



Panos Konstantin

Power and Energy Systems Technologies & Economics

Case Study Cycle Simulation CCGT

Notes:

1. Cells with black characters include inputs
2. Cells with red characters include formulas
3. Download of FluidEXL is required
4. Read notes in Chapter Case Studies of the book

The purpose of this Case Study is:

1. Training in calculation of thermodynamic cycles using FluidEXL
2. Calculation of performance parameters for cogeneration
such as σ , β , η_{cond} , η_{total}

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Panos Konstantin

Disclaimer

The Examples are solely and exclusively indented to provide support and assistance to the readers for practicing and better understanding of the theoretical part of this book.

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The author, Panos Konstantin, believes that all information and guidance provided and all calculations in these examples are correct. Nevertheless anyone using these examples should carry out their own due diligence and appraisal of the contents.

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Proposals for improvements of the contents are welcome and will be considered in upcoming updates!

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TE-CaseStudy-13_Modelling-Simulation-of-Extraction-Cond-CCGT-Cycle.xls
Simple Cycle Gas Turbine

Item	Unit	Nominal Plant Size		Formula / Remark
		ISO	RSC	
Power plant				
Type of GT	-	Siemens SGT-700		
Frequency		50 Hz		
Fuel		NG		
Number of gas turbines		2		
Site Conditions				
Elevation	m	0	608	Elevation Corr. Factor applied
Elevation Correction Factor	-	1.00	0.93	Applied to Power, Mass flow
Ambient Temperature	°C	15	48	
	°F	59	118	
Unit capacity				
Rated Power output, gross (per GT)	MW _e	31.2		
Power output, gross	MW _e	31.2	23.6	$y = -3E-05x^2 - 0.0055x + 1.0889$
Efficiency	-	36.4%	33.1%	$y = -2E-05x^2 - 0.0015x + 1.0263$
Fuel consumption	MW _t	86	71	= power output / efficiency
	MMBTU / h	293	244	Million BTU/h
Rated mass flow, per turbine	lb / s	208		
Flue gas mass flow, total	lb / s	208	171	$y = -3E-05x^2 - 0.0035x + 1.0577$
	kg / s	94	77	
Flue gas temperature	°C	528	570	$y = 2E-05x^2 + 0.0011x + 0.9794$
	°F	983	1,057	

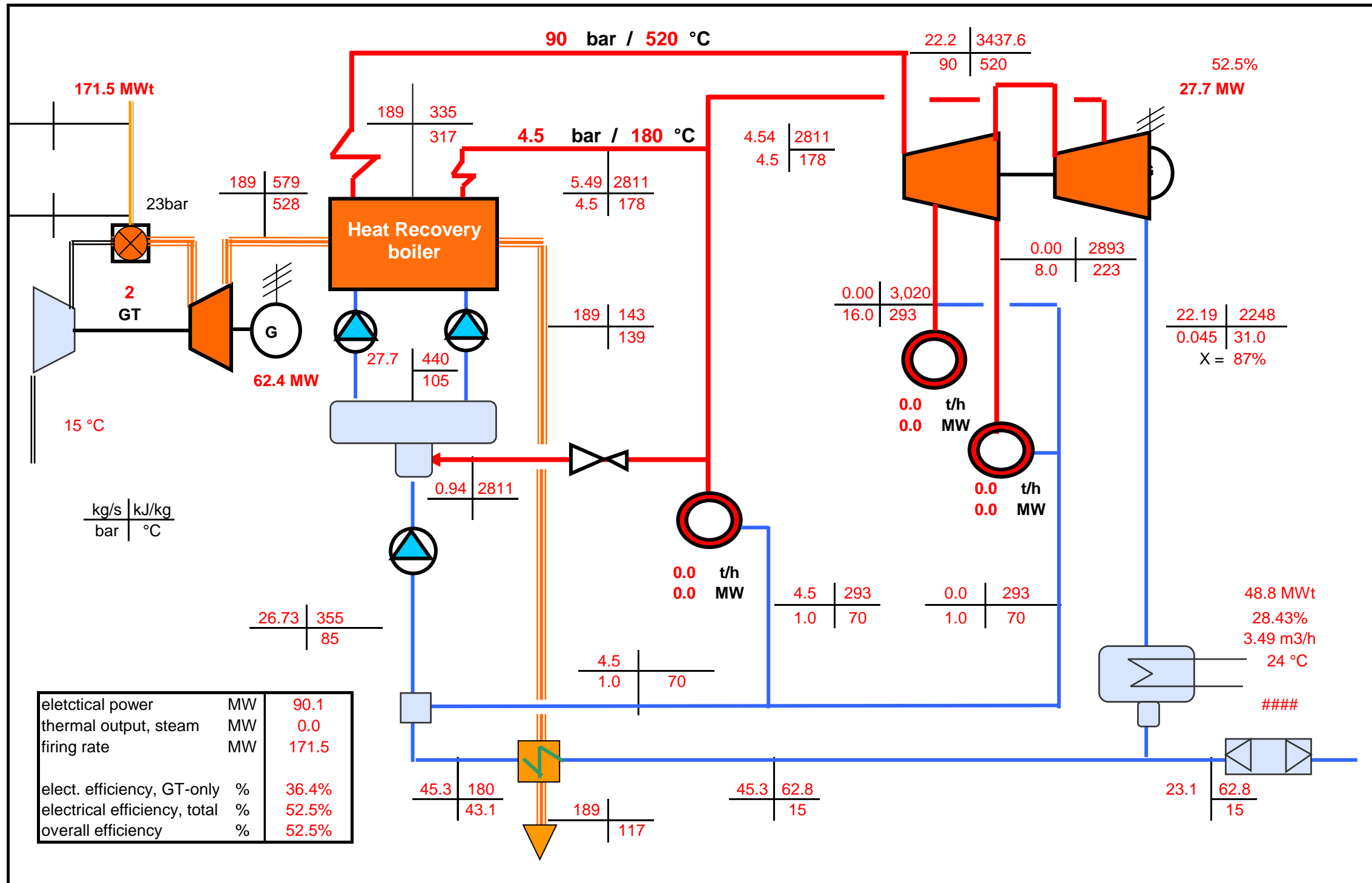
Source of ISO Data: Gas Turbine World, 2012 GTW Handbook

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Inputs CCGT

Item	Unit	Cond	Cogen
Number of gas turbines	-	2	
GT power output, each	MW	31.2	
Firing rate in LHV, each	MW	85.7	
Gas turbine make	-	Siemens SGT-700	
Flue gas HRG inlet, each	kg/s	94	
	°C	528	
HP live steam	bar	90	
	°C	520	
	t/h	80	
LP live steam (1 cond, 0 extraction)	-	1	0
	bar	4.5	
Pinch point, HRSG	K	14	
Delta feed - makeup water	K	20	
Extraction steam	t/h	0.0	20
	bar	16.0	
Backpressure steam extraction	t/h	0.0	18
	bar	8.0	
Cooling medium, condenser	water		
inlet Temperature	°C	12.0	
outlet temperature	°C	24.0	
Terminal Temperature Difference	°K	7.0	
condensing temperature	°C	31.0	
Boiler inlet	°C	105	
Condensate return from factory	%	100%	
	°C	90	
	bar	1.0	
Pinch point, preheater	K	25	
Makeup water	°C	15	

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 CCGT_ISO_cond.



electrical power	MW	90.1
thermal output, steam	MW	0.0
firing rate	MW	171.5
elect. efficiency, GT-only	%	36.4%
electrical efficiency, total	%	52.5%
overall efficiency	%	52.5%

TE-CaseStudy-13_Modelling-Simulation-of-Extraction-Cond-CCGT-Cycle.xls
 CCGT_ISO_cogen

