LA-UR-98-100

RECEIVED

MAY 28 1998

OSTI

TASK COMPLETION REPORT FOR UPDATE DTPCON

Robert G. Steinke, TSA-10

Los Alamos
NATIONAL LABORATORY

Photograph by Chris J. Lindberg

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by the University of California for the U.S. Department of Energy under contract W-7405-ENG-36. By acceptance of this article, the publisher recognizes that the U.S. Government retains a nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes. The Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy. Los Alamos National Laboratory strongly supports academic freedom and a researcher's right to publish; therefore, the Laboratory as an institution does not endorse the viewpoint of a publication or guarantee its technical correctness.

LA-UR-98-100

**TASK COMPLETION REPORT
FOR UPDATE DTPCON**

by

Robert G. Steinke

September 10, 1997

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

**Portions of this document may be illegible
electronic image products. Images are
produced from the best available original
document.**

TASK COMPLETION REPORT FOR UPDATE DTPCON

Robert G. Steinke

ABSTRACT

Update DTPCON programs TRAC-P Version 5.4.28 with a Namelist variable IDTPC option to input 21 timestep-control parameter constants and 3 switch control variables. The 21 timestep-control parameter constants are a defined part of the internal timestep-size control criteria. The 3 switch control variables prevent a timestep reduction when the outer iteration fails to converge, when the timestep size needs to be reduced below DTMIN, and when a backup evaluation is to be performed.

1.0. INTRODUCTION

TRAC-P has 25 timestep-size control criteria that are listed in Table 2-2 of Ref. 1. Of these criteria, 18 have 21 parameter constants with values set internally by TRAC-P. Knolls Atomic Power Laboratory (KAPL) has requested that the code have the capability of changing these 21 parameter-constant values through input. KAPL users of TRAC-P also want (1) three switch control variables to continue the calculation without reducing the timestep size if the NOITMX (OITMAX or SITMAX input) number of outer iterations is exceeded, (2) a smaller timestep size than DTMIN, or (3) a backup evaluation to be performed. The use of the above capability is to be controlled by a Namelist variable. Its purpose is to provide the user with the convenience of changing these parameter constants through input and to have control over turning off these three timestep-reduction criteria. This provides the potential for getting TRAC-P to run faster and avoiding timestep-size reductions.

2.0. UPDATE DTPCON

Update DTPCON and its LABPRG input-data file LABDTP (shown in Appendix A) implement the above capability in TRAC-P Version 5.4.28. The new Namelist variable for providing this capability is IDTPC (Index for Δt Parameter Constants). The 21 parameter constants and 3 switch variables are read from the TRACIN file after Main-Data Card 7 when the user inputs IDTPC = 1. They are not read when IDTPC = 0 (default).

3.0. INPUT-DATA FORMAT DESCRIPTION

The input-data format and variable descriptions for IDTPC, the 21 parameter constants (MAXITB, MAXITC, DDI, VMERMX, VRMX, FXMAX, GXMAX, CSF1D,

CSF3DH, CNFACL, CNFACH, FPMAX, XDAU, XDAL, XOAU, XOAL, DTLMC, DTVMC, DPRMC, DTSMC, and DTRMC), and the 3 switch control variables (MAXIT, MINDT, and NOBKUP) are as follows.

Add the following new Namelist variable IDTPC description between Namelist variables IDIAGS and IEEEG in Chapter 6 of the TRAC-P User's Guide.

IDTPC	0 or 1	Option for inputing timestep-control parameter constants and switch variables to prevent timestep reductions.	0
		0 = no;	
		1 = yes.	

Add the following card descriptions after Main-Data Card 7 in Chapter 6 of the TRAC-P User's Guide.

Input Main-Data Cards 8 through 12 if NAMELIST variable IDTPC=1.

Main-Data Card 8. (Format 5I14) MAXITB, MAXITC, MAXIT, MINDT, NOBKUP

Columns	Variable	Description
1-14	MAXITB	The previous converged outer-iteration number below which the previous timestep size is increased by the multiplier DDI (Word 1 on Main-Data Card 9) [0 <= MAXITB <= MAXITC; inputing 0 causes TRAC to reset MAXITB to its default value 4; inputing 1 results in MAXITB having no effect on the evaluated timestep size].
15-28	MAXITC	The previous converged outer-iteration number OITNO above which the previous timestep size is decreased by the multiplier MAXITC/OITNO [0 <= MAXITB <= MAXITC; inputing 0 causes TRAC to reset MAXITC to its default value 5; inputing MAXITC >= OITMAX or SITMAX (Words 1 or 2 on Main-Data Card 6) results in MAXITC having no effect on the evaluated timestep size].
29-42	MAXIT	Switch to continue the TRAC calculation without reducing the timestep size when outer-iteration convergence is not satisfied after OITMAX or SITMAX (Words 1 or 2 on Main-Data Card 6) outer iterations. 0 = no (default); 1 = yes.
43-56	MINDT	Switch to continue the TRAC calculation without reducing the timestep size below DTMIN which would stop the calculation. 0 = no (default); 1 = yes.
57-70	NOBKUP	Switch to continue the TRAC calculation without doing any timestep-reduction backup evaluations. 0 = no (default); 1 = yes.

Main-Data Card 9. (Format 5E14.4) DDI, VMERMX, VRMX, FXMAX, GXMAX

Columns	Variable	Description
---------	----------	-------------

1-14	DDI	Multiplier to increase the previous timestep size when the previous converged outer-iteration number OITNO is less than MAXITB (Word 1 on Main-Data Card 8) [1.0 <= DDI; inputing 0.0 causes TRAC to reset DDI to its default value 1.05; inputing 1.0 results in DDI having no effect on the evaluated timestep size].
15-28	VMERMX	VESSEL-component maximum fractional mass error; the previous timestep is reduced by the multiplier VMERMX/VMERR when VMERMX is less than the VMERR VESSEL-component maximum fractional mass error [0.0 <= VMERMX; inputing 0.0 causes TRAC to reset VMERMX to its default value 10000.0 which disables this timestep-control criterion; inputing 10000.0 results in VMERMX having no effect on the evaluated timestep size].
29-42	VRMX	Maximum fractional change in the pressure; the previous timestep is reduced by the multiplier VRMX/VARERM when VRMX is less than the VARERM maximum fractional change in the pressure [0.0 <= VRMX; inputing 0.0 causes TRAC to reset VRMX to its default value 0.1; inputing 10000.0 results in VRMX having no effect on the evaluated timestep size].
43-56	FXMAX	Valve adjustment rate timestep-control parameter FXMAX where the maximum timestep is defined by $DTDFA * \max\{FXMAX * 2 * FA / (2 - MODE * FXMAX), GXMAX\}$ where DTDFA is the ratio of the minimum previous or present timestep size to its valve flow-area fraction change, FA is the valve's current flow-area fraction, and MODE is the anticipated valve movement (+1 for opening, -1 for closing) [0.0 <= FXMAX < 2.0; inputing 0.0 causes TRAC to reset FXMAX to its default value 0.1; inputing GXMAX = 10000.0 results in FXMAX having no effect on the evaluated timestep size].
57-70	GXMAX	Valve adjustment rate timestep-control parameter GXMAX where the maximum timestep is defined by $DTDFA * \max\{FXMAX * 2.0 * FA / (2.0 - MODE * FXMAX), GXMAX\}$ where DTDFA is the ratio of the minimum previous or present timestep size to its valve flow-area fraction change, FA is the valve's current flow-area fraction, and MODE is the anticipated valve movement (+1 for opening, -1 for closing) [0.0 <= GXMAX; inputing 0.0 causes TRAC to reset GXMAX to its default value 0.05; inputing 10000.0 results in GXMAX having no effect on the evaluated timestep size].

Columns	Variable	Description
1-14	CSF1D	Multiplier applied to the 1D hydraulic-component material Courant limit to define the maximum timestep size [0.0 <= CSF1D; inputting 0.0 causes TRAC to reset CSF1D to its default value 1000.0; inputting 10000.0 results in CSF1D having no effect on the evaluated timestep size].
15-28	CSF3DH	Multiplier applied to the 3D VESSEL-component material Courant limit when the 3DSETS method is used to define the maximum timestep size [0.0 <= CSF3DH; inputting 0.0 causes TRAC to reset CSF3DH to its default value 1000.0; inputting 10000.0 results in CSF3DH having no effect on the evaluated timestep size].
29-42	CNFACL	Multiplier applied to the 3D VESSEL-component material courant limit that, when the timestep size equals or is less than its timestep, stops the evaluation of the 3DSETS method when NAMELIST variable NOSETS = 0 [0.0 <= CNFACL <= CNFACH; inputting 0.0 causes TRAC to reset CNFACL to its default value 0.75; inputting 10000.0 will result in the 3DSETS method not being evaluated and inputting 0.00001 will result in the 3DSETS method being evaluated when NOSETS = 0].
29-42	CNFACH	Multiplier applied to the 3D VESSEL-component material courant limit that, when the timestep size equals or is greater than its timestep, starts the evaluation of the 3DSETS method when NAMELIST variable NOSETS = 0 [0.0 <= CNFACL <= CNFACH; inputting 0.0 causes TRAC to reset CNFACH to its default value 0.8; inputting 10000.0 will result in the 3DSETS method not being evaluated and inputting 0.00001 will result in the 3DSETS method being evaluated when NOSETS = 0].
43-56	FPMAX	Maximum fractional change in the power generated by any HTSTR component; the previous timestep is reduced by the multiplier FPMAX*RPOWTO/ RPOWRN-RPOWTO when FPMAX*RPOWTO is less than the RPOWRN-RPOWTO change in power between the end and start of the current timestep to be evaluated [0.0 <= FPMAX; inputting 0.0 causes TRAC to reset FPMAX to its default value 0.1; inputting 10000.0 will result in FPMAX having no effect on the evaluated timestep size].

Main-Data Card 11. (Format 4E14.4) XDAU, XDAL, XOAU, XOAL

Columns	Variable	Description
1-14	XDAU	Maximum increase in the gas volume fraction; the previous timestep is reduced by the multiplier XDAU/DAU when XDAU is less than the DAU maximum increase in the gas volume fraction during the previous timestep [0.0 <= XDAU <= 1.0; inputing 0.0 causes TRAC to reset XDAU to its default value 0.05; inputing 1.0 will result in XDAU having no effect on the evaluated timestep size].
15-28	XDAL	Maximum decrease in the gas volume fraction; the previous timestep is reduced by the multiplier XDAL/ DAL when XDAL is less than the DAL maximum decrease in the gas volume fraction during the previous timestep [0.0 <= XDAL <= 1.0; inputing 0.0 causes TRAC to reset XDAL to its default value 0.2; inputing 1.0 will result in XDAL having no effect on the evaluated timestep size].
29-42	XOAU	Maximum increase in the gas volume fraction when the gas volume fraction decreased during the prior timestep; the previous timestep is reduced by the multiplier XOAU/OAU when XOAU is less than the OAU maximum increase in the gas volume fraction during the previous timestep [0.0 <= XOAU <= 1.0; inputing 0.0 causes TRAC to reset XOAU to its default value 1.0; inputing 1.0 will result in XOAU having no effect on the evaluated timestep size].
43-56	XOAL	Maximum decrease in the gas volume fraction when the gas volume fraction increased during the prior timestep; the previous timestep is reduced by the multiplier XOAL/ OAL when XOAL is less than the OAL maximum decrease in the gas volume fraction during the previous timestep [0.0 <= XOAL <= 1.0; inputing 0.0 causes TRAC to reset XOAL to its default value 1.0; inputing 1.0 will result in XOAL having no effect on the evaluated timestep size].

Main-Data Card 12. (Format 5E14.4) DTLMC, DTVMC, DPRMC, DTS MC, DTRMC

Columns	Variable	Description
1-14	DTLMC	Maximum change in the liquid temperature [0.0 <= DTLMC; inputing 0.0 causes TRAC to reset DTLMC to its default value 20.0 K (36.0 F); inputing 10000.0 K (18000.0 F)

		will result in DTLMC having no effect on the evaluated timestep size].
15-28	DTVMC	Maximum change in the gas temperature [0.0 <= DTVMC; inputting 0.0 causes TRAC to reset DTVMC to its default value 25.0 K (45.0 F); inputting 10000.0 K (18000.0 F) will result in DTVMC having no effect on the evaluated timestep size].
29-42	DPRMC	Maximum fractional change in the pressure [0.0 <= DPRMC; inputting 0.0 causes TRAC to reset DPRMC to its default value 0.5; inputting 10000.0 will result in DPRMC having no effect on the evaluated time-step size].
43-56	DTSMC	Maximum change in the 1D hydraulic-component wall outer-surface temperature [0.0 <= DTSMC; inputting 0.0 causes TRAC to reset DTSMC to its default value 20.0 K (36.0 F); inputting 10000.0 K (18000.0 F) will result in DTSMC having no effect on the evaluated timestep size].
57-70	DTRMC	Maximum change in the HTSTR-component wall inner- and outer-surface temperatures [0.0 <= DTRMC; inputting 0.0 causes TRAC to reset DTRMC to its default value 20.0 K (36.0 F); inputting 10000.0 K (18000.0 F) will result in DTRMC having no effect on the evaluated timestep size].

The convenience of inputting 0, 0.0, or a blank field and having TRAC-P internally reset the default value (that is currently used by TRAC-P) has been programmed. One or more values need to be defined on each data record for TRAC-P to recognize the record as a data line rather than a blank comment line. The input-format description for each of the variables above defines the variable and indicates its range of value, its internal default value, and the value that causes its timestep-control criteria to have no effect on the evaluated timestep size. The default values for the 24 variables are initialized by DATA statements in subroutine BLKDAT to their default-value variable names (the parameter-constant variable names preceded by the letter "n" for an integer or "d" for a real). Subroutine INPUT defines the parameter-constant variables by their default-value variables when IDTPC = 0, or when IDTPC = 1, and the input value is 0 or 0.0.

The three variables MAXIT, MINDT, and NOBKUP are ON (1)/OFF (0) switch control variables. MAXIT = 1 continues the calculation without reducing the timestep size (as if outer-iteration convergence is satisfied) when the number of outer iterations is NOITMX (OITMAX or SITMAX, Words 1 or 2 on Main-Data Card 6), and outer-iteration convergence is not satisfied. MINDT = 1 continues the calculation with timestep size DTMIN when the timestep size is DTMIN and some criterion requires that the DELT timestep size be reduced. NOBKUP = 1 continues the calculation without doing a timestep-reduction backup evaluation when the criteria for doing a backup have set logic variables LBCKV, LBKPST, and/or LBKCYL to .TRUE.. The programmed effect of variables MAXIT, MINDT, and NOBKUP in subroutines HOUT, POST, STEADY, and TRANS is shown in Appendix B with only

the FORTRAN statements and logic that demonstrate their function. Comments are added to show where LBCKV, LBKPST, and LBKCYL are defined .TRUE. and where the logic of MAXIT, MINDT, NOBKUP, LBCKV, LBKPST, LBKCYL, DELPMX, DELXMX, DELT, DTMIN, OITNO, NOITMX determines that a timestep-reduction (backup) evaluation is or is not to be performed. A recommended backup-evaluation program change that will save unnecessary evaluation in subroutine POST when LBKPST=.TRUE. is set in subroutine POST3D is discussed in Section B.5.

4.0. TESTING

Update DTPCON with other pending updates in TRAC-P Version 5.4.28 has been tested on standard test problems W4LOOP, W4LOOPR, ZIONPWR, and TFPIPE2 on an Ultra SUN workstation. This involved testing the basic functionality (when IDTPC = 1 is input) of reading the above variable data; checking the replacement of 0, 0.0, or a blank field with a variable's default value; echoing the input data to the TRCOUT and INLAB files; and verifying that the input parameter-constant values are used in the evaluation of their timestep-size criterion for some of the variables. Observing the expected TRCOUT-file difference between similar versions of the same test problem is used in testing.

The effect of the three switch control variables being ON (1) is tested. Test problem TFPIPE2 requires up to four outer iterations to converge some timesteps; therefore, setting OITMAX = 2 tests the effect of setting MAXIT = 1. Also in this test problem with MAXIT = 0, the timestep needs to be reduced below DTMIN, so the effect of setting MINDT = 1 is tested. Test problem W4LOOPR, with its OITMAX maximum number of outer iterations changed from 10 to 2, requires some backup evaluations, so the effect of setting NOBKUP = 1 is tested.

4.1. Reference Test Problems W4LP1, W4LPR1, ZION1, and TFP1

The remaining discussion covers the details of the individual cases created from the four standard test problems that were used to test specific aspects of update DPTCON. Informative portions of the terminal output from that tested on an Ultra SUN workstation are shown in Appendix C. Similar testing was done on a Cray YMP computer. Test problems W4LP1 (pages C-1 to C-2), W4LPR1 (pages C-8 to C-9), ZION1 (pages C-21 to C-23), and TFP1 (pages C-28 to C-30) are the unchanged standard test problem W4LOOP, W4LOOPR, ZIONPWR, and TFPIPE2 reference cases, respectively.

4.2. Test Problem W4LP2

Test problem W4LP2 (pages C-2 to C-5) inputs IDTPC = 1 and all the parameter constants and switch variables with values of 0 or 0.0000e+00. The only expected difference between its W4LP2OUT (TRCOUT) file and the reference case W4LP1OUT file is in the different input data being echoed to the TRCOUT files. Both solutions are the same. W4LP2OUT shows the input 0 and 0.0 values being reset to their parameter-constant default values in English units.

4.3. Test Problem W4LP3

Test problem W4LP3 (pages C-5 to C-8) is similar to test problem W4LP2, except that the 0 or 0.0 parameter-constant or switch-variable values are changed to blank fields except for one 0, 0.0, or 0.0000e+00 on each of the data records. There are no differences between the W4LP2OUT and W4LP3OUT files, and their solutions are the same.

4.4. Test Problem W4LPR2

Test problem W4LPR2 (pages C-9 to C-12) makes the same changes to problem W4LPR1 for the transient calculation that test problem W4LP2 made to problem W4LP1 for the steady-state calculation with similar results. The W4LPR2INL (INLAB) file is shown to have Namelist variable IDTPC = 1 and its 24 input parameter values correctly output to it.

4.5. Test Problem W4LPR3

Test problem W4LPR3 (pages C-12 to C-14) is the same as problem W4LPR2, except that the input value for MAXITB is 4 (its default value) and for MAXIT is 1. The solutions are the same, and the W4LPR2OUT and W4LPR3OUT files are the same, except that the output echo of these two input values are different. MAXIT = 1 did not effect the solution because the maximum number of outer iterations needed for convergence is shown to be 2, and the OTIMAX maximum number of outer iterations is 10.

4.6. Test Problem W4LPR4

Test problem W4LPR4 (pages C-14 to C-15) is the same as problem W4LPR2, except that the input value for MAXITC is 5 (its default value) and for NOBKUP is 1. The solutions are the same, and the W4LPR2OUT and W4LPR4OUT files are the same, except that the output echo of these two input values is different. NOBKUP = 1 did not affect the solution because no timestep-reduction backup evaluations were required during the transient.

4.7. Test Problem W4LPR5

Test problem W4LPR5 (pages C-15 to C-18) is the same as problem W4LPR2, except that the input value for DTVMX is 25.0 K (its default value), for DPRMC is 0.1 (its default value is 0.5), and for DTSMC is 20.0 K (its default value). Reducing the maximum fractional change in the pressure outer-iteration convergence criterion by a factor of 5 increased the total number of timesteps from 260 to 529. Because of their different numerical-solution paths, most of the lines in files W4LPR2OUT and W4LPR5OUT are different, and their solutions are slightly different.

4.8. Test Problem W4LPR6

Test problem W4LPR6 (pages C-18 to C-21) is the same as problem W4LPR5, except that the input value for NOBKUP is 1. By not performing backup evaluations that

reduce the timestep size, the total number of timesteps decreased from 529 to 525. Based on the start of solution differences in the W4LPR5OUT and W4LPR6OUT files, the first backup occurred in problem W4LPR5 (it did not occur in problem W4LPR6) at (or slightly before) problem time 2.289 s and timestep number 421.

4.9. Test Problem ZION2

Test problem ZION2 (pages C-23 to C-25) inputs IDTPC = 1 and all the parameter constants and switch variables with their default values. The only expected difference between its ZION2OUT file and the reference case ZION1OUT file is in the different input data being echoed to these TRCOUT files. Both solutions are the same.

4.10. Test Problem ZION3

Test problem ZION3 (pages C-25 to C-28) is the same as problem ZION2, except that the value of CSF1D is 2.0 and CSF3DH is 2.0 (both their default values are 1000.0). In the terminal output, the CSF3DH = 2.0 3D-Courant number is shown to limit the timestep size after 190 timesteps. This results in the total number of timesteps being 303 rather than 238. Based on the start of solution differences in the ZION2OUT and ZION3OUT files, the first 3D-Courant limit on timestep size occurred at (or slightly before) problem time 22.34 s and timestep number 193.

4.11. Test Problem TFP2

Test problem TFP2 (pages C-30 to C-32) inputs (1) IDTPC = 1, (2) the switch variables with values of 0, and (3) the parameter constants with half of them having default values and the other half having 0 or 0.0000e+00. The only expected difference between its TFP2OUT file and the reference case TFP1OUT file is in the different input data being echoed to the TRCOUT files. Both solutions are the same.

4.12. Test Problem TFP3

Test problem TFP3 (pages C-32 to C-34) is the same as problem TFP2 except for the value of NOBKUP being 1. There are no differences between the TFP2OUT and TFP3OUT files except for the different NOBKUP values echoed to output. Both solutions are the same.

4.13. Test Problem TFP4

Test problem TFP4 (pages C-34 to C-35) is the same as problem TFP2 except for the value of DDI being 1.1 (its default value is 1.05). Most lines of the TFP2OUT and TFP4OUT files are different. Their solutions are slightly different because of their different timestep sizes. Test problem TFP4 with larger timesteps required 123 timesteps compared with 144 timesteps for problem TFP2. The first timestep was 1.0E-05 s, and the second timestep was 1.1E-05 s rather than 1.05e-05 s in file TFP4OUT compared with file TFP2OUT.

4.14. Test Problem TFP5

Test problem TFP5 (pages C-35 to C-37) is the same as problem TFP4 except that the value of the OITMAX maximum number of outer iterations is 2 rather than 10. This caused the calculation to abort with a fatal error after 2 completed timesteps because the DELT timestep size needed to be reduced below DTMIN during timestep 3. This problem serves as a basecase for testing MINDT = 1 and MAXIT = 1 in the next two problems, respectively.

4.15. Test Problem TFP6

Test problem TFP6 (pages C-37 to C-39) is the same as problem TFP5 except for the value of MINDT being 1. The calculation generated the same *HOUT* warning messages as in problem TFP5 except that the calculation continued with DELT = DTMIN during timesteps 3, 4, and 5 without a calculation abort before increasing the timestep size thereafter. The MINDT = 1 switch variable allowed the calculation to continue.

4.16. Test Problem TFP7

Test problem TFP7 (pages C-39 to C-41) is the same as problem TFP5 except for the value of MAXIT being 1. The calculation continued without reducing the timestep size when outer-iteration convergence was not satisfied in 2 outer iterations because of MAXIT = 1. The timestep size was reduced during timestep 4 because of some other timestep criterion.

5.0. CONCLUSIONS

Update DTPCON and its LABPRG input-data file LABDTP program TRAC-P Version 5.4.28 to input 21 timestep-control parameter constants and 3 switch variables as a Namelist variable IDTPC option. These parameter constants provide the TRAC-P user with control over eighteen internal timestep evaluation criteria. The switch variables prevent a timestep reduction when the outer iteration fails to converge, when the timestep size needs to be reduced, and when a backup evaluation is to be performed. This provides the TRAC-P user with the potential for adjusting these parameters to get TRAC-P to run faster while hopefully not affecting the accuracy and robustness of its numerical solution.

ACKNOWLEDGMENT

The author wishes to thank Richard J. Smith for valuable discussions during the development and testing of this TRAC-P update.

6.0. REFERENCE

1. P. T. Giguere, "Improved timestep-size diagnostic edits for TRAC-P," Los Alamos National Laboratory document LA-UR-96-1502 (April 1996).

Appendix A

Listing of LABPRG Input-Data File LABDTP and Update DTPCON

File LABDTP

```

1  0  0 19  labnew data required by update dtpcon
2  cnfach  lunounit
3  cnfacl  lunounit
4  csfld   lunounit
5  csf3dh  lunounit
6  ddi     lunounit
7  dprmc   lunounit
8  dtlmc   lutempd
9  dtrmc   lutempd
10 dtsmc   lutempd
11 dtvmc   lutempd
12 fpmax   lunounit
13 fxmax   lunounit
14 gxmax   lunounit
15 vmermx   lunounit
16 vrmx    lunounit
17 xdal     lunounit
18 xdau     lunounit
19 xoal     lunounit
20 xoau     lunounit
21  0  0  0  labnew data end

```

File DTPCON

```

1  *ident dtpcon
2  */ -----Update Header Rev. 02-01-96----
3  */
4  */   File & Update Ident name (must be the same): dtpcon
5  */   TSHOOTER identifier:
6  */
7  */   Code developer: Bob Steinke           Date developed: 7/30/97
8  */   Acknowledgements: KAPL requested this capability
9  */   Update reviewer: Rich Smith           Date reviewed: 8/xx/97
10 */
11 */   Update to be applied to MOD2 _X_ or other :
12 */
13 */   CFS file path: /073417
14 */
15 */   Purpose of update: Update dtpcon (DT Parameter CONstants)
16 */                           programs the Namelist variable IDTPC=1
17 */                           option for inputing the timestep-control
18 */                           parameter-constant values used in the
19 */                           evaluation of the timestep size.  Input
20 */                           as well are three switch variables for
21 */                           continuing the calculation without
22 */                           reducing the timestep size when the
23 */                           outer iteration doesn't converge, DTMIN
24 */                           is too large, or a backup calculation
25 */                           is to be performed.
26 */
27 */   Basis for update:  To make TRAC-P run faster without
28 */                           reducing the timestep size by inputing
29 */                           different values for the timestep-

```

```

30 */               control parameter constants.
31 */
32 */   Dependencies on other updates: none
33 */
34 */   Justification of non-ANSI coding: N.A.
35 */
36 */   Is this a NULL update?  YES_X_ NO ____
37 */
38 */   Does this update generate new unit labels?  YES_X_ NO ____
39 */   If yes, path and /name of LABNEW file: /073417/labdtp
40 */
41 */   Does the TRAC I/O change because of this update?  YES_X_ NO ____
42 */   TRAC I/O includes input, dump, output, and graphics files.  If
43 */   yes, then submit the necessary manual changes.
44 */
45 */   Add the following new NAMELIST variable IDTPC description
46 */   between NAMELIST variables IDIAGS and IEEEG in chapter 6 of
47 */   the TRAC User's Guide.
48 */
49 */   IDTPC      0 or 1      Option for inputing timestep-control      0
50 */               parameter constants and switch vari-
51 */               ables to prevent timestep reductions.
52 */               0 = no;
53 */               1 = yes.
54 */
55 */   Add the following card descriptions after Main-Data Card 7 in
56 */   chapter 6 of the TRAC User's Guide.
57 */
58 */   Input Main-Data Cards 8 through 12 if NAMELIST variable IDTPC=1.
59 */
60 */
61 */   Main-Data Card 8.  (Format 5I14)  MAXITB, MAXITC, MAXIT, MINDT,
62 */               NOBKUP
63 */   Columns      Variable      Description
64 */   1-14          MAXITB        The previous converged outer-iteration
65 */               number below which the previous timestep
66 */               size is increased by the multiplier DDI
67 */               (Word 1 on Main-Data Card 9) [0 <= MAXITB
68 */               <= MAXITC; inputing 0 causes TRAC to reset
69 */               MAXITB to its default value 4; inputing 1
70 */               results in MAXITB having no effect on the
71 */               evaluated timestep size].
72 */   15-28          MAXITC        The previous converged outer-iteration
73 */               number OITNO above which the previous
74 */               timestep size is decreased by the multi-
75 */               plier MAXITC/OITNO [0 <= MAXITB <= MAXITC;
76 */               inputing 0 causes TRAC to reset MAXITC to
77 */               its default value 5; inputing MAXITC >=
78 */               OITMAX or SITMAX (Words 1 or 2 on Main-
79 */               Data Card 6) results in MAXITC having no
80 */               effect on the evaluated timestep size].
81 */   29-42          MAXIT         Switch to continue the TRAC calculation
82 */               without reducing the timestep size when
83 */               outer-iteration convergence is not sat-
84 */               isfied after OITMAX or SITMAX (Words 1 or
85 */               2 on Main-Data Card 6) outer iterations.
86 */               0 = no (default);
87 */               1 = yes.

```

88 */	43-56	MINDT	Switch to continue the TRAC calculation
89 */			without reducing the timestep size below
90 */			DTMIN which would stop the calculation.
91 */			0 = no (default);
92 */			1 = yes.
93 */	57-70	NOBKUP	Switch to continue the TRAC calculation
94 */			without doing any timestep-reduction
95 */			backup evaluations.
96 */			0 = no (default);
97 */			1 = yes.
98 */			
99 */	Main-Data Card 9. (Format 5E14.4) DDI, VMERMX, VRMX, FXMAX,		
100 */			GXMAX
101 */	Columns	Variable	Description
102 */	1-14	DDI	Multiplier to increase the previous
103 */			timestep size when the previous converged
104 */			outer-iteration number OITNO is less than
105 */			MAXITB (Word 1 on Main-Data Card 8)
106 */			[1.0 <= DDI; inputing 0.0 causes TRAC to
107 */			reset DDI to its default value 1.05;
108 */			inputing 1.0 results in DDI having no
109 */			effect on the evaluated timestep size].
110 */	15-28	VMERMX	VESSEL-component maximum fractional
111 */			mass error; the previous timestep is
112 */			reduced by the multiplier VMERMX/VMERR
113 */			when VMERMX is less than the VMERR
114 */			VESSEL-component maximum fractional
115 */			mass error [0.0 <= VMERMX; inputing
116 */			0.0 causes TRAC to reset VMERMX to its
117 */			default value 10000.0 which disables
118 */			this timestep-control criterion;
119 */			inputing 10000.0 results in VMERMX
120 */			having no effect on the evaluated
121 */			timestep size].
122 */	29-42	VRMX	Maximum fractional change in the
123 */			pressure; the previous timestep is
124 */			reduced by the multiplier VRMX/VARERM
125 */			when VRMX is less than the VARERM
126 */			maximum fractional change in the
127 */			pressure [0.0 <= VRMX; inputing 0.0
128 */			causes TRAC to reset VRMX to its
129 */			default value 0.1; inputing 10000.0
130 */			results in VRMX having no effect on
131 */			the evaluated timestep size].
132 */	43-56	FXMAX	Valve adjustment rate timestep-control
133 */			parameter FXMAX where the maximum time-
134 */			step is defined by $DTDFA \cdot \max\{FXMAX \cdot 2 \cdot FA /$
135 */			$(2 - MODE \cdot FXMAX), GXMAX\}$ where DTDFA is
136 */			the ratio of the minimum previous or
137 */			present timestep size to its valve flow-
138 */			area fraction change, FA is the valve's
139 */			current flow-area fraction, and MODE is
140 */			the anticipated valve movement (+1 for
141 */			opening, -1 for closing) [0.0 <= FXMAX
142 */			< 2.0; inputing 0.0 causes TRAC to reset
143 */			FXMAX to its default value 0.1; inputing
144 */			GXMAX = 10000.0 results in FXMAX having
145 */			no effect on the evaluated timestep size].

146 */	57-70	GXMAX	Valve adjustment rate timestep-control
147 */			parameter GXMAX where the maximum time-
148 */			step is defined by $DTDFA \cdot \max\{FXMAX \cdot 2.0 \cdot FA$
149 */			$/(2.0 - MODE \cdot FXMAX), GXMAX\}$ where DTDFA is
150 */			the ratio of the minimum previous or
151 */			present timestep size to its valve flow-
152 */			area fraction change, FA is the valve's
153 */			current flow-area fraction, and MODE is
154 */			the anticipated valve movement (+1 for
155 */			opening, -1 for closing) $[0.0 \leq GXMAX;$
156 */			inputing 0.0 causes TRAC to reset GXMAX
157 */			to its default value 0.05; inputing
158 */			10000.0 results in GXMAX having no
159 */			effect on the evaluated timestep size].
160 */			
161 */	Main-Data Card 10. (Format 5E14.4) CSF1D, CSF3DH, CNFACL, CNFACH,		
162 */			FPMAX
163 */	Columns	Variable	Description
164 */	1-14	CSF1D	Multiplier applied to the 1D hydraulic-
165 */			component material Courant limit to
166 */			define the maximum timestep size $[0.0$
167 */			$\leq CSF1D;$ inputing 0.0 causes TRAC
168 */			to reset CSF1D to its default value
169 */			1000.0; inputing 10000.0 results in
170 */			CSF1D having no effect on the evalu-
171 */			ated timestep size].
172 */	15-28	CSF3DH	Multiplier applied to the 3D VESSEL-
173 */			component material Courant limit when
174 */			the 3DSETS method is used to define
175 */			the maximum timestep size $[0.0 \leq$
176 */			CSF3DH; inputing 0.0 causes TRAC to
177 */			reset CSF3DH to its default value
178 */			1000.0; inputing 10000.0 results in
179 */			CSF3DH having no effect on the eval-
180 */			uated timestep size].
181 */	29-42	CNFACL	Multiplier applied to the 3D VESSEL-
182 */			component material courant limit that,
183 */			when the timestep size equals or is
184 */			less than its timestep, stops the
185 */			evaluation of the 3DSETS method when
186 */			NAMelist variable NOSETS = 0 $[0.0 \leq$
187 */			CNFACL $\leq CNFACH;$ inputing 0.0 causes
188 */			TRAC to reset CNFACL to its default
189 */			value 0.75; inputing 10000.0 will
190 */			result in the 3DSETS method not being
191 */			evaluated and inputing 0.00001 will
192 */			result in the 3DSETS method being
193 */			evaluated when NOSETS = 0].
194 */	29-42	CNFACH	Multiplier applied to the 3D VESSEL-
195 */			component material courant limit that,
196 */			when the timestep size equals or is
197 */			greater than its timestep, starts the
198 */			evaluation of the 3DSETS method when
199 */			NAMelist variable NOSETS = 0 $[0.0 \leq$
200 */			CNFACL $\leq CNFACH;$ inputing 0.0 causes
201 */			TRAC to reset CNFACH to its default
202 */			value 0.8; inputing 10000.0 will
203 */			result in the 3DSETS method not being

204 */			evaluated and inputing 0.00001 will
205 */			result in the 3DSETS method being
206 */			evaluated when NOSETS = 0].
207 */	43-56	FPMAX	Maximum fractional change in the power
208 */			generated by any HTSTR component; the
209 */			previous timestep is reduced by the
210 */			multiplier $FPMAX \cdot RPOWTO / RPOWRN - RPOWTO $
211 */			when $FPMAX \cdot RPOWTO$ is less than the
212 */			$RPOWRN - RPOWTO$ change in power between
213 */			the end and start of the current time-
214 */			step to be evaluated [$0.0 \leq FPMAX$;
215 */			inputing 0.0 causes TRAC to reset FPMAX
216 */			to its default value 0.1; inputing
217 */			10000.0 will result in FPMAX having no
218 */			effect on the evaluated timestep size].
219 */			
220 */	Main-Data Card 11. (Format 4E14.4) XDAU, XDAL, XOAU, XOAL		
221 */	Columns	Variable	Description
222 */	1-14	XDAU	Maximum increase in the gas volume
223 */			fraction; the previous timestep is
224 */			reduced by the multiplier $XDAU/DAU$
225 */			when XDAU is less than the DAU maximum
226 */			increase in the gas volume fraction
227 */			during the previous timestep [$0.0 \leq$
228 */			$XDAU \leq 1.0$; inputing 0.0 causes TRAC
229 */			to reset XDAU to its default value
230 */			0.05; inputing 1.0 will result in XDAU
231 */			having no effect on the evaluated
232 */			timestep size].
233 */	15-28	XDAL	Maximum decrease in the gas volume
234 */			fraction; the previous timestep is
235 */			reduced by the multiplier $XDAL/ DAL $
236 */			when XDAL is less than the DAL maximum
237 */			decrease in the gas volume fraction
238 */			during the previous timestep [$0.0 \leq$
239 */			$XDAL \leq 1.0$; inputing 0.0 causes TRAC
240 */			to reset XDAL to its default value
241 */			0.2; inputing 1.0 will result in XDAL
242 */			having no effect on the evaluated
243 */			timestep size].
244 */	29-42	XOAU	Maximum increase in the gas volume
245 */			fraction when the gas volume fraction
246 */			decreased during the prior timestep;
247 */			the previous timestep is reduced by
248 */			the multiplier $XOAU/OAU$ when XOAU is
249 */			less than the OAU maximum increase in
250 */			the gas volume fraction during the
251 */			previous timestep [$0.0 \leq XOAU \leq 1.0$;
252 */			inputing 0.0 causes TRAC to reset
253 */			XOAU to its default value 1.0;
254 */			inputing 1.0 will result in XOAU
255 */			having no effect on the evaluated
256 */			timestep size].
257 */	43-56	XOAL	Maximum decrease in the gas volume
258 */			fraction when the gas volume fraction
259 */			increased during the prior timestep;
260 */			the previous timestep is reduced by
261 */			the multiplier $XOAL/ OAL $ when XOAL is

262 */ less than the OAL maximum decrease in
 263 */ the gas volume fraction during the
 264 */ previous timestep [0.0 <= XOAL <= 1.0;
 265 */ inputing 0.0 causes TRAC to reset
 266 */ XOAL to its default value 1.0;
 267 */ inputing 1.0 will result in XOAL
 268 */ having no effect on the evaluated
 269 */ timestep size].
 270 */
 271 */ Main-Data Card 12. (Format 5E14.4) DTLMC, DTVMC, DPRMC, DTSMC,
 272 */ DTRMC
 273 */ Columns Variable Description
 274 */ 1-14 DTLMC Maximum change in the liquid temperature
 275 */ [0.0 <= DTLMC; inputing 0.0 causes TRAC
 276 */ to reset DTLMC to its default value 20.0 K
 277 */ (36.0 F); inputing 10000.0 K (18000.0 F)
 278 */ will result in DTLMC having no effect on
 279 */ the evaluated timestep size].
 280 */ 15-28 DTVMC Maximum change in the gas temperature
 281 */ [0.0 <= DTVMC; inputing 0.0 causes TRAC
 282 */ to reset DTVMC to its default value 25.0 K
 283 */ (45.0 F); inputing 10000.0 K (18000.0 F)
 284 */ will result in DTVMC having no effect on
 285 */ the evaluated timestep size].
 286 */ 29-42 DPRMC Maximum fractional change in the pressure
 287 */ [0.0 <= DPRMC; inputing 0.0 causes TRAC
 288 */ to reset DPRMC to its default value 0.5;
 289 */ inputing 10000.0 will result in DPRMC
 290 */ having no effect on the evaluated time-
 291 */ step size].
 292 */ 43-56 DTSMC Maximum change in the 1D hydraulic-
 293 */ component wall outer-surface temperature
 294 */ [0.0 <= DTSMC; inputing 0.0 causes TRAC
 295 */ to reset DTSMC to its default value 20.0 K
 296 */ (36.0 F); inputing 10000.0 K (18000.0 F)
 297 */ will result in DTSMC having no effect on
 298 */ the evaluated timestep size].
 299 */ 57-70 DTRMC Maximum change in the HTSTR-component
 300 */ wall inner- and outer-surface temperatures
 301 */ [0.0 <= DTRMC; inputing 0.0 causes TRAC
 302 */ to reset DTRMC to its default value 20.0 K
 303 */ (36.0 F); inputing 10000.0 K (18000.0 F)
 304 */ will result in DTRMC having no effect on
 305 */ the evaluated timestep size].
 306 */
 307 */ Does this change require that any of the TRAC support codes, e.g.
 308 */ EXTRACT, GOCNVRT, or EXCON, be changed? YES ___ NO X
 309 */ If yes, then include a description of the necessary changes.
 310 */ This description will be passed onto the custodian of the TRAC
 311 */ support codes.
 312 */
 313 */ Does the TRAC User's Guide, Theory Manual, or Programmer's Guide
 314 */ change because of this update? YES X NO ___
 315 */ If yes, then submit the necessary manual changes.
 316 */
 317 */ See TRAC I/O change above.
 318 */


```

319 */      DAME OF NEW
320 */      COMDECK      DESCRIPTION
321 */
322 */      DTPC          Creates a new common block DTPC that stores the
323 */                  default values initialized by subroutine BLKDAT
324 */                  and used by subroutine INPUT to define the 24
325 */                  timestep parameter constants and control switches.
326 */
327 */      NAME OF
328 */      SUBROUTINE
329 */      OR COMDECK
330 */      CHANGED      DESCRIPTION OF CHANGE
331 */
332 */      DLIMIT        Adds new variables DPRMC, DTLMC, DTRMC, DTSMC, DTVMC,
333 */                  VMERMX, VRMX, IDTPC, MAXIT, MAXITB, MAXITC, MINDT,
334 */                  and NOBKUP to common block DLIM.
335 */      EMOT          Adds new variables CNFACH and CNFACL to common block
336 */                  EMOT.
337 */      BLKDAT        Initializes the values of variables IDTPC, MAXITB,
338 */                  MAXITC, MAXIT, MINDT, NOBKUP, VMERMX, VRMX, CNFACL,
339 */                  CNFACH, DTLMC, DTVMC, DPRMC, DTSMC, and DTRMC.
340 */      HOUT          Adds logic to not reduce the timestep size when
341 */                  MAXIT.EQ.1, (MINDT.EQ.1).AND.(DELT.LE.DTMIN), and
342 */                  NOBKUP.EQ.1
343 */      INPUT          Adds NAMELIST variable IDTPC to NAMELIST group INOPTS
344 */                  and reads and checks variables MAXITB, MAXITC, MAXIT,
345 */                  MINDT, NOBKUP, DDI, VMERMX, VRMX, FXMAX, GXMAX,
346 */                  CSF1D, CSF3DH, CNFACL, CNFACH, FPMAX, XDAU, XDAL,
347 */                  XOAU, XOAL, DTLMC, DTVMC, DPRMC, DTSMC, and DTRMC on
348 */                  Main-Data Cards 8 through 12.
349 */      NAMLST        Checks NAMELIST variable IDTPC for having an input
350 */                  value of 0 or 1 or BLKDAT-initialized default value
351 */                  of 0.
352 */      NEWDLT        Deletes the data initialization of variables MAXITB,
353 */                  MAXITC, VMERMX, VRMX, CNFACL, CNFACH, DTLMC, DTVMC,
354 */                  DPRMC, DTSMC, and DTRMC.
355 */      POST          Adds logic to not reduce the timestep size when
356 */                  NOBKUP.EQ.1 or (MINDT.EQ.1).AND.(DELT.LE.DTMIN)
357 */      STEADY        Adds logic to not reduce the timestep size when
358 */                  NOBKUP.EQ.1 or (MINDT.EQ.1).AND.(DELT.LE.DTMIN)
359 */      TRANS          Adds logic to not reduce the timestep size when
360 */                  NOBKUP.EQ.1 or (MINDT.EQ.1).AND.(DELT.LE.DTMIN)
361 */
362 */      -----
363 */
364 */      *addfile,,dmpctrl
365 */      *cd dtpc
366 */          common/dtpc/      dcnfach,dcnfACL,dcsfld ,
367 */          1 dcsf3dh,dddi      ,ddprmc ,ddtlmc ,ddtrmc ,
368 */          2 ddtsmc ,ddtvmc ,dfpmax ,dfxmax ,dgxmax ,
369 */          3 dvmermx,dvrmx ,dxdal ,dxdau ,dxoal ,
370 */          4 dxoau
371 */          common/dtpc /      idtpc ,nmaxit ,nmaxitb,
372 */          1 nmaxitc,nmindt ,nnobkup
373 */      c
374 */
375 */      */ comdeck dlimit changes
376 */      *delete tsdiag2.1,dlimit.6

```

dlimit

```

377      * dprmc ,dtbkup,dtlmc ,dtrmc ,dtsmc ,
378      * dtvmc ,fpmax ,fxmax ,gxmax ,svmaxt,
379      * svnxt3,vmermx,vrmx
380      common/dlim/   maxit ,maxitb,maxitc,
381      * mindt ,nlim ,nlim2 ,nobkup
382  */
383  */ comdeck emot changes
384  *delete fxnst1.1                                emot
385      common/emot/   cnfach,cnfac1,csf   ,
386      * csfld ,csf3d ,csf3dl,csf3dh,fncif
387  */
388  */ subroutine blkdat changes
389  *insert blkdat.27                                blkdat
390  *ca dtpc
391  *delete fxnst1.2,fxnst1.3                        blkdat
392      data idtpc,nmaxitb,nmaxitc,nmaxit,nmindt,nnobkup/0,4,5,0,0,0/
393      data dddi,dvmermx,dvrmx,dfxmax,dgxmax/1.05,10000.0,0.1,0.4,0.05/
394      data dcsfld,dcsf3dh,dcnfac1,dcnfach/1000.0,1000.0,0.75,0.8/
395      data dfpmax,dxdau,dxdal,dxoau,dxoal/0.1,0.05,0.2,1.0,1.0/
396      data ddtlmc,ddtvmc,ddprmc,ddtsmc,ddtrmc/20.0,25.0,0.5,20.0,20.0/
397      data csf,csf3dl,fncif/1.0,1.0,0.7/
398  *delete tsdiag2.17                                blkdat
399      data deltit,dtddi,deltnc/-1.0,-1.0,-1.0/
400  *delete blkdat.331                                blkdat
401  *delete blkdat.464                                blkdat
402  */
403  */ subroutine hout changes
404  *delete hout.44                                    hout
405      if((delpmx.ge.0.5*delt).or.(nobkup.eq.1).or.
406      1   ((mindt.eq.1).and.(delt.le.dtmin))) go to 20
407  *delete hout.62                                    hout
408      if((delxmx.ge.0.5*delt).or.(nobkup.eq.1).or.
409      1   ((mindt.eq.1).and.(delt.le.dtmin))) go to 25
410  *delete hout.91                                    hout
411  *delete hout.106                                   hout
412      if(lbckv.and.(nobkup.eq.0).and.
413      1   ((mindt.eq.0).or.(delt.gt.dtmin))) go to 36
414  *delete hout.142                                   hout
415      if((noitmx.eq.1).or.(maxit.eq.1).or.(nobkup.eq.1).or.
416      1   ((mindt.eq.1).and.(delt.le.dtmin))) go to 50
417  */
418  */ subroutine input changes
419  *insert input.25                                    input
420  *ca chgalp
421  *ca dlimit
422  *ca dtinfo
423  *ca dtpc
424  *delete idiags.120                                input
425  *delete units.3010                                input
426      4      idiag ,idiags,idtpc ,ieeeg ,ielv ,igas ,igeom3,
427      5      ih2src,ihor ,ikfac ,imfr ,inlab ,invan ,
428  *delete fixfr.6,units.3126                        input
429  *delete idiags.121,idiags.123                    input
430      call reecho('rrrr ',hd3,hstn,htcwl,htcwv,dum,
431      1      hd3,hstn,htcwl,htcwv,dum,
432      2      'hd3','hstn','htcwl','htcwv',' ')
433      call reecho('iiii ',iadded,iblaus,icdelt,icflow,iconht,
434      1      iadded,iblaus,icdelt,icflow,iconht,

```

```

435      2      'iadded','iblaus','icdelt','icflow','iconht')
436      call reecho('iiii',idiag,idiags,idtpc,ieeeg,ielv,
437      1      idiag,idiags,idtpc,ieeeg,ielv,
438      2      'idiag','idiags','idtpc','ieeeg','ielv')
439 *insert units.3306      input
440 c
441 c      read the timestep-control parameter constants
442 c
443      if (idtpc.eq.0) then
444          maxitb=nmaxitb
445          maxitc=nmaxitc
446          maxit =nmaxit
447          mindt =nmindt
448          nobkup=nnobkup
449          ddi =dddi
450          vmermx=dvmermx
451          vrmx =dvrmx
452          fxmax =dfxmax
453          gxmax =dggxmax
454          csfld =dcsfld
455          csf3dh=dcsf3dh
456          cnfacl=dcnfacl
457          cnfach=dcnfach
458          fpmax =dfpmax
459          xdau =dxdau
460          xdal =dxdal
461          xoau =dxoau
462          xoal =dxoal
463          dtlmc =ddtlmc
464          dtvmc =ddtvmc
465          dprmc =ddprmc
466          dtsmc =ddtsmc
467          dtrmc =ddtrmc
468      else
469          call readi('iiii',maxitb,maxitc,maxit,mindt,nobkup,
470      1      'maxitb','maxitc','maxit','mindt','nobkup')
471          if (maxitb.le.0) then
472              maxitb=nmaxitb
473              write(iout,211) 'maxitb','maxitb',maxitb
474      211      format(1x,a6,' <= 0 has been reset to ',a6,' =',i2)
475          endif
476          if (maxitc.le.0) then
477              maxitc=nmaxitc
478              write(iout,211) 'maxitc','maxitc',maxitc
479          endif
480          if (maxitb.gt.maxitc) then
481              jflag=1
482              call error(2,'*input* maxitb .gt. maxitc',3)
483          endif
484          if ((maxit.ne.0).and.(maxit.ne.1)) then
485              jflag=1
486              call error(2,'*input* maxit .ne. 0 or 1',3)
487          endif
488          if ((mindt.ne.0).and.(mindt.ne.1)) then
489              jflag=1
490              call error(2,'*input* mindt .ne. 0 or 1',3)
491          endif
492          if ((nobkup.ne.0).and.(nobkup.ne.1)) then

```

```

493         jflag=1
494         call error(2,'*input* nobkup .ne. 0 or 1',3)
495     endif
496     call readr('rrrrr',ddi,vmermx,vrmx,fxmax,gxmax,
497 1         'ddi','vmermx','vrmx','fxmax','gxmax')
498     if (ddi.le.0.0) then
499         ddi=dddi
500         write(iout,217) ' ddi',' ddi', ddi,lud
501 217     format(1x,a6,' <= 0.0 has been reset to ',a6,' =',1p,e11.4,a)
502     endif
503     if (vmermx.le.0.0) then
504         vmermx=dvmermx
505         write(iout,217) 'vmermx','vmermx',vmermx,lud
506     endif
507     if (vrmx.le.0.0) then
508         vrmx=dvrmx
509         write(iout,217) ' vrmx',' vrmx', vrmx,lud
510     endif
511     if (fxmax.le.0.0) then
512         fxmax=dfxmax
513         write(iout,217) ' fxmax',' fxmax', fxmax,lud
514     endif
515     if (gxmax.le.0.0) then
516         gxmax=dgxmax
517         write(iout,217) ' gxmax',' gxmax', gxmax,lud
518     endif
519     call readr('rrrrr',csfld,csf3dh,cnfac1,cnfach,fpmax,
520 1         'csfld','csf3dh','cnfac1','cnfach','fpmax')
521     if (csfld.le.0.0) then
522         csfld=dcsfld
523         write(iout,217) ' csfld',' csfld', csfld,lud
524     endif
525     if (csf3dh.le.0.0) then
526         csf3dh=dcsf3dh
527         write(iout,217) 'csf3dh','csf3dh',csf3dh,lud
528     endif
529     if (cnfac1.le.0.0) then
530         cnfac1=dcnfac1
531         write(iout,217) 'cnfac1','cnfac1',cnfac1,lud
532     endif
533     if (cnfach.le.0.0) then
534         cnfach=dcnfach
535         write(iout,217) 'cnfach','cnfach',cnfach,lud
536     endif
537     if (cnfac1.gt.cnfach) then
538         jflag=1
539         call error(2,'*input* cnfac1 .gt. cnfach',3)
540     endif
541     if (fpmax.le.0.0) then
542         fpmax=dfpmax
543         write(iout,217) ' fpmax',' fpmax', fpmax,lud
544     endif
545     call readr('rrrrr',xdau,xdal,xoau,xoal,dum,
546 1         'xdau','xdal','xoau','xoal',' ')
547     if (xdau.le.0.0) then
548         xdau=dxda
549         write(iout,217) ' xdau',' xdau', xdau,lud
550     endif

```

```

551         if (xdal.le.0.0) then
552             xdal=dxdal
553             write(iout,217) ' xdal',' xdal', xdal,lud
554         endif
555         if (xoau.le.0.0) then
556             xoau=dxoau
557             write(iout,217) ' xoau',' xoau', xoau,lud
558         endif
559         if (xoal.le.0.0) then
560             xoal=dxoal
561             write(iout,217) ' xoal',' xoal', xoal,lud
562         endif
563         call readr('rrrrr',dtlmc,dtvmc,dprmc,dtsmc,dtrmc,
564             1      'dtlmc','dtvmc','dprmc','dtsmc','dtrmc')
565         if (dtlmc.le.0.0) then
566             dtlmc=ddtlmc
567             tmp(1)=dtlmc
568             call uncvt('dtlmc',tmp(1),1,1,ioinp-ioout)
569             write(iout,217) ' dtlmc',' dtlmc',tmp(1),lutp
570         endif
571         if (dtvmc.le.0.0) then
572             dtvmc=ddtvmc
573             tmp(1)=dtvmc
574             call uncvt('dtvmc',tmp(1),1,1,ioinp-ioout)
575             write(iout,217) ' dtvmc',' dtvmc',tmp(1),lutp
576         endif
577         if (dprmc.le.0.0) then
578             dprmc=ddprmc
579             write(iout,217) ' dprmc',' dprmc', dprmc,lud
580         endif
581         if (dtsmc.le.0.0) then
582             dtsmc=ddtsmc
583             tmp(1)=dtsmc
584             call uncvt('dtsmc',tmp(1),1,1,ioinp-ioout)
585             write(iout,217) ' dtsmc',' dtsmc',tmp(1),lutp
586         endif
587         if (dtrmc.le.0.0) then
588             dtrmc=ddtrmc
589             tmp(1)=dtrmc
590             call uncvt('dtrmc',tmp(1),1,1,ioinp-ioout)
591             write(iout,217) ' dtrmc',' dtrmc',tmp(1),lutp
592         endif
593     endif
594 c
595 */
596 */ subroutine namlst changes
597 */insert namlst.76
598 */ca dtpc
599 */insert idiags.157
600 c
601 c     check the input values for the idtpc flag
602 c
603         if((idtpc.lt.0).or.(idtpc.gt.1)) then
604             write(imout,324) idtpc
605             write( iout,324) idtpc
606 */if -def,unicos,1
607         write( itty,324) idtpc
608 */if def,unicos,1

```

namlst

namlst

```

609      write(      *,324) idtpc
610  324  format(/' *namlst* namelist variable idtpc =',i9,
611      1      ' should be 0 or 1 in value')
612      jflag=1
613      call error(2,'*namlst* idtpc has an out-of-range value',4)
614      endif
615  *delete units.4011,units.4017                                namlst
616      if((ieeeg.lt.0).or.(ieeeg.gt.1)) then
617          write(imout,325) ieeeg
618          write( iout,325) ieeeg
619  *if -def,unicos,1
620      write( itty,325) ieeeg
621  *if def,unicos,1
622      write(      *,325) ieeeg
623  *delete units.4021                                            namlst
624      call error(2,'*namlst* ieeeg has an out-of-range value',4)
625  */
626  */ subroutine newdlt changes
627  *insert tsdiag2.102                                          newdlt
628  *ca dtpc
629  *delete tsdiag2.103                                          newdlt
630  *delete newdlt.17,newdlt.18                                  newdlt
631  */
632  */ subroutine post changes
633  *delete nonest.588                                           post
634  *ca dlimit
635  *delete post.32                                              post
636  *delete upencyl.53                                           post
637      if((lbkpst.or.lbkcy1).and.(nobkup.eq.0).and.
638      1      ((mindt.eq.0).or.(delt.gt.dtmin))) go to 1500
639  *delete upencyl.54                                           post
640      if(lbkcy1.and.(nobkup.eq.0).and.
641      1      ((mindt.eq.0).or.(delt.gt.dtmin))) go to 1500
642  */
643  */ subroutine steady changes
644  *insert steady.17                                           steady
645  *ca dlimit
646  *delete upencyl.106                                          steady
647      if ((.not.lbkpst.and..not.lbkcy1).or.(nobkup.eq.1).or.
648      1      ((mindt.eq.1).and.(delt.le.dtmin))) go to 32
649  */
650  */ subroutine trans changes
651  *insert trans.14                                             trans
652  *ca dlimit
653  *delete upencyl.135                                          trans
654      if ((.not.lbkpst.and..not.lbkcy1).or.(nobkup.eq.1).or.
655      1      ((mindt.eq.1).and.(delt.le.dtmin))) go to 32
656  */
657  *compile dlimit,emot,blkdat,hout,input
658  *compile namlst,newdlt,post,steady,trans
659  */
660  */ -----

```

Appendix B

Subroutine HOUT, POST, STEADY, and TRANS Logic Effected by MAXIT, MINDT, and NOBKUP

B.1 Subroutine HOUT logic effected by MAXIT, MINDT, and NOBKUP is shown in bold type.

```

SUBROUTINE HOUT(NOITMX, IOFAIL, NMFAIL)
  . . . . .
  COMMON/BKCTRL/ IPREIT, LBCKV, LREIT,
* LREITV
  . . . . .
  LOGICAL LBCKV, LREIT, LREITV
  . . . . .
  DIMENSION NLIM(9), NLIM2(6)
  COMMON/DLIM/ DELAMX, DELCMX, DELDMX,
* DELEMV, DELPMX, DELRMX, DELVMX, DELXMX,
* DPRMC, DTBKUP, DTLMC, DTRMC, DTSMT,
* DTVMC, FPMAX, FXMAX, QXMAX, SVMAXT,
* SVMXT3, VMERMX, VRMX
  COMMON/DIM/ MAXIT, MAXITB, MAXITC,
* MINDT, NLIM, NLIM2, NOBKUP
  . . . . .
  IF((DELEPMX.GE.0.5*DELT).OR.(NOBKUP.EQ.1).OR.
  1 ((MINDT.EQ.1).AND.(DELT.LE.DTMIN))) GO TO 20 "Do no backup"
  . . . . .
  "Do a backup evaluation because of too large a core-power change"
  . . . . .
  GO TO 48
20 CONTINUE
  IF((DELXMX.GE.0.5*DELT).OR.(NOBKUP.EQ.1).OR.
  1 ((MINDT.EQ.1).AND.(DELT.LE.DTMIN))) GO TO 25 "Do no backup"
  . . . . .
  "Do a backup evaluation because of too large a valve adjustment"
  . . . . .
  GO TO 48
25 CONTINUE
  . . . . .
30 CONTINUE
  . . . . .
  LBCKV=.FALSE.
  . . . . .
  CALL OUTER "During an outer-iteration evaluation,
  . . . . . LBCKV=.TRUE. is set in subroutines TF1DS3
  . . . . . and TF3DS3 if a criterion is met for doing a
  . . . . . backup evaluation because of velocity reversal"
  . . . . .
  IF(LBCKV.AND.(NOBKUP.EQ.0).AND.
  1 ((MINDT.EQ.0).OR.(DELT.GT.DTMIN))) GO TO 36 "Do a backup"
  . . . . .
  IF(seven tests for outer-iteration convergence not satisfied) GO TO 35
  . . . . .
  GO TO 50 "The outer iteration has converged"
35 IF(OITNO.GE.NOITMX) GO TO 40 "Outer-iteration not converged and
  GO TO 30 maximum number iterations evaluated"
36 CONTINUE

```

```

      . . . . .
      "Do a backup evaluation because of velocity reversal"
      . . . . .
      GO TO 46
40  CONTINUE
      IF((NOITMX.EQ.1).OR.(MAXIT.EQ.1).OR.(NOBKUP.EQ.1).OR.
1    ((MINDT.EQ.1).AND.(DELT.LE.DTMIN))) GO TO 50  "Do no backup"
      . . . . .
      "Do a backup evaluation because of too large a pressure-matrix
      VARERM error, TVL OR TVU gas temperature change, TLL or TLU
      liquid temperature change, gas volume-fraction error
      (LREIT=.TRUE.), or flow-reversal failure (LREITV=.TRUE.)"
      . . . . .
46  CONTINUE
      . . . . .
      NMFAIL=NMFAIL+1
      . . . . .
48  CONTINUE
      IOFAIL=1
      OITNO=-100
      CALL POST
      IF(NMFAIL.GE.7) CALL ERROR(4,...) "Abort because of this fatal error"
      RETURN
50  CONTINUE
      . . . . .
      "Either the outer iteration converged successfully.OR.(MAXIT.EQ.1)
      .OR.(NUBKUP.EQ.1).OR.((MINDT.EQ.1).AND.(DELT.LE.DTMIN))"

```

B.2 Subroutine POST logic effected by MINDT and NOBKUP is shown in bold type.

```

SUBROUTINE POST
      . . . . .
      COMMON/BKPOST/ BKPALL,BKPALU,BKPSTA,
* BKPSTP,BKPSTT
      COMMON/BKPOST/ IBKPST,JBKPST,LBKPST,LBKCYL,
      LOGICAL LBKPST,LBKCYL
      . . . . .
      DIMENSION NLIM(9),NLIM2(6)
      COMMON/DLIM/  DELAMX,DELCMX,DELDMX,
* DELEMX,DELPMPX,DELRMX,DELVMX,DELXMX,
* DPRMC ,DTBKUP,DTLMC ,DTRMC ,DTSMC ,
* DTVMC ,FPMAX ,FXMAX ,QXMAX ,SVMAXT,
* SVMXT3,VMERMX,VRMX
      COMMON/DIM/  MAXIT ,MAXITB,MAXITC,
* MINDT ,NLIM ,NLIM2 ,NOBKUP
      . . . . .
      LBKPST=.FALSE.
      LBKCYL=.FALSE.
      IBKSL=1
      IBKSM=3
      IF(OITNO.EQ.-100) THEN      "When POST is called from HOUT"
          IBKSL=2
          IBKSM=2
      ENDIF
      DO 1000 IBKS=IBKSL,IBKSM  "Do loop over post-evaluation passes"
      . . . . .

```



```

DO 700 IL=1,NLOOPS      "Do loop over 1D-component loops"
. . . . .
DO 500 ICMP=IMIN,IMAX   "Do loop over 1D components in loop IL"
. . . . .
CALL 'component type'3(A(LBD),A(LVSI),LENBD) "During a POST
                                         evaluation pass, LBKPST=.TRUE. is set
                                         in subroutine BKSPLN or BKSSTB by a 1D
                                         hydraulic component if a stabilizer
                                         mass- or energy-equation criterion is
                                         met for doing a backup evaluation and
                                         LBKCYL=.TRUE. is set in subroutine
                                         POSTER by a 1D hydraulic component if
                                         an energy- conservation criterion is
                                         met for doing a backup evaluation"
. . . . .
IF((LBKPST.OR.LBKCYL).AND.(NOBKUP.EQ.0).AND.
1  ((MINDT.EQ.0).OR.(DELT.GT.DTMIN))) GO TO 1500  "Do a backup"
. . . . .
500 CONTINUE
. . . . .
700 CONTINUE
IF(NMVSSL.EQ.0) GO TO 1000
. . . . .
CALL POST3D "During a POST evaluation pass, LBKPST=.TRUE. is set
            in subroutine BKSTB3 by a 3D VESSEL component if a
            stabilizer mass- or energy-equation criterion is met
            for doing a backup calculation"
1000 CONTINUE
IF(NHTSTR.GT.0) CALL HTSTR3 "LBKCYL=.TRUE. is set in subroutine HTSTRP
                           by a heat-structure ROD or SLAB component
                           if an energy-conservation criterion is
                           met for doing a backup evaluation"
IF(LBKCYL.AND.(NOBKUP.EQ.0).AND.
1  ((MINDT.EQ.0).OR.(DELT.GT.DTMIN))) GO TO 1500  "Do a backup"
. . . . .
1500 CONTINUE
RETURN
END

```

B.3 Subroutine STEADY logic effected by MINDT and NOBKUP is shown in bold type.

```

SUBROUTINE STEADY
. . . . .
COMMON/BKPOST/ BKPALL,BKPALU,BKPSTA,
* BKPSTP,BKPSTT
COMMON/BKPOST/ IBKPST,JBKPST,LBKPST,LBKCYL,
LOGICAL LBKPST,LBKCYL
. . . . .
DIMENSION NLIM(9),NLIM2(6)
COMMON/DLIM/ DELAMX,DELCMX,DELDMX,
* DELEMX,DELPMPX,DELRMX,DELVMPX,DELXMX,
* DPRMC ,DTBKUP,DTLMC ,DTRMC ,DTSMC ,
* DTVMC ,FPMAX ,FXMAX ,QXMAX ,SVMAXT,
* SVMXT3,VMERMX,VRMX
COMMON/DIM/ MAXIT ,MAXITB,MAXITC,
* MINDT ,NLIM ,NLIM2 ,NOBKUP

```

```

10  . . . . .
    CONTINUE
    . . . . .
    CALL TIMCHK(IFLAG)
    . . . . .
20  CONTINUE
    . . . . .
    CALL TIMSTP(IENDP,IOFAIL,NMFAIL)
    . . . . .
    CALL PREP
    . . . . .
25  CALL HOUT(SITMAX,IOFAIL,NMFAIL)
    . . . . .
    IF(IOFAIL.NE.0) GO TO 20
    . . . . .
    LBKPST=.FALSE.
    LBKCYL=.FALSE.
    . . . . .
    CALL POST
    IF((.NOT.LBKPST.AND..NOT.LBKCYL).OR.(NOBKUP.EQ.1).OR.
1   ((MINDT.EQ.1).AND.(DELT.LE.DTMIN))) GO TO 32 "No backup
    IOFAIL=1                                     from POST"
    NMFAIL=NMFAIL+1
    OTINO=-100
    . . . . .
    IF(.NOT.LBKCYL) THEN
        WRITE "a message for backup caused by LBKPST=.TRUE."
    ELSE
        WRITE "a message for backup cause by LBKCYL=.TRUE."
    ENDIF
    . . . . .
    CALL POST
    GO TO 20
32  CONTINUE
C
C   TIME STEP SUCCESSFULLY COMPLETED
C
    OITNO=IT
    STIME=STIME+DELT
    ETIME=STIME
    NSTEP=NSTEP+1
    . . . . .
    IF(steady-state convergence is satisfied) GO TO 50
    . . . . .
    CALL PSTEPQ
    GO TO 10
    . . . . .
50  CONTINUE
    . . . . .

```

B.4 Subroutine TRANS logic effected by MINDT and NOBKUP is shown in bold type.

```

SUBROUTINE TRANS
    . . . . .
    COMMON/BKPOST/ BKPALL,BKPALU,BKPSTA,
* BKPSTP,BKPSTT

```

```

COMMON/BKPOST/ IBKPST,JBKPST,LBKPST,LBKCYL,
LOGICAL LBKPST,LBKCYL
. . . . .
DIMENSION NLIM(9),NLIM2(6)
COMMON/DLIM/ DELAMX,DELCMX,DELDXMX,
* DELEMX,DELPXMX,DELRMX,DELVXMX,DELXMX,
* DPRMC ,DTBKUP,DTLMC ,DTRMC ,DTSXC ,
* DTVXC ,FPMX ,FXMX ,QXMX ,SVMX,
* SVMXT3,VMERMX,VRMX
COMMON/DIM/ MAXIT ,MAXITB,MAXITC,
* MINDT ,NLIM ,NLIM2 ,NOBKUP
. . . . .
10 CONTINUE
. . . . .
CALL TIMCHK(IFLAG)
. . . . .
20 CONTINUE
. . . . .
CALL TIMSTP(IENDP,IOFAIL,NMFAIL)
DIO=ODELT
IF(IENDP.NE.1) GO TO 22
. . . . .
"End of calculation when IENDP=1 from TIMSTP" GO TO 60
22 CONTINUE
. . . . .
CALL PREP
. . . . .
30 CALL HOUT(SITMAX,IOFAIL,NMFAIL)
. . . . .
IF(IOFAIL.NE.0) GO TO 20
. . . . .
LBKPST=.FALSE.
LBKCYL=.FALSE.
. . . . .
CALL POST
IF((.NOT.LBKPST.AND..NOT.LBKCYL).OR.(NOBKUP.EQ.1).OR.
1 ((MINDT.EQ.1).AND.(DELT.LE.DTMIN))) GO TO 32 "No backup
IOFAIL=1 from POST"
NMFAIL=NMFAIL+1
OTINO=-100
. . . . .
IF(.NOT.LBKCYL) THEN
WRITE "a message for backup caused by LBKPST=.TRUE."
ELSE
WRITE "a message for backup cause by LBKCYL=.TRUE."
ENDIF
. . . . .
CALL POST
GO TO 20
32 CONTINUE
C
C TIME STEP SUCCESSFULLY COMPLETED
C
OITNO=IT
NSTEP=NSTEP+1
TIMET=TIMET+DELT
ETIME=TIMET
. . . . .

```

```

        IF(ISSCVT.EQ.0) GO TO 50  "Evaluate no steady-state convergence criteria"

        "If steady-state convergence criteria is satisfied" GO TO 60
50    CONTINUE
        . . . . .
        CALL PSTEPQ
        GO TO 10
        . . . . .
60    CONTINUE
        . . . . .

```

B.5 Recommended backup change in subroutine HOUT.

Subroutine HOUT needs to be programmed to implement an efficient backup exit when LBKPST=.TRUE. is set in POST3D and to not evaluate the LBKCYL test when NHTSTR.EQ.0. The following coding in subroutine HOUT

```

700  CONTINUE
      IF(NMVSSL.EQ.0) GO TO 1000
      . . . . .
      CALL POST3D
1000  CONTINUE
      IF(NHTSTR.GT.0) CALL HTSTR3
      IF(LBKCYL.AND.(NOBKUP.EQ.0).AND.
1      ((MINDT.EQ.0).OR.(DELT.GT.DTMIN))) GO TO 1500
      . . . . .
1500  CONTINUE
      RETURN
      END

```

needs to be changed to

```

700  CONTINUE
      IF(NMVSSL.EQ.0) GO TO 1000
      . . . . .
      CALL POST3D
      IF(LBKPST.AND.(NOBKUP.EQ.0).AND.
1      ((MINDT.EQ.0).OR.(DELT.GT.DTMIN))) GO TO 1500
1000  CONTINUE
      IF(NHTSTR.GT.0) THEN
        CALL HTSTR3
        IF(LBKCYL.AND.(NOBKUP.EQ.0).AND.
1        ((MINDT.EQ.0).OR.(DELT.GT.DTMIN))) GO TO 1500
      ENDIF
      . . . . .
1500  CONTINUE
      RETURN
      END

```

This change should have no effect on the TRAC-P solution other than not having to evaluate the remainder of subroutine HOUT when LBKPST=.TRUE. is set in subroutine POST3D.

Appendix C

W4LOOP, W4LOOPR, ZIONPWR, and TFPIPE2 Test Problem Results

W4LP1IN (W4LOOP Reference Case)

castor:/export/castor1/rgs/trac> cp w4loop w4lp1in

castor:/export/castor1/rgs/trac> cp w4lp1in tracin

Terminal Output from Test Problem W4LP1

castor:/export/castor1/rgs/trac> trac

.....

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
100	74.024827	2.000000	1		86.9655	37.2461	1	14 5
110	94.024827	2.000000	1		86.9464	37.2282	1	14 5
120	114.024827	2.000000	1		86.9489	37.2266	1	14 5
130	134.024827	2.000000	2		86.9634	37.2319	1	14 5
140	154.024827	2.000000	1		86.9765	37.2369	1	14 5
150	174.024827	2.000000	1		86.9832	37.2387	1	14 4
160	194.024827	2.000000	1		86.9849	37.2381	1	14 4

steady state converged at problem time 204.024827 s after 165 time steps

165 0.000000 2.000000 1

generalized steady-state convergence-test results

problem time is 0.000000 s and time-step size is 2.000000 s
time-step number is 165 and number of outer iterations is 1

parameters tested for convergence	max.fr.change per second over last time step	component number	cell number
pressure	0.000000	10	2
liquid velocity	-0.000041	10	3
gas velocity	-0.000027	27	4
void fraction	0.000007	27	3
liquid temperature	0.000008	10	1
gas temperature	0.000000	28	3
ncd-gas pressure	0.000000	21	1

constrained steady-state calculation parameters

component and number	minimum value	adjusted parameter	maximum value	monitored parameter	desired value
pump 4	0.00000E+00	1.13491E+03	1.90986E+03	3.37458E+07	3.37455E+07
	rpm	rpm	rpm	lbm/hr	lbm/hr
pump 13	0.00000E+00	1.13952E+03	1.90986E+03	1.01237E+08	1.01237E+08
	rpm	rpm	rpm	lbm/hr	lbm/hr
fill 8	0.00000E+00	3.08422E+06	7.93664E+07	3.08422E+06	3.08422E+06
	lbm/hr	lbm/hr	lbm/hr	lbm/hr	lbm/hr
fill 23	0.00000E+00	9.24866E+06	2.38099E+08	9.24866E+06	9.24866E+06

	lbm/hr	lbm/hr	lbm/hr	lbm/hr	lbm/hr
htstr 126	8.00000E-01	1.11070E+00	1.25000E+00	5.30347E+02	5.30330E+02
	-	-	-	f	f
htstr 127	8.00000E-01	1.11070E+00	1.25000E+00	5.30347E+02	5.30330E+02
	-	-	-	f	f
htstr 128	8.00000E-01	1.11036E+00	1.25000E+00	5.30347E+02	5.30330E+02
	-	-	-	f	f
htstr 129	8.00000E-01	1.11036E+00	1.25000E+00	5.30347E+02	5.30330E+02
	-	-	-	f	f

restart dump generated with time of 0.000000 s after 165 time steps

steady-state solution dumped with time of 0.000000 s after 165 time steps

end of problem

computative timing statistics

cpu time is s

W4LP1OUT (TRCOUT File Results from Test Problem W4LP1 for Later Comparison with W4LP2OUT)

castor:/export/castor1/rgs/trac> mv trcout w4lp1out

W4LP2IN (W4LOOP with Namelist Variable IDTPC = 1 Input and the At Parameter Constants Input as 0 or 0.0000e+00)

castor:/export/castor1/rgs/trac> cp w4loop w4lp2in

castor:/export/castor1/rgs/trac> tedi w4lp2in

w4lp2in 1982 Lines

*t72,7

72 *****

73 * namelist data *

74 *****

75 *

76 &inopts

77 cpuflg=1, iadded=10, idiag=4, inlab=3, iogrf=1, iolab=1,

78 ioout=1, nhtstr=15, noair=0, nsdl=0, nsdu=5, nspl=0, nsdu=5

79 &end

*rp77/inlab/idtpc=1, inlab

77 cpuflg=1, iadded=10, idiag=4, idtpc=1, inlab=3, iogrf=1, iolab=1,

tp/ntsv

89 * ntsv ntc b ntc f ntrp ntc p

*t90,2

90 4 0 0 2 1

91 *

92 *****

*a190

&* maxitb maxitc maxit mindt nobkup

& 0 0 0 0 0

&* ddi vmermx vrmx fxmax fxmax

& 0.0000e+00 0.0000e+00 0.0000e+00 0.0000e+00 0.0000e+00

&* csfld csf3dh cnfac1 cnfach fpmax

```

&      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00
&*      xdau      xdal      xoau      xoal
&      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00
&*      dtlmc      dtvmc      dprmc      dtsmc      dtrmc
&      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00
&
91 *      maxitb      maxitc      maxit      mindt      nobkup
92      0      0      0      0      0
93 *      ddi      vmrmx      vmrmx      fxmax      fxmax
94      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00
95 *      csfld      csf3dh      cnfac1      cnfach      fpmax
96      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00
97 *      xdau      xdal      xoau      xoal
98      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00
99 *      dtlmc      dtvmc      dprmc      dtsmc      dtrmc
100     0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00
*t85,105
85 *      epso      epss
86      1.0000e-03      1.0000e-04
87 *      oitmax      sitmax      isolut      ncontr      nccfl
88      10      10      0      8      0
89 *      ntsv      ntcb      ntcf      ntrp      ntcp
90      4      0      0      2      1
91 *      maxitb      maxitc      maxit      mindt      nobkup
92      0      0      0      0      0
93 *      ddi      vmrmx      vmrmx      fxmax      fxmax
94      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00
95 *      csfld      csf3dh      cnfac1      cnfach      fpmax
96      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00
97 *      xdau      xdal      xoau      xoal
98      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00
99 *      dtlmc      dtvmc      dprmc      dtsmc      dtrmc
100     0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00
101 *
102 *****
103 * component-number data *
104 *****
105 *
*end

```

w4lp2in 1992 Lines

castor:/export/castor1/rgs/trac> cp w4lp2in tracin

Terminal Output from Test Problem W4LP2

castor:/export/castor1/rgs/trac> trac

.....

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
100	74.024827	2.000000	1		86.9655	37.2461	1 14	5
110	94.024827	2.000000	1		86.9464	37.2282	1 14	5
120	114.024827	2.000000	1		86.9489	37.2266	1 14	5
130	134.024827	2.000000	2		86.9634	37.2319	1 14	5
140	154.024827	2.000000	1		86.9765	37.2369	1 14	5
150	174.024827	2.000000	1		86.9832	37.2387	1 14	4

160 194.024827 2.000000 1 86.9849 37.2381 1 14 4

steady state converged at problem time 204.024827 s after 165 time steps

165 0.000000 2.000000 1

generalized steady-state convergence-test results

problem time is 0.000000 s and time-step size is 2.000000 s
time-step number is 165 and number of outer iterations is 1

parameters tested for convergence	max.fr.change per second over last time step	component number	cell number
pressure	0.000000	10	2
liquid velocity	-0.000041	10	3
gas velocity	-0.000027	27	4
void fraction	0.000007	27	3
liquid temperature	0.000008	10	1
gas temperature	0.000000	28	3
ncd-gas pressure	0.000000	21	1

constrained steady-state calculation parameters

component and number	minimum value	adjusted parameter	maximum value	monitored parameter	desired value
pump 4	0.00000E+00	1.13491E+03	1.90986E+03	3.37458E+07	3.37455E+07
	rpm	rpm	rpm	lbm/hr	lbm/hr
pump 13	0.00000E+00	1.13952E+03	1.90986E+03	1.01237E+08	1.01237E+08
	rpm	rpm	rpm	lbm/hr	lbm/hr
fill 8	0.00000E+00	3.08422E+06	7.93664E+07	3.08422E+06	3.08422E+06
	lbm/hr	lbm/hr	lbm/hr	lbm/hr	lbm/hr
fill 23	0.00000E+00	9.24866E+06	2.38099E+08	9.24866E+06	9.24866E+06
	lbm/hr	lbm/hr	lbm/hr	lbm/hr	lbm/hr
htstr 126	8.00000E-01	1.11070E+00	1.25000E+00	5.30347E+02	5.30330E+02
	-	-	-	f	f
htstr 127	8.00000E-01	1.11070E+00	1.25000E+00	5.30347E+02	5.30330E+02
	-	-	-	f	f
htstr 128	8.00000E-01	1.11036E+00	1.25000E+00	5.30347E+02	5.30330E+02
	-	-	-	f	f
htstr 129	8.00000E-01	1.11036E+00	1.25000E+00	5.30347E+02	5.30330E+02
	-	-	-	f	f

restart dump generated with time of 0.000000 s after 165 time steps

steady-state solution dumped with time of 0.000000 s after 165 time steps

end of problem

computative timing statistics
cpu time is s

W4LP2OUT (TRCOUT Results from Test Problem W4LP2
for Later Comparison with W4LP3OUT)

castor:/export/castor1/rgs/trac> mv trcout w4lp2out


```
castor:/export/castor1/rgs/trac> diff w4lp1out w4lp2out
```

```
239c239
<      idiag =          4,      idiags =          0,      idtpc =          0,      ieeeeg =          0,      ielv =          0
---
>      idiag =          4,      idiags =          0,      idtpc =          1,      ieeeeg =          0,      ielv =          0
305a306,335
>      maxitb =          0,      maxitc =          0,      maxit =          0,      mindt =          0,      nobkup =          0
>      maxitb <= 0 has been reset to maxitb = 4
>      maxitc <= 0 has been reset to maxitc = 5
>      ddi = 0.0000E+00,      vmermx = 0.0000E+00,      vrmx = 0.0000E+00,      fxmax = 0.0000E+00,      gxmax = 0.0000E+00
>
>      ddi <= 0.0 has been reset to      ddi = 1.0500E+00 -
>      vmermx <= 0.0 has been reset to vmermx = 1.0000E+04 -
>      vrmx <= 0.0 has been reset to      vrmx = 1.0000E-01 -
>      fxmax <= 0.0 has been reset to      fxmax = 4.0000E-01 -
>      gxmax <= 0.0 has been reset to      gxmax = 5.0000E-02 -
>      csfld = 0.0000E+00,      csf3dh = 0.0000E+00,      cnfacl = 0.0000E+00,      cnfach = 0.0000E+00,      fpmax = 0.0000E+00
>
>      csfld <= 0.0 has been reset to      csfld = 1.0000E+03 -
>      csf3dh <= 0.0 has been reset to      csf3dh = 1.0000E+03 -
>      cnfacl <= 0.0 has been reset to      cnfacl = 7.5000E-01 -
>      cnfach <= 0.0 has been reset to      cnfach = 8.0000E-01 -
>      fpmax <= 0.0 has been reset to      fpmax = 1.0000E-01 -
>      xdau = 0.0000E+00,      xdal = 0.0000E+00,      xoau = 0.0000E+00,      xosal = 0.0000E+00
>
>      xdau <= 0.0 has been reset to      xdau = 5.0000E-02 -
>      xdal <= 0.0 has been reset to      xdal = 2.0000E-01 -
>      xoau <= 0.0 has been reset to      xoau = 1.0000E+00 -
>      xosal <= 0.0 has been reset to      xosal = 1.0000E+00 -
>      dtlmc = 0.0000E+00,      dtvmc = 0.0000E+00,      dprmc = 0.0000E+00,      dtsmc = 0.0000E+00,      dtrmc = 0.0000E+00
>
>      dtlmc <= 0.0 has been reset to      dtlmc = 3.6000E+01 f
>      dtvmc <= 0.0 has been reset to      dtvmc = 4.5000E+01 f
>      dprmc <= 0.0 has been reset to      dprmc = 5.0000E-01 -
>      dtsmc <= 0.0 has been reset to      dtsmc = 3.6000E+01 f
>      dtrmc <= 0.0 has been reset to      dtrmc = 3.6000E+01 f
```

```
castor:/export/castor1/rgs/trac>
```

Note: Inputting 0 or 0.00000e+00 for the Δt parameter constants results in TRAC-P resetting them to their default values.

W4LP3IN (W4LOOP with Namelist Variable IDTPC = 1 Input and the Δt Parameter Constants Input as blank fields after an initial single 0 or 0.0)

```
castor:/export/castor1/rgs/trac> cp w4lp2in w4lp3in
```

```
castor:/export/castor1/rgs/trac> tedi w4lp3in
w4lp3in 1992 Lines
```

```
*t72,7
72 *****
73 * namelist data *
74 *****
75 *
76 &inopts
77   cpuflg=1, iadded=10, idiag=4, idtpc=1, inlab=3, iogrf=1, iolab=1,
78   ioout=1, nhtstr=15, noair=0, nsdl=0, nsdu=5, nspl=0, nspu=5
79 &end
*t89,101
89 *          ntsv          ntcdb          ntcfb          ntrp          ntcp
90          4              0              0              2              1
91 *          maxitb          maxitc          maxit          mindt          nobkup
92          0              0              0              0              0
93 *          ddi              vmermx          vrmx          fxmax          fxmax
94          0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00
95 *          csfld          csf3dh          cnfacl          cnfach          fpmax
96          0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00
97 *          xdau          xdal          xoau          xosal
98          0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00
```

```

99 *          dtlmc          dtvmc          dprmc          dtsmc          dtrmc
100 0.0000e+00 0.0000e+00 0.0000e+00 0.0000e+00 0.0000e+00
101 *
*r192
&          0
&
- 92          0          0          0          0          0
92          0
*r194
&          0.0
&
- 94 0.0000e+00 0.0000e+00 0.0000e+00 0.0000e+00 0.0000e+00
94          0.0
*r196
&          0.0
&
- 96 0.0000e+00 0.0000e+00 0.0000e+00 0.0000e+00 0.0000e+00
96          0.0
*r198
&          0.0
&
- 98 0.0000e+00 0.0000e+00 0.0000e+00 0.0000e+00 0.0000e+00
98          0.0
*r1100
& 0.0000e+00
&
-100 0.0000e+00 0.0000e+00 0.0000e+00 0.0000e+00 0.0000e+00
100 0.0000e+00
*t89,101
89 *          ntsv          ntc b          ntc f          ntrp          ntcp
90          4          0          0          2          1
91 *          maxitb          maxitc          maxit          mindt          nobkup
92          0
93 *          ddi          vmrmx          vmrmx          fxmax          fxmax
94          0.0
95 *          csfld          csf3dh          cnfac1          cnfach          fpmax
96          0.0
97 *          xdau          xdal          xoau          xoal
98          0.0
99 *          dtlmc          dtvmc          dprmc          dtsmc          dtrmc
100 0.0000e+00
101 *
*end
w4lp3in 1992 Lines

```

Note: Inputing a blank line rather than a line with a 0 or 0.0 is treated line a comment line rather than a data record.

```
castor:/export/castor1/rgs/trac> cp w4lp3in tracin
```

Terminal Output from Test Problem W4LP3

```
castor:/export/castor1/rgs/trac> trac
```

```
.....
```

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp	cell
100	74.024827	2.000000	1		86.9655	37.2461	1	14	5
110	94.024827	2.000000	1		86.9464	37.2282	1	14	5
120	114.024827	2.000000	1		86.9489	37.2266	1	14	5
130	134.024827	2.000000	2		86.9634	37.2319	1	14	5
140	154.024827	2.000000	1		86.9765	37.2369	1	14	5
150	174.024827	2.000000	1		86.9832	37.2387	1	14	4
160	194.024827	2.000000	1		86.9849	37.2381	1	14	4

steady state converged at problem time 204.024827 s after 165 time steps

165 0.000000 2.000000 1

generalized steady-state convergence-test results

problem time is 0.000000 s and time-step size is 2.000000 s
time-step number is 165 and number of outer iterations is 1

parameters tested for convergence	max.fr.change per second over last time step	component number	cell number
pressure	0.000000	10	2
liquid velocity	-0.000041	10	3
gas velocity	-0.000027	27	4
void fraction	0.000007	27	3
liquid temperature	0.000008	10	1
gas temperature	0.000000	28	3
ncd-gas pressure	0.000000	21	1

constrained steady-state calculation parameters

component and number	minimum value	adjusted parameter	maximum value	monitored parameter	desired value
pump 4	0.00000E+00	1.13491E+03	1.90986E+03	3.37458E+07	3.37455E+07
	rpm	rpm	rpm	lbm/hr	lbm/hr
pump 13	0.00000E+00	1.13952E+03	1.90986E+03	1.01237E+08	1.01237E+08
	rpm	rpm	rpm	lbm/hr	lbm/hr
fill 8	0.00000E+00	3.08422E+06	7.93664E+07	3.08422E+06	3.08422E+06
	lbm/hr	lbm/hr	lbm/hr	lbm/hr	lbm/hr
fill 23	0.00000E+00	9.24866E+06	2.38099E+08	9.24866E+06	9.24866E+06
	lbm/hr	lbm/hr	lbm/hr	lbm/hr	lbm/hr
htstr 126	8.00000E-01	1.11070E+00	1.25000E+00	5.30347E+02	5.30330E+02
	-	-	-	f	f
htstr 127	8.00000E-01	1.11070E+00	1.25000E+00	5.30347E+02	5.30330E+02
	-	-	-	f	f
htstr 128	8.00000E-01	1.11036E+00	1.25000E+00	5.30347E+02	5.30330E+02
	-	-	-	f	f
htstr 129	8.00000E-01	1.11036E+00	1.25000E+00	5.30347E+02	5.30330E+02
	-	-	-	f	f

restart dump generated with time of 0.000000 s after 165 time steps

steady-state solution dumped with time of 0.000000 s after 165 time steps

end of problem

computative timing statistics
cpu time is s

W4LP3OUT (TRCOUT Results from Test Problem W4LP3)

```
castor:/export/castor1/rgs/trac> cp trcout w4lp3out
```

```
castor:/export/castor1/rgs/trac> diff w4lp2out w4lp3out
```

There is no difference between files W4LP2OUT and W4LP3OUT

Note: Inputing one 0 or 0.0 per record for the Δt parameter constants is the same as inputing the appropriate number of 0s or 0.0s per record.

W4LP3INL (INLAB File Results from Test Problem W4LP3)

```
castor:/export/castor1/rgs/trac> mv inlab w4lp3inl
```

```
castor:/export/castor1/rgs/trac> tedi w4lp3inl  
w4lp3inl 2016 Lines
```

```
*tp*/namelist  
21 * namelist data *  
*t20,8  
20 *****  
21 * namelist data *  
22 *****  
23 *  
24 &inopts  
25   cpuflg=1, iadded=10, idiag=4, idtpc=1, inlab=3, iogrf=1, iolab=1,  
26   ioout=1, nhtstr=15, noair=0, nsdl=0, nsdu=5, nspl=0, nspu=5  
27 &end  
28 *  
*tp*/maxit  
39 *          maxitb          maxitc          maxit          mindt          nobkup  
*t35,16  
35 *          oitmax          sitmax          isolut          ncontr          nccfl  
36           10              10              0              8              0  
37 *          ntsv            ntc b            ntc f            ntrp            ntcp  
38           4              0              0              2              1  
39 *          maxitb          maxitc          maxit          mindt          nobkup  
40           0              0              0              0              0  
41 *          ddi            vmermx          vmx          fxmax          gxmax  
42   0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  
43 *          csfld          csf3dh          cnfac1          cnfach          fpmax  
44   0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  
45 *          xda u          xda l          xoa u          xoa l  
46   0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  
47 *          dtlmc          dtvmc          dprmc          dtsmc          dtrmc  
48   0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  
49 *  
50 *****  
51 * component-number data *  
*end
```

```
castor:/export/castor1/rgs/trac> mv trcdmp trcrst
```

W4LPR1IN (W4LOOPR Reference Case)

```
castor:/export/castor1/rgs/trac> cp w4loopr w4lpr1in
```

```
castor:/export/castor1/rgs/trac> cp w4lpr1in tracin
```

Terminal Output from Test Problem W4LPR1

```
castor:/export/castor1/rgs/trac> trac
```

.....

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
10	0.074053	0.003771	2		8.9651	0.1016	1	6 2
20	0.097389	0.001141	2		1.8388	0.0437	1	6 2
30	0.108684	0.001407	2		67.2486	0.0568	1	6 2
40	0.126382	0.002292	2		67.7338	0.0967	1	6 2
50	0.155211	0.003733	2		156.1533	0.1509	1	6 2
60	0.202170	0.006081	2		276.7920	0.2368	1	6 2
70	0.278661	0.009906	2		334.2688	0.3822	1	6 2
80	0.403257	0.016136	2		447.5118	0.6108	1	6 2
90	0.606212	0.026283	2		846.8229	0.9792	1	6 2
100	0.877810	0.026493	2		1013.5059	0.9799	1	6 2
110	1.136038	0.025850	2		1002.7750	0.9348	1	6 2
117	1.316212	0.025726	2					
120	1.392960	0.025614	2		1000.6752	0.9133	1	6 2
130	1.649910	0.025823	2		998.7416	0.9039	1	6 2
140	1.909170	0.026002	2		997.9580	0.8900	1	6 2
150	2.170021	0.026137	3		1000.1465	0.8680	1	6 2
160	2.433681	0.026472	2		997.6797	0.8264	1	6 2
165	2.565866	0.026324	2					

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
170	2.697301	0.026182	2		995.7142	0.7753	1	6 2
180	2.959375	0.026168	2		998.6537	0.7363	1	6 2
190	3.219994	0.025966	2		997.6081	0.6909	1	6 2
200	3.479769	0.025949	2		998.5224	0.6543	1	6 2
210	3.739053	0.025913	2		1001.0128	0.6408	1	6 2
213	3.816714	0.025887	2					
220	3.997667	0.025820	2		998.9645	0.6741	1	6 2
230	4.255754	0.025754	2		998.4940	0.6604	1	6 2
240	4.513512	0.026253	2		1000.6812	0.6559	1	6 2
250	4.771465	0.025141	2		983.5603	0.6452	1	6 2

restart dump generated at problem time 5.021983 s after 260 time steps

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
260	5.021983	0.024976	2					

end of problem

computative timing statistics
cpu time is s

W4LPR1OUT (TRCOUT Results from Test Problem W4LPR1 for Later Comparison with W4LPR2OUT)

castor:/export/castor1/rgs/trac> mv trcout w4lpr1out

W4LPR2IN (W4LOOPR with Namelist Variable IDTPC = 1 Input and the Δt Parameter Constants Input as 0 or 0.0000e+00)

castor:/export/castor1/rgs/trac> cp w4loopr w4lpr2in

castor:/export/castor1/rgs/trac> tedi w4lpr2in

w4lpr2in 137 Lines

tp/namelist

69 * namelist data *

*t68,8

68 *****

69 * namelist data *

70 *****

71 *

72 &inopts

73 cpufg=1, dtstrt=0.01, iadded=10, icdelt=1, idiag=4,

74 inlab=3, iogrf=1, iolab=1, ioout=1, nhtstr=15,

75 noair=0, nsdl=0, nsdu=5, nspl=0, nsps=5

76 &end

*rp73/4,/4, idtpc=1,

73 cpufg=1, dtstrt=0.01, iadded=10, icdelt=1, idiag=4, idtpc=1,

tp/ntsv

86 *	ntsv	ntcb	ntcf	ntrp	ntcp
------	------	------	------	------	------

*t87,2

87	4	0	0	2	1
----	---	---	---	---	---

88 *

89 *****

*al87

&*	maxitb	maxitc	maxit	mindt	nobkup
----	--------	--------	-------	-------	--------

&	0	0	0	0	0
---	---	---	---	---	---

&*	ddi	vmrmx	vrms	fxmax	gxmax
----	-----	-------	------	-------	-------

&	0.0000e+00	0.0000e+00	0.0000e+00	0.0000e+00	0.0000e+00
---	------------	------------	------------	------------	------------

&*	csfld	csf3dh	cnfac1	cnfach	fpmax
----	-------	--------	--------	--------	-------

&	0.0000e+00	0.0000e+00	0.0000e+00	0.0000e+00	0.0
---	------------	------------	------------	------------	-----

&*	xdau	xdal	xoau	xoal	
----	------	------	------	------	--

&	0.0000e+00	0.0000e+00			
---	------------	------------	--	--	--

&*	dtlmc	dtvmc	dprmc	dtsmc	dtrmc
----	-------	-------	-------	-------	-------

&	0.0				
---	-----	--	--	--	--

&.

88 *	maxitb	maxitc	maxit	mindt	nobkup
------	--------	--------	-------	-------	--------

89	0	0	0	0	0
----	---	---	---	---	---

90 *	ddi	vmrmx	vrms	fxmax	gxmax
------	-----	-------	------	-------	-------

91	0.0000e+00	0.0000e+00	0.0000e+00	0.0000e+00	0.0000e+00
----	------------	------------	------------	------------	------------

92 *	csfld	csf3dh	cnfac1	cnfach	fpmax
------	-------	--------	--------	--------	-------

93	0.0000e+00	0.0000e+00	0.0000e+00	0.0000e+00	0.0
----	------------	------------	------------	------------	-----

94 *	xdau	xdal	xoau	xoal	
------	------	------	------	------	--

95	0.0000e+00	0.0000e+00			
----	------------	------------	--	--	--

```

96 *          dtlmc          dtvmc          dprmc          dtsmc          dtrmc
97      0.0
*t86,99
86 *          ntsv          ntcbl          ntcfl          ntrpl          ntcp
87          4              0              0              2              1
88 *          maxitb          maxitc          maxit          mindt          nobkup
89          0              0              0              0              0
90 *          ddi          vmermx          vmx          fxmax          gxmax
91      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00
92 *          csfld          csf3dh          cnfac1          cnfach          fpmax
93      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0
94 *          xdaul          xdal          xoaul          xoal
95      0.0000e+00      0.0000e+00
96 *          dtlmc          dtvmc          dprmc          dtsmc          dtrmc
97      0.0
98 *
99 *****

```

*end

w4lpr2in 147 Lines

castor:/export/castor1/rgs/trac> cp w4lpr2in tracin

Terminal Output from Test Problem W4LPR2

castor:/export/castor1/rgs/trac> trac

.....

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
10	0.074053	0.003771	2		8.9651	0.1016	1	6 2
20	0.097389	0.001141	2		1.8388	0.0437	1	6 2
30	0.108684	0.001407	2		67.2486	0.0568	1	6 2
40	0.126382	0.002292	2		67.7338	0.0967	1	6 2
50	0.155211	0.003733	2		156.1533	0.1509	1	6 2
60	0.202170	0.006081	2		276.7920	0.2368	1	6 2
70	0.278661	0.009906	2		334.2688	0.3822	1	6 2
80	0.403257	0.016136	2		447.5118	0.6108	1	6 2
90	0.606212	0.026283	2		846.8229	0.9792	1	6 2
100	0.877810	0.026493	2		1013.5059	0.9799	1	6 2
110	1.136038	0.025850	2		1002.7750	0.9348	1	6 2
117	1.316212	0.025726	2					
120	1.392960	0.025614	2		1000.6752	0.9133	1	6 2
130	1.649910	0.025823	2		998.7416	0.9039	1	6 2
140	1.909170	0.026002	2		997.9580	0.8900	1	6 2
150	2.170021	0.026137	3		1000.1465	0.8680	1	6 2
160	2.433681	0.026472	2		997.6797	0.8264	1	6 2
165	2.565866	0.026324	2					

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
170	2.697301	0.026182	2		995.7142	0.7753	1	6 2
180	2.959375	0.026168	2		998.6537	0.7363	1	6 2
190	3.219994	0.025966	2		997.6081	0.6909	1	6 2
200	3.479769	0.025949	2		998.5224	0.6543	1	6 2
210	3.739053	0.025913	2		1001.0128	0.6408	1	6 2
213	3.816714	0.025887	2					

220	3.997667	0.025820	2	998.9645	0.6741	1	6	2
230	4.255754	0.025754	2	998.4940	0.6604	1	6	2
240	4.513512	0.026253	2	1000.6812	0.6559	1	6	2
250	4.771465	0.025141	2	983.5603	0.6452	1	6	2

restart dump generated at problem time 5.021983 s after 260 time steps

time-step number	problem time (s)	time-step size (s)	outer-it. number	it. cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
260	5.021983	0.024976	2					

end of problem

computative timing statistics
cpu time is s

W4LPR2OUT (TRCOUT Results from Test Problem W4LPR2 for Later Comparison with W4LPR3OUT, W4LPR4OUT, and W4LPR5OUT)

castor:/export/castor1/rgs/trac> mv trcout w4lpr2out

castor:/export/castor1/rgs/trac> diff w4lpr1out w4lpr2out

```

235c235
<      iddiag =          4,      idiags =          0,      idtpe =          0,      ieeeeg =          0,      ielv =          0
---
>      iddiag =          4,      idiags =          0,      idtpe =          1,      ieeeeg =          0,      ielv =          0
301a302,331
>      maxitb =          0,      maxitc =          0,      maxit =          0,      mindt =          0,      nobkup =          0
>      maxitb <= 0 has been reset to maxitb = 4
>      maxitc <= 0 has been reset to maxitc = 5
>      ddi = 0.0000E+00,      vmermx = 0.0000E+00,      vmrx = 0.0000E+00,      fxmax = 0.0000E+00,      gxmax = 0.0000E+00
>
>      ddi <= 0.0 has been reset to ddi = 1.0500E+00 -
>      vmermx <= 0.0 has been reset to vmermx = 1.0000E+04 -
>      vmrx <= 0.0 has been reset to vmrx = 1.0000E-01 -
>      fxmax <= 0.0 has been reset to fxmax = 4.0000E-01 -
>      gxmax <= 0.0 has been reset to gxmax = 5.0000E-02 -
>      csfld = 0.0000E+00,      csf3dh = 0.0000E+00,      cnfac1 = 0.0000E+00,      cnfach = 0.0000E+00,      fpmax = 0.0000E+00
>
>      csfld <= 0.0 has been reset to csfld = 1.0000E+03 -
>      csf3dh <= 0.0 has been reset to csf3dh = 1.0000E+03 -
>      cnfac1 <= 0.0 has been reset to cnfac1 = 7.5000E-01 -
>      cnfach <= 0.0 has been reset to cnfach = 8.0000E-01 -
>      fpmax <= 0.0 has been reset to fpmax = 1.0000E-01 -
>      xdau = 0.0000E+00,      xdal = 0.0000E+00,      xoau = 0.0000E+00,      xcal = 0.0000E+00
>
>      xdau <= 0.0 has been reset to xdau = 5.0000E-02 -
>      xdal <= 0.0 has been reset to xdal = 2.0000E-01 -
>      xoau <= 0.0 has been reset to xoau = 1.0000E+00 -
>      xcal <= 0.0 has been reset to xcal = 1.0000E+00 -
>      dtlmc = 0.0000E+00,      dtvmc = 0.0000E+00,      dprmc = 0.0000E+00,      dtsmc = 0.0000E+00,      dtrmc = 0.0000E+00
>
>      dtlmc <= 0.0 has been reset to dtlmc = 3.6000E+01 f
>      dtvmc <= 0.0 has been reset to dtvmc = 4.5000E+01 f
>      dprmc <= 0.0 has been reset to dprmc = 5.0000E-01 -
>      dtsmc <= 0.0 has been reset to dtsmc = 3.6000E+01 f
>      dtrmc <= 0.0 has been reset to dtrmc = 3.6000E+01 f

```

W4LPR2INL (INLAB Results from Test Problem W4LPR2)

castor:/export/castor1/rgs/trac> mv inlab w4lpr2inl

castor:/export/castor1/rgs/trac> tedi w4lpr2inl

w4lpr2inl 91 Lines

tp/namelist

17 * namelist data *

*t16,8


```

92 *      csfld      csf3dh      cnfac1      cnfach      fpmax
*end
w4lpr3in 147 Lines

```

```

castor:/export/castor1/rgs/trac> cp w4lpr3in tracin

```

Terminal Output from Test Problem W4LPR3

```

castor:/export/castor1/rgs/trac> trac

```

.....

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
10	0.074053	0.003771	2		8.9651	0.1016	1	6 2
20	0.097389	0.001141	2		1.8388	0.0437	1	6 2
30	0.108684	0.001407	2		67.2486	0.0568	1	6 2
40	0.126382	0.002292	2		67.7338	0.0967	1	6 2
50	0.155211	0.003733	2		156.1533	0.1509	1	6 2
60	0.202170	0.006081	2		276.7920	0.2368	1	6 2
70	0.278661	0.009906	2		334.2688	0.3822	1	6 2
80	0.403257	0.016136	2		447.5118	0.6108	1	6 2
90	0.606212	0.026283	2		846.8229	0.9792	1	6 2
100	0.877810	0.026493	2		1013.5059	0.9799	1	6 2
110	1.136038	0.025850	2		1002.7750	0.9348	1	6 2
117	1.316212	0.025726	2					
120	1.392960	0.025614	2		1000.6752	0.9133	1	6 2
130	1.649910	0.025823	2		998.7416	0.9039	1	6 2
140	1.909170	0.026002	2		997.9580	0.8900	1	6 2
150	2.170021	0.026137	3		1000.1465	0.8680	1	6 2
160	2.433681	0.026472	2		997.6797	0.8264	1	6 2
165	2.565866	0.026324	2					

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
170	2.697301	0.026182	2		995.7142	0.7753	1	6 2
180	2.959375	0.026168	2		998.6537	0.7363	1	6 2
190	3.219994	0.025966	2		997.6081	0.6909	1	6 2
200	3.479769	0.025949	2		998.5224	0.6543	1	6 2
210	3.739053	0.025913	2		1001.0128	0.6408	1	6 2
213	3.816714	0.025887	2					
220	3.997667	0.025820	2		998.9645	0.6741	1	6 2
230	4.255754	0.025754	2		998.4940	0.6604	1	6 2
240	4.513512	0.026253	2		1000.6812	0.6559	1	6 2
250	4.771465	0.025141	2		983.5603	0.6452	1	6 2

restart dump generated at problem time 5.021983 s after 260 time steps

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
260	5.021983	0.024976	2					

end of problem

computative timing statistics
cpu time is s

W4LPR3OUT (TRCOUT Results from Test Problem W4LPR3)

```
castor:/export/castor1/rgs/trac> mv trcout w4lpr3out
```

```
castor:/export/castor1/rgs/trac> diff w4lpr2out w4lpr3out
```

```
302,303c302
< maxitb = 0, maxitc = 0, maxit = 0, mindt = 0, nobkup = 0
< maxitb <= 0 has been reset to maxitb = 4
---
> maxitb = 4, maxitc = 0, maxit = 1, mindt = 0, nobkup = 0
```

Note: Outer-iteration convergence was satisfied in OITMAX = 10 iterations or less such that MAXIT = 1 did not effect the calculative behavior of the transient.

W4LPR4IN (W4LOOPR with Namelist Variable IDTPC = 1 Input, the Δt Parameter Constants Input as 0 or 0.0000e+00, MAXITC Input as 5 {default}, and NOBKUP Input as 1)

```
castor:/export/castor1/rgs/trac> cp w4lpr2in w4lpr4in
```

```
castor:/export/castor1/rgs/trac> tedi w4lpr4in
```

```
w4lpr4in 147 Lines
```

```
*t88,89
88 *      maxitb      maxitc      maxit      mindt      nobkup
89      0              0          0          0          0
*rl89
&          0          5          0          0          1
&.
- 89      0          0          0          0          0
89      0          5          0          0          1
*t86,6
86 *      ntsv      ntc b      ntc f      ntrp      ntc p
87      4          0          0          2          1
88 *      maxitb      maxitc      maxit      mindt      nobkup
89      0          5          0          0          1
90 *      ddi      vmrmx      vrmx      fxmax      gxmax
91      0.0000e+00  0.0000e+00  0.0000e+00  0.0000e+00  0.0000e+00
92 *      csf1d      csf3dh      cnfac1      cnfach      fpmax
*end
w4lpr4in 147 Lines
```

```
castor:/export/castor1/rgs/trac> cp w4lpr4in tracin
```

Terminal Output from Test Problem W4LPR4

```
castor:/export/castor1/rgs/trac> trac
```

.....

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
10	0.074053	0.003771	2		8.9651	0.1016	1	6 2
20	0.097389	0.001141	2		1.8388	0.0437	1	6 2
30	0.108684	0.001407	2		67.2486	0.0568	1	6 2

40	0.126382	0.002292	2	67.7338	0.0967	1	6	2
50	0.155211	0.003733	2	156.1533	0.1509	1	6	2
60	0.202170	0.006081	2	276.7920	0.2368	1	6	2
70	0.278661	0.009906	2	334.2688	0.3822	1	6	2
80	0.403257	0.016136	2	447.5118	0.6108	1	6	2
90	0.606212	0.026283	2	846.8229	0.9792	1	6	2
100	0.877810	0.026493	2	1013.5059	0.9799	1	6	2
110	1.136038	0.025850	2	1002.7750	0.9348	1	6	2
117	1.316212	0.025726	2					
120	1.392960	0.025614	2	1000.6752	0.9133	1	6	2
130	1.649910	0.025823	2	998.7416	0.9039	1	6	2
140	1.909170	0.026002	2	997.9580	0.8900	1	6	2
150	2.170021	0.026137	3	1000.1465	0.8680	1	6	2
160	2.433681	0.026472	2	997.6797	0.8264	1	6	2
165	2.565866	0.026324	2					

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
170	2.697301	0.026182	2		995.7142	0.7753	1	6 2
180	2.959375	0.026168	2		998.6537	0.7363	1	6 2
190	3.219994	0.025966	2		997.6081	0.6909	1	6 2
200	3.479769	0.025949	2		998.5224	0.6543	1	6 2
210	3.739053	0.025913	2		1001.0128	0.6408	1	6 2
213	3.816714	0.025887	2					
220	3.997667	0.025820	2		998.9645	0.6741	1	6 2
230	4.255754	0.025754	2		998.4940	0.6604	1	6 2
240	4.513512	0.026253	2		1000.6812	0.6559	1	6 2
250	4.771465	0.025141	2		983.5603	0.6452	1	6 2

restart dump generated at problem time 5.021983 s after 260 time steps

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
260	5.021983	0.024976	2					

end of problem

computative timing statistics
cpu time is s

W4LPR4OUT (TRCOUT Results from Test Problem W4LPR4)

castor:/export/castor1/rgs/trac> mv trcout w4lpr4out

castor:/export/castor1/rgs/trac> diff w4lpr2out w4lpr4out

```

302c302
< maxitb = 0, maxitc = 0, maxit = 0, mindt = 0, nobkup = 0
---
> maxitb = 0, maxitc = 5, maxit = 0, mindt = 0, nobkup = 1
304d303
< maxitc <= 0 has been reset to maxitc = 5

```

Note: No backup evaluations were performed such that NOBKUP = 1 had no calculative effect of the transient.

W4LPR5IN (W4LOOPR with Namelist Variable IDTPC = 1 Input,
the Δt Parameter Constants Input as 0 or 0.0000e+00,
DTVMC Input as 25.0 {default}, and DPRMC Input as 0.01
{default is 0.5}, and DTS MC Input as 20.0 {default})

```
castor:/export/castor1/rgs/trac> cp w4lpr2in w4lpr5in
```

```
castor:/export/castor1/rgs/trac> tedi w4lpr5in
```

```
w4lpr5in 147 Lines
```

```
*tp*/dprmc
```

```
96 *          dtlmc          dtvmc          dprmc          dtsmc          dtrmc
```

```
*t97
```

```
97          0.0
```

```
*r197
```

```
&          0.0000e+00          2.5000e+01          1.0000e-02          2.0000e+01          0.0000e+00
```

```
&.
```

```
- 97          0.0
```

```
97          0.0000e+00          2.5000e+01          1.0000e-02          2.0000e+01          0.0000e+00
```

```
*t94,6
```

```
94 *          xdau          xdal          xoau          xoal
```

```
95          0.0000e+00          0.0000e+00
```

```
96 *          dtlmc          dtvmc          dprmc          dtsmc          dtrmc
```

```
97          0.0000e+00          2.5000e+01          1.0000e-02          2.0000e+01          0.0000e+00
```

```
98 *
```

```
99 *****
```

```
100 * component-number data *
```

```
*end
```

```
w4lpr5in 147 Lines
```

```
castor:/export/castor1/rgs/trac> cp w4lpr5in tracin
```

Terminal Output from Test Problem W4LPR5

```
castor:/export/castor1/rgs/trac> trac
```

```
.....
```

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
10	0.036270	0.001000	2		1.2626	0.0207	1 6 2	
20	0.046270	0.001000	2		1.3805	0.0233	1 6 2	
30	0.056270	0.001000	2		1.4693	0.0257	1 6 2	
40	0.066270	0.001000	2		1.5241	0.0324	1 6 2	
50	0.076270	0.001000	2		1.5509	0.0374	1 6 2	
60	0.086270	0.001000	2		1.5613	0.0402	1 6 2	
70	0.096270	0.001000	2		1.5286	0.0410	1 6 2	
80	0.106270	0.001000	3		41.2820	0.0410	1 6 2	
90	0.116270	0.001000	2		26.2679	0.0423	1 6 2	
100	0.126270	0.001000	2		34.9555	0.0417	1 6 2	
110	0.136270	0.001000	2		36.6936	0.0409	1 6 2	
120	0.146270	0.001000	2		37.9099	0.0402	1 6 2	
130	0.156270	0.001000	2		36.1397	0.0397	1 6 2	
140	0.166270	0.001000	2		34.7016	0.0394	1 6 2	
150	0.176722	0.001256	2		42.0474	0.0494	1 6 2	
160	0.188204	0.001000	2		30.6489	0.0394	1 6 2	

170	0.198204	0.001000	2	27.4869	0.0393	1	6	2
180	0.208204	0.001000	2	24.2133	0.0389	1	6	2
190	0.218514	0.001216	2	27.8090	0.0471	1	6	2
200	0.228754	0.001000	2	22.0051	0.0386	1	6	2
210	0.238754	0.001000	2	21.4603	0.0386	1	6	2
220	0.248754	0.001000	2	20.5943	0.0386	1	6	2
230	0.260781	0.001222	2	25.0612	0.0472	1	6	2
240	0.271006	0.001000	2	18.4058	0.0386	1	6	2
250	0.281006	0.001000	2	17.0763	0.0385	1	6	2
260	0.291230	0.001184	2	18.8818	0.0454	1	6	2
270	0.303414	0.001000	2	14.4771	0.0383	1	6	2
280	0.313414	0.001000	2	13.4873	0.0384	1	6	2
290	0.323724	0.001216	2	16.0261	0.0468	1	6	2
300	0.339012	0.001980	2	28.2595	0.0769	1	6	2
310	0.356190	0.001867	2	24.7107	0.0728	1	6	2
320	0.379667	0.003040	2	43.4355	0.1176	1	6	2
330	0.417909	0.004952	2	78.2312	0.1892	1	6	2
340	0.480201	0.008067	2	141.2259	0.3025	1	6	2
350	0.581667	0.013140	2	304.2663	0.4889	1	6	2
360	0.746946	0.021404	2	755.8734	0.8012	1	6	2
370	0.991933	0.025766	3	994.0768	0.9436	1	6	2
380	1.251040	0.025789	1	997.5804	0.9247	1	6	2
382	1.302665	0.025836	1					
390	1.507945	0.025722	2	998.8765	0.9085	1	6	2
400	1.766260	0.025966	2	999.1932	0.8982	1	6	2
410	2.026431	0.026105	2	998.5066	0.8802	1	6	2
420	2.250643	0.015155	3	408.4799	0.4887	1	6	2
430	2.441260	0.024686	2	888.0930	0.7577	1	6	2
434	2.544605	0.026522	2					

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
440	2.702488	0.026191	2		993.2084	0.7610	1	6 2
450	2.964889	0.026221	2		999.2548	0.7208	1	6 2
460	3.226005	0.025950	2		995.0836	0.6733	1	6 2
470	3.485904	0.025987	2		999.3402	0.6391	1	6 2
480	3.745375	0.025869	2		997.6384	0.6480	1	6 2
482	3.797145	0.025901	2					
490	4.004082	0.025835	2		999.0395	0.6726	1	6 2
500	4.262373	0.025774	2		998.3732	0.6475	1	6 2
510	4.521581	0.026070	2		998.2282	0.6519	1	6 2
520	4.778321	0.025097	3		982.1898	0.6456	1	6 2

restart dump generated at problem time 5.003812 s after 529 time steps

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
529	5.003812	0.024741	2					

end of problem

computative timing statistics
cpu time is s

W4LPR5OUT (TRCOUT Results from Test Problem W4LPR5 for Later Comparison with W4LPR6OUT)

```

castor:/export/castor1/rgs/trac> mv trcout w4lpr5out
yes
castor:/export/castor1/rgs/trac> tedi w4lpr2out
w4lpr2out 37780 Lines
*o/w4lpr5out
w4lpr5out 37807 Lines
*end

```

```

castor:/export/castor1/rgs/trac> tedi w4lpr2out
w4lpr2out 37780 Lines

```

```

*tp1,1000/dprmc
325      dtlmc = 0.0000E+00,      dtvmc = 0.0000E+00,      dprmc = 0.0000E+00,      dtsmc = 0.0000E+00,      dtrmc = 0.0000E+00
329      dprmc <= 0.0 has been reset to dprmc = 5.0000E-01 -
*t326,6
326      f                                f                                f                                f
327      dtlmc <= 0.0 has been reset to dtlmc = 3.6000E+01 f
328      dtvmc <= 0.0 has been reset to dtvmc = 4.5000E+01 f
329      dprmc <= 0.0 has been reset to dprmc = 5.0000E-01 -
330      dtsmc <= 0.0 has been reset to dtsmc = 3.6000E+01 f
331      dtrmc <= 0.0 has been reset to dtrmc = 3.6000E+01 f
332

```

```

*o/w4lpr5out
w4lpr5out 37807 Lines

```

```

*t325,329
325      dtlmc = 0.0000E+00,      dtvmc = 4.5000E+01,      dprmc = 1.0000E-02,      dtsmc = 3.6000E+01,      dtrmc = 0.0000E+00
326      f                                f                                f                                f
327      dtlmc <= 0.0 has been reset to dtlmc = 3.6000E+01 f
328      dtrmc <= 0.0 has been reset to dtrmc = 3.6000E+01 f
329
*end

```

Note: A DIFF of files W4LPR2OUT and W4LPR5OUT showed a difference in most of the lines of the files.

W4LPR6IN (W4LOOPR with Namelist Variable IDTPC = 1 Input,
the Δt Parameter Constants Input as 0 or 0.0000e+00,
DTVMC Input as 25.0 {default}, DPRMC Input as 0.01
{default is 0.5}, DTSMC Input as 20.0 {default}, and
NOBKUP Input as 1)

```

castor:/export/castor1/rgs/trac> cp w4lpr5in w4lpr6in

```

```

castor:/export/castor1/rgs/trac> tedi w4lpr6in
w4lpr6in 147 Lines

```

```

*tp*/nobkup
88 *      maxitb      maxitc      maxit      mindt      nobkup
*t89
89          0          0          0          0          0
*rl89
&          0          0          0          0          1
&.
- 89          0          0          0          0          0
89          0          0          0          0          1
*t86,6
86 *      ntsv      ntc b      ntc f      ntrp      ntc p

```

```

87          4          0          0          2          1
88 *      maxitb      maxitc      maxit      mindt      nobkup
89          0          0          0          0          1
90 *          ddi      vmrmx      vrmx      fxmax      gxmax
91      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00      0.0000e+00
92 *      csfld      csf3dh      cnfac1      cnfach      fpmax
*end
w4lpr6in 147 Lines

```

```
castor:/export/castor1/rgs/trac> cp w4lpr6in tracin
```

Terminal Output from Test Problem W4LPR6

```
castor:/export/castor1/rgs/trac> trac
```

.....

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
10	0.036270	0.001000	2		1.2626	0.0207	1 6 2	
20	0.046270	0.001000	2		1.3805	0.0233	1 6 2	
30	0.056270	0.001000	2		1.4693	0.0257	1 6 2	
40	0.066270	0.001000	2		1.5241	0.0324	1 6 2	
50	0.076270	0.001000	2		1.5509	0.0374	1 6 2	
60	0.086270	0.001000	2		1.5613	0.0402	1 6 2	
70	0.096270	0.001000	2		1.5286	0.0410	1 6 2	
80	0.106270	0.001000	3		41.2820	0.0410	1 6 2	
90	0.116270	0.001000	2		26.2679	0.0423	1 6 2	
100	0.126270	0.001000	2		34.9555	0.0417	1 6 2	
110	0.136270	0.001000	2		36.6936	0.0409	1 6 2	
120	0.146270	0.001000	2		37.9099	0.0402	1 6 2	
130	0.156270	0.001000	2		36.1397	0.0397	1 6 2	
140	0.166270	0.001000	2		34.7016	0.0394	1 6 2	
150	0.176722	0.001256	2		42.0474	0.0494	1 6 2	
160	0.188204	0.001000	2		30.6489	0.0394	1 6 2	
170	0.198204	0.001000	2		27.4869	0.0393	1 6 2	
180	0.208204	0.001000	2		24.2133	0.0389	1 6 2	
190	0.218514	0.001216	2		27.8090	0.0471	1 6 2	
200	0.228754	0.001000	2		22.0051	0.0386	1 6 2	
210	0.238754	0.001000	2		21.4603	0.0386	1 6 2	
220	0.248754	0.001000	2		20.5943	0.0386	1 6 2	
230	0.260781	0.001222	2		25.0612	0.0472	1 6 2	
240	0.271006	0.001000	2		18.4058	0.0386	1 6 2	
250	0.281006	0.001000	2		17.0763	0.0385	1 6 2	
260	0.291230	0.001184	2		18.8818	0.0454	1 6 2	
270	0.303414	0.001000	2		14.4771	0.0383	1 6 2	
280	0.313414	0.001000	2		13.4873	0.0384	1 6 2	
290	0.323724	0.001216	2		16.0261	0.0468	1 6 2	
300	0.339012	0.001980	2		28.2595	0.0769	1 6 2	
310	0.356190	0.001867	2		24.7107	0.0728	1 6 2	
320	0.379667	0.003040	2		43.4355	0.1176	1 6 2	
330	0.417909	0.004952	2		78.2312	0.1892	1 6 2	
340	0.480201	0.008067	2		141.2259	0.3025	1 6 2	
350	0.581667	0.013140	2		304.2663	0.4889	1 6 2	
360	0.746946	0.021404	2		755.8734	0.8012	1 6 2	
370	0.991933	0.025766	3		994.0768	0.9436	1 6 2	
380	1.251040	0.025789	1		997.5804	0.9247	1 6 2	

382	1.302665	0.025836	1						
390	1.507945	0.025722	2		998.8765	0.9085	1	6	2
400	1.766260	0.025966	2		999.1932	0.8982	1	6	2
410	2.026431	0.026105	2		998.5066	0.8802	1	6	2
420	2.288517	0.026181	3		974.7226	0.8362	1	6	2
430	2.553237	0.026475	2						

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
430	2.553237	0.026307	2		993.4069	0.7912	1	6 2
440	2.816177	0.026228	2		997.7364	0.7445	1	6 2
450	3.078395	0.026033	2		994.8331	0.6976	1	6 2
460	3.338755	0.025968	2		997.7077	0.6586	1	6 2
470	3.598579	0.025915	2		998.0862	0.6306	1	6 2
478	3.805867	0.025901	2					
480	3.857655	0.025870	2		998.6904	0.6657	1	6 2
490	4.116152	0.025826	2		999.3107	0.6667	1	6 2
500	4.374157	0.025710	2		986.9906	0.6294	1	6 2
510	4.633743	0.025834	2		1006.4621	0.6554	1	6 2
520	4.887164	0.025216	2		1003.7909	0.6550	1	6 2

restart dump generated at problem time 5.012127 s after 525 time steps

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
525	5.012127	0.025022	2					

end of problem

computative timing statistics
cpu time is s

W4LPR6OUT (TRCOUT Results from Test Problem W4LPR6)

castor:/export/castor1/rgs/trac> mv trcout w4lpr6out

castor:/export/castor1/rgs/trac> tedi w4lpr5out

w4lpr5out 37807 Lines

*o/w4lpr6out

w4lpr6out 37806 Lines

*end

castor:/export/castor1/rgs/trac> cp w4lpr5out out5

castor:/export/castor1/rgs/trac> tedi out5

out5 37807 Lines

*nv

*dl10001,)

*t]

10000 coolant mass inflow to the break is 3.08421E+06 lbm/hr and total coolant mass in to the break is 1.74807E+05 lbm

*end

castor:/export/castor1/rgs/trac> cp w4lpr6out out6

```

castor:/export/castor1/rgs/trac> tedi out6
out6 37806 Lines
*nv
*d110001,1
*tj
10000 coolant mass inflow to the break is 3.08421E+06 lbm/hr and total coolant mass in to the break is 1.74807E+05 lbm
*end

```

```

castor:/export/castor1/rgs/trac> diff out5 out6
302c302
< maxitb = 0, maxitc = 0, maxit = 0, mindt = 0, nobkup = 0
---
> maxitb = 0, maxitc = 0, maxit = 0, mindt = 0, nobkup = 1

```

Note: Only the changed input values differ in lines 1 to 10000 of files W4LPR5OUT and W4LPR6OUT.

```

castor:/export/castor1/rgs/trac> cp w4lpr5out out5

```

```

castor:/export/castor1/rgs/trac> tedi out5
out5 37807 Lines
*nv
*d120001,1
*d11,10000
*tj
10000 total inner surface area is 0.00000E+00 ft2 and
*end

```

```

castor:/export/castor1/rgs/trac> cp w4lpr6out out6

```

```

castor:/export/castor1/rgs/trac> tedi out6
out6 37806 Lines
*nv
*d120001,1
*d11,10000
*tj
10000 total inner surface area is 0.00000E+00 ft2 and
*end

```

```

castor:/export/castor1/rgs/trac> diff out5 out6

```

Note: There is no difference in lines 10001 to 20000 of files W4LPR5OUT and W4LPR6OUT.

```

castor:/export/castor1/rgs/trac> cp w4lpr5out out5

```

```

castor:/export/castor1/rgs/trac> tedi out5
out5 37807 Lines
*nv
*d130001,1
*d11,20000
*tj
10000 cell - -- btu/ft2/f/hr --- btu/f/hr btu/hr btu/hr f f
*end

```

```

castor:/export/castor1/rgs/trac> cp w4lpr6out out6

```

```

castor:/export/castor1/rgs/trac> tedi out6
out6 37806 Lines
*nv
*d130001,1
*d11,20000
*tj
10000 total power to the component from all heat-transfer surfaces is 1.255388E+06 btu/hr
*end

```

```

castor:/export/castor1/rgs/trac> diff out5 out6

```

```

9491,9493c9491,9492
<      time  dtime  power  keff
<      s      s      btu/hr  -
<      2.251  0.226  6.378E+08  1.000000
---
> Graphics dump generated at problem time      2.288517 s after   421 cycles.
>      2.289  0.262  6.372E+08  1.000000
9495c9494
< Graphics dump generated at problem time      2.298419 s after   424 cycles.
---
> Graphics dump generated at problem time      2.394333 s after   425 cycles.
9497,9500c9496
< Graphics dump generated at problem time      2.417750 s after   430 cycles.
<      2.441  0.200  6.350E+08  1.000000
<
< Graphics dump generated at problem time      2.518083 s after   434 cycles.
---
> Graphics dump generated at problem time      2.500367 s after   429 cycles.
9504c9500
< problem time is 2.544605E+00 s, time-step size is 2.6522E-02 s, time-step number is 434, outer-iteration number is 2
---
> problem time is 2.553237E+00 s, time-step size is 2.6475E-02 s, time-step number is 430, outer-iteration number is 2
9506,9510c9502,9506
< maximum convective power difference has been 0.1349176E+09 btu/hr in component 128 at time 2.4918655E+00 s
< time-step size was limited by component 6 at cell 2 to 2.6509E-05 s
< average outer-iteration count over the last 52 time steps was 2.115
< last minimum number of outer iterations was 2 at time step 433 (limited by component 11 with fr.error of 6.7440E-05)
< last maximum number of outer iterations was 4 at time step 414 (limited by component 26 with fr.error of 9.7731E-06)
---
> maximum convective power difference has been 0.1352732E+09 btu/hr in component 126 at time 2.5267617E+00 s
> time-step size was limited by component 6 at cell 2 to 2.6403E-05 s
> average outer-iteration count over the last 48 time steps was 2.188
> last minimum number of outer iterations was 2 at time step 429 (limited by component 11 with fr.error of 6.2114E-05)
> last maximum number of outer iterations was 5 at time step 417 (limited by component 26 with fr.error of 5.1861E-04)

```

Note: The solution difference in files W4LPR5OUT and W4LPR6OUT first occurs at 2.289 s (timestep number 421) where a backup evaluation was done in test problem W4LPR5.

ZION1IN (ZIONPWR Reference Case)

```
castor:/export/castor1/rgs/trac> cp zionpwr zionlin
```

```
castor:/export/castor1/rgs/trac> cp zionlin tracin
```

Terminal Output from Test Problem ZION1

```
castor:/export/castor1/rgs/trac> trac
```

```

. . . . .

time-step  problem  time-step  outer-it.  cpu    courant  numbers  sets  location
number     time (s)   size (s)   number    time (s)  1-d      3-d     flag  cmp  cell
  10       0.010000  0.001000    2         0.0053   0.0053   0       0     2    3
  20       0.022027  0.001551    2         0.0080   0.0080   0       0     2    3
  30       0.041539  0.002527    2         0.0137   0.0138   0       0     3    3
  40       0.073323  0.004116    2         0.0219   0.0219   0       0     2    3
  50       0.125095  0.006705    1         0.0357   0.0357   0       0     2    3
  60       0.209427  0.010921    1         0.0582   0.0582   0       0     2    3
  70       0.346794  0.017790    1         0.0948   0.0950   0       0     3    3
  80       0.570551  0.028978    1         0.1545   0.1554   0       0     3    3
  90       0.935027  0.047201    1         0.2516   0.2544   0       0     3    3
 100       1.528721  0.076886    1         0.4099   0.4169   0       0     3    3
 110       2.495786  0.125239    1         0.6678   0.6854   0       0     3    3

```

at 3.894929 s, the trip 1 signal crossed setpoint s1 = 5.312300E+02 f
 at 4.071032 s, the trip 1 signal is 5.312281E+02 f

at 4.071032 s, trip 1 is reset from 0 to 1 with a set status of on-forward

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
120	4.071032	0.204002	1		1.0879	1.1331	1	3 4
130	6.448270	0.250000	1		1.3334	1.4156	1	3 4
140	8.948270	0.250000	1		1.3335	1.4348	1	3 4
150	11.448270	0.250000	1		1.3335	1.4474	1	3 4
160	13.948270	0.250000	1		1.3336	1.4557	1	3 4
170	16.448270	0.250000	1		1.3336	1.4611	1	3 4
180	18.948270	0.250000	1		1.3336	1.4645	1	3 4

time domain data to be used

minimum time	maximum time	time domain	long edit	graphics edit	dump edit	short edit
step (s)	step (s)	end (s)	step (s)	step (s)	step (s)	step (s)
1.000E-02	1.000E+00	5.800E+01	3.800E+01	1.000E+00	3.900E+01	3.800E+01

convective energy-error controller is 3.4121E+20 btu/hr

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
190	21.648748	0.335024	1		1.7872	1.9657	1	3 4
200	25.862643	0.545719	1		2.9111	3.2062	1	3 4
210	32.726633	0.888918	1		4.7419	5.2272	1	3 4
220	42.528948	1.000000	1		5.3344	5.8825	1	3 4
230	52.528948	1.000000	1		5.3344	5.8830	1	3 4
236	58.528948	1.000000	1					

time domain data to be used

minimum time	maximum time	time domain	long edit	graphics edit	dump edit	short edit
step (s)	step (s)	end (s)	step (s)	step (s)	step (s)	step (s)
1.000E-02	1.000E+00	6.000E+01	5.000E-01	1.000E+00	2.000E+00	5.000E-01

convective energy-error controller is 3.4121E+20 btu/hr

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
237	59.528948	1.000000	1					

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
238	60.528948	1.000000	1					

restart dump generated at problem time 60.528948 s after 238 time steps

end of problem

computative timing statistics
 cpu time is s

ZION1OUT (TRCOUT Results from Test Problem ZION1 for Later Comparison with ZION2OUT)

```
castor:/export/castor1/rgs/trac> mv trcout zion1out
```

ZION2IN (ZIONPWR with Namelist Variable IDTPC = 1 Input and the At Parameter Constants Input with their default values)

```
castor:/export/castor1/rgs/trac> cp zionpwr zion2in
```

```
castor:/export/castor1/rgs/trac> tedi zion2in
```

```
zion2in 1884 Lines
```

```
*tp*/namelist
```

```
67 * namelist data *
```

```
*t66,8
```

```
66 *****
```

```
67 * namelist data *
```

```
68 *****
```

```
69 *
```

```
70 &inopts
```

```
71  cpuflg=1, iadded=10, idiag=4, inlab=3, iogrf=1,
```

```
72  iolab=1, ioout=1, iunlab=2, nhtstr=2, noair=0,
```

```
73  nosets=0, nrslv=1, nsdl=0, nsdu=5, nspl=0, nsps=5
```

```
74  &end
```

```
*rp71/4,/4, idtpc=1,
```

```
71  cpuflg=1, iadded=10, idiag=4, idtpc=1, inlab=3, iogrf=1,
```

```
*tp*/ntsv
```

```
84 *          ntsv          ntc b          ntc f          ntrp          ntcp
```

```
*t85,1
```

```
85          203          132          84          1          2
```

```
86 *
```

```
*al85
```

```
&*          maxitb          maxitc          maxit          mindt          nobkup
```

```
&          4          5          0          0          0
```

```
&*          ddi          vmermx          vmx          fxmax          gxmax
```

```
&          1.0500e+00          1.0000e+04          1.0000e-01          4.0000e-01          5.0000e-02
```

```
&*          csfld          csf3dh          cnfac1          cnfach          fpmax
```

```
&          1.0000e+03          1.0000e+03          7.5000e-01          8.0000e-01          1.0000e-01
```

```
&*          xda u          xda l          xoa u          xoa l
```

```
&          5.0000e-02          2.0000e-01          1.0000e+00          1.0000e+00
```

```
&*          dtlmc          dtvmc          dprmc          dtsmc          dtrmc
```

```
&          2.0000e+01          2.5000e+01          5.0000e-01          2.0000e+01          2.0000e+01
```

```
&.
```

```
86 *          maxitb          maxitc          maxit          mindt          nobkup
```

```
87          4          5          0          0          0
```

```
88 *          ddi          vmermx          vmx          fxmax          gxmax
```

```
89          1.0500e+00          1.0000e+04          1.0000e-01          4.0000e-01          5.0000e-02
```

```
90 *          csfld          csf3dh          cnfac1          cnfach          fpmax
```

```
91          1.0000e+03          1.0000e+03          7.5000e-01          8.0000e-01          1.0000e-01
```

```
92 *          xda u          xda l          xoa u          xoa l
```

```
93          5.0000e-02          2.0000e-01          1.0000e+00          1.0000e+00
```

```
94 *          dtlmc          dtvmc          dprmc          dtsmc          dtrmc
```

```
95          2.0000e+01          2.5000e+01          5.0000e-01          2.0000e+01          2.0000e+01
```

```
*t84,97
```

```
84 *          ntsv          ntc b          ntc f          ntrp          ntcp
```

```

85          203          132          84          1          2
86 *      maxitb      maxitc      maxit      mindt      nobkup
87          4          5          0          0          0
88 *      ddi      vmermx      vrmx      fxmax      gxmax
89      1.0500e+00      1.0000e+04      1.0000e-01      4.0000e-01      5.0000e-02
90 *      csfld      csf3dh      cnfac1      cnfach      fpmax
91      1.0000e+03      1.0000e+03      7.5000e-01      8.0000e-01      1.0000e-01
92 *      xdau      xdal      xoau      xoal
93      5.0000e-02      2.0000e-01      1.0000e+00      1.0000e+00
94 *      dtlmc      dtvmc      dprmc      dtsmc      dtrmc
95      2.0000e+01      2.5000e+01      5.0000e-01      2.0000e+01      2.0000e+01
96 *
97 *****
*end
zion2in 1894 Lines

```

castor:/export/castor1/rgs/trac> cp zion2in tracin

Terminal Output from Test Problem ZION2

castor:/export/castor1/rgs/trac> trac

.....

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
10	0.010000	0.001000	2		0.0053	0.0053	0	2 3
20	0.022027	0.001551	2		0.0080	0.0080	0	2 3
30	0.041539	0.002527	2		0.0137	0.0138	0	3 3
40	0.073323	0.004116	2		0.0219	0.0219	0	2 3
50	0.125095	0.006705	1		0.0357	0.0357	0	2 3
60	0.209427	0.010921	1		0.0582	0.0582	0	2 3
70	0.346794	0.017790	1		0.0948	0.0950	0	3 3
80	0.570551	0.028978	1		0.1545	0.1554	0	3 3
90	0.935027	0.047201	1		0.2516	0.2544	0	3 3
100	1.528721	0.076886	1		0.4099	0.4169	0	3 3
110	2.495786	0.125239	1		0.6678	0.6854	0	3 3

at 3.894929 s, the trip 1 signal crossed setpoint s1 = 5.312300E+02 f
at 4.071032 s, the trip 1 signal is 5.312281E+02 f

at 4.071032 s, trip 1 is reset from 0 to 1 with a set status of on-forward

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
120	4.071032	0.204002	1		1.0879	1.1331	1	3 4
130	6.448270	0.250000	1		1.3334	1.4156	1	3 4
140	8.948270	0.250000	1		1.3335	1.4348	1	3 4
150	11.448270	0.250000	1		1.3335	1.4474	1	3 4
160	13.948270	0.250000	1		1.3336	1.4557	1	3 4
170	16.448270	0.250000	1		1.3336	1.4611	1	3 4
180	18.948270	0.250000	1		1.3336	1.4645	1	3 4

time domain data to be used						
minimum time step (s)	maximum time step (s)	time domain end (s)	long edit step (s)	graphics edit step (s)	dump edit step (s)	short edit step (s)

1.000E-02 1.000E+00 5.800E+01 3.800E+01 1.000E+00 3.900E+01 3.800E+01
convective energy-error controller is 3.4121E+20 btu/hr

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
190	21.648748	0.335024	1		1.7872	1.9657	1	3 4
200	25.862643	0.545719	1		2.9111	3.2062	1	3 4
210	32.726633	0.888918	1		4.7419	5.2272	1	3 4
220	42.528948	1.000000	1		5.3344	5.8825	1	3 4
230	52.528948	1.000000	1		5.3344	5.8830	1	3 4
236	58.528948	1.000000	1					

time domain data to be used

minimum time	maximum time	time domain	long edit	graphics edit	dump edit	short edit
step (s)	step (s)	end (s)	step (s)	step (s)	step (s)	step (s)
1.000E-02	1.000E+00	6.000E+01	5.000E-01	1.000E+00	2.000E+00	5.000E-01

convective energy-error controller is 3.4121E+20 btu/hr

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
237	59.528948	1.000000	1					

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
238	60.528948	1.000000	1					

restart dump generated at problem time 60.528948 s after 238 time steps

end of problem

computative timing statistics
cpu time is s

ZION2OUT (TRCOUT Results from Test Problem ZION2 for Later Comparison with ZION3OUT)

castor:/export/castor1/rgs/trac> mv trcout zion2out

castor:/export/castor1/rgs/trac> diff zion1out zion2out

```

243c243
<      iddiag =      4,      idiags =      0,      idtpc =      0,      ieeeeg =      0,      ielv =      0
---
>      iddiag =      4,      idiags =      0,      idtpc =      1,      ieeeeg =      0,      ielv =      0
309a310,318
>      maxitb =      4,      maxitc =      5,      maxit =      0,      mindt =      0,      nobkup =      0
>      ddi = 1.0500E+00,      vmexmx = 1.0000E+04,      vmx = 1.0000E-01,      fxmax = 4.0000E-01,      gmax = 5.0000E-02
>      csf1d = 1.0000E+03,      csf3dh = 1.0000E+03,      cnfac1 = 7.5000E-01,      cnfach = 8.0000E-01,      fpmax = 1.0000E-01
>      xdau = 5.0000E-02,      xdal = 2.0000E-01,      xoau = 1.0000E+00,      xoal = 1.0000E+00
>      dtlmc = 3.6000E+01,      dtvmc = 4.5000E+01,      dprmc = 5.0000E-01,      dtamc = 3.6000E+01,      dtrmc = 3.6000E+01
>      f      f      f      f      f

```

ZION3IN (ZIONPWR with Namelist Variable IDTPC = 1 Input and the
At Parameter Constants Input with their default values except for
CSF1D = 2.0 and CSF3DH = 2.0 (their default values are 1000.0).

castor:/export/castor1/rgs/trac> cp zion2in zion3in

```

castor:/export/castor1/rgs/trac> tedi zion3in
zion3in 1894 Lines
*tp*/csfld
90 *          csfld          csf3dh          cnfac1          cnfach          fpmax
*t91
91  1.0000e+03  1.0000e+03      7.5000e-01      8.0000e-01      1.0000e-01
*rp91/1.0000e+03/2.0000e+00
91  2.0000e+00  2.0000e+00      7.5000e-01      8.0000e-01      1.0000e-01
*end
zion3in 1894 Lines

castor:/export/castor1/rgs/trac> cp zion3in tracin

```

Terminal Output from Test Problem ZION3

```

castor:/export/castor1/rgs/trac> trac

```

.....

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
10	0.010000	0.001000	2		0.0053	0.0053	0	2 3
20	0.022027	0.001551	2		0.0080	0.0080	0	2 3
30	0.041539	0.002527	2		0.0137	0.0138	0	3 3
40	0.073323	0.004116	2		0.0219	0.0219	0	2 3
50	0.125095	0.006705	1		0.0357	0.0357	0	2 3
60	0.209427	0.010921	1		0.0582	0.0582	0	2 3
70	0.346794	0.017790	1		0.0948	0.0950	0	3 3
80	0.570551	0.028978	1		0.1545	0.1554	0	3 3
90	0.935027	0.047201	1		0.2516	0.2544	0	3 3
100	1.528721	0.076886	1		0.4099	0.4169	0	3 3
110	2.495786	0.125239	1		0.6678	0.6854	0	3 3

```

at 3.894929 s, the trip 1 signal crossed setpoint s1 = 5.312300E+02 f
at 4.071032 s, the trip 1 signal is 5.312281E+02 f

```

```

at 4.071032 s, trip 1 is reset from 0 to 1 with a set status of on-forward

```

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
120	4.071032	0.204002	1		1.0879	1.1331	1	3 4
130	6.448270	0.250000	1		1.3334	1.4156	1	3 4
140	8.948270	0.250000	1		1.3335	1.4348	1	3 4
150	11.448270	0.250000	1		1.3335	1.4474	1	3 4
160	13.948270	0.250000	1		1.3336	1.4557	1	3 4
170	16.448270	0.250000	1		1.3336	1.4611	1	3 4
180	18.948270	0.250000	1		1.3336	1.4645	1	3 4

```

                                time domain data to be used
      minimum    maximum    time    long    graphics    dump    short
      time       time       domain  edit    edit    edit    edit
step (s) step (s) end (s) step (s) step (s) step (s) step (s)
1.000E-02 1.000E+00 5.800E+01 3.800E+01 1.000E+00 3.900E+01 3.800E+01
convective energy-error controller is 3.4121E+20 btu/hr

```

time-step	problem	time-step	outer-it.	cpu	courant	numbers	sets	location
-----------	---------	-----------	-----------	-----	---------	---------	------	----------

number	time (s)	size (s)	number	time (s)	1-d	3-d	flag	cmp	cell
190	21.648748	0.335024	1		1.7872	1.9657	1	3	4
200	25.049534	0.340455	1		1.8161	2.0000	1	3	4
210	28.452954	0.340229	1		1.8149	2.0000	1	3	4
220	31.854628	0.340106	1		1.8143	2.0000	1	3	4
230	35.255352	0.340039	1		1.8139	2.0000	1	3	4
240	38.655561	0.340003	1		1.8137	2.0000	1	3	4
250	42.055489	0.339983	1		1.8136	2.0000	1	3	4
260	45.455265	0.339972	1		1.8136	2.0000	1	3	4
270	48.854959	0.339966	1		1.8135	2.0000	1	3	4
280	52.254607	0.339963	1		1.8135	2.0000	1	3	4
290	55.654231	0.339962	1		1.8135	2.0000	1	3	4

time domain data to be used

minimum	maximum	time	long	graphics	dump	short
time	time	domain	edit	edit	edit	edit
step (s)	step (s)	end (s)	step (s)	step (s)	step (s)	step (s)
1.000E-02	1.000E+00	6.000E+01	5.000E-01	1.000E+00	2.000E+00	5.000E-01

convective energy-error controller is 3.4121E+20 btu/hr

time-step	problem	time-step	outer-it.	cpu	courant	numbers	sets	location
number	time (s)	size (s)	number	time (s)	1-d	3-d	flag	cmp cell
299	58.713880	0.339961	1					

time-step	problem	time-step	outer-it.	cpu	courant	numbers	sets	location
number	time (s)	size (s)	number	time (s)	1-d	3-d	flag	cmp cell
300	59.053841	0.339961	1		1.8135	2.0000	1	3 4
301	59.393801	0.339961	1					

time-step	problem	time-step	outer-it.	cpu	courant	numbers	sets	location
number	time (s)	size (s)	number	time (s)	1-d	3-d	flag	cmp cell
303	60.073722	0.339960	1					

restart dump generated at problem time 60.073722 s after 303 time steps

end of problem

computative timing statistics
cpu time is s

ZION3OUT (TRCOUT Results from Test Problem ZION3)

castor:/export/castor1/rgs/trac> mv trcout zion3out

castor:/export/castor1/rgs/trac> tedi zion2out

zion2out 13094 Lines

*o/zion3out

zion3out 13127 Lines

*end

castor:/export/castor1/rgs/trac> cp zion2out out2

castor:/export/castor1/rgs/trac> tedi out2

out2 13094 Lines

*nv

*dl8001,1

*tl

8000 ft/s

*end

```
castor:/export/castor1/rgs/trac> cp zion3out out3
```

```
castor:/export/castor1/rgs/trac> tedi out3
```

```
out3 13127 Lines
```

```
*nv
*d18001,]
*t]
8000          ft/s
*end
```

```
castor:/export/castor1/rgs/trac> diff out2 out3
```

```
313c313
<      csf1d = 1.0000E+03,      csf3dh = 1.0000E+03,      cnfac1 = 7.5000E-01,      cnfach = 8.0000E-01,      fpmax = 1.0000E-01
---
>      csf1d = 2.0000E+00,      csf3dh = 2.0000E+00,      cnfac1 = 7.5000E-01,      cnfach = 8.0000E-01,      fpmax = 1.0000E-01
5107c5107
<      1.0000E+08 s      1.0000E+08 s      1.0000E+08 s      1.0000E+08 s      1.0000E-03 s      1.0000E+08 s      1.7499E+02 s      1.0000E+08 s
---
>      1.0000E+08 s      1.0000E+08 s      1.0000E+08 s      1.0000E+08 s      1.0000E-03 s      1.0000E+08 s      3.4998E-01 s      1.0000E+08 s
6208c6208
<      1.0000E+08 s      1.0000E+08 s      1.0000E+08 s      1.0000E+08 s      1.0000E-03 s      1.0000E+08 s      1.7499E+02 s      1.0000E+08 s
---
>      1.0000E+08 s      1.0000E+08 s      1.0000E+08 s      1.0000E+08 s      1.0000E-03 s      1.0000E+08 s      3.4998E-01 s      1.0000E+08 s
7309c7309
<      1.0000E+08 s      1.0000E+08 s      1.0000E+08 s      1.0000E+08 s      1.0000E-03 s      1.0000E+08 s      1.8992E+02 s      1.0000E+08 s
---
>      1.0000E+08 s      1.0000E+08 s      1.0000E+08 s      1.0000E+08 s      1.0000E-03 s      1.0000E+08 s      3.7984E-01 s      1.0000E+08 s
```

**Note: Only the CSF1D and CSF3DH values and the DELVMX
Courant-limit timestep differ in lines 1 to 8000
of files ZION2OUT and ZION3OUT.**

```
castor:/export/castor1/rgs/trac> cp zion2out out2
```

```
castor:/export/castor1/rgs/trac> tedi out2
```

```
out2 13094 Lines
```

```
*nv
*d111001,]
*d11,8000
*t]
3000          psia          deg          psia          f
*end
```

```
castor:/export/castor1/rgs/trac> cp zion3out out3
```

```
castor:/export/castor1/rgs/trac> tedi out3
```

```
out3 13127 Lines
```

```
*nv
*d111001,]
*d11,8000
*t]
3000          sat temp s (f)          sat temp s (f)          sat temp s (f)          sat temp t (f)          sat temp t (f)
*end
```

```
castor:/export/castor1/rgs/trac> diff out2 out3
```

```
410c410
<      1.0000E+08 s      1.0000E+08 s      1.0000E+08 s      1.0000E+08 s      1.0000E-03 s      1.0000E+08 s      1.9219E+02 s      1.0000E+08 s
---
>      1.0000E+08 s      1.0000E+08 s      1.0000E+08 s      1.0000E+08 s      1.0000E-03 s      1.0000E+08 s      3.8439E-01 s      1.0000E+08 s
1686c1686,1687
< Graphics dump generated at problem time      22.335547 s after      193 cycles.
---
> Graphics dump generated at problem time      22.665358 s after      194 cycles.
>      23.347      1.704      1.109E+10      1.139896      0.00E+00-8.30E-05      1523.7-6.39E-05      572.6-1.90E-05      0.0012      0.00E+00      4.51E-03      0.00E+00
1688,1689c1689
< Graphics dump generated at problem time      23.499967 s after      196 cycles.
<      23.500      1.944      1.109E+10      1.139891      0.00E+00-8.87E-05      1524.0-6.87E-05      572.6-2.00E-05      0.0012      0.00E+00      4.51E-03      0.00E+00
---
> Graphics dump generated at problem time      23.687382 s after      197 cycles.
1691,1694c1691,1692
< Graphics dump generated at problem time      24.847928 s after      199 cycles.
<
< Graphics dump generated at problem time      25.862643 s after      201 cycles.
<      25.863      2.481      1.109E+10      1.139813      0.00E+00-7.76E-05      1528.6-5.96E-05      572.8-1.79E-05      0.0013      0.00E+00      4.51E-03      0.00E+00
```

TFP1IN (TFPIPE2 Reference Case with IADDED = 5 Added to the Namelist Data)

tfp1in 275 Lines

• • • • •

C-31

65	0.004330	0.000200	2	7.8280	0.0000	1	5	9
70	0.005330	0.000200	2	7.7903	0.0000	1	5	9
75	0.006330	0.000200	2	7.6786	0.0000	1	5	9
80	0.007330	0.000200	2	7.5617	0.0000	1	5	9
85	0.008330	0.000200	2	7.4461	0.0000	1	5	9
90	0.009330	0.000200	2	7.3385	0.0000	1	5	9
94	0.010130	0.000200	2					
95	0.010330	0.000200	1	7.2476	0.0000	1	5	9
100	0.011330	0.000200	2	7.1746	0.0000	1	5	9
105	0.012330	0.000200	2	7.1154	0.0000	1	5	9
110	0.013330	0.000200	2	7.0639	0.0000	1	5	9
115	0.014330	0.000200	2	7.0139	0.0000	1	5	9
120	0.015330	0.000200	2	6.9610	0.0000	1	5	9
125	0.016330	0.000200	1	6.8963	0.0000	1	5	9
130	0.017330	0.000200	1	6.8023	0.0000	1	5	9
135	0.018330	0.000200	1	6.6972	0.0000	1	5	9
140	0.019330	0.000200	1	6.5920	0.0000	1	5	9
144	0.020130	0.000200	1					

restart dump generated at problem time 0.020130 s after 144 time steps

end of problem

computative timing statistics
cpu time is s

TFP1OUT (TRCOUT Results from Test Problem TFP1 for Later Comparison with TFP2OUT)

castor:/export/castor1/rgs/trac> mv trcout tfplout

TFP2IN (TFPIPE2 with Namelist Variable IDTPC = 1 Input and alternate Δt Parameter Constants Input with their default values or as 0 or 0.0000e+00)

castor:/export/castor1/rgs/trac> cp tfplin tfp2in

castor:/export/castor1/rgs/trac> tedi tfp2in
tfp2in 275 Lines

```
*t50,56
50 *****
51 * namelist data *
52 *****
53 *
54 &inopts
55   iadded=5, idiag=4, nsdl=0, nsdu=5, nspl=0, nspu=5, cpuflg=1
56 &end
*rp55/4,/4, idtpc=1,
55   iadded=5, idiag=4, idtpc=1, nsdl=0, nsdu=5, nspl=0, nspu=5, cpuflg=1
*tp*/ntsv
66 *          ntsv          ntcb          ntcfl          ntrp          ntcp
*t67,1
67           0           0           0           0           0
68 *
*al67
```

```

&*      maxitb      maxitc      maxit      mindt      nobkup
&        4          0          0          0          0
&*      ddi      vmrmx      vrmx      fxmax      gxmax
& 0.0000e+00 1.0000e+04 0.0000e+00 4.0000e-01 0.0000e+00
&*      csfld      csf3dh      cnfac1      cnfach      fpmax
& 1.0000e+03 0.0000e+00 7.5000e-01 0.0000e+00 1.0000e-01
&*      xdau      xdal      xoau      xoal
& 0.0000e+00 2.0000e-01 0.0000e+00 1.0000e+00
&*      dtlmc      dtvmc      dprmc      dtsmc      dtrmc
& 2.0000e+01 0.0000e+00 5.0000e-01 0.0000e+00 2.0000e+01
&
68 *      maxitb      maxitc      maxit      mindt      nobkup
69        4          0          0          0          0
70 *      ddi      vmrmx      vrmx      fxmax      gxmax
71 0.0000e+00 1.0000e+04 0.0000e+00 4.0000e-01 0.0000e+00
72 *      csfld      csf3dh      cnfac1      cnfach      fpmax
73 1.0000e+03 0.0000e+00 7.5000e-01 0.0000e+00 1.0000e-01
74 *      xdau      xdal      xoau      xoal
75 0.0000e+00 2.0000e-01 0.0000e+00 1.0000e+00
76 *      dtlmc      dtvmc      dprmc      dtsmc      dtrmc
77 2.0000e+01 0.0000e+00 5.0000e-01 0.0000e+00 2.0000e+01
*t66,79
66 *      ntsv      ntc b      ntc f      ntrp      ntcp
67        0          0          0          0          0
68 *      maxitb      maxitc      maxit      mindt      nobkup
69        4          0          0          0          0
70 *      ddi      vmrmx      vrmx      fxmax      gxmax
71 0.0000e+00 1.0000e+04 0.0000e+00 4.0000e-01 0.0000e+00
72 *      csfld      csf3dh      cnfac1      cnfach      fpmax
73 1.0000e+03 0.0000e+00 7.5000e-01 0.0000e+00 1.0000e-01
74 *      xdau      xdal      xoau      xoal
75 0.0000e+00 2.0000e-01 0.0000e+00 1.0000e+00
76 *      dtlmc      dtvmc      dprmc      dtsmc      dtrmc
77 2.0000e+01 0.0000e+00 5.0000e-01 0.0000e+00 2.0000e+01
78 *
79 *****
*end
tfp2in 285 Lines

```

castor:/export/castor1/rgs/trac> cp tfp2in tracin

Terminal Output from Test Problem TFP2

castor:/export/castor1/rgs/trac> trac

.....

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
2	0.000021	0.000011	2					
3	0.000032	0.000011	4					
4	0.000043	0.000011	3					
5	0.000054	0.000012	3					
5	0.000054	0.000012	3		0.2794	0.0000	1	5 9
10	0.000121	0.000016	2		0.3469	0.0000	1	5 9
15	0.000207	0.000020	2		0.4886	0.0000	1	5 9
20	0.000316	0.000025	2		0.7176	0.0000	1	5 9

25	0.000456	0.000032	2	0.9409	0.0000	1	5	9
30	0.000634	0.000041	2	1.2272	0.0000	1	5	9
35	0.000862	0.000053	2	1.6106	0.0000	1	5	9
40	0.001152	0.000067	2	2.1283	0.0000	1	5	9
45	0.001522	0.000086	2	2.8323	0.0000	1	5	9
50	0.001995	0.000109	2	3.7920	0.0000	1	5	9
55	0.002599	0.000139	2	5.0883	0.0000	1	5	9
60	0.003369	0.000178	2	6.7925	0.0000	1	5	9
65	0.004330	0.000200	2	7.8280	0.0000	1	5	9
70	0.005330	0.000200	2	7.7903	0.0000	1	5	9
75	0.006330	0.000200	2	7.6786	0.0000	1	5	9
80	0.007330	0.000200	2	7.5617	0.0000	1	5	9
85	0.008330	0.000200	2	7.4461	0.0000	1	5	9
90	0.009330	0.000200	2	7.3385	0.0000	1	5	9
94	0.010130	0.000200	2					
95	0.010330	0.000200	1	7.2476	0.0000	1	5	9
100	0.011330	0.000200	2	7.1746	0.0000	1	5	9
105	0.012330	0.000200	2	7.1154	0.0000	1	5	9
110	0.013330	0.000200	2	7.0639	0.0000	1	5	9
115	0.014330	0.000200	2	7.0139	0.0000	1	5	9
120	0.015330	0.000200	2	6.9610	0.0000	1	5	9
125	0.016330	0.000200	1	6.8963	0.0000	1	5	9
130	0.017330	0.000200	1	6.8023	0.0000	1	5	9
135	0.018330	0.000200	1	6.6972	0.0000	1	5	9
140	0.019330	0.000200	1	6.5920	0.0000	1	5	9
144	0.020130	0.000200	1					

restart dump generated at problem time 0.020130 s after 144 time steps

end of problem

computative timing statistics
cpu time is s

TFP2OUT (TRCOUT Results from Test Problem TFP2 for Later Comparison with TFP3OUT and TFP4OUT)

castor:/export/castor1/rgs/trac> mv trcout tfp2out

castor:/export/castor1/rgs/trac> diff tfplout tfp2out

```

234c234
<      iddiag =      4,      idiags =      0,      idtpe =      0,      ieeeeg =      0,      ielv =      0
---
>      iddiag =      4,      idiags =      0,      idtpe =      1,      ieeeeg =      0,      ielv =      0
285a286,304
>      maxitb =      4,      maxitc =      0,      maxit =      0,      mindt =      0,      nobkup =      0
>      maxitc <= 0 has been reset to maxitc = 5
>      ddi = 0.0000E+00,      vmrmx = 1.0000E+04,      vmrmx = 0.0000E+00,      fixmax = 4.0000E-01,      gmxmax = 0.0000E+00
>
>      ddi <= 0.0 has been reset to ddi = 1.0500E+00 -
>      vmrmx <= 0.0 has been reset to vmrmx = 1.0000E-01 -
>      gmxmax <= 0.0 has been reset to gmxmax = 5.0000E-02 -
>      csfld = 1.0000E+03,      csf3dh = 0.0000E+00,      cnfac1 = 7.5000E-01,      cnfach = 0.0000E+00,      fpmax = 1.0000E-01
>
>      csf3dh <= 0.0 has been reset to csf3dh = 1.0000E+03 -
>      cnfach <= 0.0 has been reset to cnfach = 8.0000E-01 -
>      xdau = 0.0000E+00,      xdal = 2.0000E-01,      xoau = 0.0000E+00,      xcal = 1.0000E+00
>
>      xdau <= 0.0 has been reset to xdau = 5.0000E-02 -
>      xoau <= 0.0 has been reset to xoau = 1.0000E+00 -
>      dtlmc = 2.0000E+01,      dtvmc = 0.0000E+00,      dprmc = 5.0000E-01,      dtsmc = 0.0000E+00,      dtrmc = 2.0000E+01
>
>      dtvmc <= 0.0 has been reset to dtvmc = 2.5000E+01 k
>      dtsmc <= 0.0 has been reset to dtsmc = 2.0000E+01 k

```

TFP3IN (TFPIPE2 with Namelist Variable IDTPC = 1 Input,
alternate Δt Parameter Constants Input with their default
values or as 0 or 0.0000e+00, and NOBKUP = 1 Input)

```
castor:/export/castor1/rgs/trac> cp tfp2in tfp3in
```

```
castor:/export/castor1/rgs/trac> tedi tfp3in
```

```
tfp3in 285 Lines
```

```
*t68,69
```

```
68 *          maxitb          maxitc          maxit          mindt          nobkup
69              4              0              0              0              0
```

```
*rl69
```

```
&              4              0              0              0              1
```

```
&.
```

```
- 69              4              0              0              0              0
69              4              0              0              0              1
```

```
*t68,70
```

```
68 *          maxitb          maxitc          maxit          mindt          nobkup
69              4              0              0              0              1
```

```
70 *          ddi          vmermx          vmx          fxmax          gxmax
```

```
*end
```

```
tfp3in 285 Lines
```

```
castor:/export/castor1/rgs/trac> cp tfp3in tracin
```

Terminal Output from Test Problem TFP3

```
castor:/export/castor1/rgs/trac> trac
```

```
.....
```

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
2	0.000021	0.000011	2					
3	0.000032	0.000011	4					
4	0.000043	0.000011	3					
5	0.000054	0.000012	3					
5	0.000054	0.000012	3		0.2794	0.0000	1	5 9
10	0.000121	0.000016	2		0.3469	0.0000	1	5 9
15	0.000207	0.000020	2		0.4886	0.0000	1	5 9
20	0.000316	0.000025	2		0.7176	0.0000	1	5 9
25	0.000456	0.000032	2		0.9409	0.0000	1	5 9
30	0.000634	0.000041	2		1.2272	0.0000	1	5 9
35	0.000862	0.000053	2		1.6106	0.0000	1	5 9
40	0.001152	0.000067	2		2.1283	0.0000	1	5 9
45	0.001522	0.000086	2		2.8323	0.0000	1	5 9
50	0.001995	0.000109	2		3.7920	0.0000	1	5 9
55	0.002599	0.000139	2		5.0883	0.0000	1	5 9
60	0.003369	0.000178	2		6.7925	0.0000	1	5 9
65	0.004330	0.000200	2		7.8280	0.0000	1	5 9
70	0.005330	0.000200	2		7.7903	0.0000	1	5 9
75	0.006330	0.000200	2		7.6786	0.0000	1	5 9
80	0.007330	0.000200	2		7.5617	0.0000	1	5 9
85	0.008330	0.000200	2		7.4461	0.0000	1	5 9
90	0.009330	0.000200	2		7.3385	0.0000	1	5 9

94	0.010130	0.000200	2					
95	0.010330	0.000200	1	7.2476	0.0000	1	5	9
100	0.011330	0.000200	2	7.1746	0.0000	1	5	9
105	0.012330	0.000200	2	7.1154	0.0000	1	5	9
110	0.013330	0.000200	2	7.0639	0.0000	1	5	9
115	0.014330	0.000200	2	7.0139	0.0000	1	5	9
120	0.015330	0.000200	2	6.9610	0.0000	1	5	9
125	0.016330	0.000200	1	6.8963	0.0000	1	5	9
130	0.017330	0.000200	1	6.8023	0.0000	1	5	9
135	0.018330	0.000200	1	6.6972	0.0000	1	5	9
140	0.019330	0.000200	1	6.5920	0.0000	1	5	9
144	0.020130	0.000200	1					

restart dump generated at problem time 0.020130 s after 144 time steps

end of problem

computative timing statistics
cpu time is s

TFP3OUT (TRCOUT File Results from Test Problem TFP3)

castor:/export/castor1/rgs/trac> mv trcout tfp3out

castor:/export/castor1/rgs/trac> diff tfp2out tfp3out

```
286c286
< maxitb = 4, maxitc = 0, maxit = 0, mindt = 0, nobkup = 0
---
> maxitb = 4, maxitc = 0, maxit = 0, mindt = 0, nobkup = 1
```

Note: There is no difference between the TFP2OUT and TFP3OUT files except for the NOBKUP-value output echo so no backup evaluations were performed on the TFPIPE2 test problem.

**TFP4IN (TFPIPE2 with Namelist Variable IDTPC = 1 Input,
alternate Δt Parameter Constants Input with their default
values or as 0 or 0.0000e+00, and DDI = 1.1 Input (default 1.05))**

castor:/export/castor1/rgs/trac> cp tfp2in tfp4in

castor:/export/castor1/rgs/trac> tedi tfp4in

tfp4in 285 Lines

tp/ddi

70 *	ddi	vmermx	vrms	fxmax	gxmax
------	-----	--------	------	-------	-------

*t71

71	0.0000e+00	1.0000e+04	0.0000e+00	4.0000e-01	0.0000e+00
----	------------	------------	------------	------------	------------

*rp71/0.0000e+00 1/1.1000e+00 1

71	1.1000e+00	1.0000e+04	0.0000e+00	4.0000e-01	0.0000e+00
----	------------	------------	------------	------------	------------

*end

tfp4in 285 Lines

castor:/export/castor1/rgs/trac> cp tfp4in tracin

Terminal Output from Test Problem TFP4


```
castor:/export/castor1/rgs/trac> trac
```

.....

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
2	0.000021	0.000011	2					
3	0.000033	0.000012	4					
4	0.000045	0.000012	3					
5	0.000058	0.000013	3					
5	0.000058	0.000015	3		0.3313	0.0000	1	5 9
10	0.000148	0.000024	2		0.5341	0.0000	1	5 9
15	0.000292	0.000038	2		1.0731	0.0000	1	5 9
20	0.000523	0.000061	2		1.8587	0.0000	1	5 9
25	0.000897	0.000098	2		3.1898	0.0000	1	5 9
30	0.001498	0.000159	2		5.5585	0.0000	1	5 9
35	0.002423	0.000200	2		7.5082	0.0000	1	5 9
40	0.003423	0.000200	2		7.7670	0.0000	1	5 9
45	0.004423	0.000200	2		7.8763	0.0000	1	5 9
50	0.005423	0.000200	2		7.8215	0.0000	1	5 9
55	0.006423	0.000200	2		7.6971	0.0000	1	5 9
60	0.007423	0.000200	2		7.5736	0.0000	1	5 9
65	0.008423	0.000200	2		7.4545	0.0000	1	5 9
70	0.009423	0.000200	2		7.3443	0.0000	1	5 9
74	0.010223	0.000200	1					
75	0.010423	0.000200	1		7.2506	0.0000	1	5 9
80	0.011423	0.000200	2		7.1743	0.0000	1	5 9
85	0.012423	0.000200	2		7.1116	0.0000	1	5 9
90	0.013423	0.000200	2		7.0563	0.0000	1	5 9
95	0.014423	0.000200	2		7.0032	0.0000	1	5 9
100	0.015423	0.000200	2		6.9465	0.0000	1	5 9
105	0.016423	0.000200	1		6.8772	0.0000	1	5 9
110	0.017423	0.000200	1		6.7815	0.0000	1	5 9
115	0.018423	0.000200	1		6.6712	0.0000	1	5 9
120	0.019423	0.000200	1		6.5614	0.0000	1	5 9

```
restart dump generated at problem time      0.020023 s after   123 time steps
```

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
123	0.020023	0.000200	1					

end of problem

```
computative timing statistics
cpu time is      s
```

Note: With DDI = 1.1 rather than 1.05, the transient required 123 rather than 144 timesteps.

TFP4OUT (TRCOUT Results from Test Problem TFP4)

```
castor:/export/castor1/rgs/trac> mv trcout tfp4out
```

```
castor:/export/castor1/rgs/trac> diff tfp2out tfp4out
```

288c288

```

<      ddi = 0.0000E+00,      vmrmx = 1.0000E+04,      vmrmx = 0.0000E+00,      fxmax = 4.0000E-01,      gxmax = 0.0000E+00
----
>      ddi = 1.1000E+00,      vmrmx = 1.0000E+04,      vmrmx = 0.0000E+00,      fxmax = 4.0000E-01,      gxmax = 0.0000E+00
290d289
<      ddi <= 0.0 has been reset to      ddi = 1.0500E+00 -
1417c1416
<      problem time is 2.050000E-05 s, time-step size is 1.0500E-05 s, time-step number is      2, outer-iteration number is 2
----
>      problem time is 2.100000E-05 s, time-step size is 1.1000E-05 s, time-step number is      2, outer-iteration number is 2
1419,1420c1418,1419
<      maximum convective power difference has been 0.2177881E+02 w      in component      3 at time 1.0000000E-05 s
<      time-step size was limited by component      5 at cell      9 to 1.7408E-03 s
----
>      maximum convective power difference has been 0.2281518E+02 w      in component      3 at time 1.0000000E-05 s
>      time-step size was limited by component      5 at cell      9 to 1.7124E-03 s
1422,1423c1421,1422
<      last minimum number of outer iterations was 2 at time step      1 (limited by component      5 with fr.error of 6.3527E-03)
<      last maximum number of outer iterations was 2 at time step      1 (limited by component      5 with fr.error of 6.3527E-03)
----
>      last minimum number of outer iterations was 2 at time step      1 (limited by component      5 with fr.error of 6.8188E-03)
>      last maximum number of outer iterations was 2 at time step      1 (limited by component      5 with fr.error of 6.8188E-03)
1452,1453c1451,1452
<      1 9.79842E+06 0.00000E+00 0.000E+00 5.827E+02 5.790E+02 5.827E+02 7.012E+02 5.406E+01 0.000E+00 0.000E+00 3.200E-01
<      2 9.78220E+06 0.00000E+00 0.000E+00 5.826E+02 5.790E+02 5.826E+02 7.012E+02 5.395E+01 -1.300E+00 -1.297E+00 7.347E-03
----
>      1 9.79887E+06 0.00000E+00 0.000E+00 5.827E+02 5.790E+02 5.827E+02 7.012E+02 5.406E+01 0.000E+00 0.000E+00 3.200E-01
>      2 9.78220E+06 0.00000E+00 0.000E+00 5.826E+02 5.790E+02 5.826E+02 7.012E+02 5.395E+01 -1.300E+00 -1.296E+00 7.347E-03
.....

```

Note: Most lines in files TFP2OUT and TFP4OUT are different.
That is because the second timestep (shown above) and
timesteps thereafter were different because of DDI.

TFP5IN (TFPIPE2 with Namelist Variable IDTPC = 1 Input,
alternate Δt Parameter Constants Input with their default
values or as 0 or 0.0000e+00, DDI = 1.1 Input {default 1.05},
and OITMAX = 2 Input)

```
castor:/export/castor1/rgs/trac> cp tfp4in tfp5in
```

```
castor:/export/castor1/rgs/trac> tedi tfp5in
```

```
tfp5in 285 Lines
```

```
*tp*/oitmax
```

64 *	oitmax	sitmax	isolut	ncontr	nccfl
*t65					
65	10	20	0	0	0
*rp65/10/ 2/					
65	2	20	0	0	0
66 *	ntsv	ntcb	ntcf	ntrp	ntcp

```
*end
```

```
tfp5in 285 Lines
```

```
castor:/export/castor1/rgs/trac> cp tfp5in tracin
```

Terminal Output from Test Problem TFP5

```
castor:/export/castor1/rgs/trac> trac
```

```
.....
```

input data is being processed

h2o properties are used

restart dump generated at problem time 0.000000 s after 0 time steps

minimum		maximum		time domain data to be used			dump		short	
time	time	time	long	graphics	dump	short	time	time	time	time
step (s)	step (s)	end (s)	edit	edit	edit	edit	step (s)	step (s)	step (s)	step (s)
1.000E-05	1.000E-05	1.000E-05	1.000E-05	1.000E-05	1.000E-05	1.000E-05	1.000E-05	1.000E-05	1.000E-05	1.000E-05

convective energy-error controller is 1.0000E+20 w

time-step	problem	time-step	outer-it.	cpu	courant	numbers	sets	location
number	time (s)	size (s)	number	time (s)	1-d	3-d	flag	cmp cell
0	0.000000	0.000010	2		0.0058	0.0000	1	5 9
1	0.000010	0.000010	2					

restart dump generated at problem time 0.000010 s after 1 time steps

minimum		maximum		time domain data to be used			dump		short	
time	time	time	long	graphics	dump	short	time	time	time	time
step (s)	step (s)	end (s)	edit	edit	edit	edit	step (s)	step (s)	step (s)	step (s)
1.000E-05	2.000E-04	2.000E-02	1.000E-02	1.000E-03	2.000E-02	1.000E-02	1.000E-05	1.000E-05	1.000E-05	1.000E-05

convective energy-error controller is 1.0000E+20 w

time-step	problem	time-step	outer-it.	cpu	courant	numbers	sets	location
number	time (s)	size (s)	number	time (s)	1-d	3-d	flag	cmp cell
2	0.000021	0.000011	2					

hout outer iteration failed to converge at time 0.000021 s
nstep is 2, oitno is 2, nmfail is 0, and delt is 0.000012 s

hout varerm = 1.903444E-01, num = 5, j = 8

hout outer iteration failed to converge at time 0.000021 s
nstep is 2, oitno is 2, nmfail is 1, and delt is 0.000010 s

hout varerm = 1.529940E-01, num = 5, j = 8

restart dump generated at problem time 0.000021 s after 2 time steps

** fatal error **

timestep cannot reduce time step further

problem time is 0.000021 s, time-step size is 0.000010 s, time-step number is
outer-iteration number is-100, component number is 6, and component type is a bre.

Note: With OITMAX = 2, the timestep size had to be reduced below
DTMIN during timestep number 2 because the outer iteration
didn't converge. This stopped the transient calculation.

TFP5OUT (TRCOUT Results from Test Problem TFP5)

castor:/export/castor1/rgs/trac> mv trcout tfp5out

TFP6IN (TFPIPE2 with Namelist Variable IDTPC = 1 Input,
 alternate Δt Parameter Constants Input with their default
 values or as 0 or 0.0000e+00, DDI = 1.1 Input {default 1.05},
 OITMAX = 2 Input, and MINDT = 1 Input)

castor:/export/castor1/rgs/trac> cp tfp5in tfp6in

castor:/export/castor1/rgs/trac> tedi tfp6in

tfp6in 285 Lines

tp/mindt

	maxitb	maxitc	maxit	mindt	nobkup
68 *					
*t69					
69	4	0	0	0	0
*rl69					
&	4	0	0	1	0
&.					
- 69	4	0	0	0	0
69	4	0	0	1	0
*t66,6					
66 *	ntsv	ntcb	ntcf	ntrp	ntcp
67	0	0	0	0	0
68 *	maxitb	maxitc	maxit	mindt	nobkup
69	4	0	0	1	0
70 *	ddi	vmermx	vrms	fxmax	gxmax
71	1.1000e+00	1.0000e+04	0.0000e+00	4.0000e-01	0.0000e+00
72 *	csfld	csf3dh	cnfac1	cnfach	fpmax

*end

tfp6in 285 Lines

castor:/export/castor1/rgs/trac> cp tfp6in tracin

Terminal Output from Test Problem TFP6

castor:/export/castor1/rgs/trac> trac

.....

input data is being processed

h2o properties are used

restart dump generated at problem time 0.000000 s after 0 time steps

time domain data to be used						
minimum	maximum	time	long	graphics	dump	short
time	time	domain	edit	edit	edit	edit
step (s)	step (s)	end (s)	step (s)	step (s)	step (s)	step (s)
1.000E-05	1.000E-05	1.000E-05	1.000E-05	1.000E-05	1.000E-05	1.000E-05
convective energy-error controller is				1.0000E+20	w	

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
0	0.000000	0.000010	2		0.0058	0.0000	1	5 9
1	0.000010	0.000010	2					

restart dump generated at problem time 0.000010 s after 1 time steps

time domain data to be used						
minimum time	maximum time	time domain	long edit	graphics edit	dump edit	short edit
step (s)	step (s)	end (s)	step (s)	step (s)	step (s)	step (s)
1.000E-05	2.000E-04	2.000E-02	1.000E-02	1.000E-03	2.000E-02	1.000E-02

convective energy-error controller is 1.0000E+20 w

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
2	0.000021	0.000011	2					

hout outer iteration failed to converge at time 0.000021 s
nstep is 2, oitno is 2, nmfail is 0, and delt is 0.000012 s

hout varerm = 1.903444E-01, num = 5, j = 8

3	0.000031	0.000010	2
4	0.000041	0.000010	2

hout outer iteration failed to converge at time 0.000041 s
nstep is 4, oitno is 2, nmfail is 0, and delt is 0.000011 s

hout varerm = 2.184348E-02, num = 5, j = 8

5	0.000051	0.000010	2					
5	0.000051	0.000011	2		0.2539	0.0000	1	5 9
10	0.000118	0.000018	2		0.3950	0.0000	1	5 9
15	0.000226	0.000029	2		0.7350	0.0000	1	5 9
20	0.000400	0.000046	2		1.3681	0.0000	1	5 9
25	0.000681	0.000074	2		2.2945	0.0000	1	5 9
30	0.001133	0.000119	2		3.9652	0.0000	1	5 9
35	0.001860	0.000192	2		6.9497	0.0000	1	5 9
40	0.002852	0.000200	2		7.6264	0.0000	1	5 9
45	0.003852	0.000200	2		7.8306	0.0000	1	5 9
50	0.004852	0.000200	2		7.8777	0.0000	1	5 9
55	0.005852	0.000200	2		7.7807	0.0000	1	5 9
60	0.006852	0.000200	2		7.6566	0.0000	1	5 9
65	0.007852	0.000200	2		7.5362	0.0000	1	5 9
70	0.008852	0.000200	2		7.4211	0.0000	1	5 9
75	0.009852	0.000200	2		7.3179	0.0000	1	5 9
76	0.010052	0.000200	2					
80	0.010852	0.000200	2		7.2319	0.0000	1	5 9
85	0.011852	0.000200	2		7.1619	0.0000	1	5 9
90	0.012852	0.000200	2		7.1030	0.0000	1	5 9
95	0.013852	0.000200	2		7.0493	0.0000	1	5 9
100	0.014852	0.000200	2		6.9962	0.0000	1	5 9
105	0.015852	0.000200	2		6.9362	0.0000	1	5 9
110	0.016852	0.000200	1		6.8478	0.0000	1	5 9
115	0.017852	0.000200	1		6.7458	0.0000	1	5 9
120	0.018852	0.000200	1		6.6421	0.0000	1	5 9
125	0.019852	0.000200	1		6.5371	0.0000	1	5 9
126	0.020052	0.000200	1					

restart dump generated at problem time 0.020052 s after 126 time steps
end of problem

computative timing statistics
cpu time is s

Note: The TFP6 calculation didn't stop like the TFP5 calculation when the timestep needed to be reduced below DTMIN because MINDT = 1.

TFP6OUT (TRCOUT Results from Test Problem TFP6)

castor:/export/castor1/rgs/trac> cp trcout tfp6out

**TFP7IN (TFPIPE2 with Namelist Variable IDTPC = 1 Input,
alternate Δt Parameter Constants Input with their default
values or as 0 or 0.0000e+00, DDI = 1.1 Input {default 1.05},
OITMAX = 2 Input, and MAXIT = 1 Input)**

castor:/export/castor1/rgs/trac> cp tfp5in tfp7in

castor:/export/castor1/rgs/trac> tedi tfp7in

tfp7in 285 Lines

tp/maxit

	maxitb	maxitc	maxit	mindt	nobkup
68 *					
*t69					
69	4	0	0	0	0
*rl69					
&	4	0	1	0	0
&.					
- 69	4	0	0	0	0
69	4	0	1	0	0
*t66,6					
66 *	ntsv	ntcb	ntcf	ntrp	ntcp
67	0	0	0	0	0
68 *	maxitb	maxitc	maxit	mindt	nobkup
69	4	0	1	0	0
70 *	ddi	vmermx	vrms	fxmax	gxmax
71	1.1000e+00	1.0000e+04	0.0000e+00	4.0000e-01	0.0000e+00
72 *	csfld	csf3dh	cnfac1	cnfach	fpmax

*end

tfp7in 285 Lines

castor:/export/castor1/rgs/trac> cp tfp7in tracin

Terminal Output from Test Problem TFP7

castor:/export/castor1/rgs/trac> trac

.....

input data is being processed

h2o properties are used

restart dump generated at problem time 0.000000 s after 0 time steps

time domain data to be used						
minimum time	maximum time	time domain	long edit	graphics edit	dump edit	short edit
step (s)	step (s)	end (s)	step (s)	step (s)	step (s)	step (s)
1.000E-05	1.000E-05	1.000E-05	1.000E-05	1.000E-05	1.000E-05	1.000E-05

convective energy-error controller is 1.0000E+20 w

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
0	0.000000	0.000010	2		0.0058	0.0000	1	5 9
1	0.000010	0.000010	2					

restart dump generated at problem time 0.000010 s after 1 time steps

time domain data to be used						
minimum time	maximum time	time domain	long edit	graphics edit	dump edit	short edit
step (s)	step (s)	end (s)	step (s)	step (s)	step (s)	step (s)
1.000E-05	2.000E-04	2.000E-02	1.000E-02	1.000E-03	2.000E-02	1.000E-02

convective energy-error controller is 1.0000E+20 w

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
2	0.000021	0.000011	2					
3	0.000033	0.000012	2					
4	0.000043	0.000010	2					
5	0.000054	0.000011	2					
5	0.000054	0.000012	2		0.2769	0.0000	1	5 9
10	0.000128	0.000019	2		0.4370	0.0000	1	5 9
15	0.000247	0.000031	2		0.8380	0.0000	1	5 9
20	0.000439	0.000051	2		1.5009	0.0000	1	5 9
25	0.000747	0.000081	2		2.5494	0.0000	1	5 9
30	0.001244	0.000131	2		4.4265	0.0000	1	5 9
35	0.002044	0.000200	2		7.3467	0.0000	1	5 9
40	0.003044	0.000200	2		7.6755	0.0000	1	5 9
45	0.004044	0.000200	2		7.8430	0.0000	1	5 9
50	0.005044	0.000200	2		7.8459	0.0000	1	5 9
55	0.006044	0.000200	2		7.7299	0.0000	1	5 9
60	0.007044	0.000200	2		7.6057	0.0000	1	5 9
65	0.008044	0.000200	2		7.4856	0.0000	1	5 9
70	0.009044	0.000200	2		7.3719	0.0000	1	5 9
75	0.010044	0.000200	1		7.2732	0.0000	1	5 9
76	0.010244	0.000200	1					
80	0.011044	0.000200	2		7.1925	0.0000	1	5 9
85	0.012044	0.000200	2		7.1288	0.0000	1	5 9
90	0.013044	0.000200	2		7.0751	0.0000	1	5 9
95	0.014044	0.000200	2		7.0251	0.0000	1	5 9
100	0.015044	0.000200	2		6.9746	0.0000	1	5 9
105	0.016044	0.000200	2		6.9157	0.0000	1	5 9
110	0.017044	0.000200	1		6.8343	0.0000	1	5 9

115	0.018044	0.000200	1	6.7330	0.0000	1	5	9
120	0.019044	0.000200	1	6.6285	0.0000	1	5	9

restart dump generated at problem time 0.020044 s after 125 time steps

time-step number	problem time (s)	time-step size (s)	outer-it. number	cpu time (s)	courant 1-d	numbers 3-d	sets flag	location cmp cell
125	0.020044	0.000200	1					

end of problem

computative timing statistics
cpu time is s

TFP7OUT (TRCOUT Results from Test Problem TFP7)

castor:/export/castor1/rgs/trac> cp trcout tfp7out

Note: The TFP7 calculation didn't stop like the TFP5 calculation when the timestep needed to be reduced below DTMIN because nonconvergence of the outer iteration didn't reduce the timestep due to having set MAXIT = 1.