

System Summary Report

GT MASTER 27.0 Tractebel Engineering						
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Program revision date: December 15, 2017						
Plant Configuration: GT, HRSG, and condensing reheat ST						
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)	446638		9055		39,76	
Steam Turbine(s)	297576					
Plant Total	744215	728811	5996	6122	60,04	58,80
PLANT EFFICIENCIES						
PURPA efficiency	CHP (Total) efficiency		Power gen. eff. on		Canadian Class 43	
%	%		chargeable energy, %		Heat Rate, kJ/kWh	
55,71	52,61		55,13		7391	
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) =			1370512	kW		
Fuel LHV chemical energy input (77F/25C) =			1239477	kW		
Total energy input (chemical LHV + ext. addn.) =			1366904	kW		
Energy chargeable to power (93,0% LHV alt. boiler) =			1321930	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	223319	39,76	9055	522	592	
Total	446638			1044		
Number of gas turbine unit(s) =			2			
Gas turbine load [%] =			100	%		
Fuel chemical HHV (77F/25C) per gas turbine =			621121	kW		
Fuel chemical LHV (77F/25C) per gas turbine =			561735	kW		
STEAM CYCLE PERFORMANCE						
HRSG eff.	Gross power output	Internal gross	Overall	Net process heat output		
%	kW	elect. eff., %	elect. eff., %	kW		
85,92	297576	43,70	37,55	-76682		
Number of steam turbine unit(s) =				1		
Fuel chemical HHV (77F/25C) to duct burners =				128270	kW	
Fuel chemical LHV (77F/25C) to duct burners =				116006	kW	
DB fuel chemical LHV + HRSG inlet sens. heat =				792576	kW	
Net process heat output as % of total output (net elec. + net heat) =				-11,76	%	
HRSG characteristic time (Stored energy / Gas heat transfer), minutes				15,35		

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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)*	4261	kW
Condensate pump(s)*	606,4	kW
HRSR forced circulation pump(s)	0	kW
LTE recirculation pump(s)	6,847	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	2029,5	kW
Miscellaneous gas turbine auxiliaries	960,2	kW
Miscellaneous steam turbine auxiliaries	159,5	kW
Miscellaneous plant auxiliaries	372,1	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	11683	kW
Actual (user input) overall plant auxiliaries	11683	kW
Transformer losses	3721	kW
Total auxiliaries & transformer losses	15404	kW
* Heat balance related auxiliaries		

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PLANT HEAT BALANCE				
Energy In	1509987	kW		
Ambient air sensible	3087	kW		
Ambient air latent	3571	kW		
Fuel enthalpy @ supply	1375432	kW		
External gas addition to combustor	0	kW		
Steam and water	127427	kW		
Makeup and process return	470,9	kW		
Energy Out	1511157	kW		
Net power output	728811	kW		
Stack gas sensible	110264	kW		
Stack gas latent	137776	kW		
GT mechanical loss	2915,9	kW		
GT gear box loss	0	kW		
GT generator loss	5431	kW		
GT miscellaneous losses	3397	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/DA vent	444559	kW		
Process steam	28725	kW		
Process water	28442	kW		
Blowdown/leakages	1166,7	kW		
Heat radiated from steam cycle	5083	kW		
ST/generator mech/elec/gear loss	4051	kW		
Non-heat balance related auxiliaries	6816	kW		
Transformer loss	3721	kW		
Energy In - Energy Out	-1170,3	kW		
GT heat balance error (arising from GT definitions)	-1174,9	kW		
Steam cycle heat balance error	4,484	kW	0,0004	%
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	744215	kW
Total auxiliaries & transformer losses	15404	kW
Plant net power output	728811	kW
Plant LHV heat rate @ generator terminal	5996	kJ/kWh
Plant HHV heat rate @ generator terminal	6630	kJ/kWh
Plant net LHV heat rate	6122	kJ/kWh
Plant net HHV heat rate	6770	kJ/kWh
Plant LHV electric eff. @ generator terminal	60,04	%
Plant HHV electric eff. @ generator terminal	54,3	%
Plant net LHV electric efficiency	58,8	%
Plant net HHV electric efficiency	53,18	%
2. Plant Efficiencies		
PURPA efficiency, LHV	55,71	%
PURPA efficiency, HHV	50,38	%
CHP (Total) efficiency, LHV	52,61	%
CHP (Total) efficiency, HHV	47,58	%
Power generation eff. on chargeable energy, LHV	55,13	%
Power generation eff. on chargeable energy, HHV	49,86	%
Canadian Class 43 heat rate	7391	kJ/kWh
Plant fuel LHV chemical energy input (77F/25C)	1239477	kW
Plant fuel HHV chemical energy input (77F/25C)	1370512	kW
Total energy input (chemical LHV + ext. addn.)	1366904	kW
Energy chargeable to power, LHV	1321930	kW
Energy chargeable to power, HHV	1461682	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	223319	kW
Gross LHV efficiency	39,76	%
Gross HHV efficiency	35,95	%
Gross LHV heat rate	9055	kJ/kWh
Gross HHV heat rate	10013	kJ/kWh
Exhaust mass flow	521,8	kg/s
Exhaust temperature	592,1	C
Fuel chemical LHV input (77F/25C)	561735	kW
Fuel chemical HHV input (77F/25C)	621121	kW
4. Steam Cycle Performance (LHV)		
HRSG efficiency	85,92	%
Steam turbine gross power	297576	kW
Internal gross efficiency	43,7	%
Overall efficiency	37,55	%
Net process heat output	-76682	kW
Fuel chemical LHV (77F/25C) to duct burners	116006	kW
Fuel chemical HHV (77F/25C) to duct burners	128270	kW
DB fuel chemical LHV + HRSG inlet sens. heat	792576	kW
Net process heat output / total output	-11,76	%
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)	4261	kW
Condensate pump(s)	606,4	kW
HRSG forced circulation pump(s)	0	kW
LTE recirculation pump(s)	6,847	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	2029,5	kW
Miscellaneous gas turbine auxiliaries	960,2	kW
Miscellaneous steam turbine auxiliaries	159,5	kW
Miscellaneous plant auxiliaries	372,1	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	11683	kW
Actual (user input) overall plant auxiliaries	11683	kW
Transformer losses	3721	kW
Total auxiliaries & transformer losses	15404	kW

Stream Table

GT MASTER 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)	17,91	385,1	400,07	371,33	468,69	0,1547
5 GT turbine inlet (per GT)	17,01	1316,3	1692,20	1536,05	480,79	1,35
6 GT exhaust, after turbine diffuser (per GT)	1,045	592,1	771,46	625,32	521,78	1,399
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	46423,02	12,10	-
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	14,0	62,98	-2484,51	0,00	0,2091
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 (per HRSG)	1,011	100,1	237,12	79,16	523,02	0,4869
15 HP steam to HPT, aft desup, bef stop vlv	120,5	528,3	3424,76	877,27	204,31	6,583
16 HP steam to HPT, after pipe, before desup	120,5	528,3	3424,75	877,26	204,31	6,583
17 HP steam to HPT, before HP pipe (per HRSG)	122,3	529,1	3424,75	877,26	102,15	6,577
18 HPS3 exit steam (per HRSG)	122,3	529,1	3424,75	877,26	106,06	6,577
19 HPS3 inlet steam (per HRSG)	122,9	469,7	3261,98	714,49	106,06	6,364
20 HPS2 exit steam (per HRSG)	122,9	469,7	3261,98	714,49	106,06	6,364
21 HPS2 inlet steam (per HRSG)	123,2	406,8	3067,84	520,35	106,06	6,09
22 HPS1 exit steam (per HRSG)	123,2	406,8	3067,84	520,35	106,06	6,09
23 HPS1 inlet steam (per HRSG)	124	334,1	2732,29	184,80	106,06	5,562
24 HPS0 exit steam (per HRSG)	124	327,2	2676,71	129,22	84,46	5,47
25 HPS0 inlet steam (per HRSG)	124	327,2	2676,71	129,22	84,46	5,47
26 HPB exit steam (per HRSG)	124	327,2	2676,71	129,22	84,46	5,47
27 HPB blowdown (per HRSG)	124	327,2	1507,52	-1039,97	0,00	3,522
28 HPB saturated water (per HRSG)	124	327,2	1507,52	-1039,97	84,46	3,522
29 HPB inlet water (per HRSG)	133,3	332,8	1544,46	-1003,03	84,46	3,581
30 HPE3 exit water (per HRSG)	133,3	332,8	1544,46	-1003,03	84,46	3,581
31 HPE3 inlet water (per HRSG)	135,2	295,1	1312,81	-1234,68	84,46	3,187
32 HPE2 exit water (per HRSG)	135,2	295,1	1312,81	-1234,68	84,46	3,187
33 HPE2 inlet water (per HRSG)	135,2	295,1	1312,81	-1234,68	84,46	3,187
34 HPE1 exit water (per HRSG)	135,2	295,1	1312,81	-1234,68	84,46	3,187
35 HPE1 inlet water (per HRSG)	135,2	295,1	1312,81	-1234,68	84,46	3,187
36 HPE0 exit water (per HRSG)	135,2	295,1	1312,81	-1234,68	88,33	3,187
37 HP feedwater, after pump & valve (per HRSG)	136,6	159,4	680,56	-1866,93	89,77	1,921
38 HP feedwater, after pump but before valve (per HRSG)	156,7	159,1	680,56	-1866,93	89,77	1,916
39 Hot reheat after stop valve, Type 7&9	33,97	521,1	3500,40	952,91	202,97	7,235
40 Hot reheat after leakages	34,66	521,4	3500,40	952,91	202,97	7,226
41 Hot reheat to ST, after desup.	34,66	521,9	3501,58	954,09	199,86	7,227
42 Hot reheat after reheat pipe	34,66	521,9	3501,58	954,09	199,86	7,227
43 Hot reheat before reheat pipe (per HRSG)	34,79	522,0	3501,58	954,09	99,93	7,226
44 RH3 exit steam (per HRSG)	34,79	522,0	3501,58	954,09	99,93	7,226
45 RH3 inlet steam (per HRSG)	35,19	437,2	3308,42	760,93	99,93	6,964
46 RH2 exit steam (per HRSG)	35,19	437,2	3308,42	760,93	99,93	6,964
47 RH2 inlet steam (per HRSG)	35,19	437,2	3308,42	760,93	99,93	6,964
48 RH1 exit steam (per HRSG)	35,19	437,2	3308,42	760,93	99,93	6,964
49 RH1 inlet steam (per HRSG)	35,76	356,9	3119,92	572,43	99,93	6,675
50 State before RH1 inlet desup. (per HRSG)	35,76	356,9	3119,92	572,43	99,93	6,675
51 After all interactions in cold reheat line	35,76	356,9	3119,92	572,43	199,86	6,675

Stream Table

GT MASTER Streams	Exergy
	kJ/kg
Note: This is a fixed format table. Not all streams are applicable to current heat balance.	Ref @ 25C
Plant Configuration: GT, HRSG, and condensing reheat ST	Water as vapor
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)	375,12
5 GT turbine inlet (per GT)	1207,89
6 GT exhaust, after turbine diffuser (per GT)	281,42
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	5,29
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 (per HRSG)	8,39
15 HP steam to HPT, aft desup, bef stop vlv	1466,56
16 HP steam to HPT, after pipe, before desup	1466,56
17 HP steam to HPT, before HP pipe (per HRSG)	1468,38
18 HPS3 exit steam (per HRSG)	1468,38
19 HPS3 inlet steam (per HRSG)	1369,16
20 HPS2 exit steam (per HRSG)	1369,16
21 HPS2 inlet steam (per HRSG)	1256,85
22 HPS1 exit steam (per HRSG)	1256,85
23 HPS1 inlet steam (per HRSG)	1078,58
24 HPS0 exit steam (per HRSG)	1050,47
25 HPS0 inlet steam (per HRSG)	1050,47
26 HPB exit steam (per HRSG)	1050,47
27 HPB blowdown (per HRSG)	461,95
28 HPB saturated water (per HRSG)	461,95
29 HPB inlet water (per HRSG)	481,35
30 HPE3 exit water (per HRSG)	481,35
31 HPE3 inlet water (per HRSG)	367,31
32 HPE2 exit water (per HRSG)	367,31
33 HPE2 inlet water (per HRSG)	367,31
34 HPE1 exit water (per HRSG)	367,31
35 HPE1 inlet water (per HRSG)	367,31
36 HPE0 exit water (per HRSG)	367,31
37 HP feedwater, after pump & valve (per HRSG)	112,35
38 HP feedwater, after pump but before valve (per HRSG)	113,87
39 Hot reheat after stop valve, Type 7&9	1347,98
40 Hot reheat after leakages	1350,69
41 Hot reheat to ST, after desup.	1351,43
42 Hot reheat after reheat pipe	1351,43
43 Hot reheat before reheat pipe (per HRSG)	1351,92
44 RH3 exit steam (per HRSG)	1351,92
45 RH3 inlet steam (per HRSG)	1236,89
46 RH2 exit steam (per HRSG)	1236,89
47 RH2 inlet steam (per HRSG)	1236,89
48 RH1 exit steam (per HRSG)	1236,89
49 RH1 inlet steam (per HRSG)	1134,49
50 State before RH1 inlet desup. (per HRSG)	1134,49
51 After all interactions in cold reheat line	1134,49

Stream Table

GT MASTER 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	35,76	356,9	3119,92	572,43	199,86	6,675
53 After cold RH pipe but any addn. to cold RH	35,76	356,9	3119,92	572,43	199,86	6,675
54 Cold reheat, Types 7&9	35,9	357,1	3119,92	572,43	199,86	6,673
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	35,76	243,8	2802,37	254,88	0,00	6,115
59 IP steam extraction from LPT	35,9	357,1	3119,92	572,43	0,00	6,673
60 IP induction after valve and before pipe	35,76	243,8	2802,37	254,88	0,00	6,115
61 IPS2 exit after steam & heat addition (per HRSG)	36,32	244,7	2802,37	254,88	0,00	6,11
62 IPS2 exit steam (per HRSG)	36,32	244,7	2802,37	254,88	0,00	6,11
63 IPS2 inlet steam (per HRSG)	36,32	244,7	2802,37	254,88	0,00	6,11
64 IPS1 exit steam (per HRSG)	36,32	244,7	2802,37	254,88	0,00	6,11
65 IPS1 inlet steam (per HRSG)	36,32	244,7	2802,37	254,88	0,00	6,11
66 IPB exit steam (per HRSG)	36,32	244,7	2802,37	254,88	0,00	6,11
67 IP blowdown (per HRSG)	36,32	244,7	1060,01	-1487,48	0,00	2,745
68 IPB saturated water (per HRSG)	36,32	244,7	1074,23	-1473,26	0,00	2,772
69 IPB inlet water (per HRSG)	36,32	156,8	663,47	-1884,02	0,00	1,907
70 IPE2 exit water (per HRSG)	36,32	156,8	663,47	-1884,02	0,00	1,907
71 IPE2 inlet water (per HRSG)	36,32	156,8	663,47	-1884,02	0,00	1,907
72 IPE1 exit water (per HRSG)	36,32	156,8	663,47	-1884,02	0,00	1,907
73 IP feedwater, after pump & valve (per HRSG)	36,32	156,8	663,51	-1883,98	0,00	1,907
74 IP feedwater, after pump but before valve (per HRSG)	36,32	156,8	663,51	-1883,98	0,00	1,907
75 LP steam induction to LPT after pipe	-	-	-	-	-	-
76 LP induction steam before pipe (per HRSG)	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 (per HRSG)	5,583	156,0	2752,99	205,50	0,00	6,783
79 LPS inlet steam (per HRSG)	5,583	156,0	2752,99	205,50	0,00	6,783
80 LPB exit steam (per HRSG)	5,583	156,0	2752,99	205,50	10,75	6,783
81 LPB blowdown (per HRSG)	5,583	156,1	658,36	-1889,13	0,00	1,903
82 LPB saturated water (per HRSG)	5,583	156,0	658,36	-1889,13	10,75	1,903
83 LPB inlet water (per HRSG)	5,583	156,0	658,36	-1889,13	10,75	1,903
84 LPE exit water (per HRSG)	5,583	156,0	658,36	-1889,13	10,75	1,903
85 LP feedwater, after pump & valve (per HRSG)	5,583	156,0	658,36	-1889,13	10,75	1,903
86 LP feedwater, after pump but before valve (per HRSG)	5,583	156,0	658,36	-1889,13	10,75	1,903
87 Feedwater leaving LTE (to D/A) (per HRSG)	5,583	108,7	456,16	-2091,33	111,37	1,404
88 LTE exit water after bypass (per HRSG)	5,583	108,7	456,16	-2091,33	111,37	1,404
89 LTE exit water after recirculation (per HRSG)	5,583	108,7	456,16	-2091,33	111,37	1,404
90 LTE exit water (per HRSG)	5,583	108,7	456,16	-2091,33	173,17	1,404
91 LTE inlet water after recirculation	5,634	60,1	252,09	-2295,40	346,33	0,8324
92 LTE inlet water before recirculation	5,634	33,0	138,88	-2408,61	222,75	0,4783
93 Total IP+HP feedwater leaving D/A (per HRSG)	5,583	156,0	658,36	-1889,13	89,77	1,903
94 WHTR inlet water (per HRSG)	3,447	15,0	63,31	-2484,18	0,00	0,2247
95 WHTR exit water (per HRSG)	3,447	15,0	63,31	-2484,18	0,00	0,2247
96 DAB inlet water (per HRSG)	5,583	156,0	658,36	-1889,13	0,00	1,903
97 DAB saturated water (per HRSG)	5,583	146,2	615,66	-1931,83	0,00	1,803
98 DAB exit steam (per HRSG)	5,583	156,0	2752,99	205,50	0,00	6,783
99 HPT inlet steam, after stop valve	117,6	527,1	3424,76	877,27	204,31	6,594
100 HPT inlet steam, after leakages	117,6	527,1	3424,76	877,27	201,09	6,594
101 HPTX1 blading exit	115,6	526,2	3424,75	877,26	201,09	6,601
102 HPT process bleed (at bleed source)	115,6	526,2	3424,75	877,26	0,00	6,601
103 HPTX1 group exit	115,6	526,2	3424,75	877,26	201,09	6,601
104 HPTA1 blading exit (cold RH, Types 10&11)	-	-	-	-	-	-
105 Steam addition from external source to HPT	115,6	400,7	3064,65	517,16	0,00	6,109
106 HPTA1 group exit	115,6	526,2	3424,75	877,26	201,09	6,601
107 HPTL blading exit	35,9	357,1	3119,92	572,43	201,09	6,673
108 HPTL exit, after leak. (cold RH, Types 7&9)	35,9	357,1	3119,92	572,43	199,86	6,673

Stream Table

GT MASTER Streams	Exergy kJ/kg
52 After mixing additions and cold reheat	1134,49
53 After cold RH pipe but any addn. to cold RH	1134,49
54 Cold reheat, Types 7&9	1134,99
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	983,71
59 IP steam extraction from LPT	1134,99
60 IP induction after valve and before pipe	983,71
61 IPS2 exit after steam & heat addition (per HRSG)	985,48
62 IPS2 exit steam (per HRSG)	985,48
63 IPS2 inlet steam (per HRSG)	985,48
64 IPS1 exit steam (per HRSG)	985,48
65 IPS1 inlet steam (per HRSG)	985,48
66 IPB exit steam (per HRSG)	985,48
67 IP blowdown (per HRSG)	246,28
68 IPB saturated water (per HRSG)	252,31
69 IPB inlet water (per HRSG)	99,47
70 IPE2 exit water (per HRSG)	99,47
71 IPE2 inlet water (per HRSG)	99,47
72 IPE1 exit water (per HRSG)	99,47
73 IP feedwater, after pump & valve (per HRSG)	99,49
74 IP feedwater, after pump but before valve (per HRSG)	99,49
75 LP steam induction to LPT after pipe	-
76 LP induction steam before pipe (per HRSG)	818,12
77 LPT extraction for 3p CC	672,00
78 LPS exit steam (per HRSG)	735,15
79 LPS inlet steam (per HRSG)	735,15
80 LPB exit steam (per HRSG)	735,15
81 LPB blowdown (per HRSG)	95,57
82 LPB saturated water (per HRSG)	95,64
83 LPB inlet water (per HRSG)	95,64
84 LPE exit water (per HRSG)	95,64
85 LP feedwater, after pump & valve (per HRSG)	95,64
86 LP feedwater, after pump but before valve (per HRSG)	95,64
87 Feedwater leaving LTE (to D/A) (per HRSG)	42,22
88 LTE exit water after bypass (per HRSG)	42,22
89 LTE exit water after recirculation (per HRSG)	42,22
90 LTE exit water (per HRSG)	42,22
91 LTE inlet water after recirculation	8,56
92 LTE inlet water before recirculation	0,92
93 Total IP+HP feedwater leaving D/A (per HRSG)	95,64
94 WHTR inlet water (per HRSG)	0,97
95 WHTR exit water (per HRSG)	0,97
96 DAB inlet water (per HRSG)	95,64
97 DAB saturated water (per HRSG)	82,88
98 DAB exit steam (per HRSG)	735,15
99 HPT inlet steam, after stop valve	1463,45
100 HPT inlet steam, after leakages	1463,45
101 HPTX1 blading exit	1461,28
102 HPT process bleed (at bleed source)	1461,28
103 HPTX1 group exit	1461,28
104 HPTA1 blading exit (cold RH, Types 10&11)	-
105 Steam addition from external source to HPT	1247,80
106 HPTA1 group exit	1461,28
107 HPTL blading exit	1134,99
108 HPTL exit, after leak. (cold RH, Types 7&9)	1134,99

Stream Table

GT MASTER Streams	P	T	h	h*	M	s
	bar	C	kJ/kg	kJ/kg	kg/s	kJ/kg-C
109 LPT inlet, after valve	33,97	521,1	3500,40	952,91	201,46	7,235
110 LPTX1 blading exit	5,584	276,5	3014,25	466,76	201,46	7,322
111 LPT process bleed (at bleed source)	5,584	276,5	3014,25	466,76	0,00	7,322
112 LPTX1 group exit	5,584	276,5	3014,25	466,76	201,21	7,322
113 LPTA1 blading exit	5,584	276,5	3014,25	466,76	201,21	7,322
114 LP steam induction to LPT after pipe	5,584	156,9	2755,04	207,55	0,00	6,788
115 LPT extraction for 3p CC	3,447	148,9	2755,04	207,55	0,00	7,002
116 LPTA1 group exit	5,584	276,5	3014,25	466,76	201,21	7,322
117 LPTX2 blading exit	5,584	276,5	3014,25	466,76	201,21	7,322
118 LPTX2 extraction for D/A heating	5,584	276,5	3014,25	466,76	0,00	7,322
119 LPTX2 group exit	5,584	276,5	3014,25	466,76	201,21	7,322
120 LPTX3 blading exit	5,584	276,5	3014,25	466,76	201,21	7,322
121 DHC2/FWH2 bleed @ turbine	5,584	276,5	3014,25	466,76	0,00	7,322
122 LPTX3 group exit	5,584	276,5	3014,25	466,76	201,21	7,322
123 LPTX4 blading exit	5,584	276,5	3014,25	466,76	201,21	7,322
124 DHC1/FWH1 bleed @ turbine	5,584	276,5	3014,25	466,76	0,00	7,322
125 LPTX4 group exit	5,584	276,5	3014,25	466,76	201,21	7,322
126 Last rotor exit static state, bef leaving loss	0,0518	33,5	2290,70	-256,79	201,21	7,497
127 LPT exhaust aft leaving loss but bef pipe	0,0518	33,5	2306,62	-240,87	201,21	7,549
128 LPT exhaust after pipe	0,0518	33,5	2306,62	-240,87	201,21	7,549
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	10,70	5,807
131 2nd HP substream	44,82	257,2	2684,49	137,01	0,00	5,807
132 HP process steam after valve	120,5	325,0	2684,49	137,01	10,70	5,491
133 HP process steam near HRSG	122,3	326,6	2684,49	137,01	5,35	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	36,32	244,8	2802,78	255,29	0,00	6,11
138 IP process steam near HRSG	36,32	244,8	2802,78	255,29	0,00	6,11
139 LP process steam at delivery	-	-	-	-	-	-
140 LP process before valve	5,583	156,0	2752,99	205,50	0,00	6,783
141 LP process	-	-	-	-	-	-
142 HPT process bleed at delivery	42,43	537,8	0,00	-2547,49	0,00	0
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	115,6	-2,8	0,12	-2547,37	0,00	-0,0423
147 LPT process bleed at delivery	5,055	282,1	3027,44	479,95	0,00	7,391
148 1st LPT bleed substream	5,055	282,1	3027,44	479,95	0,00	7,391
149 2nd LPT bleed substream	5,055	282,1	3027,44	479,95	0,00	7,391
150 LPT process bleed, after valve	5,619	282,8	3027,44	479,95	0,00	7,342
151 LPT process bleed, before valve	5,584	282,8	3027,44	479,95	0,00	7,345
152 DA external heating stream	-	-	-	-	-	-
153 HP pegging steam to D/A	124	327,2	2676,71	129,22	0,00	5,47
154 IPB pegging steam to D/A	36,32	244,7	2802,37	254,88	0,00	6,11
155 LPB steam for D/A heating	5,583	156,0	2752,99	205,50	10,75	6,783
156 Condensate from hot well	0,4107	33,5	140,40	-2407,09	203,95	0,485
157 Condensate pump exit, before vlv	23,01	33,7	143,17	-2404,32	203,95	0,4866
158 Condenser condensate after valve	5,634	34,1	143,17	-2404,32	203,95	0,4923
159 Condenser condensate before GSC	5,634	34,1	143,24	-2404,24	203,95	0,4925
160 Condenser condensate after GSC	5,634	34,1	143,24	-2404,24	203,95	0,4925
161 Makeup water	5,634	33,0	138,88	-2408,61	-42,85	0,4783
162 Desuperheating water (per HRSG)	136,6	159,4	680,51	-1866,97	1,44	1,921
163 Process steam return condensate	5,634	82,2	344,51	-2202,98	10,70	1,101
164 Process water return stream	5,634	15,0	63,31	-2484,18	43,20	0,224
165 Crossover stream after leakages	5,584	276,5	3014,25	466,76	201,21	7,322

Stream Table

GT MASTER Streams	Exergy kJ/kg
109 LPT inlet, after valve	1347,98
110 LPTX1 blading exit	836,01
111 LPT process bleed (at bleed source)	836,01
112 LPTX1 group exit	836,01
113 LPTA1 blading exit	836,01
114 LP steam induction to LPT after pipe	735,81
115 LPT extraction for 3p CC	672,00
116 LPTA1 group exit	836,01
117 LPTX2 blading exit	836,01
118 LPTX2 extraction for D/A heating	836,01
119 LPTX2 group exit	836,01
120 LPTX3 blading exit	836,01
121 DHC2/FWH2 bleed @ turbine	836,01
122 LPTX3 group exit	836,01
123 LPTX4 blading exit	836,01
124 DHC1/FWH1 bleed @ turbine	836,01
125 LPTX4 group exit	836,01
126 Last rotor exit static state, bef leaving loss	60,09
127 LPT exhaust aft leaving loss but bef pipe	60,53
128 LPT exhaust after pipe	60,53
129 HP process @ delivery	1051,98
130 1st HP substream	957,70
131 2nd HP substream	957,70
132 HP process steam after valve	1051,98
133 HP process steam near HRSG	1053,17
134 IP process @ delivery	985,65
135 1st IP substream	665,26
136 2nd IP substream	665,26
137 IP process steam after valve	985,65
138 IP process steam near HRSG	985,65
139 LP process steam at delivery	-
140 LP process before valve	735,15
141 LP process	-
142 HPT process bleed at delivery	0,00
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	17,38
147 LPT process bleed at delivery	828,59
148 1st LPT bleed substream	828,59
149 2nd LPT bleed substream	828,59
150 LPT process bleed, after valve	842,94
151 LPT process bleed, before valve	842,08
152 DA external heating stream	-
153 HP pegging steam to D/A	1050,47
154 IPB pegging steam to D/A	985,48
155 LPB steam for D/A heating	735,15
156 Condensate from hot well	0,45
157 Condensate pump exit, before vlv	2,75
158 Condenser condensate after valve	1,04
159 Condenser condensate before GSC	1,05
160 Condenser condensate after GSC	1,05
161 Makeup water	0,92
162 Desuperheating water (per HRSG)	112,34
163 Process steam return condensate	20,94
164 Process water return stream	1,19
165 Crossover stream after leakages	836,01

Stream Table

GT MASTER Streams	P	T	h	h*	M	s
	bar	C	kJ/kg	kJ/kg	kg/s	kJ/kg-C
166 Crossover stream before leakages	5,584	276,5	3014,25	466,76	201,21	7,322
167 SSR inlet (after desup)	1,241	414,2	3307,59	760,10	3,09	8,488
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	36,32	244,7	2802,37	254,88	0,00	6,11
185 IPS1 exit water/steam addition	-	-	-	-	-	-
186 HPB exit water/steam addition	36,32	244,7	2802,37	254,88	0,00	6,11
187 IPE2 exit water/steam addition	36,32	156,8	663,47	-1884,02	0,00	1,907
188 IPE1 exit water/steam addition	36,32	156,8	663,47	-1884,02	0,00	1,907
189 LPS exit water/steam addition	4,29	293,3	3052,68	505,19	0,00	7,51
190 LPB exit water/steam addition	5,583	156,0	2752,99	205,50	0,00	6,783
191 LPE exit water/steam addition	-	-	-	-	-	-
192 LTE exit steam/water addition stream	-	-	-	-	-	-
193 Water addition stream before LTE	5,634	15,0	63,52	-2483,97	0,00	0,2247
194 Water addition stream at deaerator	5,583	15,0	63,52	-2483,97	0,00	0,2247
195 Water bleed before LTE	5,634	33,0	138,88	-2408,61	0,00	0,4783
196 Addition after cold reheat pipe	35,76	247,1	2814,82	267,33	0,00	6,139
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 (per HRSG)	5,583	156,0	658,36	-1889,13	89,77	1,903
203 Water leaving preheater and entering D/A	5,634	33,0	138,88	-2408,61	222,75	0,4783
204 HPT leakage recovered (simplified method)	34,66	488,1	3424,76	877,27	0,00	7,129
205 FWH1 inlet water	5,634	33,0	138,88	-2408,61	222,75	0,4783
206 FWH2 inlet water	5,634	33,0	138,88	-2408,61	222,75	0,4783
207 HRSG stream to fuel heating	135,2	295,1	1312,81	-1234,68	7,74	3,187
208 HRSG stream from fuel heating	135,2	35,6	161,23	-2386,26	7,74	0,5085
209 ST stream to fuel heating	5,055	282,1	3027,44	479,95	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	46423,02	1,25	-
216 GT fuel at supply	36,88	25,0	51515,02	46423,02	12,10	-
217 GT fuel at combustor	29,51	185,0	51883,40	46791,41	12,10	-
218 DH water return	-	-	-	-	-	-
219 DH water supply	-	-	-	-	-	-
220 ST off-line, ST bypass stream after desup.	0,0518	33,5	2306,62	-240,87	0,00	7,549
221 ST bypass stream to condenser	122,3	529,1	3424,75	877,26	0,00	6,577
222 Addition to ST exhaust before condenser	-	-	-	-	-	-

Stream Table

GT MASTER Streams	Exergy kJ/kg
166 Crossover stream before leakages	836,01
167 SSR inlet (after desup)	781,48
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	985,48
185 IPS1 exit water/steam addition	-
186 HPB exit water/steam addition	985,48
187 IPE2 exit water/steam addition	99,47
188 IPE1 exit water/steam addition	99,47
189 LPS exit water/steam addition	818,12
190 LPB exit water/steam addition	735,15
191 LPE exit water/steam addition	-
192 LTE exit steam/water addition stream	-
193 Water addition stream before LTE	1,19
194 Water addition stream at deaerator	1,18
195 Water bleed before LTE	0,92
196 Addition after cold reheat pipe	988,99
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 (per HRSG)	95,64
203 Water leaving preheater and entering D/A	0,92
204 HPT leakage recovered (simplified method)	1304,05
205 FWH1 inlet water	0,92
206 FWH2 inlet water	0,92
207 HRSG stream to fuel heating	367,31
208 HRSG stream from fuel heating	14,27
209 ST stream to fuel heating	828,59
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 off-line, ST bypass stream after desup.	60,53
221 ST bypass stream to condenser	1468,38
222 Addition to ST exhaust before condenser	-

Stream Table

GT MASTER Streams	P	T	h	h*	M	s
	bar	C	kJ/kg	kJ/kg	kg/s	kJ/kg-C

Stream Table

GT MASTER Streams	Exergy
	kJ/kg

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	29,39	millibar
SCR	N/A	
CO catalyst	N/A	
Duct & stack	4,9	millibar
Stack leaving loss	N/A	
Stack friction loss	N/A	
Stack buoyancy boost	N/A	
Total GT Exhaust Losses	34,29	millibar

Exergy Analysis

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

PLANT EXERGY ANALYSIS				
Exergy In		1306134	kW	
Fuel exergy		1253416	kW	
Ambient air exergy		685,6	kW	
Condenser cooling water in		67,77	kW	
Process condensate return		224,1	kW	
Process water return		51,55	kW	
Makeup water		-39,49	kW	
External steam/water		51728	kW	
Exergy Out		754293	kW	
Net electric output		728811	kW	
Process steam/water exergy @ delivery		14379	kW	
Condenser cooling water out		2324,6	kW	
Stack gas exergy		8779	kW	
Exergy Loss		551841	kW	
GT exergy loss		396190	kW	
HRSG exergy loss		95280	kW	
Steam turbine exergy loss		30696	kW	
Condenser exergy loss		9832	kW	
Non-heat balance related auxiliaries		6816	kW	
Transformer loss		3721	kW	
Miscellaneous exergy loss*		1781,7	kW	
Unaccounted exergy loss**		7525	kW	0,5761 %
* 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		568253	kW	
GT fuel exergy @ combustor		568344	kW	
Air exergy @ compressor inlet		-91,2	kW	
Exergy Out		370158	kW	
GT electric output		223319	kW	
GT exhaust exergy		146839	kW	
Exergy Loss		198095	kW	
GT combustor exergy loss		163411	kW	
GT compressor and turbine exergy loss		30511	kW	
Mechanical/electrical/gear loss		4173	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		569762	kW	
GT fuel exergy @ supply		568053	kW	
Ambient air		342,8	kW	
Steam / water to GT peripheral		1366,6	kW	
Exergy Out		370158	kW	
GT electric output		223319	kW	
GT exhaust exergy		146839	kW	
Exergy Loss		199604	kW	
GT combustor exergy loss		163411	kW	
GT compressor and turbine exergy loss		30511	kW	
Mechanical/electrical/gear loss		4173	kW	
Other		1509,1	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	466292	kW
HRSG inlet gas exergy	292787	kW
HRSG feedwater exergy	205,3	kW
Duct burner fuel exergy	117311	kW
Feedpump power	4261	kW
Steam and water addition	51728	kW
Exergy Out	371012	kW
Steam to ST - Cold reheat	343460	kW
Steam and water bleed (near HRSG)	18449	kW
Stack gas exergy	8779	kW
HRSG water to desuperheating	324,2	kW
Exergy Loss	95280	kW
Heat transfer exergy loss	41729	kW
Duct burner combustion exergy loss	44553	kW
Blowdown and feedpump losses	275,8	kW
Other	8722	kW
STEAM TURBINE EXERGY ANALYSIS		
Exergy In	342889	kW
Throttle steam exergy (before stop valve)	299631	kW
Induction/addition steam exergy	270105	kW
Extraction steam exergy	-226847	kW
Exergy Out	312193	kW
ST electric output	297576	kW
ST exhaust steam	12179	kW
Leakages not recovered to ST	2437,7	kW
Exergy Loss	30696	kW
ST expansion exergy loss	23168	kW
Mechanical/electrical/gear loss	4051	kW
Other	3477	kW
STEAM TURBINE AND CONDENSER EXERGY ANALYSIS		
Exergy In	346244	kW
Throttle steam exergy (before stop valve)	299631	kW
Induction/addition steam exergy	270105	kW
Extraction steam exergy	-226847	kW
Condenser cooling water pump power	3288	kW
Condenser cooling water in	67,77	kW
Exergy Out	302429	kW
ST electric output	297576	kW
ST exhaust condensate	90,43	kW
Leakages not recovered to ST/condenser	2437,7	kW
Condenser cooling water out	2324,6	kW
Exergy Loss	43815	kW
ST exergy loss	30696	kW
Condenser heat transfer exergy loss	9832	kW
Other	3288	kW
CONDENSER EXERGY ANALYSIS		
Exergy In	12247	kW
ST exhaust to condenser	12179	kW
Condenser cooling water in	67,77	kW
Exergy Out	2415	kW
ST exhaust condensate	90,43	kW
Condenser cooling water out	2324,6	kW
Exergy Loss	9832	kW

Computation Messages

Warning Messages	
	No warning messages
Advisory Messages	
	No advisory messages
Remarks	
	No remarks
Capacity Messages	
	No capacity messages

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 MASTER 27.0 Tractebel Engineering											
9501 05-30-2018 09:57:49 file=C:\Users\IEJ351\Documents\Duba\Duba2.GTM											
Program revision date: December 15, 2017											
Plant Configuration: GT, HRSG, and condensing reheat ST											
ESTIMATED G.T. SITE PERFORMANCE (Physical Model #611)											
Fuel = GE Gas 2014, supplied @ 25 C											
LHV @ 25 C = 46423,02 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 = 34,29 millibar											
Inlet filter = 10 millibar											
Duct & stack = 4,90, HRSG = 29,39 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	1316	592	510	223319	9055	522	75,065	12,486	3,960	7,587	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	4458	0	0	4458	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	17,91	385	468,69	28,942	77,904	20,902	0,030	0,225	0,938		
Fuel flow	29,51	185	12,10017								
Turbine inlet	17,01	1316	480,79	28,458	74,827	11,781	4,289	8,204	0,899		
Turbine coolant			40,98								
Turbine exhaust	1,05	592	521,78	28,495	75,065	12,486	3,960	7,587	0,902		
Compressor = 199248 Turbine = 426741 kW											
Turbine coolant = 8,041% compr in											
Mech loss = 1457,9 kW											
Generator total loss = 2715,4 kW (Elec. & windage loss (generator coolant) = 2287 kW, Mech. loss (lube oil) = 428,4 kW)											
Mech eff. = 99,36% Generator eff. = 98,8%											
GT specific power @ gen term = 438,2 kW per kg/s											
GT efficiency @ gen term = 35,95% HHV = 39,76% LHV											
GT efficiency @ gen term adjusted for fuel temp. @ combustor of 185 C = 35,7% HHV = 39,44% LHV											
Exhaust gas specific volume = 2,412 m^3/kg Volume flow = 1258,5 m^3/s											

Gas Turbine Summary Report

GAS TURBINE/GENERATOR HEAT BALANCE (Physical Model #611)											
Energy in =		631137		kW							
Compressor Inlet		Compressor Inlet		Water		Steam		Fuel Enthalpy		Gas/Air	
Air Sensible		Air Latent		Injection		Injection		@ Combustor		Addition	
1544		1785		0		0		627808		0	
Energy out =		631724		kW							
Misc	Mech	Gbox	Gen	Turb(Q1)	Exhaust	Exhaust	Electric		Steam(Q2)	Proc	
Loss	Loss	Loss	Loss	Coolant	Sensible	Latent	Output		Coolant	Air	
1699	1458	0	2715	0	339926	62608	223319		0	0	
Zero enthalpy: dry gases & liquid water @ 32 F (273.15 K)											
Heat Balance Error (In - Out) =		-587,4		kW		=	-0,0931	%			

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	34,29	millibar
1. Estimated G.T. Site Performance		
GT load as percent of rating	100	%
Gross power output	223319	kW
Gross LHV heat rate	9055	kJ/kWh
Gross HHV heat rate	10013	kJ/kWh
Gross LHV efficiency	39,76	%
Gross HHV efficiency	35,95	%
Gross LHV efficiency adjusted for fuel temperature	39,76	%
Gross HHV efficiency adjusted for fuel temperature	35,95	%
TIT control model	Inferred	
Compressor pressure ratio	17,89	
Turbine inlet temperature	1316,3	C
Turbine exhaust pressure	1,045	bar
Turbine exhaust temperature	592,1	C
Turbine exhaust mass flow	521,8	kg/s
Turbine exhaust molecular weight	28,5	
Flue gas mole composition N2	75,06	%
Flue gas mole composition O2	12,49	%
Flue gas mole composition CO2	3,96	%
Flue gas mole composition SO2	0	%
Flue gas mole composition H2O	7,587	%
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	223319	kW
Turbine	426741	kW
Compressor	199248	kW
Mechanical loss	1457,9	kW
Gear box loss	0	kW
Generator loss	2715,4	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)	561735	kW
Fuel chemical HHV input (77F/25C)	621121	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:	631137	kW
Inlet air sensible	1543,7	kW
Inlet air latent	1785,3	kW
Water injection	0	kW
Steam injection	0	kW
Fuel enthalpy @ combustor	627808	kW
External gas addition	0	kW
From ASU	0	kW
Energy out:	631724	kW
Miscellaneous loss	1698,6	kW
Mechanical loss	1457,9	kW
Gear box loss	0	kW
Generator loss	2715,4	kW
Turbine coolant (Q1)	0	kW
Exhaust sensible	339926	kW
Exhaust latent	62608	kW
Gross output	223319	kW
Process air	0	kW
Steam coolant (Q2)	0	kW
Heat Balance Error, In - Out	-587,4	kW
Heat Balance Error %, In - Out	-0,0931	%

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 = 46423,02 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	4458	0	0	4458	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 MASTER 27.0 Tractebel Engineering																			
9501 05-30-2018 09:57:49 file=C:\Users\IEJ351\Documents\Duba\Duba2.GTM																			
Program revision date: December 15, 2017																			
Type:7 Disconnected																			
Steam Property Formulation: IAPWS-IF97																			
STEAM CYCLE HEAT BALANCE																			
Energy in =		1067810	kW																
GT Exhaust/Air Addn.		DB Fuel	Makeup		Process		Feedpump		Steam		Ext.	GT							
Sensible		Latent		Enthalpy				Return		Aux. Load		/Heat	Water	Return					
679851		125216		128731		-5951		6421		4867		127427		0	1248				
Energy out =		1067806	kW																
Heat		Blowdown/		Mech/Elec/		Stack		Stack		Condenser		Steam		To GT	Process	Electric			
Radiated		Leakages		Gear Loss		Sensible		Latent		/DA vent		/Heat				Water		Output	
5083		1167		4051		110264		137776		444559		28725		10164		28442		297576	
Zero enthalpy: dry gases & liquid water @ 32 F (273.15 K)																			
Heat Balance Error (In - Out) =			4,484		kW		=		0,0004		%								
HRSG GAS SIDE - Each 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		591,0		529,1		61,9													
2		HPS3						177,2		1,28		521,8		17350,4		16,5		3,0	90,0
		562,6		469,7		93,0													
1		562,6		522,0		40,6													
0		RH3						177,2		1,97		521,8		19399,6		16,3		4,0	90,0
		530,6		437,2		93,4													
2		530,6		469,7		61,0													
2		HPS2						177,2		1,71		521,8		20693,1		16,1		3,0	90,0
		496,3		406,8		89,4													
Duct Burner - On																			
3		588,3		437,2		151,1													
0		RH1						177,2		0,42		523,0		18931,7		13,2		3,0	68,0
		557,5		356,9		200,5													
4		557,5		406,8		150,6													
2		HPS1						177,2		0,97		523,0		35766,8		13,9		3,0	92,0
		498,7		334,1		164,7													
6		498,7		327,2		171,5													
2		HPB1						177,2		4,62		523,0		96109,3		12,6		12,0	92,0
		336,6		327,2		9,4													
7		336,6		332,8		3,8													
2		HPE3						177,2		9,15		523,0		19663,0		10,4		26,0	104,0
		302,6		295,1		7,5													
12		302,6		295,1		7,5													
2		HPE0						177,2		6,02		523,0		56130,8		9,2		20,0	104,0
		204,1		159,4		44,8													
14		204,1		156,0		48,1													
0		LPB						177,2		1,85		523,0		22633,6		8,1		8,0	92,0

Steam Cycle Summary

	163,9	156,0	7,8							
17	163,9	108,7	55,2							
1	LTE			177,2	1,39	523,0	35510,9	7,4	6,0	92,0
	100,1	60,1	39,9							
Totals					29,39		342189,3		88	
HP pinch = 9,4 C LP pinch = 7,8 C										
HPE LMTD (Q-weighted) = 16,8 C										
Exhaust loss = 34,29 millibar:										
Duct & stack = 4,90, HRSG = 29,39 millibar										
DB Fuel=GE Gas 2014 @ 25 C										
Fuel flow = 1,2494 kg/s; LHV = 46423,02 kJ/kg; MW = 18,442										
Stack gas mole composition, %				N2 %	O2 %	CO2 %	SO2 %	H2O %	AR %	
				74,784	11,654	4,348	0,0000	8,315	0,899	
Flue gas dew point = 42 C M.W.= 28,45										
HRSG inlet flue gas specific volume = 2,412 m ³ /kg, exit = 1,079 m ³ /kg										
HRSG inlet flue gas volume flow = 1258,5 m ³ /s, exit = 564,1 m ³ /s (per HRSG)										

Steam Cycle Summary

* UPPER CASE CAPTIONS for total plant flows.

HRSG - HP CIRCUIT (Data for each of 2 HRSG's)*								
	P	T	h	m or M	s	UA	Q	A
	bar	C	kJ/kg	kg/s	kJ/kg-C	kW/C	kW	sq.m
feedpump discharge	156,71	159,10	680,56	89,774	1,9163			
HP feedwater	136,59	159,40	680,56	89,774	1,9214			
TO DESUP.	136,59	159,40	680,51	2,886	1,9213			
Heat exchanger: HPE0	135,20	295,10	1312,81	88,330	3,1868	2660,48	55852	61287
To GT fuel heater		295,10	1312,81	3,871	3,1868			
Heat exchanger: HPE3	133,29	332,80	1544,46	84,460	3,5813	3563,44	19565	79673
Heat exchanger: HPB1	124,02	327,20	2676,71	84,460	5,4701	1722,50	95631	33263
STEAM ADDITION	130,00	380,00	2949,64	43,200	5,8927			
Leaving HPS0	124,02	334,10	2732,29	106,060	5,5622			
Heat exchanger: HPS1	123,24	406,80	3067,84	106,060	6,0897	236,11	35589	6163
Heat exchanger: HPS2	122,91	469,70	3261,98	106,060	6,3642	295,09	20590	8660
Heat exchanger: HPS3	122,26	529,10	3424,75	106,060	6,5773	237,04	17264	6165
Bleed	122,26	529,10	3424,75	3,907	6,5773			
Leaving HP circuit	122,26	529,10	3424,75	102,153	6,5773			
AFTER PIPE	120,50	528,30	3424,75	204,305	6,5835			
TO HPT THROTTLE	120,50	528,30	3424,76	204,305	6,5835			
HRSG - RH CIRCUIT (Data for each of 2 HRSG's)*								
	P	T	h	m or M	s	UA	Q	A
	bar	C	kJ/kg	kg/s	kJ/kg-C	kW/C	kW	sq.m
COLD RH FROM ST	35,90	357,10	3119,92	199,863	6,6731			
AFTER COLD RH PIPE	35,76	356,90	3119,92	199,863	6,6748			
COLD REHEAT STEAM	35,76	356,90	3119,92	199,863	6,6748			
Entering reheater	35,76	356,90	3119,92	99,932	6,6748			
Heat exchanger: RH1	35,19	437,20	3308,42	99,932	6,9636	109,93	18838	1812
Heat exchanger: RH3	34,79	522,00	3501,58	99,932	7,2256	330,20	19303	9733
Leaving RH circuit	34,79	522,00	3501,58	99,932	7,2256			
AFTER HOT RH PIPE	34,66	521,90	3501,58	199,863	7,2273			
HOT REHEAT TO ST	34,66	521,90	3501,58	199,863	7,2273			

Steam Cycle Summary

HRSG - FEEDWATER (Data for each of 2 HRSG's)*								
	P	T	h	m or M	s	UA	Q	A
	bar	C	kJ/kg	kg/s	kJ/kg-C	kW/C	kW	sq.m
FROM COND WELL	0,41	33,52	140,40	203,953	0,4850			
AFTER COND PUMP	5,63	34,07	143,17	203,953	0,4923			
PROCESS RETURN	5,63	82,18	344,51	10,700	1,1009			
PROCESS WATER	5,63	14,97	63,31	43,200	0,2240			
FUEL HEATER RETURN	135,20	35,60	161,23	7,742	0,5085			
EXTRACTION	5,63	33,04	138,88	42,847	0,4783			
MIXED FEEDWATER	5,63	33,04	138,88	222,747	0,4783			
feedwater per HRSG	5,63	33,04	138,88	111,374	0,4783			
LTE recirculation addn.		108,70	456,16	61,792				
LTE inlet		60,12	252,09	173,166				
Heat exchanger: LTE	5,58	108,70	456,16	173,166	1,4040	772,02	35334	20368
To LTE recirculation	5,58	108,70	456,16	61,792	1,4040			
To deaerator	5,58	108,70	456,16	111,374	1,4040			
HRSG - DEAERATOR (Data for each of 2 HRSG's)*								
	P	T	h	m or M	s	UA	Q	A
	bar	C	kJ/kg	kg/s	kJ/kg-C	kW/C	kW	sq.m
steam from LPB	5,58	156,00	2752,99	10,752	6,7835			
PROCESS WATER BLEED	5,58	156,00	658,36	43,200	1,9030			
feedwater to LP	5,58	156,00	658,36	10,752	1,9030			
fw to IP and/or HP	5,58	156,00	658,36	89,774	1,9030			
HRSG - LP CIRCUIT (Data for each of 2 HRSG's)*								
	P	T	h	m or M	s	UA	Q	A
	bar	C	kJ/kg	kg/s	kJ/kg-C	kW/C	kW	sq.m
water from D/A	5,58	156,00	658,36	10,752	1,9030			
Heat exchanger: LPB	5,58	156,00	2752,99	10,752	6,7835	1020,82	22521	23043
LPB steam to D/A	5,58	156,00	2752,99	10,752	6,7835			
Boiler feedpumps = 2130,5 kWe								
Condensate pump(s) = 606,4 kWe								
PROCESS STEAM FLOWS								
	P	T	h	m	s	Superheat	Quality	
	bar	C	kJ/kg	kg/s	kJ/kg-C	C		
MAIN HP PROCESS:								
DESUP. WATER		159,40	680,51	2,886				
HP proc near source	122,26	326,60	2684,49	5,350	5,4871	0,4		
HP PROC AFTR VLV2	120,50	325,00	2684,49	10,700	5,4911		1,000	
HP PROCESS SUBSTREAMS:								
1ST HP SUB	44,82	257,20	2684,49	10,700	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	528,30	3424,76	204,305	6,5835	203,3				
AFTER STOP VALVE	117,57	527,10	3424,76		6,5939	204,0				
-Valve stem leak 1			3424,76	0,329						
-Valve stem leak 2			3424,76	0,110						
-HP inlet leak 1			3424,76	2,776						
HPT INLET	117,57	527,10	3424,76	201,090	6,5939	204,0				
HP Casing: Group HPTL										
GROUP IN	115,57	526,20	3424,75	201,090	6,6012	204,4			86,12*	9
GROUP OUT	35,90	357,10	3119,92	201,090	6,6731	113,0		61300	87,22**	
-HP exit leak 1			3119,92	1,227						
HPT EXIT	35,90	357,10	3119,92	199,863	6,6731	113,0				
HOT REHEAT	34,66	521,90	3501,58	199,863	7,2273	279,9				
+Valve stem leak 1			3424,76	0,329						
+HP inlet leak 1			3424,76	2,776						
BEF STOP VALVE	34,66	521,40	3500,40	202,968	7,2258	279,4				
AFT STOP VALVE	33,97	521,10	3500,40	202,968	7,2349	280,3				
-IP inlet leak 1			3500,40	1,508						
IP Casing: Group LPTX1										
GROUP IN	33,97	521,10	3500,40	201,461	7,2349	280,3			91,25*	8
GROUP OUT	5,58	276,50	3014,25	201,461	7,3215	120,4		97942	91,25**	
-IP exit leak			3014,25	0,250						
CROSSOVER	5,58	276,50	3014,25	201,211	7,3215	120,4				
LP Casing: Group LPTL										
GROUP IN	5,58	276,50	3014,25	201,211	7,3215	120,4			91,02*	7
GROUP OUT	0,052	33,50	2290,70	201,211	7,4972		0,888		93,07**	
AFTER LL	0,052	33,50	2306,62	201,211	7,5491		0,895	142384		
TO CONDENSER	0,052	33,50	2306,62	201,211	7,5491		0,895			
* : Group overall efficiency (including control valve and/or leaving losses)										
** : Group blading efficiency (excluding control valve and/or leaving losses)										
ST Model Adjustments: Disabled										
Dry exhaust loss = 22,22 kJ/kg, corrected exhaust loss = 15,92 kJ/kg (User-defined CF = 1, Adj. Factor = 1)										
Exhaust volume flow per path = 1218,3 m³/s										
ST expansion power = 301627 kW.										
ST mech. loss (lube oil) = 760,5 kW.										
Generator loss adjustment factor = 1										
Generator elec. & mech. loss = 3290 kW (Elec. & windage loss (generator coolant) = 2872,4 kW, Mech. loss = 417,7 kW)										
Generator elec. & mech. eff = 98,91 %										
ST/Generator mech. x elec. efficiency = 98,66 %										
Generator output = 297576 kWe. ST auxiliaries = 159,5 kWe										

Steam Cycle Summary

CONDENSER					
	P	T	h	m	
	bar	C	kJ/kg	kg/s	
LPT exit	0,0518	33,50	2306,62	201,21	
SSR steam		414,20	3307,59	0,30	
SSR excess steam		414,20	3307,59	2,44	
Saturation	0,0518	33,50			
Condensate out	0,4107	33,52	140,40	203,95	
Sea water in		24,00		23869,92	
Sea water out		28,68		23869,92	
Condenser model: Standard Thermoflow Model					
Duty = 444559 kW (99,67% design)					
Cooling water salt concentration = 4 %					
Tubes: OD = 25,4 mm Thickness = 0,5588 mm Length = 12,3 m Number = 20595					
Tube material: Titanium					
UA = 64502 kW/C CW velocity = 2,438 m/s					
Pr = 6,213 Re = 64171 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 = 8358 External = 14603					
Tube bundle overall h.t.c. = 3190 W/sq.m-C , Tube bundle h.t.c. / Single tube h.t.c. = 0,875					
Condenser heat transfer calculation: Hardware model					
Condenser effectiveness = 0,4932, Effectiveness adjustment factor = 1					
CW DP = 1,087 bar (0,5056 condenser + 0,5809 piping loss)					
CW pump = 3288 kWe Condensate pump = 606,4 kWe					
PIPES					
	Pipe name		Pressure loss [bar]		
1	HPB to HPT pipe		1,76		
2	Hot reheat pipe		0,13		
3	HP process pipe		0,00		
4	Cold reheat pipe		0,14		
5	Condenser cooling water pipe		0,58		
* Non-heat balance pipes are shown in PEACE output					

HRSG Hardware

HRSG 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	Solid 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	T91	T91	T91	T91	CS
Gas/water flow sequence (0=counter, 1=parallel flow)	0	0	0	0	0	0
1. Number of tube rows (longitudinal)	3	4	3	3	3	12
2. Number of tubes per row (transverse)	90	90	90	68	92	92
3. Number of rows per water side flow pass	3	4	3	3	3	12
4. Longitudinal row pitch [mm]	90	90	90	92	84	84
5. Gas path transverse width [m]	7,98	7,98	7,98	7,98	7,98	7,98
6. Tube length [m]	22,2	22,2	22,2	22,2	22,2	22,2
7. Tube outer diameter [mm]	44,5	44,5	44,5	50,8	38,1	38,1
8. Tube wall thickness [mm]	6	2,6	4	3,4	4,8	2,9
9. Fin height [mm]	12	15	15	8	12	15
10. Fin spacing [mm]	3,878	4,263	3,348	11,5	3,348	3
11. Fin thickness [mm]	1	1	1	1	1	1
12. Number of fins per meter	205	190	230	80	230	250
13. Serrated fin segment width [mm]	0	4	4	0	0	4
14. Number of serrated fin segments	0	39,66	39,66	0	0	34,64
15. Un-serrated height / fin height	0,2	0,2	0,2	0,2	0,2	0,2
16. Fin thermal conductivity @ 500 F (260 C) [W/m-C]	26,13	26,13	26,13	26,13	26,13	46,73
17. Fin thermal conductivity slope [W/m-C^2]	0,0075	0,0075	0,0075	0,0075	0,0075	-0,0249
18. Tube thermal conductivity @ 500 F (260 C) [W/m-C]	27	27	27	27	27	46,73
19. Tube thermal conductivity slope [W/m-C^2]	0,0053	0,0053	0,0053	0,0053	0,0053	-0,0249
20. Heat exchanger effectiveness adjustment factor	1	1	1	1	1	1
21. Pass inlet & exit DP (0=1 vel. head, 1=180 deg. bend)	0	0	0	0	0	0
22. 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
23. 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
24. Gas side convective h.t.c. adjustment factor	1	1	1	1	1	1
25. Gas side pressure drop correction factor	0,9	0,9	0,9	0,9	0,9	0,9
26. Water side pressure drop correction factor	2,024	1,561	2,024	1,561	2,024	1
27. Water side h.t.c. adjustment factor	1	1	1	1	1	1
Outputs:						
28. Transverse tube pitch [mm]	88,18	88,18	88,18	116,5	86,27	86,27
29. Gas path frontal area [m^2]	177,2	177,2	177,2	177,2	177,2	177,2
30. Min. gas free flow cross section / frontal area	0,4371	0,4283	0,4148	0,5489	0,4917	0,4689
31. H.T. surface area / min. free flow cross section	26,54	32,07	39,29	6,211	23,58	33,37
32. Gas side Nusselt number Re coefficient	0,1769	0,2041	0,1827	0,2373	0,174	0,201
33. Primary tube surface / total heat transfer surface	0,1081	0,093	0,0745	0,367	0,0916	0,0661
34. Gas side friction factor Re coefficient	8,268	9,579	11,14	4,348	8,08	10,38
35. Water side flow cross section area [m^2]	0,224	0,4367	0,2825	0,3102	0,1761	0,9046
36. Heat exchanger prime outside surface [m^2]	666,2	905	645,2	665	564,7	2200,2
37. Heat exchanger total fin area [m^2]	5499	8828	8015	1146,9	5598	31063
38. Heat exchanger total outside area [m^2]	6165	9733	8660	1811,8	6163	33263
39. Radiation beam mean length [m]	0,1545	0,1545	0,1545	0,1842	0,1727	0,1727
40. Gas mass flux before tube bundles [kg/m^2-s]	2,945	2,945	2,945	2,952	2,952	2,952
41. Gas mass flux @ min. free flow cross section [kg/m^2-s]	6,738	6,877	7,101	5,379	6,004	6,297
42. Gas face velocity [m/s]	7,224	6,967	6,685	7,219	6,837	5,894
43. Maximum gas velocity [m/s]	16,53	16,27	16,12	13,15	13,9	12,57
44. Gas Reynolds Number	8211	8560	9138	7858	6801	7710
45. Gas Prandtl Number	0,7137	0,7137	0,7139	0,7149	0,7152	0,7165
46. Gas convective Nusselt Number	55,42	65,71	61,39	72,31	48,28	60,53
47. Gas side convective heat transfer coeff. [W/m^2-C]	73,97	85,35	76,44	79,75	68,06	77,34
48. Gas side radiative heat transfer coeff. [W/m^2-C]	1,965	1,614	1,254	4,36	1,53	0,8388
49. Gas side total adjusted h.t.c. [W/m^2-C]	75,94	86,96	77,69	84,11	69,59	78,18
50. Fin effectiveness	0,7005	0,6256	0,6466	0,8298	0,7073	0,7386

HRSG Hardware

HRSG 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
Gas/water flow sequence (0=counter, 1=parallel flow)	0	0	0	0
1. Number of tube rows (longitudinal)	26	20	8	6
2. Number of tubes per row (transverse)	104	104	92	92
3. Number of rows per water side flow pass	2	2	8	2
4. Longitudinal row pitch [mm]	73	73	84	84
5. Gas path transverse width [m]	7,98	7,98	7,98	7,98
6. Tube length [m]	22,2	22,2	22,2	22,2
7. Tube outer diameter [mm]	31,8	31,8	38,1	38,1
8. Tube wall thickness [mm]	3,3	3,3	2,4	2,4
9. Fin height [mm]	15	15	15	16
10. Fin spacing [mm]	2,533	2,533	2,904	2,533
11. Fin thickness [mm]	0,8	0,8	0,8	0,8
12. Number of fins per meter	300	300	270	300
13. Serrated fin segment width [mm]	4	4	4	4
14. Number of serrated fin segments	29,69	29,69	34,64	34,95
15. Un-serrated height / fin height	0,2	0,2	0,2	0,2
16. Fin thermal conductivity @ 500 F (260 C) [W/m-C]	46,73	46,73	46,73	46,73
17. Fin thermal conductivity slope [W/m-C^2]	-0,0249	-0,0249	-0,0249	-0,0249
18. Tube thermal conductivity @ 500 F (260 C) [W/m-C]	46,73	46,73	46,73	46,73
19. Tube thermal conductivity slope [W/m-C^2]	-0,0249	-0,0249	-0,0249	-0,0249
20. Heat exchanger effectiveness adjustment factor	1	1	1	1
21. Pass inlet & exit DP (0=1 vel. head, 1=180 deg. bend)	0	0	0	0
22. Water/steam side fouling factor [m^2-C/W]	8,806E-05	8,806E-05	8,806E-05	8,806E-05
23. Gas side fouling factor [m^2-C/W]	1,761E-04	1,761E-04	1,761E-04	1,761E-04
24. Gas side convective h.t.c. adjustment factor	1	1	1	1
25. Gas side pressure drop correction factor	0,9	0,9	0,9	0,9
26. Water side pressure drop correction factor	1,968	1,968	1	0,2
27. Water side h.t.c. adjustment factor	1	1	1	1
Outputs:				
28. Transverse tube pitch [mm]	76,36	76,36	86,27	86,27
29. Gas path frontal area [m^2]	177,2	177,2	177,2	177,2
30. Min. gas free flow cross section / frontal area	0,4869	0,4869	0,4806	0,4668
31. H.T. surface area / min. free flow cross section	35,52	35,52	33,83	41,05
32. Gas side Nusselt number Re coefficient	0,2034	0,2034	0,1996	0,1946
33. Primary tube surface / total heat transfer surface	0,0572	0,0572	0,0665	0,0547
34. Gas side friction factor Re coefficient	11,16	11,16	10,56	11,9
35. Water side flow cross section area [m^2]	0,1037	0,1037	0,641	0,1603
36. Heat exchanger prime outside surface [m^2]	4558	3506	1533,3	1114,8
37. Heat exchanger total fin area [m^2]	75115	57781	21509	19253
38. Heat exchanger total outside area [m^2]	79673	61287	23043	20368
39. Radiation beam mean length [m]	0,162	0,162	0,1727	0,1727
40. Gas mass flux before tube bundles [kg/m^2-s]	2,952	2,952	2,952	2,952
41. Gas mass flux @ min. free flow cross section [kg/m^2-s]	6,063	6,063	6,143	6,325
42. Gas face velocity [m/s]	5,058	4,493	3,901	3,457
43. Maximum gas velocity [m/s]	10,39	9,226	8,116	7,405
44. Gas Reynolds Number	6599	7284	9847	11368
45. Gas Prandtl Number	0,7179	0,7205	0,7228	0,7232
46. Gas convective Nusselt Number	55,39	59,13	70,67	75,65
47. Gas side convective heat transfer coeff. [W/m^2-C]	78,4	74,24	65,34	61,71
48. Gas side radiative heat transfer coeff. [W/m^2-C]	0,488	0,2627	0,1102	0,0017
49. Gas side total adjusted h.t.c. [W/m^2-C]	78,89	74,5	65,45	61,71
50. Fin effectiveness	0,6981	0,7173	0,7478	0,7408

HRSG Hardware

HRSG Hardware	1. HPS3	2. RH3	3. HPS2	4. RH1	5. HPS1	6. HPB1
51. Heat exchanger effectiveness	0,4896	0,6761	0,5075	0,347	0,3257	0,9453
52. Effective / total external area	0,7329	0,6605	0,673	0,8923	0,7341	0,7559
53. Gas pressure drop [millibar]	1,277	1,965	1,715	0,4241	0,9722	4,619
54. Water side mass flux [kg/m ² -s]	473,5	228,8	375,4	322,2	602,3	1680,5
55. Water side mean velocity [m/s]	12,39	22,04	8,552	26,71	10,96	2,592
56. Water side Reynolds Number	530186	323664	519861	584181	736641	718508
57. Water side Prandtl Number	1,021	0,9455	1,112	0,989	1,44	0,7805
58. Water side Nusselt Number	879,5	577,8	890,4	940,5	1281,6	1026,5
59. Water side heat transfer coefficient [W/m ² -C]	2108	984,4	1787,4	1231,4	3357	112658
60. Water side pressure drop [bar]	0,6524	0,4018	0,326	0,5719	0,7751	0
61. Overall heat transfer coefficient [W/m ² -C]	38,45	33,93	34,08	60,68	38,31	51,79
62. Estimated minimum tube wall temperature [C]	497,5	474,6	437,2	392,9	373,7	328,3
63. Estimated maximum tube wall temperature [C]	547,7	538,3	490,4	464,3	443,1	346,4
64. Maximum allowable tube wall metal temperature [C]	648,9	648,9	648,9	648,9	648,9	426,7
65. Estimated maximum fin tip temperature [C]	564,6	551,2	510,6	492,4	486,5	403,4
66. Recommended maximum fin metal temperature [C]	676,7	676,7	676,7	676,7	676,7	510
67. Estimated maximum allowable water side pressure [bar]	326,8	128,4	237,9	181,6	395,3	139,6
Thermodynamics:						
68. Gas massflow across HX [kg/s]	521,775	521,775	521,775	523,024	523,024	523,024
69. Gas temperature entering HX [C]	591,0	562,6	530,6	588,3	557,5	498,7
70. Gas enthalpy entering HX [kJ/kg]	770,15	736,90	699,72	781,55	745,35	676,97
71. Gas temperature exiting HX [C]	562,6	530,6	496,3	557,5	498,7	336,6
72. Gas enthalpy exiting HX [kJ/kg]	736,90	699,72	660,06	745,35	676,97	493,21
73. Heat transfer from gas [kW]	17350,4	19399,6	20693,1	18931,7	35766,8	96109,3
74. Water/steam massflow exiting HX [kg/s]	106,060	99,932	106,060	99,932	106,060	84,460
75. Water/steam pressure entering HX [bar]	122,9	35,2	123,2	35,8	124,0	133,3
76. Water/steam temperature entering HX [C]	469,7	437,2	406,8	356,9	334,1	332,8
77. Water/steam enthalpy entering HX [kJ/kg]	3261,98	3308,42	3067,84	3119,92	2732,29	1544,46
78. Water/steam pressure exiting HX [bar]	122,3	34,8	122,9	35,2	123,2	124,0
79. Water/steam temperature exiting HX [C]	529,1	522,0	469,7	437,2	406,8	327,2
80. Water/steam enthalpy exiting HX [kJ/kg]	3424,75	3501,58	3261,98	3308,42	3067,84	2676,71
81. Heat transfer to water/steam [kW]	17264,1	19303,1	20590,2	18837,5	35588,8	95631,1
82. Additional water/steam pressure drop at HX exit [bar]	0	0	0	0	0	0
83. HX exit control valve water/steam pressure drop [bar]	0	0	0	0	0	0
84. Log mean temperature difference [C]	76,4	63,4	74,3	174,6	157,5	55,8
Stored Energy*:						
85. Total weight of fins [kg]	20070	27381	24859	4106	20411	98483
86. Average temperature of fins [C]	529,6	513,5	472,1	439,5	423,5	347,3
87. Total weight of tubes [kg]	34107	21447	23919	17979	24125	61628
88. Average temperature of tubes [C]	499,4	479,6	438,3	397,1	370,5	327,2
89. Stored energy in fins [MJ]	6236	8226	6817	1042,4	4979	19977
90. Stored energy in tubes [MJ]	9940	5983	6054	4090	5092	11603
91. Stored energy in HX water/steam [MJ]	635,4	342,8	871,4	266,9	622,9	10216
92. Stored energy in headers [MJ]	261	422,9	233,4	263,3	205,1	1853,3
93. Stored energy in drums [MJ]	0	0	0	0	0	22589
94. Stored energy in liner/casing [MJ]	542,2	681,1	477	4826	459	1424,3
95. Total stored energy [MJ]	17615	15655	14452	10488	11359	67664
96. Rate of increase in stored energy [kW]	0	0	0	0	0	0
97. Total weight of headers and tube sheets [kg]	790,1	1436,6	790,1	1077,4	790,1	4421
98. Total weight of interconnecting piping [kg]	4123	3770	3718	1737,1	3399	32084
*Reference = 32 F (273.15 K)						

HRSG Hardware

HRSG Hardware	7. HPE3	8. HPE0	9. LPB	10. LTE
51. Heat exchanger effectiveness	0,9088	0,9478	0,8375	0,615
52. Effective / total external area	0,7153	0,7335	0,7645	0,755
53. Gas pressure drop [millibar]	9,155	6,024	1,85	1,388
54. Water side mass flux [kg/m ² -s]	814,1	851,4	301,9	1080,6
55. Water side mean velocity [m/s]	1,18	1,013	0,3313	1,115
56. Water side Reynolds Number	250081	179205	57671	106991
57. Water side Prandtl Number	0,9566	0,8533	1,104	2,107
58. Water side Nusselt Number	471,9	348,1	153	310,5
59. Water side heat transfer coefficient [W/m ² -C]	9873	9026	26129	6252
60. Water side pressure drop [bar]	1,901	1,392	0	0,0509
61. Overall heat transfer coefficient [W/m ² -C]	44,73	43,41	44,3	37,9
62. Estimated minimum tube wall temperature [C]	296,6	168,1	156,9	67,21
63. Estimated maximum tube wall temperature [C]	333,6	296,6	161,1	118,5
64. Maximum allowable tube wall metal temperature [C]	426,7	426,7	426,7	426,7
65. Estimated maximum fin tip temperature [C]	334,9	299	176,6	135,3
66. Recommended maximum fin metal temperature [C]	510	510	510	510
67. Estimated maximum allowable water side pressure [bar]	199,3	200,9	114,3	114,3
Thermodynamics:				
68. Gas massflow across HX [kg/s]	523,024	523,024	523,024	523,025
69. Gas temperature entering HX [C]	336,6	302,6	204,1	163,9
70. Gas enthalpy entering HX [kJ/kg]	493,21	455,62	348,29	305,01
71. Gas temperature exiting HX [C]	302,6	204,1	163,9	100,1
72. Gas enthalpy exiting HX [kJ/kg]	455,62	348,29	305,01	237,12
73. Heat transfer from gas [kW]	19663,0	56130,8	22633,6	35510,9
74. Water/steam massflow exiting HX [kg/s]	84,460	88,330	10,752	173,166
75. Water/steam pressure entering HX [bar]	135,2	136,6	5,6	5,6
76. Water/steam temperature entering HX [C]	295,1	159,4	156,0	60,1
77. Water/steam enthalpy entering HX [kJ/kg]	1312,81	680,51	658,36	252,09
78. Water/steam pressure exiting HX [bar]	133,3	135,2	5,6	5,6
79. Water/steam temperature exiting HX [C]	332,8	295,1	156,0	108,7
80. Water/steam enthalpy exiting HX [kJ/kg]	1544,46	1312,81	2752,99	456,16
81. Heat transfer to water/steam [kW]	19565,2	55851,6	22521,0	35334,3
82. Additional water/steam pressure drop at HX exit [bar]	0	0	0	0
83. HX exit control valve water/steam pressure drop [bar]	0	0	0	0
84. Log mean temperature difference [C]	5,4	20,8	22,2	47,1
Stored Energy*:				
85. Total weight of fins [kg]	198026	152327	56726	50840
86. Average temperature of fins [C]	315,7	235,2	162	97,69
87. Total weight of tubes [kg]	139071	106977	34485	25864
88. Average temperature of tubes [C]	314	227,3	156	84,41
89. Stored energy in fins [MJ]	35666	19255	4720	2466,9
90. Stored energy in tubes [MJ]	24877	12987	2756,2	1079,2
91. Stored energy in HX water/steam [MJ]	29517	19297	3485	3663
92. Stored energy in headers [MJ]	3428	2015,6	561,4	231,2
93. Stored energy in drums [MJ]	0	0	8015	0
94. Stored energy in liner/casing [MJ]	2011,8	1201,7	391	204,2
95. Total stored energy [MJ]	95501	54756	19928	7645
96. Rate of increase in stored energy [kW]	0	0	0	0
97. Total weight of headers and tube sheets [kg]	9580	7369	2107	1580,2
98. Total weight of interconnecting piping [kg]	26001	20001	18197	5871
*Reference = 32 F (273.15 K)				

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	591,0	562,6	770,15	736,90	521,78	17350,4	75,065	12,486	3,960	0,000
1	562,6	530,6	736,90	699,72	521,78	19399,6	75,065	12,486	3,960	0,000
2	530,6	496,3	699,72	660,06	521,78	20693,1	75,065	12,486	3,960	0,000
3	588,3	557,5	781,55	745,35	523,02	18931,7	74,784	11,654	4,348	0,000
4	557,5	498,7	745,35	676,97	523,02	35766,8	74,784	11,654	4,348	0,000
6	498,7	336,6	676,97	493,21	523,02	96109,3	74,784	11,654	4,348	0,000
7	336,6	302,6	493,21	455,62	523,02	19663,0	74,784	11,654	4,348	0,000
12	302,6	204,1	455,62	348,29	523,02	56130,8	74,784	11,654	4,348	0,000
14	204,1	163,9	348,29	305,01	523,02	22633,6	74,784	11,654	4,348	0,000
17	163,9	100,1	305,01	237,12	523,02	35510,9	74,784	11,654	4,348	0,000
Stack		100,1		237,12	523,02		74,784	11,654	4,348	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	7,587	0,902
1	7,587	0,902
2	7,587	0,902
3	8,315	0,899
4	8,315	0,899
6	8,315	0,899
7	8,315	0,899
12	8,315	0,899
14	8,315	0,899
17	8,315	0,899
Stack	8,315	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	528,30	3424,76	204,305	6,5835	203,3				
AFTER STOP VALVE	117,57	527,10	3424,76		6,5939	204,0				
-Valve stem leak 1			3424,76	0,329						
-Valve stem leak 2			3424,76	0,110						
-HP inlet leak 1			3424,76	2,776						
HPT INLET	117,57	527,10	3424,76	201,090	6,5939	204,0				
HP Casing: Group HPTL										
GROUP IN	115,57	526,20	3424,75	201,090	6,6012	204,4			86,12*	9
GROUP OUT	35,90	357,10	3119,92	201,090	6,6731	113,0		61300	87,22**	
-HP exit leak 1			3119,92	1,227						
HPT EXIT	35,90	357,10	3119,92	199,863	6,6731	113,0				
HOT REHEAT	34,66	521,90	3501,58	199,863	7,2273	279,9				
+Valve stem leak 1			3424,76	0,329						
+HP inlet leak 1			3424,76	2,776						
BEF STOP VALVE	34,66	521,40	3500,40	202,968	7,2258	279,4				
AFT STOP VALVE	33,97	521,10	3500,40	202,968	7,2349	280,3				
-IP inlet leak 1			3500,40	1,508						
IP Casing: Group LPTX1										
GROUP IN	33,97	521,10	3500,40	201,461	7,2349	280,3			91,25*	8
GROUP OUT	5,58	276,50	3014,25	201,461	7,3215	120,4		97942	91,25**	
-IP exit leak			3014,25	0,250						
CROSSOVER	5,58	276,50	3014,25	201,211	7,3215	120,4				
LP Casing: Group LPTL										
GROUP IN	5,58	276,50	3014,25	201,211	7,3215	120,4			91,02*	7
GROUP OUT	0,052	33,50	2290,70	201,211	7,4972		0,888		93,07**	
AFTER LL	0,052	33,50	2306,62	201,211	7,5491		0,895	142384		
TO CONDENSER	0,052	33,50	2306,62	201,211	7,5491		0,895			
* : Group overall efficiency (including control valve and/or leaving losses)										
** : Group blading efficiency (excluding control valve and/or leaving losses)										
ST Model Adjustments: Disabled										
Dry exhaust loss = 22,22 kJ/kg, corrected exhaust loss = 15,92 kJ/kg (User-defined CF = 1, Adj. Factor = 1)										
Exhaust volume flow per path = 1218,3 m³/s										
ST expansion power = 301627 kW.										
ST mech. loss (lube oil) = 760,5 kW.										
Generator loss adjustment factor = 1										
Generator elec. & mech. loss = 3290 kW (Elec. & windage loss (generator coolant) = 2872,4 kW, Mech. loss = 417,7 kW)										
Generator elec. & mech. eff = 98,91 %										
ST/Generator mech. x elec. efficiency = 98,66 %										
Generator output = 297576 kWe. ST auxiliaries = 159,5 kWe										

Steam Turbine Group Data

GT MASTER 27.0 Tractebel Engineering		
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Program revision date: December 15, 2017		
STEAM TURBINE DESIGN & CONTROLS		
HP Casing: Group HPTL		
1. Number of stages	9	
2. Dry stage efficiency at the design point flow function	85,83	%
3. Design dry stage efficiency adjustment factor	1	
4. Efficiency degradation	0	%
5. Design point total inlet nozzle adjusted area	0,016	sq.m
6. Inlet nozzle area adjustment factor	1	
7. Design point flow function	0,0151	sq.m
8. Group inlet pressure control method	Throttle	
9. Number of inlet valves/nozzle sectors	N/A	
10. Minimum pressure drop of inlet control valve	0	%
11. Onset of valve partial overlap region (% of design flow)	N/A	
12. End of valve partial overlap region (% of design flow)	N/A	
13. Valve overlap schedule parameter	N/A	
14. Off-design dry stage efficiency	85,81	%
15. Group blading efficiency	87,22	%
16. Group overall efficiency (including control valve and/or leaving losses)	86,12	%
17. Off-design flow function	0,0152	sq.m
18. Group expansion power	61300	kW
IP Casing: Group LPTX1		
1. Number of stages	8	
2. Dry stage efficiency at the design point flow function	89,64	%
3. Design dry stage efficiency adjustment factor	1	
4. Efficiency degradation	0	%
5. Design point total inlet nozzle adjusted area	0,0539	sq.m
6. Inlet nozzle area adjustment factor	1	
7. Design point flow function	0,0531	sq.m
8. Group inlet pressure control method	Sliding	
9. Number of inlet valves/nozzle sectors	N/A	
10. Minimum pressure drop of inlet control valve	N/A	
11. Onset of valve partial overlap region (% of design flow)	N/A	
12. End of valve partial overlap region (% of design flow)	N/A	
13. Valve overlap schedule parameter	N/A	
14. Off-design dry stage efficiency	89,64	%
15. Group blading efficiency	91,25	%
16. Group overall efficiency (including control valve and/or leaving losses)	91,25	%
17. Off-design flow function	0,0531	sq.m
18. Group expansion power	97942	kW
LP Casing: Group LPTL		
1. Number of stages	7	
2. Dry stage efficiency at the design point flow function	94,2	%
3. Design dry stage efficiency adjustment factor	1	
4. Efficiency degradation	0	%
5. Design point total inlet nozzle adjusted area	0,2696	sq.m
6. Inlet nozzle area adjustment factor	1	
7. Design point flow function	0,2696	sq.m
8. Group inlet pressure control method	Sliding	
9. Number of inlet valves/nozzle sectors	N/A	
10. Minimum pressure drop of inlet control valve	N/A	
11. Onset of valve partial overlap region (% of design flow)	N/A	
12. End of valve partial overlap region (% of design flow)	N/A	

Steam Turbine Group Data

13. Valve overlap schedule parameter	N/A				
14. Off-design dry stage efficiency	94,2	%			
15. Group blading efficiency	93,07	%			
16. Group overall efficiency (including control valve and/or leaving losses)	91,02	%			
17. Off-design flow function	0,2696	sq.m			
18. Group expansion power	142384	kW			
STEAM TURBINE MISCELLANEOUS					
1. HPT inlet control	Throttle				
2. IPB/LPT interaction	Induction				
3. LPB/LPT interaction	Disconnected				
4. IP process pressure control, 0=sliding 1=controlled	0				
5. HPT steam addn. pressure control 0=no 1=yes (types 10&11 only)	N/A				
6. Desired LPT inlet pressure (types 10&11 only)	34,17	bar			
7. HPT inlet steam leakage	1	%			
8. Percentage of HPT leakage recovered and injected into ST	75				
9. Condensation quality (Wilson Line)	0,97				
10. Moisture efficiency penalty (Baumann coefficient)	0,72				
11. Number of LPT exhaust annuli per machine	4				
12. ST generator electrical loss correction factor	1				
13. ST generator electrical loss adjustment factor	1				
14. Resistance coefficient of HPT inlet stop valve	0,0533	m^-4			
15. ST operation: 0=on 1=off/steam to condenser 2=off/steam to proc	0				
16. Maximum steam turbine throttle flow (per ST)	255,375	kg/s			
17. Minimum pressure drop of HPT inlet control	0	%			
18. LPT last stage speed	3600	RPM			
19. LPT last stage rotor exit angle in degrees	63,45				
20. LPT last stage pitch diameter	2,282	m			
21. LPT last stage blade height	0,7917	m			
22. LPT annulus area	5,676	sq.m			
23. LPT last stage pitch velocity	430,1	m/s			
24. Axial velocity component at LPT exit	214,7	m/s			
25. Swirl velocity component at LPT exit	-0,5388	m/s			
26. Dry LPT leaving loss	22,22	kJ/kg			
27. LPT leaving loss correction factor	1				
28. LPT leaving loss adjustment factor	1				
29. Corrected LPT leaving loss	15,92	kJ/kg			
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	170,197	122	45,774	244	31,094
46	165,403	137	35,015	274	46,005
53	159,286	152	27,558	305	63,846
61	145,444	168	22,812	335	81,663
76	108,698	183	20,424	366	98,336
91	81,151	198	20,191	396	115,551
107	60,731	213	21,984	427	134,548

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	C factor	5,205	120,5	3425	0,3294
2. Valve stem leak 2	Seal steam regulator	C factor	4,647	33,97	3425	0,1103
4. HP inlet leak 1	IP inlet	C factor	42,76	92,69	3425	2,776
7. HP exit leak 1	Seal steam regulator	C factor	43,69	35,9	3120	1,227
14. IP inlet leak 1	Seal steam regulator	C factor	65,06	33,97	3500	1,508
16. IP exit leak	Seal steam regulator	C factor	54,84	5,584	3014	0,2501

SSR & GCS

Stream	P [bar]	T [C]	h [kJ/kg]	M [kg/s]
Seal Steam Regulator (SSR)				
Valve stem leak 2			3425	0,1103
HP exit leak 1			3120	1,227
IP inlet leak 1			3500	1,508
IP exit leak			3014	0,2501
Desup. water		159,4	680,5	0
Steam at SSR inlet	1,241	414,2	3308	3,095
Steam to condenser			3308	0,3024
Steam to packing exhaust			3308	0,3527
Excess SSR flow to condenser			3308	2,44
Gland Steam Condenser (GSC)				

ST Model Adjustments

ST Model Adjustments: Disabled

Cooling System Report

CONDENSER					
	P	T	h	m	
	bar	C	kJ/kg	kg/s	
LPT exit	0,0518	33,50	2306,62	201,21	
SSR steam		414,20	3307,59	0,30	
SSR excess steam		414,20	3307,59	2,44	
Saturation	0,0518	33,50			
Condensate out	0,4107	33,52	140,40	203,95	
Sea water in		24,00		23869,92	
Sea water out		28,68		23869,92	
Condenser model: Standard Thermoflow Model					
Duty = 444559 kW (99,67% design)					
Cooling water salt concentration = 4 %					
Tubes: OD = 25,4 mm Thickness = 0,5588 mm Length = 12,3 m Number = 20595					
Tube material: Titanium					
UA = 64502 kW/C CW velocity = 2,438 m/s					
Pr = 6,213 Re = 64171 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 = 8358 External = 14603					
Tube bundle overall h.t.c. = 3190 W/sq.m-C , Tube bundle h.t.c. / Single tube h.t.c. = 0,875					
Condenser heat transfer calculation: Hardware model					
Condenser effectiveness = 0,4932, Effectiveness adjustment factor = 1					
CW DP = 1,087 bar (0,5056 condenser + 0,5809 piping loss)					
CW pump = 3288 kWe Condensate pump = 606,4 kWe					

Condenser Hardware

GT MASTER 27.0 Tractebel Engineering		
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Program revision date: December 15, 2017		
CONDENSER DESIGN & OPERATING PARAMETERS		
1. Condenser tube material	Titanium	
2. Condenser tube outer diameter	25,4	mm
3. Condenser tube internal diameter	24,28	mm
4. Condenser tube thickness	0,5588	mm
5. Condenser tube thermal conductivity	21,63	W/m-C
6. Tube length	12,3	m
7. Total number of tubes per condenser	20595	
8. Number of condenser passes	1	
9. Condenser cleanliness factor	80	%
10. Condenser fouling factor	0	[W/sq.m-C]^(-1)
11. Nominal CW mass flow rate per condenser	23870	kg/s
12. Cooling water supply temperature	24	C
13. Condensate subcooling	0	C
14. Condensing external h.t.c./ Laminar film h.t.c.	1,1	
15. External head loss in cooling water circuit	5,92	m
16. Total surface area per condenser	20222	sq.m
17. Condenser tube water velocity	2,438	m/s
18. External h.t.c.	14603	W/sq.m-C
19. Internal Reynolds Number	64171	
20. Water Prandtl Number	6,213	
21. Internal Nusselt Number	334,9	
22. Water-side h.t.c.	8358	W/sq.m-C
23. Single tube overall h.t.c. from hardware	3645	W/sq.m-C
24. Tube bundle h.t.c. / Single tube h.t.c.	0,875	
25. Tube bundle overall h.t.c. from hardware	3190	W/sq.m-C
26. Condenser heat transfer calculation:, 0=Hardware model, 1=HEI method	0	
27. Tube bundle overall h.t.c. from HEI method	N/A	
28. Overall UA per condenser	64502	kW/C
29. Heat rejection rate per condenser	444559	kW
30. Cooling water discharge temperature	28,68	C
31. Condenser cooling water pressure drop	0,5056	bar

Cooling System Model Adjustments

Standard Thermoflow Model without adjustment curves.

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)	228067	1498398	306,5
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)	23549	154720	31,64
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)	251616	1653118	338,1
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	54,25	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	10,7	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	54,25	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	10,7	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	
Current Conditions (each)		
Delivery Mass Flow	44,89	kg/s
Pump Pressure Rise	151,1 (1691,1)	bar (m)
Pressure Rise After Valve Pressure Drop	131 (1465,9)	bar (m)
Suction Pressure	5,583	bar
Suction-side Mass Flow	44,89	kg/s
Delivery Pressure	136,6	bar
Pump Shaft Speed	3600	RPM
Pump Isentropic Efficiency	74,71	%
Pump Work	996,3	kW
Pump Mechanical Efficiency	96,92	%
Pump Shaft Work	1027,9	kW
Motor Total Efficiency	96,5	%
Electricity Consumption	1065,3	kW
Nameplate Conditions (each)		
Mass Flow	47,83	kg/s
Head	148,3 (1659,9)	bar (m)
Volume Flow (nominal)	3407	lpm
Head (nominal)	1645,9	m
Extraction #1 Head	35,05 (392,2)	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	1135,8	kW
Motor Shaft Power	1096,5	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	
Current Conditions (each)		
Mass Flow	204	kg/s
Pump Pressure Rise	22,6 (231,8)	bar (m)
Pressure Rise After Valve Pressure Drop	5,223 (53,55)	bar (m)
Pump Shaft Speed	1800	RPM
Pump Isentropic Efficiency	82,08	%
Pump Work	564,7	kW
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

Heat Balance Pumps

Heat Balance Pumps		
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	
Current Conditions (each)		
Mass Flow	11935	kg/s
Pump Pressure Rise	1,104 (11,29)	bar (m)
Pressure Rise After Valve Pressure Drop	1,087 (11,11)	bar (m)
Pump Shaft Speed	600	RPM
Pump Isentropic Efficiency	85,73	%
Pump Work	1540,8	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	1,76
2	Hot reheat pipe	0,13
3	HP process pipe	0,00
4	Cold reheat pipe	0,14
5	Condenser cooling water pipe	0,58
* Non-heat balance pipes are shown in PEACE output		