TASK COMPLETION REPORT FOR UPDATE SUMNMULN

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FOR UPDATE SUMNMULN**

by

Robert G. Steinke

August 29, 1997

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ABSTRACT

New "Sum N" and "Multiply N" control blocks have been programmed by update SUMNMULN in TRAC-P Version 5.4.28. They define N signal variables and/or control blocks whose values are to be summed with optional weighting factors or multiplied, respectively.

1.0. INTRODUCTION

Knolls Atomic Power Laboratory (KAPL) requested that a "Sum N" control block be programmed in TRAC-P Version 5.4.28. It would be an extension of the functionality of the operator 57 "Sum three" control block where $XOUT = G * (X1 + X2 + X3)$, and the operator 59 "Weighted summer" control block where $XOUT = G * (C1 * X1 + C2 * X2)$. Control block "Sum three" sums three signal variables and/or control blocks with the same constant gain G weighting factor. Control block "Weighted summer" sums two signal variables and/or control blocks with potentially different constant weighting factors of $G * C1$ and $G * C2$.

The "Sum N" control block,

$$XOUT = G * \sum_{n=1}^N (A_n * X_n) ,$$

defined by operator 103, sums $N > 1$ signal variables and/or control blocks with the same constant gain G weighting factor (option $M = 0$ where all A_n default to 1.0 with no units) or with potentially different constant $G * A_n$ weighting factors (option $M = 1$ where all A_n values have the same units). KAPL approved a suggestion that a "Multiply N" control block,

$$XOUT = G * \prod_{n=1}^N X_n ,$$

defined by operator 104, be programmed as well. It is similar to the $M = 0$ option of the "Sum N" control block except that multiplication replaces the addition operation.

2.0. CONTROL-BLOCK OPERATOR DESCRIPTION

The control-block operator descriptions for the "Sum N" and "Multiply N" control blocks in Table 6-3 of the TRAC-P User's Guide would have the form:

No.	Control-Block Name	Control-Block Mathematical Operation	Block Input			Constants	
			1	2	3	1	2
103	Sum N	$XOUT = G * \sum(A * X)$. The variable n is the number of A and X array elements. For $m = 0$, the A array is not input and its element values default to 1.0 with no units. For $m=1$, the A array is input with all its elements having the same units-name label LUWTA.	n	m			
104	Multiply N	$XOUT = G * \prod X$. The variable n is the number of X array elements.	n				

For the $M = 0$ option of the "Sum N" control block, $G = 1.0$ would provide a direct sum, and $G = 1.0/n$ would provide an averaged sum of the signal-variable and/or control-block parameter values.

3.0. CONTROL-BLOCK INPUT-DATA FORMAT DESCRIPTION

The "Sum N" and "Multiply N" control blocks require that the following three new cards be added to the control-block, input-data format in Chapter 6, Section 6.3.5.5, of the TRAC-P Users Guide between Card Set 5 and Card Number 6.

Note: If ICBN = 103 and $M = 1$, input Card Number 5.2 and Card Set 5.4.

Card Number 5.2. (Format A14) LUWTA

Columns	Variable	Description
1-14	LUWTA	Units-name label for all N elements of the WTA array that is input by Card Set 5.4.

Card Set 5.4. $WTA(I)$, $I = (1,N)$ Load Format.

Variable	Dimension	Description
WTA	N	Weighting factor for each of the parameter values of the N elements of the IDX array that is input by Card Set 5.6.

Note: If ICBN = 103 or 104, input Card Set 5.6.

Card Set 5.6. $IDX(I)$, $I = (1,N)$ Load Format.

Variable	Dimension	Description
IDX	N	ID number for the Ith input parameter to the control block whose value is to be weighted and summed or multiplied. $IDX(I) > 0$ defines a signal-variable parameter; $IDX(I) < 0$ defines a control-block output parameter.

Computer-memory storage for the WTA and IDX arrays needs to be reserved by variable NTCF defined by Main-Data Card 7. The value of NTCF needs to be increased by $2 * N$ for each control-block operator 103 and by N for each control-block operator 104.

4.0. UPDATE SUMNMULN AND FILE LABSNM

The "Sum N" and "Multiply N" control-block operators have been programmed by update SUMNMULN in TRAC-P Version 5.4.28. A new FORTRAN real-valued variable WTA in update SUMNMULN for the A array with elements A_n and $n = 1, 2, \dots, N$ requires that its units-name label LUSERDEF be defined by input-data file LABSMN for the TRAC-P auxiliary-program LABPRG. Listings of file LABSMN and update SUMNMULN are shown in Appendix A. Program LABPRG reads file LABSMN, renamed LABNEW, and outputs file LABOUT containing update LABOUT. Update LABOUT is included with update SUMNMULN when updating TRAC-P Version 5.4.28. The units-name label LUSERDEF for WTA is replaced during TRAC-P execution with the user-defined units-name label defined to LUWTA by Card Number 5.2.

Update SUMNMULN makes programming changes to four TRAC-P subroutines: CBEDIT, CBSET, RCNTL, and RECNTL. Subroutine CBEDIT outputs a block diagram for each control block during the TRACIN- and TRCRST-file input-data echoes to the TRCOUT file. CBEDIT is programmed by update SUMNMULN to output appropriate block diagrams for operators 103 and 104. Subroutine CBSET is programmed to evaluate the weighted-sum and multiplication operations of control-block operators 103 and 104, respectively. Subroutines RCNTL and RECNTL are programmed to (1) read from the TRACIN and TRCRST files, respectively, the input data of control-block Card Number 5.2 and Card Sets 5.4 and 5.6, (2) echo that input data to the TRCOUT file, and (3) store the WTA and IDX array data in the control-block, tabular-data section of the control-parameter data.

5.0. TESTING

Two calculations of the W4LOOP standard test problem and the W4LOOPR standard test problem were used to test update SUMNMULN. In the first calculation, file W4LOOP was modified as file W4LOOP1I to evaluate five new control blocks: one defining a constant pressure, two with operator 103 and $M=0$ and 1, and two with operator 104. The operator 104 control blocks required inputting two user-defined

- units-name labels. Both signal-variable and control-block parameter values were operated on by each of the operator 103 and 104 control blocks. A partial listing of the changes made in file W4LOOP1I, and the TRCOUT-file results from this steady-state calculation in file W4LOOP1O, are shown in Appendix B. The TRCOUT-file listing includes the echo of the modified input data and the signal-variable and control-block parameter values at iterations 0 and 165 (when steady-state convergence was satisfied). Hand calculations are shown of the control-block output values that agree with those calculated by TRAC-P.

In the second calculation, file W4LOOPR is modified as file W4LOOPR2I to input the two user-defined units-name labels and to get the input-data parameters of the five control blocks from the TRCRST file (the TRCDMP file from the W4LOOP first calculation). A partial listing of the changes made in file W4LOOPR2I, and the TRCOUT-file results from this transient calculation in file W4LOOPR2O, are shown in Appendix C. The TRCOUT-file listing shows subroutine RECNTL echoing the control-block input data in a form identical to that from subroutine RCNTL in the first calculation. The signal-variable and control-block parameter values at iterations 0 and 260 (at 5.022 s, the end of the transient calculation) are shown along with their hand-calculated values, which are in agreement.

The third calculation is a repeat of the first steady-state calculation, except that file INLAB from the first calculation, rather than file W4LOOP, is the TRACIN file renamed W4LOOP3I. Whereas file W4LOOP parameter values are in SI units, file INLAB parameter values are in English units. This required defining Namelist variable IOINP=1 in file W4LOOP3I. A partial listing of the changes made in file W4LOOP3I, and the TRCOUT-file results from this steady-state calculation in file W4LOOP3O, are shown in Appendix D. File W4LOOP3I also required further changes to correct for three INLAB-file output errors in TRAC-P. A trouble-report item on this was filed with the TRAC-P code custodian. Those corrections are commented on and shown on pages D-2 and D-3. The signal-variable and control-block parameter values at iterations 0 and 195 (when steady-state convergence was satisfied) are shown along with their hand calculated values, which are in agreement. The first- and third-calculation, steady-state solutions are similar but not identical because their input-data real-parameter values only agree to within 4 or 5 significant digits. This is because they are input with different units, and the conversion to SI units for the TRAC-P calculation does not provide identical input values. The difference in input data resulted in the third calculation requiring 195 iterations to converge, vs 165 iterations for the first calculation.

The new ZIONPWR standard test problem with 132 control blocks was evaluated to determine that update SUMNMULN doesn't affect the correct evaluation of all the other control blocks. This new test-problem version has 132 control blocks added to the current ZIONPWR standard test problem. It was used to test update FXCBI, which went into TRAC-P Version 5.4.23. TRAC-P Version 5.4.28 and TRAC-P Version 5.4.28 with all currently pending updates were executed on this new test problem ZIONPWR1I. Their TRCOUT-file results of files ZIONPWRO and ZIONPWR1O differed slightly because of the FILL- and BREAK-component mass-flow corrections of update FXFILL. The only control-block results that differed were operators 12 (derivative) and 13 (double integrator) in the seventh least significant

- digit (due to the slight solution difference) and operator 47 (random number generator). We conclude that update SUMNMULN doesn't affect the evaluation of the other control blocks. A second calculation was done with ZIONPWR1I modified as file ZIONPWR2I to include control-block operators 103 and 104 with TRAC-P internal initialization (ID numbers -103 and -104) and with CBBON2-input initialization (ID numbers -403 and -404). The TRCOUT-file results of files ZIONPWR1O and ZIONPWR2O differed only in the correctly initialized and evaluated control-block operators 103 and 104 of the later file. The input data for control-block operators 103 and 104 in file ZIONPWR2I and the control-block output data from the first and last large edits of the TRCOUT file in file ZIONPWR2O are shown in Appendix E.

6.0. CONCLUSIONS

Update SUMNMULN and its LABPRG input-data file LABSMN were programmed in TRAC-P Version 5.4.28 to evaluate new "Sum N" and "Multiply N" control-block operators 103 and 104, respectively. They were tested on modified versions of the W4LOOP, W4LOOPR, INLAB from W4LOOP, and ZIONPWR standard test problems. The input, input-data echo, evaluation, and output from control-block operators 103 and 104 operators were correct in the above test-problem calculations. This was done for both steady-state and transient calculations with the control-block, input-data parameters passed through the restart-data TRCRST file and through the labeled-input-data INLAB file with units conversion performed.

ACKNOWLEDGMENT

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APPENDIX A

Listing of LABPRG Input-Data File LABSMN and Update SUMNMULN

File LABSMN

```

1  0  0  1  labnew data required by update sumnmuln
2 wta      luserdef
3  0  0  0  labnew data end

```

Update SUMNMULN

```

1 *ident sumnmuln
2 */ -----Update Header Rev. 02-01-96-----
3 */
4 */   File & Update Ident name (must be the same): sumnmuln
5 */   TSHOOTER identifier:
6 */
7 */   Code developer: Bob Steinke           Date developed: 6/3/97
8 */   Acknowledgements: KAPL requested sum n & multiply n control blocks
9 */   Update reviewer:           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 sumnmuln (SUM N and MULTiply N) creates
16 */                       new control block operators 103 for Sum N and
17 */                       104 for Multiply N to evaluate the factor-
18 */                       weighted sum and the product of N signal
19 */                       variables and/or control blocks.
20 */
21 */   Basis for update:  To provide an extension of the functionality
22 */                       of the operator 57 Sum three and operator 59
23 */                       Weighted summer control blocks for summing
24 */                       more than three and two signal variables
25 */                       and/or control blocks, respectively.
26 */
27 */   Dependencies on other updates: none
28 */
29 */   Justification of non-ANSI coding: N.A.
30 */
31 */   Is this a NULL update?  YES_X_ NO ____
32 */   with the following exceptions:
33 */
34 */   For better readability, the control-block operator 61 label
35 */   '0thhld' as changed to '0 hold' and a blank line was added
36 */   above the control-block diagram and the control-block
37 */   tabular-data labels that are output to the trcout file.
38 */
39 */   Does this update generate new unit labels?  YES_X_ NO ____
40 */   If yes, path and /name of LABNEW file: /073417/labsmn
41 */
42 */   Does the TRAC I/O change because of this update?  YES_X_ NO ____
43 */   TRAC I/O includes input, dump, output, and graphics files.  If
44 */   yes, then submit the necessary manual changes.
45 */
46 */   The control-block input-data format requires the following
47 */   three new cards between Card Set 5 and Card Number 6.
48 */
49 */   Note: If ICBN = 103 and M = 1, input Card Number 5.2 and
50 */         Card Set 5.4.
51 */

```

```

52 */      Card Number 5.2.  (Format A14)  LUWTA
53 */      Columns   Variable   Description
54 */      1-14      LUWTA      Units-name label for all N elements of
55 */                                  the WTA array that is input by Card Set 5.4.
56 */
57 */      Card Set 5.4.  WTA(I),I=(1,N)  Load Format.
58 */      Variable   Dimension   Description
59 */      WTA        N           Weighting factor for each of the parameter
60 */                                  values of the N elements of the IDX array
61 */                                  that is input by Card Set 5.6.
62 */
63 */      Note: If ICBN = 103 or 104, input Card Set 5.6.
64 */
65 */      Card Set 5.6.  IDX(I),I=(1,N)  Load Format.
66 */      Variable   Dimension   Description
67 */      IDX        N           ID number for the Ith input parameter to
68 */                                  the control block whose value is to be
69 */                                  weighted and summed or multiplied.
70 */                                  IDX(I) > 0 defines a signal-variable
71 */                                  parameter; IDX(I) < 0 defines a control-
72 */                                  block output parameter.
73 */
74 */      Does this change require that any of the TRAC support codes, e.g.
75 */      EXTRACT, GOCNVRT, or EXCON, be changed?  YES _X_ NO ____
76 */      If yes, then include a description of the necessary changes.
77 */      This description will be passed onto the custodian of the TRAC
78 */      support codes.
79 */
80 */      GOCNVRT needs to be changed for future TRACIN files with
81 */      control block operators 103 and 104.
82 */
83 */      Does the TRAC User's Guide, Theory Manual, or Programmer's Guide
84 */      change because of this update?  YES _X_ NO ____
85 */      If yes, then submit the necessary manual changes.
86 */
87 */      The control-block input-data format changes need to be
88 */      made in Chapter 6 of the TRAC User's Guide.
89 */
90 */      NAME OF
91 */      SUBROUTINE
92 */      OR COMDECK
93 */      CHANGED      DESCRIPTION OF CHANGE
94 */
95 */      CBEDIT      Changes the control-block diagram edit to print out
96 */                                  the icb2 = 0 input-parameter value for operator 103
97 */                                  and the sum n  and mult n control-block names.
98 */      CBSET      Programmed to evaluate control-block operator 103
99 */                                  Sum N and operator 104 Multiply N.
100 */      RCNTL      Programmed to read and echo the read-data parameters
101 */                                  in the TRACIN file for control-block operator 103
102 */                                  Sum N and operator 104 Multiply N.
103 */      RECNTL      Programmed to read and echo the input-data parameters
104 */                                  in the TRCRST file for control-block operator 103
105 */                                  Sum N and operator 104 Multiply N.
106 */
107 */ -----
108 */
109 */      subroutine cbedit changes
110 */      *delete cbedit.10                                     cbedit
111 */          character*8 name(68)
112 */      *delete cbedit.23,cbedit.30                           cbedit
113 */      *delete units.69,cbedit.37                             cbedit

```

```

114 *delete units.71,units.80
115 c      '0 hold','tdelay','table1','table2',' sum n',
116 d      'mult n',' picon','pidcon'//
117 c
118     i=icbn
119     if (icbn.ge.100) i=i-38
120     if (icbn.ge.200) i=i-95
121     ncb3=icb3
122     if (((iabs(icb2)+iabs(icb3).ne.0).and.(icbn.ne.104)).or.
123     1     (icbn.eq.103)) go to 110
124     if (icbn.eq.104) ncb3=0
125     write(iout,100)
126 100 format('// the above control block has the',17x,10('*'))
127     j=icb1
128     go to 130
129 110 continue
130     ncb2=icb2
131     if ((icbn.eq. 12).or.(icbn.eq. 13).or.(icbn.eq. 18).or.
132     1     (icbn.eq. 27).or.(icbn.eq. 28).or.(icbn.eq. 30).or.
133     2     (icbn.eq. 51)) ncb2=0
134     if ((icbn.eq. 13).or.(icbn.eq. 30).or.(icbn.eq. 51).or.
135     1     (icbn.eq.100).or.(icbn.eq.101).or.(icbn.eq.103).or.
136     2     (icbn.eq.104).or.(icbn.eq.201)) ncb3=0
137     write(iout,120) icb1
138 120 format('// the above control block has the',i10,' ----> ',10('*'))
139     j=ncb2
140 130 continue
141     if ((j.ne.0).or.(icbn.eq.103)) go to 150
142 */
143 */ subroutine cbset changes
144 *insert cbset.86
145     if ((icbn.eq.103).or.(icbn.eq.104)) go to 251
146 c
147 *insert cbset.266
148 c
149 c     evaluate the "fng2or3" control block operation
150 c     by linear interpolation (without extrapolation)
151 c
152 *delete cbset.273,cbset.274
153     go to 260
154 c
155 c     evaluate the "sum n" and "multiply n" control block operations
156 c
157 251 continue
158     ii=ia(kcb+3)
159     if (icbn.eq.103) then
160         inw=lcntl+ia(kcb+5)-1
161         inx=inw+ii
162         a(kcb+17)=0.0
163     else
164         inx=lcntl+ia(kcb+5)-1
165         a(kcb+17)=1.0
166     endif
167     do 258 i=1,ii
168         inp=ia(inx+i)
169         if (inp.lt.0) go to 254
170 c
171 c     find the signal variable value corresponding to id number inp
172 c
173     kpt=ksvt
174     do 252 j=1,ntsv
175         if (inp.eq.ia(kpt+1)) go to 253

```

```

176      kpt=kpt+7
177  252 continue
178      write(imout,105) inp,i,ia(kcb+1)
179      write( iout,105) inp,i,ia(kcb+1)
180      write( itty,105) inp,i,ia(kcb+1)
181      call error(1,'*cbset* sig. var. id not found',3)
182  253 continue
183      val=a(kpt+7)
184      go to 257
185 c
186 c      find the control block output value corresponding to id number inp
187 c
188  254 continue
189      kpt=kcbt
190      do 255 j=1,ntcb
191      if (inp.eq.ia(kpt+1)) go to 256
192      kpt=kpt+17
193  255 continue
194      write(imout,135) inp,i,ia(kcb+1)
195      write( iout,135) inp,i,ia(kcb+1)
196      write( itty,135) inp,i,ia(kcb+1)
197      call error(1,'*cbset* cntl.blk. id not found',3)
198  256 continue
199      val=a(kpt+17)
200  257 continue
201      if (i.lt.4) a(kcb+12+i)=val
202      if (icbn.eq.103) then
203          a(kcb+17)=a(kcb+17)+a(inw+i)*val
204      else
205          a(kcb+17)=a(kcb+17)*val
206      endif
207  258 continue
208 *insert cbset.278                                cbset
209  260 continue
210 */
211 */ subroutine rcntl changes
212 *delete units.4427                                rcntl
213 c      is itrip(1)=11+6*ntcp+7*ntsv+17*ntcb+ntcf+6*ntcb
214 *insert rcntl.421                                rcntl
215      if (icbn.eq.103) go to 1301
216      if (icbn.eq.104) go to 1305
217 *delete units.4678                                rcntl
218  121      format(/5x,'luytab =',a,',      luxtab =',a)
219 *delete units.4690                                rcntl
220  1121      format(/5x,'luytab =',a,', luxtab(1) =',a,
221 *delete units.4703                                rcntl
222  2121      format(/5x,'luytab =',a,', luxtab(1) =',a,
223 *insert rcntl.474                                rcntl
224 c
225 c      read and edit the weighting-factor units label and
226 c      the weighting factor array data for operator 103
227 c
228  1301 continue
229      if (ioall.ne.0) then
230          if (icb2.eq.1) then
231              read(in,113) ra
232          else
233              ra='      lunounit'
234          endif
235          call justlr(ra,la,-1,ierr)
236          call justlr(la,ra,1,ierr)
237 *if def,ibm,2

```

```

238      ctrip(ii+5)=la(1:8)
239      ctrip(ii+6)=la(1:8)
240 *if -def,ibm,2
241      read(la(1:8),'(a8)') ctrip(ii+5)
242      read(la(1:8),'(a8)') ctrip(ii+6)
243      call unnumb('wta',la(1:8))
244      if (icb2.eq.1) then
245          if (inlab.eq.3) write(inlab,1302) ra
246 1302      format('*',8x,'luwta'/a)
247          write(iout,1303) ra(4:14)
248 1303      format(/6x,'luwta =',a)
249      endif
250  endif
251  if (icb2.eq.1) then
252      call load(atrip(kk+1),itrip(kk+1),icb1,1)
253      call warray('wta',atrip(kk+1),icb1,0)
254  else
255      do 1304 i=1,icb1
256          atrip(kk+i)=1.0
257 1304      continue
258      endif
259      kk=kk+icb1
260 c
261 c      read and edit the parameter id numbers for operators 103 and 104
262 c
263 1305 continue
264      call load(atrip(kk+1),itrip(kk+1),icb1,0)
265      call wiarr('idx',itrip(kk+1),icb1)
266      kk=kk+icb1
267      go to 134
268 */
269 */ subroutine recntl changes
270 *delete recntl.180
271      if (irest(kptr+2).lt.103) then
272          kk=irest(kptr+4)*2
273      else
274          kk=irest(kptr+3)*(104-irest(kptr+2))
275      endif
276 *delete units.6395
277      if ((irest(kptr+2).eq.103).or.(irest(kptr+2).eq.104)) then
278          k1=kk+1
279          kk=kk+irest(kptr+3)
280          do 2481 k=k1,kk
281              itrip(kjcf+k)=irest(kicf+k)
282 2481      continue
283      endif
284      if (irest(kptr+2).eq.100) then
285 *delete units.6400,units.6406
286      if (irest(kptr+2).lt.104) then
287 *if def,ibm,2
288         lle=crest(kcbu+5)
289         llf=crest(kcbu+6)
290 *if -def,ibm,2
291         write(lle,'(a8)') crest(kcbu+5)
292         write(llf,'(a8)') crest(kcbu+6)
293         if (irest(kptr+2).lt.103) then
294             call unnumb('cbftab',llf)
295         else
296             call unnumb('wta',llf)
297         endif
298     endif
299 *delete units.6414

```

recntl

recntl

recntl

recntl

```

300         elseif (irest(kptr+2).eq.102) then
301 *insert units.6422
302         else
303             j=1
304             if (irest(kptr+2).eq.103) then
305                 if (irest(kptr+4).eq.1) then
306                     call warray('wta',arest(kicf+j),kk/2,0)
307                 endif
308                 j=j+kk/2
309             endif
310             call wiarr('idx',irest(kicf+j),kk/(105-irest(kptr+2)))
311 */
312 *compile cbedit,cbset,rcntl,recntl
313 */
314 */ -----

```

APPENDIX B **Portions of the W4LOOP1I and W4LOOP1O File Listings** **From the Modified-W4LOOP Steady-State Calculation One**

Portions of the W4LOOP1I input-data TRACIN file

Added iunlab=2 on line 78 to input two user-defined units-name labels

```

72 *****
73 * namelist data *
74 *****
75 *
76 &inopts
77   cpuflg=1, iadded=10, idiag=4, inlab=3, iogrf=1, iolab=1, ioout=1,
78   iunlab=2, nhtstr=15, noair=0, nsdl=0, nsdu=5, nspl=0, nspl=5
79 &end

```

Changed ntcb=0 to 5 and ntcf=0 to 2*4+2*5+4+5=27 on line 90

```

87 *      oitmax      sitmax      isolut      ncontr      nccfl
88      10           10           0           8           0
89 *      ntsv        ntcb        ntcf        ntrp        ntcp
90      4           5           27          2           1

```

Defined two units-name labels needed by control blocks -8 and -9 and defined five control blocks to test operators 103 and 104

```

207 * signal variables
208 *      idsv        isvn        ilcn        icn1        icn2
209      1           0           0           0           0
210      2           21          15           3           0
211      3           21          19           2           0
212      4           21          26          1003          0
213 *
214 * user-defined units-name labels
215 *      lulabel      lunitsi      luniteng      ufactor      ushift
216      lupxx4        lupaxx4      lupsiaxx4      4.4251e-16      0.0000e+00
217      lupxx5        lupaxx5      lupsiaxx5      6.4181e-20      0.0000e+00
218 *
219 * control blocks
220 *      idcb        icbn        icb1        icb2        icb3
221      -5           9           0           0           0
222 *      lugain      luxmin      luxmax      lucon1      lucon2
223      lunounit      lupressa      lupressa      lupressa      lunounit
224 *      cbgain      cbxmin      cbxmax      cbcon1      cbcon2
225      1.0000e+00      1.5513e+07      1.5513e+07      1.5513e+07      0.0000e+00
226 *
227 *      idcb        icbn        icb1        icb2        icb3
228      -6           103          4           0           0
229 *      lugain      luxmin      luxmax      lucon1      lucon2
230      lunounit      lupressa      lupressa      lunounit      lunounit
231 *      cbgain      cbxmin      cbxmax      cbcon1      cbcon2
232      1.0000e+00      0.0000e+00      1.0000e+08      0.0000e+00      0.0000e+00
233 * idx *          2           3           4           -5e
234 *
235 *      idcb        icbn        icb1        icb2        icb3
236      -7           103          5           1           0
237 *      lugain      luxmin      luxmax      lucon1      lucon2
238      lunounit      lupressa      lupressa      lunounit      lunounit
239 *      cbgain      cbxmin      cbxmax      cbcon1      cbcon2

```



```

240      1.0000e+00      0.0000e+00      1.0000e+08      0.0000e+00      0.0000e+00
241 *      luwat
242      lunounit
243 * wta *      1.0000e-01      1.5000e-01      2.0000e-01      2.5000e-01s
244 * wta *      3.0000e-01e
245 * idx *      2      3      4      -5s
246 * idx *      -6e
247 *
248 *      idcb      icbn      icb1      icb2      icb3
249      -8      104      4      0      0
250 *      lugain      luxmin      luxmax      lucon1      lucon2
251      lunounit      lupxx4      lupxx4      lunounit      lunounit
252 *      cbgain      cbxmin      cbxmax      cbcon1      cbcon2
253      1.0000e+00      0.0000e+00      1.0000e+32      0.0000e+00      0.0000e+00
254 * idx *      2      3      4      -5e
255 *
256 *      idcb      icbn      icb1      icb2      icb3
257      -9      104      5      0      0
258 *      lugain      luxmin      luxmax      lucon1      lucon2
259      lunounit      lupxx5      lupxx5      lunounit      lunounit
260 *      cbgain      cbxmin      cbxmax      cbcon1      cbcon2
261      1.0000e+00      0.0000e+00      1.0000e+40      0.0000e+00      0.0000e+00
262 * idx *      2      3      4      -5s
263 * idx *      -6e
264 *
265 * trips

```

Portions of the W4LOOP10 output-data TRCOUT file

```

302      epso = 1.0000E-03,      epss = 1.0000E-04
303
304      oitmax =      10,      sitmax =      10,      isolut =      0,      ncontr =      8,      nccfl =      0
305      ntsv =      4,      ntcbl =      5,      ntcfl =      27,      ntrp =      2,      ntcp =      1
306
390 signal-variable data cards
391
392      idsv =      1,      isvn =      0,      ilcn =      0,      icn1 =      0,      icn2 =      0
393      idsv =      2,      isvn =      21,      ilcn =      15,      icn1 =      3,      icn2 =      0
394      idsv =      3,      isvn =      21,      ilcn =      19,      icn1 =      2,      icn2 =      0
395      idsv =      4,      isvn =      21,      ilcn =      26,      icn1 =      1003,      icn2 =      0
396
397 user-defined unit-labels data cards
398
399      lulabel =      lupxx4, lunitsi =      lupaxx4, luniteng =      lupsiaxx4, ufactor = 4.4251E-16,      ushift = 0.0000E+00
400      lulabel =      lupxx5, lunitsi =      lupaxx5, luniteng =      lupsiaxx5, ufactor = 6.4181E-20,      ushift = 0.0000E+00
401
402 control-block data cards
403
404      idcb =      -5,      icbn =      9,      icb1 =      0,      icb2 =      0,      icb3 =      0
405      lugain =      lunounit,      luxmin =      lupressa,      luxmax =      lupressa,      lucon1 =      lupressa,      lucon2 =      lunounit
406      cbgain = 1.0000E+00,      cbxmin = 2.2500E+03,      cbxmax = 2.2500E+03,      cbcon1 = 2.2500E+03,      cbcon2 = 0.0000E+00
407      -      psia      psia      psia
408
409 the above control block has the
410 following input ids, function
411 operator type, and output id
412
413      idcb =      -6,      icbn =      103,      icb1 =      4,      icb2 =      0,      icb3 =      0
414      lugain =      lunounit,      luxmin =      lupressa,      luxmax =      lupressa,      lucon1 =      lunounit,      lucon2 =      lunounit
415      cbgain = 1.0000E+00,      cbxmin = 0.0000E+00,      cbxmax = 1.4504E+04,      cbcon1 = 0.0000E+00,      cbcon2 = 0.0000E+00
416      -      psia      psia
417
418 the above control block has the
419 following input ids, function
420 operator type, and output id
421
422      idx      2      3      4      -5
423
424      idcb =      -7,      icbn =      103,      icb1 =      5,      icb2 =      1,      icb3 =      0
425      lugain =      lunounit,      luxmin =      lupressa,      luxmax =      lupressa,      lucon1 =      lunounit,      lucon2 =      lunounit
426      cbgain = 1.0000E+00,      cbxmin = 0.0000E+00,      cbxmax = 1.4504E+04,      cbcon1 = 0.0000E+00,      cbcon2 = 0.0000E+00
427      -      psia      psia
428
429 the above control block has the
430 following input ids, function
431 operator type, and output id
432
433      luwta =      lunounit
434
435 wta      1.00000E-01      1.50000E-01      2.00000E-01      2.50000E-01      3.00000E-01
436

```

```

437
438 idx          2          3          4          -5          -6
439
440      idcb =      -8,      icbn =      104,      icb1 =      4,      icb2 =      0,      icb3 =      0
441      lugain = lunounit, luxmin = lupxx4, luxmax = lupxx4, lucon1 = lunounit, lucon2 = lunounit
442      cbgain = 1.0000E+00, cbxmin = 0.0000E+00, cbxmax = 4.4251E+16, cbcon1 = 0.0000E+00, cbcon2 = 0.0000E+00
443      -
444      psiaxx4      psiaxx4
445 the above control block has the
446 following input ids, function      4 ----> * mult n * ----> -8
447 operator type, and output id
448
449 idx          2          3          4          -5
450
451      idcb =      -9,      icbn =      104,      icb1 =      5,      icb2 =      0,      icb3 =      0
452      lugain = lunounit, luxmin = lupxx5, luxmax = lupxx5, lucon1 = lunounit, lucon2 = lunounit
453      cbgain = 1.0000E+00, cbxmin = 0.0000E+00, cbxmax = 6.4181E+20, cbcon1 = 0.0000E+00, cbcon2 = 0.0000E+00
454      -
455      psiaxx5      psiaxx5
456 the above control block has the
457 following input ids, function      5 ----> * mult n * ----> -9
458 operator type, and output id
459
460 idx          2          3          4          -5          -6
461
462 trip-dimension data card
463      ntse =      0,      ntct =      0,      ntsf =      0,      ntgp =      0,      ntsd =      0

```

Control-parameter data at timestep 0

Hand calculations will be done to check the control-block output values

```

4757 trac large edit
4758
4759 problem time is 0.000000E+00 s, time-step size is 4.0000E-04 s, time-step number is 0, outer-iteration number is 0
4760
4761 maximum convective power difference has been 0.3412142E+01 btu/hr in component 0 at time-1.000000E+00 s
4762 time-step size was limited by component 0 at cell 0 to 1.0000E+08 s
4763 average outer-iteration count over the last 0 time steps was 0.000
4764 last minimum number of outer iterations was 0 at time step 0 (limited by component 0 with fr.error of 0.0000E+00)
4765 last maximum number of outer iterations was 0 at time step 0 (limited by component 0 with fr.error of 0.0000E+00)
4766 total number of times that each component (id#) was the last to converge since the last short edit
4767 0( 1) 0( 2) 0( 3) 0( 4) 0( 5) 0( 6) 0( 7) 0(10) 0(11) 0(12) 0(13) 0(14)
4768 0(15) 0(16) 0(17) 0(18) 0(19) 0(20) 0(21) 0(22) 0(23) 0(24) 0(25)
4769 0(17) 0(27) 0( 8) 0( 9) 0(18) 0(28) 0(24) 0(23) 0(26)
4770 current maximum time-step sizes and limitation counts since the last short edit
4771      delamx      delcmx      deldmx      deleamx      delpmx      delmx      delvmx      delxmx
4772      1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s
4773      0          0          0          0          0          0          0          0
4774 further limitation counts on what controls delcmx
4775      dtlmx      dtvmx      dprmx      dtsms      dtrmx      delt/2
4776      0          0          0          0          0          0
4777
4778 cpu execution time of this run is s
4779
4780 total time steps since time 0.0 s is 0
4781 total cpu time since time 0.0 s is s
4782
4783 ***** signal-variable values at time 0.00000 s *****
4784
4785      id      sig.var.      id      sig.var.      id      sig.var.      id      sig.var.      id      sig.var.
4786
4787      1      0.000000E+00      2      2.249970E+03      3      2.249970E+03      4      2.249970E+03      9901      3.374660E+07
4788      time (s)      press (psia)      press (psia)      press (psia)      z mmf (lbm/hr)
4789      9902      1.012398E+08      9903      3.083385E+06      9904      9.250156E+06      9905      5.303300E+02      9906      5.303300E+02
4790      z mmf (lbm/hr)      z mmf (lbm/hr)      z mmf (lbm/hr)      c mix temp (f)      c mix temp (f)
4791      9907      5.303300E+02      9908      5.303300E+02
4792      c mix temp (f)      c mix temp (f)
4793
4794 ***** control-block output values at time 0.00000 s *****
4795
4796      id      con.blk.      id      con.blk.      id      con.blk.      id      con.blk.      id      con.blk.
4797
4798      -5      2.249970E+03      -6      8.999882E+03      -7      4.274944E+03      -8      2.562750E+13      -9      2.306457E+17
4799      psia      psia      psia      psiaxx4      psiaxx5
4800      -9901      1.187932E+03      -9902      1.187932E+03      -9903      0.000000E+00      -9904      0.000000E+00      -9905      1.000000E+00
4801      rpm      rpm      lbm/hr
4802      -9906      1.000000E+00      -9907      1.000000E+00      -9908      1.000000E+00
4803

```

Signal variables 2, 3, and 4 and control block -5 : 1.5513e+07 Pa x 1.45037738e-04 = 2.249970e+03 psia OK
Control block -6 : 2.249970e+03 (sig.var.2) + 2.249970e+03 (sig.var.3) + 2.249970e+03 (sig.var.4) +
2.249970e+03 (con.blk.-5) = 8.999880e+03 OK
Control block -7 : 0.10*2.249970e+03 (sig.var.2) + 0.15*2.249970e+03 (sig.var.3) + 0.20*2.2499698e+03 (sig.var.4) +
0.25*2.249970e+03 (con.blk.-5) + 0.30*8.999882e+03 (con.blk.-6) = 4.274944e+03 OK
Control block -8 : 2.249970e+03 (sig.var.2) * 2.249970e+03 (sig.var.3) * 2.249970e+03 (sig.var.4) *
2.249970e+03 (con.blk.-5) = 2.562754e+13 OK
Control block -9 : 2.249970e+03 (sig.var.2) * 2.249970e+03 (sig.var.3) * 2.249970e+03 (sig.var.4) *
2.249970e+03 (con.blk.-5) * 8.999882e+03 (con.blk.-6) = 2.306448e+17 OK

Control-parameter data at timestep 165 where steady-state convergence was satisfied

```

29884 trac large edit
29885
29886 problem time is 0.000000E+00 s, time-step size is 2.0000E+00 s, time-step number is 165, outer-iteration number is 1
29887
29888 maximum convective power difference has been 0.5660492E+10 btu/hr in component 128 at time-1.000000E+00 s
29889 time-step size was limited by component 14 at cell 4 to 2.2993E-02 s

```

```

29890 average outer-iteration count over the last 160 time steps was 1.244
29891 last minimum number of outer iterations was 1 at time step 164 (limited by component 14 with fr.error of 1.1493E-07)
29892 last maximum number of outer iterations was 5 at time step 6 (limited by component 10 with fr.error of 7.3758E-07)
29893 total number of times that each component (id#) was the last to converge since the last short edit
29894 0( 1) 0( 2) 13( 3) 15( 4) 10( 5) 1( 6) 0( 7) 20( 10) 6( 11) 9( 12) 11( 13) 11( 14)
29895 4( 15) 0( 41) 2( 19) 0( 20) 3( 21) 0( 42) 0( 43) 0( 44) 5( 16) 0( 22) 0( 31) 0( 25)
29896 1( 17) 38( 27) 0( 8) 0( 9) 0( 18) 6( 28) 0( 24) 0( 23) 5( 26)
29897 current maximum time-step sizes and limitation counts since the last short edit
29898 delamx delcmx deldmx deleamx delpmx delrmx delvmx delxmx
29899 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 2.2993E+01 s 1.0000E+08 s
29900 0 0 0 0 0 0 0 0
29901 further limitation counts on what controls delcmx
29902 dtlmx dtvmx dprmx dtmsm dtrmx delt/2
29903 0 0 0 0 0 0
29904
29905 cpu execution time of this run is s
29906
29907 total time steps since time 0.0 s is 165
29908 total cpu time since time 0.0 s is s
29909
29910 ***** signal-variable values at time -2.00000 s *****
29911
29912 id sig.var. id sig.var. id sig.var. id sig.var. id sig.var.
29913
29914 1 2.020248E+02 2 2.299353E+03 3 2.250986E+03 4 2.286714E+03 9901 3.374579E+07
29915 time (s) press (psia) press (psia) press (psia) z mmf (lbm/hr)
29916 9902 1.012373E+08 9903 3.084222E+06 9904 9.248657E+06 9905 5.303466E+02 9906 5.303466E+02
29917 z mmf (lbm/hr) z mmf (lbm/hr) z mmf (lbm/hr) c mix temp (f) c mix temp (f)
29918 9907 5.303467E+02 9908 5.303467E+02
29919 c mix temp (f) c mix temp (f)
29920
29921 ***** control-block output values at time -2.00000 s *****
29922
29923 id con.blk. id con.blk. id con.blk. id con.blk. id con.blk.
29924
29925 -5 2.249970E+03 -6 9.087023E+03 -7 4.313526E+03 -8 2.662969E+13 -9 2.419859E+17
29926 psia psia psia psiaxx4 psiaxx5
29927 -9901 1.134913E+03 -9902 1.139523E+03 -9903 3.084222E+06 -9904 9.248657E+06 -9905 1.110697E+00
29928 rpm rpm lbm/hr lbm/hr
29929 -9906 1.110697E+00 -9907 1.110359E+00 -9908 1.110359E+00
29930
Control block -5 : 1.5513e+07 Pa x 1.45037738e-04 = 2.249970e+03 psia OK
Control block -6 : 2.299353e+03 (sig.var.2) + 2.250986e+03 (sig.var.3) + 2.286714e+03 (sig.var.4) +
2.249970e+03 (con.blk.-5) = 9.087023e+03 OK
Control block -7 : 0.10*2.299353e+03 (sig.var.2) + 0.15*2.250986e+03 (sig.var.3) + 0.20*2.286714e+03 (sig.var.4) +
0.25*2.249970e+03 (con.blk.-5) + 0.30*9.087023e+03 (con.blk.-6) = 4.313525e+03 OK
Control block -8 : 2.299353e+03 (sig.var.2) * 2.250986e+03 (sig.var.3) * 2.286714e+03 (sig.var.4) *
2.249970e+03 (con.blk.-5) = 2.662975e+13 OK
Control block -9 : 2.299353e+03 (sig.var.2) * 2.250986e+03 (sig.var.3) * 2.286714e+03 (sig.var.4) *
2.249970e+03 (con.blk.-5) * 9.087023e+03 (con.blk.-6) = 2.419851e+17 OK

```

APPENDIX C Portions of the W4LOOPR2I and W4LOOPR2O File Listings From the Modified-W4LOOPR Transient Calculation Two

Portions of the W4LOOPR2I input-data TRACIN file

Added iunlab=2 to line 74 to input two user-defined units-name labels

```

68 *****
69 * namelist data *
70 *****
71 *
72 &inopts
73   cpuflg=1, dtstrt=0.01, iadded=10, icdelt=1, idiag=4,
74   inlab=3, iogrf=1, iolab=1, ioout=1, iunlab=2, nhtstr=15,
75   noair=0, nsdl=0, nsdu=5, nspl=0, nsps=5
76 &end

```

Changed ntcbl=0 to 5 and ntcf=0 to 2*4+2*5+4+5=27 on line 87

```

84 *          oitmax          sitmax          isolut          ncontr          nccfl
85          10              10              0              0              0
86 *          ntsv            ntcbl            ntcf            ntrp            ntcp
87          4              5              27              2              1

```

Added two units-name labels needed for control blocks -8 and -9 and added a line of 0s to indicate all control blocks are to be read from the restart file

```

108 * signal variables
109 *
110 *          idsv            isvn            ilcn            icn1            icn2
111          0              0              0              0              0
112 *
113 * user-defined units-name labels
114 *          lulabel          lunitsi          luniteng          ufactor          ushift
115          lupxx4          lupaxx4          lupsiaxx4          4.4251e-16          0.0000e+00
116          lupxx5          lupaxx5          lupsiaxx5          6.4181e-20          0.0000e+00
117 *
118 * control blocks
119 *          idcb            icbn            icb1            icb2            icb3
120          0              0              0              0              0
121 *
122 * trips

```

Portions of the W4LOOPR2O output-data TRCOUT file

```

239   isolcn =      0,   istopt =      0,   iunout =      1,   levstg =      0,   mhtli =      0
240   ithd =      0,   iunlab =      2,   mhtvo =      0,   mwfl =      0,   mwfv =      0
241   mhtlo =      0,   mhtvi =      0,
300   oitmax =     10,   sitmax =     10,   isolut =      0,   ncontr =      0,   nccfl =      0
301   ntsv =      4,   ntcbl =      5,   ntcf =     27,   ntrp =      2,   ntcp =      1
302
310   idsv =      0,   isvn =      0,   ilcn =      0,   icn1 =      0,   icn2 =      0
311
312 user-defined unit-labels data cards
313
314   lulabel = lupxx4, lunitsi = lupaxx4, luniteng = lupsiaxx4, ufactor = 4.4251E-16, ushift = 0.0000E+00
315   lulabel = lupxx5, lunitsi = lupaxx5, luniteng = lupsiaxx5, ufactor = 6.4181E-20, ushift = 0.0000E+00
316
317 control-block data cards
318
319   idcb =      0,   icbn =      0,   icb1 =      0,   icb2 =      0,   icb3 =      0
320
321 trip-dimension data card
322   ntse =      0,   ntct =      0,   ntsf =      0,   ntcp =      0,   ntsc =      0

```

```

353 restarting from final dump found at time-step number 165 and time 0.00000E+00 s
354
355 signal variables from the restart file
356
357 idsv = 1, isvn = 0, ilcn = 0, icn1 = 0, icn2 = 0
358 idsv = 2, isvn = 21, ilcn = 15, icn1 = 3, icn2 = 0
359 idsv = 3, isvn = 21, ilcn = 19, icn1 = 2, icn2 = 0
360 idsv = 4, isvn = 21, ilcn = 26, icn1 = 1003, icn2 = 0
361
362 control-block data from the restart file
363
364 idcb = -5, icbn = 9, icb1 = 0, icb2 = 0, icb3 = 0
365 lugain = lunounit, luxmin = lupressa, luxmax = lupressa, lucon1 = lupressa, lucon2 = lunounit
366 cbgain = 1.0000E+00, cbxmin = 2.2500E+03, cbxmax = 2.2500E+03, cbcon1 = 2.2500E+03, cbcon2 = 0.0000E+00
367 psia psia
368
369 the above control block has the
370 following input ids, function
371 operator type, and output id
372
373 idcb = -6, icbn = 103, icb1 = 4, icb2 = 0, icb3 = 322
374 lugain = lunounit, luxmin = lupressa, luxmax = lupressa, lucon1 = lunounit, lucon2 = lunounit
375 cbgain = 1.0000E+00, cbxmin = 0.0000E+00, cbxmax = 1.4504E+04, cbcon1 = 0.0000E+00, cbcon2 = 0.0000E+00
376 psia psia
377
378 the above control block has the
379 following input ids, function
380 operator type, and output id
381
382 idx 2 3 4 -5
383
384 idcb = -7, icbn = 103, icb1 = 5, icb2 = 1, icb3 = 330
385 lugain = lunounit, luxmin = lupressa, luxmax = lupressa, lucon1 = lunounit, lucon2 = lunounit
386 cbgain = 1.0000E+00, cbxmin = 0.0000E+00, cbxmax = 1.4504E+04, cbcon1 = 0.0000E+00, cbcon2 = 0.0000E+00
387 psia psia
388
389 the above control block has the
390 following input ids, function
391 operator type, and output id
392
393 wta 1.00000E-01 1.50000E-01 2.00000E-01 2.50000E-01 3.00000E-01
394
395
396 idx 2 3 4 -5 -6
397
398 idcb = -8, icbn = 104, icb1 = 4, icb2 = 0, icb3 = 340
399 lugain = lunounit, luxmin = lupxxx4, luxmax = lupxxx4, lucon1 = lunounit, lucon2 = lunounit
400 cbgain = 1.0000E+00, cbxmin = 0.0000E+00, cbxmax = 4.4251E+16, cbcon1 = 0.0000E+00, cbcon2 = 0.0000E+00
401 psiaxxx4 psiaxxx4
402
403 the above control block has the
404 following input ids, function
405 operator type, and output id
406
407 idx 2 3 4 -5
408
409 idcb = -9, icbn = 104, icb1 = 5, icb2 = 0, icb3 = 344
410 lugain = lunounit, luxmin = lupxxx5, luxmax = lupxxx5, lucon1 = lunounit, lucon2 = lunounit
411 cbgain = 1.0000E+00, cbxmin = 0.0000E+00, cbxmax = 6.4181E+20, cbcon1 = 0.0000E+00, cbcon2 = 0.0000E+00
412 psiaxxx5 psiaxxx5
413
414 the above control block has the
415 following input ids, function
416 operator type, and output id
417
418 idx 2 3 4 -5 -6
419
420 trip-defining variables from the restart file

```

Control-parameter data at timestep 0
Hand calculations will be done to check the control-block output values

```

4893 trac large edit
4894
4895 problem time is 0.000000E+00 s, time-step size is 1.0000E-02 s, time-step number is 0, outer-iteration number is 0
4896
4897 maximum convective power difference has been -0.3412142E+01 btu/hr in component 0 at time -1.0000000E+00 s
4898 time-step size was limited by component 0 at cell 0 to 1.0000E+08 s
4899 average outer-iteration count over the last 0 time steps was 0.000
4900 last minimum number of outer iterations was 0 at time step 0 (limited by component 0 with fr.error of 0.0000E+00)
4901 last maximum number of outer iterations was 0 at time step 0 (limited by component 0 with fr.error of 0.0000E+00)
4902 total number of times that each component (id#) was the last to converge since the last short edit
4903 0( 1) 0( 2) 0( 3) 0( 4) 0( 5) 0( 6) 0( 7) 0( 10) 0( 11) 0( 12) 0( 13) 0( 14)
4904 0( 15) 0( 41) 0( 19) 0( 20) 0( 21) 0( 42) 0( 43) 0( 44) 0( 16) 0( 22) 0( 31) 0( 25)
4905 0( 17) 0( 27) 0( 9) 0( 8) 0( 18) 0( 28) 0( 24) 0( 23) 0( 26)
4906 current maximum time-step sizes and limitation counts since the last short edit
4907 delamx delcmx deldmx delpmx delvnx delvnx delvnx
4908 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 2.2993E+01 s 1.0000E+08 s
4909 0 0 0 0 0 0 0 0
4910 further limitation counts on what controls delcmx
4911 dtlmx dtvnx dprmx dtsms dtrmx delt/2
4912 0 0 0 0 0 0
4913
4914 cpu execution time of this run is s
4915
4916 total time steps since time 0.0 s is 165

```

```

4917 total cpu time since time 0.0 s is s
4918
4919 ***** signal-variable values at time 0.00000 s *****
4920
4921 id sig.var. id sig.var. id sig.var. id sig.var. id sig.var.
4922
4923 1 0.000000E+00 2 2.299353E+03 3 2.250986E+03 4 2.286713E+03
4924 time (s) press (psia) press (psia) press (psia)
4925
4926 ***** control-block output values at time 0.00000 s *****
4927
4928 id con.blk. id con.blk. id con.blk. id con.blk. id con.blk.
4929
4930 -5 2.249970E+03 -6 9.087023E+03 -7 4.313525E+03 -8 2.662968E+13 -9 2.419859E+17
4931 psia psia psia psiaxxx4 psiaxxx5

Control block -5 : 1.5513e+07 Pa x 1.45037738e-04 = 2.249970e+03 psia OK
Control block -6 : 2.299353e+03 (sig.var.2) + 2.250986e+03 (sig.var.3) + 2.286713e+03 (sig.var.4) +
2.249970e+03 (con.blk.-5) = 9.087022e+03 OK
Control block -7 : 0.10*2.299353e+03 (sig.var.2) + 0.15*2.250986e+03 (sig.var.3) + 0.20*2.286713e+03 (sig.var.4) +
0.25*2.249970e+03 (con.blk.-5) + 0.30*9.087023e+03 (con.blk.-6) = 4.313525e+03 OK
Control block -8 : 2.299353e+03 (sig.var.2) * 2.250986e+03 (sig.var.3) * 2.286713e+03 (sig.var.4) *
2.249970e+03 (con.blk.-5) = 2.662975e+13 OK
Control block -9 : 2.299353e+03 (sig.var.2) * 2.250986e+03 (sig.var.3) * 2.286713e+03 (sig.var.4) *
2.249970e+03 (con.blk.-5) * 9.087023e+03 (con.blk.-6) = 2.419851e+17 OK

Control-parameter data at timestep 260 after 5.022 s of the transient calculation

33757 restart dump generated at problem time 5.021983 s after 260 time steps
33758 1
33759 trac large edit
33760
33761 problem time is 5.021983E+00 s, time-step size is 2.4976E-02 s, time-step number is 260, outer-iteration number is 2
33762
33763 maximum convective power difference has been 0.3061523E+09 btu/hr in component 128 at time 3.6354410E+00 s
33764 time-step size was limited by component 6 at cell 2 to 2.4869E-05 s
33765 average outer-iteration count over the last 47 time steps was 2.106
33766 last minimum number of outer iterations was 2 at time step 259 (limited by component 12 with fr.error of 3.2679E-05)
33767 last maximum number of outer iterations was 3 at time step 255 (limited by component 4 with fr.error of 2.9871E-07)
33768 total number of times that each component (id#) was the last to converge since the last short edit
33769 0( 1) 0( 2) 3( 3) 3( 4) 4( 5) 0( 6) 0( 7) 0( 10) 0( 11) 36( 12) 0( 13) 0( 14)
33770 0( 15) 0( 41) 0( 19) 0( 20) 0( 21) 0( 42) 0( 43) 0( 44) 0( 16) 0( 22) 0( 31) 0( 25)
33771 0( 17) 0( 27) 0( 9) 0( 8) 0( 18) 0( 28) 0( 24) 0( 23) 1( 26)
33772 current maximum time-step sizes and limitation counts since the last short edit
33773 delamx delcmx deldmx delenmx delpmx delrmx delvmx delxm
33774 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 4.0388E+00 s 1.0000E+08 s 2.4976E-02 s 1.0000E+08 s
33775 0 0 0 0 0 0 47 0
33776 further limitation counts on what controls delcmx
33777 dtlmx dtvmx dprmx dtsms dtrmx delt/2
33778 0 0 0 0 0 0
33779
33780 cpu execution time of this run is s
33781
33782 total time steps since time 0.0 s is 425
33783 total cpu time since time 0.0 s is s
33784
33785 ***** signal-variable values at time 4.99701 s *****
33786
33787 id sig.var. id sig.var. id sig.var. id sig.var. id sig.var.
33788
33789 1 4.997007E+00 2 1.046063E+03 3 1.947116E+03 4 1.046578E+03
33790 time (s) press (psia) press (psia) press (psia)
33791
33792 ***** control-block output values at time 4.99701 s *****
33793
33794 id con.blk. id con.blk. id con.blk. id con.blk. id con.blk.
33795
33796 -5 2.249970E+03 -6 6.289727E+03 -7 3.055400E+03 -8 4.796197E+12 -9 3.016694E+16
33797 psia psia psia psiaxxx4 psiaxxx5

Control block -5 : 1.5513e+07 Pa x 1.45037738e-04 = 2.249970e+03 psia OK
Control block -6 : 1.046063e+03 (sig.var.2) + 1.947116e+03 (sig.var.3) + 1.046578e+03 (sig.var.4) +
2.249970e+03 (con.blk.-5) = 6.289727e+03 OK
Control block -7 : 0.10*1.046063e+03 (sig.var.2) + 0.15*1.947116e+03 (sig.var.3) + 0.20*1.046578e+03 (sig.var.4) +
0.25*2.249970e+03 (con.blk.-5) + 0.30*6.289727e+03 (con.blk.-6) = 3.055400e+03 OK
Control block -8 : 1.046063e+03 (sig.var.2) * 1.947116e+03 (sig.var.3) * 1.046578e+03 (sig.var.4) *
2.249970e+03 (con.blk.-5) = 4.796208e+12 OK
Control block -9 : 1.046063e+03 (sig.var.2) * 1.947116e+03 (sig.var.3) * 1.046578e+03 (sig.var.4) *
2.249970e+03 (con.blk.-5) * 6.289727e+03 (con.blk.-6) = 3.016684e+16 OK

```

APPENDIX D **Portions of the W4LOOP3I and W4LOOP3O File Listings** **From the Modified-INLAB (W4LOOP) Steady-State Calculation Three**

Portions of the W4LOOP3I (INLAB) input-data TRACIN file

Added ioinp=1 on line 25 because the INLAB data is in English units; has iunlab=2 on line 27 from the W4LOOP1I file

```

20 *****
21 * namelist data *
22 *****
23 *
24 &inopts
25   ioinp=1,
26   cpuflg=1, iadded=10, idiag=4, inlab=3, iogrf=1, iolab=1, ioout=1,
27   iunlab=2, nhtstr=15, noair=0, nsdl=0, nsdu=5, nspl=0, nspu=5
28 &end

```

Has ntcb=5 and ntcf=27 from the W4LOOP1I file

```

36 *      oitmax      sitmax      isolut      ncontr      nccfl
37      10           10           0           8           0
38 *      ntsv        ntcb        ntcf        ntrp        ntcp
39      4            5           27           2           1

```

Has the two units-name labels and five control blocks from the W4LOOP1I file

```

134 *      idsv      isvn      ilcn      icn1      icn2
135      4           21       26       1003        0
136 *
137 * user-defined unit labels
138 *      lulabel    lunitsi    luniteng    ufactor    ushift
139      lupxx4      lupaxx4    lupsiaxx4    4.4251E-16  0.0000E+00
140 *      lulabel    lunitsi    luniteng    ufactor    ushift
141      lupxx5      lupaxx5    lupsiaxx5    6.4181E-20  0.0000E+00
142 *
143 * control blocks
144 *      idcb      icbn      icb1      icb2      icb3
145      -5         9         0         0         0
146 *      lugain    luxmin    luxmax    lucon1    lucon2
147      lunounit    lupressa    lupressa    lupressa    lunounit
148 *      cbgain    cbxmin    cbxmax    cbcon1    cbcon2
149      1.0000E+00  2.2500E+03  2.2500E+03  2.2500E+03  0.0000E+00
150 *      idcb      icbn      icb1      icb2      icb3
151      -6         103        4         0         0
152 *      lugain    luxmin    luxmax    lucon1    lucon2
153      lunounit    lupressa    lupressa    lunounit    lunounit
154 *      cbgain    cbxmin    cbxmax    cbcon1    cbcon2
155      1.0000E+00  0.0000E+00  1.4504E+04  0.0000E+00  0.0000E+00
156 * idx      *      2         3         4         -5e
157 *      idcb      icbn      icb1      icb2      icb3
158      -7         103        5         1         0
159 *      lugain    luxmin    luxmax    lucon1    lucon2
160      lunounit    lupressa    lupressa    lunounit    lunounit
161 *      cbgain    cbxmin    cbxmax    cbcon1    cbcon2
162      1.0000E+00  0.0000E+00  1.4504E+04  0.0000E+00  0.0000E+00
163 *      luwta
164      lunounit
165 * wta      *      1.0000E-01  1.5000E-01  2.0000E-01  2.5000E-01  3.0000E-01

```

```

166 * wta      * e
167 * idx      *           2           3           4           -5           -6
168 * idx      * e
169 *          idcb      icbn      icb1      icb2      icb3
170 *          -8      104      4      0      0
171 *          lugain      luxmin      luxmax      lucon1      lucon2
172 *          lunounit      lupxx4      lupxx4      lunounit      lunounit
173 *          cbgain      cbxmin      cbxmax      cbcon1      cbcon2
174 *          1.0000E+00      0.0000E+00      4.4251E+16      0.0000E+00      0.0000E+00
175 * idx      *           2           3           4           -5e
176 *          idcb      icbn      icb1      icb2      icb3
177 *          -9      104      5      0      0
178 *          lugain      luxmin      luxmax      lucon1      lucon2
179 *          lunounit      lupxx5      lupxx5      lunounit      lunounit
180 *          cbgain      cbxmin      cbxmax      cbcon1      cbcon2
181 *          1.0000E+00      0.0000E+00      6.4181E+20      0.0000E+00      0.0000E+00
182 * idx      *           2           3           4           -5           -6
183 * idx      * e
184 *
185 * trips

```

All level data of VESSEL 26 need to have the vwfmly, vwfmlyz, vwfmlyx, vwfmlyy, vwfmlyz, and vwfmlyx array data changed to comments because Namelist variables mwfl=0 and mwfv=0. TRAC-P should not output these arrays to the INLAB file when mwfl=0 and mwfv=0.

```

1037 * level    1
1038 *
1039 * cfzlyt* f    0.0000E+00e
1040 * cfzlyz * f    3.7000E-03e
1041 * cfzlyx* f    0.0000E+00e
1042 * cfzlyy* f    0.0000E+00e
1043 * cfzlvz * f    3.7000E-03e
1044 * cfzlvx* f    0.0000E+00e
1045 * frvol   * r04 6.6390E-01r04 3.6510E-01e
1046 * frfayt * r04 4.4000E-01r04 3.3000E-01e
1047 * frfaz   * r04 6.6390E-01r04 5.7132E-01e
1048 * frfaxr * r04 3.8917E-01r04 0.0000E+00e
1049 * hdyt    * r04 2.4278E+00r04 2.6903E+00e
1050 * hdz     * r04 2.4278E+00r04 2.6903E+00e
1051 * hdxr    * r04 2.4278E+00r04 2.6903E+00e
1052 * alpn    * f    0.0000E+00e
1053 * vvnyt   * f    0.0000E+00e
1054 * vvnz    * f    0.0000E+00e
1055 * vvnxr   * f    0.0000E+00e
1056 * vlnyt   * f    0.0000E+00e
1057 * vlnz    * f    0.0000E+00e
1058 * vlnxr   * f    0.0000E+00e
1059 * tvn     * f    5.3033E+02e
1060 * tln     * f    5.3033E+02e
1061 * pn      * f    2.2500E+03e
1062 * pan     * f    0.0000E+00e
1063 * vwfmly  * f    1.0000E+00e
1064 * vwfmlyz * f    1.0000E+00e
1065 * vwfmlyx * f    1.0000E+00e
1066 * vwfmlyy * f    1.0000E+00e
1067 * vwfmlyz * f    1.0000E+00e
1068 * vwfmlyx * f    1.0000E+00e
1069 *
1070 * level    2

```


All HTSTRs need to have the htmli, htmlo, htmvi, and htmvo array data changed to comments because Namelist variables mhtli=0, mhtlo=0, mhtvi=0, and mhtvo=0. TRAC-P should not output these arrays to the INLAB file when mhtli=0, mhtlo=0, mhtvi=0, and mhtvo=0.

```

1534 ***** type          num          id          ctitle
1535 rod                127          127 $127$ bkn-loop st-gen tubes
1536 *                ncrx          ncrz          ittc          iext          mld
1537                  1              2              0              0              0
1538 *                nopowr          nrldr          modez          liqlev          iaxcnd
1539                  1              0              1              0              0
1540 *                idbci          idbco          hdri          hdro
1541                  2              2          4.8556E-02          1.1211E-01
1542 *                nrods          nodes          irftr          nzmax          irftr2
1543                  1              3              0              3              0
1544 *                dtxht(1)          dtxht(2)          dznht          hgapo          shelv
1545          5.4000E+00          1.8000E+01          1.4272E+01          0.0000E+00          0.0000E+00
1546 *
1547 * nhcomi* r03              3              2e
1548 * nhceli*              -4              4              5              3e
1549 * nhcomo* f              27e
1550 * nhcelo*              -1              1              2              3e
1551 * htmli f          1.0000E+00e
1552 * htmlo f          1.0000E+00e
1553 * htmvi f          1.0000E+00e
1554 * htmvo f          1.0000E+00e
1555 * dz * f          1.4272E+01e
1556 * grav * f          1.0000E+00e
1557 * rdx *          4.4430E+03e
1558 * radrd *          3.2316E-02          3.4400E-02          3.6483E-02e
1559 * matrd * f          10e
1560 * nfax * f          0e
1561 * rftn * f          5.3033E+02e

```

The powered HTSTR 140 needs to have the rdpwra and cpowra array data changed to comments because the rdpwr and cpowr arrays are the input data. TRAC-P should not output these internally normalized 'abs' arrays to the INLAB file.

```

1953 ***** type          num          id          ctitle
1954 rod                140          140 $140$ reactor-core fuel rods
1955 *                ncrx          ncrz          ittc          iext          mld
1956                  4              3              0              0              0

2000 * rftn * f          5.3033E+02e
2001 * rdpwr *          8.7600E-01          8.9500E-01          9.1900E-01          9.5500E-01          1.0000E+00
2002 * rdpwr * r03 0.0000E+00e
2003 * rdpwra          1.2109E+00          1.2371E+00          1.2703E+00          1.3201E+00          1.3823E+00
2004 * rdpwra r03 0.0000E+00e
2005 * cpowr * f          1.0000E+00e
2006 * cpowra f          1.0000E+00e
2007 * zpwrb *          0.0000E+00s

```

Portions of the W4LOOP30 output-data TRCOUT file

```

289      epso = 1.0000E-03,      epss = 1.0000E-04
290
291      oitmax =      10,      sitmax =      10,      isolut =      0,      ncontr =      8,      nccfl =      0
292      ntsv =      4,      ntcbl =      5,      ntcfl =      27,      ntrp =      2,      ntcp =      1

377 signal-variable data cards
378
379      idsv =      1,      isvn =      0,      ilcn =      0,      icn1 =      0,      icn2 =      0
380      idsv =      2,      isvn =      21,      ilcn =      15,      icn1 =      3,      icn2 =      0

```

```

381      idsv =      3,      isvn =      21,      ilcn =      19,      icn1 =      2,      icn2 =      0
382      idsv =      4,      isvn =      21,      ilcn =      26,      icn1 =    1003,      icn2 =      0
383
384 user-defined unit-labels data cards
385
386      lulabel =      lupxx4, lunitsi =      lupaxx4, luniteng =      lupsiaxx4, ufactor = 4.4251E-16, ushift = 0.0000E+00
387      lulabel =      lupxx5, lunitsi =      lupaxx5, luniteng =      lupsiaxx5, ufactor = 6.4181E-20, ushift = 0.0000E+00
388
389 control-block data cards
390
391      idcb =      -5,      icbn =      9,      icb1 =      0,      icb2 =      0,      icb3 =      0
392      lugain = lunounit, luxmin = lupressa, luxmax = lupressa, lucon1 = lupressa, lucon2 = lunounit
393      cbgain = 1.0000E+00, cbxmin = 2.2500E+03, cbxmax = 2.2500E+03, cbcon1 = 2.2500E+03, cbcon2 = 0.0000E+00
394      -      psia      psia      psia
395
396 the above control block has the      *****
397 following input ids, function      * const * ----> -5
398 operator type, and output id      *****
399
400      idcb =      -6,      icbn =    103,      icb1 =      4,      icb2 =      0,      icb3 =      0
401      lugain = lunounit, luxmin = lupressa, luxmax = lupressa, lucon1 = lunounit, lucon2 = lunounit
402      cbgain = 1.0000E+00, cbxmin = 0.0000E+00, cbxmax = 1.4504E+04, cbcon1 = 0.0000E+00, cbcon2 = 0.0000E+00
403      -      psia      psia
404
405 the above control block has the      4 ----> *****
406 following input ids, function      0 ----> * sum n * ----> -6
407 operator type, and output id      *****
408
409 idx      2      3      4      -5
410
411      idcb =      -7,      icbn =    103,      icb1 =      5,      icb2 =      1,      icb3 =      0
412      lugain = lunounit, luxmin = lupressa, luxmax = lupressa, lucon1 = lunounit, lucon2 = lunounit
413      cbgain = 1.0000E+00, cbxmin = 0.0000E+00, cbxmax = 1.4504E+04, cbcon1 = 0.0000E+00, cbcon2 = 0.0000E+00
414      -      psia      psia
415
416 the above control block has the      5 ----> *****
417 following input ids, function      1 ----> * sum n * ----> -7
418 operator type, and output id      *****
419
420      luwta = lunounit
421
422 wta      1.00000E-01 1.50000E-01 2.00000E-01 2.50000E-01 3.00000E-01
423
424
425 idx      2      3      4      -5      -6
426
427      idcb =      -8,      icbn =    104,      icb1 =      4,      icb2 =      0,      icb3 =      0
428      lugain = lunounit, luxmin = lupxx4, luxmax = lupxx4, lucon1 = lunounit, lucon2 = lunounit
429      cbgain = 1.0000E+00, cbxmin = 0.0000E+00, cbxmax = 4.4251E+16, cbcon1 = 0.0000E+00, cbcon2 = 0.0000E+00
430      -      psiaxx4      psiaxx4
431
432 the above control block has the      *****
433 following input ids, function      4 ----> * mult n * ----> -8
434 operator type, and output id      *****
435
436 idx      2      3      4      -5
437
438      idcb =      -9,      icbn =    104,      icb1 =      5,      icb2 =      0,      icb3 =      0
439      lugain = lunounit, luxmin = lupxx5, luxmax = lupxx5, lucon1 = lunounit, lucon2 = lunounit
440      cbgain = 1.0000E+00, cbxmin = 0.0000E+00, cbxmax = 6.4181E+20, cbcon1 = 0.0000E+00, cbcon2 = 0.0000E+00
441      -      psiaxx5      psiaxx5
442
443 the above control block has the      *****
444 following input ids, function      5 ----> * mult n * ----> -9
445 operator type, and output id      *****
446
447 idx      2      3      4      -5      -6
448
449 trip-dimension data card
450      ntse =      0,      ntct =      0,      ntsf =      0,      ntdp =      0,      ntsd =      0

```

Control-parameter data at timestep 0

Hand calculations will be done to check the control-block output values

```

4744 trac large edit
4745
4746 problem time is 0.000000E+00 s, time-step size is 4.0000E-04 s, time-step number is 0, outer-iteration number is 0
4747
4748 maximum convective power difference has been 0.3412142E+01 btu/hr in component 0 at time 1.0000000E+00 s
4749 time-step size was limited by component 0 at cell 0 to 1.0000E+08 s
4750 average outer-iteration count over the last 0 time steps was 0.000
4751 last minimum number of outer iterations was 0 at time step 0 (limited by component 0 with fr.error of 0.0000E+00)
4752 last maximum number of outer iterations was 0 at time step 0 (limited by component 0 with fr.error of 0.0000E+00)
4753 total number of times that each component (id#) was the last to converge since the last short edit
4754 0( 1) 0( 2) 0( 3) 0( 4) 0( 5) 0( 6) 0( 7) 0( 10) 0( 11) 0( 12) 0( 13) 0( 14)
4755 0( 15) 0( 41) 0( 19) 0( 20) 0( 21) 0( 42) 0( 43) 0( 44) 0( 16) 0( 22) 0( 31) 0( 25)
4756 0( 17) 0( 27) 0( 8) 0( 9) 0( 18) 0( 28) 0( 24) 0( 23) 0( 26)
4757 current maximum time-step sizes and limitation counts since the last short edit
4758      delamx      delcmx      deldmx      delenx      delpmx      delrmx      delvmx      delxmz
4759      1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s
4760      0      0      0      0      0      0      0      0
4761 further limitation counts on what controls delcmx
4762      dtlmx      dtvmx      dprmx      dtrms      dtrmx      delt/2
4763      0      0      0      0      0      0
4764
4765 cpu execution time of this run is      s
4766

```

```

4767 total time steps since time 0.0 s is 0
4768 total cpu time since time 0.0 s is s
4769
4770 ***** signal-variable values at time 0.00000 s *****
4771
4772 id sig.var. id sig.var. id sig.var. id sig.var. id sig.var.
4773
4774 1 0.000000E+00 2 2.250000E+03 3 2.250000E+03 4 2.250000E+03 9901 3.374700E+07
4775 time (s) press (psia) press (psia) press (psia) z mmf (lbm/hr)
4776 9902 1.012400E+08 9903 3.083400E+06 9904 9.250200E+06 9905 5.303300E+02 9906 5.303300E+02
4777 z mmf (lbm/hr) z mmf (lbm/hr) z mmf (lbm/hr) c mix temp (f) c mix temp (f)
4778 9907 5.303300E+02 9908 5.303300E+02
4779 c mix temp (f) c mix temp (f)
4780
4781 ***** control-block output values at time 0.00000 s *****
4782
4783 id con.blk. id con.blk. id con.blk. id con.blk. id con.blk.
4784
4785 -5 2.250000E+03 -6 9.000000E+03 -7 4.275000E+03 -8 2.562885E+13 -9 2.306609E+17
4786 psia psia psia psia psia
4787 -9901 1.187900E+03 -9902 1.187900E+03 -9903 0.000000E+00 -9904 0.000000E+00 -9905 1.000000E+00
4788 rpm rpm lbm/hr
4789 -9906 1.000000E+00 -9907 1.000000E+00 -9908 1.000000E+00
4790
Signal variables 2, 3, and 4 and control block -5 : 1.5513e+07 Pa x 1.45037738e-04 = 2.249970e+03 psia rounded
to 5 significant digits in INLAB is 2.5000e+03 psia OK
Control block -6 : 2.250000e+03 (sig.var.2) + 2.250000e+03 (sig.var.3) + 2.250000e+03 (sig.var.4) +
2.250000e+03 (con.blk.-5) = 9.000000e+03 OK
Control block -7 : 0.10*2.250000e+03 (sig.var.2) + 0.15*2.250000e+03 (sig.var.3) + 0.20*2.250000e+03 (sig.var.4) +
0.25*2.250000e+03 (con.blk.-5) + 0.30*9.000000e+03 (con.blk.-6) = 4.275000e+03 OK
Control block -8 : 2.250000e+03 (sig.var.2) * 2.250000e+03 (sig.var.3) * 2.250000e+03 (sig.var.4) *
2.250000e+03 (con.blk.-5) = 2.562891e+13 OK
Control block -9 : 2.250000e+03 (sig.var.2) * 2.250000e+03 (sig.var.3) * 2.250000e+03 (sig.var.4) *
2.250000e+03 (con.blk.-5) * 9.000000e+03 (con.blk.-6) = 2.306602e+17 OK

Control-parameter data at timestep 195 where steady-state convergence was satisfied
29885 problem time is 0.000000E+00 s, time-step size is 2.0000E+00 s, time-step number is 195, outer-iteration number is 1
29886
29887 maximum convective power difference has been 0.5661791E+10 btu/hr in component 128 at time-1.000000E+00 s
29888 time-step size was limited by component 14 at cell 4 to 2.2994E-02 s
29889 average outer-iteration count over the last 190 time steps was 1.211
29890 last minimum number of outer iterations was 1 at time step 194 (limited by component 14 with fr.error of 1.0885E-07)
29891 last maximum number of outer iterations was 5 at time step 6 (limited by component 10 with fr.error of 7.3924E-07)
29892 total number of times that each component (id#) was the last to converge since the last short edit
29893 0( 1) 0( 2) 17( 3) 15( 4) 12( 5) 0( 6) 0( 7) 19( 10) 6( 11) 13( 12) 19( 13) 17( 14)
29894 3( 15) 0( 41) 3( 19) 0( 20) 4( 21) 0( 42) 0( 43) 0( 44) 10( 16) 0( 22) 0( 31) 0( 25)
29895 2( 17) 35( 27) 0( 8) 0( 9) 0( 18) 9( 28) 0( 24) 0( 23) 6( 26)
29896 current maximum time-step sizes and limitation counts since the last short edit
29897 delamx delcmx deldmx delmx delpmx delrmx delvmx delxm
29898 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 1.0000E+08 s 2.2994E+01 s 1.0000E+08 s
29899 0 0 0 0 0 0 0 0
29900 further limitation counts on what controls delcmx
29901 dtlrmx dtvmx dprmx dtsms dtrmx delt/2
29902 0 0 0 0 0 0
29903
29904 cpu execution time of this run is s
29905
29906 total time steps since time 0.0 s is 195
29907 total cpu time since time 0.0 s is s
29908
29909 ***** signal-variable values at time -2.00000 s *****
29910
29911 id sig.var. id sig.var. id sig.var. id sig.var. id sig.var.
29912
29913 1 2.080532E+02 2 2.299384E+03 3 2.251015E+03 4 2.286743E+03 9901 3.374572E+07
29914 time (s) press (psia) press (psia) press (psia) z mmf (lbm/hr)
29915 9902 1.012371E+08 9903 3.083904E+06 9904 9.247766E+06 9905 5.303410E+02 9906 5.303410E+02
29916 z mmf (lbm/hr) z mmf (lbm/hr) z mmf (lbm/hr) c mix temp (f) c mix temp (f)
29917 9907 5.303413E+02 9908 5.303413E+02
29918 c mix temp (f) c mix temp (f)
29919
29920 ***** control-block output values at time -2.00000 s *****
29921
29922 id con.blk. id con.blk. id con.blk. id con.blk. id con.blk.
29923
29924 -5 2.250000E+03 -6 9.087143E+03 -7 4.313582E+03 -8 2.663109E+13 -9 2.420018E+17
29925 psia psia psia psia psia
29926 -9901 1.134872E+03 -9902 1.139504E+03 -9903 3.083904E+06 -9904 9.247766E+06 -9905 1.110784E+00
29927 rpm rpm lbm/hr
29928 -9906 1.110784E+00 -9907 1.110440E+00 -9908 1.110440E+00
29929

```

```

Control block -5 : 1.5513e+07 Pa x 1.45037738e-04 = 2.249970e+03 psia rounded to 5 digits = 2.500000e+03 psia OK
Control block -6 : 2.299384e+03 (sig.var.2) + 2.251015e+03 (sig.var.3) + 2.286743e+03 (sig.var.4) +
2.250000e+03 (con.blk.-5) = 9.087142e+03 OK
Control block -7 : 0.10*2.299384e+03 (sig.var.2) + 0.15*2.251015e+03 (sig.var.3) + 0.20*2.286743e+03 (sig.var.4) +
0.25*2.250000e+03 (con.blk.-5) + 0.30*9.087143e+03 (con.blk.-6) = 4.313582e+03 OK
Control block -8 : 2.299384e+03 (sig.var.2) * 2.251015e+03 (sig.var.3) * 2.286743e+03 (sig.var.4) *
2.250000e+03 (con.blk.-5) = 2.663114e+13 OK
Control block -9 : 2.299384e+03 (sig.var.2) * 2.251015e+03 (sig.var.3) * 2.286743e+03 (sig.var.4) *
2.250000e+03 (con.blk.-5) * 9.087143e+03 (con.blk.-6) = 2.420010e+17 OK

```

APPENDIX E **Portions of the ZIONPWR2I and ZIONPWR2O File Listings** **From the Modified-ZIONPWR Steady-State Calculation Two**

Portions of the ZIONPWR2I input-data TRACIN file

Changed NTCB from 132 to 136 and NTCF from 84 to 116 in line 85

82 *	oitmax	sitmax	isolut	ncontr	nccfl
83	10	10	1	0	0
84 *	ntsv	ntcb	ntcf	ntrp	ntcp
85	203	136	116	1	2
86 *					

Added control blocks -103 and -104 with TRAC-internal initialization

865 *	cftab *	2.3456e-04	2.3789e-04	2.6543e-04	2.7890e-04e
866 *					
867 *	sum n	sum of 211, 212, 213, 214, 217, and 218 weighted and averaged			
868 *	idcb	icbn	icb1	icb2	icb3
869	-103	103	6	1	0
870 *	lugain	luxmin	luxmax	lucon1	lucon2
871	lunounit	lupressa	lupressa	lunounit	lunounit
872 *	cbgain	cbxmin	cbxmax	cbcon1	cbcon2
873	4.7619e-02	0.0000e+00	1.0000e+08	0.0000e+00	0.0000e+00
874 *	luwta				
875	lunounit				
876 *					
877 *	wta *	1.0000e+00	2.0000e+00	3.0000e+00	4.0000e+00s
878 *	wta *	5.0000e+00	6.0000e+00e		
879 *	idx *	211	212	213	214s
880 *	idx *	217	218e		
881 *					
882 *	multiply n	multitply 221, 222, 232, and 233			
883 *	idcb	icbn	icb1	icb2	icb3
884	-104	104	4	0	0
885 *	lugain	luxmin	luxmax	lucon1	lucon2
886	lunounit	lutxx4	lutxx4	lunounit	lunounit
887 *	cbgain	cbxmin	cbxmax	cbcon1	cbcon2
888	1.0000e+00	0.0000e+00	1.0000e+12	0.0000e+00	0.0000e+00
889 *					
890 *	idx *	221	222	232	233e
891 *					
892 *	pi controller adjusts favlve(comp4) to get desired mfl-z(comp4,if3)				

Added control blocks -403 and -404 with CBCON2-input initialization

1445 *	cftab *	2.3456e-04	2.3789e-04	2.6543e-04	2.7890e-04e
1446 *					
1447 *	sum n	sum of 211, 212, 213, 214, 217, and 218 weighted and averaged			
1448 *	idcb	icbn	icb1	icb2	icb3
1449	-403	103	6	1	0
1450 *	lugain	luxmin	luxmax	lucon1	lucon2
1451	lunounit	lupressa	lupressa	lunounit	lunounit
1452 *	cbgain	cbxmin	cbxmax	cbcon1	cbcon2
1453	4.7619e-02	0.0000e+00	1.0000e+08	0.0000e+00	1.5221e+07
1454 *	luwta				
1455	lunounit				
1456 *					

```

1457 * wta *      1.0000e+00    2.0000e+00    3.0000e+00    4.0000e+00s
1458 * wta *      5.0000e+00    6.0000e+00e
1459 * idx *           211           212           213           214s
1460 * idx *           217           218e
1461 *
1462 * multiply n mulitply 221, 222, 232, and 233
1463 *      idcb      icbn      icb1      icb2      icb3
1464 *      -404      104      4      0      0
1465 *      lugain      luxmin      luxmax      lucon1      lucon2
1466 *      lunounit      lutxx4      lutxx4      lunounit      lunounit
1467 *      cbgain      cbxmin      cbxmax      cbcon1      cbcon2
1468 *      1.0000e+00    0.0000e+00    1.0000e+12    0.0000e+00    1.0840e+11
1469 *
1470 * idx *           221           222           232           233e
1471 *
1472 * pi controller adjusts favlve(comp4) to get desired mfl-z(comp4,if3)

```

Portions of the ZIONPWR20 output-data TRCOUT file

Large edit of control-block data at time 0.0 s, timestep number 0

```

3072 ***** control-block output values at time 0.00000 s *****
3073
3074      id      con.blk.      id      con.blk.      id      con.blk.      id      con.blk.      id      con.blk.
3075
3076      -1      1.496500E+07      -2      1.569796E+00      -3      1.496500E+07      -4      5.730000E+02      -5      1.000000E+00
3077      pa      rad      pa      rad      pa      k      k
3078      -6      1.000000E-03      -7      9.999997E-04      -8      9.999997E-04      -9      1.000000E+00      -10     1.000000E-03
3079      rad      rad      rad      rad
3080      -11     1.000000E-03      -12     0.000000E+00      -13     0.000000E+00      -14     1.000000E+00      -15     0.000000E+00
3081      pa/s      radxs
3082      -16     0.000000E+00      -17     2.585710E+00      -18     0.000000E+00      -19     0.000000E+00      -20     1.000000E+00
3083      w
3084      -21     1.000000E+00      -22     1.699457E+04      -23     0.000000E+00      -24     0.000000E+00      -25     1.000000E+00
3085      kg/s      m
3086      -26     9.026918E+05      -27     0.000000E+00      -28     0.000000E+00      -29     0.000000E+00      -30     -5.740425E+05
3087      pa
3088      -31     0.000000E+00      -32     1.432355E-01      -33     1.000000E+00      -34     0.000000E+00      -35     1.320114E+06
3089      w*s      w*s/kg
3090      -36     1.319421E+06      -37     1.319421E+06      -38     1.319421E+06      -39     0.000000E+00      -40     1.000000E+00
3091      w*s/kg      w/m2
3092      -41     1.000000E+00      -42     0.000000E+00      -43     1.000000E+00      -44     0.000000E+00      -45     5.740000E+02
3093      k
3094      -46     0.000000E+00      -47     0.000000E+00      -48     3.700000E+02      -49     1.000000E-03      -50     -3.700000E+02
3095      rad/s
3096      -51     9.026918E-01      -52     0.000000E+00      -53     0.000000E+00      -54     0.000000E+00      -55     1.000000E-03
3097      m/s      k
3098      -56     3.006400E+02      -57     0.000000E+00      -58     1.520500E+07      -59     1.515167E+07      -60     5.738000E+02
3099      pa      k
3100      -61     0.000000E+00      -100    1.000000E-10      -101    1.340000E+00      -102    1.234500E-04      -103    1.522094E+07
3101      m      w      m/s      1/k      pa
3102      -104    1.084032E+11      -200    9.500000E-01      -201    9.500000E-01      -301    1.000000E+00      -302    2.000000E+00
3103      kxx4      rad
3104      -303    3.000000E+00      -304    4.000000E+00      -305    5.000000E+00      -306    6.000000E+00      -307    7.000000E+00
3105      pa      k
3106      -308    8.000000E+00      -309    1.000000E+00      -310    1.000000E+01      -311    1.000000E-03      -312    1.200000E+01
3107      rad      rad
3108      -313    1.300000E+01      -314    1.400000E+01      -315    1.500000E+01      -316    1.600000E+01      -317    1.700000E+01
3109      radxs      pa/s
3110      -318    1.800000E+01      -319    1.900000E+01      -320    2.000000E+01      -321    2.100000E+01      -322    2.200000E+01
3111      w      kg/s
3112      -323    2.300000E+01      -324    2.400000E+01      -325    2.500000E+01      -326    9.026918E+05      -327    2.700000E+01
3113      m      pa
3114      -328    2.800000E+01      -329    2.900000E+01      -330    -5.740425E+05      -331    3.100000E+01      -332    3.200000E+01
3115      w*s      w*s/kg
3116      -333    3.300000E+01      -334    3.400000E+01      -335    3.500000E+01      -336    3.600000E+01      -337    3.700000E+01
3117      w*s/kg      w*s/kg
3118      -338    3.800000E+01      -339    3.900000E+01      -340    4.000000E+01      -341    4.100000E+01      -342    4.200000E+01
3119      w*s/kg      w/m2
3120      -343    4.300000E+01      -344    4.400000E+01      -345    4.500000E+01      -346    4.600000E+01      -347    4.700000E+01
3121      k
3122      -348    4.800000E+01      -349    4.900000E+01      -350    5.000000E+01      -351    9.026918E-01      -352    5.200000E+01
3123      rad/s      rad/s
3124      -353    5.300000E+01      -354    5.400000E+01      -355    5.500000E+01      -356    5.600000E+01      -357    5.700000E+01
3125      k
3126      -358    5.800000E+01      -359    1.515167E+07      -360    6.000000E+01      -361    6.100000E+01      -400    1.000000E+02
3127      pa      m
3128      -401    1.010000E+02      -402    1.020000E+02      -403    1.522100E+07      -404    1.084000E+11      -500    9.500000E-01
3129      m/s      1/k      pa
3130      -501    9.500000E-01
3131

```

Large edit of control-block data at time 59.53 s, timestep number 238

```

12158 ***** control-block output values at time 59.52895 s *****
12159
12160      id      con.blk.      id      con.blk.      id      con.blk.      id      con.blk.      id      con.blk.
12161
12162      -1      1.497094E+07      -2      1.569116E+00      -3      1.497094E+07      -4      5.500000E+02      -5      1.000000E+00
12163      pa      rad      pa      k      pa      k
12164      -6      1.680414E-03      -7      1.680411E-03      -8      1.680411E-03      -9      1.000000E+00      -10     1.680413E-03
12165      rad      rad      rad      rad
12166      -11     1.680413E-03      -12     -2.697058E-02      -13     6.555837E+05      -14     9.998499E-01      -15     0.000000E+00
12167      pa/s      pa/s      radxs      radxs
12168      -16     0.000000E+00      -17     2.585710E+00      -18     0.000000E+00      -19     0.000000E+00      -20     1.000000E+00
12169      w      w
12170      -21     1.000000E+00      -22     1.700506E+04      -23     2.268223E+02      -24     0.000000E+00      -25     1.000000E+00
12171      kg/s      kg/s      m      m
12172      -26     9.026918E+05      -27     0.000000E+00      -28     0.000000E+00      -29     0.000000E+00      -30     -3.488710E+05
12173      pa      pa
12174      -31     1.000000E+10      -32     1.307340E-01      -33     1.000000E+00      -34     0.000000E+00      -35     1.388205E+06
12175      w*s      w*s      w*s/kg      w*s/kg
12176      -36     1.319421E+06      -37     1.199339E+06      -38     1.199339E+06      -39     1.976530E+07      -40     1.000000E+00
12177      w*s/kg      w*s/kg      w/m2      w/m2
12178      -41     1.000000E+00      -42     0.000000E+00      -43     1.000000E+00      -44     0.000000E+00      -45     5.500000E+02
12179      k      k
12180      -46     5.752895E+01      -47     0.000000E+00      -48     3.700000E+02      -49     1.680413E-03      -50     -3.700000E+02
12181      rad/s      rad/s      rad/s      rad/s
12182      -51     9.026918E-01      -52     1.954060E+01      -53     1.000000E+00      -54     -3.554862E+01      -55     1.680413E-03
12183      m/s      m/s      k      k
12184      -56     3.129510E+02      -57     -1.433687E-02      -58     1.515768E+07      -59     1.511618E+07      -60     5.860406E+02
12185      k      k      pa      pa
12186      -61     4.548224E+00      -100     3.250000E+09      -101     2.500000E+00      -102     1.254019E-04      -103     1.513856E+07
12187      m      m      w      w
12188      -104     1.156061E+11      -200     0.000000E+00      -201     0.000000E+00      -301     1.497094E+07      -302     1.569116E+00
12189      kxx4      kxx4      rad      rad
12190      -303     1.497094E+07      -304     5.500000E+02      -305     1.000000E+00      -306     1.680414E-03      -307     1.680411E-03
12191      pa      pa      rad      rad
12192      -308     1.680411E-03      -309     1.000000E+00      -310     1.680413E-03      -311     1.680413E-03      -312     -2.697058E-02
12193      rad      rad      pa/s      pa/s
12194      -313     6.555967E+05      -314     9.998499E-01      -315     0.000000E+00      -316     0.000000E+00      -317     2.585710E+00
12195      radxs      radxs
12196      -318     1.800000E+01      -319     0.000000E+00      -320     1.000000E+00      -321     1.000000E+00      -322     1.700506E+04
12197      w      w      kg/s      kg/s
12198      -323     2.498223E+02      -324     0.000000E+00      -325     1.000000E+00      -326     9.026918E+05      -327     0.000000E+00
12199      m      m      pa      pa
12200      -328     2.800000E+01      -329     0.000000E+00      -330     -3.488710E+05      -331     1.000000E+10      -332     1.307340E-01
12201      pa      pa      w*s      w*s
12202      -333     1.000000E+00      -334     0.000000E+00      -335     1.388205E+06      -336     1.319141E+06      -337     1.199339E+06
12203      w*s/kg      w*s/kg      w*s/kg      w*s/kg
12204      -338     3.800000E+01      -339     1.976530E+07      -340     1.000000E+00      -341     1.000000E+00      -342     0.000000E+00
12205      w*s/kg      w*s/kg      w/m2      w/m2
12206      -343     1.000000E+00      -344     0.000000E+00      -345     5.500000E+02      -346     5.752895E+01      -347     0.000000E+00
12207      k      k
12208      -348     3.700000E+02      -349     1.680413E-03      -350     -3.700000E+02      -351     9.026918E-01      -352     1.954060E+01
12209      rad/s      rad/s      m/s      m/s
12210      -353     1.000000E+00      -354     -3.554862E-01      -355     1.680413E-03      -356     3.129510E+02      -357     -1.433687E-02
12211      k      k
12212      -358     1.515768E+07      -359     1.511618E+07      -360     5.860406E+02      -361     4.548224E+00      -400     3.250000E+09
12213      pa      pa      m      m
12214      -401     2.500000E+00      -402     1.254019E-04      -403     1.513856E+07      -404     1.156061E+11      -500     0.000000E+00
12215      m/s      m/s      kxx4      kxx4
12216      -501     0.000000E+00
12217

```