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PREPWATE—An Interactive Preprocessing Computer Code to the Weight Analysis of Turbine Engines (WATE) Computer Code

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UTTL: PREWATE: An interactive preprocessing computer code to the Weight Analysis of Turbine Engines (WATE) computer code
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ABA: Author
ABS: The Weight Analysis of Turbine Engines (WATE) computer code was developed by Boeing under contract to NASA Lewis. It was designed to function as an adjunct to the Navy/NASA Engine Program (NNEP). NNEP calculates the design and off-design thrust and sfc performance of User defined engine cycles. The thermodynamic parameters throughout the engine as generated by NNEP are then combined with input parameters defining the component characteristics in WATE to calculate the bare engine weight of this User defined engine. Preprocessor programs for NNEP were previously developed to simplify the task of creating input datasets. This report describes a similar preprocessor for the WATE code.

ENTER:

PREPWATE - AN INTERACTIVE PREPROCESSING COMPUTER CODE TO THE WEIGHT ANALYSIS OF TURBINE ENGINES (WATE) COMPUTER CODE

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SUMMARY

The Weight Analysis of Turbine Engines (WATE) computer code was developed by Boeing under contract to NASA Lewis (ref. 1). It was designed to function as an adjunct to the Navy/NASA Engine Program (NNEP) (ref. 2). NNEP calculates the design and off-design thrust and sfc performance of User defined engine cycles. The thermodynamic parameters throughout the engine as generated by NNEP are then combined with input parameters defining the component characteristics in WATE to calculate the bare engine weight of this User defined engine.

Preprocessor programs for NNEP were previously developed (ref. 3) to simplify the task of creating input datasets. This report describes a similar preprocessor for the WATE code.

INTRODUCTION

The NASA Lewis Research Center in conjunction with the Naval Air Development Center jointly developed a computer code (NNEP) for determining the thermodynamic performance for arbitrary turbine engines, i.e., the code can assemble arbitrary combinations of specified types of components (such as ducts, compressors, turbines, etc.) through the use of input variables rather than having to build a computer code exclusively for each engine configuration (ref. 2). In order to simplify the task of creating datasets to run on NNEP for new or occasional users, a pair of preprocessor programs KONFIG and REKONFIG were created (ref. 3). Favorable comments were received from users of the preprocessor programs. They also expressed the desire for a similar preprocessor for the Weight Analysis of Turbine Engines code (WATE) (ref. 1).

WATE was developed by Boeing under contract to NASA Lewis. It is capable of calculating the component weights and flowpaths of most engines that a user of NNEP would wish to study. It was designed to be an adjunct to NNEP and receives thermodynamic data from NNEP. Mechanical design variables are then set for each of the engine components and the weight and dimensions then determined.

As opposed to NNEP, which treats all of a particular type of component (e.g., compressors) thermodynamically the same, WATE distinguishes them by type (e.g., fan, low pressure, high pressure). Different modules then calculate the weight by sub-type. The WATE code requires two main arrays of data, IWMEC and DESVAL. IWMEC is a two dimension array where the mechanical design inputs such as component type, the existence of frames, stators, and other information are stored. DESVAL is also a two dimensional array containing the aerodynamic and design inputs such as Mach number in, Mach number out, blade aspect ratio, etc. Default values of DESVAL for each component sub-type are built into PREPWATE. When the user runs PREPWATE, he will be shown the defaulted values as well as the recommended range for each variable. He may easily change one or more of the DESVALs for each component in the engine.

The rest of this report will show the operation of PREPWATE by a sample case.

OPERATION OF PREPWATE

PREPWATE consists of the main and one subroutine. The main routine prompts the User for all of the inputs required and prepares the output dataset. The subroutine (SUBROUTINE REDOEM) is called in order to allow the User to change one or more of the DESVALs from the defaulted values.

All reads are from UNIT 30 and prompts for input on UNIT 35. The final card images for the inputs to the WATE code are written on UNIT 6 and a dataset should be datadeffed to this unit to save the images.

SAMPLE CASE

A high bypass ratio separate flow engine will be used to illustrate the use of the code. The fan will have booster stages attached to it to raise the pressure of the air that will enter the core. These stages are driven by the low pressure turbine and the outer dimension of both turbines will be limited to the outer dimension of these booster stages. An NNEP thermodynamic schematic of the engine is shown in figure 1. As indicated, NNEP does not distinguish by subcomponent type, e.g., all compressor thermodynamic calculations are done identically.

The WATE code, on the other hand, requires that the User identify the type of subcomponent, e.g., the three compressors are now a fan, a low pressure compressor, and a high pressure compressor. The mechanical schematic for the WATE code for the NNEP engine in figure 1 is shown in figure 2. The component numbers are retained so there is a one to one correspondence with the thermodynamic model. Note, however, the inlet does not appear in figure 2. Inlet weight cannot be calculated by WATE. At NASA Lewis, this weight is calculated by the INSTAL computer code (ref. 4) which was also created as an adjunct to NNEP.

The User is now ready to run PREPWATE. A terminal session for creating the WATE input data for this engine is shown in Appendix A.

As can be seen from Appendix A, the user first defines a dataset on Unit 6 into which the card images for the WATE code will be written. He then identifies the library containing the Main Routine and Subroutine and then calls the main routine. (A procedure definition containing these instructions has been prestored in the LeRC 370/3033 as PREPWATE).

The User is then prompted for the required inputs. The first inputs specify what plots and whether English or SI units are desired . The second inputs are whether or not scaled engines are desired (IWT = 4) or not (IWT = 2) and for the amount of output desired (IOUTCD = 4 gives total weight, length and maximum radius, plus component values, plus stage by stage values).

Next, the disk weight calculation method to be used is identified (B = Boeing, G = Garrett). The User is then asked to identify the component numbers of all the components contributing to the maximum length of the engine (exclusive of inlets and water injectors). All the remaining flow components in the engine including the shafts, but excluding inlets and water injectors are then identified.

The User will then be prompted to enter the NNEP generic type of each component (COMP, TURB, NOZZ, etc.) and then for detailed information about each component (type of compressor, are there stators?, frames, etc.). After this information has been entered, the code will then print out the defaulted values for each DESVAL for each subcomponent as well as the recommended range (where appropriate). The User can change any of the defaulted values of DESVAL by entering the letter code for the variable followed by the new value which MUST include a decimal point. Any or all of the variables may be changed in this manner. By entering an "R", the User may review the latest values. When satisfied, the User enters a "T" to terminate this component and proceed to the next. When all the components are done, the program will terminate.

The card images generated from PREPWATE are shown in Appendix B. The extra blanks generated for DESVAL have been eliminated. This dataset must be incorporated into a NNEP dataset in order to run the NNEP/WATE combination. This dataset is also shown in Appendix B. A brief explanation of this dataset is as follows:

The first card image is the NNEP Title Card;

Next, the first block of Namelist D data. The defaulted values for all variables are being used.

The second block of Namelist D data for NNEP is then displayed. This represents the configuration and design spec data for Mode 1. (There is only one mode in this engine). There is an IWT = 4 card which tells the code that weight should be calculated after this NNEP point has been run. This triggers the code so that the WATE code is called.

The WATE code calls for the Namelist W data and the card images created by PREPWATE are entered here. The NNEP/WATE code is now ready to run. The answers to the sample case are shown in Appendix C. The interactive graphics capability of the code (ref. 5) was used to generate a graphics plot of the engine (PLOT = T in & W). This plot has been reproduced in figure 3. Note that the LPC (component 6) overlaps the duct (component 4). Changes to the DESVALs of components 2, 4 and/or 6 can be implemented to generate a better flowpath, either by going back to the original dataset or using the interactive method of reference 5 at the graphics scope.

The PREPWATE computer code listings are shown in Appendix D.

CONCLUSIONS

PREPWATE has been created to help Users of the WATE code to prepare input datasets for the code. It is tutorial in nature and hopefully will prove to be as useful as the preprocessors KONFIG and REKONFIG for the NNEP computer code. The code is available from the author in card form (600 cards) or on a User supplied tape.

```
DDEF FT06F001,VS, WATEDATA
DDEF XX,VP,LIB.PREPWATE,OPTION=JOBLIB

GO:PREPWATE

ENTER VALUES FOR IPLT(PRINTER PLOT), PLOT(GRAPHICS PLOT), ISII(SI INPUT), ISIO(SI OUTPUT) -- T OR F

T T F F
ENTER VALUES FOR IWT (2=NO AIRFLOW SCALING,4=WITH AIRFLOW SCALING) AND
IOUTCD (0=WT,L, & MAX R,1=ADD COMPONENT WTS,2=ADD STAGE BY STAGE OUTPUT

4 2
DO YOU WANT BOEING OR GARRETT METHOD FOR DISK WEIGHT CALCULATIONS?
ENTER B FOR BOEING OR G FOR GARRETT

B
ENTER COMPONENT NUMBERS OF ALL COMPONENTS (EXCLUSIVE OF INLETS AND WINJS) THAT CONTRIBUTE TO MAX LENGTH OF ENGINE (RT. A
DJ.)

02 03 06 07 08 17 09 10 11 12 13 14
ENTER COMPONENT NUMBERS OF ALL REMAINING COMPONENTS (EXCLUSIVE OF INLETS,WINJS,LOADS,CNTLS,OPTVS, & LIMVS)

04 05 15 16
YOU WILL NOW BE PROMPTED FOR THE GENERIC (NNEP) TYPE FOR EACH COMPONENT (COMP,TURB, ETC.)
COMPONENT  2 IS A (A4)

COMP
COMPONENT  3 IS A (A4)

SPLT
COMPONENT  6 IS A (A4)

COMP
COMPONENT  7 IS A (A4)

DUCT
COMPONENT  8 IS A (A4)

COMP
COMPONENT 17 IS A (A4)

DUCT
COMPONENT  9 IS A (A4)

DUCT
COMPONENT 10 IS A (A4)

TURB
COMPONENT 11 IS A (A4)

DUCT
COMPONENT 12 IS A (A4)

TURB
COMPONENT 13 IS A (A4)

DUCT
COMPONENT 14 IS A (A4)

NOZZ
COMPONENT  4 IS A (A4)
```

```
DUCT
COMPONENT  5 IS A (A4)

NOZZ
COMPONENT 15 IS A (A4)

SHFT
COMPONENT 16 IS A (A4)

SHFT
FOR EACH NNEP COMPONENT YOU WILL BE PROMPTED FOR THE WATE SUBCOMPONENT
COMPONENT   2  IS A COMPRESSOR, OPTIONS ARE (ENTER CORRECT LETTER)
A- TYPICAL FAN
B- OUTER PORTION OF NON-ROTATING SPLITTER FAN
C- INNER PORTION OF NON-ROTATING SPLITTER FAN
D- OUTER PORTION OF ROTATING SPLITTER FAN
E- INNER PORTION OF ROTATING SPLITTER FAN
F- LOW PRESSURE COMPRESSOR
G- HIGH PRESSURE COMPRESSOR
A
INDICATE WHETHER THERE ARE STATORS OR IF THIS IS A CENTRIFUGAL COMPRESSOR
A- CALCULATE STATOR WEIGHT
B- NO STATOR WEIGHT
C- CENTRIFUGAL COMPRESSOR
B
 INDICATE WHETHER THERE IS A FRONT FRAME IN THE COMPRESSOR
A- NO FRAME
B- SNGL BEARING FRAME FOR TFS AND TJS WITHOUT POWER TAKEOFF (PTO)
C- SINGLE BEARING FRAME WITH PTO
D- TWO BEARING FRAME WHICH EXTENDS OUTWARD TOTHE FAN OUTER CASE AND HOLDS TWO BEARINGS WITH PTO
A
 INDICATE WHETHER THERE IS A  REAR FRAME IN THE COMPRESSOR
A- NO FRANE
B- SNGL BEARING FRAME FOR TFS AND TJS WITHOUT POWER TAKEOFF (PTO)
C- SINGLE BEARING FRAME WITH PTO
D- TWO BEARING FRAME WHICH EXTENDS OUTWARD TOTHE FAN OUTER CASE AND HOLDS TWO BEARINGS WITH PTO
D
GEAR BOX INDICATOR,0= NO GEAR BOX, N=SHAFT NUMBER FOR GEAR BOX

0
YOU MAY SPECIFY THE NUMBER OF STAGES-OVERRIDES MAX PR/STG., OTHERWISE ENTER 0

0
FAN/COMPRESSOR
CODE VALUE   DESCRIPTION                          LOW VALUE-HIGH VALUE
A    0.5500  FACE INLET MACH NUMBER                0.5000    0.6000
B   1.70000  MAX 1ST STAGE PRATIO                  1.50000   1.80000
C     0.450  COMPRESSOR FACE HUB TO TIP RATIO      0.400      0.500
D    1.5000  BLADE SOLIDITY (CORD/SPACING)         1.0000     1.5000
E    4.0000  BLADE ASPECT RATIO-1ST STAGE          3.0000     5.0000
F    3.0000  BLADE ASPECT RATIO-LAST STAGE         2.0000     3.0000
G    0.4500  COMPRESSOR EXIT MACH NUMBER           0.4500     0.5500
H    0.0000  MAX. COMP. INLET T- 0=CALC'D          0.0000     0.0000
I    0.0000  MAX. COMP. EXIT T- 0=CALC'D           0.0000     0.0000
J    1.0000  MAX. SPEED RATIO RPMMAX/RPMD          1.0000     1.0000
K    0.0000  BLADE MATERIAL DENSITY 0=T-SET        0.0000     0.0000
L        2.  1=CONST.HUB,2=MEAN,3=TIP DESN.          0.         0.
M    1.0000  RPM SCALER TO MATCH KNOWN RPM         1.0000     1.0000
N    0.0000  TEMP FOR MATERIAL CHANGE              0.0000     0.0000
O    0.0000  WEIGHT SCALER 0=AS CALCULATED         0.0000     0.0000
```

```
P   1.8000  STATOR BLADE TAPER RATIO                    0.0000     0.0000
S   0.0550  BLADE VOLUME RATIO                         0.0000     0.0000
ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POINT) OR ENTER
Q           QUIT PROCESSING ENTIRE ENGINE
R           REVIEW UPDATED VALUES
T           TERMINATE - GO ON TO NEXT COMPONENT
B 1.8
C .37
E 4.5
F 4.5
G .5
R
FAN/COMPRESSOR
CODE VALUE  DESCRIPTION                               LOW VALUE-HIGH VALUE
A    0.5500 FACE INLET MACH NUMBER                    0.5000    0.6000
B   1.80000 MAX 1ST STAGE PRATIO                      1.50000   1.80000
C     0.370 COMPRESSOR FACE HUB TO TIP RATIO          0.400     0.500
D    1.5000 BLADE SOLIDITY (CORD/SPACING)             1.0000    1.5000
E    4.5000 BLADE ASPECT RATIO-1ST STAGE              3.0000    5.0000
F    4.5000 BLADE ASPECT RATIO-LAST STAGE             2.0000    3.0000
G    0.5000 COMPRESSOR EXIT MACH NUMBER               0.4500    0.5500
H    0.0000 MAX. COMP. INLET T- 0=CALC'D              0.0000    0.0000
I    0.0000 MAX. COMP. EXIT T- 0=CALC'D               0.0000    0.0000
J    1.0000 MAX. SPEED RATIO RPMMAX/RPMD              1.0000    1.0000
K    0.0000 BLADE MATERIAL DENSITY 0=T-SET            0.0000    0.0000
L       2.  1=CONST.HUB,2=MEAN,3=TIP DESN.               0.        0.
M    1.0000 RPM SCALER TO MATCH KNOWN RPM             1.0000    1.0000
N    0.0000 TEMP FOR MATERIAL CHANGE                  0.0000    0.0000
O    0.0000 WEIGHT SCALER 0=AS CALCULATED             0.0000    0.0000
P    1.8000 STATOR BLADE TAPER RATIO                  0.0000    0.0000
S    0.0550 BLADE VOLUME RATIO                        0.0000    0.0000
ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POINT) OR ENTER
Q           QUIT PROCESSING ENTIRE ENGINE
R           REVIEW UPDATED VALUES
T           TERMINATE - GO ON TO NEXT COMPONENT
T
COMPONENT   3 IS A SPLITTER
WEIGHT AND LENGTH ARE IGNORED UNLESS FIRST COMPONENT IN THE ENGINE (AFTER INLET)
IF INNER STREAM IS NOT PRIMARY ENTER A "1" OR ELSE JUST HIT RETURN
-

COMPONENT   6  IS A COMPRESSOR, OPTIONS ARE (ENTER CORRECT LETTER)
A- TYPICAL FAN
B- OUTER PORTION OF NON-ROTATING SPLITTER FAN
C- INNER PORTION OF NON-ROTATING SPLITTER FAN
D- OUTER PORTION OF ROTATING SPLITTER FAN
E- INNER PORTION OF ROTATING SPLITTER FAN
F- LOW PRESSURE COMPRESSOR
G- HIGH PRESSURE COMPRESSOR
F
INDICATE WHETHER THERE ARE STATORS OR IF THIS IS A CENTRIFUGAL COMPRESSOR
A- CALCULATE STATOR WEIGHT
B- NO STATOR WEIGHT
C- CENTRIFUGAL COMPRESSOR
A
 INDICATE WHETHER THERE IS A FRONT FRAME IN THE COMPRESSOR
A- NO FRAME
B- SNGL BEARING FRAME FOR TFS AND TJS WITHOUT POWER TAKEOFF (PTO)
C- SINGLE BEARING FRAME WITH PTO
D- TWO BEARING FRAME WHICH EXTENDS OUTWARD TOTHE FAN OUTER CASE AND HOLDS TWO BEARINGS WITH PTO
```

```
A
 INDICATE WHETHER THERE IS A  REAR FRAME IN THE COMPRESSOR
A- NO FRAME
B- SNGL BEARING FRAME FOR TFS AND TJS WITHOUT POWER TAKEOFF (PTO)
C- SINGLE BEARING FRAME WITH PTO
D- TWO BEARING FRAME WHICH EXTENDS OUTWARD TOTHE FAN OUTER CASE AND HOLDS TWO BEARINGS WITH PTO
A
GEAR BOX INDICATOR,0= NO GEAR BOX, N=SHAFT NUMBER FOR GEAR BOX

0
YOU MAY SPECIFY THE NUMBER OF STAGES-OVERRIDES MAX PR/STG., OTHERWISE ENTER 0

0
FAN/COMPRESSOR
CODE VALUE  DESCRIPTION                                  LOW VALUE-HIGH VALUE
A    0.5000  FACE INLET MACH NUMBER                      0.4500    0.6000
B  1.50000  MAX 1ST STAGE PRATIO                         1.50000   1.80000
C    0.400  COMPRESSOR FACE HUB TO TIP RATIO             0.400     0.500
D    1.5000  BLADE SOLIDITY (CORD/SPACING)              1.0000    1.5000
E    4.0000  BLADE ASPECT RATIO-1ST STAGE               3.0000    5.0000
F    3.0000  BLADE ASPECT RATIO-LAST STAGE              2.0000    3.0000
G    0.4500  COMPRESSOR EXIT MACH NUMBER                0.4500    0.5500
H    0.0000  MAX. COMP. INLET T- 0=CALC'D               0.0000    0.0000
I    0.0000  MAX. COMP. EXIT T- 0=CALC'D                0.0000    0.0000
J    1.0000  MAX. SPEED RATIO RPMMAX/RPMD               1.0000    1.0000
K    0.0000  BLADE MATERIAL DENSITY 0=T-SET             0.0000    0.0000
L       2.   1=CONST.HUB,2=MEAN,3=TIP DESN.                0.        0.
M    1.0000  RPM SCALER TO MATCH KNOWN RPM              1.0000    1.0000
N    0.0000  TEMP FOR MATERIAL CHANGE                   0.0000    0.0000
O    0.0000  WEIGHT SCALER 0=AS CALCULATED             0.0000    0.0000
P    1.2000  STATOR BLADE TAPER RATIO                   0.0000    0.0000
S    0.1200  BLADE VOLUME RATIO                         0.0000    0.0000
ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POINT) OR ENTER
Q            QUIT PROCESSING ENTIRE ENGINE
R            REVIEW UPDATED VALUES
T            TERMINATE - GO ON TO NEXT COMPONENT
C .85
E 2.
F 2.
L 3.
T
COMPONENT   7 IS A DUCT, OPTIONS ARE (ENTER CORRECT LETTER)
A- PRIMARY BURNER
B- DUCT BURNER
C- AUGMENTOR
D- DUCT
ENTER LETTER

D
TYPE OF DUCT
A- DUMMY - NO WT OR LENGTH
B- INPUT LENGTH ( WILL SPECIFY L/D OF DUCT )
C- LENGTH FROM CONNECTION BETWEEN SPLITTER AND MIXER
D- CROSSOVER DUCT FOR CENTRIFUGAL COMPRESSORS
E- DIFFUSER FOR CENTRIFUGAL COMPRESSORS

B
DUCT
CODE VALUE  DESCRIPTION                                  LOW VALUE-HIGH VALUE
A      0.40 DUCT MACH NUMBER                             0.40      0.50
```

```
B  1.00000 LEN/HT IF MODE B                                        0.00000   0.00000
C    0.000 DUCT MEAN DIAM. IF =0 CALC. PER NODE BELOW               0.          0.
D     -1. IF NODE,0=MEAN D SPECIFIED,-1=CONN. COMP.                 0.          0.
ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POINT) OR ENTER
Q           QUIT PROCESSING ENTIRE ENGINE
R           REVIEW UPDATED VALUES
T           TERMINATE - GO ON TO NEXT COMPONENT
A .45
B 5.5
T
COMPONENT   8  IS A COMPRESSOR, OPTIONS ARE (ENTER CORRECT LETTER)
A- TYPICAL FAN
B- OUTER PORTION OF NON-ROTATING SPLITTER FAN
C- INNER PORTION OF NON-ROTATING SPLITTER FAN
D- OUTER PORTION OF ROTATING SPLITTER FAN
E- INNER PORTION OF ROTATING SPLITTER FAN
F- LOW PRESSURE COMPRESSOR
G- HIGH PRESSURE COMPRESSOR
G
INDICATE WHETHER THERE ARE STATORS OR IF THIS IS A CENTRIFUGAL COMPRESSOR
A- CALCULATE STATOR WEIGHT
B- NO STATOR WEIGHT
C- CENTRIFUGAL COMPRESSOR
A
 INDICATE WHETHER THERE IS A FRONT FRAME IN THE COMPRESSOR
A- NO FRAME
B- SNGL BEARING FRAME FOR TFS AND TJS WITHOUT POWER TAKEOFF (PTO)
C- SINGLE BEARING FRAME WITH PTO
D- TWO BEARING FRAME WHICH EXTENDS OUTWARD TOTHE FAN OUTER CASE AND HOLDS TWO BEARINGS WITH PTO
A
 INDICATE WHETHER THERE IS A  REAR FRAME IN THE COMPRESSOR
A- NO FRAME
B- SNGL BEARING FRAME FOR TFS AND TJS WITHOUT POWER TAKEOFF (PTO)
C- SINGLE BEARING FRAME WITH PTO
D- TWO BEARING FRAME WHICH EXTENDS OUTWARD TOTHE FAN OUTER CASE AND HOLDS TWO BEARINGS WITH PTO
A
GEAR BOX INDICATOR,0= NO GEAR BOX, N=SHAFT NUMBER FOR GEAR BOX
0
YOU MAY SPECIFY THE NUMBER OF STAGES-OVERRIDES MAX PR/STG., OTHERWISE ENTER 0
0
FAN/COMPRESSOR
CODE VALUE  DESCRIPTION                                  LOW VALUE-HIGH VALUE
A    0.4000  FACE INLET MACH NUMBER                      0.4000     0.5000
B   1.40000  MAX 1ST STAGE PRATIO                        1.40000    1.70000
C     0.700  COMPRESSOR FACE HUB TO TIP RATIO            0.600      0.800
D    1.5000  BLADE SOLIDITY (CORD/SPACING)              1.0000     1.5000
E    3.0000  BLADE ASPECT RATIO-1ST STAGE               2.0000     5.0000
F    1.5000  BLADE ASPECT RATIO-LAST STAGE              1.0000     2.0000
G    0.3000  COMPRESSOR EXIT MACH NUMBER                0.2000     0.3000
H    0.0000  MAX. COMP. INLET T- 0=CALC'D               0.0000     0.0000
I    0.0000  MAX. COMP. EXIT T- 0=CALC'D                0.0000     0.0000
J    1.0000  MAX. SPEED RATIO RPMMAX/RPMD              1.0000     1.0000
K    0.0000  BLADE MATERIAL DENSITY 0=T-SET            0.0000     0.0000
L        2.  1=CONST.HUB,2=MEAN,3=TIP DESN.               0.         0.
M    1.0000  RPM SCALER TO MATCH KNOWN RPM              1.0000     1.0000
N    0.0000  TEMP FOR MATERIAL CHANGE                   0.0000     0.0000
O    0.0000  WEIGHT SCALER 0=AS CALCULATED             0.0000     0.0000
P    1.2000  STATOR BLADE TAPER RATIO                   0.0000     0.0000
```

```
S   0.1200  BLADE VOLUME RATIO                              0.0000     0.0000
ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POINT) OR ENTER
Q           QUIT PROCESSING ENTIRE ENGINE
R           REVIEW UPDATED VALUES
T           TERMINATE - GO ON TO NEXT COMPONENT
A .45
B 1.31
C .47
E 4.5
L 3.
T
COMPONENT  17 IS A DUCT, OPTIONS ARE (ENTER CORRECT LETTER)
A- PRIMARY BURNER
B- DUCT BURNER
C- AUGMENTOR
D- DUCT
ENTER LETTER
D
TYPE OF DUCT
A- DUMMY - NO WT OR LENGTH
B- INPUT LENGTH ( WILL SPECIFY L/D OF DUCT )
C- LENGTH FROM CONNECTION BETWEEN SPLITTER AND MIXER
D- CROSSOVER DUCT FOR CENTRIFUGAL COMPRESSORS
E- DIFFUSER FOR CENTRIFUGAL COMPRESSORS

B
DUCT
CODE VALUE  DESCRIPTION                                          LOW VALUE-HIGH VALUE
A     0.40 DUCT MACH NUMBER                                       0.40       0.50
B  1.00000 LEN/HT IF MODE B                                      0.00000    0.80000
C    0.000 DUCT MEAN DIAM. IF =0 CALC. PER NODE BELOW             0.         0.
D       -1. IF NODE,0=MEAN D SPECIFIED,-1=CONN. COMP.             0.         0.
ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POINT) OR ENTER
Q           QUIT PROCESSING ENTIRE ENGINE
R           REVIEW UPDATED VALUES
T           TERMINATE - GO ON TO NEXT COMPONENT
A .3
B 8.9
T
COMPONENT   9 IS A DUCT, OPTIONS ARE (ENTER CORRECT LETTER)
A- PRIMARY BURNER
B- DUCT BURNER
C- AUGMENTOR
D- DUCT
ENTER LETTER
A
A- BURNER HAS A FRAME
B- NO FRAME

A
PRIMARY BURNER
CODE VALUE  DESCRIPTION                                        LOW VALUE-HIGH VALUE
A   100.00  BURNER THRU-FLOW VELOCITY                           100.00    150.00
B  0.01500  AIRFLOW RESIDENCY TIME                             0.01000   0.02000
C    0.000  MEAN DIAMETER - IF 0 MATCH' UPSTREAM CMPT.           0.         0.
D       0.  CMPT NUMBER FOR MATCHING DIAMETER                   0.         0.
E       0.  NUMBER OF CANS FOR CAN BURNER                       0.         0.
ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POINT) OR ENTER
```

```
Q           QUIT PROCESSING ENTIRE ENGINE
R           REVIEW UPDATED VALUES
T           TERMINATE - GO ON TO NEXT COMPONENT
B .018
T
COMPONENT  10  IS A TURBINE, OPTIONS ARE (ENTER CORRECT LETTER)
H- HIGH PRESSURE TURBINE
L- LOW PRESSURE TURBINE
H
A- NO FRAME
B- TURBINE HAS EXIT FRAME
A
ENTER COMPONENT NUMBER OF COMPRESSOR THAT SETS TURBINE RPM
08
ENTER COMPONENT NUMBER THAT LIMITS TURBINE OUTER RADIUS
   (+ = OUTLET, - = INLET,0 = FEEDING COMPONENT)
-08
YOU MAY ENTER THE NUMBER OF STAGES IF DESIRED, OTHERWISE ENTER 0
0
R- RADIAL FLOW TURBINE
A- AXIAL FLOW TURBINE
A
TURBINE
CODE VALUE  DESCRIPTION                                LOW VALUE-HIGH VALUE
A   0.3000  FACE INLET MACH NUMBER                     0.3000     0.4000
B  0.28000  LOADING PARAMETER                         0.20000    0.30000
C    1.500  BLADE SOLIDITY (CORD/SPACING)             1.000      1.500
D   1.5000  BLADE ASPECT RATIO- 1ST STAGE             1.0000     2.0000
E   1.5000  BLADE ASPECT RATIO-LAST STAGE            1.0000     2.0000
F   0.4500  TURBINE EXIT MACH NUMBER                  0.4500     0.5000
G  125000.  DISC REFERENCE STRESS                    100000.    150000.
H       2.  1=CONST TIP DESN,2=MEAN,3=HUB                0.         0.
I   1.0000  MAX. SPEED RATIO RPMMAX/RPMD              1.0000     1.0000
J   0.0000  CONTROL RADIUS- 0 IF TRANSFRD             0.0000     0.0000
K   0.0000  BLADE MATERIAL DENSITY 0=T-SET            0.0000     0.0000
L   0.1550  BLADE VOLUME FACTOR                       0.0000     0.0000
P   1.0000  BLADE TAPER RATIO                         0.0000     0.0000
S   0.1550  STATOR BLADE VOLUME FACTOR                0.0000     0.0000
ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POINT) OR ENTER
Q           QUIT PROCESSING ENTIRE ENGINE
R           REVIEW UPDATED VALUES
T           TERMINATE - GO ON TO NEXT COMPONENT
A .4
B .2
F .5
G 150000.
H 3.
T
COMPONENT  11 IS A DUCT, OPTIONS ARE (ENTER CORRECT LETTER)
A- PRIMARY BURNER
B- DUCT BURNER
C- AUGMENTOR
D- DUCT
ENTER LETTER
D
TYPE OF DUCT
A- DUMMY - NO WT OR LENGTH
```

```
B- INPUT LENGTH ( WILL SPECIFY L/D OF DUCT )
C- LENGTH FROM CONNECTION BETWEEN SPLITTER AND MIXER
D- CROSSOVER DUCT FOR CENTRIFUGAL COMPRESSORS
E- DIFFUSER FOR CENTRIFUGAL COMPRESSORS

B
DUCT
CODE VALUE  DESCRIPTION                                          LOW VALUE-HIGH VALUE
A      0.40 DUCT MACH NUMBER                                      0.40      0.50
B  1.00000 LEN/HT IF NODE B                                      0.00000   0.00000
C     0.000 DUCT MEAN DIAM. IF =0 CALC. PER NODE BELOW            0.        0.
D        -1. IF NODE,0=MEAN D SPECIFIED,-1=CONN. COMP.           0.        0.
ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POINT) OR ENTER
Q            QUIT PROCESSING ENTIRE ENGINE
R            REVIEW UPDATED VALUES
T            TERMINATE - GO ON TO NEXT COMPONENT
A .5
B 3.5
T
COMPONENT  12  IS A TURBINE, OPTIONS ARE (ENTER CORRECT LETTER)
H- HIGH PRESSURE TURBINE
L- LOW PRESSURE TURBINE
L
A- NO FRAME
B- TURBINE HAS EXIT FRAME
B
ENTER COMPONENT NUMBER OF COMPRESSOR THAT SETS TURBINE RPM

02
ENTER COMPONENT NUMBER THAT LIMITS TURBINE OUTER RADIUS
   (+ = OUTLET, - = INLET,0 = FEEDING COMPONENT)
+06
YOU MAY ENTER THE NUMBER OF STAGES IF DESIRED, OTHERWISE ENTER 0

0
R- RADIAL FLOW TURBINE
A- AXIAL FLOW TURBINE
A
TURBINE
CODE VALUE  DESCRIPTION                                  LOW VALUE-HIGH VALUE
A    0.4500 FACE INLET MACH NUMBER                        0.4000    0.5000
B   0.28000 LOADING PARAMETER                            0.20000   0.30000
C     1.500 BLADE SOLIDITY (CORD/SPACING)                1.000      1.500
D    2.0000 BLADE ASPECT RATIO- 1ST STAGE                2.0000     3.0000
E    4.0000 BLADE ASPECT RATIO-LAST STAGE                4.0000     6.0000
F    0.5500 TURBINE EXIT MACH NUMBER                     0.5500     0.6000
G  125000.  DISC REFERENCE STRESS                       100000.    150000.
H         2. 1=CONST TIP DESN,2=MEAN,3=HUB                  0.         0.
I    1.0000 MAX. SPEED RATIO RPNMAX/RPND                 1.0000     1.0000
J    0.0000 CONTROL RADIUS- 0 IF TRANSFRD                0.0000     0.0000
K    0.0000 BLADE MATERIAL DENSITY 0=T-SET               0.0000     0.0000
L    0.1950 BLADE VOLUME FACTOR                          0.0000     0.0000
P    1.0000 BLADE TAPER RATIO                            0.0000     0.0000
S    0.1950 STATOR BLADE VOLUME FACTOR                   0.0000     0.0000
ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POINT) OR ENTER
Q            QUIT PROCESSING ENTIRE ENGINE
R            REVIEW UPDATED VALUES
T            TERMINATE - GO ON TO NEXT COMPONENT
A .5
B .3
```

```
F .6
G 150000.
H 1.
T
COMPONENT  13 IS A DUCT, OPTIONS ARE (ENTER CORRECT LETTER)
A- PRIMARY BURNER
B- DUCT BURNER
C- AUGMENTOR
D- DUCT
ENTER LETTER

D
TYPE OF DUCT
A- DUMMY - NO WT OR LENGTH
B- INPUT LENGTH ( WILL SPECIFY L/D OF DUCT )
C- LENGTH FROM CONNECTION BETWEEN SPLITTER AND MIXER
D- CROSSOVER DUCT FOR CENTRIFUGAL COMPRESSORS
E- DIFFUSER FOR CENTRIFUGAL COMPRESSORS

A
DUCT
CODE VALUE  DESCRIPTION                                          LOW VALUE-HIGH VALUE
A      0.40 DUCT MACH NUMBER                                      0.40       0.50
B  1.00000 LEN/HT IF MODE B                                      0.00000    0.00000
C     0.000 DUCT MEAN DIAM. IF =0 CALC. PER NODE BELOW            0.          0.
D        -1. IF NODE,0=MEAN D SPECIFIED,-1=CONN. COMP.           0.          0.
ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POINT) OR ENTER
Q            QUIT PROCESSING ENTIRE ENGINE
R            REVIEW UPDATED VALUES
T            TERMINATE - GO ON TO NEXT COMPONENT
A .6
B .5
T
COMPONENT  14 IS A NOZZLE, ENTER NOZZLE TYPE
1= CONVERGENT
2= C-D VARIABLE AREA
1
ENTER COMPONENT NUMBER THAT LIMITS NOZZLE OUTER RADIUS
___ (+ = OUTLET, - = INLET,0 = FEEDING COMPONENT)
0
ENTER THRUST REVERSER TYPE, 0=NONE, 1=FAN, 2=PRIMARY

0
NOZZLE
CODE VALUE  DESCRIPTION                                  LOW VALUE-HIGH VALUE
A   1.0000  LENGTH TO DIAMETER RATIO                     1.0000     2.0000
B   0.0000  BYPASS RATIO FOR MIXED FLOW                  0.0000     0.0000
ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POINT) OR ENTER
Q            QUIT PROCESSING ENTIRE ENGINE
R            REVIEW UPDATED VALUES
T            TERMINATE - GO ON TO NEXT COMPONENT
T
COMPONENT   4 IS A DUCT, OPTIONS ARE (ENTER CORRECT LETTER)
A- PRIMARY BURNER
B- DUCT BURNER
C- AUGMENTOR
D- DUCT
ENTER LETTER

D
```

```
TYPE OF DUCT
A- DUMMY - NO WT OR LENGTH
B- INPUT LENGTH ( WILL SPECIFY L/D OF DUCT )
C- LENGTH FROM CONNECTION BETWEEN SPLITTER AND MIXER
D- CROSSOVER DUCT FOR CENTRIFUGAL COMPRESSORS
E- DIFFUSER FOR CENTRIFUGAL COMPRESSORS

B
DUCT
CODE VALUE  DESCRIPTION                                          LOW VALUE-HIGH VALUE
A      0.40 DUCT MACH NUMBER                                      0.40      0.50
B  1.00000 LEN/HT IF MODE B                                      0.00000   0.00000
C    0.000 DUCT MEAN DIAM. IF =0 CALC. PER NODE BELOW            0.          0.
D       -1. IF NODE,0=MEAN D SPECIFIED,-1=CONN. COMP.            0.          0.
ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POINT) OR ENTER
Q           QUIT PROCESSING ENTIRE ENGINE
R           REVIEW UPDATED VALUES
T           TERMINATE - GO ON TO NEXT COMPONENT
A .5
T
COMPONENT   5 IS A NOZZLE, ENTER NOZZLE TYPE
1= CONVERGENT
2= C-D VARIABLE AREA
1
ENTER COMPONENT NUMBER THAT LIMITS NOZZLE OUTER RADIUS
___ (+ = OUTLET, - = INLET,0 = FEEDING COMPONENT)
0
ENTER THRUST REVERSER TYPE, 0=NONE, 1=FAN, 2=PRIMARY

0
NOZZLE
CODE VALUE  DESCRIPTION                                LOW VALUE-HIGH VALUE
A   1.0000  LENGTH TO DIAMETER RATIO                   1.0000    2.0000
B   0.0000  BYPASS RATIO FOR MIXED FLOW                0.0000    0.0000
ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POINT) OR ENTER
Q           QUIT PROCESSING ENTIRE ENGINE
R           REVIEW UPDATED VALUES
T           TERMINATE - GO ON TO NEXT COMPONENT
T
COMPONENT  15 IS A SHAFT, ENTER SHAFT NUMBER FROM INNER TO OUTER, I.E. 1 2 3 ETC.

1
ENTER TURBINES CONNECTED TO THIS SHAFT

12 __ __ __
ENTER COMPONENT NUMBER OF FIRST COMPRESSOR ON THIS SHAFT

02
SHAFT
CODE VALUE  DESCRIPTION                                  LOW VALUE-HIGH VALUE
A 50000.00  SHAFT ALLOWABLE STRESS                     40000.00  50000.00
B     0.29  SHAFT MATERIAL DENSITY                         0.28      0.31
C   0.0000  DIAMETER RATIO (INNER/OUTER)                 0.0000    0.8500
D       0.  COMPONENT NUMBER ON SHAFT FOR INERTIA           0.        0.
E       0.  COMPONENT NUMBER ON SHAFT FOR INERTIA           0.        0.
F       0.  COMPONENT NUMBER ON SHAFT FOR INERTIA           0.        0.
G       0.  COMPONENT NUMBER ON SHAFT FOR INERTIA           0.        0.

ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POINT) OR ENTER
Q           QUIT PROCESSING ENTIRE ENGINE
```

```
R           REVIEW UPDATED VALUES
T           TERMINATE - GO ON TO NEXT COMPONENT
B .3
C .85
D 2.
E 6.
F 12.
T
COMPONENT  16 IS A SHAFT, ENTER SHAFT NUMBER FROM INNER TO OUTER, I.E. 1 2 3 ETC.

2
ENTER TURBINES CONNECTED TO THIS SHAFT
10 — — —
ENTER COMPONENT NUMBER OF FIRST COMPRESSOR ON THIS SHAFT

08
SHAFT
CODE VALUE  DESCRIPTION                                  LOW VALUE-HIGH VALUE
A 50000.00  SHAFT ALLOWABLE STRESS                    40000.00  50000.00
B     0.29  SHAFT MATERIAL DENSITY                         0.28      0.31
C   0.0000  DIAMETER RATIO (INNER/OUTER)                0.0000    0.8500
D       0.  COMPONENT NUMBER ON SHAFT FOR INERTIA            0.        0.
E       0.  COMPONENT NUMBER ON SHAFT FOR INERTIA            0.        0.
F       0.  COMPONENT NUMBER ON SHAFT FOR INERTIA            0.        0.
G       0.  COMPONENT NUMBER ON SHAFT FOR INERTIA            0.        0.

ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POINT) OR ENTER
Q           QUIT PROCESSING ENTIRE ENGINE
R           REVIEW UPDATED VALUES
T           TERMINATE - GO ON TO NEXT COMPONENT
B .3
D 8.
E 10.
T
 TERMINATED: STOP
```

APPENDIX B

Card Images from PREPWATE AND NNEP/WATE Input Dataset

```
&W IPLT= T,PLOT= T,ISII= F,ISIO= F,
INT=4,IOUTCD=2,
 DISKWI=0.,ACCS=0.1,ISCALE(1)=2,3,SCALE(1)=1.,.8,1.2,ACCARM=0,
ILENG(1)= 2, 3, 6, 7, 8,17, 9,10,11,12,13,14,
IWMEC(1, 2)=4HFAN ,  0,  0,  4,  0,  0,  0,
IWMEC(1, 3)=4HSPLT,  0,  0,  0,  0,  0,  0,
IWMEC(1, 4)=4HDUCT,  2,  0,  0,  0,  0,  0,
IWMEC(1, 5)=4HNOZ ,  1,  0,  0,  0,  0,  0,
IWMEC(1, 6)=4HLPC ,  1,  0,  0,  0,  0,  0,
IWMEC(1, 7)=4HDUCT,  2,  0,  0,  0,  0,  0,
IWMEC(1, 8)=4HHPC ,  1,  0,  0,  0,  0,  0,
IWMEC(1, 9)=4HPBUR,  1,  0,  0,  0,  0,  0,
IWMEC(1,10)=4HHPT ,  0,  8, -8,  0,  0,  0,
IWMEC(1,11)=4HDUCT,  2,  0,  0,  0,  0,  0,
IWMEC(1,12)=4HLPT ,  1,  2,  6,  0,  0,  0,
IWMEC(1,13)=4HDUCT,  1,  0,  0,  0,  0,  0,
IWMEC(1,14)=4HNOZ ,  1,  0,  0,  0,  0,  0,
IWMEC(1,15)=4HSHAF,  1, 12,  0,  0,  0,  2,
IWMEC(1,16)=4HSHAF,  2, 10,  0,  0,  0,  8,
IWMEC(1,17)=4HDUCT,  2,  0,  0,  0,  0,  0,
DESVAL(1,2)=0.5500,1.800,0.3700,1.500,4.500,4.500,0.5000,
 0.0000,0.0000,1.000,0.0000,2.000,1.000,0.0000,0.0000,1.800,0.5500D-01,
DESVAL(1,3)=0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,4)=0.5000,1.000,0.0000,-1.000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,5)=1.000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,6)=0.5000,1.500,0.8500,1.500,2.000,2.000,0.4500,
 0.0000,0.0000,1.000,0.0000,3.000,1.000,0.0000,0.0000,1.200,0.1200,
DESVAL(1,7)=0.4500,5.500,0.0000,-1.000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,8)=0.4500,1.310,0.4700,1.500,4.500,1.500,0.3000,
 0.0000,0.0000,1.000,0.0000,3.000,1.000,0.0000,0.0000,1.200,0.1200,
DESVAL(1,9)=100.0,0.1800D-01,0.0000,0.0000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,10)=0.4000,0.2000,1.500,1.500,1.500,0.5000,0.1500D06,
  3.000,1.000,0.0000,0.0000,0.1550,0.0000,0.0000,0.0000,1.000,0.1550,
DESVAL(1,11)=0.5000,3.500,0.0000,-1.000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,12)=0.5000,0.3000,1.500,2.000,4.000,0.6000,0.1500D06,
  1.000,1.000,0.0000,0.0000,0.1950,0.0000,0.0000,0.0000,1.000,0.1950,
DESVAL(1,13)=0.6000,0.5000,0.0000,-1.000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,14)=1.000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,15)=0.5000D05,0.3000,0.8500,2.000,6.000,12.00,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,16)=0.5000D05,0.3000,0.0000,8.000,10.00,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,17)=0.3000,8.900,0.0000,-1.000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
&END
```

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SAMPLE CASE FOR PREPWATE
&D
&END
&D MODE=1,
IWT=4,
KONFIG(1,1)='INLT',1,0,2,0,SPEC(1,1)=1000.,4*0,1.,2*0,.00001,2*0,20.,
KONFIG(1,2)='COMP',2,0,3,0,SPEC(1,2)=1.8,0,1,3761,1,3762,1,3763,1,0,0,.824,
1.734,1,
KONFIG(1,3)='SPLT',3,0,7,4,SPEC(1,3)=4.323,
KONFIG(1,4)='DUCT',4,0,5,0,SPEC(1,4)=6*0,
KONFIG(1,5)='NOZZ',5,0,6,0,SPEC(1,5)=0,1,0,0,.99,0,0,0,1,
KONFIG(1,6)='COMP',7,0,8,0,SPEC(1,6)=1.3,0,1,3761,1,3762,1,3763,1,0,0,.867,
1.373,1,
KONFIG(1,7)='DUCT',8,0,9,0,SPEC(1,7)=6*0,
KONFIG(1,8)='COMP',9,0,10,17,SPEC(1,8)=1.3,.162,1,3707,1,3708,1,3709,1,0,0,
.867,12.75,.985,
KONFIG(1,9)='DUCT',19,0,11,0,SPEC(1,9)=.048,0,0,2990.,1.,18400.,
KONFIG(1,10)='TURB',11,17,12,0,SPEC(1,10)=4,.79,1,3801,1,3802,1,1,.625,
1,.919,5600,1,
KONFIG(1,11)='DUCT',12,0,13,0,SPEC(1,11)=6*0,
KONFIG(1,12)='TURB',13,17,14,0,SPEC(1,12)=2.5,.21,1,3803,1,3804,1,1,0,1,.912,
5244,1,
KONFIG(1,13)='DUCT',14,0,15,0,SPEC(1,13)=6*0,
KONFIG(1,14)='NOZZ',15,0,16,0,SPEC(1,14)=0,1,0,0,.99,0,0,0,1,
KONFIG(1,15)='SHFT',2,6,12,0,SPEC(1,15)=4000,8*1
KONFIG(1,16)='SHFT',8,10,0,0,SPEC(1,16)=6000,8*1,
KONFIG(1,17)='DUCT',10,0,19,0,SPEC(1,17)=6*0,
&END
&N IPLT= T,PLOT= T,ISII= F,ISIO= F,
IWT=4,IOUTCD=2,
 DISKWI=0.,ACCS=0.1,ISCALE(1)=2,3,SCALE(1)=1.,.8,1.2,ACCARM=0,
ILENG(1)= 2, 3, 6, 7, 8,17, 9,10,11,12,13,14,
IWMEC(1, 2)=4HFAN ,  0,  0,  4,  0,  0,  0,
IWMEC(1, 3)=4HSPLT,  0,  0,  0,  4,  0,  0,
IWMEC(1, 4)=4HDUCT,  2,  0,  0,  0,  0,  0,
IWMEC(1, 5)=4HNOZ ,  1,  0,  0,  0,  0,  0,
IWMEC(1, 6)=4HLPC ,  1,  0,  0,  0,  0,  0,
IWMEC(1, 7)=4HDUCT,  2,  0,  0,  0,  0,  0,
IWMEC(1, 8)=4HHPC ,  1,  0,  0,  0,  0,  0,
IWMEC(1, 9)=4HPBUR,  1,  0,  0,  0,  0,  0,
IWMEC(1,10)=4HHPT ,  0,  8, -8,  0,  0,  0,
IWMEC(1,11)=4HDUCT,  2,  0,  0,  0,  0,  0,
IWMEC(1,12)=4HLPT ,  1,  2,  6,  0,  0,  0,
IWMEC(1,13)=4HDUCT,  1,  0,  0,  0,  0,  0,
IWMEC(1,14)=4HNOZ ,  1,  0,  0,  0,  0,  0,
IWMEC(1,15)=4HSHAF,  1, 12,  0,  0,  0,  2,
IWMEC(1,16)=4HSHAF,  2, 10,  0,  0,  0,  8,
IWMEC(1,17)=4HDUCT,  2,  0,  0,  0,  0,  0,
DESVAL(1,2)=0.5500,1.800,0.3700,1.500,4.500,4.500,0.5000,
 0.0000,0.0000,1.000,0.0000,2.000,1.000,0.0000,0.0000,1.800,0.5500D-01,
DESVAL(1,3)=0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,4)=0.5000,1.000,0.0000,-1.000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,5)=1.000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,6)=0.5000,1.500,0.8500,1.500,2.000,2.000,0.4500,
 0.0000,0.0000,1.000,0.0000,3.000,1.000,0.0000,0.0000,1.200,0.1200,
DESVAL(1,7)=0.4500,5.500,0.0000,-1.000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
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DESVAL(1,8)=0.4500,1.310,0.4700,1.500,4.500,1.500,0.3000,
 0.0000,0.0000,1.000,0.0000,3.000,1.000,0.0000,0.0000,1.200,0.1200,
DESVAL(1,9)=100.0,0.1800D-01,0.0000,0.0000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,10)=0.4000,0.2000,1.500,1.500,1.500,0.5000,0.1500D06,
  3.000,1.000,0.0000,0.0000,0.1550,0.0000,0.0000,0.0000,1.000,0.1550,
DESVAL(1,11)=0.5000,3.500,0.0000,-1.000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,12)=0.5000,0.3000,1.500,2.000,4.000,0.6000,0.1500D06,
  1.000,1.000,0.0000,0.0000,0.1950,0.0000,0.0000,0.0000,1.000,0.1950,
DESVAL(1,13)=0.6000,0.5000,0.0000,-1.000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,14)=1.000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,15)=0.5000D05,0.3000,0.8500,2.000,6.000,12.00,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,16)=0.5000D05,0.3000,0.0000,8.000,10.00,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
DESVAL(1,17)=0.3000,8.900,0.0000,-1.000,0.0000,0.0000,0.0000,
 0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
&END
```

APPENDIX C

Output from Sample Case from NNEP/WATE Code

```
SAMPLE CASE FOR PREPWATE
&D
&END
```

TABLE DATA INPUT SUMMARY 16 TABLES

TABLE NUMBER	REFERENCE NUMBER	ARRAY LOCATION
1	3761	1
2	3762	1075
3	3763	2149
4	3704	3223
5	3705	4297
6	3706	5371
7	3707	6445
8	3708	7681
9	3709	8917
10	3801	10153
11	3802	10606
12	3803	11203
13	3804	11656
14	3901	12397
15	3902	12799
16	3903	13213

DATA STORAGE ALLOCATION 20000
DATA STORAGE NOT USED 6385

```
&D MODE=1,
IWT=4,
KONFIG(1,1)='INLT',1,0,2,0,SPEC(1,1)=1000.,4*0,1.,2*0,.00001,2*0,20.,
KONFIG(1,2)='COMP',2,0,3,0,SPEC(1,2)=1.8,0,1,3761,1,3762,1,3763,1,0,0,.824,
1.734,1,
KONFIG(1,3)='SPLT',3,0,7,4,SPEC(1,3)=4.323,
KONFIG(1,4)='DUCT',4,0,5,0,SPEC(1,4)=6*0,
KONFIG(1,5)='NOZZ',5,0,6,0,SPEC(1,5)=0,1,0,0,.99,0,0,0,1,
KONFIG(1,6)='COMP',7,0,8,0,SPEC(1,6)=1.3,0,1,3761,1,3762,1,3763,1,0,0,.867,
1.373,1,
KONFIG(1,7)='DUCT',8,0,9,0,SPEC(1,7)=6*0,
KONFIG(1,8)='COMP',9,0,10,17,SPEC(1,8)=1.3,.162,1,3707,1,3708,1,3709,1,0,0,
.867,12.75,.985,
KONFIG(1,9)='DUCT',19,0,11,0,SPEC(1,9)=.048,0,0,2990.,1.,18400.,
KONFIG(1,10)='TURB',11,17,12,0,SPEC(1,10)=4,.79,1,3801,1,3802,1,1,.625,
1,.919,5680,1,
KONFIG(1,11)='DUCT',12,0,13,0,SPEC(1,11)=6*0,
KONFIG(1,12)='TURB',13,17,14,0,SPEC(1,12)=2.5,.21,1,3803,1,3804,1,1,0,1,.912,
5244,1,
KONFIG(1,13)='DUCT',14,0,15,0,SPEC(1,13)=6*0,
KONFIG(1,14)='NOZZ',15,0,16,0,SPEC(1,14)=0,1,0,0,.99,0,0,0,1,
KONFIG(1,15)='SHFT',2,6,12,0,SPEC(1,15)=4000,8*1
KONFIG(1,16)='SHFT',8,10,0,0,SPEC(1,16)=6000,8*1,
KONFIG(1,17)='DUCT',10,0,19,0,SPEC(1,17)=6*0,
&END
```

THE FOLLOWING REPRESENTS THE CONFIGURATION FOR MODE= 1
SAMPLE CASE FOR PREPWATE
CONFIGURATION DATA 19 STATIONS 17 COMPONENTS

COMPONENT NUMBER	NKIND	COMPONENT TYPE	UPSTREAM STATIONS		DOWNSTREAM STATIONS	
1	1	INLET	1	0	2	0
2	4	COMPRESR	2	0	3	0
3	7	SPLITTER	3	0	7	4

4	2	DUCT B	4	0	5	0
5	9	NOZZLE	5	0	6	0
6	4	COMPRESR	7	0	8	0
7	2	DUCT B	8	0	9	0
8	4	COMPRESR	9	0	10	17
9	2	DUCT B	19	0	11	0
10	5	TURBINE	11	17	12	0
11	2	DUCT B	12	0	13	0
12	5	TURBINE	13	17	14	0
13	2	DUCT B	14	0	15	0
14	9	NOZZLE	15	0	16	0
15	11	SHAFT	2	6	12	0
16	11	SHAFT	8	10	0	0
17	2	DUCT B	10	0	19	0

CASE IDENTIFICATION SAMPLE CASE FOR PREPWATE

INPUT DATA

COMPONENT NO.	TYPE	DATINP1	DATINP2	DATINP3	DATINP4	DATINP5	DATINP6	DATINP7	DATINP8	DATINP9
1	INLET	0.10000D 04	0.00000	0.00000	0.00000	0.00000	0.10000D 01	0.00000	0.00000	0.10000D-04
2	COMPRESR	0.18000D 01	0.00000	0.10000D 01	0.37610D 04	0.10000D 01	0.37620D 04	0.10000D 01	0.37630D 04	0.10000D 01
3	SPLITTER	0.43230D 01	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
4	DUCT B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
5	NOZZLE	0.00000	0.10000D 01	0.00000	0.00000	0.99000D 00	0.00000	0.00000	0.00000	0.10000D 01
6	COMPRESR	0.13000D 01	0.00000	0.10000D 01	0.37610D 04	0.10000D 01	0.37620D 04	0.10000D 01	0.37630D 04	0.10000D 01
7	DUCT B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
8	COMPRESR	0.13000D 01	0.16200D 00	0.10000D 01	0.37070D 04	0.10000D 01	0.37080D 04	0.10000D 01	0.37090D 04	0.10000D 01
9	DUCT B	0.48000D-01	0.00000	0.00000	0.29900D 04	0.10000D 01	0.18400D 05	0.00000	0.00000	0.00000
10	TURBINE	0.40000D 01	0.79000D 00	0.10000D 01	0.38010D 04	0.10000D 01	0.38020D 04	0.10000D 01	0.10000D 01	0.62500D 00
11	DUCT B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	TURBINE	0.25000D 01	0.21000D 00	0.10000D 01	0.38030D 04	0.10000D 01	0.38040D 04	0.10000D 01	0.10000D 01	0.00000
13	DUCT B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	NOZZLE	0.00000	0.10000D 01	0.00000	0.00000	0.99000D 00	0.00000	0.00000	0.00000	0.10000D 01
15	SHAFT	0.40000D 04	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01
16	SHAFT	0.60000D 04	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01
17	DUCT B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

```
 MODE    1 NOW BEING USED
 SUM OF (ERRORS**2)=      0.00000
 &W IPLT= T,PLOT= T,ISII= F,ISIO= F,
 IWT=4,IOUTCD=2,
  DISKWI=0.,ACCS=0.1,ISCALE(1)=2,3,SCALE(1)=1.,.8,1.2,ACCARM=0,
 ILENG(1)= 2, 3, 6, 7, 8,17, 9,10,11,12,13,14,
 IWMEC(1, 2)=4HFAN  ,  0,  0,  4,  0,  0,  0,
 IWMEC(1, 3)=4HSPLT,   0,  0,  0,  0,  0,  0,
 IWMEC(1, 4)=4HDUCT,   2,  0,  0,  0,  0,  0,
 IWMEC(1, 5)=4HNOZ  ,  1,  0,  0,  0,  0,  0,
 IWMEC(1, 6)=4HLPC  ,  1,  0,  0,  0,  0,  0,
 IWMEC(1, 7)=4HDUCT,   2,  0,  0,  0,  0,  0,
 IWMEC(1, 8)=4HHPC  ,  1,  0,  0,  0,  0,  0,
 IWMEC(1, 9)=4HPBUR,   1,  0,  0,  0,  0,  0,
 IWMEC(1,10)=4HHPT  ,  0,  8, -8,  0,  0,  0,
 IWMEC(1,11)=4HDUCT,   2,  0,  0,  0,  0,  0,
 IWMEC(1,12)=4HLPT  ,  1,  2,  6,  0,  0,  0,
 IWMEC(1,13)=4HDUCT,   1,  0,  0,  0,  0,  0,
 IWMEC(1,14)=4HNOZ  ,  1,  0,  0,  0,  0,  0,
 IWMEC(1,15)=4HSHAF,   1, 12,  0,  0,  0,  2,
 IWMEC(1,16)=4HSHAF,   2, 10,  0,  0,  0,  8,
 IWMEC(1,17)=4HDUCT,   2,  0,  0,  0,  0,  0,
 DESVAL(1,2)=0.5500,1.800,0.3700,1.500,4.500,4.500,0.5000,
  0.0000,0.0000,1.000,0.0000,2.000,1.000,0.8000,0.0000,1.800,0.5500D-01,
 DESVAL(1,3)=0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
  0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
 DESVAL(1,4)=0.5000,1.000,0.0000,-1.000,0.0000,0.0000,0.0000,
  0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
 DESVAL(1,5)=1.000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
  0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
 DESVAL(1,6)=0.5000,1.500,0.8500,1.500,2.000,2.000,0.4500,
  0.0000,0.0000,1.000,0.0000,3.000,1.000,0.0000,0.0000,1.200,0.1200,
 DESVAL(1,7)=0.4500,5.500,0.0000,-1.000,0.0000,0.0000,0.0000,
  0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
 DESVAL(1,8)=0.4500,1.310,0.4700,1.500,4.500,1.500,0.3000,
  0.0000,0.0000,1.000,0.0000,3.000,1.000,0.0000,0.0000,1.200,0.1200,
 DESVAL(1,9)=100.0,0.1800D-01,0.0000,0.0000,0.0000,0.0000,0.0000,
  0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000;0.0000,0.0000,
 DESVAL(1,10)=0.4000,0.2000,1.500,1.500,1.500,0.5000,0.1500D06,
   3.000,1.000,0.0000,0.0000,0.1550,0.0000,0.0000,0.0000,1.000,0.1550,
 DESVAL(1,11)=0.5000,3.500,0.0000,-1.000,0.0000,0.0000,0.0000,
  0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
 DESVAL(1,12)=0.5000,0.3000,1.500,2.000,4.000,0.6000,0.1500D06,
   1.000,1.000,0.0000,0.0000,0.1950,0.0000,0.0000,0.0000,1.000,0.1950,
 DESVAL(1,13)=0.6000,0.5000,0.0000,-1.000,0.0000,0.0000,0.0000,
  0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
 DESVAL(1,14)=1.000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
  0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
 DESVAL(1,15)=0.5000D05,0.3000,0.8500,2.000,6.000,12.00,0.0000,
  0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
 DESVAL(1,16)=0.5000D05,0.3000,0.0000,8.000,10.00,0.0000,0.0000,
  0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
 DESVAL(1,17)=0.3000,8.900,0.0000,-1.000,0.0000,0.0000,0.0000,
  0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
 &END

 ************
 *          *
```

```
*  FAN   2  *
*           *
*************2

MAX CONDITIONS OCCUR AT
***************************************
      ALT         MN        VALUE
PTOT       0.     0.000      14.7 LB/SQIN
TTOT       0.     0.000     538.7 DEG R
CWIN       0.     0.000    1019.1 LB/SEC
***************************************
DUCT
 M NO  VEL  T TOT   P TOT   P STAT  AREA    GAM
0.550  608.  539.   2116.   1723.   25.8790  1.4002

 UTIPMAX STRESS     DEN  W/AREA   TR     H/T
 1591.8 45894.5   0.168   4.970   1.800   0.370

 COMPRESSOR  2 MECHANICAL DESIGN

 LOADING   N STG   DIAM  U TIP C    RPM   C RPM   MAX RPM
   0.927    1.00   74.14  1562.0  4920.4  4828.2  4920.4

STAGE    1
  WD    WB   WS   WN   WC   CL   RHOB  RHOD   AR
225. 389.    0.   0.   35.   5.2 0.168 0.168  4.50
   PR   DEL H  MACH  AREA  R HUB  R TIP  NB UTIPMAX  STR   WEIGHT TIN   TMAX   STAGE I
1.7337  26.7 0.550 25.879 13.72  37.07  67 1591.8 45894.  649.  539.   539.   165288.

FRAME WT  =  806.03


 N STG  WEIGHT  LENGTH  CENGRA  INERTIA
    1  1455.30   10.38    8.1  165287.8

DUCT
 M NO  VEL  T TOT   P TOT   P STAT  AREA    GAM
0.550  667.  658.   3670.   2989.   16.4039  1.3977

  PR    AD EF     PO     TO     HP
 1.7340  0.8240  3669.5   649.8  37781.
  HI      HO     WI     CWI
 128.75  155.45 1000.00 1019.09

********************* TOTAL COMP WEIGHT IS  1455.303

**************
*            *
*  LPC   6   *
*            *
*************2

MAX CONDITIONS OCCUR AT
***************************************
      ALT         MN        VALUE
PTOT       0.     0.000      25.5 LB/SQIN
TTOT       0.     0.000     649.8 DEG R
CWIN       0.     0.000     121.3 LB/SEC
***************************************
```

```
DUCT
 M NO  VEL  T TOT   P TOT   P STAT  AREA    GAM
0.500  609.  650.   3670.   3094.    3.2903  1.3977

 UTIPMAX STRESS     DEN  W/AREA   TR     H/T
 1001.0  7725.8   0.168   0.627   1.200   0.850

 COMPRESSOR  6 MECHANICAL DESIGN

 LOADING   N STG   DIAM  U TIP C    RPM   C RPM   MAX RPM
   0.866    1.00   46.63   894.3  4920.4  4396.1  4920.4

STAGE    1
  WD   WB   WS   WN   WC   CL   RHOB  RHOD   AR
 71.   31.  31. 162.  17.   4.1 0.168 0.168  2.00
  PR   DEL H  MACH  AREA  R HUB  R TIP  NB UTIPMAX  STR   WEIGHT TIN   TMAX   STAGE I
1.3741  17.1 0.500  3.290 19.82  23.31 125 1001.0  7726.  314.  650.   650.    26483.

 N STG  WEIGHT  LENGTH  CENGRA  INERTIA
    1   313.76    4.09    4.1   26482.8

DUCT
 M NO  VEL  T TOT   P TOT   P STAT  AREA    GAM
0.500  641.  721.   5038.   4250.    2.5254  1.3953

  PR    AD EF     PO     TO     HP
 1.3730  0.8670  5038.3   720.6   4542.
  HI      HO     WI     CWI
 155.45  172.54  187.86  121.26

********************* TOTAL COMP WEIGHT IS   313.764

**************
*            *
*  DUCT  7   *
*            *
**************2

MAX CONDITIONS OCCUR AT
************************
      ALT          MN
PTOT      0.      0.000
TTOT      0.      0.000
************************
DUCT ,    7
RH=   20.40 RT=   23.27 LENG=   15.76
AREA=    2.731 RHO=.168
      CAS WT       INC WT       WTOT
      6.3043        5.5279       11.8322


**************
*            *
*  HPC   8   *
*            *
**************2

MAX CONDITIONS OCCUR AT
***************************************
```

```
      ALT         MN        VALUE
PTOT       0.     0.000      35.0 LB/SQIN
TTOT       0.     0.000     720.6 DEG R
CWIN       0.     0.000      93.0 LB/SEC
**********************************************
DUCT
 M NO  VEL  T TOT   P TOT   P STAT  AREA    GAM
0.450  580.  721.   5038.   4387.    2.7306  1.3953

 UTIPMAX STRESS     DEN  W/AREA   TR     H/T
 1198.8 30837.8   0.168   1.204   1.200   0.470

 COMPRESSOR  8 MECHANICAL DESIGN

 LOADING   N STG   DIAM  U TIP C    RPM    C RPM   MAX RPM
   0.842   14.08   25.35  1017.1 10838.5  9195.5 10838.5

STAGE    1
  WD   WB   WS   WN   WC   CL   RHOB  RHOD   AR
   9.  24.  24.  13.   8.   3.5 0.168 0.168  4.50
  PR  DEL H  MACH  AREA  R HUB  R TIP  NB UTIPMAX  STR   WEIGHT TIN   TMAX   STAGE I
1.3028  15.1 0.458  2.731  5.96  12.67  80 1198.8 30838.   77.  721.   721.     1372.

STAGE    2
  WD   WB   WS   WN   WC   CL   RHOB  RHOD   AR
 15.  14.  14.  10.   6.   2.8 0.168 0.168  4.27
  PR  DEL H  MACH  AREA  R HUB  R TIP  NB UTIPMAX  STR   WEIGHT TIN   TMAX   STAGE I
1.2768  15.1 0.439  2.227  7.65  12.67 101 1198.8 25244.   60.  783.   783.     1397.

STAGE    3
  WD   WB   WS   WN   WC   CL   RHOB  RHOD   AR
 18.   9.   9.   8.   5.   2.3 0.168 0.168  4.04
  PR  DEL H  MACH  AREA  R HUB  R TIP  NB UTIPMAX  STR   WEIGHT TIN   TMAX   STAGE I
1.2550  15.1 0.429  1.849  8.71  12.67 121 1198.8 20998.   50.  844.   844.     1448.

STAGE    4
  WD   WB   WS   WN   WC   CL   RHOB  RHOD   AR
 19.   7.   7.   7.   5.   2.0 0.168 0.168  3.81
  PR  DEL H  MACH  AREA  R HUB  R TIP  NB UTIPMAX  STR   WEIGHT TIN   TMAX   STAGE I
1.2366  15.1 0.418  1.559  9.44  12.67 140 1198.8 17722.   43.  906.   906.     1439.

STAGE    5
  WD   WB   WS   WN   WC   CL   RHOB  RHOD   AR
 18.   5.   5.   6.   4.   1.8 0.168 0.168  3.58
  PR  DEL H  MACH  AREA  R HUB  R TIP  NB UTIPMAX  STR   WEIGHT TIN   TMAX   STAGE I
1.2206  15.1 0.407  1.331  9.98  12.67 158 1198.8 15149.   38.  967.   967.     1382.

STAGE    6
  WD   WB   WS   WN   WC   CL   RHOB  RHOD   AR
 16.   4.   4.   6.   4.   1.6 0.168 0.168  3.35
  PR  DEL H  MACH  AREA  R HUB  R TIP  NB UTIPMAX  STR   WEIGHT TIN   TMAX   STAGE I
1.2068  15.1 0.396  1.150 10.39  12.67 174 1198.8 13100.   34. 1027.  1027.     1324.

STAGE    7
  WD   WB   WS   WN   WC   CL   RHOB  RHOD   AR
 15.   3.   3.   5.   3.   1.5 0.168 0.168  3.12
  PR  DEL H  MACH  AREA  R HUB  R TIP  NB UTIPMAX  STR   WEIGHT TIN   TMAX   STAGE I
1.1947  15.1 0.386  1.004 10.71  12.67 188 1198.8 11443.   31. 1088.  1088.     1260.

STAGE    8
```

```
  WD    WB    WS    WN    WC    CL    RHOB   RHOD    AR
 14.    3.    3.    5.    3.    1.4 0.168 0.168   2.88
  PR   DEL H  MACH   AREA  R HUB  R TIP  NB UTIPMAX  STR   WEIGHT TIN   TMAX   STAGE I
1.1840  15.1 0.375  0.885 10.96  12.67 200 1198.8 10088.   28. 1147.  1147.     1191.

STAGE    9
  WD    WB    WS    WN    WC    CL    RHOB   RHOD    AR
 25.    4.    4.    5.    3.    1.3 0.286 0.286   2.65
  PR   DEL H  MACH   AREA  R HUB  R TIP  NB UTIPMAX  STR   WEIGHT TIN   TMAX   STAGE I
1.1744  15.1 0.364  0.787 11.16  12.67 209 1198.8 15265.   42. 1206.  1206.     2142.

STAGE   10
  WD    WB    WS    WN    WC    CL    RHOB   RHOD    AR
 23.    4.    4.    5.    3.    1.3 0.286 0.286   2.42
  PR   DEL H  MACH   AREA  R HUB  R TIP  NB UTIPMAX  STR   WEIGHT TIN   TMAX   STAGE I
1.1659  15.1 0.354  0.704 11.33  12.67 215 1198.8 13673.   39. 1265.  1265.     2013.

STAGE   11
  WD    WB    WS    WN    WC    CL    RHOB   RHOD    AR
 22.    4.    4.    5.    3.    1.3 0.286 0.286   2.19
  PR   DEL H  MACH   AREA  R HUB  R TIP  NB UTIPMAX  STR   WEIGHT TIN   TMAX   STAGE I
1.1582  15.1 0.343  0.635 11.47  12.67 217 1198.8 12333.   37. 1324.  1324.     1913.

STAGE   12
  WD    WB    WS    WN    WC    CL    RHOB   RHOD    AR
 21.    3.    3.    5.    3.    1.3 0.286 0.286   1.96
  PR   DEL H  MACH   AREA  R HUB  R TIP  NB UTIPMAX  STR   WEIGHT TIN   TMAX   STAGE I
1.1513  15.1 0.332  0.577 11.59  12.67 215 1198.8 11198.   35. 1382.  1382.     1842.

STAGE   13
  WD    WB    WS    WN    WC    CL    RHOB   RHOD    AR
 20.    3.    3.    5.    3.    1.3 0.286 0.286   1.73
  PR   DEL H  MACH   AREA  R HUB  R TIP  NB UTIPMAX  STR   WEIGHT TIN   TMAX   STAGE I
1.1450  15.1 0.321  0.527 11.68  12.67 208 1198.8 10230.   34. 1439.  1439.     1796.

STAGE   14
  WD    WB    WS    WN    WC    CL    RHOB   RHOD    AR
 19.    3.    3.    5.    3.    1.4 0.286 0.286   1.50
  PR   DEL H  MACH   AREA  R HUB  R TIP  NB UTIPMAX  STR   WEIGHT TIN   TMAX   STAGE I
1.1392  15.1 0.311  0.484 11.77  12.67 197 1198.8  9399.   34. 1496.  1496.     1776.

 N STG  WEIGHT  LENGTH  CENGRA  INERTIA
   14   581.92   24.74   13.9   22295.5

DUCT
 M NO  VEL  T TOT   P TOT   P STAT  AREA    GAM
0.311  584. 1553.  64238.  60225.    0.4352  1.3475

   PR     AD EF      PO      TO      HP
12.7500   0.8670 64237.9  1553.3  56017.
  HI       HO      WI      CWI
 172.54  383.29  187.86   93.01

********** TOTAL COMP WEIGHT IS   581.918

**********
*        *
*  DUCT 17  *
*        *
**********2
```

```
MAX CONDITIONS OCCUR AT
**********************
      ALT         MN
PTOT      0.      0.000
TTOT      0.      0.000
**********************
DUCT ,  17
RH=   11.90 RT=   12.60 LENG=    6.27
AREA=   0.376 RHO=.286
      CAS WT      INC WT      WTOT
     11.3975      10.7609      22.1584


*************
*           *
*  PBUR  9  *
*           *
*************2

MAX CONDITIONS OCCUR AT
***************************************
      ALT         MN         VALUE
PTOT      0.      0.000      446.1 LB/SQIN
TTOT      0.      0.000     1553.3 DEG R
CWIN      0.      0.000        9.0 LB/SEC
***************************************
BURNER NUMBER     9
  RIN     ROUT      LENGTH      MACH      WSPEC
 10.177   14.023    21.600      0.053     4.419
 CAS WT   LIN WT    NOZ WT     INC WT     FRAME     WTOT
   43.0     54.2      21.7       31.2     178.6     328.7


*************
*           *
*  HPT  10  *
*           *
*************2

MAX CONDITIONS OCCUR AT
***************************************
      ALT         MN         VALUE
PTOT      0.      0.000      424.7 LB/SQIN
TTOT      0.      0.000     2990.0 DEG R
CWOUT     0.      0.000       55.4 LB/SEC
***************************************
DUCT
 M NO   VEL   T TOT    P TOT    P STAT   AREA     GAM
0.400   998. 2877.   61154.   55218.     0.4795  1.2912

 UTIPMAX STRESS      DEN   W/AREA    TR      H/T
 1060.5 10488.8    0.286    0.294   1.000    0.908

 TURBINE 10  MECHANICAL DESIGN
    H/T    N STG LOADING     AREA
  0.908    2.000    0.200    0.479
     UT     RTIP     RHUB    DEL H      RPM    MAXRPM   TORQ
```

```
 1060.5    11.2    10.2   224.6 10838.5 10838.5 325775.

STAGE    1
 DISK   BLADE  VANE   HWD    CASE   AR
   6.9    2.6   13.2   26.1    4.8  1.50
  PR  DEL H  MACH  AREA  R HUB  R TIP  NB MAXUTIP  STR   WEIGHT  LENGTH  STAGE I

**** WARNING FOLLOWING STAGE DESIGN LIMIT EXCEEDED *****
STAGE  LOADING  IS   0.20 DES LIMIT IS0.28
**STAGE LOADING IS TOO HIGH INCREASE LOADING INPUT 1/TLP=LOADING  .  **
1.9609 112.3 0.400  0.479 10.18  11.21 154 1060.5 10489.   53.65    2.40      634.

STAGE    2
 DISK   BLADE  VANE   HWD    CASE   AR
  11.5    7.2   36.2   42.1    8.3  1.50
  PR  DEL H  MACH  AREA  R HUB  R TIP  NB MAXUTIP  STR   WEIGHT  LENGTH  STAGE I

**** WARNING FOLLOWING STAGE DESIGN LIMIT EXCEEDED *****
STAGE  LOADING  IS   0.20 DES LIMIT IS0.28
**STAGE LOADING IS TOO HIGH INCREASE LOADING INPUT 1/TLP=LOADING    **
2.1890 112.3 0.450  0.796 10.18  11.84 101 1120.1 17422.  105.35    3.88     1356.

 N STG  LENGTH  WEIGHT   CENGRA  INERTIA
    2     6.28  159.00     5.0     1990.

DUCT
 M NO  VEL  T TOT   P TOT   P STAT  AREA    GAM
0.500 1065. 2096.  14225.  12113.    1.5459  1.3103

  PR      TR     AD EF    PO      TO     TO.1
 4.2991  1.3553  0.9190 14224.8  2122.4  2096.4
 H IN    H OUT    AREA   FLOW     HP
 777.55  552.92    5.23  176.28  56024.

********************* TOTAL TURB WEIGHT IS   158.997


**************
*            *
*  DUCT 11   *
*            *
*************2

MAX CONDITIONS OCCUR AT
**********************
      ALT         MN
PTOT      0.     0.000
TTOT      0.     0.000
**********************
DUCT ,  11
RH=   10.00 RT=   13.07 LENG=   10.74
AREA=    1.546 RHO=.286
      CAS WT       INC WT      WTOT
      4.6581        3.5643       8.2224


**************
*            *
*  LPT  12   *
```

```
*           *
************2

MAX CONDITIONS OCCUR AT
**************************************
      ALT          MN         VALUE
PTOT      0.      0.000       98.8 LB/SQIN
TTOT      0.      0.000     2096.5 DEG R
CWOUT     0.      0.000      211.0 LB/SEC
**************************************
DUCT
 M NO  VEL  T TOT   P TOT   P STAT  AREA    GAM
0.500 1065. 2097.  14229.  12117.    1.5455  1.3103

 UTIPMAX STRESS     DEN  W/AREA   TR     H/T
  899.1  6967.9   0.286   0.505   1.000   0.916

 TURBINE 12  MECHANICAL DESIGN
    H/T   N STG LOADING    AREA
  0.916   3.000   0.300   1.546
     UT    RTIP    RHUB   DEL H     RPM   MAXRPM  TORQ
  899.1    20.9    19.2   161.5  4920.4  4920.4 542172.

STAGE    1
 DISK   BLADE  VANE   HWD    CASE   AR
  30.8   13.7   68.5  119.2   11.7  2.00
  PR  DEL H  MACH  AREA  R HUB  R TIP  NB MAXUTIP  STR   WEIGHT  LENGTH  STAGE I
1.5488  53.8 0.500  1.546 19.17  20.94 223  899.1  6968.  243.83    3.10    10705.

STAGE    2
 DISK   BLADE  VANE   HWD    CASE   AR
  38.3   18.9   94.4  105.2   11.2  3.00
  PR  DEL H  MACH  AREA  R HUB  R TIP  NB MAXUTIP  STR   WEIGHT  LENGTH  STAGE I
1.6212  53.8 0.533  2.178 18.40  20.94 233  899.1  9819.  267.93    2.97    12920.

STAGE    3
 DISK   BLADE  VANE   HWD    CASE   AR
  45.1   32.8  164.1  103.5   12.8  4.00
  PR  DEL H  MACH  AREA  R HUB  R TIP  NB MAXUTIP  STR   WEIGHT  LENGTH  STAGE I
1.7172  53.8 0.567  3.209 17.07  20.94 203  899.1 14469.  358.29    3.40    16289.

FRAME WT  =  318.95


 N STG  LENGTH  WEIGHT   CENGRA  INERTIA
    3    12.62 1189.01     8.2    39914.

DUCT
 M NO  VEL  T TOT   P TOT   P STAT  AREA    GAM
0.600 1089. 1525.   3295.   2609.    5.1741  1.3350

  PR      TR     AD EF    PO      TO      TO.1
 4.3186  1.3760  0.9120  3294.8  1523.7  1524.6
 H IN    H OUT    AREA   FLOW     HP
 544.69  383.23   20.12  185.29  42328.

********************* TOTAL TURB WEIGHT IS  1189.008
```

```
**************
*            *
*  DUCT 13   *
*            *
**************2

MAX CONDITIONS OCCUR AT
**************************
       ALT          MN
PTOT       0.      0.000
TTOT       0.      0.000
**************************

**************
*            *
*  NOZ  14   *
*            *
**************2

MAX CONDITIONS OCCUR AT
**************************
       ALT          MN
PTOT       0.      0.000
TTOT       0.      0.000
**************************
NOZZLE   14
WEIGHT=   155.91 LENGTH=   41.876 TR WT=     0.00

**************
*            *
*  DUCT  4   *
*            *
**************2

MAX CONDITIONS OCCUR AT
**************************
       ALT          MN
PTOT       0.      0.000
TTOT       0.      0.000
**************************
DUCT ,   4
RH=   22.33 RT=   33.92 LENG=   11.59
AREA=  14.224 RHO=.168
      CAS WT       INC WT       WTOT
      7.1743        4.7223       11.8966

**************
*            *
*  NOZ   5   *
*            *
**************2

MAX CONDITIONS OCCUR AT
**************************
       ALT          MN
PTOT       0.      0.000
TTOT       0.      0.000
```

```
**********************
NOZZLE    5
WEIGHT=   242.87 LENGTH=   67.836 TR WT=    0.00


**************
*            *
*  SHAF 15   *
*            *
**************2

MAX TORQUE CONDITION
**********************
 TORQUE
10.6
**********************
SHAFT  15
   DO      DI    LENG      DN      WT
  6.89    5.86  89.48    0.86 277.62

TOTAL INERTIA OF THIS SPOOL IS   231684.

**************
*            *
*  SHAF 16   *
*            *
**************2

MAX TORQUE CONDITION
**********************
 TORQUE
 9.3
**********************
SHAFT  16
   DO      DI    LENG      DN      WT
  7.72    7.29  27.87    2.12  42.22


TOTAL INERTIA OF THIS SPOOL IS    24286.
HE DN VALUE OF2.12MILLION IS HIGH

**************
*            *
*  ACCS WT   *
*            *
**************2

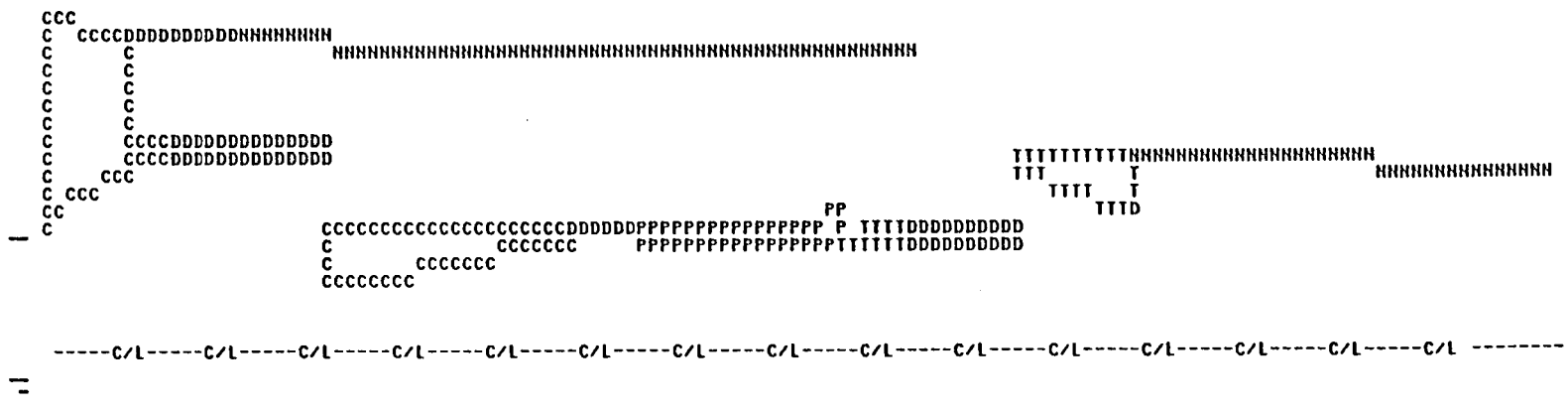
  ACCS WT= 440.164
```

WEIGHT INPUT DATA IN ENGL UNITS
WEIGHT OUTPUT DATA IN ENGL UNITS

ENGINE SCALING DATA
****
SCALE FACTOR 1.00
****

COMP NO	WT EST	COMP LEN	ACCU LEN	UPSTREAM RADIUS RI	UPSTREAM RADIUS RO	UPSTREAM RADIUS RI	UPSTREAM RADIUS RO	DOWNSTREAM RADIUS RI	DOWNSTREAM RADIUS RO	DOWNSTREAM RADIUS RI	DOWNSTREAM RADIUS RO	NSTAGE
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0
2	1455.	10.	10.	14.	37.	0.	0.	19.	34.	0.	0.	1
3	0.	0.	10.	19.	34.	0.	0.	19.	23.	23.	34.	0
4	12.	12.	22.	22.	34.	0.	0.	22.	34.	0.	0.	0
5	243.	68.	90.	0.	34.	0.	0.	0.	32.	0.	0.	0
6	314.	4.	14.	20.	23.	0.	0.	20.	23.	0.	0.	1
7	12.	16.	30.	20.	23.	0.	0.	20.	23.	0.	0.	0
8	582.	25.	55.	6.	13.	0.	0.	12.	13.	0.	0.	14
9	329.	22.	83.	10.	14.	0.	0.	10.	14.	0.	0.	0
10	159.	6.	89.	10.	11.	0.	0.	10.	13.	0.	0.	2
11	8.	11.	100.	10.	13.	0.	0.	10.	13.	0.	0.	0
12	1189.	13.	112.	19.	21.	0.	0.	14.	21.	0.	0.	3
13	0.	0.	112.	14.	21.	0.	0.	14.	21.	0.	0.	0
14	156.	42.	154.	0.	21.	0.	0.	0.	19.	0.	0.	0
15	278.	0.	89.	14.	37.	0.	0.	10.	13.	0.	0.	0
16	42.	0.	0.	20.	23.	12.	13.	0.	0.	0.	0.	0
17	22.	6.	61.	12.	13.	0.	0.	12.	13.	0.	0.	10

TOTAL BARE ENGINE WEIGHT= 4800. ACCESSORIES= 440.16 ESTIMATED TOTAL LENGTH= 154. ESTIMATED MAXIMUM RADIUS= 37.
ESTIMATED CENTER OF GRAVITY= 51.
ESTIMATED AIRFLOW SCALING EXPONENT IS 1.000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WEIGHT INPUT DATA IN ENGL UNITS
WEIGHT OUTPUT DATA IN ENGL UNITS

ENGINE SCALING DATA
****
SCALE FACTOR 0.80
****

COMP NO	WT EST	COMP LEN	ACCU LEN	UPSTREAM RADIUS RI	UPSTREAM RADIUS RO	RI	RO	DOWNSTREAM RADIUS RI	DOWNSTREAM RADIUS RO	RI	RO	NSTAGE
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0
2	1223.	9.	9.	12.	33.	0.	0.	17.	31.	0.	0.	1
3	0.	0.	9.	17.	31.	0.	0.	17.	21.	21.	31.	0
4	9.	10.	20.	20.	31.	0.	0.	20.	31.	0.	0.	0
5	197.	61.	81.	0.	31.	0.	0.	0.	29.	0.	0.	0
6	223.	4.	13.	18.	21.	0.	0.	18.	21.	0.	0.	1
7	8.	14.	27.	18.	21.	0.	0.	18.	21.	0.	0.	0
8	419.	22.	49.	5.	11.	0.	0.	11.	11.	0.	0.	14
9	268.	22.	76.	9.	13.	0.	0.	9.	13.	0.	0.	0
10	115.	6.	82.	9.	10.	0.	0.	9.	12.	0.	0.	2
11	6.	10.	92.	9.	12.	0.	0.	9.	12.	0.	0.	0
12	914.	11.	103.	17.	19.	0.	0.	13.	19.	0.	0.	3
13	0.	0.	103.	13.	19.	0.	0.	13.	19.	0.	0.	0
14	125.	37.	140.	0.	19.	0.	0.	0.	17.	0.	0.	0
15	237.	0.	82.	12.	33.	0.	0.	9.	12.	0.	0.	0
16	38.	0.	0.	18.	21.	11.	11.	0.	0.	0.	0.	0
17	16.	6.	55.	11.	11.	0.	0.	11.	11.	0.	0.	10

TOTAL BARE ENGINE WEIGHT= 3799. ACCESSORIES= 347.68 ESTIMATED TOTAL LENGTH= 140. ESTIMATED MAXIMUM RADIUS= 33.
ESTIMATED CENTER OF GRAVITY= 46.
ESTIMATED AIRFLOW SCALING EXPONENT IS 1.049

WEIGHT INPUT DATA IN ENGL UNITS
WEIGHT OUTPUT DATA IN ENGL UNITS

ENGINE SCALING DATA
****
SCALE FACTOR 1.20
****

COMP NO	WT EST	COMP LEN	ACCU LEN	UPSTREAM RADIUS RI	UPSTREAM RADIUS RO	RI	RO	DOWNSTREAM RADIUS RI	DOWNSTREAM RADIUS RO	RI	RO	NSTAGE
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0
2	1707.	11.	11.	15.	41.	0.	0.	21.	38.	0.	0.	1
3	0.	0.	11.	21.	38.	0.	0.	21.	25.	25.	38.	0
4	16.	13.	24.	24.	37.	0.	0.	24.	37.	0.	0.	0
5	288.	74.	98.	0.	37.	0.	0.	0.	35.	0.	0.	0
6	415.	4.	16.	22.	26.	0.	0.	22.	26.	0.	0.	1
7	16.	17.	33.	22.	25.	0.	0.	22.	25.	0.	0.	0
8	766.	27.	60.	7.	14.	0.	0.	13.	14.	0.	0.	14
9	389.	22.	89.	11.	15.	0.	0.	11.	15.	0.	0.	0
10	208.	7.	96.	11.	12.	0.	0.	11.	14.	0.	0.	2
11	11.	12.	107.	11.	14.	0.	0.	11.	14.	0.	0.	0
12	1489.	14.	121.	21.	23.	0.	0.	16.	23.	0.	0.	3
13	0.	0.	121.	16.	23.	0.	0.	16.	23.	0.	0.	0
14	187.	46.	167.	0.	23.	0.	0.	0.	21.	0.	0.	0
15	316.	0.	96.	15.	41.	0.	0.	11.	14.	0.	0.	0
16	46.	0.	0.	22.	25.	13.	14.	0.	0.	0.	0.	0
17	29.	7.	67.	13.	14.	0.	0.	13.	14.	0.	0.	10

TOTAL BARE ENGINE WEIGHT= 5882. ACCESSORIES= 540.64 ESTIMATED TOTAL LENGTH= 167. ESTIMATED MAXIMUM RADIUS= 41.
ESTIMATED CENTER OF GRAVITY= 56.
ESTIMATED AIRFLOW SCALING EXPONENT IS 1.114

UPDATED INPUT DATA TO REFLECT CALCULATED INPUT

COMPONENT NO.	TYPE	DATINP1	DATINP2	DATINP3	DATINP4	DATINP5	DATINP6	DATINP7	DATINP8	DATINP9
1	INLET	0.10000D 04	0.00000	0.14696D 02	0.00000	0.00000	0.10000D 01	0.00000	0.00000	0.10000D-04
2	COMPRESR	0.18000D 01	0.00000	0.39250D 04	0.37610D 04	0.10227D 04	0.37620D 04	0.95772D 00	0.37630D 04	0.39127D 00
3	SPLITTER	0.43230D 01	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
4	DUCT B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
5	NOZZLE	0.15353D 04	0.10000D 01	0.00000	0.00000	0.99000D 00	0.00000	0.00000	0.00000	0.10000D 01
6	COMPRESR	0.13000D 01	0.00000	0.35737D 04	0.37610D 04	0.12437D 03	0.37620D 04	0.10023D 01	0.37630D 04	0.18266D 00
7	DUCT B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
8	COMPRESR	0.13000D 01	0.16200D 00	0.51680D 04	0.37070D 04	0.92177D 02	0.37080D 04	0.90596D 00	0.37090D 04	0.18516D 01
9	DUCT B	0.48000D-01	0.00000	0.00000	0.29900D 04	0.10000D 01	0.18400D 05	0.00000	0.00000	0.00000
10	TURBINE	0.40000D 01	0.79000D 00	0.43996D 00	0.38010D 04	0.68035D 00	0.38020D 04	0.10336D 01	0.10993D 01	0.62500D 00
11	DUCT B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	TURBINE	0.25000D 01	0.21000D 00	0.37940D 00	0.38030D 04	0.86961D 00	0.38040D 04	0.99700D 00	0.22118D 01	0.00000
13	DUCT B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	NOZZLE	0.64017D 03	0.10000D 01	0.00000	0.00000	0.99000D 00	0.00000	0.00000	0.00000	0.10000D 01
15	SHAFT	0.40000D 04	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01
16	SHAFT	0.60000D 04	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01	0.10000D 01
17	DUCT B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

CASE IDENTIFICATION SAMPLE CASE FOR PREPWATE

STATION PROPERTY OUTPUT DATA

FLOW STATION	WEIGHT FLOW STATP1	TOTAL PRESSURE STATP2	TOTAL TEMPERATURE STATP3	FUEL/AIR RATIO STATP4	REFERRED FLOW STATP5	MACH NUMBER STATP6	STATIC PRESSURE STATP7	INTERFACE CORRECTED FLOW ERROR STATP8
1	0.10000D 04	0.14696D 02	0.53867D 03	0.00000	0.10191D 04	0.00000	0.00000	0.00000
2	0.10000D 04	0.14696D 02	0.53867D 03	0.00000	0.10191D 04	0.00000	0.00000	0.00000
3	0.10000D 04	0.25483D 02	0.64979D 03	0.00000	0.64548D 03	0.00000	0.00000	0.00000
4	0.81214D 03	0.25483D 02	0.64979D 03	0.00000	0.52422D 03	0.00000	0.00000	0.00000
5	0.81214D 03	0.25483D 02	0.64979D 03	0.00000	0.52422D 03	0.92227D 00	0.14696D 02	0.00000
6	0.81214D 03	0.25483D 02	0.64979D 03	0.00000	0.52422D 03	0.91304D 00	0.14696D 02	0.00000
7	0.18786D 03	0.25483D 02	0.64979D 03	0.00000	0.12126D 03	0.00000	0.00000	0.00000
8	0.18786D 03	0.34988D 02	0.72056D 03	0.00000	0.93005D 02	0.00000	0.00000	0.00000
9	0.18786D 03	0.34988D 02	0.72056D 03	0.00000	0.93005D 02	0.00000	0.00000	0.00000
10	0.15743D 03	0.44610D 03	0.15533D 04	0.00000	0.89748D 01	0.00000	0.00000	0.00000
11	0.16125D 03	0.42468D 03	0.29900D 04	0.24256D-01	0.13397D 02	0.00000	0.00000	0.00000
12	0.18529D 03	0.98812D 02	0.20965D 04	0.21043D-01	0.55404D 02	0.00000	0.00000	0.00000
13	0.18529D 03	0.98812D 02	0.20965D 04	0.21043D-01	0.55404D 02	0.00000	0.00000	0.00000
14	0.19168D 03	0.22886D 02	0.15247D 04	0.20327D-01	0.21104D 03	0.00000	0.00000	0.00000
15	0.19168D 03	0.22886D 02	0.15247D 04	0.20327D-01	0.21104D 03	0.83092D 00	0.14696D 02	0.00000
16	0.19168D 03	0.22886D 02	0.15247D 04	0.20327D-01	0.21104D 03	0.82261D 00	0.14696D 02	0.00000
17	0.30434D 02	0.44610D 03	0.15533D 04	0.00000	0.00000	0.00000	0.00000	0.00000
19	0.15743D 03	0.44610D 03	0.15533D 04	0.00000	0.89748D 01	0.00000	0.00000	0.00000

COMPONENT OUTPUT DATA

COMPONENT NO.	TYPE	DATOUT1	DATOUT2	DATOUT3	DATOUT4	DATOUT5	DATOUT6	DATOUT7	DATOUT8	DATOUT9
1	INLET	0.00000	0.00000	0.00000	0.10000D 01	0.10000D 01	0.00000	0.10000D 01	0.10386D 01	0.10000D-04
2	COMPRESR	-0.37786D 05	0.40000D 04	0.00000	0.18000D 01	0.81382D 01	0.10000D 01	0.10227D 04	0.82400D 00	0.17340D 01
3	SPLITTER	0.43230D 01	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
4	DUCT B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
5	NOZZLE	0.26647D 05	0.10556D 04	0.17340D 01	0.15353D 04	0.15353D 04	0.10000D 01	0.99000D 00	0.18930D 01	0.17340D 01
6	COMPRESR	-0.45423D 04	0.40000D 04	0.00000	0.13000D 01	0.16143D 01	0.10000D 01	0.12437D 03	0.86700D 00	0.13730D 01
7	DUCT B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
8	COMPRESR	-0.56024D 05	0.60000D 04	0.00000	0.13000D 01	0.32396D 02	0.98500D 00	0.92177D 02	0.86700D 00	0.12750D 02
9	DUCT B	0.00000	0.48000D-01	0.00000	0.24256D-01	0.00000	0.13747D 05	0.00000	0.10000D 01	0.29900D 04
10	TURBINE	0.56024D 05	0.60000D 04	0.10000D 01	0.40000D 01	0.43996D 00	0.56800D 04	0.68035D 00	0.91900D 00	0.42979D 01
11	DUCT B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	TURBINE	0.42328D 05	0.40000D 04	0.10000D 01	0.25000D 01	0.37940D 00	0.52440D 04	0.86961D 00	0.91200D 00	0.43176D 01
13	DUCT B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	NOZZLE	0.87342D 04	0.14660D 04	0.15573D 01	0.64017D 03	0.64017D 03	0.10000D 01	0.99000D 00	0.18616D 01	0.15573D 01
15	SHAFT	0.00000	0.40000D 04	0.40000D 04	0.40000D 04	0.40000D 04	0.00000	0.00000	0.00000	0.00000
16	SHAFT	0.00000	0.60000D 04	0.60000D 04	0.60000D 04	0.00000	0.00000	0.00000	0.00000	0.00000
17	DUCT B	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

MACH= 0.0000 ALTITUDE= 0. RECOVERY= 1.0000 0 ITERATIONS 2 PASSES

AIRFLOW (LB/SEC)	1000.00	GROSS THRUST	35380.75	FUEL FLOW (LB/HR)	13747.27
NET THRUST	35380.75	TSFC	0.3886	NET THRUST/AIRFLOW	35.3808
TOTAL INLET DRAG	0.00	TOTAL BRAKE SHAFT HP	0.00	BOATTAIL DRAG	0.00
INSTALLED THRUST	35380.75	INSTALLED TSFC	0.3886	SPILLAGE + LIP DRAG	0.00

APPENDIX D

Source Code Listing for PREPWATE

```
      IMPLICIT REAL*8 (A-H,O-Z)
      LOGICAL IPLT,PLOT,ISII,ISIO
      DIMENSION ILENG(30), IREST(30), IALL(60), ITYPE(60), ITYPEI(60), I
     1WORD(11), DEFAUL(17,18), DESVAL(17,60), RMIN(17,18), RMAX(17,18),
     2IWMEC(7,60), RMAN(7), RMIX(7)
      DATA IWORD/4HINLT,4HDUCT,4HWINJ,4HCOMP,4HTURB,4HHTEX,4HSPLT,4HMIXR
     1,4HNOZZ,4HLOAD,4HSHFT/
      INTEGER AA,BB,CC,DD,EE,FF,GG,HH,OO,PP,QQ,RR,SS,TT,PBURX,DBURX,AUGX
     1,DUCTX,FANX,FOX,FIX,RSFOX,RSFIX,HPCX,HPTX,HTXX,FMIX,SHAFX
      DATA AA,BB,CC,DD,EE,FF,GG,HH,II,JJ,KK,LL,MM,NN,OO,PP,QQ,RR,SS,TT/1
     1HA,1HB,1HC,1HD,1HE,1HF,1HG,1HH,1HI,1HJ,1HK,1HL,1HM,1HN,1HO,1HP,1HQ
     2,1HR,1HS,1HT/
      DATA PBURX,DBURX,AUGX,DUCTX/4HPBUR,4HDBUR,4HAUG ,4HDUCT/
      DATA FMIX,MIX,NOZX,SHAFX/4HFMIX,4HMIX ,4HNOZ ,4HSHAF/
      DATA FANX,FOX,FIX,RSFOX,RSFIX,LPCX,HPCX/4HFAN ,4HFO  ,4HFI  ,4HRSF
     1O,4HRSFI,4HLPC ,4HHPC /,HPTX,LPTX,HTXX/4HHPT ,4HLPT ,4HHTEX/
      DATA DEFAUL/100.,.015,15*0,150.,.015,15*0.,300.,.015,15*0.,0.4,1.,
     10.,-1.,13*0.,.55,1.7,.45,1.5,4.,3.,.45,0.,0.,1.,0.,2.,1.,2*0.,1.8,
     2.055,.55,1.7,.45,1.5,4.,3.,.45,0.,0.,1.,0.,2.,1.,2*0.,1.8,.055,.55
     3,1.7,.45,1.5,4.,3.,.45,0.,0.,1.,0.,2.,1.,2*0.,1.8,.055,.55,1.7,.45
     4,1.5,4.,3.,.45,0.,0.,1.,0.,2.,1.,2*0.,1.8,.055,.55,1.7,.45,1.5,4.,
     53.,.45,0.,0.,1.,0.,2.,1.,2*0.,1.8,.055,.50,1.5,.40,1.5,4.,3.,.45,0
     6.,0.,1.,0.,2.,1.,2*0.,1.2,.120,.40,1.4,.70,1.5,3.,1.5,.30,0.,0.,1.
     7,0.,2.,1.,2*0.,1.2,.120,.3,.28,1.5,1.5,1.5,.45,125000.,2.,1.,2*0.,
     80.155,3*0.,1.0,0.155,.45,.28,1.5,2.,4.,.55,125000.,2.,1.,2*0.,0.19
     95,3*0.,1.0,0.195,.3,4*0.,.45,11*0.,5000.,.5,.5,14*0.,1.,8.,15*0.,1
     $.,16*0.,50000.,.286,15*0./
      DATA RMIN/100.,.01,15*0.,150.,.01,15*0.,200.,.01,15*0.,.4,16*0.,.5
     1,1.5,.4,1.,3.,2.,.45,0.,0.,1.,0.,0.,1.,4*0.,.5,1.5,.4,1.,3.,2.,.45
     2,0.,0.,1.,0.,0.,1.,4*0.,.5,1.5,.4,1.,3.,2.,.45,0.,0.,1.,0.,0.,1.,4
     3*0.,.5,1.5,.4,1.,3.,2.,.45,0.,0.,1.,0.,0.,1.,4*0.,.5,1.5,.4,1.,3.,
     42.,.45,0.,0.,1.,0.,0.,1.,4*0.,.45,1.5,.4,1.,3.,2.,.45,0.,0.,1.,0.,
     50.,1.,4*0.,.4,1.4,.6,1.,2.,1.,.20,0.,0.,1.,0.,0.,1.,4*0.,.3,.2,1.,
     61.,1.,.45,100000.,0.,1.,8*0.,.4,.2,1.,2.,4.,.55,100000.,0.,1.,8*0.
     7,17*0.,0.,.3,.3,14*0.,1.,7.,15*0.,1.,16*0.,40000.,.28,15*0./
      DATA RMAX/150.,.02,15*0.,200.,.02,15*0.,300.,.02,15*0.,.5,16*0.,.6
     1,1.8,.5,1.5,5.,3.,.55,0.,0.,1.,0.,0.,1.,4*0.,.6,1.8,.5,1.5,5.,3.,.
     255,0.,0.,1.,0.,0.,1.,4*0.,.6,1.8,.5,1.5,5.,3.,.55,0.,0.,1.,0.,0.,1
     3.,4*0.,.6,1.8,.5,1.5,5.,3.,.55,0.,0.,1.,0.,0.,1.,4*0.,.6,1.8,.5,1.
     45,5.,3.,.55,0.,0.,1.,0.,0.,1.,4*0.,.6,1.8,.5,1.5,5.,3.,.55,0.,0.,1
     5.,0.,0.,1.,4*0.,.5,1.7,.8,1.5,5.,2.,.30,0.,0.,1.,0.,0.,1.,4*0.,.4,
     6.3,1.5,2.,2.,.5,150000.,0.,1.,8*0.,.5,.3,1.5,3.,6.,.6,150000.,0.,1
     7.,8*0.,17*0.,0.,.5,.5,14*0.,2.,9.,15*0.,2.,16*0.,50000.,.31,.85,14
     8*0./
      DATA RMAN,RMIX/14*0./,IPLT,PLOT,ISII,ISIO/.TRUE.,.TRUE.,.FALSE.,.F
     1ALSE./,IWT,IOUTCD/2,2/
      WRITE (35,970)
      READ (30,980) IPLT,PLOT,ISII,ISIO
      WRITE (6,990) IPLT,PLOT,ISII,ISIO
      WRITE (35,1000)
      READ (30,1010) IWT,IOUTCD
      WRITE (6,1020) IWT,IOUTCD
      WRITE (35,1210)
      READ (30,1120) IDISK
      IF (IDISK.EQ.BB) DISKWI=0.
      IF (IDISK.EQ.GG) DISKWI=1.
      WRITE (6,1220) DISKWI
      DO 10 I=1,30
      IWMEC(1,I)=0
      IWMEC(1,I+30)=0
```

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      IREST(I)=0                                                        0006100
10    ILENG(I)=0                                                        0006200
      WRITE (35,1030)                                                   0006300
      READ (30,1040) ILENG                                              0006400
      WRITE (35,1050)                                                   0006500
      READ (30,1040) IREST                                              0006600
      DO 20 I=1,30                                                      0006700
      IF (ILENG(I).EQ.0) GO TO 30                                       0006800
20    ILMAX=I                                                           0006900
30    WRITE (6,1060) (ILENG(I),I=1,ILMAX)                               0007000
      DO 40 I=1,30                                                      0007100
      IF (IREST(I).EQ.0) GO TO 50                                       0007200
40    IRMAX=I                                                           0007300
50    IBEG=ILMAX+1                                                      0007400
      IEND=ILMAX+IRMAX                                                  0007500
      DO 60 I=1,60                                                      0007600
60    IALL(I)=0                                                         0007700
      DO 70 I=1,ILMAX                                                   0007800
70    IALL(I)=ILENG(I)                                                  0007900
      DO 80 I=IBEG,IEND                                                 0008000
      IRST=I-IBEG+1                                                     0008100
80    IALL(I)=IREST(IRST)                                               0008200
C     IALL CONTAINS ALL THE COMPONENT NUMBERS FOR WHICH WE NEED INPUTS  0008300
C     NOW IDENTIFY COMPONENT TYPE PER NNEP GENERIC TYPE                 0008400
      WRITE (35,1070)                                                   0008500
      DO 90 I=1,IEND                                                    0008600
      WRITE (35,1080) IALL(I)                                           0008700
      READ (30,1090) ITYPE(I)                                           0008800
90    CONTINUE                                                          0008900
      DO 110 I=1,IEND                                                   0009000
      DO 100 J=1,11                                                     0009100
      IF (ITYPE(I).NE.IWORD(J)) GO TO 100                               0009200
      ITYPEI(I)=J                                                       0009300
      GO TO 110                                                         0009400
100   CONTINUE                                                          0009500
110   CONTINUE                                                          0009600
C     ITYPEI HAS COMPONENT TYPE BY NUMERICAL TYPE                       0009700
      WRITE (35,1100)                                                   0009800
      JCX=0                                                             0009900
120   JCX=JCX+1                                                         0010000
      JCXX=IALL(JCX)                                                    0010100
      IF (JCX.GT.IEND) GO TO 570                                        0010200
      IGO=ITYPEI(JCX)                                                   0010300
      GO TO (130,140,240,250,330,390,430,440,480,560,520), IGO          0010400
C     INLET YOU DUMMY                                                   0010500
130   GO TO 120                                                         0010600
C     DUCT                                                              0010700
140   WRITE (35,1110) IALL(JCX)                                         0010800
      READ (30,1120) IJK                                                0010900
      IF (IJK.EQ.AA) IWNEC(1,JCXX)=PBURX                                0011000
      IF (IJK.EQ.AA) KT=1                                               0011100
      IF (IJK.EQ.BB) IWNEC(1,JCXX)=DBURX                                0011200
      IF (IJK.EQ.BB) KT=2                                               0011300
      IF (IJK.EQ.CC) IWNEC(1,JCXX)=AUGX                                 0011400
      IF (IJK.EQ.CC) KT=3                                               0011500
      IF (IJK.EQ.DD) IWNEC(1,JCXX)=DUCTX                                0011600
      IF (IJK.EQ.DD) KT=4                                               0011700
      IF (KT.EQ.4) GO TO 150                                            0011800
      WRITE (35,1130)                                                   0011900
      READ (30,1120) IJK                                                0012000
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      IWMEC(2,JCXX)=0                                                   0012100
      IF (IJK.EQ.AA) IWMEC(2,JCXX)=1                                    0012200
      GO TO 160                                                         0012300
  150 WRITE (35,1140)                                                   0012400
      READ (30,1120) IJK                                                0012500
      IF (IJK.EQ.AA) IWMEC(2,JCXX)=1                                    0012600
      IF (IJK.EQ.BB) IWMEC(2,JCXX)=2                                    0012700
      IF (IJK.EQ.CC) IWMEC(2,JCXX)=3                                    0012800
      IF (IJK.EQ.DD) IWMEC(2,JCXX)=4                                    0012900
      IF (IJK.EQ.EE) IWMEC(2,JCXX)=5                                    0013000
C     NOW FILL IN THE DEFAULT VALUES FOR THIS COMPONENT                 0013100
  160 DO 170 I=1,17                                                     0013200
  170 DESVAL(I,JCXX)=DEFAUL(I,KT)                                       0013300
      KX=JCXX                                                           0013400
  180 IF (KT.GT.1) GO TO 190                                            0013500
      WRITE (35,1150) AA,DESVAL(1,KX),RMIN(1,KT),RMAX(1,KT),BB,DESVAL(2, 0013600
     1KX),RMIN(2,KT),RMAX(2,KT),CC,DESVAL(3,KX),RMIN(3,KT),RMAX(3,KT),DD 0013700
     2,DESVAL(4,KX),RMIN(4,KT),RMAX(4,KT),EE,DESVAL(5,KX),RMIN(5,KT),RMA 0013800
     3X(5,KT)                                                           0013900
      GO TO 220                                                         0014000
  190 IF (KT.GT.2) GO TO 200                                            0014100
      WRITE (35,1160) AA,DESVAL(1,KX),RMIN(1,KT),RMAX(1,KT),BB,DESVAL(2, 0014200
     1KX),RMIN(2,KT),RMAX(2,KT),CC,DESVAL(3,KX),RMIN(3,KT),RMAX(3,KT),DD 0014300
     2,DESVAL(4,KX),RMIN(4,KT),RMAX(4,KT),EE,DESVAL(5,KX),RMIN(5,KT),RMA 0014400
     3X(5,KT)                                                           0014500
      GO TO 220                                                         0014600
  200 IF (KT.GT.3) GO TO 210                                            0014700
      WRITE (35,1170) AA,DESVAL(1,KX),RMIN(1,KT),RMAX(1,KT),BB,DESVAL(2, 0014800
     1KX),RMIN(2,KT),RMAX(2,KT),CC,DESVAL(3,KX),RMIN(3,KT),RMAX(3,KT),DD 0014900
     2,DESVAL(4,KX),RMIN(4,KT),RMAX(4,KT),EE,DESVAL(5,KX),RMIN(5,KT),RMA 0015000
     3X(5,KT)                                                           0015100
      GO TO 220                                                         0015200
  210 CONTINUE                                                          0015300
      WRITE (35,1200) AA,DESVAL(1,KX),RMIN(1,KT),RMAX(1,KT),BB,DESVAL(2, 0015400
     1KX),RMIN(2,KT),RMAX(2,KT),CC,DESVAL(3,KX),RMIN(3,KT),RMAX(3,KT),DD 0015500
     2,DESVAL(4,KX),RMIN(4,KT),RMAX(4,KT)                               0015600
  220 WRITE (35,960) QQ,RR,TT                                           0015700
  230 CALL REDOEM (IND,DESVAL,JCXX)                                     0015800
      IF (IND.NE.QQ.AND.IND.NE.TT.AND.IND.NE.RR) GO TO 230              0015900
      IF (IND.EQ.QQ) GO TO 570                                          0016000
      IF (IND.EQ.TT) GO TO 120                                          0016100
      IF (IND.EQ.RR) GO TO 180                                          0016200
C     NO WEIGHT OR DIMENSIONS FOR WATER INJECTORS                       0016300
  240 CONTINUE                                                          0016400
      GO TO 120                                                         0016500
  250 WRITE (35,950) IALL(JCX)                                          0016600
      READ (30,1120) IJK                                                0016700
      IF (IJK.EQ.AA) IWMEC(1,JCXX)=FANX                                 0016800
      IF (IJK.EQ.AA) KT=5                                               0016900
      IF (IJK.EQ.BB) IWMEC(1,JCXX)=FOX                                  0017000
      IF (IJK.EQ.BB) KT=6                                               0017100
      IF (IJK.EQ.CC) IWMEC(1,JCXX)=FIX                                  0017200
      IF (IJK.EQ.CC) KT=7                                               0017300
      IF (IJK.EQ.DD) IWMEC(1,JCXX)=RSFOX                                0017400
      IF (IJK.EQ.DD) KT=8                                               0017500
      IF (IJK.EQ.EE) IWMEC(1,JCXX)=RSFIX                                0017600
      IF (IJK.EQ.EE) KT=9                                               0017700
      IF (IJK.EQ.FF) IWMEC(1,JCXX)=LPCX                                 0017800
      IF (IJK.EQ.FF) KT=10                                              0017900
      IF (IJK.EQ.GG) IWMEC(1,JCXX)=HPCX                                 0018000
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      IF (IJK.EQ.GG) KT=11                                                  0018100
      WRITE (35,850)                                                        0018200
      READ (30,1120) IJK                                                    0018300
      IF (IJK.EQ.AA) IWMEC(2,JCXX)=1                                        0018400
      IF (IJK.EQ.BB) IWMEC(2,JCXX)=0                                        0018500
      IF (IJK.EQ.CC) IWMEC(2,JCXX)=2                                        0018600
      WRITE (35,860)                                                        0018700
      READ (30,1120) IJK                                                    0018800
      IF (IJK.EQ.AA) IWMEC(3,JCXX)=0                                        0018900
      IF (IJK.EQ.BB) IWMEC(3,JCXX)=1                                        0019000
      IF (IJK.EQ.CC) IWMEC(3,JCXX)=2                                        0019100
      IF (IJK.EQ.DD) IWMEC(3,JCXX)=4                                        0019200
      WRITE (35,870)                                                        0019300
      READ (30,1120) IJK                                                    0019400
      IF (IJK.EQ.AA) IWMEC(4,JCXX)=0                                        0019500
      IF (IJK.EQ.BB) IWMEC(4,JCXX)=1                                        0019600
      IF (IJK.EQ.CC) IWMEC(4,JCXX)=2                                        0019700
      IF (IJK.EQ.DD) IWMEC(4,JCXX)=4                                        0019800
      IF (KT.LT.6.OR.KT.GT.9) GO TO 260                                     0019900
      WRITE (35,880)                                                        0020000
      READ (30,890) IWMEC(5,JCXX)                                           0020100
260   WRITE (35,900)                                                        0020200
      READ (30,890) IWMEC(6,JCXX)                                           0020300
      WRITE (35,910)                                                        0020400
      READ (30,890) IWMEC(7,JCXX)                                           0020500
C     NOW FILL IN THE DEFAULT VALUES FOR THIS COMPONENT                     0020600
      DO 270 I=1,17                                                         0020700
270   DESVAL(I,JCXX)=DEFAUL(I,KT)                                           0020800
      IF (IWMEC(2,JCXX).NE.2) GO TO 290                                     0020900
      DESVAL(4,JCXX)=DESVAL(10,JCXX)                                        0021000
      DESVAL(5,JCXX)=DESVAL(7,JCXX)                                         0021100
      DESVAL(6,JCXX)=1.                                                     0021200
      DO 280 IIJ=7,17                                                       0021300
280   DESVAL(IIJ,JCXX)=0.                                                   0021400
      GO TO 310                                                             0021500
C     NOW WE UPDATE COMPRESSOR DESIGN VALUES                                0021600
290   WRITE (35,930) AA,DESVAL(1,JCXX),RMIN(1,KT),RMAX(1,KT),BB,DESVAL(2    0021700
     1,JCXX),RMIN(2,KT),RMAX(2,KT),CC,DESVAL(3,JCXX),RMIN(3,KT),RMAX(3,K    0021800
     2T),DD,DESVAL(4,JCXX),RMIN(4,KT),RMAX(4,KT),EE,DESVAL(5,JCXX),RMIN(    0021900
     35,KT),RMAX(5,KT),FF,DESVAL(6,JCXX),RMIN(6,KT),RMAX(6,KT),GG,DESVAL    0022000
     4(7,JCXX),RMIN(7,KT),RMAX(7,KT),HH,DESVAL(8,JCXX),RMIN(8,KT),RMAX(8    0022100
     5,KT),II,DESVAL(9,JCXX),RMIN(9,KT),RMAX(9,KT),JJ,DESVAL(10,JCXX),RM    0022200
     6IN(10,KT),RMAX(10,KT),KK,DESVAL(11,JCXX),RMIN(11,KT),RMAX(11,KT),L    0022300
     7L,DESVAL(12,JCXX),RMIN(12,KT),RMAX(12,KT),MM,DESVAL(13,JCXX),RMIN(    0022400
     813,KT),RMAX(13,KT),NN,DESVAL(14,JCXX),RMIN(14,KT),RMAX(14,KT),OO,D    0022500
     9ESVAL(15,JCXX),RMIN(15,KT),RMAX(15,KT),PP,DESVAL(16,JCXX),RMIN(16,    0022600
     $KT),RMAX(16,KT),SS,DESVAL(17,JCXX),RMIN(17,KT),RMAX(17,KT)            0022700
      WRITE (35,960) QQ,RR,TT                                               0022800
300   CALL REDOEM (IND,DESVAL,JCXX)                                         0022900
      IF (IND.NE.QQ.AND.IND.NE.TT.AND.IND.NE.RR) GO TO 300                  0023000
      IF (IND.EQ.QQ) GO TO 570                                              0023100
      IF (IND.EQ.TT) GO TO 120                                              0023200
      IF (IND.EQ.RR) GO TO 290                                              0023300
310   WRITE (35,940) AA,DESVAL(1,JCXX),RMAN(1),RMIX(1),BB,DESVAL(2,JCXX)    0023400
     1,RMAN(2),RMIX(2),CC,DESVAL(3,JCXX),RMAN(3),RMIX(3),DD,DESVAL(4,JCX    0023500
     2X),RMAN(4),RMIX(4),EE,DESVAL(5,JCXX),RMAN(5),RMIX(5),FF,DESVAL(6,J    0023600
     3CXX),RMAN(6),RMIX(6),GG,DESVAL(7,JCXX),RMAN(7),RMIX(7)                0023700
      WRITE (35,960) QQ,RR,TT                                               0023800
320   CALL REDOEM (IND,DESVAL,JCXX)                                         0023900
      IF (IND.NE.QQ.AND.IND.NE.TT.AND.IND.NE.RR) GO TO 320                  0024000
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      IF (IND.EQ.QQ) GO TO 570                                          0024100
      IF (IND.EQ.TT) GO TO 120                                          0024200
      IF (IND.EQ.RR) GO TO 310                                          0024300
C      COME HERE FOR TURBINES                                           0024400
330   WRITE (35,770) IALL(JCX)                                          0024500
      READ (30,1120) ITURB                                              0024600
      IF (ITURB.EQ.HH) IWMEC(1,JCXX)=HPTX                               0024700
      IF (ITURB.EQ.LL) IWMEC(1,JCXX)=LPTX                               0024800
      WRITE (35,780)                                                    0024900
      READ (30,1120) IJK                                                0025000
      IF (IJK.EQ.AA) IWMEC(2,JCXX)=0                                    0025100
      IF (IJK.EQ.BB) IWMEC(2,JCXX)=1                                    0025200
      WRITE (35,790)                                                    0025300
      READ (30,1040) IWMEC(3,JCXX)                                      0025400
      WRITE (35,800)                                                    0025500
      READ (30,820) IWMEC(4,JCXX)                                       0025600
      WRITE (35,830)                                                    0025700
      READ (30,1040) IWMEC(5,JCXX)                                      0025800
      WRITE (35,840)                                                    0025900
      READ (30,1120) ITURB                                              0026000
      IF (ITURB.EQ.RR) IWMEC(6,JCXX)=2                                  0026100
      IF (ITURB.EQ.AA) IWMEC(6,JCXX)=0                                  0026200
      KT=12                                                             0026300
      IF (IWMEC(1,JCXX).EQ.LPTX) KT=13                                  0026400
      IF (IWMEC(6,JCXX).EQ.2) KT=14                                     0026500
      DO 340 I=1,17                                                     0026600
340   DESVAL(I,JCXX)=DEFAUL(I,KT)                                       0026700
      IF (KT.EQ.14) GO TO 370                                           0026800
350   WRITE (35,730) AA,DESVAL(1,JCXX),RMIN(1,KT),RMAX(1,KT),BB,DESVAL(2 0026900
     1,JCXX),RMIN(2,KT),RMAX(2,KT),CC,DESVAL(3,JCXX),RMIN(3,KT),RMAX(3,K 0027000
     2T),DD,DESVAL(4,JCXX),RMIN(4,KT),RMAX(4,KT),EE,DESVAL(5,JCXX),RMIN( 0027100
     35,KT),RMAX(5,KT),FF,DESVAL(6,JCXX),RMIN(6,KT),RMAX(6,KT),GG,DESVAL 0027200
     4(7,JCXX),RMIN(7,KT),RMAX(7,KT),HH,DESVAL(8,JCXX),RMIN(8,KT),RMAX(8 0027300
     5,KT),II,DESVAL(9,JCXX),RMIN(9,KT),RMAX(9,KT),JJ,DESVAL(10,JCXX),RM 0027400
     6IN(10,KT),RMAX(10,KT),KK,DESVAL(11,JCXX),RMIN(11,KT),RMAX(11,KT),L 0027500
     7L,DESVAL(12,JCXX),RMIN(12,KT),RMAX(12,KT),PP,DESVAL(16,JCXX),RMIN( 0027600
     816,KT),RMAX(16,KT),SS,DESVAL(17,JCXX),RMIN(17,KT),RMAX(17,KT)     0027700
      WRITE (35,960) QQ,RR,TT                                           0027800
360   CALL REDOEM (IND,DESVAL,JCXX)                                     0027900
      IF (IND.NE.QQ.AND.IND.NE.TT.AND.IND.NE.RR) GO TO 360              0028000
      IF (IND.EQ.QQ) GO TO 570                                          0028100
      IF (IND.EQ.TT) GO TO 120                                          0028200
      IF (IND.EQ.RR) GO TO 350                                          0028300
370   WRITE (35,740) AA,DESVAL(1,JCXX),RMIN(1,KT),RMAX(1,KT),FF,DESVAL(6 0028400
     1,JCXX),RMIN(6,KT),RMAX(6,KT)                                      0028500
      WRITE (35,960) QQ,RR,TT                                           0028600
380   CALL REDOEM (IND,DESVAL,JCXX)                                     0028700
      IF (IND.NE.QQ.AND.IND.NE.TT.AND.IND.NE.RR) GO TO 380              0028800
      IF (IND.EQ.QQ) GO TO 570                                          0028900
      IF (IND.EQ.TT) GO TO 120                                          0029000
      IF (IND.EQ.RR) GO TO 370                                          0029100
C     COME HERE IF HEAT EXCHANGER                                       0029200
390   WRITE (35,750) IALL(JCX)                                          0029300
      IWMEC(1,JCXX)=HTXX                                                0029400
      READ (30,1120) IHX                                                0029500
      IF (IHX.EQ.FF) IWMEC(2,JCXX)=1                                    0029600
      IF (IHX.EQ.RR) IWMEC(2,JCXX)=2                                    0029700
      WRITE (35,760)                                                    0029800
      READ (30,1120) IDIR                                               0029900
      IF (IDIR.EQ.PP) IWMEC(3,JCXX)=1                                   0030000
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      IF (IDIR.EQ.CC) IWMEC(3,JCXX)=2                                   0030100
      KT=15                                                             0030200
      DO 400 I=1,17                                                     0030300
400   DESVAL(I,JCXX)=DEFAUL(I,KT)                                       0030400
410   WRITE (35,920) AA,DESVAL(1,JCXX),RMIN(1,KT),RMAX(1,KT),BB,DESVAL(2 0030500
     1,JCXX),RMIN(2,KT),RMAX(2,KT),CC,DESVAL(3,JCXX),RMIN(3,KT),RMAX(3,K 0030600
     2T),DD,DESVAL(4,JCXX),RMIN(4,KT),RMAX(4,KT)                        0030700
      WRITE (35,960) QQ,RR,TT                                           0030800
420   CALL REDOEM (IND,DESVAL,JCXX)                                     0030900
      IF (IND.NE.QQ.AND.IND.NE.TT.AND.IND.NE.RR) GO TO 420              0031000
      IF (IND.EQ.QQ) GO TO 570                                          0031100
      IF (IND.EQ.TT) GO TO 120                                          0031200
      IF (IND.EQ.RR) GO TO 410                                          0031300
C     COME HERE IF SPLITTER                                             0031400
430   WRITE (35,680) IALL(JCX)                                          0031500
      READ (30,1010) IWMEC(2,JCXX)                                      0031600
      IWMEC(1,JCXX)=IWORD(7)                                            0031700
      IF (JCXX.NE.ILENG(1)) GO TO 120                                   0031800
C     FIRST COMPONENT                                                   0031900
      WRITE (35,690)                                                    0032000
      READ (30,700) DESVAL(1,JCXX),DESVAL(2,JCXX)                       0032100
      GO TO 120                                                         0032200
C     COME HERE IF MIXER                                                0032300
440   WRITE (35,710) IALL(JCX)                                          0032400
      READ (30,1120) IMIXR                                              0032500
      IF (IMIXR.EQ.FF) IWMEC(1,JCXX)=FMIX                               0032600
      IF (IMIXR.EQ.CC) IWMEC(1,JCXX)=MIX                                0032700
      WRITE (35,720)                                                    0032800
      READ (30,1010) IWMEC(2,JCXX)                                      0032900
      KT=16                                                             0033000
      DO 450 I=1,17                                                     0033100
450   DESVAL(I,JCXX)=DEFAUL(I,KT)                                       0033200
460   WRITE (35,600) AA,DESVAL(1,JCXX),RMIN(1,KT),RMAX(1,KT),BB,DESVAL(2 0033300
     1,JCXX),RMIN(2,KT),RMAX(2,KT)                                      0033400
      WRITE (35,960) QQ,RR,TT                                           0033500
470   CALL REDOEM (IND,DESVAL,JCXX)                                     0033600
      IF (IND.NE.QQ.AND.IND.NE.TT.AND.IND.NE.RR) GO TO 470              0033700
      IF (IND.EQ.QQ) GO TO 570                                          0033800
      IF (IND.EQ.TT) GO TO 120                                          0033900
      IF (IND.EQ.RR) GO TO 460                                          0034000
C     COME HERE IF NOZZLE                                               0034100
480   WRITE (35,610) IALL(JCX)                                          0034200
      IWMEC(1,JCXX)=NOZX                                                0034300
      READ (30,1010) IWMEC(2,JCXX)                                      0034400
      WRITE (35,810)                                                    0034500
      READ (30,820) IWMEC(3,JCXX)                                       0034600
      WRITE (35,620)                                                    0034700
      READ (30,1010) IWMEC(4,JCXX)                                      0034800
      KT=17                                                             0034900
      DO 490 I=1,17                                                     0035000
490   DESVAL(I,JCXX)=DEFAUL(I,KT)                                       0035100
500   WRITE (35,630) AA,DESVAL(1,JCXX),RMIN(1,KT),RMAX(1,KT),BB,DESVAL(2 0035200
     1,JCXX),RMIN(2,KT),RMAX(2,KT)                                      0035300
      WRITE (35,960) QQ,RR,TT                                           0035400
510   CALL REDOEM (IND,DESVAL,JCXX)                                     0035500
      IF (IND.NE.QQ.AND.IND.NE.TT.AND.IND.NE.RR) GO TO 510              0035600
      IF (IND.EQ.QQ) GO TO 570                                          0035700
      IF (IND.EQ.TT) GO TO 120                                          0035800
      IF (IND.EQ.RR) GO TO 500                                          0035900
C     COME HERE IF SHAFT                                                0036000
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  520   WRITE (35,640) IALL(JCX)                                                0036100
        IWMEC(1,JCXX)=SHAFX                                                     0036200
        READ (30,1010) IWMEC(2,JCXX)                                            0036300
        WRITE (35,650)                                                          0036400
        READ (30,1040) (IWMEC(NN,JCXX),NN=3,6)                                  0036500
        WRITE (35,660)                                                          0036600
        READ (30,1040) IWMEC(7,JCXX)                                            0036700
        KT=18                                                                   0036800
        DO 530 I=1,17                                                           0036900
  530   DESVAL(I,JCXX)=DEFAUL(I,KT)                                             0037000
  540   WRITE (35,670) AA,DESVAL(1,JCXX),RMIN(1,KT),RMAX(1,KT),BB,DESVAL(2     0037100
       1,JCXX),RMIN(2,KT),RMAX(2,KT),CC,DESVAL(3,JCXX),RMIN(3,KT),RMAX(3,K     0037200
       2T),DD,DESVAL(4,JCXX),RMIN(4,KT),RMAX(4,KT),EE,DESVAL(5,JCXX),RMIN(     0037300
       35,KT),RMAX(5,KT),FF,DESVAL(6,JCXX),RMIN(6,KT),RMAX(6,KT),GG,DESVAL     0037400
       4(7,JCXX),RMIN(7,KT),RMAX(7,KT)                                          0037500
        WRITE (35,960) QQ,RR,TT                                                 0037600
  550   CALL REDOEM (IND,DESVAL,JCXX)                                           0037700
        IF (IND.NE.QQ.AND.IND.NE.TT.AND.IND.NE.RR) GO TO 550                    0037800
        IF (IND.EQ.QQ) GO TO 570                                                0037900
        IF (IND.EQ.TT) GO TO 120                                                0038000
        IF (IND.EQ.RR) GO TO 540                                                0038100
  560   CONTINUE                                                                0038200
        GO TO 120                                                               0038300
  570   DO 580 I=1,60                                                           0038400
        IF (IWMEC(1,I).EQ.0) GO TO 580                                          0038500
        WRITE (6,1180) I,(IWMEC(J,I),J=1,7)                                     0038600
  580   CONTINUE                                                                0038700
        DO 590 I=1,60                                                           0038800
        IF (IWMEC(1,I).EQ.0) GO TO 590                                          0038900
        WRITE (6,1190) I,(DESVAL(J,I),J=1,17)                                   0039000
  590   CONTINUE                                                                0039100
        WRITE (6,1230)                                                          0039200
        STOP                                                                    0039300
C                                                                               0039400
  600   FORMAT ('0MIXER         '/' CODE VALUE  DESCRIPTION',31X,'LOW VALU      0039500
       1E-HIGH VALUE'/1X,A1,F9.4,'  EFF. L/DIAM IF FORCED MIXER ',F20.4,F1      0039600
       20.4/1X,A1,F9.0,'  NUMBER OF PASSAGES OR LOBES',F22.0,F10.0)             0039700
  610   FORMAT (' COMPONENT ',I3,' IS A NOZZLE, ENTER NOZZLE TYPE'/' 1= CO      0039800
       1NVERGENT'/' 2= C-D VARIABLE AREA')                                      0039900
  620   FORMAT ('0ENTER THRUST REVERSER TYPE, 0=NONE, 1=FAN, 2=PRIMARY'/'       0040000
       1 ')                                                                     0040100
  630   FORMAT ('0NOZZLE        '/' CODE VALUE  DESCRIPTION',31X,'LOW VALU      0040200
       1E-HIGH VALUE'/1X,A1,F9.4,'  LENGTH TO DIAMETER RATIO    ',F20.4,F1      0040300
       20.4/1X,A1,F9.4,'  BYPASS RATIO FOR MIXED FLOW',F21.4,F10.4)            0040400
  640   FORMAT (' COMPONENT ',I3,' IS A SHAFT, ENTER SHAFT NUMBER FROM INN      0040500
       1ER TO OUTER, I.E. 1 2 3 ETC.'/' ')                                      0040600
  650   FORMAT ('0ENTER TURBINES CONNECTED TO THIS SHAFT'/' _________ ')        0040700
  660   FORMAT ('0ENTER COMPONENT NUMBER OF FIRST COMPRESSOR ON THIS SHAFT      0040800
       1'/' __ ')                                                               0040900
  670   FORMAT ('0SHAFT         '/' CODE VALUE  DESCRIPTION',31X,'LOW VALU      0041000
       1E-HIGH VALUE'/1X,A1,F9.2,'  SHAFT ALLOWABLE STRESS      ',F20.2,F1      0041100
       20.2/1X,A1,F9.2,'  SHAFT MATERIAL DENSITY      ',F22.2,F10.2/1X,A1,F     0041200
       39.4,'  DIAMETER RATIO (INNER/OUTER)',F21.4,F10.4/4(1X,A1,F9.0,'  C     0041300
       4OMPONENT NUMBER ON SHAFT FOR INERTIA',F12.0,F10.0/))                    0041400
  680   FORMAT (' COMPONENT ',I3,' IS A SPLITTER'/' WEIGHT AND LENGTH ARE       0041500
       1IGNORED UNLESS FIRST COMPONENT IN THE ENGINE (AFTER INLET)'/' IF I      0041600
       2NNER STREAM IS NOT PRIMARY ENTER A "1" OR ELSE JUST HIT RETURN'/'       0041700
       3 ')                                                                     0041800
  690   FORMAT (' ENTER MACH NUMBER IN AND HUB TO TIP RATIO IN'/' _____ _       0041900
       1_____')                                                                 0042000
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700   FORMAT (F6.0,F7.0)                                                    0042100
710   FORMAT (' COMPONENT ',I3,' IS A MIXER, ENTER TYPE'/' F- FORCED MIX    0042200
     1ER (MECHANICAL - DAISY LOBE TYPE)'/' C- COANNULAR EMERGENCE (NOT F    0042300
     2ORCED)')                                                             0042400
720   FORMAT (' ENTER PRIMARY INPUT NODE, 0=INNER, 1=OUTER'/' _')           0042500
730   FORMAT ('0TURBINE       '/' CODE VALUE  DESCRIPTION',31X,'LOW VALU    0042600
     1E-HIGH VALUE'/1X,A1,F9.4,'  FACE INLET MACH NUMBER       ',F20.4,F1    0042700
     20.4/1X,A1,F9.5,'  LOADING PARAMETER       ',F27.5,F10.5/1X,A1,F9.3,'  0042800
     3  BLADE SOLIDITY (CORD/SPACING)             ',F5.3,F11.3/1X,A1,F9.     0042900
     44,'  BLADE ASPECT RATIO- 1ST STAGE    ',F15.4,F11.4/1X,A1,F9.4,31H    0043000
     5  BLADE ASPECT RATIO-LAST STAGE,F19.4,F11.4/1X,A1,F9.4,32H  TURBIN    0043100
     6E EXIT MACH NUMBER       ,F18.4,F11.4/1X,A1,F9.0,31H  DISC REFERENC  0043200
     7E STRESS         ,F19.0,F11.0/1X,A1,F9.0,32H  1=CONST TIP DESN,2=NE   0043300
     8AN,3=HUB ,F18.0,F11.0/1X,A1,F9.4,32H  MAX. SPEED RATIO RPMMAX/RPMD    0043400
     9  ,F18.4,F11.4/1X,A1,F9.4,31H  CONTROL RADIUS- 0 IF TRANSFRD,F19.4    0043500
     $,F11.4/1X,A1,F9.4,32H  BLADE MATERIAL DENSITY 0=I-SET,F18.4,F11.4/    0043600
     $1X,A1,F9.4,32H  BLADE VOLUME FACTOR          ,F18.4,F11.4/1X,A1,F     0043700
     $9.4,32H  BLADE TAPER RATIO                   ,F18.4,F11.4/1X,A1,F9.4,32H 0043800
     $  STATOR BLADE VOLUME FACTOR    ,F18.4,F11.4)                        0043900
740   FORMAT ('0TURBINE       '/' CODE VALUE  DESCRIPTION',31X,'LOW VALU    0044000
     1E-HIGH VALUE'/1X,A1,F9.4,'  FACE INLET MACH NUMBER       ',F20.4,F1    0044100
     20.4/1X,A1,F9.4,'  EXIT MACH NUMBER       ',F26.4,F10.4)               0044200
750   FORMAT (' COMPONENT ',I3,' IS A HEAT EXCHANGER, OPTIONS ARE'/' F-     0044300
     1FIXED  OR'/' R- ROTARY')                                             0044400
760   FORMAT (' FLOW DIRECTION IS'/' P- PARALLEL'/' C- COUNTER FLOW')       0044500
770   FORMAT (' COMPONENT ',I3,'  IS A TURBINE, OPTIONS ARE (ENTER CORRE    0044600
     1CT LETTER)'/' H- HIGH PRESSURE TURBINE'/' L- LOW PRESSURE TURBINE'    0044700
     2)                                                                    0044800
780   FORMAT (' A- NO FRAME'/' B- TURBINE HAS EXIT FRAME')                  0044900
790   FORMAT (' ENTER COMPONENT NUMBER OF COMPRESSOR THAT SETS TURBINE R    0045000
     1PM'/' __')                                                           0045100
800   FORMAT (' ENTER COMPONENT NUMBER THAT LIMITS TURBINE OUTER RADIUS'    0045200
     1/' ___ (+ = OUTLET, - = INLET,0 = FEEDING COMPONENT)')               0045300
810   FORMAT (' ENTER COMPONENT NUMBER THAT LIMITS NOZZLE OUTER RADIUS'/    0045400
     1' ___ (+ = OUTLET, - = INLET,0 = FEEDING COMPONENT)')                0045500
820   FORMAT (I3)                                                           0045600
830   FORMAT (' YOU MAY ENTER THE NUMBER OF STAGES IF DESIRED, OTHERWISE    0045700
     1 ENTER 0'/' __')                                                     0045800
840   FORMAT (' R- RADIAL FLOW TURBINE'/' A- AXIAL FLOW TURBINE')           0045900
850   FORMAT ('0INDICATE WHETHER THERE ARE STATORS OR IF THIS IS A CENTR    0046000
     1IFUGAL COMPRESSOR'/' A- CALCULATE STATOR WEIGHT'/' B- NO STATOR WE    0046100
     2IGHT'/' C- CENTRIFUGAL COMPRESSOR')                                  0046200
860   FORMAT ('0 INDICATE WHETHER THERE IS A FRONT FRAME IN THE COMPRESS    0046300
     1OR'/' A- NO FRAME'/' B- SNGL BEARING FRAME FOR TFS AND TJS WITHOUT    0046400
     2 POWER TAKEOFF (PTO)'/' C- SINGLE BEARING FRAME WITH PTO'/' D- TWO    0046500
     3 BEARING FRAME WHICH EXTENDS OUTWARD TOTHE FAN OUTER CASE AND HOLD    0046600
     4S TWO BEARINGS WITH PTO')                                            0046700
870   FORMAT ('0 INDICATE WHETHER THERE IS A  REAR FRAME IN THE COMPRESS    0046800
     1OR'/' A- NO FRAME'/' B- SNGL BEARING FRAME FOR TFS AND TJS WITHOUT    0046900
     2 POWER TAKEOFF (PTO)'/' C- SINGLE BEARING FRAME WITH PTO'/' D- TWO    0047000
     3 BEARING FRAME WHICH EXTENDS OUTWARD TOTHE FAN OUTER CASE AND HOLD    0047100
     4S TWO BEARINGS WITH PTO')                                            0047200
880   FORMAT ('0SPLIT FLOW COMPRESSOR - ENTER COMPONENT NUMBER OF OTHER     0047300
     1HALF OF COMPRESSOR'/' __')                                           0047400
890   FORMAT (I2)                                                           0047500
900   FORMAT ('0GEAR BOX INDICATOR,0= NO GEAR BOX, N=SHAFT NUMBER FOR GE    0047600
     1AR BOX'/' __')                                                       0047700
910   FORMAT ('0YOU MAY SPECIFY THE NUMBER OF STAGES-OVERRIDES MAX PR/ST    0047800
     1G., OTHERWISE ENTER 0'/' __')                                        0047900
920   FORMAT ('0HEAT EXCHANGER'/' CODE VALUE  DESCRIPTION',31X,'LOW VALU    0048000
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     1E-HIGH VALUE'/1X,A1,F9.0,'  NUMBER OF TUBES IF "FIXED"  ',F20.0,F1 0048100
     20.0/1X,A1,F9.4,'  MACH NUMBER - PRIMARY ',F27.4,F10.4/1X,A1,F9.4,' 0048200
     3  MACH NUMBER IN SECONDARY                ',F5.4,F11.4/1X,A1,F9. 0048300
     44,'  BYPASS RATIO IF "ROTARY"          ',F15.4,F11.4)             0048400
 930  FORMAT ('0FAN/COMPRESSOR'/' CODE VALUE  DESCRIPTION',31X,'LOW VALU 0048500
     1E-HIGH VALUE'/1X,A1,F9.4,'  FACE INLET MACH NUMBER      ',F20.4,F1 0048600
     20.4/1X,A1,F9.5,'  MAX 1ST STAGE PRATIO  ',F27.5,F10.5/1X,A1,F9.3,' 0048700
     3  COMPRESSOR FACE HUB TO TIP RATIO          ',F5.3,F11.3/1X,A1,F9. 0048800
     44,'  BLADE SOLIDITY (CORD/SPACING)    ',F15.4,F11.4/1X,A1,F9.4,31H 0048900
     5  BLADE ASPECT RATIO-1ST STAGE ,F19.4,F11.4/1X,A1,F9.4,32H  BLADE  0049000
     6ASPECT RATIO-LAST STAGE ,F18.4,F11.4/1X,A1,F9.4,31H  COMPRESSOR EX 0049100
     7IT MACH NUMBER  ,F19.4,F11.4/1X,A1,F9.4,32H  MAX. COMP. INLET T- 0 0049200
     8=CALC'D  ,F18.4,F11.4/1X,A1,F9.4,32H  MAX. COMP. EXIT T- 0=CALC'D  0049300
     9  ,F18.4,F11.4/1X,A1,F9.4,31H  MAX. SPEED RATIO RPMMAX/RPMD ,F19.4 0049400
     $,F11.4/1X,A1,F9.4,32H  BLADE MATERIAL DENSITY 0=T-SET,F18.4,F11.4/ 0049500
     $1X,A1,F9.0,32H  1=CONST.HUB,2=MEAN,3=TIP DESN.,F18.0,F11.0/1X,A1,F 0049600
     $9.4,32H  RPM SCALER TO MATCH KNOWN RPM ,F18.4,F11.4/1X,A1,F9.4,32H 0049700
     $  TEMP FOR MATERIAL CHANGE      ,F18.4,F11.4/1X,A1,F9.4,31H  WEIGH 0049800
     $T SCALER 0=AS CALCULATED,F19.4,F11.4/1X,A1,F9.4,32H  STATOR BLADE  0049900
     $TAPER RATIO      ,F18.4,F11.4/1X,A1,F9.4,32H  BLADE VOLUME RATIO   0050000
     $          ,F18.4,F11.4)                                           0050100
 940  FORMAT ('0CENTRIFUGAL * '/' CODE VALUE  DESCRIPTION',31X,'LOW VALU 0050200
     1E-HIGH VALUE'/1X,A1,F9.4,'  FACE INLET MACH NUMBER      ',F22.4,F1 0050300
     21.4/1X,A1,F9.5,'  MAX 1ST STAGE PRATIO  ',F29.5,F10.5/1X,A1,F9.3,' 0050400
     3  COMPRESSOR FACE HUB TO TIP RATIO          ',F6.3,F11.3/1X,A1,F9 0050500
     4.4,'  RPM RATIO -  RPMMAX/RPMD          ',F15.4,F11.4/1X,A1,F9.4,31 0050600
     5H  COMPRESSOR EXIT MACH NUMBER  ,F19.4,F11.4/1X,A1,F9.4,32H  GEAR  0050700
     6 RATIO OF POWER SHAFT    ,F18.4,F11.4/1X,A1,F9.4,31H  HORSEPOWER O 0050800
     7F POWER SHAFT    ,F19.4,F11.4)                                     0050900
 950  FORMAT (' COMPONENT ',I3,'  IS A COMPRESSOR, OPTIONS ARE (ENTER CO 0051000
     1RRECT LETTER)'/' A- TYPICAL FAN'/' B- OUTER PORTION OF NON-ROTATIN 0051100
     2G SPLITTER FAN'/' C- INNER PORTION OF NON-ROTATING SPLITTER FAN'/'  0051200
     3 D- OUTER PORTION OF ROTATING SPLITTER FAN'/' E- INNER PORTION OF  0051300
     4ROTATING SPLITTER FAN'/' F- LOW PRESSURE COMPRESSOR'/' G- HIGH PRE 0051400
     5SSURE COMPRESSOR')                                                0051500
 960  FORMAT (1H0,'ENTER LETTER FOLLOWED BY VALUE (INCLUDING DECIMAL POI 0051600
     1NT) OR ENTER'/1X,A1,11X,'QUIT PROCESSING ENTIRE ENGINE'/1X,A1,11X, 0051700
     2'REVIEW UPDATED VALUES'/1X,A1,11X,'TERMINATE - GO ON TO NEXT COMPO 0051800
     3NENT')                                                            0051900
 970  FORMAT ('0ENTER VALUES FOR IPLT(PRINTER PLOT), PLOT(GRAPHICS PLOT) 0052000
     1, ISII(SI INPUT), ISIO(SI OUTPUT) -- T OR F'/,' _ _ _ _ _')       0052100
 980  FORMAT (4L2)                                                       0052200
 990  FORMAT (' &W IPLT=',L2,',PLOT=',L2,',ISII=',L2,',ISIO=',L2,',')    0052300
1000  FORMAT ('0ENTER VALUES FOR IWT (2=NO AIRFLOW SCALING,4=WITH AIRFLO 0052400
     1W SCALING) AND'/,' IOUTCD (0=WT,L, & MAX R,1=ADD COMPONENT WTS,2=A 0052500
     2DD STAGE BY STAGE OUTPUT'/,' _ _')                                0052600
1010  FORMAT (I1,I2)                                                     0052700
1020  FORMAT (' IWT=',I1,',IOUTCD=',I1,1H,)                              0052800
1030  FORMAT ('0ENTER COMPONENT NUMBERS OF ALL COMPONENTS (EXCLUSIVE OF  0052900
     1INLETS AND WINJS) THAT CONTRIBUTE TO MAX LENGTH OF ENGINE (RT. ADJ 0053000
     2.)'/,' __ __ __ __ __ __ __ __,__ __ __ __ __ __ __ __ __ __ __ __ 0053100
     3 __ __ __ __ __ __ __ __')                                        0053200
1040  FORMAT (I2,29I3)                                                   0053300
1050  FORMAT ('0ENTER COMPONENT NUMBERS OF ALL REMAINING COMPONENTS (EXC 0053400
     1LUSIVE OF INLETS,WINJS,LOADS,CNTLS,OPTVS, & LIMVS)'/,' __ __ __ __ 0053500
     2 __ __ __ __,__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ 0053600
     3 __ __ __ __')                                                    0053700
1060  FORMAT (' ILENG(1)=',30(I2,1H,))                                   0053800
1070  FORMAT ('0YOU WILL NOW BE PROMPTED FOR THE GENERIC (NNEP) TYPE FOR 0053900
     1 EACH COMPONENT (COMP,TURB, ETC.)')                               0054000
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1080  FORMAT ('0COMPONENT',I3,' IS A (A4)'/,' ____')                          0054100
1090  FORMAT (A4)                                                             0054200
1100  FORMAT ('0FOR EACH NNEP COMPONENT YOU WILL BE PROMPTED FOR THE WAT       0054300
     1E SUBCOMPONENT')                                                        0054400
1110  FORMAT (' COMPONENT ',I3,' IS A DUCT, OPTIONS ARE (ENTER CORRECT L      0054500
     1ETTER)'/,' A- PRIMARY BURNER'/,' B- DUCT BURNER'/,' C- AUGMENTOR'/      0054600
     2,' D- DUCT'/,' ENTER LETTER'/,' _')                                     0054700
1120  FORMAT (A1)                                                             0054800
1130  FORMAT (' A- BURNER HAS A FRAME'/,' B- NO FRAME'/,'_')                  0054900
1140  FORMAT (' TYPE OF DUCT'/,' A- DUMMY - NO WT OR LENGTH'/,' B- INPUT      0055000
     1 LENGTH ( WILL SPECIFY L/D OF DUCT )'/,' C- LENGTH FROM CONNECTION      0055100
     2 BETWEEN SPLITTER AND MIXER'/' D- CROSSOVER DUCT FOR',' CENTRIFUGA      0055200
     3L COMPRESSORS'/' E- DIFFUSER FOR CENTRIFUGAL COMPRESSORS'/,' ')        0055300
1150  FORMAT ('0PRIMARY BURNER'/' CODE VALUE  DESCRIPTION',32X,'LOW VALU      0055400
     1E-HIGH VALUE'/1X,A1,F9.2,'  BURNER THRU-FLOW',' VELOCITY',F25.2,F1      0055500
     20.2/1X,A1,F9.5,'  AIRFLOW RESIDENCY TIME',F29.5,F10.5/1X,A1,F9.3,'      0055600
     3  MEAN DIAMETER - IF 0 MATCH'' UPSTREAM CMPT.',F6.0,F11.0/1X,A1,F9      0055700
     4.0,'  CMPT NUMBER FOR MATCHING DIAMETER',F15.0,F11.0/1X,A1,F9.0,'       0055800
     5 NUMBER OF CANS FOR CAN BURNER',F19.0,F11.0)                            0055900
1160  FORMAT ('0DUCT BURNER'/' CODE VALUE  DESCRIPTION',35X,'LOW VALUE-H      0056000
     1IGH VALUE'/1X,A1,F9.2,'  BURNER THRU-FLOW',' VELOCITY',F25.2,F10.2      0056100
     2/1X,A1,F9.5,'  AIRFLOW RESIDENCY TIME',F29.5,F10.5/1X,A1,F9.3,'  M      0056200
     3EAN DIAMETER - IF 0 MATCH'' UPSTREAM CMPT.',F6.0,F11.0/1X,A1,F9.0,      0056300
     4'  CMPT NUMBER FOR MATCHING DIAMETER',F15.0,F11.0/1X,A1,F9.0,'  NU      0056400
     5MBER OF CANS FOR CAN BURNER',F19.0,F11.0)                               0056500
1170  FORMAT ('0AUGMENTOR'/' CODE VALUE  DESCRIPTION',37X,'LOW VALUE-HIG      0056600
     1H VALUE'/1X,A1,F9.2,'  BURNER THRU-FLOW',' VELOCITY',F25.2,F10.2/1      0056700
     2X,A1,F9.5,'  AIRFLOW RESIDENCY TIME',F29.5,F10.5/1X,A1,F9.3,'  MEA      0056800
     3N DIAMETER - IF 0 MATCH'' UPSTREAM CMPT.',F6.0,F11.0/1X,A1,F9.0,',      0056900
     4 CMPT NUMBER FOR MATCHING DIAMETER',F15.0,F11.0/1X,A1,F9.0,'  NUMB      0057000
     5ER OF CANS FOR CAN BURNER',F19.0,F11.0)                                 0057100
1180  FORMAT (1X,'IWMEC(1,',I2,')=4H',A4,',',6(I3,1H,))                       0057200
1190  FORMAT (1X,'DESVAL(1,',I2,')=',7(G10.4,1H,)/2X,10(G10.4,1H,))           0057300
1200  FORMAT ('0DUCT      '/' CODE VALUE  DESCRIPTION',37X,'LOW VALUE-HIG      0057400
     1H VALUE'/1X,A1,F9.2,' DUCT MACH NUMBER              ',F25.2,F10.2/1      0057500
     2X,A1,F9.5,' LEN/HT IF MODE B       ',F33.5,F10.5/1X,A1,F9.3,' DUCT      0057600
     3 MEAN DIAM. IF =0 CALC. PER NODE BELOW ',F9.0,F11.0/1X,A1,F9.0,' I      0057700
     4F NODE.0=MEAN D SPECIFIED,-1=CONN. COMP.',F11.0,F11.0)                  0057800
1210  FORMAT ('0DO YOU WANT BOEING OR GARRETT METHOD FOR DISK WEIGHT CAL       0057900
     1CULATIONS?'/' ENTER B FOR BOEING OR G FOR GARRETT'/' _')                0058000
1220  FORMAT ('  DISKWI=',F2.0,',ACCS=0.1,ISCALE(1)=2,3,SCALE(1)=1.,.8,1      0058100
     1.2,ACCARM=0,')                                                          0058200
1230  FORMAT ('  &END')                                                       0058300
      END                                                                     0058400
      SUBROUTINE REDOEM(IX,DESVAL,JCXX)                                       0058500
      IMPLICIT REAL*8 (A-H,O-Z)                                               0058600
      DIMENSION DESVAL(17,60)                                                 0058700
      INTEGER AA,BB,CC,DD,EE,FF,GG,HH,OO,PP,QQ,RR,SS,TT,PBURX,DBURX,AUGX      0058800
     1,DUCTX                                                                  0058900
      DATA AA,BB,CC,DD,EE,FF,GG,HH,II,JJ,KK,LL,MM,NN,OO,PP,QQ,RR,SS,TT/1     0059000
     1HA,1HB,1HC,1HD,1HE,1HF,1HG,1HH,1HI,1HJ,1HK,1HL,1HM,1HN,1HO,1HP,1HQ     0059100
     2,1HR,1HS,1HT/                                                           0059200
      READ (30,10) IX,VALUE                                                   0059300
10    FORMAT (A1,F20.0)                                                       0059400
      IF (IX.EQ.AA) DESVAL( 1,JCXX)=VALUE                                     0059500
      IF (IX.EQ.BB) DESVAL( 2,JCXX)=VALUE                                     0059600
      IF (IX.EQ.CC) DESVAL( 3,JCXX)=VALUE                                     0059700
      IF (IX.EQ.DD) DESVAL( 4,JCXX)=VALUE                                     0059800
      IF (IX.EQ.EE) DESVAL( 5,JCXX)=VALUE                                     0059900
      IF (IX.EQ.FF) DESVAL( 6,JCXX)=VALUE                                     0060000
```

```
IF (IX.EQ.GG) DESVAL( 7,JCXX)=VALUE                                    0060100
IF (IX.EQ.HH) DESVAL( 8,JCXX)=VALUE                                    0060200
IF (IX.EQ.II) DESVAL( 9,JCXX)=VALUE                                    0060300
IF (IX.EQ.JJ) DESVAL(10,JCXX)=VALUE                                    0060400
IF (IX.EQ.KK) DESVAL(11,JCXX)=VALUE                                    0060500
IF (IX.EQ.LL) DESVAL(12,JCXX)=VALUE                                    0060600
IF (IX.EQ.MM) DESVAL(13,JCXX)=VALUE                                    0060700
IF (IX.EQ.NN) DESVAL(14,JCXX)=VALUE                                    0060800
IF (IX.EQ.OO) DESVAL(15,JCXX)=VALUE                                    0060900
IF (IX.EQ.PP) DESVAL(16,JCXX)=VALUE                                    0061000
IF (IX.EQ.SS) DESVAL(17,JCXX)=VALUE                                    0061100
RETURN                                                                 0061200
END                                                                    0061300
```

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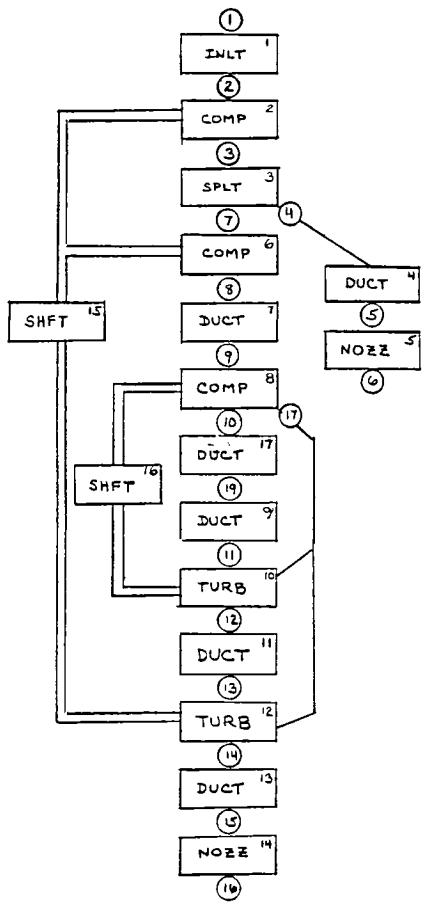

Figure 1. - Thermodynamic schematic for NNEP.

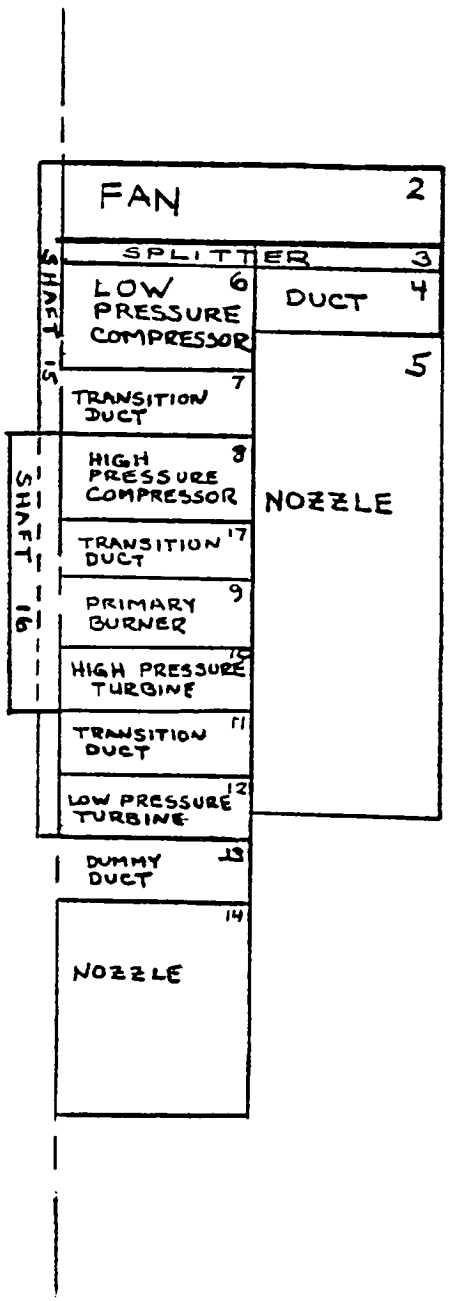

Figure 2. - "Actual" mechanical schematic for WATE by subcomponent type.

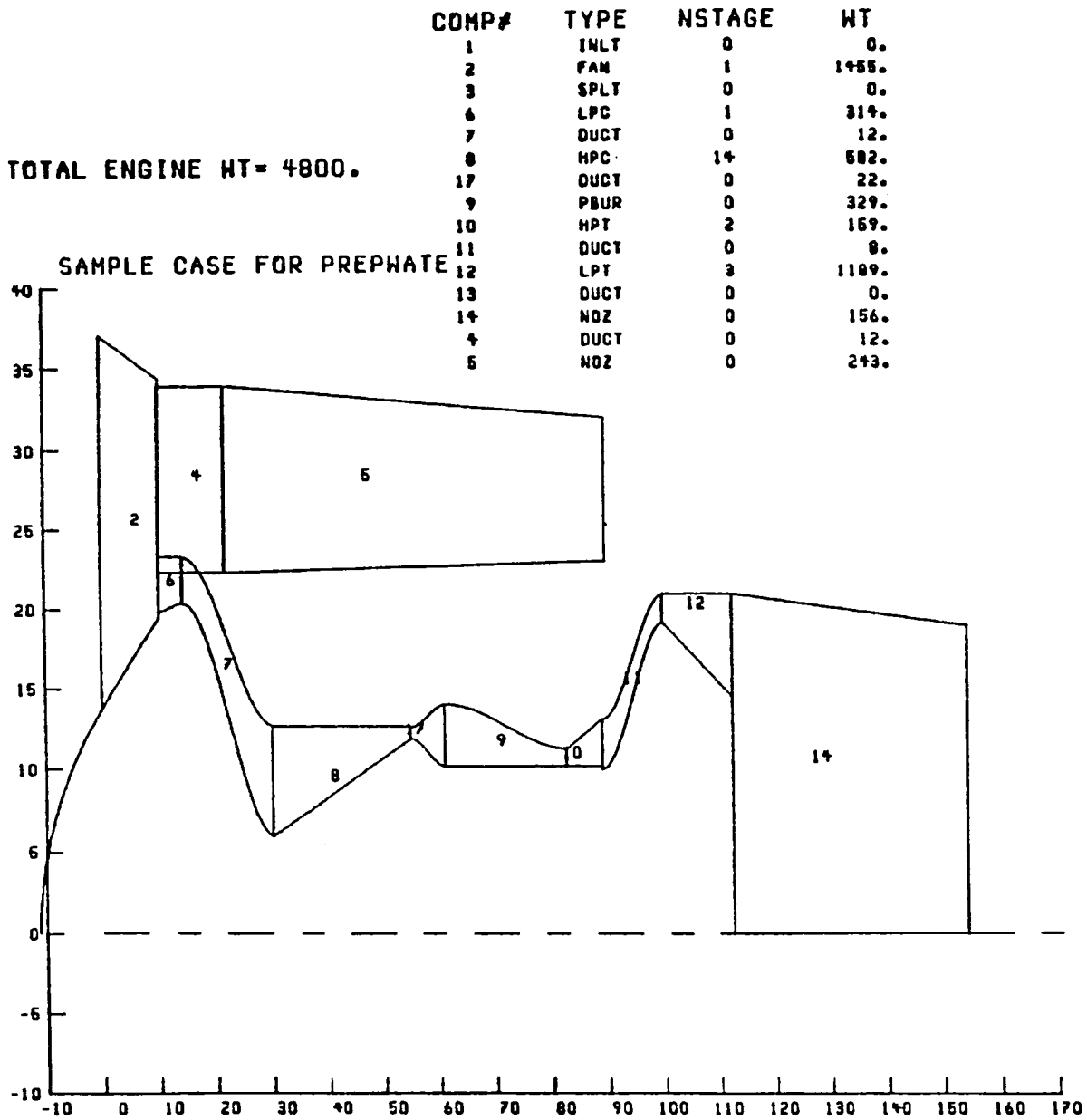

Figure 3. - Graphics plot of engine flowpath.

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15. Supplementary Notes

16. Abstract

The Weight Analysis of Turbine Engines (WATE) computer code was developed by Boeing under contract to NASA Lewis (ref. 1). It was designed to function as an adjunct to the Navy/NASA Engine Program (NNEP) (ref. 2). NNEP calculates the design and off-design thrust and sfc performance of User defined engine cycles. The thermodynamic parameters throughout the engine as generated by NNEP are then combined with input parameters defining the component characteristics in WATE to calculate the bare engine weight of this User defined engine. Preprocessor programs for NNEP were previously developed (ref. 3) to simplify the task of creating input datasets. This report describes a similar preprocessor for the WATE code.

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