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**User's Instructions for ORCENT II—
A Digital Computer Program for the
Analysis of Steam Turbine Cycles
Supplied by Light-Water-Cooled Reactors**

L. C. Fuller

OAK RIDGE NATIONAL LABORATORY
OPERATED BY UNION CARBIDE CORPORATION · FOR THE DEPARTMENT OF ENERGY

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USER'S INSTRUCTIONS FOR ORCENT II - A DIGITAL COMPUTER
PROGRAM FOR THE ANALYSIS OF STEAM TURBINE CYCLES
SUPPLIED BY LIGHT-WATER-COOLED REACTORS

L. C. Fuller

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ABSTRACT

The ORCENT-II digital computer program will perform calculations at valves-wide-open design conditions, maximum guaranteed rating conditions, and an approximation of part-load conditions for steam turbine cycles supplied with throttle steam characteristic of contemporary light-water reactors. Turbine performance calculations are based on a method published by the General Electric Company. Output includes all information normally shown on a turbine-cycle heat balance diagram. The program is written in FORTRAN IV for the IBM System 360 digital computers at the Oak Ridge National Laboratory (ORNL).

Keywords: feedwater heating, heat balance, steam cycle, turbine generator.

1. INTRODUCTION

This report describes ORCENT II, an updated version of the original ORCENT digital computer program for analyzing turbine cycles with large steam turbine generators operating with saturated or low-superheat throttle steam, such as that provided by light-water-cooled nuclear reactors (LWRs). The original ORCENT code¹ was published in January 1969, with turbine performance calculations based on the method presented by the General Electric Company at the 1967 American Power Conference.² Turbine performance calculations in ORCENT II are based on a revised method published by the General Electric Company in 1973 (Ref 3), and the ORCENT program has undergone extensive revisions to match the 1973 performance data. In addition, ORCENT II utilizes the 1967 American Society of Mechanical Engineers (ASME) formulations and iterative procedures for the calculation of the properties of steam⁴ adapted for use at ORNL by D. W. Altom. These formulations and procedures replace the equations of Keenan and Keyes⁵ and algorithms of the Westinghouse Electric Corporation⁶ used in the original ORCENT code.

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This report includes (1) a detailed description of input data requirements with recommendations for various parameters, (2) input data and program output for two example problems in Appendices A and B, and (3) a FORTRAN listing of the program in Appendix C. The methodology used is not included because it is covered in detail in Ref. 3. Access to this General Electric Company report is essential for applying and understanding the program. References 7 and 8 are also very helpful.

The ORCENT II computer program is written in FORTRAN IV for the IBM System 360 digital computers at ORNL.

2. APPLICATIONS

The current version of ORCENT permits calculations at valves-wide-open (VWO) design conditions, maximum guaranteed rating conditions, and an approximation of part-load conditions, whereas the 1969 version was limited to calculation of turbine maximum guaranteed conditions. However, the 1978 version of ORCENT is less versatile than the 1969 version in terms of cycle arrangement. Operating conditions (VWO through part-load) have been expanded, and accuracy has been improved. The preparation of input data may be more or less complex now than it was in the previous version, depending on the cycle arrangement and the accuracy requirement.

Example problems 1 and 2 in Appendices A and B demonstrate the application of ORCENT II to boiling-water-reactor (BWR) and pressurized-water-reactor (PWR) cycles, respectively. The ORCENT II program is limited to 1800-rpm tandem-compound turbine generators with single- or double-flow high-pressure sections and one, two, or three double-flow low-pressure turbine sections. Steam supply for LWR cycles is generally in the range of 900 to 1100 psia and slightly wet to 100°F of initial superheat. Normally, LWR cycles will contain a moisture separator and may contain one or two stages of steam reheat. The method in Ref. 3 is intended to be applied to condensing turbines with exhaust pressure of 5 in. Hg abs or less, but ORCENT II will also make calculations at elevated pressures. The code is intended for use on units rated 500 Mw(e)

and larger but will run to completion for units rated as low as 100 MW(e). Results should be viewed with some suspicion, because not all mechanical and generator loss functions in Ref. 3 have been plotted for generator ratings below 500 MVA. Numerous warning messages are printed when independent variables exceed their intended limits, but limit checks are by no means complete.

Appendix IV of Ref. 3 provides equations and tabular values representing curves required to determine efficiencies and losses. It also contains tabular listings for limits for throttle flow ratio, stage-group pressure ratio, first-stage bowl pressure, inlet volume flow per end, annulus velocity, generator kVA, and other independent variables.

3. DATA INPUT DESCRIPTION

Input data are entered on cards as described below and as shown in Fig. 1 and in example problems 1 and 2 of Appendices A and B. The first data card for each case must be a title or comment card. A "case" refers to a complete heat balance calculation, whether at VVO design conditions, maximum guaranteed rating conditions, or part-load conditions. Often, calculation of two cases will be required to arrive at a desired result: VVO design for the first case and maximum guaranteed rating or part load for the second case. Seventy-two columns of the first data card are read, and these comments are printed at the top of each page which is part of that case. If the user fails to include a comment card in any case, the next data card will be interpreted as a comment card. The title card may be followed by various data cards containing a flag variable IFLAG, right-adjusted in the first two columns of the card. As each data card is read, the first two columns are checked to determine which variables have been read in the remaining one through six data fields. Columns 73 to 80 are not read and may be used for card identification purposes. The format for the six data fields is F10.0,5F12.0. Integer-type data variables must either be right-adjusted or followed by a decimal point.

A first-time user of ORCENT may see what default input data and sample output look like by entering two blank cards. The first card

GPO: 1971 JK 19928

IFLAG		DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	
COLUMN	NO 2	3	13	25	37	49	61	73
	COMMENTS (UP TO 72 ALPHANUMERIC CHARACTERS)							73
1	TT	PT	AT					
2	QT	PCMU	QCR	TFR	QSGO			
3	WRATE	GC	PF	IH2				
4	EFP	EFF	CP1	CP2				
5	PDGS							
7	NHP							
9	NLP	PBLP	PXLPI	BLS	PCI			
10	MR	PMR (1)	PMR (2)	FMR (3)	PMR (4)	PMR (5)		
11	MS	EMS						
12	NRH	QERH1	TTDRH1	QERH2	TTDRH2	NDRH		
13	NF	NFH	NFL					
14	N	PE (N)	TTD (N)	ND (N)	NDC (N)	TDCA (N)		
15	IP	IFPT						
16	QAE							
17	LK							
0								

Fig. 1. Input data card headings.

is utilized as a title card with 72 blanks. The second card is interpreted as an "end of case" card.

Following are detailed descriptions of each data card and variable. As noted in the discussions, it is often possible to leave selected variable fields blank and use the default values.

1. IFLAG = 1

TT = throttle steam temperature, °F

PT = throttle steam pressure, psia

AT = throttle steam moisture, percent

Throttle temperature TT and pressure PT normally will be known. For wet or dry-and-saturated throttle conditions, either temperature or pressure should be input. If throttle steam temperature TT is input and throttle steam pressure PT is blank, PT will be selected equal to the saturation pressure corresponding to temperature TT. Similarly, PT may be input and TT will be selected as the saturation temperature corresponding to pressure PT. A blank for throttle steam moisture is interpreted as zero. Throttle temperature for LWR cycles should generally be in the range of 532°F through 656°F, with zero through 100°F superheat. Throttle moisture AT should be entered as percent (0.5 for 1/2 percent). BWR throttle conditions will generally be at or near saturation; PWR cycles may include modest superheat.

2. IFLAG = 2

QT = estimated throttle steam flow, lb/hr

PCMU = feedwater makeup rate, percent of throttle steam flow

QCR = condensate flow bypassed to steam generator, lb/hr

TFR = throttle flow ratio

QSGO = required steam generator outlet flow, lb/hr

Estimated throttle steam flow QT is required information to provide a starting point for iteration. Rapid convergence does not require a close estimate of throttle steam flow. Use of the theoretical steam rate will provide adequate estimates of throttle steam flow. In the absence of a better estimate, QT may be set equal to 10,000 times the

generator output in MW(e). This will be close enough for VWO through half of rated load heat balances.

The feedwater makeup rate PCMU is normally left blank (interpreted as zero) unless modeling a system with makeup. Condensate flow bypassed to the steam generator QCR represents flow to a condensate storage tank, as shown in Fig. 22 of Ref. 3. The ORCENT program does not include the option of a separate steam seal system employing sealing steam raised in a steam seal evaporator. When modeling this type of system, the heat rate will be more accurate if an estimate of sealing steam is included as part or all of QCR.

The first stage of the high-pressure turbine section is normally designed for multiadmission governing control. The number of admissions is determined from the turbine rating and throttle steam conditions. For ratings through 1250 MW(e), three admissions are normally used for multiadmission governing control, according to Ref. 3. For ratings greater than 1250 MW(e) to the largest sizes offered, two admissions are used. For abnormally low pressures, a single admission (full throttling) is used. Only the three-admission option is included in the present code, with the first admission occurring at a throttle flow ratio of 0.6. For a VWO heat balance, TFR should be set equal to one. For a maximum guaranteed rating heat balance, TFR should be set equal to 0.95238. This constant results from the 5% flow margin provided above the flow required to meet guaranteed output ($0.95238 = 1./1.05$). For cases where generator output or steam generator outlet flow is known, TFR must be estimated for low-load cases. Throttle flow is not a linear function of generator output. It is advisable to estimate TFR, converge on the required generator output, then modify TFR and rerun if the ratio of throttle flow to VWO throttle flow differs appreciably from the input TFR. To summarize, it is desirable, but not mandatory, that any case at a throttle flow ratio TFR of less than one be preceded by a case at VWO design (TFR = 1.). Any case not preceded by such must have a TFR value input as 1. This with all other input data corresponding to maximum guaranteed rating condition, will produce a heat rate in error by <0.3%.

If steam generator flow QSGO is known and the user wishes to solve for generator electrical output, QSGO must be input. For all other cases, QSGO should be left blank.

3. IFLAG = 3

WRATE = gross electrical output, MW(e)

GC = generator capability, MVA

PF = generator power factor

IH2 = index for generator hydrogen pressure

If required steam generator outlet flow QSGO is input on the previous card, there is still a need for an estimate of electrical output WRATE and generator capability GC. If required steam-generator outlet flow has been input but generator capability has not, then the code will calculate generator capability as electrical output divided by power factor, making use of the last iteration of electrical output. The BLOCK DATA subprogram contains a value of gross electrical output that will be used as a first guess unless it is erroneously input as blank. If the gross electrical output WRATE is input and the required steam generator output QSGO is not, the program will iterate until steam flow is sufficient to obtain the required electrical output WRATE. If generator capability GC is input, it should be set equal to electrical output at VWO divided by the power factor PF (which normally will be 0.9).

Flag variable IH2 is normally left blank or input as zero. This indicates that the generator is operated at rated hydrogen pressure. Setting IH2 equal to one reduces generator operating pressure to 15 psi below rated pressure. Generator hydrogen pressure is not continuously variable; only rated pressure or a 15-psi reduction in pressure may be selected.

4. IFLAG = 4

EFP = feedwater pump isentropic efficiency, decimal fraction

EFF = feedwater pump turbine efficiency, decimal fraction

CP1 = pressure of feedwater pump inlet above condenser pressure, psi

CP2 = ratio of feedwater pump discharge pressure to turbine throttle pressure, decimal value greater than one

To match heat balance calculations by others, ORCENT includes feedwater pump isentropic efficiency EFP, feedwater pump turbine efficiency EFF, pressure constants for feedwater pump inlet pressure above condenser pressure CP1, and ratio of feedwater pump discharge pressure to turbine throttle pressure CP2 as input data variables. The default value of pump efficiency EFP is 0.878. A 10% change in pump efficiency will result in a heat rate change of about 13 Btu/kWhr. The default value of feedwater pump turbine efficiency EFF is 0.77. A 10% change in turbine efficiency will result in about a 21-Btu/kWhr change in heat rate. For calculation purposes, it is assumed that the feedwater pump takes suction from the discharge of a hotwell or condensate pump with no intermediate feedwater booster pump. The default value of inlet pressure above condenser pressure CP1 is 220 psi, and the ratio of discharge pressure to turbine throttle pressure CP2 is 1.31.

5. IFLAG = 5

PDGS = pitch diameter of the governing stage, in.

One does not normally have sufficient detail on turbine design to use anything but a default value for the pitch diameter of the governing stage PDGS of the high-pressure turbine. Example problems in Ref. 3 indicate a value of 65 in. for PDGS, which is the value set by ORCENT II if it is not input.

6. IFLAG = 6 is not used.

7. IFLAG = 7

NHP = number of parallel high-pressure turbine sections

Reference 3 indicates that the high-pressure turbine casing is normally single flow for ratings through ~575 MW(e) and double flow at larger ratings. The number of parallel high-pressure turbine sections NHP will be set at these values by ORCENT if NHP is not input on this data card.

8. IFLAG = 8 is not used.

9. IFLAG = 9

NLP = number of parallel low-pressure turbine sections; NLP = 2 for one double-flow section, NLP = 4 for two double-flow sections, and NLP = 6 for three double-flow sections

PBLP = bowl pressure in the low pressure turbine, psia

PXLPI = low-pressure turbine exhaust pressure, in. Hg abs

PXLP = low-pressure turbine exhaust pressure, psia

BLS = length of last stage buckets in the low-pressure turbine, in.

PCI = condenser pressure, in. Hg abs

PC = condenser pressure, psia

The number of parallel low-pressure turbine sections NLP should be determined by reference to the vendor's exhaust loading limit information. The General Electric Company specifies exhaust loading limits at 3.5 in. Hg abs exhaust pressure with zero makeup as follows:⁹

<u>Last stage bucket length (in.)</u>	<u>Exhaust flow (lb/hr per row LSB)</u>
35	1,260,000
38	1,585,000
43	1,857,000

Up to the exhaust loading limit, it is possible to select turbines with considerable variation in exhaust loss and efficiency. Some utilities accept a high exhaust loss in return for a turbine of lower capital cost, while others select a lower exhaust loss with higher capital cost in return for higher efficiency. It is difficult to come up with a rule of thumb, but 10- to 30-Btu/lb exhaust loss at turbine maximum guaranteed rating is not uncommon. In general, the exhaust loss should be minimized over the expected operating load range.

The bowl pressure PBLP of the low-pressure turbine should be ~200 psia. Reference 7 indicates that optimum intermediate pressures for nonreheat, single-stage, and two-stage steam reheat cycles are ~10, 20, and 15% of initial pressure, respectively.

The user has the option of entering the low-pressure turbine section exhaust pressure in in. Hg abs or in psia. If the pressure entered in the data field is preceded by a minus sign, pressure is interpreted as PXLPI, exhaust pressure in psia. A positive sign or no sign interprets the pressure as PXLPI, exhaust pressure in in. Hg abs.

The length of the last-stage buckets BLS in the low-pressure section must be input if it is other than the default value, 43 in.

Previous applications of the ORCENT code to desalination studies required location of a heat exchanger in place of the condenser at a location remote from the low-pressure turbine exhaust. This resulted in significant pressure drop from the turbine exhaust to the "condenser" (actually a brine heater). For this application, a variable PCI may be input in in. Hg abs or psia (preceded by a minus sign for psia). If this feature is not required, the data field should be left blank, and it will be assumed that the turbine exhausts directly to the condenser with no pressure drop.

10. IFLAC = 10

MR = number of moisture removal stages in each low-pressure turbine section

PMR = moisture removal stage pressure psia

The number of moisture removal stages MR in the low-pressure turbine section and the moisture removal stage pressures PMR often require some trial and error. In general, moisture removal stages should be included in all turbine stages with a shell pressure of <60 psia and shell moisture of >4% before removal. The maximum number of moisture removal stages is five. Because the actual stage pressures are not normally known except by the turbine supplier, it is customary to select approximate stage pressures of 50, 30, 20, 10, and 5 psia for nonreheat cycles and 20, 10, and 5 psia for reheat cycles. Moisture-removal pressures should be listed in descending order. Each moisture-removal point will drain to the same or to the next lower pressure feedwater heater shell, or it will drain to the condenser if there are no intervening feedwater heaters.

11. IFLAG = 11

MS = moisture-separator index; MS = 0 for no moisture separator, MS = N if separator drains to feedwater heater No. N, and MS = NF + 1 if separator drains to condenser where NF = total number of feedwater heaters (see IFLAG = 13)

EMS = moisture-separator effectiveness, percent

The moisture-separator index (MS) indicates the number of the feedwater heater to which the external moisture separator drains. The moisture separator can drain to a feedwater heater fed from the exhaust of the high-pressure turbine section, to any lower pressure feedwater heater, or to the condenser by setting MS equal to the total number of feedwater heaters plus one. The efficiency of the moisture separator is assumed to be 100% unless another value is input. Efficiency is defined as the percentage of entering moisture removed, calculated at the moisture-separator discharge pressure.

12. IFLAG = 12

NRH = number of stages of steam reheat

QERH1 = estimated steam flow to first-stage reheater, lb/hr

TTDRH1 = terminal temperature difference for first-stage reheater, °F

QERH2 = estimated steam flow to second-stage reheater, lb/hr

TTDRH2 = terminal temperature difference for second-stage reheater, °F

NDRH = feedwater heater number for first-stage reheater drain

Optionally, one or two stages of steam reheat may be specified; NRH is set equal to 0, 1, or 2 to indicate the number of stages of steam reheat. Steam flow to the first-stage steam reheater QERH1 may be estimated as 2 to 3% of steam generator outlet flow. Steam flow to the second-stage reheater may be estimated as 8 to 9% of steam generator outlet flow. There is no incentive to make a very close estimate; the calculation converges rapidly with very poor estimates. In the absence of other information, full-load terminal temperature differences TTDRH1 and TTDRH2

should be set at 25°F. These parameters decrease somewhat in proportion to throttle flow ratio for part-load conditions.

13. IFLAG = 13

NF = total number of feedwater heaters

NFH = number of feedwater heaters supplied from the high-pressure turbine

NFL = number of feedwater heaters supplied from the low-pressure turbine

There is no simple set of rules for selection of feedwater heater parameters. The user is referred to Chapters 10 and 11 of Ref. 8 for information on heater types, cycle arrangements, and choice of extraction stages. In addition, existing nuclear cycle heat balance diagrams might be consulted for typical configurations. The user must input total number of feedwater heaters NF, number of feedwater heaters supplied from the high-pressure turbine section NFH, and number of feedwater heaters supplied from the low-pressure turbine section NFL, unless one is willing to accept the default values of 6, 2, and 4. ORCENT will accept as many as 12 feedwater heaters. The pressure drop between inside the shell of the turbine and the heater shell is assumed to be 8% of the pressure in the turbine shell, except that 5% is assumed when the heater is fed from the high-pressure exhaust or the moisture-separator outlet.

14. IFLAG = 14

N = feedwater heater number

PE(N) = extraction steam pressure, psia

TTD(N) = feedwater heater terminal temperature difference, °F

ND(N) = index for feedwater heater drain; ND = 0 for flashed drain and ND = 1 for pumped drain

NDC(N) = index for drain cooler; NDC = 0 for no drain cooler and NDC = 1 for drain cooler

TDCA(N) = drain cooler approach temperature difference, °F

Feedwater heaters are numbered from one through NF with No. 1 being the highest pressure heater. A separate IFLAG = 14 card is required for each feedwater heater. The extraction steam pressure PE(N) must be input except where a heater is fed from the exhaust of the high-pressure turbine or from the outlet of the moisture separator. If PE(N) is left blank and there is no moisture separator, then the high-pressure turbine exhaust pressure is used; if there is a moisture separator, its outlet pressure is used. ORCENT will accept feedwater heater terminal temperature differences that are positive, zero, or negative. A negative terminal temperature difference means only that feedwater outlet temperature exceeds saturation temperature at heater shell pressure. Inlet steam temperature will still be higher than feedwater outlet temperature because of extraction steam superheat. A direct-contact or deaerating heater may be specified by letting TTD(N) equal zero and ND(N) equal one. Normally, the boiler feedwater pump is connected to the discharge of the deaerator. If ND(N) is zero, the feedwater heater drain is flashed to the next lower pressure feedwater heater or to the condenser, and a drain cooler approach temperature TDCA(N) should be input. If the heater drain is flashed and the user has not input TDCA(N), ORCENT will set the drain cooler approach temperature at 10°F. For pumped drains [ND(N) = 1], no drain cooler [NDC(N) = 0] and no drain cooler approach temperature [TDCA(N) = 0] should be indicated. Flashed drains with or without drain coolers result in higher thermodynamic loss than pumped drains but result in a less complex operating system.

15. IFLAG = 15

IP = index for feedwater pump location

IFPT = index for type of feedwater pump drive

The feedwater pump location relative to the feedwater heater train is specified by index IP, which can take on any value between zero and the total number of feedwater heaters NF. If IP = 0, the feedwater pump is located at the outlet of feedwater heater No. 1, the heater supplied with the highest pressure steam; if IP = 1, the feedwater pump is located at the inlet of feedwater heater No. 1; if IP = 2, it is located at the

inlet of feedwater heater No. 2, and so on. If a deaerating heater is used as a means of boiling condensate to eliminate entrained gases, it is frequently the second feedwater heater above the condenser hot well, and the feedwater pump suction is taken from this heater. Reference to typical heat balance diagrams or flow schematics for similar cycles may provide the best guide for normal practice in cycle arrangement.

The user has the option of specifying motor-driven or turbine-driven feedwater pumps. In the absence of other information, it is suggested that motor-driven feedwater pumps be used for cycles with an electrical output below 250 MW(e), motor- or turbine-driven pumps in the range of 250 through 400 MW(e), and turbine-driven pumps above 400 MW(e). Turbine drive shows a significant increase in efficiency over motor drive. The ORCENT code does not contain provisions for shaft-driven pumps. The flag variable IFPT = 0 indicates motor drive and IFPT = 1 for turbine drive with flows and enthalpies calculated by the program.

16. IFLAG = 16

QAE = steam flow to steam jet air ejector, lb/hr

Steam flow to the steam jet air ejector QAE should be left blank or set equal to zero if there is no air ejector. A value of 15,000 lb/hr is stored in the BLOCK DATA subprogram and will be assumed if this card is omitted.

17. IFLAG = 17

LK = index for steam seal leakage calculations

If the user wants ORCENT to calculate throttle valve stem and turbine shaft leakage flows, no action is necessary. The flag variable LK is set equal to one in the BLOCK DATA subroutine. To suppress leakage calculations, LK must be set equal to zero on this card.

18. IFLAG = 0 (or blank card)

The last data card for a case must either be blank or have a zero in column 2, which will terminate reading of input data for that case. Input data will be printed, and control will be returned to the main program where the calculations will be started.

Each subsequent case must have a title card and an end-of-case card. Only the additional cards containing data to be revised from the previous case must be input.

4. PROGRAM OUTPUT

Output from the program includes all information normally shown on a steam turbine cycle heat balance diagram. The input data are printed first by subroutine DATAIN before control is returned to the main program and before the calculations are performed. If iteration limits or independent variable limits for the turbine performance functions are exceeded, warning messages will be printed next. Results of the calculations are printed by subroutine RESULT and are summarized in ten tables, each headed by the information read from the comment card. Output for two example problems is included in Appendices A and B.

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APPENDICES

Appendix A

EXAMPLE PROBLEM 1 — BWR CYCLE

Example problem No. 1 is intended to model the BWR cycle shown in Fig. 22 of Ref. 3. The ORCENT program requires two cases to be run for any condition other than VWO conditions. Because the BWR cycle of Ref. 3 was made at maximum guaranteed rating flow, example problem 1 contains a VWO case followed by a maximum guaranteed rating case. There are minor differences in the cycle configurations, but these have no significant effect on results. The turbine cycle analyzed is shown schematically in Fig. 2, and the input data for both cases, entered on coding forms ready for keypunching, are shown in Fig. 3. The complete program output listing for both cases follows. Example problem No. 1 required less than 5 sec on the IBM 360/91 for both VWO and maximum guaranteed conditions.

BLANK PAGE

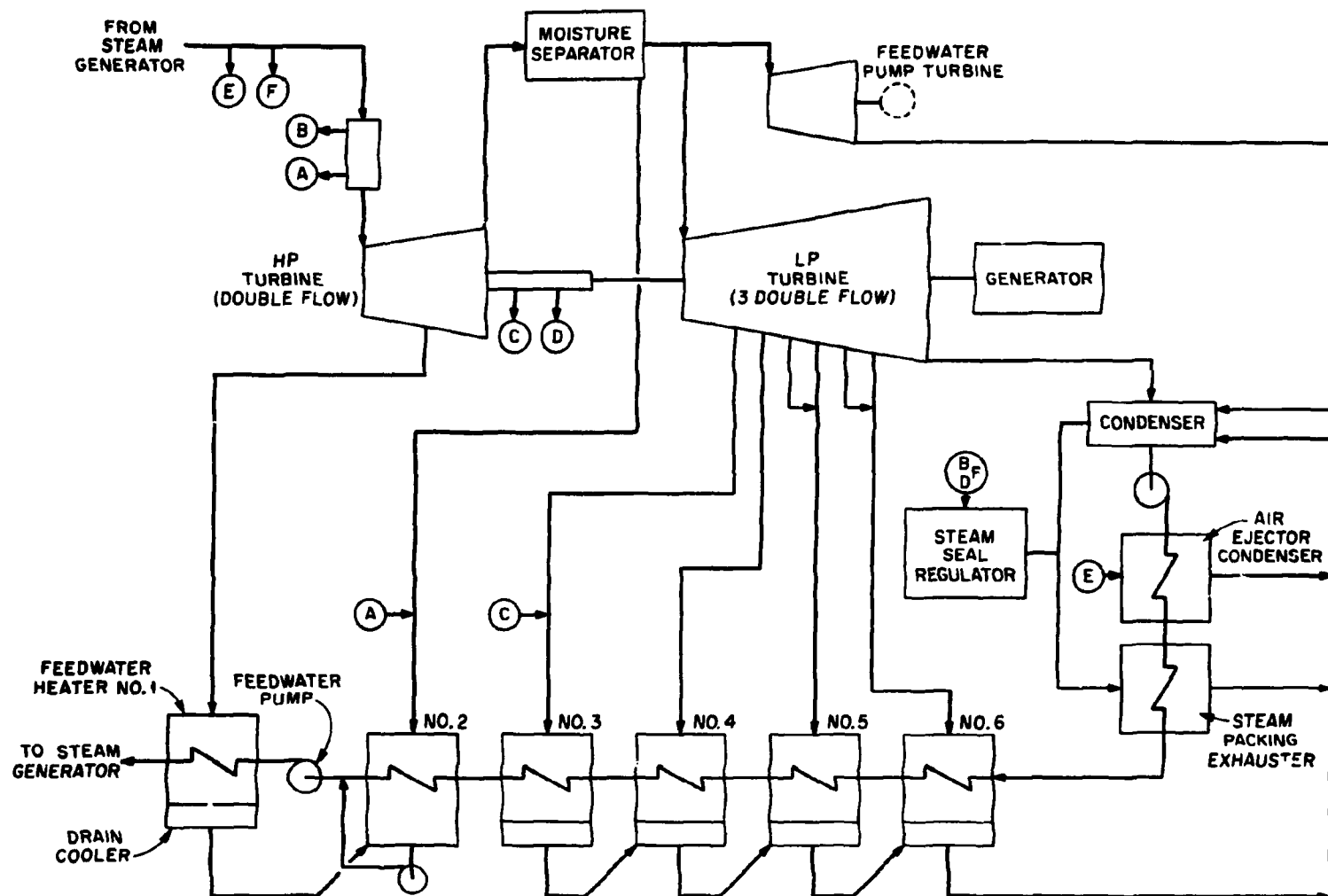


Fig. 2. BWR turbine cycle for example problem No. 1.

TWELVE DIGIT LONG FORM

KEYPUNCHING INSTRUCTIONS:
Punch only those cards containing data.

BY
REMARKS

DATE

PAGE

CHARGE

	12	18	24	30	36	42	48	54	60	66	72	REFERENCE
1	EXAMPLE PROBLEM NO. 1, VIB											
2	1											
3	EXAMPLE PROBLEM NO. 1, MAXIMUM GUARANTEE RATINGS											
4	2	15871000.	61000.	.75238	15885518.							
5	3	1260.	1457.8									
6	4	.878	.7678	210.	1.3088							
7	5	6.	194.	2.	43.							
8	10	4.	98.2	20.4	10.7	5.42						
9	14	1.	354.		0.	1.						
10	14	2.		5.	1.	0.						
11	14	3.	120.6		0.	1.						
12	14	4.	46.3		0.	1.						
13	14	5.	20.4		0.	1.						
14	14	6.	5.42		0.	1.						
15	0											
16												
17												
18												
19												
20												

UCH-6384
(8-57)

Fig. 3. Input data for example problem No. 1 ready for keypunching.

EXAMPLE PROBLEM NO. 1, VMO
STEAM TURBINE CYCLE HEAT BALANCE
ORCENT, VERSION 10-9-78

INPUT DATA

THROTTLE STEAM TEMPERATURE	540.3	F	
THROTTLE STEAM PRESSURE	965.0	PSIA	
THROTTLE STEAM MOISTURE	0.52	PER CENT	
ESTIMATED THROTTLE STEAM FLOW	16664044.	LB/HR	
PW MAKE-UP RATE (TO CONDENSER HOTWELL)	0.0	PER CENT	
CONDENSATE BY-PASSED TO STEAM GENERATOR	61000.	LB/HR	
THROTTLE FLOW RATIO	1.00000		
REQUIRED STEAM GENERATOR OUTPUT FLOW	16679080.	LB/HR	
REQUIRED ELECTRICAL OUTPUT	1113.820	MWE	
GENERATOR RATED CAPABILITY	1459.800	MVA	
GENERATOR POWER FACTOR	0.90		
GENERATOR OPERATION AT RATED HYDROGEN PRESSURE, IN2= 0			
ROTATIONAL SPEED OF TURBINE-GENERATOR	1900	RPM	
FEEDWATER PUMP ISENTROPIC EFFICIENCY	0.8780		
FEEDWATER PUMP TURBINE EFFICIENCY	0.7698		
PRESSURE OF FWP INLET ABOVE COND. PRESSURE	220.00	PSIA	
RATIO OF FWP DISCH. PRESS. TO H-P THROTTLE	1.31		
PITCH DIAMETER OF GOVERNING STAGE	65.00	IN.	
NUMBER OF PARALLEL H-P SECTIONS	2		
NUMBER OF PARALLEL L-P SECTIONS	6		
INLET PRESSURE L-P SECTION	203.7	PSIA	
EXHAUST PRESSURE L-P SECTION	0.98231	PSIA	= 2.00 IN. HGA
CONDENSER PRESSURE	0.98231	PSIA	= 2.00 IN. HGA
PITCH DIAMETER OF LAST STAGE L-P SECTION	132.00	IN.	
LENGTH OF LAST STAGE BUCKETS L-P SECTION	43.00	IN.	
NO. OF MOISTURE REMOVAL STAGES LP SECTION	4		
MOISTURE REMOVAL STAGE NO. 1			
MOISTURE REMOVAL STAGE PRESSURE	40.1	PSIA	
MOISTURE REMOVAL STAGE NO. 2			
MOISTURE REMOVAL STAGE PRESSURE	21.4	PSIA	
MOISTURE REMOVAL STAGE NO. 3			
MOISTURE REMOVAL STAGE PRESSURE	11.2	PSIA	
MOISTURE REMOVAL STAGE NO. 4			
MOISTURE REMOVAL STAGE PRESSURE	5.7	PSIA	
EXTERNAL MOISTURE SEPARATOR DRAINS TO PW HEATER NO. 2, NS= 2			
MOISTURE SEPARATOR EFFECTIVENESS	100.	PER CENT	
NUMBER OF STAGES OF REHEAT	0		
TOTAL NO. OF PW HEATERS	6		
NO. OF PW HEATERS HP SECTION	2		
NO. OF PW HEATERS LP SECTION	4		
PW HEATER NO. 1			
EXTRACTION STAGE PRESSURE	371.7	PSIA	
TERMINAL TEMPERATURE DIFFERENCE	5.0	F	

DRAIN IS FLASHED, ND(1)= 0		
THERE IS A DRAIN COOLER SECTION, NDC(1)= 1		
DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE	10.0	F
FW HEATER NO. 2		
EXTRACTION STEAM FROM MOISTURE SEPARATOR VESSEL		
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS PUMPED, ND(2)= 1		
THERE IS NO DRAIN COOLER SECTION, NDC(2)= 0		
FW HEATER NO. 3		
EXTRACTION STAGE PRESSURE	126.6	PSIA
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS FLASHED, ND(3)= 0		
THERE IS A DRAIN COOLER SECTION, NDC(3)= 1		
DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE	10.0	F
FW HEATER NO. 4		
EXTRACTION STAGE PRESSURE	69.5	PSIA
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS FLASHED, ND(4)= 0		
THERE IS A DRAIN COOLER SECTION, NDC(4)= 1		
DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE	10.0	F
FW HEATER NO. 5		
EXTRACTION STAGE PRESSURE	21.4	PSIA
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS FLASHED, ND(5)= 0		
THERE IS A DRAIN COOLER SECTION, NDC(5)= 1		
DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE	10.0	F
FW HEATER NO. 6		
EXTRACTION STAGE PRESSURE	5.7	PSIA
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS FLASHED, ND(6)= 0		
THERE IS A DRAIN COOLER SECTION, NDC(6)= 1		
DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE	10.0	F
FW PUMP IS LOCATED BEFORE FW HEATER NO. 1, IP= 1		
FW PUMP IS TURBINE DRIVEN, IPT= 1		
STEAM FLOW TO FW PUMP TURBINE WILL BE CALCULATED		
STEAM FLOW TO STEAM JET AIR EJECTOR	15300.	LB/HR
VALVE STEM AND PACKING LEAKAGES WILL BE CALCULATED, LR= 1		

EXAMPLE PROBLEM NO. 1, VVO
STEAM TURBINE CYCLE HPAT BALANCE
ORCENT, VERSION 10-9-78

CALCULATED RESULTS, PAGE 1

TABLE I OVERALL PERFORMANCE

NET TURBINE CYCLE HEAT RATE, BTU/KW-HR	10007.
NET TURBINE CYCLE EFFICIENCY, PER CENT	34.10
GROSS TURBINE CYCLE HEAT RATE, BTU/KW-HR	9859.
GROSS TURBINE CYCLE EFFICIENCY, PER CENT	34.61
GENERATOR OUTPUT, KW	1315.646
POWER PROVIDED BY TURBINE-DRIVEN PM PUMP, KW	19.789
GENERATOR OUTPUT PLUS PM PUMP POWER, KW	1335.435
MECHANICAL LOSSES, KW	6168.
GENERATOR LOSSES, KW	16283.

EXAMPLE PROBLEM NO. 1, VVO
STEAM TURBINE CYCLE HEAT BALANCE
ORCENT, VERSION 10-9-78

CALCULATED RESULTS, PAGE 2

TABLE II TURBINE EXPANSION LINE

	STEAM FLOW LB/HR	PRESSURE PSIA	TEMPERATURE F	MOISTURE PER CENT	ENTHALPY BTU/LB	ENTROPY BTU/LB-F
TURBINE THROTTLE	16664080.	965.0	540.1	0.52	1190.9	
GOVERNING STAGE BOWL	16647416.	926.4	535.4	0.71	1190.9	1.3952
GOVERNING STAGE SHELL	16647416.	718.5	506.0	3.96	1173.5	1.3988
HP SECTION ELP	15638729.	218.7	399.3	12.51	1094.9	1.4147
HP SECTION DEEP		218.7			1096.4	
EXTERNAL MOISTURE SEPARATOR INLET	15613671.	217.1			1096.4	
EXTERNAL MOISTURE SEPARATOR OUTLET	13698991.	213.0	387.1	0.0	1199.2	
LP SECTION BOWL	12752120.	203.7	384.2	0.0	1199.2	1.5446
BEFORE MOISTURE REMOVAL NO. 1		40.1	267.4	8.80	1087.7	1.5633
AFTER MOISTURE REMOVAL NO. 1		40.1	267.4	8.36	1091.7	1.5689
BEFORE MOISTURE REMOVAL NO. 2		21.4	231.6	10.66	1055.6	1.5789
AFTER MOISTURE REMOVAL NO. 2		21.4	231.6	9.74	1064.3	1.5916
BEFORE MOISTURE REMOVAL NO. 3		11.2	198.6	11.83	1029.6	1.6027
AFTER MOISTURE REMOVAL NO. 3		11.2	198.6	9.97	1047.8	1.6104
BEFORE MOISTURE REMOVAL NO. 4		5.7	167.5	12.05	1013.0	1.6424
AFTER MOISTURE REMOVAL NO. 4		5.7	167.5	9.50	1038.4	1.6829
LP SECTION ELP	9170924.	0.98231	101.1	14.39	956.4	1.7137
LP SECTION DEEP		0.98231			975.1	

EXAMPLE PROBLEM NO. 1, VVO
STEAM TURBINE CYCLE HEAT BALANCE
ORCECT, VERSION 10-9-78

CALCULATED RESULTS, PAGE 3

TABLE III STEAM JET AIR EJECTOR

STEAM FLOW, LB/HR	15000.
STEAM ENTHALPY IN, BTU/LB	1190.9
STEAM ENTHALPY OUT, BTU/LB	180.2

TABLE IV INTERNAL MOISTURE SEPARATION DRAINS TO PW HEATER NO. 2

DRAIN FLOW, LB/HR	1914680.
DRAIN PRESSURE, PSIA	213.0
DRAIN TEMPERATURE, F	387.1
DRAIN ENTHALPY, BTU/LB	361.2

TABLE V THERE IS NO REHEATER

TABLE VI MOISTURE REMOVAL STAGES

MOISTURE REMOVAL STAGE NO.	1	2	3	4
DRAINS TO PW HEATER NO.	5	5	6	6
STAGE PRESSURE, PSIA	40.1	21.4	11.2	5.7
TEMPERATURE, F	267.8	211.5	198.6	167.5
WATER REMOVED, LB/HR	51004.	112142.	211924.	281091.
WATER ENTHALPY, BTU/LB	216.3	199.9	166.7	135.5
STEAM REMOVED, LB/HR	55843.	0.	51187.	0.
STEAM ENTHALPY, BTU/LB	1091.7	0.0	1047.8	0.0

EXAMPLE PROBLEM NO. 1, VVO
STEAM TURBINE CYCLE HEAT BALANCE
ORCECT, VERSION 10-9-78

CALCULATED RESULTS, PAGE 4

TABLE VII PW HEATERS

PW HEATER NO.	1	2	3	4	5	6
PW FLOW, LB/HR	16618080.	13003455.	13003455.	13003455.	13003455.	13003455.
PW TEMPERATURE OUT, F	424.5	377.8	334.0	291.9	222.1	159.0
PW ENTHALPY OUT, BTU/LB	402.7	351.2	305.0	261.4	190.4	126.9
PW TEMPERATURE IN, F	381.3	334.0	291.9	222.1	159.0	102.8
PW ENTHALPY IN, BTU/LB	356.4	305.0	261.4	190.4	126.9	70.8
EXTRACTION STAGE PRESSURE, PSIA	371.7	213.0	126.6	69.5	21.4	5.7
EXTRACTION STEAM FLOW, LB/HR	1008687.	678272.	630977.	952627.	710095.	522266.
EXTRACTION STEAM ENTHALPY, BTU/LB	1120.3	1199.2	1163.1	1121.9	1064.3	1038.4
SHELL PRESSURE, PSIA	342.0	202.3	116.5	63.9	19.7	5.2
SHELL TEMPERATURE, F	429.5	382.8	339.0	296.9	227.1	164.0
SHELL DRAIN FLOW, LB/HR	1008687.	3614625.	637046.	1589673.	2520797.	3591931.
SHELL DRAIN TEMPERATURE, F	391.3	382.8	301.9	232.1	169.0	112.8
SHELL DRAIN ENTHALPY, BTU/LB	365.7	356.5	271.7	200.5	136.9	80.8

TABLE VIII CONDENSER

CONDENSER PRESSURE, PSIA	0.98231	-	2.00	IN. HGA
CONDENSATE FLOW, LB/HR	13064455.			
CONDENSATE TEMPERATURE, F	101.1			
CONDENSATE ENTHALPY, BTU/LB	69.1			

EXAMPLE PROBLEM NO. 1, VMO
STEAM TURBINE CYCLE HEAT BALANCE
ORCENT, VERSION 10-9-78

CALCULATED RESULTS, PAGE 5

TABLE IX CONDENSATE AND FEEDWATER

CONDENSATE FLOW BY-PASSED TO STEAM GENERATOR, LB/HR	61000.		
CONDENSATE ENTHALPY BY-PASSED TO STEAM GENERATOR, BTU/LB	70.8		
FW FLOW TO FW PUMP, LB/HR	16618080.		
FW TEMPERATURE TO FW PUMP, F	178.9		
FW ENTHALPY TO FW PUMP, BTU/LB	152.4		
FW ENTHALPY RISE ACROSS FW PUMP, BTU/LB	4.1		
FW PRESSURE INCREASE ACROSS FW PUMP, PSI	1042.		
FW FLOW TO STEAM GENERATOR, LB/HR	16618380.		
FW TEMPERATURE TO STEAM GENERATOR, F	424.5		
FW ENTHALPY TO STEAM GENERATOR, BTU/LB	402.7		
MAKE-UP TO CONDENSER NOWELL, LB/HR	0.		
STEAM FLOW FROM STEAM GENERATOR, LB/HR	16671080.		
STEAM ENTHALPY FROM STEAM GENERATOR, BTU/LB	1190.9		
THROTTLE STEAM FLOW FW PUMP TURBINE, LB/HR	268600.		
THROTTLE PRESSURE FW PUMP TURBINE, PSIA	202.1		
THROTTLE ENTHALPY FW PUMP TURBINE, BTU/LB	1199.2		
EXHAUST PRESSURE FW PUMP TURBINE, PSIA	1.22789	2.50	IN. HGA
EXHAUST ENTHALPY FW PUMP TURBINE, BTU/LB	347.8		

EXAMPLE PROBLEM NO. 1, VMO
STEAM TURBINE CYCLE HEAT BALANCE
ORCENT, VERSION 10-9-78

CALCULATED RESULTS, PAGE 6

TABLE X VALVE STEM AND SHAFT LEAKAGES

STEAM SEAL REGULATOR	
FLOW TO SSR, LB/HR	22666.
ENTHALPY AT SSR, BTU/LB	1111.7
FLOW FROM SSR TO MAIN CONDENSER, LB/HR	10800.
FLOW FROM SSR TO STEAM PACKING EXHAUSTER, LB/HR	7200.
FLOW FROM SSR TO FW HEATER NO. 6, LB/HR	4666.
MAKE-UP FROM THROTTLE STEAM, LB/HR	0.
ENTHALPY OF MAKE-UP STEAM, BTU/LB	0.0
THROTTLE VALVE STEM	
LEAK NO. 1 (DRAINS TO FW HEATER NO. 2), LB/HR	12986.
ENTHALPY LEAK NO. 1, BTU/LB	1190.9
LEAK NO. 2 (DRAINS TO SSR), LB/HR	3678.
ENTHALPY LEAK NO. 2, BTU/LB	1190.9
GOVERNING STAGE SECTION	
LEAK NO. 3 (DRAINS TO FW HEATER NO. 0), LB/HR	0.
ENTHALPY LEAK NO. 3, BTU/LB	0.0
LEAK NO. 4 (DRAINS TO SSR), LB/HR	0.
ENTHALPY LEAK NO. 4, BTU/LB	0.0
HP TURBINE SECTION	
TOTAL LEAK NO. 5 (DRAINS TO FW HEATER NO. 3), LB/HR	6069.
ENTHALPY LEAK NO. 5, BTU/LB	1096.4
TOTAL LEAK NO. 6 (DRAINS TO SSR), LB/HR	18988.
ENTHALPY LEAK NO. 6, BTU/LB	1096.4

EXAMPLE PROBLEM NO. 1, MAXIMUM GUARANTEED RATING
STEAM TURBINE CYCLE HEAT BALANCE
ORIENT, VERSION 10-9-78

INPUT DATA

THROTTLE STEAM TEMPERATURE	540.3	F		
THROTTLE STEAM PRESSURE	965.0	PSIA		
THROTTLE STEAM MOISTURE	0.52	PER CENT		
ESTIMATED THROTTLE STEAM FLOW	15871000.	LB/HR		
PW MAKE-UP RATE (TO CONDENSER HOTWELL)	0.0	PER CENT		
CONDENSATE BY-PASSED TO STEAM GENERATOR	61000.	LB/HR		
THROTTLE FLOW RATIO	0.95238			
REQUIRED STEAM GENERATOR OUTLET FLOW	15884518.	LB/HR		
REQUIRED ELECTRICAL OUTPUT	1260.000	MW		
GENERATOR RATED CAPABILITY	1459.800	MVA		
GENERATOR POWER FACTOR	0.90			
GENERATOR OPERATION AT RATED HYDROGEN PRESSURE, IN2= 0				
ROTATIONAL SPEED OF TURBINE-GENERATOR	1800	RPM		
FEEDWATER PUMP ISENTROPIC EFFICIENCY	0.8780			
FEEDWATER PUMP TURBINE EFFICIENCY	0.7698			
PRESSURE OF PWP INLET ABOVE COND. PRESSURE	210.00	PSIA		
RATIO OF PWP DISCH. PRESS. TO H-P THROTTLE	1.31			
PITCH DIAMETER OF GOV'NING STAGE	65.00	IN.		
NUMBER OF PARALLEL H-P SECTIONS	2			
NUMBER OF PARALLEL L-P SECTIONS	6			
BOWL PRESSURE L-P SECTION	194.0	PSIA		
EXHAUST PRESSURE L-P SECTION	0.98231	PSIA	=	2.00 IN. HGA
CONDENSER PRESSURE	0.98231	PSIA	=	2.00 IN. HGA
PITCH DIAMETER OF LAST STAGE L-P SECTION	132.00	IN.		
LENGTH OF LAST STAGE BUCKETS L-P SECTION	43.00	IN.		
NO. OF MOISTURE REMOVAL STAGES LP SECTION	4			
MOISTURE REMOVAL STAGE NO. 1				
MOISTURE REMOVAL STAGE PRESSURE	38.2	PSIA		
MOISTURE REMOVAL STAGE NO. 2				
MOISTURE REMOVAL STAGE PRESSURE	20.4	PSIA		
MOISTURE REMOVAL STAGE NO. 3				
MOISTURE REMOVAL STAGE PRESSURE	10.7	PSIA		
MOISTURE REMOVAL STAGE NO. 4				
MOISTURE REMOVAL STAGE PRESSURE	5.4	PSIA		
EXTERNAL MOISTURE SEPARATOR DRAINS TO PW HEATER NO. 2, NS= 2				
MOISTURE SEPARATOR EFFECTIVENESS	100.	PER CENT		
NUMBER OF STAGES OF REHEAT	0			
TOTAL NO. OF PW HEATERS	6			
NO. OF PW HEATERS HP SECTION	2			
NO. OF PW HEATERS LP SECTION	4			
PW HEATER NO. 1				
EXTRACTION STAGE PRESSURE	354.0	PSIA		
TERMINAL TEMPERATURE DIFFERENCE	5.0	F		

DRAIN IS FLASHED, ND(1) = 0
 THERE IS A DRAIN COOLER SECTION, NDC(1) = 1
 DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE 10.0 F
 FW HEATER NO. 2
 EXTRACTION STEAM FROM MOISTURE SEPARATOR VESSEL
 TERMINAL TEMPERATURE DIFFERENCE 5.0 F
 DRAIN IS PUMPED, ND(2) = 1
 THERE IS NO DRAIN COOLER SECTION, NDC(2) = 0
 FW HEATER NO. 3
 EXTRACTION STAGE PRESSURE 120.6 PSIA
 TERMINAL TEMPERATURE DIFFERENCE 5.0 F
 DRAIN IS FLASHED, ND(3) = 0
 THERE IS A DRAIN COOLER SECTION, NDC(3) = 1
 DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE 10.0 F
 FW HEATER NO. 4
 EXTRACTION STAGE PRESSURE 66.3 PSIA
 TERMINAL TEMPERATURE DIFFERENCE 5.0 F
 DRAIN IS FLASHED, ND(4) = 0
 THERE IS A DRAIN COOLER SECTION, NDC(4) = 1
 DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE 10.0 F
 FW HEATER NO. 5
 EXTRACTION STAGE PRESSURE 20.4 PSIA
 TERMINAL TEMPERATURE DIFFERENCE 5.0 F
 DRAIN IS FLASHED, ND(5) = 0
 THERE IS A DRAIN COOLER SECTION, NDC(5) = 1
 DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE 10.0 F
 FW HEATER NO. 6
 EXTRACTION STAGE PRESSURE 5.4 PSIA
 TERMINAL TEMPERATURE DIFFERENCE 5.0 F
 DRAIN IS FLASHED, ND(6) = 0
 THERE IS A DRAIN COOLER SECTION, NDC(6) = 1
 DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE 10.0 F
 FW PUMP IS LOCATED BEFORE FW HEATER NO. 1, IP= 1
 FW PUMP IS TURBINE DRIVEN, IPPT= 1
 STEAM FLOW TO FW PUMP TURBINE WILL BE CALCULATED
 STEAM FLOW TO STEAM JET AIR EJECTOR 15000. LB/HB
 VALVE STEM AND PACKING LEAKAGES WILL BE CALCULATED, LK= 1

EXAMPLE PROBLEM NO. 1, MAXIMUM GUARANTEE RATING
STEAM TURBINE CYCLE HEAT BALANCE
ORCENT, VERSION 10-9-78

CALCULATED RESULTS, PAGE 1

TABLE I OVERALL PERFORMANCE

NET TURBINE CYCLE HEAT RATE, BTU/KW-HR	10002.
NET TURBINE CYCLE EFFICIENCY, PER CENT	34.11
GROSS TURBINE CYCLE HEAT RATE, BTU/KW-HR	9854.
GROSS TURBINE CYCLE EFFICIENCY, PER CENT	34.63
GENERATOR OUTPUT, KW	1261.678
POWER REQUIRED BY TURBINE-DRIVEN PW PUMP, KW	18.969
GENERATOR OUTPUT PLUS PW PUMP POWER, KW	1280.644
MECHANICAL LOSSES, KW	6168.
GENERATOR LOSSES, KW	15304.

EXAMPLE PROBLEM NO. 1, MAXIMUM GUARANTEE RATING
STEAM TURBINE CYCLE HEAT BALANCE
ORCENT, VERSION 10-9-78

CALCULATED RESULTS, PAGE 2

TABLE II TURBINE EXPANSION LINE

	STEAM FLOW LB/HR	PRESSURE PSIA	TEMPERATURE F	MOISTURE PER CENT	ENTHALPY BTU/LB	ENTROPY BTU/LB-F
TURBINE THROTTLE	15870518.	965.0	540.3	0.52	1190.9	
GOVERNING STAGE BOWL	15853854.	918.0	534.3	0.75	1190.9	1.3960
GOVERNING STAGE SHELL	15853854.	683.6	500.5	4.31	1171.4	1.4009
HP SECTION ELEV	14909832.	208.2	385.2	12.60	1093.0	1.4168
HP SECTION DEEP		208.2			1094.5	
EXTERNAL MOISTURE SEPARATOR INLET	14885935.	206.8			1094.5	
EXTERNAL MOISTURE SEPARATOR OUTLET	13047203.	202.9	383.0	0.0	1198.5	
LP SECTION BOWL	12152792.	194.0	390.2	0.0	1198.5	1.5487
BEFORE MOISTURE REMOVAL NO. 1		38.2	264.5	8.73	1087.2	1.5674
AFTER MOISTURE REMOVAL NO. 1		38.2	264.5	8.28	1091.4	1.5732
BEFORE MOISTURE REMOVAL NO. 2		20.4	229.0	10.56	1055.3	1.5432
AFTER MOISTURE REMOVAL NO. 2		20.4	229.0	9.61	1064.5	1.5465
BEFORE MOISTURE REMOVAL NO. 3		10.7	196.4	11.70	1029.9	1.6075
AFTER MOISTURE REMOVAL NO. 3		10.7	196.4	9.79	1048.6	1.6361
BEFORE MOISTURE REMOVAL NO. 4		5.4	165.7	11.88	1013.8	1.6479
AFTER MOISTURE REMOVAL NO. 4		5.4	165.7	9.35	1039.1	1.6883
LP SECTION ELEV	8776141.	0.98231	101.1	14.15	958.9	1.7181
LP SECTION DEEP		0.98231			976.0	

EXAMPLE PROBLEM NO. 1, MAXIMUM GUARANTEE RATING
STEAM TURBINE CYCLE HEAT BALANCE
OPCENET, VERSION 10-9-78

CALCULATED RESULTS, PAGE 3

TABLE III STEAM JPT AIR PJECTOR

STEAM FLOW, LB/HR	15000.
STEAM ENTHALPY IN, BTU/LB	1190.9
STEAM ENTHALPY OUT, BTU/LB	180.2

TABLE IV EXTERNAL MOISTURE SEPARATOR DRAINS TO FW HEATER NO. 2

DRAIN FLOW, LB/HR	1839732.
DRAIN PRESSURE, PSIA	202.9
DRAIN TEMPERATURE, F	181.0
DRAIN ENTHALPY, BTU/LB	156.9

TABLE V THERE IS NO DEHEATER

TABLE VI MOISTURE REMOVAL STAGES

MOISTURE REMOVAL STAGE NO.	1	2	3	4
DRAINS TO FW HEATER NO.	5	5	6	6
STAGE PRESSURE, PSIA	38.2	20.4	10.7	5.4
TEMPERATURE, F	264.5	229.0	196.4	165.7
WATER REMOVED, LB/HR	52249.	111253.	207391.	265379.
WATER ENTHALPY, BTU/LB	233.3	197.3	164.5	133.6
STEAM REMOVED, LB/HR	53313.	0.	48890.	0.
STEAM ENTHALPY, BTU/LB	1091.4	0.0	1048.6	0.0

EXAMPLE PROBLEM NO. 1, MAXIMUM GUARANTEE RATING
STEAM TURBINE CYCLE HEAT BALANCE
OPCENET, VERSION 10-9-78

CALCULATED RESULTS, PAGE 4

TABLE VII FW HEATERS

FW HEATER NO.	1	2	3	4	5	6
FW FLOW, LB/HR	15824518.	12394059.	12394059.	12394059.	12394059.	12394059.
FW TEMPERATURE OUT, F	419.9	373.7	330.4	288.8	219.6	157.1
FW ENTHALPY OUT, BTU/LB	397.7	346.8	301.2	258.2	187.8	125.1
FW TEMPERATURE IN, F	377.2	330.4	288.8	219.6	157.1	102.9
FW ENTHALPY IN, BTU/LB	352.1	301.2	258.2	187.8	125.1	70.9
EXTRACTION STAGE PRESSURE, PSIA	354.0	202.9	120.6	66.3	20.4	5.4
EXTRACTION STEAM FLOW, LB/HR	944021.	634544.	591630.	898536.	667830.	480178.
EXTRACTION STEAM ENTHALPY, BTU/LB	1126.4	1198.5	1162.6	1121.5	1064.5	1039.1
SHELL PRESSURE, PSIA	325.7	192.7	111.0	61.0	18.6	5.0
SHELL TEMPERATURE, F	424.9	378.7	335.4	293.8	224.6	162.1
SHELL DRAIN FLOW, LB/HR	944021.	3410459.	597408.	1495944.	2380589.	3386051.
SHELL DRAIN TEMPERATURE, F	387.2	378.7	298.8	229.6	167.1	112.9
SHELL DRAIN ENTHALPY, BTU/LB	361.3	352.2	268.5	197.9	135.1	80.9

TABLE VIII CONDENSER

CONDENSER PRESSURE, PSIA	0.94231	=	2.00	IN. HGA
CONDENSATE FLOW, LB/HR	12455059.			
CONDENSATE TEMPERATURE, F	101.1			
CONDENSATE ENTHALPY, BTU/LB	69.1			

EXAMPLE PROBLEM NO. 1, MAXIMUM GUARANTEE RATING
STEAM TURBINE CYCLE HEAT BALANCE
ORCENT, VERSION 10-9-78

CALCULATED RESULTS, PAGE 5

TABLE IX CONDENSATE AND FEEDWATER

CONDENSATE FLOW BY-PASSED TO STEAM GENERATOR, LB/HR	61000.			
CONDENSATE ENTHALPY BY-PASSED TO STEAM GENERATOR, BTU/LB	70.9			
PW FLOW TO PW PUMP, LB/HR	15824519.			
PW TEMPERATURE TO PW PUMP, F	174.8			
PW ENTHALPY TO PW PUMP, BTU/LB	148.0			
PW ENTHALPY RISE ACROSS PW PUMP, BTU/LB	4.1			
PW PRESSURE INCREASE ACROSS PW PUMP, PSI	1052.			
PW FLOW TO STEAM GENERATOR, LB/HR	15824519.			
PW TEMPERATURE TO STEAM GENERATOR, F	419.9			
PW ENTHALPY TO STEAM GENERATOR, BTU/LB	197.7			
MAKE-UP TO CONDENSED HOTWELL, LB/HR	0.			
STEAM FLOW FROM STEAM GENERATOR, LB/HR	15885519.			
STEAM ENTHALPY FROM STEAM GENERATOR, BTU/LB	1190.9			
THROTTLE STEAM FLOW PW PUMP TURBINE, LB/HR	259867.			
THROTTLE PRESSURE PW PUMP TURBINE, PSIA	192.0			
THROTTLE ENTHALPY PW PUMP TURBINE, BTU/LB	1198.5			
EXHAUST PRESSURE PW PUMP TURBINE, PSIA	1.22789	*	2.50	IN. HGA
EXHAUST ENTHALPY PW PUMP TURBINE, BTU/LB	349.4			

EXAMPLE PROBLEM NO. 1, MAXIMUM GUARANTEE RATING
STEAM TURBINE CYCLE HEAT BALANCE
ORCENT, VERSION 10-9-78

CALCULATED RESULTS, PAGE 6

TABLE X VALVE STEM AND SHAFT LEAKAGES

STEAM SEAL REGULATOR				
FLOW TO SSR, LB/HR	21621.			
ENTHALPY AT SSR, BTU/LB	1110.2			
FLOW FROM SSR TO MAIN CONDENSER, LB/HR	10800.			
FLOW FROM SSR TO STEAM PACKING EXHAUSTED, LB/HR	7200.			
FLOW FROM SSR TO PW HEATER NO. 6, LB/HR	3621.			
MAKE-UP FROM THROTTLE STEAM, LB/HR	0.			
ENTHALPY OF MAKE-UP STEAM, BTU/LB	0.0			
THROTTLE VALVE STEM				
LEAK NO. 1 (DRAINS TO PW HEATER NO. 2), LB/HR	13161.			
ENTHALPY LEAK NO. 1, BTU/LB	1190.9			
LEAK NO. 2 (DRAINS TO SSR), LB/HR	3503.			
ENTHALPY LEAK NO. 2, BTU/LB	1190.9			
GOVERNING STAGE SECTION				
LEAK NO. 3 (DRAINS TO PW HEATER NO. 3), LB/HR	0.			
ENTHALPY LEAK NO. 3, BTU/LB	0.0			
LEAK NO. 4 (DRAINS TO SSR), LB/HR	0.			
ENTHALPY LEAK NO. 4, BTU/LB	0.0			
HP TURBINE SECTION				
TOTAL LEAK NO. 5 (DRAINS TO PW HEATER NO. 3), LB/HR	5779.			
ENTHALPY LEAK NO. 5, BTU/LB	1094.5			
TOTAL LEAK NO. 6 (DRAINS TO SSR), LB/HR	18118.			
ENTHALPY LEAK NO. 6, BTU/LB	1094.5			

Appendix B

EXAMPLE PROBLEM 2 — PWR CYCLE

Example problem No. 2 is intended to model the PWR cycle shown in Fig. 24 of Ref. 3. The cycle of Ref. 3 is a two-stage steam reheat cycle supplied with slightly superheated steam from a PWR employing once-through steam generators. Because the calculation is made at half-rated load, both a VWO case and a half-rated load case are required. The turbine cycle analyzed is shown schematically in Fig. 4, and the input data for both the VWO case and the half-rated load case, entered on coding forms ready for keypunching, are shown in Fig. 5. The complete program output listing for both cases follows. Example problem No. 2 required about 15 sec on the IBM 360/91 for both VWO and half-rated load conditions.

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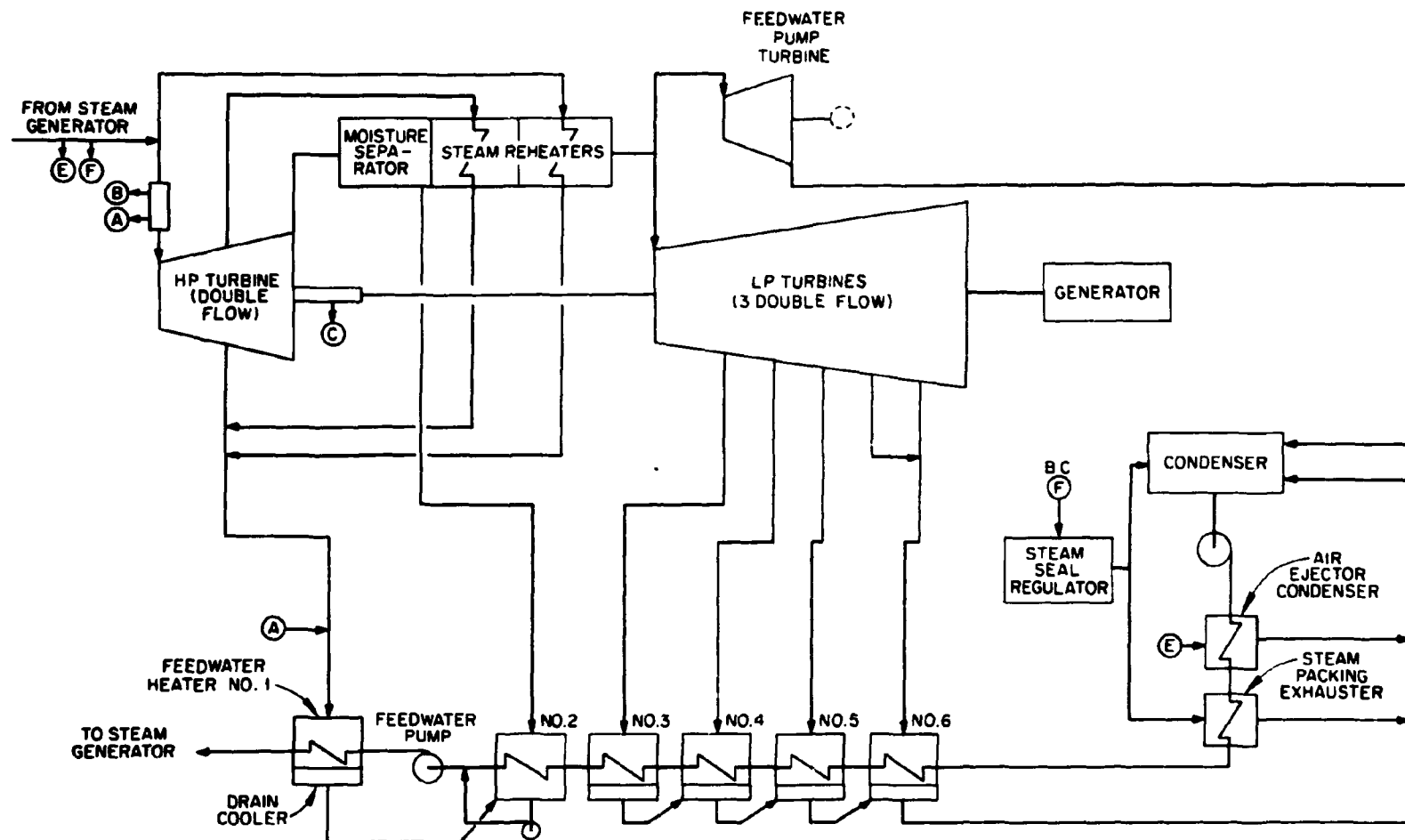


Fig. 4. PWR turbine cycle for example problem No. 2.

TWELVE DIGIT LONG FORM

KEYPUNCHING INSTRUCTIONS
Punch only those cards containing data

REMARKS

DATE
PAGE
ANALYST

EXAMPLE PROBLEM NO. 2, YMP						REMARKS
1	594.6	1000.				
2	14542000.		1.0	15381973.		
3	1323.	1456.6				
4	.870	.77	100.	1.262		
9	6.	173.2	2.	43.		
10	3.	19.5	10.2	5.2		
11	2.	100.				
12	2.	484000.	25.	792000.	25.	1.
13	6.	2.	4.			
14	1.	457.6	0.	1.		
14	2.		1.	0.		
14	3.	106.7	0.	1.		
14	4.	64.1	0.	1.		
14	5.	19.5	0.	1.		
14	6.	5.2	0.	1.		
15	1.	1.				
16	1500.					
17	1.					
0						

FORM 100-1
1-5-57

Fig. 5. Input data for example problem No. 2 ready for keypunching.

TWELVE DIGIT LONG FORM

KEYPUNCHING INSTRUCTIONS
Punch only those cards containing data

REMARKS

DATE
PAGE
THRU

						REFERENCE
1	EXAMPLE PROBLEM NO. 2, HALF RATED LOAD					
2	1 6580500.	0.	0.	.4525	7213868.	
3	3 630.	1456.6				
4	4 .878	.77	100.	1.262		
5	9 6.	84.5	2.	43.		
6	10 3.	7.57	5.01	2.66		
7	12 2.	108000.	11.9	624000.	11.9	1.
8	14 1.	214.		0.	1.	
9	14 2.		5.	1.	0.	
10	14 3.	52.5		0.	1.	
11	14 4.	52.		0.	1.	
12	14 5.	7.57		0.	1.	
13	14 6.	2.66		0.	1.	
14	0					
15						
16						
17						
18						
19						
20						

UCN-5586
13 3-571

Fig. 5 (continued)

PROBLEM NO. 2, MW3
 TURBINE CYCLE HEAT BALANCE
 BOSTON 10-9-78

THROTTLE STEAM TEMPERATURE	594.6	F		
THROTTLE STEAM PRESSURE	1000.0	PSIA		
THROTTLE STEAM MOISTURE	0.0	PER CENT		
ESTIMATED THROTTLE STEAM FLOW	14542000.	LB/HR		
FW MAKE-UP RATE (TO CONDENSER HOTWELL)	0.0	PER CENT		
CONDENSATE BY-PASSED TO STEAM GENERATOR	0.	LB/HR		
THROTTLE FLOW RATIO	1.00000			
REQUIRED STEAM GENERATOR OUTLET FLOW	15381973.	LB/HR		
REQUIRED ELECTRICAL OUTPUT	1310.930	MW		
GENERATOR RATED CAPABILITY	1456.600	MVA		
GENERATOR POWER FACTOR	0.90			
GENERATOR OPERATION AT RATED HYDROGEN PRESSURE, IN2= 0				
ROTATIONAL SPEED OF TURBINE-GENERATOR	1800	RPM		
FEEDWATER PUMP ISENTROPIC EFFICIENCY	0.8780			
FEEDWATER PUMP TURBINE EFFICIENCY	0.7700			
PRESSURE OF FWP INLET ABOVE COND. PRESSURE	100.00	PSIA		
RATIO OF FWP DISCH. PRESS. TO H-P THROTTLE	1.26			
PITCH DIAMETER OF GOVERNING STAGE	65.00	IN.		
NUMBER OF PARALLEL H-P SECTIONS	2			
NUMBER OF PARALLEL L-P SECTIONS	6			
BOWL PRESSURE L-P SECTION	173.2	PSIA		
EXHAUST PRESSURE L-P SECTION	0.98231	PSIA	=	2.00 IN. HGA
CONDENSER PRESSURE	0.98231	PSIA	=	2.00 IN. HGA
PITCH DIAMETER OF LAST STAGE L-P SECTION	132.00	IN.		
LENGTH OF LAST STAGE BUCKETS L-P SECTION	43.00	IN.		
NO. OF MOISTURE REMOVAL STAGES LP SECTION	3			
MOISTURE REMOVAL STAGE NO. 1				
MOISTURE REMOVAL STAGE PRESSURE	19.5	PSIA		
MOISTURE REMOVAL STAGE NO. 2				
MOISTURE REMOVAL STAGE PRESSURE	10.2	PSIA		
MOISTURE REMOVAL STAGE NO. 3				
MOISTURE REMOVAL STAGE PRESSURE	5.2	PSIA		
EXTERNAL MOISTURE SEPARATOR DRAINS TO FW HEATER NO. 2, MS= 2				
MOISTURE SEPARATOR EFFECTIVENESS	100.	PER CENT		
NUMBER OF STAGES OF REHEAT	2			
ESTIMATED STEAM FLOW TO 1ST STAGE REHEATER	484000.	LB/HR		
TERMINAL TEMPERATURE DIFFERENCE 1ST STAGE REHEATER	25.0	F		
1ST STAGE REHEATER DRAINS TO FW HEATER NO. 1, NDRH= 1				
ESTIMATED STEAM FLOW TO 2ND STAGE REHEATER	792000.	LB/HR		
TERMINAL TEMPERATURE DIFFERENCE 2ND STAGE REHEATER	25.0	F		
2ND STAGE REHEATER DRAINS TO FW HEATER NO. 1				
TOTAL NO. OF FW HEATERS	6			
NO. OF FW HEATERS HP SECTION	2			

NO. OF PW HEATERS LP SECTION	4	
PW HEATER NO. 1		
EXTRACTION STAGE PRESSURE	457.6	PSIA
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS FLASHED, MD(1) = 0		
THERE IS A DRAIN COOLER SECTION, MDC(1) = 1		
DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE	10.0	F
PW HEATER NO. 2		
EXTRACTION STEAM FROM MOISTURE SEPARATOR VESSEL		
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS PUMPED, MD(2) = 1		
THERE IS NO DRAIN COOLER SECTION, MDC(2) = 0		
PW HEATER NO. 3		
EXTRACTION STAGE PRESSURE	106.7	PSIA
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS FLASHED, MD(3) = 0		
THERE IS A DRAIN COOLER SECTION, MDC(3) = 1		
DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE	10.0	F
PW HEATER NO. 4		
EXTRACTION STAGE PRESSURE	64.1	PSIA
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS FLASHED, MD(4) = 0		
THERE IS A DRAIN COOLER SECTION, MDC(4) = 1		
DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE	10.0	F
PW HEATER NO. 5		
EXTRACTION STAGE PRESSURE	19.5	PSIA
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS FLASHED, MD(5) = 0		
THERE IS A DRAIN COOLER SECTION, MDC(5) = 1		
DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE	10.0	F
PW HEATER NO. 6		
EXTRACTION STAGE PRESSURE	5.2	PSIA
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS FLASHED, MD(6) = 0		
THERE IS A DRAIN COOLER SECTION, MDC(6) = 1		
DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE	10.0	F
PW PUMP IS LOCATED BEFORE PW HEATER NO. 1, LP- 1		
PW PUMP IS TURBINE DRIVEN, IPTT- 1		
STEAM FLOW TO PW PUMP TURBINE WILL BE CALCULATED		
STEAM FLOW TO STEAM JET AIR EJECTOR	1500.	LB/HH
VALVE STEM AND PACKING LEAKAGES WILL BE CALCULATED, LR- 1		

EXAMPLE PROBLEM NO. 2, VMO
STEAM TURBINE CYCLE HEAT BALANCE
ORIENT, VERSION 10-9-78

CALCULATED RESULTS, PAGE 1

TABLE I OVERALL PERFORMANCE

NET TURBINE CYCLE HEAT RATE, BTU/KW-HR	9595.
NET TURBINE CYCLE EFFICIENCY, PER CENT	15.56
GROSS TURBINE CYCLE HEAT RATE, BTU/KW-HR	9850.
GROSS TURBINE CYCLE EFFICIENCY, PER CENT	16.09
GENERATOR OUTPUT, MW	1114.701
POWER REQUIRED BY TURBINE-DRIVEN FW PUMP, KW	19.517
GENERATOR OUTPUT PLUS FW PUMP POWER, MW	1114.770
MECHANICAL LOSSES, KW	6198.
GENERATOR LOSSES, KW	16271.

EXAMPLE PROBLEM NO. 2, VMO
STEAM TURBINE CYCLE HEAT BALANCE
ORIENT, VERSION 10-9-78

CALCULATED RESULTS, PAGE 2

TABLE II TURBINE REPARATION LINE

	STEAM FLOW LB/HR	PRESSURE PSIA	TEMPERATURE °F	MOISTURE PER ENT	ENTHALPY BTU/LB	ENTROPY BTU/LB-°F
TURBINE THROTTLE	14580512.	1000.0	590.6	0.0	1240.5	
GOVERNING STAGE INLET	14565951.	960.0	589.2	0.0	1240.4	1.4468
GOVERNING STAGE SHUT	14565951.	765.9	580.7	0.0	1226.6	1.4476
HP SECTION INLET	12810291.	189.7	177.4	8.52	1125.5	1.4618
HP SECTION SHUT		189.7			1127.0	
EXTERNAL MOISTURE SEPARATOR INLET	12808922.	188.4			1127.0	
EXTERNAL MOISTURE SEPARATOR OUTLET	11746425.	186.1	175.9	0.0	1197.1	
1ST STAGE REHEATER INLET	11870157.	186.1			1197.1	
1ST STAGE REHEATER OUTLET	11870157.	181.9	428.4		1230.1	
2ND STAGE REHEATER INLET	11870157.	181.9			1230.1	
2ND STAGE REHEATER OUTLET	11870157.	181.1	517.8		1280.7	
LP SECTION INLET	10920176.	171.2	510.1	0.0	1280.7	1.6515
BEFORE MOISTURE REMOVAL NO. 1		19.5	226.6	4.40	1111.5	1.6724
AFTER MOISTURE REMOVAL NO. 1		19.5	226.6	5.96	1117.0	1.6785
BEFORE MOISTURE REMOVAL NO. 2		10.2	194.1	6.62	1078.8	1.6869
AFTER MOISTURE REMOVAL NO. 2		10.2	194.1	5.44	1090.1	1.7066
BEFORE MOISTURE REMOVAL NO. 3		5.2	161.9	7.91	1052.7	1.7302
AFTER MOISTURE REMOVAL NO. 3		5.2	161.9	6.17	1070.1	1.7422
LP SECTION SHUT	8112671.	0.98231	101.1	11.45	986.9	1.7680
LP SECTION INLET		0.98231			1001.9	

EXAMPLE PROBLEM NO. 1, VMO
STEAM TURBINE CYCLE HEAT BALANCE
ORIENT, VERSION 10-9-78

CALCULATED RESULTS, PAGE 1

TABLE III STEAM JET AIR EJECTOR

STEAM FLOW, LB/HR	1500.
STEAM ENTHALPY IN, BTU/LB	1244.5
STEAM ENTHALPY OUT, BTU/LB	120.2

TABLE IV REFERRAL NOISTURK SEPARATION DRAIN TO PW HEATER NO. 1

DRAIN FLOW, LB/HR	106.2497.
DRAIN PRESSURE, PSIA	186.1
DRAIN TEMPERATURE, F	175.9
DRAIN ENTHALPY, BTU/LB	189.2

TABLE V LIVE STEAM REHEATER

1ST STAGE DRAIN TO PW HEATER NO. 1	
1ST STAGE STEAM FLOW, LB/HR	489126.
1ST STAGE STEAM ENTHALPY, BTU/LB	1185.1
1ST STAGE PRESSURE, PSIA	437.2
1ST STAGE DRAIN TEMPERATURE, F	451.4
1ST STAGE DRAIN ENTHALPY, BTU/LB	434.1
2ND STAGE DRAIN TO PW HEATER NO. 1	
2ND STAGE STEAM FLOW, LB/HR	799041.
2ND STAGE STEAM ENTHALPY, BTU/LB	1244.5
2ND STAGE PRESSURE, PSIA	945.1
2ND STAGE DRAIN TEMPERATURE, F	542.8
2ND STAGE DRAIN ENTHALPY, BTU/LB	540.1

TABLE VI NOISTURK REMOVAL STAGES

NOISTURK REMOVAL STAGE NO.	1	2	3
DRAIN TO PW HEATER NO.	5	6	6
STAGE PRESSURE, PSIA	19.5	10.2	5.2
TEMPERATURE, F	226.6	194.1	161.9
WATER REMOVED, LB/HR	44751.	112669.	165974.
WATER ENTHALPY, BTU/LB	174.9	162.2	111.9
STEAM REMOVED, LB/HR	0.	45100.	0.
STEAM ENTHALPY, BTU/LB	7.0	1040.1	0.0

EXAMPLE PROBLEM NO. 2, VMO
STEAM TURBINE CYCLE HEAT BALANCE
ORIENT, VERSION 10-9-78

CALCULATED RESULTS, PAGE 4

TABLE VII PW HEATERS

PW HEATER NO.	1	2	3	4	5	6
PW FLOW, LB/HR	11195692.	11195692.	11195692.	11195692.	11195692.	11195692.
PW TEMPERATURE OUT, F	444.6	166.7	121.5	286.6	217.2	155.4
PW ENTHALPY OUT, BTU/LB	424.8	139.4	291.9	255.9	185.4	121.1
PW TEMPERATURE IN, F	170.7	121.5	286.6	217.2	155.4	101.9
PW ENTHALPY IN, BTU/LB	145.2	291.9	255.9	185.4	121.1	69.9
EXTRACTION STAGE PRESSURE, PSIA	457.6	186.1	106.7	64.1	19.5	5.2
EXTRACTION STEAM FLOW, LB/HR	1246584.	576269.	410674.	753660.	629280.	419314.
EXTRACTION STEAM ENTHALPY, BTU/LB	1185.6	1197.1	1216.5	1195.6	1117.8	1070.1
SHELL PRESSURE, PSIA	421.0	177.0	98.2	59.0	17.9	4.8
SHELL TEMPERATURE, F	444.6	171.7	126.5	291.6	222.2	165.4
SHELL DRAIN FLOW, LB/HR	2515651.	4186281.	416260.	1175920.	1849951.	2611740.
SHELL DRAIN TEMPERATURE, F	180.7	171.7	298.6	227.2	165.4	111.9
SHELL DRAIN ENTHALPY, BTU/LB	154.1	184.7	266.2	195.5	111.3	79.9

TABLE VIII CONDENSER

CONDENSER PRESSURE, PSIA	0.94211	-	2.00	IN. HGA
CONDENSATE FLOW, LB/HR	11195692.			
CONDENSATE TEMPERATURE, F	101.1			
CONDENSATE ENTHALPY, BTU/LB	69.1			

EXAMPLE PROBLEM NO. 2, VVO
STEAM TURBINE CYCLE HEAT BALANCE
ORIENT, VERSION 10-9-78

CALCULATED RESULTS, PAGE 5

TABLE II CONDENSATE AND FEEDWATER

FW FLOW TO FW PUMP, LB/HR	151817.1		
FW TEMPERATURE TO FW PUMP, F	168.0		
FW ENTHALPY TO FW PUMP, BTU/LB	160.8		
FW ENTHALPY RISE ACROSS FW PUMP, BTU/LB	4.1		
FW PRESSURE INCREASE ACROSS FW PUMP, PSI	116.1		
FW FLOW TO STEAM GENERATOR, LB/HR	151817.1		
FW TEMPERATURE TO STEAM GENERATOR, F	464.6		
FW ENTHALPY TO STEAM GENERATOR, BTU/LB	429.0		
MAKE-UP TO CONDENSER HOTWELL, LB/HR	0.		
STEAM FLOW FROM STEAM GENERATOR, LB/HR	151817.1		
STEAM ENTHALPY FROM STEAM GENERATOR, BTU/LB	1244.5		
THROTTLE STEAM FLOW FW PUMP TURNING, LB/HR	24978.1		
THROTTLE PRESSURE FW PUMP TURNING, PSIA	172.0		
THROTTLE ENTHALPY FW PUMP TURNING, BTU/LB	1240.7		
EXHAUST PRESSURE FW PUMP TURNING, PSIA	1.22789	*	2.50 IN. HGA
EXHAUST ENTHALPY FW PUMP TURNING, BTU/LB	1211.1		

EXAMPLE PROBLEM NO. 2, VVO
STEAM TURBINE CYCLE HEAT BALANCE
ORIENT, VERSION 10-9-78

CALCULATED RESULTS, PAGE 6

TABLE I VALVE STEAM AND SHAFT LEAKAGES

STEAM SEAL REGULATOR	
FLOW TO SSB, LB/HR	10849.
ENTHALPY AT SSB, BTU/LB	1144.1
FLOW FROM SSB TO MAIN CONDENSER, LB/HR	10800.
FLOW FROM SSB TO STEAM PACKING EXHAUSTER, LB/HR	700.
FLOW FROM SSB TO FW HEATER NO. 6, LB/HR	449.
MAKE-UP FROM THROTTLE STEAM, LB/HR	0.
ENTHALPY OF MAKE-UP STEAM, BTU/LB	9.0
THROTTLE VALVE STEAM	
LEAK NO. 1 (DRAINS TO FW HEATER NO. 2), LB/HR	11866.
ENTHALPY LEAK NO. 1, BTU/LB	1244.5
LEAK NO. 2 (DRAINS TO SSB), LB/HR	2716.
ENTHALPY LEAK NO. 2, BTU/LB	1244.5
COMPOUNDING STAGE SECTION	
LEAK NO. 3 (DRAINS TO FW HEATER NO. 0), LB/HR	0.
ENTHALPY LEAK NO. 3, BTU/LB	0.0
LEAK NO. 4 (DRAINS TO SSB), LB/HR	0.
ENTHALPY LEAK NO. 4, BTU/LB	0.0
HP TURBINE SECTION	
TOTAL LEAK NO. 5 (DRAINS TO FW HEATER NO. 1), LB/HR	5586.
ENTHALPY LEAK NO. 5, BTU/LB	1127.0
TOTAL LEAK NO. 6 (DRAINS TO SSB), LB/HR	15711.
ENTHALPY LEAK NO. 6, BTU/LB	1127.0

PIAMPLE PROBLEM NO. 2, HALF RATED LOAD
STEAM TURBINE CYCLE HEAT BALANCE
ORCENT, VERSION 10-9-78

INPUT DATA

THROTTLE STEAM TEMPERATURE	594.6	F	
THROTTLE STEAM PRESSURE	1000.0	PSIA	
THROTTLE STEAM MOISTURE	0.0	PER CENT	
ESTIMATED THROTTLE STEAM FLOW	6580500.	LB/HR	
PW MAKE-UP RATE (TO CONDENSER HOTWELL)	0.0	PER CENT	
CONDENSATE BY-PASSED TO STEAM GENERATOR	0.	LB/HR	
THROTTLE FLOW RATIO	0.45250		
REQUIRED STEAM GENERATOR GUILLET FLOW	7213868.	LB/HR	
REQUIRED ELECTRICAL OUTPUT	630.000	MWE	
GENERATOR RATED CAPABILITY	1456.600	MVA	
GENERATOR POWER FACTOR	0.90		
GENERATOR OPERATION AT RATED HYDROGEN PRESSURE, IH2= 0			
ROTATIONAL SPEED OF TURBINE-GENERATOR	1800	RPM	
FEEDWATER PUMP ISENTROPIC EFFICIENCY	0.8780		
FEEDWATER PUMP TURBINE EFFICIENCY	0.7700		
PRESSURE OF PWP INLET ABOVE COND. PRESSURE	100.00	PSIA	
RATIO OF PWP DISCH. PRESS. TO H-P THROTTLE	1.26		
PITCH DIAMETER OF GOVERNING STAGE	65.00	IN.	
NUMBER OF PARALLEL H-P SECTIONS	2		
NUMBER OF PARALLEL L-P SECTIONS	6		
BOIL PRESSURE L-P SECTION	84.5	PSIA	
EXHAUST PRESSURE L-P SECTION	0.98211	PSIA	= 2.00 IN. HGA
CONDENSER PRESSURE	0.98211	PSIA	= 2.00 IN. HGA
PITCH DIAMETER OF LAST STAGE L-P SECTION	112.00	IN.	
LENGTH OF LAST STAGE BUCKETS L-P SECTION	43.00	IN.	
NO. OF MOISTURE REMOVAL STAGES LP SECTION	3		
MOISTURE REMOVAL STAGE NO. 1			
MOISTURE REMOVAL STAGE PRESSURE	9.6	PSIA	
MOISTURE REMOVAL STAGE NO. 2			
MOISTURE REMOVAL STAGE PRESSURE	5.0	PSIA	
MOISTURE REMOVAL STAGE NO. 3			
MOISTURE REMOVAL STAGE PRESSURE	2.7	PSIA	
EXTERNAL MOISTURE SEPARATOR DRAINS TO PW HEATER NO. 2, NS= 2			
MOISTURE SEPARATOR EFFECTIVENESS	100.	PER CENT	
NUMBER OF STAGES OF REHEAT	2		
ESTIMATED STEAM FLOW TO 1ST STAGE REHEATER	189000.	LB/HR	
TERMINAL TEMPERATURE DIFFERENCE 1ST STAGE REHEATER	11.9	F	
1ST STAGE REHEATER DRAINS TO PW HEATER NO. 1, NDRH= 1			
ESTIMATED STEAM FLOW TO 2ND STAGE REHEATER	624000.	LB/HR	
TERMINAL TEMPERATURE DIFFERENCE 2ND STAGE REHEATER	11.9	F	
2ND STAGE REHEATER DRAINS TO PW HEATER NO. 1			
TOTAL NO. OF PW HEATERS	6		
NO. OF PW HEATERS HP SECTION	2		

NO. OF FW HEATERS LP SECTION	4	
FW HEATER NO. 1		
EXTRACTION STAGE PRESSURE	214.0	PSIA
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS FLASHED, MD(1) = 0		
THERE IS A DRAIN COOLER SECTION, MDC(1) = 1		
DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE	10.0	F
FW HEATER NO. 2		
EXTRACTION STEAM FROM MOISTURE SEPARATOR VESSEL		
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS PUMPPED, MD(2) = 1		
THERE IS NO DRAIN COOLER SECTION, MDC(2) = 0		
FW HEATER NO. 3		
EXTRACTION STAGE PRESSURE	52.5	PSIA
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS FLASHED, MD(3) = 0		
THERE IS A DRAIN COOLER SECTION, MDC(3) = 1		
DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE	10.0	F
FW HEATER NO. 4		
EXTRACTION STAGE PRESSURE	32.0	PSIA
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS FLASHED, MD(4) = 0		
THERE IS A DRAIN COOLER SECTION, MDC(4) = 1		
DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE	10.0	F
FW HEATER NO. 5		
EXTRACTION STAGE PRESSURE	9.6	PSIA
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS FLASHED, MD(5) = 0		
THERE IS A DRAIN COOLER SECTION, MDC(5) = 1		
DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE	10.0	F
FW HEATER NO. 6		
EXTRACTION STAGE PRESSURE	2.7	PSIA
TERMINAL TEMPERATURE DIFFERENCE	5.0	F
DRAIN IS FLASHED, MD(6) = 0		
THERE IS A DRAIN COOLER SECTION, MDC(6) = 1		
DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE	10.0	F
FW PUMP IS LOCATED BEFORE FW HEATER NO. 1, IP= 1		
FW PUMP IS TURBINE DRIVEN, IPPT= 1		
STEAM FLOW TO FW PUMP TURBINE WILL BE CALCULATED		
STEAM FLOW TO STEAM JET AIR EJECTOR	1500.	LB/HR
VALVE STEM AND PACKING LEAKAGES WILL BE CALCULATED, LK= 1		

EXAMPLE PROBLEM NO. 2, HALF RATED LOAD
STEAM TURBINE CYCLE HEAT BALANCE
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TABLE I OVERALL PERFORMANCE

NET TURBINE CYCLE HEAT RATE, BTU/KW-HR	10210.
NET TURBINE CYCLE EFFICIENCY, PER CENT	33.15
GROSS TURBINE CYCLE HEAT RATE, BTU/KW-HR	10084.
GROSS TURBINE CYCLE EFFICIENCY, PER CENT	33.84
GENERATOR OUTPUT, MW	610.590
POWER REQUIRED BY TURBINE-DRIVEN FW PUMP, MW	9.181
GENERATOR OUTPUT PLUS FW PUMP POWER, MW	619.772
MECHANICAL LOSSES, KW	6148.
GENERATOR LOSSES, KW	7629.

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TABLE II TURBINE EXPANSION LINE

	STEAM FLOW LB/HR	PRESSURE PSIA	TEMPERATURE F	MOISTURE PER CENT	ENTHALPY BTU/LB	ENTROPY BTU/LB-F
TURBINE THROTTLE	6588248.	1000.0	594.6	0.0	1244.5	
GOVERNING STAGE BOWL	6572559.	702.7	551.8	0.0	1244.4	1.4734
GOVERNING STAGE SHELL	6572559.	334.8	429.0	0.0	1204.8	1.5020
HP SECTION BLEP	6072154.	92.5	322.3	8.09	1113.5	1.5166
HP SECTION WEEP		92.5			1115.0	
EXTERNAL MOISTURE SEPARATOR INLET	6058383.	91.9			1115.0	
EXTERNAL MOISTURE SEPARATOR OUTLET	5581254.	90.9	321.0	0.0	1185.4	
1ST STAGE REHEATER INLET	5357213.	90.9			1185.4	
1ST STAGE REHEATER OUTLET	5357213.	89.7	371.8		1213.9	
2ND STAGE REHEATER INLET	5357213.	89.7			1213.9	
2ND STAGE REHEATER OUTLET	5357213.	88.4	530.9		1295.9	
LP SECTION BOWL	5225938.	84.5	530.2	0.0	1295.9	1.7441
BEFORE MOISTURE REMOVAL NO. 1		9.6	191.1	1.76	1125.3	1.7648
AFTER MOISTURE REMOVAL NO. 1		9.6	191.1	1.42	1126.6	1.7700
BEFORE MOISTURE REMOVAL NO. 2		5.0	162.3	4.16	1089.5	1.7772
AFTER MOISTURE REMOVAL NO. 2		5.0	162.3	3.21	1099.0	1.7924
BEFORE MOISTURE REMOVAL NO. 3		2.7	136.8	5.62	1063.5	1.8005
AFTER MOISTURE REMOVAL NO. 3		2.7	136.8	4.34	1076.6	1.8223
LP SECTION BLEP	4264627.	0.98231	101.1	7.80	1024.7	1.8356
LP SECTION WEEP		0.98231			1036.1	

EXAMPLE PROBLEM NO. 2, HALF RATED LOAD
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TABLE III STEAM JET AIR EJECTOR

STEAM FLOW, LB/HR	1500.
STEAM ENTHALPY IN, BTU/LB	1244.5
STEAM ENTHALPY OUT, BTU/LB	140.2

TABLE IV EXTERNAL MOISTURE SEPARATOR DRAINS TO PW HEATER NO. 2

DRAIN FLOW, LB/HR	477129.
DRAIN PRESSURE, PSIA	90.9
DRAIN TEMPERATURE, F	321.0
DRAIN ENTHALPY, BTU/LB	291.4

TABLE V LIVE STEAM HEATER

1ST STAGE DRAINS TO PW HEATER NO. 1	
1ST STAGE STEAM FLOW, LB/HR	187557.
1ST STAGE STEAM ENTHALPY, BTU/LB	1170.6
1ST STAGE PRESSURE, PSIA	204.5
1ST STAGE DRAIN TEMPERATURE, F	383.7
1ST STAGE DRAIN ENTHALPY, BTU/LB	357.5

2ND STAGE DRAINS TO PW HEATER NO. 1	
2ND STAGE STEAM FLOW, LB/HR	624120.
2ND STAGE STEAM ENTHALPY, BTU/LB	1244.5
2ND STAGE PRESSURE, PSIA	985.1
2ND STAGE DRAIN TEMPERATURE, F	542.8
2ND STAGE DRAIN ENTHALPY, BTU/LB	540.3

TABLE VI MOISTURE REMOVAL STAGES

MOISTURE REMOVAL STAGE NO.	1	2	3
DRAINS TO PW HEATER NO.	5	6	6
STAGE PRESSURE, PSIA	9.6	5.0	2.7
TEMPERATURE, F	191.1	162.3	136.8
WATER REMOVED, LB/HR	16387.	43957.	59113.
WATER ENTHALPY, BTU/LB	159.2	130.3	104.8
STEAM REMOVED, LB/HR	0.	22419.	0.
STEAM ENTHALPY, BTU/LB	0.0	1099.0	0.0

EXAMPLE PROBLEM NO. 2, HALF RATED LOAD
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TABLE VII PW HEATERS

PW HEATER NO.	1	2	3	4	5	6
PW FLOW, LB/HR	7213868.	5376713.	5376713.	5376713.	5376713.	5376713.
PW TEMPERATURE OUT, F	375.5	312.4	273.8	244.3	182.3	128.6
PW ENTHALPY OUT, BTU/LB	350.2	282.5	242.9	212.8	150.3	96.6
PW TEMPERATURE IN, F	315.8	273.8	240.3	182.3	128.6	102.7
PW ENTHALPY IN, BTU/LB	288.1	242.9	212.8	150.3	96.6	70.7
EXTRACTION STAGE PRESSURE, PSIA	214.0	90.9	52.5	32.0	9.6	2.7
EXTRACTION STEAM FLOW, LB/HR	312848.	224041.	157579.	311158.	256934.	93764.
EXTRACTION STEAM ENTHALPY, BTU/LB	1170.6	1185.4	1250.3	1208.6	1128.6	1076.6
SHELL PRESSURE, PSIA	196.9	86.3	48.3	29.4	8.8	2.4
SHELL TEMPERATURE, F	300.5	317.4	278.8	249.3	187.3	133.6
SHELL DRAIN FLOW, LB/HR	1135985.	1837155.	157579.	468737.	742057.	961310.
SHELL DRAIN TEMPERATURE, F	325.8	317.4	254.3	192.3	138.6	112.7
SHELL DRAIN ENTHALPY, BTU/LB	296.4	287.7	222.9	160.3	106.6	80.7

TABLE VIII CONDENSER

CONDENSER PRESSURE, PSIA	0.98231	-	2.00	IN. HGA
CONDENSATE FLOW, LB/HR	5376713.			
CONDENSATE TEMPERATURE, F	101.1			
CONDENSATE ENTHALPY, BTU/LB	69.1			

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TABLE IX CONDENSATE AND FEEDWATER

FW FLOW TO FW PUMP, LB/HR	7213868.		
FW TEMPERATURE TO FW PUMP, F	313.6		
FW ENTHALPY TO FW PUMP, BTU/LB	283.8		
FW ENTHALPY RISE ACROSS FW PUMP, BTU/LB	4.3		
FW PRESSURE INCREASE ACROSS FW PUMP, PSI	116.1		
FW FLOW TO STEAM GENERATOR, LB/HR	7213868.		
FW TEMPERATURE TO STEAM GENERATOR, F	375.5		
FW ENTHALPY TO STEAM GENERATOR, BTU/LB	350.2		
MAKE-UP TO CONDENSER HOTWELL, LB/HR	0.		
STEAM FLOW FROM STEAM GENERATOR, LB/HR	7213868.		
STEAM ENTHALPY FROM STEAM GENERATOR, BTU/LB	1244.5		
THROTTLE STEAM FLOW FW PUMP TURBINE, LB/HR	131275.		
THROTTLE PRESSURE FW PUMP TURBINE, PSIA	83.9		
THROTTLE ENTHALPY FW PUMP TURBINE, BTU/LB	1295.9		
EXHAUST PRESSURE FW PUMP TURBINE, PSIA	1.22789	=	2.50 IN. HGA
EXHAUST ENTHALPY FW PUMP TURBINE, BTU/LB	1057.3		

EXAMPLE PROBLEM NO. 2, HALF RATED LOAD
STEAM TURBINE CYCLE HEAT BALANCE
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TABLE X VALVE STEIN AND SHAFT LEAKAGES

STEAM SEAL REGULATOR	
FLOW TO SSR, LB/HR	18000.
ENTHALPY AT SSR, BTU/LB	1145.4
FLOW FROM SSR TO MAIN CONDENSER, LB/HR	10800.
FLOW FROM SSR TO STEAM PACKING EXHAUSTER, LB/HR	7200.
FLOW FROM SSR TO FW HEATER NO. 6, LB/HR	0.
MAKE-UP FROM THROTTLE STEAM, LB/HR	1109.
ENTHALPY OF MAKE-UP STEAM, BTU/LB	1244.5
THROTTLE VALVE STEIN	
LEAK NO. 1 (DRAINS TO FW HEATER NO. 1), LB/HR	11460.
ENTHALPY LEAK NO. 1, BTU/LB	1244.5
LEAK NO. 2 (DRAINS TO SSR), LB/HR	3120.
ENTHALPY LEAK NO. 2, BTU/LB	1244.5
GOVERNING STAGE SECTION	
LEAK NO. 3 (DRAINS TO FW HEATER NO. 0), LB/HR	0.
ENTHALPY LEAK NO. 3, BTU/LB	0.0
LEAK NO. 4 (DRAINS TO SSR), LB/HR	0.
ENTHALPY LEAK NO. 4, BTU/LB	0.0
HP TURBINE SECTION	
TOTAL LEAK NO. 5 (DRAINS TO FW HEATER NO. 0), LB/HR	0.
ENTHALPY LEAK NO. 5, BTU/LB	0.0
TOTAL LEAK NO. 6 (DRAINS TO SSR), LB/HR	13771.
ENTHALPY LEAK NO. 6, BTU/LB	1115.0

Appendix C

FORTRAN LISTING

This appendix contains a brief description and a complete FORTRAN listing of the main program and subroutines. The steam properties subroutines from Ref. 4 are not listed. The primary function of the main program is to control the order of calculations and to call the subroutines required by the cycle specified by the input data. It also performs some calculations. There are no programmed stops or exits. If a convergence criterion is not satisfied or if the allowable range of an independent variable is exceeded, a warning message will be printed and calculations will continue.

The following subroutines perform the input and output functions and the analysis of the specified turbine cycle.

AMOIST	performs internal moisture removal calculations for the low-pressure turbine section
BLOCK DATA	contains default input data to simulate VWO conditions for the cycle of Fig. 22 in Ref. 3
CROSS	calculates average group moisture for the high-pressure turbine section
DATAIN	reads input data cards, sets values by default if not input, and writes input data before returning control to MAIN
FWHEAT	performs heat and mass balance calculations for the feedwater heaters
FWHPAR	calculates the following feedwater heater parameters: shell pressure, shell drain temperature, feedwater inlet temperature, and feedwater outlet temperature
FWPT	calculates steam flow to the feedwater pump turbine
HXTRAC	calculates feedwater heater extraction steam enthalpy after the turbine expansion line has been determined
HPTURB	calculates high-pressure section efficiency including governing-type stages and single stages
INDEX	calculates integer indices for keeping track of steam flows and enthalpies in the low-pressure turbine section
PRDROP	calculates intermediate system pressure drops

RESULT	writes results of calculations for each case before proceeding to the next case
SGROUP	calculates low-pressure turbine section performance
SLEAK1	calculates valve stem packing leakages
SLEAK2	calculates bowl end turbine shaft packing leakages
SLEAK3	calculates exhaust end turbine shaft leakages
SSRE	calculates steam seal regulator flows and enthalpies
STER	produces a traceback to a steam property subroutine as a result of a division by zero
STRATE	calculates enthalpy and entropy at a given pressure on a straight line between two state points on a steam Mollier chart
XLOSS	calculates exhaust loss and used energy end point for the low-pressure turbine when exhaust pressure is less than 3 psia
XSEP	performs heat and mass balance calculations for external moisture separator

The following subroutines perform the calculations required to determine turbine efficiencies and losses. The names of the subroutines correspond to the figure numbers in Ref. 3.

F1A	high-pressure turbine efficiency corrections for governing stage -- correction at design conditions VWO
F1B	high-pressure turbine efficiency corrections for governing stage -- correction for partial load
F1C	high-pressure turbine efficiency corrections for governing stage -- adjustment to correction for partial load for wheel speed
F2	high-pressure turbine efficiency correction for moisture
F3	stage group efficiency, superheat region
F4	stage group efficiency, moisture region
FIG5	stage group efficiency, moisture region -- correction for inlet volume flow
FIG7	stage group efficiency, moisture region -- correction for inlet moisture
FIG8	noncondensing stage group end point correction for exhaust loss
F10	moisture removal stage effectiveness

F12AC	construction of typical high-pressure section expansion line and typical low-pressure section moisture region expansion line
F12B	construction of typical low-pressure section superheat region expansion line
FIG15	correction to expansion line end point for exhaust pressure
F16	1800-rpm condensing group exhaust loss for 35-, 38-, and 43-in. last-stage buckets
F17	effects of pressure feedback of VW0 throttle flow
F18	mechanical losses
F19	generator loss factor, K_1
F20	generator loss factor, K_2
F21	change in generator loss with hydrogen pressure, at constant kVA
UNIPOL	univariate polynomial
BIVPOL	bivariate polynomial
LAGRAN	fourth-order (five-point) Lagrange interpolation
RATFUN	rational function

C		ORCENT
C	PROGRAM ORCENT	ORCE 10
C	IMPLICIT REAL*8 (A-H,O-Z)	ORCE 20
C	Q2R FEEDWATER FLOW TO STEAM GENERATOR	ORCE 30
C	QT TURBINE THROTTLE FLOW	ORCE 40
C	QAE STEAM JET AIR EJECTOR STEAM FLOW	ORCE 50
C	QCR CONDENSATE FLOW BY-PASSED TO STEAM GENERATOR	ORCE 60
C	QGS GOVERNING STAGE FLOW	ORCE 70
C	QMC FLOW FROM SSR TO MAIN CONDENSER	ORCE 80
C	QMU MAKE-UP FLOW TO CONDENSER HOTWELL	ORCE 90
C	QRO STEAM FLOW FROM STEAM GENERATOR	ORCE 100
C	QRH1 LIVE STEAM REHEATER, FIRST STAGE STEAM FLOW	ORCE 110
C	QRH2 LIVE STEAM REHEATER, SECOND STAGE STEAM FLOW	ORCE 120
C	QSP2 FLOW FROM SSR TO STEAM PACKING EXHAUSTER	ORCE 130
C	QXS GOVERNING STAGE EXHAUST FLOW	ORCE 140
C	QERH1 ESTIMATED LIVE STEAM REHEATER FIRST STAGE STEAM FLOW	ORCE 150
C	QERH2 ESTIMATED LIVE STEAM REHEATER SECOND STAGE STEAM FLOW	ORCE 160
C	QSSRMU STEAM SEAL REGULATOR MAKE-UP FROM THROTTLE STEAM	ORCE 170
	COMMON /BLCK/AMBHR (5), HAMB (5), THR (6), MR, IDUH	ORCE 180
	* QBLP, PBLP, TBLP, AMBLP, HBLP, SBLP, QXLP, PXL, TXLP, AMXLP,	ORCE 190
	* HXLP, SXLP, UEEPLP	ORCE 200
	* CHTS (10), TC, TFP, TR, HR, WRATE, GC, WNL, WGL, QMU, QPP,	ORCE 210
	* DP, WGEN, WFP, HTRTN, HTRTG, CEPPN, CEPPG, PC	ORCE 220
	COMMON /CONV/HCON, UERCON, AMCON, RHCON, WCON, PCON, SSRCON, XSPCON	ORCE 230
	COMMON /PPT/QPPT, PBPPT, HBPPT, PXPPT, HXPPT, IFPT	ORCE 240
	COMMON /FWH/HAEI, HAEQ, QR, QFS (20), HFS (20), HES (20), QNF (5), HNF (5),	ORCE 250
	* QMG (5), HNG (5), QD (12), QF (12), QE (12), QCH, HCR, QRO, QC, ILLP, N	ORCE 260
	COMMON /FWPTRB/ EPP, EFP, CP1, CP2	ORCE 270
	COMMON /GS/QGS, HBGS, PBGS, ABGS, SBGS, TBGS, PXGS, AXGS, SXGS,	ORCE 280
	* VYGS, TYGS, HXGS, PDGS, MBGS, MXGS, WCGS, WGS	ORCE 290
	* QT, PT, TT, AT, HT	ORCE 300
	COMMON /RP/QBHP, PBHP, TBHP, AMHP, HBHP, SBHP, QXHP, TXHP, AMXHP, HXHP,	ORCE 310
	* SXHP, UEEHP	ORCE 320
	COMMON /HX1/PE (12), PHR (5)	ORCE 330
	COMMON /HX2/HE (12), HZ1 (12), HAMB (5), HBHR (5), SAMR (5), SBMR (5), PCWD (5)	ORCE 340
	COMMON /LEAK/QLK1, HLK1, QLK2, HLK2, QLK3, HLK3, QLK4, HLK4, QLK5, HLK5,	ORCE 350
	* QLK6, HLK6, QLK7, HLK7, QLK8, HLK8, QLK9, HLK9, QLK10, HLK10, LK, LK1, LK3,	ORCE 360
	* LK5, LK7, LK9	ORCE 370
	COMMON /PAR1/HO (12), HI (12), QAE, HC, HFP, DHP, TI (12), TD (12), TDCA (12),	ORCE 380
	* ND (12), PLA, PLB, ND (12), NDC (12), IP, NF	ORCE 390
	COMMON /PAR2/PSH (12), TSH (12), TO (12), TTD (12), PNH, PXIP	ORCE 400
	COMMON /RH1/PKRH2, PIRH2, PKRH1, PIRH1, PPPT	ORCE 410
	COMMON /RH2/QRH1, HCRH1, QRH2, HCRH2, NRH, WDRH1, NDRH2	ORCE 420
	COMMON /RH3/TTDRH1, TTDRH2, HRH1, HBH2, PCRH1, TCRH1, PCRH2, TCRH2, TXRH1,	ORCE 430
	* HXRH1, TXRH2, HXRH2, HIRH2, HIRH1, QRH	ORCE 440
	COMMON /SSR/QSP2, QNC, QSSR, HSSR, PSSB, QFWH, QSSRMU, HSSRMU	ORCE 450
	COMMON /XS1/ PSX, PSI	ORCE 460
	COMMON /XS2/HFSX, JHR	ORCE 470
	COMMON /XS3/QSI, HSI, TSX, QSI, HSX, ANSX, ENS, NS	ORCE 480
	COMMON /XX1/ PCMU, PDLS, BLS, QERH1, QERH2, PF, QSGO	ORCE 490
	COMMON /XX2/ NHP, IR, NLP, NFM, NFL, IH2	ORCE 500
	COMMON /XX3/ ANHP, HHP, PIHP, SIHP, TIHP, VIHP	ORCE 510
	COMMON /Z/ TFR, SLOPE, QKKEP, PKKEP, QGKEP, PGKEP, VGKEP, GCKKEP, DUNKEP	ORCE 520
	FIG6 (TFR) = 8.5D0 - (0.9D0) / (1.2D0 - TFR)	ORCE 530
	FIG14 (XMOIST) = .87D0 * (1.D0 - .01D0 * XMOIST) * (1.D0 - .65D - 2 * XMOIST)	ORCE 540
	NAMLIST /NAM1/ ADX, QRO	ORCE 550
	DATA VERS/'11-1-78' /	ORCE 560
	DATA BLANK/0.0D0/	ORCE 570
	DATA IH/6/	ORCE 575
C	DEFINE CONVERGENCE CRITERIA	ORCE 580
C	HCON=ENTHALPY, BTU/LB	ORCE 590
C	UERCON=USED ENERGY RATIO	ORCE 600
C	AMCON=MOISTURE FRACTION	ORCE 610
C	RCON=REHEATER MOTIVE STEAM FLOW, (DELTA Q)/Q	ORCE 620
C	WCON=REQUIRED ELECTRICAL OUTPUT, (DELTA W)/W	ORCE 630
C	PCON=GOVERNING STAGE EXHAUST PRESSURE, (DELTA P)/P	ORCE 640
C	SSRCON=STEAM SEAL REGULATOR MAKE-UP, (DELTA Q)/Q	ORCE 650
C	XSPCON=MOISTURE REMOVED BY EXTERNAL MOISTURE SEPARATOR, (DELTA Q)/Q	ORCE 660
	100 CONTINUE	ORCE 670
	DO 3 I=1,12	

3	QE(I)=0.0D0	
	CALL DATAIN(VERS)	ORCE 680
	WGS=WHP	ORCE 690
	RAIN=0	ORCE 700
	ICONV=0	
C	START CALCULATIONS	ORCE 710
C	THROTTLE STEAM ENTHALPY	ORCE 720
	HT=HPS(PT,SPTD(PT,TT))	ORCE 730
	IF(AT.LE.1.D-10) GO TO 1210	ORCE 740
	ANT1=AT*0.31D0	ORCE 750
	HT=(1.0D0-ANT1)*HT+ANT1*HPT(TT)	ORCE 760
C	GOVERNING STAGE PARAMETERS	ORCE 770
1210	CONTINUE	ORCE 780
	HBGS=HT	ORCE 790
	IF(TFR.GE..6D0) PBGS=PT*(1.D0-FIG6(TFR)/100.D0)	ORCE 800
	IF(TFR.LT..6D0) CALL PART	ORCE 810
	CALL PROPPH(ABGS,SBGS,VBGS,TBGS,MBGS,PBGS,HBGS)	ORCE 820
	WCGS=0	ORCE 830
C	INTERMEDIATE SYSTEM PRESSURE DROP AND PXHP	ORCE 850
	QHR=0.D0	ORCE 860
	HPSX=0.D0	ORCE 870
	PB=PBLP	ORCE 880
	CALL PRDROP(PXHP,PB,WRH)	ORCE 890
C	CONDENSER HOTWELL PARAMETERS	ORCE 900
	TC=TSL(PC)	ORCE 910
	HC=HPT(TC)	ORCE 920
C	STEAM JET AIR EJECTOR ENTHALPY	ORCE 930
	HAEI=HT	ORCE 940
	HABO=180.17D0	ORCE 950
C	SET INDICES FOR FW HEATER HEAT BALANCE CALCULATIONS	ORCE 960
	I1HP=1	ORCE 970
	I2HP=NPH	ORCE 980
	I1LP=I2HP+1	ORCE 990
	IF(HR.GT.0) GO TO 1340	ORCE1000
	I2LP=NPF	ORCE1010
	GO TO 1350	ORCE1020
1340	I2LP=NPF+1	ORCE1030
1350	CALL INDEX(I1LP,I2LP,NPL,NR)	ORCE1040
C	FEEDWATER PUMP ENTHALPY RISE	ORCE1050
	PLA=PT*CP2	ORCE1060
	PLB=PC*CP1	ORCE1070
	DP=PLA-PLB	ORCE1080
	DHP=DP*VPT(TSL(PLB))*144.D0/778.17D0/EFP	ORCE1090
C	FW HEATER PARAMETERS	ORCE1100
	IF(NF.EQ.0) GO TO 1400	ORCE1110
	IF(NPH.EQ.0) GOTO1390	ORCE1120
	IF(PR(I2HP).LE.(PXHP+1.0D0)) GO TO 1381	ORCE1130
	I2H=I2HP	ORCE1140
	GOTO1390	ORCE1150
1381	IF(NS.EQ.0) PR(I2HP)=PXHP	ORCE1160
	IF(NS.GT.0) PR(I2HP)=PSX	ORCE1170
	I2H=I2HP-1	ORCE1180
1390	CONTINUE	ORCE1190
	CALL FWHPAR(1,NF)	ORCE1200
C	STEAM PACKING EXHAUSTER FLOW	ORCE1210
1400	IF(LK.GT.0) GOTO1409	ORCE1220
	QSPE=0.D0	ORCE1230
	HSSR=0.D0	ORCE1240
	GOTO1440	ORCE1250
1409	QSSRHU=0.D0	ORCE1260
	QSSRH1=0.D0	ORCE1270
	QSPE=1200.0D0*NLP	ORCE1280
	QHC=1800.0D0*NLP	ORCE1290
C	STEAM SEAL REGULATOR PRESSURE	ORCE1300
	IF(PXLP.LE.18.0D0) GO TO 1430	ORCE1310
	PSSR=PXLP	ORCE1320
	GOTO1440	ORCE1330
1430	PSSR=18.0D0	ORCE1340
C	REHEATER	ORCE1350
1440	QRH1=QERH1	ORCE1360

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QRH2=QERH2
IF (NRH.NE. 1) GOTO 1900
CALL REHEAT (NE(1), PE(1), HT, PT)
1900 HAIN=HAIN+1
GCKVA=GC*1000.D0
GOKVA=1000.D0*WRATE/PP
PRKVA=GOKVA/GCKVA
C GENERATOR LOSS (TANDEM COMPOUND)
C RATED HYDROGEN PRESSURE
WGL=GOKVA*P19(GCKVA)*P20 (PRKVA)*.01D0
C TEST FOR REDUCED HYDROGEN PRESSURE
IF (IH2.EQ.0) GO TO 1267
C REDUCED HYDROGEN PRESSURE
WGL=WGL-P21(GCKVA)
C MECHANICAL LOSS
1267 WML= P18 (GCKVA)
ITGS=0
ITHP=0
NCRH=0
ITHS=0
ITSSR=0
C STEAM FLOW FROM STEAM GENERATOR
QRO=QT+QAE
IF (NRH.LT. 1) GOTO 1920
IF (NRH.EQ. 1) GOTO 1910
QRO=QRO+QLH2
GOTO 1920
1910 QRO=QRO+QRH1
C MAKE-UP FLOW
1920 QMU=QT*PCHU*0.01D0
C FEEDWATER FLOW TO STEAM GENERATOR
QR=QRO-QCR+QMU
C GOVERNING STAGE PERFORMANCE
C TEST FOR VALVE STEM LEAKAGE CALCULATIONS
IF (LK.GT.0) GOTO 2001
C GOVERNING STAGE FLOW, NO VALVE STEM LEAKAGE
QGS=QT
GOTO 2003
C VALVE STEM LEAKAGE
2001 CALL SLEAK1(NF, PE,QT,PT,HT, LK1,CLK1,HLK1,QLK2,HLK2,0 )
C GOVERNING STAGE FLOW WITH VALVE STEM LEAKAGE
2002 QGS=QT-QLK1-QLK2-QSSRHU
C 3S BOWL AND SHELL CONDITIONS
2003 CONTINUE
C TEST FOR GOVERNING STAGE SHAFT LEAKAGE
IF (LK.GT.0) GOTO 2004
C FLOW TO NEXT STAGE, NO GS SHAFT LEAKAGE
QNEXT=QGS
QKGS=QGS
GOTO 2005
C GS SHAFT LEAKAGE
2004 CALL SLEAK2(NF, PE,NGS,IR ,PXGS,VXGS,HXGS,LK3,QLK3,HLK3,QLK4,
1HLK4,PSSR,0)
C FLOW TO NEXT STAGE WITH GS SHAFT LEAKAGE
QNEXT=QGS-QLK3-1LK4
QKGS=QNEXT
C TEST FOR FW HEATER AT GS EXHAUST
2005 CONTINUE
C HIGH PRESSURE SECTION PERFORMANCE
C BOWL CONDITIONS (HP SECTION)
QBHP=QNEXT
CALL NPTURB(HXHP)
PBHP=PXGS
NBHP=HXGS
SBHP=SXGS
ABHP= AIGS
HBHP=HXGS
TBHP=TXGS
C SHELL CONDITIONS (NP SECTION)

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ORCE2010
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ORCE2050

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C EXHAUST LOSS AND UEEP (HP SECTION)	ORCE2060
XLHP=FIG8(PXHP)	ORCE2070
UEEPHP=HXHP+XLHP	ORCE2080
CALL PROPPH(AMUEHP,SUEHP,VUEHP,TUEHP,MUEHP,PXHP,UEEPHP)	ORCE2090
C EXHAUST FLOW (HP SECTION)	ORCE2100
QXHP=QBHP	ORCE2110
C TEST FOR FW HEATERS (HP SECTION)	ORCE2120
IF(WFH.EQ.0) GOTO3031	ORCE2130
C FW HEATER HEAT BALANCE (HP SECTION)	ORCE2140
I1=I1HP	ORCE2150
CALL HXTRAC(0,I1HP,I2HP,HBHP,HBHP,SBHP,MXHP,HXHP,SHHP,PIHP,HIHP,	ORCE2160
1SHHP,PXHP,UEEPHP)	ORCE2170
IF(WRH.LT.2) GO TO 3025	ORCE2180
CALL REHEAT(HE(1),PE(1),WT,PT)	ORCE2190
GOTO3025	ORCE2200
3020 I1=N	ORCE2210
3025 CALL FWHEAT(I1,I2HP,0,0,MS,ITGS)	ORCE2220
ITHP=ITHP+1	ORCE2230
C TEST FOR ONLY ONE FW HEATER (HP SECTION)	ORCE2240
C TEST FOR FW HEATER AT EXHAUST (HP SECTION)	ORCE2250
IF(WFH.EQ.1.AND.I2H.LT.I2HP) GOTO3031	ORCE2260
C EXHAUST FLOW, MORE THAN ONE FW HEATER HP SECTION,	ORCE2270
C OR ONLY ONE FW HEATER AND NOT LOCATED AT HP EXHAUST	ORCE2280
QXHP=QBHP	ORCE2290
DO3030 K=I1HP,I2H	ORCE2300
3030 QXHP=QXHP-QE(K)	ORCE2310
C TEST FOR REHEATER STEAM EXTRACTION (HP SECTION)	ORCE2320
3031 IF(WRH.LT.2) GO TO 3032	ORCE2330
QXHP=QXHP-QRH1	ORCE2340
C FLOW TO NEXT SECTION	ORCE2350
3032 QNEXT=QXHP	ORCE2360
C TEST FOR SHAFT LEAKAGE CALCULATIONS	ORCE2370
IF(LR.EQ.0)GOTO3033	ORCE2380
C SHAFT LEAKAGE FROM EXHAUST END (HP SECTION)	ORCE2390
CALL SLEAK3(WF,PE,WHP,IR ,PXHP,VUEHP,UEEPHP,LK5,QLK5,HLK5,QLK6,	ORCE2400
1HLK6,PSSR)	ORCE2410
C FLOW TO NEXT SECTION	ORCE2420
QNEXT=QNEXT-QLK5-QLK6	ORCE2430
C TEST FOR FW HEATER AT HP EXHAUST	ORCE2440
3033 IF(WFH.EQ.0.OR.I2H.EQ.I2HP)GOTO3040	ORCE2450
C FLOW TO NEXT SECTION, FW HEATER AT HP EXHAUST	ORCE2460
IF(MS.EQ.0)QNEXT=QNEXT-QE(I2HP)	ORCE2470
C TEST FOR EXTERNAL MOISTURE SEPARATOR	ORCE2480
3040 IF(MS.GT.0)GOTO4000	ORCE2490
C TEST FOR REHEATER	ORCE2500
IF(WRH.WE.0) GOTO4205	ORCE2510
C ENTHALPY TO NEXT SECTION (NO MOISTURE SEPARATOR OR REHEATER)	ORCE2520
HNEXT=UEEPHP	ORCE2530
GOTO4300	ORCE2540
C EXTERNAL MOISTURE SEPARATOR PERFORMANCE (2-SECTION MACHINE)	ORCE2550
C INLET FLOW AND ENTHALPY	ORCE2560
4000 QSI=QNEXT	ORCE2570
MSI=UEEPHP	ORCE2580
ITHS=ITHS+1	ORCE2590
C HEAT AND MASS BALANCE CALCULATION	ORCE2600
QHR1=QHR	ORCE2610
CALL ISEP	ORCE2620
C TEST FOR MOISTURE FLOW TO FW HEATER AT HP SECTION EXHAUST	ORCE2630
IF(MS.GT.I2HP)GOTO4010	ORCE2640
C TEST FOR MOISTURE REMOVAL CONVERGENCE	ORCE2650
ADQHR=DABS((QHR-QHR1)/QHR)	ORCE2660
IF(ADQHR.LE.XSPCON) GOTO4010	ORCE2670
IF(ITHS.GT.50) GOTO4008	ORCE2680
I1=I2HP	ORCE2690
GOTO3025	ORCE2700
4008 WRITE(IW,4009) ADQHR	ORCE2710
4009 FORMAT('0-NAVE PROGRAM-EXTERNAL MOISTURE SEPARATOR DRAIN CALCULATION	ORCE2720
IONS DID NOT CONVERGE, ADQHR =' ,G15.7)	ORCE2730
C TEST FOR REHEATER	ORCE2740
4010 IF(WRH.WE.0) GOTO4200	ORCE2750

C FLOW AND ENTHALPY TO NEXT SECTION (NO REHEATER, 2-SECTION MACHINE)	ORCE2760
IF (MS.GT.0) QNEXT=QSI-QF(I2HP)	ORCE2770
HNEXT=HSX	ORCE2780
GOTO4300	ORCE2790
C REHEATER PERFORMANCE	ORCE2800
C FLOW AND ENTHALPY TO REHEATER (EXTERNAL MOISTURE SEPARATOR)	ORCE2810
4200 QRH=QSI-QE(I2HP)	ORCE2820
H1RH1=HSX	ORCE2830
GOTO4210	ORCE2840
C FLOW AND ENTHALPY TO REHEATER (NO MOISTURE SEPARATOR)	ORCE2850
4205 QRH=QNEXT	ORCE2860
H1RH1=H2EHPH	ORCE2870
C 1ST STAGE HEAT BALANCE	ORCE2880
4210 HCRH=HCRH+1	ORCE2890
C LIVE STEAM REHEATER	ORCE2900
QRH1=QRH*(H1RH1-H1RH1)/(H2H1-HCRH1)	ORCE2910
C TEST FOR 2ND STAGE	ORCE2920
IF (NRH.EQ.2) GOTO4225	ORCE2930
C TEST FOR 1ST STAGE DRAIN LOCATION	ORCE2940
IF (NDRH1.GT.NFH) GO TO 4224	ORCE2950
C TEST FOR PW HEATER IN GS OR HP SECTION	ORCE2960
IF (NPH.GT.0) GO TO 4230	ORCE2970
C RE-CALCULATE REACTOR STEAM AND PW FLOW	ORCE2980
4224 QERH1=QRH1	ORCE2990
QRO=QT+QAE+2RH1	ORCE3000
QR=QRO-QCR+2HU	ORCE3010
GOTO4250	ORCE3020
C 2ND STAGE HEAT BALANCE	ORCE3030
4225 QRH2=QRH*(H1RH2-H1RH2)/(NRH2-HCRH2)	ORCE3040
C TEST FOR 2ND STAGE DRAIN LOCATION	ORCE3050
IF (NDRH2.LT.NFH) GO TO 4226	ORCE3060
QERH2=QRH2	ORCE3070
GOTO4230	ORCE3080
C TEST FOR 2ND STAGE CONVERGENCE	ORCE3090
4226 ADQ2=DABS((QRH2-QERH2)/QRH2)	ORCE3100
IF (ADQ2.LE.NHCON) GOTO4230	ORCE3110
QERH2=QRH2	ORCE3120
GOTO4240	ORCE3130
C TEST FOR 1ST STAGE CONVERGENCE	ORCE3140
4230 ADQ1=DABS((QRH1-QERH1)/QRH1)	ORCE3150
IF (ADQ1.LE.NHCON) GOTO4250	ORCE3160
4240 QERH1=QRH1	ORCE3170
IF (HCRH.LE.50) GOTO4242	ORCE3180
WRITE(IW,4241) ADQ1, ADQ2	ORCE3190
4241 FORMAT('0-MAIN PROGRAM-REHEATER CALCULATIONS DID NOT CONVERGE, ADQORCE3200	
11 =',G15.7 ,5X,'ADQ2 =',G15.7)	ORCE3210
GOTO4250	ORCE3220
C RE-CALCULATE REACTOR STEAM AND PW FLOW	ORCE3230
4242 IF (NRH.EQ.1) GOTO4243	ORCE3240
QRO=QT+QAE+2RH2	ORCE3250
GOTO4244	ORCE3260
4243 QRO=QT+QAE+2RH1	ORCE3270
4244 QR=QRO-QCR+2HU	ORCE3280
X1=I1HP	ORCE3290
GOTO3025	ORCE3300
C FLOW TO NEXT SECTION	ORCE3310
4250 QNEXT=QRH	ORCE3320
C TEST FOR 2ND STAGE	ORCE3330
IF (NRH.LT.2) GOTO4260	ORCE3340
C ENTHALPY TO NEXT TURBINE SECTION (2-STAGE REHEATER)	ORCE3350
HNEXT=H1RH2	ORCE3360
GOTO4300	ORCE3370
C ENTHALPY TO NEXT TURBINE SECTION (1-STAGE REHEATER)	ORCE3380
4260 HNEXT=H1RH1	ORCE3390
C TEST FOR PW PUMP TURBINE CALCULATIONS	ORCE3400
4300 IF (IPPT) 4320,4400,4310	ORCE3410
C PW PUMP TURBINE THROTTLE STEAM FLOW	ORCE3420
4310 CALL PPTT(PFPT,HNEXT, PC,DHP,QR)	ORCE3430

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C FLOW TO NEXT TURBINE SECTION                                ORCE3440
4320 QNEXT=QNEXT-QFPT                                         ORCE3450
4400 CONTINUE                                                ORCE3460
C TEST FOR STEAM SEAL REGULATOR                              ORCE3470
IF(LK.EQ.0)GOTO7008                                         ORCE3480
C STEAM SEAL REGULATOR ENTHALPY AND MAKEUP                   ORCE3490
CALL SSRE(PSH,HT,PXLP, ,NP)                                ORCE3500
C TEST FOR SSR MAKE-UP CONVERGENCE                             ORCE3510
IF(QSSRMU, E).QSSRM1)GOTO7008                               ORCE3520
ADMU=DABS((QSSRMU-QSSRM1)/QSSRMU)                           ORCE3530
IF(ADMU.LE.SSRCON)GOTO7008                                  ORCE3540
IF(ITSSR.GT.50)GOTO7006                                      ORCE3550
QSSRM1=QSSRMU                                                ORCE3560
GOTO2002                                                      ORCE3570
7006 WRITE(IW,7007) ADMU                                     ORCE3580
7007 FORMAT('O-MAIN PROGRAM-STEAM SEAL REGULATOR MAKE-UP CALCULATIONS DORCE3590
1 ID NOT CONVERGE, ADMU =',G15.7)
C LOW PRESSURE SECTION PERFORMANCE                           ORCE3600
C BOWL CONDITIONS (LP SECTION)                                ORCE3610
7008 QBLP=QNEXT                                              ORCE3620
HBLP=HNEXT                                                  ORCE3630
CALLPROPPH(AMRLP,SRLP,VRLP,TRLP,MRLP,PBLP,HBLP)            ORCE3640
C BASE EXPANSION LINE (LP SECTION)                            ORCE3650
IF(PXLP.GE.3.D0) GO TO 7010                                  ORCE3660
PX1=0.7367306D0                                             ORCE3670
GOTO7020                                                      ORCE3680
7010 PX1=PXLP                                                ORCE3690
7020 CALL SGR0UP(PBLP,TRLP,MRLP,SRLP,VRLP,AMRLP,MRLP,QBLP,NLP,PX1, ORCE3700
1TX1,HX1, SX1, VX1, ANX1, HX1, PILP, TILP, HILP, SILP, VILP, AHILP, HILP, PXLP) ORCE3710
C TEST FOR MOISTURE REMOVAL STAGES (LP SECTION)              ORCE3720
IF(MR.GT.0)GOTO7029                                          ORCE3730
HEP=HX1                                                      ORCE3740
ANEP=ANX1                                                     ORCE3750
GOTO7050                                                      ORCE3760
C MOISTURE REMOVAL CALCULATIONS (LP SECTION)                 ORCE3770
7029 IF(HBLP.EQ.3)GOTO7030                                   ORCE3780
PB=PBLP                                                       ORCE3790
HB=HBLP                                                       ORCE3800
SB=SRLP                                                       ORCE3810
GOTO7040                                                       ORCE3820
7030 PB=PILP                                                  ORCE3830
HB=HILP                                                       ORCE3840
SB=SILP                                                       ORCE3850
7040 CALL AMOIST(MR,PMR,PB,HB,SB,PX1, HX1, SX1, HBMR, HAMR, HEP, AMHMR, AMAMR, ORCE3860
1ANEP, SMR, SANR, PCWD, THR)
C SHELL CONDITIONS (LP SECTION)                              ORCE3870
7050 IF(PXLP.GE.3.D0) GO TO 7060                              ORCE3880
HXLP=HEP+PIG 15(PXLP*2.03602234D0)*PIG14(ANEP*100.D0)    ORCE3890
GOTO7070                                                       ORCE3900
7060 IF(MR.EQ.0)GOTO7080                                       ORCE3910
HILP=HEP                                                       ORCE3920
7070 CALLPROPPH(AHILP,SILP,VXLP,TRLP, HXLP, PXLP, HXLP)    ORCE3930
GOTO7090                                                       ORCE3940
7080 HILP=HX1                                                  ORCE3950
TXLP=TX1                                                       ORCE3960
SXLP= SX1                                                       ORCE3970
VXLP=VX1                                                       ORCE3980
AHXLP=ANX1                                                     ORCE3990
HXLP=HX1                                                       ORCE4000
7090 CONTINUE                                                 ORCE4010
C FW HEATER HEAT BALANCE (LP SECTION)                        ORCE4020
KL=1                                                         ORCE4030
OPS(KL)=QBLP                                                  ORCE4040
NPS(KL)=HBLP                                                  ORCE4050
IF(NPL.GT.0)GOTO7110                                         ORCE4060
IF(MR.EQ.0)GOTO7160                                         ORCE4070
GOTO7120                                                       ORCE4080
7110 CALL MIXTRAC(MR, IILP, NP, HBLP, HBLP, SRLP, HXLP, HILP, SILP, PILP, HILP, ORCE4090
1SILP, PXLP, OERPLP)                                         ORCE4100

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7120 CONTINUE
      IT=ITHP
      CALL PWHEAT(I1LP,I2LP,HP,KL,HS,IT)
C   TEST FOR REGRESSIVE PW HEATER HEAT BALANCE CALCULATIONS
      IF (H.FQ.I2HP.AND.WPH.GT.0) GOTO 1020
C   EXHAUST FLOW (LP SECTION)
      7150 KLT=KL
          QKLP=QPS(KLT)
C   TEST EXHAUST PRESSURE (LP SECTION)
      IF (PKLP.GE.1.D0) GO TO 7170
C   CONDENSING EXHAUST LOSS AND UERP (LP SECTION)
      CALL XLOSS(PKLP,T1LP,HEP,HKLP,QKLP,AKLP,NLP,BLS,FOLS,IR,
          1 UERP,LP,KLLP)
      GOTO 7180
C   BACK-PRESSURE EXHAUST LOSS AND UERP (LP SECTION)
      7170 KLLP=PIGR(PKLP)
          UERP,LP=HKLP+KLLP
      7180 HES(KLT)=UERP,LP
C   GENERATOR OUTPUT
      WHP=0.D0
      WLP=0.D0
C   GS SECTION
      WBTU=1.D0/3412.1400
      WGS=QGS*(HRS-HRGS)*WBTU
C   HP SECTION
      WHP=QHHP*(HHP-UERP,HP)*WBTU
C   TEST FOR PW HEATERS (HP SECTION)
      IF (WPH.EQ.0) GOTO 8050
C   TEST FOR REHEATER EXTRACTION STEAM (HP SECTION)
      IF (WRH.LT.2) GO TO 8019
C   SUBTRACT REHEATER EXTRACTION STEAM (HP SECTION)
      WHP=WHP-QRH1*(HE(1)-UERP,HP)*WBTU
C   SUBTRACT PW HEATER EXTRACTION STEAM (HP SECTION)
      8019 DO8040 1=1,HP,I2H
      8040 WHP=WHP-QE(1)*(HE(1)-UERP,HP)*WBTU
C   LP SECTION
      8050 DO8060 KL=1,KLT
      8060 WLP=WLP+QPS(KL)*(HPS(KL)-HES(KL))*WBTU
C   NET GENERATOR OUTPUT
      WGEN=(WGS+WHP+WLP-WHL-WGL)*0.00100
      IF (QSGO.NE.BLANK) GO TO 1
C   TEST NET ELECTRICAL GENERATION CONVERGENCE
      ADM=DABS((WGEN-WRATE)/WRATE)
      IF (ADM.LE.WCON) GOTO 8200
C   CHECK NUMBER OF ITERATIONS THROUGH MAIN PROGRAM
      IF (MAIN.LT.25) GOTO 8100
      WRITE(IW,8090) ADM, WGEN
      8090 FORMAT('0-MAIN PROGRAM-REQUIRED ELECTRICAL GENERATION DID NOT CONVERGE',
          1 ERGE, ADM =',G15.7',5X,'WGEN =',G15.7)
      GOTO 8200
C   CORRECT THROTTLE FLOW RATE
      8100 QT=QT*WRATE/WGEN
      GOTO 1900
      1 ADX=DABS((QRO-QSGO)/QSGO)
      IF (ADX.LE.WHCON) ICONV = ICONV + 1
      IF (ICONV.EQ.2) GO TO 8200
      IF (MAIN.LT.25) GO TO 2
      WRITE(IW,800)
      800 FORMAT('0-MAIN PROGRAM - REQUIRED STEAM GENERATOR OUTLET FLOW DID NOT CONVERGE',
          1 D NOT CONVERGE')
      WRITE(6,MAIN1)
      GO TO 8200
      2 QT=QT*QSGO/2RO
      WRATE=WGEN
      GO TO 1900
C   STEAM GENERATOR INLET ENTHALPY AND TEMPERATURE
C   TEST FOR PW HEATERS
      8200 IF (WP.GT.0) GOTO 8210
C   CONDENSER ROTHELL FLOW (NO PW HEATERS)
      QC=QR+QCR

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ORCE4130
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ORCE4790
ORCE4800
ORCE4810
ORCE4820

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C NO FW HEATERS	ORCE4810
HR=HC+QAE*(HAE1-HAE0)/QC+QSP*(HSSR-HAE0)/QC	ORCE4840
HR=HCR	ORCE4850
GOTO8240	ORCE4860
C TEST DRAIN FROM FW HEATER NO. 1	ORCE4870
A210 IF(ND(1)-EQ.0)GOTO8220	ORCE4880
C	ORCE4890
C DRAIN IS PUMPED	ORCE4900
HR=(QD(1)+HD(1)+QP(1)+HO(1))/QR	ORCE4910
GOTO8230	ORCE4920
C DRAIN IS FLASHED	ORCE4930
A220 HR=HO(1)	ORCE4940
C TEST FOR FW PUMP LOCATION	ORCE4950
A230 IF(IP.GT.0)GOTO8250	ORCE4960
C FW PUMP IS AFTER FW HEATER NO. 1	ORCE4970
A240 HPP=HR	ORCE4980
QPP=QR	ORCE4990
HR=HR+DHP	ORCE5000
GOTO8251	ORCE5010
C FW TEMPERATURE TO FW PUMP AND TO STEAM GENERATOR	ORCE5020
A250 QPP=QP(IP)	ORCE5030
A251 TPP= TSLH(HPP)	ORCE5040
TPR=TPHL(PLA,HR)	ORCE5050
RHCOHR=0.00	ORCE5060
C TEST FOR MOTOR-DRIVEN FW PUMP	ORCE5070
IF(IPPT.NE.0)GOTO8260	ORCE5080
C KW FOR MOTOR DRIVE	ORCE5090
EPHCG=0.807500	ORCE5100
WFMP=DHP+QPP/(EPHCG*3412.1400)	ORCE5110
GOTO8270	ORCE5120
C KW FOR TURBINE DRIVE	ORCE5130
A260 WFMP=QPPT*(HBPPT-HXPPT)+WHTU	ORCE5140
C NET AND GROSS CYCLE HEAT RATES (TURBINE-DRIVEN FW PUMP)	ORCE5150
HTRTN=(QHO*(HT-HR)+QCH*(HR-HCR)+QMU*(HT-HR)+RHCOHR)/(WGEN*1000.00)	ORCE5160
HTRTG=HTRTN+WGEN/(WGEN+WFMP*0.00100)	ORCE5170
GOTO8280	ORCE5180
C GROSS AND NET CYCLE HEAT RATES (MOTOR-DRIVEN FW PUMP)	ORCE5190
A270 HTRTG=(QHO*(HT-HR)+QCH*(HR-HCR)+QMU*(HT-HR)+RHCOHR)/(WGEN*1000.00)	ORCE5200
HTRTN=HTRTG*WGEN/(WGEN+WFMP*0.00100)	ORCE5210
C NET AND GROSS CYCLE EFFICIENCIES	ORCE5220
A280 CEPPN=341214.00/HTRTN	ORCE5230
CEPPG=341214.00/HTRTG	ORCE5240
IF(TPR.LT.1.000) GO TO 2525	ORCE5250
SLOPE=(HXGS-HXHP)/(SXGS-SXHP)	ORCE5260
QTKREP=QT	ORCE5270
PKREP=PXHP	ORCE5280
QKREP=QGS	ORCE5290
PKREP=PIGS	ORCE5300
VKREP=VIGS	ORCE5310
GKREP=GC	ORCE5320
2525 CONTINUE	ORCE5330
C WRITE RESULTS OF CALCULATIONS	ORCE5340
CALL RESULT(VERS)	ORCE5350
GOTO100	ORCE5360
END	ORCE5370

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C      SUBROUTINE AMOIST(R,P,PB,HB,SB,PI,HX,SI,HBMH,HAMB,HEP,AM,
      *AM225,ANEP, SBHR,S225,PCWD,TE)
      IMPLICIT REAL*8(A-H,O-Z)
C SUBPROGRAM FOR MOISTURE REMOVAL CALCULATIONS
      DIMENSION
      *PE(6),TE(6),HF(6),HFG(6),HG(6),H2S1(6),HSL(6),H2BE(6),P(5),
      *AM210(6),UE(5),S210(5),HS313(5),AE(5),BE(5),SBHR(5),
      *BGHLP(5),ANRE(5),AN(5),PCWD(5),PCPR(5),HBMH(5),HAMB(5),S225(5),
      *HS326(5),AEN(5),AM225(5), ANLP(5),CGE(5),URN(5),HGERP(5),
      *EPH(5)
      COMMON /CONV/HCON,URCON,ANCON,RHCON,UCON,PCON,SSRCON,ISPCON
      DATA IW/6/
C K=NUMBER OF MOISTURE REMOVAL POINTS
C HBMR=ENTHALPY BEFORE MOISTURE REMOVAL
C HAMB=ENTHALPY AFTER MOISTURE REMOVAL
C HEP =ENTHALPY AT END POINT AFTER MOISTURE REMOVAL
C AM=MOISTURE BEFORE MOISTURE REMOVAL
C AM225=MOISTURE AFTER MOISTURE REMOVAL
C ANEP =MOISTURE AT END POINT AFTER MOISTURE REMOVAL
C SBHR=ENTROPY BEFORE MOISTURE REMOVAL
C S225=ENTROPY AFTER MOISTURE REMOVAL
C PCWD=PER CENT WATER DRAINED
C STEAM PROPERTIES
      L=K+1
      DO 100 I=1,K
100  PE(I)=P(I)
      PE(L)=PX
      DO 110 I=1,L
      TE(I)= TSL(PE(I))
      HF(I)= HFT(TE(I))
      HG(I)=HPS(PE(I),SPTD(PE(I),TE(I)))
      HFG(I)=HG(I)-HF(I)
      SG=SPTD(PE(I),TE(I))
      AN2S1=(SG-1.0)/(SG- SPT(TE(I)))
      H2S1(I)=HG(I)-AN2S1*HFG(I)
110  HSL(I)=TE(I)+459.7
C BASE EXPANSION ANALYSIS
      DO 121 I=1,K
121  CALL F12AC (PE(I),HB,SB,HI,SI,H2BE(I),S)
      H2BE(L)=HX
      DO 122 I=1,L
122  AM210(I)=1.0-(H2BE(I)-HF(I))/HFG(I)
      DO 130 I=1,K
      UE(I)=H2BE(I)-H2BE(I+1)
      S210(I)=1.0*(H2BE(I)-H2S1(I))/HSL(I)
      HS313(I)=H2S1(I+1)+HSL(I+1)*(S210(I)-1.0)
      AE(I)=H2BE(I)-HS313(I)
      BE(I)=100.0*UE(I)/AE(I)
130  BGHLP(I)=1.0-0.435*(AM210(I)+AM210(I+1))
C MOISTURE REMOVAL CALCULATION AND NEW EXPANSION FOLLOWING MOISTURE
C REMOVAL
      DO 150 I=1,K
      ANRE(I)= F10(PE(I))
      IF(I.GT.1)GO TO 141
      AN(I)=AM210(I)
      GO TO 142
141  AN(I)=EPH(I-1)
142  PCWD(I)=ANRE(I)+AN(I)
      PCPR(I)=100.0-PCWD(I)
      IF(I.GT.1)GO TO 143
      HBMR(I)=H2BE(I)
      GO TO 144
143  HBMR(I)=HGERP(I-1)
144  SBHR(I)=1.0*(HBMR(I)-H2S1(I))/HSL(I)
      HAMB(I)=(HBMR(I)+100.0-HF(I)+PCWD(I))/PCPR(I)
      S225(I)=1.0*(HAMB(I)-H2S1(I))/HSL(I)
      HS326(I)=H2S1(I+1)+HSL(I+1)*(S225(I)-1.0)
      AEN(I)=HAMB(I)-HS326(I)
      AM225(I)=1.0-(HAMB(I)-HF(I))/HFG(I)

```

```

AMOIST
AMOI 10
AMOI 20
AMOI 30
AMOI 40
AMOI 50
AMOI 60
AMOI 70
AMOI 80
AMOI 90
AMOI 100
AMOI 110
AMOI 120
AMOI 130
AMOI 140
AMOI 150
AMOI 160
AMOI 170
AMOI 180
AMOI 190
AMOI 200
AMOI 210
AMOI 220
AMOI 230
AMOI 240
AMOI 250
AMOI 260
AMOI 270
AMOI 280
AMOI 290
AMOI 300
AMOI 310
AMOI 320
AMOI 330
AMOI 340
AMOI 350
AMOI 360
AMOI 370
AMOI 380
AMOI 390
AMOI 400
AMOI 410
AMOI 420
AMOI 430
AMOI 440
AMOI 450
AMOI 460
AMOI 470
AMOI 480
AMOI 490
AMOI 500
AMOI 510
AMOI 520
AMOI 530
AMOI 540
AMOI 550
AMOI 560
AMOI 570
AMOI 580
AMOI 590
AMOI 600
AMOI 610
AMOI 620
AMOI 630
AMOI 640
AMOI 650
AMOI 660
AMOI 670
AMOI 680
AMOI 690

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```

      EPNA=0.1
      DO 145 IT=1,100
      AMLP(I)=1.0-0.435*(AM225(I)+EPNA)
      CGE(I)=BE(I)*AMLP(I)/BGMHP(I)
      UEN(I)=AEN(I)*CGE(I)*0.01
      NGEP(I)=HAMR(I)-UEN(I)
      EPH(I)=1.0-(NGEP(I)-HP(I+1))/HFG(I+1)
      ADM=DABS(EPH(I)-EPNA)
      IF(ADM.LE.AMCON) GO TO 150
145  EPNA=EPH(I)
      WRITE(IW,145) ADM,I
146  FORMAT('0-SUBROUTINE AMOIST-END POINT MOISTURE DID NOT CONVERGE,
146  IDN =',1PD14.6,5X,'I =',I2)
150  CONTINUE
      NEP=NGEP(K)
      ANEP=EPH(K)
      RETURN
      END

```

AMOI 700
 AMOI 710
 AMOI 720
 AMOI 730
 AMOI 740
 AMOI 750
 AMOI 760
 AMOI 770
 AMOI 780
 AMOI 790
 AMOI 800
 AMOI 810
 AMOI 820
 AMOI 830
 AMOI 840
 AMOI 850
 AMOI 860
 AMOI 870

```

C      SUBROUTINE BIVPOL(A,X,Y,Z,I,J)
C      TWO DIMENSIONAL ARRAY OF POLYNOMIAL COEFS.
C      X INDEPENDENT VARIABLE
C      Y INDEPENDENT VARIABLE
C      Z DEPENDENT VARIABLE
C      I DEGREE OF X
C      J DEGREE OF Y
C      IMPLICIT REAL*8(A-H,K-Z)
C      DIMENSION A(6,7)
C      INCREASE THE ROW AND COLUMN DIMENSION EACH
C      BY ONE BECAUSE ZERO SUBSCRIPTS ARE ILLEGAL.
C      INCREMENT BELOW BASED ON ASSUMPTION DATA
C      IN CALLING ROUTINE IMPLICITLY LISTS A
C      ARRAY AS A(J,I) IN ORDER TO CONFORM
C      TO DEFINITION IN APPENDIX 1.
C      II=J+1
C      JJ=I+1
C      INITIALIZE Z
C      Z=0.0
C      DO 1 J1=1,JJ
C      DO 1 I1=1,II
1  Z=Z+A(J1,I1)*(X**(I1-1))*(Y**(J1-1))
      RETURN
      END

```

BIVPOL
 BIVP 10
 BIVP 20
 BIVP 30
 BIVP 40
 BIVP 50
 BIVP 60
 BIVP 70
 BIVP 80
 BIVP 90
 BIVP 100
 BIVP 110
 BIVP 120
 BIVP 130
 BIVP 140
 BIVP 150
 BIVP 160
 BIVP 170
 BIVP 180
 BIVP 190
 BIVP 200
 BIVP 210
 BIVP 220
 BIVP 230
 BIVP 240

	BLOCK
BLOCK DATA	BLOCK 10
IMPLICIT REAL*8(A-H,O-Z)	BLOCK 20
COMMON /BLCK/AMRHR(5),AMHR(5),THR(6),MR,IDUM	BLOCK 30
*,JBLP,PBLP,TBLP,ANBLP,NBLP,SBLP,QXLP,PXLP,TXLP,ANXLP,	BLOCK 40
*HXLP,SXLP,HPEPLP	BLOCK 50
*,CNTS(18),TC,TFP,TR,HR,WRA TE,GC,WML,WGL,QMU,QPP,	BLOCK 60
*DP,WGEN,WFPW,HTRTN,HTRTG,CEPFN,CEPPG,PC	BLOCK 70
COMMON /CONV/HCON,UBRCON,ANCON,RHCON,WCON,PCON,SSRCON,XSPCON	BLOCK 80
COMMON /DEFAULT/ PXLPI,PCI	BLOCK 90
COMMON /PPT/QPPT,PBPPT,HBPPT,PPPT,HXPPT,IPPT	BLOCK 100
COMMON /PWH/HART,HAEO,QR,QPS(20),HPS(20),HES(20),QMP(5),HMP(5),	BLOCK 110
*QMG(5),HMG(5),OD(12),QF(12),QE(12),OCR,HCR,ORO,QC,IILP,I	BLOCK 120
COMMON /FWPTBB/ EPP, EPP, CP1, CP2	BLOCK 130
COMMON /GS/QGS,HBS,PBGS,ANBGS,SBS,VBGS,TBGS,PBGS,ANBGS,SX:GS,	BLOCK 140
*VBS,TBGS,HBS,PBGS,HBGS,MBGS,NCBS,NGS	BLOCK 150
*,QT,PT,TT,AT,HT	BLOCK 160
COMMON /HX1/PE(12),PHR(5)	BLOCK 170
COMMON /LEAK/QLK1,HLK1,QLK2,HLK2,QLK3,HLK3,QLK4,HLK4,QLK5,HLK5,	BLOCK 180
*QLK6,HLK6,QLK7,HLK7,QLK8,HLK8,QLK9,HLK9,QLK10,HLK10,LK,LK1,LK1,	BLOCK 190
*LK5,LK7,LK9	BLOCK 200
COMMON /PAR1/HO(12),HI(12),QAR,HC,HFP,DHP,TI(12),TD(12),TDCA(12),	BLOCK 210
*HO(12),PLA,PLB,ND(12),NDC(12),IP,NP	BLOCK 220
COMMON /PAR2/PSH(12),TSH(12),TO(12),TTD(12),PHHP,PHIP	BLOCK 230
COMMON /RH2/QRH1,HCRH1,QRH2,HCRH2,NRH,NDRH1,NDRH2	BLOCK 240
COMMON /KS3/QSI,HSI,TSX,QSX,HSX,ANSX,EMS,MS	BLOCK 250
COMMON /XX1/PCMU,PDIS,HLS,QRH1,QRH2,PF,QSGO	BLOCK 260
COMMON /XX2/ NHP,IR,NLP,NPH,NPL,IH2	BLOCK 270
COMMON /Z/ TFR,SLOPE,UTKEEP,PKKEEP,QGKEEP,PGKEEP,VGKEEP,GCKEEP,DUMENBCK	BLOCK 280
DATA AT/.52D0/	BLOCK 290
DATA BLS/43.D0/	BLOCK 300
DATA CP1/220.D0/,CP2/1.30MHDO/	BLOCK 310
DATA EPP/.7698D0/	BLOCK 320
DATA EPP/.878D0/	BLOCK 330
DATA GC/1459.8D0/	BLOCK 340
DATA IH2/0/	BLOCK 350
DATA IP/1/,I/PT/1/	BLOCK 360
DATA IR/1800/	BLOCK 370
DATA LK/1/	BLOCK 380
DATA MR/4/,PHR/40.1D0,21.4D0,11.2D0,5.66D0,0.D0/	BLOCK 390
DATA MS/2/,EMS/100.D0/	BLOCK 400
DATA ND/0,1.4*0/	BLOCK 410
DATA NDC/1.3,4*1/	BLOCK 420
DATA NP/6/,NPH/2/,NPL/4/	BLOCK 430
DATA NHP/2/	BLOCK 440
DATA NLP/6/	BLOCK 450
DATA NRH/0/	BLOCK 460
DATA PBLP/233.7D0/	BLOCK 470
DATA PCI/2.D0/	BLOCK 480
DATA PCMU/0.D0/	BLOCK 490
DATA PDGS/65.D0/	BLOCK 500
DATA PE/371.7D0,0.D0,126.6D0,69.5D0,21.4D0,5.66D0/	BLOCK 510
DATA PF/.9D0/	BLOCK 520
DATA PT/965.D0/	BLOCK 530
DATA PXLPI/2.D0/	BLOCK 540
DATA QAE/1.5D0/	BLOCK 550
DATA QCR/61000.D0/	BLOCK 560
DATA QSGO/16679080.D0/	BLOCK 570
DATA QT/16668044.D0/	BLOCK 580
DATA TDCA/10.D0,0.D0,4*10.D0/	BLOCK 590
DATA TFR/1.D0/	BLOCK 600
DATA TT/540.325D0/	BLOCK 610
DATA TTD/6*5.D0/	BLOCK 620
DATA WRA TE/1313.020D0/	BLOCK 630
DATA HCON/.5D-1/,UBRCON/1.D-3/,ANCON/1.D-4/,RHCON/1.D-8/	BLOCK 640
DATA WCON/1.D-7/,PCON/1.D-4/,SSRCON/1.D-4/,XSPCON/1.D-6/	BLOCK 650
END	BLOCK 660

C	SUBROUTINE CROSS(HIN,SIN,PRATIO,EFFY,AGM)	CROSS
	IMPLICIT REAL*8(A-H,O-Z)	CROS 10
C	_I DRY AND SATURATED VAPOR CONDITIONS, P, T, V, H, S, A, M	CROS 20
C	ASH AVERAGE GROUP MOISTURE	CROS 30
C	_ID IDEAL CONDITIONS (REVERSIBLE ADIABATIC), P, T, V, H, S, A, M	CROS 40
C	_IN INLET CONDITIONS, P, T, V, H, S, A, M	CROS 50
C	EFFY H-P EFFICIENCY AFTER ALL CORRECTIONS	CROS 60
C	_INT ESTIMATED EXPANSION LINE POINT INTERSECTING SATURATION LINE	CROS 70
C	_OUT OUTLET CONDITIONS, P, T, V, H, S, A, M	CROS 80
C	PBOT A PRESSURE BELOW SAT. LINE ITERATIVELY APPROACHING SAT. LINE	CROS 90
C	PTOP A PRESSURE ABOVE SAT. LINE ITERATIVELY APPROACHING SAT. LINE	CROS 100
C	UETOT TOTAL USED ENERGY (DELTA H)	CROS 110
C	UEWET NET USED ENERGY (DELTA H)	CROS 120
C	DELTAH DELTA H BETWEEN SATURATION LINE AND TRIAL POINT	CROS 130
	COMMON /CONV/HCON,UPRCON,ANCON,RHCON,WCON,PCON,SSRCON,XSPCON	CROS 140
	COMMON /XXI/ AL, HL, PL, SL, TL, VL	CROS 150
	CALL PROPHS(PIN,TIN,VIN,AIN,MIN,HIN,SIN)	CROS 160
	POUT=PIN/PRATIO	CROS 170
	PID=POUT	CROS 180
	SID=SIN	CROS 190
	CALL PROPPS(AID,HID,TID,VID,MID,PID,SID)	CROS 200
	DIDEAL=HIN-HID	CROS 210
	HOUT=HIN-EFFY*DIDEAL	CROS 220
	CALL PROPPH(AOUT,SOUT,VOUT,TOUT,HOUT,POUT,HOUT)	CROS 230
	IF (HOUT.GT.1) AGM=0.00	CROS 240
	IF ((HOUT.EQ.1).AND.(MIN.LT.1)) AGM=(AIN+AOUT)/2.00	CROS 250
	IF ((HOUT.EQ.1).AND.(MIN.EQ.1)) GO TO 610	CROS 260
	GO TO 602	CROS 270
610	J=0	CROS 280
640	IF(J.GT.0) GO TO 604	CROS 290
	PTOP=PIN	CROS 300
	PBOT=POUT	CROS 310
	GO TO 605	CROS 320
604	IF (HL.LT.HINT) PTOP=PINT	CROS 330
	IF (HINT.LT.HL) PBOT=PINT	CROS 340
605	PL=(PTOP+PBOT)/2.00	CROS 350
	J=J+1	CROS 360
	CALL F12AC(PL,HIN,SIN,HOUT,SOUT,HINT,SINT)	CROS 370
	CALL PROPHS(PINT,TINT,VINT,AINT,HINT,HINT,SINT)	CROS 380
	TL=TSL(PL)	CROS 390
	HL=HPS(PL,SPTD(PL,TL))	CROS 400
	CALL PROPPH(AL,SL,VL,TL,HL,PL,HL)	CROS 410
	DELTAH=DABS(HL-HINT)	CROS 420
	IF (DELTAH.LE.HCON) GO TO 631	CROS 430
	IF (J.LT.100) GO TO 640	CROS 440
631	UEWET=HINT-HOUT	CROS 450
	UETOT=HIN-HOUT	CROS 460
	AGM=((AIN+AOUT)/2.00)*UEWET/UETOT	CROS 470
602	CONTINUE	CROS 480
	RETURN	CROS 490
	END	CROS 500
		CROS 510

C	SUBROUTINE DATAIN(VEBS)	DATAIN
	IMPLICIT REAL*8 (A-H,O-Z)	DATA 10
	COMMON /BLCK/AMBHP (5), AMAMR (5), THR (6), TR, IDUM	DATA 20
	*, JBLP, PBLP, TBLP, AMBLP, HBLP, SBLP, QXLP, PXLP, TXLP, AMXLP,	DATA 30
	*HXLP, SXLP, DEEPLP	DATA 40
	*, CNTS (18), TC, TFP, TR, HR, WRATE, GC, WML, WGL, QMU, QFP,	DATA 50
	*DP, WGEN, WFWP, HTRTN, HTRTG, CEPPN, CEPPG, PC	DATA 60
	COMMON /DEFAULT/ PILPI, PCI	DATA 70
	COMMON /PPT/QPPT, PBPPT, HBPPT, PXPPT, HXPPT, IPPT	DATA 80
	COMMON /FWH/HAEX, HAEQ, QR, QPS (20), HPS (20), HES (20), QMP (5), HMP (5),	DATA 90
	*QMG (5), RMG (5), OD (12), QF (12), QB (12), QCB, HCB, QRO, QC, I1LP, I	DATA 100
	COMMON /PWPTRB/ EFP, EFP, CP1, CP2	DATA 110
	COMMON /GS/QGS, HBGS, PBGS, ABGS, SBGS, VBGS, TBGS, PXGS, AXGS, SXGS,	DATA 120
	*VXGS, TXGS, HXGS, PDGS, MBGS, MXGS, NCGS, NGS	DATA 130
	*, QT, PT, TT, AT, HT	DATA 140
	COMMON /HX1/PE (12), PMR (5)	DATA 150
	COMMON /LEAK/OLK1, HLK1, QLK2, HLK2, QLK3, HLK3, QLK4, HLK4, QLK5, HLK5,	DATA 160
	*QLK6, HLK6, QLK7, HLK7, QLK8, HLK8, QLK9, HLK9, QLK10, HLK10, LK, LK1, LK3,	DATA 170
	*LK5, LK7, LK9	DATA 180
	COMMON /PAR1/HO (12), HI (12), QAB, HC, HFP, DHP, TI (12), TD (12), TDCA (12),	DATA 190
	*HD (12), PLA, PLB, ND (12), NDC (12), IP, NP	DATA 200
	COMMON /PAR2/PSH (12), TSH (12), TO (12), TTD (12), PXP, PXIP	DATA 210
	COMMON /RH2/QRH1, HCRH1, QRH2, HCRH2, NRH, NDRH1, NDRH2	DATA 220
	COMMON /RH3/TTDRH1, TTDRH2, HRH1, HBH2, PCRH1, TCRH1, PCRH2, TCRH2, TRH1,	DATA 230
	*HIRH1, TERH2, HIRH2, HIRH2, HIRH1, QRH	DATA 240
	COMMON /XS3/QSI, HSI, TSX, QSI, HSI, AMSX, EMS, MS	DATA 250
	COMMON /XX1/ PCNU, PDLs, BLS, QERH1, QERH2, PF, QSGO	DATA 260
	COMMON /XX2/ NHP, IR, NLP, NPH, NPL, IH2	DATA 270
	COMMON /Z/ TFR, SLOPE, QTKEEP, PKEEP, QGKEEP, PGKEEP, VGKEEP, GCKEEP, DUMED	DATA 280
	DATA BLANK/0.0D0/, CPSI/2.03602234D0/	DATA 290
C	READ ONE COMMENT CARD (COLUMNS 1-72)	DATA 300
	HSX=1200.D0	DATA 310
	READ (5,201,END=999) (CNTS(J), J=1,18)	DATA 320
	201 FORMAT(18A4)	DATA 330
C	READ DATA CARDS	DATA 340
	200 READ (5,210) IPLAG, DATA1, DATA2, DATA3, DATA4, DATA5, DATA6	DATA 350
	210 FORMAT(I2,D10.0,5D12.0)	DATA 360
	IF (IPLAG.EQ.0) GO TO 300	DATA 370
	GO TO (1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17), IPLAG	DATA 380
C	IPLAG=1	DATA 390
C	IT=THROTTLE STEAM TEMPERATURE, F	DATA 400
C	PT=THROTTLE STEAM PRESSURE, PSIA	DATA 410
C	AMF=THROTTLE STEAM MOISTURE, PER CENT	DATA 420
	1 TT=DATA1	DATA 430
	PT=DATA2	DATA 440
	AT=DATA3	DATA 450
	GO TO 200	DATA 460
C	IPLAG=2	DATA 470
C	QT=ESTIMATED THROTTLE STEAM FLOW, LBM/HR	DATA 480
C	PCNU=FW MAKE-UP RATE, PER CENT	DATA 490
C	QCR=CONDENSATE FLOW BY-PASSED TO STEAM GENERATOR, LB/HR	DATA 500
C	TFR=THROTTLE FLOW RATIO	DATA 510
C	QSGO=REQUIRED STEAM GENERATOR OUTLET FLOW	DATA 520
	2 QT=DATA1	DATA 530
	PCNU=DATA2	DATA 540
	QCR=DATA3	DATA 550
	TFR=DATA4	DATA 560
	QSGO=DATA5	DATA 570
	GO TO 200	DATA 580
C	IPLAG=3	DATA 590
C	WRATE=ELECTRICAL OUTPUT, MWE (TURBINE MAXIMUM GUARANTEED RATING)	DATA 600
C	GC=GENERATOR CAPABILITY, MVA	DATA 610
C	PF=GENERATOR POWER FACTOR	DATA 620
C	IN2=0, GENERATOR OPERATION AT RATED HYDROGEN PRESSURE	DATA 630
C	IN2=1, GENERATOR OPERATION AT REDUCED HYDROGEN PRESSURE	DATA 640
	3 WRATE=DATA1	DATA 650
	GC=DATA2	DATA 660
	PF=DATA3	DATA 670

IN2=DATA4	DATA 680
GO TO 200	DATA 690
C IFLAG=4	DATA 700
C EFP=FEEDWATER PUMP ISENTROPIC EFFICIENCY	DATA 710
C EFP=FEEDWATER PUMP TURBINE EFFICIENCY	DATA 720
C CPI=PRESSURE OF PWP INLET ABOVE CONDENSER PRESSURE, PSI	DATA 730
C CP2=RATIO OF PWP DISCHARGE PRESSURE TO H-P TURBINE THROTTLE PRESSURE	DATA 740
4 EFP=DATA1	DATA 750
EFP=DATA2	DATA 760
CPI=DATA3	DATA 770
CP2=DATA4	DATA 780
GO TO 200	DATA 790
C IFLAG=5	DATA 800
C PDGS=PITCH DIAMETER OF GOVERNING STAGE, IN.	DATA 810
5 PDGS=DATA1	DATA 820
GO TO 200	DATA 830
C IFLAG=6 IS NOT USED	DATA 840
6 CONTINUE	DATA 850
GO TO 200	DATA 860
C IFLAG=7	DATA 870
C NHP=NUMBER OF PARALLEL HP SECTIONS	DATA 880
7 NHP=DATA1	DATA 890
GO TO 200	DATA 900
C IFLAG=8 IS NOT USED	DATA 910
8 CONTINUE	DATA 920
GO TO 200	DATA 930
C IFLAG=9	DATA 940
C NLP=NUMBER OF PARALLEL LP SECTIONS	DATA 950
C PBLP=BOWL PRESSURE LP SECTION, PSIA	DATA 960
C PKLPI=EXHAUST PRESSURE LP SECTION, IN. HGA	DATA 970
C BLS=LENGTH OF LAST STAGE BUCKETS LP SECTION, IN.	DATA 980
C PCI=CONDENSER PRESSURE, IN. HGA	DATA 990
C IF DATA3.GT.0, PKLPI=DATA3 AND PCI=DATA6	DATA 1000
C PKLP=EXHAUST PRESSURE LP SECTION, PSIA	DATA 1010
C PC=CONDENSER PRESSURE, PSIA	DATA 1020
C IF DATA3.LT.0, PKLP=-DATA3 AND PC=-DATA6	DATA 1030
C PDL= PITCH DIAMETER OF LAST STAGE LP SECTION, IN.	DATA 1040
9 NLP=DATA1	DATA 1050
PBLP=DATA2	DATA 1060
PKLPI=DATA3	DATA 1070
BLS=DATA4	DATA 1080
PCI=DATA5	DATA 1090
GO TO 200	DATA 1100
C IFLAG=10	DATA 1110
C NHR=NUMBER OF MOISTURE REMOVAL STAGES LP SECTION	DATA 1120
C PMR(L)=MOISTURE REMOVAL STAGE PRESSURE, PSIA (L=1,NR)	DATA 1130
10 NR=DATA1	DATA 1140
PMR(1)=DATA2	DATA 1150
PMR(2)=DATA3	DATA 1160
PMR(3)=DATA4	DATA 1170
PMR(4)=DATA5	DATA 1180
PMR(5)=DATA6	DATA 1190
GO TO 200	DATA 1200
C IFLAG=11	DATA 1210
C NS=0, NO EXTERNAL MOISTURE SEPARATOR	DATA 1220
C NS=N, EXTERNAL MOISTURE SEPARATOR DRAINS TO FW HEATER NO. N	DATA 1230
C NS=NP+1, EXTERNAL MOISTURE SEPARATOR DRAINS TO CONDENSER	DATA 1240
C ENS=MOISTURE SEPARATOR EFFECTIVENESS, PER CENT	DATA 1250
11 NS=DATA1	DATA 1260
ENS=DATA2	DATA 1270
GO TO 200	DATA 1280
C IFLAG=12	DATA 1290
C NRH=NUMBER OF STAGES OF LIVE STEAM REHEAT	DATA 1300
C QERH1=ESTIMATED STEAM FLOW TO 1ST STAGE REHEATER, LBM/HR	DATA 1310
C TTDH1=TERMINAL TEMPERATURE DIFFERENCE 1ST STAGE REHEATER, F	DATA 1320
C QERH2=ESTIMATED STEAM FLOW TO 2ND STAGE REHEATER, LBM/HR	DATA 1330
C TTDH2=TERMINAL TEMPERATURE DIFFERENCE 2ND STAGE REHEATER, F	DATA 1340
C IF NRH=1, REHEATER ALWAYS DRAINS TO FW HEATER NO. 1	DATA 1350
C IF NRH=2 AND NDRH=0, 1ST STAGE DRAINS TO FW HEATER NO. 2	DATA 1360
C IF NRH=2 AND NDRH=1, 1ST STAGE DRAINS TO FW HEATER NO. 1	DATA 1370

C	IF NRH=2, 2ND STAGE ALWAYS DRAINS TO FW HEATER NO. 1	DATA1380
12	NRH=DATA1	DATA1390
	QERH1=DATA2	DATA1400
	TTDRH1=DATA3	DATA1410
	QERH2=DATA4	DATA1420
	TTDRH2=DATA5	DATA1430
	NDRH=DATA6	DATA1440
	GO TO 200	DATA1450
C	IPLAG=13	DATA1460
C	NP=TOTAL NUMBER OF FW HEATERS	DATA1470
C	NP1=NUMBER OF FW HEATERS HP SECTION	DATA1480
C	NPL=NUMBER OF FW HEATERS LP SECTION	DATA1490
13	NP=DATA1	DATA1500
	NPH=DATA2	DATA1510
	NPL=DATA3	DATA1520
	GO TO 200	DATA1530
C	IPLAG=14	DATA1540
C	N=FW HEATER NUMBER	DATA1550
C	PE(N)=EXTRACTION STAGE PRESSURE, PSIA	DATA1560
C	ITD(N)=FW HEATER TERMINAL TEMPERATURE DIFFERENCE, F	DATA1570
C	ND(N)=0, FW HEATER DRAIN IS FLASHED	DATA1580
C	ND(N)=1, FW HEATER DRAIN IS PUMPED	DATA1590
C	NDC(N)=0, NO DRAIN COOLER ON FW HEATER	DATA1600
C	NDC(N)=1, DRAIN COOLER SECTION ON FW HEATER	DATA1610
C	TDCA(N)=DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE, F	DATA1620
14	N=DATA1	DATA1630
	PE(N)=DATA2	DATA1640
	ITD(N)=DATA3	DATA1650
	ND(N)=DATA4	DATA1660
	NDC(N)=DATA5	DATA1670
	TDCA(N)=DATA6	DATA1680
	GO TO 200	DATA1690
C	IPLAG=15	DATA1700
C	IP=0, FW PUMP IS LOCATED AFTER FW HEATER NO. 1	DATA1710
C	IP=N, FW PUMP IS LOCATED BEFORE FW HEATER NO. N	DATA1720
C	IPPT=0, FW PUMP IS MOTOR DRIVEN	DATA1730
C	IPPT=1, FW PUMP IS TURBINE DRIVEN	DATA1740
15	IP=DATA1	DATA1810
	IPPT=DATA2	DATA1820
	GO TO 200	DATA1860
C	IPLAG=16	DATA1870
C	QAE=STEAM FLOW TO SJAE, LBM/HR	DATA1880
16	QAE=DATA1	DATA1890
	GOTO200	DATA1900
C	IPLAG=17	DATA1910
C	LK=0, VALVE STEM AND SHAFT LEAKAGES WILL NOT BE CALCULATED	DATA1920
C	LK=1, VALVE STEM AND SHAFT LEAKAGES WILL BE CALCULATED	DATA1930
17	LK=DATA1	DATA1940
	GO TO 200	DATA1950
300	CONTINUE	DATA1960
	IF (TT.EQ.BLANK) TT=TSL(PT)	DATA1970
	IF (PT.EQ.BLANK) PT=PSL(TT)	DATA1980
	IF (PF.EQ.BLANK) PF=.9	DATA1990
	IF ((GC.EQ.BLANK).AND.(TFR.GE.1.D0)) GC=WRATE/PP	DATA2000
	IF ((GC.EQ.BLANK).AND.(TFR.LT.1.D0)) GC=GCKEEP	DATA2010
	IF (PDGS.EQ.BLANK) PDGS=65.	DATA2020
	IF (PCI.EQ.BLANK) PCI=PKLPI	DATA2030
	IF (PKLPI.LT.0) GO TO 91	DATA2040
	PKLP=PKLPI/CPSI	DATA2050
	PC=PCI/CPSI	DATA2060
	GO TO 92	DATA2070
91	PKLP=-PKLPI	DATA2080
	PKLPI=PKLP*CPSI	DATA2090
	PC=-PCI	DATA2100
	PCI=PC*CPSI	DATA2110
92	CONTINUE	DATA2120
	ISEVEN=SEVEN	DATA2130
	IF ((NHP.EQ.ISEVEN).AND.(WRATE.LE.575.D0)) NHP=1	DATA2140
	IF ((NHP.EQ.ISEVEN).AND.(WRATE.GT.575.D0)) NHP=2	DATA2150
	IF (BLS.EQ.35.D0) PDLS=110.0	DATA2160
	IF (BLS.EQ.38.D0) PDLS=127.5	DATA2170

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      IF (BLS.EQ.43.D0) PDLS=132.0
      IF (EMS.EQ.BLANK) EMS=100.
      IF (NRH.EQ.1) GO TO 2012
      NDRH2=1
      IF (NDRH.NE.3) GO TO 2012
      NDRH1=2
      GO TO 602
2012 NDRH1=1
602 CONTINUE
      DO 603 N=1,NP
      IF (TTD(N).EQ.BLANK) TTD(N)=5.0
      IF ((ND(N).EQ.BLANK).AND.(TDCA(N).EQ.BLANK)) TDCA(N)=10.
603 CONTINUE
      PRINT 310, (CHTS(K),K=1,18),VERS
310 FORMAT('1',I10,18A4/
      * ' ',T10,'STEAM TURBINE CYCLE HEAT BALANCE'/
      * ' ',T10,'PERCENT, VERSION ',A8)
      WRITE(6,800) TT
800 FORMAT('0',T10,'INPUT DATA'/
      * '0',T15,'THROTTLE STEAM TEMPERATURE',T74,F7.1,T87,'F')
      WRITE(6,801) PT
801 FORMAT('0',T15,'THROTTLE STEAM PRESSURE',T74,F7.1,T87,'PSIA')
      WRITE(6,802) AT
802 FORMAT('0',T15,'THROTTLE STEAM MOISTURE',T76,F6.2,T87,'PER CENT')
      WRITE(6,803) QT
803 FORMAT('0',T15,'ESTIMATED THROTTLE STEAM FLOW',T70,F10.0,T87,
      * 'LB/HR')
      WRITE(6,804) PCMU
804 FORMAT('0',T15,'FW MAKE-UP RATE (TO CONDENSER HOTWELL)',T76,F5.1,
      * T87,'PER CENT')
      WRITE(6,805) QCR
805 FORMAT('0',T15,'CONDENSATE BY-PASSED TO STEAM GENERATOR',T70,
      * F10.0,T87,'LB/HR')
      WRITE(6,899) TFR
899 FORMAT('0',T15,'THROTTLE FLOW RATIO',T76,F9.5)
      IF (QSGO.NE. BLANK) WRITE(6,851) QSGO
851 FORMAT('0',T15,'REQUIRED STEAM GENERATOR OUTLET FLOW',T70,
      * F10.0,T87,'LB/HR')
      WRITE(6,806) WRAE
806 FORMAT('0',T15,'REQUIRED ELECTRICAL OUTPUT',T74,F9.3,T87,'MWE')
      WRITE(6,807) GC
807 FORMAT('0',T15,'GENERATOR RATED CAPABILITY',T74,F9.3,T87,'MVA')
      WRITE(6,808) PF
808 FORMAT('0',T15,'GENERATOR POWER FACTOR',T77,F5.2)
      IF (IH2.EQ.0) GO TO 701
      WRITE(6,809) IH2
809 FORMAT('0',T15,'GENERATOR OPERATION AT REDUCED HYDROGEN PRESSURE,
      * IH2=',I2)
      GO TO 702
701 WRITE(6,810) IH2
810 FORMAT('0',T15,'GENERATOR OPERATION AT RATED HYDROGEN PRESSURE,
      * I2=',I2)
702 WRITE(6,811) IR
811 FORMAT('0',T15,'ROTATIONAL SPEED OF TURBINE-GENERATOR',T74,I5,T87,
      * 'RPM')
      WRITE(6,898) EFP
898 FORMAT('0',T15,'FEEDWATER PUMP ISENTROPIC EFFICIENCY',T75,F9.4)
      WRITE(6,897) EFP
897 FORMAT('0',T15,'FEEDWATER PUMP TURBINE EFFICIENCY',T75,F9.4)
      WRITE(6,849) CP1
849 FORMAT('0',T15,'PRESSURE OF PWP INLET ABOVE COND. PRESSURE',T74,
      * F8.2,T87,'PSIA')
      WRITE(6,850) CP2
850 FORMAT('0',T15,'RATIO OF PWP DISCH. PRESS. TO H-P THROTTLE',T74,
      * F8.2)
      WRITE(6,812) PDGS
812 FORMAT('0',T15,'PITCH DIAMETER OF GOVERNING STAGE',T74,F8.2,T87,
      * 'IN.')
      WRITE(6,813) NHP
813 FORMAT('0',T15,'NUMBER OF PARALLEL H-P SECTIONS',T77,I2)
      WRITE(6,814) NLP

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DATA2180
DATA2190
DATA2200
DATA2210
DATA2220
DATA2230
DATA2240
DATA2250
DATA2260
DATA2270
DATA2280
DATA2290
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DATA2790
DATA2800
DATA2810
DATA2820
DATA2830
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DATA2850
DATA2860
DATA2870
DATA2880

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814 FORMAT('0',T15,'NUMBER OF PARALLEL L-P SECTIONS',T77,I2)          DATA2890
    WRITE(6,915) PBLP                                                  DATA2900
815 FORMAT('0',T15,'BOWL PRESSURE L-P SECTION',T75,P6.1,T87,'PSIA')    DATA2910
    WRITE(6,916) PXL, PXLPI                                           DATA2920
816 FORMAT('0',T15,'EXHAUST PRESSURE L-P SECTION',T76,P9.5,T87,        DATA2930
    *'PSIA',T95,'=',P8.2,T106,'IN. HGA')                             DATA2940
    WRITE(6,917) PC, PCI                                              DATA2950
817 FORMAT('0',T15,'CONDENSER PRESSURE',T76,P9.5,T87,'PSIA',          DATA2960
    *T95,'=',P8.2,T106,'IN. HGA')                                    DATA2970
    IF(PXL.GT. 3.) GO TO 703                                           DATA2980
    WRITE(6,918) PDLS                                                 DATA2990
818 FORMAT('0',T15,'PITCH DIAMETER OF LAST STAGE L-P SECTION',T75,    DATA3000
    *P7.2,T87,'IN.')                                                  DATA3010
    WRITE(6,919) BLS                                                  DATA3020
819 FORMAT('0',T15,'LENGTH OF LAST STAGE BUCKETS L-P SECTION',T76,    DATA3030
    *P6.2,T87,'IN.')                                                  DATA3040
703 WRITE(6,920) NR                                                  DATA3050
820 FORMAT('0',T15,'NO. OF MOISTURE REMOVAL STAGES LP SECTION',T70,7X, DATA3060
    *I2)                                                              DATA3070
    IF(NR.EQ.0) GO TO 440                                              DATA3080
    DO 601 L=1,NR                                                     DATA3090
    WRITE(6,921) L, PMR(L)                                             DATA3100
821 FORMAT('0',T15,'MOISTURE REMOVAL STAGE NO.',I2/                   DATA3110
    *'0',T17,'MOISTURE REMOVAL STAGE PRESSURE',T70,5X,P6.1,T87,'PSIA') DATA3120
601 CONTINUE                                                         DATA3130
440 IF(MS.EQ.0) GO TO 706                                             DATA3140
    IF(MS.LE.NP) GO TO 705                                             DATA3150
    WRITE(6,922) MS                                                  DATA3160
822 FORMAT('0',T15,'EXTERNAL MOISTURE SEPARATOR DRAINS TO CONDENSER, DATA3170
    *S=',I3)                                                         DATA3180
    GO TO 704                                                         DATA3190
705 WRITE(6,924) MS, MS                                              DATA3200
824 FORMAT('0',T15,'EXTERNAL MOISTURE SEPARATOR DRAINS TO FW HEATER NO DATA3210
    *,I3,', MS=',I3)                                                 DATA3220
    GO TO 704                                                         DATA3230
706 WRITE(6,927) MS                                                  DATA3240
827 FORMAT('0',T15,'THERE IS NO EXTERNAL MOISTURE SEPARATOR, MS=',I2) DATA3250
    GO TO 18                                                         DATA3260
704 WRITE(6,923) EMS                                                  DATA3270
823 FORMAT('0',T15,'MOISTURE SEPARATOR EFFECTIVENESS',T70,4X,P6.0,T87, DATA3280
    *'PER CENT')                                                     DATA3290
    18 INRH=IABS(NRH)                                                 DATA3300
    WRITE(6,925) INRH                                                 DATA3310
825 FORMAT('0',T15,'NUMBER OF STAGES OF REHEAT',T70,7X,I2)          DATA3320
    IF(NRH.EQ.0) GO TO 707                                             DATA3330
    IF(NRH.GT.0) GO TO 708                                             DATA3340
    WRITE(6,928) TDRH1                                                 DATA3350
828 FORMAT('0',T15,'TEMPERATURE OF STEAM LEAVING EXTERNAL REHEATER', DATA3360
    *T70,4X,P6.0,T87,'F')                                           DATA3370
    GO TO 707                                                         DATA3380
708 WRITE(6,929) QERH1, TDRH1, NDRH1, NDRH                          DATA3390
829 FORMAT('0',T15,'ESTIMATED STEAM FLOW TO 1ST STAGE REHEATER',T70,   DATA3400
    *2X,P8.0,T87,'LB/HR')/                                           DATA3410
    *'0',T15,'TERMINAL TEMPERATURE DIFFERENCE 1ST STAGE REHEATER',T70, DATA3420
    *5X,P6.1,T87,'F')/                                              DATA3430
    *'0',T15,'1ST STAGE REHEATER DRAINS TO FW HEATER NO.',I2,       DATA3440
    **, NDRH=',I2)                                                  DATA3450
    IF(NRH.EQ.1) GO TO 707                                             DATA3460
    WRITE(6,930) QERH2, TDRH2, NDRH2                                  DATA3470
830 FORMAT('0',T15,'ESTIMATED STEAM FLOW TO 2ND STAGE REHEATER',T70,   DATA3480
    *2X,P8.0,T87,'LB/HR')/                                           DATA3490
    *'0',T15,'TERMINAL TEMPERATURE DIFFERENCE 2ND STAGE REHEATER',T70, DATA3500
    *5X,P6.1,T87,'F')/                                              DATA3510
    *'0',T15,'2ND STAGE REHEATER DRAINS TO FW HEATER NO.',I2)      DATA3520
707 WRITE(6,926) NP                                                  DATA3530
826 FORMAT('0',T15,'TOTAL NO. OF FW HEATERS',T70,6X,I3)            DATA3540
    WRITE(6,931) NPH                                                  DATA3550
831 FORMAT('0',T15,'NO. OF FW HEATERS HP SECTION',T70,7X,I2)        DATA3560
    WRITE(6,932) NPL                                                  DATA3570
832 FORMAT('0',T15,'NO. OF FW HEATERS LP SECTION',T70,7X,I2)        DATA3580

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      IF (MP.EQ.0) GO TO 731
      DO 690 N=1,NP
      IF (PE(N).LE.0.0D0 .AND. MS.EQ.0) WRITE(6,611) N, TTD(N)
611  FORMAT('0',I15,'FW HEATER NO.',I3/
      * '0',T17,'EXTRACTION STEAM FROM TURBINE EXHAUST'/
      * '0',T17,'TERMINAL TEMPERATURE DIFFERENCE',T70,6X,P5.1,T87,'F')
      IF (PE(N).LE.0.0D0 .AND. MS.GE.1) WRITE(6,612) N, TTD(N)
612  FORMAT('0',I15,'FW HEATER NO.',I3/
      * '0',T17,'EXTRACTION STEAM FROM MOISTURE SEPARATOR VESSEL'/
      * '0',T17,'TERMINAL TEMPERATURE DIFFERENCE',T70,6X,P5.1,T87,'F')
      IF (PE(N).GT. 0.0D0) WRITE( 6,610) N, PE(N), TTD(N)
610  FORMAT('0',I15,'FW HEATER NO.',I3/
      * '0',T17,'EXTRACTION STAGE PRESSURE',T70,4X,P7.1,T87,'PSIA'/
      * '0',T17,'TERMINAL TEMPERATURE DIFFERENCE',T70,6X,P5.1,T87,'F')
      IF (ND(N).EQ.0) GO TO 709
      WRITE(6,834) N, ND(N)
834  FORMAT('0',I17,'DRAIN IS PUMPED, ND('',I2,'')='',I2)
      GO TO 650
709  WRITE(6,835) N, ND(N)
835  FORMAT('0',T17,'DRAIN IS FLASHED, ND('',I2,'')='',I2)
      IF (NDC(N).EQ.1) GO TO 711
650  WRITE(6,836) N, NDC(N)
836  FORMAT('0',T17,'THERE IS NO DRAIN COOLER SECTION, NDC('',I2,'')='',
      * I2)
      GO TO 690
711  WRITE(6,837) N, NDC(N), TDCA(N)
837  FORMAT('0',T17,'THERE IS A DRAIN COOLER SECTION, NDC('',I2,'')='',I2/
      * '0',T17,'DRAIN COOLER APPROACH TEMPERATURE DIFFERENCE',T70,6X,
      * P5.1,T87,'F')
690  CONTINUE
      IF (IP.GT.0) GO TO 720
      WRITE(6,838) IP
838  FORMAT('0',I15,'FW PUMP IS LOCATED AFTER FW HEATER NO. 1, IP='',I3)
      GO TO 731
720  WRITE(6,839) IP, IP
839  FORMAT('0',I15,'FW PUMP IS LOCATED BEFORE FW HEATER NO.',I3,
      * ', IP='',I3)
731  IF (IFPT.EQ.3) GO TO 736
      WRITE(6,840) IFPT
840  FORMAT('0',I15,'FW PUMP IS TURBINE DRIVEN, IFPT='',I3)
      IF (IFPT.LT.3) GO TO 734
      WRITE(6,841)
841  FORMAT('0',I15,'STEAM FLOW TO FW PUMP TURBINE WILL BE CALCULATED')
      GO TO 740
734  WRITE(6,842) OFPT, HOFPT, HIFPT
842  FORMAT('0',I15,'STEAM FLOW TO FW PUMP TURBINE',T70,2X,P8.0,T87,
      * 'LB/HR'/
      * '0',T15,'BOWL ENTHALPY FW PUMP TURBINE',T70,P11.1,T87,'BTU/LB'/
      * '0',T15,'EXHAUST ENTHALPY FW PUMP TURBINE',T70,P11.1,T87,'BTU/LB')
      GO TO 740
736  WRITE(6,843) IFPT
843  FORMAT('0',I15,'FW PUMP IS MOTOR DRIVEN, IFPT='',I2)
740  IF (QAE.GT.0.) GO TO 743
741  WRITE(6,844) QAE
844  FORMAT('0',I15,'THERE IS NO STEAM JET AIR EJECTOR, QAE='',F10.0)
      GO TO 755
743  IF (PKLP.LT.3.) GO TO 745
      WRITE(6,845)
845  FORMAT('0',I5,'DO NOT USE SJAE WITH B-P TURBINE')
      QAE=0.
      GO TO 741
745  WRITE(6,846) QAE
846  FORMAT (
      * '0',T15,'STEAM FLOW TO STEAM JET AIR EJECTOR',T70,3X,P7.0,T87,
      * 'LB/HR')
755  IF (LKP.GT.0) GO TO 760
      WRITE(6,847)
847  FORMAT('0',I15,'VALVE STEM AND PACKING LEAKAGES WILL NOT BE CALCULATED,
      * LK='',I2)
      RETURN

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DATA3590
 DATA3600
 DATA3610
 DATA3620
 DATA3630
 DATA3640
 DATA3650
 DATA3660
 DATA3670
 DATA3680
 DATA3690
 DATA3700
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 DATA3970
 DATA3980
 DATA3990
 DATA4000
 DATA4010
 DATA4020
 DATA4030
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 DATA4060
 DATA4070
 DATA4080
 DATA4090
 DATA4100
 DATA4110
 DATA4120
 DATA4130
 DATA4140
 DATA4150
 DATA4160
 DATA4170
 DATA4180
 DATA4190
 DATA4200
 DATA4210
 DATA4220
 DATA4230
 DATA4240
 DATA4250
 DATA4260
 DATA4270
 DATA4280

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760 WRITE(6,848) LK
848 FORMAT('0',F15,' VALVE STEM AND PACKING LEAKAGES WILL BE CALCULATED',F15)
      , LK=' ',I2)
      RETURN
999 STOP 999
      END

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DATA4290
DATA4300
DATA4310
DATA4320
DATA4330
DATA4340

C	SUBROUTINE FWHPAR(N1,N2)	FWH PAR
	IMPLICIT REAL*8(A-H,O-Z)	FWHP 10
C		FWHP 20
C	SUBPROGRAM FOR FW HEATER PARAMETERS	FWHP 30
C	SHELL PRESSURE, DRAIN TEMPERATURE, AND FW IN AND OUT TEMPERATURES	FWHP 40
C		FWHP 50
	COMMON /HX1/PE(12),PHR(5)	FWHP 60
	COMMON /PAR1/HO(12),HI(12),QAE,HC,HFP,DHP,TI(12),TD(12),TDCA(12),	FWHP 70
	*ND(12),PLA,PLB,ND(12),NDC(12),IP,NF	FWHP 80
	COMMON /PAR2/PSH(12),TSH(12),TO(12),TTD(12),PXHP,PXIP	FWHP 90
	COMMON /KS1/PSK,PSI	FWHP 100
	COMMON /XS3/QSI,HSI,TSX,QSX,HSX,AMSX,EMS,MS	FWHP 110
C		FWHP 120
	DO250 I=N1,N2	FWHP 130
C	SHELL PRESSURE	FWHP 140
	IF(PE(I).GT.(PXHP+1.0).OR.PE(I).LT.(PSK-1.0))GOTO220	FWHP 150
210	PSH(I)=0.95*PE(I)	FWHP 160
	GOTO240	FWHP 170
220	CONTINUE	FWHP 180
	PSH(I)=0.92*PE(I)	FWHP 190
240	TSH(I)=TSL(PSH(I))	FWHP 200
C	FW OUTLET	FWHP 210
	TO(I)=TSH(I)-TTD(I)	FWHP 220
	IF(I.LE.IP)GOTO241	FWHP 230
	HO(I)=HFT(TO(I))	FWHP 240
	GOTO250	FWHP 250
241	HO(I)=HFTL(PLA,TO(I))	FWHP 260
250	CONTINUE	FWHP 270
	DO310 I=N1,N2	FWHP 280
C	FW INLET	FWHP 290
	IF(I.EQ.NF)GOTO260	FWHP 300
	HI(I)=HO(I+1)	FWHP 310
	IF(ND(I+1).EQ.0)GOTO270	FWHP 320
C	CORRECT FW INLET FOR PUMPED DRAIN AT I+1	FWHP 330
	HI(I)=HI(I)+1.0	FWHP 340
	GOTO270	FWHP 350
C	CORRECT FW INLET FOR SJAE ENTHALPY RISE AND SPE ENTHALPY RISE	FWHP 360
260	HI(I)=HC+1.0	FWHP 370
270	IF(IP.NE.I)GOTO280	FWHP 380
C	FW PUMP INLET	FWHP 390
	HFP=HI(I)	FWHP 400
C	CORRECT FW INLET FOR FW PUMP ENTHALPY RISE	FWHP 410
	HI(I)=HI(I)+DHP	FWHP 420
280	IF(I.LE.IP)GOTO281	FWHP 430
	TI(I)=TSLH(HI(I))	FWHP 440
	GOTO282	FWHP 450
281	TI(I)=TPHL(PLA,HI(I))	FWHP 460
282	IF(NDC(I).EQ.0)GOTO290	FWHP 470
C	DRAIN WITH DRAIN COOLER	FWHP 480
	TD(I)=TI(I)+TDCA(I)	FWHP 490
	GOTO300	FWHP 500
C	DRAIN WITHOUT DRAIN COOLER	FWHP 510
290	TD(I)=TSH(I)	FWHP 520
300	ND(I)=HFT(TD(I))	FWHP 530
310	CONTINUE	FWHP 540
	RETURN	FWHP 550
	END	FWHP 560
		FWHP 570

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C          SUBROUTINE FWHEAT(I1,I2,MR,KL,MS,IT)
C          IMPLICIT REAL*8 (A-H,O-Z)
C
C SUBPROGRAM FOR FW HEATER HEAT BALANCE
C
C 20      DRAIN FLOW FROM PREVIOUS HEATER
C QH11    DRAIN FLOW FROM 1ST STAGE REHEATER
C QH12    DRAIN FLOW FROM 2ND STAGE REHEATER
C QH13    DRAIN FLOW FROM EXTERNAL MOIST SEPARATOR
C QLK1    DRAIN FLOW FROM VALVE STEM LEAKAGES
C QLK3    DRAIN FLOW FROM TURBINE SHAFT BOWL END
C QLK5    DRAIN FLOW FROM TURBINE SHAFT EXHAUST END
C QPWH    DRAIN FLOW FROM STEAM SEAL REGULATOR
C QMP     DRAIN FLOW FROM TURBINE MOIST REM. STAGE - WATER REMOVAL
C QMS     DRAIN FLOW FROM TURBINE MOIST REM. STAGE - STEAM REMOVAL
C
C      DIMENSION IP(13),QMPE(13)
C
C      COMMON /CONV/HCON,UCON,ANCON,BHCON,WCON,PCON,SSRCON,XSPCON
C      COMMON /FWH/HARI,HAPO,QR,QPS(20),HPS(20),HES(20),QMP(5),HMP(5),
1 QHG(5),HSG(5),QD(12),QF(12),QE(12),QCR,HCB,QRO,QC,I1LP,I
C      COMMON /HX1/PE(12),PHR(5)
C      COMMON /HX2/HE(12),HE1(12),HAMR(5),HMR(5),SAMR(5),SBMR(5),PCWD(5)
C      COMMON /IN/L1(13),L2(13),J1(13),INR(5)
C      COMMON /LEAK/QLK1,HLK1,QLK2,HLK2,QLK3,HLK3,QLK4,HLK4,QLK5,HLK5,
1 QLK6,HLK6,QLK7,HLK7,QLK8,HLK8,QLK9,HLK9,QLK10,HLK10,LK,LK1,LK3,
2 LK5,LK7,LK9
C      COMMON /PAR1/HO(12),HI(12),QAB,HC,HFP,DHP,TI(12),TD(12),TDCA(12),
* HD(12),PLA,PLB,WD(12),NDC(12),IP,NP
C      COMMON /RH2/QRH1,HCRH1,QRH2,HCRH2,NRH,NDRH1,NDRH2
C      COMMON /SSR/QSPB,QNC,QSSR,HSSR,PSSB,QPWH,QSSRMU,HSSRMU
C      COMMON /XS2/HFSX,QNR
C
C      I=I1
C      IT2=0
C      GOTO 1910
1900 I=I+1
1910 QMPE(I)=0.
C      IT1(I)=0
C      IF (MR.EQ.0) GOTO 2000
C      IF (L2(I).LT. L1(I)) GOTO 1995
C FIND DRAIN FROM TURBINE MOISTURE REMOVAL STAGE
C      H1=L1(I)
C      H2=L2(I)
C      DO 1990 L=H1,H2
C      QMP(L)=PCWD(L)*QPS(KL)*0.01
C      HMP(L)=HPT(TSL(PHR(L)))
C      IF (I.EQ.I2) GOTO 1980
C      IF (PE(I).LT. (PHR(L)-1.0)) GOTO 1980
C      QHG(L)=0.0
C      HSG(L)=0.0
C      QMPE(I)=QMP(L)
C      GOTO 2000
1980 QHG(L)=0.005*QPS(KL)
C      HSG(L)=HAMR(L)
C FIND FLOW TO FOLLOWING STAGE
C      KL=KL+1
C      OPS(KL)=OPS(KL-1)-QMP(L)-QHG(L)
C      HPS(KL)=HAMR(L)
C      HES(KL-1)=HMR(L)
1990 CONTINUE
1995 IF (I.EQ.I2) GOTO 2400
C FIND DRAIN FROM PREVIOUS FW HEATER
2000 CONTINUE
C FIND DRAINS TO FW HEATER SHELL
C      QSUM=0.0
C      SUM=0.0

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FWHE 10
FWHE 20
FWHE 30
FWHE 40
FWHE 50
FWHE 60
FWHE 70
FWHE 80
FWHE 90
FWHE 100
FWHE 110
FWHE 120
FWHE 130
FWHE 140
FWHE 150
FWHE 160
FWHE 170
FWHE 180
FWHE 190
FWHE 200
FWHE 210
FWHE 220
FWHE 230
FWHE 240
FWHE 250
FWHE 260
FWHE 270
FWHE 280
FWHE 290
FWHE 300
FWHE 310
FWHE 320
FWHE 330
FWHE 340
FWHE 350
FWHE 360
FWHE 370
FWHE 380
FWHE 390
FWHE 400
FWHE 410
FWHE 420
FWHE 430
FWHE 440
FWHE 450
FWHE 460
FWHE 470
FWHE 480
FWHE 490
FWHE 500
FWHE 510
FWHE 520
FWHE 530
FWHE 540
FWHE 550
FWHE 560
FWHE 570
FWHE 580
FWHE 590
FWHE 600
FWHE 610
FWHE 620
FWHE 630
FWHE 640
FWHE 650
FWHE 660

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C FIND PW FLOW	PWHE 670
IF (I.GT. 1) GOTO2020	PWHE 680
QF1=QR	PWHE 690
GOTO2030	PWHE 700
2020 QF1=QF(I-1)	PWHE 710
C ADD DRAIN FROM PREVIOUS PW HEATER	PWHE 720
IF (ND(I-1).EQ. 1) GOTO2030	PWHE 730
QSUN=QSUN+QD(I-1)	PWHE 740
SUN=SUN+QD(I-1)*(ND(I-1)-HD(I))	PWHE 750
C TEST FOR LIVE STEAM REHEATER	PWHE 760
2030 IF (NRH.LT. 1) GOTO2040	PWHE 770
C ADD DRAIN FROM 1ST STAGE REHEATER	PWHE 780
IF (NDRH1.NE. I) GOTO2035	PWHE 790
QSUN=QSUN+QRH1	PWHE 800
SUN=SUN+QRH1*(HCRH1-HD(I))	PWHE 810
C TEST FOR 2ND STAGE REHEATER	PWHE 820
2035 IF (NRH.LT. 2) GOTO2040	PWHE 830
C ADD DRAIN FROM 2ND STAGE REHEATER	PWHE 840
IF (NDRH2.NE. I) GOTO2040	PWHE 850
QSUN=QSUN+QRH2	PWHE 860
SUN=SUN+QRH2*(HCRH2-HD(I))	PWHE 870
C ADD DRAIN FROM EXTERNAL MOISTURE SEPARATOR	PWHE 880
2040 IF (MS.NE. I) GOTO2050	PWHE 890
QSUN=QSUN+QMR	PWHE 900
SUN=SUN+QMR*(HPSX-HD(I))	PWHE 910
C ADD DRAINS FROM VALVE STEM AND SHAFT LEAKAGES	PWHE 920
2050 IF (LK.EQ.0) GOTO2070	PWHE 930
IF (I.NE. LK1) GOTO2060	PWHE 940
QSUN=QSUN+QLK1	PWHE 950
SUN=SUN+QLK1*(HLK1-HD(I))	PWHE 960
2050 IF (I.NE. LK3) GOTO2061	PWHE 970
QSUN=QSUN+QLK3	PWHE 980
SUN=SUN+QLK3*(HLK3-HD(I))	PWHE 990
2061 CONTINUE	PWHE1000
IF (I.NE. LK5) GOTO2062	PWHE1010
QSUN=QSUN+QLK5	PWHE1020
SUN=SUN+QLK5*(HLK5-HD(I))	PWHE1030
2062 CONTINUE	PWHE1040
C ADD DRAIN FROM STEAM SEAL REGULATOR	PWHE1050
2065 IF (I.LT. NF) GOTO2070	PWHE1060
QSUN=QSUN+QFNF	PWHE1070
SUN=SUN+QFNF*(HSSR-HD(I))	PWHE1080
C ADD DRAINS FROM TURBINE MOISTURE REMOVAL STAGES	PWHE1090
2070 IF (NR.EQ.0) GOTO2090	PWHE1100
IF (L2(I).LT. L1(I)) GOTO2090	PWHE1110
C SUM DRAINS FROM TURBINE MOISTURE REMOVAL STAGES	PWHE1120
N1=L1(I)	PWHE1130
N2=L2(I)	PWHE1140
DO2080 L=N1,N2	PWHE1150
QSUN=QSUN+QNF(L)+QNG(L)	PWHE1160
SUN=SUN+QNF(L)*(HNF(L)-HD(I))+QNG(L)*(HNG(L)-HD(I))	PWHE1170
2080 CONTINUE	PWHE1180
2090 IF (ND(I).EQ. 1) GOTO2100	PWHE1190
C HEAT BALANCE (PW HEATER DRAIN IS FLASHED)	PWHE1200
QF(I)=QF1	PWHE1210
QR(I)=(QF(I)*(ND(I)-HI(I))-SUN)/(HE(I)-HD(I))	PWHE1220
QD(I)=QR(I)+QSUN	PWHE1230
GOTO2200	PWHE1240
C HEAT BALANCE (PW HEATER DRAIN IS PUMPED)	PWHE1250
2100 CONTINUE	PWHE1260
QR(I)=((QF1-QSUN)*(ND(I)-HI(I))-SUN)/(HE(I)-HD(I)+ND(I)-HI(I))	PWHE1270
QD(I)=QR(I)+QSUN	PWHE1280
QF(I)=QF1-QD(I)	PWHE1290
IF (I.EQ. 1) GOTO2200	PWHE1300
HI1=(QD(I)*ND(I)+QF(I)*ND(I))/QF1	PWHE1310
IF (IP.NE. (I-1)) GOTO2110	PWHE1320
C CORRECT PW PUMP INLET ENTHALPY	PWHE1330
HFP=HI1	PWHE1340
HI1=HI1+DHP	PWHE1350
C TEST PW INLET ENTHALPY	PWHE1360
2110 ADH=DABS(HI1-HI(I-1))	PWHE1370

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      IT1(I)=IT1(I)+1
      IF (ADH.LE.HCON)GOTO2200
      IF (I.GT.I1)GOTO2111
      IF (IT.GT.50)GOTO2112
2111 IF (IT1(I-1).LE.50)GOTO2114
2112 IX=I-1
      PRINT 2113,IX,ADH
2113 FORNAT('O-SUBROUTINE FWHEAT-FW HEATER INLET ENTHALPY IN IT1 DID NOT
      1T CONVERGE, FW HEATER NO.',I3,4X,'ADH= ',1PD14.6)
      GOTO2200
C RE-SET INDEX I TO PREVIOUS FW HEATER
2114 I=I-1
C CORRECT FW INLET TEMPERATURE
      HI(I)=HI1
      IF (I.LE.IP)GOTO2118
      TI(I)= TSLH(HI1)
      GOTO2119
2118 TI(I)=TPHL(PLA,HI1)
2119 IF (NDC(I).EQ.0)GOTO2120
C CORRECT FW HEATER DRAIN TEMPERATURE
      TD(I)=TI(I)+TDCA(I)
      HD(I)= HPT(TD(I))
2120 IF (I.EQ. (I1LP-1))GOTO2400
      IF (I.LT.I1LP)GOTO2000
C RE-SET INDEX KL (FLOW TO FOLLOWING STAGE)
      KL=I-I1LP+1+L2(I)-J1(I)
      GOTO2000
2200 CONTINUE
      IF (I.LT.I1LP)GOTO2210
C FIND FLOW TO FOLLOWING STAGE
      KL=KL+1
      QPS(KL)=QPS(KL-1)-QE(I)-QWPE(I)
      HES(KL-1)=HE1(I)
      HPS(KL)=HE(I)
2210 IF (I.LT.NP)GOTO2300
C FIND ENTHALPY RISE ACROSS SJAE AFTER-CONDENSER AND SPE
      QC=QP(I)+QCR
      DHAE=QAE*(HAE1-HAEO)/QC+QSPE*(HSSR-HAEO)/QC
      HI1=HC+DHAE
      HCR=HI1
      IF (IP.NE.NP)GOTO2220
C CORRECT FW PUMP INLET ENTHALPY
      HFP=HI1
      HI1=HI1+DHP
C TEST FW INLET ENTHALPY
2220 ADH=DABS(HI1-HI(I))
      IT2=IT2+1
      IF (ADH.LE.HCON)GOTO2230
      IF (IT2.LE.50)GOTO2229
      PRINT 2221,I,ADH
2221 FORNAT('O-SUBROUTINE FWHEAT-FW HEATER INLET ENTHALPY IN IT2 DID NOT
      1T CONVERGE, FW HEATER NO.',I3,4X,'ADH= ',1PD14.6)
      GOTO2300
2229 IF (I.LT.I1LP)GOTO2230
C RE-SET INDEX KL (FLOW TO FOLLOWING STAGE)
      KL=KL-1
C CORRECT FW INLET TEMPERATURE
2230 HI(I)=HI1
      IF (I.LE.IP)GOTO2240
      TI(I)= TSLH(HI1)
      GOTO2250
2240 TI(I)=TPHL(PLA,HI1)
2250 IF (NDC(I).EQ.0)GOTO2090
C CORRECT FW HEATER DRAIN TEMPERATURE
      TD(I)=TI(I)+TDCA(I)
      HD(I)= HPT(TD(I))
      GOTO2090
2300 IF (I.LT.I2)GOTO1900
2400 RETURN
      END

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FWHE1380
FWHE1390
FWHE1400
FWHE1410
FWHE1420
FWHE1430
FWHE1440
FWHE1450
FWHE1460
FWHE1470
FWHE1480
FWHE1490
FWHE1500
FWHE1510
FWHE1520
FWHE1530
FWHE1540
FWHE1550
FWHE1560
FWHE1570
FWHE1580
FWHE1590
FWHE1600
FWHE1610
FWHE1620
FWHE1630
FWHE1640
FWHE1650
FWHE1660
FWHE1670
FWHE1680
FWHE1690
FWHE1700
FWHE1710
FWHE1720
FWHE1730
FWHE1740
FWHE1750
FWHE1760
FWHE1770
FWHE1780
FWHE1790
FWHE1800
FWHE1810
FWHE1820
FWHE1830
FWHE1840
FWHE1850
FWHE1860
FWHE1870
FWHE1880
FWHE1890
FWHE1900
FWHE1910
FWHE1920
FWHE1930
FWHE1940
FWHE1950
FWHE1960
FWHE1970
FWHE1980
FWHE1990
FWHE2000
FWHE2010
FWHE2020
FWHE2030
FWHE2040
FWHE2050
FWHE2060
FWHE2070

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C	SUBROUTINE FWPT(PB,HB,PX,DHP,QR)	FWPT 10
	IMPLICIT REAL*8(A-H,O-Z)	FWPT 20
C	SUBPROGRAM FOR CALCULATING THROTTLE STEAM FLOW TO PW PUMP TURBINE	FWPT 30
	COMMON /PPT/QPPT,PBPPT,HBPPT,PKPPT,HKPPT,IFPT	FWPT 40
	COMMON /FWPTTB/ EFP, ZFP, CP1, CP2	FWPT 50
C	FIND BOWL ENTROPY	FWPT 60
	PBPPT=PB	FWPT 70
	HBPPT=HB	FWPT 80
	CALL PROPPH(AMB,SB,VB,TB,MB,PBPPT,HBPPT)	FWPT 90
C	FIND ISENTROPIC EXHAUST ENTHALPY	FWPT 100
	PKPPT=PX*0.24558	FWPT 110
	CALL PROPPS(AMXS,HXS,TXS,VXS,MXS,PKPPT,SB)	FWPT 120
C	FIND USED ENERGY	FWPT 130
	AE=HBPPT-HXS	FWPT 140
	UE=AE*EFP	FWPT 150
	HKPPT=HBPPT-UE	FWPT 160
C	THROTTLE STEAM FLOW TO PW PUMP TURBINE	FWPT 170
	QPPT=QR*DHP/UE	FWPT 180
	RETURN	FWPT 190
	END	FWPT 200

C	FUNCTION F1A(W,PX,PB)	F1A 10
	IMPLICIT REAL*8(A-H,O-Z)	F1A 20
	DIMENSION A(6,7)	F1A 30
	DATA IW/6/	F1A 40
	DATA A/9.9701993D-1, -2.8250567D-2, 1.1488895D-1, 3*0.0D0,	F1A 50
	* 1.1225967D-5, 1.1173166D-4, -4.5518203D-4, 3*0.0D0,	F1A 60
	* -1.9041979D-8, -1.3694475D-7, 3.9876404D-7, 3*0.0D0,	F1A 70
	* 24*0.0D0/	F1A 80
	RXB=PX/PB	F1A 90
	RBX=PB/PX	F1A 100
	IF((RBX.GT.8.0).OR.(RBX.LT.2.0))WRITE(IW,800)RBX	F1A 110
800	FORMAT(' ','RBX = ',D25.16,' IS A DATA ERROR IN F1A')	F1A 120
	CALL BIVPOL(A,W,RXB,Z,2,2)	F1A 130
	F1A=Z	F1A 140
	RETURN	F1A 150
	END	F1A 160

C	FUNCTION F1B(TFR,RBX)	F1B 10
	IMPLICIT REAL*8(A-H, O-Z)	F1B 20
	DIMENSION A(6,7)	F1B 30
	DATA IW/6/	F1B 40
	DATA A/ 2.1161407D-1, 1.1847063D0, -3.9631998D-1, 3*0.0D0,	F1B 50
	* 7.3863399D-2, -5.6665227D-2, -1.7198355D-2, 3*0.0D0,	F1B 60
	* -4.5419954D-3, 2.7427505D-3, 1.7992637D-3, 3*0.0D0,	F1B 70
	* 24*0.0D0/	F1B 80
	IF((RBX.GT.8.0).OR.(RBX.LT.2.0))WRITE(IW,800)RBX	F1B 90
800	FORMAT(' ','RBX = ',D25.16,' IS A DATA ERROR IN F1B')	F1B 100
	IF((TFR.GT.1.0).OR.(TFR.LT.0.1))WRITE(IW,801)TFR	F1B 110
801	FORMAT(' ','TFR = ',D25.16,' IS A DATA ERROR IN F1B')	F1B 120
	IF(TFR.LT. .6D0) TFX=.6D0	F1B 130
	IF(TFR.GE. .6D0) TFX=TFR	F1B 140
	CALL BIVPOL(A,RBX,TFX,Z,2,2)	F1B 150
	DELTA=Z	F1B 160
	F1B=DELTA*(1.015-0.015*TFX)	F1B 170
	RETURN	F1B 180
	END	F1B 190

C	FUNCTION F1C(W,TFR)	F1C	10
	IMPLICIT REAL*8(A-H, O-Z)	F1C	20
	DATA IW/6/	F1C	30
	IF((TFR.GT.1.0).OR.(TFR.LT.0.1))WRITE(IW,801)TFR	F1C	40
801	FORMAT(' ','TFR = ',D25.16,' IS A DATA ERROR IN F1C')	F1C	50
	IF(TFR.LT. .6D0) TFX=.6D0	F1C	60
	IF(TFR.GE. .6D0) TFX=TFR	F1C	70
	F1C = 1.0 - (56.0/W - 0.112) * (1.0 - TFX)/0.5	F1C	80
	RETURN	F1C	90
	END	F1C	100

C	FUNCTION F2(AGM,PB)	F2	10
	IMPLICIT REAL*8(A-H,O-Z)	F2	20
	DIMENSION A(6)	F2	30
	DATA I/5/	F2	40
	DATA IW/6/	F2	50
	DATA A/1.0D0, -3.8962559D0, +2.0760751D2, -6.6328180D3,	F2	60
	* +1.0109593D5, -5.9521194D5/	F2	70
	IF(AGM.LE.0.06)CALL UNIPOL(A,AGM,GAMMA,I)	F2	80
	IF(AGM.GT.0.06)GAMMA=-.9360655D-.9*(AGM-0.06)	F2	90
	IF((PB.LT.100.0).OR.(PB.GT.2000.0))WRITE(IW,801)PB	F2	100
801	FORMAT(' ','PB = ',D25.16,' IS A DATA ERROR IN F2')	F2	110
	IF(AGM.LT.0.0)WRITE(IW,802)AGM	F2	120
802	FORMAT(' ','AGM = ',D25.16,' IS A DATA ERROR IN F2')	F2	130
	F2=GAMMA+1.5D-5*(AGM/0.08)*(900.0-PB)	F2	140
	RETURN	F2	150
	END	F2	160

C	FUNCTION F3(QVN,PR)	F3	10
	IMPLICIT REAL*8(A-H,O-Z)	F3	20
	DIMENSION AALPHA(3),ATHETA(3)	F3	30
	DATA IW/6/	F3	40
	DATA AALPHA/-0.1738762D1,-0.24241363D0,0.95370576D-2/,ATHETA/	F3	50
	* -0.23694637D1,-0.99561861D-1,-0.29889354D-2/,I/2/	F3	60
	IF(QVN.LT..2D6)GO TO 15	F3	70
10	IF(QVN.LE.100.D6)GO TO 20	F3	80
15	WRITE(IW,800) QVN	F3	90
800	FORMAT(' ','QVN = ',D25.16,' IS OUTSIDE SPECIFIED LIMITS FOR F3')	F3	100
20	IF(PR.LT.1.0)GO TO 30	F3	110
25	IF(PR.LT.500.)GO TO 35	F3	120
30	WRITE(IW,801)PR	F3	130
801	FORMAT(' ','PR = ', D25.16,' IS OUTSIDE SPECIFIED LIMITS FOR F3')	F3	140
35	X = DLOG(PB)	F3	150
	CALL UNIPOL(AALPHA,X,ZALPHA,I)	F3	160
	ALPHA = DEXP(ZALPHA)	F3	170
	CALL UNIPOL(ATHETA,X,ZTHETA,I)	F3	180
	THETA = DEXP(ZTHETA)	F3	190
	PSI=1.006*(1.0-8000./QVN)	F3	200
	F3 = (1.0-(ALPHA*((THETA-ALPHA)/QVN)*((QVN-25000.)/0.975))) * PSI	F3	210
	RETURN	F3	220
	END	F3	230

C	FUNCTION F4(PR,PB,VP)	F4	10
	IMPLICIT REAL*8(A-H,O-Z)	F4	20
C	PR IS PB/PI	F4	30
	DIMENSION A(6,7)	F4	40
	DATA IW/6/	F4	50
	DATA A/0.91545965D0,-0.16800190D-1,0.22481349D-2,	F4	60
	>-0.21178936D-3,0.91380561D-5,0.D0,	F4	70
	>-0.52509228D-4,0.10910256D-4,-0.20090378D-4,	F4	80
	>0.49081537D-5,-0.35197958D-6,0.D0,	F4	90
	>0.27863077D-6,-0.38164297D-6,0.25227588D-6,	F4	100
	>-0.54516150D-7,0.38424326D-8,0.D0,	F4	110
	>-0.68155332D-9,0.10184591D-8,-0.63504086D-9,	F4	120
	>0.13690704D-9,-0.97149103D-11,0.D0,	F4	130
	>0.69937432D-12,-0.10905080D-11,0.66534494D-12,	F4	140
	>-0.14337663D-12,0.10204672D-13,0.D0,	F4	150
	>-0.32231499D-15,0.51336370D-15,-0.30982129D-15,	F4	160
	>0.66775818D-16,-0.47614905D-17,0.D0,	F4	170
	>0.54818623D-19,-0.88601007D-19,0.53145252D-19,	F4	180
	>-0.11459126D-19,0.81819448D-21,0.D0/	F4	190
	ALO=DLOG(2.D00)	F4	200
	APL=DLOG(PB)	F4	210
C	CALCULATE ETA1	F4	220
	ETA1=1.0-(0.16993783-0.08220699*((VP-250000.0)/	F4	230
	>(0.975*VP)))	F4	240
C	CHECK TO SEE IF INPUT ARGUMENTS ARE WITHIN SPECIFIED LIMITS	F4	250
	IF(PB.LE.2000.) GO TO 3	F4	260
C	IF DATA IS OUTSIDE LIMITS PRINT MESSAGE AND	F4	270
C	CONTINUE EXECUTION	F4	280
	WRITE(IW,13) PB	F4	290
	13 FORMAT(' ','PB = ',D25.16,' IS A DATA ERROR IN F4')	F4	300
	3 IF (PR-1.0) 29,5,9	F4	310
	29 WRITE(IW,14) PR	F4	320
	14 FORMAT(' ','PR = ',D25.16,' IS A DATA ERROR IN F4')	F4	330
	9 IF (PR.LE.2.0) GO TO 5	F4	340
	IF (PR-500.0) 6,6,7	F4	350
C	CALCULATE ETA2 BY CALLING A GENERAL SUBROUTINE	F4	360
C	TO COMPUTE THE BIVARIATE POLYNOMIAL	F4	370
	5 CALL BIVPOL(A,PB,ALO,Z,4,6)	F4	380
	ETA2=Z	F4	390
C	CALCULATE FIG4 WHERE PR IS BETWEEN 1.0 AND	F4	400
C	2.0 INCLUSIVE	F4	410
	F4=ETA1 + (ETA2 - ETA1) * (APL/ALO)	F4	420
	RETURN	F4	430
	7 WRITE(IW,14) PR	F4	440
C	CALCULATE F4 BY CALLING A GENERAL SUBROUTINE	F4	450
C	TO COMPUTE THE BIVARIATE POLYNOMIAL	F4	460
	6 CALL BIVPOL(A,PB,APL,Z,4,6)	F4	470
	F4 = Z	F4	480
	RETURN	F4	490
	END	F4	500

C	FUNCTION FIG5(QVN,PR,VP,PH)	FIG5 10
	IMPLICIT REAL*8(A-H,O-Z)	FIG5 20
	DIMENSION A(3),B(1)	FIG5 30
	DATA A/-0.1023976100,0.14091440D-1,-0.88660084D-3/,B/0.52514486D0/	FIG5 40
	* ,I/2/,J/1/	FIG5 50
	IF((PR.LT.1.0).OR.(PR.GT.500.))WRITE(6,16)PR	FIG5 60
16	FORMAT(5H0PR =,D25.16,3RH IS OUTSIDE SPECIFIED LIMITS FOR FIG5)	FIG5 70
	IF(PB.GT.2000.)WRITE(6,31)PR	FIG5 80
31	FORMAT(5H0PB =,D25.16,3RH IS OUTSIDE SPECIFIED LIMITS FOR FIG5)	FIG5 90
	X = DLOG(PR)	FIG5 100
	CALL RATFUN(A,B,X,XK,I,J)	FIG5 110
	CONSTK = 250000.*XK	FIG5 120
	FIG5 = ((CONSTK/QVN)+1.0)/((CONSTK/VP)+1.0)	FIG5 130
	RETURN	FIG5 140
	END	FIG5 150
C	FUNCTION FIG7(PR,PB)	FIG7 10
	IMPLICIT REAL*8(A-H,O-Z)	FIG7 20
C	PR IS PB/PR	FIG7 30
	DIMENSION A(6,7)	FIG7 40
	DATA A/0.8862096200,-0.57966163D-1,-0.70547092D-2,	FIG7 50
	10.53287932D-2,-0.10834413D-2,0.74799566D-4,0.73021511D-4,	FIG7 60
	2-0.90870584D-3,3.51487177D-3,-0.15870788D-3,0.24559973D-4,	FIG7 70
	3-0.14649524D-5,-0.9332207D-6,0.45863391D-5,-0.30414566D-5,	FIG7 80
	40.98498064D-6,-0.15284021D-6,0.90166692D-8,0.26842196D-8,	FIG7 90
	5-0.10384613D-7,0.72972894D-8,-0.24101082D-8,0.37440997D-9,	FIG7 100
	6-0.21928984D-10,-0.3056638D-11,0.10644149D-10,-0.77044070D-11,	FIG7 110
	70.25741444D-11,-0.40054815D-12,0.23384013D-13,0.15075129D-14,	FIG7 120
	8-0.49596233D-14,0.36525359D-14,-0.12292791D-14,0.19154518D-15,	FIG7 130
	9-0.11162944D-16,-0.2695461D-18,0.85580517D-18,-0.63735459D-18,	FIG7 140
	A0.21556766D-18,-0.33625662D-19,0.19575380D-20/	FIG7 150
	AL1=DLOG(2.0D0)	FIG7 160
	AP1=DLOG(PR)	FIG7 170
C	CHECK TO SEE IF INPUT ARGUMENTS ARE WITHIN SPECIFIED LIMITS	FIG7 180
	IF(PB.GT.2000.)WRITE(6,13)PR	FIG7 190
13	FORMAT(6H0PB =,D25.16,5X,23HIS A DATA ERROR IN FIG7)	FIG7 200
	IF(PR-1.0)29,5,9	FIG7 210
29	WRITE(6,14)PR	FIG7 220
14	FORMAT(6H0PR =,D25.16,5X,23HIS A DATA ERROR IN FIG7)	FIG7 230
	9 IF(PR-2.0)5,6,4	FIG7 240
	4 IF(PB-500.0)6,6,7	FIG7 250
C	CALCULATE ETA3 BY CALLING A GENERAL SUBROUTINE	FIG7 260
	5 CALL BIVPOL(A,PB,AL1,Z,5,6)	FIG7 270
	ETA3=Z	FIG7 280
C	CALCULATE FIG7 WHERE PR IS BETWEEN 1.0 AND	FIG7 290
C	2.0 INCLUDING 1.0 BUT NOT 2.0	FIG7 300
	FIG7=0.87*(ETA3-.87)*(AP1/AL1)	FIG7 310
	RETURN	FIG7 320
7	PRINT 14,PR	FIG7 330
C	CALCULATE FIG7 BY CALLING A GENERAL SUBROUTINE	FIG7 340
C	TO COMPUTE THE BIVARIATE POLYNOMIAL	FIG7 350
	6 CALL BIVPOL(A,PB,AP1,Z,5,6)	FIG7 360
	FIG7=Z	FIG7 370
	RETURN	FIG7 380
	END	FIG7 390

C	<pre> FUNCTION FIG8(PX) IMPLICIT REAL*8(A-H,O-Z) DIMENSION A(5) DATA A/0.1304D1,0.1973D2,-0.1118D2,-0.9587D2,0.3148D3/,I/4/ DATA IW/6/ IF (PX.LT.3.0) GO TO 30 IF (PX.LE.100.) GO TO 35 FIG8=1.5 RETURN 30 WRITE(IW,31) PX 31 FORMAT(5H0PX =,D25.16,3AH IS OUTSIDE SPECIFIED LIMITS FOR FIG8) 35 X = 1.0/PX CALL UNIPOL(A,X,Z,I) FIG8 = Z RETURN END </pre>	<pre> FIG8 FIG8 10 FIG8 20 FIG8 30 FIG8 40 FIG8 50 FIG8 60 FIG8 70 FIG8 80 FIG8 90 FIG8 100 FIG8 110 FIG8 120 FIG8 130 FIG8 140 FIG8 150 FIG8 160 </pre>
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C	<pre> FUNCTION F10(P) IMPLICIT REAL*8(A-H,O-Z) DIMENSION A(4), B(3) DATA A/1.3725945D-2, 1.3749009D0, -2.9965293D0, 6.1649777D1/ DATA B/-6.1862609D0, 3.9837738D1, 1.8158351D2/ IF (P.LE.3.5) X=1./3.5 IF (P.GT.3.5) X=1./P CALL RATFON(A,B,X,Z,3,3) F10=Z*100.D0 RETURN END </pre>	<pre> F10 F10 10 F10 20 F10 30 F10 40 F10 50 F10 60 F10 70 F10 80 F10 90 F10 100 F10 110 </pre>
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C	<pre> SUBROUTINE F12AC (P,HB,SB,HI,SI,H,S) IMPLICIT REAL*8(A-H,O-Z) REAL*8 K,L,N,M,LN,MN DATA IW/6/ DATA K/0.16129D5/ M=50.0*(SB-SI) N=0.1*(HB-HI) MN=M/N L=2500.0*(SB*SB-SI*SI)+0.01*(HB*HB-HI*HI) LN=L/N A=0.25*(1.0*MN*MN) B=50.0*SI*MN*(0.5*LN-0.1*HI) C=(50.0*SI)*(50.0*SI)+(0.1*HI)*(0.1*HI) >-K*LN*(0.25*LN-0.1*HI) SC=(0.25/A)*(B+DSQRT(B*B-4.*A*C)) HC=0.5*(LN-2.0*MN*SC) </pre>	<pre> F12AC F12A 10 F12A 20 F12A 30 F12A 40 F12A 50 F12A 60 F12A 70 F12A 80 F12A 90 F12A 100 F12A 110 F12A 120 F12A 130 F12A 140 F12A 150 F12A 160 F12A 170 F12A 180 F12A 190 F12A 200 F12A 210 F12A 220 F12A 230 F12A 240 F12A 250 F12A 260 F12A 270 F12A 280 </pre>
C	<pre> INITIALIZE ENTROPY AT END CONDITION SB AS=SB T= TSL(P) </pre>	
C	<pre> BEGIN ITERATIVE PROCESS ON CONVERGING ENTROPY DO 5 I=1,50 SG=SPTD(P,T) H=(SG-AS)/(SG-SPT(T)) HG=HPS(P,SPTD(P,T)) H1=HG-H*(HG-HPT(T)) S=(SC-DSQRT(K-(0.1*H1-HC)*(0.1*H1-HC)))/50.0 DIFF=S-AS IF (DABS(DIFF)-1.D-5) 2,2,1 </pre>	

1	AS=S	P12A	290
5	CONTINUE	P12A	300
C	IF ENTROPY DOES NOT CONVERGE IN 50 ITERATIONS THEN PRINT MESSAGE	P12A	310
C	AND RETURN THE LATEST VALUES OF H AND S TO CALLING ROUTINE	P12A	320
	WRITE(IW,903)	P12A	330
900	FORMAT(' ','ENTROPY IN P12AC DID NOT CONVERGE IN 50 ITERATIONS')	P12A	340
2	H=H1	P12A	350
	RETURN	P12A	360
	END	P12A	370

C	SUBROUTINE P12B (P,HB,SB,HA,SA,H,S)	P12B	
	IMPLICIT REAL*8(A-H,U-Z)	P12B	10
	DATA IW/6/	P12B	20
C	CALCULATE CONSTANT TERM R0	P12B	30
	R0 = ((SA-SB) + (0.0177) - (10.0*((HB-(HA+650.))/371.))) / (HA-HB)	P12B	40
C	INITIALIZE ENTROPY AT RND CONDITION SB	P12B	50
	AS=SB	P12B	60
C	BEGIN ITERATIVE PROCESS ON CONVERGING ENTROPY	P12B	70
	DO 5 I=1,50	P12B	80
	T=TSUPS(P,AS)	P12B	90
	H1= HPS(P,SPTD(P,T))	P12B	100
	S=10.0*((HB-(H1+650.))/371.) + R0*(H1-HB) + SB - (0.0177)	P12B	110
	DIFP=S-AS	P12B	120
	IF (DABS(DIFP) - 1.D-5) 2,2,1	P12B	130
1	AS=S	P12B	140
5	CONTINUE	P12B	150
C	IF ENTROPY DOES NOT CONVERGE IN 50 ITERATIONS THEN PRINT MESSAGE	P12B	160
C	AND RETURN THE LATEST VALUES OF H AND S TO CALLING ROUTINE	P12B	170
	WRITE(IW,903)	P12B	180
900	FORMAT(' ','ENTROPY IN P12B DID NOT CONVERGE IN 50 ITERATIONS')	P12B	190
2	H=H1	P12B	200
	RETURN	P12B	210
	END	P12B	220
		P12B	230

C	FUNCTION FIG15(INHGA)	FIG15	
	IMPLICIT REAL*8(A-I,O-Z)	FIG15	10
	DIMENSION A(3)	FIG15	20
	DATA A /-0.23984811D2,0.57862440D2,0.31849404D1/	FIG15	30
C	CHECK TO SEE IF INPUT ARGUMENTS ARE WITHIN SPECIFIED LIMITS	FIG15	40
C	IF DATA OUTSIDE LIMITS PRINT MESSAGE AND	FIG15	50
C	CONTINUE EXECUTION	FIG15	60
	IF ((INHGA.LT..25).OR.(INHGA.GT.6.0)) WRITE(6,13) INHGA	FIG15	70
13	FORMAT(9H01INHGA = ,D25.16,5X,24HIS A DATA ERROR IN FIG15)	FIG15	80
C	CALCULATE FIG15 BY CALLING A GENERAL SUBROUTINE	FIG15	90
C	TO COMPUTE THE UNIVARIATE POLYNOMIAL	FIG15	100
	ATINHGA=DLGG(INHGA)	FIG15	110
	CALL UNIPOL(A,ATINHGA,Z,2)	FIG15	120
	FIG15=Z	FIG15	130
	RETURN	FIG15	140
	END	FIG15	150
		FIG15	160

C	FUNCTION F16(VAN,BLS)	F16	10
	IMPLICIT REAL*8(A-H,O-Z)	F16	20
	DIMENSION VANX(21), F38(21)	F16	30
	DATA VANX/128.D0,150.D0,175.D0,200.D0,250.D0,300.D0,350.D0,400.D0,	F16	40
	* 450.D0,500.D0,550.D0,600.D0,650.D0,700.D0,800.D0,900.D0,1000.D0/	F16	50
	* ,1100.D0,1200.D0,1300.D0,1400.D0/	F16	60
	DATA F38/51.63D0,45.50D0,38.38D0,32.65D0,23.80D0,17.43D0,12.91D0,	F16	70
	* 9.80D0,7.97D0,7.07D0,7.02D0,7.72D0,9.00D0,11.00D0,16.25D0,	F16	80
	* 21.97D0,27.92D0,34.D0,39.92D0,45.25D0,49.85D0/	F16	90
	* NPOINT/5/,NORDER/4/	F16	100
C-----	IF VAN .LE. 4TH TABULAR VANX, USE FIRST 5 POINTS TO INTERPOLATE	F16	110
	IF (VAN - VANX(4)) 15,15,10	F16	120
C-----	IF VAN .GE. 20TH TABULAR VANX, USE LAST 5 POINTS TO INTERPOLATE	F16	130
	10 IF (VAN - VANX(20)) 20,16,16	F16	140
	15 I = 1	F16	150
	GO TO 60	F16	160
	16 I = 17	F16	170
	GO TO 60	F16	180
	20 ILO = 4	F16	190
	IHI = 20	F16	200
	DO 25 J=1,4	F16	210
	IVAN = .5*(ILO + IHI)	F16	220
	IF (VAN - VANX(IVAN)) 30,30,35	F16	230
	30 IHI = IVAN	F16	240
	GO TO 25	F16	250
	35 ILO = IVAN	F16	260
	25 CONTINUE	F16	270
	I = IHI - 3	F16	280
C	F38 APPLIES TO 35 INCH AND 43 INCH	F16	290
60	CONTINUE	F16	300
	CALL LAGRAN(VAN,VANX,F38,Z,NPOINT,NORDER,I)	F16	310
	F16=Z	F16	320
	RETURN	F16	330
	END	F16	340

C	FUNCTION F17 (PDT,PDD)	F17	10
C	PDT IS PD/PT	F17	20
C	PDD IS PD/PD*	F17	30
	IMPLICIT REAL*8(A-H,O-Z)	F17	40
	DIMENSION A(6,7)	F17	50
	DATA A/0.10387869D0,0.51016459D-1,0.29102908D1,	F17	60
	10.27471818D0,-0.21304563D1,0.D0,	F17	70
	2-0.19802735D1,-0.95190372D1,-0.37135945D2,	F17	80
	3-0.13560028D2,0.33612332D2,0.D0,	F17	90
	40.10063291D2,0.20037626D3,0.69547999D2,	F17	100
	50.98411071D2,-0.17160622D3,0.D0,	F17	110
	6-0.18538112D2,-0.27829006D3,-0.29449752D3,	F17	120
	7-0.18258882D3,0.38650991D3,0.D0,	F17	130
	80.10749035D2,0.20073785D3,0.30482186D3,	F17	140
	90.48723599D2,-0.29025217D3,0.D0,	F17	150
	A12*0.D0/	F17	160
C	CHECK TO SEE IF INPUT ARGUMENTS ARE WITHIN SPECIFIED LIMITS	F17	170
	PD=1.0/PDT	F17	180
	IF (PD-1.2) 7,3,8	F17	190
C	IF DATA OUTSIDE LIMITS PRINT MESSAGE AND	F17	200
C	CONTINUE EXECUTION	F17	210
	7 PRINT 13,PDT	F17	220
	8 IF (PD-10.0) 3,3,2	F17	230
	2 PRINT 13,PDT	F17	240
	3 PDINV=1.0/PDD	F17	250
	IF (PDINV-0.5) 9,5,10	F17	260
	9 PRINT 14,PDD	F17	270
	10 IF (PDINV-3.3) 5,5,4	F17	280
	4 PRINT 14,PDD	F17	290

C	CALCULATE FIG18 BY CALLING A GENERAL SUBROUTINE	F17	300
C	TO COMPUTE THE BIVARIATE POLYNOMIAL	F17	310
	5 APDD=DLOG(PDD)	F17	320
	CALL BIVPOL(A,PDT,APDD,Z,5,5)	F17	330
	F17=Z	F17	340
	RETURN	F17	350
13	FORMAT(7HOPDT = ,D25.16,5X,24HIS A DATA ERROR IN F17)	F17	360
14	FORMAT(7HOPDD = ,D25.16,5X,24HIS A DATA ERROR IN F17)	F17	370
	END	F17	380

C	FUNCTION F18(KVA)	F18	10
	IMPLICIT REAL*8(A-H,O-Z)	F18	20
	REAL*8 KVA	F18	30
	DIMENSION A(4)	F18	40
	DATA IW/6/	F18	50
	DATA A/6.83258D1, 4.29619D-1, -1.52886D-9, 9.92122D-16/	F18	60
	DATA I/3/	F18	70
	IF((KVA.LT.1.D5).OR.(KVA.GT.2.D6)) WRITE(IW,800)KVA	F18	80
800	FORMAT('0', 'KVA= ',D25.16,	F18	90
	* ' IS OUTSIDE SPECIFIED LIMITS FOR FIGURE 18')	F18	100
	CALL UNIPOL(A,KVA,Z,I)	F18	110
	F18 = Z	F18	120
	RETURN	F18	130
	END	F18	140

C	FUNCTION F19(KVA)	F19	10
	IMPLICIT REAL*8(A-H,O-Z)	F19	20
	REAL*8 KVA	F19	30
	DIMENSION AA(4),B(1)	F19	40
	DATA AA/1.7479050D0, 6.1637835D-2, -2.6652558D-2, 1.0759713D-3/	F19	50
	DATA B/-4.9564581D-2/	F19	60
	ALO=DLOG(KVA)	F19	70
	CALL RATFUN(AA,B,ALO,Z,3,1)	F19	80
	F19=Z	F19	90
	RETURN	F19	100
	END	F19	110

C	FUNCTION F20(FRKVA)	F20	10
	IMPLICIT REAL*8(A-H,O-Z)	F20	20
	DIMENSION ACD18(5),BCD18(1)	F20	30
	DATA ACD18/-0.22727744D0,-0.24939976D2,0.34283283D2,-0.35808901D2,	F20	40
	> 0.90544169D1/,BCD18/-0.18638959D2/,I1/4/,J1/1/	F20	50
	CALL RATFUN (ACD18,BCD18, FRKVA,Z,I1,J1)	F20	60
	F20 = Z	F20	70
	RETURN	F20	80
	END	F20	90

C	FUNCTION P21(KVA)	P21	
	IMPLICIT REAL*8(A-H,O-Z)	P21	10
	REAL*8 KVA	P21	20
	DIMENSION AC(2)	P21	30
	DATA AC	P21	40
	CALL UNIPOL(AC,KVA,Z,1)	P21	50
	P21=Z	P21	60
	RETURN	P21	70
	END	P21	80
		P21	90

C	SUBROUTINE HPTORB(MKHP)	HPTORB	
	IMPLICIT REAL*8(A-H,O-Z)	HPTO	10
C	A MOISTURE FRACTION	HPTU	20
C	M =1 WET VAPOR, =2 SATURATED VAPOR, =3 SUPERHEATED VAPOR	HPTU	30
C	Q VMO FLOW TO G-S	HPTU	40
C	W WHEEL SPEED, FPS	HPTU	50
C	AE AVAILABLE ENERGY G-S	HPTU	60
C	C1 CORRECTION FACTOR FROM F1A	HPTU	70
C	C2 CORRECTION FACTOR FROM F1B	HPTU	80
C	C3 CORRECTION FACTOR FROM F1C	HPTU	90
C	C4 CORRECTION FACTOR FROM F2	HPTU	100
C	JJ INDEX FOR LOOP TO FIND H-P ELEP	HPTU	110
C	PR PRESSURE RATIO -- VMO G-S BOWL/VMO ISENTROPIC EXHAUST H-P	HPTU	120
C	AGM AVERAGE GROUP MOISTURE	HPTU	130
C	EPF H-P EFFICIENCY BEFORE CORRECTIONS HAVE ALL BEEN INCLUDED	HPTU	140
C	NHP NUMBER OF H-P SECTION EXHAUST ENDS	HPTU	150
C	QVM INLET VOLUME FLOW PER END	HPTU	160
C	TFR THROTTLE FLOW RATIO	HPTU	170
C	VEL THEORETICAL VELOCITY CORRESPONDING TO STAGE AE	HPTU	180
C	BEFS BASE EFFICIENCY OF H-P SECTION FROM F3	HPTU	190
C	EPFY H-P EFFICIENCY AFTER ALL CORRECTIONS	HPTU	200
C	TEMP AN EFFICIENCY TEMPORARILY STORED UNTIL CONVERGENCE CHECK	HPTU	210
C	PRATIO PRESSURE RATIO AT PART LOAD	HPTU	220
	FIG6(TFR)=8.5D0-(0.9D0)/(1.2D0-TFR)	HPTU	230
	COMMON /CONV/HCON,HERCON,AMCON,RHCON,WCON,PCON,SSRCON,XSECON	HPTU	240
	COMMON /GS/2GS,HBGS,PBGS, ABGS,SBGS,VBGS,TBGS,PXGS, AXGS, SXGS,	HPTU	250
	*VXGS, TXGS, HXGS, PDGS, HBGS, MXGS, MCGS, NGS	HPTU	260
	*QT,PT,TT, AT, HT	HPTU	270
	COMMON /HP/2BHP,PBHP,TBHP,AMBHP,HBHP,SBHP,QXHP, TXHP, AMXHP, HXHP,	HPTU	280
	*SXHP, UREPH	HPTU	290
	COMMON /PAR2/PSH(12),TSH(12),TO(12),TTD(12),PXHP,PXIP	HPTU	300
	COMMON /KK2/ NHP, IR, WLP, NPH, NPL, IH2	HPTU	310
	COMMON /KK3/ AL,HL,PL,SL,TL,VL	HPTU	320
	COMMON /Z/ TFR,SLOPE,QKEEP,PKEEP,QGKEEP,PGKEEP,VGKEEP,GCKEEP,DUMEN	HPTU	330
	DATA PI/3.141592654D0/, XJoule/778.169262D0/, GRAV/32.1740486D0/	HPTU	340
C	-----THROTTLE CONDITIONS	HPTU	350
C	AT HT RT PI ST TT VT	HPTU	360
	HBGS=HT	HPTU	370
	IF (TFR.LT. 1. D0) Q=QGKEEP	HPTU	380
	IF (TFR.GE. 1. D0) Q=QGS	HPTU	390
C	-----VMO G-S BOWL CONDITIONS	HPTU	400
C	ABGSO HBGSO HBGSO PBGSO SBGSO TBGSO VBGHPTU	HPTU	410
	PDGSO=PT * (1.D0-FIG6(1.D0)/100.D0)	HPTU	420
	HBGSO=HT	HPTU	430
	CALL PROPPH(ABGSO,SBGSO,VBGSO,TBGSO,HBGSO,PBGSO,HBGSO)	HPTU	440
	QVM = Q * VBGSO/NHP	HPTU	450
	W = PI * PDGS * IR /12.D0 / 60.D0	HPTU	460
	VEL = W / .5D0	HPTU	470
	AE = VEL * VEL / 2.D0 / GRAV / XJoule	HPTU	480
C	-----VMO ISENTROPIC SHELL G-S	HPTU	490
C	AXSGSO HXSGSO HXSGSO PXSGSO SXSGSO TXSGSO VXSHTU	HPTU	500
	HXSGSO=HBGSO-AE	HPTU	510
	SXSGSO=SBGSO	HPTU	520
	CALL PROPHS(PXSGSO,FXSGSO,VXSGSO,AXSGSO,HXSGSO,HXSGSO,SXSGSO)	HPTU	530
		HPTU	540

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C-----G-S BOWL RATED LOAD POINT                                HPTU 550
C      ABGS      HBGS      MBGS      FBGS      SBGS      TBGS      VBGHPTU 560
C-----VWO ISENTROPIC EXHAUST H-P                                HPTU 570
C      AXSHPO    HXSHPO    MXSHPO    PXSHPO    SXSHPO    TXSHPO    VXSHPPTU 580
      IF(TPR.EQ. 1.00) PXSHPO = PXHP
      SXSHPO=SXSGSO
      CALL PROPPS(AXSHPO,HXSHPO,IXSHPO,VXSHPO,MXSHPO,PXSHPO,SXSHPO)
      PR=PBGS/PXSHPO
      HPTU 590
      HPTU 600
      HPTU 610
      HPTU 620
C-----H-P ISENTROPIC EXHAUST RATED LOAD                          HPTU 630
C      AXSHP     HXSHP     MXSHP     PXSHP     SXSHP     TXSHP     VXSHPPTU 640
      PESHP=PXHP
      SXSHP=SBGS
      CALL PROPPS(AXSHP,HXSHP,IXSHP,VXSHP,MXSHP,PXSHP,SXSHP)
      HPTU 650
      HPTU 660
      HPTU 670
      HPTU 680
      HPTU 690
      HPTU 700
      HPTU 710
      HPTU 720
      HPTU 730
      HPTU 740
      HPTU 750
      HPTU 760
      HPTU 770
      HPTU 780
      HPTU 790
      HPTU 800
      HPTU 810
      HPTU 820
      HPTU 830
      HPTU 840
      HPTU 850
      HPTU 860
      HPTU 870
      HPTU 880
      HPTU 890
      HPTU 900
      HPTU 910
      HPTU 920
      HPTU 930
      HPTU 940
      HPTU 950
      HPTU 960
      HPTU 970
      HPTU 980
      HPTU 990
      HPTU 1000
      HPTU 1010
      HPTU 1020
      HPTU 1030
      HPTU 1040
      HPTU 1050
      HPTU 1060
      HPTU 1070
      HPTU 1080
      HPTU 1090
      HPTU 1100
      HPTU 1110
      HPTU 1120
      HPTU 1130
      HPTU 1140
      HPTU 1150
      HPTU 1160
      HPTU 1170
      HPTU 1180
      HPTU 1190
      HPTU 1200
      HPTU 1210
      HPTU 1220
612 CONTINUE
      CALL CROSS(HBGS,SBGS,PRATIO,EFFY,AGH)
      TEMP=EFFY
      C4=P2(AGH,PBGS)
      EFFY=EPE+C4
      IF(DABS(TEMP-EFFY).LE..5D-4) GO TO 611
      JJ=JJ+1
      IF(JJ.LT.20) GO TO 612
611 CONTINUE
C-----ELEP RATED LOAD
C      AXHP      HXHP      MXHP      PXHP      SXHP      TXHP      VXXHPTU 870
      HXHP=HBGS-EFFY*(HBGS-HXSHP)
      CALL PROPPH(AXHP,HXHP,SXHP,VXHP,MXHP,PXHP,HXHP)
C-----G-S SHELL RATED LOAD POINT
      PKGS=PXSGSO*TPR
      IF(TPR.EQ. 1.000) GO TO 601
      J=0
      JJJ=0
      HPTU 940
      HPTU 950
      HPTU 960
      HPTU 970
      HPTU 980
      HPTU 990
      HPTU 1000
      HPTU 1010
      HPTU 1020
      HPTU 1030
      HPTU 1040
      HPTU 1050
      HPTU 1060
      HPTU 1070
      HPTU 1080
      HPTU 1090
      HPTU 1100
      HPTU 1110
      HPTU 1120
      HPTU 1130
      HPTU 1140
      HPTU 1150
      HPTU 1160
      HPTU 1170
      HPTU 1180
      HPTU 1190
      HPTU 1200
      HPTU 1210
      HPTU 1220
610 CALL STRATE(PKGS,HBGS,SBGS,HXHP,SXHP,HXGS,SXGS)
      CALL PROPPS(AXGS,HXGS,IXGS,VXGS,MXGS,PXGS,SXGS)
      JJJ=JJJ+1
      TEMP=PKGS
      PKGS=PGKEEP*(QBHP/QGKEEP)+DSQRT(PKGS*VXGS)/DSQRT(PGKEEP*VGKEEP)
      IF(DABS(PKGS-TEMP).LE..002) GO TO 602
      IF(JJJ.LT.50) GO TO 610
602 SLOPEG=(HXGS-HXHP)/(SXGS-SXHP)
600 CONTINUE
      J=J+1
      SXGS=SXHP+(SXGS-SXHP)*SLOPEG/SLOPE
      CALL PROPPS(AXGS,HXGS,IXGS,VXGS,MXGS,PXGS,SXGS)
      SLOPEG=(HXGS-HXHP)/(SXGS-SXHP)
      IF(J.EQ.50) GO TO 601
      IF(DABS((SLOPEG-SLOPE)/SLOPE).LT. 1.0-5) GO TO 601
      GO TO 600
601 CONTINUE
      IF(TPR.EQ. 1.00)
      *CALL STRATE(PKGS,HBGS,SBGS,HXHP,SXHP,HXGS,SXGS)
      CALL PROPPS(AXGS,HXGS,IXGS,VXGS,MXGS,PXGS,SXGS)
      IF(TPR.EQ. 1.00) GO TO 631
      IF((HXGS.LT. 3).OR. (HXHP.GT. 1)) GO TO 631
      K = 0
      PTOP = PKGS
      PBOT = PXHP
      GO TO 605
604 IF(NL.LT.NINT)PTOP=PINT
      IF(NINT.LT.NL)PBOT=PINT

```

```

605 PL=(FTOP*PBOT)/2.00
      K = K + 1
      CALL F12AC (PL,HXGS, SXGS, HXHP, SXHP, HINT, SINT)
      CALL PROPHS (PINT, TINT, VINT, AINT, MINT, HINT, SINT)
      TL=TSL (PL)
      HL=MPS (PL, SPTD (PL, TL))
      CALL PROPPH (AL, SL, VL, TL, HL, PL, HL)
      DELTAH=DABS (HL-HINT)
      IF (DELTAH.LE.HCON) GO TO 631
      IF (K.LT.100) GO TO 604
631 CONTINUE
      RETURN
      END

```

HPTU1230
HPTU1240
HPTU1250
HPTU1260
HPTU1270
HPTU1280
HPTU1290
HPTU1300
HPTU1310
HPTU1320
HPTU1330
HPTU1340
HPTU1350

```

C
      SUBROUTINE HXTRAC (NR, I1, I2, HBLP, HBLP, SBLP, HXLP, HXLP, SXLP, PIL, HIL,
      1 SIL, PX, UEEP)
      IMPLICIT REAL*8 (A-H, O-Z)
C
C SUBPROGRAM FOR FW HEATER EXTRACTION STEAM ENTHALPY
C
C NR      EXTRACTION STEAM ENTHALPY
C NR      NUMBER OF MOISTURE REMOVAL STAGES
C PE      EXTRACTION STEAM PRESSURE
C PX      TURBINE SECTION EXHAUST PRESSURE
C HAMR    ENTHALPY AFTER MOISTURE REMOVAL
C HMBR    ENTHALPY BEFORE MOISTURE REMOVAL
C HXLP    EXPANSION LINE END POINT, L-P
C HBLP    =1 BOWL CONDITIONS WET, =2 SAT. VAP., =3 SUPER. VAP.
      COMMON /HX1/PE(12),PHR(5)
      COMMON /HX2/HE(12),HBI(12),HAMR(5),HMBR(5),SAMR(5),SBMR(5),PCWD(5)
      COMMON /XS3/QSI,HSI,TSK,QSK,HSX,ANSX,EMS,MS
C
C TEST FOR PRESENCE OF MOISTURE REMOVAL STAGES
C----- NOTE: MAIN CALLS HXTRAC WITH NR=0 FOR H-P TURBINE SECTION
      IF (NR.GT.0) GO TO 4100
C NO MOISTURE REMOVAL STAGES PRESENT
      DO 4060 I=I1,I2
      IF (PE(I).GT.(PX+1.0)) GO TO 3990
      IF (MS.EQ.0) HE(I)=UEEP
      IF (MS.GT.0) HE(I)=HSX
      GO TO 4050
3990 IF (HBLP.EQ.3) GO TO 4000
C BOWL WET OR SATURATED VAPOR
      CALL F12AC (PE(I),HBLP,SBLP,HXLP,SXLP,HE(I),SE)
      GO TO 4050
C BOWL SUPERHEATED
4000 IF (HXLP.EQ.1) GO TO 4010
      CALL F12B (PE(I),HBLP,SBLP,HXLP,SXLP,HE(I),SE)
      GO TO 4050
4010 IF (PE(I).LT.PIL) GO TO 4040
      CALL F12B (PE(I),HBLP,SBLP,HIL,SIL,HE(I),SE)
      GO TO 4050
4040 CALL F12AC (PE(I),HIL,SIL,HXLP,SXLP,HE(I),SE)
4050 HE(I)=HE(I)
4060 CONTINUE
      RETURN
C
C MOISTURE REMOVAL STAGES PRESENT
4100 DO 4200 I=I1,I2
      IF (PE(I).GT.(PX+1.0)) GO TO 4110
      HE(I)=UEEP
      GO TO 4195

```

HXTB
HXTB 10
HXTB 20
HXTB 30
HXTB 40
HXTB 50
HXTB 60
HXTB 70
HXTB 80
HXTB 90
HXTB 100
HXTB 110
HXTB 120
HXTB 130
HXTB 140
HXTB 150
HXTB 160
HXTB 170
HXTB 180
HXTB 190
HXTB 200
HXTB 210
HXTB 220
HXTB 230
HXTB 240
HXTB 250
HXTB 260
HXTB 270
HXTB 280
HXTB 290
HXTB 300
HXTB 310
HXTB 320
HXTB 330
HXTB 340
HXTB 350
HXTB 360
HXTB 370
HXTB 380
HXTB 390
HXTB 400
HXTB 410
HXTB 420
HXTB 430
HXTB 440
HXTB 450
HXTB 460
HXTB 470
HXTB 480

4110 DO 4190 J=1, NP	HSTR 490
IF (PE(I).GT. (PMR(J)+1.0) .OR. PE(I).LT. (PMR(J)-1.0)) GO TO 4120	HSTR 500
HE(I)=HAMR(J)	HSTR 510
HE1(I)=HBTR(J)	HSTR 520
GO TO 4200	HSTR 530
4120 IF (PE(I).GT. PMR(J)) GO TO 4130	HSTR 540
IF (J.LT.NB) GO TO 4190	HSTR 550
NB=HAMR(J)	HSTR 560
SB=SAMR(J)	HSTR 570
HX=HXLP	HSTR 580
SX=SLP	HSTR 590
GO TO 4180	HSTR 600
4130 IF (J.EQ.1) GO TO 4140	HSTR 610
NB=HAMR(J-1)	HSTR 620
SB=SAMR(J-1)	HSTR 630
GO TO 4170	HSTR 640
4140 IF (NBLP.EQ.3) GO TO 4150	HSTR 650
NB=NBLP	HSTR 660
SB=SBLP	HSTR 670
GO TO 4170	HSTR 680
4150 IF (PE(I).GT. PIL) GO TO 4160	HSTR 690
HR=HIL	HSTR 700
SB=SIL	HSTR 710
GO TO 4170	HSTR 720
4160 CALL P12B (PE(I), NBLP, SBLP, HIL, SIL, HE(I), SE)	HSTR 730
GO TO 4195	HSTR 740
4170 HX=HBMB(J)	HSTR 750
SX=SBMR(J)	HSTR 760
4180 CALL P12AC (PE(I), NB, SB, HX, SX, HE(I), SE)	HSTR 770
GO TO 4195	HSTR 780
4190 CONTINUE	HSTR 790
4195 HE1(I)=HE(I)	HSTR 800
4200 CONTINUE	HSTR 810
RETURN	HSTR 820
END	HSTR 830

C	SUBROUTINE INDEX(I1,I2,NFLP,MR)	INDE
	IMPLICIT REAL*4(A-H,O-Z)	INDE 10
C	SUBPROGRAM FOR CALCULATING INDICES FOR LP TURBINE	INDE 20
C	I FEEDWATER HEATER NUMBER	INDE 30
C	L MOISTURE REMOVAL POINT NUMBER	INDE 40
C	I1 FIRST FEEDWATER HEATER FED FROM L-P TURBINE	INDE 50
C	I2	INDE 60
C	J1(I) TOTAL NO. OF FW HEATER EXTRACTION AND MOISTURE REMOVAL	INDE 70
C	EXTRACTION POINTS THAT COINCIDE, TO AND INCLUDING FW HEATER	INDE 80
C	EXTRACTION POINT 'I'	INDE 90
C	L1(I) FIRST MOISTURE REMOVAL EXTRACTION POINT THAT FEEDS FW HTR 'I'	INDE 100
C	L2(I) LAST MOISTURE REMOVAL EXTRACTION POINT THAT FEEDS FW HTR 'I'	INDE 110
C	MR NUMBER OF MOISTURE REMOVAL STAGES IN L-P TURBINE	INDE 120
C	NR I2-1	INDE 130
C	PE EXTRACTION STAGE PRESSURE	INDE 140
C	INR(L) MOISTURE REMOVAL POINT NUMBER L DRAINS TO FEEDWATER HEATER	INDE 150
C	NUMBER INR(L)	INDE 160
C	J1	INDE 170
C	LL1	INDE 180
C	LL2	INDE 190
C	PMR MOISTURE REMOVAL STAGE PRESSURE	INDE 200
C	NFLP NUMBER OF FEEDWATER HEATERS FED FROM L-P TURBINE	INDE 210
C	IF L1(I)=1 AND L2(I)=0, THEN NO MOISTURE REMOVAL EXTRACTION	INDE 220
C		INDE 230

C	POINTS FEED TO FW HEATER 'I'	INDE 240
	COMMON /HX1/PR(12),PHR(5)	INDE 250
	COMMON /IN/L1(13),L2(13),J1(13),IMR(5)	INDE 260
	IMR(1)=0	INDE 270
	IMR(2)=0	INDE 280
	IMR(3)=0	INDE 290
	IMR(4)=0	INDE 300
	IMR(5)=0	INDE 310
	JJ1=0	INDE 320
	LL1=0	INDE 330
	LL2=0	INDE 340
	IF (NPLR.EQ.3) GO TO 2750	INDE 350
	NN=I2-1	INDE 360
	DO 2740 I=I1,NN	INDE 370
	LL1=LL2+1	INDE 380
	IF (LL1.GT.NR) GO TO 2730	INDE 390
	DO 2710 L=LL1,NR	INDE 400
	IF (PHR(L).LT.(PE(I)-1.0)) GO TO 2730	INDE 410
	IMR(L)=I	INDE 420
	LL2=L	INDE 430
	IF (PHR(L).LT.(PE(I)+1.0).AND.PHR(L).GT.(PE(I)-1.0)) GO TO 2720	INDE 440
2710	CONTINUE	INDE 450
	GO TO 2730	INDE 460
2720	JJ1=JJ1+1	INDE 470
2730	J1(I)=JJ1	INDE 480
	L1(I)=LL1	INDE 490
	L2(I)=LL2	INDE 500
2740	CONTINUE	INDE 510
2750	J1(I2)=JJ1	INDE 520
	L1(I2)=LL2+1	INDE 530
	L2(I2)=NR	INDE 540
	RETURN	INDE 550
	END	INDE 560

C	SUBROUTINE LAGRAN(X,T,P,Z,NPOINT,NORDER,I)	LAGR 10
	IMPLICIT REAL*8(A-H,O-Z)	LAGR 20
	DIMENSION T(30),P(30),P(30),PNUM(30),PDENOM(30)	LAGR 30
C	ADJUSTING NPOINT AND NORDER FOR USE IN DO LOOPS	LAGR 40
	NPTI = NPOINT - 1 + I	LAGR 50
	NORDI = NORDER - 1 + I	LAGR 60
	Z = 0.0	LAGR 70
	DO 1 J=I,NPTI	LAGR 80
	PNUM(J) = X - T(J)	LAGR 90
1	P(J)=1.0	LAGR 100
	DO 2 K=I,NPTI	LAGR 110
	DO 3 N=I,NORDI	LAGR 120
	IF (K - N) 20,20,10	LAGR 130
10	P(K) = P(K)*PNUM(N)/(T(K) - T(N))	LAGR 140
	GO TO 3	LAGR 150
20	P(K) = P(K)*PNUM(N+1)/(T(K) - T(N+1))	LAGR 160
3	CONTINUE	LAGR 170
2	Z=Z+P(K)*P(K)	LAGR 180
	RETURN	LAGR 190
	END	LAGR 200

C	SUBROUTINE PART	PART	10
	IMPLICIT REAL*8(A-H,O-Z)	PART	20
	COMMON /GS/QGS,HBGS,PBGS, ABGS,SBGS,VBGS,TBGS,PGXS, AYGS,SGXS,	PART	30
	*VIGS,TIGS,MIGS,PDGS, HBGS,MIGS,NCGS, NGS	PART	40
	* ,QT,PT,TT, AT,HT	PART	50
	COMMON /Z/ TFR,SLOPE,QTKEEP,PKEEP,QGKEEP,PGKEEP,VGKEEP,GCKEEP,DUNEZPART	PART	60
	FIG6(TFR)=8.5D0-(0.9D0)/(1.2D0-TFR)	PART	70
	PFIRST=PT*(1.D0-FIG6(.60D0)/100.D0)	PART	80
	HPFIRST=HT	PART	90
	CALL PROPPH(APFIRST,SPFIRST,VFIRST,TFIRST,HPFIRST,PPFIRST,HPFIRST)	PART	100
C----	FIRST GUESS OF PBGS	PART	110
	JJJ=0	PART	120
	PBGS=PFIRST*TFR/.6D0	PART	130
	HBGS=HPFIRST	PART	140
610	CALL PROPPH(ABGS,SBGS,VBGS,TBGS,HBGS,PBGS,HBGS)	PART	150
	TEMP=PBGS	PART	160
	PBGS=PFIRST*(TFR/.6D0)*	PART	170
	* DSQRT(PBGS*VBGS)/DSQRT(PFIRST*VFIRST)	PART	180
	JJJ=JJJ+1	PART	190
	IF(DABS(PBGS-TEMP).LE..002) GO TO 611	PART	200
	IF(JJJ.LT.50) GO TO 610	PART	210
611	RETURN	PART	220
	END	PART	230

C	SUBROUTINE PRDROP(PXHP,PBLP, NRH)	PRDR	10
	IMPLICIT REAL*8(A-H,O-Z)	PRDR	20
C	SUBPROGRAM FOR INTERMEDIATE SYSTEM PRESSURE DROP	PRDR	30
	(TABLE III, P. 16, GET-6020)	PRDR	40
C	PIV PRESSURE AT INTERMEDIATE VALVES	PRDR	50
C	PSI SEPARATOR INLET PRESSURE	PRDR	60
C	PSX SEPARATOR OUTLET PRESSURE	PRDR	70
C	PBLP L-P TURBINE BOWL PRESSURE	PRDR	80
C	PPPT FEED PUMP TURBINE BOWL PRESSURE	PRDR	90
C	PXHP H-P TURBINE EXHAUST PRESSURE	PRDR	100
C	PIRH1 INLET REHEATER NO. 1 PRESSURE	PRDR	110
C	PIRH2 INLET REHEATER NO. 2 PRESSURE	PRDR	120
C	PXRH1 OUTLET REHEATER NO. 1 PRESSURE	PRDR	130
C	PXRH2 OUTLET REHEATER NO. 2 PRESSURE	PRDR	140
	COMMON /RH1/PXRH2,PIRH2,PXRH1,PIRH1,PPPT	PRDR	150
	COMMON /XS1/PSX,PSI	PRDR	160
	DATA A/.7D0/	PRDR	170
	DATA B1/1.9D0/, B2/1.1D0/, B3/1.1D0/	PRDR	180
	DATA C2/1.8D0/, C3/1.3D0/	PRDR	190
	DATA D3/1.5D0/, E/1.1D0/, F/3.3D0/	PRDR	200
C	NOI STURE SEPARATOR	PRDR	210
	PIV=PBLP/(1.-F/100.)	PRDR	220
	IF(NRH.NE.0) GOTO 40	PRDR	230
C	NOI STURE SEPARATOR, NO REHEATER	PRDR	240
	PSX=PIV/(1.-E/100.)	PRDR	250
	PPPT=(15.*PBLP-2.*PSX)/13.	PRDR	260
	PSI=PSX/(1.-B1/100.)	PRDR	270
	PXHP=PSI/(1.-A/100.)	PRDR	280
	RETURN	PRDR	290
40	IF(NRH.GT.1) GOTO 50	PRDR	300
C	NOI STURE SEPARATOR, 1-STAGE REHEATER	PRDR	310
	PXRH1=PIV/(1.-E/100.)	PRDR	320
	PPPT=(15.*PBLP-2.*PXRH1)/13.	PRDR	330
	PIRH1=PXRH1/(1.-C2/100.)	PRDR	340
	PSX=PIRH1	PRDR	350
	PSI=PSX/(1.-B2/100.)	PRDR	360
	PXHP=PSI/(1.-A/100.)	PRDR	370
	RETURN	PRDR	380

```

C  MOISTURE SEPARATOR, 2-STAGE REHFATER
50  PRRH2=PIV/(1.-P/100.)
    PPPT=(15.*PBLP-2.*PIRH2)/11.
    PIRH2=PIRH2/(1.-D3/100.)
    PIRH1=PIRH2
    PIRH1=PIRH1/(1.-C3/100.)
    PSX=PIRH1
    PSI=PSX/(1.-B3/100.)
    PRHP=PSI/(1.-A/100.)
    RETURN
END

```

```

PRDB 390
PRDR 400
PRDB 410
PRDB 420
PRDB 430
PRDB 440
PRDB 450
PRDB 460
PRDB 470
PRDB 480
PRDR 490

```

```

C
SUBROUTINE PROPHS(P,T,V,A,H,S)
IMPLICIT REAL*8 (A-H,O-Z)
P=PHS(H,S)
CALL PROPPS(A,H,T,V,H,P,S)
RETURN
END

```

```

PHHS
PHHS 10
PHHS 20
PHHS 30
PHHS 40
PHHS 50
PHHS 60

```

```

C
SUBROUTINE PROPPH(A,S,V,T,H,P,H)
IMPLICIT REAL*8(A-H,O-Z)
DATA TC/705.47D0/, PCA/3208.234759D0/
S=SSSISS(P,H,T,V,X)
A=1.D0-X
IF((P.GE.PCA).OR.(T.GE.TC)) GO TO 1
IF(S.GT.SGP(P)) H=3
IF(S.EQ.SGP(P)) H=2
IF(S.LT.SGP(P)) H=1
RETURN
1 CONTINUE
H=3
RETURN
END

```

```

PRPH
PRPH 10
PRPH 20
PRPH 30
PRPH 40
PRPH 50
PRPH 60
PRPH 70
PRPH 80
PRPH 90
PRPH 100
PRPH 110
PRPH 120
PRPH 130
PRPH 140

```

```

C
C  REVISION 10-20-77
SUBROUTINE PROPPS(A,H,T,V,H,P,S)
IMPLICIT REAL*8(A-H,O-Z)
H=HSSISS(P,S,T,V,X)
DATA TC/705.47D0/, PCA/3208.234759D0/
A=1.D0-X
IF((P.GE.PCA).OR.(T.GE.TC)) GO TO 1
IF(S.GT.SGP(P)) H=3
IF(S.EQ.SGP(P)) H=2
IF(S.LT.SGP(P)) H=1
RETURN
1 CONTINUE
H=3
RETURN
END

```

```

PRPS
PRPS 10
PRPS 20
PRPS 30
PRPS 40
PRPS 50
PRPS 60
PRPS 70
PRPS 80
PRPS 90
PRPS 100
PRPS 110
PRPS 120
PRPS 130
PRPS 140
PRPS 150

```

C	SUBROUTINE RATFUN(A,B,X,Z,I,J) IMPLICIT REAL*8 (A-H,O-Z) DIMENSION A(10),B(5) ZNUM = 0.0 ZDENOM = 0.0 I1 = I + 2 J1 = J + 1 DO 1 N=1,I ZNUM = ZNUM*X 1 ZNUM = ZNUM + A(I1-N) ZNUM = ZNUM *X + A(1) DO 2 M=1,J ZDENOM = ZDENOM*X 2 ZDENOM = ZDENOM + B(J1-M) ZDENOM = ZDENOM*X + 1. Z = ZNUM/ZDENOM RETURN END	RATF RATF 10 RATF 20 RATF 30 RATF 40 RATF 50 RATF 60 RATF 70 RATF 80 RATF 90 RATF 100 RATF 110 RATF 120 RATF 130 RATF 140 RATF 150 RATF 160 RATF 170 RATF 180
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C	SUBROUTINE REHEAT(HE,PE,HT,PT) IMPLICIT REAL*8 (A-H,O-Z) C SUBPROGRAM FOR REHEATER PARAMETERS COMMON /RH1/PXRH2,PIRH2,PXRH1,PIRH1,PPPT COMMON /RH2/QRH1,HCRH1,QRH2,HCRH2,NRH,NDRH1,NDRH2 COMMON /RH3/TTDRH1,TTDRH2,HRH1,HRH2,PCRH1,PCRH2,TCRH1,PCRH2,TCRH2,TXRH1, 1 HXRH1,TXRH2,HXRH2,HIRH2,HIRH1,QRH DATA IW/6/ C 1ST STAGE IF(NRH.EQ. 1) GOTO 110 HRH1=HE PCRH1=PE*(1.D0-.03D0)*(1.D0-.007D0)*(1.D0-.008D0) GOTO 120 110 HRH1=HT PCRH1=PT*(1.D0-.007D0)*(1.D0-.008D0) 120 TCRH1= TSL(PCRH1) HCRH1= HPT(TCRH1) TXRH1=TCRH1-TTDRH1 T1= TSL(PXRH1) IF(TXRH1.GE. T1) GOTO 122 TXRH1=T1 TTDRH1=TXRH1-TCRH1 WRITE(IW,121) TTDRH1 121 FORMAT('0',F10,'THERE IS A DATA ERROR IN SUBROUTINE REHEAT.'/, 1 F10,'REHEATER TERMINAL TEMPERATURE DIFFERENCE HAS BEEN CHANGED TO', 2,F10,2) 122 HXRH1=HPS(PXRH1,SPTD(PXRH1,TXRH1)) IF(NRH.EQ. 1) GOTO 130 C 2ND STAGE HRH2=HT PCRH2=PT*(1.D0-.007D0)*(1.D0-.008D0) TCRH2= TSL(PCRH2) HCRH2= HPT(TCRH2) TXRH2=TCRH2-TTDRH2 T2= TSL(PIRH2) IF(TXRH2.GE. T2) GOTO 124 TXRH2=T2 TTDRH2=TXRH2-TCRH2 WRITE(IW,121) TTDRH2 124 HXRH2=HPS(PIRH2,SPTD(PIRH2,TXRH2)) HIRH2=HXRH1 130 RETURN END	REHE REHE 10 REHE 20 REHE 30 REHE 40 REHE 50 REHE 60 REHE 70 REHE 75 REHE 80 REHE 90 REHE 100 REHE 110 REHE 120 REHE 130 REHE 140 REHE 150 REHE 160 REHE 170 REHE 180 REHE 190 REHE 200 REHE 210 REHE 220 REHE 230 REHE 240 REHE 250 REHE 260 REHE 270 REHE 280 REHE 290 REHE 300 REHE 310 REHE 320 REHE 330 REHE 340 REHE 350 REHE 360 REHE 370 REHE 380 REHE 390 REHE 400 REHE 410 REHE 420
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C      SUBROUTINE RESULT(VPRS)
      IMPLICIT REAL*8(A-H,O-Z)
C  THIS SUBPROGRAM PRINTS THE CALCULATED RESULTS
      COMMON /BLCK/AMBHP(5),AMMR(5),TMR(6),MP,IDUM
      *      ,QBLP,PBLP,TBLP,AMBLP,HBLP,SBLP,QXLP,PXLP,IXLP,AMXLP,
      *      HXLP,SKLP,UEHPLP
      *      ,CHTS(19),      TC,TPP,TR,HR,WRATE,GC,WML,WGL,QMU,OPP,
      *      DP,WGEN,WFPW,HTRTN,HTRTG,CEPPN,CEPPG,PC
      COMMON /PPT/QPPT,PBPPT,HRPPT,XPPT,HXPPT,IPPPT
      COMMON /PMH/HAEI,HAEQ,QR,QPS(20),HPS(20),HES(20),QMP(5),HMP(5),
      *      QMG(5),HMG(5),QD(12),OP(12),OE(12),OCR,HCR,ORO,QC,IILP,I
      COMMON /GS/QGS,HBGS,PRGS,ABGS,SBGS,VBGS,TBGS,PIGS,AXGS,SGS,
      *      VIGS,TXGS,HXGS,PDGS,      MBGS,NGXS,NCGS,      NG
      *      ,QT,PT,TT,AT,HT
      COMMON /HP/QBHP,PBHP,TRHP,AMBHP,HRHP,SBHP,QXHP,IXHP,AMXHP,HXHP,
      *      SXHP,UEZHP
      COMMON /HX1/PE(12),PHR(5)
      COMMON /HX2/HE(12),HE1(12),HAMP(5),HBHR(5),SAHR(5),SRHR(5),PCWD(5)
      COMMON /IN/L1(13),L2(13),J1(13),IMR(5)
      COMMON /LEAK/QLK1,HLK1,QLK2,HLK2,QLK3,HLK3,QLK4,HLK4,QLK5,HLK5,
      *      QLK6,HLK6,QLK7,HLK7,QLK8,HLK8,QLK9,HLK9,QLK10,HLK10,LK,LK1,LK3,
      *      LK5,LK7,LK9
      COMMON /PAR1/HO(12),HI(12),QAE,HC,HFP,DHP,TI(12),TD(12),TDCA(12),
      *      HD(12),PLA,PLB,ND(12),NDC(12),IP,NP
      COMMON /PAR2/PSH(12),TSH(12),TO(12),TTD(12),PXHP,PXIP
      COMMON /RH1/PXRH2,PIRH2,PXRH1,PIBH1,PPT
      COMMON /RH2/QRH1,HCRH1,QRH2,HCRH2,NRH,NDRH1,NDRH2
      COMMON /RH3/TTDRH1,TTDRH2,HRH1,H RH2,PCRH1,TCRH1,PCRH2,TCRH2,TRH1,
      *      HXRH1,TRH2,HXRH2,HIBH2,HIRH1,QRH
      COMMON /SSR/QSPH,QMC,QSSP,HSSR,PSSR,QPMH,QSSRMU,HSSRMU
      COMMON /XS1/PSI,PSI
      COMMON /XS2/HPSX,QMR
      COMMON /XS3/QSI,HSI,TSX,QSX,HSX,AMSX,ENS,MS
      COMMON /Z/TPR,SLOPE,QKKEP,PKEEF,QGKEP,PGKEP,GCKKEP,DUMZ
      DATA CPSI/2.03602234D0/
      NPAGE=1
      PRINT 100,(CHTS(K),K=1,18),VERS,NPAGE
100  FORMAT('1',F10.18A4/
      *      '1',T10,'STEAM TURBINE CYCLE HEAT BALANCE'/
      *      '1',T10,'ORCENT, VERSION',A8/
      *      '0',T10,'CALCULATED RESULTS, PAGE',I3////)
      PRINT 110,HTRTN,CEPPN,HTRTG,CEPPG,WGEN
110  FORMAT('0',T10,'TABLE I OVERALL PERFORMANCE'/
      *      '0',T10,'NET TURBINE CYCLE HEAT RATE, BTU/KW-HR',T60,P8.0/
      *      '1',T10,'NET TURBINE CYCLE EFFICIENCY, PER CENT',T60,P10.2/
      *      '0',T10,'GROSS TURBINE CYCLE HEAT RATE, BTU/KW-HR',T60,P8.0/
      *      '1',T10,'GROSS TURBINE CYCLE EFFICIENCY, PER CENT',T60,P10.2/
      *      '0',T10,'GENERATOR OUTPUT, MWE',T60,P11.3)
      IF(IPPPT.EQ.3)GOTO112
      WG=WGEN-WFPW*0.001D0
      PRINT 111,WFPW,WG
111  FORMAT('0',T10,'POWER REQUIRED BY TURBINE-DRIVEN FW PUMP, MW',
      *      T60,-3PF11.3/
      *      '1',T10,'GENERATOR OUTPUT PLUS FW PUMP POWER, MW',T60,OPP11.3)
      GOTO114
112  WG=WGEN-WFPW*0.001D0
      PRINT 113,WFPW,WG
113  FORMAT('0',T10,'POWER REQUIRED BY MOTOR-DRIVEN FW PUMP, MW',
      *      T60,-3PF11.3/
      *      '1',T10,'GENERATOR OUTPUT MINUS FW PUMP POWER, MWE',T60,OPP11.3)
114  PRINT 115,WML,WGL
115  FORMAT('0',T10,'MECHANICAL LOSSES, KW',T60,P8.0/
      *      '1',T10,'GENERATOR LOSSES, KW',T60,P8.0)
      NPAGE=NPAGE+1
      PRINT 100,(CHTS(K),K=1,18),VERS,NPAGE
      PRINT 120
120  FORMAT('0',T10,'TABLE II TURBINE EXPANSION LINE'/
      *      '0',T50,'STEAM FLOW      PRESSURE      TEMPERATURE      MOISTURE      ENTHRESU
      *      ALPY      ENTROPY'/

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      * ' , T50, ' LB/HR          PSIA          P          PER CENT          BTU/RESU 700
      * /LB          BTU/LB-F' )
      PRINT 130, QT, PT, TT, AT, HT,
      * QGS, PRGS, TBGS, ABGS, HSGS, SBGS,
      * QGS, PRGS, TXGS, AXGS, HXGS, SXGS
      RESU 710
      RESU 720
      RESU 730
      RESU 740
      RESU 750
110  FORMAT(' ' , T10, 'TJRPINE THROTTLE',
      * T50, P10.0, P12.1, P12.1, P14.2, P12.1/
      * ' , T10, 'GOVERNING STAGE BOWL',
      * T50, P10.0, P12.1, P12.1, 2PP14.2, OPP12.1, P12.4/
      * ' , T10, 'GOVERNING STAGE SHELL',
      * T50, P10.0, P12.1, P12.1, 2PP14.2, OPP12.1, P12.4)
      WRITE(6,140) QXHP, PXHP, TXHP, AXHP, HXHP, SXHP,
      * 2PXHP, UEEPHP
      RESU 760
      RESU 770
      RESU 780
      RESU 790
      RESU 800
      RESU 810
      RESU 820
      RESU 830
140  FORMAT(' ' , T10, 'HP SECTION ELEP',
      * T50, P10.0, P12.1, P12.1, 2PP14.2, OPP12.1, P12.4/
      * ' , T10, 'HP SECTION UEEP',
      * T60, P12.1, T98, P12.1)
      RESU 840
      RESU 850
      RESU 860
119  IF (MS.EQ.0) GOTO151
      PRINT 150, QSI, PSI, HSI,
      * QSK, PSK, TSX, AMSX, HSK
      RESU 870
      RESU 880
      RESU 890
150  FORMAT(' ' , T10, 'EXTERNAL MOISTURE SEPARATOR INLET',
      * T50, P10.0, P12.1, T98, P12.1/
      * ' , T10, 'EXTERNAL MOISTURE SEPARATOR OUTLET',
      * T50, P10.0, P12.1, P12.1, 2PP14.2, OPP12.1)
      RESU 900
      RESU 910
      RESU 920
      RESU 930
      RESU 940
151  CONTINUE
      RESU 950
160  IF (NRH.EQ.0) GOTO181
      PRINT 170, QRH, PIRH1, HIRH1,
      * QRH, PIRH1, TIRH1, HIRH1
      RESU 960
      RESU 970
      RESU 980
170  FORMAT(' ' , T10, '1ST STAGE REHEATER INLET',
      * T50, P10.0, P12.1, T98, P12.1/
      * ' , T10, '1ST STAGE REHEATER OUTLET',
      * T50, P10.0, P12.1, P12.1, T98, P12.1)
      RESU 990
      RESU1000
      RESU1010
      IF (NRH.LT.2) GOTO181
      PRINT 180, QRH, PIRH2, HIRH2,
      * QRH, PIRH2, TIRH2, HIRH2
      RESU1020
      RESU1030
      RESU1040
190  FORMAT(' ' , T10, '2ND STAGE REHEATER INLET',
      * T50, P10.0, P12.1, T98, P12.1/
      * ' , T10, '2ND STAGE REHEATER OUTLET',
      * T50, P10.0, P12.1, P12.1, T98, P12.1)
      RESU1050
      RESU1060
      RESU1070
      RESU1080
191  CONTINUE
      RESU1090
      PRINT 200, QBLP, PBLP, TBLP, AMBLP, HBLP, SBLP
      RESU1100
200  FORMAT(' ' , T10, 'LP SECTION BOWL',
      * T50, P10.0, P12.1, P12.1, 2PP14.2, OPP12.1, P12.4)
      RESU1110
      RESU1120
      IF (MR.EQ.0) GOTO230
      DO220 L=1, NB
      PRINT 210, L, PNR(L), IMR(L), ANBMR(L), HBMR(L), SBMR(L),
      * L, PNR(L), THR(L), ANAHR(L), HANR(L), SANR(L)
      RESU1130
      RESU1140
      RESU1150
      RESU1160
210  FORMAT(' ' , T10, 'BEFORE MOISTURE REMOVAL NO.', I2,
      * T60, P12.1, P12.1, 2PP14.2, OPP12.1, P12.4/
      * ' , T10, 'AFTER MOISTURE REMOVAL NO.', I2,
      * T60, P12.1, P12.1, 2PP14.2, OPP12.1, P12.4)
      RESU1170
      RESU1180
      RESU1190
      RESU1200
220  CONTINUE
      RESU1210
230  PRINT 240, QXLP, PXLP, TXLP, AXLP, HXLP, SXLP,
      * 1PXLP, UEEPLP
      RESU1220
      RESU1230
240  FORMAT(' ' , T10, 'LP SECTION ELEP',
      * T50, P10.0, P16.5, P8.1, 2PP14.2, OPP12.1, P12.4/
      * ' , T10, 'LP SECTION UEEP',
      * T60, P16.5, T98, P12.1)
      RESU1240
      RESU1250
      RESU1260
      RESU1270
      NPAGE=NPAGE+1
      RESU1280
      PRINT 100, (CHTS(K), K=1,18), VERS, NPAGE
      RESU1290
      IF (QAE.GT.1.0) GOTO260
      PRINT 250
      RESU1300
      RESU1310
250  FORMAT('0' , T10, 'TABLE III  THERE IS NO STEAM JET AIR EJECTOR')
      RESU1320
      GOTO275
      RESU1330
260  PRINT 270, QAE, HAEI, HAE0
      RESU1340
270  FORMAT('0' , T10, 'TABLE III  STEAM JET AIR EJECTOR'/
      * '0' , T10, 'STEAM FLOW, LB/HR', T40, P10.0/
      * ' , T10, 'STEAM ENTHALPY IN, BTU/LB', T40, P11.1/
      * ' , T10, 'STEAM ENTHALPY OUT, BTU/LB', T40, P11.1)
      RESU1350
      RESU1360
      RESU1370
      RESU1380
275  CONTINUE
      RESU1390
      IF (NS.GT.0) GOTO290
      PRINT 280
      RESU1400
      RESU1410

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290 FORMAT('0',T10,'TABLE IV  THERE IS NO EXTERNAL MOISTURE SEPARATOR' RESU1420
1) RESU1430
   GOTO350 RESU1440
290 IF(MS.LE.NP) GOTO310 RESU1450
   PRINT 300 RESU1460
310 FORMAT('0',T10,'TABLE IV  EXTERNAL MOISTURE SEPARATOR DRAINS TO CORE' RESU1470
1 INDENSEP') RESU1480
   GOTO330 RESU1490
310 PRINT 320,MS RESU1500
320 FORMAT('0',T10,'TABLE IV  EXTERNAL MOISTURE SEPARATOR DRAINS TO PW' RESU1510
1 HEATER NO.',I2) RESU1520
330 PRINT 340,QHR,PSX,TSX,HPSX RESU1530
340 FORMAT('0',T10,'DRAIN FLOW, LB/HR',T33,P10.0/ RESU1540
1' ',T10,'DRAIN PRESSURE, PSIA',T33,P11.1/ RESU1550
2' ',T10,'DRAIN TEMPERATURE, F',T33,P11.1/ RESU1560
3' ',T10,'DRAIN ENTHALPY, BTU/LB',T33,P11.1) RESU1570
350 CONTINUE RESU1580
   IF(NRH.GT.0) GOTO370 RESU1590
   IF(NRH.EQ.0) GOTO359 RESU1600
   PRINT 358 RESU1610
358 FORMAT('0',T10,'TABLE V  EXTERNAL REHEATER, SEE TABLE II') RESU1620
   GOTO400 RESU1630
359 PRINT 360 RESU1640
360 FORMAT('0',T10,'TABLE V  THERE IS NO REHEATER') RESU1650
   GOTO400 RESU1660
370 PRINT 380,NDRH1,QRH1,HRH1,PCRH1,TCRH1,HCRH1 RESU1670
390 FORMAT('0',T10,'TABLE V  LIVE STEAM REHEATER' / RESU1680
1'0',T10,'1ST STAGE DRAINS TO PW HEATER NO.',I2/ RESU1690
2' ',T10,'1ST STAGE STEAM FLOW, LB/HR',T43,P10.0/ RESU1700
3' ',T10,'1ST STAGE STEAM ENTHALPY, BTU/LB',T43,P11.1/ RESU1710
4' ',T10,'1ST STAGE PRESSURE, PSIA',T43,P11.1/ RESU1720
5' ',T10,'1ST STAGE DRAIN TEMPERATURE, F',T43,P11.1/ RESU1730
6' ',T10,'1ST STAGE DRAIN ENTHALPY, BTU/LB',T43,P11.1) RESU1740
   IF(NRH.EQ.1) GOTO400 RESU1750
   PRINT 390,NDRH2,QRH2,HRH2,PCRH2,TCRH2,HCRH2 RESU1760
390 FORMAT('0',T10,'2ND STAGE DRAINS TO PW HEATER NO.',I2/ RESU1770
1' ',T10,'2ND STAGE STEAM FLOW, LB/HR',T43,P10.0/ RESU1780
2' ',T10,'2ND STAGE STEAM ENTHALPY, BTU/LB',T43,P11.1/ RESU1790
3' ',T10,'2ND STAGE PRESSURE, PSIA',T43,P11.1/ RESU1800
4' ',T10,'2ND STAGE DRAIN TEMPERATURE, F',T43,P11.1/ RESU1810
5' ',T10,'2ND STAGE DRAIN ENTHALPY, BTU/LB',T43,P11.1) RESU1820
400 CONTINUE RESU1830
   IF(NR.GT.0) GOTO420 RESU1840
   PRINT 410 RESU1850
410 FORMAT('0',T10,'TABLE VI  THERE ARE NO MOISTURE REMOVAL STAGES') RESU1860
   GOTO440 RESU1870
420 PRINT 428 RESU1880
428 FORMAT('0',T10,'TABLE VI  MOISTURE REMOVAL STAGES') RESU1890
   PRINT 429,(L,L=1,NR) RESU1900
429 FORMAT('0',T10,'MOISTURE REMOVAL STAGE NO.',T36,5(10X,I2,2X)) RESU1910
   PRINT 430,(INE(L),L=1,NR) RESU1920
430 FORMAT(' ',T10,'DRAINS TO PW HEATER NO.',T36,5(10X,I2,2X)) RESU1930
   PRINT 431,(PNR(L),L=1,NR) RESU1940
431 FORMAT(' ',T10,'STAGE PRESSURE, PSIA',T36,5(8X,P6.1)) RESU1950
   PRINT 432,(THR(L),L=1,NR) RESU1960
432 FORMAT(' ',T10,'TEMPERATURE, F',T36,5(8X,P6.1)) RESU1970
   PRINT 433,(QHF(L),L=1,NR) RESU1980
433 FORMAT(' ',T10,'WATER REMOVED, LB/HR',T36,5(5X,P8.0,1X)) RESU1990
   PRINT 434,(RHF(L),L=1,NR) RESU2000
434 FORMAT(' ',T10,'WATER ENTHALPY, BTU/LB',T36,5(8X,P6.1)) RESU2010
   PRINT 435,(QHG(L),L=1,NR) RESU2020
435 FORMAT(' ',T10,'STEAM REMOVED, LB/HR',T36,5(5X,P8.0,1X)) RESU2030
   PRINT 436,(RHG(L),L=1,NR) RESU2040
436 FORMAT(' ',T10,'STEAM ENTHALPY, BTU/LB',T36,5(7X,P7.1)) RESU2050
440 NPAGE=NPAGE+1 RESU2060
   PRINT 100,(CNT3(K),K=1,10),VERS,NPAGE RESU2070
   IF(NP.GT.0) GOTO460 RESU2080
   PRINT 450 RESU2090
450 FORMAT('0',T10,'TABLE VII  THERE ARE NO PW HEATERS') RESU2100
   GOTO500 RESU2110

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450 PRINT 470
470 FORMAT('J',I10,'TABLE VII FW HEATERS')
N1=1
N2=NP
IF (NP.LE.5) GOTO480
N2=6
480 PRINT 481, (I,I=N1,N2)
481 FORMAT('J',I10,'FW HEATER NO.',T44,6I14)
PRINT 482, (JF(I),I=N1,N2)
482 FORMAT(' ',F10,'FW FLOW, LB/HR ',T45,6F14.0)
PRINT 483, (FO(I),I=N1,N2)
483 FORMAT(' ',F10,'FW TEMPERATURE OUT, F',T46,6F14.1)
PRINT 484, (HO(I),I=N1,N2)
484 FORMAT(' ',F10,'FW ENTHALPY OUT, BTU/LB ',T46,6F14.1)
PRINT 485, (FI(I),I=N1,N2)
485 FORMAT(' ',F10,'FW TEMPERATURE IN, F',T46,6F14.1)
PRINT 486, (HI(I),I=N1,N2)
486 FORMAT(' ',F10,'FW ENTHALPY IN, BTU/LB ',T46,6F14.1)
PRINT 487, (FE(I),I=N1,N2)
487 FORMAT(' ',F10,'EXTRACTION STAGE PRESSURE, PSIA',T46,6F14.1)
PRINT 488, (JE(I),I=N1,N2)
488 FORMAT(' ',F10,'EXTRACTION STEAM FLOW, LB/HR ',T45,6F14.0)
PRINT 489, (HE(I),I=N1,N2)
489 FORMAT(' ',F10,'EXTRACTION STEAM ENTHALPY, BTU/LB ',T46,6F14.1)
PRINT 490, (PSH(I),I=N1,N2)
490 FORMAT(' ',F10,'SHELL PRESSURE, PSIA',T46,6F14.1)
PRINT 491, (TSH(I),I=N1,N2)
491 FORMAT(' ',F10,'SHELL TEMPERATURE, F',T46,6F14.1)
PRINT 492, (QD(I),I=N1,N2)
492 FORMAT(' ',F10,'SHELL DRAIN FLOW, LB/HR ',T45,6F14.0)
PRINT 493, (TD(I),I=N1,N2)
493 FORMAT(' ',F10,'SHELL DRAIN TEMPERATURE, F',T46,6F14.1)
PRINT 494, (HD(I),I=N1,N2)
494 FORMAT(' ',F10,'SHELL DRAIN ENTHALPY, BTU/LB ',T46,6F14.1)
IF (N2.EQ.NP) GOTO500
N1=7
N2=NP
GOTO480
500 CONTINUE
PCI=PC*CPSI
PRINT 510,PC,PCI,QC,FC,HC
510 FORMAT('O',T10,'TABLE VIII CONDENSER'/
1'O',T10,'CONDENSER PRESSURE, PSIA',T41,9X,P10.5,
2T65,'=',T70,P10.2,T85,'IN. HGA'/
3' ',T10,'CONDENSATE FLOW, LB/HR',T41,P14.0/
4' ',T10,'CONDENSATE TEMPERATURE, F',T41,9X,P6.1/
5' ',T10,'CONDENSATE ENTHALPY, BTU/LB',T41,9X,P6.1)
NPAGE=NPAGE+1
PRINT 100, (CHTS(K),K=1,18),VERS,NPAGE
PRINT 511
511 FORMAT('O',T10,'TABLE IX CONDENSATE AND FEEDWATER')
IF (QCR.LT.1.) GOTO519
PRINT 512,QCR,HCR
512 FORMAT(
1'O',T10,'CONDENSATE FLOW BY-PASSED TO STEAM GENERATOR, LB/HR',
2T70,P10.0/
3' ',T10,'CONDENSATE ENTHALPY BY-PASSED TO STEAM GENERATOR, BTU/LB'
4,T70,5X,P6.1)
519 PRINT 520,QFP,TFP,HFP,DHP,DP,QR,TR,HR,ONU
520 FORMAT(
1'O',T10,'FW FLOW TO FW PUMP, LB/HR',T70,P10.0/
2' ',T10,'FW TEMPERATURE TO FW PUMP, F',T70,5X,P6.1/
3' ',T10,'FW ENTHALPY TO FW PUMP, BTU/LB',T70,5X,P6.1/
4' ',T10,'FW ENTHALPY RISE ACROSS FW PUMP, BTU/LB',T70,5X,P6.1/
5' ',T10,'FW PRESSURE INCREASE ACROSS FW PUMP, PSI',T70,4X,P6.0/
5'O',T10,'FW FLOW TO STEAM GENERATOR, LB/HR',T70,P10.0/
7' ',T10,'FW TEMPERATURE TO STEAM GENERATOR, F',T70,5X,P6.1/
9' ',T10,'FW ENTHALPY TO STEAM GENERATOR, BTU/LB',T70,5X,P6.1/
9'O',T10,'MAKE-UP TO CONDENSER HOTWELL, LB/HR',T70,P10.0)
PRINT 521,QRO,HT

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RES72120
RES02130
RES02140
RES02150
RES02160
RES02170
RES02180
RES02190
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RES02760
RES02770
RES02780
RES02790
RES02800
RES02810

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521 FORMAT('0',T10,'STEAM FLOW FROM STEAM GENERATOR, LB/HR',T70,P10.0/RESU2820
1' ',T10,'STEAM ENTHALPY FROM STEAM GENERATOR, BTU/LB',T70,4X,P7.1)RESU2830
IF(IPPT.LT.1)GOTO528 RESU2840
PRINT 525,QPPT RESU2850
525 FORMAT('0',T10,'THROTTLE STEAM FLOW PW PUMP TURBINE, LB/HR',T70, RESU2860
1P10.0) RESU2870
PKPPTI=PKPPT*CPST RESU2880
PRINT 527,PKPPT,HBPPT,QKPPT,PKPPTI,HXPPT RESU2890
527 FORMAT(' ',T10,'THROTTLE PRESSURE PW PUMP TURBINE, PSIA',T70, RESU2900
1P11.1/ RESU2910
2' ',T10,'THROTTLE ENTHALPY PW PUMP TURBINE, BTU/LB',T70,P11.1/ RESU2920
3' ',T10,'EXHAUST PRESSURE PW PUMP TURBINE, PSIA',T70,P15.5, RESU2930
1T90,' ',P10.2,T105,' IN. HGA'/ RESU2940
5' ',T10,'EXHAUST ENTHALPY PW PUMP TURBINE, BTU/LB',T70,P11.1) RESU2950
528 NPAGE=NPAGE+1 RESU2960
PRINT 100,(CRFS(K),K=1,18),VERS,NPAGE RESU2970
IF(LK.GT.0)GOTO550 RESU2980
PRINT 540 RESU2990
540 FORMAT('0',T10,'TABLE X VALVE STEM AND SHAFT LEAKAGES WERE NOT CRESU3000
1ALCULATED') RESU3010
GOTO600 RESU3020
550 PRINT 560,QSSR,HSSR,QMC,QSP RESU3030
550 FORMAT('0',T10,'TABLE X VALVE STEM AND SHAFT LEAKAGES' / RESU3040
1'0',T10,'STEAM SEAL REGULATOR' / RESU3050
2' ',T12,'FLOW TO SSR, LB/HR',T65,P8.0/ RESU3060
3' ',T12,'ENTHALPY AT SSR, BTU/LB',T67,P7.1/ RESU3070
4' ',T12,'FLOW FROM SSR TO MAIN CONDENSER, LB/HR',T65,P8.0/ RESU3080
5' ',T12,'FLOW FROM SSR TO STEAM PACKING EXHAUSTED, LB/HR',T65, RESU3090
5P8.0) RESU3100
IF(NP.EQ.0)GOTO562 RESU3110
PRINT 561,NP,QFWH RESU3120
551 FORMAT(' ',T12,'FLOW FROM SSR TO PW HEATER NO.',I3,', LB/HR',T65, RESU3130
1P8.0) RESU3140
552 PRINT 563,QSSRMU,HSSRMU RESU3150
563 FORMAT(' ',T12,'MAKE-UP FROM THROTTLE STEAM, LB/HR',T65,P8.0/ RESU3160
1' ',T12,'ENTHALPY OF MAKE-UP STEAM, BTU/LB',T67,P7.1) RESU3170
PRINT 570,LK1,QLK1,HLK1,QLK2,HLK2,LK3,QLK3,HLK3,QLK4,HLK4 RESU3180
570 FORMAT('0',T10,'THROTTLE VALVE STEM' / RESU3190
1' ',T12,'LEAK NO. 1 (DRAINS TO PW HEATER NO.',I3,',) , LB/HR',T65, RESU3200
2P8.0/ RESU3210
3' ',T12,'ENTHALPY LEAK NO. 1, BTU/LB',T67,P7.1/ RESU3220
4' ',T12,'LEAK NO. 2 (DRAINS TO SSR), LB/HR',T65,P8.0/ RESU3230
5' ',T12,'ENTHALPY LEAK NO. 2, BTU/LB',T67,P7.1/ RESU3240
5'0',T10,'GOVERNING STAGE SECTION' / RESU3250
7' ',T12,'LEAK NO. 3 (DRAINS TO PW HEATER NO.',I3,',) , LB/HR',T65, RESU3260
3P8.0/ RESU3270
9' ',T12,'ENTHALPY LEAK NO. 3, BTU/LB',T67,P7.1/ RESU3280
1' ',T12,'LEAK NO. 4 (DRAINS TO SSR), LB/HR',T65,P8.0/ RESU3290
3' ',T12,'ENTHALPY LEAK NO. 4, BTU/LB',T67,P7.1) RESU3300
PRINT 580,LK5,QLK5,HLK5,QLK6,HLK6 RESU3310
580 FORMAT('0',T10,'HP TURBINE SECTION' / RESU3320
1' ',T12,'TOTAL LEAK NO. 5 (DRAINS TO PW HEATER NO.',I3,',) , LB/HR', RESU3330
2T65,P8.0/ RESU3340
3' ',T12,'ENTHALPY LEAK NO. 5, BTU/LB',T67,P7.1/ RESU3350
4' ',T12,'TOTAL LEAK NO. 6 (DRAINS TO SSR), LB/HR',T65,P8.0/ RESU3360
5' ',T12,'ENTHALPY LEAK NO. 6, BTU/LB',T67,P7.1) RESU3370
500 CONTINUE RESU3380
RETURN RESU3390
END RESU3400

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C      SUBROUTINE SGROUP(PB, TB, HB, SB, VB, AMB, MB, QB, NE,    PX, TX, HX, SX, VX,
1    AMX, MX, PXI, TXI, HXI, SXI, VXI, AMXI, MXI, PKLP)
      IMPLICIT REAL*8(A-H, O-Z)
C SUBPROGRAM FOR STAGE GROUP STEAM CONDITIONS
COMMON /CONV/HCON, DEBCON, AMCON, RHCON, WCON, PCON, SSRCON, XS PCON
C INITIALIZE
      TX= TSL(PX)
      SI=SPTD(PX, TX)
      SP= SPT(TX)
      HG=HPS(PX, SPTD(PX, TX))
      HP= HPT(TX)
C CORRECTION FOR NONCONDENSING TURBINE SUPERSATURATION LOSS EFFECTS
C AND TECH. DES. CONSIDERATIONS(GET-6020 PAGE 5)
      IF(PXLP.LT.3.D0) GOTO10
      CT=0.99D0
      GOTO100
10    CT=1.D0
C TEST BOWL STEAM
100 IF(MB.GT.2)GOTO200
C BOWL STEAM IS WET, OR DRY AND SATURATED
C SHELL STEAM IS WET
      AMXS=(SG-SB)/(SG-SP)
      HXS=(1.D0-AMXS)*HG+AMXS*HP
      PR=PB/PX
      VP=(1.0D+6)*VPTD(PB, TB)
      QVN=QB*VB/NE
      BE= F4(PR, PB, VP)
      CIVP=FIG5(QVN, PR, VP, PB)
      CM=1.D0-AMB*FIG7(PR, PB)
      AE=HB-HXS
      UE=AE*BE*CIVP* CM*CT
      HX=HB-UE
      GOTO510
C BOWL STEAM IS SUPERHEATED
C TEST SHELL STEAM
200 IF(SG.GT.SB)GOTO300
C SHELL STEAM IS SUPERHEATED
      TXS=TSUPS(PX, SB)
      HXS=HPS(PX, SPTD(PX, TXS))
      PR=PB/PX
      QVN=QB*VB/NE
      BE= F3(QVN, PR)
      AE=HB-HXS
      UE=AE*BE*CT
      HX=HB-UE
      GOTO530
C BOWL STEAM IS SUPERHEATED
C SHELL STEAM IS WET
C FIND UE FROM BOWL TO SATURATION LINE
300 P1=PB
      P2=PX
      D3320 IT=1,100
      PXI=(P1+P2)/2.D0
      PR=PB/PXI
      QVN=QB*VB/NE
      BE= F3(QVN, PR)
      TXSI=TSUPS(PXI, SB)
      HXSI=HPS(PXI, SPTD(PXI, TXSI))
      AEI=HB-HXSI
      UEI=AEI*BE*CT
      HXI=HB-UEI
      TXI= TSL(PXI,
      HGI=HPS(PXI, SPTD(PXI, TXI))
C TEST HXI
      ADH=DABS(HGI-HXI)
      IF(ADH.LE.HCON)GOTO370

```

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SGRO
SGRO 10
SGRO 20
SGRO 30
SGRO 40
SGRO 50
SGRO 60
SGRO 70
SGRO 80
SGRO 90
SGRO 100
SGRO 110
SGRO 120
SGRO 130
SGRO 140
SGRO 150
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SGRO 570
SGRO 580
SGRO 590
SGRO 600
SGRO 610
SGRO 620
SGRO 630
SGRO 640
SGRO 650
SGRO 660

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C RE-SET P1 OR P2	SGRO 670
IF (HGT.LT.HXI) GOTO 310	SGRO 680
P2=PXI	SGRO 690
GOTO 320	SGRO 700
310 P1=PXI	SGRO 710
320 CONTINUE	SGRO 720
PRINT 321,ADH	SGRO 730
321 FORMAT('0-SUBROUTINE SGROUP-SATURATION LINE ENTHALPY DID NOT CONVE	SGRO 740
ERGE, ADH =',1PD14.6)	SGRO 750
370 IF (PX.LT. (PXI-0.1D0)) GOTO 380	SGRO 760
UE=UXI	SGRO 770
HX=HXI	SGRO 780
IF (HX.GT.HG) GOTO 530	SGRO 790
GOTO 520	SGRO 800
C FIND STEAM CONDITIONS AT SATURATION LINE	SGRO 810
380 HXI=2	SGRO 820
AMXI=0.0D0	SGRO 830
SXI=SPTD(PXI,TXI)	SGRO 840
VXI=VPTD(PXI,TXI)	SGRO 850
C FIND UE FROM SATURATION LINE TO SHELL	SGRO 860
PR=PXI/PX	SGRO 870
VF=(3.0D+6)*VXI	SGRO 880
QVN=QB*VXI/NE	SGRO 890
BE= F4 (PR,PXI,VF)	SGRO 900
CIVF=FIG5(QVN,PR,VF,PXI)	SGRO 910
AMXS=(SG-SXI)/(SG-SF)	SGRO 920
HXS=(1.0-AMXS)*HG+AMXS*HF	SGRO 930
AEIX=HXI-HXS	SGRO 940
UEIX=AEIX*BE+CIVF*CT	SGRO 950
HX=HXI-UEIX	SGRO 960
UE=HB-HX	SGRO 970
C FIND SHELL STEAM CONDITIONS	SGRO 980
C WBT	SGRO 990
510 HX=1	SGRO 1000
AMX=(HG-HX)/(HG-HF)	SGRO 1010
SX=(1.0D-AMX)*SG+AMX*SF	SGRO 1020
VX=(1.0D-AMX)*VPTD(PX,TX)+AMX* VFT(TX)	SGRO 1030
RETURN	SGRO 1040
C DRY AND SATURATED	SGRO 1050
520 HX=2	SGRO 1060
AMX=0.0D0	SGRO 1070
SX=SG	SGRO 1080
VX=VPTD(PX,TX)	SGRO 1090
RETURN	SGRO 1100
C SUPERHEATED	SGRO 1110
530 HX=3	SGRO 1120
AMX=0.0D0	SGRO 1130
TX=TSUPH(PX,HX)	SGRO 1140
SX=SPTD(PX,TX)	SGRO 1150
VX=VPTD(PX,TX)	SGRO 1160
RETURN	SGRO 1170
END	SGRO 1180

		SLK 1
	SUBROUTINE SLEAK1(NP,PSH,QT,PT,HT,LK1,QLK1,HLK1,OLK2,HLK2,NPGS)	SLK 1 10
	IMPLICIT REAL*8(A-H,O-Z)	SLK 1 20
		SLK 1 30
	SUBPROGRAM FOR VALVE STEM PACKING LEAKAGES	SLK 1 40
	TABLE II, P. 12, GER-2454A	SLK 1 50
		SLK 1 60
	DIMENSION PSH(12)	SLK 1 70
	COMMON /Z/ TFR,SLOPE,QTKEEP,PKEEP,QGKEEP,PGKEEP,VGKEEP,GCKEEP,DUMESLK 1 80	
		SLK 1 90
100	LK1=0	SLK 1 100
	IF(TFR.GE.1.0D0) QLK12=0.001*QT	SLK 1 110
	IF(TFR.LT.1.0D0) QLK12=-.001*QTKEEP	SLK 1 120
	IF(PT.GE.30D.0) GOTO 110	SLK 1 130
	QLK1=0.	SLK 1 140
	HLK1=0.	SLK 1 150
	OLK2=QLK12	SLK 1 160
	HLK2=HT	SLK 1 170
	RETURN	SLK 1 180
110	IF(NP.EQ.NPGS) GOTO 130	SLK 1 190
	I=NPGS+1	SLK 1 200
	DO 120 IL=I,NP	SLK 1 210
	IF(PSH(IL).GT.250.0) GOTO 120	SLK 1 220
	LK1=IL	SLK 1 230
	PLK1=PSH(IL)	SLK 1 240
	GOTO 140	SLK 1 250
120	CONTINUE	SLK 1 260
130	PLK1=200.	SLK 1 270
140	QLK2=QLK12*PLK1/PT	SLK 1 280
	OLK1=QLK12-QLK2	SLK 1 290
	HLK1=HT	SLK 1 300
	HLK2=HT	SLK 1 310
	RETURN	SLK 1 320
	END	SLK 1 330

		SLK 2
	SUBROUTINE SLEAK2(NP,PSH,NGS,IRGS,FXGS,VXGS,HXGS,LK3,QLK3,HLK3,	SLK 2 10
	1 QLK4,HLK4,PSSR,NPGS)	SLK 2 20
	IMPLICIT REAL*8(A-H,O-Z)	SLK 2 30
		SLK 2 40
	SUBPROGRAM FOR TURBINE SHAFT PACKING LEAKAGES (BOWL END)	SLK 2 50
	TABLE II, P. 14, GER-6020	SLK 2 60
		SLK 2 70
	DIMENSION PSH(12)	SLK 2 80
		SLK 2 90
200	LK3=0	SLK 2 100
	IF(PXGS.GT.PSSR) GOTO 211	SLK 2 110
210	QLK3=0.	SLK 2 120
	QLK4=0.	SLK 2 130
	HLK3=0.	SLK 2 140
	HLK4=0.	SLK 2 150
	RETURN	SLK 2 160
211	IF(NGS.EQ.2) GO TO 210	SLK 2 170
	C34=800.	SLK 2 180
	C4=1200.	SLK 2 190
240	IF(PXGS.GE.150.0) GOTO 250	SLK 2 200
	QLK3=0.	SLK 2 210
	HLK3=0.	SLK 2 220
	QLK4=C4*DSQRT(PXGS/VXGS)	SLK 2 230
	HLK4=HXGS	SLK 2 240
	RETURN	SLK 2 250
250	IF(NP.EQ.NPGS) GOTO 270	SLK 2 260
	I=NPGS+1	SLK 2 270
	DO 260 IL=I,NP	SLK 2 280
	IF(PSH(IL).GT.250.0) GOTO 260	SLK 2 290
	LK3=IL	SLK 2 300

PLK3=PSH(IL)	SLK 2 310
GOTO280	SLK 2 320
260 CONTINUE	SLK 2 330
270 PLK3=100.	SLK 2 340
280 HLK3=HXGS	SLK 2 350
CALL PROPPH(AM,S,VLK3,T,H,PLK3,HLK3)	SLK 2 360
QLK34=C34*DSQRT(PXGS/VXGS)	SLK 2 370
QLK4=C4*DSQRT(PLK3/VLK3)	SLK 2 380
QLK3=QLK34-QLK4	SLK 2 390
HLK4=HXGS	SLK 2 400
RETURN	SLK 2 410
END	SLK 2 420

C	SUBROUTINE SLEAK3(NP,PSH,NHP,IRHP,PXHP,VXHP,HXHP,LK5,QLK5,HLK5,	SLK 3
	1QLK6,HLK6,PSSR)	SLK 3 10
	IMPLICIT REAL*8(A-H,O-Z)	SLK 3 20
	COMMON /HIS/CHTS(18), TC,TFP,TR,HR,WRATE,GC,HNL,WGL,QMU,QFP,	SLK 3 30
	+DP,WGEN,WFPW,HRTW,HRTG,CEFFW,CEFFG,PC	SLK 3 40
C		SLK 3 50
C	SUBPROGRAM FOR TURBINE SHAFT LEAKAGES (EXHAUST END)	SLK 3 60
C	TABLE II, P. 12, GER-2454A	SLK 3 70
C		SLK 3 80
C	DIMENSION PSH(12)	SLK 3 90
C		SLK 3 100
300	LK5=0	SLK 3 110
	IF (PXHP.GT.PSSR) GOTO305	SLK 3 120
	QLK5=0.	SLK 3 130
	QLK6=0.	SLK 3 140
	HLK5=0.	SLK 3 150
	HLK6=0.	SLK 3 160
	RETURN	SLK 3 170
305	IF (NHP.EQ.2) GO TO 320	SLK 3 180
310	NE1=1	SLK 3 190
	NE2=NHP-1	SLK 3 200
	GOTO330	SLK 3 210
320	NE1=0	SLK 3 220
	NE2=NHP	SLK 3 230
330	IF (WRATE.GE.1300) GO TO 340	SLK 3 240
	C56=NE1*500. + NE2*750.	SLK 3 250
	C6=NE1*700. + NE2*1000.	SLK 3 260
	GO TO 350	SLK 3 270
340	C56= NE1*500. + NE2*1150.	SLK 3 280
	C6=NE1*700. + NE2*1500.	SLK 3 290
350	IF (PXHP.GE.150.0) GOTO360	SLK 3 300
	QLK5=0.	SLK 3 310
	HLK5=0.	SLK 3 320
	QLK6=C6*DSQRT(PXHP/VXHP)	SLK 3 330
	HLK6=HXHP	SLK 3 340
	RETURN	SLK 3 350
360	IF (NP.EQ.0) GOTO380	SLK 3 360
	DO370 IL=1,NP	SLK 3 370
	IF (PSH(IL).GT.150.0) GOTO370	SLK 3 380
	LK5=IL	SLK 3 390
	PLK5=PSH(IL)	SLK 3 400
	GOTO390	SLK 3 410
370	CONTINUE	SLK 3 420
380	PLK5=100.	SLK 3 430
390	HLK5=HXHP	SLK 3 440
	CALL PROPPH(AM,S,VLK5,T,H,PLK5,HLK5)	SLK 3 450
	QLK56=C56*DSQRT(PXHP/VXHP)	SLK 3 460
	QLK6=C6*DSQRT(PLK5/VLK5)	SLK 3 470
	QLK5=QLK56-QLK6	SLK 3 480
	HLK6=HXHP	SLK 3 490
	RETURN	SLK 3 500
	END	SLK 3 510
		SLK 3 520

C	SUBROUTINE SSRE(PSH,HT,PXLP, NP)	SSRE 10
	IMPLICIT REAL*8 (A-H,O-Z)	SSRE 20
C		SSRE 30
C	SUBPROGRAM FOR STEAM SEAL REGULATOR ENTHALPY	SSRE 40
C		SSRE 50
	DIMENSION PSH(12)	SSRE 60
C		SSRE 70
	COMMON /LEAK/QLK1,HLK1,QLK2,HLK2,QLK3,HLK3,QLK4,HLK4,QLK5,HLK5,	SSRE 80
	1QLK6,HLK6,QLK7,HLK7,QLK8,HLK8,QLK9,HLK9,QLK10,HLK10,LK,LK1,LK3,	SSRE 90
	2LK5,LK7,LK9	SSRE 100
	COMMON /SSR/QSP,E,QMC,QSSR,HSSR,PSSR,QFHH,QSSRMU,HSSRMU	SSRE 110
C		SSRE 120
	QSSR=QLK2+QLK4	SSRE 130
	HSUM=QLK2*HLK2+QLK4*HLK4	SSRE 140
	QSSR=QSSR+QLK6	SSRE 150
	HSUM=HSUM+QLK6*HLK6	SSRE 160
	HSSR=HSUM/QSSR	SSRE 170
	Q=QMC+QSP	SSRE 180
	IF (QSSR.GT.Q) GOTO 110	SSRE 190
	QFHH=0.	SSRE 200
	QSSRMU=Q-QSSR	SSRE 210
	QSSR=Q	SSRE 220
	HSSRMU=HT	SSRE 230
	HSUM=HSUM+QSSRMU*HSSRMU	SSRE 240
	HSSR=HSUM/QSSR	SSRE 250
	GOTO 140	SSRE 260
110	QSSRMU=0.	SSRE 270
	HSSRMU=0.	SSRE 280
	IF (NP.GT.0) GOTO 130	SSRE 290
120	QFHH=0.	SSRE 300
	QMC=QSSR-QSP	SSRE 310
	GOTO 140	SSRE 320
130	IF (PSSR.LE.PSH(NP)) GOTO 120	SSRE 330
	QFHH=QSSR-Q	SSRE 340
140	IF (PXLP.LE.14.696) GOTO 150	SSRE 350
	QMC=QSSR	SSRE 360
	QFHH=0.	SSRE 370
	QSP=0.	SSRE 380
150	RETURN	SSRE 390
	END	SSRE 400

C		STER 10
	SUBROUTINE STER	STER 20
	X=1./0.	STER 30
	RETURN	STER 40
	END	

C	SUBROUTINE STRATE(PXGS,H1,S1,H2,S2,HXGS, SXGS)	STRA	
	IMPLICIT REAL*8(A-H,O-Z)	STRA	10
	NAMelist/NAME1/HGUESS, HCHECK, I	STRA	20
	I=0	STRA	30
	XNNM=(H1-H2)/(S1-S2)	STRA	40
	BBB=H1-S1*XNNM	STRA	50
	HGUESS=(H1+H2)/2.	STRA	60
30	SGUESS=(HGUESS-BBB)/XNNM	STRA	70
	CALL PROPPS(A,HCHECK,T,V,H,PXGS,SGUESS)	STRA	80
	IF(DABS(HCHECK-HGUESS).LT.1.0D-3)GO TO 60	STRA	90
	HGUESS=(HGUESS+HCHECK)/2.	STRA	100
	I = I + 1	STRA	110
	IF(I.GT.50) GO TO 70	STRA	120
	GO TO 30	STRA	130
50	SXGS=SGUESS	STRA	140
	HXGS=HGUESS	STRA	150
	GO TO 80	STRA	160
70	WRITE(6,NAME1)	STRA	170
80	RETURN	STRA	180
	END	STRA	190
		STRA	200

C	SUBROUTINE UNIPOL(A,X,Z,I)	UNIP	
C A	ARRAY OF POLYNOMIAL COEFS.	UNIP	10
C X	INDEP. VARIABLE	UNIP	20
C Z	DEPENDENT VARIABLE	UNIP	30
C I	DEGREE OF POLYNOMIAL	UNIP	40
	IMPLICIT REAL*8(A-H,O-Z)	UNIP	50
	DIMENSION A(10)	UNIP	60
	Z = 0.0	UNIP	70
	I1 = I + 2	UNIP	80
	DO 1 N=1,I	UNIP	90
	Z = Z*X	UNIP	100
1	Z = Z + A(I1-N)	UNIP	110
	Z = Z*X + A(1)	UNIP	120
	RETURN	UNIP	130
	END	UNIP	140
		UNIP	150

C	SUBROUTINE KLOSS(PA,FX,HEP,HX,QA,ANEP,ANX,HE,BL,PD,IRL,UKEP,XL2)	XLOS	
	IMPLICIT REAL*8(A-H,O-Z)	XLOS	10
C SUBPROGRAM FOR LP CONDENSING TURBINE UKEP		XLOS	20
	FIG14(XHOIST)=-.87D0*(1.D0-.01D0*XHOIST)*(1.D0-.65D-2*XHOIST)	XLOS	30
	DATA CPSI/2.03602234D0/	XLOS	40
	DATA PI/3.141592654D0/	XLOS	50
	PI=PA*CPSI	XLOS	60
	AAH = PI * PD * BL / 144.D0	XLOS	70
	VP=VPTD(PA,FX)	XLOS	80
	VAN = QA * VP * (1.0D0 - ANX) / (3600.D0 * AAH * HE)	XLOS	90
	IF(VAN.GT.1400.D0) GO TO 10	XLOS	100
	XL=F16(VAN,BL)	XLOS	110
	ANF2=FIG14(ANX*100.D0)	XLOS	120
	XL2=XL*ANF2	XLOS	130
	UKEP=HX*XL2	XLOS	140
	RETURN	XLOS	150
		XLOS	160

10	PP=PX*VAN/1302.00	XLOS 170
	AMF1=FIG14(AMEP*100.)	XLJS 180
	DO 21 IT=1,50	XLOS 190
20	DEP=FIG15(PP)	XLOS 200
	HPP=HEP*DEP*AMF1	XLJS 210
	P=PP/CPSI	XLOS 220
	TPP= TSL(P)	XLOS 230
	VPP=VPTD(P,TPP)	XLJS 240
	HGPP=HPS(P,SPTD(P,TPP))	XLOS 250
	AMPP=(HGPP-HPP)/(HGPP- HPT(TPP))	XLOS 260
	VPAN = QA * VPP * (1.00-AMPP)/(3600.00 * AAN * NE)	XLJS 270
	IF (VPAN.LZ.1400.00) GO TO 30	XLOS 280
	PP=PP+VPAN/1302.0	XLOS 290
21	CONTINUE	XLJS 300
	WRITE(6,22) VPAN	XLOS 310
22	FORMAT('0-SUBROUTINE XLOSS-VPAN DID NOT CONVERGE, VPAN =',1PD14.6)	XLOS 320
30	XL=F16(VPAN,BL)	XLJS 330
	AMPP=FIG14(AMPP*100.00)	XLOS 340
	XL2=XL*AMPP	XLOS 350
	UEEP=HPP+XL2	XLJS 360
	RETURN	XLJS 370
	END	XLOS 380

C	SUBROUTINE XSEP	XSEP 10
	IMPLICIT REAL*8(A-H,O-Z)	XSEP 20
	COMMON /XS1/PSX,PSI	XSEP 30
	COMMON /XS2/HPSX,QNR	XSEP 40
	COMMON /XS3/QSI,HSI,TSX,QSX,NSX,ANSX,ENS,MS	XSEP 50
C		XSEP 60
C	SUBPROGRAM FOR EXTERNAL MOISTURE SEPARATOR CALCULATIONS	XSEP 70
C		XSEP 80
C	FMR FRACTION MOISTURE REMOVED	XSEP 90
C	ENS MOISTURE SEPARATION EFFECTIVENESS, PERCENT	XSEP 100
C	INLET: QSI, PSI, HSI	XSEP 110
C	OUTLET BEFORE MOIST. REM.: HSYB, PSX, QSI, TSX, ANSYB	XSEP 120
C	OUTLET AFTER MOIST. REM.: NSX, PSX, QSX, TSX, ANSX	XSEP 130
C	SAT. LIQ.: QNR, HPSX	XSEP 140
C	SAT. VAP.: HGSX	XSEP 150
C	STEAM CONDITIONS AT MOISTURE SEPARATOR OUTLET BEFORE SEPARATION	XSEP 160
	HSYB=HSI	XSEP 170
	TSX= TSL(PSX)	XSEP 180
	HPSX= HPT(TSX)	XSEP 190
	HGSX=HPS(PSX,SPTD(PSX,TSX))	XSEP 200
	ANSXB=(HGSX-HSYB)/(HGSX-HPSX)	XSEP 210
C	MOISTURE REMOVAL	XSEP 220
	FMR=ENS*ANSXB*0.0100	XSEP 230
	QNR=FMR*QSI	XSEP 240
	QSX=QSI-QNR	XSEP 250
C	STEAM CONDITIONS AT MOISTURE SEPARATOR OUTLET AFTER SEPARATION	XSEP 260
	ANSX=(ANSXB-FMR)/(1.000-FMR)	XSEP 270
	NSX=(HSYB-FMR*HPSX)/(1.000-FMR)	XSEP 280
	RETURN	XSEP 290
	END	XSEP 300

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