Importing PMAX Operational Data Into PEPSE Using OLE Automation

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Importing PMAX® Operational Data into PEPSE® Using COM (OLE) Automation

BACKGROUND

Version 62 introduced COM (formerly known as OLE) Automation Server into PEPSE. Using the COM Automation Server, PEPSE can be "driven" from any COM Automation Client application such as Microsoft Excel. The COM Automation Server capability added to PEPSE Version 62 "exposes" a set of objects (PEPSE Model, Components, Streams, etc.) that have methods (Functions) and properties (Data Values) which can be accessed from the COM Automation Client application.

For more information about using the COM Automation Server in PEPSE, see the OLE Automation mini training session.

Version 3 introduces a COM Automation Server into R*TIME Viewer . Using the COM Automation Server, data in an R*TIME or PMAX system can be accessed for any COM Automation Client application. The COM Automation Server capability added to R*TIME Viewer Version 3 provides the ability to retrieve current values and status, archive values and status, and descriptive information for the data points in a PMAX or R*TIME server.

For more information about using the R*TIME Viewer COM Automation Server, see the R*TIME session "*Accessing Data in other Windows Applications using R*TIME® Viewer Version 3 OLE Automation Server*".

PURPOSE

The purpose of this session is to show how to combine both of these technologies to import operational data into PEPSE.

DEMONSTRATION

The demonstration is composed of a PEPSE Special Option 6 model for the Tennessee Valley Authoritie's (TVA) Paradise Station and a PMAX system. The Excel spreadsheet used for the demonstration has been set up with multiple worksheets in a single work book.

Worksheet 1 contains a description of the data values exported from the PMAX system and used as inputs into the PEPSE model. It contains a "button" that activates a macro that imports the operational data from the PMAX system into the worksheet.

Worksheet 2 contains the results data from the PEPSE model. The values displayed on this worksheet are load from the PEPSE results file.

Worksheet 3 contains a graphical depiction of the results from worksheet 3.

Worksheet 4 contains all of the macros used by the user interface on worksheets 1 and 2.

STEP 1 - LOADING TEST DATA FROM PMAX

Worksheet 1 contains all of the input test data for the PEPSE model. Each of the input data values are input points collected by the PMAX system. To be able to automatically import the test data values into the spreadsheet a Load Test Data button is added to the spreadsheet, This button is connected to a macro that uses the R*TIME Viewer COM Automation Server interface routines to retrieve the current values from the PMAX server and place them into the worksheet. The

I/O ID	Description	Variable	Variable ID	Measured Value
1	Main Steam Temperature	TTVSC	10	1023.459839
2	Main Steam Pressure	PPVSC	10	2414.885751
3	1st Stage Pressure	OPVB	400	1770.919931
4	#1Heater Extraction Temp at Turbine	TEXIP	120	797.1449585
5	Cold Reheat Temperature	TEXIP	130	625.9585877
6	Cold Reheat Pressure	PSIPV	130	482.047403
7	Hot Reheat Temperature	TTTORH	200	1004.622803
8	Hot Reheat Pressure - Into OPVB for DP	OPVB	50	452.2115265
9	IP Exhaust Temperature	TEXIP	220	713.9902344
10	IP Exhaust Pressure	PSIPV	220	140.4950844
11	#6 Heater Extraction Temperature	TEXIP	300	520.5443116
12	#6 Heater Extraction Pressure	PSIPV	300	41.29065098
13	#7 Heater Extraction Temperature	TEXIP	310	339.6701355
14	#7A Heater Extraction Pressure at Heater	OPVB	70	17.61760712
15	#8A Heater Extraction Pressure at Heater	OPVB	71	5.969536781
16	Condenser Pressure - In Hga	PPSH	400	0.685364705
17	Circulating Water Inlet Temperature	TTVSC	900	46.04459381
18	Circulating Water Outlet Temperature A	OPVB	250	74.97433472
19	#1 Heater Extraction Pressure @ Turbine	PSIPV	120	953.8114105
20	Condensate Pump Discharge Temp	OPVB	410	86.72937394
21	Condensate Pump Discharge Press	PMPDIS	410	134.8478714
22	Condensate Pump Discharge Flow - OPVB 53	OPVB	53	3679451.416
23	Gland Steam Condenser Tube Outlet Temp	OPVB	400	89.85108948
24	A Drain Cooler Tube Outlet Temperature	TTHXTB	430	96.74966431
25	#8A Heater Condensate Outlet Temp	TTFO	500	153.3121796
26				
27	#7A Heater Condensate Outlet Temp	TTFO	510	216.3071899
28	#7A Heater Drain Outlet Temp	TTDO	510	219.3769684
29	#6A Heater Condensate Outlet Temp	TTFO	520	270.0592957
30				
31	#6A LP Heater Drain Pump Outlet Temp	OPVB	400	253.5059204
32	#6A LP Heater Drain Pump Outlet Flow	OPVB	54	187528.9612
33	Circulating Water Outlet Temperature B	OPVB	251	141.8572693
34	#5A Heater Condensate Outlet Temp	TTFO	540	299.6628113
35	#5A Heater Drain Outlet Temp	TTDO	540	287.3190308

36	#8B Heater Condensate Outlet Temp	TTFO	505	104.860199
37				
38	#7B Heater Condensate Outlet Temp	TTFO	515	204.5595093
39	#7B Heater Drain Outlet Temp	TTDO	515	208.681488
40	#6B Heater Condensate Outlet Temp	TTFO	525	269.8167725
41				
42	#6B LP Heater Drain Pump Outlet Temp	OPVB	400	256.6038208
43	#6B LP Heater Drain Pump Outlet Flow	OPVB	56	87347.27478
44	SPARE OPVB 400	OPVB	400	141.8572693
45	#5B Heater Condensate Outlet Temp	TTFO	545	299.5909424
46	#5B Heater Drain Outlet Temp	TTDO	545	286.1740112
47	Steam Seal Regulator Pressure	OPVB	400	20.31797708
48	DA Inlet Pressure	PPSI	550	127.0245453
49	DA Drain Outlet Temperature	TTDO	550	343.9374695
50	BFP A Discharge Flow - OPVB 58	OPVB	58	2375079.834
51	BFP B Discharge Flow - OPVB 59	OPVB	59	2509245.605
52	BFP A Discharge Temperature	TTDISP	600	349.9341125
53	BFP B Discharge Temperature	TTDISP	605	349.3832703
54	Reheat Spray Flow	WWFIXB	760	20.18916679
55	#3A Heater Feedwater Outlet Temp	TTFO	700	385.8574219
56	#3A Heater Feedwater Drain Temp	TTDO	700	362.7442627
57	#3A Heater Feedwater Shell Pressure	PPSI	700	228.8704468
58	#2A Heater Feedwater Outlet Temp	TTFO	710	456.4482422
59	#2A Heater Feedwater Drain Temp	TTDO	710	400.3518372
60	#2A Heater Feedwater Shell Pressure	PPSI	710	478.9929291
61	#1A Heater Feedwater Outlet Temp	TTFO	720	520.4384155
62	#1A Heater Feedwater Drain Temp	TTDO	720	469.7830505
63	#1A Heater Feedwater Shell Pressure	PPSI	720	929.2815033
64	#1A Heater Feedwater Outlet Pressure	PPFO	720	3279.807626
65	#3B Heater Feedwater Outlet Temp	TTFO	705	384.7547607
66	#3B Heater Feedwater Drain Temp	TTDO	705	361.5564575
67	#3B Heater Feedwater Shell Pressure	PPSI	705	230.1377045
68	#2B Heater Feedwater Outlet Temp	TTFO	715	457.1413269
69	#2B Heater Feedwater Drain Temp	TTDO	715	399.4946289
70	#2B Heater Feedwater Shell Pressure	PPSI	715	477.6246429
71	#1B Heater Feedwater Outlet Temp	TTFO	725	523.1817627
72	#1B Heater Feedwater Drain Temp	TTDO	725	470.5066223
73	#1B Heater Feedwater Shell Pressure	PPSI	725	927.7939545
74	#1B Heater Feedwater Outlet Pressure	PPFO	725	3279.807626
75	BFPT A Flow From Main Steam - OPVB 60	OPVB	60	0
76	BFPT B Flow From Main Steam - OPVB 61	OPVB	61	0
77	BFPT A Flow From Extraction - OPVB 62	OPVB	62	301404.7546
78	BFPT B Flow From Extraction - OPVB 63	OPVB	63	307920.5017
79	A BFPT #3 Extraction Temperature	TEXIP	640	521.5767212
80	A BFPT #3 Extraction Pressure	PSIPV	640	239.7339874
81	A BFPT #4 Extraction Temperature	TEXIP	650	420.4492798
82	A BFPT #4 Extraction Pressure	PSIPV	650	137.0365845

83	A BFPT #5 Extraction Temperature	TEXIP	660	328.8034363
84	A BFPT #5 Extraction Pressure	PSIPV	660	74.97968067
85	A BFPT #6 Exhaust Temperature	OPVB	400	278.6858215
86	A BFPT #6 Exhaust Pressure	PSIPV	670	46.75121082
87	B BFPT #3 Extraction Temperature	TEXIP	645	520.7977905
88	B BFPT #3 Extraction Pressure	PSIPV	645	237.0668884
89	B BFPT #4 Extraction Temperature	TEXIP	655	420.3205872
90	B BFPT #4 Extraction Pressure	PSIPV	655	140.0358826
91	B BFPT #5 Extraction Temperature	TEXIP	665	324.4710083
92	B BFPT #5 Extraction Pressure	PSIPV	665	74.76762546
93	B BFPT #6 Exhaust Temperature	OPVB	400	279.5845337
94	B BFPT #6 Exhaust Pressure	PSIPV	675	46.60250057
95	Mixed Ext Temp to #6 Htr - OPVB 64	OPVB	64	289.6629639
96	B Drain Cooler Tube Outlet Temperature	TTHXTB	435	95.58972168
97	Total Generator Gross	OPVB	200	675847.9614
98	#6 Heater Extraction Pressure	OPVB	65	49.81747211
99	LP Generator Gross	POWER	2	328050.3235
100	#7B Heater Extraction Pressure at Heater	OPVB	72	13.36298752
101	#8B Heater Extraction Pressure at Heater	OPVB	73	6.419466496

LoadTestData Macro

```
' Macro that transfers the test data from the PMAX system
' to the spreadsheet
Sub LoadTestData()
   Dim app As Object
   Dim aservice As Object
   Dim apoint As Object
   Dim point_name As String

   ' Open the PMAX Data Service
   Set app = CreateObject("RTIME.Application")
   Set aservice = app.DataServices("pa1")

   Set DataSheet = Sheets("Test Data")

   ' Load the data point values
   For i = 4 To 104
      Let point_name = DataSheet.Cells(i, 7)
      If point_name <> "" Then
         Set apoint = aservice.DataPoint(point_name)
         DataSheet.Cells(i, 5) = apoint.Value
      End If
   Next
End Sub
```

STEP 2 - RUNNING PEPSE MODEL

The spreadsheet provides a button that when clicked on will execute PEPSE and load the input data from the worksheet into the associated PEPSE variables. The PEPSE Special Option 6 run defined executes 27 test cases and saves the results into a results file.

```
' Macro that transfers the test data from the spreadsheet
' to the model and initiates the calculations
Sub SetTestDataAndRun()
   Dim Job As Object
   Dim model As Object

   ' Open the PEPSE model.  This assumes that the model is in
   ' the same directory as the spreadsheet
   Set model = CreateObject("PEPSE.Application").Open(ActiveWorkbook.Path + "\" +
_
                  Sheets("Output").Range("C2"))

   ' get the job description
   Set Job = model.JobDescription(1)
   ' set the name of the input deck (job file).  The
   ' input deck will be created in the same directory
   ' as this spreadsheet
   With Job
      .inputfile = ActiveWorkbook.Path + "\PAR12TST.JOB"
      ' Flag this run as Special Option 6
      .option6 = True
   End With

   ' Write the test data to the model
   Set DataSheet = Sheets("Test Data")
   With model
      ' write the test data to the model.  The data is
      ' written to the Special Option 6 test data template
      For i = 4 To 104
         .inputoutput(DataSheet.Cells(i, 1), 2).valuio = DataSheet.Cells(i, 5)
      Next
      ' convert condenser pressure to psia
      .inputoutput(DataSheet.Cells(18, 1), 2).valuio = DataSheet.Cells(18, 5) * 0.491
   End With

   ' Run the calculations
   model.Run

End Sub
```

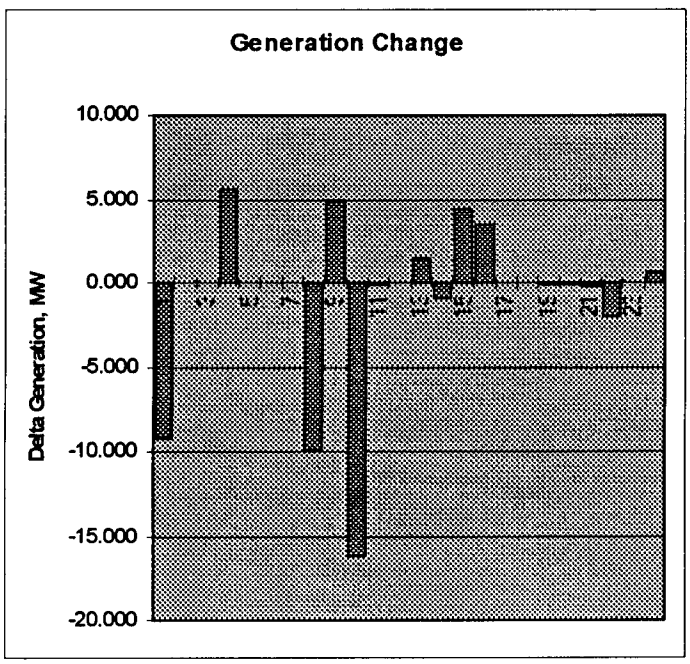
STEP 3 - LOADING RESULTS

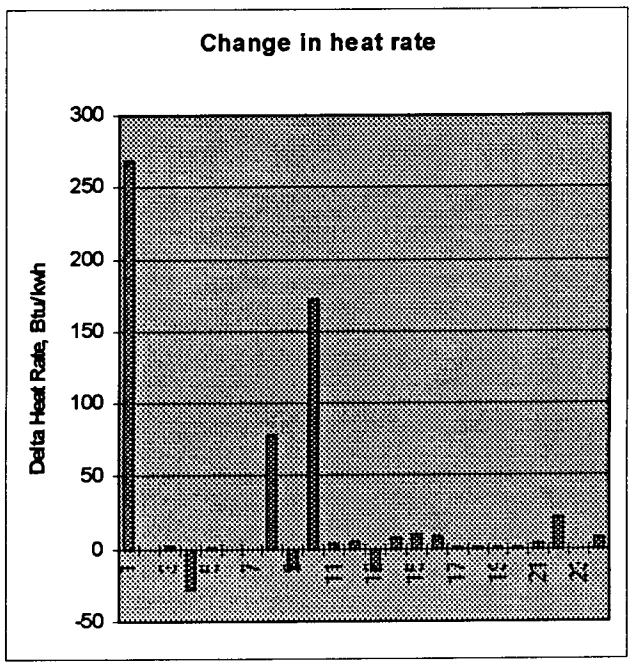
	Model:	par12se4.MDL													
	Date:	6/19/98													
Description	Gross Generation	Generation, Deviation from Expected	Heat Rate	Heat Rate, Deviation from Expected	HP Efficiency	IP Efficiency	LP Efficiency	Main Steam Flow	Main Steam Pressure	Main Steam Temp.	Condenser Pressure	Feed Pump A Eff.	Feed Pump B Eff.	Feed Pump Turbine A Eff.	Feed Pump Turbine B Eff.
TVA Design Heat Balance	694.140		7465		85.97	85.54	85.46	4845700	2415.0	1025.0	1.17	77.93%	77.93%	79.02%	79.02%
Test Data Reduction	695.556		7670		84.79	86.99	82.75	4884305	2414.9	1035.0	1.40	79.76%	81.45%	77.90%	78.94%
Correction to Std Boundary Conditions	690.113		7709		84.64	86.99	81.06	4909437	2415.0	1025.0	1.17	79.76%	81.45%	77.87%	78.91%
Return to Test Boundary Conditions	695.555	1.415	7670	205	84.79	86.99	82.75	4884305	2414.9	1035.0	1.40	79.76%	81.45%	77.90%	78.94%
Upgrade Main Steam Pressure to Design	695.586	-0.031	7670	0	84.79	86.99	82.75	4884680	2415.0	1035.0	1.40	79.76%	81.45%	77.90%	78.94%
Upgrade Main Steam Temperature to Design	695.593	-0.006	7683	-13	84.78	86.99	82.72	4909421	2415.0	1025.0	1.40	79.76%	81.45%	77.81%	78.86%
Upgrade Hot Reheat Temperature to Design	689.933	5.659	7710	-27	84.64	86.99	82.69	4909421	2415.0	1025.0	1.40	79.76%	81.45%	77.87%	78.91%
Upgrade Condenser to Design	689.753	0.180	7712	-2	84.64	86.99	76.70	4909421	2415.0	1025.0	0.71	79.76%	81.45%	77.87%	78.91%
Upgrade Reheat Sprays to Design	689.753	0.000	7712	0	84.64	86.99	76.70	4909421	2415.0	1025.0	0.71	79.76%	81.45%	77.87%	78.91%
Upgrade Makeup Flow to Design	689.753	0.000	7712	0	84.64	86.99	76.70	4909421	2415.0	1025.0	0.71	79.76%	81.45%	77.87%	78.91%
Upgrade HP Turbine	692.243	-2.489	7684	28	86.16	86.99	76.71	4909421	2415.0	1025.0	0.71	79.76%	81.45%	77.81%	78.86%
Upgrade IP Turb	687.340	4.903	7697	-12	86.02	85.54	76.60	4909421	2415.0	1025.0	0.71	79.76%	81.45%	77.91%	78.95%
Upgrade LP Turbine	705.188	-17.848	7508	189	86.02	85.54	80.60	4909421	2415.0	1025.0	0.70	79.76%	81.45%	77.91%	78.95%
Upgrade A Boiler Feed Pump	705.308	-0.120	7504	4	86.02	85.54	80.60	4909421	2415.0	1025.0	0.70	77.93%	81.45%	77.91%	78.95%
Upgrade B Boiler Feed Pump	705.306	0.001	7499	5	86.02	85.54	80.59	4909421	2415.0	1025.0	0.70	77.93%	77.93%	77.91%	78.95%
Upgrade A BFP Turbines	703.786	1.521	7514	-15	86.04	85.54	80.57	4909421	2415.0	1025.0	0.70	77.93%	77.93%	79.04%	78.93%
Upgrade B BFP Turbines	704.655	-0.869	7507	7	86.03	85.54	80.58	4909421	2415.0	1025.0	0.70	77.93%	77.93%	79.05%	79.05%
Upgrade #1A HP Feedwater Heater	700.279	4.376	7496	10	86.04	85.54	80.60	4909421	2415.0	1025.0	0.69	77.93%	77.93%	79.03%	79.03%
Upgrade #1B HP Feedwater Heater	696.756	3.523	7488	8	86.05	85.54	80.60	4909421	2415.0	1025.0	0.69	77.93%	77.93%	79.02%	79.02%
Upgrade #2A HP Feedwater Heater	696.775	-0.019	7487	1	86.05	85.54	80.61	4909421	2415.0	1025.0	0.69	77.93%	77.93%	79.02%	79.02%
Upgrade #2B HP Feedwater Heater	696.813	-0.038	7487	0	86.05	85.54	80.61	4909421	2415.0	1025.0	0.69	77.93%	77.93%	79.02%	79.02%
Upgrade #3A HP Feedwater Heater	696.928	-0.115	7486	1	86.05	85.54	80.61	4909421	2415.0	1025.0	0.69	77.93%	77.93%	79.02%	79.02%
Upgrade #3B HP Feedwater Heater	697.094	-0.166	7484	1	86.05	85.54	80.61	4909421	2415.0	1025.0	0.69	77.93%	77.93%	79.02%	79.02%
Upgrade A String LP Feedwater Heaters	696.349	0.746	7492	-8	86.05	85.54	80.60	4909421	2415.0	1025.0	0.69	77.93%	77.93%	79.02%	79.02%
Upgrade B String LP Feedwater Heaters	698.358	-2.009	7471	21	86.05	85.54	80.62	4909421	2415.0	1025.0	0.69	77.93%	77.93%	79.02%	79.02%

```
' Macro to load the results of the calculations
Sub LoadResults()
   Dim results As Object
   Dim Sheet As Object

   ' Get the PEPSE results object, and the sheet object
   Set results = CreateObject("PEPSE.Results")
   Set Sheet = Sheets("Output")

   ' Clear previous results
   ClearOutput

   On Error GoTo ExitSub

   ' Loop through each case in the results file and get
   ' the desired results
   For i = 1 To 27
      ' Open the results.  We are assuming here that the
      ' results file is in the same directory as this spreadsheet
      Let bOpened = results.Open(ActiveWorkbook.Path + "\par12tst.RES", i)
      Let Sheet.Cells(3, 3) = results.Date
      Let Sheet.Cells(i + 6, 2) = results.bkgros
      Let Sheet.Cells(i + 6, 4) = results.output(103)

      ' turbine efficiencies
      Let Sheet.Cells(i + 6, 6) = results.effsec(130) * 100#
      Let Sheet.Cells(i + 6, 7) = results.ehpp(220) * 100#
      Let Sheet.Cells(i + 6, 8) = results.effsec(330) * 100#

      ' main steam conditions
      Let Sheet.Cells(i + 6, 9) = results.ww(10)
      Let Sheet.Cells(i + 6, 10) = results.pp(10)
      Let Sheet.Cells(i + 6, 11) = results.tt(10)


      ' condenser pressure
      Let Sheet.Cells(i + 6, 12) = results.pp(401) / 0.491

      ' feed pumps and turbines
      Let Sheet.Cells(i + 6, 13) = results.efupmp(600) * results.efulnk(600)
      Let Sheet.Cells(i + 6, 14) = results.efupmp(605) * results.efulnk(605)
      Let Sheet.Cells(i + 6, 15) = results.effsec(670)
      Let Sheet.Cells(i + 6, 16) = results.effsec(675)
```

```
    ' PEPSE case title
    Let Sheet.Cells(i + 6, 1) = results.Title

    ' Calculate delta generation and heat rate, design to test
    If i = 4 Then
       Sheet.Cells(i + 6, 3) = Sheet.Cells(i + 6, 2) - Sheet.Cells(i + 3, 2)
       Sheet.Cells(i + 6, 5) = Sheet.Cells(i + 6, 4) - Sheet.Cells(i + 3, 4)
    End If
    If i > 4 Then
       Sheet.Cells(i + 6, 3) = Sheet.Cells(i + 5, 2) - Sheet.Cells(i + 6, 2)
       Sheet.Cells(i + 6, 5) = Sheet.Cells(i + 5, 4) - Sheet.Cells(i + 6, 4)
    End If

  Next
ExitSub:
  Exit Sub
End Sub
```

STEP 4 - PRINTING RESULTS






```
Sub PlotMollier()
  Dim sh As Object
  Dim results As Object
  Set results = CreateObject("PEPSE.Results")
```

```
    Set sh = Worksheets("Expansion Line")
    For i = 1 To 1
    results.Open ActiveWorkbook.Path + "\par12tst.RES", i
    sh.Cells(1, i) = results.pp(30)
    sh.Cells(2, i) = results.pp(40)
    sh.Cells(3, i) = results.pp(100)
    sh.Cells(4, i) = results.pp(120)
    sh.Cells(5, i) = results.pp(130)
    sh.Cells(6, i) = results.pp(210)
    sh.Cells(7, i) = results.pp(220)
    sh.Cells(8, i) = results.pp(240)
    sh.Cells(9, i) = results.pp(300)
    sh.Cells(10, i) = results.pp(310)
    sh.Cells(11, i) = results.pp(320)
    sh.Cells(12, i) = results.pp(330)
    sh.Cells(1, i + 1) = results.hh(30)
    sh.Cells(2, i + 1) = results.hh(40)
    sh.Cells(3, i + 1) = results.hh(100)
    sh.Cells(4, i + 1) = results.hh(120)
    sh.Cells(5, i + 1) = results.hh(130)
    sh.Cells(6, i + 1) = results.hh(210)
    sh.Cells(7, i + 1) = results.hh(220)
    sh.Cells(8, i + 1) = results.hh(240)
    sh.Cells(9, i + 1) = results.hh(300)
    sh.Cells(10, i + 1) = results.hh(310)
    sh.Cells(11, i + 1) = results.hh(320)
    sh.Cells(12, i + 1) = results.hh(330)
    Next
End Sub

' Macro to print the PEPSE schematic for each case in the results
' file.
Sub PrintSchematics()
    Dim model As Object

    ' Open the PEPSE model.  This assumes that the pepse model is in
    ' the same directory as the spreadsheet
    Set model = CreateObject("PEPSE.Application").Open(ActiveWorkbook.Path +
"\par12se4.MDL")

    On Error GoTo ExitSub
    ' For each load case in the results, print the schematic
    For i = 1 To 4
```

```
      ' Open the results file, assuming it is in the same directory
      ' as this spreadsheet
      model.LoadResults ActiveWorkbook.Path + "\par12tst.RES", i
      model.PrintOut
   Next
   Set model = Nothing

ExitSub:
   Exit Sub
End Sub
```