Middletown Cogeneration Project		
Emission Factors and Constants Used in Calculations		
Gas Turbine/HRSG		
BFG		
NOx (SCR)	12	ppmvd@15% O2 max (GE + SCR Vendor)
CO	25	ppmvd (GE)
SO2 ppm (avg)	100	ppmv (dry) Sulfur in BFG (AK Steel Basis)
SO2 #/MMBtu (avg)	0.127	#/MMBtu LHV dry - 100 ppmvd S in AP calculation 3.9.11
	0.120	#/MMBtu HHV dry (AK Steel with Cogen expected heat content)
SO2 #/MMBtu (max)	0.120	#/MMBtu HHV dry (AK Steel with Cogen expected heat content)
PM Fil.	21.2	#/hr (GT at 18 #/hr and SCR at 3.2 #/hr or 2% Conv.)
PM Total (Filterable + Condensable)	35.2	#/hr (GE estimates 14 #/hr of Condensable PM)
VOC	1.4	ppmvw (as Methane) (GE)
NH3 Slip	5	ppmvd @ 15 %02
Nat Gas		
NOx (SCR)	12	ppmvd@15% O2 max (GE + SCR Vendor)
CO	25	ppmvd (GE)
SO_2 (Annual)	0.6	lb SO2/MMSCF (2,000 grains S/MMSCF and AP-42 Table 1.4-2)
SO_2 (Max)	1.5	lb SO2/MMSCF (5,000 grains S/MMSCF)
PM Fil.	5	#/hr (GE)
PM Total (Filterable + Condensable)	10	#/hr (GE)
VOC	1.4	ppmvw (as Methane) (GE)
Aux Boilers		
BFG		
NOx	0.100	lb/mmbtu HHV dry - OEPA RACT
CO	0.104	lb/mmbtu HHV wet (Boiler vendor)
	0.110	lb/mmbtu HHV dry (Boiler vendor)
SO_2 (Annual)	0.120	#/MMBtu HHV dry - Assumes 100 ppmvd S in BFG & ignores Nat Gas
SO_2 (Max)	0.120	#/MMBtu HHV dry - Assumes 100 ppmvd S in BFG & ignores Nat Gas
PM Fil.	0.015	lb/mmbtu HHV dry (AP estimate based on Boiler vendor and BFG PM data)
PM Total (Filterable + Condensable)	0.033	lb/mmbtu (AP Estimate)
VOC	0.005	lb/mmbtu HHV dry (PA estimate based on AP-42)
Nat Gas		
NOx	0.100	lb/mmbtu HHV wet/dry - OEPA RACT
CO	0.085	lb/mmbtu HHV wet/dry (Boiler vendor)
SO_2 (Annual)	0.6	lb SO2/MMSCF (2,000 grains S/MMSCF and AP-42 Table 1.4-2)
SO_2 (Max)	1.5	lb SO2/MMSCF (5,000 grains S/MMSCF)
PM Fil.	0.005	lb/mmbtu HHV wet/dry (Boiler vendor)
PM Total (Filterable + Condensable)	0.01	lb/mmbtu HHV wet/dry (AP Estimate)
VOC	0.005	lb/mmbtu HHV wet/dry (AP-42 Section 1.4)
AP Flare		
BFG		
NOx	23	lb-NOx/MMscf EPA FIRE 6.25
CO	13.7	lb-CO/MMscf EPA FIRE 6.25
SO_2 (Annual)	0.120	#/MMBtu HHV dry - Assumes 100 ppmvd S in BFG
SO_2 (Max)	0.120	#/MMBtu HHV dry - Assumes 100 ppmvd S in BFG
PM Fil.	2.9	lb-PM/MMscf EPA FIRE 6.25
PM Total (Filterable + Condensable)	8.6	lb-PM/MMscf EPA FIRE 6.25
VOC	5	ppmvd
NG		
NOx	0.068	lb-NOx/MMBtu EPA AP-42
CO	0.37	lb-CO/MMBtu - EPA AP-42
SO_2 (Annual)	0.6	lb SO2/MMSCF (2,000 grains S/MMSCF and AP-42 Table 1.4-2)
SO_2 (Max)	1.5	lb SO2/MMSCF (5,000 grains S/MMSCF)
PM Fil.	1.9	lb/MMSCF (AP-42 Section 1.4)
VOC	0.005	lb/mmbtu HHV wet (AP-42 Section 1.4)
AK Flare and Stoves		
BFG		
NOx	23	lb-NOx/MMSCF EPA FIRE 6.25
CO	13.7	lb-CO/MMSCF EPA FIRE 6.25
SO_2 (Annual)	100	ppmvd
	0.127	#/MMBtu LHV dry - Assumes 100 ppmvd S in BFG
	85.5	ppmvd
	0.117	#/MMBtu LHV dry - Assumes 85 ppmvd S in BFG
PM Fil.	2.9	lb-PM/MMSCF EPA FIRE 6.25
PM Total	8.6	lb-PM/MMSCF EPA FIRE 6.25
VOC	0	ppmvd
AK #2 Boiler House		
BFG		
NOx	0.020	#/MMBtu LHV dry
CO	13.700	lb-CO/MMSCF EPA FIRE 6.25
SO_2 (Annual)		SAME as Flare and Stoves
PM Fil.	2.900	lb-PM/MMSCF EPA FIRE 6.25
PM Total	8.600	lb-PM/MMSCF EPA FIRE 6.25
VOC	0	ppmvd
Nat Gas		
NOx	280	#/MMSCF - AP-42
CO	84	#/MMSCF - AP-42
SO_2 (Annual)	0.6	lb SO2/MMSCF (2,000 grains S/MMSCF and AP-42 Table 1.4-2)
SO_2 (Max)	1.5	lb SO2/MMSCF (5,000 grains S/MMSCF)
PM Fil.	1.9	#/MMSCF - AP-42
VOC	5.5	#/MMSCF - AP-42

GHG Emission Factors (BFG)			
CO2 Emission Factor =	274.32	kg/MMBtu	GHG Reporting Rule for BFG Combustion
CH4 Emission Factor =	0.000022	kg/MMBtu	GHG Reporting Rule for BFG Combustion
N2O Emission Factor =	0.0001	kg/MMBtu	GHG Reporting Rule for BFG 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
GHG Emission Factors (Natural Gas)			
CO2 Emission Factor =	53.02	kg/MMBtu	GHG Reporting Rule for BFG Combustion
CH4 Emission Factor =	0.001	kg/MMBtu	GHG Reporting Rule for BFG Combustion
N2O Emission Factor =	0.0001	kg/MMBtu	GHG Reporting Rule for BFG Combustion

Cooling Tower		
Makeup Water TDS =	300	ppm - Max of 17 samples (based on 429 umhos conductivity)
Cooling Tower Cycles =	11	G. Gagliardi (Vendor design is 9 cycles)
Recirculation Rate =	35,928,720	lb/hr - Vendor (61,300 gpm expected - 71,800 max)
Drift % =	0.0005	% - Vendor

Fugitives		
CO		For BFG Equipment
NH3		For Aqueous Ammonia Equipment
VOC		For Ethylene Glycol Cooling System
PM		Roadways/Parking

Constants		
Ideal Gas	385.5	SCF/lbmole at 68 F
BFG LHV dry	119.5	Btu/SCF LHV (dry) EN-090065-U761-0002_revP_Fuel specs.pdf
BFG LHV wet	104.8	Btu/SCF LHV (wet) EN-090065-U761-0002_revP_Fuel specs.pdf
BFG HHV dry	126.5	Btu/SCF HHV (dry) EN-090065-U761-0002_revP_Fuel specs.pdf
BFG HHV wet	117.1	Btu/SCF HHV (wet) EN-090065-U761-0002_revP_Fuel specs.pdf
Minimum BFG HHV dry	88	Btu/SCF HHV (dry) EN-090065-U761-0002_rev1_Fuel specs.pdf
Natural Gas, HHV	1019.1	Btu/SCF HHV (dry or wet) EN-090065-U761-0002_revP_Fuel specs.pdf
% Natural Gas burner supplement in Boiler	4.6%	on a Btu dry basis (Equals 5% wet)
% BFG fired in Boiler on Btu basis	95.4%	Boiler Vendor
Boiler Combined Fuel Btu/SCF	168	Btu/SCF HHV (wet) at 96% BFG and 4% Nat Gas
Boiler Combined Fuel Btu/SCF	159	Btu/SCF HHV (dry) at 96% BFG and 4% Nat Gas
Destruction Rate Efficiency (DRE) of flare =	0%	Assume no destruction since VOC is so low

Average BFG Design Specifications to Cogen Plant (Battery Limit)		
Heat Rate	1,211	MMBtu/hr LHV dry
Molar Flow	26,721	Lbmole/hr dry
Volumetric Flow	169,011	dSCFM 60F
BFG HHV dry	739,872	lb/hr dry
Molecular Weight	27.69	

	Routine Operation	Non-Routine Operation	
Operating Hour Assumptions	**Annual**	**Typical Year**	**Major GT/BF Maintenance**
Gas Turbine	8760	504	800
Boilers	8760	814	1,300
Cooling Tower	8760		
Flare		310	500