	.2900E+01	.5000E+00-.2500E+00
A4120	SOIL	.2000E-01	.0000E+00	.2900E+01	.5000E+00-.3500E+00
A5120	SOIL	.2000E-01	.0000E+00	.2900E+01	.5000E+00-.4500E+00
A6120	SOIL	.2000E-01	.0000E+00	.2900E+01	.5000E+00-.5500E+00
A7120	SOIL	.2000E-01	.0000E+00	.2900E+01	.5000E+00-.6500E+00
A8120	SOIL	.2000E-01	.0000E+00	.2900E+01	.5000E+00-.7500E+00
A9120	SOIL	.2000E-01	.0000E+00	.2900E+01	.5000E+00-.8500E+00
AA120	SOIL	.2000E-01	.0000E+00	.2900E+01	.5000E+00-.9500E+00
AB120	SOIL	.2000E-01	.0000E+00	.2900E+01	.5000E+00-1.050E+01
AC120	SOIL	.2000E-01	.0000E+00	.2900E+01	.5000E+00-1.150E+01
AD120	SOIL	.2000E-01	.0000E+00	.2900E+01	.5000E+00-1.250E+01
AE120	SOIL	.1000E-01	.0000E+00	.2900E+01	.5000E+00-1.325E+01
AF120	SOIL	.1000E-01	.0000E+00	.2900E+01	.5000E+00-1.375E+01
AG120	SOIL	.2000E-01	.0000E+00	.2900E+01	.5000E+00-1.450E+01
AH120	SOIL	.4000E-01	.0000E+00	.2900E+01	.5000E+00-1.600E+01
AI120	SOIL	.6000E-01	.2000E+00	.2900E+01	.5000E+00-1.850E+01
A1121	BOUN	.1000E+30	.1000E-03	.3000E+01	.5000E+00-.5000E-01
A2121	BOUN	.1000E+30	.0000E+00	.3000E+01	.5000E+00-.1500E+00
A3121	BOUN	.1000E+30	.0000E+00	.3000E+01	.5000E+00-.2500E+00
A4121	BOUN	.			

AB121	BOUN	.1000E+30	.0000E+00		.3000E+01	.5000E+00	.1050E+01
AC121	BOUN	.1000E+30	.0000E+00		.3000E+01	.5000E+00	.1150E+01
AD121	BOUN	.1000E+30	.0000E+00		.3000E+01	.5000E+00	.1250E+01
AE121	BOUN	.1000E+30	.0000E+00		.3000E+01	.5000E+00	.1325E+01
AF121	SAT	.1000E+30	.0000E+00		.3000E+01	.5000E+00	.1375E+01
AG121	SAT	.1000E+30	.0000E+00		.3000E+01	.5000E+00	.1450E+01
AH121	SAT	.1000E+30	.0000E+00		.3000E+01	.5000E+00	.1600E+01
AI121	SAT	.1000E+30	.1000E-03		.3000E+01	.5000E+00	.1850E+01

CONNE-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

A11 1A11 2	1	.5750E-01	.7500E-01	.1000E+00			
A11 1A21 1	3	.5000E-01	.5000E-01	.1150E+00	.1000E+01		
A21 1A21 2	1	.5750E-01	.7500E-01	.1000E+00			
A21 1A31 1	3	.5000E-01	.5000E-01	.1150E+00	.1000E+01		
A31 1A31 2	1	.5750E-01	.7500E-01	.1000E+00			
A31 1A41 1	3	.5000E-01	.5000E-01	.1150E+00	.1000E+01		
A41 1A41 2	1	.5750E-01	.7500E-01	.1000E+00			
A41 1A51 1	3	.5000E-01	.5000E-01	.1150E+00	.1000E+01		
A51 1A51 2	1	.5750E-01	.7500E-01	.1000E+00			
A51 1A61 1	3	.5000E-01	.5000E-01	.1150E+00	.1000E+01		
A61 1A61 2	1	.5750E-01	.7500E-01	.1000E+00			
A61 1A71 1	3	.5000E-01	.5000E-01	.1150E+00	.1000E+01		
A71 1A71 2	1	.5750E-01	.7500E-01	.1000E+00			
A71 1A81 1	3	.5000E-01	.5000E-01	.1150E+00	.1000E+01		
A81 1A81 2	1	.5750E-01	.7500E-01	.1000E+00			
A81 1A91 1	3	.5000E-01	.5000E-01	.1150E+00	.1000E+01		
A91 1A91 2	1	.5750E-01	.7500E-01	.1000E+00			
A91 1AA1 1	3	.5000E-01	.5000E-01	.1150E+00	.1000E+01		
AA1 1AA1 2	1	.5750E-01	.7500E-01	.1000E+00			
AA1 1AB1 1	3	.5000E-01	.5000E-01	.1150E+00	.1000E+01		
AB1 1AB1 2	1	.5750E-01	.7500E-01	.1000E+00			
AB1 1AC1 1	3	.5000E-01	.5000E-01	.1150E+00	.1000E+01		
AC1 1AC1 2	1	.5750E-01	.7500E-01	.1000E+00			
AC1 1AD1 1	3	.5000E-01	.5000E-01	.1150E+00	.1000E+01		
AD1 1AD1 2	1	.5750E-01	.7500E-01	.1000E+00			
AD1 1AE1 1	3	.5000E-01	.2500E-01	.1150E+00	.1000E+01		
AE1 1AE1 2	1	.5750E-01	.7500E-01	.5000E-01			
AE1 1AF1 1	3	.2500E-01	.2500E-01	.1150E+00	.1000E+01		
AF1 1AF1 2	1	.5750E-01	.7500E-01	.5000E-01			
AF1 1AG1 1	3	.2500E-01	.5000E-01	.1150E+00	.1000E+01		
AG1 1AG1 2	1	.5750E-01	.7500E-01	.1000E+00			
AG1 1AH1 1	3	.5000E-01	.1000E+00	.1150E+00	.1000E+01		
AH1 1AH1 2	1	.5750E-01	.7500E-01	.2000E+00			
AH1 1AI1 1	3	.1000E+00	.1500E+00	.1150E+00	.1000E+01		
AI1 1AI1 2	1	.5750E-01	.7500E-01	.3000E+00			
A11 2A11 3	1	.7500E-01	.7500E-01	.1000E+00			
A11 2A21 2	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01		
A21 2A21 3	1	.7500E-01	.7500E-01	.1000E+00			
A21 2A31 2	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01		
A31 2A31 3	1	.7500E-01	.7500E-01	.1000E+00			
A31 2A41 2	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01		
A41 2A41 3	1	.7500E-01	.7500E-01	.1000E+00			
A41 2A51 2	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01		
A51 2A51 3	1	.7500E-01	.7500E-01	.1000E+00			
A51 2A61 2	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01		
A61 2A61 3	1	.7500E-01	.7500E-01	.1000E+00			
A61 2A71 2	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01		

A71 2A71 3	1	.7500E-01	.7500E-01	.1000E+00	
A71 2A81 2	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A81 2A81 3	1	.7500E-01	.7500E-01	.1000E+00	
A81 2A91 2	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A91 2A91 3	1	.7500E-01	.7500E-01	.1000E+00	
A91 2AA1 2	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AA1 2AA1 3	1	.7500E-01	.7500E-01	.1000E+00	
AA1 2AB1 2	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AB1 2AB1 3	1	.7500E-01	.7500E-01	.1000E+00	
AB1 2AC1 2	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AC1 2AC1 3	1	.7500E-01	.7500E-01	.1000E+00	
AC1 2AD1 2	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AD1 2AD1 3	1	.7500E-01	.7500E-01	.1000E+00	
AD1 2AE1 2	3	.5000E-01	.2500E-01	.1500E+00	.1000E+01
AE1 2AE1 3	1	.7500E-01	.7500E-01	.5000E-01	
AE1 2AF1 2	3	.2500E-01	.2500E-01	.1500E+00	.1000E+01
AF1 2AF1 3	1	.7500E-01	.7500E-01	.5000E-01	
AF1 2AG1 2	3	.2500E-01	.5000E-01	.1500E+00	.1000E+01
AG1 2AG1 3	1	.7500E-01	.7500E-01	.1000E+00	
AG1 2AH1 2	3	.5000E-01	.1000E+00	.1500E+00	.1000E+01
AH1 2AH1 3	1	.7500E-01	.7500E-01	.2000E+00	
AH1 2AI1 2	3	.1000E+00	.1500E+00	.1500E+00	.1000E+01
AI1 2AI1 3	1	.7500E-01	.7500E-01	.3000E+00	
A11 3A11 4	1	.7500E-01	.4250E-01	.1000E+00	
A11 3A21 3	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A21 3A21 4	1	.7500E-01	.4250E-01	.1000E+00	
A21 3A31 3	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A31 3A31 4	1	.7500E-01	.4250E-01	.1000E+00	
A31 3A41 3	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A41 3A41 4	1	.7500E-01	.4250E-01	.1000E+00	
A41 3A51 3	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A51 3A51 4	1	.7500E-01	.4250E-01	.1000E+00	
A51 3A61 3	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A61 3A61 4	1	.7500E-01	.4250E-01	.1000E+00	
A61 3A71 3	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A71 3A71 4	1	.7500E-01	.4250E-01	.1000E+00	
A71 3A81 3	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A81 3A81 4	1	.7500E-01	.4250E-01	.1000E+00	
A81 3A91 3	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A91 3A91 4	1	.7500E-01	.4250E-01	.1000E+00	
A91 3AA1 3	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AA1 3AA1 4	1	.7500E-01	.4250E-01	.1000E+00	
AA1 3AB1 3	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AB1 3AB1 4	1	.7500E-01	.4250E-01	.1000E+00	
AB1 3AC1 3	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AC1 3AC1 4	1	.7500E-01	.4250E-01	.1000E+00	
AC1 3AD1 3	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AD1 3AD1 4	1	.7500E-01	.4250E-01	.1000E+00	
AD1 3AE1 3	3	.5000E-01	.2500E-01	.1500E+00	.1000E+01
AE1 3AE1 4	1	.7500E-01	.4250E-01	.5000E-01	
AE1 3AF1 3	3	.2500E-01	.2500E-01	.1500E+00	.1000E+01
AF1 3AF1 4	1	.7500E-01	.4250E-01	.5000E-01	
AF1 3AG1 3	3	.2500E-01	.5000E-01	.1500E+00	.1000E+01
AG1 3AG1 4	1	.7500E-01	.4250E-01	.1000E+00	
AG1 3AH1 3	3	.5000E-01	.1000E+00	.1500E+00	.1000E+01
AH1 3AH1 4	1	.7500E-01	.4250E-01	.2000E+00	
AH1 3AI1 3	3	.1000E+00	.1500E+00	.1500E+00	.1000E+01

AI1 3AI1 4	1	.7500E-01	.4250E-01	.3000E+00	
A11 4A11 5	1	.4250E-01	.3750E-01	.1000E+00	
A11 4A21 4	3	.5000E-01	.5000E-01	.8500E-01	.1000E+01
A21 4A21 5	1	.4250E-01	.3750E-01	.1000E+00	
A21 4A31 4	3	.5000E-01	.5000E-01	.8500E-01	.1000E+01
A31 4A31 5	1	.4250E-01	.3750E-01	.1000E+00	
A31 4A41 4	3	.5000E-01	.5000E-01	.8500E-01	.1000E+01
A41 4A41 5	1	.4250E-01	.3750E-01	.1000E+00	
A41 4A51 4	3	.5000E-01	.5000E-01	.8500E-01	.1000E+01
A51 4A51 5	1	.4250E-01	.3750E-01	.1000E+00	
A51 4A61 4	3	.5000E-01	.5000E-01	.8500E-01	.1000E+01
A61 4A61 5	1	.4250E-01	.3750E-01	.1000E+00	
A61 4A71 4	3	.5000E-01	.5000E-01	.8500E-01	.1000E+01
A71 4A71 5	1	.4250E-01	.3750E-01	.1000E+00	
A71 4A81 4	3	.5000E-01	.5000E-01	.8500E-01	.1000E+01
A81 4A81 5	1	.4250E-01	.3750E-01	.1000E+00	
A81 4A91 4	3	.5000E-01	.5000E-01	.8500E-01	.1000E+01
A91 4A91 5	1	.4250E-01	.3750E-01	.1000E+00	
A91 4AA1 4	3	.5000E-01	.5000E-01	.8500E-01	.1000E+01
AA1 4AA1 5	1	.4250E-01	.3750E-01	.1000E+00	
AA1 4AB1 4	3	.5000E-01	.5000E-01	.8500E-01	.1000E+01
AB1 4AB1 5	1	.4250E-01	.3750E-01	.1000E+00	
AB1 4AC1 4	3	.5000E-01	.5000E-01	.8500E-01	.1000E+01
AC1 4AC1 5	1	.4250E-01	.3750E-01	.1000E+00	
AC1 4AD1 4	3	.5000E-01	.5000E-01	.8500E-01	.1000E+01
AD1 4AD1 5	1	.4250E-01	.3750E-01	.1000E+00	
AD1 4AE1 4	3	.5000E-01	.2500E-01	.8500E-01	.1000E+01
AE1 4AE1 5	1	.4250E-01	.3750E-01	.5000E-01	
AE1 4AF1 4	3	.2500E-01	.2500E-01	.8500E-01	.1000E+01
AF1 4AF1 5	1	.4250E-01	.3750E-01	.5000E-01	
AF1 4AG1 4	3	.2500E-01	.5000E-01	.8500E-01	.1000E+01
AG1 4AG1 5	1	.4250E-01	.3750E-01	.1000E+00	
AG1 4AH1 4	3	.5000E-01	.1000E+00	.8500E-01	.1000E+01
AH1 4AH1 5	1	.4250E-01	.3750E-01	.2000E+00	
AH1 4AI1 4	3	.1000E+00	.1500E+00	.8500E-01	.1000E+01
AI1 4AI1 5	1	.4250E-01	.3750E-01	.3000E+00	
A11 5A11 6	1	.3750E-01	.7000E-01	.1000E+00	
A11 5A21 5	3	.5000E-01	.5000E-01	.7500E-01	.1000E+01
A21 5A21 6	1	.3750E-01	.7000E-01	.1000E+00	
A21 5A31 5	3	.5000E-01	.5000E-01	.7500E-01	.1000E+01
A31 5A31 6	1	.3750E-01	.7000E-01	.1000E+00	
A31 5A41 5	3	.5000E-01	.5000E-01	.7500E-01	.1000E+01
A41 5A41 6	1	.3750E-01	.7000E-01	.1000E+00	
A41 5A51 5	3	.5000E-01	.5000E-01	.7500E-01	.1000E+01
A51 5A51 6	1	.3750E-01	.7000E-01	.1000E+00	
A51 5A61 5	3	.5000E-01	.5000E-01	.7500E-01	.1000E+01
A61 5A61 6	1	.3750E-01	.7000E-01	.1000E+00	
A61 5A71 5	3	.5000E-01	.5000E-01	.7500E-01	.1000E+01
A71 5A71 6	1	.3750E-01	.7000E-01	.1000E+00	
A71 5A81 5	3	.5000E-01	.5000E-01	.7500E-01	.1000E+01
A81 5A81 6	1	.3750E-01	.7000E-01	.1000E+00	
A81 5A91 5	3	.5000E-01	.5000E-01	.7500E-01	.1000E+01
A91 5A91 6	1	.3750E-01	.7000E-01	.1000E+00	
A91 5AA1 5	3	.5000E-01	.5000E-01	.7500E-01	.1000E+01
AA1 5AA1 6	1	.3750E-01	.7000E-01	.1000E+00	
AA1 5AB1 5	3	.5000E-01	.5000E-01	.7500E-01	.1000E+01
AB1 5AB1 6	1	.3750E-01	.7000E-01	.1000E+00	

AB1	5AC1	5	3	.5000E-01	.5000E-01	.7500E-01	.1000E+01
AC1	5AC1	6	1	.3750E-01	.7000E-01	.1000E+00	
AC1	5AD1	5	3	.5000E-01	.5000E-01	.7500E-01	.1000E+01
AD1	5AD1	6	1	.3750E-01	.7000E-01	.1000E+00	
AD1	5AE1	5	3	.5000E-01	.2500E-01	.7500E-01	.1000E+01
AE1	5AE1	6	1	.3750E-01	.7000E-01	.5000E-01	
AE1	5AF1	5	3	.2500E-01	.2500E-01	.7500E-01	.1000E+01
AF1	5AF1	6	1	.3750E-01	.7000E-01	.5000E-01	
AF1	5AG1	5	3	.2500E-01	.5000E-01	.7500E-01	.1000E+01
AG1	5AG1	6	1	.3750E-01	.7000E-01	.1000E+00	
AG1	5AH1	5	3	.5000E-01	.1000E+00	.7500E-01	.1000E+01
AH1	5AH1	6	1	.3750E-01	.7000E-01	.2000E+00	
AH1	5AI1	5	3	.1000E+00	.1500E+00	.7500E-01	.1000E+01
AI1	5AI1	6	1	.3750E-01	.7000E-01	.3000E+00	
A11	6A11	7	1	.7000E-01	.7500E-01	.1000E+00	
A11	6A21	6	3	.5000E-01	.5000E-01	.1400E+00	.1000E+01
A21	6A21	7	1	.7000E-01	.7500E-01	.1000E+00	
A21	6A31	6	3	.5000E-01	.5000E-01	.1400E+00	.1000E+01
A31	6A31	7	1	.7000E-01	.7500E-01	.1000E+00	
A31	6A41	6	3	.5000E-01	.5000E-01	.1400E+00	.1000E+01
A41	6A41	7	1	.7000E-01	.7500E-01	.1000E+00	
A41	6A51	6	3	.5000E-01	.5000E-01	.1400E+00	.1000E+01
A51	6A51	7	1	.7000E-01	.7500E-01	.1000E+00	
A51	6A61	6	3	.5000E-01	.5000E-01	.1400E+00	.1000E+01
A61	6A61	7	1	.7000E-01	.7500E-01	.1000E+00	
A61	6A71	6	3	.5000E-01	.5000E-01	.1400E+00	.1000E+01
A71	6A71	7	1	.7000E-01	.7500E-01	.1000E+00	
A71	6A81	6	3	.5000E-01	.5000E-01	.1400E+00	.1000E+01
A81	6A81	7	1	.7000E-01	.7500E-01	.1000E+00	
A81	6A91	6	3	.5000E-01	.5000E-01	.1400E+00	.1000E+01
A91	6A91	7	1	.7000E-01	.7500E-01	.1000E+00	
A91	6AA1	6	3	.5000E-01	.5000E-01	.1400E+00	.1000E+01
AA1	6AA1	7	1	.7000E-01	.7500E-01	.1000E+00	
AA1	6AB1	6	3	.5000E-01	.5000E-01	.1400E+00	.1000E+01
AB1	6AB1	7	1	.7000E-01	.7500E-01	.1000E+00	
AB1	6AC1	6	3	.5000E-01	.5000E-01	.1400E+00	.1000E+01
AC1	6AC1	7	1	.7000E-01	.7500E-01	.1000E+00	
AC1	6AD1	6	3	.5000E-01	.5000E-01	.1400E+00	.1000E+01
AD1	6AD1	7	1	.7000E-01	.7500E-01	.1000E+00	
AD1	6AE1	6	3	.5000E-01	.2500E-01	.1400E+00	.1000E+01
AE1	6AE1	7	1	.7000E-01	.7500E-01	.5000E-01	
AE1	6AF1	6	3	.2500E-01	.2500E-01	.1400E+00	.1000E+01
AF1	6AF1	7	1	.7000E-01	.7500E-01	.5000E-01	
AF1	6AG1	6	3	.2500E-01	.5000E-01	.1400E+00	.1000E+01
AG1	6AG1	7	1	.7000E-01	.7500E-01	.1000E+00	
AG1	6AH1	6	3	.5000E-01	.1000E+00	.1400E+00	.1000E+01
AH1	6AH1	7	1	.7000E-01	.7500E-01	.2000E+00	
AH1	6AI1	6	3	.1000E+00	.1500E+00	.1400E+00	.1000E+01
AI1	6AI1	7	1	.7000E-01	.7500E-01	.3000E+00	
A11	7A11	8	1	.7500E-01	.7500E-01	.1000E+00	
A11	7A21	7	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A21	7A21	8	1	.7500E-01	.7500E-01	.1000E+00	
A21	7A31	7	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A31	7A31	8	1	.7500E-01	.7500E-01	.1000E+00	
A31	7A41	7	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A41	7A41	8	1	.7500E-01	.7500E-01	.1000E+00	
A41	7A51	7	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01

A51 7A51 8	1	.7500E-01	.7500E-01	.1000E+00	
A51 7A61 7	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A61 7A61 8	1	.7500E-01	.7500E-01	.1000E+00	
A61 7A71 7	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A71 7A71 8	1	.7500E-01	.7500E-01	.1000E+00	
A71 7A81 7	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A81 7A81 8	1	.7500E-01	.7500E-01	.1000E+00	
A81 7A91 7	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A91 7A91 8	1	.7500E-01	.7500E-01	.1000E+00	
A91 7AA1 7	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AA1 7AA1 8	1	.7500E-01	.7500E-01	.1000E+00	
AA1 7AB1 7	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AB1 7AB1 8	1	.7500E-01	.7500E-01	.1000E+00	
AB1 7AC1 7	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AC1 7AC1 8	1	.7500E-01	.7500E-01	.1000E+00	
AC1 7AD1 7	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AD1 7AD1 8	1	.7500E-01	.7500E-01	.1000E+00	
AD1 7AE1 7	3	.5000E-01	.2500E-01	.1500E+00	.1000E+01
AE1 7AE1 8	1	.7500E-01	.7500E-01	.5000E-01	
AE1 7AF1 7	3	.2500E-01	.2500E-01	.1500E+00	.1000E+01
AF1 7AF1 8	1	.7500E-01	.7500E-01	.5000E-01	
AF1 7AG1 7	3	.2500E-01	.5000E-01	.1500E+00	.1000E+01
AG1 7AG1 8	1	.7500E-01	.7500E-01	.1000E+00	
AG1 7AH1 7	3	.5000E-01	.1000E+00	.1500E+00	.1000E+01
AH1 7AH1 8	1	.7500E-01	.7500E-01	.2000E+00	
AH1 7AI1 7	3	.1000E+00	.1500E+00	.1500E+00	.1000E+01
AI1 7AI1 8	1	.7500E-01	.7500E-01	.3000E+00	
A11 8A11 9	1	.7500E-01	.7500E-01	.1000E+00	
A11 8A21 8	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A21 8A21 9	1	.7500E-01	.7500E-01	.1000E+00	
A21 8A31 8	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A31 8A31 9	1	.7500E-01	.7500E-01	.1000E+00	
A31 8A41 8	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A41 8A41 9	1	.7500E-01	.7500E-01	.1000E+00	
A41 8A51 8	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A51 8A51 9	1	.7500E-01	.7500E-01	.1000E+00	
A51 8A61 8	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A61 8A61 9	1	.7500E-01	.7500E-01	.1000E+00	
A61 8A71 8	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A71 8A71 9	1	.7500E-01	.7500E-01	.1000E+00	
A71 8A81 8	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A81 8A81 9	1	.7500E-01	.7500E-01	.1000E+00	
A81 8A91 8	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A91 8A91 9	1	.7500E-01	.7500E-01	.1000E+00	
A91 8AA1 8	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AA1 8AA1 9	1	.7500E-01	.7500E-01	.1000E+00	
AA1 8AB1 8	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AB1 8AB1 9	1	.7500E-01	.7500E-01	.1000E+00	
AB1 8AC1 8	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AC1 8AC1 9	1	.7500E-01	.7500E-01	.1000E+00	
AC1 8AD1 8	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AD1 8AD1 9	1	.7500E-01	.7500E-01	.1000E+00	
AD1 8AE1 8	3	.5000E-01	.2500E-01	.1500E+00	.1000E+01
AE1 8AE1 9	1	.7500E-01	.7500E-01	.5000E-01	
AE1 8AF1 8	3	.2500E-01	.2500E-01	.1500E+00	.1000E+01
AF1 8AF1 9	1	.7500E-01	.7500E-01	.5000E-01	
AF1 8AG1 8	3	.2500E-01	.5000E-01	.1500E+00	.1000E+01

AG1 8AG1 9	1	.7500E-01	.7500E-01	.1000E+00	
AG1 8AH1 8	3	.5000E-01	.1000E+00	.1500E+00	.1000E+01
AH1 8AH1 9	1	.7500E-01	.7500E-01	.2000E+00	
AH1 8AI1 8	3	.1000E+00	.1500E+00	.1500E+00	.1000E+01
AI1 8AI1 9	1	.7500E-01	.7500E-01	.3000E+00	
A11 9A1110	1	.7500E-01	.7500E-01	.1000E+00	
A11 9A21 9	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A21 9A2110	1	.7500E-01	.7500E-01	.1000E+00	
A21 9A31 9	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A31 9A3110	1	.7500E-01	.7500E-01	.1000E+00	
A31 9A41 9	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A41 9A4110	1	.7500E-01	.7500E-01	.1000E+00	
A41 9A51 9	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A51 9A5110	1	.7500E-01	.7500E-01	.1000E+00	
A51 9A61 9	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A61 9A6110	1	.7500E-01	.7500E-01	.1000E+00	
A61 9A71 9	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A71 9A7110	1	.7500E-01	.7500E-01	.1000E+00	
A71 9A81 9	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A81 9A8110	1	.7500E-01	.7500E-01	.1000E+00	
A81 9A91 9	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A91 9A9110	1	.7500E-01	.7500E-01	.1000E+00	
A91 9AA1 9	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AA1 9AA110	1	.7500E-01	.7500E-01	.1000E+00	
AA1 9AB1 9	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AB1 9AB110	1	.7500E-01	.7500E-01	.1000E+00	
AB1 9AC1 9	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AC1 9AC110	1	.7500E-01	.7500E-01	.1000E+00	
AC1 9AD1 9	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AD1 9AD110	1	.7500E-01	.7500E-01	.1000E+00	
AD1 9AE1 9	3	.5000E-01	.2500E-01	.1500E+00	.1000E+01
AE1 9AE110	1	.7500E-01	.7500E-01	.5000E-01	
AE1 9AF1 9	3	.2500E-01	.2500E-01	.1500E+00	.1000E+01
AF1 9AF110	1	.7500E-01	.7500E-01	.5000E-01	
AF1 9AG1 9	3	.2500E-01	.5000E-01	.1500E+00	.1000E+01
AG1 9AG110	1	.7500E-01	.7500E-01	.1000E+00	
AG1 9AH1 9	3	.5000E-01	.1000E+00	.1500E+00	.1000E+01
AH1 9AH110	1	.7500E-01	.7500E-01	.2000E+00	
AH1 9AI1 9	3	.1000E+00	.1500E+00	.1500E+00	.1000E+01
AI1 9AI110	1	.7500E-01	.7500E-01	.3000E+00	
A1110A1111	1	.7500E-01	.7500E-01	.1000E+00	
A1110A2110	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A2110A2111	1	.7500E-01	.7500E-01	.1000E+00	
A2110A3110	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A3110A3111	1	.7500E-01	.7500E-01	.1000E+00	
A3110A4110	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A4110A4111	1	.7500E-01	.7500E-01	.1000E+00	
A4110A5110	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A5110A5111	1	.7500E-01	.7500E-01	.1000E+00	
A5110A6110	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A6110A6111	1	.7500E-01	.7500E-01	.1000E+00	
A6110A7110	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A7110A7111	1	.7500E-01	.7500E-01	.1000E+00	
A7110A8110	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A8110A8111	1	.7500E-01	.7500E-01	.1000E+00	
A8110A9110	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A9110A9111	1	.7500E-01	.7500E-01	.1000E+00	

A9110AA110	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AA110AA111	1	.7500E-01	.7500E-01	.1000E+00	
AA110AB110	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AB110AB111	1	.7500E-01	.7500E-01	.1000E+00	
AB110AC110	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AC110AC111	1	.7500E-01	.7500E-01	.1000E+00	
AC110AD110	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AD110AD111	1	.7500E-01	.7500E-01	.1000E+00	
AD110AE110	3	.5000E-01	.2500E-01	.1500E+00	.1000E+01
AE110AE111	1	.7500E-01	.7500E-01	.5000E-01	
AE110AF110	3	.2500E-01	.2500E-01	.1500E+00	.1000E+01
AF110AF111	1	.7500E-01	.7500E-01	.5000E-01	
AF110AG110	3	.2500E-01	.5000E-01	.1500E+00	.1000E+01
AG110AG111	1	.7500E-01	.7500E-01	.1000E+00	
AG110AH110	3	.5000E-01	.1000E+00	.1500E+00	.1000E+01
AH110AH111	1	.7500E-01	.7500E-01	.2000E+00	
AH110AI110	3	.1000E+00	.1500E+00	.1500E+00	.1000E+01
AI110AI111	1	.7500E-01	.7500E-01	.3000E+00	
A1111A1112	1	.7500E-01	.7500E-01	.1000E+00	
A1111A2111	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A2111A2112	1	.7500E-01	.7500E-01	.1000E+00	
A2111A3111	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A3111A3112	1	.7500E-01	.7500E-01	.1000E+00	
A3111A4111	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A4111A4112	1	.7500E-01	.7500E-01	.1000E+00	
A4111A5111	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A5111A5112	1	.7500E-01	.7500E-01	.1000E+00	
A5111A6111	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A6111A6112	1	.7500E-01	.7500E-01	.1000E+00	
A6111A7111	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A7111A7112	1	.7500E-01	.7500E-01	.1000E+00	
A7111A8111	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A8111A8112	1	.7500E-01	.7500E-01	.1000E+00	
A8111A9111	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A9111A9112	1	.7500E-01	.7500E-01	.1000E+00	
A9111AA111	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AA111AA112	1	.7500E-01	.7500E-01	.1000E+00	
AA111AB111	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AB111AB112	1	.7500E-01	.7500E-01	.1000E+00	
AB111AC111	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AC111AC112	1	.7500E-01	.7500E-01	.1000E+00	
AC111AD111	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AD111AD112	1	.7500E-01	.7500E-01	.1000E+00	
AD111AE111	3	.5000E-01	.2500E-01	.1500E+00	.1000E+01
AE111AE112	1	.7500E-01	.7500E-01	.5000E-01	
AE111AF111	3	.2500E-01	.2500E-01	.1500E+00	.1000E+01
AF111AF112	1	.7500E-01	.7500E-01	.5000E-01	
AF111AG111	3	.2500E-01	.5000E-01	.1500E+00	.1000E+01
AG111AG112	1	.7500E-01	.7500E-01	.1000E+00	
AG111AH111	3	.5000E-01	.1000E+00	.1500E+00	.1000E+01
AH111AH112	1	.7500E-01	.7500E-01	.2000E+00	
AH111AI111	3	.1000E+00	.1500E+00	.1500E+00	.1000E+01
AI111AI112	1	.7500E-01	.7500E-01	.3000E+00	
A1112A1113	1	.7500E-01	.7500E-01	.1000E+00	
A1112A2112	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A2112A2113	1	.7500E-01	.7500E-01	.1000E+00	
A2112A3112	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01

A3112A3113	1	.7500E-01	.7500E-01	.1000E+00	
A3112A4112	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A4112A4113	1	.7500E-01	.7500E-01	.1000E+00	
A4112A5112	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A5112A5113	1	.7500E-01	.7500E-01	.1000E+00	
A5112A6112	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A6112A6113	1	.7500E-01	.7500E-01	.1000E+00	
A6112A7112	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A7112A7113	1	.7500E-01	.7500E-01	.1000E+00	
A7112A8112	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A8112A8113	1	.7500E-01	.7500E-01	.1000E+00	
A8112A9112	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A9112A9113	1	.7500E-01	.7500E-01	.1000E+00	
A9112AA112	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AA112AA113	1	.7500E-01	.7500E-01	.1000E+00	
AA112AB112	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AB112AB113	1	.7500E-01	.7500E-01	.1000E+00	
AB112AC112	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AC112AC113	1	.7500E-01	.7500E-01	.1000E+00	
AC112AD112	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AD112AD113	1	.7500E-01	.7500E-01	.1000E+00	
AD112AE112	3	.5000E-01	.2500E-01	.1500E+00	.1000E+01
AE112AE113	1	.7500E-01	.7500E-01	.5000E-01	
AE112AF112	3	.2500E-01	.2500E-01	.1500E+00	.1000E+01
AF112AF113	1	.7500E-01	.7500E-01	.5000E-01	
AF112AG112	3	.2500E-01	.5000E-01	.1500E+00	.1000E+01
AG112AG113	1	.7500E-01	.7500E-01	.1000E+00	
AG112AH112	3	.5000E-01	.1000E+00	.1500E+00	.1000E+01
AH112AH113	1	.7500E-01	.7500E-01	.2000E+00	
AH112AI112	3	.1000E+00	.1500E+00	.1500E+00	.1000E+01
AI112AI113	1	.7500E-01	.7500E-01	.3000E+00	
A1113A1114	1	.7500E-01	.7500E-01	.1000E+00	
A1113A2113	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A2113A2114	1	.7500E-01	.7500E-01	.1000E+00	
A2113A3113	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A3113A3114	1	.7500E-01	.7500E-01	.1000E+00	
A3113A4113	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A4113A4114	1	.7500E-01	.7500E-01	.1000E+00	
A4113A5113	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A5113A5114	1	.7500E-01	.7500E-01	.1000E+00	
A5113A6113	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A6113A6114	1	.7500E-01	.7500E-01	.1000E+00	
A6113A7113	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A7113A7114	1	.7500E-01	.7500E-01	.1000E+00	
A7113A8113	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A8113A8114	1	.7500E-01	.7500E-01	.1000E+00	
A8113A9113	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A9113A9114	1	.7500E-01	.7500E-01	.1000E+00	
A9113AA113	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AA113AA114	1	.7500E-01	.7500E-01	.1000E+00	
AA113AB113	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AB113AB114	1	.7500E-01	.7500E-01	.1000E+00	
AB113AC113	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AC113AC114	1	.7500E-01	.7500E-01	.1000E+00	
AC113AD113	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AD113AD114	1	.7500E-01	.7500E-01	.1000E+00	
AD113AE113	3	.5000E-01	.2500E-01	.1500E+00	.1000E+01

AE113AE114	1	.7500E-01	.7500E-01	.5000E-01	
AE113AF113	3	.2500E-01	.2500E-01	.1500E+00	.1000E+01
AF113AF114	1	.7500E-01	.7500E-01	.5000E-01	
AF113AG113	3	.2500E-01	.5000E-01	.1500E+00	.1000E+01
AG113AG114	1	.7500E-01	.7500E-01	.1000E+00	
AG113AH113	3	.5000E-01	.1000E+00	.1500E+00	.1000E+01
AH113AH114	1	.7500E-01	.7500E-01	.2000E+00	
AH113AI113	3	.1000E+00	.1500E+00	.1500E+00	.1000E+01
AI113AI114	1	.7500E-01	.7500E-01	.3000E+00	
A1114A1115	1	.7500E-01	.7500E-01	.1000E+00	
A1114A2114	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A2114A2115	1	.7500E-01	.7500E-01	.1000E+00	
A2114A3114	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A3114A3115	1	.7500E-01	.7500E-01	.1000E+00	
A3114A4114	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A4114A4115	1	.7500E-01	.7500E-01	.1000E+00	
A4114A5114	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A5114A5115	1	.7500E-01	.7500E-01	.1000E+00	
A5114A6114	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A6114A6115	1	.7500E-01	.7500E-01	.1000E+00	
A6114A7114	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A7114A7115	1	.7500E-01	.7500E-01	.1000E+00	
A7114A8114	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A8114A8115	1	.7500E-01	.7500E-01	.1000E+00	
A8114A9114	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A9114A9115	1	.7500E-01	.7500E-01	.1000E+00	
A9114AA114	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AA114AA115	1	.7500E-01	.7500E-01	.1000E+00	
AA114AB114	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AB114AB115	1	.7500E-01	.7500E-01	.1000E+00	
AB114AC114	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AC114AC115	1	.7500E-01	.7500E-01	.1000E+00	
AC114AD114	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AD114AD115	1	.7500E-01	.7500E-01	.1000E+00	
AD114AE114	3	.5000E-01	.2500E-01	.1500E+00	.1000E+01
AE114AE115	1	.7500E-01	.7500E-01	.5000E-01	
AE114AF114	3	.2500E-01	.2500E-01	.1500E+00	.1000E+01
AF114AF115	1	.7500E-01	.7500E-01	.5000E-01	
AF114AG114	3	.2500E-01	.5000E-01	.1500E+00	.1000E+01
AG114AG115	1	.7500E-01	.7500E-01	.1000E+00	
AG114AH114	3	.5000E-01	.1000E+00	.1500E+00	.1000E+01
AH114AH115	1	.7500E-01	.7500E-01	.2000E+00	
AH114AI114	3	.1000E+00	.1500E+00	.1500E+00	.1000E+01
AI114AI115	1	.7500E-01	.7500E-01	.3000E+00	
A1115A1116	1	.7500E-01	.7750E-01	.1000E+00	
A1115A2115	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A2115A2116	1	.7500E-01	.7750E-01	.1000E+00	
A2115A3115	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A3115A3116	1	.7500E-01	.7750E-01	.1000E+00	
A3115A4115	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A4115A4116	1	.7500E-01	.7750E-01	.1000E+00	
A4115A5115	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A5115A5116	1	.7500E-01	.7750E-01	.1000E+00	
A5115A6115	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A6115A6116	1	.7500E-01	.7750E-01	.1000E+00	
A6115A7115	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A7115A7116	1	.7500E-01	.7750E-01	.1000E+00	

A7115A8115	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A8115A8116	1	.7500E-01	.7750E-01	.1000E+00	
A8115A9115	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
A9115A9116	1	.7500E-01	.7750E-01	.1000E+00	
A9115AA115	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AA115AA116	1	.7500E-01	.7750E-01	.1000E+00	
AA115AB115	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AB115AB116	1	.7500E-01	.7750E-01	.1000E+00	
AB115AC115	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AC115AC116	1	.7500E-01	.7750E-01	.1000E+00	
AC115AD115	3	.5000E-01	.5000E-01	.1500E+00	.1000E+01
AD115AD116	1	.7500E-01	.7750E-01	.1000E+00	
AD115AE115	3	.5000E-01	.2500E-01	.1500E+00	.1000E+01
AE115AE116	1	.7500E-01	.7750E-01	.5000E-01	
AE115AF115	3	.2500E-01	.2500E-01	.1500E+00	.1000E+01
AF115AF116	1	.7500E-01	.7750E-01	.5000E-01	
AF115AG115	3	.2500E-01	.5000E-01	.1500E+00	.1000E+01
AG115AG116	1	.7500E-01	.7750E-01	.1000E+00	
AG115AH115	3	.5000E-01	.1000E+00	.1500E+00	.1000E+01
AH115AH116	1	.7500E-01	.7750E-01	.2000E+00	
AH115AI115	3	.1000E+00	.1500E+00	.1500E+00	.1000E+01
AI115AI116	1	.7500E-01	.7750E-01	.3000E+00	
A1116A1117	1	.7750E-01	.9000E-01	.1000E+00	
A1116A2116	3	.5000E-01	.5000E-01	.1550E+00	.1000E+01
A2116A2117	1	.7750E-01	.9000E-01	.1000E+00	
A2116A3116	3	.5000E-01	.5000E-01	.1550E+00	.1000E+01
A3116A3117	1	.7750E-01	.9000E-01	.1000E+00	
A3116A4116	3	.5000E-01	.5000E-01	.1550E+00	.1000E+01
A4116A4117	1	.7750E-01	.9000E-01	.1000E+00	
A4116A5116	3	.5000E-01	.5000E-01	.1550E+00	.1000E+01
A5116A5117	1	.7750E-01	.9000E-01	.1000E+00	
A5116A6116	3	.5000E-01	.5000E-01	.1550E+00	.1000E+01
A6116A6117	1	.7750E-01	.9000E-01	.1000E+00	
A6116A7116	3	.5000E-01	.5000E-01	.1550E+00	.1000E+01
A7116A7117	1	.7750E-01	.9000E-01	.1000E+00	
A7116A8116	3	.5000E-01	.5000E-01	.1550E+00	.1000E+01
A8116A8117	1	.7750E-01	.9000E-01	.1000E+00	
A8116A9116	3	.5000E-01	.5000E-01	.1550E+00	.1000E+01
A9116A9117	1	.7750E-01	.9000E-01	.1000E+00	
A9116AA116	3	.5000E-01	.5000E-01	.1550E+00	.1000E+01
AA116AA117	1	.7750E-01	.9000E-01	.1000E+00	
AA116AB116	3	.5000E-01	.5000E-01	.1550E+00	.1000E+01
AB116AB117	1	.7750E-01	.9000E-01	.1000E+00	
AB116AC116	3	.5000E-01	.5000E-01	.1550E+00	.1000E+01
AC116AC117	1	.7750E-01	.9000E-01	.1000E+00	
AC116AD116	3	.5000E-01	.5000E-01	.1550E+00	.1000E+01
AD116AD117	1	.7750E-01	.9000E-01	.1000E+00	
AD116AE116	3	.5000E-01	.2500E-01	.1550E+00	.1000E+01
AE116AE117	1	.7750E-01	.9000E-01	.5000E-01	
AE116AF116	3	.2500E-01	.2500E-01	.1550E+00	.1000E+01
AF116AF117	1	.7750E-01	.9000E-01	.5000E-01	
AF116AG116	3	.2500E-01	.5000E-01	.1550E+00	.1000E+01
AG116AG117	1	.7750E-01	.9000E-01	.1000E+00	
AG116AH116	3	.5000E-01	.1000E+00	.1550E+00	.1000E+01
AH116AH117	1	.7750E-01	.9000E-01	.2000E+00	
AH116AI116	3	.1000E+00	.1500E+00	.1550E+00	.1000E+01
AI116AI117	1	.7750E-01	.9000E-01	.3000E+00	

A1117A1118	1	.9000E-01	.1000E+00	.1000E+00	
A1117A2117	3	.5000E-01	.5000E-01	.1800E+00	.1000E+01
A2117A2118	1	.9000E-01	.1000E+00	.1000E+00	
A2117A3117	3	.5000E-01	.5000E-01	.1800E+00	.1000E+01
A3117A3118	1	.9000E-01	.1000E+00	.1000E+00	
A3117A4117	3	.5000E-01	.5000E-01	.1800E+00	.1000E+01
A4117A4118	1	.9000E-01	.1000E+00	.1000E+00	
A4117A5117	3	.5000E-01	.5000E-01	.1800E+00	.1000E+01
A5117A5118	1	.9000E-01	.1000E+00	.1000E+00	
A5117A6117	3	.5000E-01	.5000E-01	.1800E+00	.1000E+01
A6117A6118	1	.9000E-01	.1000E+00	.1000E+00	
A6117A7117	3	.5000E-01	.5000E-01	.1800E+00	.1000E+01
A7117A7118	1	.9000E-01	.1000E+00	.1000E+00	
A7117A8117	3	.5000E-01	.5000E-01	.1800E+00	.1000E+01
A8117A8118	1	.9000E-01	.1000E+00	.1000E+00	
A8117A9117	3	.5000E-01	.5000E-01	.1800E+00	.1000E+01
A9117A9118	1	.9000E-01	.1000E+00	.1000E+00	
A9117AA117	3	.5000E-01	.5000E-01	.1800E+00	.1000E+01
AA117AA118	1	.9000E-01	.1000E+00	.1000E+00	
AA117AB117	3	.5000E-01	.5000E-01	.1800E+00	.1000E+01
AB117AB118	1	.9000E-01	.1000E+00	.1000E+00	
AB117AC117	3	.5000E-01	.5000E-01	.1800E+00	.1000E+01
AC117AC118	1	.9000E-01	.1000E+00	.1000E+00	
AC117AD117	3	.5000E-01	.5000E-01	.1800E+00	.1000E+01
AD117AD118	1	.9000E-01	.1000E+00	.1000E+00	
AD117AE117	3	.5000E-01	.2500E-01	.1800E+00	.1000E+01
AE117AE118	1	.9000E-01	.1000E+00	.5000E-01	
AE117AF117	3	.2500E-01	.2500E-01	.1800E+00	.1000E+01
AF117AF118	1	.9000E-01	.1000E+00	.5000E-01	
AF117AG117	3	.2500E-01	.5000E-01	.1800E+00	.1000E+01
AG117AG118	1	.9000E-01	.1000E+00	.1000E+00	
AG117AH117	3	.5000E-01	.1000E+00	.1800E+00	.1000E+01
AH117AH118	1	.9000E-01	.1000E+00	.2000E+00	
AH117AI117	3	.1000E+00	.1500E+00	.1800E+00	.1000E+01
AI117AI118	1	.9000E-01	.1000E+00	.3000E+00	
A1118A1119	1	.1000E+00	.1000E+00	.1000E+00	
A1118A2118	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A2118A2119	1	.1000E+00	.1000E+00	.1000E+00	
A2118A3118	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A3118A3119	1	.1000E+00	.1000E+00	.1000E+00	
A3118A4118	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A4118A4119	1	.1000E+00	.1000E+00	.1000E+00	
A4118A5118	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A5118A5119	1	.1000E+00	.1000E+00	.1000E+00	
A5118A6118	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A6118A6119	1	.1000E+00	.1000E+00	.1000E+00	
A6118A7118	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A7118A7119	1	.1000E+00	.1000E+00	.1000E+00	
A7118A8118	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A8118A8119	1	.1000E+00	.1000E+00	.1000E+00	
A8118A9118	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A9118A9119	1	.1000E+00	.1000E+00	.1000E+00	
A9118AA118	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
AA118AA119	1	.1000E+00	.1000E+00	.1000E+00	
AA118AB118	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
AB118AB119	1	.1000E+00	.1000E+00	.1000E+00	
AB118AC118	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01

AC118AC119	1	.1000E+00	.1000E+00	.1000E+00	
AC118AD118	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
AD118AD119	1	.1000E+00	.1000E+00	.1000E+00	
AD118AE118	3	.5000E-01	.2500E-01	.2000E+00	.1000E+01
AE118AE119	1	.1000E+00	.1000E+00	.5000E-01	
AE118AF118	3	.2500E-01	.2500E-01	.2000E+00	.1000E+01
AF118AF119	1	.1000E+00	.1000E+00	.5000E-01	
AF118AG118	3	.2500E-01	.5000E-01	.2000E+00	.1000E+01
AG118AG119	1	.1000E+00	.1000E+00	.1000E+00	
AG118AH118	3	.5000E-01	.1000E+00	.2000E+00	.1000E+01
AH118AH119	1	.1000E+00	.1000E+00	.2000E+00	
AH118AI118	3	.1000E+00	.1500E+00	.2000E+00	.1000E+01
AI118AI119	1	.1000E+00	.1000E+00	.3000E+00	
A1119A1120	1	.1000E+00	.1000E+00	.1000E+00	
A1119A2119	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A2119A2120	1	.1000E+00	.1000E+00	.1000E+00	
A2119A3119	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A3119A3120	1	.1000E+00	.1000E+00	.1000E+00	
A3119A4119	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A4119A4120	1	.1000E+00	.1000E+00	.1000E+00	
A4119A5119	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A5119A5120	1	.1000E+00	.1000E+00	.1000E+00	
A5119A6119	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A6119A6120	1	.1000E+00	.1000E+00	.1000E+00	
A6119A7119	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A7119A7120	1	.1000E+00	.1000E+00	.1000E+00	
A7119A8119	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A8119A8120	1	.1000E+00	.1000E+00	.1000E+00	
A8119A9119	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A9119A9120	1	.1000E+00	.1000E+00	.1000E+00	
A9119AA119	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
AA119AA120	1	.1000E+00	.1000E+00	.1000E+00	
AA119AB119	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
AB119AB120	1	.1000E+00	.1000E+00	.1000E+00	
AB119AC119	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
AC119AC120	1	.1000E+00	.1000E+00	.1000E+00	
AC119AD119	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
AD119AD120	1	.1000E+00	.1000E+00	.1000E+00	
AD119AE119	3	.5000E-01	.2500E-01	.2000E+00	.1000E+01
AE119AE120	1	.1000E+00	.1000E+00	.5000E-01	
AE119AF119	3	.2500E-01	.2500E-01	.2000E+00	.1000E+01
AF119AF120	1	.1000E+00	.1000E+00	.5000E-01	
AF119AG119	3	.2500E-01	.5000E-01	.2000E+00	.1000E+01
AG119AG120	1	.1000E+00	.1000E+00	.1000E+00	
AG119AH119	3	.5000E-01	.1000E+00	.2000E+00	.1000E+01
AH119AH120	1	.1000E+00	.1000E+00	.2000E+00	
AH119AI119	3	.1000E+00	.1500E+00	.2000E+00	.1000E+01
AI119AI120	1	.1000E+00	.1000E+00	.3000E+00	
A1120A1121	1	.1000E+00	.1000E-09	.1000E+00	
A1120A2120	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A2120A2121	1	.1000E+00	.1000E-09	.1000E+00	
A2120A3120	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A3120A3121	1	.1000E+00	.1000E-09	.1000E+00	
A3120A4120	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A4120A4121	1	.1000E+00	.1000E-09	.1000E+00	
A4120A5120	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A5120A5121	1	.1000E+00	.1000E-09	.1000E+00	

A5120A6120	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A6120A6121	1	.1000E+00	.1000E-09	.1000E+00	
A6120A7120	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A7120A7121	1	.1000E+00	.1000E-09	.1000E+00	
A7120A8120	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A8120A8121	1	.1000E+00	.1000E-09	.1000E+00	
A8120A9120	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
A9120A9121	1	.1000E+00	.1000E-09	.1000E+00	
A9120AA120	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
AA120AA121	1	.1000E+00	.1000E-09	.1000E+00	
AA120AB120	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
AB120AB121	1	.1000E+00	.1000E-09	.1000E+00	
AB120AC120	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
AC120AC121	1	.1000E+00	.1000E-09	.1000E+00	
AC120AD120	3	.5000E-01	.5000E-01	.2000E+00	.1000E+01
AD120AD121	1	.1000E+00	.1000E-09	.1000E+00	
AD120AE120	3	.5000E-01	.2500E-01	.2000E+00	.1000E+01
AE120AE121	1	.1000E+00	.1000E-09	.5000E-01	
AE120AF120	3	.2500E-01	.2500E-01	.2000E+00	.1000E+01
AF120AF121	1	.1000E+00	.1000E-09	.5000E-01	
AF120AG120	3	.2500E-01	.5000E-01	.2000E+00	.1000E+01
AG120AG121	1	.1000E+00	.1000E-09	.1000E+00	
AG120AH120	3	.5000E-01	.1000E+00	.2000E+00	.1000E+01
AH120AH121	1	.1000E+00	.1000E-09	.2000E+00	
AH120AI120	3	.1000E+00	.1500E+00	.2000E+00	.1000E+01
AI120AI121	1	.1000E+00	.1000E-09	.3000E+00	
A1121A2121	3	.5000E-01	.5000E-01	.1000E-03	.1000E+01
A2121A3121	3	.5000E-01	.5000E-01	.1000E-03	.1000E+01
A3121A4121	3	.5000E-01	.5000E-01	.1000E-03	.1000E+01
A4121A5121	3	.5000E-01	.5000E-01	.1000E-03	.1000E+01
A5121A6121	3	.5000E-01	.5000E-01	.1000E-03	.1000E+01
A6121A7121	3	.5000E-01	.5000E-01	.1000E-03	.1000E+01
A7121A8121	3	.5000E-01	.5000E-01	.1000E-03	.1000E+01
A8121A9121	3	.5000E-01	.5000E-01	.1000E-03	.1000E+01
A9121AA121	3	.5000E-01	.5000E-01	.1000E-03	.1000E+01
AA121AB121	3	.5000E-01	.5000E-01	.1000E-03	.1000E+01
AB121AC121	3	.5000E-01	.5000E-01	.1000E-03	.1000E+01
AC121AD121	3	.5000E-01	.5000E-01	.1000E-03	.1000E+01
AD121AE121	3	.5000E-01	.2500E-01	.1000E-03	.1000E+01
AE121AF121	3	.2500E-01	.2500E-01	.1000E-03	.1000E+01
AF121AG121	3	.2500E-01	.5000E-01	.1000E-03	.1000E+01
AG121AH121	3	.5000E-01	.1000E+00	.1000E-03	.1000E+01
AH121AI121	3	.1000E+00	.1500E+00	.1000E-03	.1000E+01

GENER	1	2	3	4	5	6	7	8
A11 1INF 1	0	0	0	0	WATE 4.72006E-3	83996.3		
A11 2INF 2	0	0	0	0	WATE 6.1566E-3	83996.3		
A11 3INF 3	0	0	0	0	WATE 6.1566E-3	83996.3		
A11 4INF 4	0	0	0	0	WATE 3.48874E-3	83996.3		

INCON	1	2	3	4	5	6	7	8
A11 1 19	1							
	101330.		0.97122958			20.		
A1121 0	0							
	101330.		20.			1.		
A21 1 19	1							
	101330.		0.96398330			20.		

A2121	0	0		
		101330.	20.	1.
A31 1	19	1		
		101330.	0.95411992	20.
A3121	0	0		
		101330.	20.	1.
A41 1	19	1		
		101330.	0.94038369	20.
A4121	0	0		
		101330.	20.	1.
A51 1	19	1		
		101330.	0.92076694	20.
A5121	0	0		
		101330.	20.	1.
A61 1	19	1		
		101330.	0.89199109	20.
A6121	0	0		
		101330.	20.	1.
A71 1	19	1		
		101330.	0.84864353	20.
A7121	0	0		
		101330.	20.	1.
A81 1	19	1		
		101330.	0.78193262	20.
A8121	0	0		
		101330.	20.	1.
A91 1	19	1		
		101330.	0.67879333	20.
A9121	0	0		
		101330.	20.	1.
AA1 1	19	1		
		101330.	0.52525740	20.
AA121	0	0		
		101330.	20.	1.
AB1 1	19	1		
		101330.	0.32450116	20.
AB121	0	0		
		101330.	20.	1.
AC1 1	19	1		
		101330.	0.12909198	20.
AC121	0	0		
		101330.	20.	1.
AD1 1	19	1		
		101330.	0.01947154	20.
AD121	0	0		
		101330.	20.	1.
AE1 1	19	1		
		101330.	3.562964E-4	20.
AE121	0	0		
		101330.	20.	1.
AF1 1	20	1		
		101574.76	20.	00.
AG1 1	20	1		
		102309.03	20.	00.
AH1 1	20	1		
		103777.59	20.	00.
AI1 1	20	1		

106225.19

20.

00.

ENDCY---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8
MESHM---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8
XYZ ---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8

0.0

NX

21

0.115	0.15	0.155	0.09	0.08	0.14	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.16
0.18	0.20	0.20	0.20	1.E-4			

NZ

21

0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
0.10	0.10	0.10	0.10	0.10	0.05	0.05	0.10
0.20	0.30						

ENDFI---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8

val2a ... Validation Problem No.2.

START 2-d convection cell in r-z; Reda (1984)

START 7-10-92: George's latest data file

START grid generation using MESHMAKER from TOUGH2

START flow channeling accounted for

ROCKS	1	2	3	4	5	6	7	8
SOIL1	0	2500.0	0.34	610.E-12	610.E-12	610.E-12	0.87	740.
SOIL2	0	2500.0	0.34	1159.E-12	1159.E-12	1159.E-12	0.87	740.
SOIL3	0	2500.0	0.34	1037.E-12	1037.E-12	1037.E-12	0.87	740.
SOIL4	0	2500.0	0.34	915.E-12	915.E-12	915.E-12	0.87	740.
SOIL5	0	2500.0	0.34	793.E-12	793.E-12	793.E-12	0.87	740.
SOIL6	0	2500.0	0.34	671.E-12	671.E-12	671.E-12	0.87	740.
BOUND	0	2500.0	0.34	610.E-12	610.E-12	610.E-12	0.87	1.E04
TCOND	0	2500.0	1.e-5	000.E-12	000.E-12	000.E-12	0.87	1.E54
HEATR	1	7400.0	1.e-5	0.0	0.0	0.0	50.2	569.40

1.e-5

START

PARAM	1	2	3	4	5	6	7	8
8 1 900	9001000000	0000 0 41		2.13E-5	1.80			
	0.	1.e5	-1.	1.e4A1 2	-9.807	4.	1.	
	.1	.9	9.					
	1.E-5	1.	0.1	1.	1.	1.E-8		
		2.e5		21.5	0.			

TIMES	1	2	3	4	5	6	7	8
14 14								
	100.	200.	300.	550.	800.	1100.	2000.	2500.
	3000.	3500.	4000.	5000.	1.e4	1.e5		

RPCAP	1	2	3	4	5	6	7	8
1	0.	0.	0.1	0.1				
1	0.	0.	0.1					

GENER	1	2	3	4	5	6	7	8
A9 1HEA 1	0	0	0	1	HEAT	5.8331680		
AA 1HEA 2	0	0	0	1	HEAT	5.8331680		
AB 1HEA 3	0	0	0	1	HEAT	5.8331680		
AC 1HEA 4	0	0	0	1	HEAT	5.8331680		
AD 1HEA 5	0	0	0	1	HEAT	5.8331680		
AE 1HEA 6	0	0	0	1	HEAT	5.8331680		
AF 1HEA 7	0	0	0	1	HEAT	5.8331680		
AG 1HEA 8	0	0	0	1	HEAT	5.8331680		
AH 1HEA 9	0	0	0	1	HEAT	5.8331680		
AI 1HEA10	0	0	0	1	HEAT	5.8331680		
AJ 1HEA11	0	0	0	1	HEAT	5.8331680		
AK 1HEA12	0	0	0	1	HEAT	5.8331680		

INCON	1	2	3	4	5	6	7	8

ELEME	16	11	1	5	0.00000	0.219		
A9 1					HEATR0.5943E-050.0000E+00	0.4750E-02	-.4087E+00	
AA 1					HEATR0.5943E-050.0000E+00	0.4750E-02	-.4297E+00	
AB 1					HEATR0.5943E-050.0000E+00	0.4750E-02	-.4506E+00	
AC 1					HEATR0.5943E-050.0000E+00	0.4750E-02	-.4716E+00	
AD 1					HEATR0.5943E-050.0000E+00	0.4750E-02	-.4926E+00	
AE 1					HEATR0.5943E-050.0000E+00	0.4750E-02	-.5135E+00	
AF 1					HEATR0.5943E-050.0000E+00	0.4750E-02	-.5345E+00	
AG 1					HEATR0.5943E-050.0000E+00	0.4750E-02	-.5554E+00	
AH 1					HEATR0.5943E-050.0000E+00	0.4750E-02	-.5764E+00	

AI	1	HEATR0.5943E-050.0000E+00	0.4750E-02	-.5974E+00
AJ	1	HEATR0.5943E-050.0000E+00	0.4750E-02	-.6183E+00
AK	1	HEATR0.5943E-050.0000E+00	0.4750E-02	-.6393E+00
A1	2	SOIL20.2944E-050.4013E-04	0.9825E-02	-.3668E-01
A2	2	SOIL20.2944E-050.0000E+00	0.9825E-02	-.1100E+00
A3	2	SOIL20.2944E-050.0000E+00	0.9825E-02	-.1834E+00
A4	2	SOIL20.2944E-050.0000E+00	0.9825E-02	-.2568E+00
A5	2	SOIL20.1682E-050.0000E+00	0.9825E-02	-.3144E+00
A6	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.3458E+00
A7	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.3668E+00
A8	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.3878E+00
A9	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.4087E+00
AA	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.4297E+00
AB	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.4506E+00
AC	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.4716E+00
AD	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.4926E+00
AE	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.5135E+00
AF	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.5345E+00
AG	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.5554E+00
AH	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.5764E+00
AI	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.5974E+00
AJ	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.6183E+00
AK	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.6393E+00
AL	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.6602E+00
AM	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.6812E+00
AN	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.7022E+00
AO	2	SOIL20.1682E-050.0000E+00	0.9825E-02	-.7336E+00
AP	2	SOIL20.1682E-050.0000E+00	0.9825E-02	-.7755E+00
AQ	2	SOIL20.1682E-050.0000E+00	0.9825E-02	-.8174E+00
AR	2	BOUND0.4013E+490.4013E-04	0.9825E-02	-.8384E+00
A1	3	SOIL30.3138E-050.4278E-04	0.1047E-01	-.3668E-01
A2	3	SOIL30.3138E-050.0000E+00	0.1047E-01	-.1100E+00
A3	3	SOIL30.3138E-050.0000E+00	0.1047E-01	-.1834E+00
A4	3	SOIL30.3138E-050.0000E+00	0.1047E-01	-.2568E+00
A5	3	SOIL30.1793E-050.0000E+00	0.1047E-01	-.3144E+00
A6	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.3458E+00
A7	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.3668E+00
A8	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.3878E+00
A9	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.4087E+00
AA	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.4297E+00
AB	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.4506E+00
AC	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.4716E+00
AD	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.4926E+00
AE	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.5135E+00
AF	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.5345E+00
AG	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.5554E+00
AH	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.5764E+00
AI	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.5974E+00
AJ	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.6183E+00
AK	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.6393E+00
AL	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.6602E+00
AM	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.6812E+00
AN	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.7022E+00
AO	3	SOIL30.1793E-050.0000E+00	0.1047E-01	-.7336E+00
AP	3	SOIL30.1793E-050.0000E+00	0.1047E-01	-.7755E+00
AQ	3	SOIL30.1793E-050.0000E+00	0.1047E-01	-.8174E+00
AR	3	BOUND0.4278E+490.4278E-04	0.1047E-01	-.8384E+00

A1	4	SOIL40.3333E-050.4544E-04	0.1112E-01	-.3668E-01
A2	4	SOIL40.3333E-050.0000E+00	0.1112E-01	-.1100E+00
A3	4	SOIL40.3333E-050.0000E+00	0.1112E-01	-.1834E+00
A4	4	SOIL40.3333E-050.0000E+00	0.1112E-01	-.2568E+00
A5	4	SOIL40.1905E-050.0000E+00	0.1112E-01	-.3144E+00
A6	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.3458E+00
A7	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.3668E+00
A8	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.3878E+00
A9	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.4087E+00
AA	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.4297E+00
AB	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.4506E+00
AC	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.4716E+00
AD	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.4926E+00
AE	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.5135E+00
AF	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.5345E+00
AG	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.5554E+00
AH	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.5764E+00
AI	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.5974E+00
AJ	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.6183E+00
AK	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.6393E+00
AL	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.6602E+00
AM	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.6812E+00
AN	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.7022E+00
AO	4	SOIL40.1905E-050.0000E+00	0.1112E-01	-.7336E+00
AP	4	SOIL40.1905E-050.0000E+00	0.1112E-01	-.7755E+00
AQ	4	SOIL40.1905E-050.0000E+00	0.1112E-01	-.8174E+00
AR	4	BOUND0.4544E+490.4544E-04	0.1112E-01	-.8384E+00
A1	5	SOIL50.3528E-050.4809E-04	0.1177E-01	-.3668E-01
A2	5	SOIL50.3528E-050.0000E+00	0.1177E-01	-.1100E+00
A3	5	SOIL50.3528E-050.0000E+00	0.1177E-01	-.1834E+00
A4	5	SOIL50.3528E-050.0000E+00	0.1177E-01	-.2568E+00
A5	5	SOIL50.2016E-050.0000E+00	0.1177E-01	-.3144E+00
A6	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.3458E+00
A7	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.3668E+00
A8	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.3878E+00
A9	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.4087E+00
AA	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.4297E+00
AB	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.4506E+00
AC	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.4716E+00
AD	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.4926E+00
AE	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.5135E+00
AF	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.5345E+00
AG	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.5554E+00
AH	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.5764E+00
AI	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.5974E+00
AJ	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.6183E+00
AK	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.6393E+00
AL	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.6602E+00
AM	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.6812E+00
AN	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.7022E+00
AO	5	SOIL50.2016E-050.0000E+00	0.1177E-01	-.7336E+00
AP	5	SOIL50.2016E-050.0000E+00	0.1177E-01	-.7755E+00
AQ	5	SOIL50.2016E-050.0000E+00	0.1177E-01	-.8174E+00
AR	5	BOUND0.4809E+490.4809E-04	0.1177E-01	-.8384E+00
A1	6	SOIL60.3723E-050.5074E-04	0.1242E-01	-.3668E-01
A2	6	SOIL60.3723E-050.0000E+00	0.1242E-01	-.1100E+00
A3	6	SOIL60.3723E-050.0000E+00	0.1242E-01	-.1834E+00

A4	6	SOIL60.3723E-050.0000E+00	0.1242E-01	-.2568E+00
A5	6	SOIL60.2127E-050.0000E+00	0.1242E-01	-.3144E+00
A6	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.3458E+00
A7	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.3668E+00
A8	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.3878E+00
A9	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.4087E+00
AA	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.4297E+00
AB	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.4506E+00
AC	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.4716E+00
AD	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.4926E+00
AE	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.5135E+00
AF	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.5345E+00
AG	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.5554E+00
AH	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.5764E+00
AI	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.5974E+00
AJ	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.6183E+00
AK	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.6393E+00
AL	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.6602E+00
AM	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.6812E+00
AN	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.7022E+00
AO	6	SOIL60.2127E-050.0000E+00	0.1242E-01	-.7336E+00
AP	6	SOIL60.2127E-050.0000E+00	0.1242E-01	-.7755E+00
AQ	6	SOIL60.2127E-050.0000E+00	0.1242E-01	-.8174E+00
AR	6	BOUND0.5074E+490.5074E-04	0.1242E-01	-.8384E+00
A1	7	10.1439E-040.1962E-03	0.1387E-01	-.3668E-01
A2	7	10.1439E-040.0000E+00	0.1387E-01	-.1100E+00
A3	7	10.1439E-040.0000E+00	0.1387E-01	-.1834E+00
A4	7	10.1439E-040.0000E+00	0.1387E-01	-.2568E+00
A5	7	10.8223E-050.0000E+00	0.1387E-01	-.3144E+00
A6	7	10.4111E-050.0000E+00	0.1387E-01	-.3458E+00
A7	7	10.4111E-050.0000E+00	0.1387E-01	-.3668E+00
A8	7	10.4111E-050.0000E+00	0.1387E-01	-.3878E+00
A9	7	10.4111E-050.0000E+00	0.1387E-01	-.4087E+00
AA	7	10.4111E-050.0000E+00	0.1387E-01	-.4297E+00
AB	7	10.4111E-050.0000E+00	0.1387E-01	-.4506E+00
AC	7	10.4111E-050.0000E+00	0.1387E-01	-.4716E+00
AD	7	10.4111E-050.0000E+00	0.1387E-01	-.4926E+00
AE	7	10.4111E-050.0000E+00	0.1387E-01	-.5135E+00
AF	7	10.4111E-050.0000E+00	0.1387E-01	-.5345E+00
AG	7	10.4111E-050.0000E+00	0.1387E-01	-.5554E+00
AH	7	10.4111E-050.0000E+00	0.1387E-01	-.5764E+00
AI	7	10.4111E-050.0000E+00	0.1387E-01	-.5974E+00
AJ	7	10.4111E-050.0000E+00	0.1387E-01	-.6183E+00
AK	7	10.4111E-050.0000E+00	0.1387E-01	-.6393E+00
AL	7	10.4111E-050.0000E+00	0.1387E-01	-.6602E+00
AM	7	10.4111E-050.0000E+00	0.1387E-01	-.6812E+00
AN	7	10.4111E-050.0000E+00	0.1387E-01	-.7022E+00
AO	7	10.8223E-050.0000E+00	0.1387E-01	-.7336E+00
AP	7	10.8223E-050.0000E+00	0.1387E-01	-.7755E+00
AQ	7	10.8223E-050.0000E+00	0.1387E-01	-.8174E+00
AR	7	BOUND0.1962E+480.1962E-03	0.1387E-01	-.8384E+00
A1	8	10.4033E-040.5498E-03	0.1750E-01	-.3668E-01
A2	8	10.4033E-040.0000E+00	0.1750E-01	-.1100E+00
A3	8	10.4033E-040.0000E+00	0.1750E-01	-.1834E+00
A4	8	10.4033E-040.0000E+00	0.1750E-01	-.2568E+00
A5	8	10.2305E-040.0000E+00	0.1750E-01	-.3144E+00
A6	8	10.1152E-040.0000E+00	0.1750E-01	-.3458E+00

A7	8	10.1152E-040.0000E+00	0.1750E-01	-.3668E+00
A8	8	10.1152E-040.0000E+00	0.1750E-01	-.3878E+00
A9	8	10.1152E-040.0000E+00	0.1750E-01	-.4087E+00
AA	8	10.1152E-040.0000E+00	0.1750E-01	-.4297E+00
AB	8	10.1152E-040.0000E+00	0.1750E-01	-.4506E+00
AC	8	10.1152E-040.0000E+00	0.1750E-01	-.4716E+00
AD	8	10.1152E-040.0000E+00	0.1750E-01	-.4926E+00
AE	8	10.1152E-040.0000E+00	0.1750E-01	-.5135E+00
AF	8	10.1152E-040.0000E+00	0.1750E-01	-.5345E+00
AG	8	10.1152E-040.0000E+00	0.1750E-01	-.5554E+00
AH	8	10.1152E-040.0000E+00	0.1750E-01	-.5764E+00
AI	8	10.1152E-040.0000E+00	0.1750E-01	-.5974E+00
AJ	8	10.1152E-040.0000E+00	0.1750E-01	-.6183E+00
AK	8	10.1152E-040.0000E+00	0.1750E-01	-.6393E+00
AL	8	10.1152E-040.0000E+00	0.1750E-01	-.6602E+00
AM	8	10.1152E-040.0000E+00	0.1750E-01	-.6812E+00
AN	8	10.1152E-040.0000E+00	0.1750E-01	-.7022E+00
AO	8	10.2305E-040.0000E+00	0.1750E-01	-.7336E+00
AP	8	10.2305E-040.0000E+00	0.1750E-01	-.7755E+00
AQ	8	10.2305E-040.0000E+00	0.1750E-01	-.8174E+00
AR	8	BOUND0.5498E+480.5498E-03	0.1750E-01	-.8384E+00
A1	9	10.1152E-030.1571E-02	0.2500E-01	-.3668E-01
A2	9	10.1152E-030.0000E+00	0.2500E-01	-.1100E+00
A3	9	10.1152E-030.0000E+00	0.2500E-01	-.1834E+00
A4	9	10.1152E-030.0000E+00	0.2500E-01	-.2568E+00
A5	9	10.6585E-040.0000E+00	0.2500E-01	-.3144E+00
A6	9	10.3292E-040.0000E+00	0.2500E-01	-.3458E+00
A7	9	10.3292E-040.0000E+00	0.2500E-01	-.3668E+00
A8	9	10.3292E-040.0000E+00	0.2500E-01	-.3878E+00
A9	9	10.3292E-040.0000E+00	0.2500E-01	-.4087E+00
AA	9	10.3292E-040.0000E+00	0.2500E-01	-.4297E+00
AB	9	10.3292E-040.0000E+00	0.2500E-01	-.4506E+00
AC	9	10.3292E-040.0000E+00	0.2500E-01	-.4716E+00
AD	9	10.3292E-040.0000E+00	0.2500E-01	-.4926E+00
AE	9	10.3292E-040.0000E+00	0.2500E-01	-.5135E+00
AF	9	10.3292E-040.0000E+00	0.2500E-01	-.5345E+00
AG	9	10.3292E-040.0000E+00	0.2500E-01	-.5554E+00
AH	9	10.3292E-040.0000E+00	0.2500E-01	-.5764E+00
AI	9	10.3292E-040.0000E+00	0.2500E-01	-.5974E+00
AJ	9	10.3292E-040.0000E+00	0.2500E-01	-.6183E+00
AK	9	10.3292E-040.0000E+00	0.2500E-01	-.6393E+00
AL	9	10.3292E-040.0000E+00	0.2500E-01	-.6602E+00
AM	9	10.3292E-040.0000E+00	0.2500E-01	-.6812E+00
AN	9	10.3292E-040.0000E+00	0.2500E-01	-.7022E+00
AO	9	10.6585E-040.0000E+00	0.2500E-01	-.7336E+00
AP	9	10.6585E-040.0000E+00	0.2500E-01	-.7755E+00
AQ	9	10.6585E-040.0000E+00	0.2500E-01	-.8174E+00
AR	9	BOUND0.1571E+470.1571E-02	0.2500E-01	-.8384E+00
A1	10	10.3687E-030.5027E-02	0.4000E-01	-.3668E-01
A2	10	10.3687E-030.0000E+00	0.4000E-01	-.1100E+00
A3	10	10.3687E-030.0000E+00	0.4000E-01	-.1834E+00
A4	10	10.3687E-030.0000E+00	0.4000E-01	-.2568E+00
A5	10	10.2107E-030.0000E+00	0.4000E-01	-.3144E+00
A6	10	10.1054E-030.0000E+00	0.4000E-01	-.3458E+00
A7	10	10.1054E-030.0000E+00	0.4000E-01	-.3668E+00
A8	10	10.1054E-030.0000E+00	0.4000E-01	-.3878E+00
A9	10	10.1054E-030.0000E+00	0.4000E-01	-.4087E+00

AA 10	10.1054E-030.0000E+00	0.4000E-01	-.4297E+00
AB 10	10.1054E-030.0000E+00	0.4000E-01	-.4506E+00
AC 10	10.1054E-030.0000E+00	0.4000E-01	-.4716E+00
AD 10	10.1054E-030.0000E+00	0.4000E-01	-.4926E+00
AE 10	10.1054E-030.0000E+00	0.4000E-01	-.5135E+00
AF 10	10.1054E-030.0000E+00	0.4000E-01	-.5345E+00
AG 10	10.1054E-030.0000E+00	0.4000E-01	-.5554E+00
AH 10	10.1054E-030.0000E+00	0.4000E-01	-.5764E+00
AI 10	10.1054E-030.0000E+00	0.4000E-01	-.5974E+00
AJ 10	10.1054E-030.0000E+00	0.4000E-01	-.6183E+00
AK 10	10.1054E-030.0000E+00	0.4000E-01	-.6393E+00
AL 10	10.1054E-030.0000E+00	0.4000E-01	-.6602E+00
AM 10	10.1054E-030.0000E+00	0.4000E-01	-.6812E+00
AN 10	10.1054E-030.0000E+00	0.4000E-01	-.7022E+00
AO 10	10.2107E-030.0000E+00	0.4000E-01	-.7336E+00
AP 10	10.2107E-030.0000E+00	0.4000E-01	-.7755E+00
AQ 10	10.2107E-030.0000E+00	0.4000E-01	-.8174E+00
AR 10	BOUND0.5027E+470.5027E-02	0.4000E-01	-.8384E+00
A1 11	10.6726E-030.9169E-02	0.6181E-01	-.3668E-01
A2 11	10.6726E-030.0000E+00	0.6181E-01	-.1100E+00
A3 11	10.6726E-030.0000E+00	0.6181E-01	-.1834E+00
A4 11	10.6726E-030.0000E+00	0.6181E-01	-.2568E+00
A5 11	10.3844E-030.0000E+00	0.6181E-01	-.3144E+00
A6 11	10.1922E-030.0000E+00	0.6181E-01	-.3458E+00
A7 11	10.1922E-030.0000E+00	0.6181E-01	-.3668E+00
A8 11	10.1922E-030.0000E+00	0.6181E-01	-.3878E+00
A9 11	10.1922E-030.0000E+00	0.6181E-01	-.4087E+00
AA 11	10.1922E-030.0000E+00	0.6181E-01	-.4297E+00
AB 11	10.1922E-030.0000E+00	0.6181E-01	-.4506E+00
AC 11	10.1922E-030.0000E+00	0.6181E-01	-.4716E+00
AD 11	10.1922E-030.0000E+00	0.6181E-01	-.4926E+00
AE 11	10.1922E-030.0000E+00	0.6181E-01	-.5135E+00
AF 11	10.1922E-030.0000E+00	0.6181E-01	-.5345E+00
AG 11	10.1922E-030.0000E+00	0.6181E-01	-.5554E+00
AH 11	10.1922E-030.0000E+00	0.6181E-01	-.5764E+00
AI 11	10.1922E-030.0000E+00	0.6181E-01	-.5974E+00
AJ 11	10.1922E-030.0000E+00	0.6181E-01	-.6183E+00
AK 11	10.1922E-030.0000E+00	0.6181E-01	-.6393E+00
AL 11	10.1922E-030.0000E+00	0.6181E-01	-.6602E+00
AM 11	10.1922E-030.0000E+00	0.6181E-01	-.6812E+00
AN 11	10.1922E-030.0000E+00	0.6181E-01	-.7022E+00
AO 11	10.3844E-030.0000E+00	0.6181E-01	-.7336E+00
AP 11	10.3844E-030.0000E+00	0.6181E-01	-.7755E+00
AQ 11	10.3844E-030.0000E+00	0.6181E-01	-.8174E+00
AR 11	BOUND0.9169E+470.9169E-02	0.6181E-01	-.8384E+00
A1 12	10.1125E-020.1533E-01	0.8755E-01	-.3668E-01
A2 12	10.1125E-020.0000E+00	0.8755E-01	-.1100E+00
A3 12	10.1125E-020.0000E+00	0.8755E-01	-.1834E+00
A4 12	10.1125E-020.0000E+00	0.8755E-01	-.2568E+00
A5 12	10.6428E-030.0000E+00	0.8755E-01	-.3144E+00
A6 12	10.3214E-030.0000E+00	0.8755E-01	-.3458E+00
A7 12	10.3214E-030.0000E+00	0.8755E-01	-.3668E+00
A8 12	10.3214E-030.0000E+00	0.8755E-01	-.3878E+00
A9 12	10.3214E-030.0000E+00	0.8755E-01	-.4087E+00
AA 12	10.3214E-030.0000E+00	0.8755E-01	-.4297E+00
AB 12	10.3214E-030.0000E+00	0.8755E-01	-.4506E+00
AC 12	10.3214E-030.0000E+00	0.8755E-01	-.4716E+00

AD 12	10.3214E-030.0000E+00	0.8755E-01	-.4926E+00
AE 12	10.3214E-030.0000E+00	0.8755E-01	-.5135E+00
AF 12	10.3214E-030.0000E+00	0.8755E-01	-.5345E+00
AG 12	10.3214E-030.0000E+00	0.8755E-01	-.5554E+00
AH 12	10.3214E-030.0000E+00	0.8755E-01	-.5764E+00
AI 12	10.3214E-030.0000E+00	0.8755E-01	-.5974E+00
AJ 12	10.3214E-030.0000E+00	0.8755E-01	-.6183E+00
AK 12	10.3214E-030.0000E+00	0.8755E-01	-.6393E+00
AL 12	10.3214E-030.0000E+00	0.8755E-01	-.6602E+00
AM 12	10.3214E-030.0000E+00	0.8755E-01	-.6812E+00
AN 12	10.3214E-030.0000E+00	0.8755E-01	-.7022E+00
AO 12	10.6428E-030.0000E+00	0.8755E-01	-.7336E+00
AP 12	10.6428E-030.0000E+00	0.8755E-01	-.7755E+00
AQ 12	10.6428E-030.0000E+00	0.8755E-01	-.8174E+00
AR 12	BOUND0.1533E+460.1533E-01	0.8755E-01	-.8384E+00
A1 13	10.1789E-020.2438E+00	0.1179E+00	-.3668E-01
A2 13	10.1789E-020.0000E+00	0.1179E+00	-.1100E+00
A3 13	10.1789E-020.0000E+00	0.1179E+00	-.1834E+00
A4 13	10.1789E-020.0000E+00	0.1179E+00	-.2568E+00
A5 13	10.1022E-020.0000E+00	0.1179E+00	-.3144E+00
A6 13	10.5111E-030.0000E+00	0.1179E+00	-.3458E+00
A7 13	10.5111E-030.0000E+00	0.1179E+00	-.3668E+00
A8 13	10.5111E-030.0000E+00	0.1179E+00	-.3878E+00
A9 13	10.5111E-030.0000E+00	0.1179E+00	-.4087E+00
AA 13	10.5111E-030.0000E+00	0.1179E+00	-.4297E+00
AB 13	10.5111E-030.0000E+00	0.1179E+00	-.4506E+00
AC 13	10.5111E-030.0000E+00	0.1179E+00	-.4716E+00
AD 13	10.5111E-030.0000E+00	0.1179E+00	-.4926E+00
AE 13	10.5111E-030.0000E+00	0.1179E+00	-.5135E+00
AF 13	10.5111E-030.0000E+00	0.1179E+00	-.5345E+00
AG 13	10.5111E-030.0000E+00	0.1179E+00	-.5554E+00
AH 13	10.5111E-030.0000E+00	0.1179E+00	-.5764E+00
AI 13	10.5111E-030.0000E+00	0.1179E+00	-.5974E+00
AJ 13	10.5111E-030.0000E+00	0.1179E+00	-.6183E+00
AK 13	10.5111E-030.0000E+00	0.1179E+00	-.6393E+00
AL 13	10.5111E-030.0000E+00	0.1179E+00	-.6602E+00
AM 13	10.5111E-030.0000E+00	0.1179E+00	-.6812E+00
AN 13	10.5111E-030.0000E+00	0.1179E+00	-.7022E+00
AO 13	10.1022E-020.0000E+00	0.1179E+00	-.7336E+00
AP 13	10.1022E-020.0000E+00	0.1179E+00	-.7755E+00
AQ 13	10.1022E-020.0000E+00	0.1179E+00	-.8174E+00
AR 13	BOUND0.2438E+460.2438E-01	0.1179E+00	-.8384E+00
A1 14	10.2754E-020.3754E-01	0.1538E+00	-.3668E-01
A2 14	10.2754E-020.0000E+00	0.1538E+00	-.1100E+00
A3 14	10.2754E-020.0000E+00	0.1538E+00	-.1834E+00
A4 14	10.2754E-020.0000E+00	0.1538E+00	-.2568E+00
A5 14	10.1574E-020.0000E+00	0.1538E+00	-.3144E+00
A6 14	10.7869E-030.0000E+00	0.1538E+00	-.3458E+00
A7 14	10.7869E-030.0000E+00	0.1538E+00	-.3668E+00
A8 14	10.7869E-030.0000E+00	0.1538E+00	-.3878E+00
A9 14	10.7869E-030.0000E+00	0.1538E+00	-.4087E+00
AA 14	10.7869E-030.0000E+00	0.1538E+00	-.4297E+00
AB 14	10.7869E-030.0000E+00	0.1538E+00	-.4506E+00
AC 14	10.7869E-030.0000E+00	0.1538E+00	-.4716E+00
AD 14	10.7869E-030.0000E+00	0.1538E+00	-.4926E+00
AE 14	10.7869E-030.0000E+00	0.1538E+00	-.5135E+00
AF 14	10.7869E-030.0000E+00	0.1538E+00	-.5345E+00

AG 14	10.7869E-030.0000E+00	0.1538E+00	-.5554E+00
AH 14	10.7869E-030.0000E+00	0.1538E+00	-.5764E+00
AI 14	10.7869E-030.0000E+00	0.1538E+00	-.5974E+00
AJ 14	10.7869E-030.0000E+00	0.1538E+00	-.6183E+00
AK 14	10.7869E-030.0000E+00	0.1538E+00	-.6393E+00
AL 14	10.7869E-030.0000E+00	0.1538E+00	-.6602E+00
AM 14	10.7869E-030.0000E+00	0.1538E+00	-.6812E+00
AN 14	10.7869E-030.0000E+00	0.1538E+00	-.7022E+00
AO 14	10.1574E-020.0000E+00	0.1538E+00	-.7336E+00
AP 14	10.1574E-020.0000E+00	0.1538E+00	-.7755E+00
AQ 14	10.1574E-020.0000E+00	0.1538E+00	-.8174E+00
AR 14	BOUND0.3754E+460.3754E-01	0.1538E+00	-.8384E+00
A1 15	10.4147E-020.5653E-01	0.1962E+00	-.3668E-01
A2 15	10.4147E-020.0000E+00	0.1962E+00	-.1100E+00
A3 15	10.4147E-020.0000E+00	0.1962E+00	-.1834E+00
A4 15	10.4147E-020.0000E+00	0.1962E+00	-.2568E+00
A5 15	10.2370E-020.0000E+00	0.1962E+00	-.3144E+00
A6 15	10.1185E-020.0000E+00	0.1962E+00	-.3458E+00
A7 15	10.1185E-020.0000E+00	0.1962E+00	-.3668E+00
A8 15	10.1185E-020.0000E+00	0.1962E+00	-.3878E+00
A9 15	10.1185E-020.0000E+00	0.1962E+00	-.4087E+00
AA 15	10.1185E-020.0000E+00	0.1962E+00	-.4297E+00
AB 15	10.1185E-020.0000E+00	0.1962E+00	-.4506E+00
AC 15	10.1185E-020.0000E+00	0.1962E+00	-.4716E+00
AD 15	10.1185E-020.0000E+00	0.1962E+00	-.4926E+00
AE 15	10.1185E-020.0000E+00	0.1962E+00	-.5135E+00
AF 15	10.1185E-020.0000E+00	0.1962E+00	-.5345E+00
AG 15	10.1185E-020.0000E+00	0.1962E+00	-.5554E+00
AH 15	10.1185E-020.0000E+00	0.1962E+00	-.5764E+00
AI 15	10.1185E-020.0000E+00	0.1962E+00	-.5974E+00
AJ 15	10.1185E-020.0000E+00	0.1962E+00	-.6183E+00
AK 15	10.1185E-020.0000E+00	0.1962E+00	-.6393E+00
AL 15	10.1185E-020.0000E+00	0.1962E+00	-.6602E+00
AM 15	10.1185E-020.0000E+00	0.1962E+00	-.6812E+00
AN 15	10.1185E-020.0000E+00	0.1962E+00	-.7022E+00
AO 15	10.2370E-020.0000E+00	0.1962E+00	-.7336E+00
AP 15	10.2370E-020.0000E+00	0.1962E+00	-.7755E+00
AQ 15	10.2370E-020.0000E+00	0.1962E+00	-.8174E+00
AR 15	BOUND0.5653E+460.5653E-01	0.1962E+00	-.8384E+00
A1 16	TCOND0.1010E-050.1377E-04	0.2191E+00	-.3668E-01
A2 16	TCOND0.1010E-050.0000E+00	0.2191E+00	-.1100E+00
A3 16	TCOND0.1010E-050.0000E+00	0.2191E+00	-.1834E+00
A4 16	TCOND0.1010E-050.0000E+00	0.2191E+00	-.2568E+00
A5 16	TCOND0.5771E-060.0000E+00	0.2191E+00	-.3144E+00
A6 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.3458E+00
A7 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.3668E+00
A8 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.3878E+00
A9 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.4087E+00
AA 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.4297E+00
AB 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.4506E+00
AC 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.4716E+00
AD 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.4926E+00
AE 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.5135E+00
AF 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.5345E+00
AG 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.5554E+00
AH 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.5764E+00
AI 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.5974E+00

AJ 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.6183E+00
AK 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.6393E+00
AL 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.6602E+00
AM 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.6812E+00
AN 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.7022E+00
AO 16	TCOND0.5771E-060.0000E+00	0.2191E+00	-.7336E+00
AP 16	TCOND0.5771E-060.0000E+00	0.2191E+00	-.7755E+00
AQ 16	TCOND0.5771E-060.0000E+00	0.2191E+00	-.8174E+00

CONNE

A9 1A9 2	1	1.e-100.3250E-030.1251E-02
AA 1AA 2	1	1.e-100.3250E-030.1251E-02
AB 1AB 2	1	1.e-100.3250E-030.1251E-02
AC 1AC 2	1	1.e-100.3250E-030.1251E-02
AD 1AD 2	1	1.e-100.3250E-030.1251E-02
AE 1AE 2	1	1.e-100.3250E-030.1251E-02
AF 1AF 2	1	1.e-100.3250E-030.1251E-02
AG 1AG 2	1	1.e-100.3250E-030.1251E-02
AH 1AH 2	1	1.e-100.3250E-030.1251E-02
AI 1AI 2	1	1.e-100.3250E-030.1251E-02
AJ 1AJ 2	1	1.e-100.3250E-030.1251E-02
AK 1AK 2	1	1.e-100.3250E-030.1251E-02
A1 2A1 3	10.3250E-030.3250E-030.4678E-02	
A2 2A2 3	10.3250E-030.3250E-030.4678E-02	
A3 2A3 3	10.3250E-030.3250E-030.4678E-02	
A4 2A4 3	10.3250E-030.3250E-030.4678E-02	
A5 2A5 3	10.3250E-030.3250E-030.2673E-02	
A6 2A6 3	10.3250E-030.3250E-030.1337E-02	
A7 2A7 3	10.3250E-030.3250E-030.1337E-02	
A8 2A8 3	10.3250E-030.3250E-030.1337E-02	
A9 2A9 3	10.3250E-030.3250E-030.1337E-02	
AA 2AA 3	10.3250E-030.3250E-030.1337E-02	
AB 2AB 3	10.3250E-030.3250E-030.1337E-02	
AC 2AC 3	10.3250E-030.3250E-030.1337E-02	
AD 2AD 3	10.3250E-030.3250E-030.1337E-02	
AE 2AE 3	10.3250E-030.3250E-030.1337E-02	
AF 2AF 3	10.3250E-030.3250E-030.1337E-02	
AG 2AG 3	10.3250E-030.3250E-030.1337E-02	
AH 2AH 3	10.3250E-030.3250E-030.1337E-02	
AI 2AI 3	10.3250E-030.3250E-030.1337E-02	
AJ 2AJ 3	10.3250E-030.3250E-030.1337E-02	
AK 2AK 3	10.3250E-030.3250E-030.1337E-02	
AL 2AL 3	10.3250E-030.3250E-030.1337E-02	
AM 2AM 3	10.3250E-030.3250E-030.1337E-02	
AN 2AN 3	10.3250E-030.3250E-030.1337E-02	
AO 2AO 3	10.3250E-030.3250E-030.2673E-02	
AP 2AP 3	10.3250E-030.3250E-030.2673E-02	
AQ 2AQ 3	10.3250E-030.3250E-030.2673E-02	
A1 3A1 4	10.3250E-030.3250E-030.4978E-02	
A2 3A2 4	10.3250E-030.3250E-030.4978E-02	
A3 3A3 4	10.3250E-030.3250E-030.4978E-02	
A4 3A4 4	10.3250E-030.3250E-030.4978E-02	
A5 3A5 4	10.3250E-030.3250E-030.2845E-02	
A6 3A6 4	10.3250E-030.3250E-030.1422E-02	
A7 3A7 4	10.3250E-030.3250E-030.1422E-02	
A8 3A8 4	10.3250E-030.3250E-030.1422E-02	
A9 3A9 4	10.3250E-030.3250E-030.1422E-02	

AA	3AA	4	10.3250E-030.3250E-030.1422E-02
AB	3AB	4	10.3250E-030.3250E-030.1422E-02
AC	3AC	4	10.3250E-030.3250E-030.1422E-02
AD	3AD	4	10.3250E-030.3250E-030.1422E-02
AE	3AE	4	10.3250E-030.3250E-030.1422E-02
AF	3AF	4	10.3250E-030.3250E-030.1422E-02
AG	3AG	4	10.3250E-030.3250E-030.1422E-02
AH	3AH	4	10.3250E-030.3250E-030.1422E-02
AI	3AI	4	10.3250E-030.3250E-030.1422E-02
AJ	3AJ	4	10.3250E-030.3250E-030.1422E-02
AK	3AK	4	10.3250E-030.3250E-030.1422E-02
AL	3AL	4	10.3250E-030.3250E-030.1422E-02
AM	3AM	4	10.3250E-030.3250E-030.1422E-02
AN	3AN	4	10.3250E-030.3250E-030.1422E-02
AO	3AO	4	10.3250E-030.3250E-030.2845E-02
AP	3AP	4	10.3250E-030.3250E-030.2845E-02
AQ	3AQ	4	10.3250E-030.3250E-030.2845E-02
A1	4A1	5	10.3250E-030.3250E-030.5278E-02
A2	4A2	5	10.3250E-030.3250E-030.5278E-02
A3	4A3	5	10.3250E-030.3250E-030.5278E-02
A4	4A4	5	10.3250E-030.3250E-030.5278E-02
A5	4A5	5	10.3250E-030.3250E-030.3016E-02
A6	4A6	5	10.3250E-030.3250E-030.1508E-02
A7	4A7	5	10.3250E-030.3250E-030.1508E-02
A8	4A8	5	10.3250E-030.3250E-030.1508E-02
A9	4A9	5	10.3250E-030.3250E-030.1508E-02
AA	4AA	5	10.3250E-030.3250E-030.1508E-02
AB	4AB	5	10.3250E-030.3250E-030.1508E-02
AC	4AC	5	10.3250E-030.3250E-030.1508E-02
AD	4AD	5	10.3250E-030.3250E-030.1508E-02
AE	4AE	5	10.3250E-030.3250E-030.1508E-02
AF	4AF	5	10.3250E-030.3250E-030.1508E-02
AG	4AG	5	10.3250E-030.3250E-030.1508E-02
AH	4AH	5	10.3250E-030.3250E-030.1508E-02
AI	4AI	5	10.3250E-030.3250E-030.1508E-02
AJ	4AJ	5	10.3250E-030.3250E-030.1508E-02
AK	4AK	5	10.3250E-030.3250E-030.1508E-02
AL	4AL	5	10.3250E-030.3250E-030.1508E-02
AM	4AM	5	10.3250E-030.3250E-030.1508E-02
AN	4AN	5	10.3250E-030.3250E-030.1508E-02
AO	4AO	5	10.3250E-030.3250E-030.3016E-02
AP	4AP	5	10.3250E-030.3250E-030.3016E-02
AQ	4AQ	5	10.3250E-030.3250E-030.3016E-02
A1	5A1	6	10.3250E-030.3250E-030.5577E-02
A2	5A2	6	10.3250E-030.3250E-030.5577E-02
A3	5A3	6	10.3250E-030.3250E-030.5577E-02
A4	5A4	6	10.3250E-030.3250E-030.5577E-02
A5	5A5	6	10.3250E-030.3250E-030.3187E-02
A6	5A6	6	10.3250E-030.3250E-030.1594E-02
A7	5A7	6	10.3250E-030.3250E-030.1594E-02
A8	5A8	6	10.3250E-030.3250E-030.1594E-02
A9	5A9	6	10.3250E-030.3250E-030.1594E-02
AA	5AA	6	10.3250E-030.3250E-030.1594E-02
AB	5AB	6	10.3250E-030.3250E-030.1594E-02
AC	5AC	6	10.3250E-030.3250E-030.1594E-02
AD	5AD	6	10.3250E-030.3250E-030.1594E-02
AE	5AE	6	10.3250E-030.3250E-030.1594E-02

AF	5AF	6	10.3250E-030.3250E-030.1594E-02
AG	5AG	6	10.3250E-030.3250E-030.1594E-02
AH	5AH	6	10.3250E-030.3250E-030.1594E-02
AI	5AI	6	10.3250E-030.3250E-030.1594E-02
AJ	5AJ	6	10.3250E-030.3250E-030.1594E-02
AK	5AK	6	10.3250E-030.3250E-030.1594E-02
AL	5AL	6	10.3250E-030.3250E-030.1594E-02
AM	5AM	6	10.3250E-030.3250E-030.1594E-02
AN	5AN	6	10.3250E-030.3250E-030.1594E-02
AO	5AO	6	10.3250E-030.3250E-030.3187E-02
AP	5AP	6	10.3250E-030.3250E-030.3187E-02
AQ	5AQ	6	10.3250E-030.3250E-030.3187E-02
A1	6A1	7	10.3250E-030.1125E-020.5877E-02
A2	6A2	7	10.3250E-030.1125E-020.5877E-02
A3	6A3	7	10.3250E-030.1125E-020.5877E-02
A4	6A4	7	10.3250E-030.1125E-020.5877E-02
A5	6A5	7	10.3250E-030.1125E-020.3358E-02
A6	6A6	7	10.3250E-030.1125E-020.1679E-02
A7	6A7	7	10.3250E-030.1125E-020.1679E-02
A8	6A8	7	10.3250E-030.1125E-020.1679E-02
A9	6A9	7	10.3250E-030.1125E-020.1679E-02
AA	6AA	7	10.3250E-030.1125E-020.1679E-02
AB	6AB	7	10.3250E-030.1125E-020.1679E-02
AC	6AC	7	10.3250E-030.1125E-020.1679E-02
AD	6AD	7	10.3250E-030.1125E-020.1679E-02
AE	6AE	7	10.3250E-030.1125E-020.1679E-02
AF	6AF	7	10.3250E-030.1125E-020.1679E-02
AG	6AG	7	10.3250E-030.1125E-020.1679E-02
AH	6AH	7	10.3250E-030.1125E-020.1679E-02
AI	6AI	7	10.3250E-030.1125E-020.1679E-02
AJ	6AJ	7	10.3250E-030.1125E-020.1679E-02
AK	6AK	7	10.3250E-030.1125E-020.1679E-02
AL	6AL	7	10.3250E-030.1125E-020.1679E-02
AM	6AM	7	10.3250E-030.1125E-020.1679E-02
AN	6AN	7	10.3250E-030.1125E-020.1679E-02
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AP	6AP	7	10.3250E-030.1125E-020.3358E-02
AQ	6AQ	7	10.3250E-030.1125E-020.3358E-02
A1	7A1	8	10.1125E-020.2500E-020.6914E-02
A2	7A2	8	10.1125E-020.2500E-020.6914E-02
A3	7A3	8	10.1125E-020.2500E-020.6914E-02
A4	7A4	8	10.1125E-020.2500E-020.6914E-02
A5	7A5	8	10.1125E-020.2500E-020.3951E-02
A6	7A6	8	10.1125E-020.2500E-020.1975E-02
A7	7A7	8	10.1125E-020.2500E-020.1975E-02
A8	7A8	8	10.1125E-020.2500E-020.1975E-02
A9	7A9	8	10.1125E-020.2500E-020.1975E-02
AA	7AA	8	10.1125E-020.2500E-020.1975E-02
AB	7AB	8	10.1125E-020.2500E-020.1975E-02
AC	7AC	8	10.1125E-020.2500E-020.1975E-02
AD	7AD	8	10.1125E-020.2500E-020.1975E-02
AE	7AE	8	10.1125E-020.2500E-020.1975E-02
AF	7AF	8	10.1125E-020.2500E-020.1975E-02
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AH	7AH	8	10.1125E-020.2500E-020.1975E-02
AI	7AI	8	10.1125E-020.2500E-020.1975E-02
AJ	7AJ	8	10.1125E-020.2500E-020.1975E-02

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AM	7AM	8	10.1125E-020.2500E-020.1975E-02
AN	7AN	8	10.1125E-020.2500E-020.1975E-02
AO	7AO	8	10.1125E-020.2500E-020.3951E-02
AP	7AP	8	10.1125E-020.2500E-020.3951E-02
AQ	7AQ	8	10.1125E-020.2500E-020.3951E-02
A1	8A1	9	10.2500E-020.5000E-020.9219E-02
A2	8A2	9	10.2500E-020.5000E-020.9219E-02
A3	8A3	9	10.2500E-020.5000E-020.9219E-02
A4	8A4	9	10.2500E-020.5000E-020.9219E-02
A5	8A5	9	10.2500E-020.5000E-020.5268E-02
A6	8A6	9	10.2500E-020.5000E-020.2634E-02
A7	8A7	9	10.2500E-020.5000E-020.2634E-02
A8	8A8	9	10.2500E-020.5000E-020.2634E-02
A9	8A9	9	10.2500E-020.5000E-020.2634E-02
AA	8AA	9	10.2500E-020.5000E-020.2634E-02
AB	8AB	9	10.2500E-020.5000E-020.2634E-02
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AE	8AE	9	10.2500E-020.5000E-020.2634E-02
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AG	8AG	9	10.2500E-020.5000E-020.2634E-02
AH	8AH	9	10.2500E-020.5000E-020.2634E-02
AI	8AI	9	10.2500E-020.5000E-020.2634E-02
AJ	8AJ	9	10.2500E-020.5000E-020.2634E-02
AK	8AK	9	10.2500E-020.5000E-020.2634E-02
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AM	8AM	9	10.2500E-020.5000E-020.2634E-02
AN	8AN	9	10.2500E-020.5000E-020.2634E-02
AO	8AO	9	10.2500E-020.5000E-020.5268E-02
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AQ	8AQ	9	10.2500E-020.5000E-020.5268E-02
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A3	9A3	10	10.5000E-020.1000E-010.1383E-01
A4	9A4	10	10.5000E-020.1000E-010.1383E-01
A5	9A5	10	10.5000E-020.1000E-010.7902E-02
A6	9A6	10	10.5000E-020.1000E-010.3951E-02
A7	9A7	10	10.5000E-020.1000E-010.3951E-02
A8	9A8	10	10.5000E-020.1000E-010.3951E-02
A9	9A9	10	10.5000E-020.1000E-010.3951E-02
AA	9AA	10	10.5000E-020.1000E-010.3951E-02
AB	9AB	10	10.5000E-020.1000E-010.3951E-02
AC	9AC	10	10.5000E-020.1000E-010.3951E-02
AD	9AD	10	10.5000E-020.1000E-010.3951E-02
AE	9AE	10	10.5000E-020.1000E-010.3951E-02
AF	9AF	10	10.5000E-020.1000E-010.3951E-02
AG	9AG	10	10.5000E-020.1000E-010.3951E-02
AH	9AH	10	10.5000E-020.1000E-010.3951E-02
AI	9AI	10	10.5000E-020.1000E-010.3951E-02
AJ	9AJ	10	10.5000E-020.1000E-010.3951E-02
AK	9AK	10	10.5000E-020.1000E-010.3951E-02
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AM	9AM	10	10.5000E-020.1000E-010.3951E-02
AN	9AN	10	10.5000E-020.1000E-010.3951E-02
AO	9AO	10	10.5000E-020.1000E-010.7902E-02

AP	9AP	10	10.5000E-020.1000E-010.7902E-02
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A1	10A1	11	10.1000E-010.1181E-010.2305E-01
A2	10A2	11	10.1000E-010.1181E-010.2305E-01
A3	10A3	11	10.1000E-010.1181E-010.2305E-01
A4	10A4	11	10.1000E-010.1181E-010.2305E-01
A5	10A5	11	10.1000E-010.1181E-010.1317E-01
A6	10A6	11	10.1000E-010.1181E-010.6585E-02
A7	10A7	11	10.1000E-010.1181E-010.6585E-02
A8	10A8	11	10.1000E-010.1181E-010.6585E-02
A9	10A9	11	10.1000E-010.1181E-010.6585E-02
AA	10AA	11	10.1000E-010.1181E-010.6585E-02
AB	10AB	11	10.1000E-010.1181E-010.6585E-02
AC	10AC	11	10.1000E-010.1181E-010.6585E-02
AD	10AD	11	10.1000E-010.1181E-010.6585E-02
AE	10AE	11	10.1000E-010.1181E-010.6585E-02
AF	10AF	11	10.1000E-010.1181E-010.6585E-02
AG	10AG	11	10.1000E-010.1181E-010.6585E-02
AH	10AH	11	10.1000E-010.1181E-010.6585E-02
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AJ	10AJ	11	10.1000E-010.1181E-010.6585E-02
AK	10AK	11	10.1000E-010.1181E-010.6585E-02
AL	10AL	11	10.1000E-010.1181E-010.6585E-02
AM	10AM	11	10.1000E-010.1181E-010.6585E-02
AN	10AN	11	10.1000E-010.1181E-010.6585E-02
AO	10AO	11	10.1000E-010.1181E-010.1317E-01
AP	10AP	11	10.1000E-010.1181E-010.1317E-01
AQ	10AQ	11	10.1000E-010.1181E-010.1317E-01
A1	11A1	12	10.1181E-010.1394E-010.3393E-01
A2	11A2	12	10.1181E-010.1394E-010.3393E-01
A3	11A3	12	10.1181E-010.1394E-010.3393E-01
A4	11A4	12	10.1181E-010.1394E-010.3393E-01
A5	11A5	12	10.1181E-010.1394E-010.1939E-01
A6	11A6	12	10.1181E-010.1394E-010.9694E-02
A7	11A7	12	10.1181E-010.1394E-010.9694E-02
A8	11A8	12	10.1181E-010.1394E-010.9694E-02
A9	11A9	12	10.1181E-010.1394E-010.9694E-02
AA	11AA	12	10.1181E-010.1394E-010.9694E-02
AB	11AB	12	10.1181E-010.1394E-010.9694E-02
AC	11AC	12	10.1181E-010.1394E-010.9694E-02
AD	11AD	12	10.1181E-010.1394E-010.9694E-02
AE	11AE	12	10.1181E-010.1394E-010.9694E-02
AF	11AF	12	10.1181E-010.1394E-010.9694E-02
AG	11AG	12	10.1181E-010.1394E-010.9694E-02
AH	11AH	12	10.1181E-010.1394E-010.9694E-02
AI	11AI	12	10.1181E-010.1394E-010.9694E-02
AJ	11AJ	12	10.1181E-010.1394E-010.9694E-02
AK	11AK	12	10.1181E-010.1394E-010.9694E-02
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AO	11AO	12	10.1181E-010.1394E-010.1939E-01
AP	11AP	12	10.1181E-010.1394E-010.1939E-01
AQ	11AQ	12	10.1181E-010.1394E-010.1939E-01
A1	12A1	13	10.1394E-010.1645E-010.4678E-01
A2	12A2	13	10.1394E-010.1645E-010.4678E-01
A3	12A3	13	10.1394E-010.1645E-010.4678E-01

A4 12A4 13	10.1394E-010.1645E-010.4678E-01
A5 12A5 13	10.1394E-010.1645E-010.2673E-01
A6 12A6 13	10.1394E-010.1645E-010.1337E-01
A7 12A7 13	10.1394E-010.1645E-010.1337E-01
A8 12A8 13	10.1394E-010.1645E-010.1337E-01
A9 12A9 13	10.1394E-010.1645E-010.1337E-01
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AB 12AB 13	10.1394E-010.1645E-010.1337E-01
AC 12AC 13	10.1394E-010.1645E-010.1337E-01
AD 12AD 13	10.1394E-010.1645E-010.1337E-01
AE 12AE 13	10.1394E-010.1645E-010.1337E-01
AF 12AF 13	10.1394E-010.1645E-010.1337E-01
AG 12AG 13	10.1394E-010.1645E-010.1337E-01
AH 12AH 13	10.1394E-010.1645E-010.1337E-01
AI 12AI 13	10.1394E-010.1645E-010.1337E-01
AJ 12AJ 13	10.1394E-010.1645E-010.1337E-01
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AM 12AM 13	10.1394E-010.1645E-010.1337E-01
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AO 12AO 13	10.1394E-010.1645E-010.2673E-01
AP 12AP 13	10.1394E-010.1645E-010.2673E-01
AQ 12AQ 13	10.1394E-010.1645E-010.2673E-01
A1 13A1 14	10.1645E-010.1942E-010.6195E-01
A2 13A2 14	10.1645E-010.1942E-010.6195E-01
A3 13A3 14	10.1645E-010.1942E-010.6195E-01
A4 13A4 14	10.1645E-010.1942E-010.6195E-01
A5 13A5 14	10.1645E-010.1942E-010.3540E-01
A6 13A6 14	10.1645E-010.1942E-010.1770E-01
A7 13A7 14	10.1645E-010.1942E-010.1770E-01
A8 13A8 14	10.1645E-010.1942E-010.1770E-01
A9 13A9 14	10.1645E-010.1942E-010.1770E-01
AA 13AA 14	10.1645E-010.1942E-010.1770E-01
AB 13AB 14	10.1645E-010.1942E-010.1770E-01
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AE 13AE 14	10.1645E-010.1942E-010.1770E-01
AF 13AF 14	10.1645E-010.1942E-010.1770E-01
AG 13AG 14	10.1645E-010.1942E-010.1770E-01
AH 13AH 14	10.1645E-010.1942E-010.1770E-01
AI 13AI 14	10.1645E-010.1942E-010.1770E-01
AJ 13AJ 14	10.1645E-010.1942E-010.1770E-01
AK 13AK 14	10.1645E-010.1942E-010.1770E-01
AL 13AL 14	10.1645E-010.1942E-010.1770E-01
AM 13AM 14	10.1645E-010.1942E-010.1770E-01
AN 13AN 14	10.1645E-010.1942E-010.1770E-01
AO 13AO 14	10.1645E-010.1942E-010.3540E-01
AP 13AP 14	10.1645E-010.1942E-010.3540E-01
AQ 13AQ 14	10.1645E-010.1942E-010.3540E-01
A1 14A1 15	10.1942E-010.2293E-010.7985E-01
A2 14A2 15	10.1942E-010.2293E-010.7985E-01
A3 14A3 15	10.1942E-010.2293E-010.7985E-01
A4 14A4 15	10.1942E-010.2293E-010.7985E-01
A5 14A5 15	10.1942E-010.2293E-010.4563E-01
A6 14A6 15	10.1942E-010.2293E-010.2281E-01
A7 14A7 15	10.1942E-010.2293E-010.2281E-01
A8 14A8 15	10.1942E-010.2293E-010.2281E-01

A9 14A9 15	10.1942E-010.2293E-010.2281E-01
AA 14AA 15	10.1942E-010.2293E-010.2281E-01
AB 14AB 15	10.1942E-010.2293E-010.2281E-01
AC 14AC 15	10.1942E-010.2293E-010.2281E-01
AD 14AD 15	10.1942E-010.2293E-010.2281E-01
AE 14AE 15	10.1942E-010.2293E-010.2281E-01
AF 14AF 15	10.1942E-010.2293E-010.2281E-01
AG 14AG 15	10.1942E-010.2293E-010.2281E-01
AH 14AH 15	10.1942E-010.2293E-010.2281E-01
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AJ 14AJ 15	10.1942E-010.2293E-010.2281E-01
AK 14AK 15	10.1942E-010.2293E-010.2281E-01
AL 14AL 15	10.1942E-010.2293E-010.2281E-01
AM 14AM 15	10.1942E-010.2293E-010.2281E-01
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AP 14AP 15	10.1942E-010.2293E-010.4563E-01
AQ 14AQ 15	10.1942E-010.2293E-010.4563E-01
A1 15A1 16	10.2293E-010.5000E-050.1010E+00
A2 15A2 16	10.2293E-010.5000E-050.1010E+00
A3 15A3 16	10.2293E-010.5000E-050.1010E+00
A4 15A4 16	10.2293E-010.5000E-050.1010E+00
A5 15A5 16	10.2293E-010.5000E-050.5771E-01
A6 15A6 16	10.2293E-010.5000E-050.2885E-01
A7 15A7 16	10.2293E-010.5000E-050.2885E-01
A8 15A8 16	10.2293E-010.5000E-050.2885E-01
A9 15A9 16	10.2293E-010.5000E-050.2885E-01
AA 15AA 16	10.2293E-010.5000E-050.2885E-01
AB 15AB 16	10.2293E-010.5000E-050.2885E-01
AC 15AC 16	10.2293E-010.5000E-050.2885E-01
AD 15AD 16	10.2293E-010.5000E-050.2885E-01
AE 15AE 16	10.2293E-010.5000E-050.2885E-01
AF 15AF 16	10.2293E-010.5000E-050.2885E-01
AG 15AG 16	10.2293E-010.5000E-050.2885E-01
AH 15AH 16	10.2293E-010.5000E-050.2885E-01
AI 15AI 16	10.2293E-010.5000E-050.2885E-01
AJ 15AJ 16	10.2293E-010.5000E-050.2885E-01
AK 15AK 16	10.2293E-010.5000E-050.2885E-01
AL 15AL 16	10.2293E-010.5000E-050.2885E-01
AM 15AM 16	10.2293E-010.5000E-050.2885E-01
AN 15AN 16	10.2293E-010.5000E-050.2885E-01
AO 15AO 16	10.2293E-010.5000E-050.5771E-01
AP 15AP 16	10.2293E-010.5000E-050.5771E-01
AQ 15AQ 16	10.2293E-010.5000E-050.5771E-01
A1 2A2 2	30.3668E-010.3668E-010.4013E-041.
A2 2A3 2	30.3668E-010.3668E-010.4013E-041.
A3 2A4 2	30.3668E-010.3668E-010.4013E-041.
A4 2A5 2	30.3668E-010.2096E-010.4013E-041.
A5 2A6 2	30.2096E-010.1048E-010.4013E-041.
A6 2A7 2	30.1048E-010.1048E-010.4013E-041.
A7 2A8 2	30.1048E-010.1048E-010.4013E-041.
A8 2A9 2	30.1048E-010.1048E-010.4013E-041.
A9 2AA 2	30.1048E-010.1048E-010.4013E-041.
AA 2AB 2	30.1048E-010.1048E-010.4013E-041.
AB 2AC 2	30.1048E-010.1048E-010.4013E-041.
AC 2AD 2	30.1048E-010.1048E-010.4013E-041.
AD 2AE 2	30.1048E-010.1048E-010.4013E-041.

AE	2AF	2	30.1048E-010.1048E-010.4013E-041.
AF	2AG	2	30.1048E-010.1048E-010.4013E-041.
AG	2AH	2	30.1048E-010.1048E-010.4013E-041.
AH	2AI	2	30.1048E-010.1048E-010.4013E-041.
AI	2AJ	2	30.1048E-010.1048E-010.4013E-041.
AJ	2AK	2	30.1048E-010.1048E-010.4013E-041.
AK	2AL	2	30.1048E-010.1048E-010.4013E-041.
AL	2AM	2	30.1048E-010.1048E-010.4013E-041.
AM	2AN	2	30.1048E-010.1048E-010.4013E-041.
AN	2AO	2	30.1048E-010.2096E-010.4013E-041.
AO	2AP	2	30.2096E-010.2096E-010.4013E-041.
AP	2AQ	2	30.2096E-010.2096E-010.4013E-041.
AQ	2AR	2	30.2096E-010.5000E-050.4013E-041.
A1	3A2	3	30.3668E-010.3668E-010.4278E-041.
A2	3A3	3	30.3668E-010.3668E-010.4278E-041.
A3	3A4	3	30.3668E-010.3668E-010.4278E-041.
A4	3A5	3	30.3668E-010.2096E-010.4278E-041.
A5	3A6	3	30.2096E-010.1048E-010.4278E-041.
A6	3A7	3	30.1048E-010.1048E-010.4278E-041.
A7	3A8	3	30.1048E-010.1048E-010.4278E-041.
A8	3A9	3	30.1048E-010.1048E-010.4278E-041.
A9	3AA	3	30.1048E-010.1048E-010.4278E-041.
AA	3AB	3	30.1048E-010.1048E-010.4278E-041.
AB	3AC	3	30.1048E-010.1048E-010.4278E-041.
AC	3AD	3	30.1048E-010.1048E-010.4278E-041.
AD	3AE	3	30.1048E-010.1048E-010.4278E-041.
AE	3AF	3	30.1048E-010.1048E-010.4278E-041.
AF	3AG	3	30.1048E-010.1048E-010.4278E-041.
AG	3AH	3	30.1048E-010.1048E-010.4278E-041.
AH	3AI	3	30.1048E-010.1048E-010.4278E-041.
AI	3AJ	3	30.1048E-010.1048E-010.4278E-041.
AJ	3AK	3	30.1048E-010.1048E-010.4278E-041.
AK	3AL	3	30.1048E-010.1048E-010.4278E-041.
AL	3AM	3	30.1048E-010.1048E-010.4278E-041.
AM	3AN	3	30.1048E-010.1048E-010.4278E-041.
AN	3AO	3	30.1048E-010.2096E-010.4278E-041.
AO	3AP	3	30.2096E-010.2096E-010.4278E-041.
AP	3AQ	3	30.2096E-010.2096E-010.4278E-041.
AQ	3AR	3	30.2096E-010.5000E-050.4278E-041.
A1	4A2	4	30.3668E-010.3668E-010.4544E-041.
A2	4A3	4	30.3668E-010.3668E-010.4544E-041.
A3	4A4	4	30.3668E-010.3668E-010.4544E-041.
A4	4A5	4	30.3668E-010.2096E-010.4544E-041.
A5	4A6	4	30.2096E-010.1048E-010.4544E-041.
A6	4A7	4	30.1048E-010.1048E-010.4544E-041.
A7	4A8	4	30.1048E-010.1048E-010.4544E-041.
A8	4A9	4	30.1048E-010.1048E-010.4544E-041.
A9	4AA	4	30.1048E-010.1048E-010.4544E-041.
AA	4AB	4	30.1048E-010.1048E-010.4544E-041.
AB	4AC	4	30.1048E-010.1048E-010.4544E-041.
AC	4AD	4	30.1048E-010.1048E-010.4544E-041.
AD	4AE	4	30.1048E-010.1048E-010.4544E-041.
AE	4AF	4	30.1048E-010.1048E-010.4544E-041.
AF	4AG	4	30.1048E-010.1048E-010.4544E-041.
AG	4AH	4	30.1048E-010.1048E-010.4544E-041.
AH	4AI	4	30.1048E-010.1048E-010.4544E-041.
AI	4AJ	4	30.1048E-010.1048E-010.4544E-041.

AJ	4AK	4	30.1048E-010.1048E-010.4544E-041.
AK	4AL	4	30.1048E-010.1048E-010.4544E-041.
AL	4AM	4	30.1048E-010.1048E-010.4544E-041.
AM	4AN	4	30.1048E-010.1048E-010.4544E-041.
AN	4AO	4	30.1048E-010.2096E-010.4544E-041.
AO	4AP	4	30.2096E-010.2096E-010.4544E-041.
AP	4AQ	4	30.2096E-010.2096E-010.4544E-041.
AQ	4AR	4	30.2096E-010.5000E-050.4544E-041.
A1	5A2	5	30.3668E-010.3668E-010.4809E-041.
A2	5A3	5	30.3668E-010.3668E-010.4809E-041.
A3	5A4	5	30.3668E-010.3668E-010.4809E-041.
A4	5A5	5	30.3668E-010.2096E-010.4809E-041.
A5	5A6	5	30.2096E-010.1048E-010.4809E-041.
A6	5A7	5	30.1048E-010.1048E-010.4809E-041.
A7	5A8	5	30.1048E-010.1048E-010.4809E-041.
A8	5A9	5	30.1048E-010.1048E-010.4809E-041.
A9	5AA	5	30.1048E-010.1048E-010.4809E-041.
AA	5AB	5	30.1048E-010.1048E-010.4809E-041.
AB	5AC	5	30.1048E-010.1048E-010.4809E-041.
AC	5AD	5	30.1048E-010.1048E-010.4809E-041.
AD	5AE	5	30.1048E-010.1048E-010.4809E-041.
AE	5AF	5	30.1048E-010.1048E-010.4809E-041.
AF	5AG	5	30.1048E-010.1048E-010.4809E-041.
AG	5AH	5	30.1048E-010.1048E-010.4809E-041.
AH	5AI	5	30.1048E-010.1048E-010.4809E-041.
AI	5AJ	5	30.1048E-010.1048E-010.4809E-041.
AJ	5AK	5	30.1048E-010.1048E-010.4809E-041.
AK	5AL	5	30.1048E-010.1048E-010.4809E-041.
AL	5AM	5	30.1048E-010.1048E-010.4809E-041.
AM	5AN	5	30.1048E-010.1048E-010.4809E-041.
AN	5AO	5	30.1048E-010.2096E-010.4809E-041.
AO	5AP	5	30.2096E-010.2096E-010.4809E-041.
AP	5AQ	5	30.2096E-010.2096E-010.4809E-041.
AQ	5AR	5	30.2096E-010.5000E-050.4809E-041.
A1	6A2	6	30.3668E-010.3668E-010.5074E-041.
A2	6A3	6	30.3668E-010.3668E-010.5074E-041.
A3	6A4	6	30.3668E-010.3668E-010.5074E-041.
A4	6A5	6	30.3668E-010.2096E-010.5074E-041.
A5	6A6	6	30.2096E-010.1048E-010.5074E-041.
A6	6A7	6	30.1048E-010.1048E-010.5074E-041.
A7	6A8	6	30.1048E-010.1048E-010.5074E-041.
A8	6A9	6	30.1048E-010.1048E-010.5074E-041.
A9	6AA	6	30.1048E-010.1048E-010.5074E-041.
AA	6AB	6	30.1048E-010.1048E-010.5074E-041.
AB	6AC	6	30.1048E-010.1048E-010.5074E-041.
AC	6AD	6	30.1048E-010.1048E-010.5074E-041.
AD	6AE	6	30.1048E-010.1048E-010.5074E-041.
AE	6AF	6	30.1048E-010.1048E-010.5074E-041.
AF	6AG	6	30.1048E-010.1048E-010.5074E-041.
AG	6AH	6	30.1048E-010.1048E-010.5074E-041.
AH	6AI	6	30.1048E-010.1048E-010.5074E-041.
AI	6AJ	6	30.1048E-010.1048E-010.5074E-041.
AJ	6AK	6	30.1048E-010.1048E-010.5074E-041.
AK	6AL	6	30.1048E-010.1048E-010.5074E-041.
AL	6AM	6	30.1048E-010.1048E-010.5074E-041.
AM	6AN	6	30.1048E-010.1048E-010.5074E-041.
AN	6AO	6	30.1048E-010.2096E-010.5074E-041.

AO	6AP	6	30.2096E-010.2096E-010.5074E-041.
AP	6AQ	6	30.2096E-010.2096E-010.5074E-041.
AQ	6AR	6	30.2096E-010.5000E-050.5074E-041.
A1	7A2	7	30.3668E-010.3668E-010.1962E-031.
A2	7A3	7	30.3668E-010.3668E-010.1962E-031.
A3	7A4	7	30.3668E-010.3668E-010.1962E-031.
A4	7A5	7	30.3668E-010.2096E-010.1962E-031.
A5	7A6	7	30.2096E-010.1048E-010.1962E-031.
A6	7A7	7	30.1048E-010.1048E-010.1962E-031.
A7	7A8	7	30.1048E-010.1048E-010.1962E-031.
A8	7A9	7	30.1048E-010.1048E-010.1962E-031.
A9	7AA	7	30.1048E-010.1048E-010.1962E-031.
AA	7AB	7	30.1048E-010.1048E-010.1962E-031.
AB	7AC	7	30.1048E-010.1048E-010.1962E-031.
AC	7AD	7	30.1048E-010.1048E-010.1962E-031.
AD	7AE	7	30.1048E-010.1048E-010.1962E-031.
AE	7AF	7	30.1048E-010.1048E-010.1962E-031.
AF	7AG	7	30.1048E-010.1048E-010.1962E-031.
AG	7AH	7	30.1048E-010.1048E-010.1962E-031.
AH	7AI	7	30.1048E-010.1048E-010.1962E-031.
AI	7AJ	7	30.1048E-010.1048E-010.1962E-031.
AJ	7AK	7	30.1048E-010.1048E-010.1962E-031.
AK	7AL	7	30.1048E-010.1048E-010.1962E-031.
AL	7AM	7	30.1048E-010.1048E-010.1962E-031.
AM	7AN	7	30.1048E-010.1048E-010.1962E-031.
AN	7AO	7	30.1048E-010.2096E-010.1962E-031.
AO	7AP	7	30.2096E-010.2096E-010.1962E-031.
AP	7AQ	7	30.2096E-010.2096E-010.1962E-031.
AQ	7AR	7	30.2096E-010.5000E-050.1962E-031.
A1	8A2	8	30.3668E-010.3668E-010.5498E-031.
A2	8A3	8	30.3668E-010.3668E-010.5498E-031.
A3	8A4	8	30.3668E-010.3668E-010.5498E-031.
A4	8A5	8	30.3668E-010.2096E-010.5498E-031.
A5	8A6	8	30.2096E-010.1048E-010.5498E-031.
A6	8A7	8	30.1048E-010.1048E-010.5498E-031.
A7	8A8	8	30.1048E-010.1048E-010.5498E-031.
A8	8A9	8	30.1048E-010.1048E-010.5498E-031.
A9	8AA	8	30.1048E-010.1048E-010.5498E-031.
AA	8AB	8	30.1048E-010.1048E-010.5498E-031.
AB	8AC	8	30.1048E-010.1048E-010.5498E-031.
AC	8AD	8	30.1048E-010.1048E-010.5498E-031.
AD	8AE	8	30.1048E-010.1048E-010.5498E-031.
AE	8AF	8	30.1048E-010.1048E-010.5498E-031.
AF	8AG	8	30.1048E-010.1048E-010.5498E-031.
AG	8AH	8	30.1048E-010.1048E-010.5498E-031.
AH	8AI	8	30.1048E-010.1048E-010.5498E-031.
AI	8AJ	8	30.1048E-010.1048E-010.5498E-031.
AJ	8AK	8	30.1048E-010.1048E-010.5498E-031.
AK	8AL	8	30.1048E-010.1048E-010.5498E-031.
AL	8AM	8	30.1048E-010.1048E-010.5498E-031.
AM	8AN	8	30.1048E-010.1048E-010.5498E-031.
AN	8AO	8	30.1048E-010.2096E-010.5498E-031.
AO	8AP	8	30.2096E-010.2096E-010.5498E-031.
AP	8AQ	8	30.2096E-010.2096E-010.5498E-031.
AQ	8AR	8	30.2096E-010.5000E-050.5498E-031.
A1	9A2	9	30.3668E-010.3668E-010.1571E-021.
A2	9A3	9	30.3668E-010.3668E-010.1571E-021.

A3	9A4	9	30.3668E-010.3668E-010.1571E-021.
A4	9A5	9	30.3668E-010.2096E-010.1571E-021.
A5	9A6	9	30.2096E-010.1048E-010.1571E-021.
A6	9A7	9	30.1048E-010.1048E-010.1571E-021.
A7	9A8	9	30.1048E-010.1048E-010.1571E-021.
A8	9A9	9	30.1048E-010.1048E-010.1571E-021.
A9	9AA	9	30.1048E-010.1048E-010.1571E-021.
AA	9AB	9	30.1048E-010.1048E-010.1571E-021.
AB	9AC	9	30.1048E-010.1048E-010.1571E-021.
AC	9AD	9	30.1048E-010.1048E-010.1571E-021.
AD	9AE	9	30.1048E-010.1048E-010.1571E-021.
AE	9AF	9	30.1048E-010.1048E-010.1571E-021.
AF	9AG	9	30.1048E-010.1048E-010.1571E-021.
AG	9AH	9	30.1048E-010.1048E-010.1571E-021.
AH	9AI	9	30.1048E-010.1048E-010.1571E-021.
AI	9AJ	9	30.1048E-010.1048E-010.1571E-021.
AJ	9AK	9	30.1048E-010.1048E-010.1571E-021.
AK	9AL	9	30.1048E-010.1048E-010.1571E-021.
AL	9AM	9	30.1048E-010.1048E-010.1571E-021.
AM	9AN	9	30.1048E-010.1048E-010.1571E-021.
AN	9AO	9	30.1048E-010.2096E-010.1571E-021.
AO	9AP	9	30.2096E-010.2096E-010.1571E-021.
AP	9AQ	9	30.2096E-010.2096E-010.1571E-021.
AQ	9AR	9	30.2096E-010.5000E-050.1571E-021.
A1	10A2	10	30.3668E-010.3668E-010.5027E-021.
A2	10A3	10	30.3668E-010.3668E-010.5027E-021.
A3	10A4	10	30.3668E-010.3668E-010.5027E-021.
A4	10A5	10	30.3668E-010.2096E-010.5027E-021.
A5	10A6	10	30.2096E-010.1048E-010.5027E-021.
A6	10A7	10	30.1048E-010.1048E-010.5027E-021.
A7	10A8	10	30.1048E-010.1048E-010.5027E-021.
A8	10A9	10	30.1048E-010.1048E-010.5027E-021.
A9	10AA	10	30.1048E-010.1048E-010.5027E-021.
AA	10AB	10	30.1048E-010.1048E-010.5027E-021.
AB	10AC	10	30.1048E-010.1048E-010.5027E-021.
AC	10AD	10	30.1048E-010.1048E-010.5027E-021.
AD	10AE	10	30.1048E-010.1048E-010.5027E-021.
AE	10AF	10	30.1048E-010.1048E-010.5027E-021.
AF	10AG	10	30.1048E-010.1048E-010.5027E-021.
AG	10AH	10	30.1048E-010.1048E-010.5027E-021.
AH	10AI	10	30.1048E-010.1048E-010.5027E-021.
AI	10AJ	10	30.1048E-010.1048E-010.5027E-021.
AJ	10AK	10	30.1048E-010.1048E-010.5027E-021.
AK	10AL	10	30.1048E-010.1048E-010.5027E-021.
AL	10AM	10	30.1048E-010.1048E-010.5027E-021.
AM	10AN	10	30.1048E-010.1048E-010.5027E-021.
AN	10AO	10	30.1048E-010.2096E-010.5027E-021.
AO	10AP	10	30.2096E-010.2096E-010.5027E-021.
AP	10AQ	10	30.2096E-010.2096E-010.5027E-021.
AQ	10AR	10	30.2096E-010.5000E-050.5027E-021.
A1	11A2	11	30.3668E-010.3668E-010.9169E-021.
A2	11A3	11	30.3668E-010.3668E-010.9169E-021.
A3	11A4	11	30.3668E-010.3668E-010.9169E-021.
A4	11A5	11	30.3668E-010.2096E-010.9169E-021.
A5	11A6	11	30.2096E-010.1048E-010.9169E-021.
A6	11A7	11	30.1048E-010.1048E-010.9169E-021.
A7	11A8	11	30.1048E-010.1048E-010.9169E-021.

A8 11A9 11	30.1048E-010.1048E-010.9169E-021.
A9 11AA 11	30.1048E-010.1048E-010.9169E-021.
AA 11AB 11	30.1048E-010.1048E-010.9169E-021.
AB 11AC 11	30.1048E-010.1048E-010.9169E-021.
AC 11AD 11	30.1048E-010.1048E-010.9169E-021.
AD 11AE 11	30.1048E-010.1048E-010.9169E-021.
AE 11AF 11	30.1048E-010.1048E-010.9169E-021.
AF 11AG 11	30.1048E-010.1048E-010.9169E-021.
AG 11AH 11	30.1048E-010.1048E-010.9169E-021.
AH 11AI 11	30.1048E-010.1048E-010.9169E-021.
AI 11AJ 11	30.1048E-010.1048E-010.9169E-021.
AJ 11AK 11	30.1048E-010.1048E-010.9169E-021.
AK 11AL 11	30.1048E-010.1048E-010.9169E-021.
AL 11AM 11	30.1048E-010.1048E-010.9169E-021.
AM 11AN 11	30.1048E-010.1048E-010.9169E-021.
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AO 11AP 11	30.2096E-010.2096E-010.9169E-021.
AP 11AQ 11	30.2096E-010.2096E-010.9169E-021.
AQ 11AR 11	30.2096E-010.5000E-050.9169E-021.
A1 12A2 12	30.3668E-010.3668E-010.1533E-011.
A2 12A3 12	30.3668E-010.3668E-010.1533E-011.
A3 12A4 12	30.3668E-010.3668E-010.1533E-011.
A4 12A5 12	30.3668E-010.2096E-010.1533E-011.
A5 12A6 12	30.2096E-010.1048E-010.1533E-011.
A6 12A7 12	30.1048E-010.1048E-010.1533E-011.
A7 12A8 12	30.1048E-010.1048E-010.1533E-011.
A8 12A9 12	30.1048E-010.1048E-010.1533E-011.
A9 12AA 12	30.1048E-010.1048E-010.1533E-011.
AA 12AB 12	30.1048E-010.1048E-010.1533E-011.
AB 12AC 12	30.1048E-010.1048E-010.1533E-011.
AC 12AD 12	30.1048E-010.1048E-010.1533E-011.
AD 12AE 12	30.1048E-010.1048E-010.1533E-011.
AE 12AF 12	30.1048E-010.1048E-010.1533E-011.
AF 12AG 12	30.1048E-010.1048E-010.1533E-011.
AG 12AH 12	30.1048E-010.1048E-010.1533E-011.
AH 12AI 12	30.1048E-010.1048E-010.1533E-011.
AI 12AJ 12	30.1048E-010.1048E-010.1533E-011.
AJ 12AK 12	30.1048E-010.1048E-010.1533E-011.
AK 12AL 12	30.1048E-010.1048E-010.1533E-011.
AL 12AM 12	30.1048E-010.1048E-010.1533E-011.
AM 12AN 12	30.1048E-010.1048E-010.1533E-011.
AN 12AO 12	30.1048E-010.2096E-010.1533E-011.
AO 12AP 12	30.2096E-010.2096E-010.1533E-011.
AP 12AQ 12	30.2096E-010.2096E-010.1533E-011.
AQ 12AR 12	30.2096E-010.5000E-050.1533E-011.
A1 13A2 13	30.3668E-010.3668E-010.2438E-011.
A2 13A3 13	30.3668E-010.3668E-010.2438E-011.
A3 13A4 13	30.3668E-010.3668E-010.2438E-011.
A4 13A5 13	30.3668E-010.2096E-010.2438E-011.
A5 13A6 13	30.2096E-010.1048E-010.2438E-011.
A6 13A7 13	30.1048E-010.1048E-010.2438E-011.
A7 13A8 13	30.1048E-010.1048E-010.2438E-011.
A8 13A9 13	30.1048E-010.1048E-010.2438E-011.
A9 13AA 13	30.1048E-010.1048E-010.2438E-011.
AA 13AB 13	30.1048E-010.1048E-010.2438E-011.
AB 13AC 13	30.1048E-010.1048E-010.2438E-011.
AC 13AD 13	30.1048E-010.1048E-010.2438E-011.

AD 13AE 13	30.1048E-010.1048E-010.2438E-011.
AE 13AF 13	30.1048E-010.1048E-010.2438E-011.
AF 13AG 13	30.1048E-010.1048E-010.2438E-011.
AG 13AH 13	30.1048E-010.1048E-010.2438E-011.
AH 13AI 13	30.1048E-010.1048E-010.2438E-011.
AI 13AJ 13	30.1048E-010.1048E-010.2438E-011.
AJ 13AK 13	30.1048E-010.1048E-010.2438E-011.
AK 13AL 13	30.1048E-010.1048E-010.2438E-011.
AL 13AM 13	30.1048E-010.1048E-010.2438E-011.
AM 13AN 13	30.1048E-010.1048E-010.2438E-011.
AN 13AO 13	30.1048E-010.2096E-010.2438E-011.
AO 13AP 13	30.2096E-010.2096E-010.2438E-011.
AP 13AQ 13	30.2096E-010.2096E-010.2438E-011.
AQ 13AR 13	30.2096E-010.5000E-050.2438E-011.
A1 14A2 14	30.3668E-010.3668E-010.3754E-011.
A2 14A3 14	30.3668E-010.3668E-010.3754E-011.
A3 14A4 14	30.3668E-010.3668E-010.3754E-011.
A4 14A5 14	30.3668E-010.2096E-010.3754E-011.
A5 14A6 14	30.2096E-010.1048E-010.3754E-011.
A6 14A7 14	30.1048E-010.1048E-010.3754E-011.
A7 14A8 14	30.1048E-010.1048E-010.3754E-011.
A8 14A9 14	30.1048E-010.1048E-010.3754E-011.
A9 14AA 14	30.1048E-010.1048E-010.3754E-011.
AA 14AB 14	30.1048E-010.1048E-010.3754E-011.
AB 14AC 14	30.1048E-010.1048E-010.3754E-011.
AC 14AD 14	30.1048E-010.1048E-010.3754E-011.
AD 14AE 14	30.1048E-010.1048E-010.3754E-011.
AE 14AF 14	30.1048E-010.1048E-010.3754E-011.
AF 14AG 14	30.1048E-010.1048E-010.3754E-011.
AG 14AH 14	30.1048E-010.1048E-010.3754E-011.
AH 14AI 14	30.1048E-010.1048E-010.3754E-011.
AI 14AJ 14	30.1048E-010.1048E-010.3754E-011.
AJ 14AK 14	30.1048E-010.1048E-010.3754E-011.
AK 14AL 14	30.1048E-010.1048E-010.3754E-011.
AL 14AM 14	30.1048E-010.1048E-010.3754E-011.
AM 14AN 14	30.1048E-010.1048E-010.3754E-011.
AN 14AO 14	30.1048E-010.2096E-010.3754E-011.
AO 14AP 14	30.2096E-010.2096E-010.3754E-011.
AP 14AQ 14	30.2096E-010.2096E-010.3754E-011.
AQ 14AR 14	30.2096E-010.5000E-050.3754E-011.
A1 15A2 15	30.3668E-010.3668E-010.5653E-011.
A2 15A3 15	30.3668E-010.3668E-010.5653E-011.
A3 15A4 15	30.3668E-010.3668E-010.5653E-011.
A4 15A5 15	30.3668E-010.2096E-010.5653E-011.
A5 15A6 15	30.2096E-010.1048E-010.5653E-011.
A6 15A7 15	30.1048E-010.1048E-010.5653E-011.
A7 15A8 15	30.1048E-010.1048E-010.5653E-011.
A8 15A9 15	30.1048E-010.1048E-010.5653E-011.
A9 15AA 15	30.1048E-010.1048E-010.5653E-011.
AA 15AB 15	30.1048E-010.1048E-010.5653E-011.
AB 15AC 15	30.1048E-010.1048E-010.5653E-011.
AC 15AD 15	30.1048E-010.1048E-010.5653E-011.
AD 15AE 15	30.1048E-010.1048E-010.5653E-011.
AE 15AF 15	30.1048E-010.1048E-010.5653E-011.
AF 15AG 15	30.1048E-010.1048E-010.5653E-011.
AG 15AH 15	30.1048E-010.1048E-010.5653E-011.
AH 15AI 15	30.1048E-010.1048E-010.5653E-011.

AI 15AJ 15	30.1048E-010.1048E-010.5653E-011.
AJ 15AK 15	30.1048E-010.1048E-010.5653E-011.
AK 15AL 15	30.1048E-010.1048E-010.5653E-011.
AL 15AM 15	30.1048E-010.1048E-010.5653E-011.
AM 15AN 15	30.1048E-010.1048E-010.5653E-011.
AN 15AO 15	30.1048E-010.2096E-010.5653E-011.
AO 15AP 15	30.2096E-010.2096E-010.5653E-011.
AP 15AQ 15	30.2096E-010.2096E-010.5653E-011.
AQ 15AR 15	30.2096E-010.5000E-050.5653E-011.

ENDCY---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8
 MESHM---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8
 RZ2D ---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8
 RADII

11	0.	.0095	.010150	.010800	.011450	.012100	.012750	.015
	.020	.03	.05					
LOGAR---	1---	*---	2---	*---	3---	*---	4---	*---
5		.2191						
EQUID								
1		1.e-5						
LAYER---	1---	*---	2---	*---	3---	*---	4---	*---
27								
	.07336			.04192	.02096			
							.04192	
			1.e-5					

ENDFI---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8

val2b ... Validation Problem No.2.

START 2-d convection cell in r-z; Reda (1984)

START 7-10-92: George's latest data file

START grid generation using MESHMAKER from TOUGH2

START flow channeling neglected

ROCKS	1	2	3	4	5	6	7	8
SOIL1	0	2500.0	0.34	610.E-12	610.E-12	610.E-12	0.87	740.
SOIL2	0	2500.0	0.34	610.E-12	610.E-12	610.E-12	0.87	740.
SOIL3	0	2500.0	0.34	610.E-12	610.E-12	610.E-12	0.87	740.
SOIL4	0	2500.0	0.34	610.E-12	610.E-12	610.E-12	0.87	740.
SOIL5	0	2500.0	0.34	610.E-12	610.E-12	610.E-12	0.87	740.
SOIL6	0	2500.0	0.34	610.E-12	610.E-12	610.E-12	0.87	740.
BOUND	0	2500.0	0.34	610.E-12	610.E-12	610.E-12	0.87	1.E04
TCOND	0	2500.0	1.e-5	000.E-12	000.E-12	000.E-12	0.87	1.E54
HEATR	1	7400.0	1.e-5	0.0	0.0	0.0	50.2	569.40

1.e-5

START

PARAM	1	2	3	4	5	6	7	8
8 1 350	3500000000	0000 0 41		2.13E-5	1.80			
	0.	1.e5	-1.	1.e4A9 1	-9.807	4.	1.	
	10.							
	1.E-5	1.	0.1	1.	1.	1.E-8		
		2.e5		21.5	0.			

TIMES	1	2	3	4	5	6	7	8
14 14	100.	200.	300.	550.	800.	1100.	2000.	2500.
	3000.	3500.	4000.	5000.	1.e4	1.e5		

RPCAP	1	2	3	4	5	6	7	8
1	0.	0.	0.1	0.1				
1	0.	0.	0.1					

GENER	1	2	3	4	5	6	7	8
A9 1HEA 1	0	0	0	1	HEAT	5.8331680		
AA 1HEA 2	0	0	0	1	HEAT	5.8331680		
AB 1HEA 3	0	0	0	1	HEAT	5.8331680		
AC 1HEA 4	0	0	0	1	HEAT	5.8331680		
AD 1HEA 5	0	0	0	1	HEAT	5.8331680		
AE 1HEA 6	0	0	0	1	HEAT	5.8331680		
AF 1HEA 7	0	0	0	1	HEAT	5.8331680		
AG 1HEA 8	0	0	0	1	HEAT	5.8331680		
AH 1HEA 9	0	0	0	1	HEAT	5.8331680		
AI 1HEA10	0	0	0	1	HEAT	5.8331680		
AJ 1HEA11	0	0	0	1	HEAT	5.8331680		
AK 1HEA12	0	0	0	1	HEAT	5.8331680		

INCON	1	2	3	4	5	6	7	8

ELEME	16	11	1	5	0.00000	0.219		
A9 1					HEATR0.5943E-050.0000E+00	0.4750E-02		-.4087E+00
AA 1					HEATR0.5943E-050.0000E+00	0.4750E-02		-.4297E+00
AB 1					HEATR0.5943E-050.0000E+00	0.4750E-02		-.4506E+00
AC 1					HEATR0.5943E-050.0000E+00	0.4750E-02		-.4716E+00
AD 1					HEATR0.5943E-050.0000E+00	0.4750E-02		-.4926E+00
AE 1					HEATR0.5943E-050.0000E+00	0.4750E-02		-.5135E+00
AF 1					HEATR0.5943E-050.0000E+00	0.4750E-02		-.5345E+00
AG 1					HEATR0.5943E-050.0000E+00	0.4750E-02		-.5554E+00
AH 1					HEATR0.5943E-050.0000E+00	0.4750E-02		-.5764E+00

AI	1	HEATR0.5943E-050.0000E+00	0.4750E-02	-.5974E+00
AJ	1	HEATR0.5943E-050.0000E+00	0.4750E-02	-.6183E+00
AK	1	HEATR0.5943E-050.0000E+00	0.4750E-02	-.6393E+00
A1	2	SOIL20.2944E-050.4013E-04	0.9825E-02	-.3668E-01
A2	2	SOIL20.2944E-050.0000E+00	0.9825E-02	-.1100E+00
A3	2	SOIL20.2944E-050.0000E+00	0.9825E-02	-.1834E+00
A4	2	SOIL20.2944E-050.0000E+00	0.9825E-02	-.2568E+00
A5	2	SOIL20.1682E-050.0000E+00	0.9825E-02	-.3144E+00
A6	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.3458E+00
A7	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.3668E+00
A8	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.3878E+00
A9	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.4087E+00
AA	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.4297E+00
AB	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.4506E+00
AC	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.4716E+00
AD	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.4926E+00
AE	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.5135E+00
AF	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.5345E+00
AG	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.5554E+00
AH	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.5764E+00
AI	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.5974E+00
AJ	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.6183E+00
AK	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.6393E+00
AL	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.6602E+00
AM	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.6812E+00
AN	2	SOIL20.8410E-060.0000E+00	0.9825E-02	-.7022E+00
AO	2	SOIL20.1682E-050.0000E+00	0.9825E-02	-.7336E+00
AP	2	SOIL20.1682E-050.0000E+00	0.9825E-02	-.7755E+00
AQ	2	SOIL20.1682E-050.0000E+00	0.9825E-02	-.8174E+00
AR	2	BOUND0.4013E+490.4013E-04	0.9825E-02	-.8384E+00
A1	3	SOIL30.3138E-050.4278E-04	0.1047E-01	-.3668E-01
A2	3	SOIL30.3138E-050.0000E+00	0.1047E-01	-.1100E+00
A3	3	SOIL30.3138E-050.0000E+00	0.1047E-01	-.1834E+00
A4	3	SOIL30.3138E-050.0000E+00	0.1047E-01	-.2568E+00
A5	3	SOIL30.1793E-050.0000E+00	0.1047E-01	-.3144E+00
A6	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.3458E+00
A7	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.3668E+00
A8	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.3878E+00
A9	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.4087E+00
AA	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.4297E+00
AB	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.4506E+00
AC	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.4716E+00
AD	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.4926E+00
AE	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.5135E+00
AF	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.5345E+00
AG	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.5554E+00
AH	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.5764E+00
AI	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.5974E+00
AJ	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.6183E+00
AK	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.6393E+00
AL	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.6602E+00
AM	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.6812E+00
AN	3	SOIL30.8967E-060.0000E+00	0.1047E-01	-.7022E+00
AO	3	SOIL30.1793E-050.0000E+00	0.1047E-01	-.7336E+00
AP	3	SOIL30.1793E-050.0000E+00	0.1047E-01	-.7755E+00
AQ	3	SOIL30.1793E-050.0000E+00	0.1047E-01	-.8174E+00
AR	3	BOUND0.4278E+490.4278E-04	0.1047E-01	-.8384E+00

A1	4	SOIL40.3333E-050.4544E-04	0.1112E-01	-.3668E-01
A2	4	SOIL40.3333E-050.0000E+00	0.1112E-01	-.1100E+00
A3	4	SOIL40.3333E-050.0000E+00	0.1112E-01	-.1834E+00
A4	4	SOIL40.3333E-050.0000E+00	0.1112E-01	-.2568E+00
A5	4	SOIL40.1905E-050.0000E+00	0.1112E-01	-.3144E+00
A6	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.3458E+00
A7	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.3668E+00
A8	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.3878E+00
A9	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.4087E+00
AA	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.4297E+00
AB	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.4506E+00
AC	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.4716E+00
AD	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.4926E+00
AE	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.5135E+00
AF	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.5345E+00
AG	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.5554E+00
AH	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.5764E+00
AI	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.5974E+00
AJ	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.6183E+00
AK	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.6393E+00
AL	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.6602E+00
AM	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.6812E+00
AN	4	SOIL40.9523E-060.0000E+00	0.1112E-01	-.7022E+00
AO	4	SOIL40.1905E-050.0000E+00	0.1112E-01	-.7336E+00
AP	4	SOIL40.1905E-050.0000E+00	0.1112E-01	-.7755E+00
AQ	4	SOIL40.1905E-050.0000E+00	0.1112E-01	-.8174E+00
AR	4	BOUND0.4544E+490.4544E-04	0.1112E-01	-.8384E+00
A1	5	SOIL50.3528E-050.4809E-04	0.1177E-01	-.3668E-01
A2	5	SOIL50.3528E-050.0000E+00	0.1177E-01	-.1100E+00
A3	5	SOIL50.3528E-050.0000E+00	0.1177E-01	-.1834E+00
A4	5	SOIL50.3528E-050.0000E+00	0.1177E-01	-.2568E+00
A5	5	SOIL50.2016E-050.0000E+00	0.1177E-01	-.3144E+00
A6	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.3458E+00
A7	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.3668E+00
A8	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.3878E+00
A9	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.4087E+00
AA	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.4297E+00
AB	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.4506E+00
AC	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.4716E+00
AD	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.4926E+00
AE	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.5135E+00
AF	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.5345E+00
AG	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.5554E+00
AH	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.5764E+00
AI	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.5974E+00
AJ	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.6183E+00
AK	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.6393E+00
AL	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.6602E+00
AM	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.6812E+00
AN	5	SOIL50.1008E-050.0000E+00	0.1177E-01	-.7022E+00
AO	5	SOIL50.2016E-050.0000E+00	0.1177E-01	-.7336E+00
AP	5	SOIL50.2016E-050.0000E+00	0.1177E-01	-.7755E+00
AQ	5	SOIL50.2016E-050.0000E+00	0.1177E-01	-.8174E+00
AR	5	BOUND0.4809E+490.4809E-04	0.1177E-01	-.8384E+00
A1	6	SOIL60.3723E-050.5074E-04	0.1242E-01	-.3668E-01
A2	6	SOIL60.3723E-050.0000E+00	0.1242E-01	-.1100E+00
A3	6	SOIL60.3723E-050.0000E+00	0.1242E-01	-.1834E+00

A4	6	SOIL60.3723E-050.0000E+00	0.1242E-01	-.2568E+00
A5	6	SOIL60.2127E-050.0000E+00	0.1242E-01	-.3144E+00
A6	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.3458E+00
A7	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.3668E+00
A8	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.3878E+00
A9	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.4087E+00
AA	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.4297E+00
AB	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.4506E+00
AC	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.4716E+00
AD	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.4926E+00
AE	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.5135E+00
AF	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.5345E+00
AG	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.5554E+00
AH	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.5764E+00
AI	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.5974E+00
AJ	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.6183E+00
AK	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.6393E+00
AL	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.6602E+00
AM	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.6812E+00
AN	6	SOIL60.1064E-050.0000E+00	0.1242E-01	-.7022E+00
AO	6	SOIL60.2127E-050.0000E+00	0.1242E-01	-.7336E+00
AP	6	SOIL60.2127E-050.0000E+00	0.1242E-01	-.7755E+00
AQ	6	SOIL60.2127E-050.0000E+00	0.1242E-01	-.8174E+00
AR	6	BOUND0.5074E+490.5074E-04	0.1242E-01	-.8384E+00
A1	7	10.1439E-040.1962E-03	0.1387E-01	-.3668E-01
A2	7	10.1439E-040.0000E+00	0.1387E-01	-.1100E+00
A3	7	10.1439E-040.0000E+00	0.1387E-01	-.1834E+00
A4	7	10.1439E-040.0000E+00	0.1387E-01	-.2568E+00
A5	7	10.8223E-050.0000E+00	0.1387E-01	-.3144E+00
A6	7	10.4111E-050.0000E+00	0.1387E-01	-.3458E+00
A7	7	10.4111E-050.0000E+00	0.1387E-01	-.3668E+00
A8	7	10.4111E-050.0000E+00	0.1387E-01	-.3878E+00
A9	7	10.4111E-050.0000E+00	0.1387E-01	-.4087E+00
AA	7	10.4111E-050.0000E+00	0.1387E-01	-.4297E+00
AB	7	10.4111E-050.0000E+00	0.1387E-01	-.4506E+00
AC	7	10.4111E-050.0000E+00	0.1387E-01	-.4716E+00
AD	7	10.4111E-050.0000E+00	0.1387E-01	-.4926E+00
AE	7	10.4111E-050.0000E+00	0.1387E-01	-.5135E+00
AF	7	10.4111E-050.0000E+00	0.1387E-01	-.5345E+00
AG	7	10.4111E-050.0000E+00	0.1387E-01	-.5554E+00
AH	7	10.4111E-050.0000E+00	0.1387E-01	-.5764E+00
AI	7	10.4111E-050.0000E+00	0.1387E-01	-.5974E+00
AJ	7	10.4111E-050.0000E+00	0.1387E-01	-.6183E+00
AK	7	10.4111E-050.0000E+00	0.1387E-01	-.6393E+00
AL	7	10.4111E-050.0000E+00	0.1387E-01	-.6602E+00
AM	7	10.4111E-050.0000E+00	0.1387E-01	-.6812E+00
AN	7	10.4111E-050.0000E+00	0.1387E-01	-.7022E+00
AO	7	10.8223E-050.0000E+00	0.1387E-01	-.7336E+00
AP	7	10.8223E-050.0000E+00	0.1387E-01	-.7755E+00
AQ	7	10.8223E-050.0000E+00	0.1387E-01	-.8174E+00
AR	7	BOUND0.1962E+480.1962E-03	0.1387E-01	-.8384E+00
A1	8	10.4033E-040.5498E-03	0.1750E-01	-.3668E-01
A2	8	10.4033E-040.0000E+00	0.1750E-01	-.1100E+00
A3	8	10.4033E-040.0000E+00	0.1750E-01	-.1834E+00
A4	8	10.4033E-040.0000E+00	0.1750E-01	-.2568E+00
A5	8	10.2305E-040.0000E+00	0.1750E-01	-.3144E+00
A6	8	10.1152E-040.0000E+00	0.1750E-01	-.3458E+00

A7	8	10.1152E-040.0000E+00	0.1750E-01	-.3668E+00
A8	8	10.1152E-040.0000E+00	0.1750E-01	-.3878E+00
A9	8	10.1152E-040.0000E+00	0.1750E-01	-.4087E+00
AA	8	10.1152E-040.0000E+00	0.1750E-01	-.4297E+00
AB	8	10.1152E-040.0000E+00	0.1750E-01	-.4506E+00
AC	8	10.1152E-040.0000E+00	0.1750E-01	-.4716E+00
AD	8	10.1152E-040.0000E+00	0.1750E-01	-.4926E+00
AE	8	10.1152E-040.0000E+00	0.1750E-01	-.5135E+00
AF	8	10.1152E-040.0000E+00	0.1750E-01	-.5345E+00
AG	8	10.1152E-040.0000E+00	0.1750E-01	-.5554E+00
AH	8	10.1152E-040.0000E+00	0.1750E-01	-.5764E+00
AI	8	10.1152E-040.0000E+00	0.1750E-01	-.5974E+00
AJ	8	10.1152E-040.0000E+00	0.1750E-01	-.6183E+00
AK	8	10.1152E-040.0000E+00	0.1750E-01	-.6393E+00
AL	8	10.1152E-040.0000E+00	0.1750E-01	-.6602E+00
AM	8	10.1152E-040.0000E+00	0.1750E-01	-.6812E+00
AN	8	10.1152E-040.0000E+00	0.1750E-01	-.7022E+00
AO	8	10.2305E-040.0000E+00	0.1750E-01	-.7336E+00
AP	8	10.2305E-040.0000E+00	0.1750E-01	-.7755E+00
AQ	8	10.2305E-040.0000E+00	0.1750E-01	-.8174E+00
AR	8	BOUND0.5498E+480.5498E-03	0.1750E-01	-.8384E+00
A1	9	10.1152E-030.1571E-02	0.2500E-01	-.3668E-01
A2	9	10.1152E-030.0000E+00	0.2500E-01	-.1100E+00
A3	9	10.1152E-030.0000E+00	0.2500E-01	-.1834E+00
A4	9	10.1152E-030.0000E+00	0.2500E-01	-.2568E+00
A5	9	10.6585E-040.0000E+00	0.2500E-01	-.3144E+00
A6	9	10.3292E-040.0000E+00	0.2500E-01	-.3458E+00
A7	9	10.3292E-040.0000E+00	0.2500E-01	-.3668E+00
A8	9	10.3292E-040.0000E+00	0.2500E-01	-.3878E+00
A9	9	10.3292E-040.0000E+00	0.2500E-01	-.4087E+00
AA	9	10.3292E-040.0000E+00	0.2500E-01	-.4297E+00
AB	9	10.3292E-040.0000E+00	0.2500E-01	-.4506E+00
AC	9	10.3292E-040.0000E+00	0.2500E-01	-.4716E+00
AD	9	10.3292E-040.0000E+00	0.2500E-01	-.4926E+00
AE	9	10.3292E-040.0000E+00	0.2500E-01	-.5135E+00
AF	9	10.3292E-040.0000E+00	0.2500E-01	-.5345E+00
AG	9	10.3292E-040.0000E+00	0.2500E-01	-.5554E+00
AH	9	10.3292E-040.0000E+00	0.2500E-01	-.5764E+00
AI	9	10.3292E-040.0000E+00	0.2500E-01	-.5974E+00
AJ	9	10.3292E-040.0000E+00	0.2500E-01	-.6183E+00
AK	9	10.3292E-040.0000E+00	0.2500E-01	-.6393E+00
AL	9	10.3292E-040.0000E+00	0.2500E-01	-.6602E+00
AM	9	10.3292E-040.0000E+00	0.2500E-01	-.6812E+00
AN	9	10.3292E-040.0000E+00	0.2500E-01	-.7022E+00
AO	9	10.6585E-040.0000E+00	0.2500E-01	-.7336E+00
AP	9	10.6585E-040.0000E+00	0.2500E-01	-.7755E+00
AQ	9	10.6585E-040.0000E+00	0.2500E-01	-.8174E+00
AR	9	BOUND0.1571E+470.1571E-02	0.2500E-01	-.8384E+00
A1	10	10.3687E-030.5027E-02	0.4000E-01	-.3668E-01
A2	10	10.3687E-030.0000E+00	0.4000E-01	-.1100E+00
A3	10	10.3687E-030.0000E+00	0.4000E-01	-.1834E+00
A4	10	10.3687E-030.0000E+00	0.4000E-01	-.2568E+00
A5	10	10.2107E-030.0000E+00	0.4000E-01	-.3144E+00
A6	10	10.1054E-030.0000E+00	0.4000E-01	-.3458E+00
A7	10	10.1054E-030.0000E+00	0.4000E-01	-.3668E+00
A8	10	10.1054E-030.0000E+00	0.4000E-01	-.3878E+00
A9	10	10.1054E-030.0000E+00	0.4000E-01	-.4087E+00

AA 10	10.1054E-030.0000E+00	0.4000E-01	-.4297E+00
AB 10	10.1054E-030.0000E+00	0.4000E-01	-.4506E+00
AC 10	10.1054E-030.0000E+00	0.4000E-01	-.4716E+00
AD 10	10.1054E-030.0000E+00	0.4000E-01	-.4926E+00
AE 10	10.1054E-030.0000E+00	0.4000E-01	-.5135E+00
AF 10	10.1054E-030.0000E+00	0.4000E-01	-.5345E+00
AG 10	10.1054E-030.0000E+00	0.4000E-01	-.5554E+00
AH 10	10.1054E-030.0000E+00	0.4000E-01	-.5764E+00
AI 10	10.1054E-030.0000E+00	0.4000E-01	-.5974E+00
AJ 10	10.1054E-030.0000E+00	0.4000E-01	-.6183E+00
AK 10	10.1054E-030.0000E+00	0.4000E-01	-.6393E+00
AL 10	10.1054E-030.0000E+00	0.4000E-01	-.6602E+00
AM 10	10.1054E-030.0000E+00	0.4000E-01	-.6812E+00
AN 10	10.1054E-030.0000E+00	0.4000E-01	-.7022E+00
AO 10	10.2107E-030.0000E+00	0.4000E-01	-.7336E+00
AP 10	10.2107E-030.0000E+00	0.4000E-01	-.7755E+00
AQ 10	10.2107E-030.0000E+00	0.4000E-01	-.8174E+00
AR 10	BOUND0.5027E+470.5027E-02	0.4000E-01	-.8384E+00
A1 11	10.6726E-030.9169E-02	0.6181E-01	-.3668E-01
A2 11	10.6726E-030.0000E+00	0.6181E-01	-.1100E+00
A3 11	10.6726E-030.0000E+00	0.6181E-01	-.1834E+00
A4 11	10.6726E-030.0000E+00	0.6181E-01	-.2568E+00
A5 11	10.3844E-030.0000E+00	0.6181E-01	-.3144E+00
A6 11	10.1922E-030.0000E+00	0.6181E-01	-.3458E+00
A7 11	10.1922E-030.0000E+00	0.6181E-01	-.3668E+00
A8 11	10.1922E-030.0000E+00	0.6181E-01	-.3878E+00
A9 11	10.1922E-030.0000E+00	0.6181E-01	-.4087E+00
AA 11	10.1922E-030.0000E+00	0.6181E-01	-.4297E+00
AB 11	10.1922E-030.0000E+00	0.6181E-01	-.4506E+00
AC 11	10.1922E-030.0000E+00	0.6181E-01	-.4716E+00
AD 11	10.1922E-030.0000E+00	0.6181E-01	-.4926E+00
AE 11	10.1922E-030.0000E+00	0.6181E-01	-.5135E+00
AF 11	10.1922E-030.0000E+00	0.6181E-01	-.5345E+00
AG 11	10.1922E-030.0000E+00	0.6181E-01	-.5554E+00
AH 11	10.1922E-030.0000E+00	0.6181E-01	-.5764E+00
AI 11	10.1922E-030.0000E+00	0.6181E-01	-.5974E+00
AJ 11	10.1922E-030.0000E+00	0.6181E-01	-.6183E+00
AK 11	10.1922E-030.0000E+00	0.6181E-01	-.6393E+00
AL 11	10.1922E-030.0000E+00	0.6181E-01	-.6602E+00
AM 11	10.1922E-030.0000E+00	0.6181E-01	-.6812E+00
AN 11	10.1922E-030.0000E+00	0.6181E-01	-.7022E+00
AO 11	10.3844E-030.0000E+00	0.6181E-01	-.7336E+00
AP 11	10.3844E-030.0000E+00	0.6181E-01	-.7755E+00
AQ 11	10.3844E-030.0000E+00	0.6181E-01	-.8174E+00
AR 11	BOUND0.9169E+470.9169E-02	0.6181E-01	-.8384E+00
A1 12	10.1125E-020.1533E-01	0.8755E-01	-.3668E-01
A2 12	10.1125E-020.0000E+00	0.8755E-01	-.1100E+00
A3 12	10.1125E-020.0000E+00	0.8755E-01	-.1834E+00
A4 12	10.1125E-020.0000E+00	0.8755E-01	-.2568E+00
A5 12	10.6428E-030.0000E+00	0.8755E-01	-.3144E+00
A6 12	10.3214E-030.0000E+00	0.8755E-01	-.3458E+00
A7 12	10.3214E-030.0000E+00	0.8755E-01	-.3668E+00
A8 12	10.3214E-030.0000E+00	0.8755E-01	-.3878E+00
A9 12	10.3214E-030.0000E+00	0.8755E-01	-.4087E+00
AA 12	10.3214E-030.0000E+00	0.8755E-01	-.4297E+00
AB 12	10.3214E-030.0000E+00	0.8755E-01	-.4506E+00
AC 12	10.3214E-030.0000E+00	0.8755E-01	-.4716E+00

AD 12	10.3214E-030.0000E+00	0.8755E-01	-.4926E+00
AE 12	10.3214E-030.0000E+00	0.8755E-01	-.5135E+00
AF 12	10.3214E-030.0000E+00	0.8755E-01	-.5345E+00
AG 12	10.3214E-030.0000E+00	0.8755E-01	-.5554E+00
AH 12	10.3214E-030.0000E+00	0.8755E-01	-.5764E+00
AI 12	10.3214E-030.0000E+00	0.8755E-01	-.5974E+00
AJ 12	10.3214E-030.0000E+00	0.8755E-01	-.6183E+00
AK 12	10.3214E-030.0000E+00	0.8755E-01	-.6393E+00
AL 12	10.3214E-030.0000E+00	0.8755E-01	-.6602E+00
AM 12	10.3214E-030.0000E+00	0.8755E-01	-.6812E+00
AN 12	10.3214E-030.0000E+00	0.8755E-01	-.7022E+00
AO 12	10.6428E-030.0000E+00	0.8755E-01	-.7336E+00
AP 12	10.6428E-030.0000E+00	0.8755E-01	-.7755E+00
AQ 12	10.6428E-030.0000E+00	0.8755E-01	-.8174E+00
AR 12	BOUND0.1533E+460.1533E-01	0.8755E-01	-.8384E+00
A1 13	10.1789E-020.2438E-01	0.1179E+00	-.3668E-01
A2 13	10.1789E-020.0000E+00	0.1179E+00	-.1100E+00
A3 13	10.1789E-020.0000E+00	0.1179E+00	-.1834E+00
A4 13	10.1789E-020.0000E+00	0.1179E+00	-.2568E+00
A5 13	10.1022E-020.0000E+00	0.1179E+00	-.3144E+00
A6 13	10.5111E-030.0000E+00	0.1179E+00	-.3458E+00
A7 13	10.5111E-030.0000E+00	0.1179E+00	-.3668E+00
A8 13	10.5111E-030.0000E+00	0.1179E+00	-.3878E+00
A9 13	10.5111E-030.0000E+00	0.1179E+00	-.4087E+00
AA 13	10.5111E-030.0000E+00	0.1179E+00	-.4297E+00
AB 13	10.5111E-030.0000E+00	0.1179E+00	-.4506E+00
AC 13	10.5111E-030.0000E+00	0.1179E+00	-.4716E+00
AD 13	10.5111E-030.0000E+00	0.1179E+00	-.4926E+00
AE 13	10.5111E-030.0000E+00	0.1179E+00	-.5135E+00
AF 13	10.5111E-030.0000E+00	0.1179E+00	-.5345E+00
AG 13	10.5111E-030.0000E+00	0.1179E+00	-.5554E+00
AH 13	10.5111E-030.0000E+00	0.1179E+00	-.5764E+00
AI 13	10.5111E-030.0000E+00	0.1179E+00	-.5974E+00
AJ 13	10.5111E-030.0000E+00	0.1179E+00	-.6183E+00
AK 13	10.5111E-030.0000E+00	0.1179E+00	-.6393E+00
AL 13	10.5111E-030.0000E+00	0.1179E+00	-.6602E+00
AM 13	10.5111E-030.0000E+00	0.1179E+00	-.6812E+00
AN 13	10.5111E-030.0000E+00	0.1179E+00	-.7022E+00
AO 13	10.1022E-020.0000E+00	0.1179E+00	-.7336E+00
AP 13	10.1022E-020.0000E+00	0.1179E+00	-.7755E+00
AQ 13	10.1022E-020.0000E+00	0.1179E+00	-.8174E+00
AR 13	BOUND0.2438E+460.2438E-01	0.1179E+00	-.8384E+00
A1 14	10.2754E-020.3754E-01	0.1538E+00	-.3668E-01
A2 14	10.2754E-020.0000E+00	0.1538E+00	-.1100E+00
A3 14	10.2754E-020.0000E+00	0.1538E+00	-.1834E+00
A4 14	10.2754E-020.0000E+00	0.1538E+00	-.2568E+00
A5 14	10.1574E-020.0000E+00	0.1538E+00	-.3144E+00
A6 14	10.7869E-030.0000E+00	0.1538E+00	-.3458E+00
A7 14	10.7869E-030.0000E+00	0.1538E+00	-.3668E+00
A8 14	10.7869E-030.0000E+00	0.1538E+00	-.3878E+00
A9 14	10.7869E-030.0000E+00	0.1538E+00	-.4087E+00
AA 14	10.7869E-030.0000E+00	0.1538E+00	-.4297E+00
AB 14	10.7869E-030.0000E+00	0.1538E+00	-.4506E+00
AC 14	10.7869E-030.0000E+00	0.1538E+00	-.4716E+00
AD 14	10.7869E-030.0000E+00	0.1538E+00	-.4926E+00
AE 14	10.7869E-030.0000E+00	0.1538E+00	-.5135E+00
AF 14	10.7869E-030.0000E+00	0.1538E+00	-.5345E+00

AG 14	10.7869E-030.0000E+00	0.1538E+00	-.5554E+00
AH 14	10.7869E-030.0000E+00	0.1538E+00	-.5764E+00
AI 14	10.7869E-030.0000E+00	0.1538E+00	-.5974E+00
AJ 14	10.7869E-030.0000E+00	0.1538E+00	-.6183E+00
AK 14	10.7869E-030.0000E+00	0.1538E+00	-.6393E+00
AL 14	10.7869E-030.0000E+00	0.1538E+00	-.6602E+00
AM 14	10.7869E-030.0000E+00	0.1538E+00	-.6812E+00
AN 14	10.7869E-030.0000E+00	0.1538E+00	-.7022E+00
AO 14	10.1574E-020.0000E+00	0.1538E+00	-.7336E+00
AP 14	10.1574E-020.0000E+00	0.1538E+00	-.7755E+00
AQ 14	10.1574E-020.0000E+00	0.1538E+00	-.8174E+00
AR 14	BOUND0.3754E+460.3754E-01	0.1538E+00	-.8384E+00
A1 15	10.4147E-020.5653E-01	0.1962E+00	-.3668E-01
A2 15	10.4147E-020.0000E+00	0.1962E+00	-.1100E+00
A3 15	10.4147E-020.0000E+00	0.1962E+00	-.1834E+00
A4 15	10.4147E-020.0000E+00	0.1962E+00	-.2568E+00
A5 15	10.2370E-020.0000E+00	0.1962E+00	-.3144E+00
A6 15	10.1185E-020.0000E+00	0.1962E+00	-.3458E+00
A7 15	10.1185E-020.0000E+00	0.1962E+00	-.3668E+00
A8 15	10.1185E-020.0000E+00	0.1962E+00	-.3878E+00
A9 15	10.1185E-020.0000E+00	0.1962E+00	-.4087E+00
AA 15	10.1185E-020.0000E+00	0.1962E+00	-.4297E+00
AB 15	10.1185E-020.0000E+00	0.1962E+00	-.4506E+00
AC 15	10.1185E-020.0000E+00	0.1962E+00	-.4716E+00
AD 15	10.1185E-020.0000E+00	0.1962E+00	-.4926E+00
AE 15	10.1185E-020.0000E+00	0.1962E+00	-.5135E+00
AF 15	10.1185E-020.0000E+00	0.1962E+00	-.5345E+00
AG 15	10.1185E-020.0000E+00	0.1962E+00	-.5554E+00
AH 15	10.1185E-020.0000E+00	0.1962E+00	-.5764E+00
AI 15	10.1185E-020.0000E+00	0.1962E+00	-.5974E+00
AJ 15	10.1185E-020.0000E+00	0.1962E+00	-.6183E+00
AK 15	10.1185E-020.0000E+00	0.1962E+00	-.6393E+00
AL 15	10.1185E-020.0000E+00	0.1962E+00	-.6602E+00
AM 15	10.1185E-020.0000E+00	0.1962E+00	-.6812E+00
AN 15	10.1185E-020.0000E+00	0.1962E+00	-.7022E+00
AO 15	10.2370E-020.0000E+00	0.1962E+00	-.7336E+00
AP 15	10.2370E-020.0000E+00	0.1962E+00	-.7755E+00
AQ 15	10.2370E-020.0000E+00	0.1962E+00	-.8174E+00
AR 15	BOUND0.5653E+460.5653E-01	0.1962E+00	-.8384E+00
A1 16	TCOND0.1010E-050.1377E-04	0.2191E+00	-.3668E-01
A2 16	TCOND0.1010E-050.0000E+00	0.2191E+00	-.1100E+00
A3 16	TCOND0.1010E-050.0000E+00	0.2191E+00	-.1834E+00
A4 16	TCOND0.1010E-050.0000E+00	0.2191E+00	-.2568E+00
A5 16	TCOND0.5771E-060.0000E+00	0.2191E+00	-.3144E+00
A6 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.3458E+00
A7 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.3668E+00
A8 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.3878E+00
A9 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.4087E+00
AA 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.4297E+00
AB 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.4506E+00
AC 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.4716E+00
AD 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.4926E+00
AE 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.5135E+00
AF 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.5345E+00
AG 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.5554E+00
AH 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.5764E+00
AI 16	TCOND0.2886E-060.0000E+00	0.2191E+00	-.5974E+00

AJ 16	TCONDO.2886E-060.0000E+00	0.2191E+00	-.6183E+00
AK 16	TCONDO.2886E-060.0000E+00	0.2191E+00	-.6393E+00
AL 16	TCONDO.2886E-060.0000E+00	0.2191E+00	-.6602E+00
AM 16	TCONDO.2886E-060.0000E+00	0.2191E+00	-.6812E+00
AN 16	TCONDO.2886E-060.0000E+00	0.2191E+00	-.7022E+00
AO 16	TCONDO.5771E-060.0000E+00	0.2191E+00	-.7336E+00
AP 16	TCONDO.5771E-060.0000E+00	0.2191E+00	-.7755E+00
AQ 16	TCONDO.5771E-060.0000E+00	0.2191E+00	-.8174E+00

CONNE

A9 1A9 2	1	1.e-100.3250E-030.1251E-02
AA 1AA 2	1	1.e-100.3250E-030.1251E-02
AB 1AB 2	1	1.e-100.3250E-030.1251E-02
AC 1AC 2	1	1.e-100.3250E-030.1251E-02
AD 1AD 2	1	1.e-100.3250E-030.1251E-02
AE 1AE 2	1	1.e-100.3250E-030.1251E-02
AF 1AF 2	1	1.e-100.3250E-030.1251E-02
AG 1AG 2	1	1.e-100.3250E-030.1251E-02
AH 1AH 2	1	1.e-100.3250E-030.1251E-02
AI 1AI 2	1	1.e-100.3250E-030.1251E-02
AJ 1AJ 2	1	1.e-100.3250E-030.1251E-02
AK 1AK 2	1	1.e-100.3250E-030.1251E-02
A1 2A1 3	10.3250E-030.3250E-030.4678E-02	
A2 2A2 3	10.3250E-030.3250E-030.4678E-02	
A3 2A3 3	10.3250E-030.3250E-030.4678E-02	
A4 2A4 3	10.3250E-030.3250E-030.4678E-02	
A5 2A5 3	10.3250E-030.3250E-030.2673E-02	
A6 2A6 3	10.3250E-030.3250E-030.1337E-02	
A7 2A7 3	10.3250E-030.3250E-030.1337E-02	
A8 2A8 3	10.3250E-030.3250E-030.1337E-02	
A9 2A9 3	10.3250E-030.3250E-030.1337E-02	
AA 2AA 3	10.3250E-030.3250E-030.1337E-02	
AB 2AB 3	10.3250E-030.3250E-030.1337E-02	
AC 2AC 3	10.3250E-030.3250E-030.1337E-02	
AD 2AD 3	10.3250E-030.3250E-030.1337E-02	
AE 2AE 3	10.3250E-030.3250E-030.1337E-02	
AF 2AF 3	10.3250E-030.3250E-030.1337E-02	
AG 2AG 3	10.3250E-030.3250E-030.1337E-02	
AH 2AH 3	10.3250E-030.3250E-030.1337E-02	
AI 2AI 3	10.3250E-030.3250E-030.1337E-02	
AJ 2AJ 3	10.3250E-030.3250E-030.1337E-02	
AK 2AK 3	10.3250E-030.3250E-030.1337E-02	
AL 2AL 3	10.3250E-030.3250E-030.1337E-02	
AM 2AM 3	10.3250E-030.3250E-030.1337E-02	
AN 2AN 3	10.3250E-030.3250E-030.1337E-02	
AO 2AO 3	10.3250E-030.3250E-030.2673E-02	
AP 2AP 3	10.3250E-030.3250E-030.2673E-02	
AQ 2AQ 3	10.3250E-030.3250E-030.2673E-02	
A1 3A1 4	10.3250E-030.3250E-030.4978E-02	
A2 3A2 4	10.3250E-030.3250E-030.4978E-02	
A3 3A3 4	10.3250E-030.3250E-030.4978E-02	
A4 3A4 4	10.3250E-030.3250E-030.4978E-02	
A5 3A5 4	10.3250E-030.3250E-030.2845E-02	
A6 3A6 4	10.3250E-030.3250E-030.1422E-02	
A7 3A7 4	10.3250E-030.3250E-030.1422E-02	
A8 3A8 4	10.3250E-030.3250E-030.1422E-02	
A9 3A9 4	10.3250E-030.3250E-030.1422E-02	

AA	3AA	4	10.3250E-030.3250E-030.1422E-02
AB	3AB	4	10.3250E-030.3250E-030.1422E-02
AC	3AC	4	10.3250E-030.3250E-030.1422E-02
AD	3AD	4	10.3250E-030.3250E-030.1422E-02
AE	3AE	4	10.3250E-030.3250E-030.1422E-02
AF	3AF	4	10.3250E-030.3250E-030.1422E-02
AG	3AG	4	10.3250E-030.3250E-030.1422E-02
AH	3AH	4	10.3250E-030.3250E-030.1422E-02
AI	3AI	4	10.3250E-030.3250E-030.1422E-02
AJ	3AJ	4	10.3250E-030.3250E-030.1422E-02
AK	3AK	4	10.3250E-030.3250E-030.1422E-02
AL	3AL	4	10.3250E-030.3250E-030.1422E-02
AM	3AM	4	10.3250E-030.3250E-030.1422E-02
AN	3AN	4	10.3250E-030.3250E-030.1422E-02
AO	3AO	4	10.3250E-030.3250E-030.2845E-02
AP	3AP	4	10.3250E-030.3250E-030.2845E-02
AQ	3AQ	4	10.3250E-030.3250E-030.2845E-02
A1	4A1	5	10.3250E-030.3250E-030.5278E-02
A2	4A2	5	10.3250E-030.3250E-030.5278E-02
A3	4A3	5	10.3250E-030.3250E-030.5278E-02
A4	4A4	5	10.3250E-030.3250E-030.5278E-02
A5	4A5	5	10.3250E-030.3250E-030.3016E-02
A6	4A6	5	10.3250E-030.3250E-030.1508E-02
A7	4A7	5	10.3250E-030.3250E-030.1508E-02
A8	4A8	5	10.3250E-030.3250E-030.1508E-02
A9	4A9	5	10.3250E-030.3250E-030.1508E-02
AA	4AA	5	10.3250E-030.3250E-030.1508E-02
AB	4AB	5	10.3250E-030.3250E-030.1508E-02
AC	4AC	5	10.3250E-030.3250E-030.1508E-02
AD	4AD	5	10.3250E-030.3250E-030.1508E-02
AE	4AE	5	10.3250E-030.3250E-030.1508E-02
AF	4AF	5	10.3250E-030.3250E-030.1508E-02
AG	4AG	5	10.3250E-030.3250E-030.1508E-02
AH	4AH	5	10.3250E-030.3250E-030.1508E-02
AI	4AI	5	10.3250E-030.3250E-030.1508E-02
AJ	4AJ	5	10.3250E-030.3250E-030.1508E-02
AK	4AK	5	10.3250E-030.3250E-030.1508E-02
AL	4AL	5	10.3250E-030.3250E-030.1508E-02
AM	4AM	5	10.3250E-030.3250E-030.1508E-02
AN	4AN	5	10.3250E-030.3250E-030.1508E-02
AO	4AO	5	10.3250E-030.3250E-030.3016E-02
AP	4AP	5	10.3250E-030.3250E-030.3016E-02
AQ	4AQ	5	10.3250E-030.3250E-030.3016E-02
A1	5A1	6	10.3250E-030.3250E-030.5577E-02
A2	5A2	6	10.3250E-030.3250E-030.5577E-02
A3	5A3	6	10.3250E-030.3250E-030.5577E-02
A4	5A4	6	10.3250E-030.3250E-030.5577E-02
A5	5A5	6	10.3250E-030.3250E-030.3187E-02
A6	5A6	6	10.3250E-030.3250E-030.1594E-02
A7	5A7	6	10.3250E-030.3250E-030.1594E-02
A8	5A8	6	10.3250E-030.3250E-030.1594E-02
A9	5A9	6	10.3250E-030.3250E-030.1594E-02
AA	5AA	6	10.3250E-030.3250E-030.1594E-02
AB	5AB	6	10.3250E-030.3250E-030.1594E-02
AC	5AC	6	10.3250E-030.3250E-030.1594E-02
AD	5AD	6	10.3250E-030.3250E-030.1594E-02
AE	5AE	6	10.3250E-030.3250E-030.1594E-02

AF	5AF	6	10.3250E-030.3250E-030.1594E-02
AG	5AG	6	10.3250E-030.3250E-030.1594E-02
AH	5AH	6	10.3250E-030.3250E-030.1594E-02
AI	5AI	6	10.3250E-030.3250E-030.1594E-02
AJ	5AJ	6	10.3250E-030.3250E-030.1594E-02
AK	5AK	6	10.3250E-030.3250E-030.1594E-02
AL	5AL	6	10.3250E-030.3250E-030.1594E-02
AM	5AM	6	10.3250E-030.3250E-030.1594E-02
AN	5AN	6	10.3250E-030.3250E-030.1594E-02
AO	5AO	6	10.3250E-030.3250E-030.3187E-02
AP	5AP	6	10.3250E-030.3250E-030.3187E-02
AQ	5AQ	6	10.3250E-030.3250E-030.3187E-02
A1	6A1	7	10.3250E-030.1125E-020.5877E-02
A2	6A2	7	10.3250E-030.1125E-020.5877E-02
A3	6A3	7	10.3250E-030.1125E-020.5877E-02
A4	6A4	7	10.3250E-030.1125E-020.5877E-02
A5	6A5	7	10.3250E-030.1125E-020.3358E-02
A6	6A6	7	10.3250E-030.1125E-020.1679E-02
A7	6A7	7	10.3250E-030.1125E-020.1679E-02
A8	6A8	7	10.3250E-030.1125E-020.1679E-02
A9	6A9	7	10.3250E-030.1125E-020.1679E-02
AA	6AA	7	10.3250E-030.1125E-020.1679E-02
AB	6AB	7	10.3250E-030.1125E-020.1679E-02
AC	6AC	7	10.3250E-030.1125E-020.1679E-02
AD	6AD	7	10.3250E-030.1125E-020.1679E-02
AE	6AE	7	10.3250E-030.1125E-020.1679E-02
AF	6AF	7	10.3250E-030.1125E-020.1679E-02
AG	6AG	7	10.3250E-030.1125E-020.1679E-02
AH	6AH	7	10.3250E-030.1125E-020.1679E-02
AI	6AI	7	10.3250E-030.1125E-020.1679E-02
AJ	6AJ	7	10.3250E-030.1125E-020.1679E-02
AK	6AK	7	10.3250E-030.1125E-020.1679E-02
AL	6AL	7	10.3250E-030.1125E-020.1679E-02
AM	6AM	7	10.3250E-030.1125E-020.1679E-02
AN	6AN	7	10.3250E-030.1125E-020.1679E-02
AO	6AO	7	10.3250E-030.1125E-020.3358E-02
AP	6AP	7	10.3250E-030.1125E-020.3358E-02
AQ	6AQ	7	10.3250E-030.1125E-020.3358E-02
A1	7A1	8	10.1125E-020.2500E-020.6914E-02
A2	7A2	8	10.1125E-020.2500E-020.6914E-02
A3	7A3	8	10.1125E-020.2500E-020.6914E-02
A4	7A4	8	10.1125E-020.2500E-020.6914E-02
A5	7A5	8	10.1125E-020.2500E-020.3951E-02
A6	7A6	8	10.1125E-020.2500E-020.1975E-02
A7	7A7	8	10.1125E-020.2500E-020.1975E-02
A8	7A8	8	10.1125E-020.2500E-020.1975E-02
A9	7A9	8	10.1125E-020.2500E-020.1975E-02
AA	7AA	8	10.1125E-020.2500E-020.1975E-02
AB	7AB	8	10.1125E-020.2500E-020.1975E-02
AC	7AC	8	10.1125E-020.2500E-020.1975E-02
AD	7AD	8	10.1125E-020.2500E-020.1975E-02
AE	7AE	8	10.1125E-020.2500E-020.1975E-02
AF	7AF	8	10.1125E-020.2500E-020.1975E-02
AG	7AG	8	10.1125E-020.2500E-020.1975E-02
AH	7AH	8	10.1125E-020.2500E-020.1975E-02
AI	7AI	8	10.1125E-020.2500E-020.1975E-02
AJ	7AJ	8	10.1125E-020.2500E-020.1975E-02

AK	7AK	8	10.1125E-020.2500E-020.1975E-02
AL	7AL	8	10.1125E-020.2500E-020.1975E-02
AM	7AM	8	10.1125E-020.2500E-020.1975E-02
AN	7AN	8	10.1125E-020.2500E-020.1975E-02
AO	7AO	8	10.1125E-020.2500E-020.3951E-02
AP	7AP	8	10.1125E-020.2500E-020.3951E-02
AQ	7AQ	8	10.1125E-020.2500E-020.3951E-02
A1	8A1	9	10.2500E-020.5000E-020.9219E-02
A2	8A2	9	10.2500E-020.5000E-020.9219E-02
A3	8A3	9	10.2500E-020.5000E-020.9219E-02
A4	8A4	9	10.2500E-020.5000E-020.9219E-02
A5	8A5	9	10.2500E-020.5000E-020.5268E-02
A6	8A6	9	10.2500E-020.5000E-020.2634E-02
A7	8A7	9	10.2500E-020.5000E-020.2634E-02
A8	8A8	9	10.2500E-020.5000E-020.2634E-02
A9	8A9	9	10.2500E-020.5000E-020.2634E-02
AA	8AA	9	10.2500E-020.5000E-020.2634E-02
AB	8AB	9	10.2500E-020.5000E-020.2634E-02
AC	8AC	9	10.2500E-020.5000E-020.2634E-02
AD	8AD	9	10.2500E-020.5000E-020.2634E-02
AE	8AE	9	10.2500E-020.5000E-020.2634E-02
AF	8AF	9	10.2500E-020.5000E-020.2634E-02
AG	8AG	9	10.2500E-020.5000E-020.2634E-02
AH	8AH	9	10.2500E-020.5000E-020.2634E-02
AI	8AI	9	10.2500E-020.5000E-020.2634E-02
AJ	8AJ	9	10.2500E-020.5000E-020.2634E-02
AK	8AK	9	10.2500E-020.5000E-020.2634E-02
AL	8AL	9	10.2500E-020.5000E-020.2634E-02
AM	8AM	9	10.2500E-020.5000E-020.2634E-02
AN	8AN	9	10.2500E-020.5000E-020.2634E-02
AO	8AO	9	10.2500E-020.5000E-020.5268E-02
AP	8AP	9	10.2500E-020.5000E-020.5268E-02
AQ	8AQ	9	10.2500E-020.5000E-020.5268E-02
A1	9A1	10	10.5000E-020.1000E-010.1383E-01
A2	9A2	10	10.5000E-020.1000E-010.1383E-01
A3	9A3	10	10.5000E-020.1000E-010.1383E-01
A4	9A4	10	10.5000E-020.1000E-010.1383E-01
A5	9A5	10	10.5000E-020.1000E-010.7902E-02
A6	9A6	10	10.5000E-020.1000E-010.3951E-02
A7	9A7	10	10.5000E-020.1000E-010.3951E-02
A8	9A8	10	10.5000E-020.1000E-010.3951E-02
A9	9A9	10	10.5000E-020.1000E-010.3951E-02
AA	9AA	10	10.5000E-020.1000E-010.3951E-02
AB	9AB	10	10.5000E-020.1000E-010.3951E-02
AC	9AC	10	10.5000E-020.1000E-010.3951E-02
AD	9AD	10	10.5000E-020.1000E-010.3951E-02
AE	9AE	10	10.5000E-020.1000E-010.3951E-02
AF	9AF	10	10.5000E-020.1000E-010.3951E-02
AG	9AG	10	10.5000E-020.1000E-010.3951E-02
AH	9AH	10	10.5000E-020.1000E-010.3951E-02
AI	9AI	10	10.5000E-020.1000E-010.3951E-02
AJ	9AJ	10	10.5000E-020.1000E-010.3951E-02
AK	9AK	10	10.5000E-020.1000E-010.3951E-02
AL	9AL	10	10.5000E-020.1000E-010.3951E-02
AM	9AM	10	10.5000E-020.1000E-010.3951E-02
AN	9AN	10	10.5000E-020.1000E-010.3951E-02
AO	9AO	10	10.5000E-020.1000E-010.7902E-02

AP	9AP	10	10.5000E-020.1000E-010.7902E-02
AQ	9AQ	10	10.5000E-020.1000E-010.7902E-02
A1	10A1	11	10.1000E-010.1181E-010.2305E-01
A2	10A2	11	10.1000E-010.1181E-010.2305E-01
A3	10A3	11	10.1000E-010.1181E-010.2305E-01
A4	10A4	11	10.1000E-010.1181E-010.2305E-01
A5	10A5	11	10.1000E-010.1181E-010.1317E-01
A6	10A6	11	10.1000E-010.1181E-010.6585E-02
A7	10A7	11	10.1000E-010.1181E-010.6585E-02
A8	10A8	11	10.1000E-010.1181E-010.6585E-02
A9	10A9	11	10.1000E-010.1181E-010.6585E-02
AA	10AA	11	10.1000E-010.1181E-010.6585E-02
AB	10AB	11	10.1000E-010.1181E-010.6585E-02
AC	10AC	11	10.1000E-010.1181E-010.6585E-02
AD	10AD	11	10.1000E-010.1181E-010.6585E-02
AE	10AE	11	10.1000E-010.1181E-010.6585E-02
AF	10AF	11	10.1000E-010.1181E-010.6585E-02
AG	10AG	11	10.1000E-010.1181E-010.6585E-02
AH	10AH	11	10.1000E-010.1181E-010.6585E-02
AI	10AI	11	10.1000E-010.1181E-010.6585E-02
AJ	10AJ	11	10.1000E-010.1181E-010.6585E-02
AK	10AK	11	10.1000E-010.1181E-010.6585E-02
AL	10AL	11	10.1000E-010.1181E-010.6585E-02
AM	10AM	11	10.1000E-010.1181E-010.6585E-02
AN	10AN	11	10.1000E-010.1181E-010.6585E-02
AO	10AO	11	10.1000E-010.1181E-010.1317E-01
AP	10AP	11	10.1000E-010.1181E-010.1317E-01
AQ	10AQ	11	10.1000E-010.1181E-010.1317E-01
A1	11A1	12	10.1181E-010.1394E-010.3393E-01
A2	11A2	12	10.1181E-010.1394E-010.3393E-01
A3	11A3	12	10.1181E-010.1394E-010.3393E-01
A4	11A4	12	10.1181E-010.1394E-010.3393E-01
A5	11A5	12	10.1181E-010.1394E-010.1939E-01
A6	11A6	12	10.1181E-010.1394E-010.9694E-02
A7	11A7	12	10.1181E-010.1394E-010.9694E-02
A8	11A8	12	10.1181E-010.1394E-010.9694E-02
A9	11A9	12	10.1181E-010.1394E-010.9694E-02
AA	11AA	12	10.1181E-010.1394E-010.9694E-02
AB	11AB	12	10.1181E-010.1394E-010.9694E-02
AC	11AC	12	10.1181E-010.1394E-010.9694E-02
AD	11AD	12	10.1181E-010.1394E-010.9694E-02
AE	11AE	12	10.1181E-010.1394E-010.9694E-02
AF	11AF	12	10.1181E-010.1394E-010.9694E-02
AG	11AG	12	10.1181E-010.1394E-010.9694E-02
AH	11AH	12	10.1181E-010.1394E-010.9694E-02
AI	11AI	12	10.1181E-010.1394E-010.9694E-02
AJ	11AJ	12	10.1181E-010.1394E-010.9694E-02
AK	11AK	12	10.1181E-010.1394E-010.9694E-02
AL	11AL	12	10.1181E-010.1394E-010.9694E-02
AM	11AM	12	10.1181E-010.1394E-010.9694E-02
AN	11AN	12	10.1181E-010.1394E-010.9694E-02
AO	11AO	12	10.1181E-010.1394E-010.1939E-01
AP	11AP	12	10.1181E-010.1394E-010.1939E-01
AQ	11AQ	12	10.1181E-010.1394E-010.1939E-01
A1	12A1	13	10.1394E-010.1645E-010.4678E-01
A2	12A2	13	10.1394E-010.1645E-010.4678E-01
A3	12A3	13	10.1394E-010.1645E-010.4678E-01

A4 12A4 13	10.1394E-010.1645E-010.4678E-01
A5 12A5 13	10.1394E-010.1645E-010.2673E-01
A6 12A6 13	10.1394E-010.1645E-010.1337E-01
A7 12A7 13	10.1394E-010.1645E-010.1337E-01
A8 12A8 13	10.1394E-010.1645E-010.1337E-01
A9 12A9 13	10.1394E-010.1645E-010.1337E-01
AA 12AA 13	10.1394E-010.1645E-010.1337E-01
AB 12AB 13	10.1394E-010.1645E-010.1337E-01
AC 12AC 13	10.1394E-010.1645E-010.1337E-01
AD 12AD 13	10.1394E-010.1645E-010.1337E-01
AE 12AE 13	10.1394E-010.1645E-010.1337E-01
AF 12AF 13	10.1394E-010.1645E-010.1337E-01
AG 12AG 13	10.1394E-010.1645E-010.1337E-01
AH 12AH 13	10.1394E-010.1645E-010.1337E-01
AI 12AI 13	10.1394E-010.1645E-010.1337E-01
AJ 12AJ 13	10.1394E-010.1645E-010.1337E-01
AK 12AK 13	10.1394E-010.1645E-010.1337E-01
AL 12AL 13	10.1394E-010.1645E-010.1337E-01
AM 12AM 13	10.1394E-010.1645E-010.1337E-01
AN 12AN 13	10.1394E-010.1645E-010.1337E-01
AO 12AO 13	10.1394E-010.1645E-010.2673E-01
AP 12AP 13	10.1394E-010.1645E-010.2673E-01
AQ 12AQ 13	10.1394E-010.1645E-010.2673E-01
A1 13A1 14	10.1645E-010.1942E-010.6195E-01
A2 13A2 14	10.1645E-010.1942E-010.6195E-01
A3 13A3 14	10.1645E-010.1942E-010.6195E-01
A4 13A4 14	10.1645E-010.1942E-010.6195E-01
A5 13A5 14	10.1645E-010.1942E-010.3540E-01
A6 13A6 14	10.1645E-010.1942E-010.1770E-01
A7 13A7 14	10.1645E-010.1942E-010.1770E-01
A8 13A8 14	10.1645E-010.1942E-010.1770E-01
A9 13A9 14	10.1645E-010.1942E-010.1770E-01
AA 13AA 14	10.1645E-010.1942E-010.1770E-01
AB 13AB 14	10.1645E-010.1942E-010.1770E-01
AC 13AC 14	10.1645E-010.1942E-010.1770E-01
AD 13AD 14	10.1645E-010.1942E-010.1770E-01
AE 13AE 14	10.1645E-010.1942E-010.1770E-01
AF 13AF 14	10.1645E-010.1942E-010.1770E-01
AG 13AG 14	10.1645E-010.1942E-010.1770E-01
AH 13AH 14	10.1645E-010.1942E-010.1770E-01
AI 13AI 14	10.1645E-010.1942E-010.1770E-01
AJ 13AJ 14	10.1645E-010.1942E-010.1770E-01
AK 13AK 14	10.1645E-010.1942E-010.1770E-01
AL 13AL 14	10.1645E-010.1942E-010.1770E-01
AM 13AM 14	10.1645E-010.1942E-010.1770E-01
AN 13AN 14	10.1645E-010.1942E-010.1770E-01
AO 13AO 14	10.1645E-010.1942E-010.3540E-01
AP 13AP 14	10.1645E-010.1942E-010.3540E-01
AQ 13AQ 14	10.1645E-010.1942E-010.3540E-01
A1 14A1 15	10.1942E-010.2293E-010.7985E-01
A2 14A2 15	10.1942E-010.2293E-010.7985E-01
A3 14A3 15	10.1942E-010.2293E-010.7985E-01
A4 14A4 15	10.1942E-010.2293E-010.7985E-01
A5 14A5 15	10.1942E-010.2293E-010.4563E-01
A6 14A6 15	10.1942E-010.2293E-010.2281E-01
A7 14A7 15	10.1942E-010.2293E-010.2281E-01
A8 14A8 15	10.1942E-010.2293E-010.2281E-01

A9	14A9	15	10.1942E-010.2293E-010.2281E-01
AA	14AA	15	10.1942E-010.2293E-010.2281E-01
AB	14AB	15	10.1942E-010.2293E-010.2281E-01
AC	14AC	15	10.1942E-010.2293E-010.2281E-01
AD	14AD	15	10.1942E-010.2293E-010.2281E-01
AE	14AE	15	10.1942E-010.2293E-010.2281E-01
AF	14AF	15	10.1942E-010.2293E-010.2281E-01
AG	14AG	15	10.1942E-010.2293E-010.2281E-01
AH	14AH	15	10.1942E-010.2293E-010.2281E-01
AI	14AI	15	10.1942E-010.2293E-010.2281E-01
AJ	14AJ	15	10.1942E-010.2293E-010.2281E-01
AK	14AK	15	10.1942E-010.2293E-010.2281E-01
AL	14AL	15	10.1942E-010.2293E-010.2281E-01
AM	14AM	15	10.1942E-010.2293E-010.2281E-01
AN	14AN	15	10.1942E-010.2293E-010.2281E-01
AO	14AO	15	10.1942E-010.2293E-010.4563E-01
AP	14AP	15	10.1942E-010.2293E-010.4563E-01
AQ	14AQ	15	10.1942E-010.2293E-010.4563E-01
A1	15A1	16	10.2293E-010.5000E-050.1010E+00
A2	15A2	16	10.2293E-010.5000E-050.1010E+00
A3	15A3	16	10.2293E-010.5000E-050.1010E+00
A4	15A4	16	10.2293E-010.5000E-050.1010E+00
A5	15A5	16	10.2293E-010.5000E-050.5771E-01
A6	15A6	16	10.2293E-010.5000E-050.2885E-01
A7	15A7	16	10.2293E-010.5000E-050.2885E-01
A8	15A8	16	10.2293E-010.5000E-050.2885E-01
A9	15A9	16	10.2293E-010.5000E-050.2885E-01
AA	15AA	16	10.2293E-010.5000E-050.2885E-01
AB	15AB	16	10.2293E-010.5000E-050.2885E-01
AC	15AC	16	10.2293E-010.5000E-050.2885E-01
AD	15AD	16	10.2293E-010.5000E-050.2885E-01
AE	15AE	16	10.2293E-010.5000E-050.2885E-01
AF	15AF	16	10.2293E-010.5000E-050.2885E-01
AG	15AG	16	10.2293E-010.5000E-050.2885E-01
AH	15AH	16	10.2293E-010.5000E-050.2885E-01
AI	15AI	16	10.2293E-010.5000E-050.2885E-01
AJ	15AJ	16	10.2293E-010.5000E-050.2885E-01
AK	15AK	16	10.2293E-010.5000E-050.2885E-01
AL	15AL	16	10.2293E-010.5000E-050.2885E-01
AM	15AM	16	10.2293E-010.5000E-050.2885E-01
AN	15AN	16	10.2293E-010.5000E-050.2885E-01
AO	15AO	16	10.2293E-010.5000E-050.5771E-01
AP	15AP	16	10.2293E-010.5000E-050.5771E-01
AQ	15AQ	16	10.2293E-010.5000E-050.5771E-01
A1	2A2	2	30.3668E-010.3668E-010.4013E-041.
A2	2A3	2	30.3668E-010.3668E-010.4013E-041.
A3	2A4	2	30.3668E-010.3668E-010.4013E-041.
A4	2A5	2	30.3668E-010.2096E-010.4013E-041.
A5	2A6	2	30.2096E-010.1048E-010.4013E-041.
A6	2A7	2	30.1048E-010.1048E-010.4013E-041.
A7	2A8	2	30.1048E-010.1048E-010.4013E-041.
A8	2A9	2	30.1048E-010.1048E-010.4013E-041.
A9	2AA	2	30.1048E-010.1048E-010.4013E-041.
AA	2AB	2	30.1048E-010.1048E-010.4013E-041.
AB	2AC	2	30.1048E-010.1048E-010.4013E-041.
AC	2AD	2	30.1048E-010.1048E-010.4013E-041.
AD	2AE	2	30.1048E-010.1048E-010.4013E-041.

AE	2AF	2	30.1048E-010.1048E-010.4013E-041.
AF	2AG	2	30.1048E-010.1048E-010.4013E-041.
AG	2AH	2	30.1048E-010.1048E-010.4013E-041.
AH	2AI	2	30.1048E-010.1048E-010.4013E-041.
AI	2AJ	2	30.1048E-010.1048E-010.4013E-041.
AJ	2AK	2	30.1048E-010.1048E-010.4013E-041.
AK	2AL	2	30.1048E-010.1048E-010.4013E-041.
AL	2AM	2	30.1048E-010.1048E-010.4013E-041.
AM	2AN	2	30.1048E-010.1048E-010.4013E-041.
AN	2AO	2	30.1048E-010.2096E-010.4013E-041.
AO	2AP	2	30.2096E-010.2096E-010.4013E-041.
AP	2AQ	2	30.2096E-010.2096E-010.4013E-041.
AQ	2AR	2	30.2096E-010.5000E-050.4013E-041.
A1	3A2	3	30.3668E-010.3668E-010.4278E-041.
A2	3A3	3	30.3668E-010.3668E-010.4278E-041.
A3	3A4	3	30.3668E-010.3668E-010.4278E-041.
A4	3A5	3	30.3668E-010.2096E-010.4278E-041.
A5	3A6	3	30.2096E-010.1048E-010.4278E-041.
A6	3A7	3	30.1048E-010.1048E-010.4278E-041.
A7	3A8	3	30.1048E-010.1048E-010.4278E-041.
A8	3A9	3	30.1048E-010.1048E-010.4278E-041.
A9	3AA	3	30.1048E-010.1048E-010.4278E-041.
AA	3AB	3	30.1048E-010.1048E-010.4278E-041.
AB	3AC	3	30.1048E-010.1048E-010.4278E-041.
AC	3AD	3	30.1048E-010.1048E-010.4278E-041.
AD	3AE	3	30.1048E-010.1048E-010.4278E-041.
AE	3AF	3	30.1048E-010.1048E-010.4278E-041.
AF	3AG	3	30.1048E-010.1048E-010.4278E-041.
AG	3AH	3	30.1048E-010.1048E-010.4278E-041.
AH	3AI	3	30.1048E-010.1048E-010.4278E-041.
AI	3AJ	3	30.1048E-010.1048E-010.4278E-041.
AJ	3AK	3	30.1048E-010.1048E-010.4278E-041.
AK	3AL	3	30.1048E-010.1048E-010.4278E-041.
AL	3AM	3	30.1048E-010.1048E-010.4278E-041.
AM	3AN	3	30.1048E-010.1048E-010.4278E-041.
AN	3AO	3	30.1048E-010.2096E-010.4278E-041.
AO	3AP	3	30.2096E-010.2096E-010.4278E-041.
AP	3AQ	3	30.2096E-010.2096E-010.4278E-041.
AQ	3AR	3	30.2096E-010.5000E-050.4278E-041.
A1	4A2	4	30.3668E-010.3668E-010.4544E-041.
A2	4A3	4	30.3668E-010.3668E-010.4544E-041.
A3	4A4	4	30.3668E-010.3668E-010.4544E-041.
A4	4A5	4	30.3668E-010.2096E-010.4544E-041.
A5	4A6	4	30.2096E-010.1048E-010.4544E-041.
A6	4A7	4	30.1048E-010.1048E-010.4544E-041.
A7	4A8	4	30.1048E-010.1048E-010.4544E-041.
A8	4A9	4	30.1048E-010.1048E-010.4544E-041.
A9	4AA	4	30.1048E-010.1048E-010.4544E-041.
AA	4AB	4	30.1048E-010.1048E-010.4544E-041.
AB	4AC	4	30.1048E-010.1048E-010.4544E-041.
AC	4AD	4	30.1048E-010.1048E-010.4544E-041.
AD	4AE	4	30.1048E-010.1048E-010.4544E-041.
AE	4AF	4	30.1048E-010.1048E-010.4544E-041.
AF	4AG	4	30.1048E-010.1048E-010.4544E-041.
AG	4AH	4	30.1048E-010.1048E-010.4544E-041.
AH	4AI	4	30.1048E-010.1048E-010.4544E-041.
AI	4AJ	4	30.1048E-010.1048E-010.4544E-041.

AJ	4AK	4	30.1048E-010.1048E-010.4544E-041.
AK	4AL	4	30.1048E-010.1048E-010.4544E-041.
AL	4AM	4	30.1048E-010.1048E-010.4544E-041.
AM	4AN	4	30.1048E-010.1048E-010.4544E-041.
AN	4AO	4	30.1048E-010.2096E-010.4544E-041.
AO	4AP	4	30.2096E-010.2096E-010.4544E-041.
AP	4AQ	4	30.2096E-010.2096E-010.4544E-041.
AQ	4AR	4	30.2096E-010.5000E-050.4544E-041.
A1	5A2	5	30.3668E-010.3668E-010.4809E-041.
A2	5A3	5	30.3668E-010.3668E-010.4809E-041.
A3	5A4	5	30.3668E-010.3668E-010.4809E-041.
A4	5A5	5	30.3668E-010.2096E-010.4809E-041.
A5	5A6	5	30.2096E-010.1048E-010.4809E-041.
A6	5A7	5	30.1048E-010.1048E-010.4809E-041.
A7	5A8	5	30.1048E-010.1048E-010.4809E-041.
A8	5A9	5	30.1048E-010.1048E-010.4809E-041.
A9	5AA	5	30.1048E-010.1048E-010.4809E-041.
AA	5AB	5	30.1048E-010.1048E-010.4809E-041.
AB	5AC	5	30.1048E-010.1048E-010.4809E-041.
AC	5AD	5	30.1048E-010.1048E-010.4809E-041.
AD	5AE	5	30.1048E-010.1048E-010.4809E-041.
AE	5AF	5	30.1048E-010.1048E-010.4809E-041.
AF	5AG	5	30.1048E-010.1048E-010.4809E-041.
AG	5AH	5	30.1048E-010.1048E-010.4809E-041.
AH	5AI	5	30.1048E-010.1048E-010.4809E-041.
AI	5AJ	5	30.1048E-010.1048E-010.4809E-041.
AJ	5AK	5	30.1048E-010.1048E-010.4809E-041.
AK	5AL	5	30.1048E-010.1048E-010.4809E-041.
AL	5AM	5	30.1048E-010.1048E-010.4809E-041.
AM	5AN	5	30.1048E-010.1048E-010.4809E-041.
AN	5AO	5	30.1048E-010.2096E-010.4809E-041.
AO	5AP	5	30.2096E-010.2096E-010.4809E-041.
AP	5AQ	5	30.2096E-010.2096E-010.4809E-041.
AQ	5AR	5	30.2096E-010.5000E-050.4809E-041.
A1	6A2	6	30.3668E-010.3668E-010.5074E-041.
A2	6A3	6	30.3668E-010.3668E-010.5074E-041.
A3	6A4	6	30.3668E-010.3668E-010.5074E-041.
A4	6A5	6	30.3668E-010.2096E-010.5074E-041.
A5	6A6	6	30.2096E-010.1048E-010.5074E-041.
A6	6A7	6	30.1048E-010.1048E-010.5074E-041.
A7	6A8	6	30.1048E-010.1048E-010.5074E-041.
A8	6A9	6	30.1048E-010.1048E-010.5074E-041.
A9	6AA	6	30.1048E-010.1048E-010.5074E-041.
AA	6AB	6	30.1048E-010.1048E-010.5074E-041.
AB	6AC	6	30.1048E-010.1048E-010.5074E-041.
AC	6AD	6	30.1048E-010.1048E-010.5074E-041.
AD	6AE	6	30.1048E-010.1048E-010.5074E-041.
AE	6AF	6	30.1048E-010.1048E-010.5074E-041.
AF	6AG	6	30.1048E-010.1048E-010.5074E-041.
AG	6AH	6	30.1048E-010.1048E-010.5074E-041.
AH	6AI	6	30.1048E-010.1048E-010.5074E-041.
AI	6AJ	6	30.1048E-010.1048E-010.5074E-041.
AJ	6AK	6	30.1048E-010.1048E-010.5074E-041.
AK	6AL	6	30.1048E-010.1048E-010.5074E-041.
AL	6AM	6	30.1048E-010.1048E-010.5074E-041.
AM	6AN	6	30.1048E-010.1048E-010.5074E-041.
AN	6AO	6	30.1048E-010.2096E-010.5074E-041.

AO	6AP	6	30.2096E-010.2096E-010.5074E-041.
AP	6AQ	6	30.2096E-010.2096E-010.5074E-041.
AQ	6AR	6	30.2096E-010.5000E-050.5074E-041.
A1	7A2	7	30.3668E-010.3668E-010.1962E-031.
A2	7A3	7	30.3668E-010.3668E-010.1962E-031.
A3	7A4	7	30.3668E-010.3668E-010.1962E-031.
A4	7A5	7	30.3668E-010.2096E-010.1962E-031.
A5	7A6	7	30.2096E-010.1048E-010.1962E-031.
A6	7A7	7	30.1048E-010.1048E-010.1962E-031.
A7	7A8	7	30.1048E-010.1048E-010.1962E-031.
A8	7A9	7	30.1048E-010.1048E-010.1962E-031.
A9	7AA	7	30.1048E-010.1048E-010.1962E-031.
AA	7AB	7	30.1048E-010.1048E-010.1962E-031.
AB	7AC	7	30.1048E-010.1048E-010.1962E-031.
AC	7AD	7	30.1048E-010.1048E-010.1962E-031.
AD	7AE	7	30.1048E-010.1048E-010.1962E-031.
AE	7AF	7	30.1048E-010.1048E-010.1962E-031.
AF	7AG	7	30.1048E-010.1048E-010.1962E-031.
AG	7AH	7	30.1048E-010.1048E-010.1962E-031.
AH	7AI	7	30.1048E-010.1048E-010.1962E-031.
AI	7AJ	7	30.1048E-010.1048E-010.1962E-031.
AJ	7AK	7	30.1048E-010.1048E-010.1962E-031.
AK	7AL	7	30.1048E-010.1048E-010.1962E-031.
AL	7AM	7	30.1048E-010.1048E-010.1962E-031.
AM	7AN	7	30.1048E-010.1048E-010.1962E-031.
AN	7AO	7	30.1048E-010.2096E-010.1962E-031.
AO	7AP	7	30.2096E-010.2096E-010.1962E-031.
AP	7AQ	7	30.2096E-010.2096E-010.1962E-031.
AQ	7AR	7	30.2096E-010.5000E-050.1962E-031.
A1	8A2	8	30.3668E-010.3668E-010.5498E-031.
A2	8A3	8	30.3668E-010.3668E-010.5498E-031.
A3	8A4	8	30.3668E-010.3668E-010.5498E-031.
A4	8A5	8	30.3668E-010.2096E-010.5498E-031.
A5	8A6	8	30.2096E-010.1048E-010.5498E-031.
A6	8A7	8	30.1048E-010.1048E-010.5498E-031.
A7	8A8	8	30.1048E-010.1048E-010.5498E-031.
A8	8A9	8	30.1048E-010.1048E-010.5498E-031.
A9	8AA	8	30.1048E-010.1048E-010.5498E-031.
AA	8AB	8	30.1048E-010.1048E-010.5498E-031.
AB	8AC	8	30.1048E-010.1048E-010.5498E-031.
AC	8AD	8	30.1048E-010.1048E-010.5498E-031.
AD	8AE	8	30.1048E-010.1048E-010.5498E-031.
AE	8AF	8	30.1048E-010.1048E-010.5498E-031.
AF	8AG	8	30.1048E-010.1048E-010.5498E-031.
AG	8AH	8	30.1048E-010.1048E-010.5498E-031.
AH	8AI	8	30.1048E-010.1048E-010.5498E-031.
AI	8AJ	8	30.1048E-010.1048E-010.5498E-031.
AJ	8AK	8	30.1048E-010.1048E-010.5498E-031.
AK	8AL	8	30.1048E-010.1048E-010.5498E-031.
AL	8AM	8	30.1048E-010.1048E-010.5498E-031.
AM	8AN	8	30.1048E-010.1048E-010.5498E-031.
AN	8AO	8	30.1048E-010.2096E-010.5498E-031.
AO	8AP	8	30.2096E-010.2096E-010.5498E-031.
AP	8AQ	8	30.2096E-010.2096E-010.5498E-031.
AQ	8AR	8	30.2096E-010.5000E-050.5498E-031.
A1	9A2	9	30.3668E-010.3668E-010.1571E-021.
A2	9A3	9	30.3668E-010.3668E-010.1571E-021.

A3	9A4	9	30.3668E-010.3668E-010.1571E-021.
A4	9A5	9	30.3668E-010.2096E-010.1571E-021.
A5	9A6	9	30.2096E-010.1048E-010.1571E-021.
A6	9A7	9	30.1048E-010.1048E-010.1571E-021.
A7	9A8	9	30.1048E-010.1048E-010.1571E-021.
A8	9A9	9	30.1048E-010.1048E-010.1571E-021.
A9	9AA	9	30.1048E-010.1048E-010.1571E-021.
AA	9AB	9	30.1048E-010.1048E-010.1571E-021.
AB	9AC	9	30.1048E-010.1048E-010.1571E-021.
AC	9AD	9	30.1048E-010.1048E-010.1571E-021.
AD	9AE	9	30.1048E-010.1048E-010.1571E-021.
AE	9AF	9	30.1048E-010.1048E-010.1571E-021.
AF	9AG	9	30.1048E-010.1048E-010.1571E-021.
AG	9AH	9	30.1048E-010.1048E-010.1571E-021.
AH	9AI	9	30.1048E-010.1048E-010.1571E-021.
AI	9AJ	9	30.1048E-010.1048E-010.1571E-021.
AJ	9AK	9	30.1048E-010.1048E-010.1571E-021.
AK	9AL	9	30.1048E-010.1048E-010.1571E-021.
AL	9AM	9	30.1048E-010.1048E-010.1571E-021.
AM	9AN	9	30.1048E-010.1048E-010.1571E-021.
AN	9AO	9	30.1048E-010.2096E-010.1571E-021.
AO	9AP	9	30.2096E-010.2096E-010.1571E-021.
AP	9AQ	9	30.2096E-010.2096E-010.1571E-021.
AQ	9AR	9	30.2096E-010.5000E-050.1571E-021.
A1	10A2	10	30.3668E-010.3668E-010.5027E-021.
A2	10A3	10	30.3668E-010.3668E-010.5027E-021.
A3	10A4	10	30.3668E-010.3668E-010.5027E-021.
A4	10A5	10	30.3668E-010.2096E-010.5027E-021.
A5	10A6	10	30.2096E-010.1048E-010.5027E-021.
A6	10A7	10	30.1048E-010.1048E-010.5027E-021.
A7	10A8	10	30.1048E-010.1048E-010.5027E-021.
A8	10A9	10	30.1048E-010.1048E-010.5027E-021.
A9	10AA	10	30.1048E-010.1048E-010.5027E-021.
AA	10AB	10	30.1048E-010.1048E-010.5027E-021.
AB	10AC	10	30.1048E-010.1048E-010.5027E-021.
AC	10AD	10	30.1048E-010.1048E-010.5027E-021.
AD	10AE	10	30.1048E-010.1048E-010.5027E-021.
AE	10AF	10	30.1048E-010.1048E-010.5027E-021.
AF	10AG	10	30.1048E-010.1048E-010.5027E-021.
AG	10AH	10	30.1048E-010.1048E-010.5027E-021.
AH	10AI	10	30.1048E-010.1048E-010.5027E-021.
AI	10AJ	10	30.1048E-010.1048E-010.5027E-021.
AJ	10AK	10	30.1048E-010.1048E-010.5027E-021.
AK	10AL	10	30.1048E-010.1048E-010.5027E-021.
AL	10AM	10	30.1048E-010.1048E-010.5027E-021.
AM	10AN	10	30.1048E-010.1048E-010.5027E-021.
AN	10AO	10	30.1048E-010.2096E-010.5027E-021.
AO	10AP	10	30.2096E-010.2096E-010.5027E-021.
AP	10AQ	10	30.2096E-010.2096E-010.5027E-021.
AQ	10AR	10	30.2096E-010.5000E-050.5027E-021.
A1	11A2	11	30.3668E-010.3668E-010.9169E-021.
A2	11A3	11	30.3668E-010.3668E-010.9169E-021.
A3	11A4	11	30.3668E-010.3668E-010.9169E-021.
A4	11A5	11	30.3668E-010.2096E-010.9169E-021.
A5	11A6	11	30.2096E-010.1048E-010.9169E-021.
A6	11A7	11	30.1048E-010.1048E-010.9169E-021.
A7	11A8	11	30.1048E-010.1048E-010.9169E-021.

A8 11A9 11	30.1048E-010.1048E-010.9169E-021.
A9 11AA 11	30.1048E-010.1048E-010.9169E-021.
AA 11AB 11	30.1048E-010.1048E-010.9169E-021.
AB 11AC 11	30.1048E-010.1048E-010.9169E-021.
AC 11AD 11	30.1048E-010.1048E-010.9169E-021.
AD 11AE 11	30.1048E-010.1048E-010.9169E-021.
AE 11AF 11	30.1048E-010.1048E-010.9169E-021.
AF 11AG 11	30.1048E-010.1048E-010.9169E-021.
AG 11AH 11	30.1048E-010.1048E-010.9169E-021.
AH 11AI 11	30.1048E-010.1048E-010.9169E-021.
AI 11AJ 11	30.1048E-010.1048E-010.9169E-021.
AJ 11AK 11	30.1048E-010.1048E-010.9169E-021.
AK 11AL 11	30.1048E-010.1048E-010.9169E-021.
AL 11AM 11	30.1048E-010.1048E-010.9169E-021.
AM 11AN 11	30.1048E-010.1048E-010.9169E-021.
AN 11AO 11	30.1048E-010.2096E-010.9169E-021.
AO 11AP 11	30.2096E-010.2096E-010.9169E-021.
AP 11AQ 11	30.2096E-010.2096E-010.9169E-021.
AQ 11AR 11	30.2096E-010.5000E-050.9169E-021.
A1 12A2 12	30.3668E-010.3668E-010.1533E-011.
A2 12A3 12	30.3668E-010.3668E-010.1533E-011.
A3 12A4 12	30.3668E-010.3668E-010.1533E-011.
A4 12A5 12	30.3668E-010.2096E-010.1533E-011.
A5 12A6 12	30.2096E-010.1048E-010.1533E-011.
A6 12A7 12	30.1048E-010.1048E-010.1533E-011.
A7 12A8 12	30.1048E-010.1048E-010.1533E-011.
A8 12A9 12	30.1048E-010.1048E-010.1533E-011.
A9 12AA 12	30.1048E-010.1048E-010.1533E-011.
AA 12AB 12	30.1048E-010.1048E-010.1533E-011.
AB 12AC 12	30.1048E-010.1048E-010.1533E-011.
AC 12AD 12	30.1048E-010.1048E-010.1533E-011.
AD 12AE 12	30.1048E-010.1048E-010.1533E-011.
AE 12AF 12	30.1048E-010.1048E-010.1533E-011.
AF 12AG 12	30.1048E-010.1048E-010.1533E-011.
AG 12AH 12	30.1048E-010.1048E-010.1533E-011.
AH 12AI 12	30.1048E-010.1048E-010.1533E-011.
AI 12AJ 12	30.1048E-010.1048E-010.1533E-011.
AJ 12AK 12	30.1048E-010.1048E-010.1533E-011.
AK 12AL 12	30.1048E-010.1048E-010.1533E-011.
AL 12AM 12	30.1048E-010.1048E-010.1533E-011.
AM 12AN 12	30.1048E-010.1048E-010.1533E-011.
AN 12AO 12	30.1048E-010.2096E-010.1533E-011.
AO 12AP 12	30.2096E-010.2096E-010.1533E-011.
AP 12AQ 12	30.2096E-010.2096E-010.1533E-011.
AQ 12AR 12	30.2096E-010.5000E-050.1533E-011.
A1 13A2 13	30.3668E-010.3668E-010.2438E-011.
A2 13A3 13	30.3668E-010.3668E-010.2438E-011.
A3 13A4 13	30.3668E-010.3668E-010.2438E-011.
A4 13A5 13	30.3668E-010.2096E-010.2438E-011.
A5 13A6 13	30.2096E-010.1048E-010.2438E-011.
A6 13A7 13	30.1048E-010.1048E-010.2438E-011.
A7 13A8 13	30.1048E-010.1048E-010.2438E-011.
A8 13A9 13	30.1048E-010.1048E-010.2438E-011.
A9 13AA 13	30.1048E-010.1048E-010.2438E-011.
AA 13AB 13	30.1048E-010.1048E-010.2438E-011.
AB 13AC 13	30.1048E-010.1048E-010.2438E-011.
AC 13AD 13	30.1048E-010.1048E-010.2438E-011.

AD 13AE 13	30.1048E-010.1048E-010.2438E-011.
AE 13AF 13	30.1048E-010.1048E-010.2438E-011.
AF 13AG 13	30.1048E-010.1048E-010.2438E-011.
AG 13AH 13	30.1048E-010.1048E-010.2438E-011.
AH 13AI 13	30.1048E-010.1048E-010.2438E-011.
AI 13AJ 13	30.1048E-010.1048E-010.2438E-011.
AJ 13AK 13	30.1048E-010.1048E-010.2438E-011.
AK 13AL 13	30.1048E-010.1048E-010.2438E-011.
AL 13AM 13	30.1048E-010.1048E-010.2438E-011.
AM 13AN 13	30.1048E-010.1048E-010.2438E-011.
AN 13AO 13	30.1048E-010.2096E-010.2438E-011.
AO 13AP 13	30.2096E-010.2096E-010.2438E-011.
AP 13AQ 13	30.2096E-010.2096E-010.2438E-011.
AQ 13AR 13	30.2096E-010.5000E-050.2438E-011.
A1 14A2 14	30.3668E-010.3668E-010.3754E-011.
A2 14A3 14	30.3668E-010.3668E-010.3754E-011.
A3 14A4 14	30.3668E-010.3668E-010.3754E-011.
A4 14A5 14	30.3668E-010.2096E-010.3754E-011.
A5 14A6 14	30.2096E-010.1048E-010.3754E-011.
A6 14A7 14	30.1048E-010.1048E-010.3754E-011.
A7 14A8 14	30.1048E-010.1048E-010.3754E-011.
A8 14A9 14	30.1048E-010.1048E-010.3754E-011.
A9 14AA 14	30.1048E-010.1048E-010.3754E-011.
AA 14AB 14	30.1048E-010.1048E-010.3754E-011.
AB 14AC 14	30.1048E-010.1048E-010.3754E-011.
AC 14AD 14	30.1048E-010.1048E-010.3754E-011.
AD 14AE 14	30.1048E-010.1048E-010.3754E-011.
AE 14AF 14	30.1048E-010.1048E-010.3754E-011.
AF 14AG 14	30.1048E-010.1048E-010.3754E-011.
AG 14AH 14	30.1048E-010.1048E-010.3754E-011.
AH 14AI 14	30.1048E-010.1048E-010.3754E-011.
AI 14AJ 14	30.1048E-010.1048E-010.3754E-011.
AJ 14AK 14	30.1048E-010.1048E-010.3754E-011.
AK 14AL 14	30.1048E-010.1048E-010.3754E-011.
AL 14AM 14	30.1048E-010.1048E-010.3754E-011.
AM 14AN 14	30.1048E-010.1048E-010.3754E-011.
AN 14AO 14	30.1048E-010.2096E-010.3754E-011.
AO 14AP 14	30.2096E-010.2096E-010.3754E-011.
AP 14AQ 14	30.2096E-010.2096E-010.3754E-011.
AQ 14AR 14	30.2096E-010.5000E-050.3754E-011.
A1 15A2 15	30.3668E-010.3668E-010.5653E-011.
A2 15A3 15	30.3668E-010.3668E-010.5653E-011.
A3 15A4 15	30.3668E-010.3668E-010.5653E-011.
A4 15A5 15	30.3668E-010.2096E-010.5653E-011.
A5 15A6 15	30.2096E-010.1048E-010.5653E-011.
A6 15A7 15	30.1048E-010.1048E-010.5653E-011.
A7 15A8 15	30.1048E-010.1048E-010.5653E-011.
A8 15A9 15	30.1048E-010.1048E-010.5653E-011.
A9 15AA 15	30.1048E-010.1048E-010.5653E-011.
AA 15AB 15	30.1048E-010.1048E-010.5653E-011.
AB 15AC 15	30.1048E-010.1048E-010.5653E-011.
AC 15AD 15	30.1048E-010.1048E-010.5653E-011.
AD 15AE 15	30.1048E-010.1048E-010.5653E-011.
AE 15AF 15	30.1048E-010.1048E-010.5653E-011.
AF 15AG 15	30.1048E-010.1048E-010.5653E-011.
AG 15AH 15	30.1048E-010.1048E-010.5653E-011.
AH 15AI 15	30.1048E-010.1048E-010.5653E-011.

AI 15AJ 15	30.1048E-010.1048E-010.5653E-011.
AJ 15AK 15	30.1048E-010.1048E-010.5653E-011.
AK 15AL 15	30.1048E-010.1048E-010.5653E-011.
AL 15AM 15	30.1048E-010.1048E-010.5653E-011.
AM 15AN 15	30.1048E-010.1048E-010.5653E-011.
AN 15AO 15	30.1048E-010.2096E-010.5653E-011.
AO 15AP 15	30.2096E-010.2096E-010.5653E-011.
AP 15AQ 15	30.2096E-010.2096E-010.5653E-011.
AQ 15AR 15	30.2096E-010.5000E-050.5653E-011.

ENDCY---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8
 MESHM---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8
 RZ2D ---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8
 RADII

11
 0. .0095 .010150 .010800 .011450 .012100 .012750 .015
 .020 .03 .05

LOGAR---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8
 5 .2191

EQUID

1 1.e-5
 LAYER---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8
 27
 .07336 .04192 .02096

.04192

1.e-5

ENDFI---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8

val3a ... Validation Problem No.3.

START Heat and mass flow with phase change

START Kruger and Ramey (1974); Faust and Mercer [1979]

START 7-10-92: George's latest data file

START Boundary ring included

ROCKS-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

CORE 2 2650. 0.36 1.E-13 1.E-13 1.E-13 2.10 1010.

0. 0. 2.10 1.

3 0.30 0.05

1 0. 0. 1.

TUBES 2 2650. 0.36 0. 0. 0. 2.10 1.E+6

0. 0. 2.10 1.

5

1 0. 0. 1.

BOUND 2 2650. 0.10 1.E-13 1.E-13 1.E-13 0. 1.E30

0. 0. 0. 1.

5 0.

1 0. 0. 1.

START-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

PARAM-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

10 19999 999900000001 0000 0 60 2.13E-5 1.80

0. 300. 2.E-4 5.A 98 0.000 2. 1.

1.E-6 1. .1 1. 1. 1.E-8

2.17 E6 192. 0.

RPCAP-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

5

1 0. 0. 1.

TIMES-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

1 6 50.

50.

ELEME-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

A 0 99 1CORE 1.2098E-5

B 0 99 1TUBES 1.E30

YY 1 0 0BOUND 1.E51

CONNE-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

A 0A 1 98 1 1 1 2.9845E-3 2.9845E-3 2.0268E-3 0.

A 99YY 1 0 0 0 1 2.9845E-3 1.E-10 2.0268E-3 0.

A 0B 0 99 1 1 2 7.44E-3 5.0E-3 9.5261E-4 1.

GENER-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

YY 1QQQ 1 0 0 0 2 MASS

0. 300.

-1.35395E49 -1.35395E49

YY 1QQQ 2 0 0 0 2 AIR 1

0. 300.

0. 1.526036E49

98825. 98825.

INCON-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

B 0 99 1 2.17E6 198.9 0.

A 0 2.17E6 191.96 0.

A 1 2.17E6 191.88 0.

A	2	2.17E6	191.80	0.
A	3	2.17E6	191.72	0.
A	4	2.17E6	191.64	0.
A	5	2.17E6	191.56	0.
A	6	2.17E6	191.48	0.
A	7	2.17E6	191.40	0.
A	8	2.17E6	191.32	0.
A	9	2.17E6	191.24	0.
A	10	2.17E6	191.16	0.
A	11	2.17E6	191.08	0.
A	12	2.17E6	191.00	0.
A	13	2.17E6	190.92	0.
A	14	2.17E6	190.84	0.
A	15	2.17E6	190.76	0.
A	16	2.17E6	190.68	0.
A	17	2.17E6	190.60	0.
A	18	2.17E6	190.52	0.
A	19	2.17E6	190.44	0.
A	20	2.17E6	190.36	0.
A	21	2.17E6	190.28	0.
A	22	2.17E6	190.20	0.
A	23	2.17E6	190.12	0.
A	24	2.17E6	190.04	0.
A	25	2.17E6	189.96	0.
A	26	2.17E6	189.88	0.
A	27	2.17E6	189.80	0.
A	28	2.17E6	189.72	0.
A	29	2.17E6	189.64	0.
A	30			

A 31	2.17E6	189.56	0.
A 32	2.17E6	189.48	0.
A 33	2.17E6	189.40	0.
A 34	2.17E6	189.32	0.
A 35	2.17E6	189.24	0.
A 36	2.17E6	189.16	0.
A 37	2.17E6	189.08	0.
A 38	2.17E6	189.00	0.
A 39	2.17E6	188.92	0.
A 40	2.17E6	188.84	0.
A 41	2.17E6	188.76	0.
A 42	2.17E6	188.68	0.
A 43	2.17E6	188.60	0.
A 44	2.17E6	188.52	0.
A 45	2.17E6	188.44	0.
A 46	2.17E6	188.36	0.
A 47	2.17E6	188.28	0.
A 48	2.17E6	188.20	0.
A 49	2.17E6	188.12	0.
A 50	2.17E6	188.04	0.
A 51	2.17E6	187.96	0.
A 52	2.17E6	187.88	0.
A 53	2.17E6	187.80	0.
A 54	2.17E6	187.72	0.
A 55	2.17E6	187.64	0.
A 56	2.17E6	187.56	0.
A 57	2.17E6	187.48	0.
A 58	2.17E6	187.40	0.
	2.17E6	187.32	0.

A 58	2.17E6	187.24	0.
A 60	2.17E6	187.16	0.
A 61	2.17E6	187.08	0.
A 62	2.17E6	187.00	0.
A 63	2.17E6	186.92	0.
A 64	2.17E6	186.84	0.
A 65	2.17E6	186.76	0.
A 66	2.17E6	186.68	0.
A 67	2.17E6	186.60	0.
A 68	2.17E6	186.52	0.
A 69	2.17E6	186.44	0.
A 70	2.17E6	186.36	0.
A 71	2.17E6	186.28	0.
A 72	2.17E6	186.20	0.
A 73	2.17E6	186.12	0.
A 74	2.17E6	186.04	0.
A 75	2.17E6	185.96	0.
A 76	2.17E6	185.88	0.
A 77	2.17E6	185.80	0.
A 78	2.17E6	185.72	0.
A 79	2.17E6	185.64	0.
A 80	2.17E6	185.56	0.
A 81	2.17E6	185.48	0.
A 82	2.17E6	185.40	0.
A 83	2.17E6	185.32	0.
A 84	2.17E6	185.24	0.
A 85	2.17E6	185.16	0.
A 86	2.17E6	185.08	0.
A 87			

A 88	2.17E6	185.00	0.
A 89	2.17E6	184.92	0.
A 90	2.17E6	184.84	0.
A 91	2.17E6	184.76	0.
A 92	2.17E6	184.68	0.
A 93	2.17E6	184.60	0.
A 94	2.17E6	184.52	0.
A 95	2.17E6	184.44	0.
A 96	2.17E6	184.36	0.
A 97	2.17E6	184.28	0.
A 98	2.17E6	184.20	0.
A 99	2.17E6	184.12	0.
YY 1	2.17E6	184.04	0.
	1.840965E6	20.	1.

ENDCY---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8

val3b ... Validation Problem No.3.

START Heat and mass flow with phase change

START Kruger and Ramey (1974); Faust and Mercer [1979]

START 7-10-92: George's latest data file

START Boundary ring omitted

ROCKS-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

CORE 2 2650. 0.36 1.E-13 1.E-13 1.E-13 2.10 1010.

0. 0. 2.10 1.

3 0.30 0.05

1 0. 0. 1.

BOUND 2 2650. 0.10 1.E-13 1.E-13 1.E-13 0. 1.E30

0. 0. 0. 1.

5 0.

1 0. 0. 1.

START-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

PARAM-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

10 19999 99990000001 0000 0 60 2.13E-5 1.80

0. 300. 2.E-4 5.A 98 0.000 2. 1.

1.E-6 1. .1 1. 1. 1.E-8

2.17 E6 192. 0.

RPCAP-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

5

1 0. 0. 1.

TIMES-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

1 6 50.

50.

ELEME-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

A 0 99 1CORE 1.2098E-5

YY 1 0 0BOUND 1.E51

CONNE-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

A 0A 1 98 1 1 1 2.9845E-3 2.9845E-3 2.0268E-3 0.

A 99YY 1 0 0 0 1 2.9845E-3 1.E-10 2.0268E-3 0.

GENER-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

YY 1QQQ 1 0 0 0 2 MASS

0. 300.

-1.35395E49 -1.35395E49

YY 1QQQ 2 0 0 0 2 AIR 1

0. 300.

0. 1.526036E49

98825. 98825.

INCON-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

A 0

2.17E6 191.96 0.

A 1 2.17E6 191.88 0.

A 2 2.17E6 191.80 0.

A 3 2.17E6 191.72 0.

A 4 2.17E6 191.64 0.

A 5 2.17E6 191.56 0.

A	6	2.17E6	191.48	0.
A	7	2.17E6	191.40	0.
A	8	2.17E6	191.32	0.
A	9	2.17E6	191.24	0.
A	10	2.17E6	191.16	0.
A	11	2.17E6	191.08	0.
A	12	2.17E6	191.00	0.
A	13	2.17E6	190.92	0.
A	14	2.17E6	190.84	0.
A	15	2.17E6	190.76	0.
A	16	2.17E6	190.68	0.
A	17	2.17E6	190.60	0.
A	18	2.17E6	190.52	0.
A	19	2.17E6	190.44	0.
A	20	2.17E6	190.36	0.
A	21	2.17E6	190.28	0.
A	22	2.17E6	190.20	0.
A	23	2.17E6	190.12	0.
A	24	2.17E6	190.04	0.
A	25	2.17E6	189.96	0.
A	26	2.17E6	189.88	0.
A	27	2.17E6	189.80	0.
A	28	2.17E6	189.72	0.
A	29	2.17E6	189.64	0.
A	30	2.17E6	189.56	0.
A	31	2.17E6	189.48	0.
A	32	2.17E6	189.40	0.
A	33	2.17E6	189.32	0.
A	34			

A 35	2.17E6	189.24	0.
A 36	2.17E6	189.16	0.
A 37	2.17E6	189.08	0.
A 38	2.17E6	189.00	0.
A 39	2.17E6	188.92	0.
A 40	2.17E6	188.84	0.
A 41	2.17E6	188.76	0.
A 42	2.17E6	188.68	0.
A 43	2.17E6	188.60	0.
A 44	2.17E6	188.52	0.
A 45	2.17E6	188.44	0.
A 46	2.17E6	188.36	0.
A 47	2.17E6	188.28	0.
A 48	2.17E6	188.20	0.
A 49	2.17E6	188.12	0.
A 50	2.17E6	188.04	0.
A 51	2.17E6	187.96	0.
A 52	2.17E6	187.88	0.
A 53	2.17E6	187.80	0.
A 54	2.17E6	187.72	0.
A 55	2.17E6	187.64	0.
A 56	2.17E6	187.56	0.
A 57	2.17E6	187.48	0.
A 58	2.17E6	187.40	0.
A 58	2.17E6	187.32	0.
A 60	2.17E6	187.24	0.
A 61	2.17E6	187.16	0.
A 62	2.17E6	187.08	0.
	2.17E6	187.00	0.

A 63	2.17E6	186.92	0.
A 64	2.17E6	186.84	0.
A 65	2.17E6	186.76	0.
A 66	2.17E6	186.68	0.
A 67	2.17E6	186.60	0.
A 68	2.17E6	186.52	0.
A 69	2.17E6	186.44	0.
A 70	2.17E6	186.36	0.
A 71	2.17E6	186.28	0.
A 72	2.17E6	186.20	0.
A 73	2.17E6	186.12	0.
A 74	2.17E6	186.04	0.
A 75	2.17E6	185.96	0.
A 76	2.17E6	185.88	0.
A 77	2.17E6	185.80	0.
A 78	2.17E6	185.72	0.
A 79	2.17E6	185.64	0.
A 80	2.17E6	185.56	0.
A 81	2.17E6	185.48	0.
A 82	2.17E6	185.40	0.
A 83	2.17E6	185.32	0.
A 84	2.17E6	185.24	0.
A 85	2.17E6	185.16	0.
A 86	2.17E6	185.08	0.
A 87	2.17E6	185.00	0.
A 88	2.17E6	184.92	0.
A 89	2.17E6	184.84	0.
A 90	2.17E6	184.76	0.
A 91			

	2.17E6	184.68	0.
A 92			
	2.17E6	184.60	0.
A 93			
	2.17E6	184.52	0.
A 94			
	2.17E6	184.44	0.
A 95			
	2.17E6	184.36	0.
A 96			
	2.17E6	184.28	0.
A 97			
	2.17E6	184.20	0.
A 98			
	2.17E6	184.12	0.
A 99			
	2.17E6	184.04	0.
YY 1			
	1.840965E6	20.	1.

ENDCY---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8

ver1a ... Verification Problem No.1.

START 1-d infiltration after Philip (1955) - Ross et al. (1982)

START Original data file supplied by S. Webb

ROCKS	1	2	3	4	5	6	7	8
TUBES	2385.	.45		1.2e-14			1.045	1030.
BOUND	2650.	.45		1.2e-14			1.045	10000.
RING	2	2650.	.45	1.2e-14			1.045	1.e4

1	.333	-.1	1.	0.
1	0.	.333	1.	

START-----1-----2-----3-----4-----5-----6-----7-----8
PARAM-----1-----2-----3-----4-----5-----6-----7-----8

8 2 200 600 1000000010000000 4
9504.0 -1. 5.e2f 1

1.e0
1.e-5 1.e-5 1.e-7
1.e5 .5555555556 20.

START-----1-----2-----3-----4-----5-----6-----7-----8
RPCAP-----1-----2-----3-----4-----5-----6-----7-----8

1	.333	-.1	1.	0.
1	9.79020e3	.333	1.	

TIMES-----1-----2-----3-----4-----5-----6-----7-----8

3 3 5.e2
8.64e2 5.184e3 9.504e3

ELEME-----1-----2-----3-----4-----5-----6-----7-----8

lb	0	BOUND	1.e50
f	1 39	1TUBES	5.e-3
r	1 39	1RING	1.e50

CONNE-----1-----2-----3-----4-----5-----6-----7-----8

lb	0f	1		1	1.e-10	.0025	1.	0.
f	1f	2 38	1	1	1	.0025	.0025	1.
f	1r	1 39	1	1	1	.0025	.0	10.

INCON-----1-----2-----3-----4-----5-----6-----7-----8

lb	0							
		1.e5			20.			
r	1 39	1			20.		1.	

ENDCY-----1-----2-----3-----4-----5-----6-----7-----8

ver1b ... Verification Problem No.1.

START 1-d infiltration after Philip (1955) - Ross et al. (1982)
START Removal of second row of cells; upstream weighing (MOP(11)=0)
START 7-10-92: George's latest

ROCKS	1	2	3	4	5	6	7	8
TUBES	2385.	.45		1.2e-14			1.045	1030.
BOUND	2650.	.45		1.2e-14			1.045	10000.

START	1	2	3	4	5	6	7	8
PARAM	1	2	3	4	5	6	7	8

8 2 200 600 10000000010001000 4
9504.0 -1. 5.e2f 1

1.e0
1.e-5 1.e-5 1.e-7
1.e5 .5555555556 20.

RPCAP	1	2	3	4	5	6	7	8
1	.333	-.1	1.	0.				

TIMES	1	2	3	4	5	6	7	8
1	9.79020e3	.333	1.					

	3	3	5.e2					
	8.64e2	5.184e3	9.504e3					

ELEME	1	2	3	4	5	6	7	8
lb 0		BOUND	1.e50					
f 1 39	1TUBES	5.e-3						

CONNE	1	2	3	4	5	6	7	8
lb 0f 1			1	1.e-10	.0025	1.	0.	
f 1f 2 38	1	1	1	.0025	.0025	1.	0.	

INCON	1	2	3	4	5	6	7	8
lb 0								
		1.e5		20.				

ENDCY	1	2	3	4	5	6	7	8

ver1c ... Verification Problem No.1.

START 1-d infiltration after Philip (1955) - Ross et al. (1982)

START Removal of second row of cells;midpoint weighing (MOP(11)=1)

START 7-10-92: George's latest

ROCKS----1----*----2----*----3----*----4----*----5----*----6----*----7----*----8

TUBES 2385. .45 1.2e-14 1.045 1030.

BOUND 2650. .45 1.2e-14 1.045 10000.

START----1----*----2----*----3----*----4----*----5----*----6----*----7----*----8

PARAM----1----*----2----*----3----*----4----*----5----*----6----*----7----*----8

8 2 200 600 10000000010001000 4

9504.0 -1. 5.e2f 1

1.e0

1.e-5

1.e-5

1.e5

.5555555556 20.

1.e-7

RPCAP----1----*----2----*----3----*----4----*----5----*----6----*----7----*----8

1 .333 -.1 1. 0.

1 9.79020e3 .333 1.

TIMES----1----*----2----*----3----*----4----*----5----*----6----*----7----*----8

3 3 5.e2

8.64e2 5.184e3 9.504e3

ELEME----1----*----2----*----3----*----4----*----5----*----6----*----7----*----8

lb 0 BOUND 1.e50

f 1 39 1TUBES 5.e-3

CONNE----1----*----2----*----3----*----4----*----5----*----6----*----7----*----8

lb 0f 1 1 1 1.e-10 .0025 1. 0.

f 1f 2 38 1 1 1 .0025 .0025 1. 0.

INCON----1----*----2----*----3----*----4----*----5----*----6----*----7----*----8

lb 0

1.e5

20.

ENDCY----1----*----2----*----3----*----4----*----5----*----6----*----7----*----8

ver2a ... Verification Problem No.2.

START 1-d heat transport - Avdonin (1964), Ross (1984)

START 1st modification; upstream weighting + injection

START 6-10-92: modified from George's latest

START increase V(u 0)

START fix GENER, simplify INCON

ROCKS-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

aquif 0 2898.7 0.2 1.8e-11 0. 0. 20.0 739.35

left 0 2898.7 0.2 1.8e-11 0. 0. 20.0 1.e40

right 0 2898.7 0.2 1.8e-11 0. 0. 20.0 1.e6

START-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

PARAM-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

8 11300 130010000010000000 30 2.13e-5 1.80

0. 130000. -1. 100.a 0 9.807 2. 1.0

100.

1.e-5 1.0 0.1 1. 1. 1.e-8

5.e6 170. 0.

RPCAP-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

5

1 0.0 0.0 1.0

ELEME-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

u 0 0 0left 1.

a 0 99 1aquif 10.

b 0 99 1aquif 10.

c 0 99 1aquif 10.

d 0 99 1aquif 10.

rb 1 0 0right 1.e50

CONNE-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

u 0a 0 0 0 0 1 5.E-5 0.05 100. 0.

a 0a 1 98 1 1 1 0.05 0.05 100. 0.

a 99b 0 0 0 0 1 0.05 0.05 100. 0.

b 0b 1 98 1 1 1 0.05 0.05 100. 0.

b 99c 0 0 0 0 1 0.05 0.05 100. 0.

c 0c 1 98 1 1 1 0.05 0.05 100. 0.

c 99d 0 0 0 0 1 0.05 0.05 100. 0.

d 0d 1 98 1 1 1 0.05 0.05 100. 0.

d 99rb 1 0 0 0 1 0.05 1.e-10 100. 0.

INCON-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

u 0 0 0

5.e6 160.00 0.0

GENER-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

u 0 S 1 0 0 0 0 WATE 10. 6.782e5

ENDCY-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

ver2b ... Verification Problem No.2.

START 1-d heat transport - Avdonin (1964), Ross (1984)

START 1st modification; midpoint weighting + injection

START 6-10-92: modified from George's latest

START increase V(u 0)

START fix GENER, simplify INCON

ROCKS-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

aquif 0 2898.7 0.2 1.8e-11 0. 0. 20.0 739.35

left 0 2898.7 0.2 1.8e-11 0. 0. 20.0 1.e40

right 0 2898.7 0.2 1.8e-11 0. 0. 20.0 1.e6

START-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

PARAM-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

8 11300 130010000010001000 30 2.13e-5 1.80

0. 130000. -1. 100.a 0 9.807 2. 1.0

100.

1.e-5 1.0 0.1 1. 1. 1.e-8

5.e6 170. 0.

RPCAP-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

5

1 0.0 0.0 1.0

ELEME-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

u 0 0 0left 1.

a 0 99 1aquif 10.

b 0 99 1aquif 10.

c 0 99 1aquif 10.

d 0 99 1aquif 10.

rb 1 0 0right 1.e50

CONNE-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

u 0a 0 0 0 0 1 5.E-5 0.05 100. 0.

a 0a 1 98 1 1 1 0.05 0.05 100. 0.

a 99b 0 0 0 0 1 0.05 0.05 100. 0.

b 0b 1 98 1 1 1 0.05 0.05 100. 0.

b 99c 0 0 0 0 1 0.05 0.05 100. 0.

c 0c 1 98 1 1 1 0.05 0.05 100. 0.

c 99d 0 0 0 0 1 0.05 0.05 100. 0.

d 0d 1 98 1 1 1 0.05 0.05 100. 0.

d 99rb 1 0 0 0 1 0.05 1.e-10 100. 0.

INCON-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

u 0 0 0

5.e6 160.00 0.0

GENER-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

u 0 S 1 0 0 0 0 WATE 10. 6.782e5

ENDCY-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

ver3a ... Verification Problem No.3.

START 1-d radial heat transport - Avdonin (1964), Ross (1984)

START upstream weighting + injection

START 7-10-92: George's latest

START grid generation using MESHPAKER from TOUGH2

ROCKS	1	2	3	4	5	6	7	8
WELL	0	2898.68	0.26.6646E-13				20.0	1.0E50
AQUIF	0	2898.68	0.26.6646E-13				20.0	7.3935E2
BOUND	0	2898.68	0.26.6646E-13				20.0	1.0E6

START	1	2	3	4	5	6	7	8
PARAM	1	2	3	4	5	6	7	8

8	13000357510000000001	0000	0	40	2.13E-5	1.80		
	0.	1.E9	-1.	1.E6A	0	9.807	2.	1.0

1.								
1.E-5	1.0	0.1	1.	1.	1.E-8			
	5.E6		170.		0.			

RPCAP	1	2	3	4	5	6	7	8

5								
1	0.0	0.0	1.0					

TIMES	1	2	3	4	5	6	7	8

9	9	1.E6						
	1.E1	1.E2	1.E3	1.E4	1.E5	1.E6	1.E7	1.E8
	1.E9							

ELEME	1	2	3	4	5	6	7	8

A1	1	OWELL	.6252E-03	.1250E-04		.9950E-02		-.5000E+02
A1	2	0AQUIF	.1036E+00	.2072E-02		.1537E-01		-.5000E+02
A1	3	0AQUIF	.1917E+00	.3834E-02		.2649E-01		-.5000E+02
A1	4	0AQUIF	.2984E+00	.5969E-02		.3843E-01		-.5000E+02
A1	5	0AQUIF	.4270E+00	.8541E-02		.5124E-01		-.5000E+02
A1	6	0AQUIF	.5813E+00	.1163E-01		.6499E-01		-.5000E+02
A1	7	0AQUIF	.7654E+00	.1531E-01		.7975E-01		-.5000E+02
A1	8	0AQUIF	.9846E+00	.1969E-01		.9558E-01		-.5000E+02
A1	9	0AQUIF	.1244E+01	.2489E-01		.1126E+00		-.5000E+02
A1	10	0AQUIF	.1552E+01	.3104E-01		.1308E+00		-.5000E+02
A1	11	0AQUIF	.1915E+01	.3829E-01		.1504E+00		-.5000E+02
A1	12	0AQUIF	.2342E+01	.4683E-01		.1714E+00		-.5000E+02
A1	13	0AQUIF	.2844E+01	.5687E-01		.1939E+00		-.5000E+02
A1	14	0AQUIF	.3432E+01	.6865E-01		.2181E+00		-.5000E+02
A1	15	0AQUIF	.4122E+01	.8244E-01		.2441E+00		-.5000E+02
A1	16	0AQUIF	.4928E+01	.9857E-01		.2719E+00		-.5000E+02
A1	17	0AQUIF	.5871E+01	.1174E+00		.3018E+00		-.5000E+02
A1	18	0AQUIF	.6970E+01	.1394E+00		.3339E+00		-.5000E+02
A1	19	0AQUIF	.8251E+01	.1650E+00		.3684E+00		-.5000E+02
A1	20	0AQUIF	.9743E+01	.1949E+00		.4053E+00		-.5000E+02
A1	21	0AQUIF	.1148E+02	.2296E+00		.4450E+00		-.5000E+02
A1	22	0AQUIF	.1350E+02	.2700E+00		.4875E+00		-.5000E+02
A1	23	0AQUIF	.1584E+02	.3168E+00		.5332E+00		-.5000E+02
A1	24	0AQUIF	.1856E+02	.3713E+00		.5822E+00		-.5000E+02
A1	25	0AQUIF	.2172E+02	.4345E+00		.6348E+00		-.5000E+02
A1	26	0AQUIF	.2539E+02	.5077E+00		.6913E+00		-.5000E+02
A1	27	0AQUIF	.2963E+02	.5926E+00		.7519E+00		-.5000E+02
A1	28	0AQUIF	.3455E+02	.6910E+00		.8169E+00		-.5000E+02
A1	29	0AQUIF	.4024E+02	.8049E+00		.8867E+00		-.5000E+02
A1	30	0AQUIF	.4684E+02	.9367E+00		.9615E+00		-.5000E+02
A1	31	0AQUIF	.5446E+02	.1089E+01		.1042E+01		-.5000E+02
A1	32	0AQUIF	.6329E+02	.1266E+01		.1128E+01		-.5000E+02

A1 33	0AQUIF	.7349E+02	.1470E+01	.1221E+01	-.5000E+02
A1 34	0AQUIF	.8528E+02	.1706E+01	.1320E+01	-.5000E+02
A1 35	0AQUIF	.9891E+02	.1978E+01	.1427E+01	-.5000E+02
A1 36	0AQUIF	.1147E+03	.2293E+01	.1541E+01	-.5000E+02
A1 37	0AQUIF	.1329E+03	.2657E+01	.1664E+01	-.5000E+02
A1 38	0AQUIF	.1539E+03	.3077E+01	.1795E+01	-.5000E+02
A1 39	0AQUIF	.1781E+03	.3563E+01	.1937E+01	-.5000E+02
A1 40	0AQUIF	.2061E+03	.4123E+01	.2089E+01	-.5000E+02
A1 41	0AQUIF	.2385E+03	.4769E+01	.2251E+01	-.5000E+02
A1 42	0AQUIF	.2758E+03	.5516E+01	.2426E+01	-.5000E+02
A1 43	0AQUIF	.3188E+03	.6377E+01	.2614E+01	-.5000E+02
A1 44	0AQUIF	.3685E+03	.7370E+01	.2815E+01	-.5000E+02
A1 45	0AQUIF	.4258E+03	.8517E+01	.3031E+01	-.5000E+02
A1 46	0AQUIF	.4919E+03	.9839E+01	.3263E+01	-.5000E+02
A1 47	0AQUIF	.5682E+03	.1136E+02	.3511E+01	-.5000E+02
A1 48	0AQUIF	.6561E+03	.1312E+02	.3778E+01	-.5000E+02
A1 49	0AQUIF	.7575E+03	.1515E+02	.4065E+01	-.5000E+02
A1 50	0AQUIF	.8744E+03	.1749E+02	.4372E+01	-.5000E+02
A1 51	0AQUIF	.1009E+04	.2018E+02	.4702E+01	-.5000E+02
A1 52	0AQUIF	.1165E+04	.2329E+02	.5056E+01	-.5000E+02
A1 53	0AQUIF	.1344E+04	.2688E+02	.5436E+01	-.5000E+02
A1 54	0AQUIF	.1550E+04	.3101E+02	.5844E+01	-.5000E+02
A1 55	0AQUIF	.1788E+04	.3577E+02	.6282E+01	-.5000E+02
A1 56	0AQUIF	.2063E+04	.4125E+02	.6751E+01	-.5000E+02
A1 57	0AQUIF	.2379E+04	.4758E+02	.7255E+01	-.5000E+02
A1 58	0AQUIF	.2743E+04	.5486E+02	.7796E+01	-.5000E+02
A1 59	0AQUIF	.3163E+04	.6326E+02	.8377E+01	-.5000E+02
A1 60	0AQUIF	.3647E+04	.7294E+02	.9000E+01	-.5000E+02
A1 61	0AQUIF	.4205E+04	.8409E+02	.9668E+01	-.5000E+02
A1 62	0AQUIF	.4847E+04	.9694E+02	.1039E+02	-.5000E+02
A1 63	0AQUIF	.5587E+04	.1117E+03	.1116E+02	-.5000E+02
A1 64	0AQUIF	.6440E+04	.1288E+03	.1198E+02	-.5000E+02
A1 65	0AQUIF	.7423E+04	.1485E+03	.1287E+02	-.5000E+02
A1 66	0AQUIF	.8556E+04	.1711E+03	.1382E+02	-.5000E+02
A1 67	0AQUIF	.9860E+04	.1972E+03	.1484E+02	-.5000E+02
A1 68	0AQUIF	.1136E+05	.2273E+03	.1594E+02	-.5000E+02
A1 69	0AQUIF	.1309E+05	.2619E+03	.1711E+02	-.5000E+02
A1 70	0AQUIF	.1509E+05	.3018E+03	.1838E+02	-.5000E+02
A1 71	0AQUIF	.1739E+05	.3477E+03	.1973E+02	-.5000E+02
A1 72	0AQUIF	.2003E+05	.4007E+03	.2118E+02	-.5000E+02
A1 73	0AQUIF	.2308E+05	.4617E+03	.2275E+02	-.5000E+02
A1 74	0AQUIF	.2660E+05	.5319E+03	.2442E+02	-.5000E+02
A1 75	0AQUIF	.3064E+05	.6129E+03	.2622E+02	-.5000E+02
A1 76	0AQUIF	.3530E+05	.7061E+03	.2814E+02	-.5000E+02
A1 77	0AQUIF	.4067E+05	.8135E+03	.3021E+02	-.5000E+02
A1 78	0AQUIF	.4686E+05	.9371E+03	.3243E+02	-.5000E+02
A1 79	0AQUIF	.5398E+05	.1080E+04	.3482E+02	-.5000E+02
A1 80	0AQUIF	.6219E+05	.1244E+04	.3738E+02	-.5000E+02
A1 81	0AQUIF	.7164E+05	.1433E+04	.4012E+02	-.5000E+02
A1 82	0AQUIF	.8253E+05	.1651E+04	.4307E+02	-.5000E+02
A1 83	0AQUIF	.9507E+05	.1901E+04	.4623E+02	-.5000E+02
A1 84	0AQUIF	.1095E+06	.2190E+04	.4962E+02	-.5000E+02
A1 85	0AQUIF	.1261E+06	.2523E+04	.5326E+02	-.5000E+02
A1 86	0AQUIF	.1453E+06	.2906E+04	.5717E+02	-.5000E+02
A1 87	0AQUIF	.1674E+06	.3348E+04	.6136E+02	-.5000E+02
A1 88	0AQUIF	.1928E+06	.3856E+04	.6586E+02	-.5000E+02
A1 89	0AQUIF	.2221E+06	.4442E+04	.7069E+02	-.5000E+02

A1 90	0AQUIF	.2558E+06	.5116E+04	.7587E+02	-.5000E+02
A1 91	0AQUIF	.2946E+06	.5893E+04	.8144E+02	-.5000E+02
A1 92	0AQUIF	.3394E+06	.6788E+04	.8741E+02	-.5000E+02
A1 93	0AQUIF	.3909E+06	.7818E+04	.9381E+02	-.5000E+02
A1 94	0AQUIF	.4502E+06	.9005E+04	.1007E+03	-.5000E+02
A1 95	0AQUIF	.5186E+06	.1037E+05	.1081E+03	-.5000E+02
A1 96	0AQUIF	.5973E+06	.1195E+05	.1160E+03	-.5000E+02
A1 97	0AQUIF	.6880E+06	.1376E+05	.1245E+03	-.5000E+02
A1 98	0AQUIF	.7924E+06	.1585E+05	.1336E+03	-.5000E+02
A1 99	0AQUIF	.9127E+06	.1825E+05	.1434E+03	-.5000E+02
A11 0	0AQUIF	.1051E+07	.2102E+05	.1539E+03	-.5000E+02
A11 1	0AQUIF	.1211E+07	.2422E+05	.1652E+03	-.5000E+02
A11 2	0AQUIF	.1395E+07	.2789E+05	.1772E+03	-.5000E+02
A11 3	0AQUIF	.1606E+07	.3212E+05	.1902E+03	-.5000E+02
A11 4	0AQUIF	.1850E+07	.3700E+05	.2042E+03	-.5000E+02
A11 5	0AQUIF	.2131E+07	.4261E+05	.2191E+03	-.5000E+02
A11 6	0AQUIF	.2454E+07	.4908E+05	.2351E+03	-.5000E+02
A11 7	0AQUIF	.2826E+07	.5653E+05	.2524E+03	-.5000E+02
A11 8	0AQUIF	.3255E+07	.6510E+05	.2708E+03	-.5000E+02
A11 9	0AQUIF	.3749E+07	.7498E+05	.2907E+03	-.5000E+02
A1110	0AQUIF	.4318E+07	.8636E+05	.3120E+03	-.5000E+02
A1111	0AQUIF	.4973E+07	.9947E+05	.3348E+03	-.5000E+02
A1112	0AQUIF	.5728E+07	.1146E+06	.3593E+03	-.5000E+02
A1113	0AQUIF	.6597E+07	.1319E+06	.3856E+03	-.5000E+02
A1114	0AQUIF	.7598E+07	.1520E+06	.4138E+03	-.5000E+02
A1115	0AQUIF	.8751E+07	.1750E+06	.4441E+03	-.5000E+02
A1116	0AQUIF	.1008E+08	.2016E+06	.4766E+03	-.5000E+02
A1117	0AQUIF	.1161E+08	.2322E+06	.5115E+03	-.5000E+02
A1118	0AQUIF	.1337E+08	.2674E+06	.5489E+03	-.5000E+02
A1119	0AQUIF	.1540E+08	.3079E+06	.5891E+03	-.5000E+02
A1120	0AQUIF	.1773E+08	.3547E+06	.6322E+03	-.5000E+02
A1121	0AQUIF	.2042E+08	.4085E+06	.6785E+03	-.5000E+02
A1122	0AQUIF	.2352E+08	.4704E+06	.7282E+03	-.5000E+02
A1123	0AQUIF	.2709E+08	.5418E+06	.7815E+03	-.5000E+02
A1124	0AQUIF	.3120E+08	.6240E+06	.8387E+03	-.5000E+02
A1125	0AQUIF	.3593E+08	.7187E+06	.9000E+03	-.5000E+02
A1126	0AQUIF	.4139E+08	.8277E+06	.9659E+03	-.5000E+02
A1127	0BOUND	.1000E+39	.1257E+05	.1000E+04	-.5000E+02

CONNE-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

A1 1A1 2	1	.5000E-04	.5366E-02	.6283E+01
A1 2A1 3	1	.5366E-02	.5759E-02	.1303E+02
A1 3A1 4	1	.5759E-02	.6180E-02	.2026E+02
A1 4A1 5	1	.6180E-02	.6632E-02	.2803E+02
A1 5A1 6	1	.6632E-02	.7117E-02	.3636E+02
A1 6A1 7	1	.7117E-02	.7638E-02	.4531E+02
A1 7A1 8	1	.7638E-02	.8197E-02	.5490E+02
A1 8A1 9	1	.8197E-02	.8797E-02	.6521E+02
A1 9A1 10	1	.8797E-02	.9441E-02	.7626E+02
A1 10A1 11	1	.9441E-02	.1013E-01	.8812E+02
A1 11A1 12	1	.1013E-01	.1087E-01	.1009E+03
A1 12A1 13	1	.1087E-01	.1167E-01	.1145E+03
A1 13A1 14	1	.1167E-01	.1252E-01	.1292E+03
A1 14A1 15	1	.1252E-01	.1344E-01	.1449E+03
A1 15A1 16	1	.1344E-01	.1442E-01	.1618E+03
A1 16A1 17	1	.1442E-01	.1548E-01	.1799E+03
A1 17A1 18	1	.1548E-01	.1661E-01	.1994E+03

A1 18A1 19	1	.1661E-01	.1782E-01	.2202E+03
A1 19A1 20	1	.1782E-01	.1913E-01	.2426E+03
A1 20A1 21	1	.1913E-01	.2053E-01	.2667E+03
A1 21A1 22	1	.2053E-01	.2203E-01	.2925E+03
A1 22A1 23	1	.2203E-01	.2364E-01	.3202E+03
A1 23A1 24	1	.2364E-01	.2537E-01	.3499E+03
A1 24A1 25	1	.2537E-01	.2723E-01	.3818E+03
A1 25A1 26	1	.2723E-01	.2922E-01	.4160E+03
A1 26A1 27	1	.2922E-01	.3136E-01	.4527E+03
A1 27A1 28	1	.3136E-01	.3366E-01	.4921E+03
A1 28A1 29	1	.3366E-01	.3612E-01	.5344E+03
A1 29A1 30	1	.3612E-01	.3876E-01	.5798E+03
A1 30A1 31	1	.3876E-01	.4160E-01	.6285E+03
A1 31A1 32	1	.4160E-01	.4464E-01	.6808E+03
A1 32A1 33	1	.4464E-01	.4791E-01	.7369E+03
A1 33A1 34	1	.4791E-01	.5141E-01	.7971E+03
A1 34A1 35	1	.5141E-01	.5518E-01	.8617E+03
A1 35A1 36	1	.5518E-01	.5921E-01	.9310E+03
A1 36A1 37	1	.5921E-01	.6355E-01	.1005E+04
A1 37A1 38	1	.6355E-01	.6820E-01	.1085E+04
A1 38A1 39	1	.6820E-01	.7319E-01	.1171E+04
A1 39A1 40	1	.7319E-01	.7854E-01	.1263E+04
A1 40A1 41	1	.7854E-01	.8429E-01	.1362E+04
A1 41A1 42	1	.8429E-01	.9046E-01	.1468E+04
A1 42A1 43	1	.9046E-01	.9708E-01	.1581E+04
A1 43A1 44	1	.9708E-01	.1042E+00	.1703E+04
A1 44A1 45	1	.1042E+00	.1118E+00	.1834E+04
A1 45A1 46	1	.1118E+00	.1200E+00	.1975E+04
A1 46A1 47	1	.1200E+00	.1288E+00	.2125E+04
A1 47A1 48	1	.1288E+00	.1382E+00	.2287E+04
A1 48A1 49	1	.1382E+00	.1483E+00	.2461E+04
A1 49A1 50	1	.1483E+00	.1591E+00	.2647E+04
A1 50A1 51	1	.1591E+00	.1708E+00	.2847E+04
A1 51A1 52	1	.1708E+00	.1833E+00	.3062E+04
A1 52A1 53	1	.1833E+00	.1967E+00	.3292E+04
A1 53A1 54	1	.1967E+00	.2111E+00	.3539E+04
A1 54A1 55	1	.2111E+00	.2265E+00	.3805E+04
A1 55A1 56	1	.2265E+00	.2431E+00	.4089E+04
A1 56A1 57	1	.2431E+00	.2609E+00	.4395E+04
A1 57A1 58	1	.2609E+00	.2800E+00	.4723E+04
A1 58A1 59	1	.2800E+00	.3005E+00	.5075E+04
A1 59A1 60	1	.3005E+00	.3225E+00	.5452E+04
A1 60A1 61	1	.3225E+00	.3461E+00	.5857E+04
A1 61A1 62	1	.3461E+00	.3714E+00	.6292E+04
A1 62A1 63	1	.3714E+00	.3986E+00	.6759E+04
A1 63A1 64	1	.3986E+00	.4277E+00	.7260E+04
A1 64A1 65	1	.4277E+00	.4590E+00	.7797E+04
A1 65A1 66	1	.4590E+00	.4926E+00	.8374E+04
A1 66A1 67	1	.4926E+00	.5287E+00	.8993E+04
A1 67A1 68	1	.5287E+00	.5674E+00	.9658E+04
A1 68A1 69	1	.5674E+00	.6089E+00	.1037E+05
A1 69A1 70	1	.6089E+00	.6534E+00	.1114E+05
A1 70A1 71	1	.6534E+00	.7012E+00	.1196E+05
A1 71A1 72	1	.7012E+00	.7526E+00	.1284E+05
A1 72A1 73	1	.7526E+00	.8076E+00	.1378E+05
A1 73A1 74	1	.8076E+00	.8667E+00	.1480E+05
A1 74A1 75	1	.8667E+00	.9301E+00	.1589E+05

A1 75A1 76	1	.9301E+00	.9982E+00	.1706E+05
A1 76A1 77	1	.9982E+00	.1071E+01	.1831E+05
A1 77A1 78	1	.1071E+01	.1150E+01	.1966E+05
A1 78A1 79	1	.1150E+01	.1234E+01	.2110E+05
A1 79A1 80	1	.1234E+01	.1324E+01	.2265E+05
A1 80A1 81	1	.1324E+01	.1421E+01	.2432E+05
A1 81A1 82	1	.1421E+01	.1525E+01	.2610E+05
A1 82A1 83	1	.1525E+01	.1636E+01	.2802E+05
A1 83A1 84	1	.1636E+01	.1756E+01	.3007E+05
A1 84A1 85	1	.1756E+01	.1885E+01	.3228E+05
A1 85A1 86	1	.1885E+01	.2023E+01	.3465E+05
A1 86A1 87	1	.2023E+01	.2171E+01	.3719E+05
A1 87A1 88	1	.2171E+01	.2329E+01	.3992E+05
A1 88A1 89	1	.2329E+01	.2500E+01	.4285E+05
A1 89A1 90	1	.2500E+01	.2683E+01	.4599E+05
A1 90A1 91	1	.2683E+01	.2879E+01	.4936E+05
A1 91A1 92	1	.2879E+01	.3090E+01	.5298E+05
A1 92A1 93	1	.3090E+01	.3316E+01	.5686E+05
A1 93A1 94	1	.3316E+01	.3559E+01	.6103E+05
A1 94A1 95	1	.3559E+01	.3819E+01	.6550E+05
A1 95A1 96	1	.3819E+01	.4098E+01	.7030E+05
A1 96A1 97	1	.4098E+01	.4398E+01	.7545E+05
A1 97A1 98	1	.4398E+01	.4720E+01	.8097E+05
A1 98A1 99	1	.4720E+01	.5066E+01	.8691E+05
A1 99A1 0	1	.5066E+01	.5436E+01	.9327E+05
A1 0A1 1	1	.5436E+01	.5834E+01	.1001E+06
A1 1A1 2	1	.5834E+01	.6261E+01	.1074E+06
A1 2A1 3	1	.6261E+01	.6719E+01	.1153E+06
A1 3A1 4	1	.6719E+01	.7211E+01	.1237E+06
A1 4A1 5	1	.7211E+01	.7738E+01	.1328E+06
A1 5A1 6	1	.7738E+01	.8305E+01	.1425E+06
A1 6A1 7	1	.8305E+01	.8912E+01	.1530E+06
A1 7A1 8	1	.8912E+01	.9564E+01	.1642E+06
A1 8A1 9	1	.9564E+01	.1026E+02	.1762E+06
A1 9A1 10	1	.1026E+02	.1102E+02	.1891E+06
A1 10A1 11	1	.1102E+02	.1182E+02	.2029E+06
A1 11A1 12	1	.1182E+02	.1269E+02	.2178E+06
A1 12A1 13	1	.1269E+02	.1361E+02	.2337E+06
A1 13A1 14	1	.1361E+02	.1461E+02	.2508E+06
A1 14A1 15	1	.1461E+02	.1568E+02	.2692E+06
A1 15A1 16	1	.1568E+02	.1683E+02	.2889E+06
A1 16A1 17	1	.1683E+02	.1806E+02	.3100E+06
A1 17A1 18	1	.1806E+02	.1938E+02	.3327E+06
A1 18A1 19	1	.1938E+02	.2080E+02	.3571E+06
A1 19A1 20	1	.2080E+02	.2232E+02	.3832E+06
A1 20A1 21	1	.2232E+02	.2395E+02	.4113E+06
A1 21A1 22	1	.2395E+02	.2571E+02	.4414E+06
A1 22A1 23	1	.2571E+02	.2759E+02	.4737E+06
A1 23A1 24	1	.2759E+02	.2961E+02	.5083E+06
A1 24A1 25	1	.2961E+02	.3177E+02	.5455E+06
A1 25A1 26	1	.3177E+02	.3410E+02	.5855E+06
A1 26A1 27	1	.3410E+02	.5000E+00	.6283E+06

GENER-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

A1	1S	1	0	0	0	0	WATE	10.

INCON-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

A1	1	0	0	0.2	
			5.05E6		1.6E2
A1	2	97	1	0.2	
			5.05E6		1.7E2
A11	0	27	1	0.2	
			5.05E6		1.7E2

ENDCY---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8
MESHM---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8
RZ2D ---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8

RADII

1

1.0E-4

LOGAR---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8

125

1000.

1.0E-2

RADII

1

1.E0

LAYER---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8

1

100

ENDFI---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8

ver3b ... Verification Problem No.3.

START 1-d radial heat transport - Avdonin (1964), Ross (1984)

START Midpoint weighting + injection

START 7-10-92: George's latest

START grid generation using MESHMAKER from TOUGH2

ROCKS	1	2	3	4	5	6	7	8
WELL	0	2898.68	0.26.6646E-13			20.0	1.0E50	
AQUIF	0	2898.68	0.26.6646E-13			20.0	7.3935E2	
BOUND	0	2898.68	0.26.6646E-13			20.0	1.0E6	

START	1	2	3	4	5	6	7	8
PARAM	1	2	3	4	5	6	7	8

8	13000357510000000001	0010	0	40	2.13E-5	1.80		
	0.	1.E9	-1.	1.E6A	0	9.807	2.	1.0
	1.							
	1.E-5	1.0	0.1	1.	1.	1.E-8		
		5.E6		170.		0.		

RPCAP	1	2	3	4	5	6	7	8
	5							

	1	0.0	0.0	1.0				

TIMES	1	2	3	4	5	6	7	8

9	9	1.E6						
	1.E1	1.E2	1.E3	1.E4	1.E5	1.E6	1.E7	1.E8
	1.E9							

ELEME	1	2	3	4	5	6	7	8

A1	1	OWELL	.6252E-03	.1250E-04		.9950E-02		-.5000E+02
A1	2	OAQUIF	.1036E+00	.2072E-02		.1537E-01		-.5000E+02
A1	3	OAQUIF	.1917E+00	.3834E-02		.2649E-01		-.5000E+02
A1	4	OAQUIF	.2984E+00	.5969E-02		.3843E-01		-.5000E+02
A1	5	OAQUIF	.4270E+00	.8541E-02		.5124E-01		-.5000E+02
A1	6	OAQUIF	.5813E+00	.1163E-01		.6499E-01		-.5000E+02
A1	7	OAQUIF	.7654E+00	.1531E-01		.7975E-01		-.5000E+02
A1	8	OAQUIF	.9846E+00	.1969E-01		.9558E-01		-.5000E+02
A1	9	OAQUIF	.1244E+01	.2489E-01		.1126E+00		-.5000E+02
A1	10	OAQUIF	.1552E+01	.3104E-01		.1308E+00		-.5000E+02
A1	11	OAQUIF	.1915E+01	.3829E-01		.1504E+00		-.5000E+02
A1	12	OAQUIF	.2342E+01	.4683E-01		.1714E+00		-.5000E+02
A1	13	OAQUIF	.2844E+01	.5687E-01		.1939E+00		-.5000E+02
A1	14	OAQUIF	.3432E+01	.6865E-01		.2181E+00		-.5000E+02
A1	15	OAQUIF	.4122E+01	.8244E-01		.2441E+00		-.5000E+02
A1	16	OAQUIF	.4928E+01	.9857E-01		.2719E+00		-.5000E+02
A1	17	OAQUIF	.5871E+01	.1174E+00		.3018E+00		-.5000E+02
A1	18	OAQUIF	.6970E+01	.1394E+00		.3339E+00		-.5000E+02
A1	19	OAQUIF	.8251E+01	.1650E+00		.3684E+00		-.5000E+02
A1	20	OAQUIF	.9743E+01	.1949E+00		.4053E+00		-.5000E+02
A1	21	OAQUIF	.1148E+02	.2296E+00		.4450E+00		-.5000E+02
A1	22	OAQUIF	.1350E+02	.2700E+00		.4875E+00		-.5000E+02
A1	23	OAQUIF	.1584E+02	.3168E+00		.5332E+00		-.5000E+02
A1	24	OAQUIF	.1856E+02	.3713E+00		.5822E+00		-.5000E+02
A1	25	OAQUIF	.2172E+02	.4345E+00		.6348E+00		-.5000E+02
A1	26	OAQUIF	.2539E+02	.5077E+00		.6913E+00		-.5000E+02
A1	27	OAQUIF	.2963E+02	.5926E+00		.7519E+00		-.5000E+02
A1	28	OAQUIF	.3455E+02	.6910E+00		.8169E+00		-.5000E+02
A1	29	OAQUIF	.4024E+02	.8049E+00		.8867E+00		-.5000E+02
A1	30	OAQUIF	.4684E+02	.9367E+00		.9615E+00		-.5000E+02
A1	31	OAQUIF	.5446E+02	.1089E+01		.1042E+01		-.5000E+02
A1	32	OAQUIF	.6329E+02	.1266E+01		.1128E+01		-.5000E+02

A1 33	0AQUIF	.7349E+02	.1470E+01	.1221E+01	-.5000E+02
A1 34	0AQUIF	.8528E+02	.1706E+01	.1320E+01	-.5000E+02
A1 35	0AQUIF	.9891E+02	.1978E+01	.1427E+01	-.5000E+02
A1 36	0AQUIF	.1147E+03	.2293E+01	.1541E+01	-.5000E+02
A1 37	0AQUIF	.1329E+03	.2657E+01	.1664E+01	-.5000E+02
A1 38	0AQUIF	.1539E+03	.3077E+01	.1795E+01	-.5000E+02
A1 39	0AQUIF	.1781E+03	.3563E+01	.1937E+01	-.5000E+02
A1 40	0AQUIF	.2061E+03	.4123E+01	.2089E+01	-.5000E+02
A1 41	0AQUIF	.2385E+03	.4769E+01	.2251E+01	-.5000E+02
A1 42	0AQUIF	.2758E+03	.5516E+01	.2426E+01	-.5000E+02
A1 43	0AQUIF	.3188E+03	.6377E+01	.2614E+01	-.5000E+02
A1 44	0AQUIF	.3685E+03	.7370E+01	.2815E+01	-.5000E+02
A1 45	0AQUIF	.4258E+03	.8517E+01	.3031E+01	-.5000E+02
A1 46	0AQUIF	.4919E+03	.9839E+01	.3263E+01	-.5000E+02
A1 47	0AQUIF	.5682E+03	.1136E+02	.3511E+01	-.5000E+02
A1 48	0AQUIF	.6561E+03	.1312E+02	.3778E+01	-.5000E+02
A1 49	0AQUIF	.7575E+03	.1515E+02	.4065E+01	-.5000E+02
A1 50	0AQUIF	.8744E+03	.1749E+02	.4372E+01	-.5000E+02
A1 51	0AQUIF	.1009E+04	.2018E+02	.4702E+01	-.5000E+02
A1 52	0AQUIF	.1165E+04	.2329E+02	.5056E+01	-.5000E+02
A1 53	0AQUIF	.1344E+04	.2688E+02	.5436E+01	-.5000E+02
A1 54	0AQUIF	.1550E+04	.3101E+02	.5844E+01	-.5000E+02
A1 55	0AQUIF	.1788E+04	.3577E+02	.6282E+01	-.5000E+02
A1 56	0AQUIF	.2063E+04	.4125E+02	.6751E+01	-.5000E+02
A1 57	0AQUIF	.2379E+04	.4758E+02	.7255E+01	-.5000E+02
A1 58	0AQUIF	.2743E+04	.5486E+02	.7796E+01	-.5000E+02
A1 59	0AQUIF	.3163E+04	.6326E+02	.8377E+01	-.5000E+02
A1 60	0AQUIF	.3647E+04	.7294E+02	.9000E+01	-.5000E+02
A1 61	0AQUIF	.4205E+04	.8409E+02	.9668E+01	-.5000E+02
A1 62	0AQUIF	.4847E+04	.9694E+02	.1039E+02	-.5000E+02
A1 63	0AQUIF	.5587E+04	.1117E+03	.1116E+02	-.5000E+02
A1 64	0AQUIF	.6440E+04	.1288E+03	.1198E+02	-.5000E+02
A1 65	0AQUIF	.7423E+04	.1485E+03	.1287E+02	-.5000E+02
A1 66	0AQUIF	.8556E+04	.1711E+03	.1382E+02	-.5000E+02
A1 67	0AQUIF	.9860E+04	.1972E+03	.1484E+02	-.5000E+02
A1 68	0AQUIF	.1136E+05	.2273E+03	.1594E+02	-.5000E+02
A1 69	0AQUIF	.1309E+05	.2619E+03	.1711E+02	-.5000E+02
A1 70	0AQUIF	.1509E+05	.3018E+03	.1838E+02	-.5000E+02
A1 71	0AQUIF	.1739E+05	.3477E+03	.1973E+02	-.5000E+02
A1 72	0AQUIF	.2003E+05	.4007E+03	.2118E+02	-.5000E+02
A1 73	0AQUIF	.2308E+05	.4617E+03	.2275E+02	-.5000E+02
A1 74	0AQUIF	.2660E+05	.5319E+03	.2442E+02	-.5000E+02
A1 75	0AQUIF	.3064E+05	.6129E+03	.2622E+02	-.5000E+02
A1 76	0AQUIF	.3530E+05	.7061E+03	.2814E+02	-.5000E+02
A1 77	0AQUIF	.4067E+05	.8135E+03	.3021E+02	-.5000E+02
A1 78	0AQUIF	.4686E+05	.9371E+03	.3243E+02	-.5000E+02
A1 79	0AQUIF	.5398E+05	.1080E+04	.3482E+02	-.5000E+02
A1 80	0AQUIF	.6219E+05	.1244E+04	.3738E+02	-.5000E+02
A1 81	0AQUIF	.7164E+05	.1433E+04	.4012E+02	-.5000E+02
A1 82	0AQUIF	.8253E+05	.1651E+04	.4307E+02	-.5000E+02
A1 83	0AQUIF	.9507E+05	.1901E+04	.4623E+02	-.5000E+02
A1 84	0AQUIF	.1095E+06	.2190E+04	.4962E+02	-.5000E+02
A1 85	0AQUIF	.1261E+06	.2523E+04	.5326E+02	-.5000E+02
A1 86	0AQUIF	.1453E+06	.2906E+04	.5717E+02	-.5000E+02
A1 87	0AQUIF	.1674E+06	.3348E+04	.6136E+02	-.5000E+02
A1 88	0AQUIF	.1928E+06	.3856E+04	.6586E+02	-.5000E+02
A1 89	0AQUIF	.2221E+06	.4442E+04	.7069E+02	-.5000E+02

A1 90	0AQUIF	.2558E+06	.5116E+04	.7587E+02	-.5000E+02
A1 91	0AQUIF	.2946E+06	.5893E+04	.8144E+02	-.5000E+02
A1 92	0AQUIF	.3394E+06	.6788E+04	.8741E+02	-.5000E+02
A1 93	0AQUIF	.3909E+06	.7818E+04	.9381E+02	-.5000E+02
A1 94	0AQUIF	.4502E+06	.9005E+04	.1007E+03	-.5000E+02
A1 95	0AQUIF	.5186E+06	.1037E+05	.1081E+03	-.5000E+02
A1 96	0AQUIF	.5973E+06	.1195E+05	.1160E+03	-.5000E+02
A1 97	0AQUIF	.6880E+06	.1376E+05	.1245E+03	-.5000E+02
A1 98	0AQUIF	.7924E+06	.1585E+05	.1336E+03	-.5000E+02
A1 99	0AQUIF	.9127E+06	.1825E+05	.1434E+03	-.5000E+02
A11 0	0AQUIF	.1051E+07	.2102E+05	.1539E+03	-.5000E+02
A11 1	0AQUIF	.1211E+07	.2422E+05	.1652E+03	-.5000E+02
A11 2	0AQUIF	.1395E+07	.2789E+05	.1772E+03	-.5000E+02
A11 3	0AQUIF	.1606E+07	.3212E+05	.1902E+03	-.5000E+02
A11 4	0AQUIF	.1850E+07	.3700E+05	.2042E+03	-.5000E+02
A11 5	0AQUIF	.2131E+07	.4261E+05	.2191E+03	-.5000E+02
A11 6	0AQUIF	.2454E+07	.4908E+05	.2351E+03	-.5000E+02
A11 7	0AQUIF	.2826E+07	.5653E+05	.2524E+03	-.5000E+02
A11 8	0AQUIF	.3255E+07	.6510E+05	.2708E+03	-.5000E+02
A11 9	0AQUIF	.3749E+07	.7498E+05	.2907E+03	-.5000E+02
A1110	0AQUIF	.4318E+07	.8636E+05	.3120E+03	-.5000E+02
A1111	0AQUIF	.4973E+07	.9947E+05	.3348E+03	-.5000E+02
A1112	0AQUIF	.5728E+07	.1146E+06	.3593E+03	-.5000E+02
A1113	0AQUIF	.6597E+07	.1319E+06	.3856E+03	-.5000E+02
A1114	0AQUIF	.7598E+07	.1520E+06	.4138E+03	-.5000E+02
A1115	0AQUIF	.8751E+07	.1750E+06	.4441E+03	-.5000E+02
A1116	0AQUIF	.1008E+08	.2016E+06	.4766E+03	-.5000E+02
A1117	0AQUIF	.1161E+08	.2322E+06	.5115E+03	-.5000E+02
A1118	0AQUIF	.1337E+08	.2674E+06	.5489E+03	-.5000E+02
A1119	0AQUIF	.1540E+08	.3079E+06	.5891E+03	-.5000E+02
A1120	0AQUIF	.1773E+08	.3547E+06	.6322E+03	-.5000E+02
A1121	0AQUIF	.2042E+08	.4085E+06	.6785E+03	-.5000E+02
A1122	0AQUIF	.2352E+08	.4704E+06	.7282E+03	-.5000E+02
A1123	0AQUIF	.2709E+08	.5418E+06	.7815E+03	-.5000E+02
A1124	0AQUIF	.3120E+08	.6240E+06	.8387E+03	-.5000E+02
A1125	0AQUIF	.3593E+08	.7187E+06	.9000E+03	-.5000E+02
A1126	0AQUIF	.4139E+08	.8277E+06	.9659E+03	-.5000E+02
A1127	OBOUND	.1000E+39	.1257E+05	.1000E+04	-.5000E+02

CONNE-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

A1 1A1 2	1	.5000E-04	.5366E-02	.6283E+01
A1 2A1 3	1	.5366E-02	.5759E-02	.1303E+02
A1 3A1 4	1	.5759E-02	.6180E-02	.2026E+02
A1 4A1 5	1	.6180E-02	.6632E-02	.2803E+02
A1 5A1 6	1	.6632E-02	.7117E-02	.3636E+02
A1 6A1 7	1	.7117E-02	.7638E-02	.4531E+02
A1 7A1 8	1	.7638E-02	.8197E-02	.5490E+02
A1 8A1 9	1	.8197E-02	.8797E-02	.6521E+02
A1 9A1 10	1	.8797E-02	.9441E-02	.7626E+02
A1 10A1 11	1	.9441E-02	.1013E-01	.8812E+02
A1 11A1 12	1	.1013E-01	.1087E-01	.1009E+03
A1 12A1 13	1	.1087E-01	.1167E-01	.1145E+03
A1 13A1 14	1	.1167E-01	.1252E-01	.1292E+03
A1 14A1 15	1	.1252E-01	.1344E-01	.1449E+03
A1 15A1 16	1	.1344E-01	.1442E-01	.1618E+03
A1 16A1 17	1	.1442E-01	.1548E-01	.1799E+03
A1 17A1 18	1	.1548E-01	.1661E-01	.1994E+03

A1 18A1 19	1	.1661E-01	.1782E-01	.2202E+03
A1 19A1 20	1	.1782E-01	.1913E-01	.2426E+03
A1 20A1 21	1	.1913E-01	.2053E-01	.2667E+03
A1 21A1 22	1	.2053E-01	.2203E-01	.2925E+03
A1 22A1 23	1	.2203E-01	.2364E-01	.3202E+03
A1 23A1 24	1	.2364E-01	.2537E-01	.3499E+03
A1 24A1 25	1	.2537E-01	.2723E-01	.3818E+03
A1 25A1 26	1	.2723E-01	.2922E-01	.4160E+03
A1 26A1 27	1	.2922E-01	.3136E-01	.4527E+03
A1 27A1 28	1	.3136E-01	.3366E-01	.4921E+03
A1 28A1 29	1	.3366E-01	.3612E-01	.5344E+03
A1 29A1 30	1	.3612E-01	.3876E-01	.5798E+03
A1 30A1 31	1	.3876E-01	.4160E-01	.6285E+03
A1 31A1 32	1	.4160E-01	.4464E-01	.6808E+03
A1 32A1 33	1	.4464E-01	.4791E-01	.7369E+03
A1 33A1 34	1	.4791E-01	.5141E-01	.7971E+03
A1 34A1 35	1	.5141E-01	.5518E-01	.8617E+03
A1 35A1 36	1	.5518E-01	.5921E-01	.9310E+03
A1 36A1 37	1	.5921E-01	.6355E-01	.1005E+04
A1 37A1 38	1	.6355E-01	.6820E-01	.1085E+04
A1 38A1 39	1	.6820E-01	.7319E-01	.1171E+04
A1 39A1 40	1	.7319E-01	.7854E-01	.1263E+04
A1 40A1 41	1	.7854E-01	.8429E-01	.1362E+04
A1 41A1 42	1	.8429E-01	.9046E-01	.1468E+04
A1 42A1 43	1	.9046E-01	.9708E-01	.1581E+04
A1 43A1 44	1	.9708E-01	.1042E+00	.1703E+04
A1 44A1 45	1	.1042E+00	.1118E+00	.1834E+04
A1 45A1 46	1	.1118E+00	.1200E+00	.1975E+04
A1 46A1 47	1	.1200E+00	.1288E+00	.2125E+04
A1 47A1 48	1	.1288E+00	.1382E+00	.2287E+04
A1 48A1 49	1	.1382E+00	.1483E+00	.2461E+04
A1 49A1 50	1	.1483E+00	.1591E+00	.2647E+04
A1 50A1 51	1	.1591E+00	.1708E+00	.2847E+04
A1 51A1 52	1	.1708E+00	.1833E+00	.3062E+04
A1 52A1 53	1	.1833E+00	.1967E+00	.3292E+04
A1 53A1 54	1	.1967E+00	.2111E+00	.3539E+04
A1 54A1 55	1	.2111E+00	.2265E+00	.3805E+04
A1 55A1 56	1	.2265E+00	.2431E+00	.4089E+04
A1 56A1 57	1	.2431E+00	.2609E+00	.4395E+04
A1 57A1 58	1	.2609E+00	.2800E+00	.4723E+04
A1 58A1 59	1	.2800E+00	.3005E+00	.5075E+04
A1 59A1 60	1	.3005E+00	.3225E+00	.5452E+04
A1 60A1 61	1	.3225E+00	.3461E+00	.5857E+04
A1 61A1 62	1	.3461E+00	.3714E+00	.6292E+04
A1 62A1 63	1	.3714E+00	.3986E+00	.6759E+04
A1 63A1 64	1	.3986E+00	.4277E+00	.7260E+04
A1 64A1 65	1	.4277E+00	.4590E+00	.7797E+04
A1 65A1 66	1	.4590E+00	.4926E+00	.8374E+04
A1 66A1 67	1	.4926E+00	.5287E+00	.8993E+04
A1 67A1 68	1	.5287E+00	.5674E+00	.9658E+04
A1 68A1 69	1	.5674E+00	.6089E+00	.1037E+05
A1 69A1 70	1	.6089E+00	.6534E+00	.1114E+05
A1 70A1 71	1	.6534E+00	.7012E+00	.1196E+05
A1 71A1 72	1	.7012E+00	.7526E+00	.1284E+05
A1 72A1 73	1	.7526E+00	.8076E+00	.1378E+05
A1 73A1 74	1	.8076E+00	.8667E+00	.1480E+05
A1 74A1 75	1	.8667E+00	.9301E+00	.1589E+05

A1 75A1 76	1	.9301E+00	.9982E+00	.1706E+05
A1 76A1 77	1	.9982E+00	.1071E+01	.1831E+05
A1 77A1 78	1	.1071E+01	.1150E+01	.1966E+05
A1 78A1 79	1	.1150E+01	.1234E+01	.2110E+05
A1 79A1 80	1	.1234E+01	.1324E+01	.2265E+05
A1 80A1 81	1	.1324E+01	.1421E+01	.2432E+05
A1 81A1 82	1	.1421E+01	.1525E+01	.2610E+05
A1 82A1 83	1	.1525E+01	.1636E+01	.2802E+05
A1 83A1 84	1	.1636E+01	.1756E+01	.3007E+05
A1 84A1 85	1	.1756E+01	.1885E+01	.3228E+05
A1 85A1 86	1	.1885E+01	.2023E+01	.3465E+05
A1 86A1 87	1	.2023E+01	.2171E+01	.3719E+05
A1 87A1 88	1	.2171E+01	.2329E+01	.3992E+05
A1 88A1 89	1	.2329E+01	.2500E+01	.4285E+05
A1 89A1 90	1	.2500E+01	.2683E+01	.4599E+05
A1 90A1 91	1	.2683E+01	.2879E+01	.4936E+05
A1 91A1 92	1	.2879E+01	.3090E+01	.5298E+05
A1 92A1 93	1	.3090E+01	.3316E+01	.5686E+05
A1 93A1 94	1	.3316E+01	.3559E+01	.6103E+05
A1 94A1 95	1	.3559E+01	.3819E+01	.6550E+05
A1 95A1 96	1	.3819E+01	.4098E+01	.7030E+05
A1 96A1 97	1	.4098E+01	.4398E+01	.7545E+05
A1 97A1 98	1	.4398E+01	.4720E+01	.8097E+05
A1 98A1 99	1	.4720E+01	.5066E+01	.8691E+05
A1 99A11 0	1	.5066E+01	.5436E+01	.9327E+05
A11 0A11 1	1	.5436E+01	.5834E+01	.1001E+06
A11 1A11 2	1	.5834E+01	.6261E+01	.1074E+06
A11 2A11 3	1	.6261E+01	.6719E+01	.1153E+06
A11 3A11 4	1	.6719E+01	.7211E+01	.1237E+06
A11 4A11 5	1	.7211E+01	.7738E+01	.1328E+06
A11 5A11 6	1	.7738E+01	.8305E+01	.1425E+06
A11 6A11 7	1	.8305E+01	.8912E+01	.1530E+06
A11 7A11 8	1	.8912E+01	.9564E+01	.1642E+06
A11 8A11 9	1	.9564E+01	.1026E+02	.1762E+06
A11 9A1110	1	.1026E+02	.1102E+02	.1891E+06
A1110A1111	1	.1102E+02	.1182E+02	.2029E+06
A1111A1112	1	.1182E+02	.1269E+02	.2178E+06
A1112A1113	1	.1269E+02	.1361E+02	.2337E+06
A1113A1114	1	.1361E+02	.1461E+02	.2508E+06
A1114A1115	1	.1461E+02	.1568E+02	.2692E+06
A1115A1116	1	.1568E+02	.1683E+02	.2889E+06
A1116A1117	1	.1683E+02	.1806E+02	.3100E+06
A1117A1118	1	.1806E+02	.1938E+02	.3327E+06
A1118A1119	1	.1938E+02	.2080E+02	.3571E+06
A1119A1120	1	.2080E+02	.2232E+02	.3832E+06
A1120A1121	1	.2232E+02	.2395E+02	.4113E+06
A1121A1122	1	.2395E+02	.2571E+02	.4414E+06
A1122A1123	1	.2571E+02	.2759E+02	.4737E+06
A1123A1124	1	.2759E+02	.2961E+02	.5083E+06
A1124A1125	1	.2961E+02	.3177E+02	.5455E+06
A1125A1126	1	.3177E+02	.3410E+02	.5855E+06
A1126A1127	1	.3410E+02	.5000E+00	.6283E+06

GENER-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8
 A1 1S 1 0 0 0 0 WATE 10.

INCON-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

A1	1	0	0	0.2	
			5.05E6		1.6E2
A1	2	97	1	0.2	
			5.05E6		1.7E2
A11	0	27	1	0.2	
			5.05E6		1.7E2

ENDCY---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8
 MESHM---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8
 RZ2D ---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8

RADII

1

1.0E-4

LOGAR---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8

125

1000.

1.0E-2

RADII

1

1.E0

LAYER---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8

1

100

ENDFI---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8

ver4 ... Verification Problem No.4.

START Flow to a geothermal well - Garg (1980) in paper SPE 7479

START Data file as in the TOUGH User's Guide (Pruess, 1987)

ROCKS-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

LAY 1 2650. .20 1.E-14 4.20 1000.

START-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

PARAM-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

1 50 5000030000000000030

-1.

AA 1

2.

9.E6

300.

RPCAP-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

3 .30 .05

1 1.

ELEME-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

AA 1 LAY 1 3.142E+02
AA 2 LAY 1 9.425E+02
AA 3 LAY 1 1.571E+03
AA 4 LAY 1 2.199E+03
AA 5 LAY 1 2.827E+03
AA 6 LAY 1 3.456E+03
AA 7 LAY 1 4.084E+03
AA 8 LAY 1 4.712E+03
AA 9 LAY 1 5.341E+03
AA 10 LAY 1 5.969E+03
AA 11 LAY 1 7.634E+03
AA 12 LAY 1 9.797E+03
AA 13 LAY 1 1.261E+04
AA 14 LAY 1 1.627E+04
AA 15 LAY 1 2.106E+04
AA 16 LAY 1 2.731E+04
AA 17 LAY 1 3.549E+04
AA 18 LAY 1 4.620E+04
AA 19 LAY 1 6.025E+04
AA 20 LAY 1 7.869E+04
AA 21 LAY 1 1.029E+05
AA 22 LAY 1 1.347E+05
AA 23 LAY 1 1.766E+05
AA 24 LAY 1 2.316E+05
AA 25 LAY 1 3.041E+05
AA 26 LAY 1 3.996E+05
AA 27 LAY 1 5.253E+05
AA 28 LAY 1 6.909E+05
AA 29 LAY 1 9.092E+05
AA 30 LAY 1 1.197E+06
AA 31 LAY 1 1.576E+06
AA 32 LAY 1 2.077E+06
AA 33 LAY 1 2.737E+06
AA 34 LAY 1 3.607E+06
AA 35 LAY 1 4.756E+06
AA 36 LAY 1 6.271E+06
AA 37 LAY 1 8.271E+06
AA 38 LAY 1 1.091E+07
AA 39 LAY 1 1.439E+07
AA 40 LAY 1 1.899E+07

AA 41	LAY 1 2.505E+07
AA 42	LAY 1 3.306E+07
AA 43	LAY 1 4.363E+07
AA 44	LAY 1 5.758E+07
AA 45	LAY 1 7.600E+07
AA 46	LAY 1 1.003E+08
AA 47	LAY 1 1.324E+08
AA 48	LAY 1 1.748E+08
AA 49	LAY 1 2.307E+08
AA 50	LAY 1 3.045E+08

CONNE---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8

AA 1AA 2	1 5.000E-01 5.000E-01 6.283E+02
AA 2AA 3	1 5.000E-01 5.000E-01 1.257E+03
AA 3AA 4	1 5.000E-01 5.000E-01 1.885E+03
AA 4AA 5	1 5.000E-01 5.000E-01 2.513E+03
AA 5AA 6	1 5.000E-01 5.000E-01 3.142E+03
AA 6AA 7	1 5.000E-01 5.000E-01 3.770E+03
AA 7AA 8	1 5.000E-01 5.000E-01 4.398E+03
AA 8AA 9	1 5.000E-01 5.000E-01 5.027E+03
AA 9AA 10	1 5.000E-01 5.000E-01 5.655E+03
AA 10AA 11	1 5.000E-01 5.745E-01 6.283E+03
AA 11AA 12	1 5.745E-01 6.602E-01 7.005E+03
AA 12AA 13	1 6.602E-01 7.585E-01 7.835E+03
AA 13AA 14	1 7.585E-01 8.716E-01 8.788E+03
AA 14AA 15	1 8.716E-01 1.002E+00 9.883E+03
AA 15AA 16	1 1.002E+00 1.151E+00 1.114E+04
AA 16AA 17	1 1.151E+00 1.322E+00 1.259E+04
AA 17AA 18	1 1.322E+00 1.519E+00 1.425E+04
AA 18AA 19	1 1.519E+00 1.746E+00 1.616E+04
AA 19AA 20	1 1.746E+00 2.006E+00 1.835E+04
AA 20AA 21	1 2.006E+00 2.305E+00 2.087E+04
AA 21AA 22	1 2.305E+00 2.649E+00 2.377E+04
AA 22AA 23	1 2.649E+00 3.043E+00 2.710E+04
AA 23AA 24	1 3.043E+00 3.497E+00 3.092E+04
AA 24AA 25	1 3.497E+00 4.018E+00 3.532E+04
AA 25AA 26	1 4.018E+00 4.617E+00 4.037E+04
AA 26AA 27	1 4.617E+00 5.305E+00 4.617E+04
AA 27AA 28	1 5.305E+00 6.096E+00 5.284E+04
AA 28AA 29	1 6.096E+00 7.005E+00 6.050E+04
AA 29AA 30	1 7.005E+00 8.049E+00 6.930E+04
AA 30AA 31	1 8.049E+00 9.248E+00 7.941E+04
AA 31AA 32	1 9.248E+00 1.063E+01 9.104E+04
AA 32AA 33	1 1.063E+01 1.221E+01 1.044E+05
AA 33AA 34	1 1.221E+01 1.403E+01 1.197E+05
AA 34AA 35	1 1.403E+01 1.612E+01 1.374E+05
AA 35AA 36	1 1.612E+01 1.852E+01 1.576E+05
AA 36AA 37	1 1.852E+01 2.129E+01 1.809E+05
AA 37AA 38	1 2.129E+01 2.446E+01 2.077E+05
AA 38AA 39	1 2.446E+01 2.810E+01 2.384E+05
AA 39AA 40	1 2.810E+01 3.229E+01 2.737E+05
AA 40AA 41	1 3.229E+01 3.711E+01 3.143E+05
AA 41AA 42	1 3.711E+01 4.264E+01 3.609E+05
AA 42AA 43	1 4.264E+01 4.899E+01 4.145E+05
AA 43AA 44	1 4.899E+01 5.629E+01 4.761E+05
AA 44AA 45	1 5.629E+01 6.468E+01 5.468E+05
AA 45AA 46	1 6.468E+01 7.433E+01 6.281E+05

```

GENER---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8
AA  1PRO 1                                MASS          -14.
INCON---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8
ENDCY---1---*---2---*---3---*---4---*---5---*---6---*---7---*---8

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ver5 ... Verification Problem No.5.

START Heat pipe problem - Udel and Fitch (1985)

START Data file as in the TOUGH User's Guide (Pruess, 1987)

ROCKS-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

SAMPL 2 2600. 0.4 1.E-12 1.E-12 1.E-12 1.13 700.
0.582 0.5

6 0.150

6 632455.53 0.150

LBND 2 2600. 0.4 1.E-12 1.E-12 1.E-12 1.13 700. E4

0.582 0.5

1 0.1 0.8 0.2 0.9

1 0. 0.1 0.9

START-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

PARAM-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

8 2 1003600 2000000001000000000400000000 2.6 E-5 1. E-10

0. 1.000 SAM 1 9.817 5.

101330. 0.5 70.

ELEME-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

LBD00 LBND 1. E30

SAM00 89 1SAMPL 0.025

CONNE-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

LBD00SAM00 1 1. E-10 .0125 1. 0.

SAM00SAM01 88 1 1 1 .0125 .0125 1. 0.

GENER-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8

SAM89Q 1 HEAT 100.

ENDCY-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8