Utilizing LOTUS 123 In Conjunction With PEPSE®

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Dairyland Power Cooperative has nine fossil units, ranging in size from 18 MW to 370 MW. The units range in age from 40 years to 10 years. We are in the process of developing PEPSE models for all units. Our goal is to have turbine models, and data reduction models for all units by the end of the year. We are in the process of developing a fairly aggressive heat rate improvement program, and would like to use PEPSE to assist with data reduction, data evaluation and data trending. We would also like to have the capability of using the turbine models for predictive analysis by other users; such as plant operators, plant management and other engineers.

Using PEPSE for test data reduction and evaluation is not new. With features such as Special Option 6, PEPSE becomes a very powerful data evaluation tool. There is one drawback, however, which makes the tool somewhat cumbersome and clumsy; data input into the PEPSE model. The Special Input Processor provides an easy medium for making changes to specific input values. The data must still be manually entered. If one is reducing several tests, this method of data input becomes time consuming and tiring. LOTUS 123 was reviewed as a possible solution because of ease of use and general familiarity. Test data could be entered into LOTUS, thereby reducing the chances for error. LOTUS could also be used to average test data, perform engineering conversions and create a report of averaged, converted data. There are still problems of entering the LOTUS produced data into PEPSE. This still has to be done manually.

Another goal involves the use of PEPSE by personnel not familiar with the PEPSE program or PEPSE models. Making changes to the model, via the Special Input Processor, to run different cases is very easy to do. However, since you must edit the model to do this, there is a chance that other inadvertent changes to the model could be made; thereby causing model solving problems. In order to reduce the risk involved with user input, an input preprocessor will have to be developed. LOTUS was revived to see if it could be used. LOTUS could provide an input menu of values which are to be changed and the user would make the desired changes accordingly. There is still the problem of entering the data into PEPSE.

The development of new versions of DOS and LOTUS 123 have enabled some problems to be solved. Experience in programming LOTUS macros and in creating DOS batch files is required to accomplish this task. The following deals with the interfacing of LOTUS 123 and PEPSE on a IBM PC or compatible computer. DOS versions of 3.0 or later and LOTUS versions of 2.2 or 3.0 are required in order to perform automatic interfacing of PEPSE and LOTUS 123. Manual interfacing to PEPSE may be accomplished with LOTUS version 2.1.

The following methods are currently in use on two units within the Dairyland system. We are in the process of developing PEPSE models for the balance of the units. The LOTUS 123 interface described here will be incorporated into the models for each unit.

It is assumed that a PEPSE input deck has been developed and debugged. The values which are to be entered via LOTUS have been checked using the Special Input Processor. The interface to LOTUS will not help in the debugging process, but will assist in future operation after the model is operational. The LOTUS spreadsheet and PEPSE model developed for Dairyland's Alma Unit #4 will be used as an example.

A spreadsheet was developed for test data input and averaging. This is shown in Figure 1. We also use this section of the spreadsheet to perform engineering units conversions rather than using operations in PEPSE. With LOTUS macros, you can take advantage of the logical commands available to help reduce the test data. This particular spreadsheet has the capability of automatically setting heater in service flags based on the temperature differential across the heater. If the temperature differential is greater than 5 degrees, the heater is considered to be in service. If the temperature differential is less than 5 degrees, the heater is labeled as out of service. Based on these criteria, the macro will automatically set the heater in service flags.

Next, we created a macro to duplicate the Special Input Processor section of the PEPSE input deck, incorporating the averaged and converted test data. This macro is shown in Figure 2. The results of the macro are shown in Figure 3. The description of each point, the 89xxx0 card, is entered in as a label in the spreadsheet directly. A macro could be used to do this, but we opted to enter these labels outside of the macro. The macro creates the input portion, the 89xxx1 card. The macro command which creates the input portion is as follows:

```
{LET A101,+"890011   TTVSC,  10,  "&@STRING(U9,2)&",  I"}
```

The above command is broken into four segments. The first segment; LET A101; tells LOTUS to put the results of the calculation in to cell A101. The second segment; +"890011   TTVSC, 10, "; creates a label in the cell with the contents of what is inside the quotes. The + mark prior to the quotation marks is critical. It tells LOTUS to perform a calculation on the following string values. The third segment; &@STRING(U9,2); tells LOTUS to convert the value in cell U9 to a string with two points behind the decimal and to add this string to the previous string. (Note that there are no spaces or commas between the quotation marks of the first segment and the & symbol of the second segment.) The last segment; &", I"; again creates a string which is to be added to the end of the previous two segments. The resulting label created by the macro and residing in cell A101 looks like this:

```
890011   TTVSC,  10,  995.00,  I
```

Use this type of command to create the input section for the PEPSE deck.

To print this segment of the spreadsheet to a file for incorporation into PEPSE, use the following command installed at the end of the macro:

/PF**filename**~R**rangename**~AGQ

This command tells LOTUS to print to a file, /PF, called, **filename**, for the range, **rangename**. The ~ marks after the **filename** and the **rangename** act as a return key. The AGQ tells LOTUS to align to the top of the page, go and quit printing, respectively. Also included in the print command, but not shown in the macro command are the following print options which should be set:

```
Right Margin - 76
Left Margin -   0
Top Margin -    0
```

Bottom Margin - 0
Unformatted (as shown)

These margin settings will place the values in column 1 so that PEPSE can read them. The unformatted command allows you to print with no page breaks and no buffer spaces left at top and bottom. The page breaks and buffer spaces may confuse PEPSE.

The next step is to break up the PEPSE model into three segments. The first segment is from the beginning of the model to the start of the special input section. This segment is called MODEL1. This is saved as a separate file. The second section is the special input section. Delete this section, as we will use the file developed from LOTUS for this section. The third section is the remaining portion of the model, which we will call MODEL2. This process is illustrated in Figure 4. A DOS command is then used to combine these files into one. The DOS command for this example would be as follows:

```
COPY MODEL1+TEST.PRN+MODEL2 TESTRUN
```

The + symbols tell DOS to add these file together. The TEST.PRN is the file printed from LOTUS. TESTRUN is the name given to the entire test run for PEPSE. PEPSE can now be run using the normal PEPSE commands.

This method of combining files into one file and then running PEPSE may be built into a batch command. The batch file may also be executed directly from LOTUS if the user has either LOTUS version 2.2 or 3.0. This will be discussed later.

After the PEPSE model has converged, the results from the model need to be transferred back into LOTUS for trending purposes. This can be done on the same worksheet as the data entry and conversion, but is best done on a separate worksheet. We use the data entry spreadsheet as a template. Once data is entered, the resultant data sheet is saved using a name that tells unit number and date of test. This enables us to keep a hard copy of the actual test data. Also, the results output from a Special Option 6 turbine test run can be very long and will take up a considerable amount of room on the spreadsheet.

In order to bring PEPSE results into LOTUS, the user must decide which values from the results file should be saved in a database. Items such as as tested input data, as tested heat rate, as tested load, as tested heater TTD's and DCA's, as tested turbine efficiencies, corrected flow and pressure ratios, and heat rate deviations for major components are common. The next step is to create a database within LOTUS with the desired values as field names. LOTUS may also be used to convert certain PEPSE results into desired values, such as turbine pressure ratios and flow coefficients. Figure 5 shows an example of the database headings used for Alma Unit #4.

After the database structure has been defined within LOTUS, the user must then import the PEPSE results file into LOTUS. This may be accomplished with manual commands or within a macro. The following commands are required to import the the PEPSE results into LOTUS:

{GOTO}A150~
/FIN**filename**~

The GOTO command positions the cursor at the desired location, in this case cell A150. The next command tells LOTUS to import **the file "filename"** using numbers for each individual cell. This command bring the entire results file into the LOTUS spreadsheet. Figure 6 shows an example of imported PEPSE results within LOTUS.

Once the PEPSE results are in LOTUS, it is simply a matter of transferring the appropriate values to their proper location within the database. To accomplish this, we use an intermediate storage section of the spreadsheet to copy desired results. This enables us to check the information prior to storage in the database. This storage section may also be used to perform any necessary calculations before the data is stored in the database. It is very helpful to have a copy of the PEPSE subroutine EIKON to look at when trying to figure out which numbers are the desired results. This subroutine lists the variables printed and the order in which they are printed for the results file. The user then has to locate the cell which contains the required information and copy it to the storage section. Again this may be done with manual commands or a macro. Since the amount of information is quite extensive, a macro is recommended. An example of the commands used in a macro to transfer results to the storage section would be as follows:

```
{LET B100,+D400}
{LET C100,(D405*B100)}
```

The first command tells LOTUS to store the value located in cell D400 to cell B100. The second command is an example of doing a calculation on a PEPSE result prior to storing it in the storage section. Development of this portion of the spreadsheet is the most time consuming because of the amount of information involved.

Once all the desired results are manipulated and stored in the storage section of the worksheet, the storage section can then be transferred to the database section for archive purposes. Once the data is in the storage section, it may be transferred to other programs using LOTUS's exporting capabilities. We use the LOTUS database as an intermediate storage area. Primary data storage is in a corresponding file in the dBase program.

The methods described above for transferring data between LOTUS and PEPSE, may also be used to create a spreadsheet which drives a PEPSE "What If" model. This type of spreadsheet would eliminate problems of non-modelers entering a PEPSE model and inadvertently making changes to the model itself. The only changes made would be through the spreadsheet and the input processor of PEPSE. This spreadsheet would allow the casual user, such as operators, management and other engineers not familiar with PEPSE modeling, to change the desired conditions and view the end results on the same screen. Figure 7 shows an example of the users input and results screen, as used for Dairyland's Genoa Station #3.

To develop a non-modeler input/view screen spreadsheet, such as shown in Figure 7,the following must be performed:

1). Develop the complete "What If" PEPSE model, including the special input section.
2). Develop the input screen, similar to the test data input screen.
3). Separate the model into two files, the complete model and the input data.
4). Use DOS to combine the two files into a third file.
5). Run PEPSE using the combined third file.

6). Bring the results file back into LOTUS and display the desired results.

The following is an example of what the macro would look like:

```
/RIDATAIN~
{LET A101,+"890011   TTVSC,  10,  "&@STRING(U9,2)&",  I"}
 etc.
/PFALMA4IF~RPEPSEIN~AGQ
{SYSTEM "IF4"}
{GOTO}A200~
/FINALMA4IF.RES~
{LET D15,+D400}
etc.
{RETURN}
```

The first command tells LOTUS to input data within the range named DATAIN. This is where the user inputs the desired changes. The second command through the etc. develops the special input processor required for PEPSE. The next command tells LOTUS to print to file ALMA4IF for the named range of PEPSEIN. The next command tells LOTUS to temporarily halt LOTUS and execute a DOS batch file named IF4. This command may only be performed in LOTUS versions 2.2 and 3.0. This batch file will combine the PEPSE model and the data input file into a third file and run PEPSE using the third file. Upon completion of the batch file, the LOTUS macro will then move the cursor to cell A200 and import the results file (ALMA4IF.RES) utilizing numbers per each cell. The next commands retrieve the desired PEPSE results and display them in the appropriate cells.

An example of the batch file, IF4.bat, would be as follows:

```
ECHO OFF
CD\PEP386
COPY C:\LOTUS\ALMA4IF.PRN
COPY ALMA41+ALMA4IF.PRN ALMA4IF
pep386 YES ALMA4IF
CLS
CD\LOTUS
ECHO ON
```

This batch file will combine the PEPSE model (ALMA41) and the PEPSE input data (ALMA4IF.PRN) into a file called ALMA4IF. It will then run PEPSE using the ALMA4IF input deck. Upon completion, it will return to the LOTUS directory and then stop. Note that the data input file has a .PRN extension. This is the extension used by LOTUS to designate a print file.

We are currently using the data input technique for two fossil units, with plans for expanding this capability to all nine units as the PEPSE models are built. We have just started using this method this year and it seems to be working very well. We are in the process of incorporating the data storage technique into these same two models. We are also in the process of incorporating the "What If" preprocessor on all models. We hope to have all nine units fully modeled and utilizing these two techniques by then end of this year.

EXAMPLE TURBINE TEST DATA INPUT

ALMA 4 TURBINE DATA
TEST DATE: 11/9/89 NO.VLVS OPEN: 6

PARAMETER	UNITS	1	2	3	AVERAGES	CORRECTED
TIME	HHMM					
THROTTLE PRESSURE	PSIG	1450.00	1450.00	1450.00	1450.00	1464.49
THROTTLE TEMPERATURE	DEG F	995.00	995.00	995.00	995.00	995.00
FIRST STAGE PRESSURE	PSIG	1100.00	1100.00	1100.00	1100.00	1114.49
COLD REHEAT PRESSURE	PSIG	480.00	480.00	480.00	480.00	494.49
COLD REHEAT TEMPERATURE	DEG F	775.00	775.00	775.00	775.00	775.00
HOT REHEAT PRESSURE	PSIG	475.00	475.00	475.00	475.00	489.49
HOT REHEAT TEMPERATURE	DEG F	995.00	995.00	995.00	995.00	995.00
CROSSOVER PRESSURE	PSIG	15.00	15.00	15.00	15.00	29.49
CROSSOVER TEMPERATURE	DEG F	380.00	380.00	380.00	380.00	380.00
CONDENSER PRESSURE	In Hg	27.85	27.85	27.85	27.85	1.65
CIRC WATER IN TEMP	DEG F	50.00	50.00	50.00	50.00	50.00
CIRC WATER OUT TEMP	DEG F	90.00	90.00	90.00	90.00	90.00
HOTWELL TEMPERATURE	DEG F	95.00	95.00	95.00	95.00	95.00
BFP SUCTION TEMP	DEG F	335.00	335.00	335.00	335.00	335.00
BFP 41 AMPS	AMPS	221.00	221.00	221.00	221.00	------
BFP 42 AMPS	AMPS	180.00	180.00	180.00	180.00	401.00
FW FLOW	KLB/HR	470.00	470.00	470.00	470.00	470000.0
SH SPRAY FLOW	KLB/HR	0.00	0.00	0.00	0.00	0.0
RH SPRAY FLOW	KLB/HR	0.00	0.00	0.00	0.00	0.0
DRUM PRESSURE	PSIG	1595.00	1595.00	1595.00	1595.00	1609.49
EXCESS O2	%	204.00	204.00	204.00	204.00	204.00
GAS EXIT TEMPERATURE 41	DEG F	360.00	360.00	360.00	360.00	------
GAS EXIT TEMPERATURE 42	DEG F	370.00	370.00	370.00	370.00	365.00
AIR INLET TEMPRATURE 41	DEG F	100.00	100.00	100.00	100.00	------
AIR INLET TEMPRATURE 42	DEG F	100.00	100.00	100.00	100.00	100.00
GROSS MW	MW	62.00	62.00	62.00	62.00	62.00
BFP DISCH PRESS	PSIG	1555.00	1555.00	1555.00	1555.00	1569.49
BAROMETRIC PRESS	In Hg	29.50	29.50	29.50	29.50	14.49
HTR 45 STEAM PRESSURE	PSIG	475.00	475.00	475.00	475.00	489.49
HTR 45 STEAM TEMP.	DEG F	770.00	770.00	770.00	770.00	770.00
HTR 45 INLET TEMP.	DEG F	371.00	371.00	371.00	371.00	371.00
HTR 45 OUTLET TEMP.	DEG F	460.00	460.00	460.00	460.00	460.00
HTR 45 DRAIN TEMP.	DEG F	375.00	375.00	375.00	375.00	375.00
HTR 44 STEAM PRESSURE	PSIG	182.00	182.00	182.00	182.00	197.64
HTR 44 STEAM TEMP.	DEG F	800.00	800.00	800.00	800.00	800.00
HTR 44 INLET TEMP.	DEG F	342.00	342.00	342.00	342.00	342.00
HTR 44 OUTLET TEMP.	DEG F	380.00	380.00	380.00	380.00	380.00
HTR 44 DRAIN TEMP.	DEG F	335.00	335.00	335.00	335.00	335.00
HTR 43 STEAM PRESSURE	PSIG	51.00	51.00	51.00	51.00	66.10
HTR 43 STEAM TEMP.	DEG F	615.00	615.00	615.00	615.00	615.00
HTR 42 STEAM PRESSURE	PSIG	18.00	18.00	18.00	18.00	33.16
HTR 42 STEAM TEMP.	DEG F	380.00	380.00	380.00	380.00	380.00
HTR 42 INLET TEMP.	DEG F	176.00	176.00	176.00	176.00	176.00
HTR 42 OUTLET TEMP.	DEG F	240.00	240.00	240.00	240.00	240.00
HTR 42 DRAIN TEMP.	DEG F	205.00	205.00	205.00	205.00	205.00
HTR 41 STEAM PRESSURE	PSIA	−14.00	−14.00	−14.00	−14.00	6.98
HTR 41 STEAM TEMP.	DEG F	170.00	170.00	170.00	170.00	170.00
HTR 41 INLET TEMP.	DEG F	107.00	107.00	107.00	107.00	107.00
HTR 41 OUTLET TEMP.	DEG F	176.00	176.00	176.00	176.00	176.00
HTR 41 DRAIN TEMP.	DEG F	135.00	135.00	135.00	135.00	135.00

FIGURE 1

PEPSE DATA INPUT MACRO

```
{LET A101,+"890011   TTVSC, 10, "&@STRING(U9,2)&",  I"}
{LET A103,+"890021   PPVSC, 10, "&@STRING(U8,2)&",  I"}
{LET A105,+"890031   PSIPV, 40, "&@STRING(U10,2)&",  I"}
{LET A107,+"890041   PSIPV, 50, "&@STRING(U11,2)&",  I"}
{LET A109,+"890051   TEXIP, 50, "&@STRING(U12,2)&",  I"}
{LET A111,+"890061  PPTORH, 75, "&@STRING(U13,2)&",  I"}
{LET A113,+"890071  TTTORH, 75, "&@STRING(U14,2)&",  I"}
{LET A115,+"890081    PPSH, 130, "&@STRING((-1*U17),2)&",  I"}
{LET A117,+"890111    OPVB, 12, "&@STRING(U24,1)&",  I"}
{LET A119,+"890121  WWFIXB, 205, "&@STRING(U25,1)&",  I"}
{LET A121,+"890131    OPVB, 13, "&@STRING(U26,1)&",  I"}
{LET A123,+"890141    OPVB, 14, 0.,  I"}
{LET A125,+"890151   POWER,  1, "&@STRING(U33,2)&",  I"}
{LET A127,+"890161  PMPDIS, 170, "&@STRING(U34,2)&",  I"}
{IF (U41-U40)>=5}{LET AH20,2.0}{BRANCH AA22}                          2
{LET AH20,-1.0}                                                     2
{LET A129,+"890171  SWTCHV, 51, "&@STRING(AH20,1)&",  I"}             2
{LET A131,+"890181    TTFO, 185, "&@STRING(U41,2)&",  I"}             2
{LET A133,+"890191    TTDO, 185, "&@STRING(U42,2)&",  I"}             2
{IF (U47-U46)>=5}{LET AH21,2.0}{BRANCH AA27}
{LET AH21,-1.0}
{LET A135,+"890201  SWTCHV, 86, "&@STRING(AH21,1)&",  I"}
{LET A137,+"890211    TTFO, 180, "&@STRING(U47,2)&",  I"}
{LET A139,+"890221    TTDO, 180, "&@STRING(U48,2)&",  I"}
{LET A141,+"890231   PSIPV, 180, "&@STRING(U44,2)&",  I"}
{IF (U56-U55)>=5}{LET AH22,2.0}{BRANCH AA33}
{LET AH22,-1.0}
{LET A143,+"890241  SWTCHV, 96, "&@STRING(AH22,1)&",  I"}
{LET A145,+"890251    TTFO, 160, "&@STRING(U56,2)&",  I"}
{LET A147,+"890261    TTDO, 160, "&@STRING(U57,2)&",  I"}
{LET A149,+"890271   PSIPV, 95, "&@STRING(U53,2)&",  I"}
{IF (U62-U61)>=5}{LET AH23,2.0}{BRANCH AA39}
{LET AH23,-1.0}
{LET A151,+"890281  SWTCHV, 245, "&@STRING(AH23,1)&",  I"}
{LET A153,+"890291    TTFO, 155, "&@STRING(U62,2)&",  I"}
{LET A155,+"890301    TTDO, 155, "&@STRING(U63,2)&",  I"}
{LET A157,+"890311   PSIPV, 120, "&@STRING(U59,2)&",  I"}
{IF (U46-U56)>=10}{LET AH24,2.0}{BRANCH AA45}
{LET AH24,-1.0}
{LET A159,+"890321  SWTCHV, 91, "&@STRING(AH24,1)&",  I"}
{LET A161,+"890331   PSIPV, 90, "&@STRING(U50,2)&",  I"}
{LET A163,+"890341   TEXIP, 85, "&@STRING(U45,2)&",  I"}
{LET A165,+"890351   TEXIP, 90, "&@STRING(U51,2)&",  I"}
{LET A167,+"890361   TEXIP, 95, "&@STRING(U54,2)&",  I"}
{LET A169,+"890371   PSIPV, 125, "&@STRING((U17*.4912),2)&",  I"}
{LET A171,+"890391   BKPMOT, 170, "&@STRING((U23*4156.92/1000),2)&",  I"
/PFA4TEST~RRPEPSEIN~AGQ~{CALCMENU}
```

FIGURE 2

PEPSE MACRO OUTPUT

```
=ALMA 4  11/9/89
890010   'THROTTLE TEMP'
890011   TTVSC, 10, 995.00,  I
890020   'THROTTLE PRESSURE (PSIA)'
890021   PPVSC, 10, 1464.49,  I
890030   'FISRT STAGE PRESS (PSIA)'
890031   PSIPV, 40, 1114.49,  I
890040   'COLD REHEAT PRESS (PSIA)'
890041   PSIPV, 50, 494.49,  I
890050   'COLD REHEAT TEMP'
890051   TEXIP, 50, 775.00,  I
890060   'HOT REHEAT PRESS (PSIA)'
890061  PPTORH, 75, 489.49,  I
890070   'HOT REHEAT TEMP'
890071  TTTORH, 75, 995.00,  I
890080   'CONDENSER BACK PRESS (In Hg)'
890081    PPSH, 130, -1.65,  I
890110   ' FEEDWATER FLOW (LB/HR)'
890111    OPVB, 12, 470000.0,  I
890120   'SH SPRAY FLOW (LB/HR)'
890121  WWFIXB, 205, 0.0,  I
890130   'RH SPRAY FLOW (LB/HR)'
890131    OPVB, 13, 0.0,  I
890140   'BLOWDOWN FLOW (LB/HR)'
890141    OPVB, 14, 0.,  I
890150   'GROSS MW'
890151   POWER,  1, 62.00,  I
890160   'BFP DISCH PRESS (PSIA)'
890161  PMPDIS, 170, 1569.49,  I
890170   'HTR 45 IN SVC'
890171  SWTCHV, 51, 2.0,  I
890180   'HTR 45 OUTLET TEMP'
890181    TTFO, 185, 460.00,  I
890190   'HTR 45 DRAIN TEMP'
890191    TTDO, 185, 375.00,  I
890200   'HTR 44 IN SVC'
890201  SWTCHV, 86, 2.0,  I
890210   'HTR 44 OUTLET TEMP'
890211    TTFO, 180, 380.00,  I
890220   'HTR 44 DRAIN TEMP'
890221    TTDO, 180, 335.00,  I
890230   'HTR 44 STM PRESS (PSIA)'
890231   PSIPV, 180, 197.64,  I
890240   'HTR 42 IN SVC'
890241  SWTCHV, 96, 2.0,  I
890250   'HTR 42 OUTLET TEMP'
890251    TTFO, 160, 240.00,  I
890260   'HTR 42 DRAIN TEMP'
890261    TTDO, 160, 205.00,  I
890270   'HTR 42 STM PRESS (PSIA)'
890271   PSIPV, 95, 33.16,  I
```

FIGURE 3

DIAGRAM OF FILE COMBINING

MODEL 1

```
*
* EIKON/PEPSE USER : USER
*              DATE : 10/16/89
*              TIME : 16:04
*      DATA FILE ID : A4TURB
*     MODEL FILE ID : A4TURB
*
= ALMA UNIT 4 TURBINE TEST
*
*
*** GENERIC INPUT DATA
*
*SPECIAL OPTION FLAG
850000  2
850002  120
* UNITS FLAGS
010000  ENGLISH,  ENGLISH
*

*
*END OF BASE DECK
*
*SPECIAL INPUT SECTION
```

TEST.PRN

```
*SPECIAL INPUT SECTION

= ALMA 4 TURBINE TEST 11/15/89
890010   'THROTTLE TEMP'
890011   TTVSC, 10, 992.67,  I
890020   'THROTTLE PRESSURE (PSIA)'
890021   PPVSC, 10, 1464.27,  I
890030   'FIRST STAGE PRESS (PSIA)'
890031   PSIPV, 40, 1008.60,  I

890360   'CROSSOVER TEMP'
890361   TEXIP, 95, 456.53,  I
890370   'LP EXHAUST PRESS'
890371   PSIPV, 125, 0.56,  I
890390   'BFP MOTOR POWER (KW)'
890391   BKPMOT, 170, 1567.16,  I
```

MODEL 2

```
/
*STANDARDIZATION DECK
= ALMA 4 VWO TEST STANDARDIZATION
*TABLE SUPPRESSION
890401   SUPRES, 35, 1., I
890411   SUPRES, 42, 1., I
890421   SUPRES, 1,  1., I
890431   SUPRES, 19, 1., I
890441   SUPRES, 38, 1., I
890451   SUPRES, 21, 1., I
*

*
*RESTORE COMPONENTS
850662 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60,
850663 85, 90, 95, 100, 105, 120, 125, 135, 140
850664 145, 155, 160, 165, 170, 175, 180, 185, 190
850665 205, 215, 220, 225, 230
*RESTORE STREAMS
```

FIGURE 4

ALMA #4 ARCHIVAL STORAGE NAMES

	AS TESTED VARIABLES	CORRECTED VARIABLES	DEVIATION VARIABLES
Steam Flow (Klb/hr)	WMS	WMSC	----
Throttle Pressure (psia)	PMS	PMSC	PMSD
Throttle Temperature (Deg F)	TMS	----	TMSD
First Stage Pressure (psia)	P1STG	P1STGC	----
First Stage Temperature (Deg F)	T1STG	----	----
Cold Reheat Pressure (psia)	PCRH	PCRHC	----
Cold Reheat Temperature (Deg F)	TCRH	----	----
Hot Reheat Pressure (psia)	PHRH	PHRHC	----
Hot Reheat Temperature (Deg F)	THRH	----	THRHD
IP-1 Extraction Pressure (psia)	PIP1	PIP1C	----
IP-1 Extraction Temperature (Deg F)	TIP1	----	----
IP-2 Extraction Pressure (psia)	PIP2	PIP2C	----
IP-2 Extraction Temperature (Deg F)	TIP2	----	----
Crossover Pressure (psia)	PXVR	PXVRC	----
Crossover Temperature (Deg F)	TXVR	----	----
LP-1 Extraction Pressure (psia)	PLP1	PLP1C	----
LP-1 Extraction Temperature (Deg F)	TLP1	----	----
Condenser Back Pressure (In Hg)	PCBP	----	----
Governing Stage Efficiency (%)	GSEFF	GSEFFC	----
Governing Stage Pressure Ratio	GSRAT	GSRATC	----
HP-1 Efficiency (%)	HP1EFF	HP1EFC	----
HP-1 Pressure Ratio	HP1RAT	HP1RAC	----
HP Turbine Efficiency (%)	HPEFF	HPEFFC	HPEFFD
IP-1 Efficiency (%)	IP1EFF	IP1EFC	----
IP-1 Pressure Ratio	IP1RAT	IP1RAC	----
IP-1 Flow Coefficient	IP1COF	IP1CFC	----
IP-2 Efficiency (%)	IP2EFF	IP2EFC	----
IP-2 Pressure Ratio	IP2RAT	IP2RAC	----
IP-2 Flow Coefficient	IP2COF	IP2CFC	----
IP-3 Efficiency (%)	IP3EFF	IP3EFC	----
IP-3 Pressure Ratio	IP3RAT	IP3RAC	----
IP Turbine Efficiency (%)	IPEFF	IPEFFC	IPEFFD
LP-1 Efficiency (%)	LP1EFF	LP1EFC	----
LP-1 Pressure Ratio	LP1RAT	LP1RAC	----
LP-1 Flow Coefficient	LP1COF	LP1CFC	----
LP-2 Efficiency (%)	LP2EFF	LP2EFC	----
LP-2 Pressure Ratio	LP2RAT	LP2RAC	----
LP Turbine Efficiency (%)	LPEFF	LPEFFC	LPEFFD
Expansion Line End Point	HELEP	HELEPC	----
Heater 1 TTD (Deg F)	TTD1	----	HTR1D
Heater 1 DCA (Deg F)	DCA1	----	----
Heater 2 TTD (Deg F)	TTD2	----	HTR2D
Heater 2 DCA (Deg F)	DCA2	----	----
Heater 4 TTD (Deg F)	TTD4	----	HTR4D
Heater 4 DCA (Deg F)	DCA4	----	----
Heater 5 TTD (Deg F)	TTD5	----	HTR5D
Heater 5 DCA (Deg F)	DCA5	----	----
Generator Load (MWe)	MWE	MWEC	----
Net Turbine Heat Rate (Btu/Kw)	NTHR	NTHRC	----
Boiler Efficiency	BLREFF	----	BLREFD
Net Unit Heat Rate (Btu/Kw)	NHR	NHRC	NHRD
Circ Water Temperature In (Deg F)	TCIRCI	----	TCIRCD
Circ Water Temperature Out (Deg F)	TCIRCO	----	----
BFP 1 Amps	BFP1A	----	----
BFP 2 Amps	BFP2A	----	----
BFP 1 Efficiency (%)	BFP1EF	----	BFP1D
BFP 2 Efficiency (%)	BFP2EF	----	BFP2D
Condenser Cleanliness	CLEAN	CLEANC	CLEAND
Condenser TTD (Deg F)	CONTTD	----	----
Throttle Flow Ratio	WTFR	WTFRC	----
Auxiliary Power (MWe)	AUX	----	AUXD
Feedwater Outlet Temp. (Deg F)	TFWO	----	TFWOD
Superheat Spray Flow (Klb/hr)	WSS	----	WSSD
Reheat Spray Flow (Klb/hr)	WRS	----	WRSD
Air Htr Steam Flow (Klb/hr)	WAIR	----	WAIRD

FIGURE 5

EXAMPLE OF PEPSE RESULTS FILE IN LOTUS

4					
11	9	89	10		
58.24927	57.15833	8521.951	8749.728	0	
10	33				
0	0				
1	10	0	432270		
1000	1465	1.565326	1491.177	0.553305	1.603545
15	34				
58.6	0.04				
1	10	0	432270		
1000	1465	1.565326	1491.177	0.553305	1.603545
1	15	0	432270		
996.9133	1406.4	1.549632	1491.177	0.576493	1.607744
20	61				
1	15	0	432270		
996.9133	1406.4	1.549632	1491.177	0.576493	1.607744
1	20	0	430432.9		
996.9133	1406.4	1.549632	1491.177	0.576493	1.607744
2	220	0	1837.129		
996.9133	1406.4	1.549632	1491.177	0.576493	1.607744
25	61				
1	20	0	430432.9		
996.9133	1406.4	1.549632	1491.177	0.576493	1.607744
1	25	0	429137.2		
996.9133	1406.4	1.549632	1491.177	0.576493	1.607744
2	26	0	1295.638		
996.9133	1406.4	1.549632	1491.177	0.576493	1.607744
30	35				
42.192	0.03				
1	25	0	429137.2		
996.9133	1406.4	1.549632	1491.177	0.576493	1.607744
1	30	0	429137.2		
994.6758	1364.208	1.538786	1491.177	0.594426	1.610885
35	63				
1	30	0	429137.2		
994.6758	1364.208	1.538786	1491.177	0.594426	1.610885
1	35	0	424845.9		
994.6758	1364.208	1.538786	1491.177	0.594426	1.610885
2	36	0	4291.372		
994.6758	1364.208	1.538786	1491.177	0.594426	1.610885
40	8				
0.89181	12738340	10912.3			
1	35	0	424845.9		
994.6758	1364.208	1.538786	1491.177	0.594426	1.610885
1	40	0	424845.9		
927.3569	1084.171	1.427924	1461.193	0.715265	1.613514
45	61				
1	40	0	424845.9		
927.3569	1084.171	1.427924	1461.193	0.715265	1.613514
1	45	0	408451.9		
927.3569	1084.171	1.427924	1461.193	0.715265	1.613514
2	46	0	16393.99		
927.3569	1084.171	1.427924	1461.193	0.715265	1.613514

FIGURE 6

EXAMPLE OF "WHAT IF" INPUT SCREEN

GENOA 3 PEPSE WHAT IF INPUT DATA

	FLOWS (KLB/HR)	
FEEDWATER	2100.0	
HP REHEATER SPRAY	61.8	
LP REHEATER SPRAY	0.0	
AIR HTR STEAM	11.6	
	PRESSURE (PSIG)	TEMPERATURE (DEG F)
THROTTLE	3500.0	995.0
HP REHEATER	-----	1000.0
LP REHEATER	-----	985.0
RIVER WATER	-----	50.0
	PRESSURE (In Hg)	CLEANLINESS (fract)
HP CONDENSER	2.63	0.88
LP CONDENSER	2.54	0.88
BFPT CONDENSER	3.01	0.88
CONDENSER CALC SWITCH	0.0	

(INPUT 1.0 TO USE CONDENSER PRESS.; 0.0 TO CALC. CONDENSER PRESS)

CIRC. PUMPS IN SVC 2.0

FEEDWATER HEATERS (INPUT 2.0 FOR HTR IN SVC; −1.0 FOR OUT OF SERVICE)

	TTD	DCA	In Svc
HTR 1A	5.0	10.0	2.0
HTR 1B	5.0	10.0	2.0
HTR 2	5.0	10.0	2.0
HTR 3	5.0	10.0	2.0
HTR 5	0.0	10.0	2.0
HTR 6	0.0	10.0	2.0
HTR 7	−2.0	10.0	2.0
HTR 8	−2.0	10.0	2.0

GENOA 3 PEPSE WHAT IF RESULTS

LOAD (MW): 330.93 TURBINE HEAT RATE: 7381.43 (BTU/KWH)

CONDENSER PRESSURES (In Hg)

HP CONDENSER:	1.06
LP CONDENSER:	0.88
BFPT CONDENSER:	3.01

TURBINE EFFICIENCIES (%)

VHP:	79.67
HP:	84.62
IP:	89.27
LP1:	88.01
LP2:	88.25

FEEDWATER HEATERS

	TEMP IN (DEG F)	TEMP OUT (DEG F)	DRAIN TEMP (DEG F)	STM PRESS (PSIA)	STM FLOW (KLB/HR)
HTR 1A:	83.53	168.06	93.53	6.43	57326.71
HTR 1B:	83.53	170.15	93.53	6.74	58694.30
HTR 2:	169.12	200.18	179.12	12.82	57788.67
HTR 3:	200.18	249.62	210.18	32.32	73333.75
HTR 4:	249.62	319.63	------	89.18	85362.89
HTR 5:	328.52	366.16	338.52	165.29	56539.70
HTR 6:	366.16	443.63	376.16	396.06	139968.10
HTR 7:	443.63	485.42	453.63	584.64	85244.28
HTR 8:	485.42	551.63	495.42	1042.25	190430.80

FIGURE 7