Appendix III

Combustion Analysis and Efficiency Testing Results

The compiled combustion data were input into a database to facilitate the calculation of the required parameters. Measured fuel and exhaust gas compositions were used to determine the air-to-fuel and exhaust-to-fuel ratios. Species mole balances and the following simple combustion relation were used:

$$Fuel + a \cdot Air \rightarrow b \cdot Flue + d \cdot H_2O$$

A carbon mole balance was used to determine *b*, a nitrogen balance to determine *a* and a hydrogen balance to determine *d*. These coefficients were then used to determine the flow rates of the unknown streams from the known flow.

Combustion efficiency is defined as the total enthalpy contained in the reactants minus the total enthalpy contained in the products divided by the energy content of the fuel. This may be written as follows:

$$\frac{\left(\dot{m}_{FUEL} \cdot h^f_{FUEL} + \dot{m}_{AIR} \cdot h^f_{AIR} - \dot{m}_{FLUE} \cdot h^f_{FLUE}\right)}{\dot{m}_{FUEL} \cdot LHV}$$

$\dot{m}$ is the molar flow rate of the stream (i.e., fuel, air, or flue gas) (kmole/h),
h^f is the heat of formation of the stream (MJ/kmole), and
LHV is the lower heating value of the fuel gas stream (MJ/kmole)

For ideal operation, combustion efficiencies calculated with this equation are expected to be in the range of 95 to 98 percent.

While combustion efficiency is useful in demonstrating how much of the energy in the fuel is converted to heat, it does not provide a complete description of how effectively the equipment is utilizing this energy. An energy balance on a typical reciprocating engine yields the following (based on manufacturers' heat load data):

- Energy from Fuel 100 %
- Useful Work 30 to 35 %
- Jacket Water and Oil Cooler 15 to 40 %
- Radiation 3.5 to 7.5 %
- Turbocharger After Cooler 1 to 6 %
- Exhaust 20 to 35 %

The heat loads for jacket water, oil cooler, turbocharger after cooler and radiation are typically determined by design or safe operating conditions. Heat lost to exhaust is a function of combustion efficiency and the quantity of combustion air that is required for efficient operation. Useful work is whatever is left over after all losses have been accounted. Since heat losses to jacket water, oil cooler, turbocharger after cooler and radiation are typically fixed by design, the amount of heat lost up the stack is a good indication of whether or not the unit is being operated in an efficient manner.

The situation is similar, although less complicated, for heaters/boilers and gas turbine engines. For heaters and boilers:

- Energy from Fuel 100 %
- Useful Work 70 to 85 %
- Radiation 2 to 5 %
- Exhaust 15 to 25 %

And for gas turbines:

- Energy from Fuel 100 %
- Useful Work 30 to 40 %
- Radiation 2 to 5 %
- Exhaust 60 to 70 %

Stack heat losses have been calculated using a simplified heat balance. The equation used is:

$$Fraction\ of\ Heat\ Lost = \frac{Stack\ Losses}{Heat\ Input}$$

where

$$Heat\ Input = Energy\ Content\ of\ Fuel + Sensible\ Heat\ in\ Fuel + Sensible\ Heat\ in\ Combustion\ Air$$

$$Stack\ Losses = Energy\ Content\ of\ the\ Exhaust\ Gas + Convective\ Stack\ Losses + Sensible\ Heat\ in\ the\ Exhaust\ Gas$$

The costs associated with the improper operation of combustion units are made up of two components: the value of any unburned fuel in the exhaust gas and the incremental fuel associated with operating at excessive air-to-fuel ratios. The former is determined by calculating the heating value of the unburned or partially burned components of the exhaust gas and assigning a value per GJ of energy equal to that of natural gas.

The cost associated with too much excess air is determined by comparing the measured air-to-fuel ratio with typical manufacturers' values. The loss is then calculated by determining the amount of heat required to heat the excess air from ambient temperature to the exhaust stack temperature.

The optimum air-to-fuel ratio varies significantly for reciprocating engines according to make and model of unit. Accordingly, specific manufacturers' values were used wherever possible. In the absence of manufactures' data, average values for the types of units tested were used. For heaters and boilers, 15 percent excess air was assumed to be sufficient for proper operation.

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-13 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.960040
ethane	0.018300
propane	0.000950
isobutane	0.000020
n-butane	0.000040
n-heptane	0.000010
nitrogen	0.020460
carbon_dioxide	0.000200
Total	1.000020

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 97.500

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	32.8	----	0.0
Fuel	32.8	N/A	0.0
Combustion Air	32.8	N/A	0.0
Flue Gas	513.3	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	708
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	5.0	Percent

Carbon Monoxide	158	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	4687	PPM
Nitrogen Dioxide	321	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-13 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.58
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.7
Net Heating Value (MJ/m^3)	33.4
Theoretical combustion air requirement (kmol air/kmol fuel)	9.5

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	6.60	1000 std. m^3/day
Air	85.63	1000 std. m^3/day
Stack Gas	92.29	1000 std. m^3/day

EXCESS AIR:

Actual (%)	37.0
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	2912.6
Net input energy (kW)	2376.1

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Unburnt Fuel	0.1	2.0	432
Recoverable Heat in Flue Gas (*)	28.3	672.9	143879

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	14.1	335.6

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site # 3	TEST BY:	Operator
SOURCE:	CM-13	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	57.5
Carbon Combustion Efficiency (%)	99.8

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	27.95
Dew temperature (°C)	52.2

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	69
Carbon Dioxide	49230
Nitric Oxide	2205
Nitrogen Dioxide	232
Total Oxides of Nitrogen	2436

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-14 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.960040
ethane	0.018300
propane	0.000950
isobutane	0.000020
n-butane	0.000040
n-heptane	0.000010
nitrogen	0.020460
carbon_dioxide	0.000200
Total	1.000020

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 97.500

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	30.6	----	0.0
Fuel	30.6	N/A	0.0
Combustion Air	30.6	N/A	0.0
Flue Gas	497.8	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	708
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	9.9	Percent
Carbon Monoxide	186	PPM
Total Combustible (*)	0	PPM

Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	2592	PPM
Nitrogen Dioxide	149	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-14 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.58
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.7
Net Heating Value (MJ/m^3)	33.4
Theoretical combustion air requirement (kmol air/kmol fuel)	9.5

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	4.49	1000 std. m^3/day
Air	85.63	1000 std. m^3/day
Stack Gas	90.17	1000 std. m^3/day

EXCESS AIR:

Actual (%)	101.3
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	1968.2
Net input energy (kW)	1777.5

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	6.0	106.3	22720
Unburnt Fuel	0.1	2.3	497
Recoverable Heat in Flue Gas (*)	35.6	632.0	135125

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.0	53.9

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-14 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	61.3
Carbon Combustion Efficiency (%)	99.6

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.22
Dew temperature (°C)	45.0

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	117
Carbon Dioxide	49155
Nitric Oxide	1751
Nitrogen Dioxide	154
Total Oxides of Nitrogen	1905

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-9 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.960040
ethane	0.018300
propane	0.000950
isobutane	0.000020
n-butane	0.000040
n-heptane	0.000010
nitrogen	0.020460
carbon_dioxide	0.000200
Total	1.000020

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 97.500

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	33.9	----	0.0
Fuel	33.9	N/A	0.0
Combustion Air	33.9	N/A	0.0
Flue Gas	478.3	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	485
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	0.2	Percent
Carbon Monoxide	1044	PPM
Total Combustible (*)	0	PPM

Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	2775	PPM
Nitrogen Dioxide	20	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-9 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.58
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.7
Net Heating Value (MJ/m^3)	33.4
Theoretical combustion air requirement (kmol air/kmol fuel)	9.5

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	4.11	1000 std. m^3/day
Air	39.53	1000 std. m^3/day
Stack Gas	43.71	1000 std. m^3/day

EXCESS AIR:

Actual (%)	1.5
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	1794.5
Net input energy (kW)	1620.0

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Unburnt Fuel	0.4	6.3	1352
Recoverable Heat in Flue Gas (*)	18.1	293.7	62797

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	2.2	35.6

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:	Company	DATE:	
LOCATION:	Site # 3	TEST BY:	Operator
SOURCE:	CM-9	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	79.3
Carbon Combustion Efficiency (%)	98.9

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	27.65
Dew temperature (°C)	58.0

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	349
Carbon Dioxide	48791
Nitric Oxide	993
Nitrogen Dioxide	11
Total Oxides of Nitrogen	1004

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-19 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.960040
ethane	0.018300
propane	0.000950
isobutane	0.000020
n-butane	0.000040
n-heptane	0.000010
nitrogen	0.020460
carbon_dioxide	0.000200
Total	1.000020

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 97.500

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	33.9	----	0.0
Fuel	33.9	N/A	0.0
Combustion Air	33.9	N/A	0.0
Flue Gas	467.2	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	820
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	0.1	Percent
Carbon Monoxide	1214	PPM
Total Combustible (*)	0	PPM

Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	2355	PPM
Nitrogen Dioxide	8	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-19 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.58
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.7
Net Heating Value (MJ/m^3)	33.4
Theoretical combustion air requirement (kmol air/kmol fuel)	9.5

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	7.00	1000 std. m^3/day
Air	66.90	1000 std. m^3/day
Stack Gas	74.02	1000 std. m^3/day

EXCESS AIR:

Actual (%)	0.8
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	3057.9
Net input energy (kW)	2760.5

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Unburnt Fuel	0.5	12.5	2663
Recoverable Heat in Flue Gas (*)	17.5	483.2	103306

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	2.2	60.4

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-19 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	79.9
Carbon Combustion Efficiency (%)	98.7

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	27.64
Dew temperature (°C)	58.1

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	403
Carbon Dioxide	48706
Nitric Oxide	837
Nitrogen Dioxide	4
Total Oxides of Nitrogen	842

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-12 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.960040
ethane	0.018300
propane	0.000950
isobutane	0.000020
n-butane	0.000040
n-heptane	0.000010
nitrogen	0.020460
carbon_dioxide	0.000200
Total	1.000020

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 97.500

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	30.0	----	0.0
Fuel	30.0	N/A	0.0
Combustion Air	30.0	N/A	0.0
Flue Gas	533.9	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	814
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	0.3	Percent
Carbon Monoxide	7365	PPM
Total Combustible (*)	0	PPM

Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	2823	PPM
Nitrogen Dioxide	9	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-12 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.58
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.7
Net Heating Value (MJ/m^3)	33.4
Theoretical combustion air requirement (kmol air/kmol fuel)	9.5

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	6.98	1000 std. m^3/day
Air	66.41	1000 std. m^3/day
Stack Gas	73.74	1000 std. m^3/day

EXCESS AIR:

Actual (%)	0.4
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	3065.6
Net input energy (kW)	2490.7

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Unburnt Fuel	3.0	75.3	16097
Recoverable Heat in Flue Gas (*)	22.7	565.5	120903

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	14.2	352.9

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-12 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	60.1
Carbon Combustion Efficiency (%)	92.2

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	27.55
Dew temperature (°C)	58.1

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	2442
Carbon Dioxide	45502
Nitric Oxide	1003
Nitrogen Dioxide	5
Total Oxides of Nitrogen	1008

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-203 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.960040
ethane	0.018300
propane	0.000950
isobutane	0.000020
n-butane	0.000040
n-heptane	0.000010
nitrogen	0.020460
carbon_dioxide	0.000200
Total	1.000020

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 97.500

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	30.0	----	0.0
Fuel	30.0	N/A	0.0
Combustion Air	30.0	N/A	0.0
Flue Gas	440.0	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	895
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	0.2	Percent
Carbon Monoxide	224	PPM
Total Combustible (*)	0	PPM

Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	2800	PPM
Nitrogen Dioxide	11	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-203 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.58
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.7
Net Heating Value (MJ/m^3)	33.4
Theoretical combustion air requirement (kmol air/kmol fuel)	9.5

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	7.57	1000 std. m^3/day
Air	72.98	1000 std. m^3/day
Stack Gas	80.64	1000 std. m^3/day

EXCESS AIR:

Actual (%)	1.8
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	3301.0
Net input energy (kW)	2979.5

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Unburnt Fuel	0.1	2.5	535
Recoverable Heat in Flue Gas (*)	16.4	488.6	104478

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	2.2	65.6

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-203 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	81.3
Carbon Combustion Efficiency (%)	99.8

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	27.67
Dew temperature (°C)	57.9

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	75
Carbon Dioxide	49221
Nitric Oxide	1003
Nitrogen Dioxide	6
Total Oxides of Nitrogen	1009

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-202 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.960040
ethane	0.018300
propane	0.000950
isobutane	0.000020
n-butane	0.000040
n-heptane	0.000010
nitrogen	0.020460
carbon_dioxide	0.000200
Total	1.000020

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 97.500

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	30.0	----	0.0
Fuel	30.0	N/A	0.0
Combustion Air	30.0	N/A	0.0
Flue Gas	432.2	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	895
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	0.1	Percent
Carbon Monoxide	2747	PPM
Total Combustible (*)	0	PPM

Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	2994	PPM
Nitrogen Dioxide	14	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-202 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.58
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.7
Net Heating Value (MJ/m^3)	33.4
Theoretical combustion air requirement (kmol air/kmol fuel)	9.5

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	7.66	1000 std. m^3/day
Air	72.98	1000 std. m^3/day
Stack Gas	80.83	1000 std. m^3/day

EXCESS AIR:

Actual (%)	0.6
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	3339.0
Net input energy (kW)	3013.8

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Unburnt Fuel	1.0	30.8	6581
Recoverable Heat in Flue Gas (*)	15.9	478.4	102296

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	2.2	66.0

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-202 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	80.9
Carbon Combustion Efficiency (%)	97.1

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	27.62
Dew temperature (°C)	58.1

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	910
Carbon Dioxide	47908
Nitric Oxide	1063
Nitrogen Dioxide	8
Total Oxides of Nitrogen	1071

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: Company DATE:
LOCATION: Site # 3 Test BY: Operator
SOURCE: CM-4 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.960040
ethane	0.018300
propane	0.000950
isobutane	0.000020
n-butane	0.000040
n-heptane	0.000010
nitrogen	0.020460
carbon_dioxide	0.000200
Total	1.000020

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 97.500

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	27.2	----	0.0
Fuel	27.2	N/A	0.0
Combustion Air	27.2	N/A	0.0
Flue Gas	447.8	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	746
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	10.7	Percent
Carbon Monoxide	118	PPM
Total Combustible (*)	0	PPM

Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	254	PPM
Nitrogen Dioxide	62	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 Test BY: Operator
SOURCE: CM-4 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.58
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.7
Net Heating Value (MJ/m^3)	33.4
Theoretical combustion air requirement (kmol air/kmol fuel)	9.5

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	4.42	1000 std. m^3/day
Air	90.14	1000 std. m^3/day
Stack Gas	94.61	1000 std. m^3/day

EXCESS AIR:

Actual (%)	115.3
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	1934.0
Net input energy (kW)	1746.3

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	7.5	130.6	27922
Unburnt Fuel	0.1	1.5	331
Recoverable Heat in Flue Gas (*)	33.5	584.5	124969

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.1	54.7

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:	Company	DATE:	
LOCATION:	Site # 3	Test BY:	Operator
SOURCE:	CM-4	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	63.3
Carbon Combustion Efficiency (%)	99.7

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.26
Dew temperature (°C)	43.8

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	79
Carbon Dioxide	49214
Nitric Oxide	183
Nitrogen Dioxide	68
Total Oxides of Nitrogen	251

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: Company DATE:
LOCATION: Site # 3 Test BY: Operator
SOURCE: CM-5 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.960040
ethane	0.018300
propane	0.000950
isobutane	0.000020
n-butane	0.000040
n-heptane	0.000010
nitrogen	0.020460
carbon_dioxide	0.000200
Total	1.000020

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 97.500

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	26.1	----	0.0
Fuel	26.1	N/A	0.0
Combustion Air	26.1	N/A	0.0
Flue Gas	447.8	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	746
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	8.2	Percent
Carbon Monoxide	150	PPM
Total Combustible (*)	0	PPM

Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	1925	PPM
Nitrogen Dioxide	184	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 Test BY: Operator
SOURCE: CM-5 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.58
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.7
Net Heating Value (MJ/m^3)	33.4
Theoretical combustion air requirement (kmol air/kmol fuel)	9.5

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	5.52	1000 std. m^3/day
Air	90.14	1000 std. m^3/day
Stack Gas	95.71	1000 std. m^3/day

EXCESS AIR:

Actual (%)	72.4
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	2408.9
Net input energy (kW)	2174.5

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	1.0	21.3	4559
Unburnt Fuel	0.1	2.0	426
Recoverable Heat in Flue Gas (*)	27.2	590.6	126276

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	2.8	61.7

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 Test BY: Operator
SOURCE: CM-5 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	69.9
Carbon Combustion Efficiency (%)	99.7

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.13
Dew temperature (°C)	47.9

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	82
Carbon Dioxide	49210
Nitric Oxide	1123
Nitrogen Dioxide	165
Total Oxides of Nitrogen	1288

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-7 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.960040
ethane	0.018300
propane	0.000950
isobutane	0.000020
n-butane	0.000040
n-heptane	0.000010
nitrogen	0.020460
carbon_dioxide	0.000200
Total	1.000020

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 97.500

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	30.0	----	0.0
Fuel	30.0	N/A	0.0
Combustion Air	30.0	N/A	0.0
Flue Gas	548.9	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	1193
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	0.2	Percent
Carbon Monoxide	3887	PPM
Total Combustible (*)	0	PPM

Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	2423	PPM
Nitrogen Dioxide	15	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-7 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.58
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.7
Net Heating Value (MJ/m^3)	33.4
Theoretical combustion air requirement (kmol air/kmol fuel)	9.5

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	10.20	1000 std. m^3/day
Air	97.31	1000 std. m^3/day
Stack Gas	107.82	1000 std. m^3/day

EXCESS AIR:

Actual (%)	0.7
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	4478.8
Net input energy (kW)	3638.9

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Unburnt Fuel	1.6	58.1	12423
Recoverable Heat in Flue Gas (*)	23.6	857.0	183240

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	14.2	515.8

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-7 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	60.7
Carbon Combustion Efficiency (%)	95.9

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	27.61
Dew temperature (°C)	58.1

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1290
Carbon Dioxide	47312
Nitric Oxide	861
Nitrogen Dioxide	8
Total Oxides of Nitrogen	870

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-5 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.960040
ethane	0.018300
propane	0.000950
isobutane	0.000020
n-butane	0.000040
n-heptane	0.000010
nitrogen	0.020460
carbon_dioxide	0.000200
Total	1.000020

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 97.500

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	21.7	----	0.0
Fuel	21.7	N/A	0.0
Combustion Air	21.7	N/A	0.0
Flue Gas	547.2	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	1193
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	0.2	Percent
Carbon Monoxide	1794	PPM
Total Combustible (*)	0	PPM

Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	2516	PPM
Nitrogen Dioxide	20	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-5 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.58
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.7
Net Heating Value (MJ/m^3)	33.4
Theoretical combustion air requirement (kmol air/kmol fuel)	9.5

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	10.14	1000 std. m^3/day
Air	97.31	1000 std. m^3/day
Stack Gas	107.65	1000 std. m^3/day

EXCESS AIR:

Actual (%)	1.3
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	4439.8
Net input energy (kW)	3604.9

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Unburnt Fuel	0.7	26.8	5724
Recoverable Heat in Flue Gas (*)	23.7	853.3	182453

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	14.2	512.9

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-5 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	61.4
Carbon Combustion Efficiency (%)	98.1

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	27.64
Dew temperature (°C)	58.0

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	598
Carbon Dioxide	48399
Nitric Oxide	898
Nitrogen Dioxide	11
Total Oxides of Nitrogen	909

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-4 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.960040
ethane	0.018300
propane	0.000950
isobutane	0.000020
n-butane	0.000040
n-heptane	0.000010
nitrogen	0.020460
carbon_dioxide	0.000200
Total	1.000020

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 97.500

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	21.7	----	0.0
Fuel	21.7	N/A	0.0
Combustion Air	21.7	N/A	0.0
Flue Gas	510.0	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	895
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	0.2	Percent
Carbon Monoxide	2029	PPM
Total Combustible (*)	0	PPM

Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	2467	PPM
Nitrogen Dioxide	17	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-4 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.58
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.7
Net Heating Value (MJ/m^3)	33.4
Theoretical combustion air requirement (kmol air/kmol fuel)	9.5

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	7.61	1000 std. m^3/day
Air	72.98	1000 std. m^3/day
Stack Gas	80.75	1000 std. m^3/day

EXCESS AIR:

Actual (%)	1.2
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	3309.7
Net input energy (kW)	2986.4

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Unburnt Fuel	0.8	22.7	4857
Recoverable Heat in Flue Gas (*)	19.7	587.1	125520

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	2.2	65.8

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-4 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	77.4
Carbon Combustion Efficiency (%)	97.8

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	27.64
Dew temperature (°C)	58.0

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	676
Carbon Dioxide	48277
Nitric Oxide	880
Nitrogen Dioxide	9
Total Oxides of Nitrogen	890

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-3 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.960040
ethane	0.018300
propane	0.000950
isobutane	0.000020
n-butane	0.000040
n-heptane	0.000010
nitrogen	0.020460
carbon_dioxide	0.000200
Total	1.000020

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 97.500

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	22.2	----	0.0
Fuel	22.2	N/A	0.0
Combustion Air	22.2	N/A	0.0
Flue Gas	510.0	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	597
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	0.1	Percent
Carbon Monoxide	9190	PPM
Total Combustible (*)	0	PPM

Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	2526	PPM
Nitrogen Dioxide	15	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-3 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.58
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.7
Net Heating Value (MJ/m^3)	33.4
Theoretical combustion air requirement (kmol air/kmol fuel)	9.5

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	5.20	1000 std. m^3/day
Air	48.65	1000 std. m^3/day
Stack Gas	54.16	1000 std. m^3/day

EXCESS AIR:

Actual (%)	-1.2
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	2275.7
Net input energy (kW)	1847.5

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Unburnt Fuel	3.7	69.0	14752
Recoverable Heat in Flue Gas (*)	21.2	392.4	83892

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	14.2	262.7

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-3 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	60.8
Carbon Combustion Efficiency (%)	90.4

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	27.51
Dew temperature (°C)	58.4

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	3006
Carbon Dioxide	44616
Nitric Oxide	885
Nitrogen Dioxide	8
Total Oxides of Nitrogen	893

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-2 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.960040
ethane	0.018300
propane	0.000950
isobutane	0.000020
n-butane	0.000040
n-heptane	0.000010
nitrogen	0.020460
carbon_dioxide	0.000200
Total	1.000020

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 97.500

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	22.2	----	0.0
Fuel	22.2	N/A	0.0
Combustion Air	22.2	N/A	0.0
Flue Gas	531.1	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	597
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	0.3	Percent
Carbon Monoxide	8170	PPM
Total Combustible (*)	0	PPM

Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	2050	PPM
Nitrogen Dioxide	21	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-2 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.58
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.7
Net Heating Value (MJ/m^3)	33.4
Theoretical combustion air requirement (kmol air/kmol fuel)	9.5

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	5.14	1000 std. m^3/day
Air	48.65	1000 std. m^3/day
Stack Gas	54.06	1000 std. m^3/day

EXCESS AIR:

Actual (%)	-0.0
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	2248.8
Net input energy (kW)	1825.8

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Unburnt Fuel	3.4	61.2	13092
Recoverable Heat in Flue Gas (*)	22.6	411.8	88049

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	14.2	259.6

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-2 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	59.9
Carbon Combustion Efficiency (%)	91.4

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	27.54
Dew temperature (°C)	58.2

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	2700
Carbon Dioxide	45096
Nitric Oxide	726
Nitrogen Dioxide	11
Total Oxides of Nitrogen	737

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-1 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.960040
ethane	0.018300
propane	0.000950
isobutane	0.000020
n-butane	0.000040
n-heptane	0.000010
nitrogen	0.020460
carbon_dioxide	0.000200
Total	1.000020

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 97.500

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	22.8	----	0.0
Fuel	22.8	N/A	0.0
Combustion Air	22.8	N/A	0.0
Flue Gas	510.0	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	283
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	0.4	Percent
Carbon Monoxide	7145	PPM
Total Combustible (*)	0	PPM

Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	2026	PPM
Nitrogen Dioxide	22	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-1 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.58
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.7
Net Heating Value (MJ/m^3)	33.4
Theoretical combustion air requirement (kmol air/kmol fuel)	9.5

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	2.42	1000 std. m^3/day
Air	23.11	1000 std. m^3/day
Stack Gas	25.65	1000 std. m^3/day

EXCESS AIR:

Actual (%)	0.8
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	1052.8
Net input energy (kW)	950.0

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Unburnt Fuel	2.7	25.4	5432
Recoverable Heat in Flue Gas (*)	19.6	185.9	39755

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	2.2	20.9

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: Company DATE:
LOCATION: Site # 3 TEST BY: Operator
SOURCE: CM-1 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	75.6
Carbon Combustion Efficiency (%)	92.4

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	27.56
Dew temperature (°C)	58.0

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	2377
Carbon Dioxide	45604
Nitric Oxide	722
Nitrogen Dioxide	12
Total Oxides of Nitrogen	734

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #4 TEST BY: Dave/Jeff
SOURCE: North Injection Compressor PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.688320
ethane	0.065760
propane	0.002390
isobutane	0.000270
n-butane	0.000770
isopentane	0.001980
n-pentane	0.001540
n-hexane	0.000560
n-heptane	0.000070
nitrogen	0.238340
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 101.100

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	26.7	----	0.0
Fuel	26.7	N/A	0.0
Combustion Air	26.7	N/A	0.0
Flue Gas	254.6	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	1864
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	14.5	Percent
Carbon Monoxide	0	PPM
Total Combustible (*)	6488	PPM
Unburnt Fuel (calculated)	6488	PPM
Nitric Oxide	0	PPM
Nitrogen Dioxide	0	PPM

Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #4 TEST BY: Dave/Jeff
SOURCE: North Injection Compressor PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	20.17
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	31.5
Net Heating Value (MJ/m^3)	28.0
Theoretical combustion air requirement (kmol air/kmol fuel)	7.9

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	6.37	1000 std. m^3/day
Air	152.06	1000 std. m^3/day
Stack Gas	158.67	1000 std. m^3/day

EXCESS AIR:

Actual (%)	202.1
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	2331.1
Net input energy (kW)	2146.1

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	15.0	321.4	68717
Unburnt Fuel	17.4	372.4	79627
Recoverable Heat in Flue Gas (*)	23.5	503.5	107659

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	3.2	69.1

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy stillleft in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #4	TEST BY:	Dave/Jeff
SOURCE:	North Injection Compressor	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	56.0
Carbon Combustion Efficiency (%)	83.8

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.46
Dew temperature (°C)	34.6

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Dioxide	42267
Methane	2398
Ethane	429.5
Total VOC	103
Total Hydrocarbons	2931

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #4 TEST BY: Dave/Jeff
SOURCE: Injection Compressor #1 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.688320
ethane	0.065760
propane	0.002390
isobutane	0.000270
n-butane	0.000770
isopentane	0.001980
n-pentane	0.001540
n-hexane	0.000560
n-heptane	0.000070
nitrogen	0.238340
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 101.100

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	26.7	----	0.0
Fuel	26.7	N/A	0.0
Combustion Air	26.7	N/A	0.0
Flue Gas	115.0	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	1864
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	15.2	Percent
Carbon Monoxide	0	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	0	PPM
Nitrogen Dioxide	0	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #4 TEST BY: Dave/Jeff
SOURCE: Injection Compressor #1 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	20.17
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	31.5
Net Heating Value (MJ/m^3)	28.0
Theoretical combustion air requirement (kmol air/kmol fuel)	7.9

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	4.86	1000 std. m^3/day
Air	152.06	1000 std. m^3/day
Stack Gas	157.14	1000 std. m^3/day

EXCESS AIR:

Actual (%)	295.9
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	1898.7
Net input energy (kW)	1607.5

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	8.7	140.1	29964
Recoverable Heat in Flue Gas (*)	10.4	167.6	35835

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	12.1	194.1

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #4	TEST BY:	Dave/Jeff
SOURCE:	Injection Compressor #1	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	77.5
Carbon Combustion Efficiency (%)	100.0

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.54
Dew temperature (°C)	33.0

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Dioxide	50417

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #4 TEST BY: Dave/Jeff
SOURCE: East Solar Turbine PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.688320
ethane	0.065760
propane	0.002390
isobutane	0.000270
n-butane	0.000770
isopentane	0.001980
n-pentane	0.001540
n-hexane	0.000560
n-heptane	0.000070
nitrogen	0.238340
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 101.100

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	26.7	----	0.0
Fuel	26.7	0.1	0.0
Combustion Air	26.7	N/A	0.0
Flue Gas	283.3	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Turbine
Nominal rated power output (kW)	895
Assumed equipment efficiency (%)	12.6
Assumed percent loading (%)	43.5
Turbine Pressure Ratio	17.9
Turbine Fuel Pressure (kPa)	1810
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	16.4	Percent
Carbon Monoxide	0	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM

Nitric Oxide	0	PPM
Nitrogen Dioxide	0	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #4 TEST BY: Dave/Jeff
SOURCE: East Solar Turbine PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	20.17
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	31.5
Net Heating Value (MJ/m^3)	28.0
Theoretical combustion air requirement (kmol air/kmol fuel)	7.9

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	8.50	1000 std. m^3/day
Air	341.48	1000 std. m^3/day
Stack Gas	350.36	1000 std. m^3/day

EXCESS AIR:

Actual (%)	408.6
Recommended (%)	360 to 690

ENERGY BALANCE:

Gross input energy (kW)	5027.0
Net input energy (kW)	4732.8

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Recoverable Heat in Flue Gas (*)	27.2	1287.1	275193

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	2.6	122.0

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #4	TEST BY:	Dave/Jeff
SOURCE:	East Solar Turbine	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	70.2
Carbon Combustion Efficiency (%)	100.0

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.61
Dew temperature (°C)	28.8

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Dioxide	50417

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #4 TEST BY: Dave/Jeff
SOURCE: West Solar Turbine PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.688320
ethane	0.065760
propane	0.002390
isobutane	0.000270
n-butane	0.000770
isopentane	0.001980
n-pentane	0.001540
n-hexane	0.000560
n-heptane	0.000070
nitrogen	0.238340
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 101.100

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	26.7	----	0.0
Fuel	26.7	0.1	0.0
Combustion Air	26.7	N/A	0.0
Flue Gas	285.0	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Turbine
Nominal rated power output (kW)	895
Assumed equipment efficiency (%)	12.6
Assumed percent loading (%)	43.5
Turbine Pressure Ratio	17.9
Turbine Fuel Pressure (kPa)	1810
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	17.5	Percent
Carbon Monoxide	0	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM

Nitric Oxide	0	PPM
Nitrogen Dioxide	0	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #4 TEST BY: Dave/Jeff
SOURCE: West Solar Turbine PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	20.17
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	31.5
Net Heating Value (MJ/m^3)	28.0
Theoretical combustion air requirement (kmol air/kmol fuel)	7.9

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	8.50	1000 std. m^3/day
Air	446.82	1000 std. m^3/day
Stack Gas	455.70	1000 std. m^3/day

EXCESS AIR:

Actual (%)	565.5
Recommended (%)	360 to 690

ENERGY BALANCE:

Gross input energy (kW)	5628.9
Net input energy (kW)	5334.6

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Recoverable Heat in Flue Gas (*)	32.0	1709.6	365527

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	2.4	128.5

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy stillleft in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #4	TEST BY:	Dave/Jeff
SOURCE:	West Solar Turbine	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	65.5
Carbon Combustion Efficiency (%)	100.0

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.66
Dew temperature (°C)	24.3

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Dioxide	50417

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #4 TEST BY: Dave/Jeff
SOURCE: Inlet Compressor (2nd from N end) PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.688320
ethane	0.065760
propane	0.002390
isobutane	0.000270
n-butane	0.000770
isopentane	0.001980
n-pentane	0.001540
n-hexane	0.000560
n-heptane	0.000070
nitrogen	0.238340
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 101.100

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	26.7	----	0.0
Fuel	26.7	N/A	0.0
Combustion Air	26.7	N/A	0.0
Flue Gas	415.2	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	447
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	16.5	Percent
Carbon Monoxide	0	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	0	PPM
Nitrogen Dioxide	0	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH_4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #4 TEST BY: Dave/Jeff
SOURCE: Inlet Compressor (2nd from N end) PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	20.17
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	31.5
Net Heating Value (MJ/m^3)	28.0
Theoretical combustion air requirement (kmol air/kmol fuel)	7.9

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	0.90	1000 std. m^3/day
Air	36.49	1000 std. m^3/day
Stack Gas	37.44	1000 std. m^3/day

EXCESS AIR:

Actual (%)	412.4
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	337.8
Net input energy (kW)	306.6

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	54.2	166.2	35525
Recoverable Heat in Flue Gas (*)	70.2	215.1	45991

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	4.2	13.0

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy stillleft in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #4	TEST BY:	Dave/Jeff
SOURCE:	Inlet Compressor (2nd from N end)	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	25.6
Carbon Combustion Efficiency (%)	100.0

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.61
Dew temperature (°C)	28.6

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Dioxide	50417

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-23 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	29.0	----	0.0
Fuel	29.0	N/A	0.0
Combustion Air	29.0	N/A	0.0
Flue Gas	373.0	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	895
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	14.3	Percent
Carbon Monoxide	1200	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	1122	PPM
Nitrogen Dioxide	56	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-23 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	6.96	1000 std. m^3/day
Air	219.46	1000 std. m^3/day
Stack Gas	226.56	1000 std. m^3/day

EXCESS AIR:

Actual (%)	236.8
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3029.4
Net input energy (kW)	2736.1

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	20.9	571.3	122159
Unburnt Fuel	1.4	37.7	8058
Recoverable Heat in Flue Gas (*)	41.7	1139.6	243662

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.6	97.6

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-23 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	53.4
Carbon Combustion Efficiency (%)	96.0

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.45
Dew temperature (°C)	34.2

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1241
Carbon Dioxide	47186
Nitric Oxide	1243
Nitrogen Dioxide	95
Total Oxides of Nitrogen	1338

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY:		DATE:	
LOCATION:	Site #5 North Plant	TEST BY:	Operator
SOURCE:	C-24	PAGE:	1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	37.0	----	0.0
Fuel	37.0	N/A	0.0
Combustion Air	37.0	N/A	0.0
Flue Gas	381.5	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	895
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	13.6	Percent
Carbon Monoxide	1580	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	1017	PPM
Nitrogen Dioxide	50	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-24 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	6.96	1000 std. m^3/day
Air	197.39	1000 std. m^3/day
Stack Gas	204.51	1000 std. m^3/day

EXCESS AIR:

Actual (%)	202.9
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3048.8
Net input energy (kW)	2755.5

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	16.7	459.5	98244
Unburnt Fuel	1.6	44.8	9578
Recoverable Heat in Flue Gas (*)	38.2	1053.4	225230

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.4	93.9

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-24 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	56.7
Carbon Combustion Efficiency (%)	95.3

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.40
Dew temperature (°C)	36.1

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1475
Carbon Dioxide	46819
Nitric Oxide	1017
Nitrogen Dioxide	77
Total Oxides of Nitrogen	1094

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-27 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	28.0	----	0.0
Fuel	28.0	N/A	0.0
Combustion Air	28.0	N/A	0.0
Flue Gas	364.0	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	895
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	14.9	Percent
Carbon Monoxide	980	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	1027	PPM
Nitrogen Dioxide	51	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH_4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-27 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	6.96	1000 std. m^3/day
Air	241.95	1000 std. m^3/day
Stack Gas	249.04	1000 std. m^3/day

EXCESS AIR:

Actual (%)	271.3
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3030.4
Net input energy (kW)	2737.0

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	24.5	670.1	143281
Unburnt Fuel	1.2	33.8	7234
Recoverable Heat in Flue Gas (*)	44.6	1220.8	261024

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.7	100.9

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 North Plant	TEST BY:	Operator
SOURCE:	C-27	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	50.5
Carbon Combustion Efficiency (%)	96.4

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.49
Dew temperature (°C)	32.5

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1114
Carbon Dioxide	47386
Nitric Oxide	1251
Nitrogen Dioxide	95
Total Oxides of Nitrogen	1346

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-34 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	35.0	----	0.0
Fuel	35.0	N/A	0.0
Combustion Air	35.0	N/A	0.0
Flue Gas	344.1	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	987
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	13.6	Percent
Carbon Monoxide	1620	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	1034	PPM
Nitrogen Dioxide	51	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-34 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	7.67	1000 std. m^3/day
Air	217.59	1000 std. m^3/day
Stack Gas	225.46	1000 std. m^3/day

EXCESS AIR:

Actual (%)	202.9
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3354.7
Net input energy (kW)	3031.3

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	14.9	452.4	96738
Unburnt Fuel	1.7	50.6	10826
Recoverable Heat in Flue Gas (*)	33.9	1027.0	219581

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.4	103.5

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 North Plant	TEST BY:	Operator
SOURCE:	C-34	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	61.0
Carbon Combustion Efficiency (%)	95.2

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.40
Dew temperature (°C)	36.1

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1512
Carbon Dioxide	46760
Nitric Oxide	1034
Nitrogen Dioxide	78
Total Oxides of Nitrogen	1112

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-37 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	28.0	----	0.0
Fuel	28.0	N/A	0.0
Combustion Air	28.0	N/A	0.0
Flue Gas	367.6	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	987
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	14.6	Percent
Carbon Monoxide	970	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	999	PPM
Nitrogen Dioxide	49	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-37 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	7.67	1000 std. m^3/day
Air	253.81	1000 std. m^3/day
Stack Gas	261.61	1000 std. m^3/day

EXCESS AIR:

Actual (%)	253.3
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3338.5
Net input energy (kW)	3015.2

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	22.6	681.4	145694
Unburnt Fuel	1.2	35.2	7522
Recoverable Heat in Flue Gas (*)	43.0	1295.3	276962

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.6	109.4

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 North Plant	TEST BY:	Operator
SOURCE:	C-37	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	52.2
Carbon Combustion Efficiency (%)	96.6

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.47
Dew temperature (°C)	33.4

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1051
Carbon Dioxide	47486
Nitric Oxide	1159
Nitrogen Dioxide	87
Total Oxides of Nitrogen	1246

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-38 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	28.0	----	0.0
Fuel	28.0	N/A	0.0
Combustion Air	28.0	N/A	0.0
Flue Gas	328.9	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	990
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	13.0	Percent
Carbon Monoxide	2160	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	1735	PPM
Nitrogen Dioxide	86	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-38 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	7.70	1000 std. m^3/day
Air	201.86	1000 std. m^3/day
Stack Gas	209.79	1000 std. m^3/day

EXCESS AIR:

Actual (%)	179.9
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3341.2
Net input energy (kW)	3016.6

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	12.2	367.1	78486
Unburnt Fuel	2.1	62.8	13432
Recoverable Heat in Flue Gas (*)	29.9	902.4	192942

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.3	100.8

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 North Plant	TEST BY:	Operator
SOURCE:	C-38	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	64.7
Carbon Combustion Efficiency (%)	94.0

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.36
Dew temperature (°C)	37.5

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1869
Carbon Dioxide	46199
Nitric Oxide	1609
Nitrogen Dioxide	122
Total Oxides of Nitrogen	1731

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-39 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	28.0	----	0.0
Fuel	28.0	N/A	0.0
Combustion Air	28.0	N/A	0.0
Flue Gas	353.2	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	987
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	12.5	Percent
Carbon Monoxide	2310	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	1485	PPM
Nitrogen Dioxide	74	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-39 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	7.67	1000 std. m^3/day
Air	188.34	1000 std. m^3/day
Stack Gas	196.25	1000 std. m^3/day

EXCESS AIR:

Actual (%)	162.2
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3326.2
Net input energy (kW)	3002.8

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	11.1	334.5	71530
Unburnt Fuel	2.1	62.8	13437
Recoverable Heat in Flue Gas (*)	30.6	918.1	196307

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.3	97.8

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-39 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	64.1
Carbon Combustion Efficiency (%)	94.0

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.33
Dew temperature (°C)	38.6

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1877
Carbon Dioxide	46187
Nitric Oxide	1293
Nitrogen Dioxide	99
Total Oxides of Nitrogen	1391

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-40 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	28.0	----	0.0
Fuel	28.0	N/A	0.0
Combustion Air	28.0	N/A	0.0
Flue Gas	355.7	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	987
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	14.6	Percent
Carbon Monoxide	970	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	999	PPM
Nitrogen Dioxide	49	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-40 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	7.67	1000 std. m^3/day
Air	253.81	1000 std. m^3/day
Stack Gas	261.61	1000 std. m^3/day

EXCESS AIR:

Actual (%)	253.3
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3338.5
Net input energy (kW)	3015.2

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	21.8	656.8	140428
Unburnt Fuel	1.2	35.2	7522
Recoverable Heat in Flue Gas (*)	41.3	1246.2	266457

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.6	109.4

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 North Plant TEST BY: Operator
SOURCE: C-40 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	53.9
Carbon Combustion Efficiency (%)	96.6

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.47
Dew temperature (°C)	33.4

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1051
Carbon Dioxide	47486
Nitric Oxide	1159
Nitrogen Dioxide	87
Total Oxides of Nitrogen	1246

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-12 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	28.0	----	0.0
Fuel	28.0	N/A	0.0
Combustion Air	28.0	N/A	0.0
Flue Gas	369.7	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	1312
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	14.6	Percent
Carbon Monoxide	870	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	965	PPM
Nitrogen Dioxide	48	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-12 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	10.20	1000 std. m^3/day
Air	337.77	1000 std. m^3/day
Stack Gas	348.14	1000 std. m^3/day

EXCESS AIR:

Actual (%)	253.4
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	4441.3
Net input energy (kW)	4011.1

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	22.8	913.2	195250
Unburnt Fuel	1.0	42.0	8978
Recoverable Heat in Flue Gas (*)	43.3	1735.9	371158

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.6	145.6

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 Middle Plant	TEST BY:	Operator
SOURCE:	C-12	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	52.0
Carbon Combustion Efficiency (%)	97.0

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.47
Dew temperature (°C)	33.4

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	943
Carbon Dioxide	47655
Nitric Oxide	1120
Nitrogen Dioxide	85
Total Oxides of Nitrogen	1206

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-11 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	29.0	----	0.0
Fuel	29.0	N/A	0.0
Combustion Air	29.0	N/A	0.0
Flue Gas	371.3	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	1312
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	12.5	Percent
Carbon Monoxide	2310	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	1485	PPM
Nitrogen Dioxide	74	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH_4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-11 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	10.20	1000 std. m^3/day
Air	250.55	1000 std. m^3/day
Stack Gas	261.07	1000 std. m^3/day

EXCESS AIR:

Actual (%)	162.2
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	4428.7
Net input energy (kW)	3998.5

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	11.7	469.5	100375
Unburnt Fuel	2.1	83.6	17875
Recoverable Heat in Flue Gas (*)	32.4	1297.0	277309

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.3	130.1

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 Middle Plant	TEST BY:	Operator
SOURCE:	C-11	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	62.2
Carbon Combustion Efficiency (%)	94.0

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.33
Dew temperature (°C)	38.6

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1877
Carbon Dioxide	46187
Nitric Oxide	1293
Nitrogen Dioxide	99
Total Oxides of Nitrogen	1391

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-10 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	32.0	----	0.0
Fuel	32.0	N/A	0.0
Combustion Air	32.0	N/A	0.0
Flue Gas	350.4	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	1312
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	14.0	Percent
Carbon Monoxide	1480	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	1458	PPM
Nitrogen Dioxide	72	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH_4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-10 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	10.20	1000 std. m^3/day
Air	307.90	1000 std. m^3/day
Stack Gas	318.35	1000 std. m^3/day

EXCESS AIR:

Actual (%)	222.2
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	4454.2
Net input energy (kW)	4024.0

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	17.6	707.7	151310
Unburnt Fuel	1.6	65.3	13965
Recoverable Heat in Flue Gas (*)	36.9	1484.9	317500

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.5	140.9

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 Middle Plant	TEST BY:	Operator
SOURCE:	C-10	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	58.0
Carbon Combustion Efficiency (%)	95.3

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.43
Dew temperature (°C)	35.0

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1467
Carbon Dioxide	46832
Nitric Oxide	1548
Nitrogen Dioxide	117
Total Oxides of Nitrogen	1665

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-9 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	28.0	----	0.0
Fuel	28.0	N/A	0.0
Combustion Air	28.0	N/A	0.0
Flue Gas	425.7	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	999
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	13.0	Percent
Carbon Monoxide	2800	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	1804	PPM
Nitrogen Dioxide	90	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-9 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	7.77	1000 std. m^3/day
Air	203.05	1000 std. m^3/day
Stack Gas	211.12	1000 std. m^3/day

EXCESS AIR:

Actual (%)	179.0
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3371.3
Net input energy (kW)	3043.7

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	16.1	491.3	105046
Unburnt Fuel	2.7	81.9	17522
Recoverable Heat in Flue Gas (*)	40.6	1235.4	264145

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.3	101.6

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-9 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	53.4
Carbon Combustion Efficiency (%)	92.3

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.35
Dew temperature (°C)	37.5

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	2417
Carbon Dioxide	45339
Nitric Oxide	1668
Nitrogen Dioxide	128
Total Oxides of Nitrogen	1796

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-7 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	29.0	----	0.0
Fuel	29.0	N/A	0.0
Combustion Air	29.0	N/A	0.0
Flue Gas	365.5	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	999
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	14.3	Percent
Carbon Monoxide	1200	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	1122	PPM
Nitrogen Dioxide	56	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH_4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-7 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	7.77	1000 std. m^3/day
Air	245.06	1000 std. m^3/day
Stack Gas	252.99	1000 std. m^3/day

EXCESS AIR:

Actual (%)	236.8
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3382.9
Net input energy (kW)	3055.3

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	20.4	623.5	133323
Unburnt Fuel	1.4	42.1	8999
Recoverable Heat in Flue Gas (*)	40.7	1242.3	265630

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.6	109.0

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 Middle Plant	TEST BY:	Operator
SOURCE:	C-7	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	54.4
Carbon Combustion Efficiency (%)	96.0

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.45
Dew temperature (°C)	34.2

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1241
Carbon Dioxide	47186
Nitric Oxide	1243
Nitrogen Dioxide	95
Total Oxides of Nitrogen	1338

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-8 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	29.0	----	0.0
Fuel	29.0	N/A	0.0
Combustion Air	29.0	N/A	0.0
Flue Gas	379.3	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	895
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	12.5	Percent
Carbon Monoxide	2310	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	1485	PPM
Nitrogen Dioxide	74	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH_4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-8 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	6.96	1000 std. m^3/day
Air	170.83	1000 std. m^3/day
Stack Gas	178.00	1000 std. m^3/day

EXCESS AIR:

Actual (%)	162.2
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3019.6
Net input energy (kW)	2726.3

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	12.0	327.8	70089
Unburnt Fuel	2.1	57.0	12188
Recoverable Heat in Flue Gas (*)	33.3	907.0	193926

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.3	88.7

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 Middle Plant	TEST BY:	Operator
SOURCE:	C-8	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	61.4
Carbon Combustion Efficiency (%)	94.0

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.33
Dew temperature (°C)	38.6

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1877
Carbon Dioxide	46187
Nitric Oxide	1293
Nitrogen Dioxide	99
Total Oxides of Nitrogen	1391

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-6 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	35.0	----	0.0
Fuel	35.0	N/A	0.0
Combustion Air	35.0	N/A	0.0
Flue Gas	373.1	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	895
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	13.6	Percent
Carbon Monoxide	1620	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	1034	PPM
Nitrogen Dioxide	1085	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-6 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	6.96	1000 std. m^3/day
Air	200.06	1000 std. m^3/day
Stack Gas	207.08	1000 std. m^3/day

EXCESS AIR:

Actual (%)	207.0
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3043.6
Net input energy (kW)	2750.3

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	16.9	463.9	99182
Unburnt Fuel	1.7	46.5	9944
Recoverable Heat in Flue Gas (*)	37.8	1039.4	222245

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.4	94.4

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 Middle Plant	TEST BY:	Operator
SOURCE:	C-6	PAGE:	3

EFFICIENCIES:	
Apparent Thermal Efficiency (%)	57.1
Carbon Combustion Efficiency (%)	95.1
STACK GAS CHARACTERISTICS:	
Molecular weight (kg/kmol)	28.42
Dew temperature (°C)	35.8

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1531
Carbon Dioxide	46730
Nitric Oxide	1047
Nitrogen Dioxide	1685
Total Oxides of Nitrogen	2732

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-5 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	28.0	----	0.0
Fuel	28.0	N/A	0.0
Combustion Air	28.0	N/A	0.0
Flue Gas	331.3	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	999
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	14.9	Percent
Carbon Monoxide	980	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	1027	PPM
Nitrogen Dioxide	51	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH_4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-5 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	7.77	1000 std. m^3/day
Air	270.18	1000 std. m^3/day
Stack Gas	278.09	1000 std. m^3/day

EXCESS AIR:

Actual (%)	271.3
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3383.9
Net input energy (kW)	3056.4

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	22.0	673.0	143903
Unburnt Fuel	1.2	37.8	8078
Recoverable Heat in Flue Gas (*)	39.9	1219.7	260784

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.7	112.7

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 Middle Plant	TEST BY:	Operator
SOURCE:	C-5	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	55.2
Carbon Combustion Efficiency (%)	96.4

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.49
Dew temperature (°C)	32.5

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1114
Carbon Dioxide	47386
Nitric Oxide	1251
Nitrogen Dioxide	95
Total Oxides of Nitrogen	1346

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-3 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	28.0	----	0.0
Fuel	28.0	N/A	0.0
Combustion Air	28.0	N/A	0.0
Flue Gas	289.9	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	999
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	14.6	Percent
Carbon Monoxide	970	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	999	PPM
Nitrogen Dioxide	49	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-3 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	7.77	1000 std. m^3/day
Air	257.07	1000 std. m^3/day
Stack Gas	264.97	1000 std. m^3/day

EXCESS AIR:

Actual (%)	253.3
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3381.4
Net input energy (kW)	3053.9

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	17.3	527.8	112848
Unburnt Fuel	1.2	35.6	7618
Recoverable Heat in Flue Gas (*)	32.4	988.3	211305

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.6	110.8

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-3 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	62.8
Carbon Combustion Efficiency (%)	96.6

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.47
Dew temperature (°C)	33.4

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1051
Carbon Dioxide	47486
Nitric Oxide	1159
Nitrogen Dioxide	87
Total Oxides of Nitrogen	1246

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-2 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	24.0	----	0.0
Fuel	24.0	N/A	0.0
Combustion Air	24.0	N/A	0.0
Flue Gas	393.2	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	895
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	13.0	Percent
Carbon Monoxide	2210	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	1472	PPM
Nitrogen Dioxide	73	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH_4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-2 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	6.96	1000 std. m^3/day
Air	182.01	1000 std. m^3/day
Stack Gas	189.19	1000 std. m^3/day

EXCESS AIR:

Actual (%)	179.3
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3008.1
Net input energy (kW)	2714.7

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	15.0	407.7	87176
Unburnt Fuel	2.1	58.0	12393
Recoverable Heat in Flue Gas (*)	37.1	1008.0	215519

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.4	91.0

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 Middle Plant	TEST BY:	Operator
SOURCE:	C-2	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	57.4
Carbon Combustion Efficiency (%)	93.9

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.36
Dew temperature (°C)	37.5

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1909
Carbon Dioxide	46137
Nitric Oxide	1362
Nitrogen Dioxide	104
Total Oxides of Nitrogen	1465

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-1 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	28.0	----	0.0
Fuel	28.0	N/A	0.0
Combustion Air	28.0	N/A	0.0
Flue Gas	403.6	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	895
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	13.0	Percent
Carbon Monoxide	2160	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	1735	PPM
Nitrogen Dioxide	86	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH_4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-1 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	6.96	1000 std. m^3/day
Air	182.40	1000 std. m^3/day
Stack Gas	189.57	1000 std. m^3/day

EXCESS AIR:

Actual (%)	179.9
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3019.1
Net input energy (kW)	2725.8

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	15.3	417.6	89290
Unburnt Fuel	2.1	56.8	12137
Recoverable Heat in Flue Gas (*)	38.2	1041.8	222752

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.3	91.1

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 Middle Plant	TEST BY:	Operator
SOURCE:	C-1	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	56.4
Carbon Combustion Efficiency (%)	94.0

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.36
Dew temperature (°C)	37.5

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	1869
Carbon Dioxide	46199
Nitric Oxide	1609
Nitrogen Dioxide	122
Total Oxides of Nitrogen	1731

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-17 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	26.0	----	0.0
Fuel	26.0	N/A	0.0
Combustion Air	26.0	N/A	0.0
Flue Gas	504.4	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	895
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	0.5	Percent
Carbon Monoxide	12390	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	2347	PPM
Nitrogen Dioxide	117	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 South Plant TEST BY: Operator
SOURCE: C-30 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	20.0	----	0.0
Fuel	20.0	N/A	0.0
Combustion Air	20.0	N/A	0.0
Flue Gas	580.5	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	1976
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	13.1	Percent
Carbon Monoxide	130	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	286	PPM
Nitrogen Dioxide	0	PPM

Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 South Plant TEST BY: Operator
SOURCE: C-30 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	8.98	1000 std. m^3/day
Air	238.88	1000 std. m^3/day
Stack Gas	247.90	1000 std. m^3/day

EXCESS AIR:

Actual (%)	183.9
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	3870.3
Net input energy (kW)	3491.6

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	24.3	849.9	181729
Unburnt Fuel	0.1	4.5	955
Recoverable Heat in Flue Gas (*)	59.8	2089.6	446786

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.4	118.3

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 South Plant	TEST BY:	Operator
SOURCE:	C-30	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	36.6
Carbon Combustion Efficiency (%)	99.6

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.39
Dew temperature (°C)	37.2

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	114
Carbon Dioxide	48957
Nitric Oxide	269
Total Oxides of Nitrogen	269

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 South Plant TEST BY: Operator
SOURCE: C-31 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	20.0	----	0.0
Fuel	20.0	N/A	0.0
Combustion Air	20.0	N/A	0.0
Flue Gas	570.0	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_LowNOx
Nominal rated power output (kW)	1976
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	12.4	Percent
Carbon Monoxide	140	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	45	PPM
Nitrogen Dioxide	0	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 South Plant TEST BY: Operator
SOURCE: C-31 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	9.83	1000 std. m^3/day
Air	238.88	1000 std. m^3/day
Stack Gas	248.75	1000 std. m^3/day

EXCESS AIR:

Actual (%)	159.5
Recommended (%)	44.0 to 66.0

ENERGY BALANCE:

Gross input energy (kW)	4232.6
Net input energy (kW)	3818.2

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	18.9	722.7	154525
Unburnt Fuel	0.1	4.8	1032
Recoverable Heat in Flue Gas (*)	53.8	2052.3	438821

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	3.3	124.8

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 South Plant	TEST BY:	Operator
SOURCE:	C-31	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	42.9
Carbon Combustion Efficiency (%)	99.6

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.35
Dew temperature (°C)	38.8

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	113
Carbon Dioxide	48960
Nitric Oxide	39
Total Oxides of Nitrogen	39

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-22 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	20.0	----	0.0
Fuel	20.0	N/A	0.0
Combustion Air	20.0	N/A	0.0
Flue Gas	588.0	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	895
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	0.5	Percent
Carbon Monoxide	14590	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	2348	PPM
Nitrogen Dioxide	117	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH_4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-22 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	7.83	1000 std. m^3/day
Air	72.98	1000 std. m^3/day
Stack Gas	81.42	1000 std. m^3/day

EXCESS AIR:

Actual (%)	-0.5
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	3387.8
Net input energy (kW)	2747.5

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Unburnt Fuel	6.0	164.7	35212
Recoverable Heat in Flue Gas (*)	25.5	701.9	150067

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	14.2	390.5

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 Middle Plant	TEST BY:	Operator
SOURCE:	C-22	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	54.2
Carbon Combustion Efficiency (%)	84.6

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	27.43
Dew temperature (°C)	56.4

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	4816
Carbon Dioxide	41569
Nitric Oxide	830
Nitrogen Dioxide	63
Total Oxides of Nitrogen	894

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-17 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	26.0	----	0.0
Fuel	26.0	N/A	0.0
Combustion Air	26.0	N/A	0.0
Flue Gas	504.4	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	895
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	0.5	Percent
Carbon Monoxide	12390	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	2347	PPM
Nitrogen Dioxide	117	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH_4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-17 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	7.79	1000 std. m^3/day
Air	72.98	1000 std. m^3/day
Stack Gas	81.29	1000 std. m^3/day

EXCESS AIR:

Actual (%)	0.1
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	3375.4
Net input energy (kW)	2738.9

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Unburnt Fuel	5.1	139.6	29852
Recoverable Heat in Flue Gas (*)	21.2	581.8	124400

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	14.2	388.3

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-17 PAGE: 3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	59.5
Carbon Combustion Efficiency (%)	86.9

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	27.47
Dew temperature (°C)	56.3

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	4107
Carbon Dioxide	42683
Nitric Oxide	833
Nitrogen Dioxide	64
Total Oxides of Nitrogen	897

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-19 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	27.0	----	0.0
Fuel	27.0	N/A	0.0
Combustion Air	27.0	N/A	0.0
Flue Gas	584.5	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Engine_Recip_Normal
Nominal rated power output (kW)	895
Assumed equipment efficiency (%)	30.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	0.5	Percent
Carbon Monoxide	8680	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	2449	PPM
Nitrogen Dioxide	122	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH_4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: C-19 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	7.71	1000 std. m^3/day
Air	72.98	1000 std. m^3/day
Stack Gas	81.06	1000 std. m^3/day

EXCESS AIR:

Actual (%)	1.1
Recommended (%)	2.0 to 12.0

ENERGY BALANCE:

Gross input energy (kW)	3342.8
Net input energy (kW)	2712.9

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
Unburnt Fuel	3.6	97.5	20854
Recoverable Heat in Flue Gas (*)	25.6	695.7	148754

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	14.2	384.5

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 Middle Plant	TEST BY:	Operator
SOURCE:	C-19	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	56.6
Carbon Combustion Efficiency (%)	90.7

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	27.53
Dew temperature (°C)	56.2

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	2899
Carbon Dioxide	44582
Nitric Oxide	876
Nitrogen Dioxide	67
Total Oxides of Nitrogen	943

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: Hot Oil Heater PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	25.0	----	0.0
Fuel	25.0	N/A	0.0
Combustion Air	25.0	N/A	0.0
Flue Gas	315.6	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Boiler_Natural
Nominal rated power output (kW)	791
Assumed equipment efficiency (%)	82.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	7.8	Percent
Carbon Monoxide	10	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	63	PPM
Nitrogen Dioxide	3	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH_4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: Hot Oil Heater PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	1.56	1000 std. m^3/day
Air	24.22	1000 std. m^3/day
Stack Gas	25.79	1000 std. m^3/day

EXCESS AIR:

Actual (%)	65.5
Recommended (%)	10 to 15

ENERGY BALANCE:

Gross input energy (kW)	674.0
Net input energy (kW)	608.1

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	5.2	31.8	6803
Unburnt Fuel	0.0	0.0	8
Recoverable Heat in Flue Gas (*)	17.1	103.8	22190

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat		

in Flue Gas	2.7	16.3

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 Middle Plant	TEST BY:	Operator
SOURCE:	Hot Oil Heater	PAGE:	3

EFFICIENCIES:	
Apparent Thermal Efficiency (%)	80.2
Carbon Combustion Efficiency (%)	100.0
STACK GAS CHARACTERISTICS:	
Molecular weight (kg/kmol)	28.09
Dew temperature (°C)	47.0

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Monoxide	5
Carbon Dioxide	49128
Nitric Oxide	35
Nitrogen Dioxide	3
Total Oxides of Nitrogen	38

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: B-01 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	25.0	----	0.0
Fuel	25.0	N/A	0.0
Combustion Air	25.0	N/A	0.0
Flue Gas	260.0	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Boiler_Natural
Nominal rated power output (kW)	29281
Assumed equipment efficiency (%)	82.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	6.8	Percent
Carbon Monoxide	0	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	0	PPM
Nitrogen Dioxide	0	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH_4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: B-01 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	62.82	1000 std. m^3/day
Air	897.12	1000 std. m^3/day
Stack Gas	960.09	1000 std. m^3/day

EXCESS AIR:

Actual (%)	52.4
Recommended (%)	10 to 15

ENERGY BALANCE:

Gross input energy (kW)	27227.9
Net input energy (kW)	24578.9

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	3.1	763.1	163154
Recoverable Heat in Flue Gas (*)	12.2	2999.6	641351

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	2.6	630.6

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY:		DATE:	
LOCATION:	Site #5 Middle Plant	TEST BY:	Operator
SOURCE:	B-01	PAGE:	3

EFFICIENCIES:

Apparent Thermal Efficiency (%)	85.2
Carbon Combustion Efficiency (%)	100.0

STACK GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	28.03
Dew temperature (°C)	48.5

EMISSION FACTORS FOR VARIOUS COMPONENTS (ng/J) (*):

Component	Flue Gas
Carbon Dioxide	49136

(*) Based on gross heating value of the fuel at 15 °C and 101.325 kPa

------ COMBUSTION ANALYSIS: INPUT DATA ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: B-02 PAGE: 1

THE FUEL GAS ANALYSIS:

Component	Mole Fraction
methane	0.975620
ethane	0.004300
propane	0.000200
nitrogen	0.019880
Total	1.000000

OPERATING CONDITIONS (Measured):
Barometric pressure (kPa) 89.300

Gas Stream	Temperature (°C)	Flow @ STP (m^3/s)	Relative Humidity (%)
Ambient Air	25.0	----	0.0
Fuel	25.0	N/A	0.0
Combustion Air	25.0	N/A	0.0
Flue Gas	260.0	N/A	N/A
Radiator Air (In)	N/A	N/A	N/A
Radiator Air (Out)	N/A	N/A	N/A
Crank Case Exhaust	----	N/A	----

Type of equipment	Boiler_Natural
Nominal rated power output (kW)	29281
Assumed equipment efficiency (%)	82.0
Assumed percent loading (%)	100.0
Cost of the fuel gas ($/GJ)	6.78

STACK GAS ANALYSIS:

Component	Concentration	Unit
Oxygen	4.5	Percent
Carbon Monoxide	0	PPM
Total Combustible (*)	0	PPM
Unburnt Fuel (calculated)	0	PPM
Nitric Oxide	0	PPM
Nitrogen Dioxide	0	PPM
Sulphur Dioxide	0	PPM

(*) CO + THC expressed as a CH_4 equivalent

------ COMBUSTION ANALYSIS: RESULTS ------

COMPANY: DATE:
LOCATION: Site #5 Middle Plant TEST BY: Operator
SOURCE: B-02 PAGE: 2

FUEL GAS CHARACTERISTICS:

Molecular weight (kg/kmol)	16.35
Quality (inlet condition) 1.00000	
Gross Heating Value (MJ/m^3)	37.3
Net Heating Value (MJ/m^3)	33.0
Theoretical combustion air requirement (kmol air/kmol fuel)	9.4

MATERIAL BALANCE:

Stream	Flow Rate	Unit
Fuel	73.65	1000 std. m^3/day
Air	897.12	1000 std. m^3/day
Stack Gas	970.95	1000 std. m^3/day

EXCESS AIR:

Actual (%)	30.0
Recommended (%)	10 to 15

ENERGY BALANCE:

Gross input energy (kW)	31877.4
Net input energy (kW)	28771.7

AVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)	Loss Value ($/year)
High Excess Air	1.2	358.9	76746
Recoverable Heat in Flue Gas (*)	10.5	3012.2	644046

UNAVOIDABLE ENERGY LOSSES:

	% net energy input	Loss Rate (kW)
Unrecoverable Heat in Flue Gas	2.4	685.9

(*) The amount of potential recoverable heat was estimated by cooling the flue gas to 10 °C above its dew point and no less than the temperature of 15 °C. The unrecoverable portion is the energy still left in the flue gas at that temperature.