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Docket Number:	13-AFC-01
Project Title:	Alamitos Energy Center
TN #:	201620-34
Document Title:	AEC AFC Appendix 2A Heat Balance Cases
Description:	Previously TN# 201493-7
Filer:	Tiffani Winter
Organization:	CH2M Hill
Submitter Role:	Applicant Consultant
Submission Date:	2/3/2014 12:47:11 PM
Docketed Date:	2/3/2014

Appendix 2A
Heat Balances

Alamitos Energy Center (AEC) AFC Heat Balance Cases for CCGT Blocks 2 and 4 with Reduced Noise Air Cooled Condenser

An additional seventeen heat balance studies were performed to characterize various operating conditions of the AEC Blocks 2 and 4 equipment performance which include a reduced noise Air Cooled Condenser.

Case 1 represents the base case full load operating information for three combustion turbines and one steam turbine operating at full load without evaporative cooling operation at Site Ambient Average Temperature (SAAT) conditions.

Cases 2 through 17 represent alternate scenarios used to develop expected plant output, heat rate, and operating conditions at various equipment configurations and ambient temperatures.

Case	Heat Balance Number	Description	Ambient Temp Data Set	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Case
1	1a	Three combustion turbines (at max. heat input) w.o. Evap. Cooling Operation	SAAT	65.3	62.7	86.6	1
2	1b	Two combustion turbines (at max. heat input) w.o. Evap. Cooling Operation	SAAT	65.3	62.7	86.6	2
3	1c	One combustion turbine (at max. heat input) w.o. Evap. Cooling Operation	SAAT	65.3	62.7	86.6	3
4	2a	Three combustion turbines (at max. heat input) w. Evap. Cooling Operation	SAAT	65.3	62.7	86.6	4
5	2b	Two combustion turbines (at max. heat input) w. Evap. Cooling Operation	SAAT	65.3	62.7	86.6	5
6	2c	One combustion turbine (at max. heat input) w. Evap. Cooling Operation	SAAT	65.3	62.7	86.6	6
7	3a	Three combustion turbines (at max. heat input) w. Evap. Cooling Operation	SMMAAT	84.6	69.4	45.83	7
8	3b	Two combustion turbines (at max. heat input) w. Evap. Cooling Operation	SMMAAT	84.6	69.4	45.83	8
9	3b(1)	Two combustion turbines (at max. heat input) w. Evap. Cooling and Duct Burner Operation	SMMAAT	84.6	69.4	45.83	9
10	3c	One combustion turbine (at max. heat input) w. Evap. Cooling Operation	SMMAAT	84.6	69.4	45.83	10
11	3c(1)	One combustion turbine (at max. heat input) w. Evap. Cooling and Duct Burner Operation	SMMAAT	84.6	69.4	45.83	11
12	4a	Three combustion turbines (at min. heat input) w.o. Evap. Cooling Operation	SMMAAT	84.6	69.4	45.83	12
13	4b	Two combustion turbines (at min. heat input) w.o. Evap. Cooling Operation	SMMAAT	84.6	69.4	45.83	13
14	4b(1)	Two combustion turbines (at min. heat input) w.o. Evap. Cooling Operation w. portion of HRSG steam sent to ACC	SMMAAT	84.6	69.4	45.83	14
15	4c	One combustion turbine (at min. heat input) w.o. Evap. Cooling Operation	SMMAAT	84.6	69.4	45.83	15
16	5	Three combustion turbines (at max. heat input) w.o. Evap. Cooling Operation (Site Minimum Winter Ambient temperature of 1 hr. duration)	SMWAT	28	26	78.07	16
17	6	Three combustion turbines (at max. heat input) w. Evap. Cooling Operation (Site Peak Summer Ambient Temperature of 1 hr. duration)	SPSAT	107	67.5	9.97	17

Information Sources Used for Developing Heat Balance Cases

Heat balances information was obtained inputting manufacturer design information for combustion turbines (CT), heat recovery steam generators (HRSG) and steam turbine (ST) into the GT Pro Heat Balance Software Program. The centerline of the air intake is assumed to be 30ft. elevation.

The weather data used for the heat balances use Long Beach CA Weather Data (Dry Bulb, Wet Bulb, Relative Humidity). The Long Beach weather data was obtained from the following internet websites:

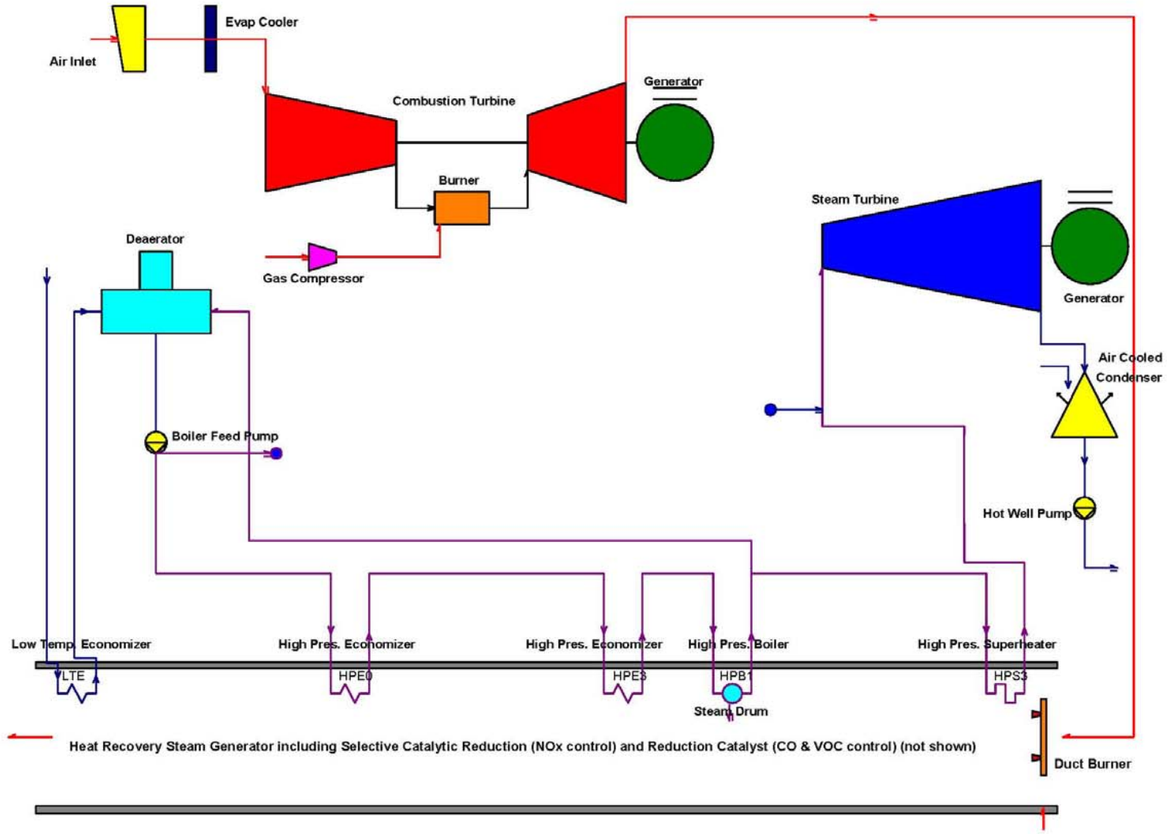
Average Dry Bulb	http://www.weather.com/weather/wxclimatology/monthly/USCA0632
Average Wet Bulb	http://www.opc.ca.gov/webmaster/ftp/project_pages/OTC/engineering%20study/Chapter_7F_Haynes_Generating_Station.pdf
Daily Max Dry Bulb	http://hurricane.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals.pl
Daily Min Dry Bulb	http://hurricane.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals.pl
MCWB	http://web.utk.edu/~archinfo/EcoDesign/escurriculum/weather_data/reports/los_angeles_ca.pdf
30 Year Max Dry Bulb	http://weather-warehouse.com/WeatherHistory/PastWeatherData_LongBeachDaughertyField_LongBeach_CA_July.html
30 Year Max Wet Bulb	http://web.utk.edu/~archinfo/EcoDesign/escurriculum/weather_data/reports/los_angeles_ca.pdf
30 Year Min Dry Bulb	http://weather-warehouse.com/WeatherHistory/PastWeatherData_LongBeachDaughertyField_LongBeach_CA_December.html
30 Year Min Wet Bulb	http://web.utk.edu/~archinfo/EcoDesign/escurriculum/weather_data/reports/los_angeles_ca.pdf

Various analytical methods were used to determine the dry and wet bulb temperatures and relative humidity data for four temperature cases:

1. Site Average Ambient Temperature (SAAT) is 65.3 °F (Dry Bulb) and 62.7 °F (Wet Bulb) and relative humidity (RH) of 86.62%).
2. Site Monthly Maximum Average Ambient Temperature (SMMAAT) is 84.6 °F (Dry Bulb) and 69.4 °F (Wet Bulb) and relative humidity (RH) of 45.83%).
3. The 30 year, one hour duration, Site Peak Summer Ambient Temperature (SPSAT) is 107 °F (Dry Bulb) and 67.5 °F (Wet Bulb) and relative humidity (RH) of 9.97%).
4. The 30 year, one hour duration, Site Minimum Winter Ambient Temperature (SMWAT) is 28 °F (Dry Bulb) and 26 °F (Wet Bulb) and relative humidity (RH) of 78.1%).

Legend for Typical Equipment Configuration for AEC Heat Balance Cases

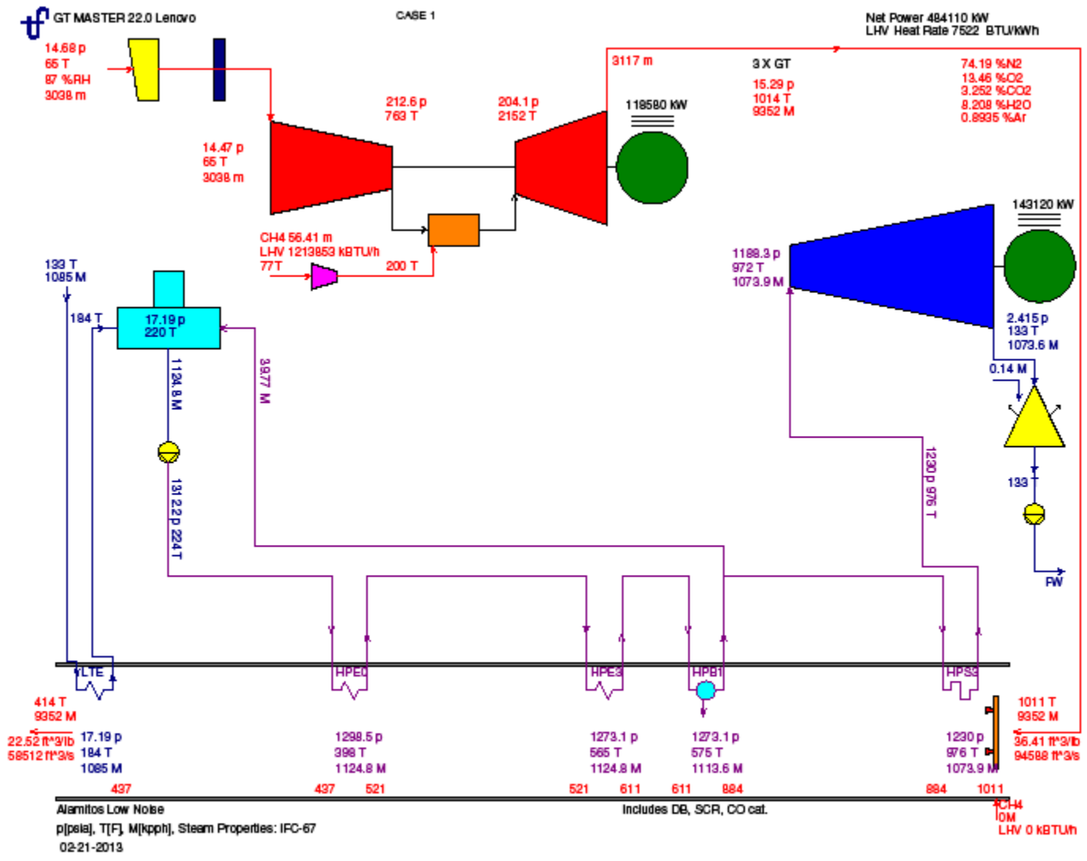
(If more than one combustion turbine is installed then the estimated operating information shown represents the sum of the number of combustion turbines modeled. Every combustion turbine represented is paired with its own HRSG)



Case 1

Case 1 Heat Balance Number 1a Three Combustion Turbines Operating at Maximum Heat Input without Evaporative Cooling

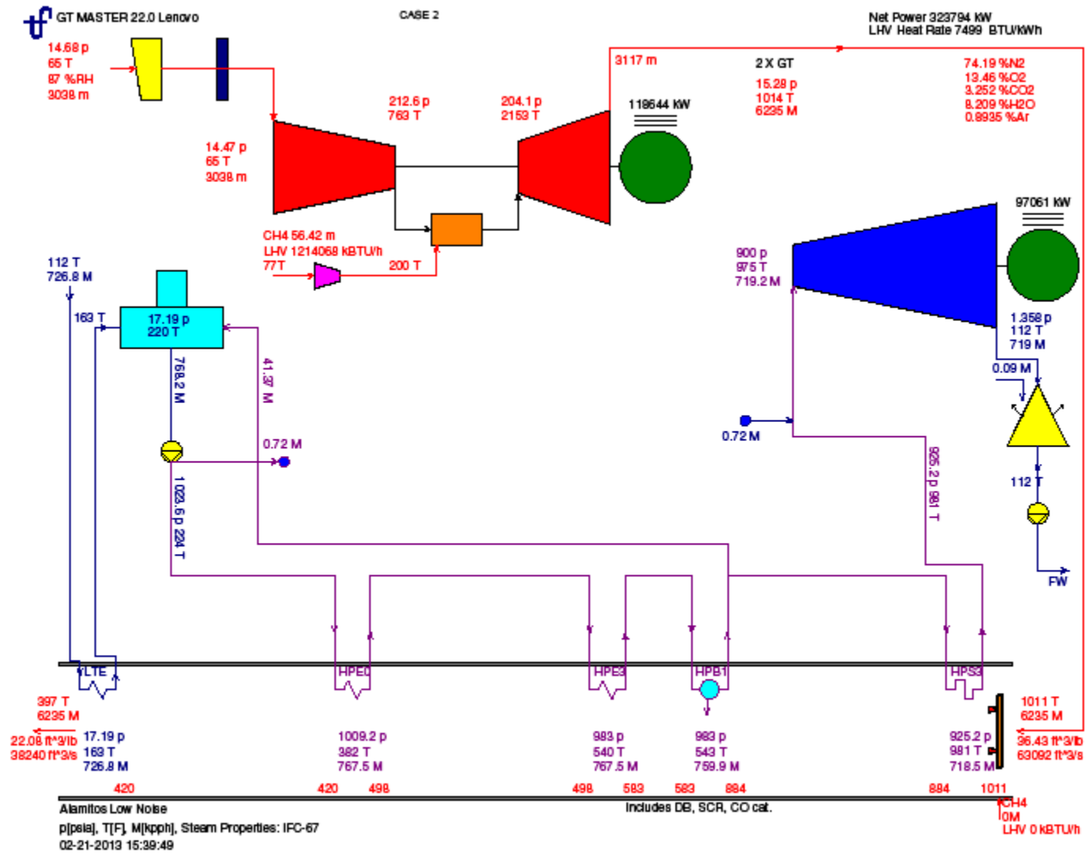
Site Average Annual Temperature (SAAT), Dry Bulb 65.3 F, Wet Bulb 62.7 F, Relative Humidity 86.62%



Case 2

Case 2 Heat Balance Number 1b Two Combustion Turbines Operating at Maximum Heat Input without Evaporative Cooling

Site Average Annual Temperature (SAAT), Dry Bulb 65.3 F, Wet Bulb 62.7 F, Relative Humidity 86.62%



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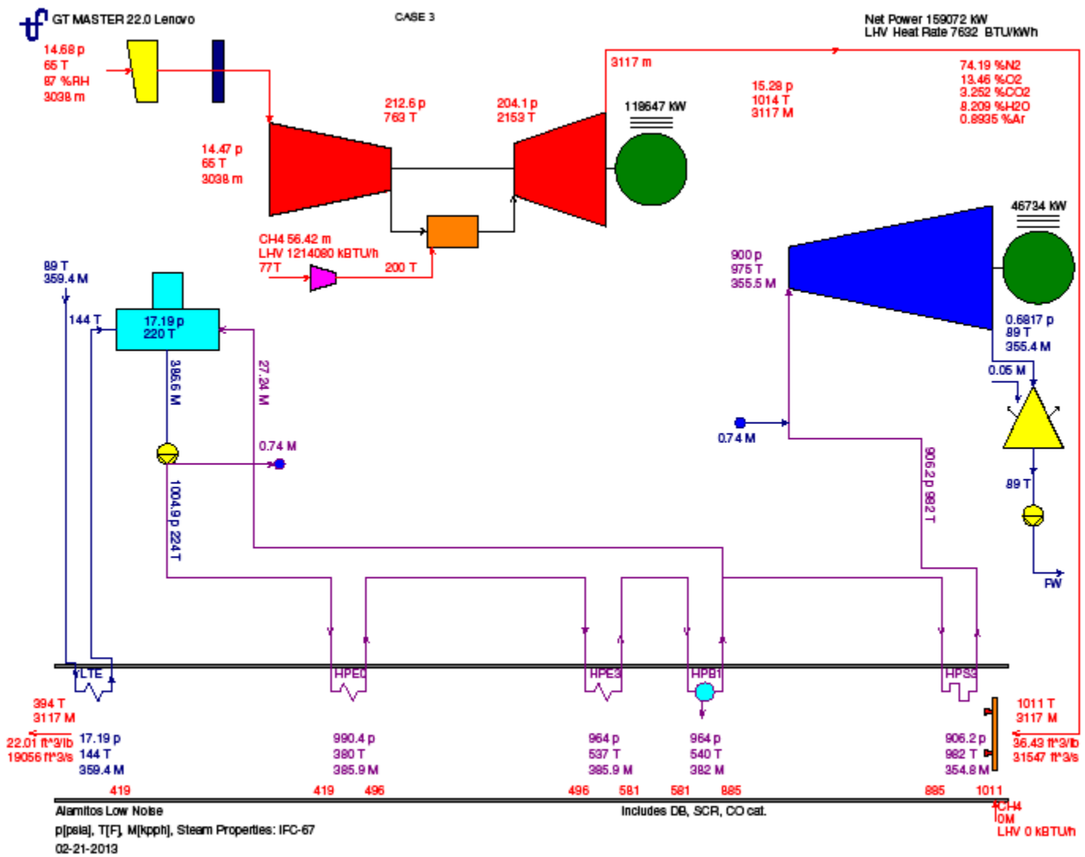
Case 3

Case 3 Heat Balance Number 1c One Combustion Turbine Operating at Maximum Heat Input without Evaporative Cooling

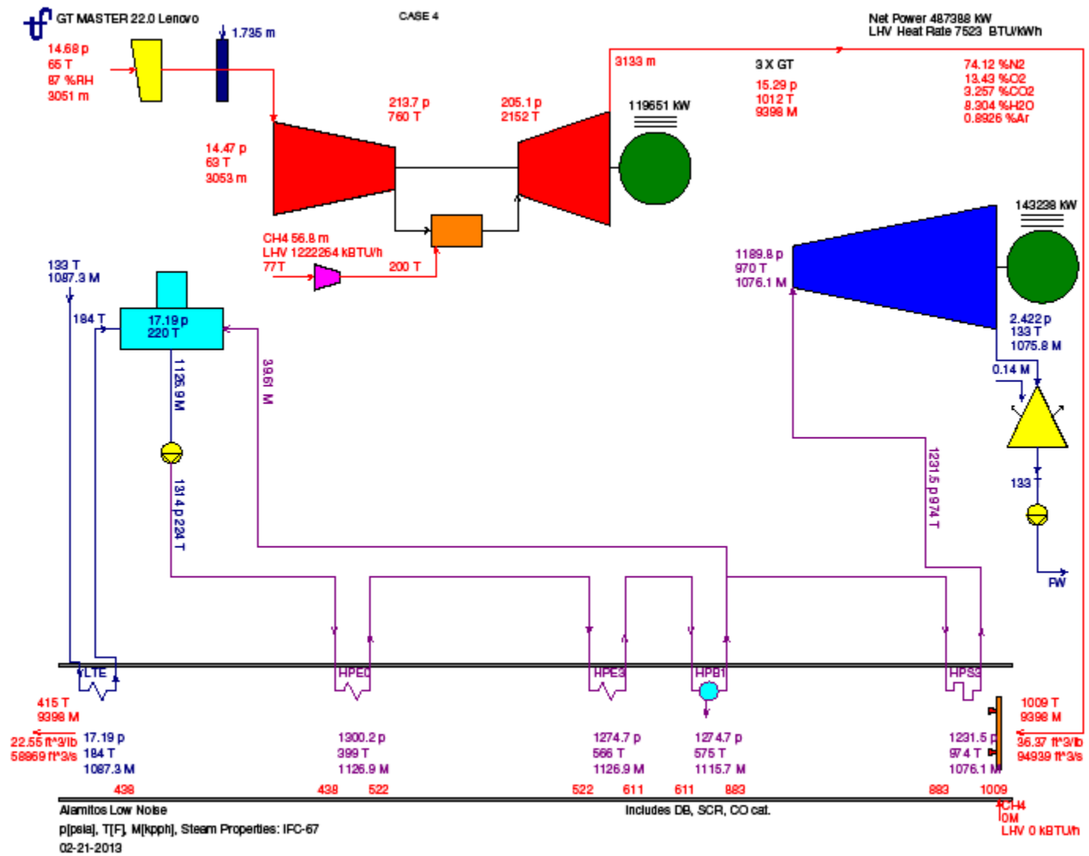
Site Average Annual Temperature (SAAT), Dry Bulb 65.3 F, Wet Bulb 62.7 F, Relative Humidity 86.62%



Case 4

Case 4 Heat Balance Number 2a Three Combustion Turbines Operating at Maximum Heat Input with Evaporative Cooling

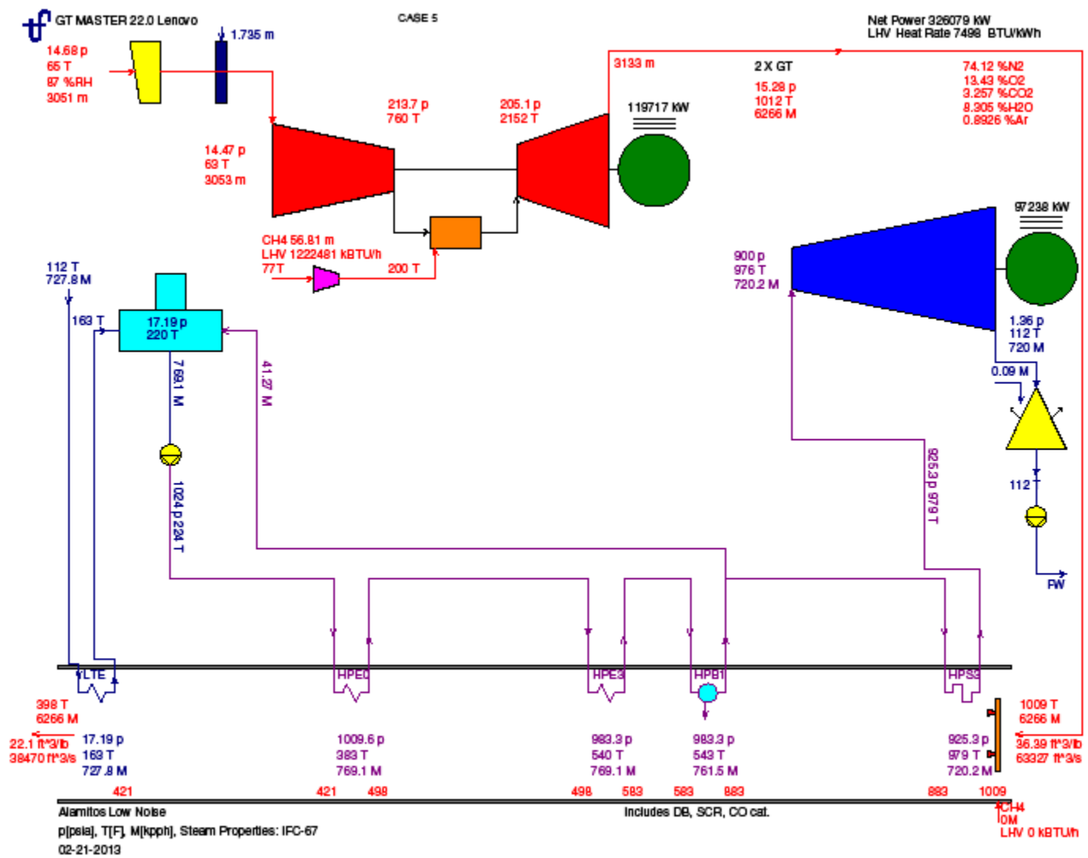
Site Average Annual Temperature (SAAT), Dry Bulb 65.3 F, Wet Bulb 62.7 F, Relative Humidity 86.62%



Case 5

Case 5 Heat Balance Number 2b Two Combustion Turbines Operating at Maximum Heat Input with Evaporative Cooling

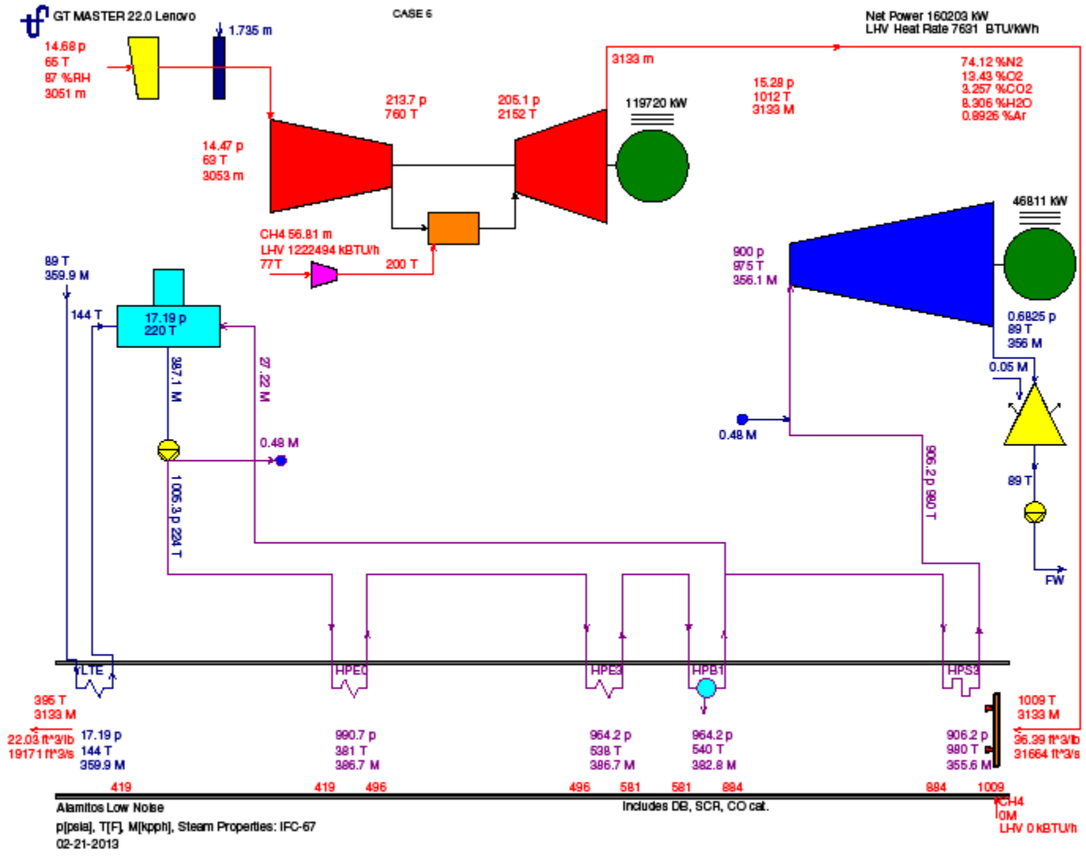
Site Average Annual Temperature (SAAT), Dry Bulb 65.3 F, Wet Bulb 62.7 F, Relative Humidity 86.62%



Case 6

Case 6 Heat Balance Number 2c One Combustion Turbine Operating at Maximum Heat Input with Evaporative Cooling

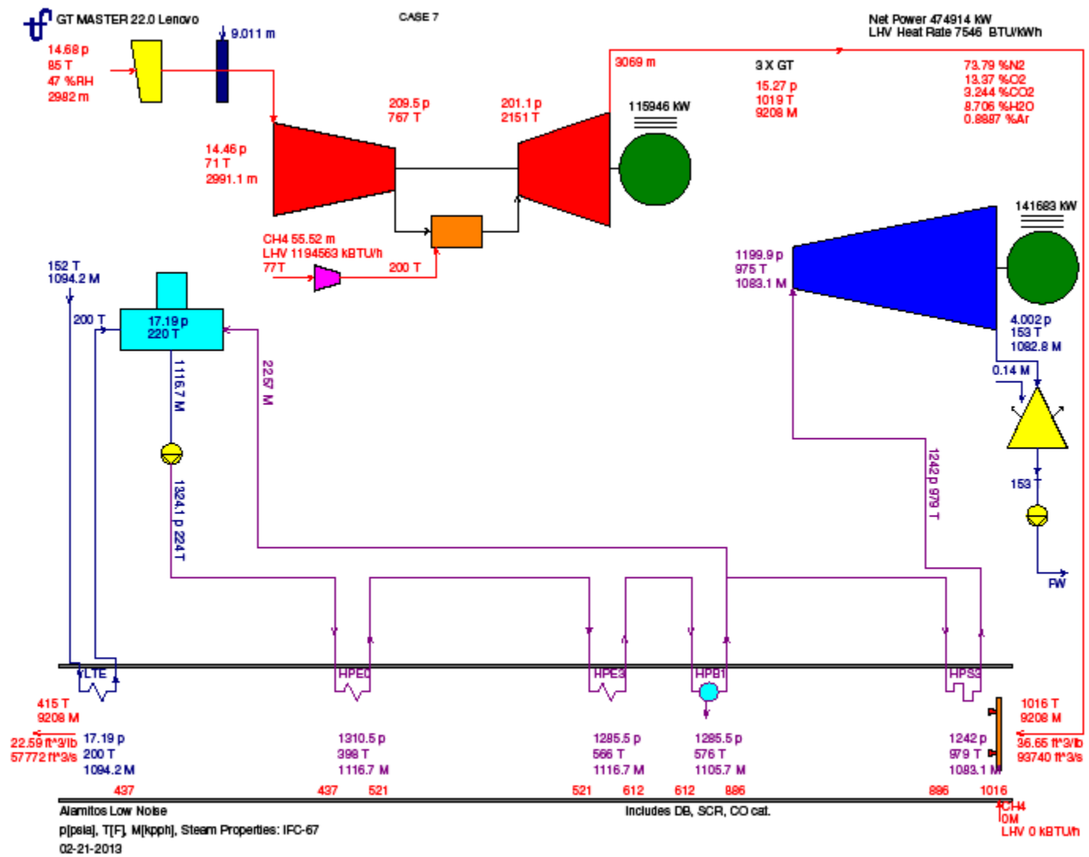
Site Average Annual Temperature (SAAT), Dry Bulb 65.3 F, Wet Bulb 62.7 F, Relative Humidity 86.62%



Case 7

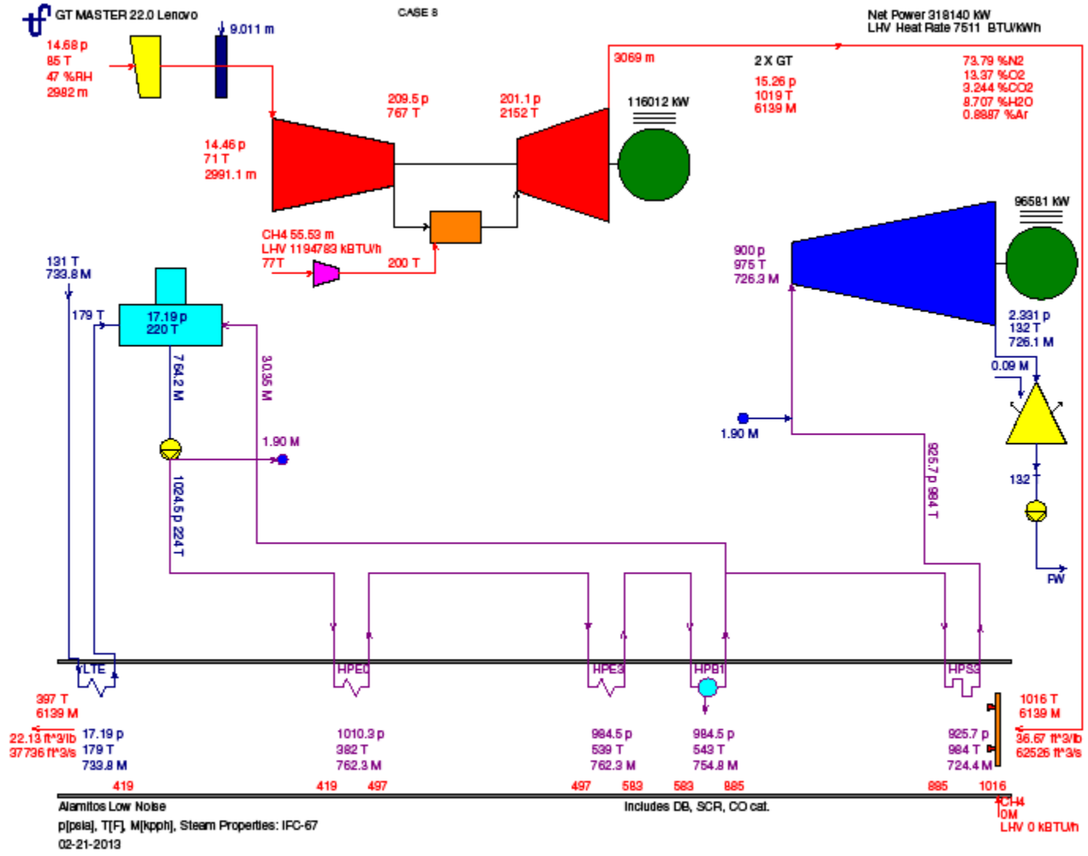
Case 7 Heat Balance Number 3a Three Combustion Turbines Operating at Maximum Heat Input with Evaporative Cooling

Site Monthly Maximum Average Ambient Temperature (SMMAAT) is 84.6 °F (Dry Bulb) and 69.4 °F (Wet Bulb) and relative humidity (RH) of 45.83%



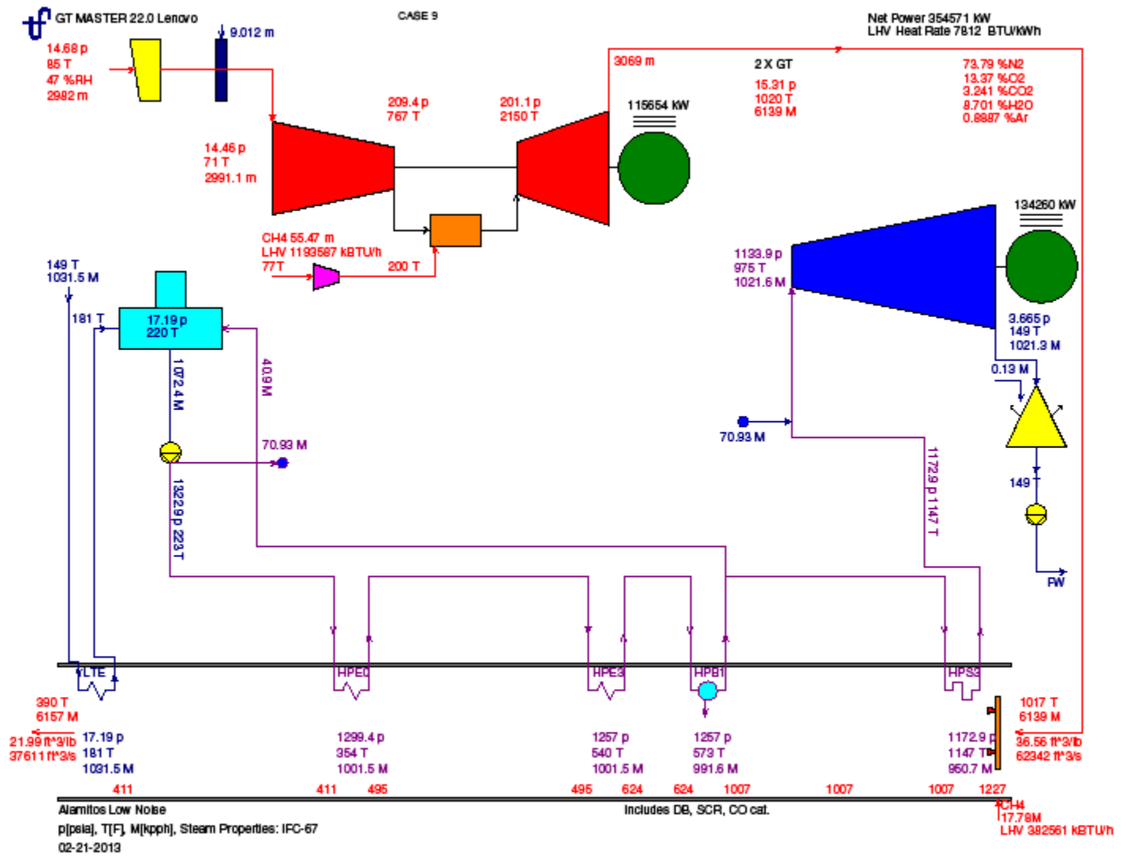
Case 8

Case 8 Heat Balance Number 3b Two Combustion Turbines Operating at Maximum Heat Input with Evaporative Cooling
Site Monthly Maximum Average Ambient Temperature (SMMAAT) is 84.6 °F (Dry Bulb) and 69.4 °F (Wet Bulb) and relative humidity (RH) of 45.83%



Case 9

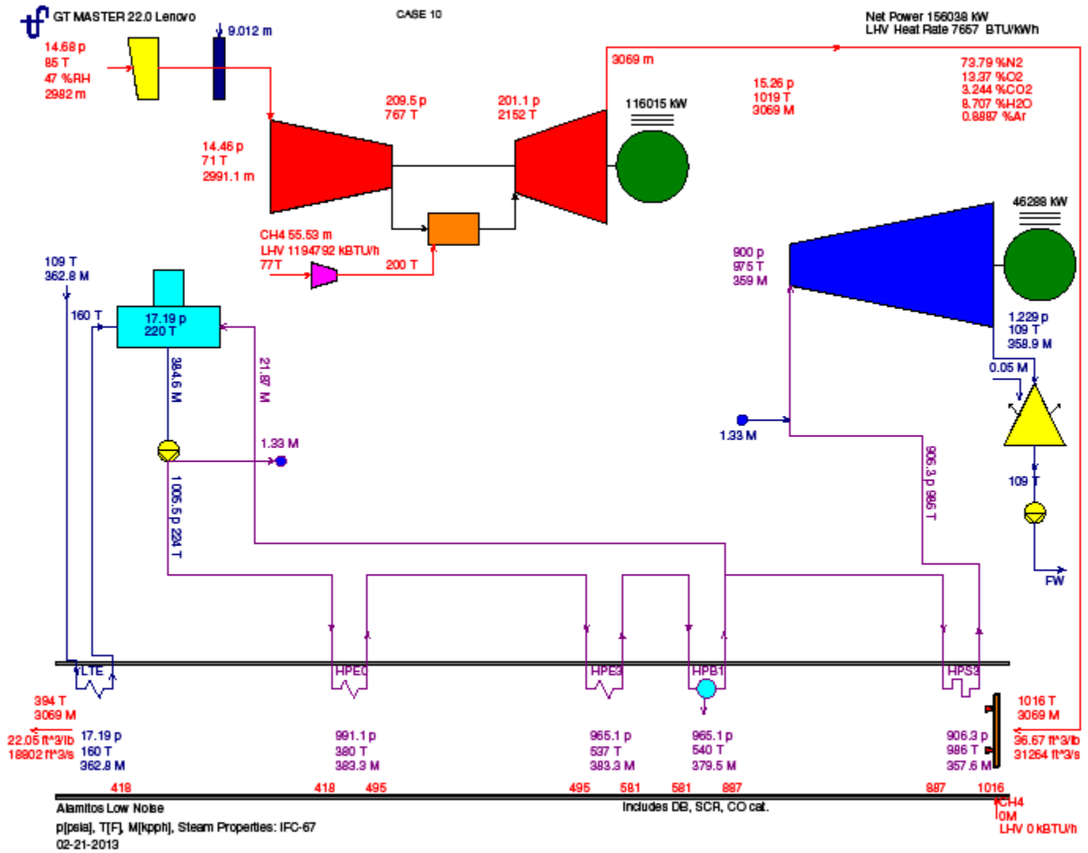
Case 9 Heat Balance Number 3b(1) Two Combustion Turbines Operating at Maximum Heat Input with Evaporative Cooling and Duct Burner
Site Monthly Maximum Average Ambient Temperature (SMMAAT) is 84.6 °F (Dry Bulb) and 69.4 °F (Wet Bulb) and relative humidity (RH) of 45.83%



Case 10

Case 10 Heat Balance Number 3c One Combustion Turbine Operating at Maximum Heat Input with Evaporative Cooling

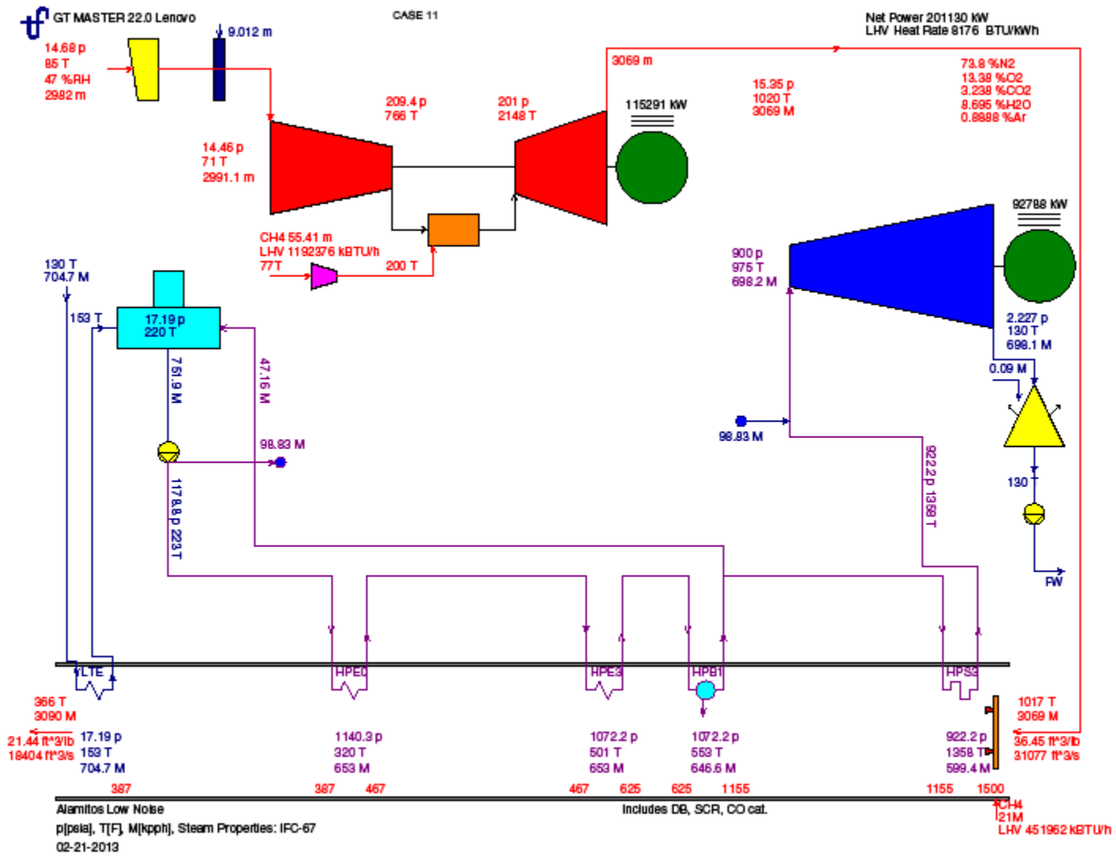
Site Monthly Maximum Average Ambient Temperature (SMMAAT) is 84.6 °F (Dry Bulb) and 69.4 °F (Wet Bulb) and relative humidity (RH) of 45.83%



Case 11

Case 11 Heat Balance Number 3c(1) One Combustion Turbine Operating at Maximum Heat Input with Evaporative Cooling and Duct Burning

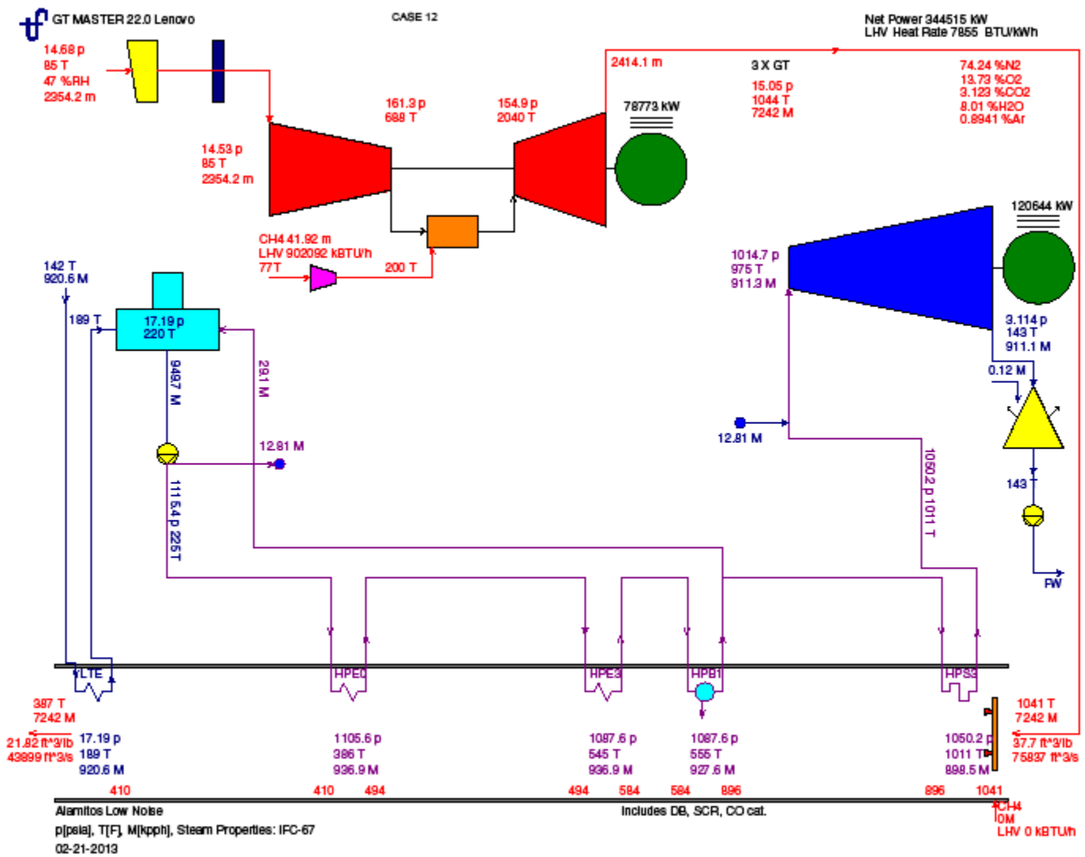
Site Monthly Maximum Average Ambient Temperature (SMMAAT) is 84.6 °F (Dry Bulb) and 69.4 °F (Wet Bulb) and relative humidity (RH) of 45.83%



Case 12

Case 12 Heat Balance Number 4a Three Combustion Turbines Operating at Minimum Heat Input without Evaporative Cooling

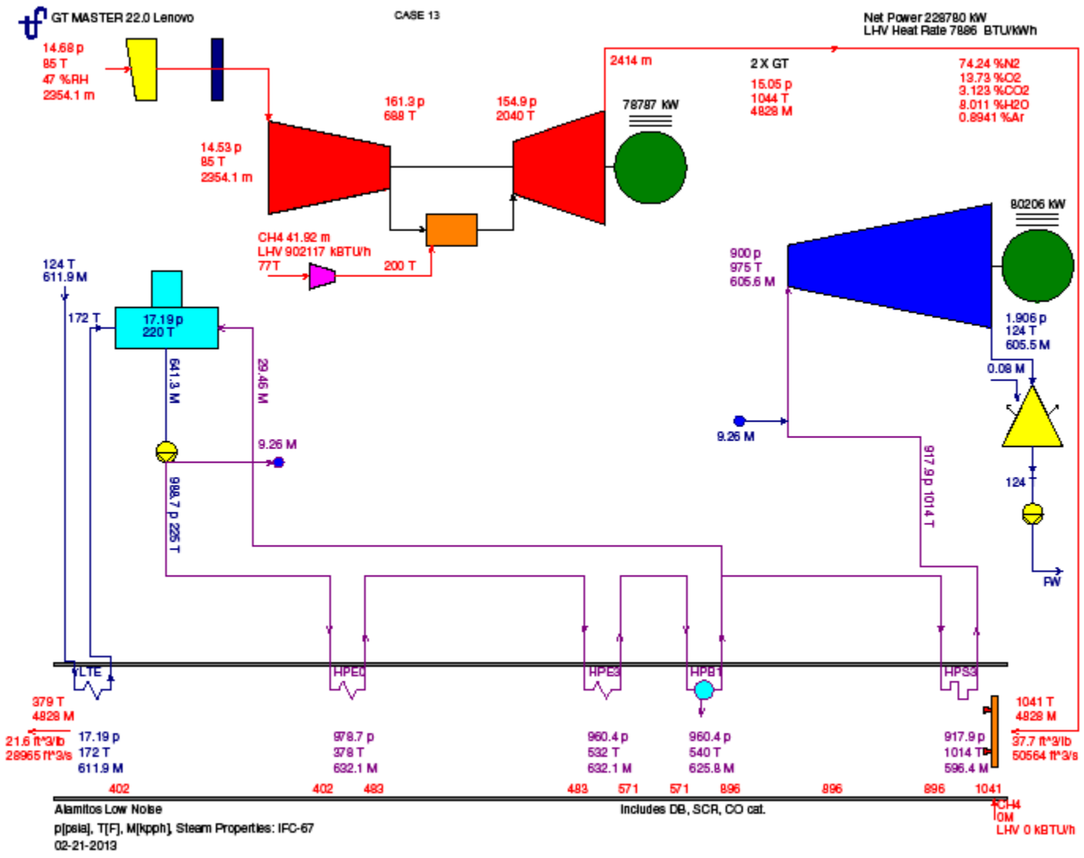
Site Monthly Maximum Average Ambient Temperature (SMMAAT) is 84.6 °F (Dry Bulb) and 69.4 °F (Wet Bulb) and relative humidity (RH) of 45.83%



Case 13

Case 13 Heat Balance Number 4b Two Combustion Turbines Operating at Minimum Heat Input without Evaporative Cooling

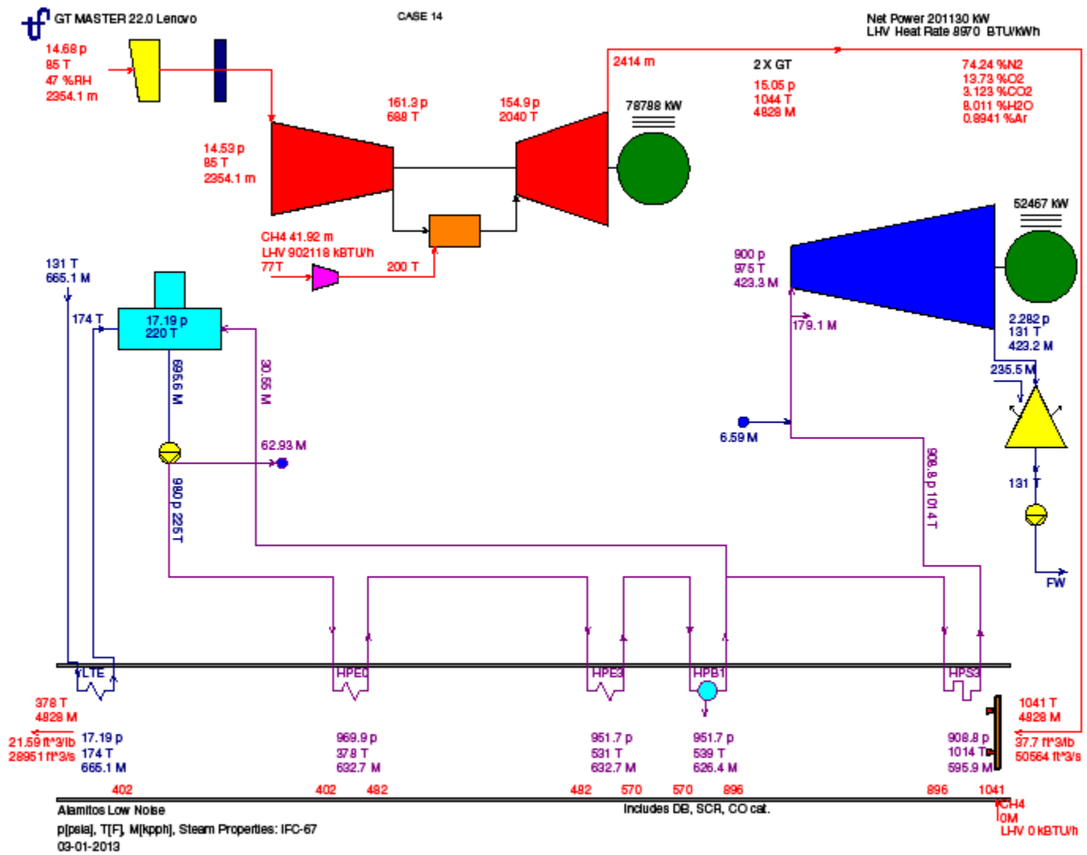
Site Monthly Maximum Average Ambient Temperature (SMMAAT) is 84.6 °F (Dry Bulb) and 69.4 °F (Wet Bulb) and relative humidity (RH) of 45.83%



Case 14

Case 14 Heat Balance Number 4b(1) Two Combustion Turbines Operating at Minimum Heat Input without Evaporative Cooling w. portion of HRSG steam sent to ACC

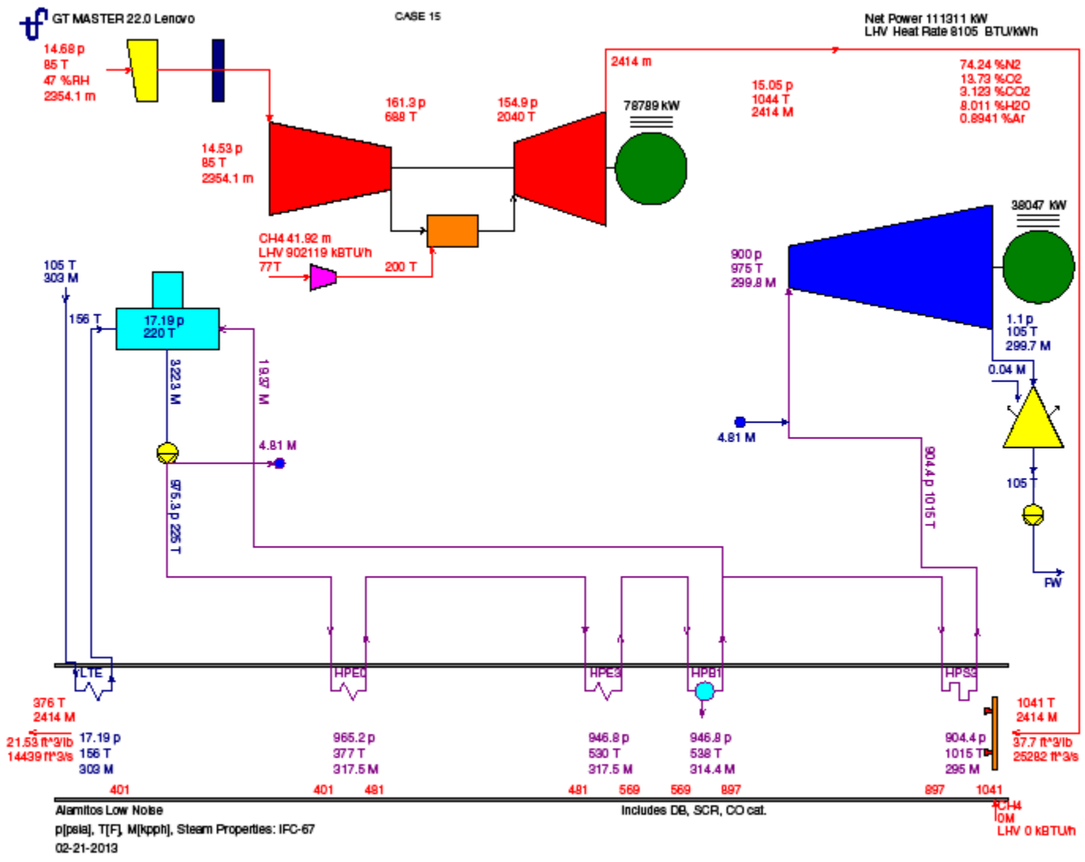
Site Monthly Maximum Average Ambient Temperature (SMMAAT) is 84.6 °F (Dry Bulb) and 69.4 °F (Wet Bulb) and relative humidity (RH) of 45.83%



Case 15

Case 15 Heat Balance Number 4c One Combustion Turbine Operating at Minimum Heat Input without Evaporative Cooling

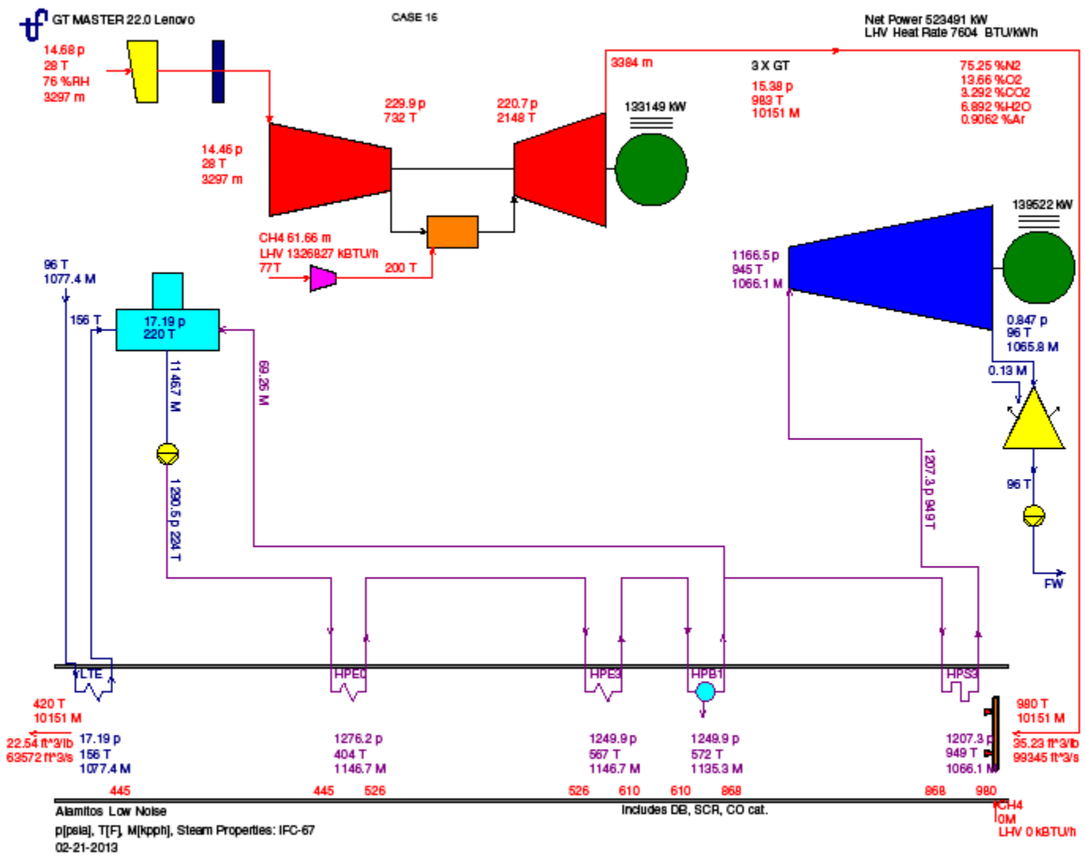
Site Monthly Maximum Average Ambient Temperature (SMMAAT) is 84.6 °F (Dry Bulb) and 69.4 °F (Wet Bulb) and relative humidity (RH) of 45.83%



Case 16

Case 16 Heat Balance Number 5 Three Combustion Turbines Operating at Maximum Heat Input without Evaporative Cooling

Site Minimum Winter Ambient Temperature (SMWAT) is 28 °F (Dry Bulb) and 26 °F (Wet Bulb) and relative humidity (RH) of 78.1%



Case 17

Case 17 Heat Balance Number 6 Three Combustion Turbines Operating at Maximum Heat Input with Evaporative Cooling
Site Peak Summer Ambient Temperature (SPSAT) is 107 °F (Dry Bub) and 67.5 °F (Wet Bulb) and relative humidity (RH) of 9.97%