Appendix A

Emission Calculations

Appendix A: TFO Emissions Inventory

Appendix A: Table of Contents

Table Number	Description
1	Table A.1 Summary of TFO Project Emission Increases/Decreases (by Unit)
2	Table A.2. Toledo Feedstock Optimization (TFO) Project Detail Emission Increases/Decreases
3	Table A.3 Proposed Administrative SO2 Emissions Limits
4	Table A.4 BPH Historic Throughputs for Process Units
5	Table A.5. BPH Historic Firing Rate values for Combustion Devices (MMBtu/hr)
6	Table A.6 BPH Historic Firing Rate values for Combustion Devices (MMSCF/hr)
7	Table A.7 Emissions Increases and Decreases from Projects Occurring in Contemporaneous Period
8	Table A.8 Coker 3 Drum TFO emissions estimate
9	Table A.9 TFO Project Sulfur Recovery Complex Emissions
10	Table A.10 TFO Project Coke Crushing and Handling Emissions
11	Table A.11 Project Temporary Coke Pile Emissions
12	A.12 - Diagram of Distance to Temporary Coke Pile
13	Table A.13 TFO increases from Increased Cooling Tower Usage
14	Table A.14 TFO Project Effects on Firing Rate for Combustion Sources
15	Table A.15. TFO Project Baseline (2004-2005) Combustion Emissions
16	Table A.16. TFO Project Combustion Emissions Increase
17	Table A.17 Summary of TFO Fugitive Emissions Increases
18	Table A.18 Fugitive Emission Calculations for New Components at Crude Vac 1 Process Unit (P011)
19	Table A.19 Fugitive Emission Calculations for Components at Coker 3 Process Unit (P036)
20	Table A.20 Fugitive Emission Calculations for Components at ADHT Process Unit (P029)
21	Table A.21 Fugitive Emission Calculations for Coker Gas Plant
22	Table A.22 Emission Factors for Carbon Monoxide Emissions
23	Table A.23 Emission Factors for Nitrogen Dioxide Emissions
24	Table A.24 Emission Factors for Sulfur Dioxide Emissions
25	Table A.25 BP-Husky Toledo Refinery TRS testing Results Summary
26	Table A.26 Emissions for PM10 and PM2.5 (Filterable + Condensable) Emissions
27	Table A.27 Emission Factors for Volatile Organic Compound Emissions
28	Table A.28 Emission Factors for Lead Emissions
29	Table A.29 Combustion HAP Emission Factors
30	Table A.30 Fugitive Emission Factors
31	Table A.31 Emission Factors for CO2e Green House Gas (GHG) from combustion
32	Table A.32 Green House Gas Emission Factors for Process Units
33	Table A.33 Diesel Tankage increase from TFO Project
34	Table A.34 TFO Estimated New Waste Water Sewer Component Emissions
34a	Table A.34a - Description of Waste Water Treatment TFO Project Elements

Attachment 1 - Detailed Coker 3 Emissions Back-up Documentation
Attachment 2 - Detailed SRU SO2 Emissions Back-up Documentation
Attachment 3 - Greenhouse Gas Emission Factor Back-up Documentation

Table A.1 Summary of TFO Project Emission Increases/Decreases (by Unit)

Code	OEPA ID	Description	VOC tpy	NO_x tpy	SO_2 tpy	PM tpy	PM_{10} tpy	$PM_{2.5}$ tpy	CO tpy	CO_2e tpy	Total HAP tpy
	Crude Units (replace Heaters, upgrade piping)										
Mod	P011	Crude/ Vac 1 (fugitives)	1.8								
SD	B015	Crude 1 Heater (Shutdown)	-7.6	-309.1	-36.6	-10.5	-10.5	-10.5	-115.7	-176,916	-2.6
SD	B031	Vac 1 Heater (Shutdown)	-2.3	-30.4	-11.3	-3.2	-3.2	-3.2	-35.8	-54,708	-0.8
New	TBD	New Crude Heater	10.6	78.8	15.6	14.7	14.7	14.7	118.3	248,149	3.6
New	TBD	New Vac 1 Heater	3.5	26.3	5.2	4.9	4.9	4.9	39.4	82,716	1.2
	Coker Units (expand unit capacity)										
Aff	B032	Coker 3 Heater	0.4	5.4	-11.9	0.6	0.6	0.6	6.9	10,595	0.2
Mod	P036	Coker 3 Drum vent and Fugitive	3.9			0.04	0.04	0.04	0.01	36.7	
Aff	F002, F005, F006	Coke Handling (Pile/Handling/Crushing)				2.4	2.1	0.3			
	ADHT Unit (increased utilization)										
Mod	P028	ADHT Unit (fugitives)	0.6								
Aff	B029	ADHT Heater (possible Increase)	0.2	3.1	0.5	0.3	0.3	0.3	3.7	6,297	0.1
	Steam Boilers (increased steam use)										
Aff	B034/ B035	Boilers (increased Stm use)	1.5	9.7	2.1	2.0	2.0	2.0	22.2	32,971	0.5
	Sulfur Recovery Complex (increased loading)										
Aff	P009/P037	SRU 1,2&3 (increased load)	0.4	7.6	46.4	0.6	0.6	0.6	6.3	26,654.8	0.1
	Miscellaneous										
Aff	B017/B019/ B022	SO_2 Credits for reducing TRS in RFG			-18.6						
Aff	Various	Increased Cooling Water throughput	1.8			6.9	6.9	3.5			
Aff	Various	Increased product throughputs/tankage	0.2								
Aff	P025	WWT New Components	6.1								
		Project Emission Increases only	31.2	130.9	69.8	32.5	32.1	26.9	196.7	407,419	5.7
		Project Emission Decreases only	-9.9	-339.6	-78.3	-13.7	-13.7	-13.7	-151.5	-231,625	-3.4
		Total Creditable/Contemporaneous Changes	*n/a*	*-195.9*	*44.9*	*-17.9*	*-17.9*	*-17.9*	*-109.7*	*-57,511*	
		Total Project Net Emission Changes	**n/a**	**-404.5**	**36.4**	**0.8**	**0.5**	**-4.7**	**-64.5**	**118,283**	
		PSD Significance Levels	40	40	40	25	15	10	100	75,000	
		Sum of Project Increases & Decreases (excludes contemporaneous)	21.3	-208.6	-8.5	18.7	18.4	13.2	45.2	175,794	2.3

Contemporaneous Summary			VOC	NO_x	SO_2	PM	PM_{10}	$PM_{2.5}$	CO	CO_2e
Year	**Permit Number**	**Project Description**	**tpy**	**tpy**	**tpy**	**tpy**	**tpy**	**tpy**	**tpy**	**tpy**
2012	P0103974	New Oily Water Sewer Project	0.72	NA	NA	NA	NA	NA	NA	NA
2012	P01003694	Reformer 3 Project	12.25	-167.91	32.98	-19.34	-19.34	-19.34	-129.01	-81,416
2012	P0107114	190,000 bbl FR Oil tank - conservation vent, N2 blanket	9.99	NA	NA	NA	NA	NA	NA	NA
2013	P0108950	BGOT Recycle Gas Compressor Project	5.32	6.99	4.99	1.43	1.43	1.43	15.80	24,512
2012	P0108887	FCCU Preheat Heater Replacement	2.48	-35.01	6.91	-0.01	-0.01	-0.01	3.48	-607

Table A.2. Toledo Feedstock Optimization (TFO) Project Detail Emission Increases/Decreases

Code	OEPA ID	Process Unit	Permit Capacity	Units	Baseline 2004 - 2005		Assumed Rates TFO Project End State		Project Scope Notes	VOC	NO_X	SO_2	Total PM (Filterable + Condensable)	PM_{10} (Filterable + Condensable)	$PM_{2.5}$ (Filterable + Condensable)	CO	Pb	H_2SO_4 Mist	Total HAP	H_2S	CO2e
										tpy	tpy	tpy[2]	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy
Crude Units																					
Mod	P011	Crude/ Vac 1 (fugs)	120	KBPD	97	KBPD	120	KBPD	Metallurgy change	1.76											
SD	B015	Crude 1 Heater	325	MMBtu/hr	321	MMBtu/hr	0.0	MMBtu/hr	Shutdown Crude 1 heater	-7.58	-309.15	-36.56	-10.47	-10.47	-10.47	-115.72	-6.89E-04	-1.68	-2.60		-176,916
SD	B031	Vac 1 Heater	140	MMBtu/hr	99	MMBtu/hr	0.0	MMBtu/hr	Shutdown Vac 1 heaters	-2.34	-30.42	-11.25	-3.24	-3.24	-3.24	-35.79	-2.13E-04	-0.52	-0.80		-54,708
NA	B019	CV 2 Heater	258	MMBtu/hr	216	MMBtu/hr	258	MMBtu/hr	Only SO_2 affected - reduce allowable SO_2 limit			-12.07						-0.55			
New	TBD	New Crude 1 Heaters (225 MMBtu/hr each)	450	MMBtu/hr	0.0	MMBtu/hr	450	MMBtu/hr	New Crude 1 Heaters	10.63	78.84	15.61	14.69	14.69	14.69	118.26	9.66E-04	0.72	3.65		248,149
New	TBD	New Vac 1 Heater	150	MMBtu/hr	0.0	MMBtu/hr	150	MMBtu/hr	New Vac 1 Heater	3.54	26.28	5.20	4.90	4.90	4.90	39.42	3.22E-04	0.24	1.22		82,716
Coker Units																					
Mod	P036	Coker 3 Unit (including fugs)	26	KBPD	22	KBPD	33.0	KBPD	Reduced cycle time & Increased unit capacity; modifications to Gas Plant and Blowdown system	3.88			0.04	0.04	0.04	0.01				1.80	37
Aff	B032	Coker 3 Heater	247	MMBtu/hr	228	MMBtu/hr	247	MMBtu/hr	Possible increase in utilization due to unit mods	0.45	5.41	-11.88	0.62	0.62	0.62	6.85	4.08E-05	-0.55	0.15		10,595
Aff	F002	Coke Pile	N/A	N/A	1,266	TPD	2,300	TPD	Possible increase in utilization due to unit mods				0.22	0.18	0.03						
Aff	F005	Coke Handling	N/A	N/A	1,266	TPD	2,300	TPD	Possible increase in utilization due to unit mods				1.01	0.74	0.11						
Aff	F006	Coke Crushing	N/A	N/A	1,266	TPD	2,300	TPD	Possible increase in utilization due to unit mods				1.13	1.13	0.17						
NA	B017	Coker 2 Heater	77	MMBtu/hr	42	MMBtu/hr	77	MMBtu/hr	Only SO_2 affected - reduce allowable SO_2 limit			-2.08						-0.10			
ADHT Unit																					
Aff	P028	ADHT Unit (fugs)	20	KBPD	14	KBPD	20	KBPD	More severe hydrotreating of diesel - additional fugitive components	0.62											
Aff	B029	ADHT Heater	20	MMBtu/hr	10	MMBtu/hr	20	MMBtu/hr	Possible increase in utilization due to unit mods	0.24	3.14	0.51	0.33	0.33	0.33	3.69	2.20E-05	0.02	0.083		6,297
Naphtha Heater																					
NA	B022	Naphtha Hydrotreater Heater	77	MMBtu/hr	63	MMBtu/hr	77	MMBtu/hr	Only SO_2 affected - reduce allowable SO_2 limit			-4.46						-0.21			
Steam Boilers																					
Aff	B034/ B035	Steam Boilers	430	MMBtu/hr	0.0	MMBtu/hr	62	MMBtu/hr	Incremental increase in Steam Demand	1.45	9.70	2.13	2.01	2.01	2.01	22.18	1.32E-04	0.10	0.50		32,971
Sulfur Recovery Complex																					
Aff	P009	SRU 1 natural and acid gas	99	LTPD	51	LTPD	99	LTPD	Possible increased utilization to accommodate additional sulfur in crude	0.17	3.18	46.39	0.24	0.24	0.24	2.67	1.59E-05		0.060		21,586
Aff	P037	SRU 2&3 natural and acid gas	210	LTPD	146	LTPD	210	LTPD	Possible increased utilization to accommodate additional sulfur in crude	0.24	4.40		0.33	0.33	0.33	3.63	2.16E-05		0.081		5,069
Miscellaneous																					
Aff	various	Diesel Storage Tanks					2,000	BPD increase	Possible 2000 BPD increase to Diesel tanks	0.24											
Aff	various	Cooling Tower					10,000	GPM increase	Possible increase with the new chillers at Coker 3 unit	1.84			6.93	6.93	3.47						
Aff	WWT	New WasteWater Sewer Component Emissions							Additional Sewer Components for TFO project	6.13			1.84	1.84	0.92						
									increases =>	31.19	130.94	69.85	32.46	32.14	26.93	196.71	1.52E-03	1.08	5.74		407,419
									decreases =>	-9.92	-339.56	-78.31	-13.71	-13.71	-13.71	-151.51	-9.02E-04	-3.60	-3.41		-231,625

Emission Factor Source References

Baseline period assumed to be 2004 to 2005 for every pollutant.

See Tables A.3 through A.30 for back-up documentation

Codes

New	New Unit
Mod	Modified Unit
NA	Not affected (except SO_2)
SD	Shutdown

Table A.3 Proposed Administrative SO_2 Emissions Limits

	Date of PTI issuance			RFG Source	Existing SO_2 Limit	Est. New SO_2 Limit	Creditable Decrease	Baseline Period Emissions (04/05)
PTI		OEPA ID	Description		tpy	tpy	tpy	tpy
04-01346	7/20/2004	B029	ADHT Heater	TIU	2.32	0.69		0.18
04-01471	7/17/2007	B032	Coker 3 Heater	EPA	20.46	8.58	-11.88	20.46
NA	NA	B017**	Coker 2 Heater	TIU	91.45	2.69	-2.08	4.77
NA	NA	B022**	Naphtha Hydro Heater	TIU	91.45	2.69	-4.46	7.15
04-01290	7/25/2002	B019	Crude Vac 2 Heater	TIU	21.02	8.95	-12.07	21.02

** Annual limit based on SIP requirement of 0.29 lb SO2/MMBtu (OAC 3745-18-54)

	Revised Long-term Basis
RFG Source	ppm TRS (incl. H2S)
TIUMD	70
EPA	70

Table A.4 BPH Historic Throughputs for Process Units

		Estimated	2004	2005	Baseline	
OEPA ID	Description	Capacity	Daily Thruput	Daily Thruput	2004-2005 Average	Units
P009	SRU #1	99	55.7	47.2	51.5	LTPD
P037	SRU 2	105	80.9	69.6	75.2	LTPD
P037	SRU 3	105	74.9	66.0	70.4	LTPD
	Total SRUS	309	211.5	182.8	197.1	LTPD
P011	Crude/Vac 1 Unit	120	140.4	0.0	70.2	KBPD
P011	Crude 1	120	98.9	95.5	97.2	KBPD
P011	Vac 1	55	41.5	43.6	42.6	KBPD
P028	A-DHT Unit	20	14.2	12.9	13.5	KBPD
P036	Coker 3	26	24.5	20.2	22.4	KBPD
Z038	Naptha hydrotreater	40	37.5	35.9	36.7	KBPD
J005	Asphalt Loading	9	4.2	3.7	4.0	KBPD
F004	Coke Crusher	na				na
F005	Coke Handling	na	1,348.3	1,183	1,266	TPD
F006	Coke Crusher 2	na	1,348.3	1,183	1,266	TPD

Source Reference
Data from BP-Husky Refinery eCHOKE system
"K" represents thousands.

Table A.5. BPH Historic Firing Rate values for Combustion Devices (MMBtu/hr)

OEPA ID	Process Description	Estimated Capacity (HHV)	Units	RFG Mix Drum Reference	2004	2005	Average Baseline 2004 - 2005	Unit	Source	Reference
B015	Crude 1 Heater	325	MMBtu/hr	TIUMD	318.40	323.25	**320.82**	MMBtu/hr	PI	note 3
B015[a]	Crude RFG		MMBtu/hr	TIUMD	307.01	313.25	**310.13**	MMBtu/hr	PI	note 3
B015[a]	Vac off-gas - routed to RFG system (fall 2012)		MMBtu/hr	Vac Gas	11.39	10.00	**10.69**	MMBtu/hr	PI	note 3
B031	Vac 1 Heater	140	MMBtu/hr	TIUMD	97.72	100.70	**99.21**	MMBtu/hr	PI	note 1
B019	Crude Vac 2 Heater	258	MMBtu/hr	TIUMD	201.68	230.74	**216.21**	MMBtu/hr	PI	note 1
B032	Coker 3 Heater	247	MMBtu/hr	K3	233.51	223.11	**228.31**	MMBtu/hr	PI	note 1
B017	Coker 2 Heater	77	MMBtu/hr	TIUMD	44.81	39.11	**41.96**	MMBtu/hr	PI	note 1
B029	ADHT Heater	20	MMBtu/hr	ESMD	9.83	9.71	**9.77**	MMBtu/hr	PI	note 1
B022	Naphtha Treater Heater	77	MMBtu/hr	TIUMD	64.67	61.31	**62.99**	MMBtu/hr	PI	note 1
P009	SRU 1 natural gas	Estimated	MMBtu/hr	TIUMD/ NG	6.83	7.38	**7.10**	MMBtu/hr	PI	note 2
P037	SRU 2&3 natural gas	29	MMBtu/hr	TIUMD/ NG	19.45	18.44	**18.95**	MMBtu/hr	PI	note 2

Source References

note 1 - The average annual fuel firing MMBtu/hr was calculated from daily average values of fuel flow (MSCFH) and refinery fuel gas heating value (BTU/SCF) retrieved from BPH refinery's PI system. The daily averages were then averaged over the annual period indicated.

note 2 - The annual average SRU 1 and SRU 2&3 fuel usage data was estimated from daily average values of fuel flow (MSCFH) and typical natural gas heating value of 1020 BTU/SCF. The fuel flows were retrieved from BP-Husky's PI system. The daily averages were averaged over the annual period indicated.

note 3 - The Crude 1 Heater firing rate includes fuel from the TIUMD RFG system and Off-gas from the Vac 1 tower. These fuels were estimated separately and added togetl for a combined annual average firing rate to the Heater. The heating value for the RFG is based on the TIU Mix Drum BTU analyzer data. The Vac off-gas heating va is from 3-31-2010 to 5-20-2010 weekly samples average of 1658 Btu/scf. The Vac 1 off-gas is going to be routed directly to the RFG system in Fall 2012.

Refinery Fuel Gas (RFG) mix drum reference		2004 Avg (HHV) BTU/SCF	2005 Avg (HHV) BTU/SCF	Baseline Avg HHV BTU/SCF
TIUMD	- TIU Mix drum (west side)	1428.38	1557.05	1492.71
Vac gas	- Vac 1 off-gas flow monitor. Heating value based on testing at the refinery.	1658.00	1658.00	1658.00
K3	- Coker gas treated at the EPA wet gas treater, can sometimes mix with natural gas. Fuel Gas samples are taken weekly, recorded, and used for calculations.	1428.38	1557.05	1492.71
ESMD	- East side mix drum.	1128.99	1326.60	1227.80
Boiler FG	- the Alstom boilers have their own BTU analyzers for the fuel gas that is combusted. May combined RFG, NG, or other combustible gases.	NA	NA	1492.71
NG	- Natural gas.			

HHV Correction factor* **0.93**

**factor based on typical difference for Actual 2012 data*

Table A.6 BPH Historic Firing Rate values for Combustion Devices (MMSCF/hr)

OEPA ID	Process Description	Estimated Capacity (HHV)	Units	RFG Mix Drum Reference	2004	2005	Average Baseline 2004 - 2005	Unit	Source	Reference
B015	Crude 1 Heater	325	MMBtu/hr	TIUMD	2.10E-01	2.10E-01	**2.10E-01**	MMSCF/hr	PI	note 3
B015[a]	Crude RFG		MMBtu/hr	TIUMD	2.03E-01	2.01E-01	**2.02E-01**	MMSCF/hr	PI	note 1
B015[a]	Vac off-gas - routed to RFG system in fall 2012		MMBtu/hr	Vac Gas	6.75E-03	9.52E-03	**8.14E-03**	MMSCF/hr	PI	note 1
B031	Vac 1 Heater	140	MMBtu/hr	TIUMD	6.47E-02	6.47E-02	**6.47E-02**	MMSCF/hr	PI	note 1
B019	Crude Vac 2 Heater	258	MMBtu/hr	TIUMD	1.34E-01	1.48E-01	**1.41E-01**	MMSCF/hr	PI	note 1
B032	Coker 3 Heater	247	MMBtu/hr	K3	1.59E-01	1.47E-01	**1.53E-01**	MMSCF/hr	PI	note 1
B017	Coker 2 Heater	77	MMBtu/hr	TIUMD	2.97E-02	2.51E-02	**2.74E-02**	MMSCF/hr	PI	note 1
B029	ADHT Heater	20	MMBtu/hr	ESMD	6.74E-03	7.32E-03	**7.03E-03**	MMSCF/hr	PI	note 1
B022	Naphtha Treater Heater	77	MMBtu/hr	TIUMD	4.28E-02	3.94E-02	**4.11E-02**		PI	note 1
P009	SRU 1 natural gas	Estimated	MMBtu/hr	NG	6.70E-03	7.23E-03	**6.96E-03**	MMSCF/hr	PI	note 2
P037	SRU 2&3 natural gas	29.0	MMBtu/hr	NG	1.47E-02	1.33E-02	**1.40E-02**	MMSCF/hr	PI	note 2

Source References

note 1 - The annual average values of fuel flow (MSCFH) were estimated from the daily average values retrieved from BPH refinery's PI system. The daily averages were then averaged over the annual period indicated.

note 2 - The annual average SRU 1 and SRU 2&3 fuel usage data was estimated from daily average values of fuel flow (MSCFH). The fuel flows were retrieved from BP-Husky's PI system. The daily averages were averaged over the annual period indicated.

note 3 - The Crude 1 Heater firing rate includes fuel from the TIUMD RFG system and Off-gas from the Vac 1 tower. These fuels were estimated separately and added together for a combined annual average fuel flow to the Heater. The Vac 1 off-gas is going to be routed directly to the RFG system in Fall 2012.

Refinery Fuel Gas (RFG) mix drum reference

TIUMD - TIU Mix drum (west side)

Vac gas - Vac 1 off-gas flow monitor. Heating value based on testing at the refinery.

K3 - Coker gas treated at the EPA wet gas treater, can sometimes mix with natural gas. Fuel Gas samples are taken weekly, recorded, and used for calculations.

ESMD - East side mix drum.

Boiler FG - the Alstom boilers have their own BTU analyzers for the fuel gas that is combusted. May combined RFG, NG, or other combustible gases.

NG - Natural gas.

Table A.7 Emissions Increases and Decreases from Projects Occurring in Contemporaneous Period

Description of Project	Permit	Date of Change	NO_x (tons/yr)	CO (tons/yr)	SO_2 (tons/yr)	PM/ PM_{10}/ $PM_{2.5}$ (tons/yr)	VOC (tons/yr)	H_2SO_4 (tons/yr)	HAPs (tons/yr)	CO_2e (tons/yr)	NOTES/ Comments
New Oily water sewer drains	P0103974	Summer 2012					0.72	0.00		0	
New Oily Water Sewer Project Totals							**0.72**	**0.00**		**0**	
Reformer 3 (Note 1)	P01003694	Fall 2012	79.61	84.63	38.00	**NA**	28.27	1.75		287,477	
Shutdown of Reformer 1 Heater (B014)	P01003694	Fall 2012	-105.41	-55.94	-1.57	-5.06	-3.66	-0.07		-73,323	
Shutdown of Reformer 1 Regenerator Heater (B013)	P01003694	Fall 2012	-1.14	-0.96	-0.02	-0.09	-0.06	0.00		-928	
Shutdown of Reformer 2 Heater (B006)	P01003694	Fall 2012	-72.98	-86.63	-1.96	-7.84	-5.67	-0.09		-113,693	
Shutdown of Reformer 2 Regenerator Heater (B005)	P01003694	Fall 2012	-3.69	-3.10	-0.07	-0.28	-0.20	0.00		-3,693	
Shutdown of Reformer 1 (P019)	P01003694	Fall 2012					-1.74	0.00		-121	<= Using throughput factor based on 2011 reported GHG MRR emissions.
Shutdown of Reformer 2 (P020)	P01003694	Fall 2012					-0.19	0.00		-589	
Shutdown of Hydrogen Heater (B001) and Hydrogen Plant (P042)	P01003694	Fall 2013	-64.29	-67.01	-1.40	-6.07	-4.50	-0.06		-176,546	<= Includes default GHG MRR LDAR factor for Hydrogen Plants
New Reformer 3 Contemporaneous Project Totals			**-167.91**	**-129.01**	**32.98**	**-19.34**	**12.25**	**1.52**	**0.00**	**-81,416**	
New 190,000 bbl Oil tank w fixed roof, conservation vent, and N2 blanket	P0107114	Late 2012					9.99				
New Oil Tank with fixed roof and N_2 blanket							**9.99**				
New BGOT RGC Project Fugitives	P0108950	Spring 2013					2.96		0.30		
Increase (B030) from BGOT RGC	P0108950	Spring 2013	6.99	3.79	1.13	0.34	0.25	0.05	0.12	6,767	<= SO_2 emissions reflect issued permit allowable increase
Increase (B033) from BGOT RGC	P0108950	Spring 2013		12.01	3.86	1.09	0.79	0.18	0.01	17,745	
Increase Crude 1 Heater firing (9 MMBtu/hr increment)	P0108950	Spring 2013	Emissions not included in contemp totals because of double counting - This furnace is being shutdown for the TFO project								
Incremental feed rate increase to FCCU from BGOT RGC feed rate increase to BGOT unit	P0108950	Spring 2013	This source experienced an emissions decrease from the baseline period for the BGOT RGC project. No increases to show for the contemporaneous period.								
New Oily sewer drain plus Crude & Gas Tankage throughput increase	P0108950	Spring 2013					1.32				
New BGOT RGC Contemporaneous Project Totals			**6.99**	**15.80**	**4.99**	**1.43**	**5.32**	**0.23**	**0.43**	**24,512**	
Incremental Steam demand needed for replacement of FCCU Preheater Heater with heat exchangers	P0108887	Fall 2012	2.72	14.80	11.01	0.25	0.73	0.51	0.25	16,121	
New fugitive components for new FCCU heat exchangers	P0108887	Fall 2012					2.49			4	
FCCU Preheat Heater shutdown (B018)	P0108887	Fall 2012	-37.73	-11.32	-4.10	-0.26	-0.74	-0.19	-0.25	-16,732	
New FCCU Preheat Replacement Project Totals			**-35.01**	**3.48**	**6.91**	**-0.01**	**2.48**	**0.32**	**0.00**	**-607**	
		Contemporaneous Totals	**-195.93**	**-109.73**	**44.88**	**-17.92**	**20.77**	**2.06**	**0.43**	**-57,511**	

Note 1: 16.94 tons/yr PM10 increase from Reformer 3 went thru PSD, and therefore does not have to be included in netting.

Note 2: Permit allowed SO_2 increase from BGOT Heaters to current allowable and not beyond.

Note 3: GHG shutdown credits from Reformer 3 permit for Heaters was estimated based on the baseline firing rate from the permit multiplied by the GHG factor from 2011

Table A.8 Coker 3 Drum TFO emissions estimate

Methodology

There are three batch steps that can generate emissions from the delayed coking units; venting, cutting, and draining. During the delayed coker operating cycle, the vast majority of the vapors from the coke drum are routed to a closed blowdown system with no emissions.

The first emissions event from the coke drums occurs when the coke drum is vented to the atmosphere after the coke drum is depressured to its set point. The amount of gas vented from the delayed coking unit during this final depressurization step has been estimated using an enthalpy balance and the resulting emissions are calculated based on the concentration of each pollutant measured during the July 2011 stack test of the BPH Coker 3 unit (particulate, CH4, CO, VOC, H2S). The size of the drums, mass of coke, the resulting void space in the drums, and temperature and pressure at venting were all used to estimate the total flow rate of the vented gas per venting event. Past actual baseline emissions are estimated based on the actual number of venting events (drum cycles) in the baseline period and assumed venting at 3 psig (the average past venting pressure). Future emissions are based on a new coke drum cycle of 14 hrs, resulting in 626 venting events per year (8760 hrs/yr divided by 14 hrs per cycle) and venting at a new lower pressure of 2 psig.

The next step in the de-coking process involves removing the coke from the drums using a high pressure water stream. Coke cutting emissions of VOC, H2S, CO, CH4, and CO2 are estimated using an enthalpy balance to calculate the amount of water that is vaporized based on the heat contained in the coke. Emissions are estimated based on the concentration of constituents present.

Lastly, emissions from the evaporation of trace VOC and H2S in the cutting water after it drains from the coke drums are estimated based on VOC and H2S concentration data obtained at Toledo and a mass balance of water through the

Back-up calculations included in Attachment 1

Coker 3 Estimates

	Venting	Cutting	Draining	Total (Venting + Cutting + Draining)	Coking Cycles	avg 2004-2005
	TPY	TPY	TPY	TPY	423.5	cycles/yr
Pollutant	**Past Emissions (18 hr cycle, 3 psig)**				3	psig venting
H_2S	2.8	0.1	3.5	6.4		
VOC	7.6	0.2	0.9	8.6		
CO	0.2	0.0		0.2		
PM	1.9			1.9		
CH_4	35.9	0.8		36.7		
CO_2	7.1	0.2		7.3		
CO_2e	761.9	16.9		778.8		
	Future Emissions (14 hr cycle, 2 psig)					(14-hr cycle)
H_2S	2.9	0.1	5.2	8.2	626	cycles/yr
VOC	7.7	0.2	1.4	9.3	2	psig venting
CO	0.2	0.0		0.2		
PM	2.0			2.0		
CH_4	36.8	1.2		38.0		
CO_2	7.3	0.2		7.5		
CO_2e	779.7	24.9		804.6		
	Estimated Project Increases					
H_2S	0.1	0.0	1.7	1.8		
VOC	0.2	0.1	0.4	0.7		
CO	0.0	0.0	0.0	0.0		
PM	0.0	0.0	0.0	0.0		
CH_4	0.8	0.4	0.0	1.2		
CO_2	0.2	0.1	0.0	0.2		
CO_2e	17.8	8.0	0.0	25.8		

Table A.9 TFO Project Sulfur Recovery Complex Emissions

METHODOLOGY

PAST ACTUAL: Past actual emissions estimated based on BP-Husky refinery process data including SO_2 CEMs data for the baseline period of 2004 and 2005. SO_2 emissions have been corrected for SRU1 because stack flow measurement was not available for the baseline period. Estimated stack flow rate from recent stack flow measurements and SRU 1 LTPD processed. Used baseline period SRU 1 LTPD processed to estimate stack flow rate. SRU 2&3 flow and SO_2 CEMs data were both available for the baseline period. Baseline does not include any periods of excess emissions (i.e. greater than 250 ppm SO_2) or out of control and downtimes for the SO_2 CEMs. See Attachment 2 for details. Other criteria pollutants from the SRUs are estimated for the natural gas fired in the Tail gas treating units. These emissions are estimated with the combustion emissions in Tables A.15 and A.16.

TFO 2012 SRU: SO_2 potential emissions are based on a proposed TFO SO_2 limit.

DATA

2004 Annual Estimates

Code	OEPA ID	Process Unit	SO_2 tpy
Aff	P009	SRU 1	19.92
Aff	P037	SRU 2&3	23.93
		Total	43.85

2005 Annual Estimates

Code	OEPA ID	2005 Est Process Unit	SO_2 tpy
Aff	P009	SRU 1	14.54
Aff	P037	SRU 2&3	8.94
		Total	23.48

Baseline 24-mo average (tpy)	SO_2
SRU1	17.23
SRU 2&3	16.44

Predicted Future emissions (tpy)	Combined Proposed SO_2 Limit tpy
SRU1	80.00
SRU 2&3	

Project Predicted Increases (tpy)	SO_2
SRU1	46.34
SRU 2&3	
Total	46.34

Emission Factor CO2e tons/yr per LTPD sulfur produced	Emissions Increase TFO increase in CO2e tpy	Reference
159.64	**17,856**	Average Emission Factor from 2011 GHG MRR sour gas emissions (See Table A.30) - combined for all SRUs

Equip. Name	Units	Baseline (2004-2005)	Potential
Total Sulfur load to SRUs 1, 2&3	Long ton per day	197	309

Source References

NOTE: Current numbers exclude sulfur sent to marsulex

Data from TRP and SRU Emissions 1Q10 with 2004 and 2005 data - values.xls

Average GHG Emission Factor based on the 2011 actual GHG emissions divided by 2011 actual LTPD produced.

Table A.10 TFO Project Coke Crushing and Handling Emissions

Methodology: Estimated emissions occur from several steps in the handling process as discussed below.
The coke handling emissions (F005) include coke that has been removed from the Coke drums and forms a pile in the coke pit. Wind erosion from the pit coke pile is estimated using Equation 4 from Section 2.1.2 (Aggregate Storage Piles) of the RACM document. No control efficiency credit for the partial enclosure of the pit is assumed in the calculation. All of the coke is removed from the pile with a clamshell crane and dropped into the inlet chute of a crusher. Emissions from this transfer operation are estimated using the equation from AP-42 Section 13.2.4.3 (11/06) for aggregate drop operations. Additionally, it is assumed that 25% of the coke is re-handled once to manage the pile (i.e.; one additional drop operation). These operations take place in the pit, but no control credit is taken for the partial enclosure of the pit. Dust generated by movement of the clamshell crane around the pit to access all the coke has been estimated using AP-42 Section 13.2.2 (11/06) for vehicle traffic on unpaved surfaces at industrial sites.
The coke crusher (F006) is assumed to process 100% of the coke production from Coker 3. The crushing operation takes place inside an enclosed crusher. Emissions from coke crushing are based on the factor for the primary crushing of coal from Table 2.19-2 of Ohio EPA's Reasonably Available Control Measures for Fugitive Dust document (August 1983, page 2-431) and an estimated 70% control for the process enclosure.
From the crusher, the coke is dropped onto a conveyor belt which transports it to an offsite customer (Toledo Edison who operates a coke fired boiler near the refinery.) There are two drop operations (transfer points) on the conveyor, one loading it onto the conveyor and one midway along the conveyor route. These emissions are part of the handling operations (F005) and are estimated using the equation from AP-42 Section 13.2.4.3 (11/06) for drop operations. The conveyor and drop points are partially enclosed and a control effectiveness of 70% has been assumed.

		Estimated Past Actual Emissions, tpy				
Past Actual (2004-2005)	**Past Actual Average Tons Handled/ Crushed**	**Crushing (F006), PM/PM10**	**Crushing (F006), PM2.5**	**Handling (F005), PM10**	**Handling PM**	**Handling PM2.5**
annual	462,021	**1.39**	**0.21**	0.94	1.39	0.14
daily	1,266					

Estimated Future Project Emissions					Notes
OEPA ID	**Coke Crushed ton/day**	**Crushing (F006) Emissions, tpy**			
		PM	**PM-10**	**PM-2.5**	
F006	2,300	2.52	2.52	0.38	Future PM emissions based on existing PM/ PM-10/ PM-2.5 emissions limits in PTI 04-01471 issued 7/17/2007 for F006. PM-2.5 assumed to equal 0.15*PM-10 based on AP-42 Section 13.2.4 (11/06)
OEPA ID	**Coke Handled ton/day**	**Handling (F005) Emissions, tpy**			
		PM-30	**PM-10**	**PM-2.5**	
F005	2,300	2.40	1.68	0.25	PM-10 emission based on methodology outlined below for F005. NOTE PTI 04-01471 limits PM10 emissions to 6.31 tpy. PM-2.5 assumed to equal 0.15*PM-10 based on AP-42 Section 13.2.4 (11/06).

TFO Project Increases				
	Coke Crushing (est. ton/day)	**Crushing (F006) Emissions, tpy**		
		PM	**PM-10**	**PM-2.5**
F006	1,034	1.13	1.13	0.17
Future Potential Summary				
	Coke Handled (est. ton/day)	**Handling (F005) Emissions, tpy**		
		PM-30	**PM-10**	**PM-2.5**
F005	1,034	1.01	0.74	0.11

Table A.10 TFO Project Coke Crushing and Handling Emissions

Coke Crushing (F006) Emission Factor Basis

0.02	lb/ton for primary crushing of coal from Table 2.19-2 of Ohio EPA's Reasonably Available Control Measures for Fugitive Dust document (August 1983, page 2-431)
70%	percent control from partial enclosure based on control shown for partial enclosure of conveying in Table 2.1.3-3 of the RACM document (page 2-62)
0.006	**Controlled EF = 0.02 lb/ton * (1 - 0.7 control)**

Coke Handling (F005) Emission Factor Basis

Emission factor on lb/ton basis is the sum of factors for all transfer points and coke pit wind erosion
Emissions from crane movement are estimated separately on a vehicle miles traveled basis.

	PM-30	PM-10	PM-2.5
Combined emission factor, lb/ton	0.005	0.004	0.0006
Additional crane emissions, lb/month	24.759	6.6839	0.66839

Transfer Points:
Emissions for the following points are estimated using the equation in AP-42 Section 13.2.4.3 (11/06) for drop operations.
70% control is assumed for enclosed transfer points based on the control shown for partial enclosure of conveying in Table 2.1.3-3 of the RACM document (page 2-62). Only 25% of the coke is assumed to be moved within the coke pit. The final conveyor is not actually a BPH emission unit but this emission point is conservatively included. Note that the moisture content assumption used here is conservatively low.

		Emission factor, lb/ton		
Point	**Control Description**	PM-30	PM-10	PM-2.5
Transfer within pit	uncontrolled; only 25% of total thruput	0.00037	0.00018	0.00003
Pit to truck or crusher	uncontrolled	0.00149	0.00071	0.00011
Transfer to conveyor	controlled by partial enclosure	0.00045	0.00021	0.00003
Conveyor	controlled by partial enclosure	0.00045	0.00021	0.00003
TOTAL		0.0028	0.0013	0.0002

Description	**Equation and Data**	**Units**	**Notes/ Comments**
Particulate emissions from transfer points	E = k * (0.0032) * (U / 5.0)^1.3 / (M / 2)^1.4	lbs/ton transferred	AP-42 Section 13.2.4.3 (11/06) for drop operations
k_{PM-30}, particle size multiplier	0.74	unitless	AP42 Section 13.2.4.3, 11/06 for particle size <30 microns
k_{PM-10}, particle size multiplier	0.35	unitless	AP42 Section 13.2.4.3, 11/06 for particle size <10 microns
$k_{PM-2.5}$, particle size multiplier	0.053	unitless	AP42 Section 13.2.4.3, 11/06 for particle size <2.5 microns
U, mean wind speed	9.40	miles/hr	AP42 Table 7.1-9, 9/97 (Toledo, OH)
M, material moisture content	5.0	percent	Conservative assumption (typically greater than 5%)
Control efficiency from enclosure	70%	percent	Table 2.1.3-3 of the RACM document for partial enclosure of conveying

Table A.10 TFO Project Coke Crushing and Handling Emissions

Wind Erosion from Coke Pit:

For wind erosion from the coke pit, AP-42 Section 13.2.5 (specified the published Title V (10-13-04) provides detailed and complex estimation procedures for wind erosion from storage piles. A simpler procedure from the RACM document was originally used to permit this source, and is used here to demonstrate compliance. Permit P04-01471 issued July 17, 2007 changed the compliance demonstration method from the complex AP-42 methodology to the one used here. The subsequent application for a Title V Minor Permit Mod was submitted to TDES.

Emissions from wind erosion of material from the coke pit are estimated using Equation 4 from Section 2.1.2 (Aggregate Storage Piles) of the RACM document.

Emission factor = 0.0026 lb/ton This is assumed to represent PM-10 and TSP; PM-2.5 is assumed to be 0.15 * PM-10 based on AP-42 Section 13.2.4.

Description	Equation and Data	Units	Notes/ Comments
Particulate emissions from wind erosion	E = 0.05 * (s/1.5) * (D/90) * (d/235) * (f/15)	lbs/ton stored	Equation 4 from RACM document Section 2.1.2
s, silt content	5.4	percent	BPH estimate based on AP-42 Table 13.2.4-1 (11/06)
D, duration of storage in pile (coke pit)	1	days	N Thurber, 2/14/06
d, dry days per year	229	days/year	Figure 2.1.2-2 of the RACM document for Toledo, page 2-36
f, time wind speed exceeds 12 mph	20	percent	Conservative assumption

Crane Movement on the Pile:

Emissions are estimated using AP-42 Section 13.2.2 (11/06) for unpaved surfaces at industrial sites.

Potential emissions from this source are based on vehicle miles traveled of 384 feet/day. For purposes of estimating actual emissions, these potential emissions are assumed to occur evenly throughout the year.

	PM-30	PM-10	PM-2.5	
Emission factor (E)	11.19	3.02	0.30	lb/VMT
Emissions =	0.15	0.040	0.0040	tons/year

Description	Equation and Data	Units	Notes/ Comments
Particulate emissions from vehicle traffic	$E = k * (s/12)^a * (W/3)^b$	lbs/VMT	AP-42 Section 13.2.2 (11/06) for unpaved surfaces at industrial sites
Particulate emissions from vehicle traffic	E * VMT (feet/day) * 365 days/year /(5280 feet/mile * 2000 lbs/ton)	tons/year	
k_{PM-30}, constant	4.9	unitless	AP-42 Table 13.2.2-2 (11/06) for PM-30 and industrial roads
k_{PM-10}, constant	1.5	unitless	AP-42 Table 13.2.2-2 (11/06) for PM-10 and industrial roads
$k_{PM-2.5}$, constant	0.15	unitless	AP-42 Table 13.2.2-2 (11/06) for PM-2.5 and industrial roads
s, surface material silt content	6.4	%	AP-42 Table 13.2.2-1 (11/06) for municipal solid waste landfills
a, constant, PM-10 or PM-2.5	0.9	unitless	AP-42 Table 13.2.2-2 (11/06) for PM-10 or 2.5, industrial roads
a, constant, PM-30	0.7	unitless	AP-42 Table 13.2.2-2 (11/06) for PM-30, industrial roads
b, constant, PM-2.5, 10, or 30	0.45	unitless	AP-42 Table 13.2.2-2 (11/06) for industrial roads
W, mean vehicle weight (crane)	50	tons	engineering estimate
Distance traveled by crane	384	feet/day	engineering estimate
Conversion, feet per mile	5,280	feet/mile	

Table A.11 Project Temporary Coke Pile Emissions

Methodology

Emissions in Table A.10 describe process steps are represent the normal handling process for Coker 3 coke. Occasionally, due to off spec product, conveyor downtime or operating problems at Toledo Edison, it is necessary to divert some of the coke production to a temporary storage pile (F002). Emissions from this occasional activity are calculated assuming that 5% of the Coker 3 coke requires these additional/alternative handling steps.
The coke which is transported to the temporary pile is loaded by the clamshell crane into haul trucks. The emissions from this loading are already covered by the estimated emissions from assuming all coke is loaded into the crusher inlet chute because all of the coke goes one place or the other. Both activities represent uncontrolled drop operations with equivalent emissions.
The roadway dust emitted by the haul truck traffic to and from the pile is estimated using AP-42 Section 13.2.1 (1/11) for vehicle traffic on paved surfaces at industrial sites. No natural mitigation or additional control efficiency is assumed. Emissions from the roadway dust from movement of a front-end loader used to manage the temporary storage pile is estimated using AP-42 Section 13.2.2 (11/06) for vehicle traffic on unpaved surfaces at industrial sites.
Finally, emissions from wind erosion of material in the temporary coke storage pile are estimated using Equation 4 from Section 2.1.2 (Aggregate Storage Piles) of the RACM document taking no credit for any controls. Load into and out of the temporary storage pile is estimated using the equation from AP-42 Section 13.2.4.3 (11/06) for aggregate drop operations.

Past Actual Emissions	TSP, tpy	PM-10, tpy	PM-2.5, tpy	
Wind erosion	0.19	0.19	0.03	PM-2.5 assumed to equal 0.15*PM-10 based on AP-42 Section 13.2.4.
Load-in & out	0.05	0.02	0.0037	
Truck movement	0.023	0.005	0.002	
Project Emissions	**TSP, tpy**	**PM-10, tpy**	**PM-2.5, tpy**	
Wind erosion	0.35	0.35	0.05	PM-2.5 assumed to equal 0.15*PM-10 based on AP-42 Section 13.2.4.
Load-in and Load out	0.09	0.04	0.0067	
Truck movement	0.047	0.010	0.003	
Project Increases				
Total	**0.22**	**0.18**	**0.03**	

Data

Description	Data	Units	Notes/ Comments
Past Actual Amount of coke passing through pile in a year	23,101	tons/year	5% of Coke production is routed through the pile (baseline period)
Amount of coke passing through the pile in a year	41,975	tons/year	Assume 5% of Coke production is routed through the pile (Future potential of 2300 tpd)

Transfer Points:

Emissions for the following points are estimated using the equation in AP-42 Section 13.2.4.3 (11/06) for drop operations.
Note that the moisture content assumption used here is conservatively low.

	Emission factor, lb/ton		
Point	PM-30	PM-10	PM-2.5
From Pit to Truck	0.00149	0.00071	0.00011
From Truck to Temp Pile	0.00149	0.00071	0.00011
From Temp Pile to Truck	0.00149	0.00071	0.00011
TOTAL	0.0045	0.0021	0.0003

Description	Equation and Data	Units	Notes/ Comments
Particulate emissions from transfer points	E = k * (0.0032) * (U / 5.0)^1.3 / (M / 2)^1.4	lbs/ton transferred	AP-42 Section 13.2.4.3 (11/06) for drop operations
k_{PM-30}, particle size multiplier	0.74	unitless	AP42 Section 13.2.4.3, 11/06 for particle size <30 microns
k_{PM-10}, particle size multiplier	0.35	unitless	AP42 Section 13.2.4.3, 11/06 for particle size <10 microns
$k_{PM-2.5}$, particle size multiplier	0.053	unitless	AP42 Section 13.2.4.3, 11/06 for particle size <2.5 microns
U, mean wind speed	9.40	miles/hr	AP42 Table 7.1-9, 9/97 (Toledo, OH)
M, material moisture content	5.0	percent	Conservative assumption (typically greater than 5%)

Wind Erosion from Temporary Pile:

Emissions from wind erosion of material from the coke pile are estimated using Equation 4 from Section 2.1.2 (Aggregate Storage Piles) of the RACM document.
Emission factor = 0.0165 lb/ton This is assumed to represent PM-10 and TSP
0.0025 lb/ton PM-2.5 is assumed to be 0.15 * PM-10 based on AP-42 Section 13.2.4.

Description	Equation and Data	Units	Notes/ Comments
Particulate emissions from wind erosion	E = 0.05 * (s/1.5) * (D/90) * (d/235) * (f/15)	lbs/ton stored	Equation 4 from RACM document Section 2.1.2 (Aggregate Storage Piles), page 2-33.
s, silt content	4.9	percent	BPH estimate based on AP-42 Table 13.2.4-1 (11/06) for Coke Breeze
D, duration of storage in pile	7	days	N Thurber, 2/14/06
d, dry days per year	229	days/year	Figure 2.1.2-2 of the RACM document for Toledo, page 2-36
f, time wind speed exceeds 12	20	percent	Conservative assumption

Table A.11 Project Temporary Coke Pile Emissions

Truck Transfer Movement:

Emissions are estimated using AP-42 Section 13.2.1 (1/11) for paved surfaces at industrial sites for truck transfers
Emissions are estimated using AP-42 Section 13.2.2 (11/06) for unpaved surfaces at industrial sites for truck movement on pile.
Potential emissions from this source are based on vehicle miles traveled in feet/day. For purposes of estimating actual emissions, these potential emissions are assumed to occur evenly throughout the year.

	PM-30	PM-10	PM-2.5	
Unpaved Roads Emission Factor, E	9.3	2.4	2.4	lb/VMT
Paved Roads Emission factor (E)	4.70	0.94	0.23	lb/VMT
Past Actual Emissions =	0.02	0.005	0.002	tons/year
Future Potential Emissions =	0.05	0.010	0.003	tons/year

Description	Equation and Data	Units	Notes/ Comments
Particulate emissions from vehicle traffic	$E = k * (s/12)^a * (W/3)^b$	lbs/VMT	AP-42 Section 13.2.2 (11/06) for unpaved surfaces at industrial sites
Particulate emissions from vehicle traffic	E * VMT (feet/day) * 365 days/year /(5280 feet/mile * 2000 lbs/ton)	tons/year	
k_{PM-30}, constant	4.9	unitless	AP-42 Table 13.2.2-2 (11/06) for PM-30 and industrial roads
k_{PM-10}, constant	1.5	unitless	AP-42 Table 13.2.2-2 (11/06) for PM-10 and industrial roads
$k_{PM-2.5}$, constant	0.2	unitless	AP-42 Table 13.2.2-2 (11/06) for PM-2.5 and industrial roads
s, surface material silt content	4.9	%	AP-42 Table 13.2.2-1 (11/06) for municipal solid waste landfills
a, constant, PM-10 or PM-2.5	0.9	unitless	AP-42 Table 13.2.2-2 (11/06) for PM-10 or 2.5, industrial roads
a, constant, PM-30	0.7	unitless	AP-42 Table 13.2.2-2 (11/06) for PM-30, industrial roads
b, constant, PM-2.5, 10, or 30	0.5	unitless	AP-42 Table 13.2.2-2 (11/06) for industrial roads
Particulate emissions from vehicle traffic	$E = k * (sL)^{0.91} \times W^{1.02}$	lb/VMT	AP-42 Section 13.2.1 (1/11) for paved surfaces
Particulate emissions from vehicle traffic	E * VMT (feet/yr) /(5280 feet/mile * 2000 lbs/ton)	tons/year	
k_{PM-30} constant	0.011	lb/VMT	AP-42 Table 13.2.1-1
k_{PM-10} constant	0.0022	lb/VMT	AP-42 Table 13.2.1-1
$k_{PM-2.5}$ constant	0.00054	lb/VMT	AP-42 Table 13.2.1-1
sL	9.7	g/m^2	Silt loading from AP-42 Table 13.2.1-3 for Iron and Steel Production
W, mean vehicle weight	50.0	tons	engineering estimate
Distance traveled on pile	2,400	feet/yr	Past Actual engineering estimate (200 ft on the pile - estimate occurs 12 x per year)
Distance traveled on pile	4,800	feet/yr	Future Potential engineering estimate - assume 2X's as past actual since 2Xs as much coke
Distance traveled by truck	48,000	feet/yr	Past Actual engineering estimate (2000 ft to and from pile - estimate occurs 24 x per year)
Distance traveled by truck	96,000	feet/yr	Future Potential engineering estimate - assume 2X's as past actual since 2Xs as much coke produced
Conversion, feet per mile	5,280	feet/mile	

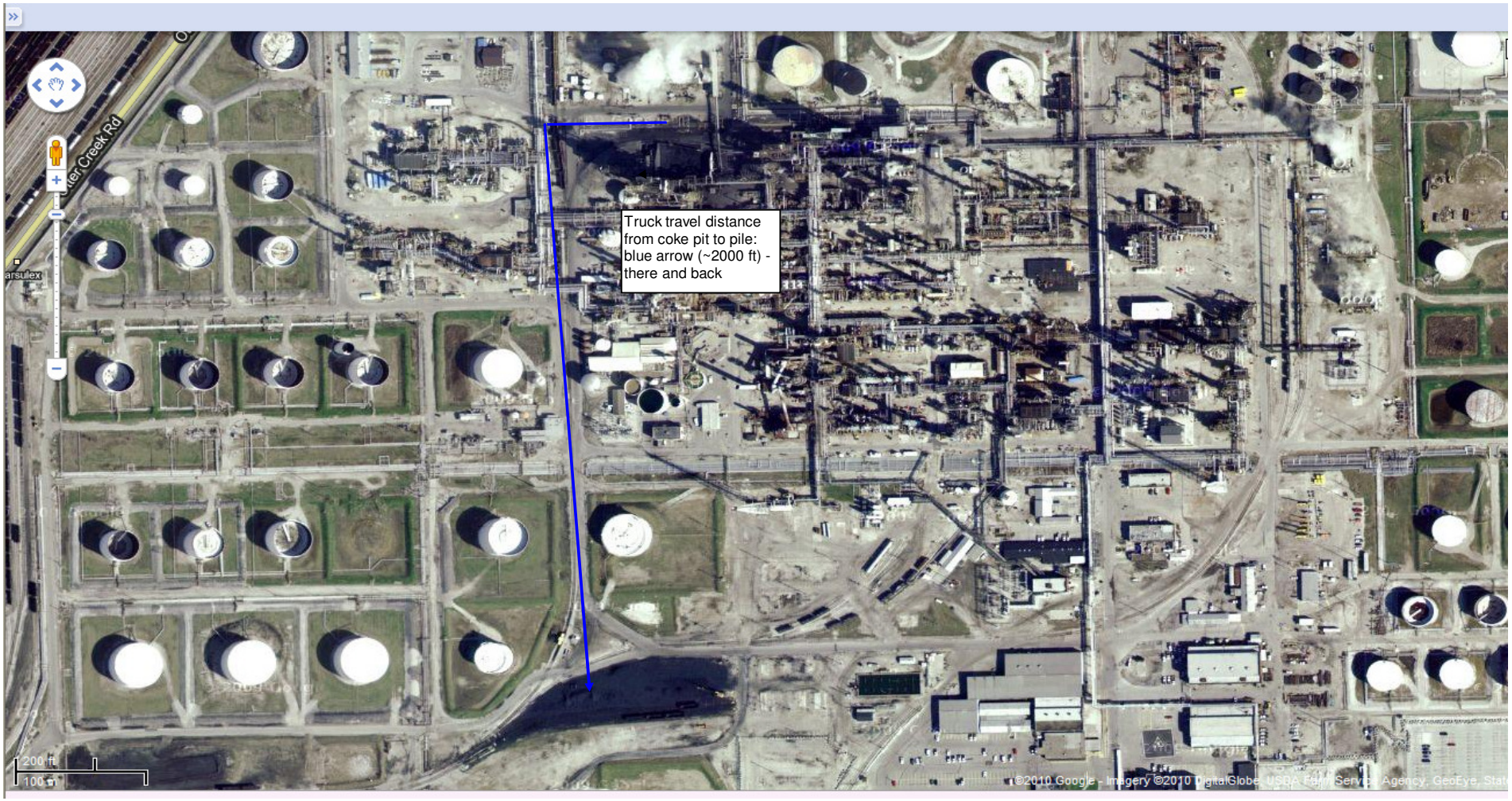

Truck travel distance from coke pit to pile: blue arrow (~2000 ft) - there and back
200 ft
100 m
©2010 Google - Imagery ©2010 DigitalGlobe, USDA Farm Service Agency, GeoEye, Stat

Table A.13 TFO increases from Increased Cooling Tower Usage

Increase in Cooling Water Circulation	10,000	gal/min	Potential Worst-Case increase in cooling water circulation Per Ted Spidle in email 8/30/2012
Liquid Drift	0.0200	%	Percent of circulating water flow for induced draft towers from AP-42 table 13.4-1 (1/95)
VOC Emission Factor	0.7	$lb/10^6$ gal	AP-42 Table 5.1-2 (1/95) for towers controlled by "minimization of hydrocarbon leaks into cooling water system; monitoring of cooling water for hydrocarbons"

PM emissions, lb/hr = [(gallons/minute) x (mg/liter TDS) x (0.0002 liquid drift) x (60 min/hr) x (3.785 liters/gallon)] ÷ (453,592 mg/lb)
PM emissions, lb/year = PM emissions, lb/hr * hours/year
VOC emissions, tons/yr = 40,000 gal/minute * 8760 hours/year * 60 min/hour * 0.7 $lb/10^6$ gal / (10^6 * 2000 lb/ton)

Total hours/year	8760	hr/yr		
24 Month Baseline average TDS	1,581	(Worst-case value from Annual Emissions Reporting Spreadsheet)		
lb PM/hr	**1.58**			
			PM2.5 (estimated to be half of PM10 emissions estimate)	
Annual PM10 Emissions	**6.93**	**tpy PM10**	**3.47**	**tpy PM2.5**
Annual VOC Emissions	**1.8**	**tpy VOC**		

Table A.14 TFO Project Effects on Firing Rate for Combustion Sources

OEPA ID	Process Description	Estimated Capacity	Units	Assumed Firing Rates				Assumed Firing Rates (adjusted to HHV)				Comments for Projected Firing
		(HHV)		Baseline		Baseline		Project Expected		Project Expected		TFO project assumptions
Crude Units				2004 - 2005		2004 - 2005		TFO		TFO		
B015	Crude 1 Heater	325	MMBtu/hr	320.82	MMBtu/hr	2.10E-01	MMSCF/hr	0.0	MMBtu/hr	0.00E+00	MMSCF/hr	Shutdown Crude 1 heater
B031	Vac 1 Heater	140	MMBtu/hr	99.2	MMBtu/hr	6.47E-02	MMSCF/hr	0.0	MMBtu/hr	0.00E+00	MMSCF/hr	Shutdown Vac 1 heaters
B019	Crude Vac 2 Heater	258	MMBtu/hr	216.2	MMBtu/hr	1.41E-01	MMSCF/hr	258.1	MMBtu/hr	1.73E-01	MMSCF/hr	No mod to heater. Capacity used only to establish new allowable SO_2 limit to make decreases enforceable.
TBD	New Crude Heaters	450	MMBtu/hr	0.0	MMBtu/hr	0.0E+00	MMSCF/hr	450.0	MMBtu/hr	3.01E-01	MMSCF/hr	New Crude 1 Heaters (two 225 MMBtu/hr heaters)
TBD	New Vac 1	150	MMBtu/hr	0.0	MMBtu/hr	0.0E+00	MMSCF/hr	150.0	MMBtu/hr	1.00E-01	MMSCF/hr	New Vac 1 Heater
Cokers												
B032	Coker 3 Heater	247	MMBtu/hr	228.3	MMBtu/hr	1.5E-01	MMSCF/hr	247	MMBtu/hr	1.66E-01	MMSCF/hr	No Mod but possible increase in firing rate due to TFO. New allowable SO_2 limit to make decreases enforceable.
B017	Coker 2 Heater	77	MMBtu/hr	42.0	MMBtu/hr	2.7E-02	MMSCF/hr	77.4	MMBtu/hr	5.19E-02	MMSCF/hr	No mod to heater. Capacity used only to establish new SO_2 limit to make decreases enforceable.
ADHT												
B029	ADHT Heater	20	MMBtu/hr	9.8	MMBtu/hr	7.0E-03	MMSCF/hr	20.0	MMBtu/hr	1.34E-02	MMSCF/hr	No Mod but possible increase in firing rate due to TFO
NDHT												
B022	Naphtha Treater Heater	77	MMBtu/hr	63.0	MMBtu/hr	4.1E-02	MMSCF/hr	77.4	MMBtu/hr	5.19E-02	MMSCF/hr	No mod to heater. Capacity used only to establish new SO_2 limit to make decreases enforceable.
Boilers												
B034/ B035	Steam Boilers	430	MMBtu/hr	0.0	MMBtu/hr	0.0E+00	MMBtu/hr	61.5	MMBtu/hr	4.12E-02	MMBtu/hr	Incremental Steam increase for TFO
Sulfur Recovery Complex												
P009	SRU 1 natural gas	14.5	MMBtu/hr	7.1	MMBtu/hr	7.0E-03	MMSCF/hr	14.5	MMBtu/hr	1.42E-02	MMSCF/hr	Possible increase in utilization based on higher sulfur in crude. No modification.
P037	SRU 2&3 natural gas	29	MMBtu/hr	18.9	MMBtu/hr	1.4E-02	MMSCF/hr	29.0	MMBtu/hr	2.84E-02	MMSCF/hr	Possible increase in utilization based on higher sulfur in crude. No modification.

Table A.15 TFO Project Baseline Combustion Emissions

OEPA ID	Process Unit	Baseline[1]		Baseline[1]		Baseline Comments	VOC			NO_X			SO_2			$PM_{10}/PM_{2.5}$ (Filterable + Condensable)		
		2004 - 2005		2004 - 2005			EF	Unit	tpy	EF	Unit	tpy	EF	Unit	tpy[2]	EF	Unit	tpy
Crude Units																		
B015	Crude 1 Heater RFG	320.8	MMBtu/hr	2.10E-01	MMSCF/hr	Shutdown Emissions	0.0054	lb/MMBtu	7.58	0.220	lb/MMBtu	309.15	39.71	lb/MMSCF	36.56	0.0075	lb/MMBtu	10.47
B031	Vac 1 Heater	99.2	MMBtu/hr	6.47E-02	MMSCF/hr	Shutdown Emissions	0.0054	lb/MMBtu	2.34	0.070	lb/MMBtu	30.42	39.71	lb/MMSCF	11.25	0.0075	lb/MMBtu	3.24
B019	Crude Vac 2 Heater	216.2	MMBtu/hr	1.41E-01	MMSCF/hr	Only SO_2 emissions affected	NA			NA			39.71	lb/MMSCF	21.02	NA		
TBD	New Crude Heater	0.0	MMBtu/hr	0.00E+00	MMBtu/hr	Not in operation	NA			NA			NA			NA		
TBD	New Vac 1	0.0	MMBtu/hr	0.00E+00	MMBtu/hr	Not in operation	NA			NA			NA			NA		
Cokers																		
B032	Coker 3 Heater	228.3	MMBtu/hr	1.53E-01	MMSCF/hr	2004-2005 Baseline	0.0054	lb/MMBtu	5.39	0.065	lb/MMBtu	65.00	62.08	lb/MMSCF	20.46	0.0075	lb/MMBtu	7.45
B017	Coker 2 Heater	42.0	MMBtu/hr	2.74E-02	MMSCF/hr	Only SO_2 emissions affected	NA			NA			39.71	lb/MMSCF	4.77	NA		
ADHT																		
B029	ADHT Heater	9.8	MMBtu/hr	7.03E-03	MMSCF/hr	2004-2005 Baseline	0.0054	lb/MMBtu	0.23	0.07	lb/MMBtu	3.00	5.87	lb/MMSCF	0.18	0.0075	lb/MMBtu	0.32
NDHT																		
B022	Naphtha Hydrotreater Heater	63.0	MMBtu/hr	4.11E-02	MMSCF/hr	Only SO_2 emissions affected	N/A			N/A			39.71	lb/MMSCF	7.15	NA		
Boilers																		
B034/ B035	Steam Boilers	0.0	MMBtu/hr	0.00E+00	MMBtu/hr	Only incremental increase estimated	NA			NA			NA			NA		
Sulfur Recovery Complex																		
P009	SRU 1 NG	7.1	MMBtu/hr	6.96E-03	MMSCF/hr	No H_2SO_4 formed in SRU stacks	0.0054	lb/MMBtu	0.17	0.098	lb/MMBtu	3.05	0.60	lb/MMSCF	0.02	0.0075	lb/MMBtu	0.23
P037	SRU 2&3 NG	18.9	MMBtu/hr	1.40E-02	MMSCF/hr		0.0054	lb/MMBtu	0.45	0.10	lb/MMBtu	8.30	0.60	lb/MMSCF	0.04	0.0075	lb/MMBtu	0.62

Emission Factor Source References

[1] Baseline period assume to be 2004 - 2005.

[2] Assume 3% SO_2 emissions convert to SO_3 and total conversion of SO_3 to H_2SO_4

(SO_2(tpy)*(3/100)%*98(MW H_2SO_4)/64(MW SO_2)

Table A.15 TFO Project Baseline Combustion Emissions

OEPA ID	Process Unit	Baseline[1]		Baseline[1]		CO			Pb			H_2SO_4 Mist[2]	Total HAP			CO2e (GHG)		
		2004 - 2005		2004 - 2005		EF	Unit	tpy	EF	Unit	tpy	tpy	EF	Unit	tpy	EF	Unit	tpy
Crude Units																		
B015	Crude 1 Heater RFG	320.8	MMBtu/hr	2.10E-01	MMSCF/hr	0.082	lb/MMBtu	115.72	4.90E-07	lb/MMBtu	6.89E-04	1.68	1.85E-03	lb/MMBtu	2.60	125.9	lb/MMBtu	176,916
B031	Vac 1 Heater	99.2	MMBtu/hr	6.47E-02	MMSCF/hr	0.082	lb/MMBtu	35.79	4.90E-07	lb/MMBtu	2.13E-04	0.52	1.85E-03	lb/MMBtu	0.80	125.9	lb/MMBtu	54,708
B019	Crude Vac 2 Heater	216.2	MMBtu/hr	1.41E-01	MMSCF/hr	NA			NA			1.13	NA			NA		
TBD	New Crude Heater	0.0	MMBtu/hr	0.00E+00	MMBtu/hr	NA			NA				NA			NA		
TBD	New Vac 1	0.0	MMBtu/hr	0.00E+00	MMBtu/hr	NA			NA				NA			NA		
Cokers																		
B032	Coker 3 Heater	228.3	MMBtu/hr	1.53E-01	MMSCF/hr	0.082	lb/MMBtu	82.35	4.90E-07	lb/MMBtu	4.90E-04	1.91	1.85E-03	lb/MMBtu	1.85	127.3	lb/MMBtu	127,300
B017	Coker 2 Heater	42.0	MMBtu/hr	2.74E-02	MMSCF/hr	NA			NA			0.22	NA			NA		
ADHT																		
B029	ADHT Heater	9.8	MMBtu/hr	7.03E-03	MMSCF/hr	0.082	lb/MMBtu	3.52	4.90E-07	lb/MMBtu	2.10E-05	0.01	1.85E-03	lb/MMBtu	0.08	110.6	lb/MMBtu	4,732
NDHT																		
B022	Naphtha Hydrotreater Heater	63.0	MMBtu/hr	4.11E-02	MMSCF/hr	NA			NA			0.33	NA			NA		
Boilers																		
B034/ B035	Steam Boilers	0.0	MMBtu/hr	0.00E+00	MMBtu/hr	NA			NA				NA			NA		
Sulfur Recovery Complex																		
P009	SRU 1 NG	7.1	MMBtu/hr	6.96E-03	MMSCF/hr	0.082	lb/MMBtu	2.56	4.90E-07	lb/MMBtu	1.53E-05		1.85E-03	lb/MMBtu	0.06	115.1	lb/MMBtu	3,582
P037	SRU 2&3 NG	18.9	MMBtu/hr	1.40E-02	MMSCF/hr	0.082	lb/MMBtu	6.83	4.90E-07	lb/MMBtu	4.07E-05		1.85E-03	lb/MMBtu	0.15	115.1	lb/MMBtu	9,555

Emission Factor Source References

[1] Baseline period assume to be 2004 - 2005.

[2]Assume 3% SO_2 emissions convert to SO_3 and total conversion of SO_3 to H_2S

(SO_2(tpy)*(3/100)%*98(MW H_2SO_4)/64(MW SO_2)

Table A.16 TFO Project Combustion Emissions Increase

OEPA	Process Unit	Project Expected		Project Expected		Comments for Projected Firing	VOC			NO_X			SO_2[2]			$PM_{10}/PM_{2.5}$ (Filterable + Condensable)		
ID		Firing Rate (HHV)		Firing Rate (HHV)		TFO project assumptions	EF	Unit	tpy	EF	Unit	tpy	EF	Unit	tpy[3]	EF	Unit	tpy
Crude Units																		
B015	Crude 1 Heater	0.00	MMBtu/hr	0.00	MMSCF/hr	Shutdown Crude 1 heater	N/A			N/A			N/A			N/A		
B031	Vac 1 Heater	0.00	MMBtu/hr	0.00	MMSCF/hr	Shutdown Vac 1 heaters	N/A			N/A			N/A			N/A		
B019	Crude Vac 2 Heater	258.06	MMBtu/hr	1.73E-01	MMSCF/hr	Only SO_2 emissions affected	N/A			N/A			*See Table 24	lb/MMSCF	8.95	N/A		
TBD	New Crude Heater	450.00	MMBtu/hr	3.01E-01	MMSCF/hr	New Crude 1 Heaters (two 225 MMBtu/hr heaters)	0.0054	lb/MMBtu	10.63	0.04	lb/MMBtu	78.84	*See Table 24	lb/MMSCF	15.61	0.0075	lb/MMBtu	14.69
TBD	New Vac 1	150.00	MMBtu/hr	1.00E-01	MMSCF/hr	New Vac 1 Heater	0.0054	lb/MMBtu	3.54	0.04	lb/MMBtu	26.28	*See Table 24	lb/MMSCF	5.20	0.0075	lb/MMBtu	4.90
Cokers																		
B032	Coker 3 Heater	247.31	MMBtu/hr	1.66E-01	MMSCF/hr	No modification but possible increase in firing rate. SO_2 emission reduction.	0.0054	lb/MMBtu	5.84	0.07	lb/MMBtu	70.41	*See Table 24	lb/MMSCF	8.58	0.0075	lb/MMBtu	8.07
B017	Coker 2 Heater	77.42	MMBtu/hr	5.19E-02	MMSCF/hr	Only SO_2 emissions affected	N/A			N/A			*See Table 24	lb/MMSCF	2.69	N/A		
ADHT																		
B029	ADHT Heater	20.00	MMBtu/hr	1.34E-02	MMSCF/hr	No modification but possible increase in firing rate.	0.0054	lb/MMBtu	0.47	0.07	lb/MMBtu	6.13	*See Table 24	lb/MMSCF	0.69	0.0075	lb/MMBtu	0.65
NDHT																		
B022	Naphtha Hydrotreater Heater	77.42	MMBtu/hr	5.19E-02	MMSCF/hr	Only SO_2 emissions affected	N/A			N/A			*See Table 24	lb/MMSCF	2.69	N/A		
Boilers																		
B034/ B035	Steam Boilers	61.50	MMBtu/hr	4.12E-02	MMSCF/hr	Incremental Steam increase for TFO	0.0054	lb/MMBtu	1.45	0.036	lb/MMBtu	9.70	11.82	lb/MMBtu	2.13	0.0075	lb/MMBtu	2.01
Sulfur Recovery Complex																		
P009[1]	SRU 1 NG	14.50	MMBtu/hr	1.42E-02	MMSCF/hr	Possible increase in utilization based on higher sulfur in crude. No modification.	0.0054	lb/MMBtu	0.34	0.098	lb/MMBtu	6.23	0.60	lb/MMSCF	0.04	0.0075	lb/MMBtu	0.47
P037	SRU 2&3 NG	29.00	MMBtu/hr	2.84E-02	MMSCF/hr	Possible increase in utilization based on higher sulfur in crude. No modification.	0.0054	lb/MMBtu	0.68	0.10	lb/MMBtu	12.70	0.60	lb/MMSCF	0.07	0.0075	lb/MMBtu	0.95

Emission Factor Source References

[1] Project Expected Fuel Use is not known, estimated to be half of SRU 2&3 TOX Capacity

[2] Annual Average (tpy) SO_2 emissions based on 70 ppm TRS

[3] Assume 3% SO_2 emissions convert to SO_3 and total conversion of SO_3 to H_2SO_4

(SO_2(tpy)*(3/100)%*98(MW H_2SO_4)/64(MW SO_2)

Table A.16 TFO Project Combustion Emissions Increase

OEPA	Process Unit	Project Expected		Project Expected		Comments for Projected Firing	CO			Pb			H_2SO_4 Mist[3]	Total HAP			CO2e (GHG)		
ID		Firing Rate (HHV)		Firing Rate (HHV)		TFO project assumptions	EF	Unit	tpy	EF	Unit	tpy	tpy	EF	Unit	tpy	EF	Unit	tpy
Crude Units																			
B015	Crude 1 Heater	0.00	MMBtu/hr	0.00	MMSCF/hr	Shutdown Crude 1 heater	N/A			N/A			N/A	N/A			N/A		
B031	Vac 1 Heater	0.00	MMBtu/hr	0.00	MMSCF/hr	Shutdown Vac 1 heaters	N/A			N/A			N/A	N/A			N/A		
B019	Crude Vac 2 Heater	258.06	MMBtu/hr	1.73E-01	MMSCF/hr	Only SO_2 emissions affected	N/A			N/A			0.00	N/A			N/A		
TBD	New Crude Heater	450.00	MMBtu/hr	3.01E-01	MMSCF/hr	New Crude 1 Heaters (two 225 MMBtu/hr heaters)	0.06	lb/MMBtu	118.26	4.90E-07	lb/MMBtu	9.66E-04	0.00	1.85E-03	lb/MMBtu	3.65	125.9	lb/MMBtu	248,149
TBD	New Vac 1	150.00	MMBtu/hr	1.00E-01	MMSCF/hr	New Vac 1 Heater	0.06	lb/MMBtu	39.42	4.90E-07	lb/MMBtu	3.22E-04	0.00	1.85E-03	lb/MMBtu	1.22	125.9	lb/MMBtu	82,716
Cokers																			
B032	Coker 3 Heater	247.31	MMBtu/hr	1.66E-01	MMSCF/hr	No modification but possible increase in firing rate. SO_2 emission reduction.	0.082	lb/MMBtu	89.21	4.90E-07	lb/MMBtu	5.31E-04	0.00	1.85E-03	lb/MMBtu	2.00	127.3	lb/MMBtu	137,895
B017	Coker 2 Heater	77.42	MMBtu/hr	5.19E-02	MMSCF/hr	Only SO_2 emissions affected	N/A			N/A			0.00	N/A			N/A		
ADHT																			
B029	ADHT Heater	20.00	MMBtu/hr	1.34E-02	MMSCF/hr	No modification but possible increase in firing rate.	0.082	lb/MMBtu	7.21	4.90E-07	lb/MMBtu	4.29E-05	0.00	1.85E-03	lb/MMBtu	0.16	125.9	lb/MMBtu	11,029
NDHT																			
B022	Naphtha Hydrotreater Heater	77.42	MMBtu/hr	5.19E-02	MMSCF/hr	Only SO_2 emissions affected	N/A			N/A			0.00	N/A			N/A		
Boilers																			
B034/ B035	Steam Boilers	61.50	MMBtu/hr	4.12E-02	MMSCF/hr	Incremental Steam increase for TFO	0.082	lb/MMBtu	22.18	4.90E-07	lb/MMBtu	1.32E-04	0.10	1.85E-03	lb/MMBtu	0.50	122.4	lb/MMBtu	32,971
Sulfur Recovery Complex																			
P009[1]	SRU 1 NG	14.50	MMBtu/hr	1.42E-02	MMSCF/hr	Possible increase in utilization based on higher sulfur in crude. No modification.	0.082	lb/MMBtu	5.23	4.90E-07	lb/MMBtu	3.11E-05	N/A	1.85E-03	lb/MMBtu	0.12	115.1	lb/MMBtu	7,312
P037	SRU 2&3 NG	29.00	MMBtu/hr	2.84E-02	MMSCF/hr	Possible increase in utilization based on higher sulfur in crude. No modification.	0.082	lb/MMBtu	10.46	4.90E-07	lb/MMBtu	6.23E-05	N/A	1.85E-03	lb/MMBtu	0.24	115.1	lb/MMBtu	14,624

Emission Factor Source References

[1] Project Expected Fuel Use is not known, estimated to be half of SRU 2&3 TOX Capacity

[2] Annual Average (tpy) SO_2 emissions based on 70 ppm TRS

[3] Assume 3% SO_2 emissions convert to SO_3 and total conversion of SO_3 to H_2SO_4

(SO_2(tpy)*(3/100)%*98(MW H_2SO_4)/64(MW SO_2)

Table A.17 Summary of TFO Fugitive Emissions Increases

Unit Name =>	Crude/Vac 1		Coker 3		ADHT	
OEPA ID =>	P011		P036		P028	
	Comments	VOC Emissions (tons/year)	Comments	VOC Emissions (tons/year)	Component Counts	VOC Emissions (tons/year)
BPH TFO Project =>	New Components at Crude Vac 1 were provided on marked up P&IDs from the TFO project team.	1.76	New Components at Coker 3 other than the additions to the Gas plant were provided on marked up P&IDs from the TFO project team.	1.56	New Components at ADHT Unit were provided on marked up P&IDs from the TFO project team.	0.62
			New Components for the mods at the Coker Gas Plant were provided on marked up P&IDs from the TFO project team.	1.6		
		GHG emissions assumes GHG are 32% of the total VOCs estimated (CH_4 Global warming potential = 21)		CO_2e emissions (tons/year)		
				10.9		

Note: These are emissions from net new fugitive piping components from the project.

Table A.18 Fugitive Emission Calculations for New Components at Crude Vac 1 Process Unit (P011)

Annual Hours of Service: 8760

Component Type	Component Count[1]	EPA Factors (lb/hr/component) [2]	Factor Source	For monitored components, EPA factor for Control no detect (lb/hr/component) [3]	Assumed % leakers	Maximum Uncontrolled Emission Rate (lbs/hr)	Percent in VOC Service	Total VOC Emissions (Tons/yr)
Valves								
Gas/Vapor	251	4.87E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	1.72E-05	2%	0.0287	100%	1.26E-01
Light Liquid		4.87E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	1.72E-05	2%		100%	
Heavy Liquid	0	5.07E-04	Conservatively assume no monitoring of heavy liquids, so using Refinery Average emission factor		0%	0.0000	100%	0.00E+00
Pumps								
Light Liquid	4	3.05E-02	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	5.29E-05	10%	0.0124	100%	5.43E-02
Heavy Liquid	0	8.29E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	5.29E-05	10%	0.0000	100%	0.00E+00
Flanges								
Gas/Vapor	294	5.51E-04	Conservatively assume not monitored, so using Refinery Average emission factor		0%	0.1620	100%	7.10E-01
Light Liquid								
Heavy Liquid								
Connectors	154	5.51E-04	Conservatively assume not monitored, so using Refinery Average emission factor		0%	0.0849	100%	3.72E-01
Compressors	0	6.81E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	8.82E-06	100%	0.0000	100%	0.00
Relief Valves	16	7.05E-03	Connected to flare so assuming 98% control. Using Refinery Average emission factor (EF = 0.353 lb/hr/component) x (1-0.98))		0%	0.1129	100%	4.94E-01

Total VOC Emissions (tons/yr): 1.76

[1]New Components at Crude Vac 1 were provided on marked up P&IDs from the TFO project team. See 'BP Metal up file for fugitive emissions rev2.xlsx'.

[2]For unmonitored stream, Average Refinery Factors from US EPA protocol Table 2-2 are used for all components. These factors are conservative.
For monitored streams, this column has the EPA correlation factor from Table 2-10 for detected leakers assuming a 10,000 ppmv screening value for all leaking components.
All other components use the default 0 factor in Table 2-14 for non-detect components. Factors are taken from EPA Document EPA-453/R-95-017, Nov. 1995.

[3]For monitored components, the Default 0 factors for Table 2-14 are used for components assumed to be non-detect. Factors are estimated from EPA Document EPA-453/R-95-017, Nov. 1995.

Table A.19 Fugitive Emission Calculations for Components at Coker 3 Process Unit (P036)

Annual Hours of Service: 8760

Component Type	Component Count[1]	EPA Factors (lb/hr/component) [2]	Factor Source	For monitored components, EPA factor for Control no detect (lb/hr/component) [3]	Assumed % leakers	Maximum Uncontrolled Emission Rate (lbs/hr)	Percent in VOC Service	Total VOC Emissions (Tons/yr)
Valves								
Gas/Vapor	199	4.87E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	1.72E-05	2%	0.0227	100%	0.100
Light Liquid		4.87E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	1.72E-05	2%		100%	
Heavy Liquid	89	5.07E-04	Conservatively assume no monitoring of heavy liquids, so using Refinery Average emission factor		0%	0.0451	100%	0.198
Pumps								
Light Liquid	2	3.05E-02	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	5.29E-05	10%	0.0062	100%	0.027
Heavy Liquid	1	8.29E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	5.29E-05	10%	0.0009	100%	0.004
Flanges								
Gas/Vapor	201	5.51E-04	Conservatively assume not monitored, so using Refinery Average emission factor		0%	0.1108	100%	0.485
Light Liquid								
Heavy Liquid								
Connectors	143	5.51E-04	Conservatively assume no monitoring of connectors, so using Refinery Average emission factor		0%	0.0788	100%	0.345
Compressors	3	6.81E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	8.82E-06	100%	0.0204	100%	0.089
Relief Valves	10	7.05E-03	Connected to flare so assuming 98% control. Using Refinery Average emission factor (EF = 0.353 lb/hr/component) x (1-0.98))		0%	0.0705	100%	0.309
Open-ended Lines	0	3.18E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	4.41E-06	2%	0.0000	100%	0.00
							Total VOC Emissions (tons/yr):	**1.56**

[1]Components at Coker 3 were provided on marked up P&IDs from the TFO project team. See 'BP Metal up file for fugitive emissions rev 2.xlsx'

[2]For unmonitored stream, Average Refinery Factors from US EPA protocol Table 2-2 are used for all components. These factors are conservative.
For monitored streams, this column has the EPA correlation factor from Table 2-10 for detected leakers assuming a 10,000 ppmv screening value for all leaking components.
All other components use the default 0 factor in Table 2-14 for non-detect components. Factors are taken from EPA Document EPA-453/R-95-017, Nov. 1995.

[3]For monitored components, the Default 0 factors for Table 2-14 are used for components assumed to be non-detect. Factors are estimated from EPA Document EPA-453/R-95-017, Nov. 1995.

Table A.20 Fugitive Emission Calculations for Components at ADHT Process Unit (P029)

Annual Hours of Service: 8760

Component Type	Component Count[1]	EPA Factors (lb/hr/component) [2]	Factor Source	For monitored components, EPA factor for Control no detect (lb/hr/component) [3]	Assumed % leakers	Maximum Uncontrolled Emission Rate (lbs/hr)	Percent in VOC Service	Total VOC Emissions (Tons/yr)
Valves								
Gas/Vapor	11	4.87E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	1.72E-05	2%	0.0013	100%	5.50E-03
Light Liquid		4.87E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	1.72E-05	2%		100%	
Heavy Liquid	79	5.07E-04	Conservatively assume no monitoring of heavy liquids, so using Refinery Average emission factor		0%	0.0401	100%	1.75E-01
Pumps								
Light Liquid	0	3.05E-02	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	5.29E-05	10%	0.0000	100%	0.00E+00
Heavy Liquid	0	8.29E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	5.29E-05	10%	0.0000	100%	0.00E+00
Flanges								
Gas/Vapor	54	5.51E-04	Conservatively assume not monitored, so using Refinery Average emission factor		0%	0.0298	100%	1.30E-01
Light Liquid								
Heavy Liquid								
Connectors	29	5.51E-04	Conservatively assume not monitored, so using Refinery Average emission factor		0%	0.0160	100%	7.00E-02
Compressors	5	6.81E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	8.82E-06	100%	0.0340	100%	0.15
Relief Valves	3	7.05E-03	Connected to flare so assuming 98% control. Using Refinery Average emission factor (EF = 0.353 lb/hr/component) x (1-0.98))		0%	0.0212	100%	9.27E-02
Open-ended Lines	0	3.18E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	4.41E-06	2%	0.0000	100%	0.00
							Total VOC Emissions (tons/yr):	**0.62**

[1]Components at ADHT were provided on marked up P&IDs from the TFO project team. See 'BP Metal up file for fugitive emissions rev 2.xlsx

[2]For unmonitored stream, Average Refinery Factors from US EPA protocol Table 2-2 are used for all components. These factors are conservative.
For monitored streams, this column has the EPA correlation factor from Table 2-10 for detected leakers assuming a 10,000 ppmv screening value for all leaking components.
All other components use the default 0 factor in Table 2-14 for non-detect components. Factors are taken from EPA Document EPA-453/R-95-017, Nov. 1995.

[3]For monitored components, the Default 0 factors for Table 2-14 are used for components assumed to be non-detect. Factors are estimated from EPA Document EPA-453/R-95-017, Nov. 1995.

Table A.21 Fugitive Emission Calculations for Coker Gas Plant

Annual Hours of Service: 8760

Component Type	Component Count[1]	EPA Factors (lb/hr/component) [2]	Factor Source	For monitored components, EPA factor for Control no detect (lb/hr/component) [3]	Assumed % leakers	Maximum Uncontrolled Emission Rate (lbs/hr)	Percent in VOC Service	Total VOC Emissions (Tons/yr)
Valves								
Gas/Vapor	255	4.87E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	1.72E-05	2%	0.0291	100%	0.128
Light Liquid		4.87E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	1.72E-05	2%		100%	
Heavy Liquid	0	5.07E-04	Conservatively assume no monitoring of heavy liquids, so using Refinery Average emission factor		0%	0.0000	100%	0.000
Pumps								
Light Liquid	7	3.05E-02	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	5.29E-05	10%	0.0217	100%	0.095
Heavy Liquid	0	8.29E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	5.29E-05	10%	0.0000	100%	0.000
Flanges								
Gas/Vapor	337	5.51E-04	Conservatively assume not monitored, so using Refinery Average emission factor		0%	0.1857	100%	0.814
Light Liquid								
Heavy Liquid								
Connectors	190	5.51E-04	Conservatively assume no monitoring of connectors, so using Refinery Average emission factor		0%	0.1047	100%	0.459
Compressors	0	6.81E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	8.82E-06	100%	0.0000	100%	0.000
Relief Valves	4	7.05E-03	Connected to flare so assuming 98% control. Using Refinery Average emission factor (EF = 0.353 lb/hr/component) x (1-0.98))		0%	0.0282	100%	0.124
Open-ended Lines	0	3.18E-03	Monitored. Using correlation for leakers and EPA default 0 factor for remaining.	4.41E-06	2%	0.0000	100%	0.00

Total VOC Emissions (tons/yr): 1.62

[1]Components at Coker Gas Plant are assumed to be equal to the existing components counts for the Sat Gas Plant obtained in 2009.

[2]For unmonitored stream, Average Refinery Factors from US EPA protocol Table 2-2 are used for all components. These factors are conservative.
For monitored streams, this column has the EPA correlation factor from Table 2-10 for detected leakers assuming a 10,000 ppmv screening value for all leaking components.
All other components use the default 0 factor in Table 2-14 for non-detect components. Factors are taken from EPA Document EPA-453/R-95-017, Nov. 1995.

[3]For monitored components, the Default 0 factors for Table 2-14 are used for components assumed to be non-detect. Factors are estimated from EPA Document EPA-453/R-95-017, Nov. 1995.

Table A.22 Emission Factors for Carbon Monoxide Emissions

		Estimated Capacity		Baseline (2004-2005) Emissions Basis				TFO Project Potential Emissions Basis				Emission Factors in lb/MMBtu	
OEPA ID	Process Unit	(HHV)	Units	Emission Factor	Unit	Source	Justification	Emission Factor	Unit	Source	Justification	Baseline	Future Potential
												(2004-2005)	TFO
B015	Crude 1 Heater	325	MMBtu/hr	84	lb/10^6 scf	AP-42[1]	EF B Rating[2]	Shutdown				0.082	Shutdown
B031	Vac 1 Heater	140	MMBtu/hr	84	lb/10^6 scf	AP-42[1]	EF B Rating[2]	Shutdown				0.082	Shutdown
TBD	New Crude Heater	450	MMBtu/hr	Not operating				0.06	lb/MMBtu	Eng Est[3]	Refinery Data	Not operating	0.06
TBD	New Vac 1	150	MMBtu/hr	Not operating				0.06	lb/MMBtu	Eng Est[3]	Refinery Data	Not operating	0.06
B032	Coker 3 Heater	247	MMBtu/hr	84	lb/10^6 scf	AP-42[1]	EF B Rating[2]	84	lb/10^6 scf	AP-42[2]	EF B Rating[2]	0.082	0.082
B029	ADHT Heater	20	MMBtu/hr	84	lb/10^6 scf	AP-42[1]	EF B Rating[2]	84	lb/10^6 scf	AP-42[2]	EF B Rating[9]	0.082	0.082
B034	East Alstom Boiler	430	MMBtu/hr	Not operating				84	lb/10^6 scf	AP-42[2]	EF B Rating[2]	Not operating	0.082
B035	West Alstom Boiler		MMBtu/hr	Not operating				84	lb/10^6 scf	AP-42[2]	EF B Rating[2]	Not operating	0.082
P009	SRU 1	Estimated	MMBtu/hr	84	lb/10^6 scf	AP-42[1]	EF B Rating[2]	84	lb/10^6 scf	AP-42[2]	EF B Rating[2]	0.082	0.082
P037	SRU 2&3	29	MMBtu/hr	84	lb/10^6 scf	AP-42[1]	EF B Rating[2]	84	lb/10^6 scf	AP-42[2]	EF B Rating[2]	0.082	0.082

Emission Factor Source References

[1] U.S. AP-42. EPA. Fifth Edition. Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources. Chapter 1, Section 1.4, "Natural Gas Combustion," Table 1.4-1. EMISSION FACTORS FOR NITROGEN OXIDES (NOx) AND CARBON MONOXIDE

[3] Reformer 3 heater (capacity 519 MMBtu/hr) vendor guaranteed 0.0359 lb CO/MMBtu equal to 50 ppm CO at 3% O2 in the stack. Data collected from the CO CEMS on the Alstom Boiler stack (353 MMBtu/hr) shows typical lb CO/MMBtu around 0.01 lb CO/MMBtu. Using 0.06 lb CO/MMBtu to be conservative for new heaters.

Justification References

[2] The carbon monoxide (CO) emission factors from AP-42 are used in the refinery industry as a standard when source specific data is not available.
Each AP-42 emission factor has a quality rating which indicates the quality of the test(s) used to develop the factor. The ratings are as follows:
A - Excellent - Developed only from the highest rated test data taken from many randomly chosen facilities in the industry population.
B - Above Average - Developed from the highest rated test data from a reasonable number of facilities.
C - Average - Developed from highly rated test data from a reasonable number of facilities.
D - Below Average - Developed from highly rated test data from a small number of facilities.

Table A.23 Emission Factors for Nitrogen Dioxide Emissions

OEPA ID	Process Unit	Permitted Capacity	Units	Baseline (2004-2005) Emissions Basis				TFO Project Potential Emissions Basis				Emission Factors in lb/MMBtu	
				Emission Factor	Unit	Source	Justification	Emission Factor	Unit	Source	Justification	Baseline (2004-2005)	Future Potential TFO
B015	Crude 1 Heater	325	MMBtu/hr	0.22	lb/MMBtu	Stack Test[1]	Source Specific	Shutdown				0.220	Shutdown
B031	Vac 1 Heater	140	MMBtu/hr	0.07	lb/MMBtu	PTI 04-959[2]	PTI basis[7]	Shutdown				0.070	Shutdown
TBD	New Crude Heater	450	MMBtu/hr	Not operating				0.040	lb/MMBtu	Ohio BAT determination[6]	See Sec. 4.0 of application	Not operating	0.040
TBD	New Vac 1	150	MMBtu/hr	Not operating				0.040	lb/MMBtu	Ohio BAT determination[6]	See Sec. 4.0 of application	Not operating	0.040
B032	Coker 3 Heater	247	MMBtu/hr	0.065	lb/MMBtu	Stack Test[3]	Source Specific	0.065	lb/MMBtu	Stack Test[3]	Source Specific	0.065	0.065
B029	ADHT Heater	20	MMBtu/hr	0.07	lb/MMBtu	PTI 04-01346[2]	PTI basis[7]	0.07	lb/MMBtu	PTI 04-01346[2]	PTI basis[7]	0.070	0.070
B034	East Alstom Boiler	430	MMBtu/hr	Not operating				0.036	lb/MMBtu	P0106444[4]	long-term average	Not operating	0.036
B035	West Alstom Boiler		MMBtu/hr	Not operating				0.036	lb/MMBtu	P0106444[4]	long-term average	Not operating	0.036
P009	SRU 1	Estimated	MMBtu/hr	100	lb/10^6 scf	AP-42[5]	EF B Rating[8]	100	lb/10^6 scf	AP-42[5]	EF B Rating[8]	0.098	0.098
P037	SRU 2&3	29	MMBtu/hr	0.10	lb/MMBtu	PTI 04-1046[2]	PTI basis[7]	0.10	lb/MMBtu	PTI 04-1046[2]	PTI basis[7]	0.100	0.100

Emission Factor Source References

[1] Based on stack test performed for BP-Husky Toledo Refinery - Stack Test performed in June 1991 (yielded NOx emission factor of 0.22 lb/MMBTU)

2 NOx emission factor based on permit specified compliance determination with this Heater's NOx limits in issued PTI and current Title V Permit

[3] Based on stack test performed for BP-Husky Toledo Refinery - Stack Test performed on 8/17/1999

[4] Based on BAT determination for issued Alstom Boilers for issued Permit PTI P0106444.

[5] U.S. EPA. AP-42. Fifth Edition. Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources. Chapter 1, Section 1.4 "Natural Gas Combustion," Table 1.4-1. EMISSION FACTORS FOR NITROGEN OXIDES (NOx) AND CARBON MONOXIDE (CO) FROM NATURAL GAS COMBUSTION SMALL BOILERS; (July 1998).

[6] Based on Ohio EPA BAT determination discussion in Section 4.0 of this application.

Justification References

[7] Emission factor used to estimate emissions in source Permit to Install.

[8] The Nitrogen Oxides (NOx) emission factors from AP-42 are used in the refinery industry as a standard when source specific data is not available. Each AP-42 emission factor has a quality rating which indicates the quality of the test(s) used to develop the factor. The ratings are as follows

A - Excellent - Developed only from the highest rated test data taken from many randomly chosen facilities in the industry population.

B - Above Average - Developed from the highest rated test data from a reasonable number of facilities.

C - Average - Developed from highly rated test data from a reasonable number of facilities.

D - Below Average - Developed from highly rated test data from a small number of facilities.

Table A.24 Emission Factors for Sulfur Dioxide Emissions

OEPA ID	Process Unit	Permitted Capacity	Units	SO_2 Emissions Limit	Units	RFG Mix Drum Reference	Baseline (2004-2005) Emissions Basis				TFO Project Potential Emissions Basis				Emission Factors in lb/MMSCF	
							Emission Factor	Unit	Source	Reference	Annual Emission Basis	Unit	Source	Justification	Baseline	Future (Annual) Factor
				note 4												
B015[a]	Crude 1 Heater	325	MMBtu/hr	NA		TIUMD	235.14	ppm TRS	Test	note 1	Shutdown				39.71	Shutdown
B031	Vac 1 Heater	140	MMBtu/hr	2.8	lb/hr	TIUMD	235.14	ppm TRS	Test	note 1	Shutdown				39.71	Shutdown
B019	Crude Vac 2 Heater	258	MMBtu/hr	21.02	tpy	TIUMD	235.14	ppm TRS	Test	note 1	70.00	ppm TRS	Vendor	notes 3 & 4	39.71	11.82
TBD	New Crude Heater	450	MMBtu/hr	NA		TIUMD	Not operating				70.00	ppm TRS	Vendor	notes 3 & 4	Not operating	11.82
TBD	New Vac 1	150	MMBtu/hr	NA		TIUMD	Not operating				70.00	ppm TRS	Vendor	notes 3 & 4	Not operating	11.82
B032	Coker 3 Heater	247	MMBtu/hr	20.46	tpy	K3	367.61	ppm TRS	Test	note 1	70.00	ppm TRS	Vendor	notes 3 & 4	62.08	11.82
B017	Coker 2 Heater	77	MMBtu/hr	91.45	tpy	TIUMD	235.14	ppm TRS	Test	note 1	70.00	ppm TRS	Vendor	notes 3 & 4	39.71	11.82
B029	ADHT Heater	20	MMBtu/hr	2.32	tpy	ESMD	34.74	ppm TRS	Test	note 1	Will not fire ESMD gas in the TFO potential timeframe				5.87	
B029	ADHT Heater	20	MMBtu/hr	2.32	tpy	TIUMD	Did not fire TIUMD gas in baseline period				70.00	ppm TRS	Vendor	notes 3 & 4		11.82
B022	Naphtha Hydrotreater Heater	77	MMBtu/hr	NA		TIUMD	235.14	ppm TRS	Test	note 1	70.00	ppm TRS	Vendor	notes 3 & 4	39.71	11.82
B034/ B035	Steam Boilers	430	MMBtu/hr	22	tpy combined	Boiler FG	Not operating				70.00	ppm TRS	Vendor	notes 3 & 4	Not operating	11.82
P009	SRU 1	Estimated	MMBtu/hr	NA		NG	0.60	lb/MMSCF	AP-42	note 2	0.60	lb/MMSCF	AP-42	note 2	0.60	0.60
P037	SRU 2&3	29	MMBtu/hr	NA		NG	0.60	lb/MMSCF	AP-42	note 2	0.60	lb/MMSCF	AP-42	note 2	0.60	0.60

Emission Factor Source References

note 1 - Baseline factor is equal to the average concentration of the results from the three TRS tests conducted on the RFG system at the BP-Husky Toledo Refinery in November 2010, February 2011, and May 2011. (see Attachment 3

note 2 - U.S. EPA. AP-42. Fifth Edition. Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources. Chapter 1, Section 1.4

TABLE 1.4-2. EMISSION FACTORS FOR CRITERIA POLLUTANTS AND GREENHOUSE GASES FROM NATURAL GAS COMBUSTION. EF Rating A

Based on 100% conversion of fuel sulfur to SO_2. Assumes sulfur content is natural gas of 2,000 grains/10^6 scf. The SO_2 emission factor in this table can be converted to other natural gas sulfur contents by multiplying the SO_2 emission factor by the ratio of the site-specific sulfur content (grains/10^6 scf) to 2,000 grains/10^6 scf.

note 3 - Annual Emissions Basis based on vendor guarantee on control from the new Coker Gas Plant that will control the amount of TRS concentration in the Refinery Fuel Gas Streams.

note 4 - Past Baseline emissions are limited to the allowable SO_2 ton/year limit in cases where the baseline emissions are estimated to be higher than the allowable.

RFG Source	BPH TRS Avg RFG Test Results (TRS ppm)	Controlled TRS in RFG (ppm) for Annual Avg Basis
TIUMD	235.14	70
K3	367.61	70
Boiler FG	367.61	70

Emission Factor Source References

lb/MMSCF = ppm in Fuel Gas (1 SCF/ MMSCF)) x (64 lb SO2/ lbmol / 379 SCF/ lbr *note - 379 SCF/lbmol is at 60 F and 14.7 psia

Table A.25 BP-Husky Toledo Refinery TRS testing Results Summary

	Average Nov 2010 Test Results
RFG Mix Drum ID	**ppm TRS**
ESMD/R2, H2	34.74
TIUMD	191.86
EPA Contactor	271.46

	Average Feb 2011 Test Results
RFG Mix Drum ID	**ppm TRS**
TIUMD	186
EPA Contactor	460

	Average May 2011 Test Results
RFG Mix Drum ID	**ppm TRS**
TIUMD	328
EPA Contactor	372

	Average Overall Test Results
RFG Mix Drum ID	**ppm TRS**
ESMD/R2, H2	34.74
TIUMD	235.14
EPA Contactor	367.61

Table A.26 Emissions for PM10 and PM2.5 (Filterable + Condensable) Emissions

OEPA ID	Process Unit	Permitted Capacity	Units	Baseline (2004-2005) Emissions Basis				TFO Project Potential Emissions Basis				Emission Factors in lb/MMBtu	
				Emission Factor	Unit	Source	Justification	Emission Factor	Unit	Source	Justification	Baseline	Future Potential
												(2004-2005)	TFO
B015	Crude 1 Heater	325	MMBtu/hr	7.6	lb/10^6 scf	AP-42[1]	EF D Rating[2]	Shutdown				0.007	Shutdown
B031	Vac 1 Heater	140	MMBtu/hr	7.6	lb/10^6 scf	AP-42[1]	EF D Rating[2]	Shutdown				0.007	Shutdown
TBD	New Crude Heater	450	MMBtu/hr	Not operating				7.6	lb/10^6 scf	AP-42[1]	EF D Rating[7]	Not operating	0.007
TBD	New Vac Heater	150	MMBtu/hr	Not operating				7.6	lb/10^6 scf	AP-42[1]	EF D Rating[7]	Not operating	0.007
B032	Coker 3 Heater	247	MMBtu/hr	7.6	lb/10^6 scf	AP-42[1]	EF D Rating[2]	7.6	lb/10^6 scf	AP-42[1]	EF D Rating[2]	0.007	0.007
B029	ADHT Heater	20	MMBtu/hr	7.6	lb/10^6 scf	AP-42[1]	EF D Rating[7]	7.6	lb/10^6 scf	AP-42[1]	EF D Rating[7]	0.007	0.007
B034	East Alstom Boiler	430	MMBtu/hr	Not operating				7.6	lb/10^6 scf	AP-42[1]	EF D Rating[2]	Not operating	0.007
B035	West Alstom Boiler		MMBtu/hr	Not operating				7.6	lb/10^6 scf	AP-42[1]	EF D Rating[2]	Not operating	0.007
P009	SRU 1	Estimated	MMBtu/hr	7.6	lb/10^6 scf	AP-42[1]	EF D Rating[2]	7.6	lb/10^6 scf	AP-42[1]	EF D Rating[2]	0.007	0.007
P037	SRU 2&3	29	MMBtu/hr	7.6	lb/10^6 scf	AP-42[1]	EF D Rating[2]	7.6	lb/10^6 scf	AP-42[1]	EF D Rating[2]	0.007	0.007

Emission Factor Source References

[1] U.S. EPA. AP-42. Fifth Edition. Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources. Chapter 1, Section 1.4 "Natural Gas Combustion," Table 1.4-2. EMISSION FACTORS FOR CRITERIA POLLUTANTS AND GREENHOUSE GASES FROM NATURAL GAS COMBUSTION; (July 1998).

Justification References

[2] The total particulate matter (PM) emission factors from AP-42 are used in the refinery industry as a standard when site specific data is not available. Each AP-42 emission factor has a quality rating which indicates the quality of the test(s) used to develop the factor. The ratings are as follows:

A - Excellent - Developed only from the highest rated test data taken from many randomly chosen facilities in the industry population.
B - Above Average - Developed from the highest rated test data from a reasonable number of facilities.
C - Average - Developed from highly rated test data from a reasonable number of facilities.
D - Below Average - Developed from highly rated test data from a small number of facilities.
E - Poor - Developed from lower rated test data from a small number of facilities.

Table A.27 Emission Factors for Volatile Organic Compound Emissions

OEPA ID	Process Unit	Permitted Capacity	Units	Baseline (2004-2005) Emissions Basis				TFO Project Potential Emissions Basis				Emission Factors in lb/MMBtu	
				Emission Factor	Unit	Source	Justification	Emission Factor	Unit	Source	Justification	Baseline	Future Potential
												(2004-2005)	TFO
B015	Crude 1 Heater (RFG)	325	MMBtu/hr	5.5	lb/10^6 scf	AP-42[1]	EF C Rating[2]	Shutdown				0.0054	Shutdown
B031	Vac 1 Heater	140	MMBtu/hr	5.5	lb/10^6 scf	AP-42[1]	EF C Rating[2]	Shutdown				0.0054	Shutdown
TBD	New Crude 1 Heater	450	MMBtu/hr	Not operating				5.5	lb/10^6 scf	AP-42[1]	EF C Rating[2]	Not operating	0.0054
TBD	New Vac 1 Heater	150	MMBtu/hr	Not operating				5.5	lb/10^6 scf	AP-42[1]	EF C Rating[2]	Not operating	0.0054
B032	Coker 3 Heater	247	MMBtu/hr	5.5	lb/10^6 scf	AP-42[1]	EF C Rating[2]	5.5	lb/10^6 scf	AP-42[1]	EF C Rating[2]	0.0054	0.0054
B029	ADHT Heater	20	MMBtu/hr	5.5	lb/10^6 scf	AP-42[1]	EF C Rating[7]	5.5	lb/10^6 scf	AP-42[1]	EF C Rating[7]	0.0054	0.0054
B034	East Alstom Boiler	430	MMBtu/hr	Not operating				5.5	lb/10^6 scf	AP-42[1]	EF C Rating[2]	Not operating	0.0054
B035	West Alstom Boiler		MMBtu/hr	Not operating				5.5	lb/10^6 scf	AP-42[1]	EF C Rating[2]	Not operating	0.0054
P009	SRU 1	Estimated	MMBtu/hr	5.5	lb/10^6 scf	AP-42[1]	EF C Rating[2]	5.5	lb/10^6 scf	AP-42[1]	EF C Rating[2]	0.0054	0.0054
P037	SRU 2&3	29	MMBtu/hr	5.5	lb/10^6 scf	AP-42[1]	EF C Rating[2]	5.5	lb/10^6 scf	AP-42[1]	EF C Rating[2]	0.0054	0.0054

Emission Factor Source References

[1] U.S. EPA. AP-42. Fifth Edition. Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources. Chapter 1, Section 1.4, "Natural Gas Combustion," Table 1.4-2. EMISSION FACTORS FOR CRITERIA POLLUTANTS AND GREENHOUSE GASES FROM NATURAL GAS COMBUSTION; (July 1998).

[2] U.S. EPA. AP-42. Fifth Edition. Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources. Chapter 5, Section 5.1, "Petroleum Refining," Table 5.1-1. EMISSIONS FOR PETROLEUM REFINERIES; (July 1995). (VOC negligible for FCCU w/ CO Boiler and ESP)

Justification References

[2] The Volatile Organic Compound (VOC) emission factors from AP-42 are used in the refinery industry as a standard when site specific data is not available. Each AP-42 emission factor has a quality rating which indicates the quality of the test(s) used to develop the factor. The ratings are as follows:

A - Excellent - Developed only from the highest rated test data taken from many randomly chosen facilities in the industry population.

B - Above Average - Developed from the highest rated test data from a reasonable number of facilities.

C - Average - Developed from highly rated test data from a reasonable number of facilities.

D - Below Average - Developed from highly rated test data from a small number of facilities.

Table A.28 Emission Factors for Lead Emissions

OEPA ID	Process Unit	Permitted Capacity	Units	Baseline (2004-2005) Emissions Basis				TFO Project Potential Emissions Basis				Emission Factors in lb/MMBtu	
				Emission Factor	Unit	Source	Justification	Emission Factor	Unit	Source	Justification	Baseline	Future Potential
												(2004-2005)	TFO
B015	Crude 1 Heater	325	MMBtu/hr	5.00E-04	lb/10^6 scf	AP-42[1]	EF D Rating[2]	Shutdown				4.90E-07	Shutdown
B031	Vac 1 Heater	140	MMBtu/hr	5.00E-04	lb/10^6 scf	AP-42[1]	EF D Rating[2]	Shutdown				4.90E-07	Shutdown
TBD	New Crude Heater	450	MMBtu/hr	Not operating				5.00E-04	lb/10^6 scf	AP-42[1]	EF D Rating[2]	Not operating	4.90E-07
TBD	New Vac Heater	150	MMBtu/hr	Not operating				5.00E-04	lb/10^6 scf	AP-42[1]	EF D Rating[2]	Not operating	4.90E-07
B032	Coker 3 Heater	247	MMBtu/hr	5.00E-04	lb/10^6 scf	AP-42[1]	EF D Rating[2]	5.00E-04	lb/10^6 scf	AP-42[1]	EF D Rating[2]	4.90E-07	4.90E-07
B029	ADHT Heater	20	MMBtu/hr	5.00E-04	lb/10^6 scf	AP-42[1]	EF D Rating[2]	5.00E-04	lb/10^6 scf	AP-42[1]	EF D Rating[2]	4.90E-07	4.90E-07
B034	East Alstom Boiler	430	MMBtu/hr	Not operating				5.00E-04	lb/10^6 scf	AP-42[1]	EF D Rating[2]	Not operating	4.90E-07
B035	West Alstom Boiler		MMBtu/hr	Not operating				5.00E-04	lb/10^6 scf	AP-42[1]	EF D Rating[2]	Not operating	4.90E-07
P009	SRU 1	Estimated	MMBtu/hr	5.00E-04	lb/10^6 scf	AP-42[1]	EF D Rating[2]	5.00E-04	lb/10^6 scf	AP-42[1]	EF D Rating[2]	4.90E-07	4.90E-07
P037	SRU 2&3	29	MMBtu/hr	5.00E-04	lb/10^6 scf	AP-42[1]	EF D Rating[2]	5.00E-04	lb/10^6 scf	AP-42[1]	EF D Rating[2]	4.90E-07	4.90E-07

Emission Factor Source References

[1] U.S. EPA. AP-42. Fifth Edition. Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources. Chapter 1, Section 1.4, "Natural Gas Combustion," Table 1.4-2. EMISSION FACTORS FOR CRITERIA POLLUTANTS AND GREENHOUSE GASES FROM NATURAL GAS COMBUSTION; (July 1998).

Justification References

[2] The Volatile Organic Compound (VOC) emission factors from AP-42 are used in the refinery industry as a standard when site specific data is not available. Each AP-42 emission factor has a quality rating which indicates the quality of the test(s) used to develop the factor. The ratings are as follows:

A - Excellent - Developed only from the highest rated test data taken from many randomly chosen facilities in the industry population.

B - Above Average - Developed from the highest rated test data from a reasonable number of facilities.

C - Average - Developed from highly rated test data from a reasonable number of facilities.

D - Below Average - Developed from highly rated test data from a small number of facilities.

Table A.29 Basis of HAP Emissions for Combustion Sources

AP-42 Heating Value 1,020 Btu/scf

EMISSION FACTOR BASED INVENTORY		Emission Factor			Notes
POLLUTANT	**CAS #**	**Source**	**lb/MMscf**	**lb/MMBtu**	
2-Methyl Naphthalene	91-57-6	AP-42, Table 1.4-3	2.40E-05	2.35E-08	a
3-Methylchloranthrene	56-49-5	AP-42, Table 1.4-3	1.80E-06	1.76E-09	a
7,12-Dimethylbenz(a)anthracene	57-97-6	AP-42, Table 1.4-3	1.60E-05	1.57E-08	a, b
Acenaphthene	83-32-9	AP-42, Table 1.4-3	1.80E-06	1.76E-09	a, b
Acenaphthylene	208-96-8	AP-42, Table 1.4-3	1.80E-06	1.76E-09	a, b
Anthracene	120-12-7	AP-42, Table 1.4-3	2.40E-06	2.35E-09	a, b
Benz(a)anthracene	56-55-3	AP-42, Table 1.4-3	1.80E-06	1.76E-09	a, b
Benzene	71-43-2	AP-42, Table 1.4-3	2.10E-03	2.06E-06	a
Benzo(a)pyrene	50-32-8	AP-42, Table 1.4-3	1.20E-06	1.18E-09	a, b
Benzo(b)fluoranthene	205-99-2	AP-42, Table 1.4-3	1.80E-06	1.76E-09	a, b
Benzo(g,h,i)perylene	191-24-2	AP-42, Table 1.4-3	1.20E-06	1.18E-09	a, b
Benzo(k)fluoranthene	205-82-3	AP-42, Table 1.4-3	1.80E-06	1.76E-09	a, b
Chrysene	218-01-9	AP-42, Table 1.4-3	1.80E-06	1.76E-09	a, b
Dibenzo(a,h)anthracene	53-70-3	AP-42, Table 1.4-3	1.20E-06	1.18E-09	a, b
Dichlorobenzene	25321-22-6	AP-42, Table 1.4-3	1.20E-03	1.18E-06	a
Fluoranthene	206-44-0	AP-42, Table 1.4-3	3.00E-06	2.94E-09	a, b
Fluorene	86-73-7	AP-42, Table 1.4-3	2.80E-06	2.75E-09	a, b
Formaldehyde	50-00-0	AP-42, Table 1.4-3	7.50E-02	7.35E-05	a
Hexane	110-54-3	AP-42, Table 1.4-3	1.80E+00	1.76E-03	a
Indeno(1,2,3-cd)pyrene	193-39-5	AP-42, Table 1.4-3	1.80E-06	1.76E-09	a, b
Naphthalene	91-20-3	AP-42, Table 1.4-3	6.10E-04	5.98E-07	a
Phenanathrene	85-01-8	AP-42, Table 1.4-3	1.70E-05	1.67E-08	a, b
Pyrene	129-00-0	AP-42, Table 1.4-3	5.00E-06	4.90E-09	a, b
Toluene	108-88-3	AP-42, Table 1.4-3	3.40E-03	3.33E-06	a
Arsenic	7440-38-2	AP-42, Table 1.4-4	2.00E-04	1.96E-07	a
Beryllium	7440-41-7	AP-42, Table 1.4-4	1.20E-05	1.18E-08	a
Cadmium	7440-43-9	AP-42, Table 1.4-4	1.10E-03	1.08E-06	a
Chromium	7440-47-3	AP-42, Table 1.4-4	1.40E-03	1.37E-06	a
Cobalt	7440-48-4	AP-42, Table 1.4-4	8.40E-05	8.24E-08	a
Manganese	7439-96-5	AP-42, Table 1.4-4	3.80E-04	3.73E-07	a
Mercury	7439-97-6	AP-42, Table 1.4-4	2.60E-04	2.55E-07	a
Nickel	7440-02-0	AP-42, Table 1.4-4	2.10E-03	2.06E-06	a
Selenium	7782-49-2	AP-42, Table 1.4-4	2.40E-05	2.35E-08	a
		Total HAP =	**1.88796**	**0.00185**	

Source

[1] U.S. EPA. AP-42. Fifth Edition. Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources. Chapter 1, Section 1.4, "Natural Gas Combustion,"TABLE 1.4-3. EMISSION FACTORS FOR SPECIATED ORGANIC COMPOUNDSFROM NATURAL GAS COMBUSTION (July 1998) and "TABLE 1.4-4. EMISSION FACTORS FOR METALS FROM NATURAL GAS COMBUSTION" (July 1998)

Notes:

a. Hazardous Air Pollutant (HAP) as defined by Section 112(b) of the Clean Air Act.

b. HAP because it is Polycyclic Organic Matter (POM). POM is a HAP as defined by Section 112(b) of CAA

Table A.29 Basis of HAP Emissions for Combustion Sources

OEPA ID =>	B015	B031	TBD	TBD	B032	B029	B034/ B035	P009	P037		
Description =>	Crude 1 Heater	Vac 1 Heater	New Crude 1 Heaters	New Vac 1 Heater	Coker 3 Heater	ADHT Heater	Steam Boilers	SRU 1 natural gas	SRU 2&3 natural gas	Total (tpy)	
Delta MMBtu/hr =>	-320.8	-99.2	450.0	150.0	19.0	10.2	61.5	7.4	10.1	increases	decreases
tpy =>	-3.31E-05	-1.02E-05	4.64E-05	1.55E-05	1.96E-06	1.05E-06	6.34E-06	7.62E-07	1.04E-06	7.30E-05	-4.33E-05
tpy =>	-2.48E-06	-7.67E-07	3.48E-06	1.16E-06	1.47E-07	7.91E-08	4.75E-07	5.72E-08	7.77E-08	5.47E-06	-3.25E-06
tpy =>	-2.20E-05	-6.82E-06	3.09E-05	1.03E-05	1.31E-06	7.03E-07	4.23E-06	5.08E-07	6.91E-07	4.87E-05	-2.89E-05
tpy =>	-2.48E-06	-7.67E-07	3.48E-06	1.16E-06	1.47E-07	7.91E-08	4.75E-07	5.72E-08	7.77E-08	5.47E-06	-3.25E-06
tpy =>	-2.48E-06	-7.67E-07	3.48E-06	1.16E-06	1.47E-07	7.91E-08	4.75E-07	5.72E-08	7.77E-08	5.47E-06	-3.25E-06
tpy =>	-3.31E-06	-1.02E-06	4.64E-06	1.55E-06	1.96E-07	1.05E-07	6.34E-07	7.62E-08	1.04E-07	7.30E-06	-4.33E-06
tpy =>	-2.48E-06	-7.67E-07	3.48E-06	1.16E-06	1.47E-07	7.91E-08	4.75E-07	5.72E-08	7.77E-08	5.47E-06	-3.25E-06
tpy =>	-2.89E-03	-8.95E-04	4.06E-03	1.35E-03	1.71E-04	9.23E-05	5.55E-04	6.67E-05	9.06E-05	6.39E-03	-3.79E-03
tpy =>	-1.65E-06	-5.11E-07	2.32E-06	7.73E-07	9.79E-08	5.27E-08	3.17E-07	3.81E-08	5.18E-08	3.65E-06	-2.16E-06
tpy =>	-2.48E-06	-7.67E-07	3.48E-06	1.16E-06	1.47E-07	7.91E-08	4.75E-07	5.72E-08	7.77E-08	5.47E-06	-3.25E-06
tpy =>	-1.65E-06	-5.11E-07	2.32E-06	7.73E-07	9.79E-08	5.27E-08	3.17E-07	3.81E-08	5.18E-08	3.65E-06	-2.16E-06
tpy =>	-2.48E-06	-7.67E-07	3.48E-06	1.16E-06	1.47E-07	7.91E-08	4.75E-07	5.72E-08	7.77E-08	5.47E-06	-3.25E-06
tpy =>	-2.48E-06	-7.67E-07	3.48E-06	1.16E-06	1.47E-07	7.91E-08	4.75E-07	5.72E-08	7.77E-08	5.47E-06	-3.25E-06
tpy =>	-1.65E-06	-5.11E-07	2.32E-06	7.73E-07	9.79E-08	5.27E-08	3.17E-07	3.81E-08	5.18E-08	3.65E-06	-2.16E-06
tpy =>	-1.65E-03	-5.11E-04	2.32E-03	7.73E-04	9.79E-05	5.27E-05	3.17E-04	3.81E-05	5.18E-05	3.65E-03	-2.16E-03
tpy =>	-4.13E-06	-1.28E-06	5.80E-06	1.93E-06	2.45E-07	1.32E-07	7.92E-07	9.53E-08	1.29E-07	9.12E-06	-5.41E-06
tpy =>	-3.86E-06	-1.19E-06	5.41E-06	1.80E-06	2.28E-07	1.23E-07	7.39E-07	8.89E-08	1.21E-07	8.51E-06	-5.05E-06
tpy =>	-0.10	-0.03	0.14	0.05	0.01	0.00	0.02	0.00	0.00	**2.28E-01**	**-1.35E-01**
tpy =>	-2.48	-0.77	3.48	1.16	0.15	0.08	0.48	0.06	0.08	**5.47**	**-3.25**
tpy =>	-2.48E-06	-7.67E-07	3.48E-06	1.16E-06	1.47E-07	7.91E-08	4.75E-07	5.72E-08	7.77E-08	5.47E-06	-3.25E-06
tpy =>	-8.40E-04	-2.60E-04	1.18E-03	3.93E-04	4.98E-05	2.68E-05	1.61E-04	1.94E-05	2.63E-05	1.86E-03	-1.10E-03
tpy =>	-2.34E-05	-7.24E-06	3.29E-05	1.10E-05	1.39E-06	7.47E-07	4.49E-06	5.40E-07	7.34E-07	5.17E-05	-3.07E-05
tpy =>	-6.89E-06	-2.13E-06	9.66E-06	3.22E-06	4.08E-07	2.20E-07	1.32E-06	1.59E-07	2.16E-07	1.52E-05	-9.02E-06
tpy =>	-4.68E-03	-1.45E-03	6.57E-03	2.19E-03	2.77E-04	1.49E-04	8.98E-04	1.08E-04	1.47E-04	1.03E-02	-6.13E-03
tpy =>	-2.76E-04	-8.52E-05	3.86E-04	1.29E-04	1.63E-05	8.79E-06	5.28E-05	6.35E-06	8.63E-06	6.08E-04	-3.61E-04
tpy =>	-1.65E-05	-5.11E-06	2.32E-05	7.73E-06	9.79E-07	5.27E-07	3.17E-06	3.81E-07	5.18E-07	3.65E-05	-2.16E-05
tpy =>	-1.52E-03	-4.69E-04	2.13E-03	7.09E-04	8.98E-05	4.83E-05	2.90E-04	3.49E-05	4.75E-05	3.35E-03	-1.98E-03
tpy =>	-1.93E-03	-5.96E-04	2.71E-03	9.02E-04	1.14E-04	6.15E-05	3.70E-04	4.45E-05	6.04E-05	4.26E-03	-2.53E-03
tpy =>	-1.16E-04	-3.58E-05	1.62E-04	5.41E-05	6.85E-06	3.69E-06	2.22E-05	2.67E-06	3.63E-06	2.55E-04	-1.52E-04
tpy =>	-5.24E-04	-1.62E-04	7.34E-04	2.45E-04	3.10E-05	1.67E-05	1.00E-04	1.21E-05	1.64E-05	1.16E-03	-6.85E-04
tpy =>	-3.58E-04	-1.11E-04	5.02E-04	1.67E-04	2.12E-05	1.14E-05	6.87E-05	8.26E-06	1.12E-05	7.91E-04	-4.69E-04
tpy =>	-2.89E-03	-8.95E-04	4.06E-03	1.35E-03	1.71E-04	9.23E-05	5.55E-04	6.67E-05	9.06E-05	6.39E-03	-3.79E-03
tpy =>	-3.31E-05	-1.02E-05	4.64E-05	1.55E-05	1.96E-06	1.05E-06	6.34E-06	7.62E-07	1.04E-06	7.30E-05	-4.33E-05

Table A.30 Fugitive Emission Factors

Equipment/Service	EPA Refinery Default-Zero Values[A] kg/hr/source	EPA Refinery Default-Zero Values[A] lb/hr/source	EPA Refinery Correlation Equation Emission Factors - 10,000 ppmv Screening ValueB kg/hr/source	EPA Refinery Correlation Equation Emission Factors - 10,000 ppmv Screening ValueB lb/hr/source	API Study Average HL Factors[C] lb/hr/source	EPA Refinery Average Emission factors[D] kg/hr/source	EPA Refinery Average Emission factors[D] lb/hr/source
Valves							
Gas/Vapor	7.80E-06	1.72E-05	0.002	4.87E-03		2.68E-02	5.91E-02
Light Liquid	7.80E-06	1.72E-05	0.002	4.87E-03		1.09E-01	2.40E-01
Heavy Liquid	7.80E-06	1.72E-05	0.002	4.87E-03	1.79E-04	2.30E-04	5.07E-04
Pumps							
Light Liquid	2.40E-05	5.29E-05	0.014	3.05E-02		1.14E-01	2.51E-01
Heavy Liquid	2.40E-05	5.29E-05	0.014	3.05E-02	8.29E-03	2.10E-02	4.63E-02
Flanges							
Gas/Vapor	3.10E-07	6.83E-07	0.003	6.59E-03		2.50E-04	5.51E-04
Light Liquid	3.10E-07	6.83E-07	0.003	6.59E-03		2.50E-04	5.51E-04
Heavy Liquid	3.10E-07	6.83E-07	0.003	6.59E-03	8.25E-05	2.50E-04	5.51E-04
Connectors	7.50E-06	1.65E-05	0.0013	2.94E-03	8.25E-05	2.50E-04	5.51E-04
Agitators	4.00E-06	8.82E-06	0.014	3.05E-02			
Compressors	4.00E-06	8.82E-06	3.09E-03	6.81E-03		6.36E-01	1.40E+00
Relief Valves	4.00E-06	8.82E-06	3.09E-03	6.81E-03		1.60E-01	3.53E-01
Open-ended Lines	2.00E-06	4.41E-06	1.44E-03	3.18E-03		2.30E-03	5.07E-03
Sampling Connections	4.00E-06	8.82E-06	3.09E-03	6.81E-03		1.50E-02	3.31E-02

[A] Factors are taken from EPA Document EPA-453/R-95-017, Nov. 1995, Table 2-14,

[B] Factors are estimated from EPA Document EPA-453/R-95-017, Nov. 1995, Table 2-10

10,000 ppmv - assumed Screening Value for all leaking components

[C] API Pub. 337, August 1996

[D] For unmonitored stream, Average Refinery Factors from US EPA protocol Table 2-2 are used for all components.

Table A.31 Emission Factors for CO_2e Green House Gas (GHG) from combustion

Emission Factor Reference

Fuel gas system	Baseline	Project
	lbs CO_2e/ MMBtu[1]	
TIU Mix Drum	125.9	125.9
Coker 3 Heater fuel gas	127.3	127.3
East Mix Drum	110.6	110.6
Alstom Boiler fuel gas	122.4	122.4
Natural Gas[2]	115.1	115.1

OEPA ID	Process Unit	Permitted Capacity	Units	RFG Mix Drum Reference	Emission Factors		Units
					Baseline (2004-2005)	TFO Project Potential	
B015[a]	Crude 1 Heater RFG	325	MMBtu/hr	TIUMD	125.90	Shutdown	lb CO_2e/MMBtu
B031	Vac 1 Heater	140	MMBtu/hr	TIUMD	125.90	Shutdown	lb CO_2e/MMBtu
TBD	New Crude 1 Heaters	450	MMBtu/hr	TIUMD	Not operating	125.90	lb CO_2e/MMBtu
TBD	New Vac 1	150	MMBtu/hr	TIUMD	Not operating	125.90	lb CO_2e/MMBtu
B032	Coker 3 Heater	247	MMBtu/hr	Coker 3	127.30	127.30	lb CO_2e/MMBtu
B029	ADHT Heater[3]	20	MMBtu/hr	ESMD	110.60	On TIUMD FG	lb CO_2e/MMBtu
B029	ADHT Heater		MMBtu/hr	TIUMD	On ESMD FG	125.90	lb CO_2e/MMBtu
B034	East Alstom Boiler	430	MMBtu/hr	Boiler FG	Not operating	122.40	lb CO_2e/MMBtu
B035	West Alstom Boiler		MMBtu/hr	Boiler FG	Not operating	122.40	lb CO_2e/MMBtu
P009	SRU 1 - NG	Estimated	MMBtu/hr	NG	115.13	115.13	lb CO_2e/MMBtu
P037	SRU 2&3 - NG	29	MMBtu/hr	NG	115.13	115.13	lb CO_2e/MMBtu

Notes [1]CO2e GHG emission factors are based on actual refinery fuel gas data collected pursuant to the GHG MMR rule (40 CFR Part 98) for 2010 and 2011 and up to June 13, 2012. To be conservative, the past actual and future potential emission factor is based on the highest annual average factor for this time period. Backup documentation provided in spreadsheet "GHG CC MW and HHV 2010 and 2011.xls" -

[2]Using GHG Natural gas factors: 53.02 kg CO_2/mmBtu x 1 lb/0.454 kg = 116.78 lb CO_2/mm Btu. BPH is lower because measured heating value was 1013 instead of 1028 Btu/scf.

3 The ADHT Heater fired RFG from the East Mix Drum in the baseline period and will fire TIU Mix drum RFG in the future

Table A.32 Green House Gas Emission Factors for Process Units

Estimate of Average GHG emission factors based on BP-Husky 2011 reported GHG emissions and readily available Process Parameter

Unit/Common Pipe)	2011 Reported Total CO2e (tonnes)	Parameter used to Estimate Emission Factor	2011 Value of Parameter used to Estimate Emission Factor	Estimated GHG Emission Factor	GHG Emission Factor units	Calculated GHG Emission Factor	Alternate GHG Emission Factor units	Reference
Reformer 1 (note 1)	72	Unit feed rate (KBPD)	7.20	9.94	CO2e tonnes/ KBPD feed	10.94	CO2e tons/ KBPD feed	2011 feed rate from Sarah Steen 5-23-2012 email (FRC502).
Reformer 2 (note 1)	354	Unit feed rate (KBPD)	13.30	26.64	CO2e tonnes/ KBPD feed	29.34	CO2e tons/ KBPD feed	2011 feed rate from Sarah Steen 5-23-2012 email (FRC_4554).
SRU 1 and SRU 2 & 3 Combined (note 2)	38,901	LTPD of Total Sulfur produced	268.38	144.95	CO2e tonnes/ average LTPD sulfur produced	159.64	CO2e ton/ average LTPD sulfur produced	Sulfur produced from accounting transaction reports provided by BPH

note 1 - GHG emissions calculated based on 40 CFR 98 methodology using actual coke burned, default carbon content and default emission factor
note 2 - GHG emissions calculated based on 40 CFR 98 methodology using actual sour gas input rate, and default carbon content fraction

Generic LDAR GHG Emission Factors

Type of unit	tonnes CH4/ unit	tonnes CO2e/unit	tons CO2e/unit
Emission factor for atmospheric crude oil distillation columns at facility	0.4	8.4	9.3
Emission factor for catalytic cracking units, coking units (delayed or fluid), hydrocracking, and full range distillation columns (including depropanizer and debutanizer distillation columns) at the facility.	0.2	4.2	4.6
Emission factor for hydrotreating/hydro-refining units, catalytic reforming units, and visbreaking units at the facility	0.1	2.1	2.3
Emission factor for hydrogen plants	4.3	90.3	99.4
Emission factor for fuel gas system	6.0	126.0	138.8

***Reference** : LDAR GHG Factors from Equation Y-21 in GHG MRR, 40 CFR 98.253(l)(2) (Subpart Y)*

Table A.33 Diesel Tankage increase from TFO Project

Based on + 2 KB/day diesel throughput increase

Methodology

TFO Project Estimated Emission Increase from Tankage:
Emissions from increased throughput through existing tanks was calculated by first reviewing tank characteristics and emission calculations to determine which diesel storage tanks have the highest emissions at the same throughput.

Once the tank with the highest potential increased emissions were identified, the expected increased in throughput was assumed to be routed through the worse case tank for a conservative estimate of increased emissions using the EPA Tanks 4.09d methodology outlined in AP-42 Chapter 7. Past actual throughput for this calculation purpose was set at the average throughput of these tanks for 2008 thru 2010 (although the base throughput is irrelevant to these calculations since the incremental emissions remain the same for a given incremental throughput.

Since the increased throughput will be spread throughout all existing tankage, not all in the worst-case tank, actual emissions increases are expected to be less.

Calculations
Diesel Tankage (based on Tank 761)

Case	VOC emissions, tons/yr
TK761 Baseline	5.11
Project Estimate (increase of 2K bbls/day)	5.35
Estimated Project Increase	**0.24**

Average Ambient Wind Speed in mph (TANKS 4.09d data)	9.425
Daily Solar Insolation Factor in Btu/ft2-day (TANKS 4.09d data)	1233
Daily Maximum Ambient Temperature in °F (TANKS 4.09d data)	58.617
Daily Minimum Ambient Temperature in °F (TANKS 4.09d data)	38.258
Daily Average Ambient Temperature in °F	48.44
Daily Ambient Temperature Range in °F	20.36
Atmospheric Pressure, psia (calculated based on site elevation)	14.1

Tank #	Tank	Annual Net Throughput	Paint Color	Tank Diameter	Shell Height	Liquid Height	Max. Liquid Height	**Mol Wt. of Vapor**	**Vapor Pressure**	Paint Solar Absorptance	Standing Storage Loss	Working Loss	Total Loss		
		bbl/year Q		ft D	ft Hs	ft Hl	ft Hlx	**lb/lb-mole Mv**	**psia Pva**	Alpha	lb/yr Ls	lb/yr Lw	lb/yr Lt	tonnes/yr Lt	tons/yr Lt
	Typical past throughput														
761	Diesel Fuel #2	2,042,291	Aluminum	90	48	24	48	130	0.03	0.6	2,538	7,691	10230	4.6402	5.1150
	With +2K bbls/day														
761	Diesel Fuel #2	2,772,291	Aluminum	90	48	24	48	130	0.03	0.6	2,538	8,166	10704	4.8555	5.3522

Table A.34 TFO Estimated New Waste Water Sewer Component Emissions

	EQUIPMENT TYPE	Description	#1 Amine Contactor	#2 Merox Contactor	#3 Two (2) Distillation Towers & A Couple of Drums	#4 Drum & Two (2) Pumps	#5 Two (2) New Desalters	#6 Two (2) Heaters	#7 One (1) Heater	#8 Overhead Drum	#9 Stripper Tower	#10 A couple of Vessels	#11 A couple of Vessels	#12 A couple of Vessels	#13 Air Coolers	Total Number of Components	Emission Factor (kg/day/unit)	VOC Emissions (tons/yr)	Reference
			Number of Components																
Drains or sewer connections/access	Atmospheric Drain Hub with a water seal	Elevated or ground level oily water process drain hub (or open cup drains) with water trap.	0	5	15	3	0	0	0	1	1	0	0	0	5	**30**	0.35	4.17	NSPS QQQ BIDa page 4-9 estimates a 50% reduction in emissions of an atmospheric drain in the presence of a water seal. Therefore assume 50% less than AP-42 Table 5.1-3 estimate of 0.69 kg/day/unit for a drain.
Drains or sewer connections/access	Catch basin w/o trap- combined oil service (Including pad drain and paving drain)	Ground level drain (deck drain, paving drain, or pad drain) for combined oil water collection.	1	1	1	0	0	2	0	0	0	0	0	0	2	**7**	0.69	1.95	Catch basin without a trap is assumed to have the same emissions as an uncontrolled atmospheric drain hub and was taken from AP-42 Table 5.1-3.
Drains or sewer connections/access	Cleanouts	Capped (generally screwed cap) opening generally at the origin of each sewer branch for inspection, maintenance or sampling.	1	6	16	3	0	2	0	1	1	0	0	0	6	**36**	0	0.00	All of these points are blind flanged. EPA Protocol for Equipment Leak Emission Estimates, Table 5-1 requires 100% control efficiency for these lines.
Sumps or Separators	Sumps with sump pump (vented to 95% effic. Control device)	Below ground collection device (similar to a manhole or junction box) with a tightly sealed cover and degassing through a vent usually to a carbon canister. Sump pumps route waste to overhead sewer line. May have oil water separation capabilities.	0	0	0	0	1	0	0	0	0	0	0	0	0	**1**	0.035	0.01	All new sumps with sump pumps include a vent with a carbon canister. 40 CFR §61.349(a)(2)(iv)(A) requires all control devices to operate with 95% efficient. Therefore, 5% of the uncontrolled value from AP 42 Table 5.1-3 for an uncontrolled drain was assumed.
												Estimated Total (Tons/yr)						6.13	tpy VOC
												Contingency						30%	
												Assumed Total (tons/yr)						7.97	tpy VOC

Table A.34a - Description of Waste Water Treatment TFO Project Elements
Individual Drain Systems
Subject to 40 CFR Part 60, Subpart QQQ

Emissions Unit ID	Facility Description	Individual Drain System Description	Controls	Notes
1	Amine Contactor	Catch basin w/trap, ground level drain (paving drain) for storm water collection with water trap (1-req)	Water seal	New area drain storm water sewer, catch basin with water seal. No additional drain hubs. Sewer system is combined oily waste/storm
1	Amine Contactor	Cleanout on area drain sewer, screwed cap (1- req,)	Sealed cap	New storm sewer to new SRU sewer that will be QQQ qualified. Tee connection to SRU sewer.
2	Merox Contactor	Catch basin w/trap, ground level drain (paving drain) for storm water collection with water trap (1-req)	Water seal	New area drain storm sewer, catch basin with water seal. Sewer system is combined oily waste/storm
2	Merox Contactor	Cleanout on area drain sewer, screwed cap (1-req)	Sealed cap	New storm sewer to new SRU sewer that will be QQQ qualified. Tee connection to SRU sewer.
2	Merox Contactor	Atmospheric drain hubs with a water seal (5-req)	Water seal	Assume a sewer network to collect hubs and convey to area drain sewer. Connect to area drain sewer with wye connections
2	Merox Contactor	Cleanout on hub drain sewer network, screwed cap (5-req)	Sealed cap	Assume one cleanout per hub on sewer collection network
3	Two Distillation Towers & Drums	Catch basin w/trap, ground level drain (paving drain) for storm water collection with water trap (1-req)	Water seal	New area drain storm sewer, catch basin with water seal. Sewer system is combined oily waste/storm
3	Two Distillation Towers & Drums	Cleanout on area drain sewer, screwed cap (1-req)	Sealed cap	New storm sewer to new existing QQQ qualified sewer to the north. Wye connection to QQQ sewer.
3	Two Distillation Towers & Drums	Atmospheric drain hubs with a water seal (15-req)	Water seal	Assume a sewer network to collect hubs and convey to area drain sewer. Connect to area drain sewer with wye connections.
3	Two Distillation Towers & Drums	Cleanout on hub drain sewer network, screwed cap (15-req)	Sealed cap	Assume one cleanout per hub on sewer collection network

Table A.34a - Description of Waste Water Treatment TFO Project Elements
Individual Drain Systems
Subject to 40 CFR Part 60, Subpart QQQ

Emissions Unit ID	Facility Description	Individual Drain System Description	Controls	Notes
4	Drum & Two Pumps	Atmospheric drain hubs with a water seal (3-req)	Water seal	Assume a sewer network to collect hubs and convey to existing area drain sewer. Connect to existing area drain sewer with wye connections. Use existing area drain.
4	Drum & Two Pumps	Cleanout on hub drain sewer network, screwed cap (3-req)	Sealed cap	Assume one cleanout per hub on sewer collection network
5	Two Desalters	Sump with sump pump vented to carbon canister (1-req.)	Carbon canister	New sump and pump. No new hubs required. Use existing area drain storm sewer. Sewer system is combined oily waste/storm
6	Two Heaters	Catch basin w/trap, ground level drain (paving drain) for storm water collection with water trap (2-req)	Water seal	New area drain storm water sewer (one for each Heater), catch basin with water seal. No additional drain hubs. Sewer system is combined oily waste/storm
6	Two Heaters	Cleanout on area drain sewer, screwed cap (2-req)	Sealed cap	New storm sewer from each Heater to new existing sewer. Wye connection to QQQ sewer.
7	One Heater			Use existing area drain for storm water. No new drain hubs required
8	Overhead Drum	Atmospheric drain hubs with a water seal (1-req)	Water seal	Assume a sewer network to collect hub and convey to existing area drain sewer. Connect to existing area drain sewer with wye connections. Use existing area drain.
8	Overhead Drum	Cleanout on hub drain sewer network, screwed cap (1-req)	Sealed cap	Assume one cleanout per hub on sewer collection network
9	Stripper Tower	Atmospheric drain hubs with a water seal (1-req)	Water seal	Assume a sewer network to collect hub and convey to existing area drain sewer. Connect to existing area drain sewer with wye connections. Use existing area drain.
9	Stripper Tower	Cleanout on hub drain sewer network, screwed cap (1-req)	Sealed cap	Assume one cleanout per hub on sewer collection network
10	Vessels			Use existing area drain for storm water. No new drain hubs required
11	Vessels			Use existing area drain for storm water. No new drain hubs required

Table A.34a - Description of Waste Water Treatment TFO Project Elements
Individual Drain Systems
Subject to 40 CFR Part 60, Subpart QQQ

Emissions Unit ID	Facility Description	Individual Drain System Description	Controls	Notes
12	Vessels			Use existing area drain for storm water. No new drain hubs required
13	Air Coolers	Catch basin w/trap, ground level drain (paving drain) for storm water collection with water trap (2-req)	Water seal	New area drain storm water sewer with two catch basins, catch basin with water seal. No additional drain hubs. Sewer system is combined oily waste/storm. Wye connection to existing sewer.
13	Air Coolers	Cleanout on area drain sewer, screwed cap (1-req)	Sealed cap	New storm sewer from area with cleanout near wye connection to existing sewer.
13	Air Coolers	Atmospheric drain hubs with a water seal (5-req)	Water seal	Assume a sewer network to collect hubs and convey to area drain sewer. Connect to area drain sewer with wye connections
13	Air Coolers	Cleanout on hub drain sewer network, screwed cap (5-req)	Sealed cap	Assume one cleanout per hub on sewer collection network

Appendix A

Attachment 1

Coker 3 Back-up Calculation Documentation

TRP Coker 3 Emission Estimates

	Venting	Cutting	Draining	Venting+Cutting+Draining
	TPY	TPY	TPY	TPY
Toledo Coker 3 Past Emissions				
H2S	2.8	0.1	3.5	6.4
VOC	7.6	0.2	0.9	8.6
CO	0.2	0.0		0.2
PM	1.9			1.9
CH4	35.9	0.8		36.7
CO2	7.1	0.2		7.3
CO2e	761.9	16.9		778.8
Toledo Coker 3 Future Emissions				
H2S	2.9	0.1	5.2	8.2
VOC	7.7	0.2	1.4	9.3
CO	0.2	0.0		0.2
PM	2.0			2.0
CH4	36.8	1.2		38.0
CO2	7.3	0.2		7.5
CO2e	779.7	24.9		804.6
Increases				
H2S	0.1	0.0	1.7	1.8
VOC	0.2	0.1	0.4	0.7
CO	0.0	0.0		0.0
CH4	0.8	0.4		1.2
CO2	0.2	0.1		0.2
CO2e	17.8	8.0		25.8

	cycles/yr	psig	
Toledo Coker 3 Past Emissions	423.5	3	venting
Toledo Coker 3 Future Emissions	626	2	venting

Coke Drum Venting Emissions - Industry Data with Known Water Vaporization

Potential to Emit (TFO Project) Estimates

MLL-01/19/10

MRK 7/Apr/2010

ARA for TRP June 2012

Variable	Units	Toledo K3	
Drum ID	ft	27.0	
T/T Length	ft	78.0	
Coke Outage from Top Flange	ft	28.6	
Top Flange Height	ft	3.0	
Top Flange ID (Vapor)	ft	2.5	
Top Eliptical Head Height	ft	6.8	
Coke Outage from Top T/L	ft	18.9	
Coke Height in Cylinder	ft	59.1	
Bottom Cone Height	ft	20.0	
Bottom Flange Height	ft	1.5	
Bottom Flange ID	ft	6.0	
Total Coke Drum Height	ft	109.3	
Bottom Flange Volume	ft3	42	
Bottom Cone Volume	ft3	4854	
Coke Volume in Cylinder	ft3	33838	
Total Volume in Cylinder	ft3	44659	
Top Eliptical Head Volume	ft3	2576	
Top Flange Volume (Vapor)	ft3	15	
Total Volume of Coke with void spaces	ft3	38734	
Coke Density in Coke Drum	lb/ft3	56.0	
Total Coke in Coke Drum	tons	1085	
Total Coke Drum Volume	ft3	52147	
Void Volume of Coke	ft3/ft3	0.50	
Volume of Water Covering Coke	ft3	19367	
Additional Water Height over Coke Bed	ft	6	
Additional Water Volume over Coke Bed	ft3	3654	
Total Water Vol in Coke Drum before Vent	ft3	23021	
Water Density before Venting	lb/ft3	59.6	
Mass of Water in Coke Drum	klb	1373	
Vapor Space Volume	ft3	9758	
Material in Vapor Space = PV/RT	lb-moles	22.4	
Pressure in Drum Before Venting	psig	2.0	
Temp in Drum Before Venting	degF	218.4	
Vapor Generated from Water Flashing	wt%	0.67	
Vapor Generated from Water Flashing	lbs	9155	
Vapor from Vent Mole Weight	lb/lb-mol	18.1	
Vapor Generated from Water Flashing	lb-mol	506	
Vapor Generated per Event	lb-mol	528	
The rows below were added to calculate the average volume vented per cycle needed for Green House Gas calculations.			
Conversion factor kg - moles to scf	scf/kg mole	836.6	From GHG MRR regulation for standard temp of 60 F
Conversion factor lb - moles to scf	scf/lb mole	379.8	0.454 kg = 1 lb
Volume per cycle	scf/cycle	200,730	lb moles vented * conversion factor
Average cycle time from open to atmosphere to drum open for cutting	hours	1.50	Coker 3 from "Drum Times" worksheet cell R1.

Coke Drum Venting Emissions - Industry Data with Known Water Vaporization

Potential to Emit (TFO Project) Estimates

MLL-01/19/10

MRK 7/Apr/2010

ARA for TRP June 2012

Variable	Units	Toledo K3	
Average vented rate	scf/hr	133,820	volume vented/ cycle time
% Water in Coke Drum Vent	mol%	98.2	
CH4 in Vent Vapor (wet)	mPPM	13867	Updated w/July Vent Testing
C2s in Vent Vapor (wet)	mPPM	1712	Updated w/July Vent Testing
H2S in Vent Vapor (wet)	mPPM	510	Updated w/July Vent Testing
VOCs in Vent Vapor (wet)	mPPM	1063	Updated w/July Vent Testing
CO in Vent Vapor (wet)	mPPM	51	Updated w/July Vent Testing
CO2 in Vent Vapor (wet)	mPPM	1000	GHG
PM in Vent Vapor (dry)	gr/DSCF	12	Updated w/July Vent Testing
CH4 Emissions per Event	lb-mol	7.3	
C2H6 Emissions per Event	lb-mol	0.9	
H2S Emissions per Event	lb-mol	0.3	
VOC Emissions per Event	lb-mol	0.6	
CO Emissions per Event	lb-mol	0.0	
CO2 Emissions per Event	lb-mol	0.5	
CH4 Mole Weight	lb/lb-mol	16.0	
C2H6 Mole Weight	lb/lb-mol	30.1	
H2S Mole Weight	lb/lb-mol	34.1	
VOC Mole Weight	lb/lb-mol	44.0	Updated w/July Vent Testing
CO Mole Weight	lb/lb-mol	28.0	
CO2 Mole Weight	lb/lb-mol	44.0	
CH4 Emissions per Event	lbs	117.6	
C2H6 Emissions per Event	lbs	27.2	
H2S Emissions per Event	lbs	9.2	
VOC Emissions per Event	lbs	24.7	
CO Emissions per Event	lbs	0.8	
CO2 Emissions per Event	lbs	23.3	
PM Emissions per Event	lbs	6.3	
Coke Drum Cycle Time	hrs	14.0	
# of Coke Drum Pairs	#	1	
Theoretical Drums Vented per Year	Events/yr	626	
Actual Drums Vented per Year	Events/yr	626	
CH4 Emissions Per Year	TPY	36.8	
C2H6 Emissions Per Year	TPY	8.5	
H2S Emissions Per Year	TPY	2.9	
VOC Emissions Per Year	TPY	7.7	
CO Emissions Per Year	TPY	0.2	
CO2 Emissions Per Year	TPY	7.3	
PM Emissions Per Year	TPY	2.0	

Coke Drum Venting Emissions - Industry Data with Known Water Vaporization

Past Actual Baseline (2004-2005) Estimates

MLL-01/19/10

MRK 7/Apr/2010

ARA for TRP June 2012

Variable	Units	Toledo K3
Drum ID	ft	27.0
T/T Length	ft	78.0
Coke Outage from Top Flange	ft	28.6
Top Flange Height	ft	3.0
Top Flange ID (Vapor)	ft	2.5
Top Eliptical Head Height	ft	6.8
Coke Outage from Top T/L	ft	18.9
Coke Height in Cylinder	ft	59.1
Bottom Cone Height	ft	20.0
Bottom Flange Height	ft	1.5
Bottom Flange ID	ft	6.0
Total Coke Drum Height	ft	109.3
Bottom Flange Volume	ft3	42
Bottom Cone Volume	ft3	4854
Coke Volume in Cylinder	ft3	33838
Total Volume in Cylinder	ft3	44659
Top Eliptical Head Volume	ft3	2576
Top Flange Volume (Vapor)	ft3	15
Total Volume of Coke with void spaces	ft3	38734
Coke Density in Coke Drum	lb/ft3	56.0
Total Coke in Coke Drum	tons	1085
Total Coke Drum Volume	ft3	52147
Void Volume of Coke	ft3/ft3	0.50
Volume of Water Covering Coke	ft3	19367
Additional Water Height over Coke Bed	ft	6
Additional Water Volume over Coke Bed	ft3	3654
Total Water Vol in Coke Drum before Vent	ft3	23021
Water Density before Venting	lb/ft3	59.6
Mass of Water in Coke Drum	klb	1371
Vapor Space Volume	ft3	9758
Material in Vapor Space = PV/RT	lb-moles	23.6
Pressure in Drum Before Venting	psig	3.0
Temp in Drum Before Venting	degF	221.4
Vapor Generated from Water Flashing	wt%	0.98
Vapor Generated from Water Flashing	lbs	13376
Vapor from Vent Mole Weight	lb/lb-mol	18.1
Vapor Generated from Water Flashing	lb-mol	739
Vapor Generated per Event	lb-mol	763

Coke Drum Venting Emissions - Industry Data with Known Water Vaporization

Past Actual Baseline (2004-2005) Estimates

MLL-01/19/10
MRK 7/Apr/2010
ARA for TRP June 2012

Variable	Units	Toledo K3	
The rows below were added to calculate the average volume vented per cycle needed for Green House Gas calculations.			
Conversion factor kg - moles to scf	scf/kg mole	836.6	From GHG MRR regulation for standard temp of 60 F
Conversion factor lb - moles to scf	scf/lb mole	379.8	0.454 kg = 1 lb
Volume per cycle	scf/cycle	289,808	lb moles vented * conversion factor
Average cycle time from open to atmosphere to drum open for cutting	hours	1.50	Coker 3 from "Drum Times" worksheet cell R1.
Average vented rate	scf/hr	193,205	volume vented/ cycle time
% Water in Coke Drum Vent	mol%	98.2	
CH4 in Vent Vapor (wet)	mPPM	13867	Updated w/July Vent Testing
C2s in Vent Vapor (wet)	mPPM	1712	Updated w/July Vent Testing
H2S in Vent Vapor (wet)	mPPM	510	Updated w/July Vent Testing
VOCs in Vent Vapor (wet)	mPPM	1063	Updated w/July Vent Testing
CO in Vent Vapor (wet)	mPPM	51	Updated w/July Vent Testing
CO2 in Vent Vapor (wet)	mPPM	1000	GHG
PM in Vent Vapor (dry)	gr/DSCF	12	Updated w/July Vent Testing
CH4 Emissions per Event	lb-mol	10.6	
C2H6 Emissions per Event	lb-mol	1.3	
H2S Emissions per Event	lb-mol	0.4	
VOC Emissions per Event	lb-mol	0.8	
CO Emissions per Event	lb-mol	0.0	
CO2 Emissions per Event	lb-mol	0.8	
CH4 Mole Weight	lb/lb-mol	16.0	
C2H6 Mole Weight	lb/lb-mol	30.1	
H2S Mole Weight	lb/lb-mol	34.1	
VOC Mole Weight	lb/lb-mol	44.0	Updated w/July Vent Testing
CO Mole Weight	lb/lb-mol	28.0	
CO2 Mole Weight	lb/lb-mol	44.0	
CH4 Emissions per Event	lbs	169.7	
C2H6 Emissions per Event	lbs	39.3	
H2S Emissions per Event	lbs	13.3	

Coke Drum Venting Emissions - Industry Data with Known Water Vaporization

Past Actual Baseline (2004-2005) Estimates

MLL-01/19/10

MRK 7/Apr/2010

ARA for TRP June 2012

Variable	Units	Toledo K3
VOC Emissions per Event	lbs	35.7
CO Emissions per Event	lbs	1.1
CO2 Emissions per Event	lbs	33.6
PM Emissions per Event	lbs	9.0
Coke Drum Cycle Time	hrs	18.0
# of Coke Drum Pairs	#	1
Theoretical Drums Vented per Year	Events/yr	487
Actual Drums Vented per Year	Events/yr	424
CH4 Emissions Per Year	TPY	35.9
C2H6 Emissions Per Year	TPY	8.3
H2S Emissions Per Year	TPY	2.8
VOC Emissions Per Year	TPY	7.6
CO Emissions Per Year	TPY	0.2
CO2 Emissions Per Year	TPY	7.1
PM Emissions Per Year	TPY	1.9

Coke Drum Cutting Emissions - Industry Data with Known Water Vaporization

MLL-01/19/10 *=Data needed from each BP Site*

MRK 7/Apr/2010 *=Assumptions*

11B Coker - Enthalpy Balance Method

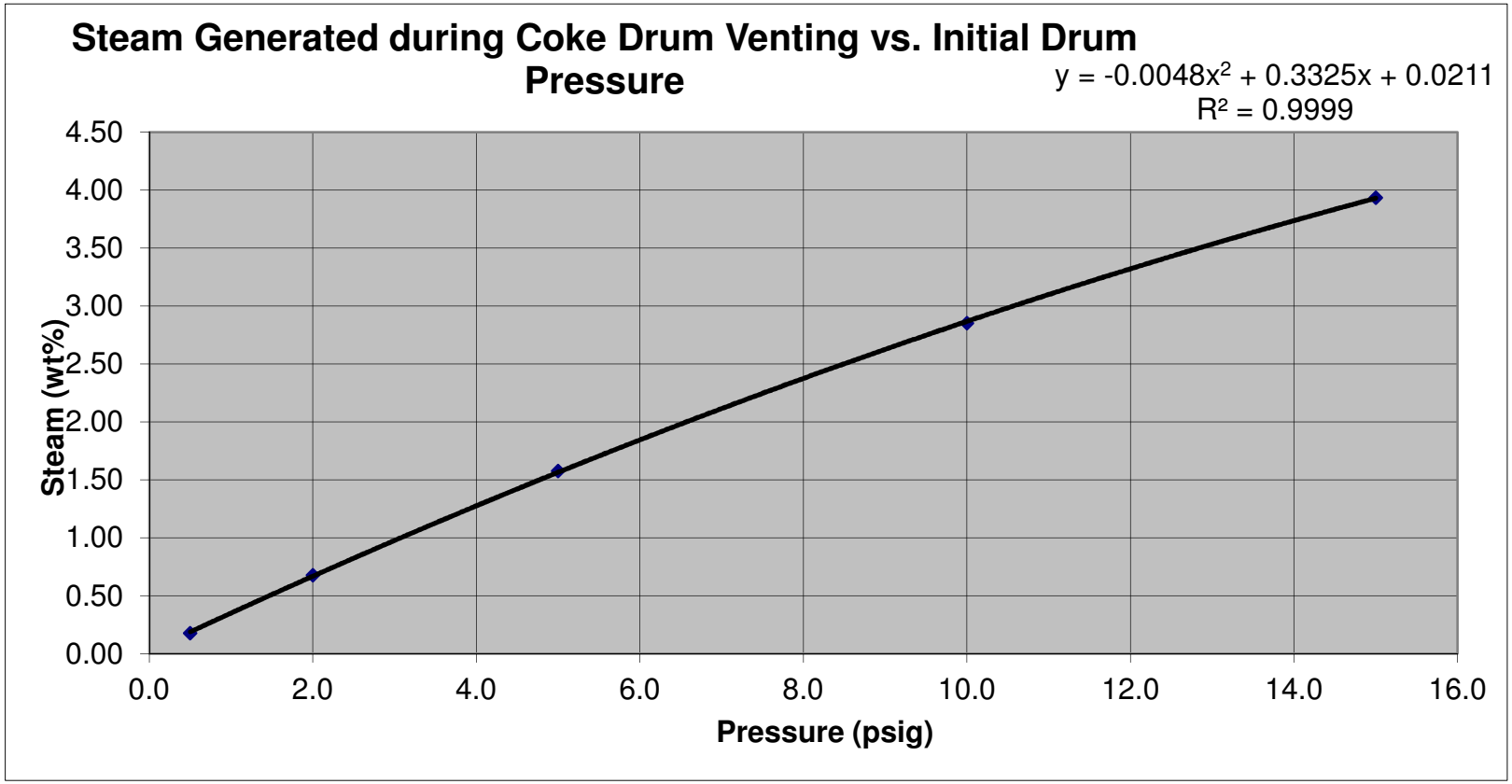
Variable	Value	Units	Comments	Carson #1	Toledo K3 - Past	Toledo K3 PTE	
N	1893	#/year	Number of Vessel Openings	1150	424	626	
Mc	339	tons	Mass of Coke per drum	653	1085	1085	
Md	78	tons	Mass of Individual Coke Drum	150	260	260	
Cpc	0.265	Btu/lb-F	Specific Heat of Coke, Perry's ChemE Handbook	0.265	0.265	0.265	
Cpd	0.12	Btu/lb-F	Specific Heat of Steel	0.12	0.12	0.12	
Cpw	1	Btu/lb-F	Specific Heat of Water	1	1	1	
T1	244	degF	Initial Temp of Coke (stm sat at 12psig)	227	213	213	
T2	212	degF	Final Temp of Coke (where water stops boiling)	212	212	212	
Tcw	81	degF	Temp of the cutting water (cooling circuit)	75	75	75	
Qc	5.7	MMBtu	Heat available from Coke	5.2	0.3	0.3	
Qd	0.6	MMBtu	Heat available from Coke Drum	0.5	0.0	0.0	
Qtot	6.3	MMBtu	Total Heat available from Coke/Coke Drum	5.7	0.3	0.3	
Pi	12	psig	Initial Pressure before Venting	5	0.1	0.1	
Pf	0	psig	Final Pressure	0	0	0	
Pave	6	psig	Average Pressure for Latent Heat	2.5	0.05	0.05	
Hv	960	Btu/lb	Heat of vaporization of water	966	970	970	
Hs	131	Btu/lb	Sensible Heat of Water	137	137	137	
Mw	5798	lb	Water Vaporized per drum	5209	304	304	
Mw	10974912	lbs/yr	Water Vaporized per year	5990056	128770.15	190255.8	
MWw	18.0	lb/lb-mol	Mole weight of vent	18.0	18.0	18.0	
Nw	609209.6	lb-mol/yr	Water Vaporized per year	332503.8	7147.9404	10560.96	
MF CH4	0.0120	mol frac	Mole Fraction of CH4	0.0120	0.0139	0.0139	Updated w/stack testing
MF C2H6	0.0042	mol frac	Mole Fraction of C2H6	0.0042	0.001712	0.001712	Updated w/stack testing
MF H2S	0.0002	mol frac	Mole Fraction of H2S	0.0002	0.00051	0.00051	Updated w/stack testing
MF VOC	0.0005	mol frac	Mole Fraction of VOC	0.0005	0.001063	0.001063	Updated w/stack testing
MF CO	0.0001	mol frac	Mole Fraction of CO	0.0001	0.000051	0.000051	Updated w/stack testing
MF CO2	0.001	mol frac	Mole Fraction of CO2	0.001	0.001	0.001	
Nch4	7311	lb-mol/yr	CH4/yr	3990	99	146	
Nc2h6	2559	lb-mol/yr	C2H6/yr	1397	12	18	
Nh2s	122	lb-mol/yr	H2S/yr	67	4	5	
Nvoc	305	lb-mol/yr	VOC/yr	166	8	11	
Nco	61	lb-mol/yr	CO/yr	33	0	1	
Nco2	609	lb-mol/yr	CO2/yr	333	7	11	
MWch4	16.0	lb/lb-mol	Mole Weight of CH4	16.0	16.0	16.0	
MWc2H6	30.1	lb/lb-mol	Mole Weight of C2H6	30.1	30.1	30.1	
MWh2S	34.1	lb/lb-mol	Mole Weight of H2S	34.1	34.1	34.1	
MWvoc	70.0	lb/lb-mol	Mole Weight of VOC	70.0	44.0	44.0	Updated w/stack testing
MWco	28.0	lb/lb-mol	Mole Weight of CO	28.0	28.0	28.0	
MWco2	44.0	lb/lb-mol	Mole Weight of CO2	44.0	44.0	44.0	
Mch4	58.6	TPY	CH4/yr	32.0	0.8	1.2	
Mc2h6	38.5	TPY	C2H6/yr	21.0	0.2	0.3	
Mh2S	2.1	TPY	H2S/yr	1.1	0.1	0.1	
Mvoc	10.7	TPY	VOC/yr	5.8	0.2	0.2	
Mco	0.9	TPY	CO/yr	0.5	0.0	0.0	
Mco2	13.4	TPY	CO2/yr	7.3	0.2	0.2	

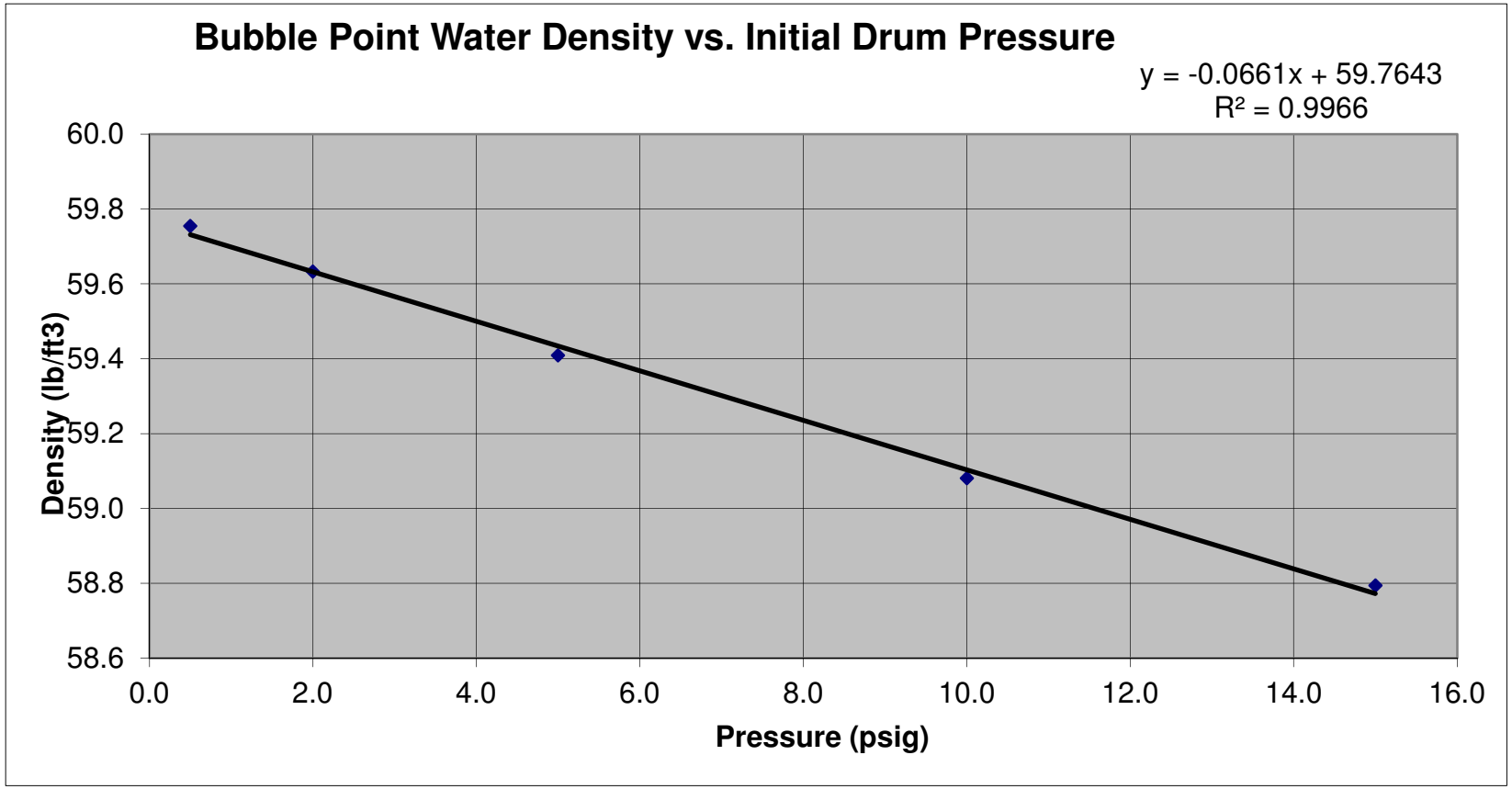
Coke Drum Draining Emissions - BP Data with Simplified Evaporative Emissions
MRK 12/Apr/2010

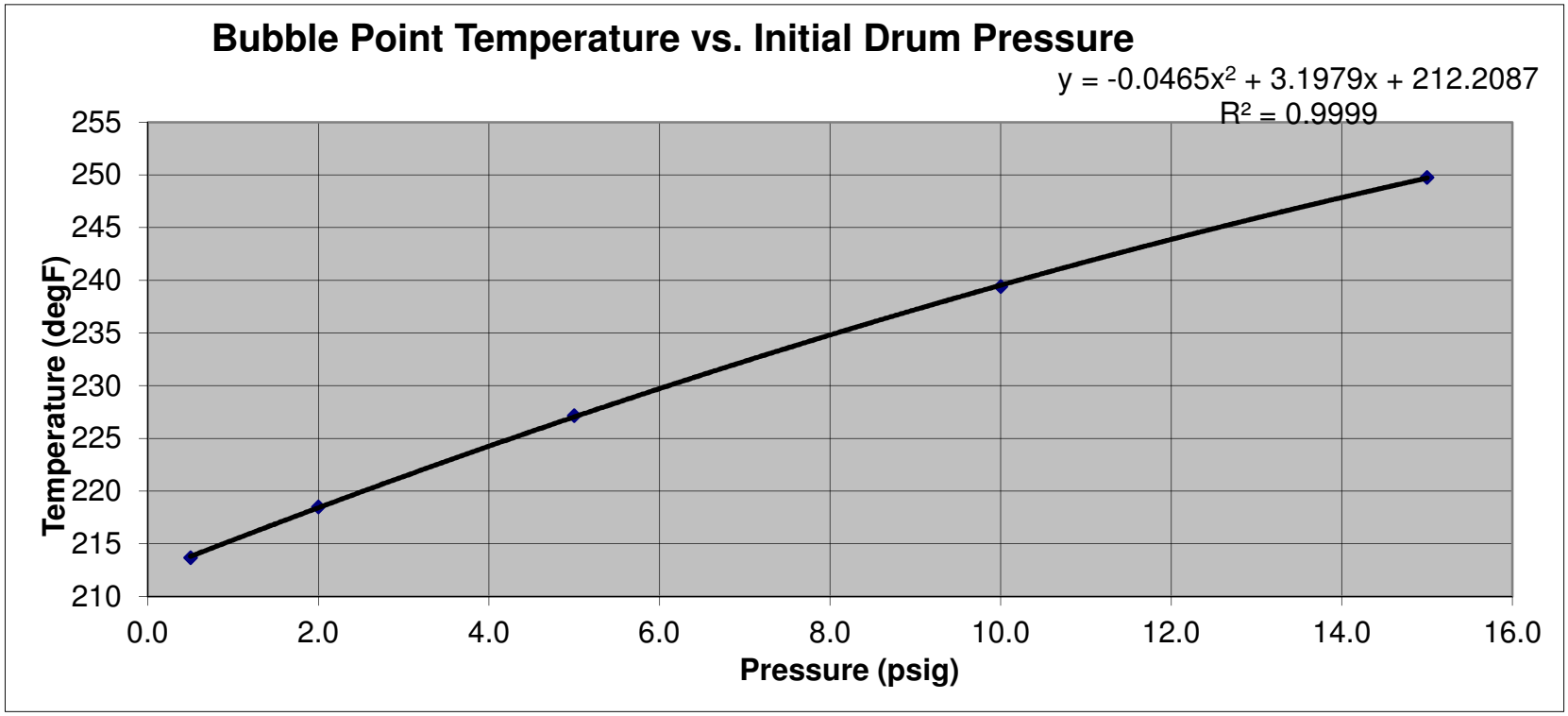
Variable	Units	Toledo K3 -Past	Toledo K3 PTE
Mass of Water in Coke Drum	klb	1371.3	1372.8
Vapor Generated from Water Flashing	wt%	0.98	0.67
Mass of Water Drained from Drum	k lbs	1357.9	1363.7
Actual Drums Vented per Year	Events/yr	424	626
Drilling water flow rate	gpm	1000	1000
Time required to drill a coke drum	hrs	3.5	3.5
Water used to drill a coke drum	k lbs	1751.4	1751.4
Water analysis based on Toledo K3 data			
VOC's in water drained from drum	mg/L	3	3
VOC's in water from drum while drilling	mg/L	1.4	1.4
VOC's in water base line	mg/L	0.7	0.7
H2S in water drained from drum	mg/L	16	16
H2S in water from drum while drilling	mg/L	6	6
H2S in water base line	mg/L	5	5
Pounds of VOC's per drum draining	lbs	3.123	3.136
Pounds of H2S per drum draining	lbs	14.937	15.000
Pounds of VOC's per drum drilling	lbs	1.226	1.226
Pounds of H2S per drum drilling	lbs	1.751	1.751
Tons/yr VOC's total	T/yr	0.92	1.36
Tons/yr H2S total	T/yr	3.53	5.24

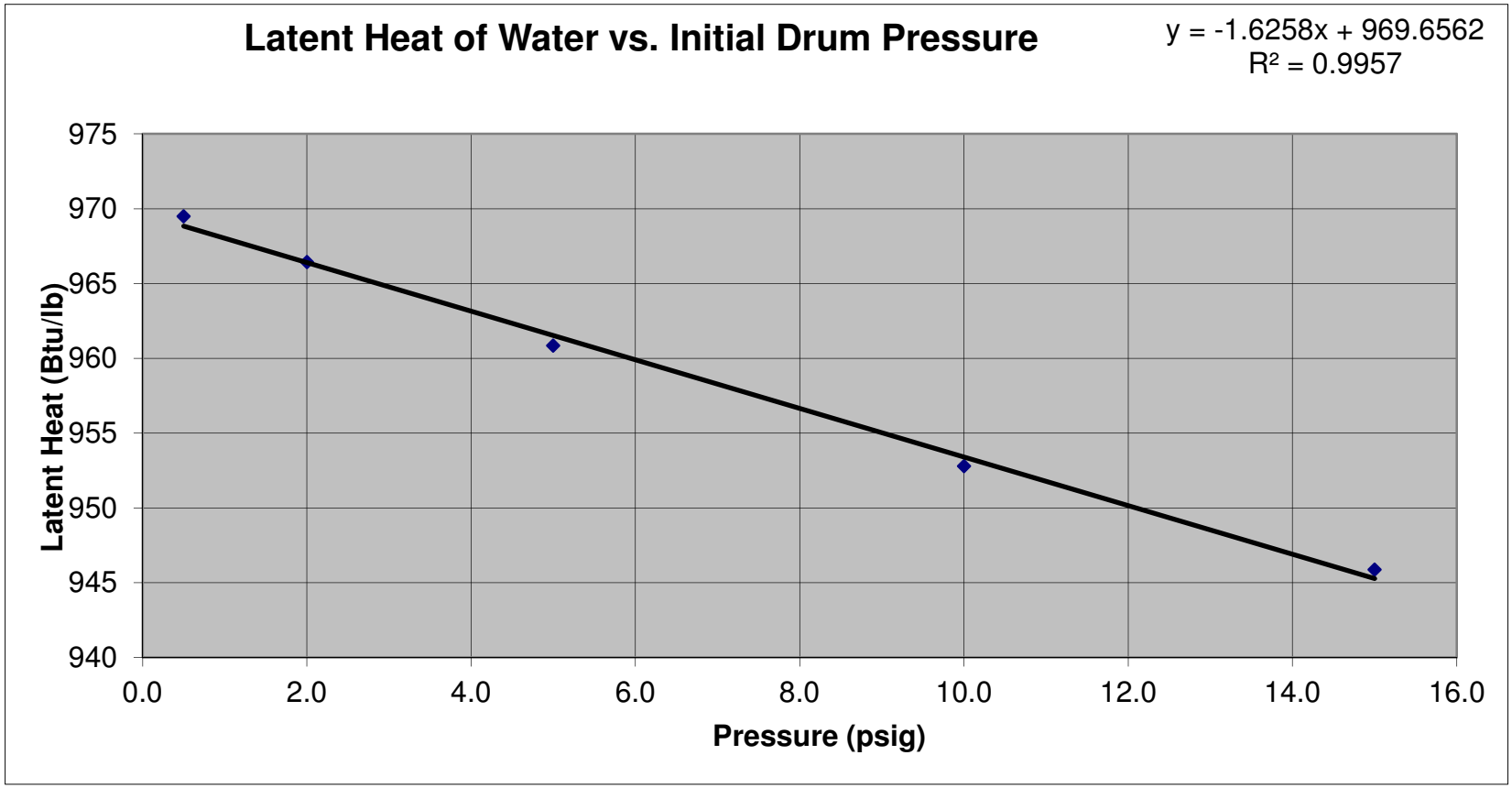
Water Vaporization vs. Initial Drum Pressure (assume 100% H2O)
MLL-11/30/09

Initial Conditions				Final Conditions			
Drum Press	Water Temp	Density	Latent Heat	Drum Press	Water Temp	Steam Generated	Water Remaining
psig	degF	lb/ft3	Btu/lb	psig	degF	wt%	wt%
15.0	250	58.8	946	0	212	3.93	96.07
10.0	239	59.1	953	0	212	2.85	97.15
5.0	227	59.4	961	0	212	1.57	98.43
2.0	219	59.6	966	0	212	0.68	99.32
0.5	214	59.8	970	0	212	0.18	99.82




Bubble Point Water Density vs. Initial Drum Pressure
y = -0.0661x + 59.7643
R² = 0.9966
60.0
59.8
59.6
59.4
59.2
59.0
58.8
58.6
Density (lb/ft3)
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
Pressure (psig)


Bubble Point Temperature vs. Initial Drum Pressure
y = -0.0465x² + 3.1979x + 212.2087
R² = 0.9999
Temperature (degF)
255
250
245
240
235
230
225
220
215
210
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
Pressure (psig)


Latent Heat of Water vs. Initial Drum Pressure
y = -1.6258x + 969.6562
R² = 0.9957
975
970
965
960
955
950
945
940
Latent Heat (Btu/lb)
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
Pressure (psig)

Appendix A

Attachment 2

SRU SO_2 Baseline Calculation Documentation

This workbook estimates emissions from Sulfur Recovery Unit 1 (P009) and SRUs 2&3 (P037). P009 does not have any mass emission limits.

At both SRUs, natural gas is fired for process heat and also in a thermal oxidizer that converts any H2S remaining in the tail gas to SO2. SO2 emissions are calculated from stack SO2 monitoring data and calculated stack flows.

The SO2 sheet documents the basis of the calculated stack flow.

The SRU #1 sheet calculates lbs SO2/day for permit recordkeeing, and other pollutants for annual emissions for use in fee statement reporting.

The SRU 2-3 Emissions sheet calculates 12-month rolling average emissions for use in compliance checking; the 4th quarter data is also used for annual fee reporting. The SRU 2-3 Data sheet pulls in PI data used in these calculations.

Annual emissions are summarized above for use in fee reporting.

Formatting Key
Blue font indicates cells that need to be updated manually. **Red shading with bold black text indicates values that exceed emission limits.**
Columns with sky blue headers indicate columns where calculations are performed. Columns with white headers pull in PI data. Columns with lavender headers contain hand-entered data.

SRU #2 & 3 Thermal Oxidizer Emissions

Month	Days in Month	SO2 Emissions Monthly lb/hr	SO2 Emissions Monthly ton/month
January-2004	31	2.812	1.05
February-2004	29	2.940	1.02
March-2004	31	3.284	1.22
April-2004	30	4.459	1.61
May-2004	31	7.390	2.75
June-2004	30	8.131	2.93
July-2004	31	8.547	3.18
August-2004	31	9.645	3.59
September-2004	30	6.954	2.50
October-2004	31	5.526	2.06
November-2004	30	4.466	1.61
December-2004	31	1.127	0.42
	Average	5.4402	23.9263

Limits set by PTI and Title V. DO NOT CHANGE.

LIMIT	**172 tons/rolling 12 months**
Title V (10-13-04)	Part III, A.I.1.RR.5
PTI 04-1046 (8/5/98)	Page 5

Example Calculations

SO2 Emissions (monthly tons) = total flue gas flow (mscfh) * (1000 / m) (560 R/520 R)
* 0.1733 (lb SO2/ft3 SO2) * (SO2 in TO exhaust (ppmv) / 1(
* 24 hours/day * no. days/month / 2000 lb/ton

See SO2 sheet for derivation of this equation.

BP Oil Company, Toledo Refinery **2004 data** avg Updated 2012

SRU 2&3 (P037) Thermal Oxidizer Data 456.77

	fc5719	ai5704	ai5705	fi5707	Flue Gas		Original values Flue Gas	
Month	TRP SRU T.O. - Fuel Gas mscfh dry, actual O2	TRP T.O. - SO2 ppm dry, actual O2	TRP T.O. - O2 % dry	TGT Vent Gas mscfh dry, actual O2	Theoretical (w/o excess air) mscfh	Total (w/ excess air) mscfh	Theoretical (w/o excess air) mscfh	Total (w/ excess air) mscfh
January 2004	12.67766346	23.15041321	2.357910296	455.3033412	578	651	604	681
February 2004	12.1527459	25.81724779	3.102577972	403.7256433	520	610	546	641
March 2004	12.47767541	29.50319593	3.361892917	382.5173594	501	596	529	630
April 2004	12.94513944	34.20650548	3.516981966	Failed to retrieve	**582**	698	526	632
May 2004	13.8112734	62.84256808	2.707994912	417.8748536	549	630	580	666
June 2004	13.72689576	69.48936907	2.030861789	435.5552912	566	627	596	660
July 2004	15.48692181	70.93095889	2.751873975	415.7861719	561	646	597	687
August 2004	15.89043275	72.22103234	1.938035617	498.3449065	650	716	684	754
September 2004	15.93684532	52.13591563	2.42508604	481.050358	632	715	667	754
October 2004	16.21215959	41.52611331	2.857899692	463.0802382	616	713	652	755
November 2004	17.68837698	30.5916397	2.155671054	534.240007	702	782	741	826
December 2004	17.37402654	7.630024721	2.370196721	537.0099931	702	791	740	834
January 2005								

Equations:

Flue Gas Theoretical, mscfh = NG fired, mscfh x ft3 flue gas/ft3 fuel gas + TGT vent gas, mscfh x ft3 flue gas / ft3 vent feed
Ratios of flue gas volume to fuel gas and vent feed volumes are calculated on the SO2 sheet.

Flue gas Actual (w/ excess air) = scf flue theoretical * (1 + (1/((21/stack O2) - 1))
This equation is derived on the SO2 sheet.

SRU #2 & 3 Thermal Oxidizer Emissions

Month	Days in Month	SO2 Emissions Monthly lb/hr	Ton/month
January 2005	31	1.862	0.69
February 2005	28	4.241	1.42
March 2005	31	1.188	0.44
April 2005	30	1.810	0.65
May-2005	31	0.879	0.33
June-2005	30	0.943	0.34
July-2005	31	1.554	0.58
August-2005	31	3.595	1.34
September-2005	30	3.075	1.11
October-2005	31	1.029	0.38
November-2005	30	0.529	0.19
December-2005	31	3.953	1.47
	Average	2.0548	8.9437

Limits set by PTI and Title V. DO NOT CHANGE.

LIMIT	**172 tons/rolling 12 months**
Title V (10-13-04)	Part III, A.I.1.RR.5
PTI 04-1046 (8/5/98)	Page 5

Example Calculations

SO2 Emissions (monthly tons) = total flue gas flow (mscfh) * (1000 / m) (560 R/520 R)
* 0.1733 (lb SO2/ft3 SO2) * (SO2 in TO exhaust (ppmv) / 10^6)
* 24 hours/day * no. days/month / 2000 lb/ton

See SO2 sheet for derivation of this equation.

BP Oil Company, Toledo Refinery **2005** Updated 2012

SRU 2&3 (P037) Thermal Oxidizer Data

	fc5719	ai5704	ai5705	fi5707	Flue Gas		Original values Flue Gas	
Month	TRP SRU T.O. - Fuel Gas mscfh dry, actual O2	TRP T.O. - SO2 ppm dry, actual O2	TRP T.O. - O2 % dry	TGT Vent Gas mscfh dry, actual O2	Theoretical (w/o excess air) mscfh	Total (w/ excess air) mscfh	Theoretical (w/o excess air) mscfh	Total (w/ excess air) mscfh
January 2005	16.3153453	13.25276617	3.082952367	487.5962876	642.1297509	753		
February 2005	15.49256189	33.46302185	4.908909996	376.1995064	520.2893821	679		
March 2005	15.85526857	8.671797756	3.750277748	453.6305883	603.1891119	734		
April 2005	13.86703929	18.72617354	1.962390299	340.4605259	469.5460679	518		
May 2005	13.35757942	7.475668519	2.0769005	440.0517946	567.8175715	630		
June 2005	11.56578151	8.31641237	1.903621457	440.2051411	552.6392946	608		
July 2005	9.635454354	12.70940127	1.870919344	499.2138478	596.9276948	655		
August 2005	10.50629445	30.72855625	3.058996705	432.3742442	535.5009679	627		
September 2005	14.74345355	31.77151756	4.750408562	266.9095594	401.2507725	519		
October 2005	12.77406806	14.87130735	8.315124186	111.1537872	223.8830496	371		
November 2005	12.27795734	4.410882899	2.995051537	432.5203773	550.8155293	642		
December 2005	13.05226289	30.54235833	2.877898424	472.322171	598.4599928	693		
January 2006								

Equations:

Flue Gas Theoretical, mscfh = NG fired, mscfh x ft3 flue gas/ft3 fuel gas + TGT vent gas, mscfh x ft3 flue gas / ft3 vent feed
Ratios of flue gas volume to fuel gas and vent feed volumes are calculated on the SO2 sheet.

Flue gas Actual (w/ excess air) = scf flue theoretical * (1 + (1/((21/stack O2) - 1))
This equation is derived on the SO2 sheet.

SRU 1 SO2 daily SO2 emissions (and other Fee emission calculations) **2004**

NOTE: Need to correct flow default of 300 MSCFH. Per "2004 TRP and SRU emissions.xls", echoke said unit ran 8760 hours (full time).

This looks like it should be %, not ppm. Using value as %.

FI3614 (the stack flow meter) was not operating in 2004. Per Unit Engineer max flow would be 300MSCFH. - based on stack test and ratio based on LTPD production - flow more like 125 MSCFH

	FI3516	ai3508c	2004 stack %O2 PI tag ai3507	fi3614		Flue Gas			
	SR1-FL GAS TO THRML OX	SR1-STACK SO_2--DRY	Thermo Oxidiz Stack O_2	TG1-TG ABS KO > THM OX	Flow rate corrected	Theoretical (w/o excess air)	Total (with excess air)	SRU 1 SO_2 emissions	Comment
Date	MSCFH	PPM	% O2	MSCFH	MSCFH	mscfh	mscfh	lb/hr	
01-Jan-04 00:00:00	5.807	77.743	3.154	10.939	125	**178.79**	210.39	3.05	
02-Jan-04 00:00:00	5.778	75.772	2.855	14.361	125	**178.55**	206.65	2.92	
03-Jan-04 00:00:00	5.331	74.218	3.297	15.491	125	**174.72**	207.27	2.87	
04-Jan-04 00:00:00	5.739	69.045	3.617	9.622	125	**178.21**	215.30	2.77	
05-Jan-04 00:00:00	6.409	72.448	4.034	9.086	125	**183.95**	227.69	3.08	
06-Jan-04 00:00:00	5.396	62.784	3.334	10.119	125	**175.28**	208.36	2.44	
07-Jan-04 00:00:00	6.147	67.060	3.880	13.761	125	**181.70**	222.89	2.79	
08-Jan-04 00:00:00	5.888	95.144	0.890	16.383	125	**179.49**	187.44	3.33	
09-Jan-04 00:00:00	5.545	83.848	0.135	19.640	125	**176.56**	177.70	2.78	
10-Jan-04 00:00:00	6.093	76.773	0.692	17.244	125	**181.24**	187.42	2.69	
11-Jan-04 00:00:00	8.910	71.537	3.072	9.157	125	**205.35**	240.54	3.21	
12-Jan-04 00:00:00	7.488	78.091	1.393	11.342	125	**193.18**	206.91	3.02	
13-Jan-04 00:00:00	6.582	75.439	0.814	12.903	125	**185.43**	192.90	2.72	
14-Jan-04 00:00:00	7.048	79.873	1.695	10.109	125	**189.41**	206.05	3.07	
15-Jan-04 00:00:00	6.725	67.866	1.348	9.547	125	**186.65**	199.45	2.53	
16-Jan-04 00:00:00	6.681	74.410	1.556	9.876	125	**186.27**	201.18	2.79	
17-Jan-04 00:00:00	7.415	63.184	1.510	10.904	125	**192.56**	207.47	2.45	
18-Jan-04 00:00:00	6.621	58.797	0.823	13.766	125	**185.76**	193.34	2.12	
19-Jan-04 00:00:00	6.674	58.097	0.694	15.932	125	**186.21**	192.58	2.09	
20-Jan-04 00:00:00	7.063	57.941	2.222	12.624	125	**189.55**	211.97	2.29	
21-Jan-04 00:00:00	6.498	67.090	1.939	12.709	125	**184.71**	203.50	2.55	
22-Jan-04 00:00:00	7.032	66.204	2.444	11.438	125	**189.28**	214.21	2.65	
23-Jan-04 00:00:00	5.803	77.127	1.125	16.772	125	**178.76**	188.87	2.72	
24-Jan-04 00:00:00	6.083	72.849	1.381	15.867	125	**181.16**	193.91	2.64	
25-Jan-04 00:00:00	5.889	69.509	1.273	13.942	125	**179.50**	191.08	2.48	
26-Jan-04 00:00:00	6.417	72.806	1.412	12.711	125	**184.02**	197.29	2.68	
27-Jan-04 00:00:00	6.612	87.216	1.410	13.063	125	**185.68**	199.04	3.24	
28-Jan-04 00:00:00	6.336	60.848	1.564	11.660	125	**183.32**	198.08	2.25	
29-Jan-04 00:00:00	6.171	64.273	1.634	12.215	125	**181.91**	197.25	2.37	
30-Jan-04 00:00:00	5.848	60.935	1.581	11.747	125	**179.14**	193.73	2.20	
31-Jan-04 00:00:00	6.901	72.389	1.953	10.617	125	**188.16**	207.45	2.80	
01-Feb-04 00:00:00	5.081	79.472	2.253	12.585	125	**172.58**	193.32	2.87	
02-Feb-04 00:00:00	5.973	74.941	2.201	12.793	125	**180.22**	201.32	2.82	
03-Feb-04 00:00:00	5.864	70.332	2.151	12.950	125	**179.28**	199.74	2.62	
04-Feb-04 00:00:00	6.528	64.895	2.679	13.352	125	**184.97**	212.02	2.57	
05-Feb-04 00:00:00	6.117	69.336	2.571	14.215	125	**181.45**	206.77	2.68	
06-Feb-04 00:00:00	5.817	74.244	2.512	14.634	125	**178.88**	203.18	2.82	
07-Feb-04 00:00:00	5.661	65.876	2.499	14.223	125	**177.55**	201.53	2.48	
08-Feb-04 00:00:00	5.676	77.310	2.660	14.714	125	**177.67**	203.44	2.94	
09-Feb-04 00:00:00	5.965	74.379	2.356	15.255	125	**180.15**	202.92	2.82	
10-Feb-04 00:00:00	6.389	74.177	2.671	14.976	125	**183.77**	210.55	2.91	
11-Feb-04 00:00:00	6.221	75.965	2.690	15.263	125	**182.34**	209.12	2.96	
12-Feb-04 00:00:00	6.502	75.173	2.612	15.244	125	**184.75**	210.99	2.96	
13-Feb-04 00:00:00	5.883	70.175	2.497	14.625	125	**179.45**	203.67	2.67	
14-Feb-04 00:00:00	6.132	77.465	2.462	14.637	125	**181.58**	205.69	2.97	
15-Feb-04 00:00:00	5.813	75.467	2.372	14.900	125	**178.84**	201.62	2.84	
16-Feb-04 00:00:00	5.885	78.433	2.403	15.743	125	**179.46**	202.65	2.97	
17-Feb-04 00:00:00	6.312	83.089	2.569	16.421	125	**183.12**	208.63	3.24	
18-Feb-04 00:00:00	6.976	83.351	2.586	14.365	125	**188.80**	215.32	3.35	
19-Feb-04 00:00:00	7.169	87.368	2.532	16.193	125	**190.46**	216.56	3.53	
20-Feb-04 00:00:00	7.287	80.909	2.386	15.606	125	**191.46**	216.00	3.26	
21-Feb-04 00:00:00	6.562	77.494	2.145	15.796	125	**185.26**	206.33	2.98	
22-Feb-04 00:00:00	6.335	81.025	2.341	17.121	125	**183.31**	206.31	3.12	
23-Feb-04 00:00:00	6.401	79.054	2.278	17.122	125	**183.88**	206.25	3.04	
24-Feb-04 00:00:00	6.470	77.228	2.493	15.011	125	**184.47**	209.32	3.02	
25-Feb-04 00:00:00	6.541	74.660	2.939	12.393	125	**185.08**	215.20	3.00	
26-Feb-04 00:00:00	6.233	73.988	2.662	13.766	125	**182.44**	208.93	2.88	
27-Feb-04 00:00:00	5.745	79.617	2.626	13.809	125	**178.27**	203.75	3.03	
28-Feb-04 00:00:00	4.913	83.466	2.464	15.986	125	**171.14**	193.89	3.02	

SRU 1 SO2 daily SO2 emissions (and other Fee emission calculations) **2004**

NOTE: Need to correct flow default of 300 MSCFH. Per "2004 TRP and SRU emissions.xls", echoke said unit ran 8760 hours (full time).

This looks like it should be %, not ppm. Using value as %.

FI3614 (the stack flow meter) was not operating in 2004. Per Unit Engineer max flow would be 300MSCFH. - based on stack test and ratio based on LTPD production - flow more like 125 MSCFH

	FI3516	ai3508c	2004 stack %O2 PI tag ai3507	fi3614		Flue Gas			
	SR1-FL GAS TO THRML OX	SR1-STACK SO_2--DRY	Thermo Oxidiz Stack O_2	TG1-TG ABS KO > THM OX	Flow rate corrected	Theoretical (w/o excess air)	Total (with excess air)	SRU 1 SO_2 emissions	Comment
Date	MSCFH	PPM	% O2	MSCFH	MSCFH	mscfh	mscfh	lb/hr	
29-Feb-04 00:00:00	5.358	82.422	2.523	15.390	125	**174.95**	198.85	3.06	
01-Mar-04 00:00:00	6.044	77.804	2.452	14.960	125	**180.82**	204.72	2.97	
02-Mar-04 00:00:00	5.986	81.198	2.412	14.906	125	**180.33**	203.73	3.09	
03-Mar-04 00:00:00	5.666	79.239	2.653	14.775	125	**177.59**	203.27	3.01	
04-Mar-04 00:00:00	5.834	82.939	2.594	14.263	125	**179.02**	204.26	3.16	
05-Mar-04 00:00:00	6.603	63.291	2.602	14.044	125	**185.61**	211.86	2.50	
06-Mar-04 00:00:00	5.695	65.257	2.507	14.552	125	**177.83**	201.94	2.46	
07-Mar-04 00:00:00	5.666	72.886	2.607	13.914	125	**177.59**	202.76	2.76	
08-Mar-04 00:00:00	5.859	70.216	2.653	14.834	125	**179.24**	205.15	2.69	
09-Mar-04 00:00:00	5.904	73.347	2.832	13.884	125	**179.62**	207.63	2.84	
10-Mar-04 00:00:00	5.689	75.090	2.754	13.493	125	**177.78**	204.62	2.87	
11-Mar-04 00:00:00	5.697	72.950	2.619	13.822	125	**177.86**	203.20	2.77	
12-Mar-04 00:00:00	5.303	68.359	2.603	14.495	125	**174.48**	199.17	2.54	
13-Mar-04 00:00:00	5.686	69.574	2.989	13.567	125	**177.76**	207.26	2.69	
14-Mar-04 00:00:00	6.159	66.248	2.937	13.872	125	**181.81**	211.37	2.61	
15-Mar-04 00:00:00	5.719	73.937	2.715	14.540	125	**178.04**	204.48	2.82	
16-Mar-04 00:00:00	5.540	65.313	2.606	14.224	125	**176.51**	201.52	2.46	
17-Mar-04 00:00:00	5.748	71.679	2.723	15.090	125	**178.29**	204.85	2.74	
18-Mar-04 00:00:00	4.233	94.666	2.142	8.687	125	**165.32**	184.10	3.25	
19-Mar-04 00:00:00	8.761	Good Data Fo	4.633	0.005	125	**204.08**	261.85	**0.00**	SRU1 down?
20-Mar-04 00:00:00	7.625	Good Data Fo	4.887	0.005	125	**194.36**	253.30	**0.00**	SRU1 down?
21-Mar-04 00:00:00	6.419	Good Data Fo	4.985	0.005	125	**184.03**	241.31	**0.00**	SRU1 down?
22-Mar-04 00:00:00	6.349	201.230	5.551	0.005	125	**183.44**	249.35	9.36	SRU1 down?
23-Mar-04 00:00:00	3.875	210.291	6.165	0.005	125	**162.26**	229.69	9.01	SRU1 down?
24-Mar-04 00:00:00	4.857	220.863	7.441	0.005	125	**170.67**	264.33	10.90	SRU1 down?
25-Mar-04 00:00:00	7.134	186.046	5.487	0.005	125	**190.15**	257.41	8.94	SRU1 down?
26-Mar-04 00:00:00	7.149	213.872	6.035	0.005	125	**190.28**	267.01	10.66	SRU1 down?
27-Mar-04 00:00:00	7.289	212.160	4.187	0.005	125	**191.48**	239.16	9.47	SRU1 down?
28-Mar-04 00:00:00	7.441	189.160	3.056	0.005	125	**192.78**	225.61	7.96	SRU1 down?
29-Mar-04 00:00:00	7.104	204.800	3.032	0.005	125	**189.90**	221.95	8.48	SRU1 down?
30-Mar-04 00:00:00	8.122	184.908	5.105	0.005	125	**198.61**	262.40	9.06	SRU1 down?
31-Mar-04 00:00:00	8.221	169.392	3.161	0.005	125	**199.46**	234.80	7.42	SRU1 down?
01-Apr-04 00:00:00	8.191	163.412	5.802	0.005	125	**199.20**	275.25	8.39	SRU1 down?
02-Apr-04 00:00:00	8.162	177.165	4.751	0.005	125	**198.95**	257.12	8.50	SRU1 down?
03-Apr-04 00:00:00	8.132	176.914	4.367	0.005	125	**198.69**	250.86	8.28	SRU1 down?
04-Apr-04 00:00:00	8.384	133.133	3.635	0.005	125	**200.85**	242.90	6.04	SRU1 down?
05-Apr-04 00:00:00	9.163	117.430	6.466	0.005	125	**207.52**	299.84	6.57	SRU1 down?
06-Apr-04 00:00:00	9.591	Good Data Fo	7.444	0.005	125	**211.18**	327.14	**0.00**	SRU1 down?
07-Apr-04 00:00:00	9.581	Good Data Fo	5.760	0.005	125	**211.10**	290.88	**0.00**	SRU1 down?
08-Apr-04 00:00:00	7.431	131.243	0.848	16.593	125	**192.69**	200.80	4.92	
09-Apr-04 00:00:00	7.365	105.336	4.163	28.153	125	**192.13**	239.64	4.71	
10-Apr-04 00:00:00	6.104	102.311	2.832	31.335	125	**181.34**	209.61	4.00	
11-Apr-04 00:00:00	5.660	102.945	2.450	34.336	125	**177.54**	200.98	3.86	
12-Apr-04 00:00:00	5.754	91.126	2.639	36.944	125	**178.34**	203.98	3.47	
13-Apr-04 00:00:00	5.815	89.445	2.575	38.943	125	**178.87**	203.87	3.40	
14-Apr-04 00:00:00	5.972	89.962	2.516	43.503	125	**180.21**	204.74	3.44	
15-Apr-04 00:00:00	5.779	96.875	2.409	44.463	125	**178.56**	201.70	3.65	
16-Apr-04 00:00:00	6.058	98.117	2.651	44.314	125	**180.94**	207.08	3.79	
17-Apr-04 00:00:00	6.232	103.423	2.683	46.203	125	**182.44**	209.16	4.04	
18-Apr-04 00:00:00	6.192	92.009	2.516	45.952	125	**182.09**	206.87	3.55	
19-Apr-04 00:00:00	6.284	90.822	2.564	43.679	125	**182.87**	208.31	3.53	
20-Apr-04 00:00:00	6.041	84.189	2.623	44.106	125	**180.80**	206.60	3.25	
21-Apr-04 00:00:00	6.078	92.014	2.447	46.092	125	**181.11**	205.00	3.52	
22-Apr-04 00:00:00	6.092	94.130	2.604	46.287	125	**181.24**	206.90	3.63	
23-Apr-04 00:00:00	5.835	97.778	2.327	45.254	125	**179.04**	201.34	3.67	
24-Apr-04 00:00:00	5.742	96.294	2.245	45.026	125	**178.24**	199.58	3.59	
25-Apr-04 00:00:00	5.755	95.315	2.474	42.942	125	**178.35**	202.16	3.60	
26-Apr-04 00:00:00	5.975	94.925	2.914	38.911	125	**180.23**	209.27	3.71	
27-Apr-04 00:00:00	5.895	85.853	2.681	42.992	125	**179.55**	205.83	3.30	

SRU 1 SO2 daily SO2 emissions (and other Fee emission calculations) **2004**

NOTE: Need to correct flow default of 300 MSCFH. Per "2004 TRP and SRU emissions.xls", echoke said unit ran 8760 hours (full time).

This looks like it should be %, not ppm. Using value as %.

FI3614 (the stack flow meter) was not operating in 2004. Per Unit Engineer max flow would be 300MSCFH. - based on stack test and ratio based on LTPD production - flow more like 125 MSCFH

	FI3516	ai3508c	2004 stack %O2 PI tag ai3507	fi3614		Flue Gas			
	SR1-FL GAS TO THRML OX	SR1-STACK SO_2--DRY	Thermo Oxidiz Stack O_2	TG1-TG ABS KO > THM OX	Flow rate corrected	Theoretical (w/o excess air)	Total (with excess air)	SRU 1 SO_2 emissions	Comment
Date	MSCFH	PPM	% O2	MSCFH	MSCFH	mscfh	mscfh	lb/hr	
28-Apr-04 00:00:00	6.036	83.964	2.695	44.069	125	**180.75**	207.36	3.25	
29-Apr-04 00:00:00	6.211	92.646	2.737	45.307	125	**182.25**	209.57	3.62	
30-Apr-04 00:00:00	6.605	100.136	3.132	44.605	125	**185.62**	218.16	4.08	
01-May-04 00:00:00	6.205	95.237	2.720	43.893	125	**182.20**	209.31	3.72	
02-May-04 00:00:00	5.833	86.581	2.495	41.469	125	**179.01**	203.15	3.28	
03-May-04 00:00:00	6.007	87.479	2.909	43.812	125	**180.50**	209.53	3.42	
04-May-04 00:00:00	6.248	89.809	3.452	38.303	125	**182.57**	218.48	3.66	
05-May-04 00:00:00	6.815	100.924	4.366	32.799	125	**187.42**	236.62	4.46	
06-May-04 00:00:00	6.988	99.996	4.303	32.591	125	**188.90**	237.59	4.43	
07-May-04 00:00:00	7.310	83.099	4.357	33.610	125	**191.66**	241.83	3.75	
08-May-04 00:00:00	6.993	70.029	3.833	38.196	125	**188.94**	231.14	3.02	
09-May-04 00:00:00	6.822	53.038	3.669	38.759	125	**187.48**	227.17	2.25	
10-May-04 00:00:00	7.189	53.532	3.346	49.019	125	**190.62**	226.75	2.27	
11-May-04 00:00:00	7.292	51.029	2.990	57.699	125	**191.51**	223.31	2.13	
12-May-04 00:00:00	6.952	51.786	2.497	58.551	125	**188.60**	214.05	2.07	
13-May-04 00:00:00	6.921	54.240	2.514	56.686	125	**188.33**	213.94	2.17	
14-May-04 00:00:00	6.971	51.003	2.536	55.736	125	**188.76**	214.69	2.04	
15-May-04 00:00:00	7.116	44.953	2.961	53.149	125	**190.00**	221.18	1.86	
16-May-04 00:00:00	7.161	45.059	3.128	53.374	125	**190.38**	223.70	1.88	
17-May-04 00:00:00	7.269	47.091	3.010	54.608	125	**191.31**	223.32	1.96	
18-May-04 00:00:00	7.146	52.000	2.716	56.112	125	**190.25**	218.52	2.12	
19-May-04 00:00:00	6.882	45.782	2.761	54.369	125	**188.00**	216.45	1.85	
20-May-04 00:00:00	7.059	49.370	2.677	56.561	125	**189.51**	217.20	2.00	
21-May-04 00:00:00	7.252	48.924	2.861	54.936	125	**191.16**	221.32	2.02	
22-May-04 00:00:00	7.073	48.974	2.672	56.819	125	**189.63**	217.27	1.99	
23-May-04 00:00:00	7.574	49.325	3.046	56.444	125	**193.91**	226.82	2.09	
24-May-04 00:00:00	8.154	45.647	3.606	54.333	125	**198.88**	240.12	2.05	
25-May-04 00:00:00	8.428	51.080	3.838	54.034	125	**201.22**	246.23	2.35	
26-May-04 00:00:00	8.016	56.070	3.528	54.751	125	**197.70**	237.61	2.49	
27-May-04 00:00:00	7.547	53.475	3.150	56.305	125	**193.68**	227.86	2.27	
28-May-04 00:00:00	7.179	62.067	2.868	55.349	125	**190.54**	220.67	2.56	
29-May-04 00:00:00	7.077	81.322	2.952	56.341	125	**189.66**	220.69	3.35	
30-May-04 00:00:00	6.957	83.913	2.630	57.130	125	**188.64**	215.65	3.38	
31-May-04 00:00:00	7.045	83.085	2.630	57.737	125	**189.39**	216.51	3.36	
01-Jun-04 00:00:00	7.127	89.336	2.982	57.388	125	**190.09**	221.55	3.69	
02-Jun-04 00:00:00	7.540	89.048	3.250	57.032	125	**193.63**	229.09	3.81	
03-Jun-04 00:00:00	7.491	87.020	3.258	56.702	125	**193.21**	228.68	3.71	
04-Jun-04 00:00:00	7.361	90.621	3.230	55.828	125	**192.09**	227.01	3.84	
05-Jun-04 00:00:00	7.357	96.996	3.168	55.733	125	**192.06**	226.19	4.09	
06-Jun-04 00:00:00	7.511	105.176	3.191	56.159	125	**193.38**	228.03	4.48	
07-Jun-04 00:00:00	7.437	110.937	3.083	58.127	125	**192.75**	225.91	4.68	
08-Jun-04 00:00:00	7.579	126.629	3.013	59.264	125	**193.96**	226.46	5.35	
09-Jun-04 00:00:00	7.135	160.514	2.560	59.857	125	**190.16**	216.56	6.49	
10-Jun-04 00:00:00	7.669	172.598	3.356	61.434	125	**194.74**	231.78	7.47	
11-Jun-04 00:00:00	7.292	169.937	3.403	57.657	125	**191.50**	228.53	7.25	
12-Jun-04 00:00:00	6.936	168.937	3.183	59.081	125	**188.46**	222.12	7.00	
13-Jun-04 00:00:00	7.136	181.572	3.027	60.280	125	**190.17**	222.19	7.53	
14-Jun-04 00:00:00	6.909	192.465	2.756	61.319	125	**188.23**	216.66	7.78	
15-Jun-04 00:00:00	6.308	174.514	2.145	62.397	125	**183.08**	203.91	6.64	
16-Jun-04 00:00:00	6.614	151.946	2.792	58.316	125	**185.70**	214.18	6.07	
17-Jun-04 00:00:00	6.311	131.779	2.056	59.417	125	**183.11**	202.98	4.99	
18-Jun-04 00:00:00	6.706	143.273	2.614	58.845	125	**186.49**	213.01	5.70	
19-Jun-04 00:00:00	6.391	125.767	2.165	59.529	125	**183.79**	204.92	4.81	
20-Jun-04 00:00:00	5.753	117.731	1.401	61.559	125	**178.33**	191.08	4.20	
21-Jun-04 00:00:00	5.490	115.353	0.981	60.582	125	**176.08**	184.71	3.98	
22-Jun-04 00:00:00	5.774	121.911	1.390	59.466	125	**178.51**	191.16	4.35	
23-Jun-04 00:00:00	5.577	123.926	1.310	59.712	125	**176.82**	188.58	4.36	
24-Jun-04 00:00:00	5.755	121.951	1.486	58.480	125	**178.35**	191.92	4.37	
25-Jun-04 00:00:00	5.719	119.810	1.577	57.027	125	**178.04**	192.50	4.30	

SRU 1 SO2 daily SO2 emissions (and other Fee emission calculations) **2004**

NOTE: Need to correct flow default of 300 MSCFH. Per "2004 TRP and SRU emissions.xls", echoke said unit ran 8760 hours (full time).

This looks like it should be %, not ppm. Using value as %.

FI3614 (the stack flow meter) was not operating in 2004. Per Unit Engineer max flow would be 300MSCFH. - based on stack test and ratio based on LTPD production - flow more like 125 MSCFH

	FI3516	ai3508c	2004 stack %O2 PI tag ai3507	fi3614		Flue Gas			
	SR1-FL GAS TO THRML OX	SR1-STACK SO_2--DRY	Thermo Oxidiz Stack O_2	TG1-TG ABS KO > THM OX	Flow rate corrected	Theoretical (w/o excess air)	Total (with excess air)	SRU 1 SO_2 emissions	Comment
Date	MSCFH	PPM	% O2	MSCFH	MSCFH	mscfh	mscfh	lb/hr	
26-Jun-04 00:00:00	5.570	116.316	1.260	59.974	125	**176.77**	188.05	4.08	
27-Jun-04 00:00:00	5.683	121.581	1.340	59.868	125	**177.74**	189.85	4.31	
28-Jun-04 00:00:00	5.788	132.454	1.340	59.201	125	**178.63**	190.81	4.72	
29-Jun-04 00:00:00	5.630	138.705	1.610	58.699	125	**177.28**	192.00	4.97	
30-Jun-04 00:00:00	6.414	160.387	2.637	59.544	125	**183.99**	210.41	6.30	
01-Jul-04 00:00:00	7.492	153.907	3.448	52.693	125	**193.22**	231.18	6.64	
02-Jul-04 00:00:00	7.698	140.816	3.428	32.026	125	**194.98**	233.02	6.12	
03-Jul-04 00:00:00	7.758	138.949	3.442	34.397	125	**195.49**	233.82	6.06	
04-Jul-04 00:00:00	7.489	137.778	3.330	33.403	125	**193.19**	229.60	5.90	
05-Jul-04 00:00:00	7.747	138.462	3.468	34.285	125	**195.40**	234.04	6.05	
06-Jul-04 00:00:00	7.722	141.903	3.535	34.866	125	**195.18**	234.68	6.22	
07-Jul-04 00:00:00	7.661	140.444	3.457	34.642	125	**194.67**	233.03	6.11	
08-Jul-04 00:00:00	7.742	131.726	3.600	34.037	125	**195.36**	235.78	5.80	
09-Jul-04 00:00:00	7.884	140.723	3.626	35.015	125	**196.57**	237.59	6.24	
10-Jul-04 00:00:00	7.788	150.653	3.655	35.188	125	**195.75**	237.00	6.66	
11-Jul-04 00:00:00	7.622	149.812	3.478	35.900	125	**194.33**	232.90	6.51	
12-Jul-04 00:00:00	7.482	150.641	3.337	35.674	125	**193.13**	229.62	6.46	
13-Jul-04 00:00:00	7.793	156.662	3.483	37.103	125	**195.79**	234.72	6.86	
14-Jul-04 00:00:00	7.588	143.123	3.374	35.312	125	**194.04**	231.19	6.18	
15-Jul-04 00:00:00	7.531	138.076	3.428	35.328	125	**193.55**	231.31	5.96	
16-Jul-04 00:00:00	7.703	145.306	3.648	35.072	125	**195.02**	236.02	6.40	
17-Jul-04 00:00:00	7.630	144.727	3.558	33.562	125	**194.39**	234.05	6.32	
18-Jul-04 00:00:00	6.985	140.036	3.154	34.968	125	**188.88**	222.25	5.81	
19-Jul-04 00:00:00	6.612	139.056	2.678	39.593	125	**185.68**	212.83	5.52	
20-Jul-04 00:00:00	6.438	143.318	2.634	40.490	125	**184.20**	210.61	5.63	
21-Jul-04 00:00:00	6.550	145.534	2.543	40.285	125	**185.16**	210.67	5.72	
22-Jul-04 00:00:00	6.502	141.426	2.505	39.085	125	**184.74**	209.77	5.54	
23-Jul-04 00:00:00	6.556	126.893	2.399	38.275	125	**185.21**	209.09	4.95	
24-Jul-04 00:00:00	6.607	128.543	2.474	41.542	125	**185.64**	210.43	5.05	
25-Jul-04 00:00:00	6.554	122.034	2.351	41.641	125	**185.19**	208.53	4.75	
26-Jul-04 00:00:00	6.594	122.722	2.395	39.740	125	**185.53**	209.42	4.80	
27-Jul-04 00:00:00	6.041	125.162	2.964	27.637	125	**180.80**	210.51	4.92	
28-Jul-04 00:00:00	6.452	144.475	3.478	30.549	125	**184.31**	220.90	5.96	
29-Jul-04 00:00:00	6.154	152.664	3.323	31.038	125	**181.76**	215.93	6.15	
30-Jul-04 00:00:00	6.285	153.360	3.289	30.884	125	**182.89**	216.86	6.21	
31-Jul-04 00:00:00	6.876	142.220	2.522	42.831	125	**187.95**	213.60	5.67	
01-Aug-04 00:00:00	7.092	138.454	2.661	53.399	125	**189.79**	217.33	5.62	
02-Aug-04 00:00:00	7.020	151.011	2.246	49.306	125	**189.18**	211.84	5.97	
03-Aug-04 00:00:00	7.419	160.877	2.182	49.382	125	**192.59**	214.92	6.45	
04-Aug-04 00:00:00	7.856	160.498	2.522	44.446	125	**196.33**	223.14	6.68	
05-Aug-04 00:00:00	7.477	150.125	2.453	45.487	125	**193.09**	218.63	6.13	
06-Aug-04 00:00:00	7.711	140.365	2.166	52.242	125	**195.10**	217.53	5.70	
07-Aug-04 00:00:00	7.446	151.558	2.312	53.850	125	**192.82**	216.67	6.13	
08-Aug-04 00:00:00	7.583	154.880	2.402	53.352	125	**194.00**	219.05	6.33	
09-Aug-04 00:00:00	7.488	161.178	2.461	51.890	125	**193.18**	218.83	6.58	
10-Aug-04 00:00:00	7.458	157.158	2.504	50.494	125	**192.92**	219.04	6.42	
11-Aug-04 00:00:00	7.758	152.675	2.809	49.118	125	**195.49**	225.67	6.43	
12-Aug-04 00:00:00	7.974	162.345	2.802	49.520	125	**197.34**	227.73	6.90	
13-Aug-04 00:00:00	7.778	153.185	2.702	50.452	125	**195.67**	224.56	6.42	
14-Aug-04 00:00:00	7.749	159.409	2.733	51.411	125	**195.42**	224.65	6.68	
15-Aug-04 00:00:00	7.789	158.731	2.688	52.603	125	**195.76**	224.49	6.65	
16-Aug-04 00:00:00	8.034	156.634	2.903	56.026	125	**197.86**	229.59	6.71	
17-Aug-04 00:00:00	8.039	161.377	2.906	54.926	125	**197.90**	229.67	6.92	
18-Aug-04 00:00:00	7.695	160.546	2.639	57.646	125	**194.96**	222.98	6.68	
19-Aug-04 00:00:00	7.702	155.478	2.650	56.973	125	**195.02**	223.17	6.48	
20-Aug-04 00:00:00	7.740	154.371	2.599	55.318	125	**195.34**	222.94	6.42	
21-Aug-04 00:00:00	7.528	149.628	2.546	55.003	125	**193.52**	220.22	6.15	
22-Aug-04 00:00:00	7.558	155.498	2.594	51.147	125	**193.78**	221.09	6.42	
23-Aug-04 00:00:00	8.175	177.228	2.847	52.887	125	**199.07**	230.28	7.62	

SRU 1 SO2 daily SO2 emissions (and other Fee emission calculations) **2004**

NOTE: Need to correct flow default of 300 MSCFH. Per "2004 TRP and SRU emissions.xls", echoke said unit ran 8760 hours (full time).

This looks like it should be %, not ppm. Using value as %.

FI3614 (the stack flow meter) was not operating in 2004. Per Unit Engineer max flow would be 300MSCFH. - based on stack test and ratio based on LTPD production - flow more like 125 MSCFH

	FI3516	ai3508c	2004 stack %O2 PI tag ai3507	fi3614		Flue Gas			
	SR1-FL GAS TO THRML OX	SR1-STACK SO_2--DRY	Thermo Oxidiz Stack O_2	TG1-TG ABS KO > THM OX	Flow rate corrected	Theoretical (w/o excess air)	Total (with excess air)	SRU 1 SO_2 emissions	Comment
Date	MSCFH	PPM	% O2	MSCFH	MSCFH	mscfh	mscfh	lb/hr	
24-Aug-04 00:00:00	7.989	167.948	2.611	55.474	125	**197.47**	225.50	7.07	
25-Aug-04 00:00:00	8.153	170.100	2.621	52.788	125	**198.88**	227.24	7.21	
26-Aug-04 00:00:00	8.485	169.735	2.712	55.684	125	**201.72**	231.62	7.34	
27-Aug-04 00:00:00	8.538	166.066	2.631	56.253	125	**202.17**	231.13	7.16	
28-Aug-04 00:00:00	8.394	167.203	2.603	57.645	125	**200.94**	229.37	7.16	
29-Aug-04 00:00:00	8.554	151.097	2.538	56.361	125	**202.31**	230.12	6.49	
30-Aug-04 00:00:00	8.340	153.919	2.460	59.893	125	**200.47**	227.07	6.52	
31-Aug-04 00:00:00	8.151	150.071	2.298	63.042	125	**198.86**	223.29	6.25	
01-Sep-04 00:00:00	7.946	153.453	2.024	69.550	125	**197.11**	218.13	6.25	
02-Sep-04 00:00:00	7.774	157.646	2.088	57.312	125	**195.63**	217.23	6.39	
03-Sep-04 00:00:00	7.931	161.165	2.042	59.255	125	**196.97**	218.19	6.56	
04-Sep-04 00:00:00	7.589	160.477	2.331	50.041	125	**194.05**	218.28	6.54	
05-Sep-04 00:00:00	6.865	169.521	2.883	31.786	125	**187.85**	217.74	6.89	
06-Sep-04 00:00:00	6.947	159.828	2.981	30.990	125	**188.55**	219.75	6.55	
07-Sep-04 00:00:00	6.965	148.065	3.026	30.892	125	**188.71**	220.47	6.09	
08-Sep-04 00:00:00	6.939	145.717	2.962	51.785	125	**188.48**	219.43	5.97	
09-Sep-04 00:00:00	6.753	143.129	2.580	97.975	125	**186.89**	213.07	5.69	
10-Sep-04 00:00:00	6.342	191.387	2.055	77.480	125	**183.37**	203.27	7.26	
11-Sep-04 00:00:00	5.717	155.991	2.456	21.889	125	**178.02**	201.60	5.87	
12-Sep-04 00:00:00	5.824	164.860	2.609	39.053	125	**178.94**	204.33	6.29	
13-Sep-04 00:00:00	5.604	168.883	2.204	39.580	125	**177.06**	197.82	6.23	
14-Sep-04 00:00:00	5.624	157.335	2.221	59.527	125	**177.22**	198.19	5.82	
15-Sep-04 00:00:00	5.686	154.844	2.405	58.405	125	**177.76**	200.75	5.80	
16-Sep-04 00:00:00	5.118	250.000	2.825	17.272	125	**172.90**	199.77	9.32	
17-Sep-04 00:00:00	9.692	250.000	4.286	0.005	125	**212.05**	266.43	12.43	SRU1 down?
18-Sep-04 00:00:00	5.299	250.000	4.783	0.005	125	**174.45**	225.89	10.54	SRU1 down?
19-Sep-04 00:00:00	0.098	180.920	3.755	0.005	0	**0.84**	1.03	0.03	SRU1 and TO down?
20-Sep-04 00:00:00	0.098	10.495	4.844	0.005	0	**0.84**	1.10	0.00	SRU1 and TO down?
21-Sep-04 00:00:00	0.098	7.925	3.390	0.005	0	**0.84**	1.01	0.00	SRU1 and TO down?
22-Sep-04 00:00:00	0.098	8.267	5.491	0.005	0	**0.84**	1.14	0.00	SRU1 and TO down?
23-Sep-04 00:00:00	0.098	8.430	2.907	0.005	0	**0.84**	0.98	0.00	SRU1 and TO down?
24-Sep-04 00:00:00	0.098	8.619	3.495	0.005	0	**0.84**	1.01	0.00	SRU1 and TO down?
25-Sep-04 00:00:00	0.098	11.310	2.964	0.005	0	**0.84**	0.98	0.00	SRU1 and TO down?
26-Sep-04 00:00:00	0.098	7.717	5.317	0.005	0	**0.84**	1.13	0.00	SRU1 and TO down?
27-Sep-04 00:00:00	0.098	6.653	0.286	0.005	0	**0.84**	0.85	0.00	SRU1 and TO down?
28-Sep-04 00:00:00	0.098	6.388	5.039	0.005	0	**0.84**	1.11	0.00	SRU1 and TO down?
29-Sep-04 00:00:00	0.098	75.127	3.276	0.005	0	**0.84**	1.00	0.01	SRU1 and TO down?
30-Sep-04 00:00:00	0.535	250.000	2.930	0.005	0	**4.58**	5.33	0.25	SRU1 and TO down?
01-Oct-04 00:00:00	8.575	250.000	4.711	0.005	0	**73.40**	94.62	4.41	SRU1 down?
02-Oct-04 00:00:00	6.561	175.530	2.691	75.834	125	**185.25**	212.47	6.96	
03-Oct-04 00:00:00	6.618	100.468	2.815	88.821	125	**185.73**	214.49	4.02	
04-Oct-04 00:00:00	6.371	97.092	2.194	95.588	125	**183.63**	205.05	3.72	
05-Oct-04 00:00:00	6.382	88.719	2.605	88.224	125	**183.72**	209.74	3.47	
06-Oct-04 00:00:00	6.104	119.880	3.359	66.840	125	**181.34**	215.86	4.83	
07-Oct-04 00:00:00	6.195	117.221	3.333	71.552	125	**182.12**	216.47	4.74	
08-Oct-04 00:00:00	6.219	123.226	2.697	80.332	125	**182.32**	209.18	4.81	
09-Oct-04 00:00:00	6.143	111.086	2.499	78.393	125	**181.67**	206.21	4.28	

SRU 1 SO2 daily SO2 emissions (and other Fee emission calculations) **2004**

NOTE: Need to correct flow default of 300 MSCFH. Per "2004 TRP and SRU emissions.xls", echoke said unit ran 8760 hours (full time).

This looks like it should be %, not ppm. Using value as %.

FI3614 (the stack flow meter) was not operating in 2004. Per Unit Engineer max flow would be 300MSCFH. - based on stack test and ratio based on LTPD production - flow more like 125 MSCFH

	FI3516	ai3508c	2004 stack %O2 PI tag ai3507	fi3614		Flue Gas			
	SR1-FL GAS TO THRML OX	SR1-STACK SO_2--DRY	Thermo Oxidiz Stack O_2	TG1-TG ABS KO > THM OX	Flow rate corrected	Theoretical (w/o excess air)	Total (with excess air)	SRU 1 SO_2 emissions	Comment
Date	MSCFH	PPM	% O2	MSCFH	MSCFH	mscfh	mscfh	lb/hr	
10-Oct-04 00:00:00	6.529	87.252	2.234	97.276	125	**184.98**	207.00	3.37	
11-Oct-04 00:00:00	6.666	79.240	2.101	112.377	125	**186.15**	206.84	3.06	
12-Oct-04 00:00:00	6.916	82.507	2.288	112.854	125	**188.29**	211.30	3.25	
13-Oct-04 00:00:00	6.757	81.296	2.056	113.120	125	**186.93**	207.22	3.14	
14-Oct-04 00:00:00	6.869	93.139	1.638	123.199	125	**187.88**	203.78	3.54	
15-Oct-04 00:00:00	7.192	80.616	1.710	131.680	125	**190.65**	207.55	3.12	
16-Oct-04 00:00:00	7.098	93.575	2.561	110.050	125	**189.85**	216.22	3.78	
17-Oct-04 00:00:00	7.305	104.492	3.030	102.233	125	**191.61**	223.92	4.37	
18-Oct-04 00:00:00	7.466	81.032	3.115	105.044	125	**193.00**	226.61	3.43	
19-Oct-04 00:00:00	7.940	152.528	3.480	109.256	125	**197.05**	236.19	6.72	
20-Oct-04 00:00:00	7.623	106.011	2.700	105.947	125	**194.34**	223.02	4.41	
21-Oct-04 00:00:00	8.102	110.476	2.899	105.424	125	**198.44**	230.21	4.75	
22-Oct-04 00:00:00	8.450	110.036	3.170	105.897	125	**201.41**	237.23	4.87	
23-Oct-04 00:00:00	8.816	122.463	3.348	107.540	125	**204.55**	243.35	5.56	
24-Oct-04 00:00:00	8.463	124.675	3.132	106.934	125	**201.53**	236.85	5.51	
25-Oct-04 00:00:00	8.678	119.751	2.986	104.235	125	**203.37**	237.09	5.30	
26-Oct-04 00:00:00	7.943	105.824	2.155	112.300	125	**197.08**	219.62	4.34	
27-Oct-04 00:00:00	8.222	105.100	2.524	115.155	125	**199.46**	226.71	4.45	
28-Oct-04 00:00:00	8.631	110.951	2.605	116.354	125	**202.96**	231.71	4.80	
29-Oct-04 00:00:00	8.742	118.442	2.589	124.437	125	**203.92**	232.59	5.14	
30-Oct-04 00:00:00	8.652	132.493	2.218	132.609	125	**203.15**	227.13	5.62	
31-Oct-04 00:00:00	8.323	127.302	2.204	131.784	125	**200.33**	223.82	5.32	
01-Nov-04 00:00:00	8.452	103.941	2.174	137.372	125	**201.43**	224.70	4.36	
02-Nov-04 00:00:00	8.732	99.609	2.287	139.029	125	**203.83**	228.74	4.25	
03-Nov-04 00:00:00	8.868	111.178	2.080	150.539	125	**205.00**	227.53	4.72	
04-Nov-04 00:00:00	8.934	114.891	2.092	154.245	125	**205.56**	228.31	4.90	
05-Nov-04 00:00:00	8.818	176.963	2.676	157.112	125	**204.56**	234.44	7.74	
06-Nov-04 00:00:00	8.941	142.344	3.005	136.464	125	**205.62**	239.95	6.37	
07-Nov-04 00:00:00	8.965	133.737	2.451	140.047	125	**205.82**	233.02	5.82	
08-Nov-04 00:00:00	8.883	125.415	2.063	134.759	125	**205.12**	227.47	5.32	
09-Nov-04 00:00:00	8.357	122.195	2.894	91.687	125	**200.62**	232.68	5.31	
10-Nov-04 00:00:00	8.193	137.374	2.865	92.111	125	**199.22**	230.69	5.91	
11-Nov-04 00:00:00	8.380	155.031	2.487	93.922	125	**200.82**	227.80	6.59	
12-Nov-04 00:00:00	8.511	139.996	1.760	119.432	125	**201.94**	220.41	5.76	
13-Nov-04 00:00:00	8.777	133.478	1.588	134.482	125	**204.22**	220.92	5.50	
14-Nov-04 00:00:00	8.777	133.462	1.548	135.992	125	**204.22**	220.47	5.49	
15-Nov-04 00:00:00	8.919	156.233	1.559	136.059	125	**205.43**	221.91	6.47	
16-Nov-04 00:00:00	8.780	159.934	1.391	137.510	125	**204.24**	218.74	6.53	
17-Nov-04 00:00:00	8.795	138.515	1.257	138.428	125	**204.37**	217.38	5.62	
18-Nov-04 00:00:00	8.641	94.350	1.029	140.255	125	**203.05**	213.52	3.76	
19-Nov-04 00:00:00	8.399	126.974	0.807	136.707	125	**200.98**	209.01	4.95	
20-Nov-04 00:00:00	1.417	134.485	0.095	23.840	125	**141.22**	141.86	3.56	
21-Nov-04 00:00:00	6.336	250.000	1.011	21.630	125	**183.32**	192.59	8.99	
22-Nov-04 00:00:00	7.858	159.353	1.966	49.768	125	**196.35**	216.63	6.44	
23-Nov-04 00:00:00	7.092	135.295	1.508	50.705	125	**189.80**	204.48	5.16	
24-Nov-04 00:00:00	8.105	150.812	2.212	42.973	125	**198.46**	221.83	6.24	
25-Nov-04 00:00:00	7.868	151.572	2.247	45.853	125	**196.43**	219.97	6.22	
26-Nov-04 00:00:00	7.111	158.434	1.894	47.543	125	**189.96**	208.79	6.17	
27-Nov-04 00:00:00	6.960	153.141	1.505	47.655	125	**188.66**	203.23	5.81	
28-Nov-04 00:00:00	7.158	167.575	2.028	44.767	125	**190.36**	210.70	6.59	
29-Nov-04 00:00:00	8.498	115.348	3.754	47.122	125	**201.83**	245.75	5.29	
30-Nov-04 00:00:00	8.899	114.209	3.744	47.433	125	**205.26**	249.79	5.32	
01-Dec-04 00:00:00	8.957	116.259	3.834	45.376	125	**205.75**	251.71	5.46	
02-Dec-04 00:00:00	8.197	196.221	3.781	33.537	125	**199.25**	243.01	8.90	
03-Dec-04 00:00:00	9.265	250.000	4.308	0.005	125	**208.40**	262.18	12.23	SRU1 down?
04-Dec-04 00:00:00	9.280	250.000	4.219	0.005	125	**208.52**	260.95	12.18	SRU1 down?
05-Dec-04 00:00:00	5.260	189.091	6.264	0.005	125	**174.11**	248.12	8.76	SRU1 down?
06-Dec-04 00:00:00	0.098	8.416	2.645	0.005	0	**0.84**	0.96	0.00	SRU1 and TO down?

SRU 1 SO2 daily SO2 emissions (and other Fee emission calculations) **2004**

NOTE: Need to correct flow default of 300 MSCFH. Per "2004 TRP and SRU emissions.xls", echoke said unit ran 8760 hours (full time).

This looks like it should be %, not ppm. Using value as %.

FI3614 (the stack flow meter) was not operating in 2004. Per Unit Engineer max flow would be 300MSCFH. - based on stack test and ratio based on LTPD production - flow more like 125 MSCFH

	FI3516	ai3508c	2004 stack %O2 PI tag ai3507	fi3614		Flue Gas			
	SR1-FL GAS TO THRML OX	SR1-STACK SO_2--DRY	Thermo Oxidiz Stack O_2	TG1-TG ABS KO > THM OX	Flow rate corrected	Theoretical (w/o excess air)	Total (with excess air)	SRU 1 SO_2 emissions	Comment
Date	MSCFH	PPM	% O2	MSCFH	MSCFH	mscfh	mscfh	lb/hr	
07-Dec-04 00:00:00	0.098	7.230	0.506	0.005	0	**0.84**	0.86	0.00	SRU1 and TO down?
08-Dec-04 00:00:00	0.391	31.431	5.423	0.005	0	**3.35**	4.51	0.03	SRU1 and TO down?
09-Dec-04 00:00:00	3.059	250.000	6.872	0.005	125	**155.28**	230.80	10.77	SRU1 down?
10-Dec-04 00:00:00	6.889	250.000	4.490	11.249	125	**188.05**	239.20	11.16	
11-Dec-04 00:00:00	8.372	72.391	3.599	57.938	125	**200.74**	242.26	3.27	
12-Dec-04 00:00:00	7.306	85.884	2.230	56.512	125	**191.63**	214.39	3.44	
13-Dec-04 00:00:00	6.999	67.219	2.043	58.566	125	**189.00**	209.36	2.63	
14-Dec-04 00:00:00	6.992	64.488	1.908	61.928	125	**188.93**	207.81	2.50	
15-Dec-04 00:00:00	6.193	84.920	1.412	62.573	125	**182.10**	195.22	3.09	
16-Dec-04 00:00:00	5.744	85.386	1.094	63.329	125	**178.25**	188.05	3.00	
17-Dec-04 00:00:00	6.174	71.932	1.779	66.218	125	**181.94**	198.78	2.67	
18-Dec-04 00:00:00	6.085	75.691	1.593	65.983	125	**181.17**	196.04	2.77	
19-Dec-04 00:00:00	6.256	57.200	1.802	61.157	125	**182.64**	199.78	2.13	
20-Dec-04 00:00:00	5.960	74.965	1.825	56.052	125	**180.11**	197.24	2.76	
21-Dec-04 00:00:00	6.615	71.634	2.875	53.320	125	**185.71**	215.17	2.88	
22-Dec-04 00:00:00	7.753	70.909	4.057	51.628	125	**195.45**	242.24	3.21	
23-Dec-04 00:00:00	7.702	58.472	3.588	50.552	125	**195.02**	235.21	2.57	
24-Dec-04 00:00:00	7.907	59.652	4.103	54.039	125	**196.77**	244.55	2.72	
25-Dec-04 00:00:00	7.924	57.268	3.998	54.026	125	**196.92**	243.22	2.60	
26-Dec-04 00:00:00	7.501	60.743	3.803	54.298	125	**193.29**	236.04	2.68	
27-Dec-04 00:00:00	7.944	62.042	4.010	55.463	125	**197.08**	243.60	2.82	
28-Dec-04 00:00:00	7.398	68.025	3.574	52.530	125	**192.42**	231.88	2.94	
29-Dec-04 00:00:00	8.083	110.051	3.847	53.412	125	**198.27**	242.74	4.99	
30-Dec-04 00:00:00	8.557	133.085	4.016	52.792	125	**202.33**	250.17	6.21	
31-Dec-04 00:00:00	7.763	97.317	3.308	51.061	125	**195.54**	232.10	4.22	
TOTAL							Average	19.57 tpy	

Example Calculations

Flue Gas Theoretical, mscfh = NG fired, mscfh x ft3 flue gas/ft3 fuel gas + TGT vent gas, mscfh x ft3 flue gas / ft3 vent feed

Flue gas Actual (w/ excess air) = scf flue theoretical * (1 + (1/((21/stack O_2) - 1))

SO_2 Emissions (annual tons) = actual flue gas flow (mscfh, dry) * (1000 / m) (560 R/520 R) * 0.1733 (lb SO2/ft3 SO_2)
* (SO_2 in TO exhaust (ppmv) / 10^6) *8760 hours/year / 2000 lb/ton

These equations are derived and documented on the SO2 sheet.

SRU 1 SO2 daily SO2 emissions (and other Fee emission calculations) 2005

This looks like it should be %, not ppm. Using value as %.

FI3614 (the stack flow meter) was not operating in 2005. Per Unit Engineer max flow would be 300MSCFH. - based on stack test and ratio based on LTPD production - flow more like 106 MSCFH

	FI3516	ai3508c	2005 stack %O2 PI tag ai3507	fi3614		Flue Gas			
	SR1-FL GAS TO THRML OX	SR1-STACK SO_2--DRY	Thermo Oxidiz Stack O_2	TG1-TG ABS KO > THM OX	TG1-TG ABS KO > THM OX	Theoretical (w/o excess air)	Total (with excess air)	SRU 1 SO2 emissions	Comment
Date	MSCFH	PPM	% O2	MSCFH	MSCFH	mscfh	mscfh	lb/hr	
01-Jan-05 00:00:00	7.413165863	86.213203	3.0274017	54.73786151	106	**172.84**	201.96	3.25	
02-Jan-05 00:00:00	7.086730819	99.7826364	2.5233057	57.05571664	106	**170.05**	193.27	3.60	
03-Jan-05 00:00:00	6.780708939	71.4193113	2.21730307	56.99319224	106	**167.43**	187.19	2.50	
04-Jan-05 00:00:00	6.774000966	70.6568086	2.35700344	58.87140538	106	**167.37**	188.53	2.49	
05-Jan-05 00:00:00	6.551978672	69.9886983	1.92187254	55.84386114	106	**165.47**	182.14	2.38	
06-Jan-05 00:00:00	6.580539632	76.2904475	1.77258942	57.10957689	106	**165.72**	180.99	2.58	
07-Jan-05 00:00:00	6.940130056	77.3917042	2.6031766	58.06262506	106	**168.79**	192.68	2.78	
08-Jan-05 00:00:00	6.754306808	75.735093	2.413455	57.97676134	106	**167.20**	188.91	2.67	
09-Jan-05 00:00:00	6.876902353	82.2458109	2.61442741	59.07478617	106	**168.25**	192.18	2.95	
10-Jan-05 00:00:00	6.614666305	80.9967271	2.27352552	59.55250018	106	**166.01**	186.16	2.81	
11-Jan-05 00:00:00	6.442801159	71.9588247	2.03739354	60.42454702	106	**164.54**	182.22	2.45	
12-Jan-05 00:00:00	6.231048261	83.5962526	1.68113097	61.48821796	106	**162.72**	176.88	2.76	
13-Jan-05 00:00:00	6.128679926	80.7699116	1.58121814	58.66609451	106	**161.85**	175.03	2.64	
14-Jan-05 00:00:00	6.5516842	57.8693487	2.17470308	61.07775504	106	**165.47**	184.58	1.99	
15-Jan-05 00:00:00	6.91742469	63.8938666	2.67376959	60.77112913	106	**168.60**	193.20	2.30	
16-Jan-05 00:00:00	6.920924654	54.1916164	2.64294618	59.34436152	106	**168.63**	192.91	1.95	
17-Jan-05 00:00:00	6.916222458	56.4729749	2.80122346	59.90618918	106	**168.59**	194.54	2.05	
18-Jan-05 00:00:00	6.646470202	210.043496	2.28655902	56.91243758	106	**166.28**	186.60	7.31	
19-Jan-05 00:00:00	5.721233626	168.557949	0.94680451	49.11706335	106	**158.36**	165.84	5.22	
20-Jan-05 00:00:00	6.671425098	71.4957201	1.70928779	54.61756595	106	**166.49**	181.25	2.42	
21-Jan-05 00:00:00	7.347261066	63.6635531	2.58620557	53.55192836	106	**172.28**	196.47	2.33	
22-Jan-05 00:00:00	7.520802503	57.5675775	2.80456368	51.29272129	106	**173.76**	200.55	2.15	
23-Jan-05 00:00:00	7.313778133	38.2927659	2.58941613	55.6161386	106	**171.99**	196.18	1.40	
24-Jan-05 00:00:00	7.764232804	59.9429994	3.0433098	51.33682325	106	**175.85**	205.65	2.30	
25-Jan-05 00:00:00	8.106407425	83.5675672	3.44025542	50.89329812	106	**178.78**	213.80	3.33	
26-Jan-05 00:00:00	8.053470466	72.4308767	3.24058503	48.8675545	106	**178.32**	210.86	2.85	
27-Jan-05 00:00:00	9.138269749	56.8734852	3.9976696	51.54572338	106	**187.61**	231.72	2.46	
28-Jan-05 00:00:00	9.140785603	72.410927	3.81764895	52.16665277	106	**187.63**	229.32	3.10	
29-Jan-05 00:00:00	9.266383659	92.7443978	4.01868508	50.88698779	106	**188.70**	233.36	4.04	
30-Jan-05 00:00:00	9.334963529	80.6744277	3.89826802	49.85730421	106	**189.29**	232.44	3.50	
31-Jan-05 00:00:00	9.348847329	75.6119552	3.91016142	51.15916017	106	**189.41**	232.75	3.28	
01-Feb-05 00:00:00	9.390186459	83.6731469	4.01187782	53.18044641	106	**189.76**	234.58	3.66	
02-Feb-05 00:00:00	9.305352384	80.6097702	3.8710163	52.99581299	106	**189.04**	231.76	3.49	
03-Feb-05 00:00:00	9.181346159	86.8425888	3.76248183	54.06720599	106	**187.98**	229.01	3.71	
04-Feb-05 00:00:00	9.302847706	86.9393276	3.97664173	54.19684895	106	**189.02**	233.17	3.78	
05-Feb-05 00:00:00	9.307652123	90.6018889	3.91427079	53.70559215	106	**189.06**	232.37	3.93	
06-Feb-05 00:00:00	9.229112508	86.5701432	3.4956382	54.08794761	106	**188.39**	226.01	3.65	
07-Feb-05 00:00:00	9.25182043	82.5515222	3.49242792	53.01939959	106	**188.58**	226.20	3.48	
08-Feb-05 00:00:00	9.0803794	80.6629384	3.30898402	55.71911972	106	**187.11**	222.11	3.34	
09-Feb-05 00:00:00	9.016780369	78.7306834	3.38103273	53.80935744	106	**186.57**	222.37	3.27	
10-Feb-05 00:00:00	9.573124101	70.2743615	3.58320668	54.72039676	106	**191.33**	230.69	3.03	
11-Feb-05 00:00:00	9.426978033	80.5484483	3.5787601	54.48073958	106	**190.08**	229.13	3.44	
12-Feb-05 00:00:00	9.11931456	82.0940204	3.32854474	57.16152497	106	**187.45**	222.75	3.41	
13-Feb-05 00:00:00	8.740164735	114.502334	2.91540171	54.5596168	106	**184.20**	213.90	4.57	
14-Feb-05 00:00:00	9.178075824	81.2187174	3.01823299	45.83319878	106	**187.95**	219.50	3.33	
15-Feb-05 00:00:00	8.902239793	91.7980141	2.97227078	47.50529098	106	**185.59**	216.19	3.70	
16-Feb-05 00:00:00	8.889652094	86.3412569	3.02454211	48.0938733	106	**185.48**	216.69	3.49	
17-Feb-05 00:00:00	8.86851973	74.7114759	3.08012404	47.28290806	106	**185.30**	217.15	3.03	
18-Feb-05 00:00:00	9.316115113	75.9836618	3.39697678	50.53990324	106	**189.13**	225.63	3.20	
19-Feb-05 00:00:00	9.296088889	85.4982717	3.38688468	48.72534185	106	**188.96**	225.29	3.59	
20-Feb-05 00:00:00	9.106326303	86.7404505	3.09034328	47.7205032	106	**187.33**	219.66	3.56	
21-Feb-05 00:00:00	8.745382107	99.0278	2.6141413	49.45817529	106	**184.24**	210.44	3.89	
22-Feb-05 00:00:00	8.662005602	106.683322	2.69224709	49.22841111	106	**183.53**	210.52	4.19	
23-Feb-05 00:00:00	8.135842594	112.860361	2.63368542	46.90735221	106	**179.03**	204.70	4.31	
24-Feb-05 00:00:00	7.733925017	111.529727	2.34324948	51.21648851	106	**175.59**	197.64	4.11	
25-Feb-05 00:00:00	8.147437663	114.590745	2.49647847	51.05464731	106	**179.13**	203.29	4.35	
26-Feb-05 00:00:00	8.597593402	113.081861	2.59253566	50.9830608	106	**182.98**	208.75	4.41	
27-Feb-05 00:00:00	8.678609203	121.913107	2.6536007	50.20444449	106	**183.67**	210.24	4.78	
28-Feb-05 00:00:00	8.602632664	137.595888	2.72021883	49.38238275	106	**183.02**	210.26	5.40	

SRU 1 SO2 daily SO2 emissions (and other Fee emission calculations) 2005

This looks like it should be %, not ppm. Using value as %.

FI3614 (the stack flow meter) was not operating in 2005. Per Unit Engineer max flow would be 300MSCFH. - based on stack test and ratio based on LTPD production - flow more like 106 MSCFH

	FI3516	ai3508c	2005 stack %O2 PI tag ai3507	fi3614		Flue Gas			
	SR1-FL GAS TO THRML OX	SR1-STACK SO_2--DRY	Thermo Oxidiz Stack O_2	TG1-TG ABS KO > THM OX	TG1-TG ABS KO > THM OX	Theoretical (w/o excess air)	Total (with excess air)	SRU 1 SO2 emissions	Comment
Date	MSCFH	PPM	% O2	MSCFH	MSCFH	mscfh	mscfh	lb/hr	
01-Mar-05 00:00:00	9.032990429	116.325394	2.79065	47.49885213	106	**186.71**	215.32	4.67	
02-Mar-05 00:00:00	9.191599719	120.969463	2.74538226	49.80735461	106	**188.06**	216.35	4.88	
03-Mar-05 00:00:00	9.150534348	132.307965	2.78181902	51.15847274	106	**187.71**	216.38	5.34	
04-Mar-05 00:00:00	9.000062621	147.275781	2.69712407	50.84992883	106	**186.42**	213.90	5.88	
05-Mar-05 00:00:00	8.863299241	156.713664	2.55860847	50.10428611	106	**185.25**	210.96	6.17	
06-Mar-05 00:00:00	8.471746447	148.360181	2.40236393	49.27091343	106	**181.90**	205.40	5.69	
07-Mar-05 00:00:00	8.928278091	146.353945	2.50626766	48.17568669	106	**185.81**	210.99	5.76	
08-Mar-05 00:00:00	9.076907364	116.23245	2.58515401	49.96133354	106	**187.08**	213.35	4.63	
09-Mar-05 00:00:00	8.703016965	145.051759	2.36695644	51.77407721	106	**183.88**	207.24	5.61	
10-Mar-05 00:00:00	8.731635782	144.18384	2.49370153	50.15137152	106	**184.13**	208.94	5.62	
11-Mar-05 00:00:00	8.829452982	147.339845	2.49277251	50.96607664	106	**184.96**	209.88	5.77	
12-Mar-05 00:00:00	8.834158131	140.781728	2.59107332	49.7908495	106	**185.00**	211.04	5.55	
13-Mar-05 00:00:00	8.811555024	143.905668	2.62688356	53.24385864	106	**184.81**	211.23	5.67	
14-Mar-05 00:00:00	8.415740401	152.007985	2.56798266	53.74204173	106	**181.42**	206.70	5.86	
15-Mar-05 00:00:00	8.504010054	151.539406	2.58314244	54.47035396	106	**182.18**	207.73	5.88	
16-Mar-05 00:00:00	7.251684323	182.55259	2.4713472	44.45092482	106	**171.46**	194.33	6.62	
17-Mar-05 00:00:00	4.515274743	250	3.07135096	0.090870407	0	**38.65**	45.27	2.11	SRU1 down?
18-Mar-05 00:00:00	7.925865919	250	4.20729321	0.00491348	0	**67.84**	84.84	3.96	SRU1 down?
19-Mar-05 00:00:00	6.063621739	250	4.6997854	0.00491348	0	**51.90**	66.86	3.12	SRU1 down?
20-Mar-05 00:00:00	7.565186613	250	6.80941551	0.00491348	0	**64.75**	95.82	4.47	SRU1 down?
21-Mar-05 00:00:00	7.409484379	250	0.83828217	5.755641822	0	**63.42**	66.06	3.08	
22-Mar-05 00:00:00	8.31038179	183.814049	1.9887752	56.51613813	106	**180.52**	199.41	6.84	
23-Mar-05 00:00:00	8.273155932	139.979514	2.1369865	52.47669945	106	**180.20**	200.62	5.24	
24-Mar-05 00:00:00	8.137935378	134.21153	2.28051367	56.56934654	106	**179.05**	200.86	5.03	
25-Mar-05 00:00:00	8.189764696	140.29925	2.41164826	56.08944496	106	**179.49**	202.78	5.31	
26-Mar-05 00:00:00	7.934460419	133.626866	2.14384495	56.49225486	106	**177.30**	197.46	4.92	
27-Mar-05 00:00:00	7.746143935	133.869109	2.05778914	57.95679161	106	**175.69**	194.78	4.87	
28-Mar-05 00:00:00	7.17518553	126.672491	2.11044007	55.25368087	106	**170.81**	189.89	4.49	
29-Mar-05 00:00:00	8.911789594	130.629207	3.88916377	56.188214	106	**185.67**	227.87	5.56	
30-Mar-05 00:00:00	8.448223874	136.9416	3.12060217	58.97220016	106	**181.70**	213.41	5.45	
31-Mar-05 00:00:00	8.77907972	128.775998	3.45302397	59.96148471	106	**184.53**	220.85	5.31	
01-Apr-05 00:00:00	9.230766937	131.008908	3.84352503	64.19479959	106	**188.40**	230.61	5.64	
02-Apr-05 00:00:00	8.468609313	113.534491	2.72642571	59.14341404	106	**181.88**	209.01	4.43	
03-Apr-05 00:00:00	7.66735347	99.1112528	1.91844195	64.38138344	106	**175.02**	192.61	3.56	
04-Apr-05 00:00:00	8.437140836	106.856078	3.03035276	68.75440957	106	**181.61**	212.23	4.23	
05-Apr-05 00:00:00	8.507878974	117.008359	2.45021823	72.18556184	106	**182.21**	206.28	4.50	
06-Apr-05 00:00:00	8.273309394	112.827792	2.48512105	74.40274461	106	**180.20**	204.39	4.30	
07-Apr-05 00:00:00	8.586890282	90.2828062	2.59564251	68.75596128	106	**182.89**	208.68	3.52	
08-Apr-05 00:00:00	8.738994729	113.667554	2.9266392	66.37567019	106	**184.19**	214.02	4.54	
09-Apr-05 00:00:00	8.434555912	109.219507	2.7015668	69.21403508	106	**181.58**	208.39	4.25	
10-Apr-05 00:00:00	8.504761922	117.742949	2.89461273	64.9327068	106	**182.19**	211.31	4.64	
11-Apr-05 00:00:00	8.738354767	111.091638	3.01071055	52.18086671	106	**184.18**	215.01	4.46	
12-Apr-05 00:00:00	8.570053161	100.289685	2.79436264	48.91185821	106	**182.74**	210.79	3.95	
13-Apr-05 00:00:00	8.453251188	100.603118	2.66657451	50.3303896	106	**181.74**	208.18	3.91	
14-Apr-05 00:00:00	8.195571297	100.808127	2.63002772	51.35286933	106	**179.54**	205.24	3.86	
15-Apr-05 00:00:00	8.867762082	115.98465	3.39952304	49.63712561	106	**185.29**	221.08	4.79	
16-Apr-05 00:00:00	9.078513739	132.457885	3.46645437	51.06715022	106	**187.10**	224.09	5.54	
17-Apr-05 00:00:00	8.666712438	132.608395	3.02652187	52.15089949	106	**183.57**	214.48	5.31	
18-Apr-05 00:00:00	8.556462322	130.613948	2.96133659	51.78672641	106	**182.63**	212.61	5.18	
19-Apr-05 00:00:00	8.308107327	140.376946	2.69312992	53.99563781	106	**180.50**	207.06	5.42	
20-Apr-05 00:00:00	8.1470277	165.434599	2.49682086	49.86577191	106	**179.12**	203.29	6.28	
21-Apr-05 00:00:00	8.748234437	148.228736	1.78636705	141.2594127	106	**184.27**	201.40	5.57	
22-Apr-05 00:00:00	8.594803824	161.659327	1.63884589	180.0553595	106	**182.96**	198.44	5.99	
23-Apr-05 00:00:00	8.671748721	145.422309	3.5113934	93.31451463	106	**183.61**	220.48	5.98	
24-Apr-05 00:00:00	8.534817333	164.917401	2.01142556	134.2307227	106	**182.44**	201.77	6.21	
25-Apr-05 00:00:00	8.447748401	206.536707	2.37391738	145.0526369	106	**181.70**	204.85	7.90	
26-Apr-05 00:00:00	7.775105867	128.953633	1.78770887	138.19409	106	**175.94**	192.31	4.63	
27-Apr-05 00:00:00	7.934130848	122.250928	1.91985387	142.4113736	106	**177.30**	195.14	4.45	
28-Apr-05 00:00:00	8.169475059	120.811366	2.55581365	44.40080534	106	**179.32**	204.16	4.60	

SRU 1 SO2 daily SO2 emissions (and other Fee emission calculations) 2005

This looks like it should be %, not ppm. Using value as %.

FI3614 (the stack flow meter) was not operating in 2005. Per Unit Engineer max flow would be 300MSCFH. - based on stack test and ratio based on LTPD production - flow more like 106 MSCFH

	FI3516	ai3508c	2005 stack %O2 PI tag ai3507	fi3614		Flue Gas			
	SR1-FL GAS TO THRML OX	SR1-STACK SO_2--DRY	Thermo Oxidiz Stack O_2	TG1-TG ABS KO > THM OX	TG1-TG ABS KO > THM OX	Theoretical (w/o excess air)	Total (with excess air)	SRU 1 SO2 emissions	Comment
Date	MSCFH	PPM	% O2	MSCFH	MSCFH	mscfh	mscfh	lb/hr	
29-Apr-05 00:00:00	8.248044534	116.007631	2.45195532	39.09949889	106	**179.99**	203.78	4.41	
30-Apr-05 00:00:00	7.929677674	123.036074	2.19368886	39.24304534	106	**177.26**	197.94	4.55	
01-May-05 00:00:00	8.326132957	133.256664	2.86789172	36.50571471	106	**180.66**	209.23	5.20	
02-May-05 00:00:00	8.470818777	138.477298	2.96369641	38.25448592	106	**181.89**	211.78	5.47	
03-May-05 00:00:00	8.366548055	128.441383	2.81417565	34.88469863	106	**181.00**	209.01	5.01	
04-May-05 00:00:00	7.93593676	165.592345	3.26651894	28.11914439	106	**177.32**	209.98	6.49	
05-May-05 00:00:00	8.123742031	211.720793	2.21571113	34.35107158	106	**178.92**	200.03	7.90	
06-May-05 00:00:00	7.58723117	144.414895	3.2960923	24.72003193	106	**174.33**	206.79	5.57	
07-May-05 00:00:00	7.748153847	121.720692	3.29767826	25.87185554	106	**175.71**	208.44	4.74	
08-May-05 00:00:00	7.722499274	103.16146	2.78142954	29.19898762	106	**175.49**	202.28	3.89	
09-May-05 00:00:00	7.713875561	119.839404	2.58015294	30.21714144	106	**175.42**	199.99	4.47	
10-May-05 00:00:00	8.18722125	117.681429	2.85635539	30.96452378	106	**179.47**	207.72	4.56	
11-May-05 00:00:00	7.549515445	136.259405	2.78441767	35.73364023	106	**174.01**	200.61	5.10	
12-May-05 00:00:00	8.858032391	172.605859	3.51661154	37.62890164	106	**185.21**	222.46	7.17	
13-May-05 00:00:00	8.563609104	91.3074094	3.67132144	30.47547508	106	**182.69**	221.39	3.77	
14-May-05 00:00:00	8.736801054	129.948401	3.38796544	33.76121893	106	**184.17**	219.60	5.33	
15-May-05 00:00:00	8.39492278	107.252144	2.67859903	36.03866858	106	**181.25**	207.74	4.16	
16-May-05 00:00:00	7.715759556	101.564811	2.05737333	37.30794287	106	**175.43**	194.49	3.69	
17-May-05 00:00:00	6.90136616	115.728103	1.2424855	41.13420188	106	**168.46**	179.06	3.87	
18-May-05 00:00:00	7.518823207	101.062237	2.10013209	40.7899042	106	**173.75**	193.05	3.64	
19-May-05 00:00:00	8.059166346	90.1916114	3.07527694	96.38833066	106	**178.37**	208.97	3.52	
20-May-05 00:00:00	8.066508002	86.7362347	3.33589013	85.90054997	106	**178.43**	212.13	3.43	
21-May-05 00:00:00	7.743933533	89.7360078	3.11547616	56.87768419	106	**175.67**	206.28	3.45	
22-May-05 00:00:00	8.178635448	79.3972899	3.50776631	81.66452537	106	**179.39**	215.37	3.19	
23-May-05 00:00:00	7.466038095	60.9947966	2.52330351	76.14493185	106	**173.29**	196.96	2.24	
24-May-05 00:00:00	7.154705134	72.4308982	2.0355143	31.82674969	106	**170.63**	188.94	2.55	
25-May-05 00:00:00	6.840064842	83.025726	2.75090323	36.37349891	106	**167.94**	193.25	2.99	
26-May-05 00:00:00	6.485639294	75.0063689	3.57924291	37.40627435	106	**164.90**	198.78	2.78	
27-May-05 00:00:00	7.306411835	57.1592545	3.23564147	36.98433776	106	**171.93**	203.24	2.17	
28-May-05 00:00:00	7.357820499	44.9301746	3.81795005	33.35777506	106	**172.37**	210.67	1.77	
29-May-05 00:00:00	7.574824528	37.8212305	3.70943041	34.0360641	106	**174.23**	211.60	1.49	
30-May-05 00:00:00	7.547048944	33.9733544	3.86697331	31.61587408	106	**173.99**	213.26	1.35	
31-May-05 00:00:00	7.225175173	56.2287236	2.41557509	32.74597045	106	**171.23**	193.49	2.03	
01-Jun-05 00:00:00	7.200186557	69.5671456	2.3485778	32.02003288	106	**171.02**	192.55	2.50	
02-Jun-05 00:00:00	7.294677698	79.5074258	2.30086218	32.21590462	106	**171.83**	192.97	2.86	
03-Jun-05 00:00:00	7.628381357	77.4995716	2.88399268	31.92039774	106	**174.68**	202.49	2.93	
04-Jun-05 00:00:00	7.9031109	63.6936945	3.32789688	30.89181223	106	**177.04**	210.37	2.50	
05-Jun-05 00:00:00	8.040004363	87.5893837	3.55349061	29.98444047	106	**178.21**	214.50	3.51	
06-Jun-05 00:00:00	8.116788631	91.3170543	3.58898505	31.1517341	106	**178.86**	215.73	3.68	
07-Jun-05 00:00:00	7.784649757	110.570489	3.16455513	30.6553864	106	**176.02**	207.25	4.28	
08-Jun-05 00:00:00	8.072574243	107.036487	3.18925057	30.17372119	106	**178.49**	210.45	4.20	
09-Jun-05 00:00:00	8.134342235	106.158841	3.24823022	29.49118177	106	**179.01**	211.77	4.20	
10-Jun-05 00:00:00	8.619125476	123.279883	3.43285284	31.28426942	106	**183.16**	218.96	5.04	
11-Jun-05 00:00:00	8.538346565	119.161488	3.40898044	31.59683644	106	**182.47**	217.83	4.84	
12-Jun-05 00:00:00	8.566531395	250	3.56799562	16.95687735	106	**182.71**	220.11	10.27	
13-Jun-05 00:00:00	8.912903138	250	7.9527101	0.00491348	0	**76.29**	122.79	5.73	SRU1 down?
14-Jun-05 00:00:00	8.056250208	250	6.42266352	0.00491348	0	**68.95**	99.34	4.63	SRU1 down?
15-Jun-05 00:00:00	8.254185074	250	4.38896584	5.04387213	0	**70.65**	89.32	4.17	SRU1 down?
16-Jun-05 00:00:00	5.02852422	250	4.77290414	0.553743691	0	**43.04**	55.70	2.60	SRU1 down?
17-Jun-05 00:00:00	8.454894817	250	7.43407682	0.00491348	0	**72.37**	112.02	5.23	SRU1 down?
18-Jun-05 00:00:00	9.598839914	250	5.60260953	0.00491348	0	**82.16**	112.05	5.23	SRU1 down?
19-Jun-05 00:00:00	7.948157936	250	0.94783386	54.39607139	106	**177.42**	185.81	8.67	
20-Jun-05 00:00:00	8.688224786	250	2.48884989	4.038396885	106	**183.76**	208.46	9.73	SRU1 down?
21-Jun-05 00:00:00	7.345323643	103.672877	3.01983526	31.52519255	106	**172.26**	201.19	3.89	
22-Jun-05 00:00:00	8.031052578	64.1660613	3.13537333	30.79607943	106	**178.13**	209.39	2.51	
23-Jun-05 00:00:00	8.170046025	66.8707573	3.484572	30.06673554	106	**179.32**	215.00	2.68	
24-Jun-05 00:00:00	8.695623089	72.238127	3.84586413	29.13880063	106	**183.82**	225.03	3.03	
25-Jun-05 00:00:00	8.465598628	80.5391694	3.68328621	28.70717182	106	**181.85**	220.53	3.31	
26-Jun-05 00:00:00	8.4466968	116.282903	3.43386498	26.2312368	106	**181.69**	217.21	4.71	

SRU 1 SO2 daily SO2 emissions (and other Fee emission calculations) 2005

This looks like it should be %, not ppm. Using value as %.

FI3614 (the stack flow meter) was not operating in 2005. Per Unit Engineer max flow would be 300MSCFH. - based on stack test and ratio based on LTPD production - flow more like 106 MSCFH

	FI3516	ai3508c	2005 stack %O2 PI tag ai3507	fi3614		Flue Gas			
	SR1-FL GAS TO THRML OX	SR1-STACK SO_2--DRY	Thermo Oxidiz Stack O_2	TG1-TG ABS KO > THM OX	TG1-TG ABS KO > THM OX	Theoretical (w/o excess air)	Total (with excess air)	SRU 1 SO2 emissions	Comment
Date	MSCFH	PPM	% O2	MSCFH	MSCFH	mscfh	mscfh	lb/hr	
27-Jun-05 00:00:00	8.75598626	98.240689	3.58151043	27.11698231	106	**184.34**	222.24	4.07	
28-Jun-05 00:00:00	8.759277888	84.6020921	3.8141701	26.81145352	106	**184.36**	225.28	3.56	
29-Jun-05 00:00:00	9.226798094	84.5158698	4.09078915	26.20928439	106	**188.37**	233.94	3.69	
30-Jun-05 00:00:00	9.224529486	68.004981	3.93427962	25.7906829	106	**188.35**	231.77	2.94	
01-Jul-05 00:00:00	8.769388802	56.7869444	3.7044763	25.83335906	106	**184.45**	223.96	2.37	
02-Jul-05 00:00:00	8.752654338	61.6339242	3.94168568	25.0118066	106	**184.31**	226.90	2.61	
03-Jul-05 00:00:00	8.909453413	62.8308169	3.75299076	33.87174329	106	**185.65**	226.05	2.65	
04-Jul-05 00:00:00	8.559607112	50.1714993	3.51022341	26.93148885	106	**182.65**	219.31	2.05	
05-Jul-05 00:00:00	8.820916751	50.0062728	3.56281632	24.56912013	106	**184.89**	222.67	2.08	
06-Jul-05 00:00:00	8.937969985	50.8869129	3.53525876	23.35653357	106	**185.89**	223.52	2.12	
07-Jul-05 00:00:00	9.030479083	66.4465028	3.56932275	24.37085432	106	**186.69**	224.91	2.79	
08-Jul-05 00:00:00	9.265999067	63.2698379	3.93950841	24.71580604	106	**188.70**	232.27	2.74	
09-Jul-05 00:00:00	9.266324733	68.5412394	4.01172944	27.68931219	106	**188.70**	233.27	2.98	
10-Jul-05 00:00:00	9.156628831	80.407924	3.80800956	28.68612257	106	**187.76**	229.35	3.44	
11-Jul-05 00:00:00	8.987490061	84.5176318	3.56882661	24.79930869	106	**186.32**	224.46	3.54	
12-Jul-05 00:00:00	8.910635971	83.0998505	3.35388035	24.13127208	106	**185.66**	220.95	3.43	
13-Jul-05 00:00:00	8.879955861	88.94988	3.3849705	24.48806665	106	**185.40**	221.02	3.67	
14-Jul-05 00:00:00	9.00791336	88.8604531	3.47903299	24.81973403	106	**186.49**	223.52	3.71	
15-Jul-05 00:00:00	9.096618235	95.2779835	3.51301374	24.77581384	106	**187.25**	224.87	4.00	
16-Jul-05 00:00:00	9.259968429	99.0202066	3.69386029	24.94308808	106	**188.65**	228.92	4.23	
17-Jul-05 00:00:00	8.948560646	95.4129478	3.36700886	25.85268615	106	**185.98**	221.50	3.94	
18-Jul-05 00:00:00	8.57788698	88.8728757	3.11030435	25.82208804	106	**182.81**	214.59	3.56	
19-Jul-05 00:00:00	8.046564278	96.4822838	2.72086448	26.78814203	106	**178.26**	204.80	3.69	
20-Jul-05 00:00:00	8.149495344	74.0641457	3.00276598	27.32626299	106	**179.14**	209.03	2.89	
21-Jul-05 00:00:00	9.013846778	51.117733	3.51520585	24.56529377	106	**186.54**	224.05	2.14	
22-Jul-05 00:00:00	8.953235283	47.5027945	3.29319072	24.92255986	106	**186.02**	220.62	1.96	
23-Jul-05 00:00:00	8.539443269	44.478318	3.04449907	26.63580479	106	**182.48**	213.42	1.77	
24-Jul-05 00:00:00	8.682007258	45.9913002	3.20735792	25.27457058	106	**183.70**	216.82	1.86	
25-Jul-05 00:00:00	8.881034396	63.5332387	3.25721686	25.72242257	106	**185.41**	219.44	2.60	
26-Jul-05 00:00:00	9.260970058	74.4802268	3.94938738	24.67022179	106	**188.66**	232.36	3.23	
27-Jul-05 00:00:00	8.512725902	57.620046	2.78551144	25.80509752	106	**182.25**	210.13	2.26	
28-Jul-05 00:00:00	8.226694068	67.1653471	3.11896936	25.10116684	106	**179.81**	211.17	2.65	
29-Jul-05 00:00:00	9.118919015	71.3573483	4.01371593	30.42853692	106	**187.44**	231.73	3.09	
30-Jul-05 00:00:00	9.273064287	75.2894295	4.16126865	23.9164212	106	**188.76**	235.41	3.31	
31-Jul-05 00:00:00	8.284856928	77.9273762	2.65744457	30.01851901	106	**180.30**	206.43	3.00	
01-Aug-05 00:00:00	8.458872394	89.8390099	2.61547161	27.88323217	106	**181.79**	207.66	3.48	
02-Aug-05 00:00:00	8.709462871	177.582664	2.32268741	36.16365047	106	**183.94**	206.81	6.85	
03-Aug-05 00:00:00	8.980752376	90.6447522	2.86124143	26.65602626	106	**186.26**	215.64	3.65	
04-Aug-05 00:00:00	8.846323604	82.4134141	2.76299999	23.98157367	106	**185.11**	213.15	3.28	
05-Aug-05 00:00:00	8.821105873	84.6768049	2.67247266	23.31234685	106	**184.89**	211.85	3.35	
06-Aug-05 00:00:00	8.118958239	67.4887497	2.1542401	23.74198058	106	**178.88**	199.33	2.51	
07-Aug-05 00:00:00	8.585306898	94.5028087	3.98154942	15.30364679	106	**182.87**	225.66	3.98	
08-Aug-05 00:00:00	8.904945673	115.337918	5.38414945	5.400463827	106	**185.61**	249.61	5.37	
09-Aug-05 00:00:00	7.391904078	105.720773	3.27711297	6.47314357	106	**172.66**	204.59	4.04	
10-Aug-05 00:00:00	6.871200133	82.0165502	1.5029295	15.12951889	106	**168.20**	181.17	2.77	
11-Aug-05 00:00:00	8.081347585	62.7023842	2.33486862	23.08661655	106	**178.56**	200.90	2.35	
12-Aug-05 00:00:00	8.645828433	64.702507	2.96648239	22.51378007	106	**183.39**	213.56	2.58	
13-Aug-05 00:00:00	9.137358373	71.6624608	3.73383015	21.77813734	106	**187.60**	228.17	3.05	
14-Aug-05 00:00:00	9.158233294	64.1451334	3.33002223	23.05893117	106	**187.78**	223.17	2.67	
15-Aug-05 00:00:00	8.430997562	65.1293542	2.63901826	23.32229991	106	**181.55**	207.65	2.52	
16-Aug-05 00:00:00	8.799989767	69.8343564	3.0316763	21.4530221	106	**184.71**	215.88	2.81	
17-Aug-05 00:00:00	8.555749403	73.5703056	2.70057418	22.21026231	106	**182.62**	209.57	2.88	
18-Aug-05 00:00:00	7.935193927	74.7394545	2.09833248	22.01828769	106	**177.31**	196.99	2.75	
19-Aug-05 00:00:00	8.030089205	75.7301747	2.1444342	23.14008523	106	**178.12**	198.38	2.80	
20-Aug-05 00:00:00	8.080152061	79.3995177	2.25570819	22.86755949	106	**178.55**	200.04	2.96	
21-Aug-05 00:00:00	7.929598579	76.789621	2.40718037	22.60704287	106	**177.26**	200.21	2.87	
22-Aug-05 00:00:00	8.38059237	51.3534202	2.87453414	21.28389033	106	**181.12**	209.85	2.01	
23-Aug-05 00:00:00	8.103728253	45.2487262	2.63964198	21.69097981	106	**178.75**	204.45	1.73	
24-Aug-05 00:00:00	7.777356378	69.6938719	2.29783527	22.21696621	106	**175.96**	197.58	2.57	

SRU 1 SO2 daily SO2 emissions (and other Fee emission calculations) 2005

This looks like it should be %, not ppm. Using value as %.

FI3614 (the stack flow meter) was not operating in 2005. Per Unit Engineer max flow would be 300MSCFH. - based on stack test and ratio based on LTPD production - flow more like 106 MSCFH

	FI3516	ai3508c	2005 stack %O2 PI tag ai3507	fi3614		Flue Gas			
	SR1-FL GAS TO THRML OX	SR1-STACK SO_2--DRY	Thermo Oxidiz Stack O_2	TG1-TG ABS KO > THM OX	TG1-TG ABS KO > THM OX	Theoretical (w/o excess air)	Total (with excess air)	SRU 1 SO2 emissions	Comment
Date	MSCFH	PPM	% O2	MSCFH	MSCFH	mscfh	mscfh	lb/hr	
25-Aug-05 00:00:00	8.074017259	75.9604111	2.50556615	22.67677069	106	**178.50**	202.68	2.87	
26-Aug-05 00:00:00	8.726637873	81.0079603	2.83410311	23.2172954	106	**184.08**	212.80	3.22	
27-Aug-05 00:00:00	8.327044668	75.6460893	2.38742882	23.52705753	106	**180.66**	203.84	2.88	
28-Aug-05 00:00:00	8.64869717	74.3426617	3.01577169	22.93802821	106	**183.42**	214.17	2.97	
29-Aug-05 00:00:00	8.582131675	84.3301797	2.97745392	22.02723079	106	**182.85**	213.06	3.35	
30-Aug-05 00:00:00	8.609339873	80.961522	2.76699883	21.28608944	106	**183.08**	210.86	3.19	
31-Aug-05 00:00:00	8.162501686	75.5195247	2.35923616	22.6615886	106	**179.26**	201.94	2.85	
01-Sep-05 00:00:00	8.701906335	79.9958621	3.14972623	23.57389493	106	**183.87**	216.32	3.23	
02-Sep-05 00:00:00	9.016155762	79.7255012	3.4506011	23.16097021	106	**186.56**	223.24	3.32	
03-Sep-05 00:00:00	9.01073532	85.3584738	3.31141193	22.74533497	106	**186.52**	221.43	3.53	
04-Sep-05 00:00:00	9.193856894	99.5687975	3.50171649	21.32871497	106	**188.08**	225.72	4.19	
05-Sep-05 00:00:00	9.242740379	91.3817592	3.36582432	21.16138779	106	**188.50**	224.48	3.83	
06-Sep-05 00:00:00	8.887975161	79.4268765	3.09386164	21.73011539	106	**185.47**	217.51	3.22	
07-Sep-05 00:00:00	9.013293429	79.9583483	3.19864895	21.83194486	106	**186.54**	220.06	3.28	
08-Sep-05 00:00:00	8.512023972	74.775261	2.73621205	21.95406334	106	**182.25**	209.55	2.92	
09-Sep-05 00:00:00	8.537150046	94.178207	2.61171152	21.89963366	106	**182.46**	208.38	3.66	
10-Sep-05 00:00:00	8.678909538	71.643427	2.93973236	21.81766912	106	**183.68**	213.57	2.86	
11-Sep-05 00:00:00	8.553713247	62.1362041	2.90036248	23.22373328	106	**182.60**	211.87	2.46	
12-Sep-05 00:00:00	8.126847732	75.0043031	2.64759078	24.55402354	106	**178.95**	204.77	2.87	
13-Sep-05 00:00:00	8.118563828	45.6784036	2.51681682	22.49273144	106	**178.88**	203.24	1.73	
14-Sep-05 00:00:00	8.801103416	57.3105902	2.88512663	22.8541716	106	**184.72**	214.14	2.29	
15-Sep-05 00:00:00	8.5601203	39.175641	2.62095007	22.10387957	106	**182.66**	208.71	1.53	
16-Sep-05 00:00:00	8.702681772	46.7815436	2.73381572	21.80899117	106	**183.88**	211.40	1.85	
17-Sep-05 00:00:00	8.837572687	14.1847861	2.46685148	22.52968714	106	**185.03**	209.66	0.56	
18-Sep-05 00:00:00	8.813439883	10.9336905	2.5690167	22.53484705	106	**184.83**	210.59	0.43	
19-Sep-05 00:00:00	8.558402639	9.74203309	2.23709055	21.95609423	106	**182.64**	204.42	0.37	
20-Sep-05 00:00:00	8.349433063	9.39125766	2.18276019	22.89628057	106	**180.86**	201.83	0.35	
21-Sep-05 00:00:00	8.57313887	9.00248312	2.3613197	22.59300863	106	**182.77**	205.93	0.35	
22-Sep-05 00:00:00	8.181624377	10.6364826	2.12557825	22.63391301	106	**179.42**	199.63	0.40	
23-Sep-05 00:00:00	7.698485101	49.0196048	2.68822784	13.99231768	106	**175.28**	201.02	1.84	
24-Sep-05 00:00:00	8.057071356	25.9745458	4.13958435	9.021138546	106	**178.35**	222.14	1.08	
25-Sep-05 00:00:00	7.720596607	29.5394051	3.559963	8.221927182	106	**175.47**	211.29	1.16	
26-Sep-05 00:00:00	7.726085031	25.869558	3.50531607	8.463857051	106	**175.52**	210.69	1.02	
27-Sep-05 00:00:00	6.705807628	23.901351	3.24085411	6.547184527	106	**166.79**	197.22	0.88	
28-Sep-05 00:00:00	6.27767235	250	4.34287576	0.959530598	106	**163.12**	205.65	9.60	SRU1 down?
29-Sep-05 00:00:00	9.688037006	250	5.31772158	0.00491348	106	**192.31**	257.52	12.02	SRU1 down?
30-Sep-05 00:00:00	5.559780302	250	4.49303137	0.00491348	106	**156.98**	199.71	9.32	SRU1 down?
01-Oct-05 00:00:00	4.968329163	67.6922296	3.36481173	0.00491348	106	**151.92**	180.90	2.29	SRU1 down?
02-Oct-05 00:00:00	0.580871523	92.5859547	5.49658028	0.00491348	0	**4.97**	6.73	0.12	SRU1 and TO down?
03-Oct-05 00:00:00	0.098498471	36.1855594	3.05098249	0.00491348	0	**0.84**	0.99	0.01	SRU1 and TO down?
04-Oct-05 00:00:00	0.098498471	13.2234593	4.51712491	0.00491348	0	**0.84**	1.07	0.00	SRU1 and TO down?
05-Oct-05 00:00:00	0.098498471	10.7873097	1.77552569	0.00491348	0	**0.84**	0.92	0.00	SRU1 and TO down?
06-Oct-05 00:00:00	0.098498471	9.22751811	0.0392797	0.00491348	0	**0.84**	0.84	0.00	SRU1 and TO down?
07-Oct-05 00:00:00	0.098498471	4.68278766	1.62768347	0.00491348	0	**0.84**	0.91	0.00	SRU1 and TO down?
08-Oct-05 00:00:00	0.098498471	3.72798721	2.95730332	0.00491348	0	**0.84**	0.98	0.00	SRU1 and TO down?
09-Oct-05 00:00:00	0.098498471	3.7832417	7.6258751	0.00491348	0	**0.84**	1.32	0.00	SRU1 and TO down?
10-Oct-05 00:00:00	0.098498471	2.58285358	5.89724545	0.00491348	0	**0.84**	1.17	0.00	SRU1 and TO down?
11-Oct-05 00:00:00	0.098498471	2.15335742	5.3956917	0.00491348	0	**0.84**	1.13	0.00	SRU1 and TO down?

SRU 1 SO2 daily SO2 emissions (and other Fee emission calculations) 2005

This looks like it should be %, not ppm. Using value as %.

FI3614 (the stack flow meter) was not operating in 2005. Per Unit Engineer max flow would be 300MSCFH. - based on stack test and ratio based on LTPD production - flow more like 106 MSCFH

	FI3516	ai3508c	2005 stack %O2 PI tag ai3507	fi3614		Flue Gas			
	SR1-FL GAS TO THRML OX	SR1-STACK SO_2--DRY	Thermo Oxidiz Stack O_2	TG1-TG ABS KO > THM OX	TG1-TG ABS KO > THM OX	Theoretical (w/o excess air)	Total (with excess air)	SRU 1 SO2 emissions	Comment
Date	MSCFH	PPM	% O2	MSCFH	MSCFH	mscfh	mscfh	lb/hr	
12-Oct-05 00:00:00	0.098498471	6.6244244	4.79633207	0.00491348	0	**0.84**	1.09	0.00	SRU1 and TO down?
13-Oct-05 00:00:00	0.098498471	5.43537961	4.97725969	0.00491348	0	**0.84**	1.10	0.00	SRU1 and TO down?
14-Oct-05 00:00:00	0.098498471	3.37801602	5.61181644	0.00491348	0	**0.84**	1.15	0.00	SRU1 and TO down?
15-Oct-05 00:00:00	0.098498471	3.36000642	6.78266575	0.00491348	0	**0.84**	1.25	0.00	SRU1 and TO down?
16-Oct-05 00:00:00	0.098498471	2.53684808	6.13903926	0.00491348	0	**0.84**	1.19	0.00	SRU1 and TO down?
17-Oct-05 00:00:00	0.098498471	2.83509969	5.64624229	0.00491348	0	**0.84**	1.15	0.00	SRU1 and TO down?
18-Oct-05 00:00:00	0.098498471	3.10647852	5.9947224	0.00491348	0	**0.84**	1.18	0.00	SRU1 and TO down?
19-Oct-05 00:00:00	0.098498471	2.89540325	6.21645058	0.00491348	0	**0.84**	1.20	0.00	SRU1 and TO down?
20-Oct-05 00:00:00	0.098498471	9.5225509	5.46707635	0.00491348	0	**0.84**	1.14	0.00	SRU1 and TO down?
21-Oct-05 00:00:00	0.098498471	3.59630437	6.40538893	0.00491348	0	**0.84**	1.21	0.00	SRU1 and TO down?
22-Oct-05 00:00:00	0.098498471	3.93911055	5.74151106	0.00491348	0	**0.84**	1.16	0.00	SRU1 and TO down?
23-Oct-05 00:00:00	0.098498471	3.5991465	5.4920528	0.00491348	0	**0.84**	1.14	0.00	SRU1 and TO down?
24-Oct-05 00:00:00	0.098498471	5.05411054	7.25774638	0.00491348	0	**0.84**	1.29	0.00	SRU1 and TO down?
25-Oct-05 00:00:00	0.098498471	5.25979965	7.17470151	0.00491348	0	**0.84**	1.28	0.00	SRU1 and TO down?
26-Oct-05 00:00:00	0.098498471	5.07606971	7.84217337	0.00491348	0	**0.84**	1.35	0.00	SRU1 and TO down?
27-Oct-05 00:00:00	0.715848256	18.1436068	8.26100822	0.00491348	0	**6.13**	10.10	0.03	SRU1 and TO down?
28-Oct-05 00:00:00	3.722881865	250	5.22499328	0.00491348	0	**31.86**	42.42	1.98	SRU1 down?
29-Oct-05 00:00:00	1.833743846	250	1.93772335	0.00491348	106	**125.09**	137.80	6.43	SRU1 down?
30-Oct-05 00:00:00	2.274538748	250	4.32767588	0.00491348	106	**128.86**	162.31	7.57	SRU1 down?
31-Oct-05 00:00:00	3.558874805	250	4.89555919	10.45410962	106	**139.85**	182.37	8.51	SRU1 down?
01-Nov-05 00:00:00	8.902277019	250	4.84427933	4.431523703	106	**185.59**	241.24	11.26	SRU1 down?
02-Nov-05 00:00:00	7.614345627	32.5068818	3.12987141	23.09415329	106	**174.56**	205.14	1.24	SRU1 down?
03-Nov-05 00:00:00	5.543296734	22.5552457	4.88575239	5.703203639	106	**156.84**	204.39	0.86	SRU1 down?
04-Nov-05 00:00:00	5.22200862	29.3276382	4.11321858	3.568074598	106	**154.09**	191.62	1.05	SRU1 down?
05-Nov-05 00:00:00	4.85921913	27.2851964	3.79246995	2.501464729	106	**150.98**	184.26	0.94	SRU1 down?
06-Nov-05 00:00:00	5.022606558	31.260601	3.28425192	4.023288223	106	**152.38**	180.63	1.05	SRU1 down?
07-Nov-05 00:00:00	5.111876546	24.4462643	2.48715459	8.700233612	106	**153.15**	173.72	0.79	SRU1 down?
08-Nov-05 00:00:00	5.270448316	28.6558678	2.18065913	10.21936994	106	**154.50**	172.41	0.92	
09-Nov-05 00:00:00	5.809892512	26.7837007	3.3607196	10.08428554	106	**159.12**	189.44	0.95	
10-Nov-05 00:00:00	6.250357242	28.9820019	3.16052119	16.88850775	106	**162.89**	191.75	1.04	
11-Nov-05 00:00:00	5.834759442	37.1555409	4.91249007	15.48530631	106	**159.33**	207.99	1.44	
12-Nov-05 00:00:00	6.163953653	63.4166367	5.72799491	14.47052329	106	**162.15**	222.97	2.64	
13-Nov-05 00:00:00	5.599410932	63.3185553	3.56192817	15.78474253	106	**157.32**	189.45	2.24	
14-Nov-05 00:00:00	5.135977707	74.801202	3.14785855	17.3605552	106	**153.35**	180.39	2.52	
15-Nov-05 00:00:00	3.58529965	95.6345905	2.09939462	21.04065859	106	**140.08**	155.64	2.78	
16-Nov-05 00:00:00	5.430903396	60.0841656	3.78471119	18.92440123	106	**155.88**	190.14	2.13	
17-Nov-05 00:00:00	4.472000975	73.0412755	2.59494096	33.39622766	106	**147.67**	168.49	2.30	
18-Nov-05 00:00:00	4.693332755	65.9941809	2.96221389	24.58847186	106	**149.56**	174.12	2.14	
19-Nov-05 00:00:00	5.107090337	70.2727612	3.21567889	24.01734936	106	**153.10**	180.79	2.37	
20-Nov-05 00:00:00	5.429127236	67.7365696	3.53486547	23.62312643	106	**155.86**	187.41	2.37	
21-Nov-05 00:00:00	5.2935064	69.7750281	3.15767545	24.70007437	106	**154.70**	182.08	2.37	
22-Nov-05 00:00:00	4.897994965	53.6385231	2.87776034	23.47107555	106	**151.31**	175.34	1.76	

SRU 1 SO2 daily SO2 emissions (and other Fee emission calculations) 2005

This looks like it should be %, not ppm. Using value as %.

FI3614 (the stack flow meter) was not operating in 2005. Per Unit Engineer max flow would be 300MSCFH. - based on stack test and ratio based on LTPD production - flow more like 106 MSCFH

	FI3516	ai3508c	2005 stack %O2 PI tag ai3507	fi3614		Flue Gas			
	SR1-FL GAS TO THRML OX	SR1-STACK SO_2--DRY	Thermo Oxidiz Stack O_2	TG1-TG ABS KO > THM OX	TG1-TG ABS KO > THM OX	Theoretical (w/o excess air)	Total (with excess air)	SRU 1 SO2 emissions	Comment
Date	MSCFH	PPM	% O2	MSCFH	MSCFH	mscfh	mscfh	lb/hr	
23-Nov-05 00:00:00	5.258782845	59.8556659	3.27060435	24.20885752	106	**154.40**	182.89	2.04	
24-Nov-05 00:00:00	4.911363696	48.2701048	3.10063407	24.4579213	106	**151.43**	177.66	1.60	
25-Nov-05 00:00:00	4.949357607	54.5430991	3.39660755	25.60229643	106	**151.75**	181.04	1.84	
26-Nov-05 00:00:00	5.206683143	63.1943788	3.07424252	28.52462276	106	**153.96**	180.36	2.13	
27-Nov-05 00:00:00	5.19783985	70.8507554	3.01246533	28.78200862	106	**153.88**	179.65	2.38	
28-Nov-05 00:00:00	5.492495475	75.441619	3.38615536	28.5162502	106	**156.40**	186.47	2.63	
29-Nov-05 00:00:00	5.839756508	57.9072531	3.98754906	24.92260175	106	**159.38**	196.73	2.13	
30-Nov-05 00:00:00	5.745043009	61.2599457	3.5868676	24.44404389	106	**158.56**	191.23	2.19	
01-Dec-05 00:00:00	5.448906812	62.5523189	3.18818317	25.76481557	106	**156.03**	183.96	2.15	
02-Dec-05 00:00:00	5.768731443	56.5022788	3.4001485	24.00864503	106	**158.77**	189.44	2.00	
03-Dec-05 00:00:00	6.253224489	61.3790261	3.63180527	23.87469114	106	**162.91**	196.98	2.26	
04-Dec-05 00:00:00	6.249354864	59.5517575	3.45212857	24.23805	106	**162.88**	194.92	2.17	
05-Dec-05 00:00:00	6.141435691	63.7625918	3.51953264	24.46837008	106	**161.96**	194.57	2.32	
06-Dec-05 00:00:00	6.212053336	60.9959327	3.46578753	20.30834233	106	**162.56**	194.69	2.22	
07-Dec-05 00:00:00	6.705944806	74.0967339	3.58127653	18.21960021	106	**166.79**	201.08	2.78	
08-Dec-05 00:00:00	7.518496474	83.8362662	3.41010685	17.85277542	106	**173.74**	207.43	3.25	
09-Dec-05 00:00:00	6.287768505	60.599134	2.57739666	18.29277545	106	**163.21**	186.04	2.10	
10-Dec-05 00:00:00	7.3795384	54.8777844	3.69378617	16.4953147	106	**172.55**	209.38	2.14	
11-Dec-05 00:00:00	5.851220596	78.5253573	2.19412771	20.81524054	106	**159.47**	178.08	2.61	
12-Dec-05 00:00:00	7.602052919	70.9497318	4.31066331	18.4032604	106	**174.46**	219.52	2.91	
13-Dec-05 00:00:00	9.831557248	89.488536	6.13449524	17.78138424	106	**193.54**	273.41	4.57	
14-Dec-05 00:00:00	9.747730812	70.793103	5.3605907	19.5177826	106	**192.82**	258.92	3.42	
15-Dec-05 00:00:00	5.517544145	79.2591912	1.92019199	24.57311582	106	**156.62**	172.38	2.55	
16-Dec-05 00:00:00	6.867340561	72.5563407	3.50131769	23.60265191	106	**168.17**	201.82	2.73	
17-Dec-05 00:00:00	9.021846964	174.91978	4.61590449	20.89395502	106	**186.61**	239.19	7.81	
18-Dec-05 00:00:00	7.622039716	128.80018	2.81165239	21.6799192	106	**174.63**	201.63	4.85	
19-Dec-05 00:00:00	5.081628131	113.251216	1.92618402	21.7040287	106	**152.89**	168.33	3.56	
20-Dec-05 00:00:00	7.242562006	54.9159043	3.75662354	18.19690246	106	**171.38**	208.72	2.14	
21-Dec-05 00:00:00	5.515285301	99.129438	2.14348561	21.41076053	106	**156.60**	174.40	3.23	
22-Dec-05 00:00:00	5.551586144	62.6336477	2.90120556	24.07049933	106	**156.91**	182.06	2.13	
23-Dec-05 00:00:00	4.963949576	72.7333095	2.09110356	27.52118437	106	**151.88**	168.68	2.29	
24-Dec-05 00:00:00	4.916707986	88.1110562	2.83595421	32.80442401	106	**151.47**	175.12	2.88	
25-Dec-05 00:00:00	4.480224931	82.8732682	2.48568085	35.26158047	106	**147.74**	167.57	2.59	
26-Dec-05 00:00:00	5.07304472	62.963671	2.82521659	30.61687163	106	**152.81**	176.57	2.07	
27-Dec-05 00:00:00	5.114443579	77.9981781	2.98664449	27.77618688	106	**153.17**	178.56	2.60	
28-Dec-05 00:00:00	6.128452538	95.840221	2.30501121	23.69919335	106	**161.85**	181.80	3.25	
29-Dec-05 00:00:00	6.125382713	68.3842502	3.05708908	24.37812053	106	**161.82**	189.39	2.42	
30-Dec-05 00:00:00	6.131872141	92.0149623	2.91034019	23.88873776	106	**161.88**	187.92	3.23	
31-Dec-05 00:00:00	5.994205735	103.977677	2.98503959	24.49779687	106	**160.70**	187.32	3.64	

TOTAL Average 14.54 tpy

Example Calculations

Flue Gas Theoretical, mscfh = NG fired, mscfh x ft3 flue gas/ft3 fuel gas + TGT vent gas, mscfh x ft3 flue gas / ft3 vent feed

Flue gas Actual (w/ excess air) = scf flue theoretical * (1 + (1/((21/stack O_2) - 1))

SO_2 Emissions (annual tons) = actual flue gas flow (mscfh, dry) * (1000 / m) (560 R/520 R) * 0.1733 (lb SO2/ft3 SO_2)
* (SO_2 in TO exhaust (ppmv) / 10^6) *8760 hours/year / 2000 lb/ton

These equations are derived and documented on the SO2 sheet.

SRU 1 Flow Correction

SRU1		2004	2005	Flowrate from Stack Test in 2011
Load	LTPD	55.7	47.2	95.6
Emissions	tons/yr			
PPM SO2		112.1	91.79	74
Stack O2		2.80	3.26	5.8
ppm so2 at zero O2				102.4
TG flow		unknown	unknown	
Total Stack Flow		unknown	unknown	475.6
Probable actual TG flow		125	106	215

SRU SO2 Emissions Equations Updated 3-21-07

This sheet derives the equations used in the Emissions sheets to calculate SO2 emissions in lb/hr and tons/year.

TGT and NG compositions are used to develop ratios of the volume of TO flue gas to the volumes of TGT vent gas and fuel gas/NG entering the TO. Complete combustion of all hydrocarbons, hydrogen, and CO is assumed. Ratios of moles of CO2 and H2O per mole of each molecule burned are listed in Tables 1 and 2. The mole ratios are multiplied by the percentage of each molecule in the fuel gas to give the volumes of CO2 and H2O in flue gas per unit volume of fuel burned.

Combustion air added to the system is accounted for in two calculations. The first (in Tables 1 and 2) accounts for air whose oxygen is combusted. Moles of oxygen needed for combustion of each compound are listed, and the volume of nitrogen that accompanies this oxygen in combustion air is calculated, assuming air is 21% O2 and 79% N2, so that 79/21 or 3.76 ft3 of N2 is added per ft3 of O2 burned.

Tables 3 and 4 add the volume fractions of noncombustibles in the vent gas or fuel gas to the volume fractions of CO2, H2O, and N2 in flue gas that are calculated in Tables 1 and 2 to arrive at the ratio of flue gas volume to vent gas or fuel gas volume. All PI concentration tags are assumed to be on a dry basis, so water is excluded from the flue gas calculations (natural gas is already on a dry basis) and from the nominator of the volume ratios calculated in Tables 3 and 4. These calculations only address the vent or fuel gas and combustion air that is used; the following calculations add in the volume of excess air using the measured oxygen percentage in the stack.

Theoretical flue gas volume (without excess air) = TGT vent gas flow * 1.031 (from T3 below) + NG fuel flow * 8.559 (from T4 below)

The following calculations are derived here, but actually performed on the SRU 2-3 Emissions and SRU1 Emissions sheets:

The portion of air added to the system that is not used for combustion is calculated here:
Total flue gas volume (with excess air) is derived in terms of the theoretical flue gas volume (without excess air) and stack %O2 (from PI):
Stack O2 (%) * (one / 100%) = scf excess O2 / scf total flue gas = scf excess O2 /(scf flue theoretical + scf excess air)
Scf excess O2 = 0.21 * scf excess air (assuming oxygen content of air to be 21%v/v)
Stack O2 (fraction) = 0.21 * 100 * scf excess air /(scf flue theoretical + scf excess air)
Solving this equation for excess air: scf excess air = scf flue theoretical / ((21/stack O2) - 1)
Total scf flue gas (w/excess air) = scf flue theoretical + scf excess air = scf flue theoretical * (1 + (1/((21/stack O2) - 1))

Finally, the weight of SO2 emitted is calculated using SO2 density and the Ideal Gas Law:
Stack SO2 Emissions at 560 R = scf flue gas * 0.1733 lb/ft3 (SO2 density at 520 R) * (560/520) * stack SO2 ppmv / (1e6 part /ppm)
The conversion to 100 F (560 R) may be a refinery standard temperature from the old Sohio engineering/technical data book per Linda Wilson 3/12/07. Actual stack temperature is likely to be significantly higher. Does this need to be revised?

SO2 concentrations from PI are assumed to be on a dry basis, actual oxygen, parts per million volume basis.

T1. TGT VENT GAS

This is probably from SRU design basis.

Compound	mole %	mole %, dry basis	ft3 of CO2 in flue gas per ft3 of compound	ft3 of CO2 in flue gas per ft3 dry fuel	ft3 of H2O in flue gas per ft3 of compound	ft3 of H2O in flue gas per ft3 dry fuel	ft3 O2 needed per ft3 of compound	ft3 of N2 in flue gas per ft3 of compound	ft3 of N2 in flue gas per ft3 dry fuel
hydrogen	3.3	3.5	0.0	0.000	1.0	0.035	0.5	1.881	0.065
nitrogen	88.5	94.0	0.0	0.000	0.0	0.000	0.0	0.000	0.000
oxygen	0.0	0.0	0.0	0.000	0.0	0.000	0.0	0.000	0.000
carbon monoxide	0.0	0.0	1.0	0.000	0.0	0.000	0.5	1.881	0.000
methane	0.0	0.0	1.0	0.000	2.0	0.000	2.0	7.524	0.000
carbon dioxide	2.4	2.5	0.0	0.000	0.0	0.000	0.0	0.000	0.000
water	5.92	0	0	0.000	0.0	0.000	0.0	0.000	0.000
Total	100.0	100.0		0.000		0.035			0.065

T2. NATURAL GAS

(typical, from http://www.uniongas.com/aboutus/aboutng

Compound	mole %	(already dry basis)	ft3 of CO2 in flue gas per ft3 of compound	ft3 of CO2 in flue gas per ft3 of fuel	ft3 of H2O in flue gas per ft3 of compound	ft3 of H2O in flue gas per ft3 of fuel	ft3 O2 needed per ft3 of compound	ft3 of N2 in flue gas per ft3 of compound	ft3 of N2 in flue gas per ft3 of fuel
carbon dioxide	0.7		0	0	0	0	0.0	0.000	0
methane	94.9		1	0.949	2	1.898	2.0	7.524	7.140
ethane	2.5		2	0.05	3	0.075	3.5	13.167	0.329
propane	0.2		3	0.006	4	0.008	5.0	18.810	0.038
normal/iso-c4	0.06		4	0.0024	5	0.003	6.5	24.452	0.015
pentane	0.02		5	0.001	6	0.0012	8.0	30.095	0.006
oxygen	0.02		0	0.000	0	0.000	0.0	0.000	0.000
H2	0		0	0.000	1	0.000	0.5	1.881	0.000
H2O	0		0	0.000	0.0	0.000	0.0	0.000	0.000
CO	0		1.0	0.000	0.0	0.000	0.5	1.881	0.000
N2	1.6		0.0	0.000	0.0	0.000	0.0	0.000	0.000
Total	100			1.0084		1.9852			7.528

T3.Flue Gas / Vent Gas Volume Ratio (excluding excess air)

	(ft3/dry fuel ft3)	vent prod (ft3/dry fuel ft3)	(ft3/dry fuel ft3)	Total mole %
carbon dioxide	0.025	0.000	0.025	2.424
water	0.000	0.035	0.000	0.000
nitrogen	0.940	0.065	1.006	97.576
oxygen	0.000	0.000	0.000	0.000
Total			1.031	100.000

T4. Flue Gas / Fuel Gas Volume Ratio (excluding excess air)

	fuel feed (ft3/ft3)	fuel prod (ft3/ft3)	Totals (ft3/ft3)	Totals mole %
carbon dioxide	0.007	1.008	1.015	11.863
water	0.000	1.985	0.000	0.000
nitrogen	0.016	7.528	7.544	88.134
oxygen	0.000	0.000	0.000	0.002
Total			8.559	100.000

FUEL GAS COMPOSITION		ft3 of CO2 in flue gas		ft3 of H2O in flue gas		ft3 of N2 in flue gas	
exact data source unknown		per ft3	per ft3	per ft3	per ft3	per ft3	per ft3
Compound	mole %	const.	of fuel	const.	of fuel	const.	of fuel
carbon dioxide	1	0	0	0	0	0	0
methane	35.79	1	0.3579	2	0.7158	7.528	2.694
ethane	18.94	2	0.3788	3	0.5682	13.175	2.495
propane	1.34	3	0.0402	4	0.0536	18.821	0.252
normal/iso-c4	1.22	4	0.0488	5	0.061	24.467	0.298
pentane	0.44	5	0.022	6	0.0264	30.114	0.133
uC2	14.18	2	0.2836	2	0.2836	11.293	1.601
uC3	3	3	0.09	3	0.09	16.939	0.508
uC4	1.33	4	0.0532	4	0.0532	22.583	0.300
H2	7.98	0	0	1	0.0798	1.882	0.150
H2O	1.26	0	0.000	0.0	0.000	0.000	0.000
CO	0.44	1.0	0.004	0.0	0.000	1.882	0.008
N2	13.08	0.0	0.000	0.0	0.000	0.000	0.000
Total	100		1.2789		1.9316		8.441