

System Summary Report

GT PRO 27.0 Tractebel Engineering						
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Program revision date: December 15, 2017						
Plant Configuration: GT, HRSG, and condensing reheat ST						
2 GE 7F.05 Engines (Physical Model #611), One Steam Turbine, GT PRO Type 7, Subtype 7						
Steam Property Formulation: IAPWS-IF97						
SYSTEM SUMMARY						
	Power Output kW		LHV Heat Rate kJ/kWh		Elect. Eff. LHV%	
	@ gen. term.	net	@ gen. term.	net	@ gen. term.	net
Gas Turbine(s)	447777		9041		39,82	
Steam Turbine(s)	300386					
Plant Total	748162	732792	5970	6095	60,30	59,06
PLANT EFFICIENCIES						
PURPA efficiency	CHP (Total) efficiency		Power gen. eff. on		Canadian Class 43	
%	%		chargeable energy, %		Heat Rate, kJ/kWh	
54,90	50,73		54,21		7659	
GT fuel HHV/LHV ratio =			1,106			
DB fuel HHV/LHV ratio =			1,106			
Total plant fuel HHV heat input / LHV heat input =			1,106			
Fuel HHV chemical energy input (77F/25C) =			1371900	kW		
Fuel LHV chemical energy input (77F/25C) =			1240732	kW		
Total energy input (chemical LHV + ext. addn.) =			1368159	kW		
Energy chargeable to power (93,0% LHV alt. boiler) =			1351836	kW		
Line frequency			60 Hz			
GAS TURBINE PERFORMANCE - GE 7F.05 (Physical Model #611)						
	Gross power	Gross LHV	Gross LHV Heat Rate	Exh. flow	Exh. temp.	
	output, kW	efficiency, %	kJ/kWh	kg/s	C	
per unit	223888	39,82	9041	522	592	
Total	447777			1044		
Number of gas turbine unit(s) =			2			
Gas turbine load [%] =			100	%		
Fuel chemical HHV (77F/25C) per gas turbine =			621733	kW		
Fuel chemical LHV (77F/25C) per gas turbine =			562288	kW		
STEAM CYCLE PERFORMANCE						
HRSG eff.	Gross power output	Internal gross	Overall	Net process heat output		
%	kW	elect. eff., %	elect. eff., %	kW		
83,06	300386	45,62	37,89	-103327		
Number of steam turbine unit(s) =			1			
Fuel chemical HHV (77F/25C) to duct burners =			128435	kW		
Fuel chemical LHV (77F/25C) to duct burners =			116155	kW		
DB fuel chemical LHV + HRSG inlet sens. heat =			792689	kW		
Net process heat output as % of total output (net elec. + net heat) =			-16,42	%		

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ESTIMATED PLANT AUXILIARIES (kW)		
GT fuel compressor(s)*	0	kW
GT supercharging fan(s)*	0	kW
GT electric chiller(s)*	0	kW
GT chiller/heater water pump(s)	0	kW
HRSR feedpump(s)*	4212	kW
Condensate pump(s)*	606,4	kW
HRSR forced circulation pump(s)	0	kW
LTE recirculation pump(s)	34,48	kW
Cooling water pump(s)	3288	kW
Air cooled condenser fans	0	kW
Cooling tower fans	0	kW
Dilution air fan(s)	0	kW
Aux. from PEACE running motor/load list	1995	kW
Miscellaneous gas turbine auxiliaries	960,2	kW
Miscellaneous steam turbine auxiliaries	159,4	kW
Miscellaneous plant auxiliaries	374,1	kW
Constant plant auxiliary load	0	kW
Gasification plant, ASU*	0	kW
Gasification plant, fuel preparation	0	kW
Gasification plant, AGR*	0	kW
Gasification plant, other/misc	0	kW
Desalination plant auxiliaries	0	kW
Program estimated overall plant auxiliaries	11629	kW
Actual (user input) overall plant auxiliaries	11629	kW
Transformer losses	3741	kW
Total auxiliaries & transformer losses	15370	kW
* Heat balance related auxiliaries		

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PLANT HEAT BALANCE				
Energy In	1508074	kW		
Ambient air sensible	3087	kW		
Ambient air latent	3571	kW		
Fuel enthalpy @ supply	1376824	kW		
External gas addition to combustor	0	kW		
Steam and water	127427	kW		
Makeup and process return	0	kW		
Energy Out	1509275	kW		
Net power output	732792	kW		
Stack gas sensible	133098	kW		
Stack gas latent	137912	kW		
GT mechanical loss	2916,4	kW		
GT gear box loss	0	kW		
GT generator loss	5444	kW		
GT miscellaneous losses	3401	kW		
GT ancillary heat rejected	0	kW		
GT process air bleed	0	kW		
Fuel compressor mech/elec loss	0	kW		
Supercharging fan mech/elec loss	0	kW		
Condenser	446064	kW		
Process steam	268,5	kW		
Process water	26601	kW		
Blowdown/leakages	1175,5	kW		
Heat radiated from steam cycle	4970	kW		
ST/generator mech/elec/gear loss	4081	kW		
Non-heat balance related auxiliaries	6811	kW		
Transformer loss	3741	kW		
Energy In - Energy Out	-1201,1	kW		
GT heat balance error (arising from GT definitions)	-1177,1	kW		
Steam cycle heat balance error	-23,87	kW	-0,0022	%
Zero enthalpy: dry gases & liquid water @ 32 F (273.15 K)				

System Summary Table

Plant Summary		
1. System Summary		
Plant total power output @ generator terminal	748162	kW
Total auxiliaries & transformer losses	15370	kW
Plant net power output	732792	kW
Plant LHV heat rate @ generator terminal	5970	kJ/kWh
Plant HHV heat rate @ generator terminal	6601	kJ/kWh
Plant net LHV heat rate	6095	kJ/kWh
Plant net HHV heat rate	6740	kJ/kWh
Plant LHV electric eff. @ generator terminal	60,3	%
Plant HHV electric eff. @ generator terminal	54,53	%
Plant net LHV electric efficiency	59,06	%
Plant net HHV electric efficiency	53,41	%
2. Plant Efficiencies		
PURPA efficiency, LHV	54,9	%
PURPA efficiency, HHV	49,65	%
CHP (Total) efficiency, LHV	50,73	%
CHP (Total) efficiency, HHV	45,88	%
Power generation eff. on chargeable energy, LHV	54,21	%
Power generation eff. on chargeable energy, HHV	49,02	%
Canadian Class 43 heat rate	7659	kJ/kWh
Plant fuel LHV chemical energy input (77F/25C)	1240732	kW
Plant fuel HHV chemical energy input (77F/25C)	1371900	kW
Total energy input (chemical LHV + ext. addn.)	1368159	kW
Energy chargeable to power, LHV	1351836	kW
Energy chargeable to power, HHV	1494750	kW
GT fuel chemical HHV/LHV ratio	1,106	
DB fuel chemical HHV/LHV ratio	1,106	
Plant fuel HHV heat input /LHV heat input	1,106	
3. Gas Turbine Performance (per unit) (Physical Model #611)		
	GE 7F.05	2 unit(s)
Gross power output	223888	kW
Gross LHV efficiency	39,82	%
Gross HHV efficiency	36,01	%
Gross LHV heat rate	9041	kJ/kWh
Gross HHV heat rate	9997	kJ/kWh
Exhaust mass flow	521,8	kg/s
Exhaust temperature	592,1	C
Fuel chemical LHV input (77F/25C)	562288	kW
Fuel chemical HHV input (77F/25C)	621733	kW
4. Steam Cycle Performance (LHV)		
HRSG efficiency	83,06	%
Steam turbine gross power	300386	kW
Internal gross efficiency	45,62	%
Overall efficiency	37,89	%
Net process heat output	-103327	kW
Fuel chemical LHV (77F/25C) to duct burners	116155	kW
Fuel chemical HHV (77F/25C) to duct burners	128435	kW
DB fuel chemical LHV + HRSG inlet sens. heat	792688	kW
Net process heat output / total output	-16,42	%
5. Plant Auxiliaries		
GT fuel compressor(s)	0	kW
GT supercharging fan(s)	0	kW
GT electric chiller(s)	0	kW
GT chiller/heater water pump(s)	0	kW

System Summary Table

Plant Summary		
HRSG feedpump(s)	4212	kW
Condensate pump(s)	606,4	kW
HRSG forced circulation pump(s)	0	kW
LTE recirculation pump(s)	34,48	kW
Cooling water pump(s)	3288	kW
Air cooled condenser fans	0	kW
Cooling tower fans	0	kW
Dilution air fan(s)	0	kW
Aux. from PEACE running motor/load list	1995	kW
Miscellaneous gas turbine auxiliaries	960,2	kW
Miscellaneous steam turbine auxiliaries	159,4	kW
Miscellaneous plant auxiliaries	374,1	kW
Constant plant auxiliary load	0	kW
Gasification plant, ASU	0	kW
Power to AGR	0	kW
Gasification plant, air boost compressor	0	kW
Gasification plant, fuel preparation	0	kW
Gasification plant, syngas recirculation compressor	0	kW
Gasification plant, Other/misc	0	kW
Desalination plant auxiliaries	0	kW
Program estimated overall plant auxiliaries	11629	kW
Actual (user input) overall plant auxiliaries	11629	kW
Transformer losses	3741	kW
Total auxiliaries & transformer losses	15370	kW

Stream Table

GT PRO Streams	P	T	h	h*	M	s
	bar	C	kJ/kg	kJ/kg	kg/s	kJ/kg-C
Note: This is a fixed format table. Not all streams are applicable to current heat balance.			Ref @ 0C	Ref @ 25C		H2O: ref @ 0C
Plant Configuration: GT, HRSG, and condensing reheat ST			/ Water	/ Vapor		Gas: ref @ 25C
Cycle Type = 7						
Steam Property Formulation: IAPWS-IF97						
1 Ambient conditions	1,011	3,0	6,53	-22,21	509,67	0,0904
2 Air after inlet heater or chiller	1,001	3,0	6,53	-22,21	509,67	0,0933
3 GT compressor inlet air (per GT)	1,001	3,0	6,53	-22,21	509,67	0,0933
4 GT compressor discharge (per GT)	17,92	385,6	400,55	371,82	468,69	0,1553
5 GT turbine inlet (per GT)	17,02	1317,4	1693,91	1537,64	480,80	1,351
6 GT exhaust, after turbine diffuser (per GT)	1,042	592,1	771,52	625,26	521,79	1,4
7 Compressor bleed to outside process (per GT)	1,001	3,0	6,53	-22,21	0,00	0,0933
8 GT fuel (per GT), after comp. but bef heating	29,51	25,0	51515,02	46423,01	12,11	-
9 Steam injection to GT combustor (all GT's)	44,82	287,8	2907,30	359,81	0,00	6,222
10 GT injection water stream	44,82	15,0	67,26	-2480,23	0,00	0,224
11 GT compressor leakage stream	-	-	-	-	0,00	-
12 Compressor water injection, Sprint engines	-	-	-	-	-	-
13 Steam inj. to LP turbine (total, all GT's)	14,82	232,2	2881,80	334,31	0,00	6,634
14 Stack gas	1,011	120,6	259,07	100,99	1046,08	0,5438
15 HP steam to HPT, aft desup, bef stop vlv	120,5	543,7	3464,87	917,38	204,30	6,633
16 HP steam to HPT, after pipe, before desup	120,5	543,7	3464,87	917,38	204,30	6,633
17 HP steam to HPT, before HP pipe	122,3	544,4	3464,87	917,38	204,30	6,627
18 HPS3 exit steam	122,3	544,4	3464,87	917,38	204,37	6,627
19 HPS3 inlet steam	122,6	522,8	3407,73	860,24	204,37	6,555
20 HPS2 exit steam	122,6	522,8	3407,73	860,24	204,37	6,555
21 HPS2 inlet steam	123,3	482,3	3297,04	749,55	204,37	6,41
22 HPS1 exit steam	123,3	482,8	3298,43	750,94	204,27	6,412
23 HPS1 inlet steam	126,6	335,9	2729,82	182,33	204,27	5,552
24 HPS0 exit steam	126,6	328,8	2670,86	123,37	161,07	5,455
25 HPS0 inlet steam	126,6	328,8	2670,86	123,37	161,07	5,455
26 HPB exit steam	126,6	328,8	2670,86	123,37	161,07	5,455
27 HPB blowdown	126,6	328,8	1517,82	-1029,67	0,00	3,539
28 HPB saturated water	126,6	328,8	1517,82	-1029,67	161,07	3,539
29 HPB inlet water	126,6	325,8	1496,97	-1050,52	161,07	3,504
30 HPE3 exit water	126,6	325,8	1496,97	-1050,52	161,07	3,504
31 HPE3 inlet water	128,9	225,4	971,31	-1576,18	161,07	2,548
32 HPE2 exit water	128,9	225,4	971,31	-1576,18	161,07	2,548
33 HPE2 inlet water	128,9	225,4	971,31	-1576,18	161,07	2,548
34 HPE1 exit water	128,9	225,4	971,31	-1576,18	161,07	2,548
35 HPE1 inlet water	128,9	225,4	971,31	-1576,18	161,07	2,548
36 HPE0 exit water	128,9	225,4	971,31	-1576,18	172,07	2,548
37 HP feedwater, after pump & valve	130,4	149,7	638,61	-1908,88	172,29	1,825
38 HP feedwater, after pump but before valve	160,9	149,2	638,61	-1908,88	172,29	1,817
39 Hot reheat after stop valve, Type 7&9	34,17	529,5	3519,26	971,77	203,01	7,256
40 Hot reheat after leakages	34,87	529,8	3519,26	971,77	203,01	7,247
41 Hot reheat to ST, after desup.	34,87	530,2	3520,10	972,61	199,95	7,248
42 Hot reheat after reheat pipe	34,87	530,2	3520,10	972,61	199,95	7,248
43 Hot reheat before reheat pipe	35	530,3	3520,10	972,61	199,95	7,246
44 RH3 exit steam	35	530,3	3520,10	972,61	199,95	7,246
45 RH3 inlet steam	35,93	470,1	3382,45	834,96	199,95	7,056
46 RH2 exit steam	35,93	470,6	3383,59	836,10	199,86	7,058
47 RH2 inlet steam	35,93	470,6	3383,59	836,10	199,86	7,058
48 RH1 exit steam	35,93	470,6	3383,59	836,10	199,86	7,058
49 RH1 inlet steam	37,45	374,6	3158,84	611,35	199,86	6,716
50 State before RH1 inlet desup.	37,45	374,6	3158,84	611,35	199,86	6,716
51 After all interactions in cold reheat line	37,45	374,6	3158,84	611,35	199,86	6,716

Stream Table

GT PRO Streams	Exergy kJ/kg
Note: This is a fixed format table. Not all streams are applicable to current heat balance.	Ref @ 25C Water as vapor
Plant Configuration: GT, HRSG, and condensing reheat ST	
Cycle Type = 7	
Steam Property Formulation: IAPWS-IF97	
1 Ambient conditions	0,67
2 Air after inlet heater or chiller	-0,18
3 GT compressor inlet air (per GT)	-0,18
4 GT compressor discharge (per GT)	375,42
5 GT turbine inlet (per GT)	1209,19
6 GT exhaust, after turbine diffuser (per GT)	281,10
7 Compressor bleed to outside process (per GT)	-0,18
8 GT fuel (per GT), after comp. but bef heating	46915,11
9 Steam injection to GT combustor (all GT's)	1056,88
10 GT injection water stream	5,13
11 GT compressor leakage stream	-
12 Compressor water injection, Sprint engines	-
13 Steam inj. to LP turbine (total, all GT's)	908,46
14 Stack gas	13,24
15 HP steam to HPT, aft desup, bef stop vlv	1491,89
16 HP steam to HPT, after pipe, before desup	1491,89
17 HP steam to HPT, before HP pipe	1493,78
18 HPS3 exit steam	1493,78
19 HPS3 inlet steam	1458,10
20 HPS2 exit steam	1458,10
21 HPS2 inlet steam	1390,63
22 HPS1 exit steam	1391,47
23 HPS1 inlet steam	1079,14
24 HPS0 exit steam	1049,23
25 HPS0 inlet steam	1049,23
26 HPB exit steam	1049,23
27 HPB blowdown	467,31
28 HPB saturated water	467,31
29 HPB inlet water	456,80
30 HPE3 exit water	456,80
31 HPE3 inlet water	216,20
32 HPE2 exit water	216,20
33 HPE2 inlet water	216,20
34 HPE1 exit water	216,20
35 HPE1 inlet water	216,20
36 HPE0 exit water	216,20
37 HP feedwater, after pump & valve	99,19
38 HP feedwater, after pump but before valve	101,52
39 Hot reheat after stop valve, Type 7&9	1360,59
40 Hot reheat after leakages	1363,31
41 Hot reheat to ST, after desup.	1363,83
42 Hot reheat after reheat pipe	1363,83
43 Hot reheat before reheat pipe	1364,33
44 RH3 exit steam	1364,33
45 RH3 inlet steam	1283,30
46 RH2 exit steam	1283,98
47 RH2 inlet steam	1283,98
48 RH1 exit steam	1283,98
49 RH1 inlet steam	1161,19
50 State before RH1 inlet desup.	1161,19
51 After all interactions in cold reheat line	1161,19

Stream Table

GT PRO Streams	P	T	h	h*	M	s
	bar	C	kJ/kg	kJ/kg	kg/s	kJ/kg-C
52 After mixing additions and cold reheat	37,45	374,6	3158,84	611,35	199,86	6,716
53 After cold RH pipe but any addn. to cold RH	37,45	374,6	3158,84	611,35	199,86	6,716
54 Cold reheat, Types 7&9	37,59	374,7	3158,84	611,35	199,86	6,714
55 Cold reheat, Types 10&11	-	-	-	-	-	-
56 Hot RH after stop valve, Types 10&11	-	-	-	-	-	-
57 Hot RH to ST, after leakages, Types 10&11	-	-	-	-	-	-
58 IP steam induction to LPT, after pipe	36,18	319,7	3026,47	478,99	0,00	6,517
59 IP steam extraction from LPT	-	-	-	-	-	-
60 IP induction after valve and before pipe	37,45	321,1	3026,47	478,99	0,00	6,502
61 IPS2 exit after steam & heat addition	37,45	321,1	3026,47	478,99	0,00	6,502
62 IPS2 exit steam	37,45	321,1	3026,47	478,99	0,00	6,502
63 IPS2 inlet steam	38,2	247,6	2801,70	254,21	0,00	6,089
64 IPS1 exit steam	38,2	247,6	2801,70	254,21	0,00	6,089
65 IPS1 inlet steam	38,2	247,6	2801,70	254,21	0,00	6,089
66 IPB exit steam	38,2	247,6	2801,70	254,21	0,00	6,089
67 IP blowdown	38,2	247,6	1074,23	-1473,26	0,00	2,772
68 IPB saturated water	38,2	247,6	1074,23	-1473,26	0,00	2,772
69 IPB inlet water	38,2	242,1	1047,51	-1499,98	0,00	2,72
70 IPE2 exit water	38,2	242,1	1047,51	-1499,98	0,00	2,72
71 IPE2 inlet water	39,34	146,9	620,87	-1926,62	0,00	1,806
72 IPE1 exit water	39,34	146,9	620,87	-1926,62	0,00	1,806
73 IP feedwater, after pump & valve	39,34	146,9	620,87	-1926,62	0,00	1,806
74 IP feedwater, after pump but before valve	39,34	146,9	620,87	-1926,62	0,00	1,806
75 LP steam induction to LPT after pipe	-	-	-	-	-	-
76 LP induction steam before pipe	4,29	293,3	3052,68	505,19	0,00	7,51
77 LPT extraction for 3p CC	3,447	148,9	2755,04	207,55	0,00	7,002
78 LPS exit steam	4,29	293,3	3052,68	505,19	0,00	7,51
79 LPS inlet steam	4,29	146,2	2741,23	193,74	0,00	6,872
80 LPB exit steam	4,29	146,2	2741,23	193,74	14,52	6,872
81 LPB blowdown	4,29	146,2	615,66	-1931,83	0,00	1,803
82 LPB saturated water	4,29	146,2	615,66	-1931,83	14,51	1,803
83 LPB inlet water	4,293	146,2	615,75	-1931,74	14,51	1,803
84 LPE exit water	4,293	146,2	615,75	-1931,74	14,52	1,803
85 LP feedwater, after pump & valve	4,293	146,2	615,75	-1931,74	14,52	1,803
86 LP feedwater, after pump but before valve	4,29	146,2	615,75	-1931,74	14,51	1,803
87 Feedwater leaving LTE (to D/A)	4,293	112,6	472,57	-2074,92	215,49	1,447
88 LTE exit water after bypass	4,293	112,6	472,57	-2074,92	215,49	1,447
89 LTE exit water after recirculation	4,293	112,6	472,57	-2074,92	215,49	1,447
90 LTE exit water	4,293	112,6	472,57	-2074,92	333,78	1,447
91 LTE inlet water after recirculation	4,421	60,1	251,93	-2295,56	333,78	0,8323
92 LTE inlet water before recirculation	4,421	31,1	130,81	-2416,68	215,49	0,4523
93 Total IP+HP feedwater leaving D/A	4,293	146,2	615,75	-1931,74	172,29	1,803
94 WHTR inlet water	3,447	15,0	63,31	-2484,18	0,00	0,2247
95 WHTR exit water	3,447	65,0	272,34	-2275,14	0,00	0,8934
96 DAB inlet water	4,29	146,2	615,66	-1931,83	0,00	1,803
97 DAB saturated water	4,29	146,2	615,66	-1931,83	0,00	1,803
98 DAB exit steam	4,29	146,2	2741,23	193,74	0,00	6,872
99 HPT inlet steam, after stop valve	117,5	542,5	3464,87	917,38	204,30	6,644
100 HPT inlet steam, after leakages	117,5	542,5	3464,87	917,38	201,13	6,644
101 HPTX1 blading exit	117,5	542,5	3464,87	917,38	201,13	6,644
102 HPT process bleed (at bleed source)	-	-	-	-	-	-
103 HPTX1 group exit	117,5	542,5	3464,87	917,38	201,13	6,644
104 HPTA1 blading exit (cold RH, Types 10&11)	-	-	-	-	-	-
105 Steam addition from external source to HPT	44,82	343,3	3064,65	517,16	0,00	6,49
106 HPTA1 group exit	117,5	542,5	3464,87	917,38	201,13	6,644
107 HPTL blading exit	37,59	374,7	3158,84	611,35	201,13	6,714
108 HPTL exit, after leak. (cold RH, Types 7&9)	37,59	374,7	3158,84	611,35	199,86	6,714

Stream Table

GT PRO Streams	Exergy kJ/kg
52 After mixing additions and cold reheat	1161,19
53 After cold RH pipe but any addn. to cold RH	1161,19
54 Cold reheat, Types 7&9	1161,67
55 Cold reheat, Types 10&11	-
56 Hot RH after stop valve, Types 10&11	-
57 Hot RH to ST, after leakages, Types 10&11	-
58 IP steam induction to LPT, after pipe	1088,12
59 IP steam extraction from LPT	-
60 IP induction after valve and before pipe	1092,45
61 IPS2 exit after steam & heat addition	1092,45
62 IPS2 exit steam	1092,45
63 IPS2 inlet steam	990,96
64 IPS1 exit steam	990,96
65 IPS1 inlet steam	990,96
66 IPB exit steam	990,96
67 IP blowdown	252,54
68 IPB saturated water	252,54
69 IPB inlet water	241,19
70 IPE2 exit water	241,19
71 IPE2 inlet water	87,00
72 IPE1 exit water	87,00
73 IP feedwater, after pump & valve	87,00
74 IP feedwater, after pump but before valve	87,00
75 LP steam induction to LPT after pipe	-
76 LP induction steam before pipe	818,12
77 LPT extraction for 3p CC	672,00
78 LPS exit steam	818,12
79 LPS inlet steam	697,01
80 LPB exit steam	697,01
81 LPB blowdown	82,78
82 LPB saturated water	82,78
83 LPB inlet water	82,87
84 LPE exit water	82,87
85 LP feedwater, after pump & valve	82,87
86 LP feedwater, after pump but before valve	82,87
87 Feedwater leaving LTE (to D/A)	45,77
88 LTE exit water after bypass	45,77
89 LTE exit water after recirculation	45,77
90 LTE exit water	45,77
91 LTE inlet water after recirculation	8,43
92 LTE inlet water before recirculation	0,61
93 Total IP+HP feedwater leaving D/A	82,87
94 WHTR inlet water	0,97
95 WHTR exit water	10,64
96 DAB inlet water	82,78
97 DAB saturated water	82,78
98 DAB exit steam	697,01
99 HPT inlet steam, after stop valve	1488,67
100 HPT inlet steam, after leakages	1488,67
101 HPTX1 blading exit	1488,67
102 HPT process bleed (at bleed source)	-
103 HPTX1 group exit	1488,67
104 HPTA1 blading exit (cold RH, Types 10&11)	-
105 Steam addition from external source to HPT	1134,36
106 HPTA1 group exit	1488,67
107 HPTL blading exit	1161,67
108 HPTL exit, after leak. (cold RH, Types 7&9)	1161,67

Stream Table

GT PRO Streams	P	T	h	h*	M	s
	bar	C	kJ/kg	kJ/kg	kg/s	kJ/kg-C
109 LPT inlet, after valve	34,17	529,5	3519,26	971,77	201,50	7,256
110 LPTX1 blading exit	5,619	282,9	3027,48	479,99	201,50	7,343
111 LPT process bleed (at bleed source)	5,619	282,9	3027,48	479,99	0,00	7,343
112 LPTX1 group exit	5,619	282,9	3027,48	479,99	201,25	7,343
113 LPTA1 blading exit	5,619	282,9	3027,48	479,99	201,25	7,343
114 LP steam induction to LPT after pipe	3,447	148,9	2755,04	207,55	0,00	7,002
115 LPT extraction for 3p CC	3,447	148,9	2755,04	207,55	0,00	7,002
116 LPTA1 group exit	5,619	282,9	3027,48	479,99	201,25	7,343
117 LPTX2 blading exit	5,619	282,9	3027,48	479,99	201,25	7,343
118 LPTX2 extraction for D/A heating	5,619	156,3	2753,27	205,78	0,00	6,781
119 LPTX2 group exit	5,619	282,9	3027,48	479,99	201,25	7,343
120 LPTX3 blading exit	5,619	282,9	3027,48	479,99	201,25	7,343
121 DHC2/FWH2 bleed @ turbine	0,9997	99,6	2672,37	124,88	0,00	7,352
122 LPTX3 group exit	5,619	282,9	3027,48	479,99	201,25	7,343
123 LPTX4 blading exit	5,619	282,9	3027,48	479,99	201,25	7,343
124 DHC1/FWH1 bleed @ turbine	0,7929	93,2	2662,27	114,78	0,00	7,43
125 LPTX4 group exit	5,619	282,9	3027,48	479,99	201,25	7,343
126 Last rotor exit static state, bef leaving loss	0,0519	33,5	2296,85	-250,64	201,25	7,516
127 LPT exhaust aft leaving loss but bef pipe	0,0519	33,5	2312,88	-234,61	201,25	7,569
128 LPT exhaust after pipe	0,0519	33,5	2312,88	-234,61	201,25	7,569
129 HP process @ delivery	120,5	325,0	2684,49	137,01	0,00	5,491
130 1st HP substream	44,82	257,2	2684,49	137,01	0,10	5,807
131 2nd HP substream	44,82	257,2	2684,49	137,01	0,00	5,807
132 HP process steam after valve	122,3	326,6	2684,49	137,01	0,10	5,487
133 HP process steam near HRSG	122,3	326,6	2684,49	137,01	0,10	5,487
134 IP process @ delivery	36,32	244,8	2802,78	255,29	0,00	6,11
135 1st IP substream	3,447	138,3	2731,30	183,81	0,00	6,945
136 2nd IP substream	3,447	138,3	2731,30	183,81	0,00	6,945
137 IP process steam after valve	37,59	246,9	2802,78	255,29	0,00	6,097
138 IP process steam near HRSG	37,59	246,9	2802,78	255,29	0,00	6,097
139 LP process steam at delivery	-	-	-	-	-	-
140 LP process before valve	-	-	-	-	-	-
141 LP process	-	-	-	-	-	-
142 HPT process bleed at delivery	-	-	-	-	-	-
143 1st HPT bleed substream	42,43	537,8	0,00	-2547,49	0,00	0
144 2nd HPT bleed substream	42,43	537,8	0,00	-2547,49	0,00	0
145 HPT process bleed, after valve	-	-	-	-	-	-
146 HPT process bleed, before valve	-	-	-	-	-	-
147 LPT process bleed at delivery	5,055	282,1	3027,48	479,99	0,00	7,391
148 1st LPT bleed substream	5,055	282,1	3027,48	479,99	0,00	7,391
149 2nd LPT bleed substream	5,055	282,1	3027,48	479,99	0,00	7,391
150 LPT process bleed, after valve	5,619	282,9	3027,48	479,99	0,00	7,343
151 LPT process bleed, before valve	5,619	282,9	3027,48	479,99	0,00	7,343
152 DA external heating stream	-	-	-	-	-	-
153 HP pegging steam to D/A	-	-	-	-	-	-
154 IPB pegging steam to D/A	-	-	-	-	-	-
155 LPB steam for D/A heating	4,29	146,2	2741,23	193,74	14,52	6,872
156 Condensate from hot well	0,4108	33,6	140,54	-2406,95	204,03	0,4854
157 Condensate pump exit, before vlv	23,01	33,7	143,30	-2404,19	204,03	0,487
158 Condenser condensate after valve	4,421	34,1	143,30	-2404,19	204,03	0,4931
159 Condenser condensate before GSC	4,421	34,1	143,38	-2404,11	204,03	0,4934
160 Condenser condensate after GSC	4,421	34,1	143,38	-2404,11	204,03	0,4934
161 Makeup water	4,421	31,1	130,81	-2416,68	-42,85	0,4523
162 Desuperheating water	130,4	149,7	638,61	-1908,88	0,22	1,825
163 Process steam return condensate	4,421	82,2	344,51	-2202,98	0,10	1,101
164 Process water return stream	4,421	15,0	63,31	-2484,18	43,20	0,2244
165 Crossover stream after leakages	5,619	282,9	3027,48	479,99	201,25	7,343

Stream Table

GT PRO Streams	Exergy kJ/kg
109 LPT inlet, after valve	1360,59
110 LPTX1 blading exit	842,96
111 LPT process bleed (at bleed source)	842,96
112 LPTX1 group exit	842,96
113 LPTA1 blading exit	842,96
114 LP steam induction to LPT after pipe	672,00
115 LPT extraction for 3p CC	672,00
116 LPTA1 group exit	842,96
117 LPTX2 blading exit	842,96
118 LPTX2 extraction for D/A heating	736,11
119 LPTX2 group exit	842,96
120 LPTX3 blading exit	842,96
121 DHC2/FWH2 bleed @ turbine	485,03
122 LPTX3 group exit	842,96
123 LPTX4 blading exit	842,96
124 DHC1/FWH1 bleed @ turbine	451,67
125 LPTX4 group exit	842,96
126 Last rotor exit static state, bef leaving loss	60,48
127 LPT exhaust aft leaving loss but bef pipe	60,93
128 LPT exhaust after pipe	60,93
129 HP process @ delivery	1051,98
130 1st HP substream	957,70
131 2nd HP substream	957,70
132 HP process steam after valve	1053,20
133 HP process steam near HRSG	1053,20
134 IP process @ delivery	985,65
135 1st IP substream	665,26
136 2nd IP substream	665,26
137 IP process steam after valve	989,58
138 IP process steam near HRSG	989,58
139 LP process steam at delivery	-
140 LP process before valve	-
141 LP process	-
142 HPT process bleed at delivery	-
143 1st HPT bleed substream	0,00
144 2nd HPT bleed substream	0,00
145 HPT process bleed, after valve	-
146 HPT process bleed, before valve	-
147 LPT process bleed at delivery	828,62
148 1st LPT bleed substream	828,62
149 2nd LPT bleed substream	828,62
150 LPT process bleed, after valve	842,96
151 LPT process bleed, before valve	842,96
152 DA external heating stream	-
153 HP pegging steam to D/A	-
154 IPB pegging steam to D/A	-
155 LPB steam for D/A heating	697,01
156 Condensate from hot well	0,45
157 Condensate pump exit, before vlv	0,00
158 Condenser condensate after valve	0,93
159 Condenser condensate before GSC	0,93
160 Condenser condensate after GSC	0,93
161 Makeup water	0,61
162 Desuperheating water	99,19
163 Process steam return condensate	20,84
164 Process water return stream	1,07
165 Crossover stream after leakages	842,96

Stream Table

GT PRO Streams	P	T	h	h*	M	s
	bar	C	kJ/kg	kJ/kg	kg/s	kJ/kg-C
166 Crossover stream before leakages	5,619	282,9	3027,48	479,99	201,25	7,343
167 SSR inlet (after desup)	1,241	426,2	3332,61	785,12	3,13	8,524
168 GSC inlet	-	-	-	-	-	-
169 GSC condensate	0,8274	94,4	395,46	-2152,03	0,00	1,243
170 Leakage stream to condenser	-	-	-	-	-	-
171 Process extraction as neg. HPT addn.	-	-	-	-	-	-
172 Process extraction as neg. LPT addn.	-	-	-	-	-	-
173 HPS3 exit water/steam addition	-	-	-	-	-	-
174 HPS2 exit water/steam addition	-	-	-	-	-	-
175 HPS1 exit water/steam addition	-	-	-	-	-	-
176 HPS0 exit water/steam addition	130	380,0	2949,64	402,15	43,20	5,893
177 HPB exit water/steam addition	126,6	328,8	2670,86	123,37	0,00	5,455
178 HPE3 exit water/steam addition	-	-	-	-	-	-
179 HPE2 exit water/steam addition	-	-	-	-	-	-
180 HPE1 exit water/steam addition	-	-	-	-	-	-
181 RH3 exit water/steam addition	-	-	-	-	-	-
182 RH2 exit water/steam addition	-	-	-	-	-	-
183 RH1 exit water/steam addition	-	-	-	-	-	-
184 IPS2 exit water/steam addition	-	-	-	-	-	-
185 IPS1 exit water/steam addition	-	-	-	-	-	-
186 HPB exit water/steam addition	38,2	247,6	2801,70	254,21	0,00	6,089
187 IPE2 exit water/steam addition	-	-	-	-	-	-
188 IPE1 exit water/steam addition	-	-	-	-	-	-
189 LPS exit water/steam addition	4,29	293,3	3052,68	505,19	0,00	7,51
190 LPB exit water/steam addition	4,29	146,2	2741,23	193,74	0,00	6,872
191 LPE exit water/steam addition	-	-	-	-	-	-
192 LTE exit steam/water addition stream	-	-	-	-	-	-
193 Water addition stream before LTE	4,421	15,0	63,41	-2484,08	0,00	0,2247
194 Water addition stream at deaerator	4,293	15,0	63,39	-2484,10	0,00	0,2247
195 Water bleed before LTE	4,421	31,1	130,81	-2416,68	0,00	0,4523
196 Addition after cold reheat pipe	37,45	247,1	2804,31	256,82	0,00	6,101
197 Steam cooling to cold reheat line	37,45	321,1	3026,47	478,99	0,00	6,502
198 Types 10 & 11, cold reheat aft leakages	-	-	-	-	-	-
199 External/reheat steam supply, bef piping	-	-	-	-	-	-
200 External/reheat steam @ delivery	-	-	-	-	-	-
201 External/reheat steam supply, aft piping	-	-	-	-	-	-
202 Feedwater from D/A, after preheater	4,293	146,2	615,75	-1931,74	0,00	1,803
203 Water leaving preheater and entering D/A	4,421	31,1	130,81	-2416,68	215,49	0,4523
204 HPT leakage recovered (simplified method)	34,87	505,9	3464,87	917,38	0,00	7,178
205 FWH1 inlet water	4,421	31,1	130,81	-2416,68	215,49	0,4523
206 FWH2 inlet water	4,421	31,1	130,81	-2416,68	215,49	0,4523
207 HRSG stream to fuel heating	128,9	225,4	971,31	-1576,18	11,01	2,548
208 HRSG stream from fuel heating	128,9	35,6	160,67	-2386,82	11,01	0,5087
209 ST stream to fuel heating	5,055	282,1	3027,48	479,99	0,00	7,391
210 ST stream from fuel heating	-	-	-	-	-	-
211 HRSG stream to GT heat rejection Q1	-	-	-	-	-	-
212 HRSG stream from GT heat rejection Q1	-	-	-	-	-	-
213 HRSG stream to GT heat rejection Q2	-	-	-	-	-	-
214 HRSG stream from GT heat rejection Q2	-	-	-	-	-	-
215 Duct burner fuel (per HRSG)	36,88	25,0	51515,02	46423,01	1,25	-
216 GT fuel at supply	36,88	25,0	51515,02	46423,01	12,11	-
217 GT fuel at combustor	29,51	185,0	51883,41	46791,41	12,11	-
218 DH water return	-	-	-	-	-	-
219 DH water supply	-	-	-	-	-	-
220 ST bypass stream to condenser	122,3	544,4	3464,87	917,38	0,00	6,627
221 Addition to ST exhaust before condenser	-	-	-	-	-	-

Stream Table

GT PRO Streams	Exergy kJ/kg
166 Crossover stream before leakages	842,96
167 SSR inlet (after desup)	795,74
168 GSC inlet	-
169 GSC condensate	29,44
170 Leakage stream to condenser	-
171 Process extraction as neg. HPT addn.	-
172 Process extraction as neg. LPT addn.	-
173 HPS3 exit water/steam addition	-
174 HPS2 exit water/steam addition	-
175 HPS1 exit water/steam addition	-
176 HPS0 exit water/steam addition	1197,39
177 HPB exit water/steam addition	1049,23
178 HPE3 exit water/steam addition	-
179 HPE2 exit water/steam addition	-
180 HPE1 exit water/steam addition	-
181 RH3 exit water/steam addition	-
182 RH2 exit water/steam addition	-
183 RH1 exit water/steam addition	-
184 IPS2 exit water/steam addition	-
185 IPS1 exit water/steam addition	-
186 HPB exit water/steam addition	990,96
187 IPE2 exit water/steam addition	-
188 IPE1 exit water/steam addition	-
189 LPS exit water/steam addition	818,12
190 LPB exit water/steam addition	697,01
191 LPE exit water/steam addition	-
192 LTE exit steam/water addition stream	-
193 Water addition stream before LTE	1,06
194 Water addition stream at deaerator	1,05
195 Water bleed before LTE	0,61
196 Addition after cold reheat pipe	989,81
197 Steam cooling to cold reheat line	1092,45
198 Types 10 & 11, cold reheat aft leakages	-
199 External/reheat steam supply, bef piping	-
200 External/reheat steam @ delivery	-
201 External/reheat steam supply, aft piping	-
202 Feedwater from D/A, after preheater	82,87
203 Water leaving preheater and entering D/A	0,61
204 HPT leakage recovered (simplified method)	1329,42
205 FWH1 inlet water	0,61
206 FWH2 inlet water	0,61
207 HRSG stream to fuel heating	216,20
208 HRSG stream from fuel heating	13,64
209 ST stream to fuel heating	828,62
210 ST stream from fuel heating	-
211 HRSG stream to GT heat rejection Q1	-
212 HRSG stream from GT heat rejection Q1	-
213 HRSG stream to GT heat rejection Q2	-
214 HRSG stream from GT heat rejection Q2	-
215 Duct burner fuel (per HRSG)	46945,10
216 GT fuel at supply	46945,10
217 GT fuel at combustor	46969,19
218 DH water return	-
219 DH water supply	-
220 ST bypass stream to condenser	1493,78
221 Addition to ST exhaust before condenser	-

Gas Pressure Losses

Gas Pressure Losses		
Inlet filter	10	millibar
Supercharging fan boost	N/A	
Inlet chiller	N/A	
Evap cooler	N/A	
Fogger	N/A	
Total GT Inlet Losses	10	millibar
HRSG	25,99	millibar
SCR	N/A	
CO catalyst	N/A	
Duct & stack	4,981	millibar
Stack leaving loss	N/A	
Stack friction loss	N/A	
Stack buoyancy boost	N/A	
Total GT Exhaust Losses	30,97	millibar

Exergy Analysis

Reference: 1.013 bar, 25 C, water as vapor.

PLANT EXERGY ANALYSIS				
Exergy In		1307189	kW	
Fuel exergy		1254686	kW	
Ambient air exergy		685,6	kW	
Condenser cooling water in		67,77	kW	
Process condensate return		2,084	kW	
Process water return		46,09	kW	
Makeup water		-26,18	kW	
External steam/water		51728	kW	
Exergy Out		752661	kW	
Net electric output		732792	kW	
Process steam/water exergy @ delivery		3676	kW	
Condenser cooling water out		2338,2	kW	
Stack gas exergy		13855	kW	
Exergy Loss		554528	kW	
GT exergy loss		396491	kW	
HRSG exergy loss		100175	kW	
Steam turbine exergy loss		30159	kW	
Condenser exergy loss		9900	kW	
Non-heat balance related auxiliaries		6811	kW	
Transformer loss		3741	kW	
Miscellaneous exergy loss*		1795,6	kW	
Unaccounted exergy loss**		5454	kW	0,4173 %
* Includes piping loss, ST leakage to external sink, fuel compressor loss, condensate pump loss, etc.				
** Includes losses from desuperheating, mixing, and throttling, small water streams, misc. aux. and heat rejection, etc.				
GAS TURBINE EXERGY ANALYSIS - GE 7F.05 (Physical Model #611) (Each of 2 GT's)				
Exergy In		568813	kW	
GT fuel exergy @ combustor		568904	kW	
Air exergy @ compressor inlet		-91,2	kW	
Exergy Out		370567	kW	
GT electric output		223888	kW	
GT exhaust exergy		146679	kW	
Exergy Loss		198245	kW	
GT combustor exergy loss		163469	kW	
GT compressor and turbine exergy loss		30597	kW	
Mechanical/electrical/gear loss		4180	kW	
* Air starts at compressor inlet and fuel at combustor.				
GAS TURBINE & PERIPHERAL EXERGY ANALYSIS - GE 7F.05 (Physical Model #611) (Each of 2 GT's)				
Exergy In		570070	kW	
GT fuel exergy @ supply		568612	kW	
Ambient air		342,8	kW	
Steam / water to GT peripheral		1115	kW	
Exergy Out		370567	kW	
GT electric output		223888	kW	
GT exhaust exergy		146679	kW	
Exergy Loss		199503	kW	
GT combustor exergy loss		163469	kW	
GT compressor and turbine exergy loss		30597	kW	
Mechanical/electrical/gear loss		4180	kW	
Other		1257,2	kW	
* Air starts at ambient and fuel at supply.				
* GT peripheral includes any compressor inlet air conditioning and/or fuel heating.				

Exergy Analysis

HRSG EXERGY ANALYSIS - (Totals of 2 HRSG's)		
Exergy In	465999	kW
HRSG inlet gas exergy	292466	kW
HRSG feedwater exergy	131,6	kW
Duct burner fuel exergy	117461	kW
Feedpump power	4212	kW
Steam and water addition	51728	kW
Exergy Out	365824	kW
Steam to ST - Cold reheat	345897	kW
Steam and water bleed (near HRSG)	6068	kW
Stack gas exergy	13855	kW
HRSG water to desuperheating	2,739	kW
Exergy Loss	100175	kW
Heat transfer exergy loss	49458	kW
Duct burner combustion exergy loss	42550	kW
Blowdown and feedpump losses	274,3	kW
Other	7893	kW
STEAM TURBINE EXERGY ANALYSIS		
Exergy In	345316	kW
Throttle steam exergy (before stop valve)	304798	kW
Induction/addition steam exergy	272697	kW
Extraction steam exergy	-232178	kW
Exergy Out	315157	kW
ST electric output	300386	kW
ST exhaust steam	12262	kW
Leakages not recovered to ST	2509,3	kW
Exergy Loss	30159	kW
ST expansion exergy loss	22997	kW
Mechanical/electrical/gear loss	4081	kW
Other	3082	kW
STEAM TURBINE AND CONDENSER EXERGY ANALYSIS		
Exergy In	348672	kW
Throttle steam exergy (before stop valve)	304798	kW
Induction/addition steam exergy	272697	kW
Extraction steam exergy	-232178	kW
Condenser cooling water pump power	3288	kW
Condenser cooling water in	67,77	kW
Exergy Out	305324	kW
ST electric output	300386	kW
ST exhaust condensate	91,25	kW
Leakages not recovered to ST/condenser	2509,3	kW
Condenser cooling water out	2338,2	kW
Exergy Loss	43347	kW
ST exergy loss	30159	kW
Condenser heat transfer exergy loss	9900	kW
Other	3288	kW
CONDENSER EXERGY ANALYSIS		
Exergy In	12330	kW
ST exhaust to condenser	12262	kW
Condenser cooling water in	67,77	kW
Exergy Out	2429,5	kW
ST exhaust condensate	91,25	kW
Condenser cooling water out	2338,2	kW
Exergy Loss	9900	kW

Exergy Analysis



Computation Messages

Warning Messages	
	No warning messages
Advisory Messages	
	No advisory messages
Remarks	
1.	Duct burner is on for desired HPT flow. HPB at minimum pinch.

Commentary

Content in this table is for guidance and information only. Key plant design parameters are listed along with a 'typical' range for each. Some ranges depend on type and size of plant while others are static.
The parameter ranges are somewhat subjective. Comments do not mean anything is 'right' or 'wrong' with your design.
This information is intended to serve as a simple indicator that some items may warrant further review by you, the plant designer.

PLANT COMMENTARY				
	Typical	Current	Units	Comments
1. Plant net electric efficiency	> 45	59,06	%	
2. ST throttle pressure	110 - 180	120,5	bar	
3. ST throttle temperature	480 - 650	543,7	C	
4. Hot reheat pressure	18 - 30	34,87	bar	High.
5. Hot reheat temperature	480 - 650	530,2	C	
6. Reheat steam turbine output	> 40000	300386	kW	
GT CYCLE COMMENTARY				
	Typical	Current	Units	Comments
1. Inlet filter pressure drop	5 - 15	10	millibar	
2. GT exhaust pressure drop	5 - 40	30,97	millibar	
3. GT fuel chemical LHV (77F/25C)	38300 - 52300	46423	kJ/kg	
4. GT compressor efficiency reduction	0	-1,957	%	Consult vendor.
5. TIT control temperature increase	0	-52,5	C	Consult vendor.
HRSG COMMENTARY				
	Typical	Current	Units	Comments
1. HRSG gas pressure drop	5 - 40	25,99	millibar	
2. HRSG HX gas side pressure drop correction factor	0,8 - 1,2	1		
3. HRSG gas massflux	2 - 5,9	3,592	kg/m ² -s	
4. Stack gas temperature	85 - 140	120,6	C	
5. Duct firing temperature	< 800	630,9	C	
6. HRSG aspect ratio (tube length / duct width)	0,75 - 4	2,297		
7. HRSG radiant loss as percentage of heat recovered	0,25 - 1,5	0,5	%	
8. HPB pinch temperature difference	5 - 40	9,997	C	
9. HPB approach subcooling	0 - 10	3	C	
10. HPB blowdown	0 - 2	0	%	
11. LPB pinch temperature difference	> 5	40,71	C	
12. LPB blowdown	0 - 2	0	%	
13. DA feedwater subcooling	< 20	33,57	C	High.
14. Overall pressure loss in HP superheaters (DP/P)	< 7,5	3,5	%	
15. Overall pressure loss in reheaters (DP/P)	< 12	7	%	
16. Individual heat exchanger gas side pressure drop correction factor	0,8 - 1,2			Pass
17. Individual heat exchanger water velocity - economisers	0,61 - 3,7			Pass
18. RH3 steam velocity	6,1 - 37	39,08	m/s	High.
19. Individual heat exchanger approach temperature difference	> 10			Pass
20. Individual heat exchanger gas side convective h.t.c. adjustment factor	0,8 - 1,2			Pass
STEAM TURBINE COMMENTARY				
	Typical	Current	Units	Comments
1. HPT stop valve pressure drop (DP/P)	< 5	2,5	%	
2. Hot reheat stop valve pressure drop (DP/P)	< 5	2	%	
3. Corrected LPT exhaust loss	< 35	16,03	kJ/kg	
4. Annulus velocity at LPT exit	89 - 310	214,9	m/s	
5. Total leakage flow / Throttle flow	< 7,5	3,033	%	
6. Exhaust flow / Throttle flow	> 10	98,51	%	
7. Individual ST group group blading efficiency	> 80			Pass
8. Individual ST group group overall efficiency	> 80			Pass
COOLING SYSTEM COMMENTARY				

Commentary

	Typical	Current	Units	Comments
1. Condenser pressure	0,03 - 0,28	0,0519	bar	
2. Condenser cooling water velocity	0,91 - 3,7	2,438	m/s	
3. Condenser cooling water temperature rise	> 5	4,7	C	Low.
MAIN STEAM PIPES				
	Typical	Current	Units	Comments
1. HPB to HPT pipe pressure loss (DP/P)	< 5	1,5	%	
2. Hot reheat pipe pressure loss (DP/P)	< 8	0,37	%	
3. HP process pipe pressure loss (DP/P)	< 5	1,5	%	
4. Cold reheat pipe pressure loss (DP/P)	< 8	0,37	%	

Custom Output List

Custom Output List	
Nothing to display. Use the [Custom Variable List] -> [Edit Variable List] input menu to select variables to display on this repo	

Custom Output List

Custom Output List	
Nothing to display. Use the [Custom Variable List] -> [Edit Variable List] input menu to select variables to display on this repo	

Gas Turbine Summary Report

GT PRO 27.0 Tractebel Engineering											
9501 05-30-2018 09:47:48 file=C:\Users\IEJ351\Documents\Duba\Duba2.gtp											
Program revision date: December 15, 2017											
Plant Configuration: GT, HRSG, and condensing reheat ST											
2 GE 7F.05 Engines (Physical Model #611), One Steam Turbine, GT PRO Type 7, Subtype 7											
ESTIMATED G.T. SITE PERFORMANCE (Physical Model #611)											
Fuel = GE Gas 2014, supplied @ 25 C											
LHV @ 25 C = 46423,01 kJ/kg											
G.T. @ 100 % rating, inferred TIT control model, CC limit											
Site ambient conditions: 1,011 bar, 3 C, 30% RH											
Total inlet loss = 10 millibar, Exhaust loss = 30,97 millibar											
Inlet filter = 10 millibar											
Duct & stack = 4,98, HRSG = 25,99 millibar											
G.T. DEVIATION FROM NOMINAL, CLEAN ENGINE											
Compressor efficiency reduction % =								-1,957	%		
Maximum firing temperature excess over base load =								-52,5	C		
GE 7F.05 (Physical Model #611)											
PR	TIT	TET	Mair	kW	H.R.LHV	Mex	N2	O2	CO2	H2O	Ar
	C	C	kg/s		kJ/kWh	kg/s	%	%	%	%	%
17,9	1317	592	510	223888	9041	522	75,062	12,478	3,963	7,594	0,902
Engine ID =611											
FUEL HEATING & COOLING AIR PRECOOLER (per GT)											
Sources of Fuel Heat kW					Heat Sinks of CA Precooler kW						
CA Preclr	HRSG	ST	Ext.	Total	Fuel	HRSG	Ext.	Total			
0	4462	0	0	4462	0	0	0	0			
0%	100%	0%	0%	100%	0%	0%	0%	0%			
Fuel temp. after heating = 185 C											
Fuel molecular weight = 18,44; LHV @ combustor = 46791 kJ/kg											
G.T. auxiliary power = 480,1 kWe.											
ESTIMATED G.T. CYCLE											
Stream	p	T	M	M.W.	MOLE COMPOSITION %						
	bar	C	kg/s		N2	O2	CO2	H2O	Ar		
Ambient air in	1,01	3	509,67	28,942	77,904	20,902	0,030	0,225	0,938		
After filter	1,00	3	509,67	28,942	77,904	20,902	0,030	0,225	0,938		
Compressor inlet	1,00	3	509,67	28,942	77,904	20,902	0,030	0,225	0,938		
Turbine coolant			40,98								
Compressor discharge	17,92	386	468,69	28,942	77,904	20,902	0,030	0,225	0,938		
Fuel flow	29,51	185	12,11208								
Turbine inlet	17,02	1317	480,80	28,457	74,824	11,772	4,293	8,211	0,899		
Turbine coolant			40,98								
Turbine exhaust	1,04	592	521,79	28,495	75,062	12,478	3,963	7,594	0,902		
Compressor = 199493 Turbine = 427562 kW											
Turbine coolant = 8,041% compr in											
Mech loss = 1458,2 kW											
Generator total loss = 2722 kW (Elec. & windage loss (generator coolant) = 2293,6 kW, Mech. loss (lube oil) = 428,4 kW)											
Mech eff. = 99,36% Generator eff. = 98,8%											
GT specific power @ gen term = 439,3 kW per kg/s											
GT efficiency @ gen term = 36,01% HHV = 39,82% LHV											
GT efficiency @ gen term adjusted for fuel temp. @ combustor of 185 C = 35,75% HHV = 39,5% LHV											

Gas Turbine Summary Report

Exhaust gas specific volume = 2,419 m ³ /kg Volume flow = 1262,4 m ³ /s

Gas Turbine Summary Report

GAS TURBINE/GENERATOR HEAT BALANCE (Physical Model #611)									
Energy in =		631755		kW					
Compressor Inlet		Compressor Inlet		Water		Steam		Fuel Enthalpy	
Air Sensible		Air Latent		Injection		Injection		@ Combustor	
1544		1785		0		0		628426	
Energy out =		632344		kW					
Misc	Mech	Gbox	Gen	Turb(Q1)	Exhaust	Exhaust	Electric		Steam(Q2)
Loss	Loss	Loss	Loss	Coolant	Sensible	Latent	Output		Coolant
1700	1458	0	2722	0	339907	62668	223888		0
Zero enthalpy: dry gases & liquid water @ 32 F (273.15 K)									
Heat Balance Error (In - Out) =		-588,6		kW		=	-0,0932	%	

Gas Turbine Summary Table

Gas Turbine Summary - GE 7F.05 (Physical Model #611)		
Ambient pressure	1,011	bar
Ambient temperature	3	C
Ambient relative humidity	30	%
Total inlet loss	10	millibar
Total exhaust loss	30,97	millibar
1. Estimated G.T. Site Performance		
GT load as percent of rating	100	%
Gross power output	223888	kW
Gross LHV heat rate	9041	kJ/kWh
Gross HHV heat rate	9997	kJ/kWh
Gross LHV efficiency	39,82	%
Gross HHV efficiency	36,01	%
Gross LHV efficiency adjusted for fuel temperature	39,82	%
Gross HHV efficiency adjusted for fuel temperature	36,01	%
TIT control model	Inferred	
Compressor pressure ratio	17,9	
Turbine inlet temperature	1317,4	C
Turbine exhaust pressure	1,042	bar
Turbine exhaust temperature	592,1	C
Turbine exhaust mass flow	521,8	kg/s
Turbine exhaust molecular weight	28,49	
Flue gas mole composition N2	75,06	%
Flue gas mole composition O2	12,48	%
Flue gas mole composition CO2	3,963	%
Flue gas mole composition SO2	0	%
Flue gas mole composition H2O	7,594	%
Flue gas mole composition AR	0,9023	%
Steam injection mass flow	0	kg/s
Water injection mass flow	0	kg/s
Steam injection / fuel flow	0	
Water injection / fuel flow	0	
2. Power		
Gross power output	223888	kW
Turbine	427562	kW
Compressor	199493	kW
Mechanical loss	1458,2	kW
Gear box loss	0	kW
Generator loss	2722	kW
Mechanical efficiency	99,36	%
Gear box efficiency	NA	
Generator efficiency	98,8	%
3. Fuel - GE Gas 2014		
Fuel supply temperature	25	C
Fuel chemical LHV @ 77F/25C	46423	kJ/kg
Fuel chemical HHV @ 77F/25C	51331	kJ/kg
Fuel LHV @ supply temperature	46423	kJ/kg
Fuel LHV after fuel compressor	46423	kJ/kg
Fuel LHV after fuel heating	46791	kJ/kg
Fuel LHV @ combustor	46791	kJ/kg
Fuel chemical LHV input (77F/25C)	562288	kW
Fuel chemical HHV input (77F/25C)	621733	kW
4. G.T. Deviation from Nominal, Clean Engine		
Compressor inlet airflow reduction	0	%

Gas Turbine Summary Table

Gas Turbine Summary - GE 7F.05 (Physical Model #611)		
Compressor efficiency reduction	-1,957	%
Turbine efficiency reduction	0	%
Maximum firing temperature excess over base load	-52,5	C
Combustor % pressure loss	0	%
Combustor inefficiency + heat loss	0	%
Cooling air increase	0	%
Fuel consumption margin	0	%
Exhaust temperature adder	0	C
Exhaust flow margin	0	%
Generator power margin	0	%
Turbine nozzle area % increase	0	%
5. Gas Turbine/Generator Heat Ballance		
Zero enthalpy: dry gases & liquid water @ 32 F (273.15 K)		
Energy in:	631755	kW
Inlet air sensible	1543,7	kW
Inlet air latent	1785,3	kW
Water injection	0	kW
Steam injection	0	kW
Fuel enthalpy @ combustor	628426	kW
External gas addition	0	kW
From ASU	0	kW
Energy out:	632344	kW
Miscellaneous loss	1700,3	kW
Mechanical loss	1458,2	kW
Gear box loss	0	kW
Generator loss	2722	kW
Turbine coolant (Q1)	0	kW
Exhaust sensible	339907	kW
Exhaust latent	62668	kW
Gross output	223888	kW
Process air	0	kW
Steam coolant (Q2)	0	kW
Heat Balance Error, In - Out	-588,6	kW
Heat Balance Error %, In - Out	-0,0932	%

Gas Turbine Fuel

Gas Fuel		
Fuel Name: GE Gas 2014		
Fuel supply temperature	25	C
Molecular weight	18,44	
Total LHV + Sensible heat @ 25C	46423	kJ/kg
Total fuel enthalpy referenced to 0C	51515	kJ/kg
Volumetric LHV (P = 1,013 bar, T = 25 C)	35003	kJ/m ³
Volumetric HHV (P = 1,013 bar, T = 25 C)	38704	kJ/m ³
Wobbe index (P = 1,013 bar, T = 25 C)	49314	kJ/m ³
Modified Wobbe index	2582,9	kJ/m ³ -K ^{0.5}
Heating Values		
LHV @ 25C	46423	kJ/kg
HHV @ 25C	51331	kJ/kg
Analysis of Fuel (volume %)		
Hydrogen H2	0	%
Oxygen O2	0	%
Water Vapor H2O	0	%
Nitrogen N2	4	%
Carbon Monoxide CO	0	%
Carbon Dioxide CO2	0	%
Methane CH4	85,1	%
Ethane C2H6	8,1	%
Propane C3H8	2,8	%
n-Butane C4H10	0	%
n-Pentane C5H12	0	%
Hexane C6H14	0	%
Ethylene C2H4	0	%
Propylene C3H6	0	%
Butylene C4H8	0	%
Pentene C5H10	0	%
Benzene C6H6	0	%
Toluene C7H8	0	%
Xylene C8H10	0	%
Acetylene C2H2	0	%
Naphthalene C10H8	0	%
Methanol CH3OH	0	%
Ethanol C2H5OH	0	%
Ammonia NH3	0	%
Hydrogen Sulfide H2S	0	%
Sulfur Dioxide SO2	0	%
Isobutane C4H10	0	%
Carbonyl Sulfide COS	0	%
Hydrogen Cyanide CHN	0	%
Argon Ar	0	%
Total	100	%

Gas Turbine Fuel Heating

Fuel = GE Gas 2014, supplied @ 25 C, 36,88 bar								
LHV = 46423,01 kJ/kg								
FUEL HEATING & COOLING AIR PRECOOLER (per GT)								
Sources of Fuel Heat kW					Heat Sinks of CA Precooler kW			
CA Preclr	HRSg	ST	Ext.	Total	Fuel	HRSg	Ext.	Total
0	4462	0	0	4462	0	0	0	0
0%	100%	0%	0%	100%	0%	0%	0%	0%
Fuel temp. after heating = 185 C								
Fuel molecular weight = 18,44; LHV @ combustor = 46791 kJ/kg								
G.T. auxiliary power = 480,1 kWe.								

Steam Cycle Summary

GT PRO 27.0 Tractebel Engineering										
9501 05-30-2018 09:47:48 file=C:\Users\IEJ351\Documents\Duba\Duba2.gtp										
Program revision date: December 15, 2017										
Plant Configuration: GT, HRSG, and condensing reheat ST										
2 GE 7F.05 Engines (Physical Model #611), One Steam Turbine, GT PRO Type 7, Subtype 7										
Steam Property Formulation: IAPWS-IF97										
STEAM CYCLE HEAT BALANCE										
Energy in =		1065225	kW							
GT Exhaust/Air Addn.		DB Fuel	Makeup	Process		Feedpump		Steam		Ext. GT
Sensible	Latent	Enthalpy		Return		Aux. Load		/Heat		Water Return
679815	125335	128896	-5605	2770		4819		127427		0 1769
Energy out =		1065249	kW							
Heat	Blowdown/	Mech/Elec/	Stack	Stack	Condenser	Steam	To GT	Process	Electric	
Radiated	Leakages	Gear Loss	Sensible	Latent		/Heat		Water	Output	
4970	1175	4081	133098	137912	446064	268	10693	26601	300386	
Zero enthalpy: dry gases & liquid water @ 32 F (273.15 K)										
Heat Balance Error (In - Out) =			-23,87	kW	=	-0,0022	%			
HRSG GAS SIDE - Totals of 2 HRSG's.										
Zone	Tg	Tw	DT	Afrn	DP	Mg	Qg	Vg	Tube	Tubes
/path	C	C	C	sq.m	millibar	kg/s	kW	m/s	rows	per row
0	590,9	544,4	46,5							
2	HPS3			291,2	0,86	1043,6	11736,6	19,0	4	208
	581,4	522,8	58,6							
1	581,4	530,3	51,1							
0	RH3			291,2	1,27	1043,6	27660,2	18,4	8	156
	558,7	470,1	88,6							
2	558,7	522,8	35,9							
2	HPS2			291,2	1,51	1043,6	22736,1	18,2	8	208
	540,0	482,3	57,7							
Duct Burner - On										
3	630,9	470,6	160,3							
0	RH1			291,2	1,03	1046,1	45144,4	20,3	4	156
	594,5	374,6	219,9							
4	594,5	482,8	111,7							
2	HPS1			291,2	2,48	1046,1	116730,4	18,7	12	208
	499,0	335,9	163,1							
6	499,0	328,8	170,2							
2	HPB1			291,2	8,17	1046,1	190021,3	17,6	24	208
	338,8	328,8	10,0							
7	338,8	325,8	13,0							
2	HPE3			291,2	6,65	1046,1	85090,7	12,7	32	184
	265,0	225,4	39,6							
12	265,0	225,4	39,6							
2	HPE0			291,2	1,75	1046,1	57535,9	10,9	12	184
	214,4	149,7	64,7							
14	214,4	146,2	68,2							

Steam Cycle Summary

0	LPB			291,2	0,88	1046,1	31002,7	10,2	6	184
	186,9	146,2	40,7							
17	186,9	112,6	74,3							
1	LTE			291,2	1,40	1046,1	74017,3	9,1	12	184
	120,6	60,1	60,5							
Totals					25,99		661675,3		61	
HP pinch = 10,0 C LP pinch = 40,7 C										
HPE LMTD (Q-weighted) = 34,9 C										
HRSG gas-side mass flux = 3,592 kg/m^2-s										
Exhaust loss = 30,97 millibar:										
Duct & stack = 4,98, HRSG = 25,99 millibar										
DB Fuel = GE Gas 2014 @ 25 C										
Fuel flow = 2,5021 kg/s; LHV = 46423,01 kJ/kg; MW = 18,442										
Stack gas mole composition, %			N2 %	O2 %	CO2 %	SO2 %	H2O %	AR %		
			74,781	11,645	4,353	0,0000	8,323	0,899		
Flue gas dew point = 42 C M.W.= 28,45										
HRSG inlet flue gas specific volume = 2,419 m^3/kg, exit = 1,138 m^3/kg										
HRSG inlet flue gas volume flow = 1262,4 m^3/s, exit = 595,3 m^3/s (per HRSG)										

Steam Cycle Summary

HRSG - HP CIRCUIT (Totals of 2 HRSG's)								
	P	T	h	M	s	UA	Q	A
	bar	C	kJ/kg	kg/s	kJ/kg-C	kW/C	kW	sq.m
from FW Pump	160,95	149,20	638,61	172,291	1,8170			
HP Feedwater	130,39	149,70	638,61	172,291	1,8248			
To desup	130,39	149,70	638,61	0,218	1,8248			
Heat exchanger: HPE0	128,85	225,40	971,31	172,074	2,5483	1125,29	57250	22305
To GT fuel heater		225,40	971,31	11,008	2,5483			
Heat exchanger: HPE3	126,59	325,80	1496,97	161,065	3,5044	3565,15	84667	72641
Heat exchanger: HPB1	126,59	328,80	2670,86	161,065	5,4546	3363,22	189076	55876
Steam addition	130,00	380,00	2949,64	43,200	5,8927			
Leaving HPS0	126,59	335,90	2729,82	204,265	5,5520			
Heat exchanger: HPS1	123,28	482,80	3298,43	204,265	6,4116	859,77	116150	14118
Desup. water		149,70	638,61	0,107				
Leaving HPS1	123,28	482,30	3297,04	204,372	6,4098			
Heat exchanger: HPS2	122,64	522,80	3407,73	204,372	6,5547	495,11	22623	7421
Heat exchanger: HPS3	122,31	544,40	3464,87	204,372	6,6267	224,39	11678	3589
Bleed	122,31	544,40	3464,87	0,072	6,6267			
HP steam	122,31	544,40	3464,87	204,300	6,6267			
After HP pipe	120,50	543,70	3464,87	204,300	6,6330			
To HPT throttle	120,50	543,70	3464,87	204,300	6,6330			
HRSG - RH CIRCUIT (Totals of 2 HRSG's)								
	P	T	h	M	s	UA	Q	A
	bar	C	kJ/kg	kg/s	kJ/kg-C	kW/C	kW	sq.m
Cold reheat from ST	37,59	374,70	3158,84	199,862	6,7142			
After cold RH pipe	37,45	374,60	3158,84	199,862	6,7158			
Cold reheat	37,45	374,60	3158,84	199,862	6,7158			
into RH1	37,45	374,60	3158,84	199,862	6,7158			
Heat exchanger: RH1	35,93	470,60	3383,59	199,862	7,0578	239,50	44920	5731
Desup. water		149,70	638,61	0,083				
Leaving RH2	35,93	470,10	3382,45	199,945	7,0562			
Heat exchanger: RH3	35,00	530,30	3520,10	199,945	7,2461	405,98	27523	6870
Reheat steam	35,00	530,30	3520,10	199,945	7,2461			
Before desup.	34,87	530,20	3520,10	199,945	7,2478			
Hot reheat to ST	34,87	530,20	3520,10	199,945	7,2478			

Steam Cycle Summary

HRSG - FEEDWATER (Totals of 2 HRSG's)								
	P	T	h	M	s	UA	Q	A
	bar	C	kJ/kg	kg/s	kJ/kg-C	kW/C	kW	sq.m
Condensate return	0,41	33,55	140,54	204,030	0,4854			
After pump	4,42	34,13	143,30	204,030	0,4931			
Process steam return	4,42	82,20	344,51	0,100	1,1012			
Process water return	4,42	15,00	63,31	43,200	0,2244			
GT return	128,85	35,60	160,67	11,008	0,5087			
Blowdown	4,42	31,14	130,81	42,847	0,4523			
FW to LTE	4,42	31,14	130,81	215,491	0,4523			
LTE recirculation	4,29	112,60	472,57	118,291	1,4471			
LTE inlet		60,10		333,782				
Heat exchanger: LTE	4,29	112,60	472,57	333,782	1,4471	1102,11	73649	22885
LTE to D/A	4,29	112,60	472,57	215,491	1,4471			
HRSG - DEAERATOR (Totals of 2 HRSG's)								
	P	T	h	M	s	UA	Q	A
	bar	C	kJ/kg	kg/s	kJ/kg-C	kW/C	kW	sq.m
LPB to D/A	4,29	146,20	2741,23	14,516	6,8720			
D/A water bleed		146,20	615,75	43,200				
Feedwater to LP	4,29	146,20	615,75	14,516	1,8029			
Feedwater to IP/HP	4,29	146,20	615,75	172,292	1,8029			
HRSG - LP CIRCUIT (Totals of 2 HRSG's)								
	P	T	h	M	s	UA	Q	A
	bar	C	kJ/kg	kg/s	kJ/kg-C	kW/C	kW	sq.m
LP Feedwater	4,29	146,20	615,75	14,516	1,8029			
Heat exchanger: LPB	4,29	146,20	2741,23	14,516	6,8720	581,95	30848	11786
Steam made	4,29	146,20	2741,23	14,516	6,8720			
Steam to D/A	4,29	146,20	2741,23	14,516	6,8720			
Boiler feedpumps = 4212 kWe								
Condensate pump(s) = 606,4 kWe								
PROCESS STEAM FLOWS - Plant Totals								
	P	T	h	M	s	Superheat	Quality	
	bar	C	kJ/kg	kg/s	kJ/kg-C	C		
Main HP Process:								
Desup. water		149,70	638,61	0,028				
From source	122,31	326,60	2684,49	0,100	5,4870	0,5		
HP Process Substreams:								
1st HP substream	44,82	257,20	2684,49	0,100	5,8073		0,932	

Steam Cycle Summary

STEAM TURBINE FLOWS										
	P	T	h	M	s	Superheat	Quality	Exp Pwr	Eff	No. of
	bar	C	kJ/kg	kg/s	kJ/kg-C	C		kW	%	stages
Before stop valve	120,50	543,70	3464,87	204,300	6,6330	218,7				
After stop valve	117,49	542,50	3464,87		6,6438	219,4				
-Valve stem leak 1			3464,87	0,324						
-Valve stem leak 2			3464,87	0,110						
-HP inlet leak 1			3464,87	2,740						
HPT inlet	117,49	542,50	3464,87	201,126	6,6438	219,4				
HP Casing: Group HPTL										
GROUP IN	117,49	542,50	3464,87	201,126	6,6438	219,4			87,20*	9
GROUP OUT	37,59	374,70	3158,84	201,126	6,7142	128,0		61552	87,20**	
-HP exit leak 1			3158,84	1,264						
HPT exit	37,59	374,70	3158,84	199,862	6,7142	128,0				
Hot reheat	34,87	530,20	3520,10	199,945	7,2478	287,9				
+Valve stem leak 1			3464,87	0,324						
+HP inlet leak 1			3464,87	2,740						
Before stop valve	34,87	529,80	3519,26	203,010	7,2467	287,5				
After stop valve	34,17	529,50	3519,26	203,010	7,2559	288,3				
-IP inlet leak 1			3519,26	1,508						
IP Casing: Group LPTX1										
GROUP IN	34,17	529,50	3519,26	201,502	7,2559	288,3			91,24*	8
GROUP OUT	5,62	282,90	3027,48	201,502	7,3426	126,6		99096	91,24**	
-IP exit leak			3027,48	0,250						
Crossover	5,62	282,90	3027,48	201,252	7,3426	126,6				
LP Casing: Group LPTL										
GROUP IN	5,62	282,90	3027,48	201,252	7,3426	126,6			91,15*	7
GROUP OUT	0,052	33,53	2296,85	201,252	7,5164		0,891		93,20**	
After LL	0,052	33,53	2312,88	201,252	7,5687		0,897	143817		
To condenser	0,052	33,53	2312,88	201,252	7,5687		0,897			
* : Group overall efficiency (including control valve and/or leaving losses)										
** : Group blading efficiency (excluding control valve and/or leaving losses)										

Steam Cycle Summary

STEAM TURBINE DESIGN							
Casing	Group name	No. of stages	Dry step eff. %	Group Blading eff. %	Group Overall eff. %	Exit quality	Exp Pwr kW
HP Casing	HPTL	9	85,83	87,20	87,20	Sup.	61552,4
IP Casing	LPTX1	8	89,63	91,24	91,24	Sup.	99096,4
LP Casing	LPTL	7	94,19	93,20	91,15	0,891	143817,5
Number of physical casings = 3							
ST expansion power = 304466 kW							
ST mech. loss (lube oil) = 761,2 kW. No gear box							
Gen. elec. & mech. loss = 3319 kW (Elec. & windage loss (generator coolant) = 2901,7 kW, Mech. loss = 417,7 kW)							
Generator elec. & mech. efficiency = 98,91 %							
ST/Generator mech. x elec. efficiency = 98,66 %							
Generator output = 300386 kWe. ST auxiliaries = 159,4 kWe							
Annulus velocity = 214,9 m/s, RPM = 3600							
Dry exhaust loss = 22,28 kJ/kg, corrected exhaust loss = 16,03 kJ/kg (User-defined CF = 1)							
Exhaust volume flow per path = 1219,9 m³/s							
No. of LPT paths = 4, exhaust annulus area per path = 5,676 sq.m							
Last stage bucket length = 791,7 mm, pitch dia. = 2281,9 mm							
DRY EXHAUST LOSS							
Annulus Vel.	Exh. Loss	Annulus Vel.	Exh. Loss	Annulus Vel.	Exh. Loss		
m/s	kJ/kg	m/s	kJ/kg	m/s	kJ/kg		
39	170,200	122	45,775	244	31,094		
46	165,406	137	35,016	274	46,004		
53	159,289	152	27,559	305	63,845		
61	145,448	168	22,813	335	81,662		
76	108,701	183	20,425	366	98,335		
91	81,153	198	20,191	396	115,551		
107	60,733	213	21,984	427	134,547		

Steam Cycle Summary

CONDENSER					
	P	T	h	M	
	bar	C	kJ/kg	kg/s	
LPT exit	0,0519	33,53	2312,88	201,25	
Saturation	0,0519	33,53			
SSR steam		426,20	3332,61	0,30	
SSR excess steam		426,20	3332,61	2,48	
Condensate out	0,4108	33,55	140,54	204,03	
Sea water in		24,00		23870,63	
Sea water out		28,70		23870,63	
Duty = 446064 kW					
Cooling water salt concentration = 4 %					
Number of passes = 1 UA = 64493 kW/C Surface area = 20221 sq.m					
Pr = 6,212 Re = 64184 Nu = 334,9					
Cleanliness = 80,0 % Fouling factor = 0,0525 * 10^-3 [W/sq.m-C]^-1					
Single tube h.t.c. [W/sq.m-C]: Overall = 3645 Internal = 8359 External = 14592					
Tube bundle overall h.t.c. = 3189 W/sq.m-C , Tube bundle h.t.c. / Single tube h.t.c. = 0,875					
Condenser heat transfer calculation: Hardware model					
Tubes: OD = 25,4 mm Thickness = 0,5588 mm Length = 12,31 m Number = 20595					
Tube material: Titanium					
CW vel. = 2,438 m/s DP = 1,104 bar (0,5056 condenser + 0,5982 piping)					
CW pump(s) = 3288 kWe Condensate pump(s) = 606,4 kWe					
PIPES					
	Pipe name		Pressure loss [bar]		
1	HPB to HPT pipe		1,81		
2	Hot reheat pipe		0,13		
3	HP process pipe		1,81		
4	Cold reheat pipe		0,14		
5	Condenser cooling water pipe		0,60		
* Non-heat balance pipes are shown in PEACE output					

HRSR Hardware

HRSR Hardware	1. HPS3	2. RH3	3. HPS2	4. RH1	5. HPS1	6. HPB1
Gas zone / path	[0 / 2]	[1 / 0]	[2 / 2]	[3 / 0]	[4 / 2]	[6 / 2]
Tubing	Serrated fins	Serrated fins	Serrated fins	Solid fins	Solid fins	Serrated fins
Tube arrangement	Staggered	Staggered	Staggered	Staggered	Staggered	Staggered
Fin material	TP409	TP409	TP409	TP409	TP409	CS
Tube material	T91	T22	T91	T22	T91	CS
1. Tube outer diameter [mm]	38,1	50,8	38,1	50,8	38,1	38,1
2. Tube wall thickness [mm]	2,794	2,794	2,667	2,667	2,413	3,404
3. Fin height [mm]	12,7	12,7	12,7	9,525	9,525	12,7
4. Fin spacing [mm]	10,67	11,03	10,16	3,348	4,837	2,73
5. Fin thickness [mm]	0,9906	0,9906	0,9906	0,9906	0,9906	0,9906
6. Number of fins per meter	85,77	83,22	89,67	230,5	171,6	268,8
7. Serrated fin segment width [mm]	3,97	3,97	3,97	0	0	3,97
8. Number of serrated fin segments	34,17	44,22	34,17	0	0	34,17
9. Un-serrated height / fin height	0,2	0,2	0,2	0,2	0,2	0,2
10. Longitudinal row pitch [mm]	95,25	127	95,25	127	95,25	95,25
11. Transverse tube pitch [mm]	76,2	101,4	76,2	101,4	76,2	76,2
12. Fin thermal conductivity @ 500 F (260 C) [W/m-C]	26,13	26,13	26,13	26,13	26,13	46,73
13. Fin thermal conductivity slope [W/m-C^2]	0,0075	0,0075	0,0075	0,0075	0,0075	-0,0249
14. Tube thermal conductivity @ 500 F (260 C) [W/m-C]	27	36,86	27	36,86	27	46,73
15. Tube thermal conductivity slope [W/m-C^2]	0,0053	-0,0109	0,0053	-0,0109	0,0053	-0,0249
16. Pass inlet & exit DP (0=1 vel. head, 1=180 deg. bend)	0	0	0	0	0	0
17. Water/steam side fouling factor [m^2-C/W]	8,806E-05	8,806E-05	8,806E-05	8,806E-05	8,806E-05	8,806E-05
18. Gas side fouling factor [m^2-C/W]	1,761E-04	1,761E-04	1,761E-04	1,761E-04	1,761E-04	1,761E-04
19. Gas side convective h.t.c. adjustment factor	1	1	1	1	1	1
20. Gas side pressure drop correction factor	0,9	0,9	0,9	0,9	0,9	0,9
21. Water side h.t.c. adjustment factor	1	1	1	1	1	1
Outputs:						
22. Number of tube rows (longitudinal)	2	4	4	2	6	12
23. Number of rows per water side flow pass	2	2	2	2	2	12
24. Number of tubes per row (transverse)	104	78	104	78	104	104
25. Tube length [m]	18,29	18,29	18,29	18,29	18,29	18,29
26. Gas path transverse width [m]	7,961	7,961	7,961	7,961	7,961	7,961
27. Gas path frontal area [m^2]	145,6	145,6	145,6	145,6	145,6	145,6
28. Min. gas free flow cross section / frontal area	0,4694	0,4755	0,4681	0,4534	0,4553	0,4093
29. H.T. surface area / min. free flow cross section	13,14	12,42	13,62	21,72	17,76	39,06
30. Gas side Nusselt number Re coefficient	0,2117	0,229	0,2387	0,1519	0,2048	0,1844
31. Primary tube surface / total heat transfer surface	0,232	0,243	0,2234	0,1225	0,1605	0,0718
32. Gas side friction factor Re coefficient	6,264	5,337	5,8	7,76	6,293	10,4
33. Heat exchanger prime outside surface [m^2]	416,3	834,6	829,1	351	1133	2004,8
34. Heat exchanger total fin area [m^2]	1378	2600,5	2881,7	2514,3	5926	25933
35. Heat exchanger total outside area [m^2]	1794,3	3435	3711	2865,3	7059	27938
36. Radiation beam mean length [m]	0,1728	0,2296	0,1728	0,2296	0,1728	0,1728
37. Gas mass flux before tube bundles [kg/m^2-s]	3,592	3,592	3,592	3,592	3,592	3,592
38. Gas mass flux @ min. free flow cross section [kg/m^2-s]	7,653	7,555	7,674	7,923	7,89	8,777
39. Gas face velocity [m/s]	8,908	8,741	8,526	9,198	8,513	7,185
40. Maximum gas velocity [m/s]	18,98	18,38	18,21	20,28	18,7	17,56
41. Gas Reynolds Number	7842	10536	8089	11246	8701	10731
42. Gas Prandtl Number	0,7136	0,7137	0,7137	0,7147	0,7149	0,7165
43. Gas convective Nusselt Number	64,37	84,39	74,06	58,43	66,68	68,86
44. Gas side convective heat transfer coeff. [W/m^2-C]	102,7	98,35	113,9	66,88	97,28	88,15
45. Gas side radiative heat transfer coeff. [W/m^2-C]	3,466	3,878	3,05	2,783	2,382	0,9134
46. Gas side total adjusted h.t.c. [W/m^2-C]	106,2	102,2	117	69,66	99,66	89,06
47. Fin effectiveness	0,6543	0,6605	0,6326	0,8035	0,7347	0,7724
48. Heat exchanger effectiveness	0,3175	0,5407	0,5302	0,3746	0,5681	0,9413
49. Effective / total external area	0,7345	0,743	0,7147	0,8275	0,7773	0,7888
50. Gas pressure drop [millibar]	0,8571	1,273	1,512	1,032	2,477	8,167
51. Water side flow cross section area [m^2]	0,1726	0,2504	0,1753	0,2532	0,1808	0,96

HRSR Hardware

HRSR Hardware	7. HPE3	8. HPE0	9. LPB	10. LTE
Gas zone / path	[7 / 2]	[12 / 2]	[14 / 0]	[17 / 1]
Tubing	Serrated fins	Serrated fins	Serrated fins	Serrated fins
Tube arrangement	Staggered	Staggered	Staggered	Staggered
Fin material	CS	CS	CS	CS
Tube material	CS	CS	CS	CS
1. Tube outer diameter [mm]	38,1	38,1	38,1	38,1
2. Tube wall thickness [mm]	3,404	3,404	2,108	3,048
3. Fin height [mm]	15,88	15,88	15,88	15,88
4. Fin spacing [mm]	3,303	4,37	4,048	4,218
5. Fin thickness [mm]	0,9906	0,9906	0,9906	0,9906
6. Number of fins per meter	232,9	186,6	198,5	192
7. Serrated fin segment width [mm]	3,97	3,97	3,97	3,97
8. Number of serrated fin segments	35,17	35,17	35,17	35,17
9. Un-serrated height / fin height	0,2	0,2	0,2	0,2
10. Longitudinal row pitch [mm]	107,2	107,2	107,2	107,2
11. Transverse tube pitch [mm]	86,06	86,06	86,06	86,06
12. Fin thermal conductivity @ 500 F (260 C) [W/m-C]	46,73	46,73	46,73	46,73
13. Fin thermal conductivity slope [W/m-C^2]	-0,0249	-0,0249	-0,0249	-0,0249
14. Tube thermal conductivity @ 500 F (260 C) [W/m-C]	46,73	46,73	46,73	46,73
15. Tube thermal conductivity slope [W/m-C^2]	-0,0249	-0,0249	-0,0249	-0,0249
16. Pass inlet & exit DP (0=1 vel. head, 1=180 deg. bend)	0	0	0	0
17. Water/steam side fouling factor [m^2-C/W]	8,806E-05	8,806E-05	8,806E-05	8,806E-05
18. Gas side fouling factor [m^2-C/W]	1,761E-04	1,761E-04	1,761E-04	1,761E-04
19. Gas side convective h.t.c. adjustment factor	1	1	1	1
20. Gas side pressure drop correction factor	0,9	0,9	0,9	0,9
21. Water side h.t.c. adjustment factor	1	1	1	1
Outputs:				
22. Number of tube rows (longitudinal)	16	6	3	6
23. Number of rows per water side flow pass	1	1	3	1
24. Number of tubes per row (transverse)	92	92	92	92
25. Tube length [m]	18,29	18,29	18,29	18,29
26. Gas path transverse width [m]	7,961	7,961	7,961	7,961
27. Gas path frontal area [m^2]	145,6	145,6	145,6	145,6
28. Min. gas free flow cross section / frontal area	0,4696	0,4864	0,4821	0,4845
29. H.T. surface area / min. free flow cross section	33,19	26,23	27,97	27,02
30. Gas side Nusselt number Re coefficient	0,1922	0,2051	0,1892	0,2034
31. Primary tube surface / total heat transfer surface	0,0683	0,0884	0,0824	0,0856
32. Gas side friction factor Re coefficient	9,826	8,572	9,355	8,717
33. Heat exchanger prime outside surface [m^2]	2480,2	985,9	485,7	979,4
34. Heat exchanger total fin area [m^2]	33840	10167	5407	10463
35. Heat exchanger total outside area [m^2]	36320	11152	5893	11443
36. Radiation beam mean length [m]	0,2279	0,2279	0,2279	0,2279
37. Gas mass flux before tube bundles [kg/m^2-s]	3,592	3,592	3,592	3,592
38. Gas mass flux @ min. free flow cross section [kg/m^2-s]	7,65	7,385	7,452	7,415
39. Gas face velocity [m/s]	5,971	5,325	4,919	4,432
40. Maximum gas velocity [m/s]	12,71	10,95	10,2	9,149
41. Gas Reynolds Number	10326	11049	11879	13017
42. Gas Prandtl Number	0,7188	0,7215	0,7227	0,7234
43. Gas convective Nusselt Number	70,07	78,23	75,7	86,37
44. Gas side convective heat transfer coeff. [W/m^2-C]	79,35	78,31	70,43	72,26
45. Gas side radiative heat transfer coeff. [W/m^2-C]	0,5543	0,3123	0,1919	0,064
46. Gas side total adjusted h.t.c. [W/m^2-C]	79,9	78,62	70,62	72,32
47. Fin effectiveness	0,7184	0,7295	0,7527	0,7534
48. Heat exchanger effectiveness	0,8855	0,6566	0,4033	0,5225
49. Effective / total external area	0,7376	0,7534	0,7731	0,7745
50. Gas pressure drop [millibar]	6,65	1,748	0,8763	1,402
51. Water side flow cross section area [m^2]	0,0708	0,0708	0,2491	0,074

HRSG Hardware

HRSG Hardware	1. HPS3	2. RH3	3. HPS2	4. RH1	5. HPS1	6. HPB1
52. Water side mean velocity [m/s]	16,5	39,08	15,29	33,04	11,66	2,344
53. Water side Reynolds Number	631251	630095	654727	707407	749333	630744
54. Water side Prandtl Number	0,9904	0,9436	1,019	0,9814	1,335	0,7812
55. Water side Nusselt Number	1001,2	983,8	1040,5	1093,4	1267,4	925,2
56. Water side pressure drop from hardware [bar]	0,4466	1,113	0,8052	0,4557	0,8641	0
57. Water side pressure drop correction factor	2,023	1,561	2,023	1,561	2,023	1
58. Water side heat transfer coefficient [W/m ² -C]	2503,4	1511,9	2484,6	1455,3	2769,6	103900
59. Overall heat transfer coefficient [W/m ² -C]	63,41	59,07	66,76	42,46	61,32	60,19
60. Estimated minimum tube wall temperature [C]	532,9	488,6	493	430,5	367,6	330,1
61. Estimated maximum tube wall temperature [C]	552,4	540,9	529,4	511,4	504,5	350,9
62. Maximum allowable tube wall metal temperature [C]	648,9	648,9	648,9	648,9	648,9	426,7
63. Estimated maximum fin tip temperature [C]	571,3	560,4	544,7	542,5	535,7	399,3
64. Recommended maximum fin metal temperature [C]	676,7	676,7	676,7	676,7	676,7	510
65. Estimated maximum allowable water side pressure [bar]	152,5	65,81	158,4	95,82	155,3	167,1
Thermodynamics:						
66. Gas massflow across HX [kg/s]	521,787	521,787	521,787	523,038	523,038	523,038
67. Gas temperature entering HX [C]	590,9	581,4	558,7	630,9	594,5	499,0
68. Gas enthalpy entering HX [kJ/kg]	770,21	758,97	732,46	832,19	789,04	677,45
69. Gas temperature exiting HX [C]	581,4	558,7	540,0	594,5	499,0	338,8
70. Gas enthalpy exiting HX [kJ/kg]	758,97	732,46	710,68	789,04	677,45	495,80
71. Heat transfer from gas [kW]	5868,3	13830,1	11368,0	22572,2	58365,2	95010,6
72. Water/steam massflow exiting HX [kg/s]	102,186	99,973	102,186	99,931	102,133	80,533
73. Water/steam pressure entering HX [bar]	122,6	35,9	123,3	37,4	126,6	126,6
74. Water/steam temperature entering HX [C]	522,8	470,1	482,3	374,6	335,9	325,8
75. Water/steam enthalpy entering HX [kJ/kg]	3407,73	3382,45	3297,04	3158,84	2729,82	1496,97
76. Water/steam pressure exiting HX [bar]	122,3	35,0	122,6	35,9	123,3	126,6
77. Water/steam temperature exiting HX [C]	544,4	530,3	522,8	470,6	482,8	328,8
78. Water/steam enthalpy exiting HX [kJ/kg]	3464,87	3520,10	3407,73	3383,59	3298,43	2670,86
79. Heat transfer to water/steam [kW]	5839,1	13761,3	11311,5	22459,9	58074,8	94537,9
80. Log mean temperature difference [C]	52,3	68,1	45,9	188,5	135,8	56,5

HRSG Hardware

HRSG Hardware	7. HPE3	8. HPE0	9. LPB	10. LTE
52. Water side mean velocity [m/s]	1,482	1,371	0,5698	2,33
53. Water side Reynolds Number	366219	260715	94945	219601
54. Water side Prandtl Number	0,8546	0,9419	1,176	2,056
55. Water side Nusselt Number	616,9	485,4	232,8	547,4
56. Water side pressure drop from hardware [bar]	1,388	0,5437	0	1,73
57. Water side pressure drop correction factor	1,966	1,966	1	0,2
58. Water side heat transfer coefficient [W/m ² -C]	11742	10559	39467	11490
59. Overall heat transfer coefficient [W/m ² -C]	48,57	50,12	49,38	48,25
60. Estimated minimum tube wall temperature [C]	231,9	158,9	149,6	67,82
61. Estimated maximum tube wall temperature [C]	327,9	231	151,9	122,1
62. Maximum allowable tube wall metal temperature [C]	426,7	426,7	426,7	426,7
63. Estimated maximum fin tip temperature [C]	332,3	244,2	174	145
64. Recommended maximum fin metal temperature [C]	510	510	510	510
65. Estimated maximum allowable water side pressure [bar]	168,1	169	99,25	149,1
Thermodynamics:				
66. Gas massflow across HX [kg/s]	523,038	523,038	523,038	523,038
67. Gas temperature entering HX [C]	338,8	265,0	214,4	186,9
68. Gas enthalpy entering HX [kJ/kg]	495,80	414,46	359,46	329,82
69. Gas temperature exiting HX [C]	265,0	214,4	186,9	120,6
70. Gas enthalpy exiting HX [kJ/kg]	414,46	359,46	329,82	259,07
71. Heat transfer from gas [kW]	42545,3	28767,9	15501,3	37008,6
72. Water/steam massflow exiting HX [kg/s]	80,533	86,037	7,258	166,891
73. Water/steam pressure entering HX [bar]	128,9	130,4	4,3	4,4
74. Water/steam temperature entering HX [C]	225,4	149,7	146,2	60,1
75. Water/steam enthalpy entering HX [kJ/kg]	971,31	638,61	615,75	251,93
76. Water/steam pressure exiting HX [bar]	126,6	128,9	4,3	4,3
77. Water/steam temperature exiting HX [C]	325,8	225,4	146,2	112,6
78. Water/steam enthalpy exiting HX [kJ/kg]	1496,97	971,31	2741,23	472,57
79. Heat transfer to water/steam [kW]	42333,7	28624,8	15424,2	36824,5
80. Log mean temperature difference [C]	23,9	51,1	53,3	67,2

HRSG Gas Summary

Zone	Tin	Tout	Hin	Hout	Min	Q	N2	O2	CO2	SO2
	C	C	kJ/kg	kJ/kg	kg/s	kW	Mole %	%	%	%
0	590,9	581,4	770,21	758,97	521,79	5868,3	75,062	12,478	3,963	0,000
1	581,4	558,7	758,97	732,46	521,79	13830,1	75,062	12,478	3,963	0,000
2	558,7	540,0	732,46	710,68	521,79	11368,0	75,062	12,478	3,963	0,000
3	630,9	594,5	832,19	789,04	523,04	22572,2	74,781	11,645	4,353	0,000
4	594,5	499,0	789,04	677,45	523,04	58365,2	74,781	11,645	4,353	0,000
6	499,0	338,8	677,45	495,80	523,04	95010,6	74,781	11,645	4,353	0,000
7	338,8	265,0	495,80	414,46	523,04	42545,3	74,781	11,645	4,353	0,000
12	265,0	214,4	414,46	359,46	523,04	28767,9	74,781	11,645	4,353	0,000
14	214,4	186,9	359,46	329,82	523,04	15501,3	74,781	11,645	4,353	0,000
17	186,9	120,6	329,82	259,07	523,04	37008,6	74,781	11,645	4,353	0,000
Stack		120,6		259,07	523,04		74,781	11,645	4,353	0,000
Each of 2 units										
Zero enthalpy:	dry gases &	liquid water	at 32 F	(273.15 K)						

HRSG Gas Summary

Zone	H2O	Ar
	%	%
0	7,594	0,902
1	7,594	0,902
2	7,594	0,902
3	8,323	0,899
4	8,323	0,899
6	8,323	0,899
7	8,323	0,899
12	8,323	0,899
14	8,323	0,899
17	8,323	0,899
Stack	8,323	0,899
Each of 2 units		
Zero enthalpy:		

Duct Burner Fuel

Gas Fuel		
Fuel Name: GE Gas 2014		
Fuel supply temperature	25	C
Molecular weight	18,44	
Total LHV + Sensible heat @ 25C	46423	kJ/kg
Total fuel enthalpy referenced to 0C	51515	kJ/kg
Volumetric LHV (P = 1,013 bar, T = 25 C)	35003	kJ/m ³
Volumetric HHV (P = 1,013 bar, T = 25 C)	38704	kJ/m ³
Wobbe index (P = 1,013 bar, T = 25 C)	49314	kJ/m ³
Modified Wobbe index	2582,9	kJ/m ³ -K ^{0.5}
Heating Values		
LHV @ 25C	46423	kJ/kg
HHV @ 25C	51331	kJ/kg
Analysis of Fuel (volume %)		
Hydrogen H2	0	%
Oxygen O2	0	%
Water Vapor H2O	0	%
Nitrogen N2	4	%
Carbon Monoxide CO	0	%
Carbon Dioxide CO2	0	%
Methane CH4	85,1	%
Ethane C2H6	8,1	%
Propane C3H8	2,8	%
n-Butane C4H10	0	%
n-Pentane C5H12	0	%
Hexane C6H14	0	%
Ethylene C2H4	0	%
Propylene C3H6	0	%
Butylene C4H8	0	%
Pentene C5H10	0	%
Benzene C6H6	0	%
Toluene C7H8	0	%
Xylene C8H10	0	%
Acetylene C2H2	0	%
Naphthalene C10H8	0	%
Methanol CH3OH	0	%
Ethanol C2H5OH	0	%
Ammonia NH3	0	%
Hydrogen Sulfide H2S	0	%
Sulfur Dioxide SO2	0	%
Isobutane C4H10	0	%
Carbonyl Sulfide COS	0	%
Hydrogen Cyanide CHN	0	%
Argon Ar	0	%
Total	100	%

Steam Turbine Summary Report

STEAM TURBINE FLOWS										
	P	T	h	M	s	Superheat	Quality	Exp Pwr	Eff	No. of
	bar	C	kJ/kg	kg/s	kJ/kg-C	C		kW	%	stages
Before stop valve	120,50	543,70	3464,87	204,300	6,6330	218,7				
After stop valve	117,49	542,50	3464,87		6,6438	219,4				
-Valve stem leak 1			3464,87	0,324						
-Valve stem leak 2			3464,87	0,110						
-HP inlet leak 1			3464,87	2,740						
HPT inlet	117,49	542,50	3464,87	201,126	6,6438	219,4				
HP Casing: Group HPTL										
GROUP IN	117,49	542,50	3464,87	201,126	6,6438	219,4			87,20*	9
GROUP OUT	37,59	374,70	3158,84	201,126	6,7142	128,0		61552	87,20**	
-HP exit leak 1			3158,84	1,264						
HPT exit	37,59	374,70	3158,84	199,862	6,7142	128,0				
Hot reheat	34,87	530,20	3520,10	199,945	7,2478	287,9				
+Valve stem leak 1			3464,87	0,324						
+HP inlet leak 1			3464,87	2,740						
Before stop valve	34,87	529,80	3519,26	203,010	7,2467	287,5				
After stop valve	34,17	529,50	3519,26	203,010	7,2559	288,3				
-IP inlet leak 1			3519,26	1,508						
IP Casing: Group LPTX1										
GROUP IN	34,17	529,50	3519,26	201,502	7,2559	288,3			91,24*	8
GROUP OUT	5,62	282,90	3027,48	201,502	7,3426	126,6		99096	91,24**	
-IP exit leak			3027,48	0,250						
Crossover	5,62	282,90	3027,48	201,252	7,3426	126,6				
LP Casing: Group LPTL										
GROUP IN	5,62	282,90	3027,48	201,252	7,3426	126,6			91,15*	7
GROUP OUT	0,052	33,53	2296,85	201,252	7,5164		0,891		93,20**	
After LL	0,052	33,53	2312,88	201,252	7,5687		0,897	143817		
To condenser	0,052	33,53	2312,88	201,252	7,5687		0,897			
* : Group overall efficiency (including control valve and/or leaving losses)										
** : Group blading efficiency (excluding control valve and/or leaving losses)										

Steam Turbine Summary Report

STEAM TURBINE DESIGN							
Casing	Group	No. of	Dry step	Group Blading	Group Overall	Exit	Exp Pwr
	name	stages	eff. %	eff. %	eff. %	quality	kW
HP Casing	HPTL	9	85,83	87,20	87,20	Sup.	61552,4
IP Casing	LPTX1	8	89,63	91,24	91,24	Sup.	99096,4
LP Casing	LPTL	7	94,19	93,20	91,15	0,891	143817,5
Number of physical casings = 3							
ST expansion power = 304466 kW							
ST mech. loss (lube oil) = 761,2 kW. No gear box							
Gen. elec. & mech. loss = 3319 kW (Elec. & windage loss (generator coolant) = 2901,7 kW, Mech. loss = 417,7 kW)							
Generator elec. & mech. efficiency = 98,91 %							
ST/Generator mech. x elec. efficiency = 98,66 %							
Generator output = 300386 kWe. ST auxiliaries = 159,4 kWe							
Annulus velocity = 214,9 m/s, RPM = 3600							
Dry exhaust loss = 22,28 kJ/kg, corrected exhaust loss = 16,03 kJ/kg (User-defined CF = 1)							
Exhaust volume flow per path = 1219,9 m^3/s							
No. of LPT paths = 4, exhaust annulus area per path = 5,676 sq.m							
Last stage bucket length = 791,7 mm, pitch dia. = 2281,9 mm							
DRY EXHAUST LOSS							
Annulus Vel.	Exh. Loss	Annulus Vel.	Exh. Loss	Annulus Vel.	Exh. Loss		
m/s	kJ/kg	m/s	kJ/kg	m/s	kJ/kg		
39	170,200	122	45,775	244	31,094		
46	165,406	137	35,016	274	46,004		
53	159,289	152	27,559	305	63,845		
61	145,448	168	22,813	335	81,662		
76	108,701	183	20,425	366	98,335		
91	81,153	198	20,191	396	115,551		
107	60,733	213	21,984	427	134,547		

Steam Turbine Group Data

HP Casing - Group HPTL		
Number paths	1	
Number of stages	9	
Dry step efficiency	85,83	%
Group blading efficiency	87,2	%
Group overall efficiency	87,2	%
Work	61552	kW
Mass flow	201,1	kg/s
Shaft speed	3600	RPM
Before valve		
Pressure	117,5	bar
Temperature	542,5	C
Enthalpy	3465	kJ/kg
HPTL - Blading Inlet		
Pressure	117,5	bar
Temperature	542,5	C
Enthalpy	3465	kJ/kg
Volume flow	5,648	m ³ /s
Nozzle area	0,016	m ²
HPTL - Blading Exit		
Pressure	37,59	bar
Temperature	374,7	C
Enthalpy	3159	kJ/kg
Volume flow	15,04	m ³ /s
IP Casing - Group LPTX1		
Number paths	1	
Number of stages	8	
Dry step efficiency	89,63	%
Group blading efficiency	91,24	%
Group overall efficiency	91,24	%
Work	99096	kW
Mass flow	201,5	kg/s
Shaft speed	3600	RPM
LPTX1 - Blading Inlet		
Pressure	34,17	bar
Temperature	529,5	C
Enthalpy	3519	kJ/kg
Volume flow	21,35	m ³ /s
Nozzle area	0,0539	m ²
LPTX1 - Blading Exit		
Pressure	5,619	bar
Temperature	282,9	C
Enthalpy	3027	kJ/kg
Volume flow	90,6	m ³ /s
LP Casing - Group LPTL		
Number paths	4	
Number of stages	7	
Dry step efficiency	94,19	%
Group blading efficiency	93,2	%

Steam Turbine Group Data

HP Casing - Group HPTL		
Group overall efficiency	91,15	%
Work (per path)	35954	kW
Work (all paths)	143817	kW
Mass flow (per path)	50,31	kg/s
Mass flow (all paths)	201,3	kg/s
Shaft speed	3600	RPM
LPTL - Blading Inlet		
Pressure	5,619	bar
Temperature	282,9	C
Enthalpy	3027	kJ/kg
Volume flow (per path)	22,62	m ³ /s
Nozzle area (per path)	0,0674	m ²
LPTL - Blading Exit		
Pressure	0,0519	bar
Temperature	33,53	C
Enthalpy	2296,8	kJ/kg
Volume flow (per path)	1219,9	m ³ /s
Annulus area (per path)	5,676	m ²
Annulus velocity	214,9	m/s
Pitch diameter	2281,9	mm
Bucket length	791,7	mm
Pitch speed	430,1	m/s
Tip speed	579,4	m/s
After leaving loss		
Pressure	0,0519	bar
Temperature	33,53	C
Enthalpy	2312,9	kJ/kg
Mass flow (per path)	50,31	kg/s
Mass flow (all paths)	201,3	kg/s

ST Leakages

Leakage Stream	Destination	Leakage Flow Model	C Factor m ²	P (source) bar	h kJ/kg	M kg/s
1. Valve stem leak 1	IP inlet	Automatic	5,205	120,5	3465	0,3244
2. Valve stem leak 2	Seal steam regulator	Automatic	4,647	34,17	3465	0,1095
4. HP inlet leak 1	IP inlet	Automatic	42,76	92,69	3465	2,74
7. HP exit leak 1	Seal steam regulator	Automatic	43,69	37,59	3159	1,264
14. IP inlet leak 1	Seal steam regulator	Automatic	65,06	34,17	3519	1,508
16. IP exit leak	Seal steam regulator	Automatic	54,84	5,619	3027	0,2502

SSR & GCS

Stream	P [bar]	T [C]	h [kJ/kg]	M [kg/s]
Seal Steam Regulator (SSR)				
Valve stem leak 2			3465	0,1095
HP exit leak 1			3159	1,264
IP inlet leak 1			3519	1,508
IP exit leak			3027	0,2502
Steam at SSR inlet	1,241	426,2	3333	3,132
Steam to condenser			3333	0,3024
Steam to packing exhaust			3333	0,3527
Excess SSR flow to condenser			3333	2,476
Gland Steam Condenser (GSC)				

Cooling System Report

CONDENSER					
	P	T	h	M	
	bar	C	kJ/kg	kg/s	
LPT exit	0,0519	33,53	2312,88	201,25	
Saturation	0,0519	33,53			
SSR steam		426,20	3332,61	0,30	
SSR excess steam		426,20	3332,61	2,48	
Condensate out	0,4108	33,55	140,54	204,03	
Sea water in		24,00		23870,63	
Sea water out		28,70		23870,63	
Duty = 446064 kW					
Cooling water salt concentration = 4 %					
Number of passes = 1 UA = 64493 kW/C Surface area = 20221 sq.m					
Pr = 6,212 Re = 64184 Nu = 334,9					
Cleanliness = 80,0 % Fouling factor = $0,0525 \cdot 10^{-3} \text{ [W/sq.m-C]}^{-1}$					
Single tube h.t.c. [W/sq.m-C]: Overall = 3645 Internal = 8359 External = 14592					
Tube bundle overall h.t.c. = 3189 W/sq.m-C , Tube bundle h.t.c. / Single tube h.t.c. = 0,875					
Condenser heat transfer calculation: Hardware model					
Tubes: OD = 25,4 mm Thickness = 0,5588 mm Length = 12,31 m Number = 20595					
Tube material: Titanium					
CW vel. = 2,438 m/s DP = 1,104 bar (0,5056 condenser + 0,5982 piping)					
CW pump(s) = 3288 kWe Condensate pump(s) = 606,4 kWe					

Emissions

Emissions	kg/hr	metric ton/year	kg/MW hr (gross)
Gas Turbine Emissions (total for 2 units) - burning gas fuel			
NOx as NO2	0	0	0
CO	0	0	0
UHC as CH4	0	0	0
SOx as SO2	0	0	0
CO2 (net)	228291	1499874	305,1
Duct Burner Emissions (total for 2 units) - burning gas fuel			
NOx as NO2	0	0	0
CO	0	0	0
UHC as CH4	0	0	0
SOx as SO2	0	0	0
CO2 (net)	23580	154919	31,52
Plant Total Emissions			
NOx as NO2	0	0	0
CO	0	0	0
UHC as CH4	0	0	0
SOx as SO2	0	0	0
CO2 (net)	251871	1654792	336,7
NH3	0	0	0
Plant Total Ammonia Consumption for SCR			
Pure NH3	0	0	0
Aqueous Ammonia	0	0	0
Stack Levels			
	ng/J LHV	mg/Nm3 @15% O2, dry	ppmvd @15% O2
NOx as NO2	0	0	0
CO	0	0	0
UHC as CH4	0	0	0
SOx as SO2	0	0	0
NH3	0	0	0
Nm3 at 0 C, 101.325 kPa (32 F, 14.696 psia)			
Note:			
Gas turbine and duct burner NOx, CO, and UHC emissions are computed from user-specified concentrations, input on the Environment topic.			
NH3 emissions are user-specified via 'Ammonia slip' input on the SCR design menu.			
The program DOES NOT predict emissions of these compounds.			
It is the user's responsibility to input OEM-provided data consistent with equipment operation at this specific running condition.			

Water Balance

Plant Water/Steam Mass Flow Balance	Mass flow	
Mass Flow In	43,65	kg/s
Evaporative cooler makeup	0	kg/s
Fogger	0	kg/s
External water to GT injection	0	kg/s
External steam to GT injection	0	kg/s
Steam cycle makeup	-42,85	kg/s
Cooling tower makeup	0	kg/s
Wet air cooled condenser makeup	0	kg/s
Auxiliary cooling tower makeup	0	kg/s
LMS100 cooling tower makeup	0	kg/s
Total HRSG water addition	0	kg/s
Total HRSG steam addition	43,2	kg/s
Condensate addition	0	kg/s
Addition before LTE (FW Tank)	0	kg/s
Deaerator water addition	0	kg/s
Deaerator steam addition	0	kg/s
Process condensate return	0,1	kg/s
Process water return	43,2	kg/s
External steam to HPT	0	kg/s
External steam to LPT	0	kg/s
Mass Flow Out	43,65	kg/s
Water evaporated at GT inlet	0	kg/s
GT water injection	0	kg/s
GT steam injection	0	kg/s
GT fuel heating condensate to external sink	0	kg/s
HRSG blowdown	0	kg/s
Cooling tower blowdown	0	kg/s
Cooling tower water evaporation	0	kg/s
Wet air cooled condenser blowdown	0	kg/s
Wet air cooled condenser water evaporation	0	kg/s
Auxiliary cooling tower blowdown	0	kg/s
Auxiliary cooling tower water evaporation	0	kg/s
LMS100 cooling tower blowdown	0	kg/s
LMS100 cooling tower water evaporation	0	kg/s
Evaporative cooler blowdown	0	kg/s
Total HRSG water bleed	0	kg/s
Total HRSG steam bleed	0	kg/s
Total process steam	0,1	kg/s
Deaerator bleed	43,2	kg/s
IPE bleed	0	kg/s
HPE bleed	0	kg/s
Condensate bleed	0	kg/s
Bleed before LTE (FW Tank)	0	kg/s
ST leakage to external sink	0,3527	kg/s

Water Accounting

Plant Water Accounting	Current flow	% included		
Total Water Consumption			-42,85	kg/s
Evaporative cooler makeup	0	100	0	kg/s
Fogger	0	100	0	kg/s
External water to GT injection	0	100	0	kg/s
Steam cycle makeup	-42,85	100	-42,85	kg/s
Cooling tower makeup	0	100	0	kg/s
Wet air cooled condenser makeup	0	100	0	kg/s
Total HRSG water addition	0	0	0	kg/s
Condensate addition	0	0	0	kg/s
Addition before LTE (FW Tank)	0	0	0	kg/s
Addition at deaerator	0	0	0	kg/s
Auxiliary cooling tower makeup	0	100	0	kg/s
LMS100 cooling tower makeup	0	100	0	kg/s
Total Water Discharge			43,2	kg/s
HRSG blowdown	0	100	0	kg/s
Cooling tower blowdown	0	100	0	kg/s
Wet air cooled condenser blowdown	0	100	0	kg/s
Total HRSG water bleed	0	100	0	kg/s
Deaerator bleed	43,2	100	43,2	kg/s
IPE bleed	0	100	0	kg/s
HPE bleed	0	100	0	kg/s
Condensate bleed	0	100	0	kg/s
Bleed before LTE (FW Tank)	0	100	0	kg/s
Water condensed from GT inlet chilling	0	100	0	kg/s
Auxiliary cooling tower blowdown	0	100	0	kg/s
LMS100 cooling tower blowdown	0	100	0	kg/s
Evaporative cooler blowdown	0	100	0	kg/s

Heat Balance Pumps

Heat Balance Pumps		
1. Integral Feedwater Pump (P29)		
Type	Fixed RPM	
Number in Plant	6	
Number Operating	4	
Number per HRSG	3 - 50%	
Current Conditions (each)		
Delivery Mass Flow	43,07	kg/s
Pump Pressure Rise	156,7 (1735,3)	bar (m)
Pressure Rise After Valve Pressure Drop	126,1 (1396,8)	bar (m)
Suction Pressure	4,293	bar
Suction-side Mass Flow	43,07	kg/s
Extraction #1 Delivery Pressure	39,34	bar
Extraction #1 Mass Flow	0	kg/s
Delivery Pressure	130,4	bar
Pump Shaft Speed	3600	RPM
Pump Isentropic Efficiency	74,45	%
Pump Work	984,5	kW
Pump Mechanical Efficiency	96,89	%
Pump Shaft Work	1016,1	kW
Motor Total Efficiency	96,49	%
Electricity Consumption	1053,1	kW
Nameplate Conditions (each)		
Mass Flow	47,86	kg/s
Head	148,3 (1643,2)	bar (m)
Volume Flow (nominal)	3407	lpm
Head (nominal)	1645,9	m
Extraction #1 Head	35,05 (388,3)	bar (m)
Extraction #1 Mass Flow	0	kg/s
Pump Shaft Speed	3600	RPM
Pump Isentropic Efficiency	75	%
Pump Mechanical Efficiency	97	%
Motor Nameplate Shaft HP / Pump Nameplate Shaft HP	1,035	
Motor Total Efficiency	96,53	%
Nominal Electricity Consumption	1136,5	kW
Motor Shaft Power	1097,1	kW
Motor Shaft Power (rounded)	1118,6	kW
2. HP Feedwater Pump (P1)		
	None	
3. IP Feedwater Pump (P2)		
	None	
4. LP Feedwater Pump (P3)		
	None	
5. Condensate Forwarding Pump (P6)		
Type	Fixed RPM	
Number in Plant	2	
Number Operating	1	
Number per Condenser	2 - 100%	
Current Conditions (each)		
Mass Flow	204	kg/s
Pump Pressure Rise	22,6 (231,7)	bar (m)
Pressure Rise After Valve Pressure Drop	4,01 (41,12)	bar (m)
Flow Margin	20	%
Head Margin	80	%
Pump Shaft Speed	1800	RPM
Pump Isentropic Efficiency	82,1	%
Pump Work	564,7	kW

Heat Balance Pumps

Heat Balance Pumps		
Pump Mechanical Efficiency	96,82	%
Pump Shaft Work	583,2	kW
Motor Total Efficiency	96,18	%
Electricity Consumption	606,4	kW
Nameplate Conditions (each)		
Mass Flow	255	kg/s
Head	20,05 (205,6)	bar (m)
Volume Flow (nominal)	17034	lpm
Head (nominal)	213,4	m
Pump Shaft Speed	1800	RPM
Pump Isentropic Efficiency	85	%
Pump Mechanical Efficiency	97	%
Motor Nameplate Shaft HP / Pump Nameplate Shaft HP	1,035	
Motor Total Efficiency	96,23	%
Nominal Electricity Consumption	670,7	kW
Motor Shaft Power	645,5	kW
Motor Shaft Power (rounded)	671,1	kW
6. Condenser C.W. Pump (P4)		
Type	Fixed RPM	
Number in Plant	2	
Number Operating	2	
Number per Condenser	2 - 50%	
Current Conditions (each)		
Mass Flow	11935	kg/s
Pump Pressure Rise	1,104 (11,29)	bar (m)
Pressure Rise After Valve Pressure Drop	1,104 (11,29)	bar (m)
Flow Margin	10	%
Head Margin	-6,3	%
Pump Shaft Speed	600	RPM
Pump Isentropic Efficiency	85,73	%
Pump Work	1540,9	kW
Pump Mechanical Efficiency	96,93	%
Pump Shaft Work	1589,7	kW
Motor Total Efficiency	96,71	%
Electricity Consumption	1643,8	kW
Nameplate Conditions (each)		
Mass Flow	13261	kg/s
Head	1,038 (10,62)	bar (m)
Volume Flow (nominal)	798722	lpm
Head (nominal)	10,67	m
Pump Shaft Speed	600	RPM
Pump Isentropic Efficiency	87	%
Pump Mechanical Efficiency	97	%
Motor Nameplate Shaft HP / Pump Nameplate Shaft HP	1,035	
Motor Total Efficiency	96,74	%
Nominal Electricity Consumption	1750,3	kW
Motor Shaft Power	1693,3	kW
Motor Shaft Power (rounded)	1677,8	kW
7. GT Inlet Air Chiller/Heater Water Pump (P15)		
	None	

Heat Balance Pipes

PIPES		
	Pipe name	Pressure loss [bar]
1	HPB to HPT pipe	1,81
2	Hot reheat pipe	0,13
3	HP process pipe	1,81
4	Cold reheat pipe	0,14
5	Condenser cooling water pipe	0,60
* Non-heat balance pipes are shown in PEACE output		