Combined Cycle Performance Analysis

Presented by:

George Slanina

Houston Lighting & Power Company

Model by:

G. L. Slanina
A. Lau
Houston Lighting & Power Company

COMBINED CYCLE PERFORMANCE ANALYSIS

ABSTRACT

Previous Gas Turbine (GT) analysis was basically limited to unit output and heat rate for the following reasons:

- o GT component analysis requires accurate temperature and pressure measurements
- o Additional temperature, pressure and flow measurements are required
- o HRSG flows, pressures and temperatures must be accurately determined
- o Flue gas bypassing must be determined

As a result of the above a performance model was built in PEPSE. This performance model includes four GTs, four bypass stacks, four HRSGs, one steam turbine generator, one condenser, one condensate pump, one boiler feed pump and one gland steam condenser. Each GT exhausts into an HRSG which is modeled in the performance mode as a convective boiler section. The amount of flue gas escaping thru the stack by-pass is modeled by controlling the bypass flow of flue gas to obtain the stack temperature. The steam turbine is modeled as a general turbine with one extraction. Since HL&P's Maximum Capability Testing is performed at Valves Wide Open (VWO) on the steam turbine, the bleeds and leakoffs are modeled as fixed flows. There are assumptions and controls built into the model to simulate interstage cooling air by-passing the compressor section. Estimates are made since these are internal flow paths and are not easily measured. A fixed percentage is used for this cooling flow, the reason for this is because in actuality multiple air extractions exist and the amount from each is not measured or readily measurable. This cooling air is then mixed with the expander first stage aft section. This requires modeling the expander as two sections with a cooling air mixer. This has to be done to compensate somewhat for PEPSEs' lack of interstage modeling capabilities. In reality the admission of cooling air is complicated somewhat since the air is injected in the first stage buckets, first stage forward and aft wheelspace, second stage wheelspaces and third stage wheelspaces.

The HL&P Maximum Capability Test is designed to establish the maximum generation of the unit, document any equipment limitations, and define current equipment performance or efficiency. General plant process instruments are used for pressures, temperatures and flows in general. Where more accurate instrumentation is required the Central Results Performance Analysis Group will supply and install necessary test grade instrumentation. For these Combined Cycle tests, ambient temperature is monitored, GT by-pass temperature, HRSG flue gas temperature and fuel gas components, fuel flow (P,T,Diff.) and fuel analysis, along with standard PEPSE inputs for the HRSG, Steam

Turbine, Condenser and Pumps.

INTRODUCTION

The purpose of this paper is to demonstrate some of the capabilities of PEPSE in performing Combined Cycle Unit Performance Analysis. Thru the use of Controls, Schedules, Operations, and Operational Variables a method of evaluation for the Combined Cycle and adjustment to standard conditions is possible.

The T. H. Wharton Units 3 and 4 are each a Combined Cycle (CC) unit comprised of four (4) General Electric(GE) Frame 7, Model MS7000 Gas Turbines (GTs), four (4) Heat Recovery Steam Generators (HRSGs) and one Steam Turbine Generator also furnished by GE. The units were originally placed in service on August 16, 1974. Each gas turbine has a base rating of 50.25 MW without inlet air filter and a design heat rate of 12,900 BTu(HHV)/KWHr. The combined cycle unit has a base rating of 279.9 MW Net for the unit output without inlet air filters and a heat rate of 8710 BTu(HHV)/KWHr. The turbine generator is rated at 133,000 KVA, three phase, 60 cycle, 0.85 PF, 13,800 VOLTS, 0.58 SCR at 30 psig H_2, and designed for 95°F cooling water. The combined cycle performance is based on 3.5 inHg absolute back pressure at the steam turbine exhaust, ambient temperature of 100°F, atmospheric pressure of 14.64 psia and an elevation of 122 feet above sea level with gas turbine exhaust silencers installed.

Each GT exhaust is directed to a dedicated HRSG. The steam generated form the HRSG then feeds the GE 100MW steam turbine with the rated inlet conditions of 800psig and 850°F. The steam turbine is and outdoor rated, tandem-compound, double flow, non-reheat, non-regenerative cycle machine with 23" last stage blades. There is a gland steam condenser with no other provisions for feedwater heating. For the above conditions, the maximum expected steam flow to the turbine is 990,000 lb/hr.

Over the years the GE Frame 7 GTs have undergone several modifications such a installation of inlet guide vanes, inlet air bag house filters. Most of the modifications have increased pressure drops and cost the unit in heat rates. However, being completed in 1995 are GT prime upgrades designed to upgrade output by some 4.4% and 9.9% and reduce the GT heatrate by some 2% and 3.2% at 40°F and 100°F respectively. The test data analysis this paper covers was performed in June of 1992 on the T. H. Wharton Unit 4.

BODY OF PAPER

A Maximum Capability test was performed on T. H. Wharton Combine Cycle Unit 4 on

June 25, 1992. This test was designed to evaluate the maximum generation achievable with four (4) gas turbines, four (4) heat recovery steam generators and the steam turbine in service. The test is to also identify actual and potential equipment limitations and problems related to capacity or heat rate.

Previous Combined Cycle Analyses methods required component analysis with accurate temperatures, pressures and flows that required considerable instrumentation and was done during design verification and initial testing or under research projects with EPRI. The HRSG feed water flow, pressure and temperature had to be accurately measured and with some flue gas by-passing thru the bypass dampers it was difficult to analyze the system.

As for methods used in Combined Cycle Analysis, The American Society of Mechanical Engineers (ASME) performance test codes cover the unit output and heat rate issues but do not address individual GT section and other Combined Cycle component analysis. There are some GT and Combine Cycle analysis software applications offered by various software companies, GT experts, and the Electric Power Research Institute (EPRI). At this period the Performance Analysis Division had not evaluated these applications although HL&P's Maintenance Division had procured EPRIs Gas Turbine Evaluation (GATE) and Efficiency Map (EMAP) software applications. These applications, upon preliminary review, required detail GT and combined cycle design parameters. Some customizing and training would be required before one could expect to fully realize some of their value and capability. As an alternative a performance model built with PEPSE, the general purpose thermodynamic application, was investigated since several Performance Analysis personnel were familiar with the software.

To aid in this analysis a PEPSE model was made and verified. The test inputs were identified to be obtained on the unit. Plant instrumentation was used along with Performance Analysis instruments on low pressure and critical areas or where plant instruments are not installed. Performance Analysis also supplied a flue gas analysis trailer to collect flue gas component and temperatures in the HRSG stacks. Manual data was taken for all data except the fuel gas data that came from the Bailey terminal.

The PEPSE model uses several controls to perform function in the thermodynamic balance for each gas turbine in the model:

- The gas turbine efficiency is controlled to obtain the test MW load.
- The compressor efficiency is controlled to obtain the compressor outlet test temperature.
- The stack bypass is controlled to obtain the test measured stack outlet temperature.

The steam turbine is modeled as a general turbine PEPSE Type 08 with and expansion line swing to match the test measured exhaust pressure and gross generation.

Gas Turbine thermal kit correction curves are incorporated as Schedules for correction to the ISO (59°F) conditions from the test measured conditions:

- The gas turbine heat rate vs. inlet temperature.
- The gas turbine MW output vs. inlet temperature.
- The gas turbine air flow vs. inlet temperature.
- The gas turbine exhaust temperature vs. inlet temperature.

The above corrections are made utilizing Operational Variables and Operations. Additionally a correction for altitude is implemented.

The Replacement Features and the Special Input /Output capabilities of PEPSE are utilized to enter data and obtain outputs for each GT,HRSG, and the Steam Turbine, Condenser, Pumps and other model equipment. The corrected outputs are then printed for easy identification with the proper labels to make the report writing easier and less time consuming.

The stack leakage is greatly influenced by the stack temperature, feedwater and steam temperature, and indicated steam flow in addition to the calculated flue gas flow.

The PEPSE model of the Combined Cycle T. H. Wharton Unit 4 is shown in Figure 1. The body of this paper incorporates the PEPSE model as developed for Combined Cycle Performance Analysis.

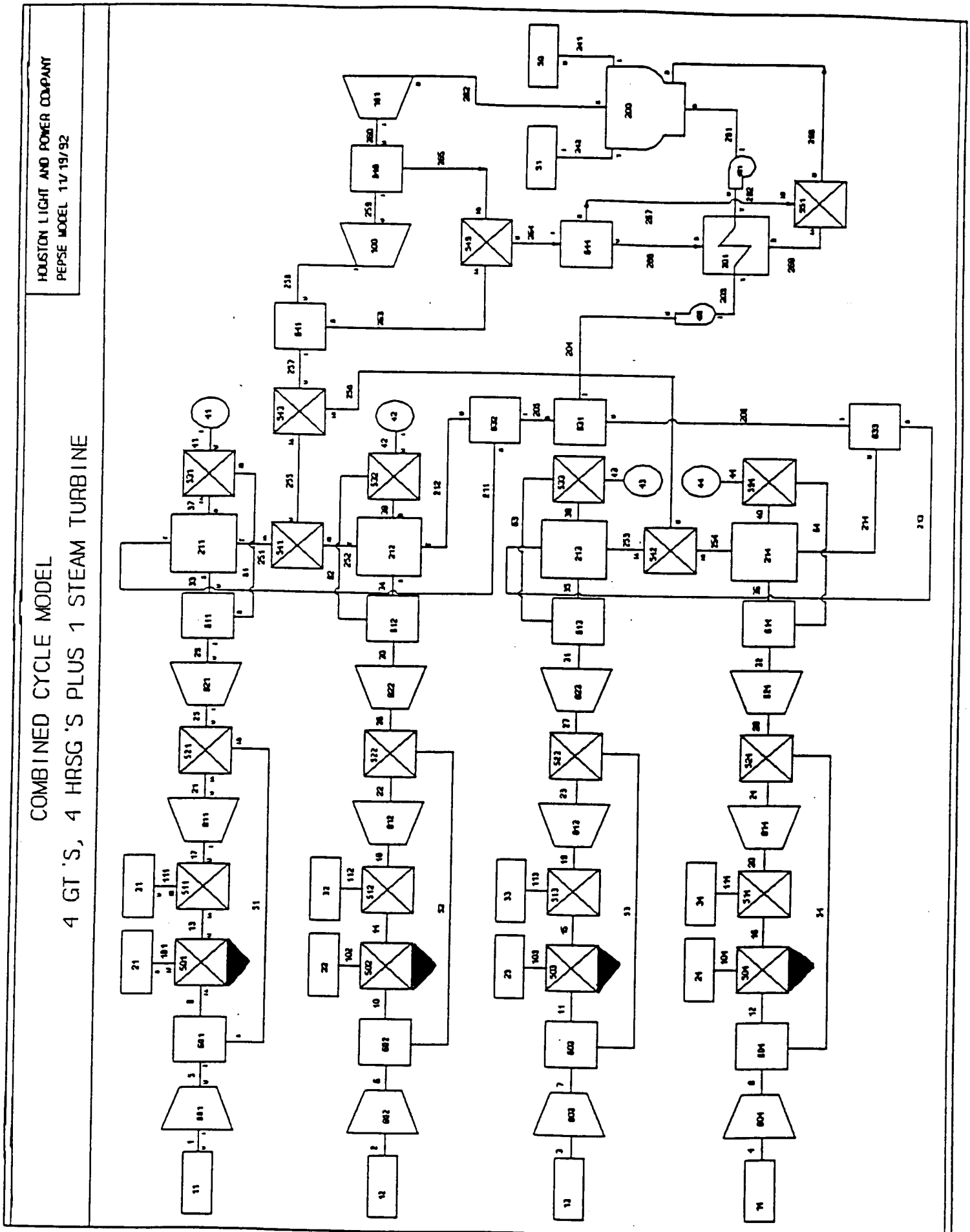


Figure 1. PEPSE™ Configuration.

```
     LISTIN   F INPUT DATA FOR CASE  1

**************************************************
**       GE STAG          COMBINED CYCLE MODEL       **
**                              8/27/92              **
**************************************************************
**       This is a base model of four gas turbines, four      **
*               heat recovery boilers (HRSG), one steam        *
*               non-reheat turbine and one condenser.          *
**************************************************************
*       CYCLE FLAG
010200  2       0       5       1       0
*       MAX ITERATIONS
012000  35
*       SUPPRESSION TABLE
*       GEOMETRY
020001  NOPR
020002  NOPR
020004  NOPR
020013  NOPR
020015  NOPR
020019  NOPR
020034  NOPR
*       SECOND LAW
020021  NOPR
020022  NOPR
020023  NOPR
020024
020039
************************        GEOMETRY        *****
*       FIRST GT UNIT           ONE             *****
500010  11      U       801     I
500050  801     U       601     I
500090  601     U       501     IA
500130  501     U       511     IA
500170  511     U       811     I
500210  811     U       521     IA
500250  521     U       821     I
500290  821     U       611     I
500330  611     U       211     S
500370  211     D       531     IA
500410  531     U       41      I
501010  21      U       501     IF
501110  31      U       511     IB
500510  601     B       521     IB
500610  611     B       531     IB
**      SECOND GT UNIT          TWO             *****
500020  12      U       802     I
500060  802     U       602     I
500100  602     U       502     IA
500140  502     U       512     IA
500180  512     U       812     I
500220  812     U       522     IA
500260  522     U       822     I
500300  822     U       612     I
500340  612     U       212     S
500380  212     D       532     IA
500420  532     U       42      I
501020  22      U       502     IF
501120  32      U       512     IB
500520  602     B       522     IB
500620  612     B       532     IB
**      THIRD GT UNIT           THREE           *****
500030  13      U       803     I
500070  803     U       603     I
```

```
500110  60?      U        503      IA
500150  503      U        513      IA
500190  513      U        813      I
500230  813      U        523      IA
500270  523      U        823      I
500310  823      U        613      I
500350  613      U        213      S
500390  213      D        533      IA
500430  533      U        43       I
501030  23       U        503      IF
501130  33       U        513      IB
500530  603      B        523      IB
500630  613      B        533      IB
**      FOURTH GT UNIT             FOUR          *****
500040  14       U        804      I
500080  804      U        604      I
500120  604      U        504      IA
500160  504      U        514      IA
500200  514      U        814      I
500240  814      U        524      IA
500280  524      U        824      I
500320  824      U        614      I
500360  614      U        214      S
500400  214      D        534      IA
500440  534      U        44       I
501040  24       U        504      IF
501140  34       U        514      IB
500540  604      B        524      IB
500640  614      B        534      IB
*       FEEDWATER
502010  200      D        401      I
502020  401      U        201      T
502030  201      T        402      I
502040  402      U        631      I
502050  631      B        632      I
502060  631      U        633      I
502110  632      U        211      T
502120  632      B        212      T
502130  633      B        213      T
502140  633      U        214      T
*       STEAM FROM HRSG
502150  211      T        541      IA
502520  212      T        541      IB
502550  541      U        543      IA
502530  213      T        542      IA
502540  214      T        542      IB
502560  542      U        543      IB
502570  543      U        641      I
*
502580  641      U        100      I
502590  100      U        649      I
502600  649      U        101      I
502620  101      U        200      S
*       EXTRACTION
502630  641      B        549      IA
502640  549      U        644      I
502650  649      B        549      IB
502660  644      U        201      S
502670  644      B        551      IB
502680  201      D        551      IA
502690  551      U        200      D
*       CW
502410  50       U        200      T
502420  200      T        51       I
*
```

```
***      OTF    CONCERNS/ASSUMPTIONS       ***
*
*        ASSIGNED COMBUSTION PRESSURE DROP (REF: EPRI)
600170   2    0.035
600180   2    0.035
600190   2    0.035
600200   2    0.035
*        GENERATOR HOOKUP
011010   1   1   1   0   3600   70000.   .90   70.   70.
011020   2   1   1   0   3600   70000.   .90   70.   70.
011030   3   1   1   0   3600   70000.   .90   70.   70.
011040   4   1   1   0   3600   70000.   .90   70.   70.
011050   5   2   1   0   3600   133000.   .85   30.   30.
*<<<<<<<    BASE DATA IS FROM THW 3 COMBINED CYCLE TEST DONE ON 5/21/92    >>>>>>>
*        COMPONENTS:
*                ENTER    Test Barometric pressure in psia
870920                    14.80365
*          FIRST GT UNIT ------- ONE -------
*             T amb   P amb. (at inlet plenum)     AIR FLOW GUESS
700110   31    82.9             14.709                    1900000.
700112   0        1
*              REL HUM
700113   AIR    0.63
*   TRY ENVELOP 1
*600010 6        1        1        82.9     14.709   1900000.
*600013 AIR      0.63
*   COMPRESSOR     OUTLET P.         EFF. GUESS
708010   44    1     130.66     1.0      .89
*   COMPRESSOR AIR TO GT INTERSTAGE COOLING @ 2%
706010   63    0.0    0.019999
*   COMBUSTOR              EXCESS AIR?
705010   70    0    2    0      0.0
*   NOX SPRAY MIXER
705110   50
*   FIRST SECTION EXPANDER WITH ASSUMED EFFICIENCY & EXH. P.
708110   09    1    0    1    1
*        ASSUMED EFF.     ASSUMED P.
708111   0.850001         87.0001
*   INTERSTAGE COOLING MIXER
705210   50
*   MAIN SECTION EXPANDER WITH EFF. GUESS & MEAS. EXH. P.
708210   09    1    3    1    1
*        EFF. GUESS       MEASURED EXH. P.
708211   0.85             15.277
*   EXHAUST BYPASS DAMPER    LEAKAGE GUESS
706110   63    0.0              0.10
*   CONVECTIVE STAGE -- HRSG
*                STM FLOW    FW P. FW IN T. STM T.
702110   28    2    230000.    832.7    121.    860.    0.0    0.0    0.0    0.0
*             STM OUT P.       STACK P.
702113   0.0    754.7    0.0    14.7
*   MIXER TO ATMO.
705310   50
*   FUEL SOURCE   T-FUEL   P-FUEL   MASS FLOW
700210   31         65.0     14.7     31874.8
700212   0        1
*   FUEL SPEC.    HHV
700213   FUEL     22621.   SSVL  0.0  C  .7268  H2  .2375  O2 .0305 N2 .00513
*   NOX SPRAY SOURCE    T       P     MASS FLOW
700310   31             79.    250.      7506.
700312   0        1
*   ATMOSPHERE
700410   30
*
*** ADD CONTROLS --      FIRST GT          +  +  +  +  +
```

```
* CONTROL :    T AIR FLOW TO COMPRESSOR TO ACHIEVE GOAL TURBINE OUTLET   MP
*                          TURB EXH. T.
840100  WWVSC   11         981.57   0.0    1.0    TT    -29
*  CONTROL TURBINE EFF. TO PRODUCE DESIRED LOAD - MW
840200  EFFTRE   821                                  50.699    0.0    1.0    BKGRO   1
*  CONTROL COMP. EFF. TO OBTAIN            COMP. OUT TEMP.
840300  EFFPMP   801                       593.33    0.0001   1.0    TT    -5
*  CONTROL BYPASS LEAK TO OBTAIN           STACK TEMP
840400  FRSPL   611                        360.    0.0    1.0    TT    -37
********          FINISHED DATA ENTRY FOR GT ONE  ************
*        COMPONENTS:
*          SECOND GT UNIT ------- TWO -------
*             T amb  P amb (at inlet plenum)    AIR FLOW GUESS
700120  31    82.9           14.718                  1900000.
700122  0        1
*              REL HUM
700123  AIR    0.63
*  COMPRESSOR     OUTLET P.         EFF. GUESS
708020  44    2     129.72     1.0      .89
*  COMPRESSOR AIR TO GT INTERSTAGE COOLING @ 2%
706020  63    0.0    0.019999
*  COMBUSTOR              EXCESS AIR?
705020  70    0    2    0      0.0
*  NOX SPRAY MIXER
705120  50
*  FIRST SECTION EXPANDER WITH ASSUMED EFFICIENCY & EXH. P.
708120  09    2    0    1    1
*        ASSUMED EFF.     ASSUMED EXH. P.
708121  0.850001          87.0001
*  INTERSTATE COOLING MIXER
705220  50
*  MAIN SECTION EXPANDER WITH EFF. GUESS & MEAS. EXH. P.
708220  09    2    3    1    1
*        EFF. GUESS       MEASURED EXH. P.
708221  0.85             15.31116
*  EXHAUST BYPASS DAMPER    LEAKAGE GUESS
706120  63    0.0                0.10
*  CONVECTIVE STAGE -- HRSG
*                STM FLOW    FW P. FW IN T. STM OUT T.
702120  28    2    230000.    814.7    108.    840.    0.0    0.0    0.0    0.0
*             STM OUT P.        STACK P.
702123  0.0    774.7    0.0    14.7
*  MIXER TO ATMO.
705320  50
*  FUEL SOURCE   T-FUEL   P-FUEL   MASS FLOW
700220  31         65.0     14.7     32630.20
700222  0        1
*  FUEL SPEC.    HHV
700223  FUEL     22621.  SSVL  0.0  C  .7268  H2  .2375  O2 .0305 N2 .00513
*  NOX SPRAY SOURCE    T       P     MASS FLOW
700320  31             79.    250.    11008.8
700322  0        1
*  ATMOSPHERE
700420  30
*
*** ADD CONTROLS ---     SECOND GT        +  +  +  +  +
* CONTROL INLET AIR FLOW TO COMPRESSOR TO ACHIEVE GOAL TURBINE OUTLET TEMP
*                          TURB EXH. T.
840500  WWVSC  12         978.417   0.0    1.0    TT    -30
*  CONTROL TURBINE EFF. TO PRODUCE DESIRED LOAD - MW
840600  EFFTRE   822                                  52.2449   0.0    1.0    BKGRO   2
*  CONTROL COMP. EFF. TO OBTAIN            COMP. OUT TEMP.
840700  EFFPMP   802                       602.5    0.0001   1.0    TT    -6
*  CONTROL BYPASS LEAK TO OBTAIN           STACK TEMP
840800  FRSPL   612                        360.    0.0    1.0    TT    -38
```

```
*****            FINISHED DATA ENTRY FOR GT TWO  ************
*        COM.  .ENT
*          THIRD GT UNIT -------- THREE --------
*              T amb  P amb (at inlet plenum)   AIR FLOW GUESS
700130  31    82.9          14.666                  1900000.
700132  0        1
*               REL HUM
700133  AIR    0.63
*  COMPRESSOR     OUTLET P.        EFF. GUESS
708030  44    3     127.804     1.0     .89
*  COMPRESSOR AIR TO GT INTERSTAGE COOLING @ 2%
706030  63    0.0    0.019999
*  COMBUSTOR              EXCESS AIR?
705030  70    0    2    0      0.0
*  NOX SPRAY MIXER
705130  50
*  FIRST SECTION EXPANDER WITH ASSUMED EFFICIENCY & EXH. P.
708130  09    3    0    1    1
*        ASSUMED EFF.     ASSUMED EXH. P.
708131  0.850001          87.0001
*  INTERSTATE COOLING MIXER
705230  50
*  MAIN SECTION EXPANDER WITH EFF. GUESS & MEAS. EXH. P.
708230  09    3    3    1    1
*        EFF. GUESS       MEASURED EXH. P.
708231  0.85             15.345
*  EXHAUST BYPASS DAMPER    LEAKAGE GUESS
706130  63    0.0              0.10
*  CONVECTIVE STAGE -- HRSG
*                STM FLOW    FW P. FW IN T. STM OUT T.
702130  28    2    230000.    814.7   120.    890.    0.0    0.0    0.0    0.0
*             STM OUT P.       STACK P.
702133  0.0    774.7    0.0    14.7
*  MIXER TO ATMO.
705330  50
*  FUEL SOURCE  T-FUEL  P-FUEL  MASS FLOW
700230  31        65.0     14.7     31593.2
700232  0        1
*  FUEL SPEC.    HHV
700233  FUEL     22621.  SSVL  0.0  C  .7268  H2  .2375  O2 .0305 N2 .00513
*  NOX SPRAY SOURCE    T       P     MASS FLOW
700330  31            79.    250.    12009.6
700332  0        1
*  ATMOSPHERE
700430  30
*
*** ADD CONTROLS  --  THIRD GT  +  +  +  +  +
* CONTROL INLET AIR FLOW TO COMPRESSOR TO ACHIEVE GOAL TURBINE OUTLET TEMP
*  TURB EXH.
840900  WWVSC    13    977.5    0.0    1.0    TT    -31
*  CONTROL TURBINE EFF. TO PRODUCE DESIRED LOAD - MW
841000  EFFTRE    823                                  50.9234    0.0    1.0    BKGRO    3
*  CONTROL COMP. EFF. TO OBTAIN          COMP. OUT TEMP.
841100  EFFPMP    803                   602.    0.0001    1.0    TT    -7
*  CONTROL BYPASS LEAK TO OBTAIN         STACK TEMP
841200  FRSPL    613                    370.    0.0    1.0    TT    -39
*********        FINISHED DATA ENTRY FOR GT THREE       ******
*        COMPONENT
*          FOURTH GT UNIT -------- FOUR --------
*              T amb  P amb (at inlet plenum)   AIR FLOW GUESS
700140  31    82.9          14.666                  1900000.
700142  0        1
*               REL HUM
700143  AIR    0.63
*  COMPRESSOR     OUTLET P.        EFF. GUESS
```

```
708040  44          129.954     1.0     .89
*  COMPRESS    AIR TO GT INTERSTAGE COOLING @ 2%
706040  63    0.0    0.019999
*  COMBUSTOR                EXCESS AIR?
705040  70    0    2    0       0.0
*  NOX SPRAY MIXER
705140  50
*  FIRST SECTION EXPANDER WITH ASSUMED EFFICIENCY & EXH. P.
708140  09    4    0    1    1
*         ASSUMED EFF.      ASSUMED EXH. P.
708141  0.850001          87.0001
*  INTERSTATE COOLING MIXER
705240  50
*  MAIN SECTION EXPANDER WITH EFF. GUESS & MEAS. EXH. P.
708240  09    4    3    1    1
*         EFF. GUESS        MEASURED EXH. P.
708241  0.85              15.331
*  EXHAUST BYPASS DAMPER    LEAKAGE GUESS
706140  63    0.0                 0.10
*  CONVECTIVE STAGE -- HRSG
*                STM FLOW    FW P. FW IN T. STM OUT T.
702140  28    2    230000.    794.7    122.    890.    0.0    0.0    0.0    0.0
*             STM OUT P.        STACK P.
702143  0.0    754.7    0.0    14.7
*  MIXER TO ATMO
705340  50
*  FUEL SOURCE  T-FUEL   P-FUEL   MASS FLOW
700240  31         65.0     14.7     31964.5
700242  0         1
*  FUEL SPEC.    HHV
700243  FUEL     22621.   SSVL  0.0  C  .7268  H2  .2375  O2 .0305 N2 .00513
*  NOX SPRAY SOURCE    T       P      MASS FLOW
700340  31             79.    250.    10008.0
700342  0         1
*  ATMOSPHERE
700440  30
*
*** ADD CONTROLS --- FOURTH GT  +  +  +  +  +
* CONTROL INLET AIR FLOW TO COMPRESSOR TO ACHIEVE GOAL TURBINE OUTLET TEMP
*  TURB EXH.
841300  WWVSC    14    971.62    0.0    1.0    TT    -32
*  CONTROL TURBINE EFF. TO PRODUCE DESIRED LOAD - MW
841400  EFFTRE    824                                    52.2317    0.0    1.0    BKGRO    4
*  CONTROL COMP. EFF. TO OBTAIN          COMP. OUT TEMP.
841500  EFFPMP    804                     600.5    0.0001    1.0    TT    -8
*  CONTROL BYPASS LEAK TO OBTAIN         STACK TEMP
841600  FRSPL    614                      360.    0.0    1.0    TT    -40
*******          FINISHED DATA ENTRY FOR GT FOUR    ********
*****************************************************************
*         COMPONENT                                              *
*           STEAM CYCLE              STEAM CYCLE      *         *
*            STEAM TURBINE                           *  *
*****************************************************************
*         TRY ENVELOP - ENVEL 2 FOR STEAM TURBINE AND ENVEL 1 FOR GTs.
602570  6         1         2         860.     755.     840000.
602040  6         2         1         121.     1220.    840000.
*         STEAM TURBINE                                    GROSS GENERATION
011050  5  2  1 0    3600    133000.    0.85  30.  30.  102476.000
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*         HP SECTION MODEL (GENERAL TURBINE)
701000  08    5  0  0  5  0  1  5  0.0
*         EXP. LINE CURVE
*701008 3
*  ASSUME CROSS-OVER    P      &      H
701005                 103.00      1234.000
```

```
*       LP    TION MODEL (GENERAL TURBINE)
701010  08    , 3  0  4  0  2  5  0.0  0.0  32.9
*  EXP. LINE CURVE
*701018  3
*  LAST STAGE --    P     &  ENTHALPY
701015            1.584       1010.000
*  CONDENSER
702000  10  1  2  0.0  1.5832
*
700500  33  80.97  44.2  3.333E7
700502  0       2
700510  32
* CONDENSER              OUTLET TEMP CONTROL
842200  WWVSC  50        107.67  -.  1.0  TT  -242
*  CONDENSER PUMP
704010  41  114.7  .95  1.0  0.8
*
704020  41  1244.7  .95  1.0  0.85
*  FIRST FW SPLITTER TO UNIT TWO
706310  63  0.0  0.5
*  SECOND FW SPLITTER TO UNIT ONE AND UNIT TWO
706320  63  0.0  0.5
*  THIRD FW SPLITTER TO UNIT THREE AND UNIT FOUR
706330  63  0.0  0.5
*  STEAM MIXER FOR HRSG ONE AND TWO
705410  50
*  STEAM MIXER FOR HRSG THREE AND FOUR
705420  50
*  TOTAL MAIN STEAM MIXER TO TURBINE
705430  50
*  STEM LEAK OFF                  SET FLOW
706410  61       0.0               582.0
*  GLAND STEAM LEAK OFF           SET FLOW
706490  61       0.0               3219.0
*  STEM SEAL REGULATOR
705490  50
*  SPLITTER TO G.S.C.             SET FLOW
706440  61       0.0               2401.0
*  G.S.C.
702010  10  0  2  0.0  2.0
*  MIXER FOR DRAINS TO CONDENSER
705510  50
*  SWING WHOLE STEAM TURBINE
850000  2
850002  100
* -------------- ADD SCHEDULES FOR ISO DESIGN PARAMETERS VS. INLET TEMP ----*
801100  'GT HEAT RATE VS. INLET TEMP.'
811100          40.    45.    50.    55.  59.     65.     70.    75.     80.    85.     90.
811110  0.0   .982   .988   .992   .997  1.0   1.0055   1.01   1.015   1.02   1.026   1.032
830100  11       OPVB  11          TT  1
830200  11       OPVB  21          TT  2
830300  11       OPVB  31          TT  3
830400  11       OPVB  41          TT  4
*
801200  'GT OUTPUT VS. INLET TEMP.'
811200           40.      50.      59.      70.      80.      90.      100.
811210  0.       1.075    1.036    1.0      0.96     0.922    0.885    0.848
831100  12       OPVB  12          TT  1
831200  12       OPVB  22          TT  2
831300  12       OPVB  32          TT  3
831400  12       OPVB  42          TT  4
*
801300  'GT AIR FLOW VS. INLET TEMP.'
811300           40.      50.      59.      70.      80.      90.      100.
811310  0.       1.04     1.02     1.0      0.979    0.958    0.937    0.917
```

```
832100  13      OPVB  13        TT  1
832200  13      OPVB  23        TT  2
832300  13      OPVB  33        TT  3
832400  13      OPVB  43        TT  4
*
801400  'GT EXHAUST TEMPERATURE VS. INLET TEMP.'
811400          40.     50.     59.     70.     80.     90.     100.
811410  0.      936.    944.    950.    956.    962.    969.    975.5
833100  14      OPVB  14        TT  1
833200  14      OPVB  24        TT  2
833300  14      OPVB  34        TT  3
833400  14      OPVB  44        TT  4
*       ------  end   of  schedules  -----------------  ************
*       OPERATIONS -------      OPERATIONS  ----------  OPERATIONS      **
*  * CONVERSION CONSTANTS:  STANDARD BAR. PRESSURE, HR TO MIN, UNITY, MW TO KW.
870010  14.7
870050  60.0
870060  1.0
870990  1000.0000
*       ALTITUDE CORRECTION FACTOR
880910  OPVB    92      DIV     OPVB    1       OPVB    90
*       ----    FIRST GT        -----   FIRST GT
890110  'FIRST GT TEST HEAT INPUT, BTU/HR'
890111          QFLHHV  501
890120  'FIRST GT TEST GROSS GENERATION, MW'
890121          BKGRO   1
890130  'FIRST GT TEST GROSS HEAT RATE, BTU/KWH'
890131          OPVB    16
880120  QFLHHV  501     DIV     BKGRO   1       OPVB    16
881120  OPVB    16      DIV     OPVB    99      OPVB    16
*       ----    FIRST GT CORRECTIONS    ------
890140  'FIRST GT CORR. ISO GROSS HEAT RATE'
881130  OPVB    16      DIV     OPVB    11      OPVB    17
890141          OPVB    17
890150  'FIRST GT CORR. ISO GROSS GENERATION'
880140  BKGRO   1       DIV     OPVB    12      OPVB    18
881140  OPVB    18      DIV     OPVB    90      OPVB    18
890151          OPVB    18
890160  'FIRST GT CORR. ISO AIR FLOW, LB/HR'
880150  WW      1       DIV     OPVB    13      OPVB    19
890161          OPVB    19
890170  'FIRST GT CORR. ISO EXHAUST TEMP., DEGF'
890171          OPVB    14
890180  '1ST GT COMPRESSOR EFFICIENCY'
890181  EFFPMP  801
890190  '1ST GT OVERALL EXPANDER EFFICIENCY'
890191  EFFSEC  821
890100  '1ST GT COMPRESSOR CALC. AIR FLOW, ACFM'
881100  WV      -1      DIV     OPVB    05      OPVB    10
890101  OPVB    10
*
*       ----    SECOND GT       -----   SECOND GT
890210  'SECOND GT TEST HEAT INPUT, BTU/HR'
890211          QFLHHV  502
890220  'SECOND GT TEST GROSS GENERATION, MW'
890221          BKGRO   2
890230  'SECOND GT TEST GROSS HEAT RATE, BTU/KWH'
890231          OPVB    26
880220  QFLHHV  502     DIV     BKGRO   2       OPVB    26
881220  OPVB    26      DIV     OPVB    99      OPVB    26
*       ----    SECOND GT CORRECTIONS   ------
890240  'SECOND GT CORR. ISO GROSS HEAT RATE'
881230  OPVB    26      DIV     OPVB    21      OPVB    27
890241          OPVB    27
890250  'SECOND GT CORR. ISO GROSS GENERATION'
```

```
880240  BK(     2       DIV     OPVB    22      OPVB    28
881240  OP\     28      DIV     OPVB    90      OPVB    28
890251          OPVB    28
890260  'SECOND GT CORR. ISO AIR FLOW, LB/HR'
880250  WW      2       DIV     OPVB    23      OPVB    29
890261          OPVB    29
890270  'SECOND GT CORR. ISO EXHAUST TEMP., DEGF'
890271          OPVB    24
890280  '2ND GT COMPRESSOR EFFICIENCY'
890281  EFFPMP  802
890290  '2ND GT OVERALL EXPANDER EFFICIENCY'
890291  EFFSEC  822
890200  '2ND GT COMPRESSOR CALC. AIR FLOW, ACFM'
880270  WV      -2      DIV     OPVB    5       OPVB    20
890201  OPVB    20
*
*       ----    THIRD GT        -----   THIRD GT
890310  'THIRD GT TEST HEAT INPUT, BTU/HR'
890311          QFLHHV  503
890320  'THIRD GT TEST GROSS GENERATION, MW'
890321          BKGRO   3
890330  'THIRD GT TEST GROSS HEAT RATE, BTU/KWH'
890331          OPVB    36
880320  QFLHHV  503     DIV     BKGRO   3       OPVB    36
881320  OPVB    36      DIV     OPVB    99      OPVB    36
*       ----    THIRD GT CORRECTIONS    ------
890340  'THIRD GT CORR. ISO GROSS HEAT RATE'
881330  OPVB    36      DIV     OPVB    31      OPVB    37
890341          OPVB    37
890350  'THIRD GT CORR. ISO GROSS GENERATION'
880340  BKGRO   3       DIV     OPVB    32      OPVB    38
881340  OPVB    38      DIV     OPVB    90      OPVB    38
890351          OPVB    38
890360  'THIRD GT CORR. ISO AIR FLOW, LB/HR'
880350  WW      3       DIV     OPVB    33      OPVB    39
890361          OPVB    39
890370  'THIRD GT CORR. ISO EXHAUST TEMP., DEGF'
890371          OPVB    34
890380  '3RD GT COMPRESSOR EFFICIENCY'
890381  EFFPMP  803
890390  '3RD GT OVERALL EXPANDER EFFICIENCY'
890391  EFFSEC  823
890300  '3RD GT COMPRESSOR CALC. AIR FLOW, ACFM'
880370  WV      -3      DIV     OPVB    5       OPVB    30
890301  OPVB    30
*
*       ----    FOURTH GT       -----   FOURTH GT
890410  'FOURTH GT TEST HEAT INPUT, BTU/HR'
890411          QFLHHV  504
890420  'FOURTH GT TEST GROSS GENERATION, MW'
890421          BKGRO   4
890430  'FOURTH GT TEST GROSS HEAT RATE, BTU/KWH'
890431          OPVB    46
880420  QFLHHV  504     DIV     BKGRO   4       OPVB    46
881420  OPVB    46      DIV     OPVB    99      OPVB    46
*       ----    FOURTH GT CORRECTIONS   ------
890440  'FOURTH GT CORR. ISO GROSS HEAT RATE'
881430  OPVB    46      DIV     OPVB    41      OPVB    47
890441          OPVB    47
890450  'FOURTH GT CORR. ISO GROSS GENERATION'
880440  BKGRO   4       DIV     OPVB    42      OPVB    48
881440  OPVB    48      DIV     OPVB    90      OPVB    48
890451          OPVB    48
890460  'FOURTH GT CORR. ISO AIR FLOW, LB/HR'
880450  WW      4       DIV     OPVB    43      OPVB    49
```

```
890461          OPVB    49
890470  'FL   .H GT CORR. ISO EXHAUST TEMP., DEGF'
890471          OPVB    44
890480  '4TH GT COMPRESSOR EFFICIENCY'
890481  EFFPMP  804
890490  '4TH GT OVERALL EXPANDER EFFICIENCY'
890491  EFFSEC  824
890400  '4TH GT COMPRESSOR CALC. AIR FLOW, ACFM'
880470  WV      -4      DIV     OPVB    5       OPVB    40
890401  OPVB    40
* --- UNIT PARAMETERS ---        UNIT PARAMETERS --------*
890700  'SIMPLE CYCLE GROSS GENERATION, MW'
880700  BKGRO   1       ADD     BKGRO   2       OPVB    70
880710  BKGRO   3       ADD     OPVB    70      OPVB    70
880720  BKGRO   4       ADD     OPVB    70      OPVB    70
890701          OPVB    70
*
890710  'STEAM TURBINE GROSS GENERATION, KW'
890711          POWER   5
*
890720  'UNIT AUXILIARY LOAD, MW'
870710  3.993
890721          OPVB    71
*
890730  'COMBINED CYCLE GROSS GENERATION, MW'
880730  POWER   5       DIV     OPVB    99      OPVB    95
881730  OPVB    95      ADD     OPVB    70      OPVB    72
890731          OPVB    72
*
890740  'COMBINED CYCLE NET GENERATION, MW'
880740  OPVB    72      SUB     OPVB    71      OPVB    73
890741          OPVB    73
*
890750  'TOTAL UNIT HEAT INPUT, BTU/HR'
880750  QFLHHV  501     ADD     QFLHHV  502     OPVB    74
880760  QFLHHV  503     ADD     OPVB    74      OPVB    74
880770  QFLHHV  504     ADD     OPVB    74      OPVB    74
890751          OPVB    74
*
890760  'GROSS UNIT HEAT RATE, BTU/KWH'
880780  OPVB    74      DIV     OPVB    72      OPVB    75
881780  OPVB    75      DIV     OPVB    99      OPVB    75
890761          OPVB    75
*
890770  'NET UNIT HEAT RATE, BTU/KWH'
880790  OPVB    74      DIV     OPVB    73      OPVB    76
881790  OPVB    76      DIV     OPVB    99      OPVB    76
890771          OPVB    76
*
890780  'GROSS STEAM TURBINE HEAT RATE, BTU/KWH'
880800  HH      -257    SUB     HH      -204    OPVB    77
880810  WW      204     MUL     OPVB    77      OPVB    77
880820  OPVB    77      DIV     POWER   5       OPVB    77
890781          OPVB    77
*
890790  'STEAM TURBINE EFFICIENCY'
890791  EFFSEC  101
*       HRSG EFFECTIVENESS      *
891410  '1ST HRSG EFFECTIVENESS'
891411          EFFHX   211
891420  '2ND HRSG EFFECTIVENESS'
891421          EFFHX   212
891430  '3RD HRSG EFFECTIVENESS'
891431          EFFHX   213
891440  '4TH HRSG EFFECTIVENESS'
```

```
891441          EFFHX   214
*       *       *       STACK FLUE GAS CONSTITUENTS     *       *       *
891500  '1ST STACK O2, DRY FRACT. (MOLE) VOL'
881500  OPVB    6       SUB     H2OM    37      OPVB    111
881510  O2M     37      DIV     OPVB    111     OPVB    112
891501  OPVB    112
891510  '1ST STACK CO2, DRY FRACT. (MOLE) VOL'
881520  CO2M    37      DIV     OPVB    111     OPVB    113
891511  OPVB    113
*
891600  '2ND STACK O2, DRY FRACT. (MOLE) VOL'
881600  OPVB    6       SUB     H2OM    38      OPVB    121
881610  O2M     38      DIV     OPVB    121     OPVB    122
891601  OPVB    122
891610  '2ND STACK CO2, DRY FRACT. (MOLE) VOL'
881620  CO2M    38      DIV     OPVB    121     OPVB    123
891611  OPVB    123
*
891700  '3RD STACK O2, DRY FRACT. (MOLE) VOL'
881700  OPVB    6       SUB     H2OM    39      OPVB    131
881710  O2M     39      DIV     OPVB    131     OPVB    132
891701  OPVB    132
891710  '3RD STACK CO2, DRY FRACT. (MOLE) VOL'
881720  CO2M    39      DIV     OPVB    131     OPVB    133
891711  OPVB    133
*
891800  '4TH STACK O2, DRY FRACT. (MOLE) VOL'
881800  OPVB    6       SUB     H2OM    40      OPVB    141
881810  O2M     40      DIV     OPVB    141     OPVB    142
891801  OPVB    142
891810  '4TH STACK CO2, DRY FRACT. (MOLE) VOL'
881820  CO2M    40      DIV     OPVB    141     OPVB    143
891811  OPVB    143
*       *       *       *       *       *       *
*****************         END OF          ****************
*****************         BASE  DECK      ****************
*------------------------  START OF TEST DATA ENTRY -----------*------------
  THW 4 COMBINED CYCLE TEST, 6/25/92, MED stm flow, MEA stack T. (4CC_6_25_92)
*       COMPONENTS:                                                     *
*               ENTER-- Test Barometric pressure in psia                *
870920                  14.676
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*         FIRST GT UNIT -------- ONE --------                           *
*            T amb  P amb. (at inlet plenum)    AIR FLOW GUESS        *
700110  31    90.2            14.58                 1900000.
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*             REL HUM                                                   *
700113  AIR   0.54
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  TRY ENVELOP 1                                                        *
*600010 6       1       1       82.9    14.709  1900000.
*600013 AIR     0.54
*  COMPRESSOR    OUTLET P.       EFF. GUESS                            *
708010  44   1    130.78    1.0     .89
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  COMPRESSOR AIR TO GT INTERSTAGE COOLING @ 2%                         *
706010  63   0.0   0.019999
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  COMBUSTOR            EXCESS AIR?                                     *
705010  70   0   2   0     0.0
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  NOX SPRAY MIXER                                                      *
705110  50
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  FIRST SECTION EXPANDER WITH ASSUMED EFFICIENCY & EXH. P.     *
```

```
708110  09        0    1    1
                                        *** CARD ABOVE IS A REPLACEMEN1    RD. ***
*       ASSUMED EFF.     ASSUMED P.                                      *
708111  0.850001         87.0001
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  INTERSTAGE COOLING MIXER                                             *
705210  50
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  MAIN SECTION EXPANDER WITH EFF. GUESS & MEAS. EXH. P.                *
708210  09    1    3    1    1
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*       EFF. GUESS       MEASURED EXH. P.                               *
708211  0.85             15.242
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  EXHAUST BYPASS DAMPER    LEAKAGE GUESS                               *
706110  63    0.0                0.10
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONVECTIVE STAGE -- HRSG                                             *
*                 STM FLOW    FW P. FW IN T. STM OUT T.
702110  28    2    210000.    783.68   124.5    867.    0.0    0.0    0.0    0.0
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*            STM OUT P.        STACK P.
702113  0.0    754.68    0.0    14.7
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  MIXER TO ATMO.                                                       *
705310  50
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  FUEL SOURCE  T-FUEL   P-FUEL   MASS FLOW                             *
700210  31        65.0     14.7     31828.9
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  FUEL SPEC.    HHV                                                    *
700213  FUEL     22470.  SSVL  0.0  C  .72558  H2  .23503  O2 .0362 N2 .0032
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  NOX SPRAY SOURCE    T      P     MASS FLOW                           *
700310  31             86.6    250.     8707.
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  ATMOSPHERE                                                           *
700410  30
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*                                                                       *
*** ADD CONTROLS ----    FIRST GT         +  +  +  +  +                 *
* CONTROL INLET AIR FLOW TO COMPRESSOR TO ACHIEVE GOAL TURBINE OUTLET TEMP
*                       TURB EXH. T.                                    *
840100  WWVSC    11      982.4    0.0    1.0    TT    -29
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONTROL TURBINE EFF. TO PRODUCE DESIRED LOAD - MW                    *
840200  EFFTRE   821                              51.5564  0.00001  1.0  BKGRO   1
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONTROL COMP. EFF. TO OBTAIN          COMP. OUT TEMP.                *
840300  EFFPMP   801                    616.2    0.0001    1.0    TT    -5
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONTROL BYPASS LEAK TO OBTAIN         STACK TEMP                     *
840400  FRSPL    611                    341.5    0.0    1.0    TT    -37
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
**      ADD CONTROL LIMITS       MIN.     MAX.     **
840409                           0.00     0.333333
********        FINISHED DATA ENTRY FOR GT ONE  ************     *
*       COMPONENTS:                                                     *
*         SECOND GT UNIT -------- TWO --------                          *
*            T amb  P amb (at inlet plenum)   AIR FLOW GUESS            *
700120  31    90.2          14.58                 1900000.
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*             REL HUM                                                   *
700123  AIR    0.54
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
```

```
*  COMPRESS       OUTLET P.        EFF. GUESS                          *
708020  44         128.88     1.0     .89
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  COMPRESSOR AIR TO GT INTERSTAGE COOLING @ 2%                        *
706020  63    0.0    0.019999
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  COMBUSTOR              EXCESS AIR?                                  *
705020  70    0    2    0      0.0
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  NOX SPRAY MIXER                                                     *
705120  50
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  FIRST SECTION EXPANDER WITH ASSUMED EFFICIENCY & EXH. P.            *
708120  09    2    0    1    1
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*       ASSUMED EFF.     ASSUMED EXH. P.                               *
708121  0.850001         87.0001
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  INTERSTATE COOLING MIXER                                            *
705220  50
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  MAIN SECTION EXPANDER WITH EFF. GUESS & MEAS. EXH. P.               *
708220  09    2    3    1    1
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*       EFF. GUESS       MEASURED EXH. P.                              *
708221  0.85             15.189
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  EXHAUST BYPASS DAMPER    LEAKAGE GUESS                              *
706120  63    0.0                0.10
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONVECTIVE STAGE -- HRSG                                            *
*                STM FLOW    FW P. FW IN T. STM OUT T.
702120  28    2    210000.    794.68    124.5    867.    0.0    0.0    0.0    0.0
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*            STM OUT P.       STACK P.
702123  0.0    734.68    0.0    14.7
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  MIXER TO ATMO.                                                      *
705320  50
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  FUEL SOURCE  T-FUEL  P-FUEL  MASS FLOW                              *
700220  31         65.0     14.7     31370.8
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  FUEL SPEC.    HHV                                                   *
700223  FUEL     22470.  SSVL  0.0  C  .72558  H2  .23502  O2 .0362 N2 .0032
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  NOX SPRAY SOURCE    T      P     MASS FLOW                          *
700320  31             86.6    250.    9908.
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  ATMOSPHERE                                                          *
700420  30
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*                                                                      *
*** ADD CONTROLS ----    SECOND GT        +   +   +   +   +           *
* CONTROL INLET AIR FLOW TO COMPRESSOR TO ACHIEVE GOAL TURBINE OUTLET TEMP
*                        TURB EXH. T.                                 *
840500  WWVSC  12        974.1    0.0    1.0    TT    -30
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONTROL TURBINE EFF. TO PRODUCE DESIRED LOAD - MW                   *
840600  EFFTRE    822                          51.1495  0.00001  1.0  BKGRO    2
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONTROL COMP. EFF. TO OBTAIN          COMP. OUT TEMP.              *
840700  EFFPMP    802                   615.5    0.0001    1.0    TT    -6
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONTROL BYPASS LEAK TO OBTAIN         STACK TEMP                   *
```

```
840800  FRS     612                       344.5   0.0   1.0   TT   -38
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
**      ADD CONTROL LIMITS        MIN.     MAX.    **
840809                            0.00     0.333333
*****           FINISHED DATA ENTRY FOR GT TWO  ************     *
*       COMPONENT                                                 *
*         THIRD GT UNIT -------- THREE --------                   *
*            T amb  P amb (at inlet plenum)    AIR FLOW GUESS     *
700130  31   90.2          14.586                  1900000.
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*             REL HUM                                             *
700133  AIR   0.54
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  COMPRESSOR     OUTLET P.        EFF. GUESS                     *
708030  44   3     132.68    1.0     .89
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  COMPRESSOR AIR TO GT INTERSTAGE COOLING @ 2%                   *
706030  63   0.0   0.019999
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  COMBUSTOR              EXCESS AIR?                             *
705030  70   0   2   0      0.0
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  NOX SPRAY MIXER                                               *
705130  50
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  FIRST SECTION EXPANDER WITH ASSUMED EFFICIENCY & EXH. P.       *
708130  09   3   0   1   1
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*       ASSUMED EFF.     ASSUMED EXH. P.                          *
708131  0.850001         87.0001
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  INTERSTATE COOLING MIXER                                      *
705230  50
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  MAIN SECTION EXPANDER WITH EFF. GUESS & MEAS. EXH. P.          *
708230  09   3   3   1   1
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*       EFF. GUESS       MEASURED EXH. P.                         *
708231  0.85             15.171
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  EXHAUST BYPASS DAMPER   LEAKAGE GUESS                         *
706130  63   0.0               0.10
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONVECTIVE STAGE -- HRSG                                      *
*               STM FLOW   FW P. FW IN T. STM OUT T.
702130  28   2   210000.   814.68   124.5   867.   0.0   0.0   0.0   0.0
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*           STM OUT P.       STACK P.
702133  0.0   754.68   0.0   14.7
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  MIXER TO ATMO.                                                *
705330  50
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  FUEL SOURCE  T-FUEL  P-FUEL  MASS FLOW                        *
700230  31        65.0    14.7    31560.4
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  FUEL SPEC.   HHV                                              *
700233  FUEL    22470.  SSVL  0.0  C  .72558  H2  .23503  O2 .0362 N2 .0032
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  NOX SPRAY SOURCE   T     P    MASS FLOW                       *
700330  31           86.6   250.   10508.
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  ATMOSPHERE                                                    *
700430  30
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
```

```
                                        *** CARD ABOVE IS A REPLACEMENT   RD. ***
*  FUEL SOL   .  T-FUEL  P-FUEL  MASS FLOW                                    *
700240  31        65.0    14.7    32065.8
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  FUEL SPEC.   HHV                                                          *
700243  FUEL    22470.  SSVL  0.0  C  .72558  H2  .23503  O2 .0362 N2 .0032
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  NOX SPRAY SOURCE   T      P     MASS FLOW                                 *
700340  31           86.6   250.   9458.0
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  ATMOSPHERE                                                                *
700440  30
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*                                                                           *
*** ADD CONTROLS ----- FOURTH GT          +  +  +  +  +                     *
* CONTROL INLET AIR FLOW TO COMPRESSOR TO ACHIEVE GOAL TURBINE OUTLET TEMP
*                      TURB EXH. T.                                         *
841300  WWVSC   14      975.9   0.0   1.0   TT   -32
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONTROL TURBINE EFF. TO PRODUCE DESIRED LOAD - MW                         *
841400  EFFTRE   824                          52.3901  0.00001  1.0 BKGRO   4
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONTROL COMP. EFF. TO OBTAIN          COMP. OUT TEMP.                     *
841500  EFFPMP   804                          617.7   0.0001   1.0   TT   -8
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONTROL BYPASS LEAK TO OBTAIN         STACK TEMP                          *
841600  FRSPL   614                           343.5   0.0   1.0   TT   -40
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
**       ADD CONTROL LIMITS       MIN.     MAX.     **
841609                            0.00     0.333333
*******          FINISHED DATA ENTRY FOR GT FOUR    ********
**********************************************************************
*        COMPONENT                                                 *   *
*          STEAM CYCLE            STEAM CYCLE      *        *        *
*           STEAM TURBINE TEST DATA ENTRY          *   *             *
**********************************************************************
*        STEAM TURBINE                                  GROSS GEN. KW    *
011050  5  2  1 0   3600   133000. 0.85 30. 30. 102463.000
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*                                              UNIT AUX LOAD MW*
870710                                         3.901
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*        HP SECTION MODEL (GENERAL TURBINE)                                *
701000  08   5  0  0  5  0  1  5  0.0
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*        EXP. LINE CURVE                                                   *
*701008 3
*  ASSUME CROSS-OVER   P      &     H                                       *
701005                103.00     1234.000
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*        LP SECTION MODEL (GENERAL TURBINE)                                *
701010  08   5  3  0  4  0  2  5  0.0  0.0  32.9
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  EXP. LINE CURVE NUMBER                                                  *
*701018  3
*  LAST STAGE --   P     &  ENTHALPY                                        *
701015           1.9        1010.000
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONDENSER                                                               *
702000  10  1  2  0.0  1.8901
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*         CW IN T. CW IN P.      CW FLOW GUESS                              *
700500  33  87.35   49.58        3.333E7
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
700510  32
```

```
*                                                                       *
*** ADD CON  LS ----   THIRD GT        +  +  +  +  +                    *
* CONTROL INLET AIR FLOW TO COMPRESSOR TO ACHIEVE GOAL TURBINE OUTLET TEMP
*                      TURB EXH. T.                                     *
840900  WWVSC   13      974.0   0.0   1.0   TT   -31
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONTROL TURBINE EFF. TO PRODUCE DESIRED LOAD - MW                    *
841000  EFFTRE  823                                 50.8359  0.00001  1.0  BKGRO   3
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONTROL COMP. EFF. TO OBTAIN         COMP. OUT TEMP.                 *
841100  EFFPMP  803                    620.   0.0001   1.0   TT   -7
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONTROL BYPASS LEAK TO OBTAIN        STACK TEMP                      *
841200  FRSPL   613                    340.   0.0   1.0   TT   -39
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
**      ADD CONTROL LIMITS      MIN.    MAX.    **
841209                          0.00    0.333333
*********       FINISHED DATA ENTRY FOR GT THREE      ******    *
*       COMPONENT                                                       *
*         FOURTH GT UNIT ------- FOUR -------                           *
*           T amb  P amb (at inlet plenum)   AIR FLOW GUESS             *
700140  31   90.2          14.58                 1900000.
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*            REL HUM                                                    *
700143  AIR   0.54
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  COMPRESSOR    OUTLET P.       EFF. GUESS                            *
708040  44   4    127.48    1.0     .89
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  COMPRESSOR AIR TO GT INTERSTAGE COOLING @ 2%                         *
706040  63   0.0   0.019999
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  COMBUSTOR            EXCESS AIR?                                     *
705040  70   0   2   0      0.0
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  NOX SPRAY MIXER                                                      *
705140  50
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  FIRST SECTION EXPANDER WITH ASSUMED EFFICIENCY & EXH. P.             *
708140  09   4   0   1   1
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*       ASSUMED EFF.    ASSUMED EXH. P.                                 *
708141  0.850001        87.0001
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  INTERSTATE COOLING MIXER                                             *
705240  50
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  MAIN SECTION EXPANDER WITH EFF. GUESS & MEAS. EXH. P.                *
708240  09   4   3   1   1
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*       EFF. GUESS      MEASURED EXH. P.                                *
708241  0.85            15.1745
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  EXHAUST BYPASS DAMPER   LEAKAGE GUESS                                *
706140  63   0.0              0.10
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONVECTIVE STAGE -- HRSG                                             *
*                STM FLOW   FW P. FW IN T. STM OUT T.
702140  28   2   210000.   794.68   124.5   867.   0.0   0.0   0.0   0.0
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*           STM OUT P.      STACK P.
702143  0.0   754.68    0.0   14.7
                                      *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  MIXER TO ATMO                                                        *
705340  50
```

```
 OT ADD TO A VALUE OF 1.0 FOR COMPONENT WITH
 SER ID =  23.  THE SUM IS  1.00001E+00. THE
MATERIAL MASS FRACTIONS HAVE BEEN NORMALIZED TO
YIELD A SUM OF 1.0.


*** WARNING FROM READ03 ROUTINE ***
    THE INPUT VALUES OF MATERIAL MASS FRACTIONS DO
    NOT ADD TO A VALUE OF 1.0 FOR COMPONENT WITH
    USER ID =  24.  THE SUM IS  1.00001E+00. THE
    MATERIAL MASS FRACTIONS HAVE BEEN NORMALIZED TO
    YIELD A SUM OF 1.0.
```

```
                                        *** CARD ABOVE IS A REPLACEMENT   RD. ***
* CONDENSEI                OUTLET TEMP CONTROL                              *
842200  WWVSC  50          114.12  -.  1.0  TT  -242
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  CONDENSER PUMP P.                                                       *
704010  41  117.68  .95  1.0  0.8
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  BOILER FEED PUMP P.                                                     *
704020  41  1274.68  .95  1.0  0.85
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  FIRST FW SPLITTER TO UNIT TWO                                           *
706310  63  0.0  0.5
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  SECOND FW SPLITTER TO UNIT ONE AND UNIT TWO                             *
706320  63  0.0  0.5
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  THIRD FW SPLITTER TO UNIT THREE AND UNIT FOUR                           *
706330  63  0.0  0.5
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  STEAM MIXER FOR HRSG ONE AND TWO                                        *
705410  50
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  STEAM MIXER FOR HRSG THREE AND FOUR                                     *
705420  50
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  TOTAL MAIN STEAM MIXER TO TURBINE                                       *
705430  50
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  STEM LEAK OFF                SET FLOW                                   *
706410  61       0.0             582.0
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  GLAND STEAM LEAK OFF         SET FLOW                                   *
706490  61       0.0             3219.0
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  STEM SEAL REGULATOR                                                     *
705490  50
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  SPLITTER TO G.S.C.           SET FLOW                                   *
706440  61       0.0             2401.0
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  G.S.C.                                                                  *
702010  10  0  2  0.0  2.0
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  MIXER FOR DRAINS TO CONDENSER                                           *
705510  50
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*  SWING WHOLE STEAM TURBINE                                               *
850002  100
                                        *** CARD ABOVE IS A REPLACEMENT CARD. ***
*-*-*-*-*-*-*  END  OF  TEST  DATA  REPLACEMENT  DECK  -*-*-*-*-*
.


      *** WARNING FROM READ03 ROUTINE ***
          THE INPUT VALUES OF MATERIAL MASS FRACTIONS DO
          NOT ADD TO A VALUE OF 1.0 FOR COMPONENT WITH
          USER ID =  21.  THE SUM IS  1.00001E+00. THE
          MATERIAL MASS FRACTIONS HAVE BEEN NORMALIZED TO
          YIELD A SUM OF 1.0.


      *** WARNING FROM READ03 ROUTINE ***
          THE INPUT VALUES OF MATERIAL MASS FRACTIONS DO
```

INPUT SCHEDULE NUMBER 13 TABLE OF VALUES

GT AIR FLOW VS. INLET TEMP.

UNIVARIATE TABLE OF Y VERSUS X

VALUES OF X

4.000E+01	5.000E+01	5.900E+01	7.000E+01	8.000E+01	9.000E+01	1.000E+02

VALUES OF Y

1.040E+00	1.020E+00	1.000E+00	9.790E-01	9.580E-01	9.370E-01	9.170E-01

INPUT SCHEDULE NUMBER 14 TABLE OF VALUES

GT EXHAUST TEMPERATURE VS. INLET TEMP.

UNIVARIATE TABLE OF Y VERSUS X

VALUES OF X

4.000E+01	5.000E+01	5.900E+01	7.000E+01	8.000E+01	9.000E+01	1.000E+02

VALUES OF Y

9.360E+02	9.440E+02	9.500E+02	9.560E+02	9.620E+02	9.690E+02	9.755E+02

INPUT SCHEDULE NUMBER 11 TABLE OF VALUES

GT HEAT RATE VS. INLET TEMP.

UNIVARIATE TABLE OF Y VERSUS X

VALUES OF X

4.000E+01	4.500E+01	5.000E+01	5.500E+01	5.900E+01	6.500E+01	7.000E+01
7.500E+01	8.000E+01	8.500E+01	9.000E+01			

VALUES OF Y

9.820E-01	9.880E-01	9.920E-01	9.970E-01	1.000E+00	1.005E+00	1.010E+00
1.015E+00	1.020E+00	1.026E+00	1.032E+00			

INPUT SCHEDULE NUMBER 12 TABLE OF VALUES

GT OUTPUT VS. INLET TEMP.

UNIVARIATE TABLE OF Y VERSUS X

VALUES OF X

4.000E+01	5.000E+01	5.900E+01	7.000E+01	8.000E+01	9.000E+01	1.000E+02

VALUES OF Y

1.075E+00	1.036E+00	1.000E+00	9.600E-01	9.220E-01	8.850E-01	8.480E-01

14	1.0E	* BKGRO (4)			EFFTRE(824)	
	5.23901E+01		4.2E-08	5.23901E+01	8.67320E-01	YES
15	1.0E+00	* TT (-8)			EFFPMP(804)	
	6.17691E+02		1.5E-05	6.17700E+02	8.72017E-01	YES
16	1.0E+00	* TT (-40)			FRSPL (614)	
	3.43499E+02		4.3E-06	3.43500E+02	1.51773E-01	YES
22	1.0E+00	* TT (-242)			WWVSC (50)	
	1.14211E+02		-8.0E-04	1.14120E+02	2.88429E+07	YES

CONTROLLED VARIABLE VALUES CALCULATED

CONTROL SET	Y VARIABLE/ VALUE FROM ITERATE 18	FRAC(ABS) DEVIATION FROM GOAL	Y VARIABLE GOAL VALUE	X VARIABLE/ VALUE USED AT ITERATE 18	CONVG LAST ITN X LIMTD
1	1.0E+00 * TT (-29) 9.82519E+02	-1.2E-04	9.82400E+02	WWVSC (11) 1.88601E+06	YES
2	1.0E+00 * BKGRO (1) 5.15564E+01	2.7E-10	5.15564E+01	EFFTRE(821) 8.52850E-01	YES
3	1.0E+00 * TT (-5) 6.16211E+02	-1.7E-05	6.16200E+02	EFFPMP(801) 8.88349E-01	YES
4	1.0E+00 * TT (-37) 3.41811E+02	-9.1E-04	3.41500E+02	FRSPL (611) 1.54108E-01	YES
5	1.0E+00 * TT (-30) 9.74234E+02	-1.4E-04	9.74100E+02	WWVSC (12) 1.86468E+06	YES
6	1.0E+00 * BKGRO (2) 5.11495E+01	1.2E-09	5.11495E+01	EFFTRE(822) 8.61255E-01	YES
7	1.0E+00 * TT (-6) 6.15498E+02	2.7E-06	6.15500E+02	EFFPMP(802) 8.81682E-01	YES
8	1.0E+00 * TT (-38) 3.44500E+02	8.7E-07	3.44500E+02	FRSPL (612) 1.29605E-01	YES
9	1.0E+00 * TT (-31) 9.74207E+02	-2.1E-04	9.74000E+02	WWVSC (13) 1.88207E+06	YES
10	1.0E+00 * BKGRO (3) 5.08359E+01	-7.7E-10	5.08359E+01	EFFTRE(823) 8.47701E-01	YES
11	1.0E+00 * TT (-7) 6.20004E+02	-6.7E-06	6.20000E+02	EFFPMP(803) 8.89294E-01	YES
12	1.0E+00 * TT (-39) 3.40031E+02	-9.0E-05	3.40000E+02	FRSPL (613) 1.44148E-01	YES
13	1.0E+00 * TT (-32) 9.76396E+02	-5.1E-04	9.75900E+02	WWVSC (14) 1.90363E+06	YES

COMPONENT PROPERTIES

COMP	STREAM /PORT	FLU ID	MASS FLOW (LBM/HR)	TEMP (F)	PRESS (PSIA)	QUALITY (-)	ENTH (B/LB)	ENTRPY (B/LB-F)	SPEC. VOLUME (FT3/LBM)
200 COND	262/S	0	836199.	124.0	1.89	0.899	1012.8	1.74919	1.65E+02
	241/T	0	28842924.	87.3	49.58	-0.210	55.5	0.10672	1.61E-02
	269/D	0	3801.	344.1	124.65	0.606	846.8	1.15645	2.19E+00
	201/D	0	840000.	124.0	1.89	0.000	92.0	0.17146	1.62E-02
	242/T	0	28842924.	114.2	49.58	-0.181	82.3	0.15454	1.62E-02
201 COND	266/S	0	1400.	517.0	124.90	1.108	1285.7	1.69145	4.54E+00
	202/T	0	840000.	124.1	117.68	-0.248	92.4	0.17162	1.62E-02
	268/D	0	1400.	126.1	2.00	0.000	94.0	0.17500	1.62E-02
	203/T	0	840000.	126.1	117.68	-0.246	94.4	0.17502	1.62E-02
211 HCNV	211/T	0	210000.	127.3	1274.68	-0.807	98.5	0.17610	1.62E-02
	33/S	15	1629645.	982.5	15.24	N.A.	422.5	1.90676	3.61E+01
	215/T	0	210000.	867.0	754.68	1.341	1439.1	1.63491	9.94E-01
	37/D	15	1629645.	341.8	14.70	N.A.	249.7	1.75167	2.08E+01
212 HCNV	212/T	0	210000.	127.3	1274.68	-0.807	98.5	0.17610	1.62E-02
	34/S	17	1658937.	974.2	15.19	N.A.	420.8	1.90570	3.60E+01
	252/T	0	210000.	867.0	734.68	1.339	1439.8	1.63831	1.02E+00
	38/D	17	1658937.	344.5	14.70	N.A.	251.0	1.75278	2.09E+01
213 HCNV	213/T	0	210000.	127.3	1274.68	-0.807	98.5	0.17610	1.62E-02
	35/S	19	1646779.	974.2	15.17	N.A.	420.9	1.90589	3.61E+01
	253/T	0	210000.	867.0	754.68	1.341	1439.1	1.63491	9.94E-01
	39/D	19	1646779.	340.0	14.70	N.A.	250.0	1.75145	2.08E+01
214 HCNV	214/T	0	210000.	127.3	1274.68	-0.807	98.5	0.17610	1.62E-02
	36/S	21	1649932.	976.4	15.17	N.A.	421.1	1.90603	3.61E+01
	254/T	0	210000.	867.0	754.68	1.341	1439.1	1.63491	9.94E-01
	40/D	21	1649932.	343.5	14.70	N.A.	250.4	1.75234	2.08E+01
401 PMEL	201/I	0	840000.	124.0	1.89	0.000	92.0	0.17146	1.62E-02
	202/U	0	840000.	124.1	117.68	-0.248	92.4	0.17162	1.62E-02
402 PMEL	203/I	0	840000.	126.1	117.68	-0.246	94.4	0.17502	1.62E-02
	204/U	0	840000.	127.3	1274.68	-0.807	98.5	0.17610	1.62E-02
501 COMB	9/IA	2	1848287.	616.2	130.78	N.A.	280.3	1.66932	3.09E+00
	101/IF	6	31829.	65.0	14.70	N.A.	426.9	4.05335	N.A.
	13/U	10	1880116.	1787.6	130.78	N.A.	653.9	1.88294	6.54E+00

COMPONENT PROPERTIES

COMP	STREAM /PORT	FLU ID	MASS FLOW (LBM/HR)	TEMP (F)	PRESS (PSIA)	QUALITY (-)	ENTH (B/LB)	ENTRPY (B/LB-F)	SPEC. VOLUME (FT3/LBM)
11 SRCE	1/U	2	1886006.	90.2	14.58	N.A.	149.4	1.65537	1.42E+01
12 SRCE	2/U	3	1864681.	90.2	14.58	N.A.	149.4	1.65537	1.42E+01
13 SRCE	3/U	4	1882072.	90.2	14.59	N.A.	149.4	1.65534	1.42E+01
14 SRCE	4/U	5	1903631.	90.2	14.58	N.A.	149.4	1.65537	1.42E+01
21 SRCE	101/U	6	31829.	65.0	14.70	N.A.	426.9	4.05335	N.A.
22 SRCE	102/U	7	31371.	65.0	14.70	N.A.	426.8	4.05322	N.A.
23 SRCE	103/U	8	31560.	65.0	14.70	N.A.	426.9	4.05335	N.A.
24 SRCE	104/U	9	32066.	65.0	14.70	N.A.	426.9	4.05335	N.A.
31 SRCE	111/U	0	8707.	86.6	250.00	-0.388	55.3	0.10526	1.61E-02
32 SRCE	112/U	0	9908.	86.6	250.00	-0.388	55.3	0.10526	1.61E-02
33 SRCE	113/U	0	10508.	86.6	250.00	-0.388	55.3	0.10526	1.61E-02
34 SRCE	114/U	0	9458.	86.6	250.00	-0.388	55.3	0.10526	1.61E-02
41 SINK	41/I	15	1926541.	444.9	14.83	N.A.	276.4	1.78229	2.33E+01
42 SINK	42/I	17	1905960.	429.8	14.80	N.A.	273.0	1.77831	2.29E+01
43 SINK	43/I	19	1924140.	435.5	14.81	N.A.	274.6	1.78005	2.31E+01
44 SINK	44/I	21	1945155.	443.8	14.81	N.A.	276.3	1.78218	2.33E+01
50 IPUT	241/U	0	28842924.	87.3	49.58	-0.210	55.5	0.10672	1.61E-02
51 OPUT	242/I	0	28842924.	114.2	49.58	-0.181	82.3	0.15454	1.62E-02
100 TGEN	258/I	0	839418.	867.0	749.57	1.340	1439.3	1.63576	1.00E+00
	259/U	0	839418.	458.8	103.00	1.079	1257.9	1.68281	5.16E+00
101 TGEN	260/I	0	836199.	458.8	103.00	1.079	1257.9	1.68281	5.16E+00
	262/U	0	836199.	124.0	1.89	0.899	1012.8	1.74919	1.65E+02

COMPONENT PROPERTIES

COMP	STREAM /PORT	FLU ID	MASS FLOW (LBM/HR)	TEMP (F)	PRESS (PSIA)	QUALITY (-)	ENTH (B/LB)	ENTRPY (B/LB-F)	SPEC. VOLUME (FT3/LBM)
524 MIXR	24/IA	20	1907084.	1608.2	87.00	N.A.	606.5	1.88926	9.07E+00
	54/IB	5	38071.	617.7	127.48	N.A.	280.7	1.67145	3.18E+00
	28/U	21	1945155.	1590.4	87.28	N.A.	600.1	1.88628	8.96E+00
531 MIXR	37/IA	15	1629645.	341.8	14.70	N.A.	249.7	1.75167	2.08E+01
	61/IB	15	296896.	982.5	15.24	N.A.	422.5	1.90676	3.61E+01
	41/U	15	1926541.	444.9	14.83	N.A.	276.4	1.78229	2.33E+01
532 MIXR	38/IA	17	1658937.	344.5	14.70	N.A.	251.0	1.75278	2.09E+01
	62/IB	17	247023.	974.2	15.19	N.A.	420.8	1.90570	3.60E+01
	42/U	17	1905960.	429.8	14.80	N.A.	273.0	1.77831	2.29E+01
533 MIXR	39/IA	19	1646779.	340.0	14.70	N.A.	250.0	1.75145	2.08E+01
	63/IB	19	277362.	974.2	15.17	N.A.	420.9	1.90589	3.61E+01
	43/U	19	1924140.	435.5	14.81	N.A.	274.6	1.78005	2.31E+01
534 MIXR	40/IA	21	1649932.	343.5	14.70	N.A.	250.4	1.75234	2.08E+01
	64/IB	21	295223.	976.4	15.17	N.A.	421.1	1.90603	3.61E+01
	44/U	21	1945155.	443.8	14.81	N.A.	276.3	1.78218	2.33E+01
541 MIXR	215/IA	0	210000.	867.0	754.68	1.341	1439.1	1.63491	9.94E-01
	252/IB	0	210000.	867.0	734.68	1.339	1439.8	1.63831	1.02E+00
	255/U	0	420000.	867.0	744.54	1.340	1439.5	1.63662	1.01E+00
542 MIXR	253/IA	0	210000.	867.0	754.68	1.341	1439.1	1.63491	9.94E-01
	254/IB	0	210000.	867.0	754.68	1.341	1439.1	1.63491	9.94E-01
	256/U	0	420000.	867.0	754.68	1.341	1439.1	1.63491	9.94E-01
543 MIXR	255/IA	0	420000.	867.0	744.54	1.340	1439.5	1.63662	1.01E+00
	256/IB	0	420000.	867.0	754.68	1.341	1439.1	1.63491	9.94E-01
	257/U	0	840000.	867.0	749.57	1.340	1439.3	1.63576	1.00E+00
549 MIXR	263/IA	0	582.	867.0	749.57	1.340	1439.3	1.63576	1.00E+00
	265/IB	0	3219.	458.8	103.00	1.079	1257.9	1.68281	5.16E+00
	264/U	0	3801.	517.0	124.90	1.108	1285.7	1.69145	4.54E+00
551 MIXR	268/IA	0	1400.	126.1	2.00	0.000	94.0	0.17500	1.62E-02
	267/IB	0	2401.	517.0	124.90	1.108	1285.7	1.69145	4.54E+00
	269/U	0	3801.	344.1	124.65	0.606	846.8	1.15645	2.19E+00

COMPONENT PROPERTIES

COMP	STREAM /PORT	FLU ID	MASS FLOW (LBM/HR)	TEMP (F)	PRESS (PSIA)	QUALITY (-)	ENTH (B/LB)	ENTRPY (B/LB-F)	SPEC. VOLUME (FT3/LBM)
502 COMB	10/IA	3	1827389.	615.5	128.88	N.A.	280.1	1.67017	3.14E+00
	102/IF	7	31371.	65.0	14.70	N.A.	426.8	4.05322	N.A.
	14/U	11	1858760.	1783.7	128.88	N.A.	652.6	1.88343	6.62E+00
503 COMB	11/IA	4	1844432.	620.0	132.68	N.A.	281.3	1.66922	3.06E+00
	103/IF	8	31560.	65.0	14.70	N.A.	426.9	4.05335	N.A.
	15/U	12	1875993.	1784.0	132.68	N.A.	652.6	1.88141	6.43E+00
504 COMB	12/IA	5	1865560.	617.7	127.48	N.A.	280.7	1.67145	3.18E+00
	104/IF	9	32066.	65.0	14.70	N.A.	426.9	4.05335	N.A.
	16/U	13	1897626.	1786.8	127.48	N.A.	653.6	1.88463	6.71E+00
511 MIXR	13/IA	10	1880116.	1787.6	130.78	N.A.	653.9	1.88294	6.54E+00
	111/IB	0	8707.	86.6	250.00	-0.388	55.3	0.10526	1.61E-02
	17/U	14	1888823.	1758.5	130.78	N.A.	651.2	1.88138	6.47E+00
512 MIXR	14/IA	11	1858760.	1783.7	128.88	N.A.	652.6	1.88343	6.62E+00
	112/IB	0	9908.	86.6	250.00	-0.388	55.3	0.10526	1.61E-02
	18/U	16	1868668.	1750.2	128.88	N.A.	649.5	1.88163	6.54E+00
513 MIXR	15/IA	12	1875993.	1784.0	132.68	N.A.	652.6	1.88141	6.43E+00
	113/IB	0	10508.	86.6	250.00	-0.388	55.3	0.10526	1.61E-02
	19/U	18	1886501.	1748.9	132.68	N.A.	649.2	1.87951	6.35E+00
514 MIXR	16/IA	13	1897626.	1786.8	127.48	N.A.	653.6	1.88463	6.71E+00
	114/IB	0	9458.	86.6	250.00	-0.388	55.3	0.10526	1.61E-02
	20/U	20	1907084.	1755.5	127.48	N.A.	650.7	1.88295	6.63E+00
521 MIXR	21/IA	14	1888823.	1600.5	87.00	N.A.	603.8	1.88798	9.04E+00
	51/IB	2	37718.	616.2	130.78	N.A.	280.3	1.66932	3.09E+00
	25/U	15	1926541.	1582.8	87.30	N.A.	597.5	1.88500	8.92E+00
522 MIXR	22/IA	16	1868668.	1598.8	87.00	N.A.	604.0	1.88806	9.03E+00
	52/IB	3	37292.	615.5	128.88	N.A.	280.1	1.67017	3.14E+00
	26/U	17	1905960.	1581.1	87.29	N.A.	597.7	1.88508	8.92E+00
523 MIXR	23/IA	18	1886501.	1585.7	87.00	N.A.	600.3	1.88627	8.97E+00
	53/IB	4	37640.	620.0	132.68	N.A.	281.3	1.66922	3.06E+00
	27/U	19	1924140.	1568.3	87.31	N.A.	594.1	1.88331	8.86E+00

COMPONENT PROPERTIES

COMP	STREAM /PORT	FLU ID	MASS FLOW (LBM/HR)	TEMP (F)	PRESS (PSIA)	QUALITY (-)	ENTH (B/LB)	ENTRPY (B/LB-F)	SPEC. VOLUME (FT3/LBM)
633 SPCT	206/I	0	420000.	127.3	1274.68	-0.807	98.5	0.17610	1.62E-02
	214/U	0	210000.	127.3	1274.68	-0.807	98.5	0.17610	1.62E-02
	213/B	0	210000.	127.3	1274.68	-0.807	98.5	0.17610	1.62E-02
641 SFIX	257/I	0	840000.	867.0	749.57	1.340	1439.3	1.63576	1.00E+00
	258/U	0	839418.	867.0	749.57	1.340	1439.3	1.63576	1.00E+00
	263/B	0	582.	867.0	749.57	1.340	1439.3	1.63576	1.00E+00
644 SFIX	264/I	0	3801.	517.0	124.90	1.108	1285.7	1.69145	4.54E+00
	266/U	0	1400.	517.0	124.90	1.108	1285.7	1.69145	4.54E+00
	267/B	0	2401.	517.0	124.90	1.108	1285.7	1.69145	4.54E+00
649 SFIX	259/I	0	839418.	458.8	103.00	1.079	1257.9	1.68281	5.16E+00
	260/U	0	836199.	458.8	103.00	1.079	1257.9	1.68281	5.16E+00
	265/B	0	3219.	458.8	103.00	1.079	1257.9	1.68281	5.16E+00
801 PMAC	1/I	2	1886006.	90.2	14.58	N.A.	149.4	1.65537	1.42E+01
	5/U	2	1886006.	616.2	130.78	N.A.	280.3	1.66932	3.09E+00
802 PMAC	2/I	3	1864681.	90.2	14.58	N.A.	149.4	1.65537	1.42E+01
	6/U	3	1864681.	615.5	128.88	N.A.	280.1	1.67017	3.14E+00
803 PMAC	3/I	4	1882072.	90.2	14.59	N.A.	149.4	1.65534	1.42E+01
	7/U	4	1882072.	620.0	132.68	N.A.	281.3	1.66922	3.06E+00
804 PMAC	4/I	5	1903631.	90.2	14.58	N.A.	149.4	1.65537	1.42E+01
	8/U	5	1903631.	617.7	127.48	N.A.	280.7	1.67145	3.18E+00
811 TGAS	17/I	14	1888823.	1758.5	126.20	N.A.	651.2	1.88390	6.71E+00
	21/U	14	1888823.	1600.5	87.00	N.A.	603.8	1.88798	9.04E+00
812 TGAS	18/I	16	1868668.	1750.2	124.37	N.A.	649.5	1.88414	6.78E+00
	22/U	16	1868668.	1598.8	87.00	N.A.	604.0	1.88806	9.03E+00
813 TGAS	19/I	18	1886501.	1748.9	128.04	N.A.	649.2	1.88202	6.58E+00
	23/U	18	1886501.	1585.7	87.00	N.A.	600.3	1.88627	8.97E+00
814 TGAS	20/I	20	1907084.	1755.5	123.02	N.A.	650.7	1.88546	6.87E+00
	24/U	20	1907084.	1608.2	87.00	N.A.	606.5	1.88926	9.07E+00

COMPONENT PROPERTIES

COMP	STREAM /PORT	FLU ID	MASS FLOW (LBM/HR)	TEMP (F)	PRESS (PSIA)	QUALITY (-)	ENTH (B/LB)	ENTRPY (B/LB-F)	SPEC. VOLUME (FT3/LBM)
601 SPCT	5/I	2	1886006.	616.2	130.78	N.A.	280.3	1.66932	3.09E+00
	9/U	2	1848287.	616.2	130.78	N.A.	280.3	1.66932	3.09E+00
	51/B	2	37718.	616.2	130.78	N.A.	280.3	1.66932	3.09E+00
602 SPCT	6/I	3	1864681.	615.5	128.88	N.A.	280.1	1.67017	3.14E+00
	10/U	3	1827389.	615.5	128.88	N.A.	280.1	1.67017	3.14E+00
	52/B	3	37292.	615.5	128.88	N.A.	280.1	1.67017	3.14E+00
603 SPCT	7/I	4	1882072.	620.0	132.68	N.A.	281.3	1.66922	3.06E+00
	11/U	4	1844432.	620.0	132.68	N.A.	281.3	1.66922	3.06E+00
	53/B	4	37640.	620.0	132.68	N.A.	281.3	1.66922	3.06E+00
604 SPCT	8/I	5	1903631.	617.7	127.48	N.A.	280.7	1.67145	3.18E+00
	12/U	5	1865560.	617.7	127.48	N.A.	280.7	1.67145	3.18E+00
	54/B	5	38071.	617.7	127.48	N.A.	280.7	1.67145	3.18E+00
611 SPCT	29/I	15	1926541.	982.5	15.24	N.A.	422.5	1.90676	3.61E+01
	33/U	15	1629645.	982.5	15.24	N.A.	422.5	1.90676	3.61E+01
	61/B	15	296896.	982.5	15.24	N.A.	422.5	1.90676	3.61E+01
612 SPCT	30/I	17	1905960.	974.2	15.19	N.A.	420.8	1.90570	3.60E+01
	34/U	17	1658937.	974.2	15.19	N.A.	420.8	1.90570	3.60E+01
	62/B	17	247023.	974.2	15.19	N.A.	420.8	1.90570	3.60E+01
613 SPCT	31/I	19	1924140.	974.2	15.17	N.A.	420.9	1.90589	3.61E+01
	35/U	19	1646779.	974.2	15.17	N.A.	420.9	1.90589	3.61E+01
	63/B	19	277362.	974.2	15.17	N.A.	420.9	1.90589	3.61E+01
614 SPCT	32/I	21	1945155.	976.4	15.17	N.A.	421.1	1.90603	3.61E+01
	36/U	21	1649932.	976.4	15.17	N.A.	421.1	1.90603	3.61E+01
	64/B	21	295223.	976.4	15.17	N.A.	421.1	1.90603	3.61E+01
631 SPCT	204/I	0	840000.	127.3	1274.68	-0.807	98.5	0.17610	1.62E-02
	206/U	0	420000.	127.3	1274.68	-0.807	98.5	0.17610	1.62E-02
	205/B	0	420000.	127.3	1274.68	-0.807	98.5	0.17610	1.62E-02
632 SPCT	205/I	0	420000.	127.3	1274.68	-0.807	98.5	0.17610	1.62E-02
	211/U	0	210000.	127.3	1274.68	-0.807	98.5	0.17610	1.62E-02
	212/B	0	210000.	127.3	1274.68	-0.807	98.5	0.17610	1.62E-02

PROPERTIES FOR ACTIVE STREAMS

STRM	STRM TYPE	FROM /TO	FLU ID	MASS FLOW (LBM/HR)	TEMP (F)	PRESS (PSIA)	QUALITY (-)	ENTHALPY (B/LB)	PDRP/P (-)
17	2	511-U	14	1888823.	1758.5	130.8	N.A.	651.2	0.035
		811-I			1758.5	126.2	N.A.	651.2	
18	2	512-U	16	1868668.	1750.2	128.9	N.A.	649.5	0.035
		812-I			1750.2	124.4	N.A.	649.5	
19	2	513-U	18	1886501.	1748.9	132.7	N.A.	649.2	0.035
		813-I			1748.9	128.0	N.A.	649.2	
20	2	514-U	20	1907084.	1755.5	127.5	N.A.	650.7	0.035
		814-I			1755.5	123.0	N.A.	650.7	
204	6	402-U	0	840000.	127.3	1274.7	-0.8071	98.5	0.000
		631-I			127.3	1274.7	-0.8071	98.5	
257	6	543-U	0	840000.	867.0	749.6	1.3408	1439.3	0.000
		641-I			867.0	749.6	1.3408	1439.3	

PEPSE C' BY NUS CORPORATION, IDAHO FALLS, ID.
VERSION 1 CREATED 22 JAN 91 DATE 01-07-93. AGE 21
THW 4 COMBINED CYCLE TEST, 6/25/92, MED stm flow, MEA stack T. (4CC_6_25_92)

COMPONENT PROPERTIES

COMP	STREAM /PORT	FLU ID	MASS FLOW (LBM/HR)	TEMP (F)	PRESS (PSIA)	QUALITY (-)	ENTH (B/LB)	ENTRPY (B/LB-F)	SPEC. VOLUME (FT3/LBM)
821 TGAS	25/I	15	1926541.	1582.8	87.30	N.A.	597.5	1.88500	8.92E+00
	29/U	15	1926541.	982.5	15.24	N.A.	422.5	1.90676	3.61E+01
822 TGAS	26/I	17	1905960.	1581.1	87.29	N.A.	597.7	1.88508	8.92E+00
	30/U	17	1905960.	974.2	15.19	N.A.	420.8	1.90570	3.60E+01
823 TGAS	27/I	19	1924140.	1568.3	87.31	N.A.	594.1	1.88331	8.86E+00
	31/U	19	1924140.	974.2	15.17	N.A.	420.9	1.90589	3.61E+01
824 TGAS	28/I	21	1945155.	1590.4	87.28	N.A.	600.1	1.88628	8.96E+00
	32/U	21	1945155.	976.4	15.17	N.A.	421.1	1.90603	3.61E+01

MATERIAL DESCRIPTIONS USED IN THE MODEL

FLUID ID	CONSTITUENT MASS FRACTIONS									FUEL HIGH HEAT VALUE (BTU/LBM)
	CO2	H2O	SO2	O2	N2	CO	H2	C	S	ASH	
19	0.044	0.056		0.161	0.739						N.A.
20	0.045	0.056		0.159	0.739						N.A.
21	0.044	0.056		0.161	0.740						N.A.

FLUID ID	CONSTITUENT MOLE FRACTIONS, EXCLUSIVE OF ASH								
	CO2	H2O	SO2	O2	N2	CO	H2	C	S
0		1.000							
1				0.209	0.791				
2		0.026		0.203	0.771				
3		0.026		0.203	0.771				
4		0.026		0.203	0.771				
5		0.026		0.203	0.771				
6				0.006	0.001		0.654	0.339	
7				0.006	0.001		0.654	0.339	
8				0.006	0.001		0.654	0.339	
9				0.006	0.001		0.654	0.339	
10	0.029	0.081		0.141	0.749				
11	0.029	0.081		0.141	0.749				
12	0.029	0.081		0.142	0.749				
13	0.029	0.081		0.141	0.749				
14	0.029	0.088		0.140	0.743				
15	0.028	0.086		0.142	0.744				
16	0.029	0.088		0.140	0.743				
17	0.028	0.087		0.142	0.743				
18	0.028	0.089		0.140	0.742				
19	0.028	0.087		0.142	0.743				
20	0.029	0.088		0.140	0.743				
21	0.028	0.087		0.142	0.744				

MATERIAL DESCRIPTIONS USED IN THE MODEL

FLUID ID	CONSTITUENT MASS FRACTIONS									FUEL HIGH HEAT VALUE (BTU/LBM)
	CO2	H2O	SO2	O2	N2	CO	H2	C	S	ASH	
0		1.000									
1				0.232	0.769						N.A.
2		0.016		0.228	0.756						N.A.
3		0.016		0.228	0.756						N.A.
4		0.016		0.228	0.756						N.A.
5		0.016		0.228	0.756						N.A.
6				0.036	0.003		0.235	0.726			2.2470E+04
7				0.036	0.003		0.235	0.726			2.2470E+04
8				0.036	0.003		0.235	0.726			2.2470E+04
9				0.036	0.003		0.235	0.726			2.2470E+04
10	0.045	0.052		0.160	0.743						N.A.
11	0.045	0.052		0.160	0.743						N.A.
12	0.045	0.051		0.161	0.743						N.A.
13	0.045	0.052		0.160	0.743						N.A.
14	0.045	0.056		0.159	0.740						N.A.
15	0.044	0.055		0.161	0.740						N.A.
16	0.045	0.057		0.160	0.739						N.A.
17	0.044	0.056		0.161	0.740						N.A.
18	0.044	0.057		0.160	0.739						N.A.

COMPARISON OF COMPONENT PORT TEST DATA WITH PEPSE EMPLOYED STREAM PROPERTIES

STREAM NUMBER	STRM TYPE	PEPSE/ TEST	STREAM START/ END	TEMPERATURE (F)	THERMO PRESSURE (PSIA)	QUALITY (-)
5	0	PEPSE	START		130.78	
		TEST	START		130.78	
6	0	PEPSE	START		128.88	
		TEST	START		128.88	
7	0	PEPSE	START		132.68	
		TEST	START		132.68	
8	0	PEPSE	START		127.48	
		TEST	START		127.48	
37	0	PEPSE	START		14.70	
		TEST	START		14.70	
38	0	PEPSE	START		14.70	
		TEST	START		14.70	
39	0	PEPSE	START		14.70	
		TEST	START		14.70	
40	0	PEPSE	START		14.70	
		TEST	START		14.70	
202	0	PEPSE	START		117.68	
		TEST	START		117.68	
204	6	PEPSE	START		1274.68	
		TEST	START		1274.68	
215	0	PEPSE	START	867.0	754.68	
		TEST	START	867.0	754.68	
252	0	PEPSE	START	867.0	734.68	
		TEST	START	867.0	734.68	
253	0	PEPSE	START	867.0	754.68	
		TEST	START	867.0	754.68	
254	0	PEPSE	START	867.0	754.68	
		TEST	START	867.0	754.68	

PEPSE C/ BY NUS CORPORATION, IDAHO FALLS, ID.
VERSION 1 CREATED 22 JAN 91 DATE 01-07-93. AGE 25
THW 4 COMBINED CYCLE TEST, 6/25/92, MED stm flow, MEA stack T. (4CC_6_25_92)

STREAMS CARRYING THE TABULATED MATERIALS

FLU ID	ORIGIN +CMP/-STR	STREAMS:
0	N.A.	111, 112, 113, 114, 201, 202, 203, 204, 205, 206, 211, 212 213, 214, 215, 241, 242, 252, 253, 254, 255, 256, 257, 258 259, 260, 262, 263, 264, 265, 266, 267, 268, 269
1	0	
2	11	1, 5, 9, 51
3	12	2, 6, 10, 52
4	13	3, 7, 11, 53
5	14	4, 8, 12, 54
6	21	101
7	22	102
8	23	103
9	24	104
10	501	13
11	502	14
12	503	15
13	504	16
14	511	17, 21
15	521	25, 29, 33, 37, 41, 61
16	512	18, 22
17	522	26, 30, 34, 38, 42, 62
18	513	19, 23
19	523	27, 31, 35, 39, 43, 63
20	514	20, 24
21	524	28, 32, 36, 40, 44, 64

DETAILED TURBINE PERFORMANCE TABLE B

COMPONENT	STG GROUP BOWL FLOW (LBM/HR)	PRESSURE AT LOAD BOWL (PSIA)	PRESSURE AT LOAD SHELL (PSIA)	ENTHALPY AT LOAD BOWL (BTU/LBM)	ENTHALPY AT LOAD SHELL (BTU/LBM)	ENTROPY AT LOAD BOWL (BTU/LB-F)	ENTROPY AT LOAD SHELL (BTU/LB-F)	PRESS RATIO (-)	SHELL FLOW COEFF (*)	EXTR PRESS DROP (-)
811/GAS	1888823.	126.20	87.00	651.2	603.8	1.884	1.888	1.45	N.A.	N.A.
821/	1926541.	87.30	15.24	597.5	422.5	1.885	1.907	5.73	N.A.	N.A.
812/	1868668.	124.37	87.00	649.5	604.0	1.884	1.888	1.43	N.A.	N.A.
822/	1905960.	87.29	15.19	597.7	420.8	1.885	1.906	5.75	N.A.	N.A.
813/	1886501.	128.04	87.00	649.2	600.3	1.882	1.886	1.47	N.A.	N.A.
823/	1924140.	87.31	15.17	594.1	420.9	1.883	1.906	5.75	N.A.	N.A.
814/	1907084.	123.02	87.00	650.7	606.5	1.885	1.889	1.41	N.A.	N.A.
824/	1945155.	87.28	15.17	600.1	421.1	1.886	1.906	5.75	N.A.	N.A.
100/GENL	839418.	749.57	103.00	1439.3	1257.9	1.636	1.683	7.28	187221.	.00
101/	836199.	103.00	1.89	1257.9	1012.8	1.683	1.749	54.49	N.A.	.00

DETAILED TURBINE PERFORMANCE TABLE C

BASE END POINT PRESSURE IS 1.500 IN.HG

COMP NUMB	ACTUAL ANNULUS VELOCITY REF (FT/SEC)	ACTUAL ANNULUS VELOCITY LOAD (FT/SEC)	SONIC ANNULUS VELOCITY REF (FT/SEC)	SONIC ANNULUS VELOCITY LOAD (FT/SEC)	EFFICIENCY AT BASE END PRESSURE (-)	EFFICIENCY EXHAUST LOSS (BTU/LBM)	ENERGY END POINTS ELEP BASE P (B T U / L B M)	ELEP COND P	ELEP CHOK P	CHOKE PRESS (PSIA)
101	N.A.	578.8	N.A.	1462.6	0.87488	5.28	966.12	1007.55	N.A.	N.A.

DETAILED TURBINE PERFORMANCE TABLE A

COMPONENT	NUM FLOW ENDS	STAGE GRP EFFCYS REF. CASE (-)	STAGE GRP EFFCYS LOAD CASE (-)	MECHANICAL POWER REF. CASE (MW)	MECHANICAL POWER LOAD CASE (MW)	EXTRACT FLOW AT LOAD STEAM EXTRACTION (L B M / H R)	EXTRACT FLOW AT LOAD LIQUID REMOVED (L B M / H R)
811/GAS	1	N.A.	0.85000	N.A.	8.94551E+07		
821/	1	N.A.	0.85285	N.A.	3.37143E+08		
SECTION EFFICIENCY AT LOAD = 0.87837							
812/	1	N.A.	0.85000	N.A.	8.48766E+07		
822/	1	N.A.	0.86125	N.A.	3.37185E+08		
SECTION EFFICIENCY AT LOAD = 0.88486							
813/	1	N.A.	0.85000	N.A.	9.22965E+07		
823/	1	N.A.	0.84770	N.A.	3.33145E+08		
SECTION EFFICIENCY AT LOAD = 0.87435							
814/	1	N.A.	0.85000	N.A.	8.42676E+07		
824/	1	N.A.	0.86732	N.A.	3.48239E+08		
SECTION EFFICIENCY AT LOAD = 0.88964							
100/GENL	1	N.A.	0.81441	N.A.	4.46201E+01	0.	0.
101/	2	N.A.	0.86349	N.A.	6.00564E+01	0.	0.
SECTION EFFICIENCY AT LOAD = 0.86562							

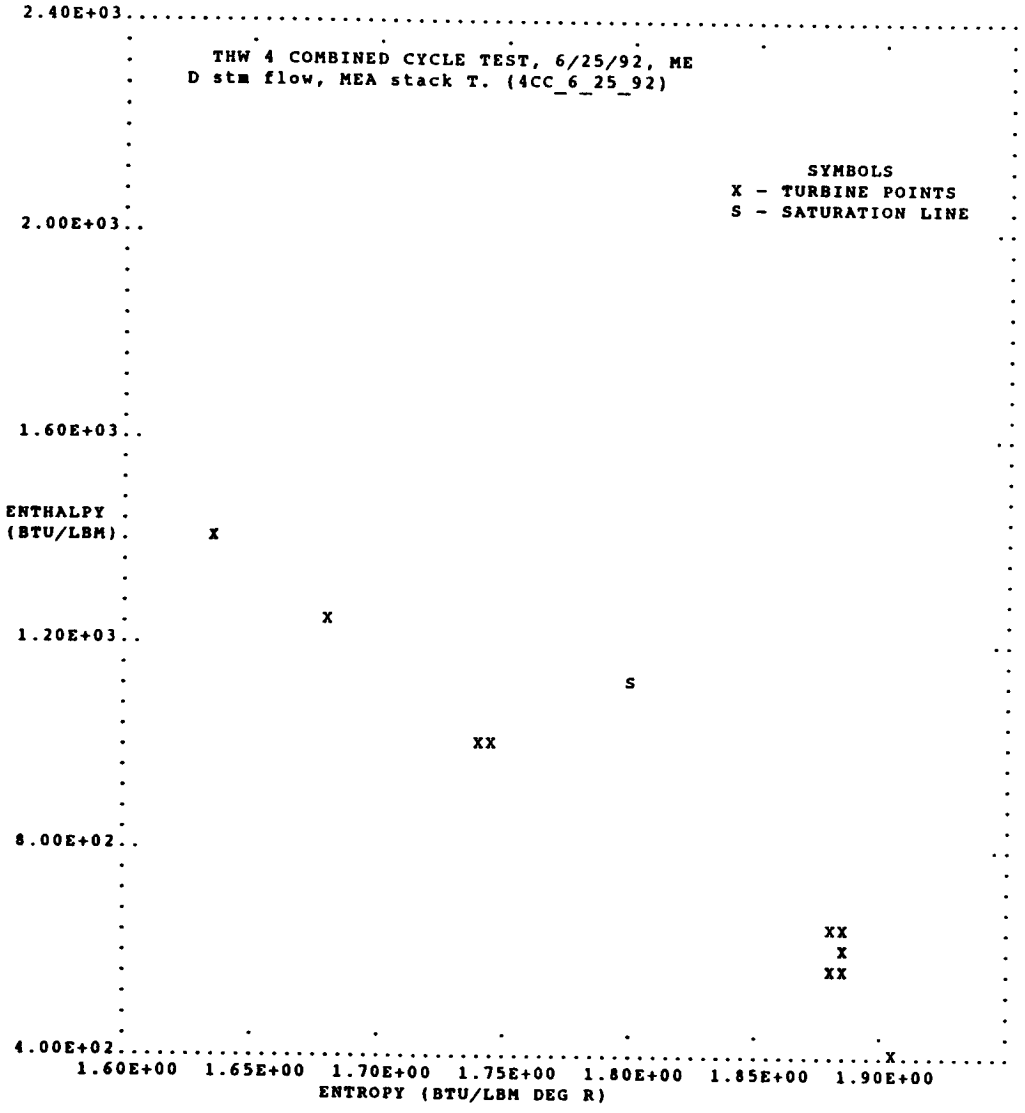
PEPSE C(BY NUS CORPORATION, IDAHO FALLS, ID.
VERSION 1 CREATED 22 JAN 91 DATE 01-07-93. AGE 30
THW 4 COMBINED CYCLE TEST, 6/25/92, MED stm flow, MEA stack T. (4CC_6_25_92)

DETAILED FEEDWATER HEATER PERFORMANCE OUTPUT - TABLE A
(EXTRACTION FLOW UPDATING BEGINS AT ITERATION 2)

HTR NO.	COMP NO.	COMPONENT DESCRIPTION	HEAT TRANSFER/DEG* CONDENSING SECTION (B T U / H R - F)	SUBCOOL/MX SECTION	HEAT# EX PERF INDEX (-)	TERM TEMP DIFF (TTD) (F)	DRAIN COOL DIFF (DCA) (F)	FW OR TUBE PRESS DROP (PSIA)	UPD INT/ (RELAXN) DEMAND REFERENCE (-)
A	200	STD. CONDENSER	3.79E+07	7.84E+04	9.62	N.A.	N.A.	0.0	N.A.
B	201	STD. CONDENSER	2.28E+04	0.00E+00	9.98	N.A.	N.A.	0.0	N.A.

* HEAT TRANSFER/DEG IS SIMILAR TO UA. SEE VOL 1 OUTPUT DESCRIPTION.
# PERFORMANCE INDEX IS SIMILAR TO EFFECTIVENESS. SEE VOL 1 OUTPUT DESCRIPTION.

TURBINE EXPANSION CHARACTERISTICS



DETAILED HEAT EXCHANGER PERFORMANCE OUTPUT

COMPONENT NUMBER	COMPONENT DESCRIPTION	HEAT EXCH SHELL LOSSES (BTU/HR)	HEAT TO TUBE SIDE FLUID (BTU/HR)	HEAT EXCH PERF INDEX# (-)	PRESSURE DROP TUBE (P S I)	PRESSURE DROP SHELL (P S I)
211	CONVECTIVE STAGE	0.0000	2.8153E+08	0.9544	520.000	0.542
212	CONVECTIVE STAGE	0.0000	2.8169E+08	0.9576	540.000	0.489
213	CONVECTIVE STAGE	0.0000	2.8153E+08	0.9575	520.000	0.471
214	CONVECTIVE STAGE	0.0000	2.8153E+08	0.9567	520.000	0.475

PERFORMANCE INDEX IS SIMILAR TO EFFECTIVENESS. SEE VOL 1 OUTPUT DESCRIPTION.

PEPSE C/ BY NUS CORPORATION, IDAHO FALLS, ID.
VERSION 1 CREATED 22 JAN 91 DATE 01-07-93. AGE 31
THW 4 COMBINED CYCLE TEST, 6/25/92, MED stm flow, MEA stack T. (4CC_6_25_92)

DETAILED FEEDWATER HEATER PERFORMANCE OUTPUT - TABLE B

HTR NO.	COMP NO.	COMPONENT DESCRIPTION	HEAT XFER TO FW OR CIRC.H2O (BTU/HR)	ENTHALPY RISE FW.OR CIRC. (BTU/LBM)	ENTHALPY DROP EXT STEAM (BTU/LBM)	MASS FLOWS TO HEATER SHELL (LBM/HR)	MASS FLOWS RATE HEATER DRAIN IN (LBM/HR)	MASS FLOWS RATE THRU TUBES (LBM/HR)
A	200	STD. CONDENSER	7.73E+08	26.8	920.9	836199.	3801.	28842924.
B	201	STD. CONDENSER	1.67E+06	2.0	1191.6	1400.	0.	840000.

DETAILED SPLITTER PERFORMANCE OUTPUT

COMPONENT NUMBER	COMPONENT DESCRIPTION	B PORT FLOW (LBM/HR)	B PORT QUALITY (-)	LEAKAGE CONSTANT (*)	MOISTURE REMOVAL EFFECTIVENESS (-)
601	FIXED P.C. SPLIT	37718.	N.A.	N.A.	N.A.
602	FIXED P.C. SPLIT	37292.	N.A.	N.A.	N.A.
603	FIXED P.C. SPLIT	37640.	N.A.	N.A.	N.A.
604	FIXED P.C. SPLIT	38071.	N.A.	N.A.	N.A.
611	FIXED P.C. SPLIT	296896.	N.A.	N.A.	N.A.
612	FIXED P.C. SPLIT	247023.	N.A.	N.A.	N.A.
613	FIXED P.C. SPLIT	277362.	N.A.	N.A.	N.A.
614	FIXED P.C. SPLIT	295223.	N.A.	N.A.	N.A.
631	FIXED P.C. SPLIT	420000.	-0.8071	N.A.	N.A.
632	FIXED P.C. SPLIT	210000.	-0.8071	N.A.	N.A.
633	FIXED P.C. SPLIT	210000.	-0.8071	N.A.	N.A.
641	FIXED FLOW SPLIT	582.	1.3409	N.A.	N.A.
644	FIXED FLOW SPLIT	2401.	1.1081	N.A.	N.A.
649	FIXED FLOW SPLIT	3219.	1.0791	N.A.	N.A.

DETAILED PUMP/COMPRESSOR PERFORMANCE OUTPUT

COMP NO.	COMPONENT DESCRIPTION	PUMP/COMP EFFICIENCY (-)	LINKAGE/ DRIVER EFFIC (-)	PRESSURE RISE (PSI)	ENTH RISE (BTU/LBM)	DRIVER POWER (KW)	GLAND/SEAL LOSSES (BTU/HR)
401	STD. ELE. PUMP	0.8000	1.0000 0.9500	115.79 267.13 FT	0.43	1.1257E+02	0.0000
402	STD. ELE. PUMP	0.8500	1.0000 0.9500	1157.00 2669.19 FT	4.08	1.0573E+03	0.0000
801	AUX. DR. FAN/CMP	0.8883	1.0000 N.A.	116.20	130.87	7.2337E+04	0.0000
802	AUX. DR. FAN/CMP	0.8817	1.0000 N.A.	114.30	130.69	7.1419E+04	0.0000
803	AUX. DR. FAN/CMP	0.8893	1.0000 N.A.	118.09	131.85	7.2726E+04	0.0000
804	AUX. DR. FAN/CMP	0.8720	1.0000 N.A.	112.90	131.25	7.3226E+04	0.0000

INPUT POWER	WHP	ACTUAL INPUT POWER	PUMP EFF
106.94 KW	85.55 KW 63.795 HP	93.181 BHP	68.46

FIRST LAW OF THERMODYNAMICS PERFORMANCE - ENVELOPE 1

TERM			
	HEAT SUPPLIED (ALL UNITS ARE BTU/HR) -		
	MAKEUP HEATS BY FLOW INTO THE ENVELOPE		
1	AT SOURCE/SINK COMPONENT, USER ID 11	6.09671E+06	
2	AT SOURCE/SINK COMPONENT, USER ID 12	6.02777E+06	
3	AT SOURCE/SINK COMPONENT, USER ID 13	6.08396E+06	
4	AT SOURCE/SINK COMPONENT, USER ID 14	6.15368E+06	
5	AT SOURCE/SINK COMPONENT, USER ID 21	6.44628E+08	
6	AT SOURCE/SINK COMPONENT, USER ID 22	6.35352E+08	
7	AT SOURCE/SINK COMPONENT, USER ID 23	6.39190E+08	
8	AT SOURCE/SINK COMPONENT, USER ID 24	6.49426E+08	
9	AT SOURCE/SINK COMPONENT, USER ID 31	-9.05426E+06	
10	AT SOURCE/SINK COMPONENT, USER ID 32	-1.03032E+07	
11	AT SOURCE/SINK COMPONENT, USER ID 33	-1.09271E+07	
12	AT SOURCE/SINK COMPONENT, USER ID 34	-9.83521E+06	
13	AT BOUNDARY STREAM, USER ID 204	-8.37243E+08	
	LETDOWN HEATS BY FLOW FROM THE ENVELOPE		
14	AT SOURCE/SINK COMPONENT, USER ID 41	1.80368E+08	
15	AT SOURCE/SINK COMPONENT, USER ID 42	1.71014E+08	
16	AT SOURCE/SINK COMPONENT, USER ID 43	1.75528E+08	
17	AT SOURCE/SINK COMPONENT, USER ID 44	1.81568E+08	
18	AT BOUNDARY STREAM, USER ID 257	2.89032E+08	
19	NET HEAT TO ENVELOPE BY FLOW		7.18085E+08
20	CIRC WATER LOAD CREDIT (HEAT IN)	0.00000E+00	
21	FURNACE UNACCOUNTED HEAT LOSSES	0.00000E+00	
22	BOILER REHEAT (TYPE 25 COMPONENTS)	0.00000E+00	
23	UNSPECIFIED HEAT EXCHANGERS (HEAT IN)	0.00000E+00	
24	COMPONENT VESSEL LOSSES	0.00000E+00	
25	PIPE HEAT AND ELEVATION LOSSES	-6.97500E-07	
26	PUMP/COMP/FAN INEFFICIENCY LOSSES	0.00000E+00	
27	PUMP GLANDS AND SEALS LOSSES	0.00000E+00	
28	GENERATOR HYD AND OIL COOLER (HEAT IN)	0.00000E+00	
29	HEAT IN AS ELECTRIC PUMP/COMP/FAN POWER	0.00000E+00	
30	NET POWER SUPPLIED		7.18085E+08
	POWER OUT (ALL UNITS ARE MWE) -		
31	NET TURBINE WHEEL POWER TO GENERATORS	2.10450E+02	
32	APPORTIONED GENERATOR MECHANICAL LOSSES	1.56513E+00	
33	APPORTIONED GENERATOR ELECTRICAL LOSSES	2.93030E+00	
34	GROSS GENERATOR POWER		2.05954E+02
35	ELECTRIC POWER USED FOR PUMP/COMP/FAN	0.00000E+00	
36	APP HOUSE LOAD EXC ELEC PUMP/COMP/FAN	0.00000E+00	
37	NET GENERATOR POWER		2.05954E+02
	ENVELOPE PERFORMANCE, EFFICIENCY, -	9.78639E-01	
	ENVELOPE PERFORMANCE, HEAT RATE, BTU/KW-HR	3.48662E+03	

BY DEFAULT, EFFICIENCY IS DEFINED AS (NET GENERATOR POWER / NET POWER SUPPLIED)
BY DEFAULT, HEAT RATE IS DEFINED AS (NET POWER SUPPLIED / NET GENERATOR POWER)

DETAILED COMBUSTOR PERFORMANCE OUTPUT

COMP NO.	FUEL FIRING RATE (LBM/HR)	FRACT. EXCESS AIR (-)	AD. FLAME TEMP. (F)	EXIT TEMP. (F)	ENERGY (BTU/HR) IN-AIR/ IN-FUEL	OUT-REFUSE/ OUT-FLU GAS	LOST TO ENVIR.	RESIDENT HX'S
501	3.183E+04	2.5148	1787.6	1787.6	2.479E+08 6.446E+08	0.000E+00 8.925E+08	0.000E+00	0.000E+00
502	3.137E+04	2.5259	1783.7	1783.7	2.447E+08 6.354E+08	0.000E+00 8.801E+08	0.000E+00	0.000E+00
503	3.156E+04	2.5374	1784.0	1784.0	2.492E+08 6.392E+08	0.000E+00 8.883E+08	0.000E+00	0.000E+00
504	3.207E+04	2.5215	1786.8	1786.8	2.509E+08 6.494E+08	0.000E+00 9.003E+08	0.000E+00	0.000E+00

FIRST LAW OF THERMODYNAMICS PERFORMANCE - SYSTEM

HEAT SUPPLIED (ALL UNITS ARE BTU/HR) -		
BOILER HEAT TO WORKING FLUID	-7.72896E+08	
1ST BOILER REHEAT (IN, TYPE 25 COMPONENT)	0.00000E+00	
2ND BOILER REHEAT (IN, TYPE 25 COMPONENT)	0.00000E+00	
UNSPECIFIED HEAT EXCHANGERS (HEAT IN)	0.00000E+00	
GROSS HEAT SUPPLIED		-7.72896E+08
MAKEUP HEAT (BY FLOW IN)	2.55284E+09	
LETDOWN HEAT (BY FLOW OUT)	7.08478E+08	
CIRC WATER LOAD CREDIT (HEAT IN)	7.74565E+08	
COMPONENT VESSEL LOSSES	0.00000E+00	
PIPE HEAT AND ELEVATION LOSSES	-6.97500E-07	
PUMP/COMP/FAN INEFFICIENCY LOSSES	1.99590E+05	
PUMP GLANDS AND SEALS LOSSES	0.00000E+00	
GENERATOR HYD AND OIL COOLER (HEAT IN)	0.00000E+00	
NET HEAT SUPPLIED		1.84583E+09
HEAT IN AS ELECTRIC PUMP/COMP/FAN POWER	3.99180E+06	
NET POWER SUPPLIED		1.84982E+09

POWER OUT (ALL UNITS ARE MWE) -		
NET TURBINE WHEEL POWER TO GENERATORS	315.126	
GENERATOR MECHANICAL LOSSES	2.344	
GENERATOR ELECTRICAL LOSSES	4.388	
GROSS GENERATOR POWER		308.395
ELECTRIC POWER USED FOR PUMP/COMP/FAN	1.170	
HOUSE LOAD POWER, EXCLUDING ELEC PUMP/COMP/FAN	0.000	
NET GENERATOR POWER		307.225

SYSTEM PERFORMANCE	THERMAL EFF. (-)	HEAT RATE (BTU/KW-HR)
GROSS ACTUAL TURBINE CYCLE (GROSS HEAT SUPPLIED / GROSS GENERATOR POWER)	-1.36149	-2506.
NET ACTUAL TURBINE CYCLE (MOD NET POWER SUPPLIED / NET GENERATOR POWER)	0.56664	6022.
TURBINE CYCLE STEAM RATE, LBM/KW-HR		93.5259

NOTE: MOD NET POWER SUPPLIED = NET POWER SUPPLIED + COMPONENT VESSEL LOSSES + PIPE HEAT AND ELEVATION LOSSES + PUMP INEFFICIENCY LOSSES + PUMP GLANDS AND SEALS LOSSES

FIRST LAW OF THERMODYNAMICS PERFORMANCE - ENVELOPE 2

	TERM		
	HEAT SUPPLIED (ALL UNITS ARE BTU/HR) -		
	MAKEUP HEATS BY FLOW INTO THE ENVELOPE		
1	AT SOURCE/SINK COMPONENT, USER ID 50	-2.99873E+10	
2	AT BOUNDARY STREAM, USER ID 257	2.89032E+08	
	LETDOWN HEATS BY FLOW FROM THE ENVELOPE		
3	AT SOURCE/SINK COMPONENT, USER ID 51	-2.92144E+10	
4	AT BOUNDARY STREAM, USER ID 204	-8.37243E+08	
5	NET HEAT TO ENVELOPE BY FLOW		3.53379E+08
6	CIRC WATER LOAD CREDIT (HEAT IN)	7.74565E+08	
7	FURNACE UNACCOUNTED HEAT LOSSES	0.00000E+00	
8	BOILER REHEAT (TYPE 25 COMPONENTS)	0.00000E+00	
9	UNSPECIFIED HEAT EXCHANGERS (HEAT IN)	0.00000E+00	
10	COMPONENT VESSEL LOSSES	0.00000E+00	
11	PIPE HEAT AND ELEVATION LOSSES	0.00000E+00	
12	PUMP/COMP/FAN INEFFICIENCY LOSSES	1.99590E+05	
13	PUMP GLANDS AND SEALS LOSSES	0.00000E+00	
14	GENERATOR HYD AND OIL COOLER (HEAT IN)	0.00000E+00	
15	HEAT IN AS ELECTRIC PUMP/COMP/FAN POWER	3.99180E+06	
16	NET POWER SUPPLIED		1.13174E+09
	POWER OUT (ALL UNITS ARE MWE) -		
17	NET TURBINE WHEEL POWER TO GENERATORS	1.04677E+02	
18	APPORTIONED GENERATOR MECHANICAL LOSSES	7.78488E-01	
19	APPORTIONED GENERATOR ELECTRICAL LOSSES	1.45752E+00	
20	GROSS GENERATOR POWER		1.02441E+02
21	ELECTRIC POWER USED FOR PUMP/COMP/FAN	1.16988E+00	
22	APP HOUSE LOAD EXC ELEC PUMP/COMP/FAN	0.00000E+00	
23	NET GENERATOR POWER		1.01271E+02

ENVELOPE PERFORMANCE, EFFICIENCY, - 3.05327E-01

ENVELOPE PERFORMANCE, HEAT RATE, BTU/KW-HR 1.11754E+04

BY DEFAULT, EFFICIENCY IS DEFINED AS (NET GENERATOR POWER / NET POWER SUPPLIED)
BY DEFAULT, HEAT RATE IS DEFINED AS (NET POWER SUPPLIED / NET GENERATOR POWER)

SPECIAL OUTPUT TABLE OF SPECIFIED VARIABLES

INDEX	DESCRIPTION	VARIABLE(ID)	VALUE
151	1ST STACK CO2, DRY FRACT. (MOLE) VOL	OPVB (113)	3.077116E-02
160	2ND STACK O2, DRY FRACT. (MOLE) VOL	OPVB (122)	1.550696E-01
161	2ND STACK CO2, DRY FRACT. (MOLE) VOL	OPVB (123)	3.067261E-02
170	3RD STACK O2, DRY FRACT. (MOLE) VOL	OPVB (132)	1.552490E-01
171	3RD STACK CO2, DRY FRACT. (MOLE) VOL	OPVB (133)	3.056948E-02
180	4TH STACK O2, DRY FRACT. (MOLE) VOL	OPVB (142)	1.550007E-01
181	4TH STACK CO2, DRY FRACT. (MOLE) VOL	OPVB (143)	3.071148E-02

SPECIAL OUTPUT TABLE OF SPECIFIED VARIABLES

INDEX	DESCRIPTION	VARIABLE(ID)	VALUE
10	1ST GT COMPRESSOR CALC. AIR FLOW, ACFM	OPVB (10)	4.455621E+05
11	FIRST GT TEST HEAT INPUT, BTU/HR	QFLHHV(501)	7.151954E+08
12	FIRST GT TEST GROSS GENERATION, MW	BKGRO (1)	5.155640E+01
13	FIRST GT TEST GROSS HEAT RATE, BTU/KWH	OPVB (16)	1.387210E+04
14	FIRST GT CORR. ISO GROSS HEAT RATE	OPVB (17)	1.343883E+04
15	FIRST GT CORR. ISO GROSS GENERATION	OPVB (18)	5.839992E+01
16	FIRST GT CORR. ISO AIR FLOW, LB/HR	OPVB (19)	2.013672E+06
17	FIRST GT CORR. ISO EXHAUST TEMP., DEGF	OPVB (14)	9.691300E+02
18	1ST GT COMPRESSOR EFFICIENCY	EFFPMP(801)	8.883488E-01
19	1ST GT OVERALL EXPANDER EFFICIENCY	EFFSEC(821)	8.783732E-01
20	2ND GT COMPRESSOR CALC. AIR FLOW, ACFM	OPVB (20)	4.405243E+05
21	SECOND GT TEST HEAT INPUT, BTU/HR	QFLHHV(502)	7.049019E+08
22	SECOND GT TEST GROSS GENERATION, MW	BKGRO (2)	5.114950E+01
23	SECOND GT TEST GROSS HEAT RATE, BTU/KWH	OPVB (26)	1.378121E+04
24	SECOND GT CORR. ISO GROSS HEAT RATE	OPVB (27)	1.335078E+04
25	SECOND GT CORR. ISO GROSS GENERATION	OPVB (28)	5.793901E+01
26	SECOND GT CORR. ISO AIR FLOW, LB/HR	OPVB (29)	1.990904E+06
27	SECOND GT CORR. ISO EXHAUST TEMP., DEGF	OPVB (24)	9.691300E+02
28	2ND GT COMPRESSOR EFFICIENCY	EFFPMP(802)	8.816818E-01
29	2ND GT OVERALL EXPANDER EFFICIENCY	EFFSEC(822)	8.848555E-01
30	3RD GT COMPRESSOR CALC. AIR FLOW, ACFM	OPVB (30)	4.444481E+05
31	THIRD GT TEST HEAT INPUT, BTU/HR	QFLHHV(503)	7.091622E+08
32	THIRD GT TEST GROSS GENERATION, MW	BKGRO (3)	5.083590E+01
33	THIRD GT TEST GROSS HEAT RATE, BTU/KWH	OPVB (36)	1.395003E+04
34	THIRD GT CORR. ISO GROSS HEAT RATE	OPVB (37)	1.351433E+04
35	THIRD GT CORR. ISO GROSS GENERATION	OPVB (38)	5.758378E+01
36	THIRD GT CORR. ISO AIR FLOW, LB/HR	OPVB (39)	2.009472E+06
37	THIRD GT CORR. ISO EXHAUST TEMP., DEGF	OPVB (34)	9.691300E+02
38	3RD GT COMPRESSOR EFFICIENCY	EFFPMP(803)	8.892937E-01
39	3RD GT OVERALL EXPANDER EFFICIENCY	EFFSEC(823)	8.743471E-01
40	4TH GT COMPRESSOR CALC. AIR FLOW, ACFM	OPVB (40)	4.497261E+05
41	FOURTH GT TEST HEAT INPUT, BTU/HR	QFLHHV(504)	7.205185E+08
42	FOURTH GT TEST GROSS GENERATION, MW	BKGRO (4)	5.239010E+01
43	FOURTH GT TEST GROSS HEAT RATE, BTU/KWH	OPVB (46)	1.375295E+04
44	FOURTH GT CORR. ISO GROSS HEAT RATE	OPVB (47)	1.332341E+04
45	FOURTH GT CORR. ISO GROSS GENERATION	OPVB (48)	5.934428E+01
46	FOURTH GT CORR. ISO AIR FLOW, LB/HR	OPVB (49)	2.032491E+06
47	FOURTH GT CORR. ISO EXHAUST TEMP., DEGF	OPVB (44)	9.691300E+02
48	4TH GT COMPRESSOR EFFICIENCY	EFFPMP(804)	8.720173E-01
49	4TH GT OVERALL EXPANDER EFFICIENCY	EFFSEC(824)	8.896399E-01
70	SIMPLE CYCLE GROSS GENERATION, MW	OPVB (70)	2.059319E+02
71	STEAM TURBINE GROSS GENERATION, KW	POWER (5)	1.024630E+05
72	UNIT AUXILIARY LOAD, MW	OPVB (71)	3.901000E+00
73	COMBINED CYCLE GROSS GENERATION, MW	OPVB (72)	3.083949E+02
74	COMBINED CYCLE NET GENERATION, MW	OPVB (73)	3.044939E+02
75	TOTAL UNIT HEAT INPUT, BTU/HR	OPVB (74)	2.849778E+09
76	GROSS UNIT HEAT RATE, BTU/KWH	OPVB (75)	9.240678E+03
77	NET UNIT HEAT RATE, BTU/KWH	OPVB (76)	9.359064E+03
78	GROSS STEAM TURBINE HEAT RATE, BTU/KWH	OPVB (77)	1.099202E+04
79	STEAM TURBINE EFFICIENCY	EFFSEC(101)	8.656199E-01
141	1ST HRSG EFFECTIVENESS	EFFHX (211)	9.543887E-01
142	2ND HRSG EFFECTIVENESS	EFFHX (212)	9.576370E-01
143	3RD HRSG EFFECTIVENESS	EFFHX (213)	9.575183E-01
144	4TH HRSG EFFECTIVENESS	EFFHX (214)	9.566920E-01
150	1ST STACK O2, DRY FRACT. (MOLE) VOL	OPVB (112)	1.548963E-01

COMBINED CYCLE

The maximum capability test was performed on the T. H. Wharton Unit 4 on June 25,1992 at a combined gross load of 308,395 KW. The gross unit heat rate was calculated at 9204.7 BTu/KHr and the net unit heat rate at 9359.1 BTu/KWHr. The steam turbine gross generation is 102,463 KW with a gross turbine heat rate of 10992.2 BTu/KWHr.

Unit 41 GT and HRSG

Unit 41 GT produced a corrected output of 58,400 KW while the corrected heat rate is 13,435 BTu/KWHr. The compressor efficiency is 88.83% while the compressor suction flow is 1,886,006 lb/hr or 445,568 acfm. The expander isentropic efficiency is calculated at 87.84%.

The Unit 41 HRSG performance is based on the PEPSE calculated heat exchanger effectiveness. The Unit 41 HRSG has an effectiveness of 0.9544 with a measured stack temperature of 341.5°F. The estimated bypass stack leakage for this unit is 15.41%.

Unit 42 GT and HRSG

Unit 42 GT produced a corrected output of 57,939 KW while the corrected heat rate is 13,351 BTu/KWHr. The compressor efficiency is 88.17% while the compressor suction flow is 1,864,681 lb/hr or 440,524 acfm. The expander isentropic efficiency is calculated at 88.49%.

The Unit 42 HRSG performance is based on the PEPSE calculated heat exchanger effectiveness. The Unit 42 HRSG has an effectiveness of 0.9576 with a measured stack temperature of 344.5°F. The estimated bypass stack leakage for this unit is 12.98%.

Unit 43 GT and HRSG

Unit 43 GT produced a corrected output of 57,584KW while the corrected heat rate is 13,514 BTu/KWHr. The compressor efficiency is 88.93% while the compressor suction flow is 1,882,072 lb/hr or 444,448 acfm. The expander isentropic efficiency is calculated at 87.43%.

The Unit 43 HRSG performance is based on the PEPSE calculated heat exchanger effectiveness. The Unit 43 HRSG has an effectiveness of 0.9575 with a measured stack temperature of 340.0°F. The estimated bypass stack leakage for this unit is 14.41%.

Unit 44 GT and HRSG

Unit 44 GT produced a corrected output of 59,344 KW while the corrected heat rate is

13,323 BTu/KWHr. The compressor efficiency is 87.20% while the compressor suction flow is 1,903,631 lb/hr or 449,726 acfm. The expander isentropic efficiency is calculated at 88.96%.

The Unit 44 HRSG performance is based on the PEPSE calculated heat exchanger effectiveness. The Unit 44 HRSG has an effectiveness of 0.9567 with a measured stack temperature of 343.5°F. The estimated bypass stack leakage for this unit is 15.18%.

Auxiliary Equipment

The Condenser can reject 7.73e+8 BTu/Hr with an inlet temperature of 87.35°F and an outlet temperature of 114.12°F, a temperature rise of about 26.8°F. This provides a backpressure of 1.89 psia or 3.85 inHg for the steam turbine exhaust condition

The circulating water pump is delivering a flow of 57,908 gpm with a condenser inlet pressure of 34.8 psig.

The condensate pump is delivering a flow of 1696.6 gpm at a discharge head of 103 psig with an efficiency of 71.09%, the expected efficiency at this flow is 73.2% at a developed head of 280 ft or 121.21 psig.

The boiler feed pump is delivering a flow of 1686.1 gpm at a discharge head of 1260 psig with and efficiency of 74.77%, the expected efficiency at this flow is 74.2% at a developed head of 2370 ft or 1026 psig.

CONCLUSIONS

The T. H. Wharton Unit 4 Combined Cycle can achieve the maximum summer rated capability of 285 MW without any equipment limitations. The Unit 44 GT is the best performing GT with higher output and lowest heat rate. There is estimated a significant leakage thru the bypass dampers on each HSRG system, the dampers should be examined and adjusted for tighter closure. If this is not possible then an additional guillotine or knife gate closure device should be installed to reduce the exhaust gas loss.

If a detailed GT, HRSG, steam turbine or other component analysis is required or any cycle critical flows, temperatures and pressures are required on an on going basis then better monitoring instrumentation will need to be installed. Plant Engineers and their Instrument and Controls personnel, Maintenance Services GT personnel and Performance Analysis personnel should meet to discuss the need for better performance monitoring and the required instrumentation.

The condensate pump is head deficient and should be inspected at the next opportunity. Initially the lift should be reset and performance monitored, if not improved, the pump

should be scheduled for maintenance.

The boiler feed pump is operating as inspected and head capability is adequate for continued operation.

The circulating water pump is operating as expected and is adequate for continued operation.

The GT Prime modifications project underway will alleviate some of the simple cycle GT deficiencies but other maintenance is required for the balance of the combined cycle system as discussed above.

ACKNOWLEDGEMENTS

A. LAU HL&P Performance Analysis Supervising Engineer for test data and PEPSE run on T. H. Wharton Unit 4.

ASME -American Society of Mechanical Engineers Performance Test Codes (PTC)

PEPSE - Trademark of Halliburton NUS Corporation

Bailey - Trademark of Bailey Meter Co.

EPRI - Electric Power Research Institute

GATE and EMAP - Trademarks of Gas Turbine Performance Software Products liscensed by EPRI

PEPSE Users Manuals Volumes I & II, Halliburton Nus Corporation

GE-Trademark of General Electric Corporation