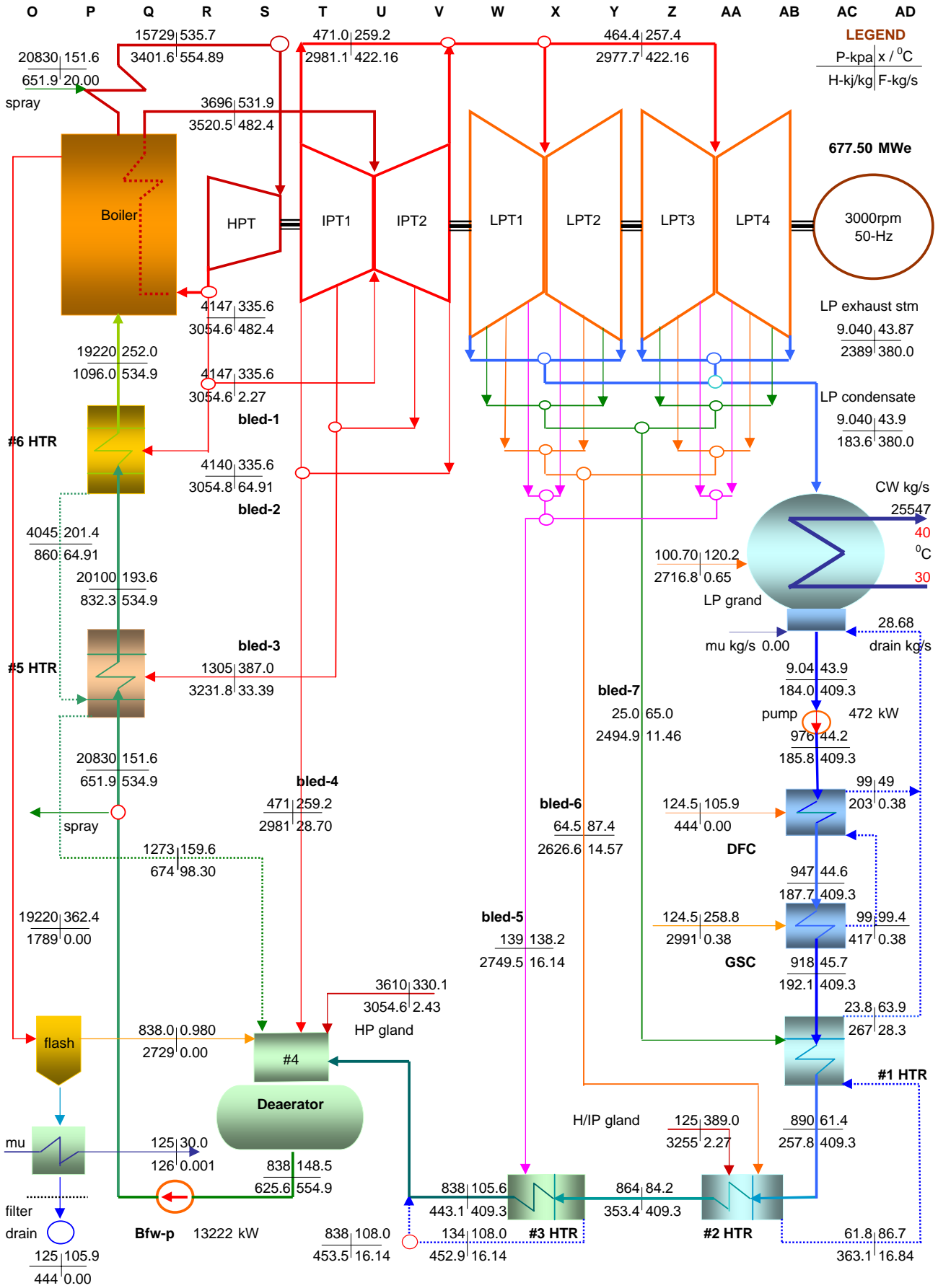


Heat Balance

EIM 1

A	B	c	D	E	F	G	H	I	J	K	L	M	N	
02	OEM Design Point	Efficiencies are basis on heat balance calculation/calibration						Steam parameters		kpa	°C/x	kJ/kg		
03	Steam flow factors	factor			Leak-off fraction	design			Economizer inlet		19220	252.00	1096.00	
04	Turbine proper	1.0000			Stop valve	0.0025	0.0025		Boiler main steam		16300	575.83	3401.50	
05	Gland to Dea	0.0044			HP gland	0.0054	0.0054		Sprayed main stm		16300	538.02	3401.50	
06	Gland to #2htr	0.0041			IP gland	0.0008	0.0008		Reheater cold stm		4147.0	335.56	3054.60	
07	Gland to GSC	0.0007			LP gland	0.0012	0.0012		Reheater hot stm		4140.0	539.35	3532.97	
08	LP gland to Cond	0.0012			plant leak	0.0000			Sprayed reheat stm		3830.0	538.00	3532.97	
09	Turbine flow total	1.0103			By-pass	fraction	design		HP turbine stm inlet		15729	535.70	3401.56	
10	Boiler evaporation	1.0103			HP spray	0.0360	0.0360		HP turbine stm exit		4147.0	335.56	3054.60	
11	Boiler blowdown	0.0000			RH spray	0.0000	0.0000		IP turbine stm inlet		3696.0	537.41	3532.97	
12	Boiler feed water	1.0103			IP cooling	0.0041	0.0041		IP turbine rotor cool		3696.0	531.89	3520.49	
13	Bd flash	°C/x	kJ/kg		IP-LPgsc	0.0016	0.0016		IP turbine stm exit		471.00	259.17	2981.11	
14	blr-drum	362.39	1788.67		Plant efficiencies		calibrate		LP turbine stm inlet		464.41	257.42	2977.70	
15	flash stm	0.98	2728.52		Boiler	0.925	0.925		LP turbine stm exit		9.040	0.92	2389.48	
16	sat water	172.35	729.41		Turbine	0.996	0.995		Condensate outlet		9.040	43.87	183.64	
17	mu-inlet	30.00	125.77		Generator	0.986	0.985		Gland stm to Dea		3610.0	330.12	3054.60	
18	flash drain	105.87	443.86		Bfw-pump	0.839	0.839		Gland stm to #2htr		124.50	389.04	3255.22	
19	mu-outlet	30.00	125.77		Flash-tank	0.990	0.990		Gland-stm to GSC		124.50	258.82	2991.31	
20	Blowdown factors			Dea level / Fwp inlet-p / enthalpy-rise / temp					GSC sat-liq to DFC		100.70	99.83	418.33	
21	flash stm	0.0000			Dea:m/kpa/ki/kgk	38.85	837.99	1.826	Gland to Condenser		100.70	120.20	2716.80	
22	flash drain	0.0000			Fwp:ki/kg/Δh/°C	647.69	26.31	151.6						
23	make-up	0.0000			Cond-p:ki/kg/°C	184.58	185.71	44.18	IP / LP press-drop	1.40%		7.34	kJ/kg.k	
24									RH heat:	1490.45	RH gain:	478.37	kJ/kg	
25	Bled stm	design	kpa	°C	kJ/kg	quality			Htr inlet	design	kpa	°C	sat kJ/kg	liq kJ/kg
26	B1>hp-ip	4147.0	4147.0	335.56	3054.60	1.000			IPcool-B1	4120.0	4121.0	252.11	2799.8	1096.05
27	B2>#6htr	4140.0	4140.0	335.56	3054.79	1.000			#6htr-B2	4050.0	4045.0	251.00	2800.1	1090.64
28	B3>#5htr	1205.0	1305.0	387.00	3231.85	1.000			#5htr-B3	1273.0	1273.0	190.65	2784.7	810.40
29	B4>Dea	471.0	471.0	259.17	2981.11	1.000			#4-Dea-B-	457.0	457.0	148.49	2743.6	625.62
30	B5>#3htr	139.0	139.0	138.23	2749.52	1.000			#3htr-B5	134.0	134.0	108.02	2688.3	452.95
31	B6>#2htr	64.50	64.50	87.40	2626.58	0.987			#2htr-B6	61.80	61.80	86.71	2654.8	363.12
32	B7>#1htr	25.00	25.00	65.00	2494.93	0.947			#1htr-B7	23.80	23.80	63.90	2616.5	267.40
33									GSC calobrate	99.31	99.44	2675.1	416.70	
34	BFW exit	calibrate	kpa	°C	kJ/kg	δ°C								
35	#6htr	19220	19220	252.00	1096.00	1.00								
36	#5htr	20100	20100	193.58	832.30	2.93								
37	Dea/Fwp	20830	20830	151.63	651.93	0.00			Htr drain	ref δ°C	δ°C correct⁰C	kJ/kg	design	
38	#3htr	838.0	838.0	105.57	443.10	2.45			#6htr	8.00	-49.57	201.43	859.79	859.80
39	#2htr	864.0	864.0	84.25	353.40	2.47			#5htr	8.00	7.92	159.56	673.93	673.90
40	#1htr	890.0	890.0	61.43	257.79	2.47			#3htr		0.00	108.02	452.95	453.00
41	GSC	918.0	918.0	45.70	192.06	53.74			#2htr		0.00	86.71	363.12	363.20
42	DFC	947.0	947.0	44.64	187.68	54.79			#1htr		0.00	63.90	267.40	267.30
43	Cond-p	976.0	976.0	44.18	185.76	0.00			GSC		-50.88	48.56	203.30	203.30
44														
45									Turbine flow / power output	kg/s-in	kg/s-out	kWe		
46	Bled frac	design	htr-eff	fraction	defect	deficit			P2 stage (#6htr) flows/work	554.89	64.91	189056		
47	#6htr	0.1170	0.990	0.1170	0.7673	0.0898			P3 stage (#5htr) flows/work	489.98	33.39	138953		
48	#5htr	0.0602	0.990	0.0602	0.5652	0.0340			P4 stage (Dea) flows/work	456.59	28.70	112484		
49	Dea	0.0517	0.999	0.0517	0.3969	0.0205			P5 stage (#3htr) flows/work	427.90	16.14	95929		
50	#3htr	0.0291	0.997	0.0291	0.2416	0.0070			P6 stage (#2htr) flows/work	411.76	14.57	49739		
51	#2htr	0.0263	0.951	0.0263	0.1591	0.0042			P7 stage (#1htr) flows/work	397.19	11.46	51375		
52	#1htr	0.0207	0.955	0.0207	0.0708	0.0015			Condensing stage flows/work	385.73	385.73	39965		
53	Balance	aft-Dea:	0.76511	Reheat:	0.8694	0.1570			Total flows kg/s / total output	554.89	554.89	677500		
54														
55	Total plant steam/water flow		kg/h	kg/h	kg/h				Design flow/hr/s/output kWe	1997619	554.89	685030		
56	Boiler:evap / feed / makeup		2018273	1997621	2				Heat-Q:turbine/boiler/pipe-eff	5468387	5563634	0.983		
57	Boiler:blow / flash / drain		0	0	0				Plant-eff / HR / Tbn-HR kJ/kg	0.399	9032	8071.4		
58	Turbine:HP / RH / LP inlets		1997619	1736706	1519791				Stm rate:Plant / Tbn / coal-rate	2.949	2.949	0.309		
59	LP turbine stm condense		1367996						Fwp kWe cap:LP / HP / /total	472	13222	13694		



LEGEND

P-kpa x / °C
 H-kj/kg | F-kg/s

677.50 MWe

3000rpm
 50-Hz

LP exhaust stm
 9.040 43.87
 2389 380.0

LP condensate
 9.040 43.9
 183.6 380.0

CW kg/s 25547
 °C 40
 30

mu kg/s 0.00
 drain kg/s 28.68

pump 472 kW
 976 44.2
 185.8 409.3

DFC 99 49
 203 0.38

GSC 99 99.4
 417 0.38

#1 HTR 23.8 63.9
 267 28.3

H/IP gland 125 389.0
 3255 2.27

#2 HTR 890 61.4
 257.8 409.3

#3 HTR 61.8 86.7
 363.1 16.84

status	net eff	total output	net pwr output	plant heat rate	turb heat rate	plant stm rate	turb stm rate	7000kcal-sce
condens	0.399	691.19 MW	677.50 MW	9032 kj/kWh	8071 kj/kWh	2.949 kg/kWh	2.949 kg/kWh	0.309 kg/kWh

OEM design point gland stm flows:

source	kg/hr	kJ/kg	exit point
HP valve	1	3401.5	gland-c
HP valve	5016	3401.5	#2 htr
HP inlet	4639	3054.6	dearator
HP exit	4117	3054.6	dearator
HP inlet	915	3054.6	#2 htr
HP exit	932	3054.6	#2 htr
HP inlet	92	3054.6	gland-c
HP exit	90	3054.6	gland-c
IP exit	607	2981.1	#2 htr
IP exit	718	2981.1	#2 htr
IP exit	110	2981.1	gland-c
IP exit	129	2981.1	gland-c
IP-LPgsc	929	2981.1	gland-c
LP exit	2357	2716.8	cond

Sum:	dearator	#2 htr	gland-c	cond
mix flow	8756	8188	1351	2357 kg/hr
mix enth	3054.6	3255.2	2991.3	2716.8 kJ/kg
pipe-p	3990	124.5	124.5	100.7 kpa-mcr
pipe-p	3610	124.5	124.5	100.7 kpa-ecr
fraction	0.0044	0.0041	0.0007	0.0012

Shaft:	HP-valve	HP-shaft	IP-shaft	LP-shaft	kg/hr
fraction	0.0025	0.0054	0.0008	0.0012	

Fraction=flows/total-flow (1997619kg/hr=554.894kg/s) **2E+06**

OEM design point bled stm flows:

source	kg/hr	fraction	exit point
HP-exh1	8165	0.00409	IP rotor
HP-exh2	233678	0.11698	#6 htr
IP-bled3	120205	0.06017	#5 htr
IP-exh4	103324	0.05172	#4-Dea
LP-bled5	58091	0.02908	#3 htr
LP-bled6	52440	0.02625	#2 htr
LP-bled7	41251	0.02065	#1 htr

OEM design point by-pass stm flows:

source	kg/hr	fraction	exit point
Dea/bfw1	72000	0.03604	Blr-SH
Dea/bfw1	0	0	Reheater
IP exh8	3268	0.0016	LP gsc

Off-Design efficiency evaluation:

loaction	design	$\delta\eta$
#6htr	0.990	0.00
#5htr	0.990	0.00
Dea	0.999	0.00
#3htr	0.997	0.00
#2htr	0.951	0.00
#1htr	0.955	0.00