Middletown Cogeneration Facility Emission Calculations

Emission Point:	**P001**
Operating Scenario	**MWERF1-MSS-1**
Description:	**Gas Turbine/HRSG Emissions when Blast Furnace is Down**

Physical Characteristics:	Height of Stack above grade =	125	ft		
	Diameter of Stack =	16.5	ft		
Inputs shaded in Green	Stack Gas Exit Temperature =	317	F		
	Operating Schedule =	800	hours/year (assumes a major Blast Furnace Outage - Typical is 300 hours)		
		8,760	Permitted hours per year		
Emission data:	Nat Gas Firing rate =	1,100	MMBtu/hr HHV (dry)	Max Firing Rate (Minimum for Nat Gas is 644 MMBtu/hr LHV dry (GE))	730.4
	Nat Gas Heat Value =	1,019	Btu/SCF HHV (dry)	GE Rev 6 Emission Input File at Average Ambient conditions	
Inputs shaded in Green	Exhaust Mass Rate (wet) =	3,605,982	lb/hr Wet	GE File EN-090065-U761-004 R13 File of 1,874,000 adjusted to 1,000 MMBtu/hr HHV	
	Exhaust Molar Rate (dry) @ 15% O2=	107,554	lbmole/hr Dry @15% O2		
	Exhaust Molar Rate (dry) =	114,880	lbmole/hr Dry		
	Exhaust Molar Rate (wet) =	126,659	lbmole/hr Wet		
	NOx Average Emission Factor =	12	ppmvd@15%O2	SCR performance guarantee (assumes 25 ppm Inlet)	
	CO Average Emission Factor =	25	ppmvd	Gas Turbine performance guarantee	
	Average SO2 Emission Factor =	0.60	lb/MMSCF	assumes 2,000 grains S/MMSCF	
	Maximum SO2 Emission Factor =	1.50	lb/MMSCF	assumes 5,000 grains S/MMSCF	
	PM Filterable Average Emission Factor =	5	#/hr	Gas Turbine performance guarantee	
	PM Total Average Emission Factor =	10	#/hr (Fil. & Cond.)	Gas Turbine performance guarantee	
	VOC Average Emission Factor =	1.4	ppmvw	Gas Turbine performance guarantee (as methane)	
	NH3 Average Slip Concentration =	5	ppmvw	SCR performance guarantee	
	CO2 Emission Factor =	53.02	kg/MMBtu	GHG Reporting Rule for Nat Gas Combustion	
	CH4 Emission Factor =	0.0010	kg/MMBtu	GHG Reporting Rule for Nat Gas Combustion	
	N2O Emission Factor =	0.00010	kg/MMBtu	GHG Reporting Rule for Nat Gas Combustion	
	CO2 Global Warming Potential =	1		GHG Reporting Rule	
	CH4 Global Warming Potential =	21		GHG Reporting Rule	
	N2O Global Warming Potential =	310		GHG Reporting Rule	
	Max Factor =	2		Assume maximum hourly emissions are 100% above average emission rate	

Exhaust Stack %mole	
ARGON	0.9%
NITROGEN	73.9%
OXYGEN	14.1%
CARBON DIOXIDE	2.8%
WATER	9.3%
Mole. Wt. Dry	26.8
Mole. Wt. Wet	28.5
%O2 dry	15.4%

Average Emission Rate Calculations at 800 hours:

Average Concentration (PPMV) **X** Molar Flow Rate (lbmole/hr) **X** Operating Hours X Molecular Weight (lbs/lbmole) / 2,000 lbs/ton X 1,000,000 **=** Tons/Year

Component Specific Emission Factor (lbs/MMBtu) **X** Firing Rate (MMBtu/hr) X Operating Hours / 2,000 lbs/ton = Tons/Year

NOx Emissions:

NOx (tpy) =	12	ppmv avg	**X**	107,554	lbmole/hr	**X**	800	hrs/yr	**X**	46	lbs/lbmole	**/** (2,000 **X** 1,000,000) =	**23.7**	**tpy - NOx**
NOx (lb/hr) =	12	ppmv avg	**X**	107,554	lbmole/hr	**X**	46	lbs/lbmole	/	1,000,000	lbs/ppm	=	**59.4**	**lbs/hr - NOx**

CO Emissions:

CO (tpy) =	25	ppmv avg	**X**	114,880	lbmole/hr	**X**	800	hrs/yr	**X**	28	lbs/lbmole	**/** (2,000 **X** 1,000,000) =	**32**	**tpy - CO**
CO (lb/hr) =	25	ppmv avg	**X**	114,880	lbmole/hr	**X**	28	lbs/lbmole	/	1,000,000	lbs/ppm	=	**80**	**lbs/hr - CO**

SO2 Emissions:

SO2 (tpy) =	0.65	lbs SO2/hr		800	hrs/yr	**/**	2,000	lbs/ton	=	**0.26** **tpy - SO2**
SO2 (lb/hr) =	0.60	lbs/MMSCF avg	**X**	1100	MMBtu/hr	**/**	1019	Btu/SCF	=	**0.65** **lbs/hr - SO2**

PM Fil. Emissions:

PM_{fil} (tpy) =	5	lb/hr	**X**	800	hrs/yr	**/**	2,000	lbs/ton =	**2.0**	**tpy - PM_{fil}**
PM_{fil} (lb/hr) =	5	lb/hr							**5**	**lbs/hr - PM_{fil}**

PM Total Emissions:

PM_{fil} (tpy) =	10	lb/hr	**X**	800	hrs/yr	**/**	2,000	lbs/ton =	**4.0**	**tpy - PM_{fil}**
PM_{fil} (lb/hr) =	10	lb/hr							**10**	**lbs/hr - PM_{fil}**

VOC Emissions:

VOC (tpy) =	1.4	ppmv avg	**X**	126,659	lbmole/hr	**X**	800	hrs/yr	**X**	16	lbs/lbmole	**/** (2,000 **X** 1,000,000) =	**1.1**	**tpy - VOC (as methane)**
VOC (lb/hr) =	1.4	ppmv avg	**X**	126,659	lbmole/hr	**X**	16	lbs CH4/lbmole	/	1,000,000	lbs/ppm	=	**2.8**	**lbs/hr - VOC (as methane)**

NH3 Emissions:

NH3 (tpy) =	5	ppmv avg	**X**	126,659	lbmole/hr	**X**	800	hrs/yr	**X**	17	lbs/lbmole	**/** (2,000 **X** 1,000,000) =	**4**	**tpy - NH3**
NH3 (lb/hr) =	5	ppmv avg	**X**	126,659	lbmole/hr	**X**	17	lbs/lbmole	/	1,000,000	lbs/ppm	=	**11**	**lbs/hr - NH3**

Additional CO2 Emissions: **None since CO2e emission during Nat Gas firing are lower than during BFG firing. Routine Emission allowance covers this operating mode.**

Maximum Emission Rate Calculations: