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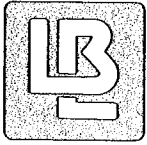
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1. Introduction

A study was made based on suggestions made by Kent S. Sorenson (1992) on improving the applicability and ease of usage of the wellbore simulators HOLA, GWELL and GWNACL (Bjornsson, 1987; Aunzo et al., 1991). The study concentrated mainly on the usage of Option 2 (please refer to the User's Guide; Aunzo et al., 1991) and modeling flow of superheated steam when using these computer codes. Amendments were made to the simulators to allow implementation of a variety of input data. A wide range of input data was used to test the modifications to the codes. The study did not attempt to modify or improve the physics or formulations which were used in the models. It showed that a careful check of the input data is required. This report addresses these two areas of interest: usage of Option 2, and simulation of wellbore flow of superheated steam.

2. Supplements to Option 2

The discussions and amendments described in this section apply to all three simulators. In Option 2 calculations are carried out from bottom to top to obtain a required wellhead pressure and other wellhead parameters (i.e., wellhead enthalpy, flowrate, temperature,

and gas or dissolved solids content). Using known reservoir parameters the flowing bottomhole pressure is varied until the calculated wellhead pressure is close to the required wellhead pressure. The input in Option 2 includes:

- required wellhead pressure
- initial guess for flowing bottomhole pressure of the deepest feedzone
- calculation step for bottomhole pressure changes
- maximum allowable error in wellhead pressure (difference between required and calculated wellhead pressures)
- feedzone parameters: reservoir pressure, temperature (or enthalpy), productivity index and mass fraction of gas or dissolved solids.
- well geometry
- rock thermal properties

Starting with an initial guess to the bottomhole pressure for the deepest feedzone, iterations are performed to calculate the thermodynamic parameters along the well and obtain the wellhead pressure within the maximum specified error. At the start of the calculation, the use of the guessed bottomhole pressure could result in a wellhead pressure which is lower or higher than the required wellhead pressure. The iteration scheme in Subroutine "ITHEAD" is then used to decide whether the next step is to reduce or increase the bottomhole pressure. Once the direction of the iteration is decided, the scheme may quickly converge to the bottomhole pressure which results in an acceptable wellhead pressure. If the iteration is not converging, the scheme decides what action to take next. The elaborate scheme was designed to accommodate different possible iteration directions. When it works smoothly the model is fast and accurate. However, because the input data are diverse, the correct solution may not be obtained in every case. In this study the iteration scheme was tested using a variety of input data. The tests and the modifications made are discussed below.

During the iterations to obtain a wellhead pressure within the prescribed error range, the bottomhole pressure of the deepest feed is varied, and the difference between the required and calculated wellhead pressures (DIFF) is recorded. As iterations progress, DIFF may change sign. In the old version iterations were stopped and an output was obtained corresponding to the last DIFF. As pointed out by Sorenson (1992), the calculated wellhead pressure may not be within the specified error limit, particularly when large step sizes are used. In the present study methods were investigated to remedy this situation. Most of the necessary modifications were made in Subroutine "ITHEAD".

The first attempt was to divide the step size in bottomhole pressure change (PSTEP) by two whenever a sign change in DIFF occurred, and let the iteration continue. However, this resulted in DIFF oscillating between positive and negative values, causing other problems within the code. Because other calculations and fluid property evaluations within the code have their own iterative procedures, the modification was not acceptable. This is particularly true when superheated steam is involved.

The option which was found acceptable was to assign a reduced constant step size (PSTEP) and continue iteration in the opposite direction (i.e., changing from increasing to decreasing bottomhole pressure, or vice versa). For this purpose reducing the step size by a factor of ten was found acceptable. Thus, if a sign change in DIFF occurs, PSTEP is reduced by a factor of ten and the calculation allowed to continue in the opposite direction. For most cases this will result in the desired solution. However, if the selected maximum error in wellhead pressure is very small, DIFF may not converge to the required solution. This could happen if the desired maximum error in wellhead pressure is very small or if the step size is very large. In both cases the sign of DIFF may again change. In the present set-up, iterations are stopped if the sign changes twice. It then becomes easier to make changes in the input file. The code already

has so many options that additional options may interfere with the existing ones.

One solution to the above problem is to reduce the size of PSTEP in the input file. If the sign of DIFF changes, PSTEP will be reduced by a factor of ten, which would allow much smaller bottomhole pressure changes and the desired solution could be obtained. An alternative solution to the problem would be to use a reasonable maximum allowable error in wellhead pressure. It is worth noting that the different calculation schemes within the code have their own error limits, and a very small overall error limit may not be attainable.

Another area of the study involved making the iteration scheme more reliable. In the old version, for some input data, solutions could not be obtained mainly due to convergence problems. Modifications have now been made in the iteration scheme to improve convergence.

With the modified codes, an efficient use of Option 2 will result in the desired wellhead pressure without major problems. This requires a careful selection of the maximum error between calculated and required wellhead pressures, step size (PSTEP), initial bottomhole pressure, and feed zone characteristics. For example, too high a mass flowrate would result in choking. Care must be taken when modeling the flow of superheated steam using this option, as discussed below.

3. Simulating Flow of Superheated Steam

The application of the simulators to model wellbore flow of superheated steam was also studied. As dissolved solids are assumed to remain in the liquid phase, the simulator GWNACL was not included in the study. The simulators were designed to handle superheated steam, although more emphasis was given to two-phase

and single phase liquid. Consequently, the User's Guide (Aunzo et al., 1991) has very little reference to modeling flow of superheated steam.

To use the existing simulators to model wellbore flow under superheated conditions required a cautious use of input data, as well as modifications of some subroutines. As an example, problems encountered in modeling flow of superheated steam using the simulator GWELL with Option 2 are discussed here. Simulations were carried out for selected input data. The correct solution was not always obtained. In the cases where output was not obtained, messages such as "choking" and "pressure less than zero" were displayed. A closer look at the subroutines shows other problems as well. In the iteration scheme described in Section 2, temperature, pressure or both could attain high values and go out of bounds. The fluid property equations have limits which do not allow excessive values of pressure and temperature. Upon checking the subroutines in GWELL and the input and output files, the problems could be traced to:

(a.) Input data. Excessive fluid velocities could, for example, be caused by assigning very high mass flowrates and small pipe radii. Too low a bottomhole pressure or a large step size also have a similar effect.

(b.) Limits set in the subroutines. A maximum temperature of 374.15 °C had been set.

To address the problem discussed in part (b) above, changes were made in relevant subroutines. The modifications described below apply to both Options 1 and 2. As pointed out by Sorenson (1992), the code had limitations in the handling of superheated steam. These were mostly due to limits set for fluid properties. As also pointed out by Sorenson(1992), one of these limits was in Subroutine "GENERAL" for critical flow. This subroutine checks for the critical point of water. The criterion used was based on

temperature only. However, the critical point of water is defined by both p= 212.2 bar and T= 374.15 °C. The pressure criterion has been added in the subroutine "GENERAL". Similar changes were made in other subroutines also.

Other limits are in the equations of state used to evaluate fluid properties. For water, the steam table equations used by the reservoir simulator MULKOM (Pruess, 1983) were adopted. The property equations were originally given by the International Formulation Committee (1967). The simulator GWELL, which handles non-condensable gases, uses equations of state for the CO_2-H_2O system . These equations have specified accuracy and usage ranges (please refer to the User's Guide; Aunzo et al., 1991 for individual equations). Thus, the use of these equations is limited to their individual specific temperature and pressure ranges. As mentioned above, very high temperatures may be encountered during the iterations even if the converged final temperatures are within limits. But the existing codes do not allow the temperature to go beyond 374.15 °C and in such occasions the iteration process was stopped. The maximum temperature has now been set to 500 °C.

4. Exercises Using Option 2

The following are example problems using the modified simulators HOLA and GWELL with Option 2. The first ten example problems are based on Sample 3, described on page 97 of the User's Guide, (Aunzo et al., 1991). In these example problems the well has liquid conditions at bottomhole, and flashing occurs inside the well. The well has three feed zones. Only HOLA was used for these problems. Problems 11 and 12 are examples of modeling flow of superheated steam using the simulators HOLA and GWELL. In these two cases superheated conditions exist in the entire well, from bottomhole to wellhead. Selected input and output files are shown on pages 11 to 28.

Summary of Sample 3 input data (from User's Guide; Aunzo et al., 1991):

Required wellhead pressure	30 bar
Initial bottomhole pressure of the deepest feed	141 bar
Bottomhole temperature of the deepest feed	290 °C
Maximum error in wellhead pressure	1 bar
Step size for the bottomhole pressure, PSTEP	0.02 bar

A complete list of the input and output files for Sample 3 are shown on pp. 97 - 102 of the User's Guide. As indicated above, the next ten example problems used Sample 3 as a base, and values of PSTEP and bottomhole pressure were varied. In each exercise only one parameter was changed at a time, keeping all others constant. In all the problems the maximum wellhead pressure was set at 0.1 bar. The results are summarized below.

Example problem (1): PSTEP = 1 bar
- The calculated wellhead pressure was within the specified maximum error limit.

Example problem (2): PSTEP = 9 bar
- Results were similar to (1).

Example problem(3): PSTEP = 15 bar
- The solution was acceptable although the error in wellhead pressure was slightly higher than prescribed. Reducing PSTEP would result in better accuracy.

Example problem(4): PSTEP = 30 bar
- No solution was obtained because the bottomhole pressure was too low. The large step size in change of bottomhole pressure lowered the pressure too much. Selection of such a large step size should be avoided.

Example problem(5): PSTEP = 0.1 bar

- The step size was too small to obtain a solution within the maximum allowed 50 iterations (value fixed in the code). Convergence was too slow and thus a larger step size would be required.

Example problem(6): Bottomhole pressure = 151 bar; PSTEP = 2 bar
- Because the bottomhole pressure of the deepest feed was higher than what had been used in Sample 3 (i.e., 141 bar), one might also expect a higher calculated initial wellhead pressure. However, due to interactions with the other feed zones and because flashing occurred at a much higher elevation, the calculated wellhead pressure corresponding to the initial bottomhole pressure was even lower than required. A solution was not obtained. An increase in PSTEP or a reduction in bottomhole pressure, given in the input, would be required.

Example problem(7): Bottomhole pressure = 151 bar; PSTEP = 4 bar
- The final calculated wellhead pressure was within the specified error limit.

Example problem(8): Bottomhole pressure = 101 bar; PSTEP = 2 bar
- No solution was obtained. The selected bottomhole pressure was too low and choking occurred.

Example problem(9): Bottomhole pressure = 121 bar; PSTEP = 3 bar
- The calculated wellhead pressure was within the specified error limit.

Example problem(10): Bottomhole pressure = 121 bar; PSTEP = 1 bar
- A solution was not reached within the allowed 50 iterations. The initial bottomhole pressure was much lower than the required final value, and the step size was small. An increase in either PSTEP or bottomhole pressure or both, would solve the problem.

Example problem(11): Simulation of superheated steam using Option 2 (HOLA was used)

  - The calculated wellhead pressure was within the specified error. A careful selection of bottomhole pressure and step size was required. Care was taken not to let the bottomhole pressure drop too low.

Example problem(12): Simulation of superheated steam using Option 2 (GWELL was used)

  - Similar results were obtained as in Example problem (11). The simulation time was longer for this case because it included CO_2 in the calculations.

5. Conclusion

The study showed that the wellbore simulators HOLA, GWELL and GWNACL needed some modifications, mainly to improve the performance of the iteration scheme in Option 2 and modeling flow of superheated steam. The simulators were tested after the modifications were made and the results are better. More studies are required to further improve performance of the simulators.

References

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Bjornsson, G., *A Multi-Feedzone Geothermal Wellbore Simulator*, Report LBL-23546, Lawrence Berkeley Laboratory, 1987.

International Formulation Committee, *A Formulation of the Thermodynamic Properties of Ordinary Water Substance*, IFC Secretariat, Dusseldorf, Germany, 1967.

Pruess, K., *Development of the General Purpose Simulator MULKOM*, Annual Report 1982, Earth Sciences Division, Report LBL-15500, Lawrence Berkeley Laboratory, 1983.

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Acknowledgments

Example Problem (1) Output File

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


                       HOLA - MODEL RESULTS


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



        - Option 2 used -

              Wellhead pressure ( bar abs. ) :      29.94
              Wellhead temperature ( C )      :     233.73
              Wellhead dryness                :       0.234
              Wellhead enthalpy ( kJ/kg )     :    1428.16
              Wellhead total flow ( kg/s )    :      45.12


        Feedzone no:   Depth (m)   Flow (kg/s)   Enthalpy (kJ/kg)  Res.Pres (Bar)  Satur.    Prod. Ind. (m3)
        ------------------------------------------------------------------------------------------------------
             1          1110.0      11.2317         1600.0            100.000        0.68     0.500000E-12
             2          2010.0      19.8708         1200.0            135.000        0.00     0.800000E-12
             3          2530.0      14.0210         1284.4            153.500        0.00     0.500000E-12
        ------------------------------------------------------------------------------------------------------
```
```
***********************************************************************************************************************
```

Depth (m)	Press (Pa)	Temp (C)	Dryness	Hw (J/kg)	Hs (J/kg)	Vw (m/s)	Vs (m/s)	Dw (kg/m3)	Ds (kg/m3)	H_t (J/kg)	Rad (m)	Reg
0.0	2994132.	233.73	0.23422	1007841.	2802403.	13.74	20.11	822.29	14.98	1428163.	0.110	Sl
25.0	3032454.	234.44	0.23293	1011177.	2802434.	13.53	19.77	821.32	15.17	1428420.	0.110	Bu
50.0	3070840.	235.14	0.23165	1014489.	2802455.	13.32	19.45	820.36	15.36	1428676.	0.110	Bu
75.0	3109300.	235.83	0.23038	1017779.	2802467.	13.12	19.14	819.41	15.56	1428932.	0.110	Bu
100.0	3147842.	236.52	0.22911	1021050.	2802469.	12.92	18.83	818.46	15.75	1429187.	0.110	Bu
125.0	3186475.	237.21	0.22784	1024301.	2802463.	12.72	18.53	817.51	15.95	1429443.	0.110	Bu
150.0	3225208.	237.89	0.22658	1027534.	2802447.	12.53	18.23	816.57	16.14	1429698.	0.110	Bu
175.0	3264049.	238.56	0.22533	1030750.	2802423.	12.35	17.95	815.63	16.34	1429952.	0.110	Bu
200.0	3303007.	239.23	0.22407	1033950.	2802389.	12.16	17.66	814.69	16.53	1430207.	0.110	Bu
225.0	3342089.	239.90	0.22282	1037135.	2802347.	11.99	17.39	813.75	16.73	1430461.	0.110	Bu
250.0	3381305.	240.57	0.22157	1040306.	2802297.	11.81	17.12	812.82	16.93	1430715.	0.110	Bu
275.0	3420663.	241.23	0.22033	1043463.	2802238.	11.64	16.86	811.88	17.13	1430969.	0.110	Bu
300.0	3460170.	241.88	0.21908	1046609.	2802170.	11.47	16.60	810.95	17.33	1431223.	0.110	Bu
315.0	3483949.	242.28	0.21834	1048491.	2802126.	11.37	16.45	810.39	17.45	1431373.	0.110	Bu
330.0	3507778.	242.67	0.21759	1050368.	2802078.	11.27	16.30	809.84	17.57	1431524.	0.110	Bu
345.0	3531668.	243.06	0.21685	1052242.	2802027.	11.18	16.15	809.28	17.70	1431674.	0.110	Bu
360.0	3555591.	243.45	0.21610	1054110.	2801974.	11.08	16.00	808.72	17.82	1431824.	0.110	Bu
375.0	3579579.	243.84	0.21536	1055974.	2801917.	10.99	15.86	808.17	17.94	1431974.	0.110	Bu
390.0	3603585.	244.22	0.21461	1057832.	2801858.	10.89	15.71	807.61	18.06	1432124.	0.110	Bu
405.0	3627657.	244.61	0.21387	1059687.	2801795.	10.80	15.57	807.06	18.18	1432274.	0.110	Bu
420.0	3651731.	244.99	0.21313	1061534.	2801730.	10.71	15.43	806.50	18.31	1432422.	0.110	Bu
435.0	3675874.	245.37	0.21239	1063378.	2801662.	10.62	15.29	805.95	18.43	1432571.	0.110	Bu
450.0	3700002.	245.75	0.21165	1065213.	2801591.	10.53	15.16	805.40	18.55	1432719.	0.110	Bu
465.0	3724200.	246.13	0.21091	1067045.	2801517.	10.44	15.02	804.85	18.68	1432867.	0.110	Bu

480.0	3748365.	246.51	0.21018	1068867.	2801441.	10.36	14.89	804.30	18.80	1433014.	0.110	Bu
495.0	3772603.	246.89	0.20944	1070687.	2801362.	10.27	14.76	803.75	18.93	1433160.	0.110	Bu
510.0	3796787.	247.26	0.20871	1072496.	2801280.	10.19	14.63	803.21	19.05	1433306.	0.110	Bu
525.0	3821046.	247.63	0.20797	1074302.	2801195.	10.10	14.50	802.66	19.18	1433452.	0.110	Bu
540.0	3845232.	248.00	0.20724	1076096.	2801108.	10.02	14.38	802.12	19.30	1433596.	0.110	Bu
555.0	3869494.	248.37	0.20652	1077887.	2801018.	9.94	14.25	801.58	19.43	1433740.	0.110	Bu
570.0	3893661.	248.74	0.20579	1079665.	2800926.	9.86	14.13	801.04	19.55	1433882.	0.110	Bu
585.0	3917906.	249.11	0.20506	1081441.	2800832.	9.78	14.01	800.50	19.67	1434025.	0.110	Bu
600.0	3942034.	249.47	0.20434	1083201.	2800735.	9.70	13.89	799.96	19.80	1434166.	0.110	Bu
615.0	3966241.	249.83	0.20362	1084961.	2800635.	9.62	13.77	799.43	19.92	1434306.	0.110	Bu
630.0	3990308.	250.19	0.20290	1086703.	2800534.	9.55	13.66	798.90	20.05	1434445.	0.110	Bu
645.0	4014455.	250.55	0.20219	1088444.	2800430.	9.47	13.54	798.36	20.17	1434584.	0.110	Bu
660.0	4038438.	250.90	0.20148	1090166.	2800324.	9.40	13.43	797.84	20.30	1434721.	0.110	Bu
675.0	4062501.	251.25	0.20076	1091888.	2800215.	9.33	13.32	797.31	20.42	1434857.	0.110	Bu
690.0	4086377.	251.60	0.20006	1093590.	2800105.	9.25	13.21	796.79	20.55	1434992.	0.110	Bu
705.0	4110332.	251.95	0.19935	1095291.	2799993.	9.18	13.10	796.27	20.67	1435126.	0.110	Bu
720.0	4134074.	252.29	0.19865	1096971.	2799879.	9.11	13.00	795.75	20.79	1435258.	0.110	Bu
735.0	4157896.	252.64	0.19795	1098650.	2799763.	9.04	12.89	795.24	20.92	1435390.	0.110	Bu
750.0	4181480.	252.98	0.19726	1100306.	2799645.	8.98	12.79	794.73	21.04	1435520.	0.110	Bu
775.0	4220961.	253.54	0.19611	1103065.	2799444.	8.87	12.62	793.88	21.24	1435737.	0.110	Bu
800.0	4260669.	254.10	0.19495	1105824.	2799235.	8.76	12.46	793.02	21.45	1435954.	0.110	Bu
825.0	4300608.	254.66	0.19379	1108582.	2799020.	8.65	12.29	792.17	21.66	1436171.	0.110	Bu
850.0	4340787.	255.23	0.19263	1111340.	2798797.	8.54	12.13	791.31	21.87	1436388.	0.110	Bu
875.0	4381212.	255.79	0.19146	1114099.	2798567.	8.43	11.97	790.46	22.08	1436605.	0.110	Bu
900.0	4421889.	256.35	0.19029	1116859.	2798330.	8.33	11.81	789.60	22.29	1436821.	0.110	Bu
910.0	4438233.	256.57	0.18982	1117963.	2798233.	8.29	11.75	789.25	22.38	1436907.	0.110	Bu
935.0	4503139.	257.45	0.18784	1122323.	2797838.	14.59	17.97	787.89	22.72	1437052.	0.087	Bu
960.0	4552494.	258.12	0.18641	1125613.	2797528.	14.36	17.69	786.86	22.98	1437272.	0.087	Bu
985.0	4601977.	258.78	0.18498	1128888.	2797210.	14.14	17.41	785.83	23.24	1437492.	0.087	Bu
1010.0	4651600.	259.44	0.18355	1132150.	2796882.	13.92	17.13	784.80	23.50	1437712.	0.087	Bu
1035.0	4701374.	260.09	0.18212	1135401.	2796545.	13.71	16.86	783.78	23.77	1437932.	0.087	Bu
1060.0	4751310.	260.74	0.18069	1138640.	2796199.	13.51	16.59	782.75	24.03	1438151.	0.087	Bu
1085.0	4801420.	261.39	0.17927	1141870.	2795844.	13.30	16.33	781.73	24.30	1438371.	0.087	Bu
1110.0	4851715.	262.04	0.17784	1145091.	2795479.	13.10	16.08	780.71	24.57	1438590.	0.087	Bu
1110.0	4851715.	262.04	0.04868	1145091.	2795479.	3.95	4.98	780.71	24.57	1225439.	0.087	Bu
1135.0	4942066.	263.18	0.04552	1150825.	2794805.	3.78	4.76	778.88	25.05	1225652.	0.087	Bu
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1185.0	5135915.	265.59	0.03874	1162913.	2793276.	3.43	4.31	775.00	26.09	1226078.	0.087	Bu
1210.0	5240572.	266.86	0.03510	1169324.	2792405.	3.25	4.08	772.93	26.65	1226291.	0.087	Bu
1235.0	5351375.	268.19	0.03125	1176027.	2791451.	3.07	3.85	770.76	27.25	1226504.	0.087	Bu
1260.0	5469307.	269.58	0.02716	1183069.	2790398.	2.89	3.62	768.46	27.90	1226717.	0.087	Bu
1285.0	5595626.	271.04	0.02278	1190513.	2789229.	2.71	3.38	766.02	28.59	1226930.	0.087	Bu
1310.0	5731999.	272.59	0.01806	1198438.	2787921.	2.52	3.14	763.41	29.34	1227143.	0.087	Bu
1335.0	5880709.	274.24	0.01292	1206954.	2786443.	2.32	2.89	760.58	30.16	1227356.	0.087	Bu
1360.0	6045030.	276.04	0.00724	1216218.	2784746.	2.12	2.63	757.49	31.07	1227568.	0.087	Bu
1385.0	6212580.	277.83	0.00000	1227781.	2782951.	1.88	1.88	753.54	32.01	1227781.	0.087	Bu
1410.0	6374999.	278.32	0.00000	1227993.	0.	1.88	0.00	753.70	0.00	1227993.	0.087	1p
1435.0	6537451.	278.37	0.00000	1228205.	0.	1.88	0.00	753.86	0.00	1228205.	0.087	1p
1460.0	6699937.	278.43	0.00000	1228417.	0.	1.88	0.00	754.02	0.00	1228417.	0.087	1p
1485.0	6862455.	278.49	0.00000	1228629.	0.	1.88	0.00	754.17	0.00	1228629.	0.087	1p
1510.0	7025006.	278.54	0.00000	1228842.	0.	1.88	0.00	754.33	0.00	1228842.	0.087	1p
1535.0	7187591.	278.60	0.00000	1229054.	0.	1.88	0.00	754.49	0.00	1229054.	0.087	1p

1560.0	7350208.	278.66	0.00000	1229266.	0.	1.88	0.00	754.65	0.00	1229266.	0.087	1p
1585.0	7512859.	278.71	0.00000	1229478.	0.	1.88	0.00	754.80	0.00	1229478.	0.087	1p
1610.0	7675542.	278.77	0.00000	1229691.	0.	1.87	0.00	754.96	0.00	1229691.	0.087	1p
1635.0	7838258.	278.83	0.00000	1229903.	0.	1.87	0.00	755.12	0.00	1229903.	0.087	1p
1660.0	8001007.	278.88	0.00000	1230115.	0.	1.87	0.00	755.27	0.00	1230115.	0.087	1p
1685.0	8163789.	278.94	0.00000	1230327.	0.	1.87	0.00	755.43	0.00	1230327.	0.087	1p
1710.0	8326604.	278.99	0.00000	1230539.	0.	1.87	0.00	755.59	0.00	1230539.	0.087	1p
1735.0	8489451.	279.05	0.00000	1230752.	0.	1.87	0.00	755.74	0.00	1230752.	0.087	1p
1760.0	8652330.	279.11	0.00000	1230964.	0.	1.87	0.00	755.90	0.00	1230964.	0.087	1p
1785.0	8815243.	279.16	0.00000	1231176.	0.	1.87	0.00	756.05	0.00	1231176.	0.087	1p
1810.0	8978187.	279.22	0.00000	1231388.	0.	1.87	0.00	756.21	0.00	1231388.	0.087	1p
1835.0	9141164.	279.27	0.00000	1231601.	0.	1.87	0.00	756.36	0.00	1231601.	0.087	1p
1860.0	9304174.	279.33	0.00000	1231813.	0.	1.87	0.00	756.52	0.00	1231813.	0.087	1p
1885.0	9467216.	279.39	0.00000	1232025.	0.	1.87	0.00	756.67	0.00	1232025.	0.087	1p
1910.0	9630290.	279.44	0.00000	1232237.	0.	1.87	0.00	756.83	0.00	1232237.	0.087	1p
1935.0	9793397.	279.50	0.00000	1232450.	0.	1.87	0.00	756.98	0.00	1232450.	0.087	1p
1960.0	9956535.	279.55	0.00000	1232662.	0.	1.87	0.00	757.13	0.00	1232662.	0.087	1p
1985.0	10119706.	279.61	0.00000	1232874.	0.	1.87	0.00	757.29	0.00	1232874.	0.087	1p
2010.0	10282909.	279.66	0.00000	1233086.	0.	1.87	0.00	757.44	0.00	1233086.	0.087	1p
2010.0	10282909.	288.56	0.00000	1279977.	0.	0.79	0.00	740.35	0.00	1279977.	0.087	1p
2035.0	10440608.	288.62	0.00000	1280189.	0.	0.79	0.00	740.52	0.00	1280189.	0.087	1p
2060.0	10598340.	288.68	0.00000	1280401.	0.	0.79	0.00	740.68	0.00	1280401.	0.087	1p
2085.0	10756107.	288.74	0.00000	1280613.	0.	0.79	0.00	740.84	0.00	1280613.	0.087	1p
2110.0	10913908.	288.80	0.00000	1280825.	0.	0.79	0.00	741.00	0.00	1280825.	0.087	1p
2135.0	11071742.	288.86	0.00000	1281038.	0.	0.79	0.00	741.16	0.00	1281038.	0.087	1p
2160.0	11229611.	288.92	0.00000	1281250.	0.	0.79	0.00	741.32	0.00	1281250.	0.087	1p
2185.0	11387513.	288.98	0.00000	1281462.	0.	0.79	0.00	741.48	0.00	1281462.	0.087	1p
2210.0	11545450.	289.04	0.00000	1281674.	0.	0.79	0.00	741.64	0.00	1281674.	0.087	1p
2235.0	11703420.	289.10	0.00000	1281886.	0.	0.79	0.00	741.80	0.00	1281886.	0.087	1p
2260.0	11861424.	289.16	0.00000	1282099.	0.	0.79	0.00	741.96	0.00	1282099.	0.087	1p
2285.0	12019461.	289.22	0.00000	1282311.	0.	0.79	0.00	742.11	0.00	1282311.	0.087	1p
2310.0	12177532.	289.28	0.00000	1282523.	0.	0.79	0.00	742.27	0.00	1282523.	0.087	1p
2335.0	12335637.	289.34	0.00000	1282735.	0.	0.79	0.00	742.43	0.00	1282735.	0.087	1p
2360.0	12493775.	289.40	0.00000	1282947.	0.	0.79	0.00	742.59	0.00	1282947.	0.087	1p
2385.0	12651947.	289.45	0.00000	1283160.	0.	0.79	0.00	742.75	0.00	1283160.	0.087	1p
2410.0	12810152.	289.51	0.00000	1283372.	0.	0.79	0.00	742.91	0.00	1283372.	0.087	1p
2435.0	12968390.	289.57	0.00000	1283584.	0.	0.79	0.00	743.06	0.00	1283584.	0.087	1p
2460.0	13126662.	289.63	0.00000	1283796.	0.	0.79	0.00	743.22	0.00	1283796.	0.087	1p
2485.0	13284967.	289.69	0.00000	1284008.	0.	0.79	0.00	743.38	0.00	1284008.	0.087	1p
2510.0	13443306.	289.75	0.00000	1284221.	0.	0.79	0.00	743.53	0.00	1284221.	0.087	1p
2530.0	13570000.	289.80	0.00000	1284390.	2802398.	0.79	20.21	743.66	14.95	1284390.	0.087	1p
2530.0	13570000.	289.80	0.00000	1284390.	2802398.	0.79	20.21	743.66	14.95	1284390.	0.087	1p

13

P required (bars)	Max Error (bars)	Step size (bars)	Pbott Max (bars)	Pbott min (bars)
30.0000	0.1000	1.0000	152.5000	30.0000

It no	P bottom (bars)	P top (bars)	Difference (bars)	Q top (kg/s)	H top (kJ/kg)
0	141.0000	33.0529	3.0529	37.075	1446.516
1	140.0000	32.6292	2.6292	38.559	1443.362
2	139.0000	31.9346	1.9346	40.111	1439.388
3	138.0000	31.3297	1.3297	41.635	1435.853
4	137.0000	30.7185	0.7185	43.156	1432.411
5	136.0000	30.2472	0.2472	44.639	1429.588
6	135.0000	29.5482	-0.4518	46.173	1426.066
7	135.1000	29.6068	-0.3932	46.022	1426.368
8	135.2000	29.6648	-0.3352	45.872	1426.670
9	135.3000	29.7222	-0.2778	45.722	1426.971
10	135.4000	29.7790	-0.2210	45.572	1427.270
11	135.5000	29.8336	-0.1664	45.423	1427.569
12	135.6000	29.8877	-0.1123	45.273	1427.866
13	135.7000	29.9413	-0.0587	45.123	1428.163

Example Problem (9) Output File

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HOLA - MODEL RESULTS

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- Option 2 used -

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        Wellhead pressure ( bar abs. ) :       29.94
        Wellhead temperature ( C )      :      233.73
        Wellhead dryness                :        0.234
        Wellhead enthalpy ( kJ/kg )     :     1428.16
        Wellhead total flow ( kg/s )    :       45.12
```

Feedzone no:	Depth (m)	Flow (kg/s)	Enthalpy (kJ/kg)	Res.Pres (Bar)	Satur.	Prod. Ind. (m3)
1	1110.0	11.2317	1600.0	100.000	0.68	0.500000E-12
2	2010.0	19.8708	1200.0	135.000	0.00	0.800000E-12
3	2530.0	14.0210	1284.4	153.500	0.00	0.500000E-12

****

Depth (m)	Press (Pa)	Temp (C)	Dryness	Hw (J/kg)	Hs (J/kg)	Vw (m/s)	Vs (m/s)	Dw (kg/m3)	Ds (kg/m3)	H_t (J/kg)	Rad (m)	Reg
0.0	2994132.	233.73	0.23422	1007841.	2802403.	13.74	20.11	822.29	14.98	1428163.	0.110	Sl
25.0	3032454.	234.44	0.23293	1011177.	2802434.	13.53	19.77	821.32	15.17	1428420.	0.110	Bu
50.0	3070840.	235.14	0.23165	1014489.	2802455.	13.32	19.45	820.36	15.36	1428676.	0.110	Bu
75.0	3109300.	235.83	0.23038	1017779.	2802467.	13.12	19.14	819.41	15.56	1428932.	0.110	Bu
100.0	3147842.	236.52	0.22911	1021050.	2802469.	12.92	18.83	818.46	15.75	1429187.	0.110	Bu
125.0	3186475.	237.21	0.22784	1024301.	2802463.	12.72	18.53	817.51	15.95	1429443.	0.110	Bu
150.0	3225208.	237.89	0.22658	1027534.	2802447.	12.53	18.23	816.57	16.14	1429698.	0.110	Bu
175.0	3264049.	238.56	0.22533	1030750.	2802423.	12.35	17.95	815.63	16.34	1429952.	0.110	Bu
200.0	3303007.	239.23	0.22407	1033950.	2802389.	12.16	17.66	814.69	16.53	1430207.	0.110	Bu
225.0	3342089.	239.90	0.22282	1037135.	2802347.	11.99	17.39	813.75	16.73	1430461.	0.110	Bu
250.0	3381305.	240.57	0.22157	1040306.	2802297.	11.81	17.12	812.82	16.93	1430715.	0.110	Bu
275.0	3420663.	241.23	0.22033	1043463.	2802238.	11.64	16.86	811.88	17.13	1430969.	0.110	Bu
300.0	3460170.	241.88	0.21908	1046609.	2802170.	11.47	16.60	810.95	17.33	1431223.	0.110	Bu
315.0	3483949.	242.28	0.21834	1048491.	2802126.	11.37	16.45	810.39	17.45	1431373.	0.110	Bu
330.0	3507778.	242.67	0.21759	1050368.	2802078.	11.27	16.30	809.84	17.57	1431524.	0.110	Bu
345.0	3531668.	243.06	0.21685	1052242.	2802027.	11.18	16.15	809.28	17.70	1431674.	0.110	Bu
360.0	3555591.	243.45	0.21610	1054110.	2801974.	11.08	16.00	808.72	17.82	1431824.	0.110	Bu
375.0	3579579.	243.84	0.21536	1055974.	2801917.	10.99	15.86	808.17	17.94	1431974.	0.110	Bu
390.0	3603585.	244.22	0.21461	1057832.	2801858.	10.89	15.71	807.61	18.06	1432124.	0.110	Bu
405.0	3627657.	244.61	0.21387	1059687.	2801795.	10.80	15.57	807.06	18.18	1432274.	0.110	Bu
420.0	3651731.	244.99	0.21313	1061534.	2801730.	10.71	15.43	806.50	18.31	1432422.	0.110	Bu
435.0	3675874.	245.37	0.21239	1063378.	2801662.	10.62	15.29	805.95	18.43	1432571.	0.110	Bu
450.0	3700002.	245.75	0.21165	1065213.	2801591.	10.53	15.16	805.40	18.55	1432719.	0.110	Bu

465.0	3724200.	246.13	0.21091	1067045.	2801517.	10.44	15.02	804.85	18.68	1432867.	0.110	Bu
480.0	3748365.	246.51	0.21018	1068867.	2801441.	10.36	14.89	804.30	18.80	1433014.	0.110	Bu
495.0	3772603.	246.89	0.20944	1070687.	2801362.	10.27	14.76	803.75	18.93	1433160.	0.110	Bu
510.0	3796787.	247.26	0.20871	1072496.	2801280.	10.19	14.63	803.21	19.05	1433306.	0.110	Bu
525.0	3821046.	247.63	0.20797	1074302.	2801195.	10.10	14.50	802.66	19.18	1433452.	0.110	Bu
540.0	3845232.	248.00	0.20724	1076096.	2801108.	10.02	14.38	802.12	19.30	1433596.	0.110	Bu
555.0	3869494.	248.37	0.20652	1077887.	2801018.	9.94	14.25	801.58	19.43	1433740.	0.110	Bu
570.0	3893661.	248.74	0.20579	1079665.	2800926.	9.86	14.13	801.04	19.55	1433882.	0.110	Bu
585.0	3917906.	249.11	0.20506	1081441.	2800832.	9.78	14.01	800.50	19.67	1434025.	0.110	Bu
600.0	3942034.	249.47	0.20434	1083201.	2800735.	9.70	13.89	799.96	19.80	1434166.	0.110	Bu
615.0	3966241.	249.83	0.20362	1084961.	2800635.	9.62	13.77	799.43	19.92	1434306.	0.110	Bu
630.0	3990308.	250.19	0.20290	1086703.	2800534.	9.55	13.66	798.90	20.05	1434445.	0.110	Bu
645.0	4014455.	250.55	0.20219	1088444.	2800430.	9.47	13.54	798.36	20.17	1434584.	0.110	Bu
660.0	4038438.	250.90	0.20148	1090166.	2800324.	9.40	13.43	797.84	20.30	1434721.	0.110	Bu
675.0	4062501.	251.25	0.20076	1091888.	2800215.	9.33	13.32	797.31	20.42	1434857.	0.110	Bu
690.0	4086377.	251.60	0.20006	1093590.	2800105.	9.25	13.21	796.79	20.55	1434992.	0.110	Bu
705.0	4110332.	251.95	0.19935	1095291.	2799993.	9.18	13.10	796.27	20.67	1435126.	0.110	Bu
720.0	4134074.	252.29	0.19865	1096971.	2799879.	9.11	13.00	795.75	20.79	1435258.	0.110	Bu
735.0	4157896.	252.64	0.19795	1098650.	2799763.	9.04	12.89	795.24	20.92	1435390.	0.110	Bu
750.0	4181480.	252.98	0.19726	1100306.	2799645.	8.98	12.79	794.73	21.04	1435520.	0.110	Bu
775.0	4220961.	253.54	0.19611	1103065.	2799444.	8.87	12.62	793.88	21.24	1435737.	0.110	Bu
800.0	4260669.	254.10	0.19495	1105824.	2799235.	8.76	12.46	793.02	21.45	1435954.	0.110	Bu
825.0	4300608.	254.66	0.19379	1108582.	2799020.	8.65	12.29	792.17	21.66	1436171.	0.110	Bu
850.0	4340787.	255.23	0.19263	1111340.	2798797.	8.54	12.13	791.31	21.87	1436388.	0.110	Bu
875.0	4381212.	255.79	0.19146	1114099.	2798567.	8.43	11.97	790.46	22.08	1436605.	0.110	Bu
900.0	4421889.	256.35	0.19029	1116859.	2798330.	8.33	11.81	789.60	22.29	1436821.	0.110	Bu
910.0	4438233.	256.57	0.18982	1117963.	2798233.	8.29	11.75	789.25	22.38	1436907.	0.110	Bu
935.0	4503139.	257.45	0.18784	1122323.	2797838.	14.59	17.97	787.89	22.72	1437052.	0.087	Bu
960.0	4552494.	258.12	0.18641	1125613.	2797528.	14.36	17.69	786.86	22.98	1437272.	0.087	Bu
985.0	4601977.	258.78	0.18498	1128888.	2797210.	14.14	17.41	785.83	23.24	1437492.	0.087	Bu
1010.0	4651600.	259.44	0.18355	1132150.	2796882.	13.92	17.13	784.80	23.50	1437712.	0.087	Bu
1035.0	4701374.	260.09	0.18212	1135401.	2796545.	13.71	16.86	783.78	23.77	1437932.	0.087	Bu
1060.0	4751310.	260.74	0.18069	1138640.	2796199.	13.51	16.59	782.75	24.03	1438151.	0.087	Bu
1085.0	4801420.	261.39	0.17927	1141870.	2795844.	13.30	16.33	781.73	24.30	1438371.	0.087	Bu
1110.0	4851715.	262.04	0.17784	1145091.	2795479.	13.10	16.08	780.71	24.57	1438590.	0.087	Bu
1110.0	4851715.	262.04	0.04868	1145091.	2795479.	3.95	4.98	780.71	24.57	1225439.	0.087	Bu
1135.0	4942066.	263.18	0.04552	1150825.	2794805.	3.78	4.76	778.88	25.05	1225652.	0.087	Bu
1160.0	5036625.	264.37	0.04221	1156757.	2794073.	3.60	4.53	776.98	25.55	1225865.	0.087	Bu
1185.0	5135915.	265.59	0.03874	1162913.	2793276.	3.43	4.31	775.00	26.09	1226078.	0.087	Bu
1210.0	5240572.	266.86	0.03510	1169324.	2792405.	3.25	4.08	772.93	26.65	1226291.	0.087	Bu
1235.0	5351375.	268.19	0.03125	1176027.	2791451.	3.07	3.85	770.76	27.25	1226504.	0.087	Bu
1260.0	5469307.	269.58	0.02716	1183069.	2790398.	2.89	3.62	768.46	27.90	1226717.	0.087	Bu
1285.0	5595626.	271.04	0.02278	1190513.	2789229.	2.71	3.38	766.02	28.59	1226930.	0.087	Bu
1310.0	5731999.	272.59	0.01806	1198438.	2787921.	2.52	3.14	763.41	29.34	1227143.	0.087	Bu
1335.0	5880709.	274.24	0.01292	1206954.	2786443.	2.32	2.89	760.58	30.16	1227356.	0.087	Bu
1360.0	6045030.	276.04	0.00724	1216218.	2784746.	2.12	2.63	757.49	31.07	1227568.	0.087	Bu
1385.0	6212580.	277.83	0.00000	1227781.	2782951.	1.88	1.88	753.54	32.01	1227781.	0.087	Bu
1410.0	6374999.	278.32	0.00000	1227993.	2784114.	1.88	2.38	753.70	31.41	1227993.	0.087	1p
1435.0	6537451.	278.37	0.00000	1228205.	2782455.	1.88	2.09	753.86	32.27	1228205.	0.087	1p
1460.0	6699937.	278.43	0.00000	1228417.	2783966.	1.88	2.68	754.02	31.49	1228417.	0.087	1p
1485.0	6862455.	278.49	0.00000	1228629.	2782303.	1.88	2.33	754.17	32.35	1228629.	0.087	1p
1510.0	7025006.	278.54	0.00000	1228842.	2783942.	1.88	3.43	754.33	31.50	1228842.	0.087	1p

1535.0	7187591.	278.60	0.00000	1229054.	2782151.	1.88	2.56	754.49	32.42	1229054.	0.087	1p
1560.0	7350208.	278.66	0.00000	1229266.	2783781.	1.88	3.72	754.65	31.58	1229266.	0.087	1p
1585.0	7512859.	278.71	0.00000	1229478.	2781992.	1.88	2.80	754.80	32.51	1229478.	0.087	1p
1610.0	7675542.	278.77	0.00000	1229691.	2791105.	1.87	6.61	754.96	27.47	1229691.	0.087	1p
1635.0	7838258.	278.83	0.00000	1229903.	2790113.	1.87	6.24	755.12	28.07	1229903.	0.087	1p
1660.0	8001007.	278.88	0.00000	1230115.	2789032.	1.87	5.86	755.27	28.70	1230115.	0.087	1p
1685.0	8163789.	278.94	0.00000	1230327.	2787846.	1.87	5.47	755.43	29.38	1230327.	0.087	1p
1710.0	8326604.	278.99	0.00000	1230539.	2786535.	1.87	5.08	755.59	30.11	1230539.	0.087	1p
1735.0	8489451.	279.05	0.00000	1230752.	2785074.	1.87	4.69	755.74	30.90	1230752.	0.087	1p
1760.0	8652330.	279.11	0.00000	1230964.	2783427.	1.87	4.28	755.90	31.77	1230964.	0.087	1p
1785.0	8815243.	279.16	0.00000	1231176.	2781629.	1.87	3.28	756.05	32.69	1231176.	0.087	1p
1810.0	8978187.	279.22	0.00000	1231388.	0.	1.87	0.00	756.21	0.00	1231388.	0.087	1p
1835.0	9141164.	279.27	0.00000	1231601.	0.	1.87	0.00	756.36	0.00	1231601.	0.087	1p
1860.0	9304174.	279.33	0.00000	1231813.	0.	1.87	0.00	756.52	0.00	1231813.	0.087	1p
1885.0	9467216.	279.39	0.00000	1232025.	0.	1.87	0.00	756.67	0.00	1232025.	0.087	1p
1910.0	9630290.	279.44	0.00000	1232237.	0.	1.87	0.00	756.83	0.00	1232237.	0.087	1p
1935.0	9793397.	279.50	0.00000	1232450.	0.	1.87	0.00	756.98	0.00	1232450.	0.087	1p
1960.0	9956535.	279.55	0.00000	1232662.	0.	1.87	0.00	757.13	0.00	1232662.	0.087	1p
1985.0	10119706.	279.61	0.00000	1232874.	0.	1.87	0.00	757.29	0.00	1232874.	0.087	1p
2010.0	10282909.	279.66	0.00000	1233086.	0.	1.87	0.00	757.44	0.00	1233086.	0.087	1p
2010.0	10282909.	288.56	0.00000	1279977.	0.	0.79	0.00	740.35	0.00	1279977.	0.087	1p
2035.0	10440608.	288.62	0.00000	1280189.	0.	0.79	0.00	740.52	0.00	1280189.	0.087	1p
2060.0	10598340.	288.68	0.00000	1280401.	0.	0.79	0.00	740.68	0.00	1280401.	0.087	1p
2085.0	10756107.	288.74	0.00000	1280613.	0.	0.79	0.00	740.84	0.00	1280613.	0.087	1p
2110.0	10913908.	288.80	0.00000	1280825.	0.	0.79	0.00	741.00	0.00	1280825.	0.087	1p
2135.0	11071742.	288.86	0.00000	1281038.	0.	0.79	0.00	741.16	0.00	1281038.	0.087	1p
2160.0	11229611.	288.92	0.00000	1281250.	0.	0.79	0.00	741.32	0.00	1281250.	0.087	1p
2185.0	11387513.	288.98	0.00000	1281462.	0.	0.79	0.00	741.48	0.00	1281462.	0.087	1p
2210.0	11545450.	289.04	0.00000	1281674.	0.	0.79	0.00	741.64	0.00	1281674.	0.087	1p
2235.0	11703420.	289.10	0.00000	1281886.	0.	0.79	0.00	741.80	0.00	1281886.	0.087	1p
2260.0	11861424.	289.16	0.00000	1282099.	0.	0.79	0.00	741.96	0.00	1282099.	0.087	1p
2285.0	12019461.	289.22	0.00000	1282311.	0.	0.79	0.00	742.11	0.00	1282311.	0.087	1p
2310.0	12177532.	289.28	0.00000	1282523.	0.	0.79	0.00	742.27	0.00	1282523.	0.087	1p
2335.0	12335637.	289.34	0.00000	1282735.	0.	0.79	0.00	742.43	0.00	1282735.	0.087	1p
2360.0	12493775.	289.40	0.00000	1282947.	0.	0.79	0.00	742.59	0.00	1282947.	0.087	1p
2385.0	12651947.	289.45	0.00000	1283160.	0.	0.79	0.00	742.75	0.00	1283160.	0.087	1p
2410.0	12810152.	289.51	0.00000	1283372.	0.	0.79	0.00	742.91	0.00	1283372.	0.087	1p
2435.0	12968390.	289.57	0.00000	1283584.	0.	0.79	0.00	743.06	0.00	1283584.	0.087	1p
2460.0	13126662.	289.63	0.00000	1283796.	0.	0.79	0.00	743.22	0.00	1283796.	0.087	1p
2485.0	13284967.	289.69	0.00000	1284008.	0.	0.79	0.00	743.38	0.00	1284008.	0.087	1p
2510.0	13443306.	289.75	0.00000	1284221.	0.	0.79	0.00	743.53	0.00	1284221.	0.087	1p
2530.0	13570000.	289.80	0.00000	1284390.	2802428.	0.79	19.68	743.66	15.13	1284390.	0.087	1p
2530.0	13570000.	289.80	0.00000	1284390.	2802428.	0.79	19.68	743.66	15.13	1284390.	0.087	1p

P required (bars)		Max Error (bars)	Step size (bars)	Pbott Max (bars)	Pbott min (bars)
30.0000		0.1000	3.0000	150.5000	30.0000

It no	P bottom (bars)	P top (bars)	Difference (bars)	Q top (kg/s)	H top (kJ/kg)
0	121.0000	18.8119	-11.1881	67.286	1385.456
1	118.0000	15.6509	-14.3491	71.828	1375.745
2	124.0000	21.6250	-8.3750	62.755	1394.025
3	127.0000	24.0720	-5.9280	58.233	1402.507
4	130.0000	26.3641	-3.6359	53.691	1411.418
5	133.0000	28.3731	-1.6269	49.169	1420.222
6	136.0000	30.2472	0.2472	44.639	1429.588
7	135.7000	29.9413	-0.0587	45.123	1428.163

Example Problem (11) Input Data

```
   - Option 2 used -

7.0000E+05
28.00E+05
0.100E+05

2530.000
0.000
2800.000
1000.000
6.0480E+05
20
    300.0   0.1102 4.6E-5     25.0    90.0
     30.0   0.1102 4.6E-5     15.0    88.0
     30.0   0.1102 4.6E-5     15.0    86.0
     30.0   0.1102 4.6E-5     15.0    84.0
     30.0   0.1102 4.6E-5     15.0    82.0
     30.0   0.1102 4.6E-5     15.0    80.0
     30.0   0.1102 4.6E-5     15.0    78.0
     30.0   0.1102 4.6E-5     15.0    76.0
     30.0   0.1102 4.6E-5     15.0    74.0
     30.0   0.1102 4.6E-5     15.0    72.0
     30.0   0.1102 4.6E-5     15.0    70.0
     30.0   0.1102 4.6E-5     15.0    68.0
     30.0   0.1102 4.6E-5     15.0    66.0
     30.0   0.1102 4.6E-5     15.0    64.0
     30.0   0.1102 4.6E-5     15.0    62.0
     30.0   0.1102 4.6E-5     15.0    60.0
    150.0   0.1102 4.6E-5     25.0    60.0
     10.0   0.1102 4.6E-5     10.0    60.0
   1600.0   0.0873 1.5E-5     25.0    60.0
     20.0   0.0873 1.5E-5     20.0    60.0
4
    0.0    25.00
 1000.0   260.00
 2000.0   310.00
 2500.0   330.00
1
 2530.0   32.00E+05   400.0E+00   1.E-11
```

Example Problem (11) Output File

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


                              HOLA - MODEL RESULTS


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



        - Option 2 used -


            Wellhead pressure ( bar abs. ) :        7.03
            Wellhead temperature ( C )      :      369.24
            Wellhead dryness                :        1.000
            Wellhead enthalpy ( kJ/kg )     :     3204.49
            Wellhead total flow ( kg/s )    :        7.50


            Feedzone no:   Depth (m)   Flow (kg/s)   Enthalpy (kJ/kg)   Res.Pres (Bar)   Satur.   Prod. Ind. (m3)
            ---------------------------------------------------------------------------------------------------
                 1          2530.0       7.4983          3229.2             32.000        1.00      0.100000E-10
            ---------------------------------------------------------------------------------------------------
```

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

Depth (m) Press (Pa)  Temp (C) Dryness  Hw (J/kg)  Hs (J/kg)  Vw (m/s)  Vs (m/s)  Dw (kg/m3)  Ds (kg/m3)  H_t (J/kg)  Rad (m)  Reg
      0.0    702735.   369.24  1.00000     0.      3204486.     0.00      81.99      0.00        2.40      3204486.    0.110    1p
     25.0    716050.   369.53  1.00000     0.      3204853.     0.00      80.48      0.00        2.44      3204853.    0.110    1p
     50.0    729156.   369.81  1.00000     0.      3205212.     0.00      79.05      0.00        2.49      3205212.    0.110    1p
     75.0    742064.   370.08  1.00000     0.      3205564.     0.00      77.70      0.00        2.53      3205564.    0.110    1p
    100.0    754783.   370.35  1.00000     0.      3205909.     0.00      76.41      0.00        2.57      3205909.    0.110    1p
    125.0    767323.   370.62  1.00000     0.      3206247.     0.00      75.17      0.00        2.61      3206247.    0.110    1p
    150.0    779691.   370.88  1.00000     0.      3206580.     0.00      74.00      0.00        2.66      3206580.    0.110    1p
    175.0    791896.   371.14  1.00000     0.      3206908.     0.00      72.87      0.00        2.70      3206908.    0.110    1p
    200.0    803943.   371.39  1.00000     0.      3207231.     0.00      71.80      0.00        2.74      3207231.    0.110    1p
    225.0    815841.   371.64  1.00000     0.      3207550.     0.00      70.77      0.00        2.78      3207550.    0.110    1p
    250.0    827594.   371.89  1.00000     0.      3207865.     0.00      69.78      0.00        2.82      3207865.    0.110    1p
    275.0    839209.   372.13  1.00000     0.      3208176.     0.00      68.82      0.00        2.86      3208176.    0.110    1p
    300.0    850692.   372.37  1.00000     0.      3208484.     0.00      67.91      0.00        2.89      3208484.    0.110    1p
    315.0    857521.   372.51  1.00000     0.      3208666.     0.00      67.38      0.00        2.92      3208666.    0.110    1p
    330.0    864304.   372.66  1.00000     0.      3208848.     0.00      66.86      0.00        2.94      3208848.    0.110    1p
    345.0    871043.   372.80  1.00000     0.      3209028.     0.00      66.35      0.00        2.96      3209028.    0.110    1p
    360.0    877739.   372.94  1.00000     0.      3209208.     0.00      65.85      0.00        2.98      3209208.    0.110    1p
    375.0    884393.   373.08  1.00000     0.      3209386.     0.00      65.36      0.00        3.01      3209386.    0.110    1p
    390.0    891004.   373.21  1.00000     0.      3209563.     0.00      64.88      0.00        3.03      3209563.    0.110    1p
    405.0    897575.   373.35  1.00000     0.      3209739.     0.00      64.42      0.00        3.05      3209739.    0.110    1p
    420.0    904105.   373.49  1.00000     0.      3209914.     0.00      63.96      0.00        3.07      3209914.    0.110    1p
    435.0    910596.   373.62  1.00000     0.      3210088.     0.00      63.51      0.00        3.09      3210088.    0.110    1p
    450.0    917047.   373.76  1.00000     0.      3210260.     0.00      63.07      0.00        3.12      3210260.    0.110    1p
    465.0    923461.   373.89  1.00000     0.      3210432.     0.00      62.64      0.00        3.14      3210432.    0.110    1p
    480.0    929836.   374.02  1.00000     0.      3210602.     0.00      62.22      0.00        3.16      3210602.    0.110    1p
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495.0	936175.	374.16	1.00000	0.	3210771.	0.00	61.80	0.00	3.18	3210771.	0.110	1p
510.0	942476.	374.29	1.00000	0.	3210939.	0.00	61.40	0.00	3.20	3210939.	0.110	1p
525.0	948742.	374.42	1.00000	0.	3211106.	0.00	61.00	0.00	3.22	3211106.	0.110	1p
540.0	954971.	374.55	1.00000	0.	3211271.	0.00	60.61	0.00	3.24	3211271.	0.110	1p
555.0	961167.	374.67	1.00000	0.	3211435.	0.00	60.22	0.00	3.26	3211435.	0.110	1p
570.0	967325.	374.80	1.00000	0.	3211597.	0.00	59.85	0.00	3.28	3211597.	0.110	1p
585.0	973452.	374.93	1.00000	0.	3211759.	0.00	59.48	0.00	3.30	3211759.	0.110	1p
600.0	979543.	375.05	1.00000	0.	3211919.	0.00	59.11	0.00	3.32	3211919.	0.110	1p
615.0	985602.	375.18	1.00000	0.	3212078.	0.00	58.76	0.00	3.34	3212078.	0.110	1p
630.0	991626.	375.30	1.00000	0.	3212235.	0.00	58.41	0.00	3.37	3212235.	0.110	1p
645.0	997620.	375.42	1.00000	0.	3212391.	0.00	58.06	0.00	3.39	3212391.	0.110	1p
660.0	1003579.	375.54	1.00000	0.	3212545.	0.00	57.72	0.00	3.40	3212545.	0.110	1p
675.0	1009509.	375.66	1.00000	0.	3212698.	0.00	57.39	0.00	3.42	3212698.	0.110	1p
690.0	1015403.	375.78	1.00000	0.	3212849.	0.00	57.06	0.00	3.44	3212849.	0.110	1p
705.0	1021270.	375.90	1.00000	0.	3212999.	0.00	56.74	0.00	3.46	3212999.	0.110	1p
720.0	1027102.	376.02	1.00000	0.	3213147.	0.00	56.42	0.00	3.48	3213147.	0.110	1p
735.0	1032907.	376.14	1.00000	0.	3213294.	0.00	56.11	0.00	3.50	3213294.	0.110	1p
750.0	1038677.	376.25	1.00000	0.	3213439.	0.00	55.80	0.00	3.52	3213439.	0.110	1p
775.0	1048237.	376.44	1.00000	0.	3213678.	0.00	55.30	0.00	3.55	3213678.	0.110	1p
800.0	1057727.	376.63	1.00000	0.	3213917.	0.00	54.82	0.00	3.59	3213917.	0.110	1p
825.0	1067150.	376.82	1.00000	0.	3214155.	0.00	54.34	0.00	3.62	3214155.	0.110	1p
850.0	1076506.	377.01	1.00000	0.	3214392.	0.00	53.88	0.00	3.65	3214392.	0.110	1p
875.0	1085797.	377.19	1.00000	0.	3214628.	0.00	53.43	0.00	3.68	3214628.	0.110	1p
900.0	1095025.	377.38	1.00000	0.	3214864.	0.00	52.98	0.00	3.71	3214864.	0.110	1p
910.0	1098699.	377.45	1.00000	0.	3214958.	0.00	52.81	0.00	3.72	3214958.	0.110	1p
935.0	1132501.	376.92	1.00000	0.	3213242.	0.00	81.52	0.00	3.84	3213242.	0.087	1p
960.0	1155342.	377.26	1.00000	0.	3213583.	0.00	79.93	0.00	3.92	3213583.	0.087	1p
985.0	1177794.	377.60	1.00000	0.	3213915.	0.00	78.42	0.00	3.99	3213915.	0.087	1p
1010.0	1199878.	377.93	1.00000	0.	3214238.	0.00	76.99	0.00	4.07	3214238.	0.087	1p
1035.0	1221614.	378.25	1.00000	0.	3214554.	0.00	75.64	0.00	4.14	3214554.	0.087	1p
1060.0	1243017.	378.56	1.00000	0.	3214863.	0.00	74.35	0.00	4.21	3214863.	0.087	1p
1085.0	1264105.	378.88	1.00000	0.	3215166.	0.00	73.12	0.00	4.28	3215166.	0.087	1p
1110.0	1284892.	379.18	1.00000	0.	3215463.	0.00	71.95	0.00	4.35	3215463.	0.087	1p
1135.0	1305392.	379.48	1.00000	0.	3215755.	0.00	70.83	0.00	4.42	3215755.	0.087	1p
1160.0	1325617.	379.78	1.00000	0.	3216043.	0.00	69.76	0.00	4.49	3216043.	0.087	1p
1185.0	1345579.	380.07	1.00000	0.	3216326.	0.00	68.74	0.00	4.56	3216326.	0.087	1p
1210.0	1365290.	380.35	1.00000	0.	3216605.	0.00	67.76	0.00	4.62	3216605.	0.087	1p
1235.0	1384759.	380.64	1.00000	0.	3216881.	0.00	66.82	0.00	4.69	3216881.	0.087	1p
1260.0	1403997.	380.92	1.00000	0.	3217153.	0.00	65.91	0.00	4.75	3217153.	0.087	1p
1285.0	1423012.	381.19	1.00000	0.	3217423.	0.00	65.04	0.00	4.81	3217423.	0.087	1p
1310.0	1441813.	381.47	1.00000	0.	3217689.	0.00	64.20	0.00	4.88	3217689.	0.087	1p
1335.0	1460407.	381.73	1.00000	0.	3217953.	0.00	63.40	0.00	4.94	3217953.	0.087	1p
1360.0	1478803.	382.00	1.00000	0.	3218215.	0.00	62.62	0.00	5.00	3218215.	0.087	1p
1385.0	1497007.	382.26	1.00000	0.	3218474.	0.00	61.87	0.00	5.06	3218474.	0.087	1p
1410.0	1515028.	382.53	1.00000	0.	3218730.	0.00	61.14	0.00	5.12	3218730.	0.087	1p
1435.0	1532870.	382.78	1.00000	0.	3218984.	0.00	60.44	0.00	5.18	3218984.	0.087	1p
1460.0	1550539.	383.04	1.00000	0.	3219236.	0.00	59.76	0.00	5.24	3219236.	0.087	1p
1485.0	1568041.	383.29	1.00000	0.	3219487.	0.00	59.10	0.00	5.30	3219487.	0.087	1p
1510.0	1585382.	383.54	1.00000	0.	3219736.	0.00	58.46	0.00	5.36	3219736.	0.087	1p
1535.0	1602566.	383.79	1.00000	0.	3219984.	0.00	57.84	0.00	5.41	3219984.	0.087	1p
1560.0	1619598.	384.04	1.00000	0.	3220230.	0.00	57.24	0.00	5.47	3220230.	0.087	1p
1585.0	1636483.	384.28	1.00000	0.	3220475.	0.00	56.66	0.00	5.53	3220475.	0.087	1p

1610.0	1653225.	384.53	1.00000	0.	3220718.	0.00	56.10	0.00	5.58	3220718.	0.087	1p
1635.0	1669829.	384.77	1.00000	0.	3220961.	0.00	55.55	0.00	5.64	3220961.	0.087	1p
1660.0	1686299.	385.01	1.00000	0.	3221202.	0.00	55.01	0.00	5.69	3221202.	0.087	1p
1685.0	1702637.	385.25	1.00000	0.	3221442.	0.00	54.49	0.00	5.75	3221442.	0.087	1p
1710.0	1718849.	385.48	1.00000	0.	3221681.	0.00	53.99	0.00	5.80	3221681.	0.087	1p
1735.0	1734937.	385.72	1.00000	0.	3221920.	0.00	53.49	0.00	5.85	3221920.	0.087	1p
1760.0	1750905.	385.95	1.00000	0.	3222157.	0.00	53.01	0.00	5.91	3222157.	0.087	1p
1785.0	1766756.	386.18	1.00000	0.	3222394.	0.00	52.54	0.00	5.96	3222394.	0.087	1p
1810.0	1782493.	386.41	1.00000	0.	3222629.	0.00	52.09	0.00	6.01	3222629.	0.087	1p
1835.0	1798119.	386.64	1.00000	0.	3222864.	0.00	51.64	0.00	6.06	3222864.	0.087	1p
1860.0	1813637.	386.87	1.00000	0.	3223099.	0.00	51.21	0.00	6.12	3223099.	0.087	1p
1885.0	1829050.	387.09	1.00000	0.	3223332.	0.00	50.78	0.00	6.17	3223332.	0.087	1p
1910.0	1844360.	387.32	1.00000	0.	3223565.	0.00	50.37	0.00	6.22	3223565.	0.087	1p
1935.0	1859569.	387.54	1.00000	0.	3223797.	0.00	49.96	0.00	6.27	3223797.	0.087	1p
1960.0	1874680.	387.77	1.00000	0.	3224029.	0.00	49.57	0.00	6.32	3224029.	0.087	1p
1985.0	1889696.	387.99	1.00000	0.	3224260.	0.00	49.18	0.00	6.37	3224260.	0.087	1p
2010.0	1904619.	388.21	1.00000	0.	3224491.	0.00	48.80	0.00	6.42	3224491.	0.087	1p
2035.0	1919450.	388.43	1.00000	0.	3224721.	0.00	48.43	0.00	6.47	3224721.	0.087	1p
2060.0	1934192.	388.64	1.00000	0.	3224950.	0.00	48.07	0.00	6.51	3224950.	0.087	1p
2085.0	1948847.	388.86	1.00000	0.	3225179.	0.00	47.72	0.00	6.56	3225179.	0.087	1p
2110.0	1963417.	389.08	1.00000	0.	3225408.	0.00	47.37	0.00	6.61	3225408.	0.087	1p
2135.0	1977904.	389.29	1.00000	0.	3225636.	0.00	47.03	0.00	6.66	3225636.	0.087	1p
2160.0	1992309.	389.51	1.00000	0.	3225864.	0.00	46.70	0.00	6.71	3225864.	0.087	1p
2185.0	2006634.	389.72	1.00000	0.	3226091.	0.00	46.37	0.00	6.75	3226091.	0.087	1p
2210.0	2020881.	389.93	1.00000	0.	3226318.	0.00	46.05	0.00	6.80	3226318.	0.087	1p
2235.0	2035052.	390.14	1.00000	0.	3226544.	0.00	45.73	0.00	6.85	3226544.	0.087	1p
2260.0	2049148.	390.35	1.00000	0.	3226770.	0.00	45.43	0.00	6.89	3226770.	0.087	1p
2285.0	2063170.	390.56	1.00000	0.	3226996.	0.00	45.12	0.00	6.94	3226996.	0.087	1p
2310.0	2077121.	390.77	1.00000	0.	3227222.	0.00	44.83	0.00	6.99	3227222.	0.087	1p
2335.0	2091001.	390.98	1.00000	0.	3227447.	0.00	44.54	0.00	7.03	3227447.	0.087	1p
2360.0	2104813.	391.18	1.00000	0.	3227671.	0.00	44.25	0.00	7.08	3227671.	0.087	1p
2385.0	2118556.	391.39	1.00000	0.	3227896.	0.00	43.97	0.00	7.12	3227896.	0.087	1p
2410.0	2132234.	391.60	1.00000	0.	3228120.	0.00	43.69	0.00	7.17	3228120.	0.087	1p
2435.0	2145846.	391.80	1.00000	0.	3228344.	0.00	43.42	0.00	7.21	3228344.	0.087	1p
2460.0	2159394.	392.00	1.00000	0.	3228568.	0.00	43.16	0.00	7.26	3228568.	0.087	1p
2485.0	2172880.	392.21	1.00000	0.	3228791.	0.00	42.89	0.00	7.30	3228791.	0.087	1p
2510.0	2186304.	392.41	1.00000	0.	3229014.	0.00	42.64	0.00	7.35	3229014.	0.087	1p
2530.0	2197000.	392.57	1.00000	0.	3229193.	0.00	42.43	0.00	7.38	3229193.	0.087	1p
2530.0	2197000.	392.57	1.00000	0.	3229193.	0.00	42.43	0.00	7.38	3229193.	0.087	1p

P required (bars)	Max Error (bars)	Step size (bars)	Pbott Max (bars)	Pbott min (bars)
7.0000	0.1000	0.3000	31.7000	7.0000

It no	P bottom (bars)	P top (bars)	Difference (bars)	Q top (kg/s)	H top (kJ/kg)
0	28.0000	24.4688	17.4688	3.291	3206.968
1	27.7000	23.9569	16.9569	3.522	3206.976
2	27.4000	23.4254	16.4254	3.751	3206.984
3	27.1000	22.8734	15.8734	3.977	3206.993
4	26.8000	22.2997	15.2997	4.201	3207.001
5	26.5000	21.7032	14.7032	4.423	3207.009
6	26.2000	21.0824	14.0824	4.643	3207.016
7	25.9000	20.4356	13.4356	4.860	3207.022
8	25.6000	19.7607	12.7607	5.075	3207.027
9	25.3000	19.0553	12.0553	5.288	3207.029
10	25.0000	18.3164	11.3164	5.499	3207.027
11	24.7000	17.5404	10.5404	5.707	3207.020
12	24.4000	16.7228	9.7228	5.913	3207.006
13	24.1000	15.8579	8.8579	6.117	3206.982
14	23.8000	14.9383	7.9383	6.318	3206.941
15	23.5000	13.9540	6.9540	6.518	3206.878
16	23.2000	12.8915	5.8915	6.715	3206.778
17	22.9000	11.7309	4.7309	6.909	3206.617
18	22.6000	10.4421	3.4421	7.102	3206.340
19	22.3000	8.9735	1.9735	7.292	3205.824
20	22.0000	7.2248	0.2248	7.480	3204.674
21	21.7000	4.9380	-2.0620	7.665	3200.825
22	21.7300	5.2075	-1.7925	7.647	3201.559
23	21.7600	5.4652	-1.5348	7.628	3202.161
24	21.7900	5.7123	-1.2877	7.610	3202.661
25	21.8200	5.9501	-1.0499	7.591	3203.085
26	21.8500	6.1794	-0.8206	7.573	3203.447
27	21.8800	6.4011	-0.5989	7.554	3203.762
28	21.9100	6.6160	-0.3840	7.535	3204.034
29	21.9400	6.8246	-0.1754	7.517	3204.274
30	21.9700	7.0274	0.0274	7.498	3204.486

Example Problem (12) Input Data

```
    - Option 2 used -

1.0000E+06
62.40E+05
0.100E+05
0.00
2530.000
0.000
2800.000
1000.000
6.0480E+05
1
 2530.0   0.0873 1.5E-5     25.3    90.0
4
     0.0    25.00
 1000.0   260.00
 2000.0   310.00
 2500.0   330.00
1
 2530.0   65.35E+05   350.0       60.0E-12 0.01
```

Example Problem (12) Output File

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

                        GWELL - MODEL RESULTS

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       - Option 2 used -

             Wellhead pressure ( bar abs. ) :       9.98
             Wellhead temperature ( C )      :     268.90
             Wellhead dryness                :       1.000
             Wellhead enthalpy ( kJ/kg )     :    2958.19
             Wellhead total flow ( kg/s )    :      21.63
             Wellhead CO2                    :       0.0100


       Feedzone no:   Depth (m)   Flow (kg/s)   Enthalpy (kJ/kg)   Res.Pres (Bar)  Satur.    Prod. Ind. (m3)        XCO2
                   ----------------------------------------------------------------------------------------------------------

             1        2530.0      21.6319          3005.8              65.350       1.00      0.600000E-10         0.0100
                   ----------------------------------------------------------------------------------------------------------


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Depth (m)	Press (Pa)	Temp (C)	Dryness	Hw (J/kg)	Hs (J/kg)	Vw (m/s)	Vs (m/s)	Dw (kg/m3)	Ds (kg/m3)	H_t (J/kg)	Rad (m)	Reg	XCO2
0.0	998123.	268.90	1.00000	0.	2958186.	0.00	216.55	0.00	4.17	2958186.	0.087	1p	0.010
25.3	1135160.	273.34	1.00000	0.	2963576.	0.00	191.34	0.00	4.72	2963576.	0.087	1p	0.010
50.6	1261299.	276.76	1.00000	0.	2967207.	0.00	172.76	0.00	5.23	2967207.	0.087	1p	0.010
75.9	1378593.	279.55	1.00000	0.	2969831.	0.00	158.41	0.00	5.70	2969831.	0.087	1p	0.010
101.2	1488575.	281.93	1.00000	0.	2971829.	0.00	146.95	0.00	6.15	2971829.	0.087	1p	0.010
126.5	1592408.	284.02	1.00000	0.	2973415.	0.00	137.55	0.00	6.57	2973415.	0.087	1p	0.010
151.8	1690992.	285.90	1.00000	0.	2974717.	0.00	129.66	0.00	6.97	2974717.	0.087	1p	0.010
177.1	1785037.	287.60	1.00000	0.	2975815.	0.00	122.93	0.00	7.35	2975815.	0.087	1p	0.010
202.4	1875113.	289.18	1.00000	0.	2976762.	0.00	117.11	0.00	7.71	2976762.	0.087	1p	0.010
227.7	1961681.	290.65	1.00000	0.	2977595.	0.00	112.01	0.00	8.07	2977595.	0.087	1p	0.010
253.0	2045127.	292.03	1.00000	0.	2978338.	0.00	107.49	0.00	8.41	2978338.	0.087	1p	0.010
278.3	2125770.	293.33	1.00000	0.	2979012.	0.00	103.46	0.00	8.73	2979012.	0.087	1p	0.010
303.6	2203881.	294.57	1.00000	0.	2979628.	0.00	99.84	0.00	9.05	2979628.	0.087	1p	0.010
328.9	2279692.	295.75	1.00000	0.	2980199.	0.00	96.55	0.00	9.36	2980199.	0.087	1p	0.010
354.2	2353401.	296.89	1.00000	0.	2980732.	0.00	93.56	0.00	9.66	2980732.	0.087	1p	0.010
379.5	2425181.	297.97	1.00000	0.	2981232.	0.00	90.82	0.00	9.95	2981232.	0.087	1p	0.010
404.8	2495184.	299.02	1.00000	0.	2981706.	0.00	88.30	0.00	10.23	2981706.	0.087	1p	0.010
430.1	2563542.	300.04	1.00000	0.	2982158.	0.00	85.97	0.00	10.51	2982158.	0.087	1p	0.010
455.4	2630374.	301.02	1.00000	0.	2982589.	0.00	83.81	0.00	10.78	2982589.	0.087	1p	0.010
480.7	2695782.	301.97	1.00000	0.	2983004.	0.00	81.79	0.00	11.05	2983004.	0.087	1p	0.010
506.0	2759863.	302.90	1.00000	0.	2983404.	0.00	79.91	0.00	11.31	2983404.	0.087	1p	0.010
531.3	2822698.	303.80	1.00000	0.	2983792.	0.00	78.15	0.00	11.56	2983792.	0.087	1p	0.010
556.6	2884366.	304.68	1.00000	0.	2984168.	0.00	76.50	0.00	11.81	2984168.	0.087	1p	0.010
581.9	2944933.	305.54	1.00000	0.	2984534.	0.00	74.94	0.00	12.06	2984534.	0.087	1p	0.010
607.2	3004462.	306.38	1.00000	0.	2984891.	0.00	73.47	0.00	12.30	2984891.	0.087	1p	0.010

632.5	3063012.	307.20	1.00000	0.	2985241.	0.00	72.08	0.00	12.53	2985241.	0.087	1p	0.010
657.8	3120632.	308.00	1.00000	0.	2985583.	0.00	70.76	0.00	12.77	2985583.	0.087	1p	0.010
683.1	3177373.	308.78	1.00000	0.	2985919.	0.00	69.51	0.00	13.00	2985919.	0.087	1p	0.010
708.4	3233277.	309.55	1.00000	0.	2986249.	0.00	68.33	0.00	13.22	2986249.	0.087	1p	0.010
733.7	3288384.	310.31	1.00000	0.	2986574.	0.00	67.19	0.00	13.45	2986574.	0.087	1p	0.010
759.0	3342734.	311.05	1.00000	0.	2986894.	0.00	66.11	0.00	13.67	2986894.	0.087	1p	0.010
784.3	3396360.	311.78	1.00000	0.	2987210.	0.00	65.08	0.00	13.88	2987210.	0.087	1p	0.010
809.6	3449294.	312.50	1.00000	0.	2987522.	0.00	64.09	0.00	14.10	2987522.	0.087	1p	0.010
834.9	3501569.	313.20	1.00000	0.	2987830.	0.00	63.15	0.00	14.31	2987830.	0.087	1p	0.010
860.2	3553208.	313.90	1.00000	0.	2988135.	0.00	62.24	0.00	14.52	2988135.	0.087	1p	0.010
885.5	3604241.	314.58	1.00000	0.	2988437.	0.00	61.37	0.00	14.72	2988437.	0.087	1p	0.010
910.8	3654692.	315.25	1.00000	0.	2988736.	0.00	60.54	0.00	14.92	2988736.	0.087	1p	0.010
936.1	3704583.	315.92	1.00000	0.	2989033.	0.00	59.73	0.00	15.13	2989033.	0.087	1p	0.010
961.4	3753937.	316.57	1.00000	0.	2989327.	0.00	58.96	0.00	15.32	2989327.	0.087	1p	0.010
986.7	3802773.	317.21	1.00000	0.	2989619.	0.00	58.21	0.00	15.52	2989619.	0.087	1p	0.010
1012.0	3851110.	317.85	1.00000	0.	2989909.	0.00	57.49	0.00	15.72	2989909.	0.087	1p	0.010
1037.3	3898965.	318.48	1.00000	0.	2990197.	0.00	56.79	0.00	15.91	2990197.	0.087	1p	0.010
1062.6	3946361.	319.10	1.00000	0.	2990483.	0.00	56.12	0.00	16.10	2990483.	0.087	1p	0.010
1087.9	3993308.	319.71	1.00000	0.	2990767.	0.00	55.47	0.00	16.29	2990767.	0.087	1p	0.010
1113.2	4039926.	320.32	1.00000	0.	2991047.	0.00	54.84	0.00	16.47	2991047.	0.087	1p	0.010
1138.5	4085926.	320.91	1.00000	0.	2991325.	0.00	54.23	0.00	16.66	2991325.	0.087	1p	0.010
1163.8	4131622.	321.50	1.00000	0.	2991602.	0.00	53.64	0.00	16.84	2991602.	0.087	1p	0.010
1189.1	4176926.	322.09	1.00000	0.	2991878.	0.00	53.07	0.00	17.03	2991878.	0.087	1p	0.010
1214.4	4221952.	322.67	1.00000	0.	2992153.	0.00	52.51	0.00	17.21	2992153.	0.087	1p	0.010
1239.7	4266410.	323.24	1.00000	0.	2992426.	0.00	51.97	0.00	17.39	2992426.	0.087	1p	0.010
1265.0	4310613.	323.80	1.00000	0.	2992699.	0.00	51.45	0.00	17.56	2992699.	0.087	1p	0.010
1290.3	4354471.	324.36	1.00000	0.	2992970.	0.00	50.94	0.00	17.74	2992970.	0.087	1p	0.010
1315.6	4397993.	324.92	1.00000	0.	2993241.	0.00	50.44	0.00	17.91	2993241.	0.087	1p	0.010
1340.9	4441191.	325.47	1.00000	0.	2993511.	0.00	49.96	0.00	18.08	2993511.	0.087	1p	0.010
1366.2	4484072.	326.01	1.00000	0.	2993780.	0.00	49.49	0.00	18.26	2993780.	0.087	1p	0.010
1391.5	4526646.	326.55	1.00000	0.	2994048.	0.00	49.03	0.00	18.43	2994048.	0.087	1p	0.010
1416.8	4568922.	327.08	1.00000	0.	2994315.	0.00	48.59	0.00	18.60	2994315.	0.087	1p	0.010
1442.1	4610907.	327.61	1.00000	0.	2994582.	0.00	48.15	0.00	18.76	2994582.	0.087	1p	0.010
1467.4	4652610.	328.13	1.00000	0.	2994848.	0.00	47.73	0.00	18.93	2994848.	0.087	1p	0.010
1492.7	4694038.	328.65	1.00000	0.	2995114.	0.00	47.31	0.00	19.09	2995114.	0.087	1p	0.010
1518.0	4735198.	329.17	1.00000	0.	2995379.	0.00	46.91	0.00	19.26	2995379.	0.087	1p	0.010
1543.3	4776097.	329.68	1.00000	0.	2995643.	0.00	46.52	0.00	19.42	2995643.	0.087	1p	0.010
1568.6	4816742.	330.19	1.00000	0.	2995907.	0.00	46.13	0.00	19.58	2995907.	0.087	1p	0.010
1593.9	4857139.	330.69	1.00000	0.	2996170.	0.00	45.76	0.00	19.75	2996170.	0.087	1p	0.010
1619.2	4897294.	331.19	1.00000	0.	2996433.	0.00	45.39	0.00	19.91	2996433.	0.087	1p	0.010
1644.5	4937213.	331.68	1.00000	0.	2996696.	0.00	45.03	0.00	20.06	2996696.	0.087	1p	0.010
1669.8	4976903.	332.17	1.00000	0.	2996958.	0.00	44.68	0.00	20.22	2996958.	0.087	1p	0.010
1695.1	5016367.	332.66	1.00000	0.	2997219.	0.00	44.33	0.00	20.38	2997219.	0.087	1p	0.010
1720.4	5055612.	333.14	1.00000	0.	2997480.	0.00	44.00	0.00	20.53	2997480.	0.087	1p	0.010
1745.7	5094643.	333.62	1.00000	0.	2997741.	0.00	43.67	0.00	20.69	2997741.	0.087	1p	0.010
1771.0	5133465.	334.10	1.00000	0.	2998002.	0.00	43.34	0.00	20.84	2998002.	0.087	1p	0.010
1796.3	5172082.	334.57	1.00000	0.	2998262.	0.00	43.03	0.00	21.00	2998262.	0.087	1p	0.010
1821.6	5210499.	335.04	1.00000	0.	2998521.	0.00	42.72	0.00	21.15	2998521.	0.087	1p	0.010
1846.9	5248721.	335.51	1.00000	0.	2998781.	0.00	42.41	0.00	21.30	2998781.	0.087	1p	0.010
1872.2	5286751.	335.97	1.00000	0.	2999040.	0.00	42.12	0.00	21.45	2999040.	0.087	1p	0.010
1897.5	5324595.	336.43	1.00000	0.	2999298.	0.00	41.82	0.00	21.60	2999298.	0.087	1p	0.010
1922.8	5362255.	336.89	1.00000	0.	2999557.	0.00	41.54	0.00	21.75	2999557.	0.087	1p	0.010

1948.1	5399737.	337.35	1.00000	0.	2999815.	0.00	41.26	0.00	21.90	2999815.	0.087	1p	0.010
1973.4	5437043.	337.80	1.00000	0.	3000073.	0.00	40.98	0.00	22.05	3000073.	0.087	1p	0.010
1998.7	5474177.	338.25	1.00000	0.	3000331.	0.00	40.71	0.00	22.19	3000331.	0.087	1p	0.010
2024.0	5511143.	338.69	1.00000	0.	3000588.	0.00	40.44	0.00	22.34	3000588.	0.087	1p	0.010
2049.3	5547945.	339.14	1.00000	0.	3000845.	0.00	40.18	0.00	22.49	3000845.	0.087	1p	0.010
2074.6	5584585.	339.58	1.00000	0.	3001102.	0.00	39.92	0.00	22.63	3001102.	0.087	1p	0.010
2099.9	5621067.	340.01	1.00000	0.	3001359.	0.00	39.67	0.00	22.77	3001359.	0.087	1p	0.010
2125.2	5657394.	340.45	1.00000	0.	3001615.	0.00	39.42	0.00	22.92	3001615.	0.087	1p	0.010
2150.5	5693569.	340.88	1.00000	0.	3001872.	0.00	39.18	0.00	23.06	3001872.	0.087	1p	0.010
2175.8	5729595.	341.31	1.00000	0.	3002128.	0.00	38.94	0.00	23.20	3002128.	0.087	1p	0.010
2201.1	5765476.	341.74	1.00000	0.	3002384.	0.00	38.70	0.00	23.34	3002384.	0.087	1p	0.010
2226.4	5801212.	342.17	1.00000	0.	3002639.	0.00	38.47	0.00	23.48	3002639.	0.087	1p	0.010
2251.7	5836809.	342.59	1.00000	0.	3002895.	0.00	38.25	0.00	23.62	3002895.	0.087	1p	0.010
2277.0	5872267.	343.01	1.00000	0.	3003150.	0.00	38.02	0.00	23.76	3003150.	0.087	1p	0.010
2302.3	5907590.	343.43	1.00000	0.	3003405.	0.00	37.80	0.00	23.90	3003405.	0.087	1p	0.010
2327.6	5942780.	343.85	1.00000	0.	3003660.	0.00	37.58	0.00	24.04	3003660.	0.087	1p	0.010
2352.9	5977840.	344.26	1.00000	0.	3003915.	0.00	37.37	0.00	24.18	3003915.	0.087	1p	0.010
2378.2	6012772.	344.67	1.00000	0.	3004170.	0.00	37.16	0.00	24.31	3004170.	0.087	1p	0.010
2403.5	6047578.	345.08	1.00000	0.	3004425.	0.00	36.95	0.00	24.45	3004425.	0.087	1p	0.010
2428.8	6082261.	345.49	1.00000	0.	3004679.	0.00	36.75	0.00	24.59	3004679.	0.087	1p	0.010
2454.1	6116822.	345.90	1.00000	0.	3004933.	0.00	36.55	0.00	24.72	3004933.	0.087	1p	0.010
2479.4	6151264.	346.30	1.00000	0.	3005187.	0.00	36.35	0.00	24.86	3005187.	0.087	1p	0.010
2504.7	6185590.	346.70	1.00000	0.	3005441.	0.00	36.15	0.00	24.99	3005441.	0.087	1p	0.010
2530.0	6219800.	347.10	1.00000	0.	3005695.	0.00	35.96	0.00	25.13	3005695.	0.087	1p	0.010
2530.0	6219800.	347.10	1.00000	0.	3005695.	0.00	35.96	0.00	25.13	3005695.	0.087	1p	0.010

P required (bars)		Max Error (bars)	Step size (bars)	Pbott Max (bars)	Pbott min (bars)
10.0000		0.1000	0.0100	65.3400	10.0000

It no	P bottom (bars)	P top (bars)	Difference (bars)	Q top (kg/s)	H top (kJ/kg)
0	62.4000	21.3428	11.3428	20.322	2974.093
1	62.3900	21.0659	11.0659	20.340	2976.767
2	62.3800	20.6285	10.6285	20.407	2976.532
3	62.3700	20.1812	10.1812	20.475	2976.279
4	62.3600	19.7237	9.7237	20.542	2975.998
5	62.3500	19.2552	9.2552	20.610	2975.690
6	62.3400	18.7751	8.7751	20.677	2975.350
7	62.3300	18.2825	8.2825	20.744	2974.976
8	62.3200	17.7766	7.7766	20.811	2974.555
9	62.3100	17.2566	7.2566	20.879	2974.083
10	62.3000	16.7210	6.7210	20.946	2973.555
11	62.2900	16.1691	6.1691	21.013	2972.952
12	62.2800	15.5992	5.5992	21.081	2972.264
13	62.2700	15.0100	5.0100	21.148	2971.467
14	62.2600	14.3995	4.3995	21.215	2970.538
15	62.2500	13.7656	3.7656	21.282	2969.445
16	62.2400	13.1060	3.1060	21.350	2968.136
17	62.2300	12.4179	2.4179	21.417	2966.549
18	62.2200	11.6977	1.6977	21.484	2964.593
19	62.2100	10.9420	0.9420	21.551	2962.126
20	62.2000	10.1455	0.1455	21.618	2958.939
21	62.1900	9.3036	-0.6964	21.686	2954.692
22	62.1910	9.3900	-0.6100	21.679	2955.177
23	62.1920	9.4760	-0.5240	21.672	2955.648
24	62.1930	9.5614	-0.4386	21.665	2956.104
25	62.1940	9.6464	-0.3536	21.659	2956.546
26	62.1950	9.7308	-0.2692	21.652	2956.975
27	62.1960	9.8148	-0.1852	21.645	2957.391
28	62.1970	9.8982	-0.1018	21.639	2957.794
29	62.1980	9.9812	-0.0188	21.632	2958.186