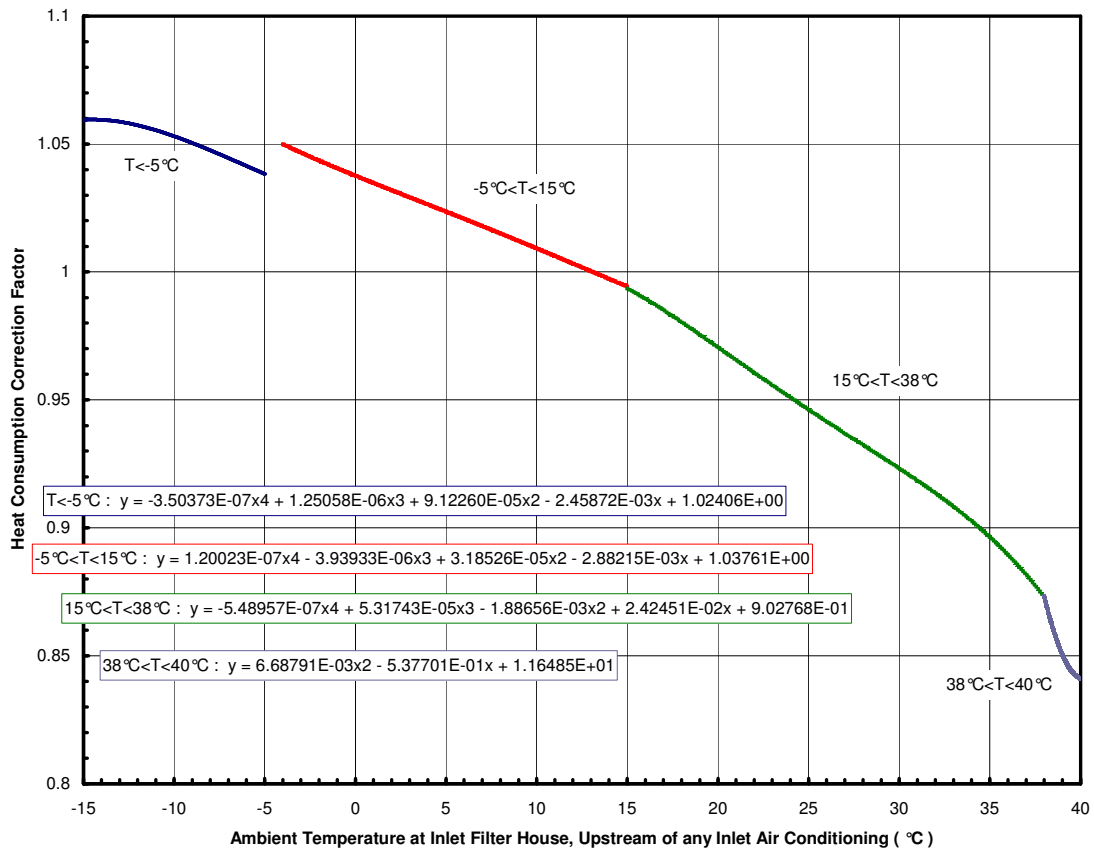


Lacq Combined Cycle Net Plant Performance Estimated Heat Consumption vs. Ambient Temperature

Rating Point Basis:

Gas turbine(s) at Stable, Steady State Base Load
 Fuel is Natural Gas
 Ambient Temperature = 13.1 °C
 Compressor Inlet Temperature = 13.1 °C
 Barometric Pressure = 1.001 bar,a
 Relative Humidity = 79.2 %
 Generator Frequency = 50 Hz
 Power Factor = 0.85
 Fuel LHV = 48018 kJ/kg
 Fuel composition (mole %): N2=1.8, CO2=0.3, CH4=96.2, C2H6=1.2,
 C3H8=0.3, C4H10=0.1, C5H12=0.1



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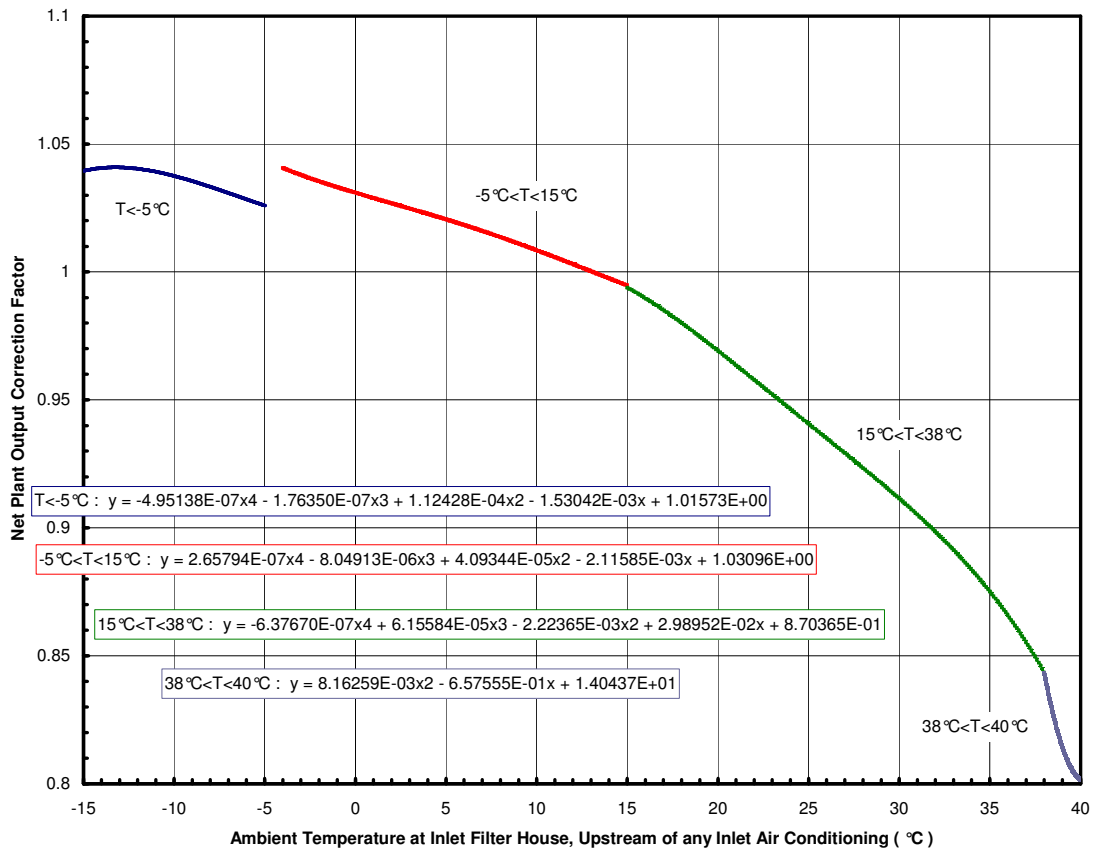
102H2004
11-avr-2008

Lacq Combined Cycle Net Plant Performance

Estimated Net Plant Output vs. Ambient Temperature

Rating Point Basis:

Gas turbine(s) at Stable, Steady State Base Load
 Fuel is Natural Gas
 Ambient Temperature = 13.1 °C
 Compressor Inlet Temperature = 13.1 °C
 Barometric Pressure = 1.001 bar,a
 Relative Humidity = 79.2 %
 Generator Frequency = 50 Hz
 Power Factor = 0.85
 Fuel LHV = 48018 kJ/kg
 Fuel composition (mole %): N2=1.8, CO2=0.3, CH4=96.2, C2H6=1.2,
 C3H8=0.3, C4H10=0.1, C5H12=0.1



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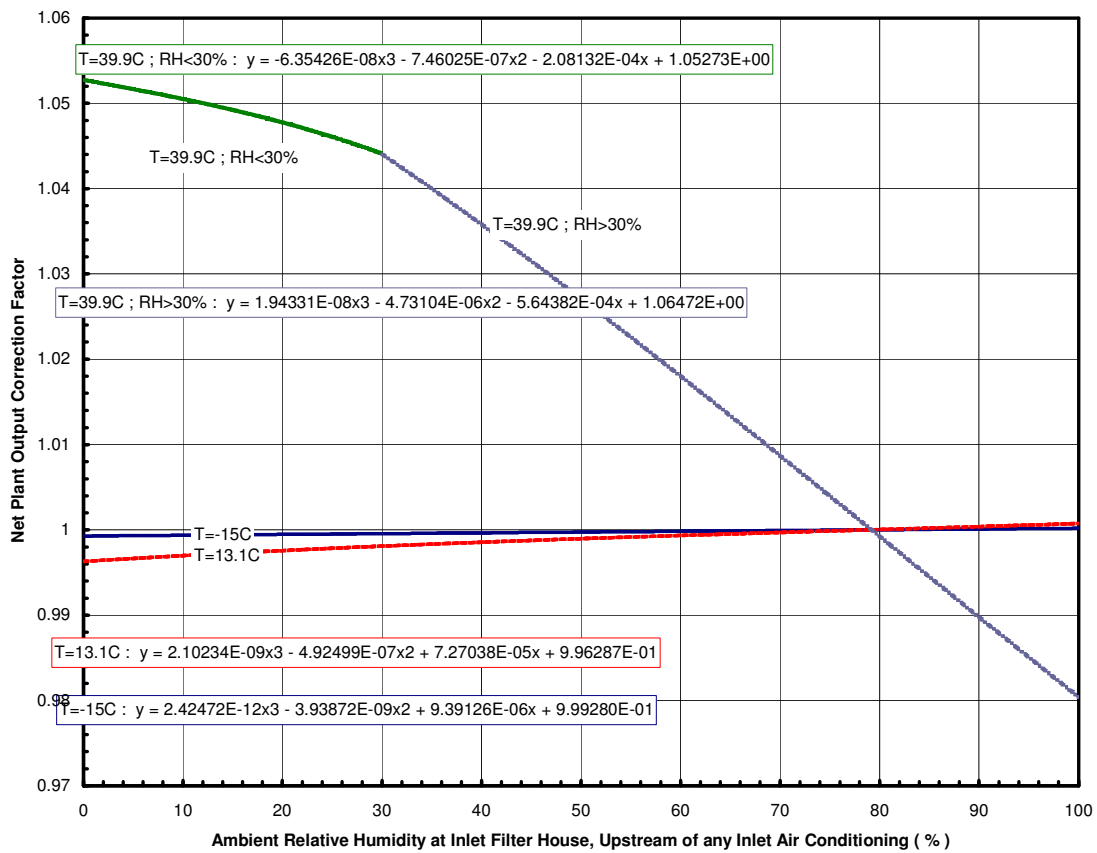
102H2003
 11-avr-2008

Lacq Combined Cycle Net Plant Performance

Estimated Net Plant Output vs. Ambient Relative Humidity

Rating Point Basis:

Gas turbine(s) at Stable, Steady State Base Load
 Fuel is Natural Gas
 Ambient Temperature = 13.1 °C
 Compressor Inlet Temperature = 13.1 °C
 Barometric Pressure = 1.001 bar,a
 Relative Humidity = 79.2 %
 Generator Frequency = 50 Hz
 Power Factor = 0.85
 Fuel LHV = 48018 kJ/kg
 Fuel composition (mole %): N2=1.8, CO2=0.3, CH4=96.2, C2H6=1.2,
 C3H8=0.3, C4H10=0.1, C5H12=0.1



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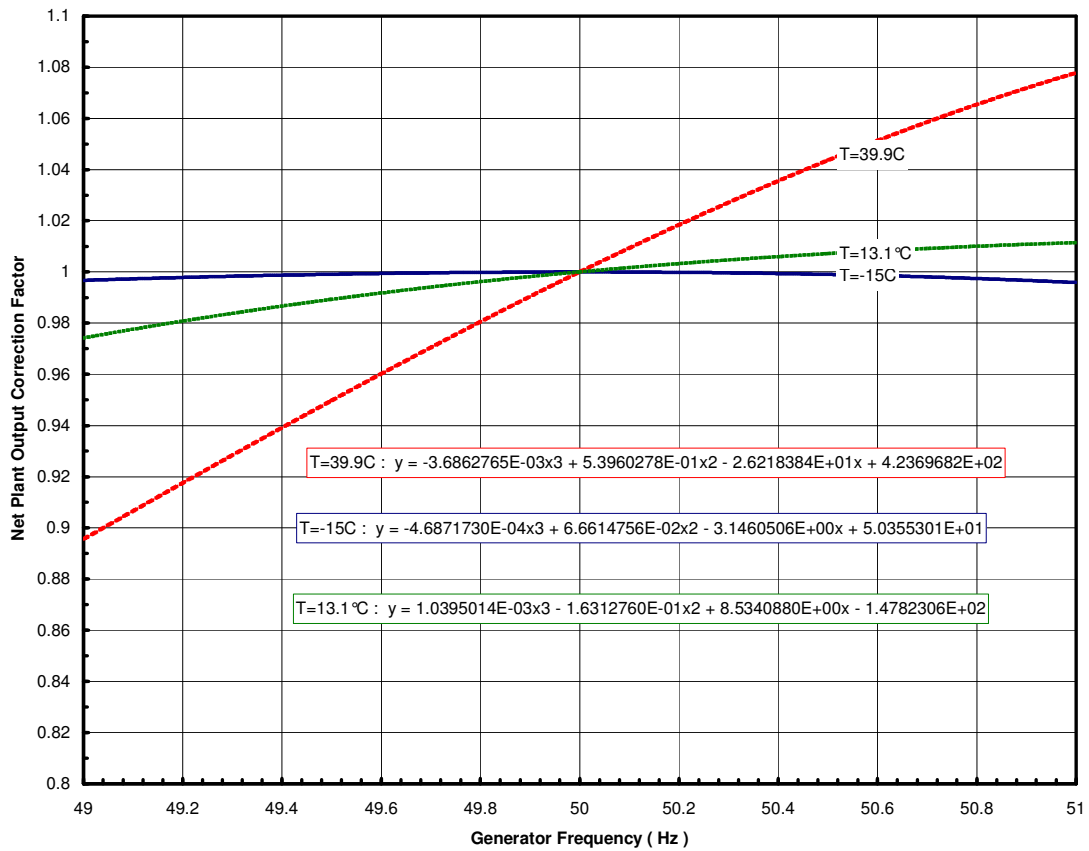
102H2007
 11-avr-2008

Lacq Combined Cycle Net Plant Performance

Estimated Net Plant Output vs. Generator Frequency

Rating Point Basis:

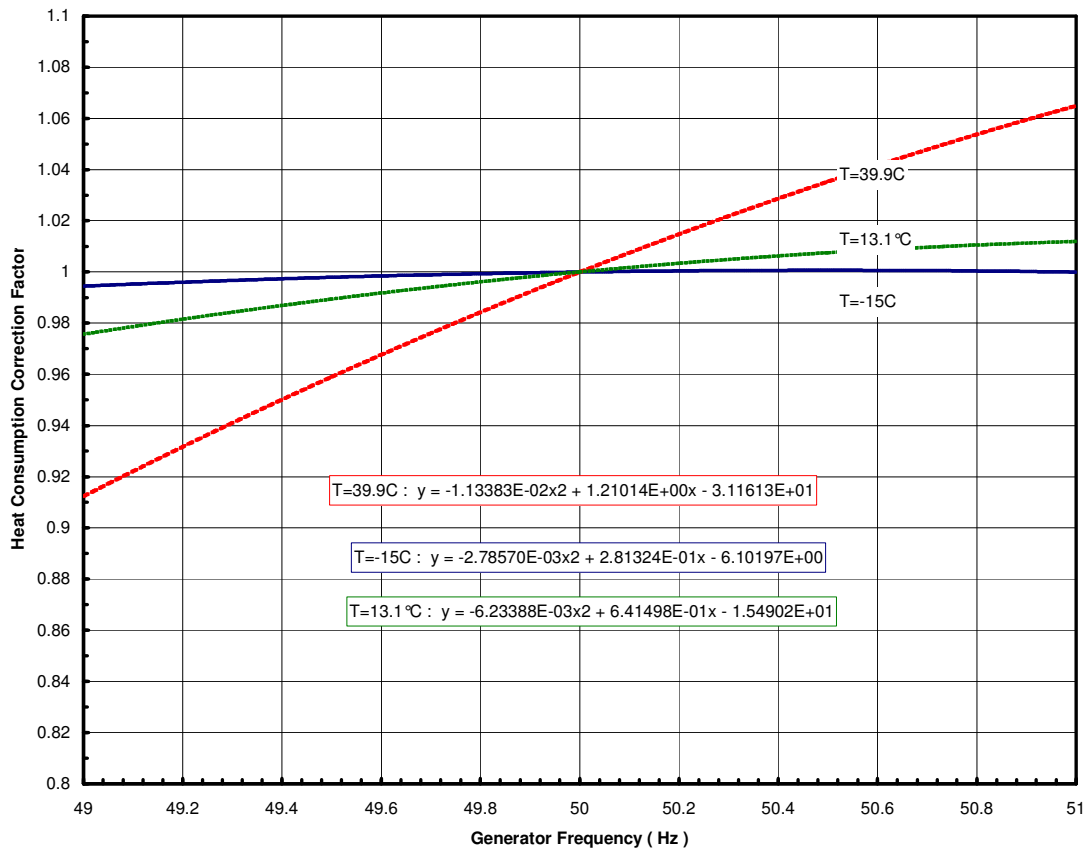
Gas turbine(s) at Stable, Steady State Base Load
 Fuel is Natural Gas
 Ambient Temperature = 13.1 °C
 Compressor Inlet Temperature = 13.1 °C
 Barometric Pressure = 1.001 bar,a
 Relative Humidity = 79.2 %
 Generator Frequency = 50 Hz
 Power Factor = 0.85
 Fuel LHV = 48018 kJ/kg
 Fuel composition (mole %): N2=1.8, CO2=0.3, CH4=96.2, C2H6=1.2,
 C3H8=0.3, C4H10=0.1, C5H12=0.1



Lacq Combined Cycle Net Plant Performance Estimated Heat Consumption vs. Generator Frequency

Rating Point Basis:

Gas turbine(s) at Stable, Steady State Base Load
 Fuel is Natural Gas
 Ambient Temperature = 13.1 °C
 Compressor Inlet Temperature = 13.1 °C
 Barometric Pressure = 1.001 bar,a
 Relative Humidity = 79.2 %
 Generator Frequency = 50 Hz
 Power Factor = 0.85
 Fuel LHV = 48018 kJ/kg
 Fuel composition (mole %): N2=1.8, CO2=0.3, CH4=96.2, C2H6=1.2,
 C3H8=0.3, C4H10=0.1, C5H12=0.1



Lacq Combined Cycle Net Plant Performance

Estimated Net Plant Output vs. Fuel Lower Heating Value

Rating Point Basis:

Gas turbine(s) at Stable, Steady State Base Load

Fuel is Natural Gas

Ambient Temperature = 13.1 °C

Barometric Pressure = 1.001 bar,a

Relative Humidity = 79.2 %

Generator Frequency = 50 Hz

Power Factor = 0.85

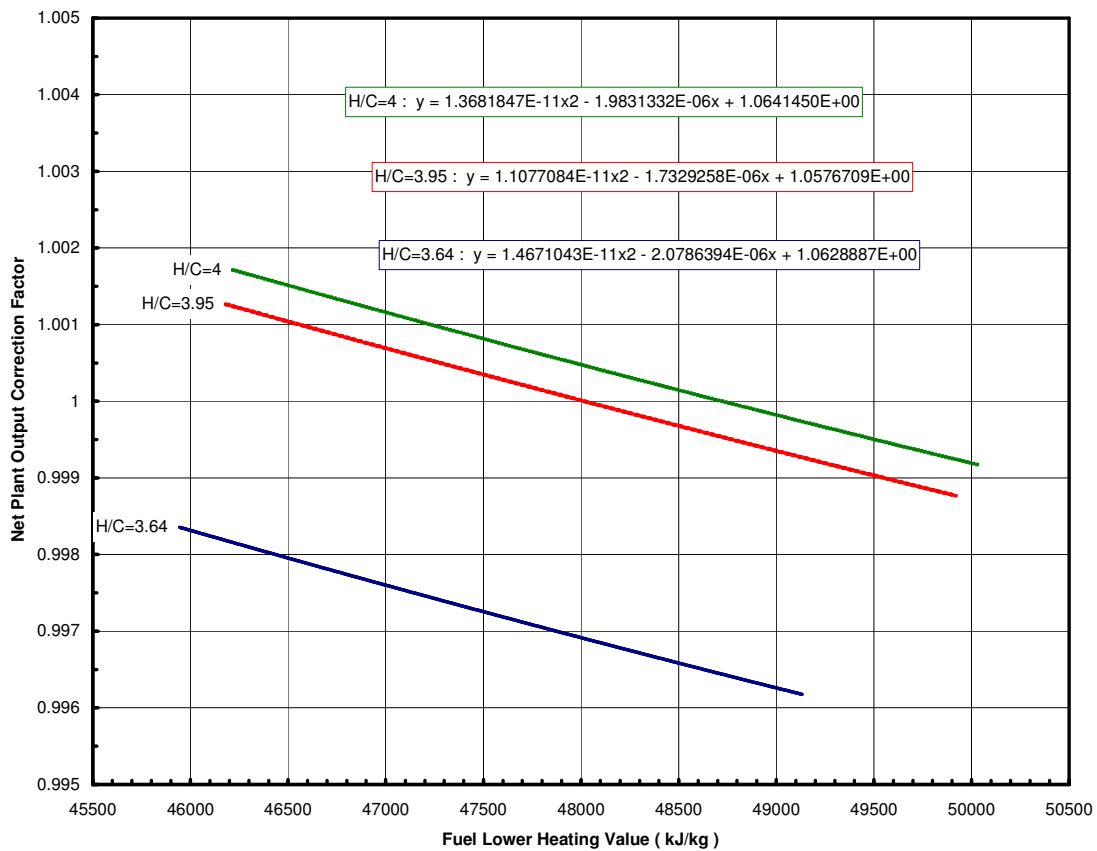
Fuel composition (mole %) at rating point: N2=1.8, CO2=0.3, CH4=96.2, C2H6=1.2,
C3H8=0.3, C4H10=0.1, C5H12=0.1

At rating point, fuel LHV = 48018 kJ/kg and H/C=3.95

H/C = Apparent Fuel Hydrogen to Carbon atom ratio in combustibles

Fuel is assumed to be dry.

This curve valid only if GT inlet bleed heat is not operating and if the GT exhaust temperature has not reached the isothermal limit.
All points on this curve are not necessarily allowable operating points.



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102H2011
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Lacq Combined Cycle Net Plant Performance

Estimated Heat Consumption vs. Fuel Lower Heating Value

Rating Point Basis:

Gas turbine(s) at Stable, Steady State Base Load

Fuel is Natural Gas

Ambient Temperature = 13.1 °C

Barometric Pressure = 1.001 bar,a

Relative Humidity = 79.2 %

Generator Frequency = 50 Hz

Power Factor = 0.85

Fuel composition (mole %) at rating point: N2=1.8, CO2=0.3, CH4=96.2, C2H6=1.2,
C3H8=0.3, C4H10=0.1, C5H12=0.1

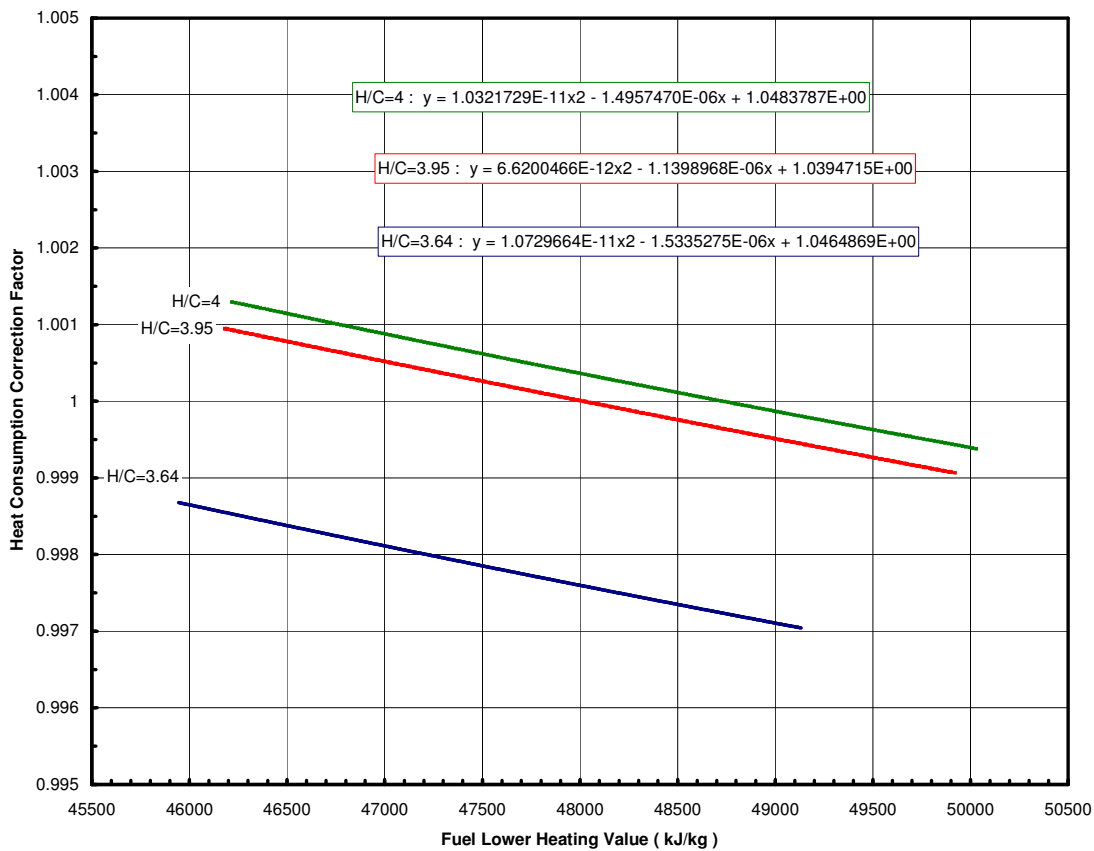
At rating point, fuel LHV = 48018 kJ/kg and H/C=3.95

H/C = Apparent Fuel Hydrogen to Carbon atom ratio in combustibles

=Sum [(Vol %) x (# of H atoms)] / Sum [(Vol %) x (# of C atoms)]

Fuel is assumed to be dry.

This curve valid only if GT inlet bleed heat is not operating and if the GT exhaust temperature has not reached the isothermal limit.
All points on this curve are not necessarily allowable operating points.



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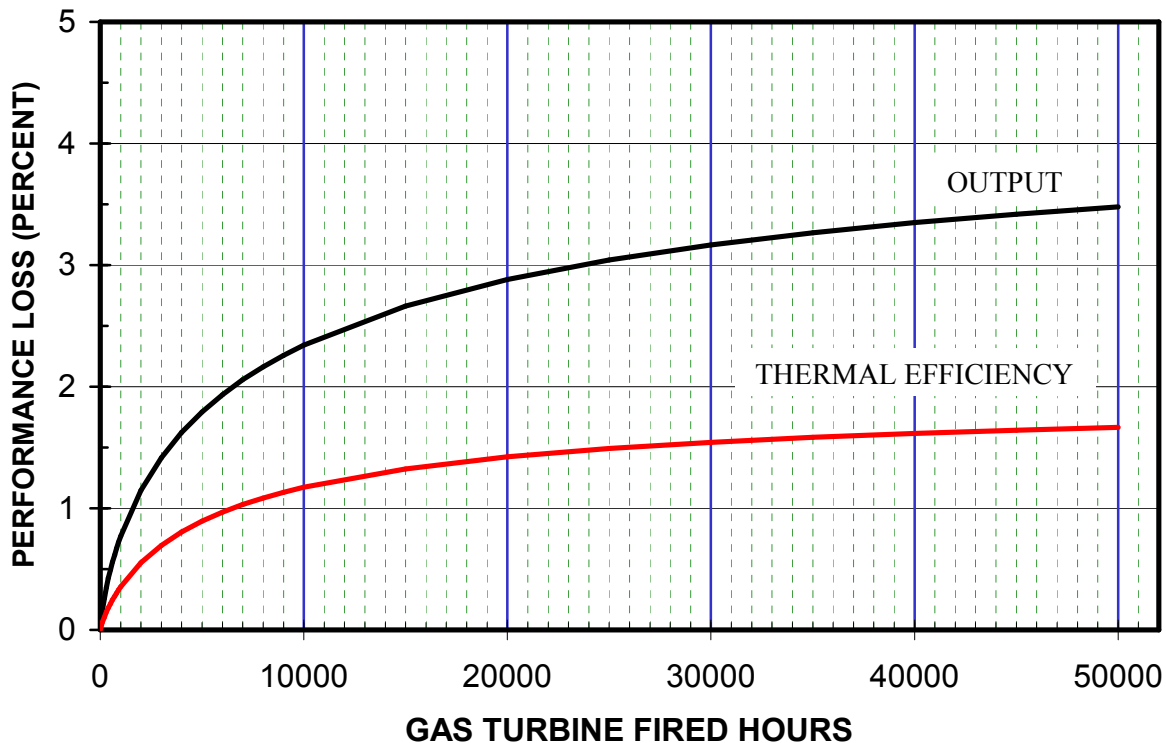
102H2012
11-avr-2008

EXPECTED “F CLASS GT” COMBINED CYCLE PLANT PERFORMANCE LOSS FOLLOWING NORMAL MAINTENANCE AND OFF-LINE COMPRESSOR WATER WASH

THE AGED PERFORMANCE EFFECTS REPRESENTED BY THESE CURVES ARE BASED ON THE FOLLOWING:

- PERFORMANCE IS RELATIVE TO THE GUARANTEE LEVEL
- ALL COMBINED CYCLE PLANT EQUIPMENT SHALL BE OPERATED AND MAINTAINED IN ACCORDANCE WITH GE’S RECOMMENDED PROCEDURES FOR OPERATION, PREVENTIVE MAINTENANCE, INSPECTION AND BOTH ON-LINE AND OFF-LINE CLEANING
- ALL OPERATIONS SHALL BE WITHIN THE DESIGN CONDITIONS SPECIFIED IN THE RELEVANT TECHNICAL SPECIFICATION.
- A DETAILED OPERATIONAL LOG SHALL BE MAINTAINED FOR ALL RELEVANT OPERATIONAL DATA, TO BE AGREED TO AMONGST THE PARTIES PRIOR TO COMMENCEMENT OF CONTRACT.
- GE TECHNICAL PERSONNEL SHALL HAVE ACCESS TO PLANT OPERATIONAL DATA, AND SITE VISITS PRIOR TO CONDUCTING A PERFORMANCE TEST. THE OWNER WILL CLEAN AND MAINTAIN THE EQUIPMENT. THE DEGREE OF CLEANING AND MAINTENANCE WILL BE DETERMINED BASED ON THE OPERATING HISTORY OF EACH UNIT, ATMOSPHERIC CONDITIONS EXPERIENCED DURING THE PERIOD OF OPERATION, THE PREVENTIVE AND SCHEDULED MAINTENANCE PROGRAMS EXECUTED, AND THE RESULTS OF THE GE INSPECTION.
- THE COMBINED CYCLE PLANT WILL BE SHUT DOWN FOR INSPECTION AND OFF-LINE COMPRESSOR WATER WASH, AS A MINIMUM, IMMEDIATELY PRIOR TO PERFORMANCE TESTING TO DETERMINE PERFORMANCE LOSS. THE COMBINED CYCLE PERFORMANCE TEST SHALL OCCUR WITHIN 100 FIRED HOURS OF THESE ACTIONS.
- DEMONSTRATION OF GAS TURBINE AND COMBINED CYCLE PLANT PERFORMANCE SHALL BE IN ACCORDANCE WITH TEST PROCEDURES WHICH ARE MUTUALLY AGREED UPON.
- CURVE FIT EQUATIONS FOR OUTPUT AND EFFICIENCY LOSSES ARE IN THE FORM OF $Y=(A* B +C*(X + E)^D)/(B +(X + E)^D)$
COEFFICIENTS FOR OUTPUT LOSS (A=-0.05885, B=589.157, C=4.509545, D=0.703598, E=18)
COEFFICIENTS FOR EFFICIENCY LOSS (A=-0.00757, B=1323.705, C=1.963382, D=0.823937, E=7)

$\text{Output Loss} = \frac{\text{Output (New\&Clean)} - \text{Output}}{\text{Output (New\&Clean)}} \times 100$	$\text{Efficiency Loss} = \frac{\text{Efficiency (New\&Clean)} - \text{Efficiency}}{\text{Efficiency (New\&Clean)}} \times 100$
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Y. Nasraddine
Rev.- July 12, 2004

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