

**Hyperion Energy Center**

Emission Calculations

Process Heaters

# of Units <sup>1</sup>	Service	Max. Firing Rate [MMBtu/hr]		Pollutant	lb/MMBtu	Emission Rate	
		(LHV)	(HHV)			[#/hr]	[ton/yr]
2	CDU/VDU Crude Charge Heater	472.88	530.15	NOx	0.0060	6.4	27.9
				SO2	0.0046	4.9	21.5
				CO	0.040	42.4	185.8
				VOC	0.0047	5.0	21.8
				PM10	0.0075	8.0	34.8
				PM	0.0019	2.0	8.8
				H2SO4	0.0007	0.8	3.3
				Org HAP	0.0013	1.3	5.9
				HCl	0.0012	1.3	5.6
				NH3	0.0022	2.3	10.2
2	CDU/VDU Vacuum Charge Heater	191.47	214.66	NOx	0.0060	2.6	11.3
				SO2	0.0046	2.0	8.7
				CO	0.040	17.2	75.2
				VOC	0.0047	2.0	8.8
				PM10	0.0075	3.2	14.1
				PM	0.0019	0.8	3.6
				H2SO4	0.0007	0.3	1.3
				Org HAP	0.0013	0.5	2.4
				HCl	0.0012	0.5	2.3
				NH3	0.0022	0.9	4.1
1	NHT with Splitter Charge Heater	178.04	199.60	NOx	0.0060	1.2	5.2
				SO2	0.0046	0.9	4.0
				CO	0.040	8.0	35.0
				VOC	0.0047	0.9	4.1
				PM10	0.0075	1.5	6.6
				PM	0.0019	0.4	1.7
				H2SO4	0.0007	0.1	0.6
				Org HAP	0.0013	0.3	1.1
				HCl	0.0012	0.2	1.0
				NH3	0.0022	0.4	1.9
1	NHT with Splitter Stripper Reboiler Heater	150.54	168.78	NOx	0.0060	1.0	4.4
				SO2	0.0046	0.8	3.4
				CO	0.040	6.8	29.6
				VOC	0.0047	0.8	3.5
				PM10	0.0075	1.3	5.5
				PM	0.0019	0.3	1.4
				H2SO4	0.0007	0.1	0.5
				Org HAP	0.0013	0.2	0.9
				HCl	0.0012	0.2	0.9
				NH3	0.0022	0.4	1.6
1	NHT with Splitter Naphtha Splitter Reboiler Heater	220.18	246.84	NOx	0.0060	1.5	6.5
				SO2	0.0046	1.1	5.0
				CO	0.040	9.9	43.2
				VOC	0.0047	1.2	5.1
				PM10	0.0075	1.9	8.1
				PM	0.0019	0.5	2.1
				H2SO4	0.0007	0.2	0.8
				Org HAP	0.0013	0.3	1.4
				HCl	0.0012	0.3	1.3
				NH3	0.0022	0.5	2.4

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Process Heaters

# of Units <sup>1</sup>	Service	Max. Firing Rate [MMBtu/hr]		Pollutant	lb/MMBtu	Emission Rate	
		(LHV)	(HHV)			[#/hr]	[ton/yr]
1	DHT Combined Feed Heater	125.37	140.55	NOx	0.0060	0.8	3.7
				SO2	0.0046	0.7	2.8
				CO	0.040	5.6	24.6
				VOC	0.0047	0.7	2.9
				PM10	0.0075	1.1	4.6
				PM	0.0019	0.3	1.2
				H2SO4	0.0007	0.1	0.4
				Org HAP	0.0013	0.2	0.8
				HCl	0.0012	0.2	0.7
				NH3	0.0022	0.3	1.4
				2	Delayed Coker Unit Drum Pair 1	216.26	242.46
SO2	0.0046	2.2	9.8				
CO	0.040	19.4	85.0				
VOC	0.0047	2.3	10.0				
PM10	0.0075	3.6	15.9				
PM	0.0019	0.9	4.0				
H2SO4	0.0007	0.3	1.5				
Org HAP	0.0013	0.6	2.7				
HCl	0.0012	0.6	2.5				
NH3	0.0022	1.1	4.7				
2	Delayed Coker Unit Drum Pair 2	216.26	242.46				
				SO2	0.0046	2.2	9.8
				CO	0.040	19.4	85.0
				VOC	0.0047	2.3	10.0
				PM10	0.0075	3.6	15.9
				PM	0.0019	0.9	4.0
				H2SO4	0.0007	0.3	1.5
				Org HAP	0.0013	0.6	2.7
				HCl	0.0012	0.6	2.5
				NH3	0.0022	1.1	4.7
				2	CCR Platforming Charge Heater + Interheater No.1 + Common Convection - HTR001/002	735.45	824.52
SO2	0.0046	7.6	33.4				
CO	0.040	66.0	288.9				
VOC	0.0047	7.7	33.9				
PM10	0.0075	12.4	54.2				
PM	0.0019	3.1	13.7				
H2SO4	0.0007	1.2	5.1				
Org HAP	0.0013	2.1	9.2				
HCl	0.0012	2.0	8.7				
NH3	0.0022	3.6	15.9				
2	CCR Platforming No. 2 Interheater + No. 3 Interheater + Common Convection - HTR003/004	439.61	492.85				
				SO2	0.0046	4.6	20.0
				CO	0.040	39.4	172.7
				VOC	0.0047	4.6	20.3
				PM10	0.0075	7.4	32.4
				PM	0.0019	1.9	8.2
				H2SO4	0.0007	0.7	3.1
				Org HAP	0.0013	1.3	5.5
				HCl	0.0012	1.2	5.2
				NH3	0.0022	2.2	9.5

**Hyperion Energy Center**  
Emission Calculations  
Process Heaters

# of Units <sup>1</sup>	Service	Max. Firing Rate [MMBtu/hr]		Pollutant	lb/MMBtu	Emission Rate					
		(LHV)	(HHV)			[#/hr]	[ton/yr]				
1	CCR Reformate Splitter CCR Reformate Splitter Reboiler	123.09	138.00	NOx	0.0060	0.8	3.6				
				SO2	0.0046	0.6	2.8				
				CO	0.040	5.5	24.2				
				VOC	0.0047	0.6	2.8				
				PM10	0.0075	1.0	4.5				
				PM	0.0019	0.3	1.1				
				H2SO4	0.0007	0.1	0.4				
				Org HAP	0.0013	0.2	0.8				
				HCl	0.0012	0.2	0.7				
				NH3	0.0022	0.3	1.3				
				2	Hydrocracker Rxn Section Stage 1 Recycle Gas Heater Train 1	59.64	66.86	NOx	0.025	3.3	14.6
SO2	0.0046	0.6	2.7								
CO	0.040	5.3	23.4								
VOC	0.0047	0.6	2.8								
PM10	0.0075	1.0	4.4								
PM	0.0019	0.3	1.1								
H2SO4	0.0001	0.0	0.1								
Org HAP	0.0013	0.2	0.7								
HCl	0.0012	0.2	0.7								
2	Hydrocracker Rxn Section Stage 1 Recycle Gas Heater Train 2	59.64	66.86					NOx	0.025	3.3	14.6
								SO2	0.0046	0.6	2.7
				CO	0.040	5.3	23.4				
				VOC	0.0047	0.6	2.8				
				PM10	0.0075	1.0	4.4				
				PM	0.0019	0.3	1.1				
				H2SO4	0.0001	0.0	0.1				
				Org HAP	0.0013	0.2	0.7				
				HCl	0.0012	0.2	0.7				
				2	Hydrocracker Rxn Section Stage 1 Recycle Gas Heater Train 3	59.64	66.86	NOx	0.025	3.3	14.6
								SO2	0.0046	0.6	2.7
CO	0.040	5.3	23.4								
VOC	0.0047	0.6	2.8								
PM10	0.0075	1.0	4.4								
PM	0.0019	0.3	1.1								
H2SO4	0.0001	0.0	0.1								
Org HAP	0.0013	0.2	0.7								
HCl	0.0012	0.2	0.7								
2	Hydrocracker Rxn Section Stage 2 Recycle Gas Heater Train 1	57.89	64.91					NOx	0.025	3.2	14.2
								SO2	0.0046	0.6	2.6
				CO	0.040	5.2	22.7				
				VOC	0.0047	0.6	2.7				
				PM10	0.0075	1.0	4.3				
				PM	0.0019	0.2	1.1				
				H2SO4	0.0001	0.0	0.1				
				Org HAP	0.0013	0.2	0.7				
				HCl	0.0012	0.2	0.7				

**Hyperion Energy Center**  
Emission Calculations  
Process Heaters

# of Units <sup>1</sup>	Service	Max. Firing Rate [MMBtu/hr]		Pollutant	lb/MMBtu	Emission Rate	
		(LHV)	(HHV)			[#/hr]	[ton/yr]
2	Hydrocracker Rxn Section Stage 2 Recycle Gas Heater Train 2	57.89	64.91	NOx	0.025	3.2	14.2
				SO2	0.0046	0.6	2.6
				CO	0.040	5.2	22.7
				VOC	0.0047	0.6	2.7
				PM10	0.0075	1.0	4.3
				PM	0.0019	0.2	1.1
				H2SO4	0.0001	0.0	0.1
				Org HAP	0.0013	0.2	0.7
				HCl	0.0012	0.2	0.7
				2	Hydrocracker Frac Section Product Fractionator Feed Heater	602.54	675.52
SO2	0.0046	6.3	27.4				
CO	0.040	54.0	236.7				
VOC	0.0047	6.3	27.8				
PM10	0.0075	10.1	44.4				
PM	0.0019	2.6	11.2				
H2SO4	0.0007	1.0	4.2				
Org HAP	0.0013	1.7	7.5				
HCl	0.0012	1.6	7.1				
NH3	0.0022	3.0	13.1				
1	Oleflex Charge Heater+ Interheater No. 1 + Interheater No. 2 + Convection Steam Generation + Convection Economizer	539.14	604.43	NOx	0.0060	3.6	15.9
				SO2	0.0046	2.8	12.3
				CO	0.040	24.2	105.9
				VOC	0.0047	2.8	12.4
				PM10	0.0075	4.5	19.9
				PM	0.0019	1.1	5.0
				H2SO4	0.0007	0.4	1.9
				Org HAP	0.0013	0.8	3.4
				HCl	0.0012	0.7	3.2
				NH3	0.0022	1.3	5.8

Notes:

1. In cases where there are multiple units, heat input rate is provided for one heater; emission rates are provided for all heaters in total.

Hyperion Energy Center  
Emission Calculations  
Coker Blowdown Vents

Parameter	Value	Units
<b>VOC / Organic HAP Emissions:</b>		
Atmospheric pressure at South Dakota site	14	psia
Starting pressure in drum at 5 psig	19	psia
Volume exhausted during 1 event	80,488	scf
Mole % VOC as C	1.00%	%
Molecular weight of C	14.3	lb/lb-mole
Pounds of hydrocarbon per event	30.4	lb/event
Events per year	2,190	events/yr
Tons VOC per year from drum vents	<b>33.3</b>	<b>ton/yr</b>
<b>CO Emissions:</b>		
Mole % CO	0.005%	%
Molecular weight of CO	28	lb/lb-mole
Pounds of CO per event	0.3	lb/event
lb/hr CO (duration of 1 event = 1 hr)	<b>0.3</b>	<b>lb/hr</b>
Events per year	2,190	events/yr
Tons VOC per year from drum vents	<b>0.3</b>	<b>ton/yr</b>
<b>PM/PM<sub>10</sub> Emissions:</b>		
PM/PM-10 concentration	0.26	gr/scf
Pounds of PM/PM-10 per event	3.0	lb/event
lb/hr PM/PM-10 (duration of 1 event = 1 hr)	<b>3.0</b>	<b>lb/hr</b>
Events per year	2,190	events/yr
Tons PM/PM-10 per year from drum vents	<b>3.27</b>	<b>ton/yr</b>

**Hyperion Energy Center**  
Emission Calculations  
Combined Cycle Gas Turbines

# of Units <sup>1</sup>	Fuel	Max. Firing Rate [MMBtu/hr]		Pollutant	lb/MMBtu	Emission Rate	
		(LHV)	(HHV)			[#/hr]	[ton/yr]
4	Combustion Turbines (Syngas)	697.1	971.0	NOx	0.0109	42.2	184.9
				SO2	0.0063	24.5	107.3
				CO	0.0066	25.7	112.5
				VOC	0.0017	6.6	28.9
				PM10	0.0220	85.4	374.3
				PM	0.0056	21.6	94.8
				H2SO4	0.0006	2.1	9.4
				Org HAP	0.00090	3.5	15.3
				Hg	0.00000059	0.0023	0.010
				NH3	0.0067	26.0	113.9
4	Combustion Turbines (Diesel)	697.1	971.0	NOx	0.0228	88.6	22.2
				SO2	0.0016	6.1	1.5
				CO	0.0066	25.7	6.4
				VOC	0.0017	6.6	1.7
				PM10	0.0220	85.4	21.4
				PM	0.0056	21.6	5.4
				H2SO4	0.0006	2.1	0.5
				Org HAP	0.00084	3.3	0.8
				Hg	0.00000081	0.0031	0.0008
				NH3	0.0067	26.0	6.5
4	Power Island Duct Burners	642.1	706.4	NOx	0.0109	30.7	134.5
				SO2	0.0063	17.8	78.1
				CO	0.0066	18.7	81.9
				VOC	0.0017	4.8	21.0
				PM10	0.0220	62.2	272.3
				PM	0.0056	15.7	69.0
				H2SO4	0.0006	1.6	6.8
				Org HAP	0.00090	2.5	11.1
				Hg	0.00000059	0.0017	0.0004
				NH3	0.0067	18.9	82.8
4	Worst-Case <sup>2</sup> Combustion Turbine + Duct Burners	1339.2	1677.4	NOx	0.0178	119.3	331.0
				SO2	0.0063	42.3	185.4
				CO	0.0066	44.4	194.4
				VOC	0.0017	11.4	50.0
				PM10	0.022	147.6	646.5
				PM	0.0056	37.4	163.8
				H2SO4	0.00055	3.7	16.2
				Org HAP	0.00090	6.0	26.4
				Hg	0.00000071	0.005	0.011
				NH3	0.0067	44.9	196.7

Notes:

1. Heat input rate is provided for one unit; emission rates are provided for all units in total.
2. In the case of pollutants for which the diesel firing emission factor is higher, the annual emissions are calculated assuming 500 hrs/yr diesel firing and 8260 hrs/yr gas firing

## Hyperion Energy Center

### Emission Calculations

#### Diesel Engines

	units	kW	hrs/yr	kWh/yr	
Fire water pump 1	1	2250	300	675,000	
Fire water pump 2	1	2250	300	675,000	
Generator 1	1	600	300	180,000	
Generator 2	1	600	300	180,000	
Generator 3	1	600	300	180,000	
Generator 4	1	600	300	180,000	
	g/kWh				
	NOx	CO	SO2	VOC	PM
Fire water pump 1	6.4	3.5	0.0074	0.33	0.2
Fire water pump 2	6.4	3.5	0.0074	0.33	0.2
Generator 1	6.4	3.5	0.0074	0.33	0.2
Generator 2	6.4	3.5	0.0074	0.33	0.2
Generator 3	6.4	3.5	0.0074	0.33	0.2
Generator 4	6.4	3.5	0.0074	0.33	0.2
	hourly lb/hr				
	NOx	CO	SO2	VOC	PM
Fire water pump 1	31.75	17.36	0.04	1.64	0.99
Fire water pump 2	31.75	17.36	0.04	1.64	0.99
Generator 1	8.47	4.63	0.01	0.44	0.26
Generator 2	8.47	4.63	0.01	0.44	0.26
Generator 3	8.47	4.63	0.01	0.44	0.26
Generator 4	8.47	4.63	0.01	0.44	0.26
<b>Totals</b>	<b>97.4</b>	<b>53.2</b>	<b>0.1</b>	<b>5.0</b>	<b>3.0</b>
	annual tons/yr				
	NOx	CO	SO2	VOC	PM
Fire water pump 1	4.76	2.60	0.01	0.25	0.15
Fire water pump 2	4.76	2.60	0.01	0.25	0.15
Generator 1	1.27	0.69	0.00	0.07	0.04
Generator 2	1.27	0.69	0.00	0.07	0.04
Generator 3	1.27	0.69	0.00	0.07	0.04
Generator 4	1.27	0.69	0.00	0.07	0.04
<b>Totals</b>	<b>14.60</b>	<b>7.99</b>	<b>0.02</b>	<b>0.75</b>	<b>0.46</b>