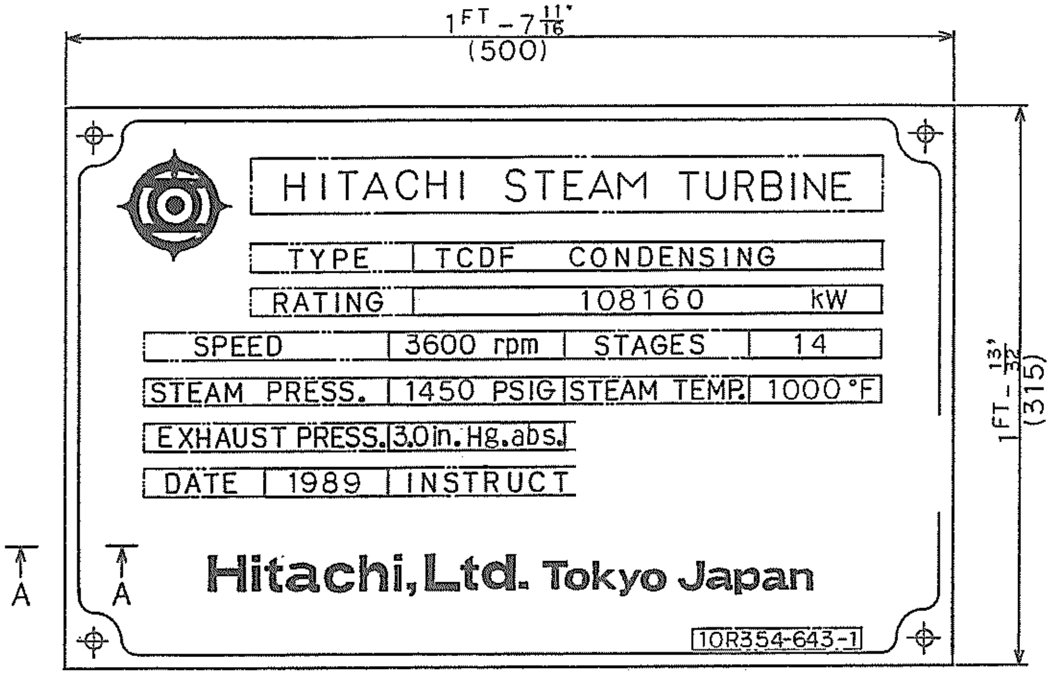
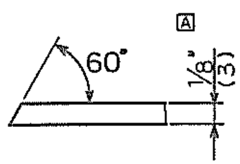




SECTION A A (SCALE 2/1)

SYM.	DWG ZONE	REVISIONS	DATE	REVD.	CHKD.	RE. DWG	MTR	RE. MF.
A	C-1	ADDED DIMENSION 1/8".	88.09.30	A. Suzuki	Y. Kikuchi			

NOTE

1. THE OUTER FRAME AND FIGURES WILL BE COLORED IN BLACK.
2. MATERIAL — STAINLESS STEEL (CODE: JIS SUS304-HP)
3. 10R354-643-1 IN THIS DRAWING IS WORKING DRAWING No..

FINAL DRAWING

Hitachi,Ltd.
88-10-06
HITACHI WORKS

DWN.	A. Suzuki	88.07.11	THIRD ANG. PROJ.	
CHKD.	A. Suzuki	88.07.11		SCALE 1/2
CHKD.	Y. Kikuchi	88.07.12		
APPD.	K. Kurihara	88.07.12		

TITLE: NAME PLATE OF STEAM TURBINE

Hitachi,Ltd. Tokyo Japan

HITACHI WORKS DWG. NO. 10R354-642 REVD. A

S A H a

5 221350 (A2 DWG. PAPER)

TURBINE DESIGN DATA

Hitachi manufacturing No. ----------

Hitachi Turbine No. ----------

Technical Specifications :

Type ----------	SC-26 (Hitachi impulse type, tandem compound single extraction, single flow exhaust condensing turbine, indoor use)
Normal rating ----------	108,160 kW (at no process)
Speed ----------	3,600 rpm
Direction of rotation ----------	Counter-clockwise when viewed from turbine front
Rated inlet steam pressure -------	1,450 psig (101.9 kg/cm^2.g)
Rated inlet steam temperature -----	1,000°F (538°C)
Rated extraction steam pressure at turbine flange ---------	460 psig (32.3 kg/cm^2.g)
Exhaust steam pressure ----------	3.0 in. Hg abs. (76.2 mm Hg abs.)
Number of stages ----------	14 (H.P. : 3, I.P. : 7, L.P. : 4)
Number of extraction ;	
Uncontrolled ----------	Four (6th, 8th, 10th and 12th stage shell)
Controlled ----------	One (1) (3rd stage shell)
Length of last stage bucket -----	26 in. (663.6 mm)
Type of rotor ----------	Solid-forged
Method of coupling ----------	Rigid (bolts-coupled)

Technical Specifications (Cont'd) :

Critical speeds of turbine-generator combined rotor;

	Critical speeds (rpm)	Mode
First	1,624	Generator rotor (1st)
Second	2,049	Turbine rotor (1st)
Third	4,266	Generator rotor (2nd)

Frequency range of safely continuous operation ---------- 58.5 - 60.5 Hz

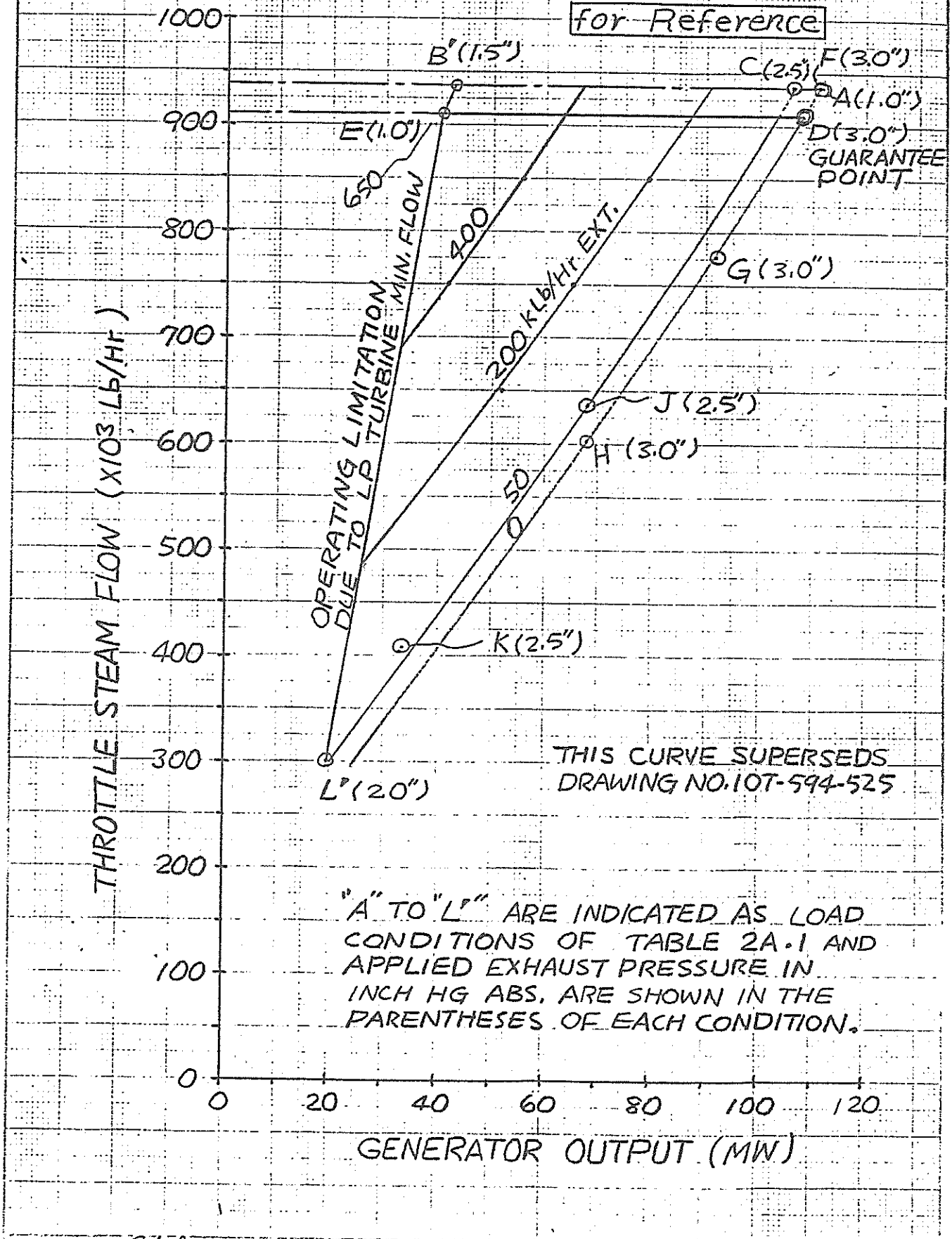
Definition of shaft-vibration amplitude level on normal operation (peak to peak : mils)

Very good ----------	Less than 1.5
Normal ----------	Less than 2.0
Acceptable ----------	Less than 3.5
Rebalance or acceptable until corrective action can be taken ----------	Less than 5.0
Tolerance for short time ---	Less than 6.0
Immediately stop ----------	7.5 or over 6.0 in case of rapid increase

Rev. A: Revised point B, D and E (89.03.15) A.Ito

TURBINE PERFORMANCE CURVES

for Reference



Y. Ohmura 88.07.12
K.C. 88.07.15
Y. Ito 88.07.18

TURBINE PERFORMANCE CURVES

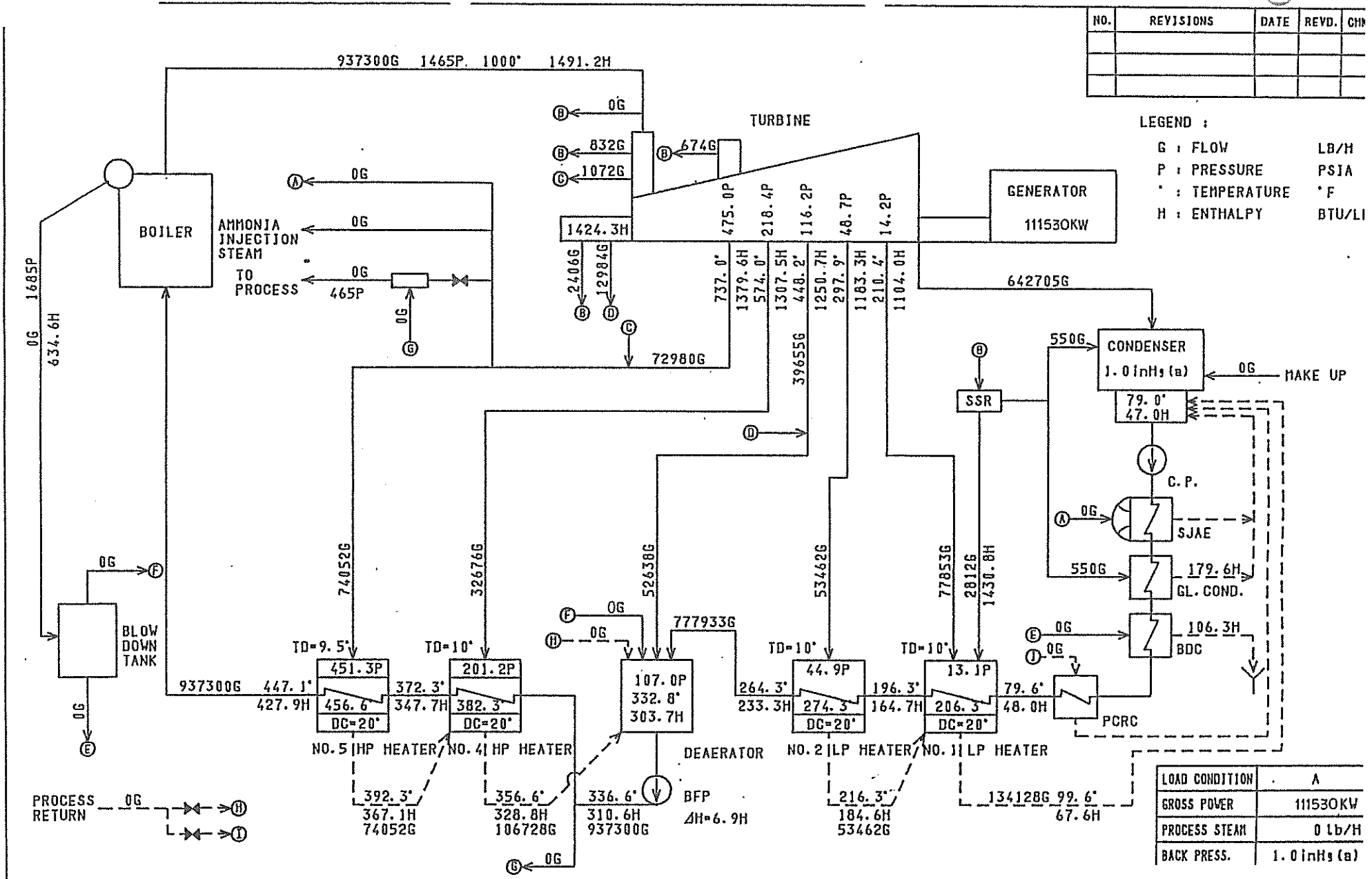
NO.	REVISIONS	DATE	REVD.	CHKD.
A	REVISED LOAD CONDITIONS B, D, E, K AND L	88-12-14		

PERFORMANCE SUMMARY TABLE

LOAD CONDITION	NET TURBINE CAPABILITY AT	THROTTLE STEAM CONDITION (psia/°F)	THROTTLE STEAM FLOW (lb/h)	EXHAUST PRESSURE (in.Hg abs)	BOILER BLOWDOWN (%)	PROCESS STEAM FLOW (lb/h)	SJAE STEAM FLOW (lb/h)	NH3 INJECTION STEAM FLOW (lb/h)	GENERATOR OUTPUT (KW)	GROSS HEAT RATE (Btu/kWH)	HEAT BALANCE DRAWING No.
A	MAX. CALCULATED (V.W.O.)	1450/1000	937300	1.0	0.0	0	0	0	111530	8936	
B	MAX. EXTRACTION (V.W.O.)	1450/1000	937300	1.5	1.0	650000	500	650	42740	23492	
C	EXPECTED OPERATION (V.W.O.)	1450/1000	937300	2.5	1.0	50000	500	650	106750	9354	
D	GUARANTEED UNIT CAPABILITY	1450/1000	910000*	3.0	1.0	0	500	650	108130*	8966*	
E	GUARANTEED EXTRACTION CAPABILITY	1450/1000	910000*	1.0	1.0	650000*	500	650	40210	24243	
F	FIRST VALVE POINT	1450/1000	937300	3.0	1.0	0	500	650	111410	8963	
G	SECOND VALVE POINT	1450/1000	776000	3.0	1.0	0	500	650	91690	9017	
H	THIRD VALVE POINT	1450/1000	602000	3.0	1.0	0	500	650	67970	9436	
J	EXPECTED 70% OPERATING	1450/1000	637000	2.5	1.0	50000	500	650	68000	9980	
K	EXPECTED 45% OPERATING	1450/950	409500	2.5	1.0	50000	500	650	33460	12671	
L	EXPECTED 33% OPERATING	1450/925	300000	2.0	1.0	50000	500	650	19820	15441	

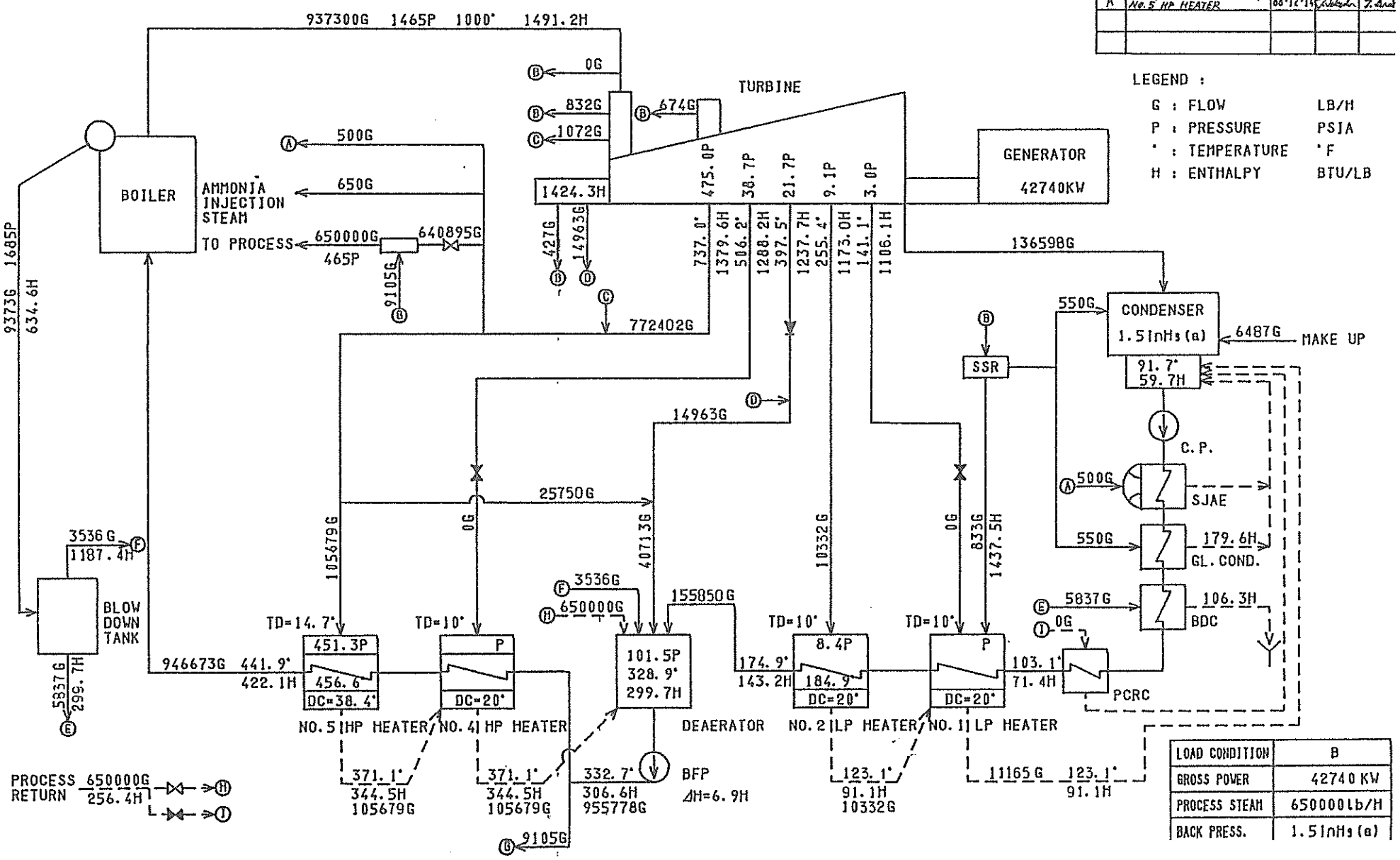
* : GUARANTEED VALUES

DWN.	Y. TAKEDA	88-08-20	TITLE	Hitachi, Ltd. Tokyo Japan
CHKD.	S. HOIZUMI	88-08-20	PERFORMANCE SUMMARY TABLE	
APPD.	Y. HORIKAWA	88-08-20		



$$\text{HEAT RATE (GROSS)} = \frac{937300(1491.2-427.9)}{111530} = 8936 \text{ Btu/kWH}$$

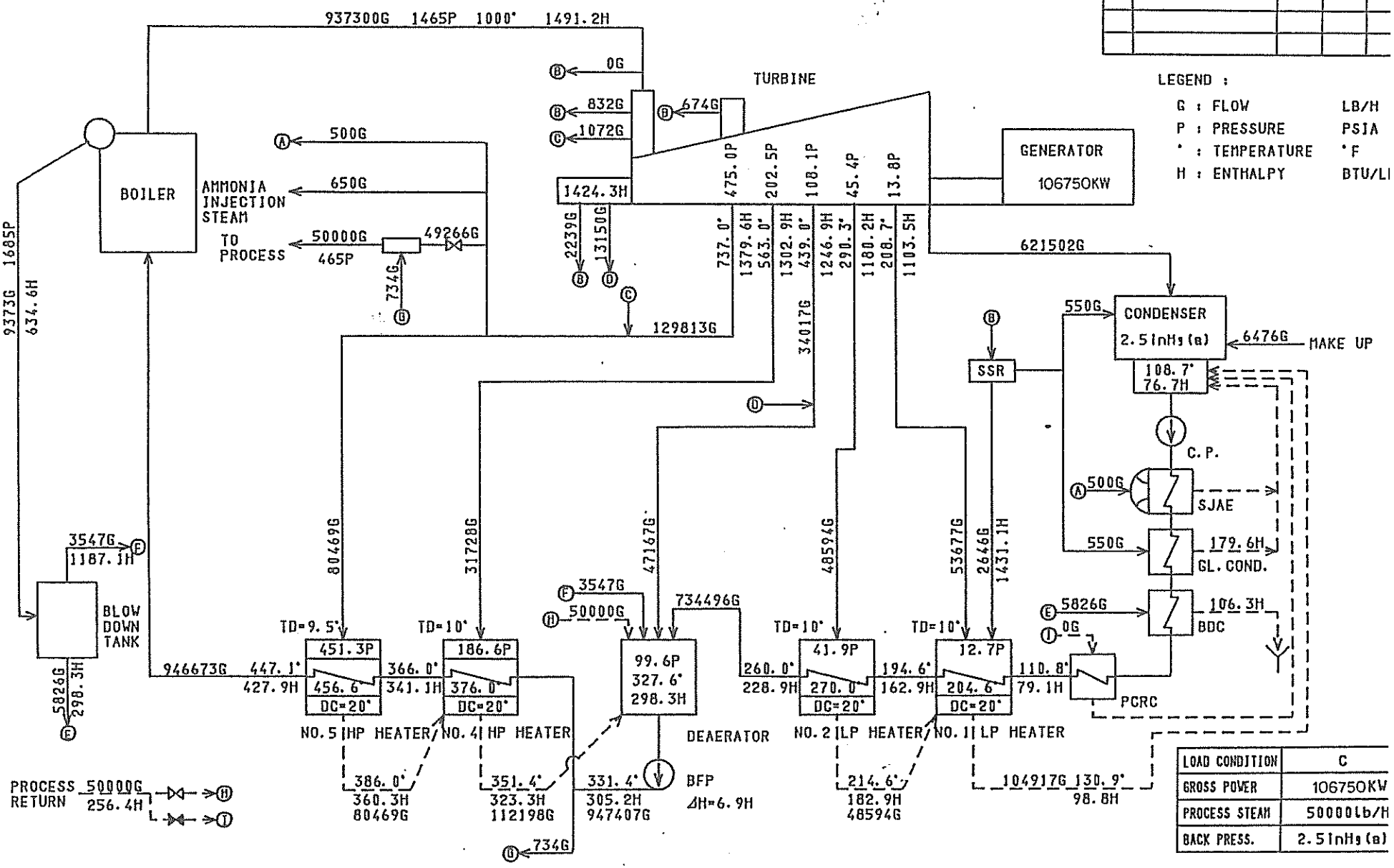
NO.	REVISIONS	DATE	REVD.	CHKD
A	REVISED TD AND DC OF No.5 HP HEATER	88-12-14		



LOAD CONDITION	B
GROSS POWER	42740 KW
PROCESS STEAM	650000Lb/H
BACK PRESS.	1.5InHg(a)

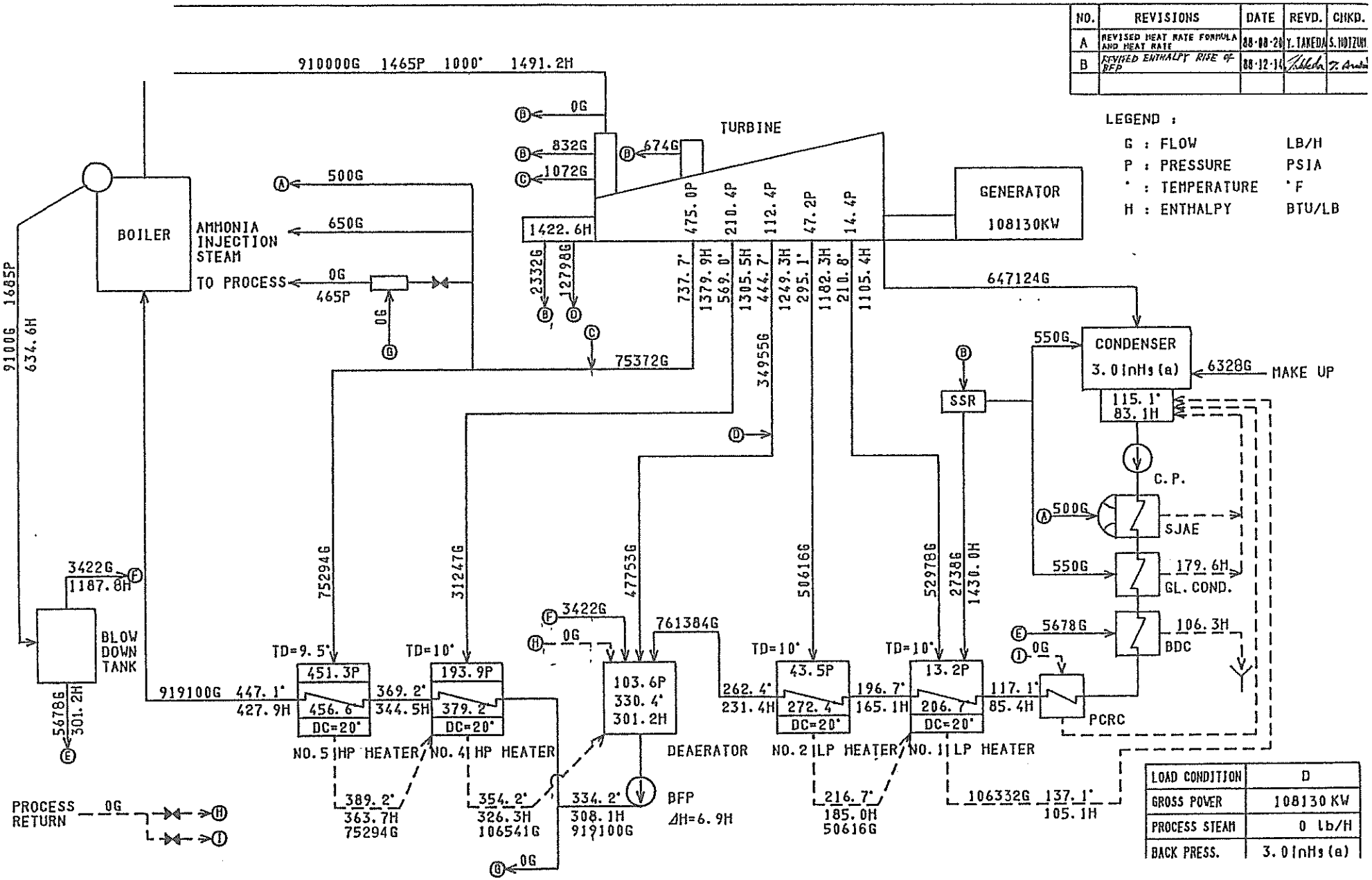
$$\text{HEAT RATE} = \frac{946673(634.6-422.1)+937300(1491.2-634.6)}{42740} = 23492 \text{ Btu/kWH}$$

NO.	REVISIONS	DATE	REVD.	CHK



LOAD CONDITION	C
GROSS POWER	106750KW
PROCESS STEAM	50000Lb/H
BACK PRESS.	2.5 InHg (a)

$$\text{HEAT RATE (GROSS)} = \frac{946673(634.6-427.9)+937300(1491.2-634.6)}{106750} = 9354 \text{ Btu/kWH}$$



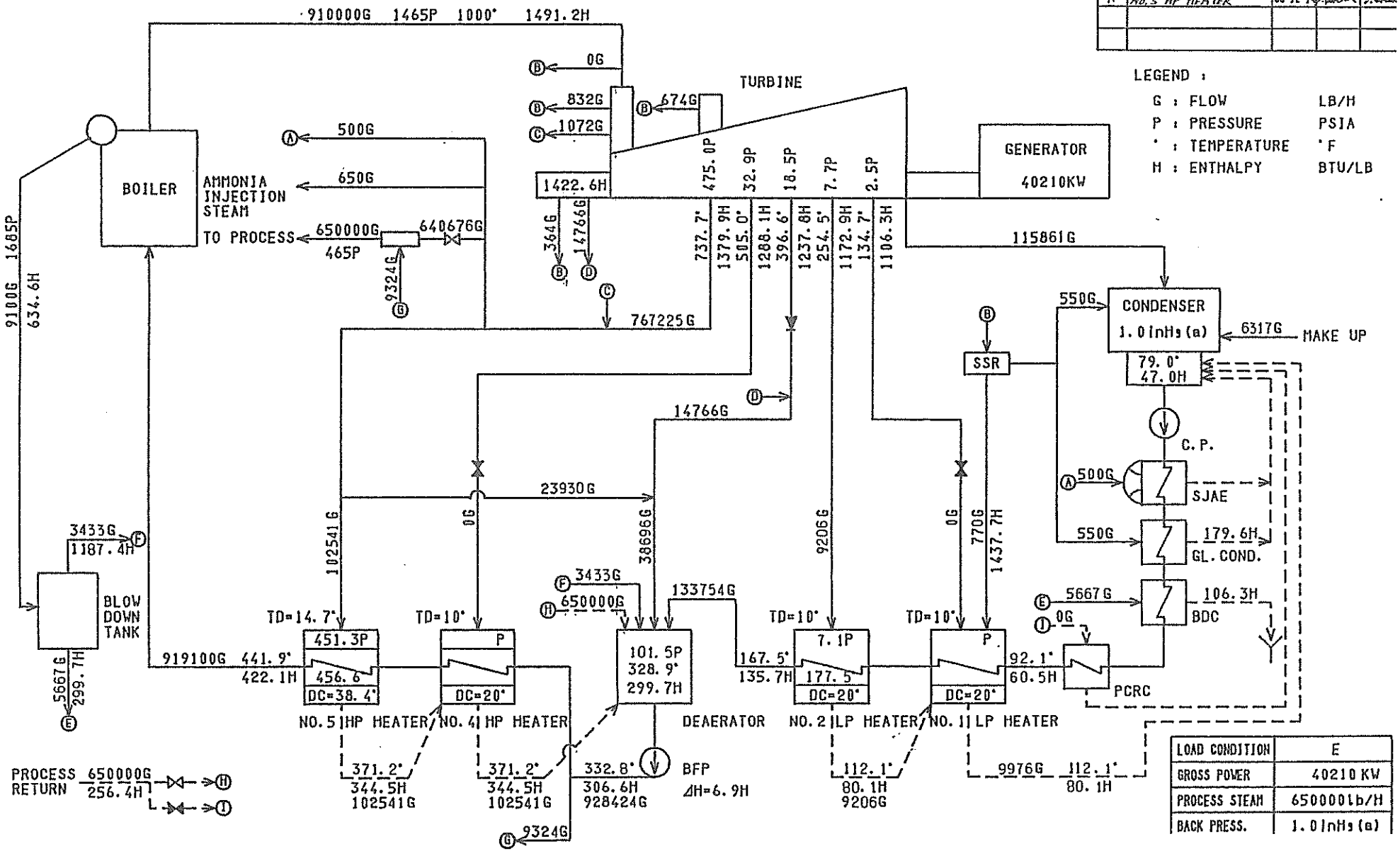
NO.	REVISIONS	DATE	REVD.	CHKD.
A	REVISED HEAT RATE FORMULA AND HEAT RATE	88-08-26	Y. TAKEDA	S. HOTZUMI
B	REVISED ENTHALPY RISE OF BFP	88-12-14		

LEGEND :

G	: FLOW	LB/H
P	: PRESSURE	PSIA
°	: TEMPERATURE	°F
H	: ENTHALPY	BTU/LB

$$\text{HEAT RATE} = \frac{919100(634.6-427.9)+910000(1491.2-634.6)}{108130} = 8966 \text{ Btu/kWH}$$

NO.	REVISIONS	DATE	REVD.	CHKD
A	REVISED TD AND DC OF No.5 HP HEATER	88-12-14		

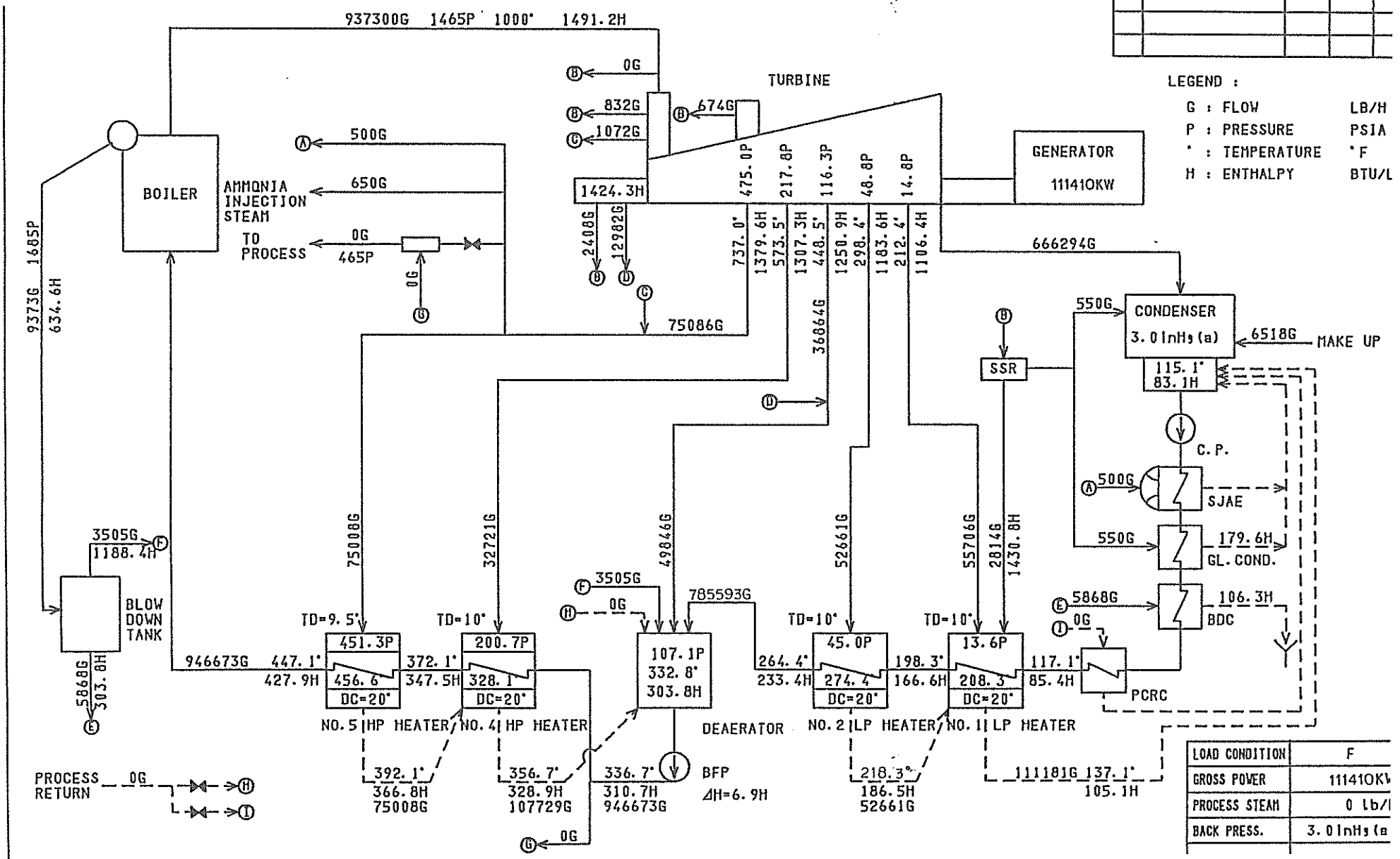


LEGEND :

G	: FLOW	LB/H
P	: PRESSURE	PSIA
°	: TEMPERATURE	°F
H	: ENTHALPY	BTU/LB

$$\text{HEAT RATE} = \frac{919100(634.6-422.1)+910000(1491.2-634.6)}{40210} = 24243 \text{ Btu/kWH}$$

NO.	REVISIONS	DATE	REVD.	CH



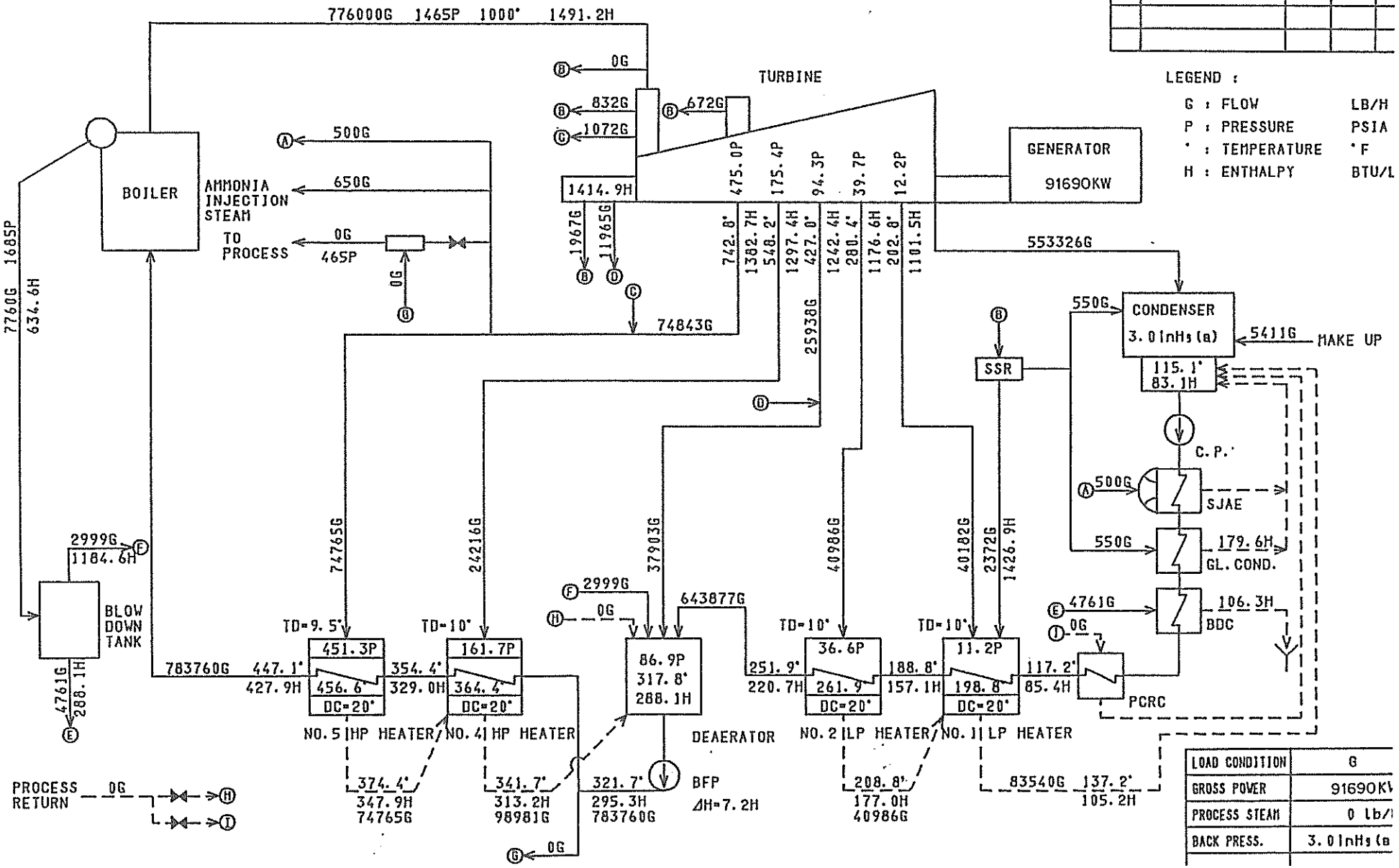
LEGEND :

G	: FLOW	LB/H
P	: PRESSURE	PSIA
°	: TEMPERATURE	°F
H	: ENTHALPY	BTU/L

LOAD CONDITION	F
GROSS POWER	11141OKW
PROCESS STEAM	0 lb/l
BACK PRESS.	3.0InHg(a

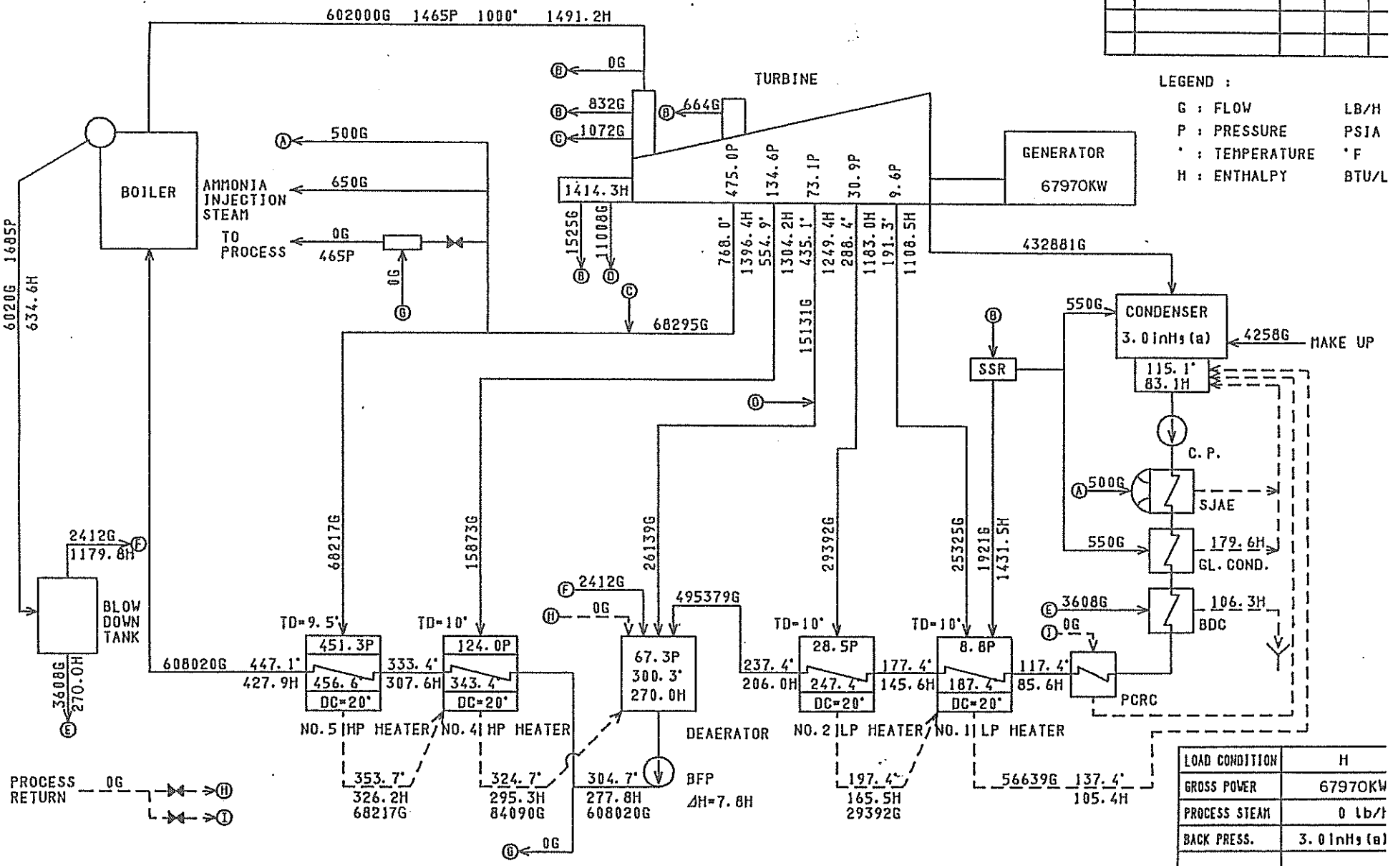
$$\text{HEAT RATE (GROSS)} = \frac{946673(634.6-427.9)+937300(1491.2-634.6)}{111410} = 8963 \text{ Btu/kWH}$$

NO.	REVISIONS	DATE	REVD.	CH

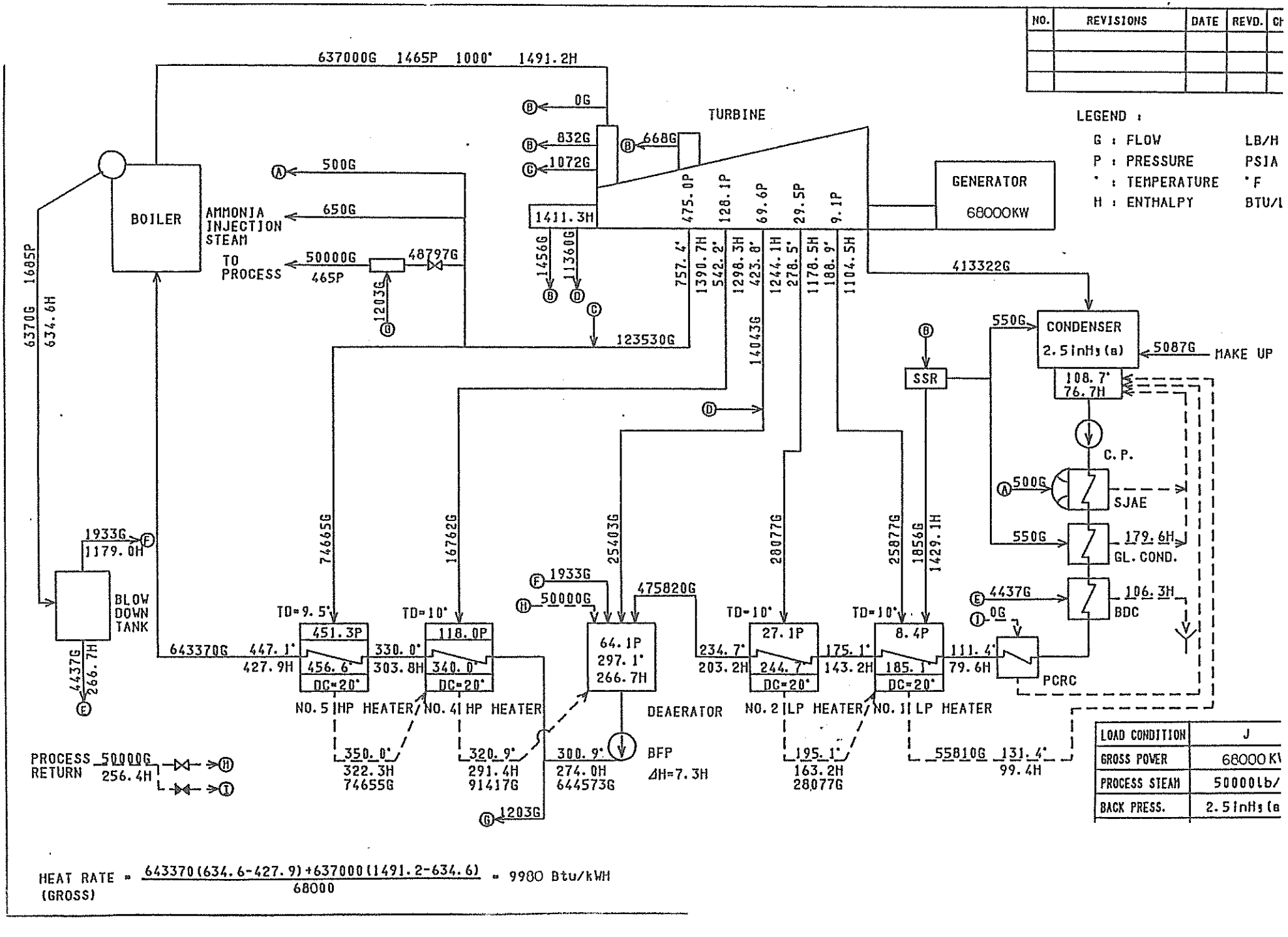


$$\text{HEAT RATE (GROSS)} = \frac{783760(634.6-427.9)+776000(1491.2-634.6)}{91690} = 9017 \text{ Btu/kWH}$$

NO.	REVISIONS	DATE	REVD.	CH



$$\text{HEAT RATE (GROSS)} = \frac{608020(634.6-427.9)+602000(1491.2-634.6)}{67970} = 9436 \text{ Btu/kWH}$$

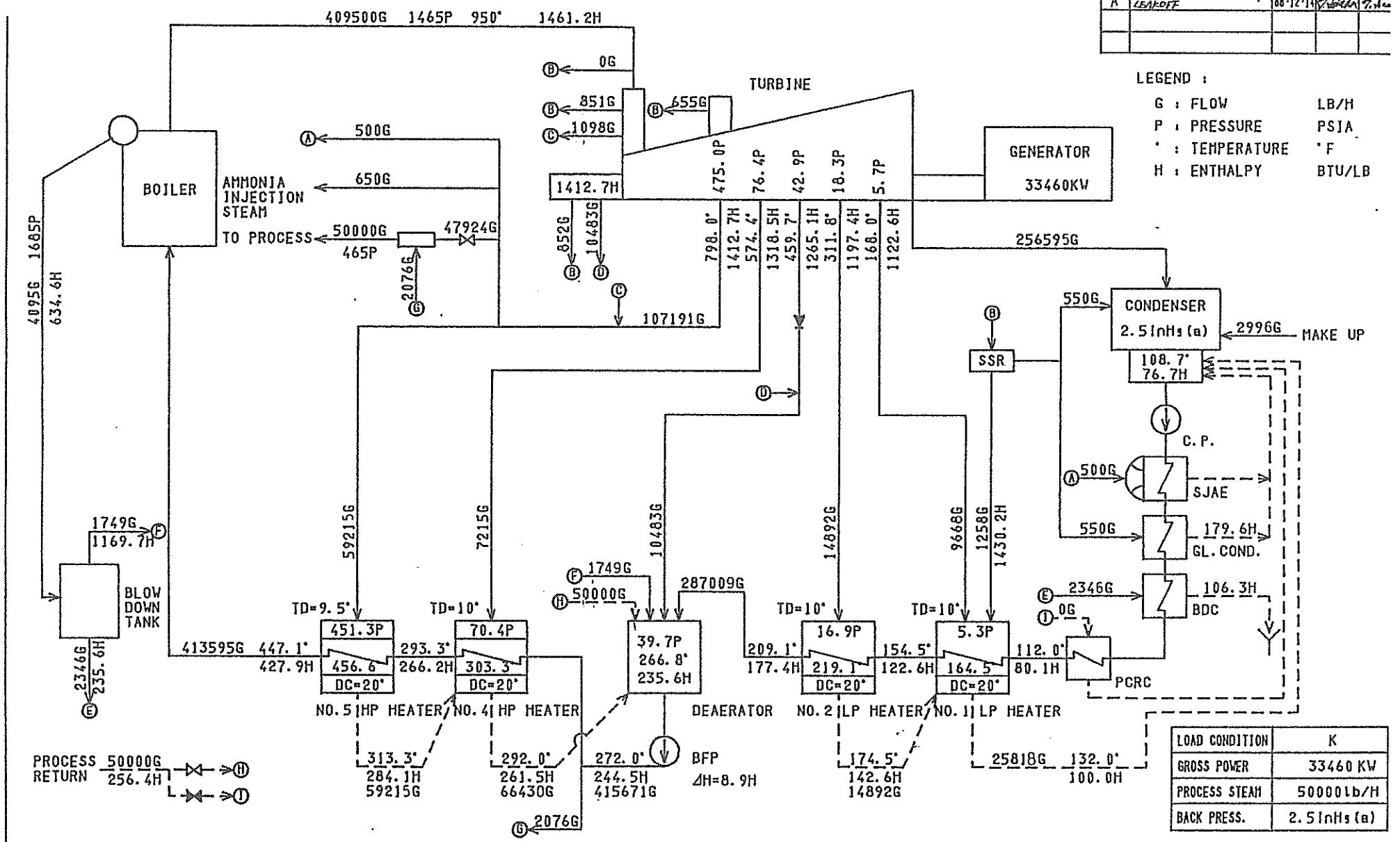


NO.	REVISIONS	DATE	REVD.	CH

LEGEND :

G	: FLOW	LB/H
P	: PRESSURE	PSIA
°	: TEMPERATURE	°F
H	: ENTHALPY	BTU/L

NO.	REVISIONS	DATE	REVD.	CHKD
A	REVISED NO.1 PACKING LEAKOFF	88-12-14		



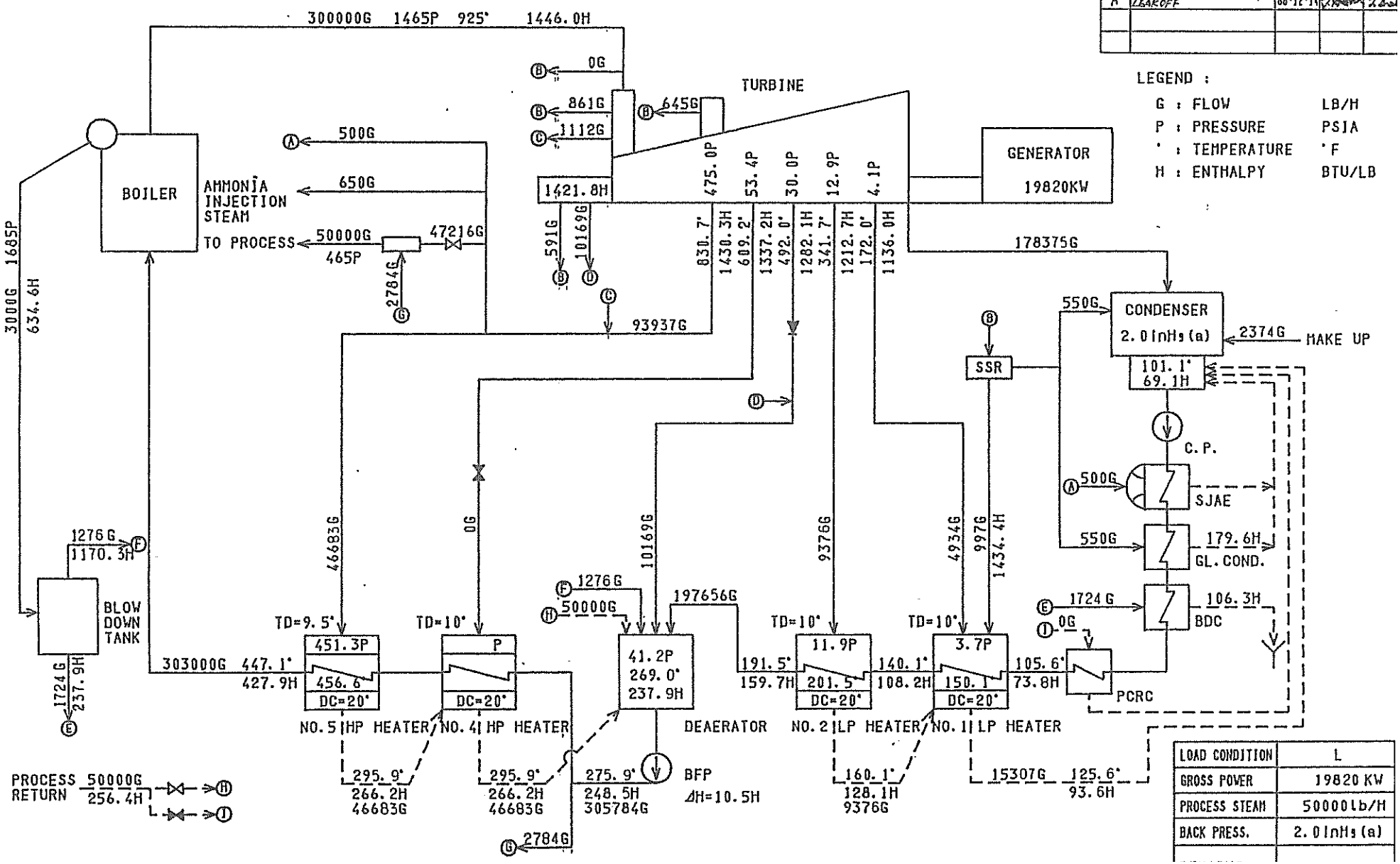
LEGEND :

G	FLOW	LB/H
P	PRESSURE	PSIA
°	TEMPERATURE	°F
H	ENTHALPY	BTU/LB

LOAD CONDITION	K
GROSS POWER	33460 KW
PROCESS STEAM	50000 lb/H
BACK PRESS.	2.5 inHg(a)

$$\text{HEAT RATE} = \frac{413595(634.6-427.9)+409500(1461.2-634.6)}{33460} = 12671 \text{ Btu/kWH}$$

NO.	REVISIONS	DATE	REVD.	CHKD
A	REVISED NO.1 PACKING LEAKOFF	88-12-14		



LEGEND :

G	: FLOW	LB/H
P	: PRESSURE	PSIA
°	: TEMPERATURE	°F
H	: ENTHALPY	BTU/LB

LOAD CONDITION	L
GROSS POWER	19820 KW
PROCESS STEAM	50000Lb/H
BACK PRESS.	2.0 inHg(a)

$$\text{HEAT RATE} = \frac{303000(634.6-427.9)+300000(1446.0-634.6)}{19820} = 15441 \text{ Btu/kWH}$$

SPECIFICATIONS OF GENERATOR

1. Generator Specifications

(1)	Quantity	133,333 KVA	3-phase AC generator 1 set
(2)	Type form	TFLQQ-KD	Totally-enclosed forced ventilated, forced lubricated, solid rotor turbine generator

(3) Generator continuous operation output

Hydrogen pressure (psig)	Capacity (KVA)	Power factor
30	* 133,333	0.9
15	80,000	0.9

* Name plate rating

(4)	Rating	continuous
(5)	Terminal voltage	13,800 V
(6)	Number of phases	3-phase
(7)	Frequency	60 Hz
(8)	Number of poles	2-poles
(9)	Power factor	0.9 (lag)
(10)	Revolution speed	3,600 rpm
(11)	Neutral point	Transformer grounding
(12)	Excitation method	Static
(13)	Rotational direction	Counterclockwise view from turbine side
(14)	Connecting method	2Y
(15)	Cooling method	Stator: conventional hydrogen cooling method Rotor: direct hydrogen cooling method
(16)	Short circuit ratio	NLT. 0.55
(17)	Driving method	120 MW steam turbine
(18)	Insulation	F class insulation.

3. Specifications and Performance of Hydrogen Cooler

(1) Number of units — 4/Generator — 1 set

(2) Performance

Hydrogen pressure	30 psig
Quantity of cooling water	Approx. 790 gpm
Cooling water inlet temperature	95°F (35°C)
Cooling water outlet temperature	Approx. 109°F (43°C)
Cooling inlet hydrogen gas temperature	Approx. 140°F (60°C)
Cooling outlet hydrogen gas temperature	Approx. 115°F (46°C) + 5 °C
Water head loss	Approx. 16 ft

(3) Quality of cooling water — fresh water

(4) Construction of cooler — surface cooling type with a cooling pipe with fins

(5) Control method — Water quantity automatically adjusted (Quantity of cooling water is automatically controlled by controling valve to keep cooler outlet hydrogen gas temperature constant.)

4. Specifications and Performance of Hydrogen Gas Control Device and Seal Oil Equipment

(1) Hydrogen gas pressure in generator

Rated pressure — 30 psig

(2) Gas substitution method — indirect substitution method by CO_2 gas

(3) Gas capacity in the generator — approximately 1800 ft^3

(4) Gas quantity and time required for substitution

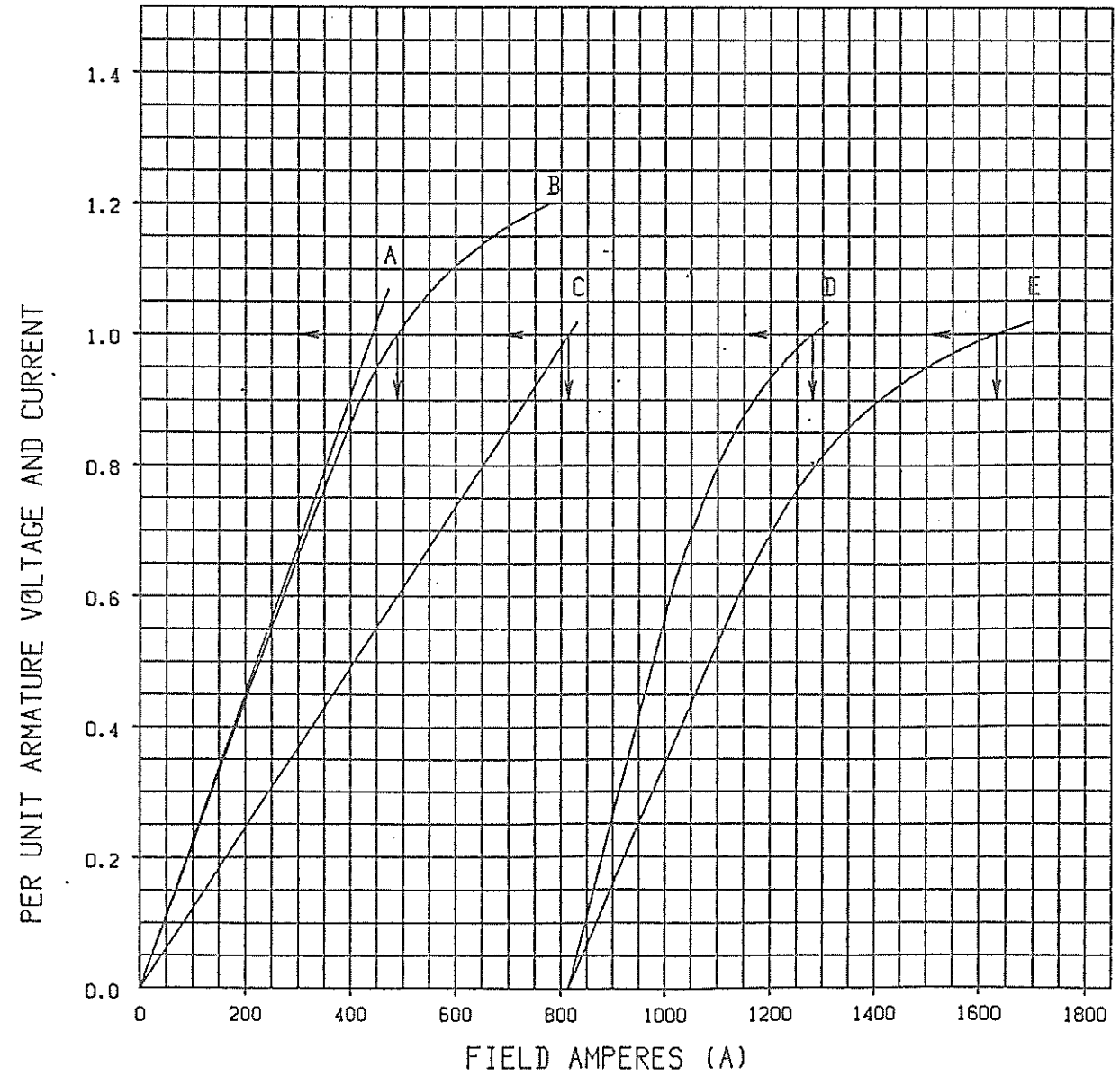
Replacing gas	Existing gas	Purity (%)	Quantity of gas required (ft^3)		Time required (h)
			In operation	At shutdown	
CO_2	Air	About 70	About 2,160	About 1,800	About 1.0
H_2	CO_2	About 90	About 4,170	About 3,150	About 1.5
H_2	Raise H_2 pressure by 30 psig	About 93	About 3,800	About 3,800	About 1.5
CO_2	H_2	About 90	About 5,400	About 3,600	About 2.0

ESTIMATED GENERATOR SATURATION AND SYNCHRONOUS IMPEDANCE CURVES

2POLE 133333 KVA 3600RPM 13800VOLTS 0.90PF 30 PSIG H_2
5578 ARM AMPS 440FLD VOLTS

FIELD CURRENT CALCULATED BY IEEE METHOD

A : AIR GAP
B : NO LOAD SATURATION
C : SYNCHRONOUS IMPEDANCE
D : SATURATION AT RATED ARM. AMPS. RATED PF
E : SATURATION AT RATED ARM. AMPS. OPF (LAG)

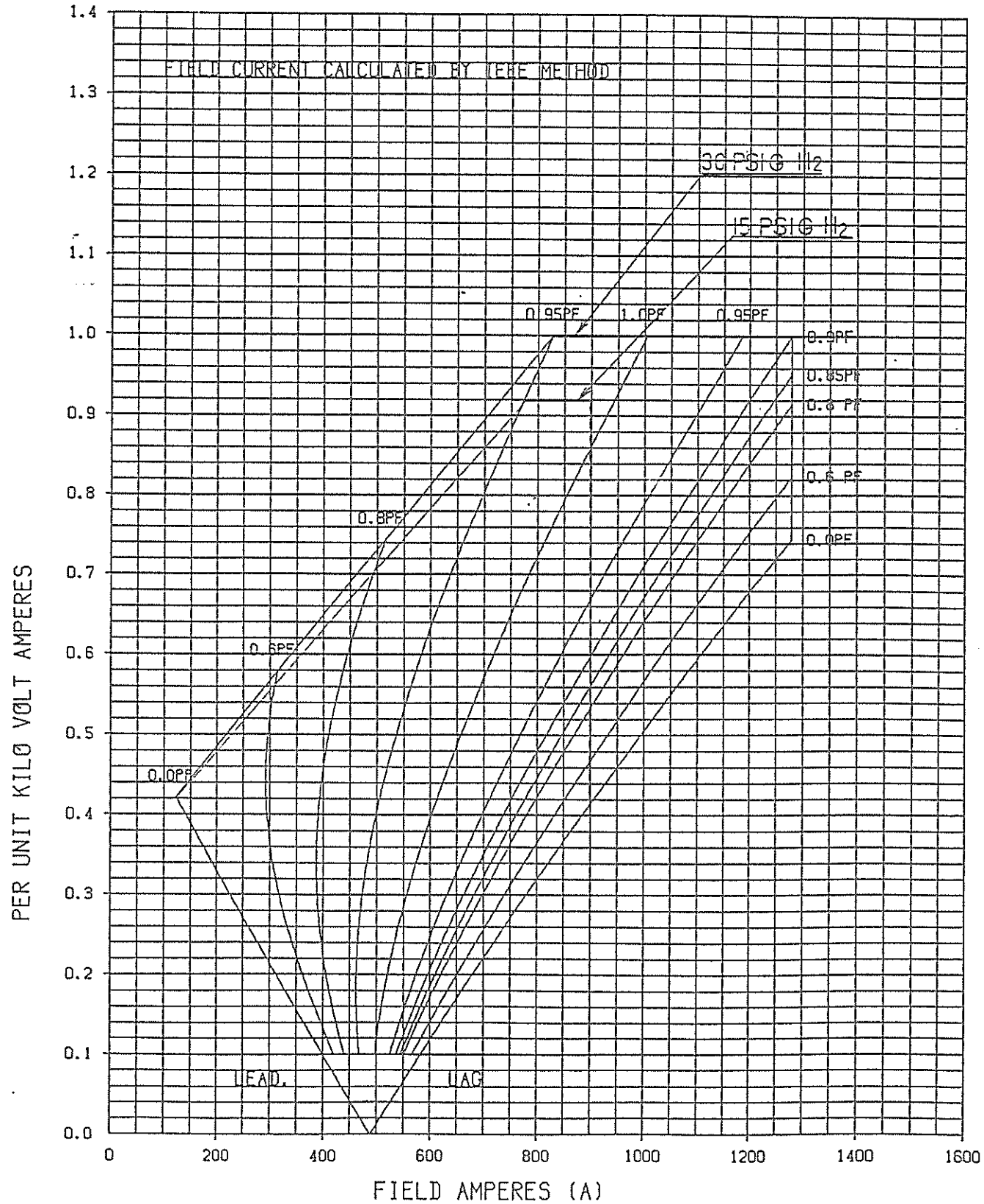


REGD 89.-02. 15	DWN	M. Sasaki	89.02.09	ESTIMATED GENERATOR SATURATION AND SYNCHRONOUS IMPEDANCE CURVES
	CHKD	S. Shima	89.02.10	
	APPD	K Tanaka	89 02.10	

HITACHI LTD
TOKYO JAPAN

ESTIMATED GENERATOR EXCITATION V CURVES

2POLE 133333 KVA 3600RPM 13800VOLTS 0.90PF 30 PSIG H_2
5578 ARM AMPS 440FLD VOLTS

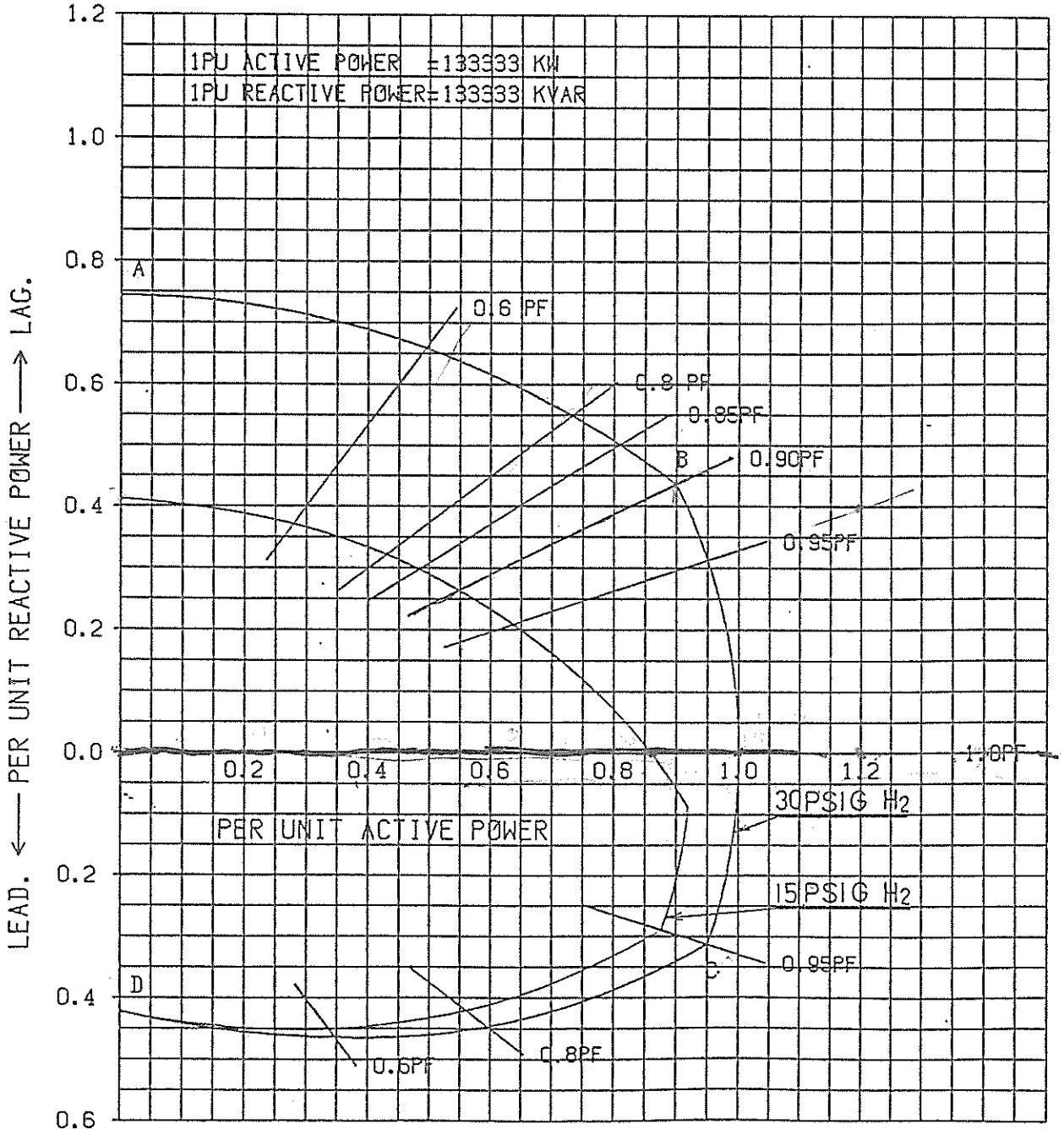


REGD 89.02.15	DWN	M. Sasaki	89.02.09	ESTIMATED GENERATOR EXCITATION V CURVES	HITACHI LTD. TOKYO JAPAN
	CHKD	K. Shima	89.02.10		
	APPD	K. Ijuda	89.02.10		

ESTIMATED GENERATOR REACTIVE CAPABILITY CURVES

2POLE 133333 KVA 3600RPM 13800VOLTS 0.90PF 30 PSIG H_2
5578 ARM AMPS 440FLD VOLTS

FIELD CURRENT CALCULATED BY IEEE METHOD
CURVE AB LIMITED BY FIELD HEATING
CURVE BC LIMITED BY ARMATURE HEATING
CURVE CD LIMITED BY ARMATURE CORE END HEATING



DWN	Y. Sasaki	89.02.09	ESTIMATED GENERATOR REACTIVE CAPABILITY CURVES	HITACHI LTD. TOKYO JAPAN
CHKD	K. Shima	89.02.10		
APPD	K. Tomita	89.02.10		