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Study of Refinery Fugitive Emissions from Equipment Leaks

Appendices

Air Toxics Multi-Year Study

April 1994

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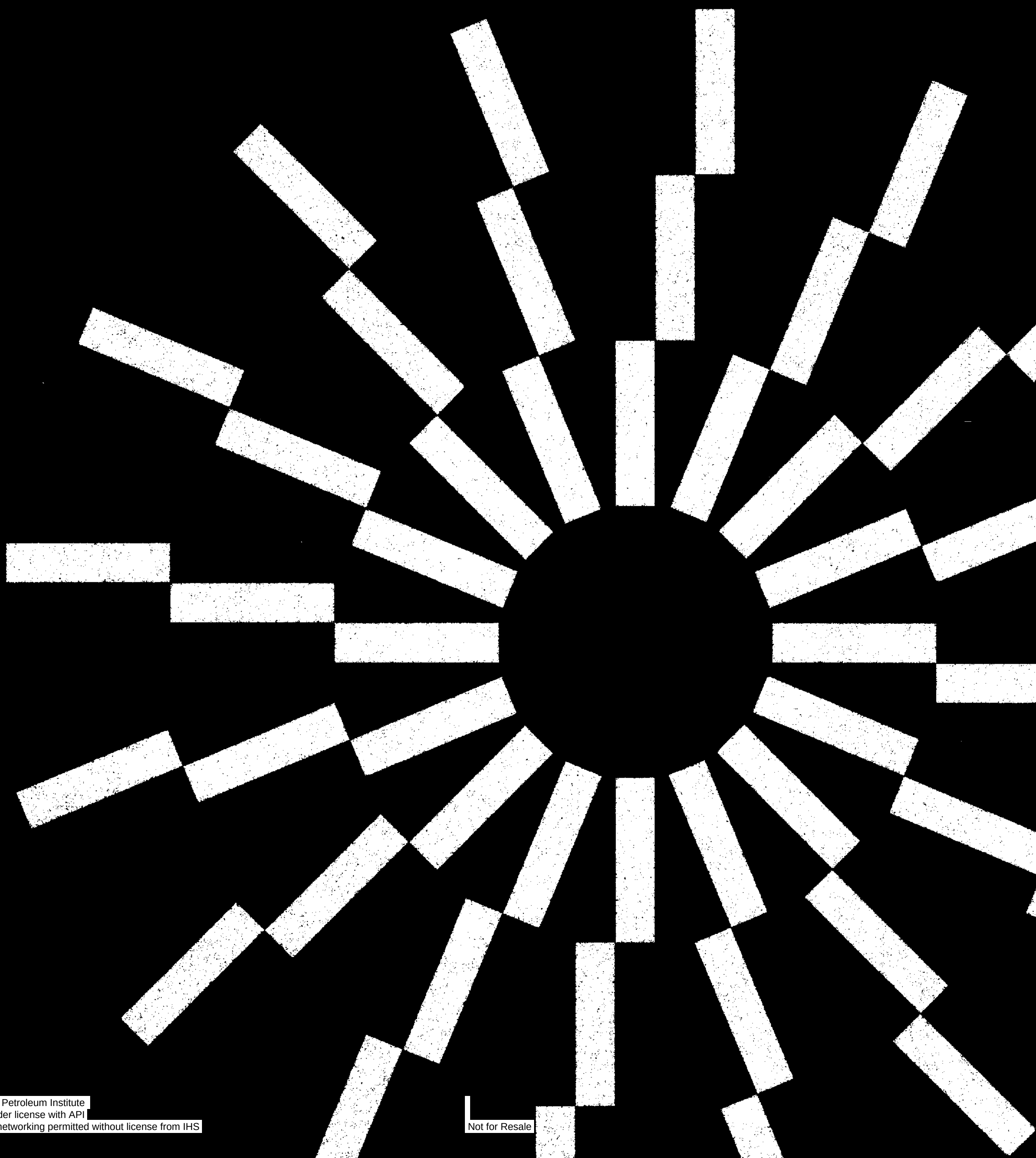

1993 Study of Refinery Fugitive Emissions from Equipment Leaks

Volume III: Appendices

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NOTE: This is to advise the reader that these studies are now under review by the U.S. Environmental Protection Agency. The Agency's review may be complete by summer 1994.

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LIST OF APPENDICES

Appendix — Page

1 Introduction 1-1

A Raw Data from Field and Emissions Calculations A-1

A.1 WSPA Emission Rate Calculation Spreadsheet A-1

A.2 Emission Correlation Equations Data A-123

A.3 Zero Component Emissions Data A-130

A.4 Pegged Component Emissions Data A-134

B Comparison of Vapor Leak Composition to Liquid Stream Composition Data and Calculations B-1

C Statistical Evaluations and Correlation Details C-1

D Development of Emission Correlation Equations Using the Measurement Error Method (MEM) Statistical Analysis Method D-1

E Independent Audit Results E-1

F Response to Regulatory Agency Comments on the Final Draft of the 1993 Refinery Study F-1

INTRODUCTION

This volume, Volume III of the *1993 Study of Refinery Fugitive Emissions from Equipment Leaks*, contains the appendices related to the data calculations and independent audit results. Specifically:

- Appendix A contains raw data from field and emissions calculations;
- Appendix B documents the comparison of vapor leak composition to liquid stream composition data and calculations;
- Appendix C contains statistical evaluations and correlation details;
- Appendix D discusses the development of emission correlation equations using the Measurement Error Method (MEM) statistical analysis method;
- Appendix E contains independent audit results; and
- Appendix F reprints the Response to Regulatory Agency Comments on the Final Draft of the 1993 Refinery Study.

APPENDIX A

RAW DATA FROM FIELD AND EMISSIONS CALCULATIONS

A.1

WSPA EMISSION RATE CALCULATION SPREADSHEET

KEY

CODES:

ACCY	=	Accuracy check
AUDTC	=	Audit gas directly to canister
AUDTD	=	Audit duplicate
AUDTT	=	Audit gas through tent
BL	=	Blank sample
DINV	=	Determined to be invalid after review
DUP	=	Sample duplicate
DZ	=	Default zero
INV	=	Invalid
L	=	Liquid sample
N2-#	=	Nitrogen flow test
PEG	=	Pegged source
PEGF	=	Final screening value pegged but not initial
PEGI	=	Initial screening value pegged but not final
PGAC	=	Pure gas accuracy check
SINV	=	Screening values invalid (ie, initial and final screening values varied by more than a factor of 2)
*DRIP	=	Component dripping; liquids collected and liquid concentration added to emission rates

ACTUATION:

C	=	Control
M	=	Manual

SERVICE:

HL	=	Heavy liquid
LL	=	Light liquid

UNIT:

SRU	=	Sulfur recovery unit
VRU	=	Vapor recovery unit

COMPONENT CATEGORY:

C	=	Connector
OEL	=	Open-ended line
PRV	=	Pressure relief valve

***Note: In the calculation of emission rates for dripping components a density of .75 * lbs/g (0.0022) was assumed.**

KEY

COMPONENT TYPE:

BTFY	=	Butterfly valve
C	=	Connector
CENT	=	Centrifugal
COUP	=	Coupler
DIA	=	Diaphram valve
FL	=	Flange
HC	=	Horizontal centrifugal
MC	=	Motor control
NEDL	=	Needle
OEL	=	Open-ended line
PRV	=	Pressure relief valve
TH	=	Threaded connector
U	=	Union connector
VC	=	Vertical centrifugal
VERT	=	Vertical

PRODUCT:

DB	=	Debutinized bottoms
HCO	=	Heavy cycle oil
HTGO	=	Hydrotreated gas oil
LCO	=	Light cycle oil
LPG	=	Liquified petroleum gas
LVGO	=	Light vacuum gas oil
OVHG gas	=	Overhead gas
Pa B	=	Pa bottoms
R Diesel	=	Recycled diesel
Reg UL	=	Regular unleaded gasoline

LABORATORY DATA:

NA	=	Not analyzed

Page 1a

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure (°Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
V-1	ACCY	2.5	72	33.50	VALVE	0.50	GATE		Y	H2O	Water
V-2		2.5	80	33.50	VALVE	4.00	GATE		Y	LL	Butane
V-3		2.5	82	33.50	VALVE	1.50	GLOBE		Y	LL	Butane
V-4	SINV	7.5	82	33.50	VALVE	3.00	GATE		Y	LL	Butane
V-5		7.5	80	33.50	VALVE	4.00	GATE		Y	LL	Butane
V-6	INV	2.5	73	30.24	PUMP		HC		Y	LL	Butane
V-7	INV	2.5	71	30.24	VALVE	1.00	MC				
V-8		2.5	76	30.24	VALVE	1.00	MC		Y	LL	Butane
V-9		2.5	80	30.24	VALVE	1.00	MC		Y	LL	Butane
V-10		2.5	85	30.24	VALVE	4.00	MC		Y	LL	H Naptha
V-11	SINV	2.5	85	30.24	VALVE	3.00	GATE		Y	LL	H Naptha
V-12	PEG	2.5	84	30.24	OEL	0.50	OEL		Y	GAS	Fuel Gas
V-13		2.5	85	30.24	VALVE	0.75	GATE		Y	LL	Butane reformat
V-14	PEG	2.5	75	30.16	VALVE	1.00	MC		Y	LL	H2 H Naptha
V-15		2.5	75	30.16	VALVE	0.75	GATE		Y	LL	Reformate
V-16	INV	2.5	79		VALVE	2.00	GATE		Y	LL	Butane
V-17		2.5	82	30.15	VALVE	2.00	GATE		Y	LL	Butane
V-18		2.5	84	30.15	OEL	0.50	OEL		N	LL	Reformate
V-19		2.5	84	30.10	OEL	0.50	OEL		N	LL	Reformate
V-20		7.5	85	30.10	VALVE	1.00	GATE		N	GAS	H2
V-21	DUP	7.5	85	30.10	VALVE	1.00	GATE		N	GAS	H2
V-22	SINV	7.5	85	30.10	PRV	1.00	PRV		N	LL	
V-23		2.5	85	30.10	OEL	0.50	OEL		N	GAS	H2
V-24		2.5	68	30.25	VALVE	4.00	MC		N	GAS	Butane
V-25		7.5	69	30.25	C	1.00	TH		Y	GAS	H2
V-26		2.5	70	30.25	VALVE	0.75	GLOBE		N	GAS	Fuel Gas
V-27		2.5	72	30.15	VALVE	2.00	GATE		Y	GAS	Fuel Gas
V-28		2.5	71	30.24	VALVE	2.00	GATE		N	GAS	Fuel Gas
V-29	DINV	2.5	73	30.24	VALVE	1.50	GATE		Y	GAS	Fuel Gas
V-30		2.5	78	30.24	VALVE	0.75	GATE		N	GAS	H2
V-31	PEG	2.5	80	30.23	VALVE	1.00	MC		N	GAS	H2
V-32		2.5	80	30.20	OEL	1.00	OEL		Y	GAS	H2
V-33	DINV	2.5	80	30.02	C	1.00	TH		Y	GAS	H2 Purge
V-34		7.5	82	30.04	C	1.00	U		Y	GAS	H2 Purge
V-35		2.5	80	30.02	C	1.50	FL		Y	GAS	H2
V-36		2.5	87	30.04	VALVE	0.75	GATE		Y	GAS	H2

Page 1b

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
V-1	ACCY		3				3				3	3	0
V-2		500	2,000				4,000				3,000	8	2,992
V-3		1,000	1,200				1,500				1,350	2	1,348
V-4	SINV	2,000	700				2,000				1,350	5	1,345
V-5		500	8,000				9,000				8,500	10	8,490
V-6	INV	1,000	2,000				2,000				2,000	3	1,998
V-7	INV												
V-8		300	700				900				800	4	796
V-9		3,000	4,000				4,000				4,000	4	3,996
V-10		10,050	6,700				6,700				6,700	10	6,690
V-11	SINV	3,000	584				1,460				1,022	18	1,004
V-12	PEG	100,000	89,000				89,000				89,000	5	88,995
V-13		30	2,000				3,000				2,500	4	2,496
V-14	PEG	100,000	67,000				67,000				67,000	12	66,988
V-15		100	100				120				110	10	100
V-16	INV	100	150				0				75	7	68
V-17		100	180				180				180	7	173
V-18			1,500				1,500				1,500	7	1,493
V-19			200				300				250	3	247
V-20		200	50				90				70	4	66
V-21	DUP	200	50				90				70	4	66
V-22	SINV		10				4				7	3	4
V-23			15				30				23	2	20
V-24		100,000	8,000				8,000				8,000	2	7,998
V-25			200				350				275	4	271
V-26		1,500	1,500				1,500				1,500	5	1,495
V-27		100	60				80				70	2	69
V-28		2,000	700				750				725	1	724
V-29	DINV	700	600				600				600	3	598
V-30		200	800				700				750	15	735
V-31	PEG	3,000	120,000				120,000				120,000	4	119,996
V-32		50	50,000				40,000				45,000	2	44,998
V-33	DINV		200				200				200	3	197
V-34			15				15				15	2	13
V-35			100				100				100	3	97
V-36		200	300				300				300	3	297

Page 1c

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
V-1	ACCY	1,140	1,080	1,110	956	925	941	0.94	3.20	4.10	3.65	0.07
V-2		2,475	2,475	2,475	2,818	2,818	2,818	2.82	4.80	5.20	5.00	0.22
V-3		750	500	625	2,563	2,563	2,563	2.56	3.50	2.90	3.20	0.18
V-4	SINV	945	945	945	2,891	3,279	3,085	3.09	4.00	1.50	2.75	0.21
V-5		1,575	1,680	1,628	3,028	3,091	3,060	3.06	4.50	2.50	3.50	0.22
V-6	INV	4,150	4,150	4,150	8,384	8,384	8,384	8.38	7.50	7.50	7.50	0.78
V-7	INV											
V-8		825	818	822	5,243	5,243	5,243	5.24	3.00	4.00	3.50	0.38
V-9		2,010	2,680	2,345	3,139	3,193	3,166	3.17	0.20	0.50	0.35	0.19
V-10		1,943	6,700	4,322	2,959	2,917	2,938	2.94	2.30	4.50	3.40	0.21
V-11	SINV	1,533	2,336	1,935	3,057	3,095	3,076	3.08	4.00	2.30	3.15	0.22
V-12	PEG	89,000	89,000	89,000	1,153	850	1,002	1.00	1.50	2.40	1.95	0.07
V-13		623	490	557	2,525	2,501	2,513	2.51	1.30	0.30	0.80	0.16
V-14	PEG	67,000	67,000	67,000	2,146	2,113	2,130	2.13	0.50	0.40	0.45	0.13
V-15		400	450	425	2,071	2,071	2,071	2.07	0.60	0.20	0.40	0.13
V-16	INV	94		94	2,875		2,875	2.88	4.00		4.00	0.21
V-17		120	120	120	3,657	3,657	3,657	3.66	1.30	2.40	1.85	0.24
V-18		243	320	282	942	812	877	0.88	1.50	2.00	1.75	0.06
V-19		166	149	158	868	869	869	0.87	1.70	3.80	2.75	0.06
V-20		117	117	117	2,266	2,252	2,259	2.26	0.30	0.20	0.25	0.14
V-21	DUP	117	117	117	2,266	2,252	2,259	2.26	0.30	0.20	0.25	0.14
V-22	SINV	22	18	20	2,194	2,206	2,200	2.20	2.80	2.00	2.40	0.15
V-23		20	24	22	978	983	981	0.98	1.50	1.50	1.50	0.06
V-24		6,400	6,400	6,400	2,858	2,873	2,866	2.87	3.00	3.20	3.10	0.20
V-25		1,296	792	1,044	877	879	878	0.88	4.00	4.00	4.00	0.07
V-26		715	910	813	2,402	2,398	2,400	2.40	1.00	0.20	0.60	0.15
V-27		23	25	24	2,222	2,269	2,246	2.25	1.80	0.30	1.05	0.14
V-28		600	600	600	2,291	2,308	2,300	2.30	2.80	1.90	2.35	0.16
V-29	DINV	427	732	580	2,100	2,078	2,089	2.09	4.60	5.20	4.90	0.16
V-30		1,950	5,200	3,575	1,929	1,931	1,930	1.93	0.20	0.20	0.20	0.12
V-31	PEG	120,000	120,000	120,000	2,349	2,330	2,340	2.34	0.60	0.40	0.50	0.14
V-32		17,000	17,000	17,000	966	1,004	985	0.99	0.10	0.10	0.10	0.06
V-33	DINV	113	450	281	638	629	634	0.63	5.00	5.40	5.20	0.05
V-34		29	25	27	805	808	807	0.81	3.60	3.60	3.60	0.06
V-35		68	228	148	733	1,134	934	0.93	1.20	0.40	0.80	0.06
V-36		267	369	318	2,357	2,385	2,371	2.37	0.80	0.40	0.60	0.15

Page 1d

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
V-1	ACCY	76	79	78	537			1,200.00		280.00	
V-2		83	86	85	544	NA	2,492.50	10.00	5.66	1,600.00	2,498.16
V-3		83	85	84	544	NA	1,046.71	4.60	2.61	670.00	1,049.32
V-4	SINV	83	82	83	542	NA	1,172.41	5.10	2.90	750.00	1,175.31
V-5		82	81	82	541	NA	1,873.42	8.10	4.60	1,200.00	1,878.02
V-6	INV	103	109	106	566	NA	4,189.21	16.00	9.03	2,700.00	4,198.23
V-7	INV							4.40		650.00	
V-8		87	83	85	545	NA	1,093.50	4.10	2.33	700.00	1,095.82
V-9		84	88	86	546	NA	2,197.65	5.10	2.91	1,400.00	2,200.56
V-10		95	96	96	555	NA	7,809.24	0.00	0.00	5,000.00	7,809.24
V-11	SINV	106	113	110	569	NA	10,924.34	0.00	0.00	7,000.00	10,924.34
V-12	PEG	84	84	84	544	NA	0.00	140,000.00	78,155.64	35,000.00	53,854.12
V-13		93	97	95	555	NA	190.44	300.00	171.09	230.00	361.53
V-14	PEG	77	76	77	536	NA	84,951.25	700.00	387.02	56,000.00	85,338.27
V-15		90	106	98	558	NA	440.36	0.00	0.00	280.00	440.36
V-16	INV	83		83	543	NA	40.01	26.00	14.76	35.00	54.77
V-17		87	86	87	546	NA	59.97	2.20	1.25	39.00	61.22
V-18		83	84	84	543	NA	486.61	0.00	0.00	310.00	486.61
V-19		84	85	85	544	NA	119.14	0.00	0.00	76.00	119.14
V-20		86	86	86	546	NA	84.96	0.00	0.00	54.00	84.96
V-21	DUP	86	86	86	546	NA	81.81	0.00	0.00	52.00	81.81
V-22	SINV	86	85	86	545	NA	6.27	0.00	0.00	4.00	6.27
V-23		86	84	85	545	NA	10.84	0.00	0.00	6.90	10.84
V-24		70	71	71	530	NA	5,413.93	380.00	215.59	3,600.00	5,629.53
V-25		81	83	82	542	NA	2,656.30	2.80	1.59	1,700.00	2,657.89
V-26		73	72	73	532	NA	0.00	380.00	216.79	110.00	172.97
V-27		72	74	73	533	NA	23.74	19.00	10.83	22.00	34.57
V-28		71	72	72	531	NA	0.00	340.00	193.49	69.00	108.23
V-29	DINV	82	83	83	542	NA	0.00	230.00	130.42	41.00	64.08
V-30		80	79	80	539	NA	1,547.12	320.00	182.56	1,100.00	1,729.68
V-31	PEG	81	80	81	540	NA	91,026.81	35,000.00	19,168.58	73,000.00	110,195.39
V-32		79	80	80	539	NA	10,513.60	4,100.00	2,329.88	8,200.00	12,843.48
V-33	DINV	80	80	80	540	NA	0.00	13.00	7.37	1.80	2.81
V-34		84	86	85	545	NA	7.67	0.00	0.00	4.90	7.67
V-35		90	92	91	551	NA	53.45	0.00	0.00	34.00	53.45
V-36		92	98	95	555	NA	155.35	86.00	49.06	130.00	204.41

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
							NMOC		Methane		THC	
ID	Code	MW fraction O2	MW fraction C3H8	% fraction N2	MW fraction N2	MW Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
V-1	ACCY	1.2	0.0124	96.3	27.0	28.17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V-2		1.6	0.0706	94.8	26.6	28.24	1.39E-03	1.22E+01	3.16E-06	2.76E-02	1.39E-03	1.22E+01
V-3		1.0	0.0296	96.7	27.1	28.16	4.76E-04	4.17E+00	1.19E-06	1.04E-02	4.77E-04	4.18E+00
V-4	SINV	0.9	0.0331	97.2	27.2	28.14	6.27E-04	5.49E+00	1.55E-06	1.36E-02	6.28E-04	5.50E+00
V-5		1.1	0.0529	96.4	27.0	28.18	1.04E-03	9.10E+00	2.55E-06	2.23E-02	1.04E-03	9.13E+00
V-6	INV	2.4	0.1191	92.2	25.8	28.36	7.95E-03	6.96E+01	1.71E-05	1.50E-01	7.97E-03	6.98E+01
V-7	INV											
V-8		1.1	0.0309	96.4	27.0	28.17	1.03E-03	9.04E+00	2.20E-06	1.93E-02	1.03E-03	9.06E+00
V-9		0.1	0.0618	99.5	27.9	28.06	1.06E-03	9.25E+00	1.40E-06	1.22E-02	1.06E-03	9.26E+00
V-10		1.1	0.2206	96.1	26.9	28.24	4.04E-03	3.54E+01	0.00E+00	0.00E+00	4.04E-03	3.54E+01
V-11	SINV	1.0	0.3088	96.2	26.9	28.26	5.70E-03	4.99E+01	0.00E+00	0.00E+00	5.70E-03	4.99E+01
V-12	PEG	0.6	1.5439	94.6	26.5	28.66	0.00E+00	0.00E+00	1.32E-02	1.16E+02	9.09E-03	7.97E+01
V-13		0.3	0.0101	99.2	27.8	28.06	7.30E-05	6.40E-01	6.56E-05	5.75E-01	1.39E-04	1.21E+00
V-14	PEG	0.1	2.4702	94.0	26.3	28.94	2.90E-02	2.54E+02	1.32E-04	1.16E+00	2.91E-02	2.55E+02
V-15		0.1	0.0124	99.6	27.9	28.04	1.36E-04	1.19E+00	0.00E+00	0.00E+00	1.36E-04	1.19E+00
V-16	INV	1.3	0.0015	96.0	26.9	28.18	2.14E-05	1.88E-01	7.90E-06	6.92E-02	2.93E-05	2.57E-01
V-17		0.6	0.0017	98.1	27.5	28.09	3.59E-05	3.14E-01	7.50E-07	6.57E-03	3.66E-05	3.21E-01
V-18		0.6	0.0137	98.2	27.5	28.09	6.99E-05	6.12E-01	0.00E+00	0.00E+00	6.99E-05	6.12E-01
V-19		0.9	0.0034	97.2	27.2	28.13	1.79E-05	1.56E-01	0.00E+00	0.00E+00	1.79E-05	1.56E-01
V-20		0.1	0.0024	99.7	27.9	28.03	2.90E-05	2.54E-01	0.00E+00	0.00E+00	2.90E-05	2.54E-01
V-21	DUP	0.1	0.0023	99.7	27.9	28.03	2.79E-05	2.44E-01	0.00E+00	0.00E+00	2.79E-05	2.44E-01
V-22	SINV	0.8	0.0002	97.6	27.3	28.12	2.33E-06	2.04E-02	0.00E+00	0.00E+00	2.33E-06	2.04E-02
V-23		0.5	0.0003	98.5	27.6	28.08	1.71E-06	1.50E-02	0.00E+00	0.00E+00	1.71E-06	1.50E-02
V-24		1.0	0.1588	96.5	27.1	28.20	2.81E-03	2.46E+01	1.12E-04	9.80E-01	2.92E-03	2.56E+01
V-25		1.3	0.0750	95.8	26.9	28.21	4.35E-04	3.81E+00	2.60E-07	2.28E-03	4.36E-04	3.82E+00
V-26		0.2	0.0049	99.4	27.8	28.05	0.00E+00	0.00E+00	8.19E-05	7.17E-01	6.53E-05	5.72E-01
V-27		0.3	0.0010	98.9	27.7	28.06	8.58E-06	7.51E-02	3.91E-06	3.43E-02	1.25E-05	1.09E-01
V-28		0.8	0.0030	97.6	27.4	28.11	0.00E+00	0.00E+00	7.69E-05	6.74E-01	4.30E-05	3.77E-01
V-29	DINV	1.6	0.0018	95.1	26.6	28.22	0.00E+00	0.00E+00	5.37E-05	4.70E-01	2.64E-05	2.31E-01
V-30		0.1	0.0485	99.7	27.9	28.05	4.55E-04	3.99E+00	5.37E-05	4.70E-01	5.09E-04	4.46E+00
V-31	PEG	0.2	3.2200	92.2	25.8	29.21	3.42E-02	3.00E+02	7.21E-03	6.32E+01	4.14E-02	3.63E+02
V-32		0.0	0.3617	99.1	27.8	28.16	1.58E-03	1.38E+01	3.49E-04	3.06E+00	1.93E-03	1.69E+01
V-33	DINV	1.7	0.0001	94.8	26.6	28.23	0.00E+00	0.00E+00	9.42E-07	8.25E-03	3.59E-07	3.15E-03
V-34		1.2	0.0002	96.4	27.0	28.16	1.12E-06	9.82E-03	0.00E+00	0.00E+00	1.12E-06	9.82E-03
V-35		0.3	0.0015	99.2	27.8	28.05	7.67E-06	6.72E-02	0.00E+00	0.00E+00	7.67E-06	6.72E-02
V-36		0.2	0.0057	99.4	27.8	28.05	5.56E-05	4.87E-01	1.76E-05	1.54E-01	7.32E-05	6.41E-01

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
V-1	ACCY	Bagging accuracy check.
V-2		SV varied by a factor of 2. High O2.
V-3		
V-4	SINV	SV varied by a factor of 2.9.
V-5		
V-6	INV	O2 too high (7.5%).
V-7	INV	Resampled.
V-8		
V-9		
V-10		
V-11	SINV	SV varied by a factor of 2.5.
V-12	PEG	
V-13		
V-14	PEG	
V-15		
V-16	INV	Unstable O2 concentration
V-17		
V-18		
V-19		
V-20		
V-21	DUP	Duplicate of V020.
V-22	SINV	SV varied by a factor of 2.9.
V-23		SV varied by a factor of 2.
V-24		
V-25		
V-26		
V-27		
V-28		
V-29	DINV	Final O2 concentration is greater than 5% (5.2%).
V-30		
V-31	PEG	
V-32		
V-33	DINV	O2 too high (5.2%). Variable bagged THC.
V-34		Liquid sample V040 taken.
V-35		Variable bagged THC and O2 concentration.
V-36		Liquid sample V041 taken.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ('Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
V-37		7.5	84	30.00	PUMP	12.00	HC		N	LL	LT Naptha
V-38		5.0	86		C	1.00	U		Y	LL	LT Naptha
V-39	L	5.0	86						Y		
V-40	L								Y		
V-41	L								Y		
V-42		5.0	85	30.00	C	1.00	TH		Y	LL	LT Naptha
V-43		15.0	85	29.90	C	4.00	FL		Y	LL	LT Naptha
V-44		12.5	87	29.90	VALVE	1.00	GATE		Y	LL	H Naptha
V-45	DUP	12.5	87	29.90	VALVE	1.00	GATE		Y	LL	H Naptha
V-46	INV	10.0	65		VALVE	1.00	GATE		Y	LL	Naptha
V-47	SINV	10.0	64	30.24	VALVE	3.00	GATE		Y	LL	H Naptha
V-48		10.0	65	30.24	C	1.00	TH		Y	LL	H Naptha
V-49	SINV	5.0	66	30.24	VALVE	2.00	GATE		Y	LL	H Naptha
V-50	L	10.0	65	30.24					Y		
V-51	L	5.0	66	30.24					Y		
V-52	DINV	2.5	77	30.24	VALVE	10.00	GATE		Y	LL	Naptha Feed
V-53		2.5	71	30.24	VALVE	2.00	GATE		Y	LL	Naptha Feed
V-54	BL										
V-55	DINV	2.5	67	30.44	VALVE	10.00	GATE		Y	LL	Naptha Feed
V-56		15.0	60	30.46	VALVE	3.00	GATE		Y	GAS	H2 Isobutane
V-57	L/INV	2.5	67	30.44					Y		
V-58	PEG	2.5	59	30.48	OEL	0.75	OEL		Y	GAS	Fuel Gas
V-59	PEG	7.5	63	30.49	VALVE	0.50	GATE		Y	GAS	Fuel Gas
V-60	PEG	7.5	62	30.49	VALVE	3.00	MC		Y	GAS	
V-61		2.5	62	30.49	VALVE	1.00	GATE		Y	GAS	Fuel Gas
V-62	PEG	7.5	62	30.49	C	1.00	TH		Y	GAS	Fuel Gas
V-63		7.5	60	30.40	OEL	0.50	OEL		Y	HL	Kerosene
V-64	DINV	7.5	58	30.40	C	0.75	TH		Y	HL	Kerosene
V-65		7.5	61	30.40	VALVE	0.75	GLOBE		Y	HL	Kerosene
V-66	PEG/DRIP	7.5	64	30.40	C	1.00	TH		Y	HL	Kerosene
V-67	INV	7.5		30.40	C	0.75	TH		Y	HL	
V-68	L	7.5	60	30.40							
V-69	L	7.5	61	30.40							
V-70	L	7.5	59	30.00							
V-71		7.5	65	30.40	C	0.75	TH		Y	HL	
V-72		7.5	59	30.00	PUMP		HC		Y	HL	
V-73		2.5	65	30.25	VALVE	3.00	GLOBE		Y	HL	Kerosene

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
V-37		200	15				20				18	2	16
V-38			20				20				20	2	18
V-39	L												
V-40	L												
V-41	L												
V-42			40				40				40	2	38
V-43			1,500				1,500				1,500	5	1,495
V-44		500	4,000				3,000				3,500	7	3,493
V-45	DUP	500	4,000				3,000				3,500	7	3,493
V-46	INV	100,000	20,000				8,000				14,000	2	
V-47	SINV	50	70				150				110	1	109
V-48			3,000				4,200				3,600	5	3,596
V-49	SINV	200	700				1,700				1,200	4	1,196
V-50	L												
V-51	L												
V-52	DINV	30	5				8				7	1	6
V-53		0	4,000				6,000				5,000	3	4,998
V-54	BL												
V-55	DINV	500	2,000				2,000				2,000	1	1,999
V-56		50	15				15				15	2	13
V-57	L/INV												
V-58	PEG	100,000	100,000				100,000				100,000	3	99,998
V-59	PEG	1,000	100,000				100,000				100,000	2	99,999
V-60	PEG	100,000	109,000				109,000				109,000	1	108,999
V-61		50	60				100				80	2	78
V-62	PEG		91,000				91,000				91,000	3	90,998
V-63			200				210				205	10	195
V-64	DINV		450				480				465	5	460
V-65			120				230				175	8	167
V-66	PEG/DRIP		1,700				1,200				1,450	16	1,434
V-67	INV		75				0				38	5	33
V-68	L												
V-69	L												
V-70	L												
V-71			75				60				68	9	59
V-72			350				320				335	12	323
V-73			180				200				190	7	183

Page 2c

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
V-37		1,656	1,840	1,748	3,456	3,470	3,463	3.46	0.40	0.40	0.40	0.21
V-38		28	32	30	865	872	869	0.87	1.20	2.60	1.90	0.06
V-39	L											
V-40	L											
V-41	L											
V-42		51	34	43	893	908	901	0.90	0.50	1.40	0.95	0.06
V-43		73,600	78,200	75,900	2,353	2,385	2,369	2.37	0.50	0.20	0.35	0.14
V-44		1,638	1,911	1,775	2,104	2,072	2,088	2.09	0.60	0.20	0.40	0.13
V-45	DUP	1,638	1,911	1,775	2,104	2,072	2,088	2.09	0.60	0.20	0.40	0.13
V-46	INV	8,000	8,000		1,974	1,960			0.20	0.30		
V-47	SINV	135	99	117	4,004	4,004	4,004	4.00	3.50	1.50	2.50	0.27
V-48		3,486	3,486	3,486	859	875	867	0.87	0.60	0.50	0.55	0.05
V-49	SINV	325	360	343	3,800	3,762	3,781	3.78	2.00	1.00	1.50	0.24
V-50	L											
V-51	L											
V-52	DINV	14	12	13	6,056	6,056	6,056	6.06	5.00	6.50	5.75	0.50
V-53		7,280	7,280	7,280	3,888	3,155	3,522	3.52	3.50	1.50	2.50	0.24
V-54	BL											
V-55	DINV	383	340	362	6,324	6,382	6,353	6.35	4.20	5.60	4.90	0.50
V-56		17	16	16	3,555	5,262	4,409	4.41	2.20	1.00	1.60	0.29
V-57	L/INV											
V-58	PEG	10,000	7,500	8,750	732	702	717	0.72	2.00	2.00	2.00	0.05
V-59	PEG	12,000	19,000	15,500	2,931	2,927	2,929	2.93	3.00	1.40	2.20	0.20
V-60	PEG	17,440	19,620	18,530	1,561	1,572	1,567	1.57	0.40	0.70	0.55	0.10
V-61		189	258	224	1,134	1,140	1,137	1.14	0.60	0.70	0.65	0.07
V-62	PEG	91,000	91,000	91,000	740	741	741	0.74	0.40	0.40	0.40	0.05
V-63		221	221	221	563	564	564	0.56	0.40	0.40	0.40	0.03
V-64	DINV	192	178	185	916	910	913	0.91	5.00	5.20	5.10	0.07
V-65		91	117	104	2,013	1,654	1,834	1.83	0.40	0.30	0.35	0.11
V-66	PEG/DRIP	1,235	845	1,040	1,360	2,667	2,014	2.01	1.00	0.40	0.70	0.12
V-67	INV	131	109	120	811	6,458	3,635	3.63	2.00	0.20	1.10	0.23
V-68	L											
V-69	L											
V-70	L											
V-71		218	153	186	1,163	1,177	1,170	1.17	1.00	0.80	0.90	0.07
V-72		436	436	436	8,847	8,847	8,847	8.85	5.10	5.10	5.10	0.70
V-73		275	220	248	3,464	3,418	3,441	3.44	3.90	1.10	2.50	0.23

Page 2d

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
V-37		86	88	87	547	NA	2,196.47	6.90	3.93	1,400.00	2,200.41
V-38		88	87	88	547	NA	10.83	0.00	0.00	6.90	10.83
V-39	L										
V-40	L										
V-41	L										
V-42		86	85	86	545	NA	5.03	0.00	0.00	3.20	5.03
V-43		88	88	88	548	NA	23,356.51	68.00	38.48	15,000.00	23,394.99
V-44		87	88	88	547	NA	1,568.43	6.40	3.65	1,000.00	1,572.08
V-45	DUP	87	88	88	547	NA	1,568.54	6.20	3.54	1,000.00	1,572.08
V-46	INV	62	63					15.00		2,800.00	
V-47	SINV	70	70	70	530	NA	188.18	0.00	0.00	120.00	188.18
V-48		67	69	68	528	NA	4,239.58	0.00	0.00	2,700.00	4,239.58
V-49	SINV	72	74	73	533	NA	376.88	0.00	0.00	240.00	376.88
V-50	L										
V-51	L										
V-52	DINV	79	80	80	539	NA	4.06	0.00	0.00	2.60	4.06
V-53		74	74	74	534	NA	1,171.12	8.10	4.61	750.00	1,175.73
V-54	BL					NA		0.00		0.00	
V-55	DINV	72	74	73	533	26.00	40.64	0.00	0.00	NA	40.64
V-56		61	61	61	521	47.00	73.80	0.00	0.00	NA	73.80
V-57	L/INV										
V-58	PEG	65	68	67	526	900.00	1,412.48	1,900.00	1,081.87	NA	2,494.34
V-59	PEG	64	63	64	523	4,200.00	6,589.69	4,000.00	2,276.97	NA	8,866.65
V-60	PEG	69	69	69	529	7,500.00	11,794.85	7,200.00	4,108.14	NA	15,902.99
V-61		64	64	64	524	4.50	7.08	22.00	12.55	NA	19.63
V-62	PEG	63	62	63	522	65.00	102.24	41,000.00	23,398.55	NA	23,500.80
V-63		69	65	67	527	12.00	18.88	27.00	15.41	NA	34.28
V-64	DINV	95	104	100	559	5.70	8.91	0.00	0.00	NA	8.91
V-65		76	90	83	543	370.00	582.04	0.00	0.00	NA	582.04
V-66	PEG/DRIP	72	67	70	529	1,400.00	2,201.24	40.00	22.82	NA	2,224.06
V-67	INV	80	93	87	546	70.00	110.00	2.80	1.60	NA	111.60
V-68	L										
V-69	L										
V-70	L										
V-71		90	103	97	556	4.50	7.07	0.00	0.00	NA	7.07
V-72		135	130	133	592	720.00	1,125.04	3.10	1.76	NA	1,126.80
V-73		77	83	80	540	540.00	846.89	0.00	0.00	NA	846.89

WSPA EMISSION RATE CALCULATION SPREADSHEET SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
		MW fraction	MW fraction	% fraction	MW fraction	MW	NMOC		Methane		THC	
ID	Code	O2	C3H8	N2	N2	Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
V-37		0.1	0.0618	99.5	27.9	28.06	1.15E-03	1.01E+01	2.07E-06	1.81E-02	1.16E-03	1.01E+01
V-38		0.6	0.0003	98.1	27.5	28.10	1.54E-06	1.35E-02	0.00E+00	0.00E+00	1.54E-06	1.35E-02
V-39	L											
V-40	L											
V-41	L											
V-42		0.3	0.0001	99.0	27.8	28.06	7.08E-07	6.21E-03	0.00E+00	0.00E+00	7.08E-07	6.21E-03
V-43		0.1	0.6617	98.2	27.5	28.28	8.43E-03	7.38E+01	1.39E-05	1.22E-01	8.44E-03	7.40E+01
V-44		0.1	0.0441	99.5	27.9	28.05	4.97E-04	4.35E+00	1.16E-06	1.01E-02	4.98E-04	4.36E+00
V-45	DUP	0.1	0.0441	99.5	27.9	28.05	4.97E-04	4.35E+00	1.12E-06	9.81E-03	4.98E-04	4.36E+00
V-46	INV											
V-47	SINV	0.8	0.0053	97.5	27.3	28.12	1.32E-04	1.15E+00	0.00E+00	0.00E+00	1.32E-04	1.15E+00
V-48		0.2	0.1191	99.2	27.8	28.09	5.83E-04	5.11E+00	0.00E+00	0.00E+00	5.83E-04	5.11E+00
V-49	SINV	0.5	0.0106	98.5	27.6	28.08	2.35E-04	2.06E+00	0.00E+00	0.00E+00	2.35E-04	2.06E+00
V-50	L											
V-51	L											
V-52	DINV	1.8	0.0001	94.2	26.4	28.25	5.15E-06	4.51E-02	0.00E+00	0.00E+00	5.15E-06	4.51E-02
V-53		0.8	0.0331	97.4	27.3	28.13	7.16E-04	6.27E+00	2.82E-06	2.47E-02	7.19E-04	6.30E+00
V-54	BL											
V-55	DINV	1.6	0.0000	95.1	26.6	28.22	5.18E-05	4.53E-01	0.00E+00	0.00E+00	5.18E-05	4.53E-01
V-56		0.5	0.0000	98.4	27.6	28.08	5.51E-05	4.83E-01	0.00E+00	0.00E+00	5.51E-05	4.83E-01
V-57	L/INV											
V-58	PEG	0.6	0.0000	98.0	27.5	28.10	1.73E-04	1.52E+00	1.33E-04	1.16E+00	3.06E-04	2.68E+00
V-59	PEG	0.7	0.0000	97.8	27.4	28.11	3.36E-03	2.94E+01	1.16E-03	1.02E+01	4.52E-03	3.96E+01
V-60	PEG	0.2	0.0000	99.5	27.9	28.04	2.92E-03	2.56E+01	1.02E-03	8.91E+00	3.94E-03	3.45E+01
V-61		0.2	0.0000	99.4	27.8	28.05	1.29E-06	1.13E-02	2.29E-06	2.00E-02	3.58E-06	3.13E-02
V-62	PEG	0.1	0.0000	99.6	27.9	28.04	1.20E-05	1.05E-01	2.75E-03	2.41E+01	2.76E-03	2.42E+01
V-63		0.1	0.0000	99.6	27.9	28.04	1.67E-06	1.47E-02	1.37E-06	1.20E-02	3.04E-06	2.66E-02
V-64	DINV	1.6	0.0000	94.9	26.6	28.22	1.57E-06	1.38E-02	0.00E+00	0.00E+00	1.57E-06	1.38E-02
V-65		0.1	0.0000	99.7	27.9	28.03	1.63E-04	1.43E+00	0.00E+00	0.00E+00	1.63E-04	1.43E+00
V-66	PEG/DRIP	0.2	0.0000	99.3	27.8	28.05	7.54E-04	6.61E+00	7.31E-06	6.40E-02	7.07E-02	6.19E+02
V-67	INV	0.4	0.0000	98.9	27.7	28.06	6.29E-05	5.51E-01	9.13E-07	8.00E-03	6.38E-05	5.59E-01
V-68	L											
V-69	L											
V-70	L											
V-71		0.3	0.0000	99.1	27.8	28.06	1.27E-06	1.11E-02	0.00E+00	0.00E+00	1.27E-06	1.11E-02
V-72		1.6	0.0000	94.9	26.6	28.22	1.82E-03	1.59E+01	2.84E-06	2.49E-02	1.82E-03	1.60E+01
V-73		0.8	0.0000	97.5	27.3	28.12	5.00E-04	4.38E+00	0.00E+00	0.00E+00	5.00E-04	4.38E+00

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
V-37		
V-38		Liquid sample V039 taken.
V-39	L	Reported with sample V038.
V-40	L	Reported with sample V034.
V-41	L	Reported with sample V036.
V-42		
V-43		
V-44		
V-45	DUP	Duplicate of V044.
V-46	INV	
V-47	SINV	SV varied by a factor of 2.1. Liquid sample V050 taken.
V-48		Liquid sample V050 taken.
V-49	SINV	SV varied by a factor of 2.4. Liquid sample V051 taken.
V-50	L	Reported with samples V047 and V048.
V-51	L	Reported with sample V049.
V-52	DINV	O2 too high (5.75%).
V-53		
V-54	BL	
V-55	DINV	Final O2 concentration is greater than 5% (5.6%). Liquid sample V057 taken.
V-56		
V-57	L/INV	Reported with sample V055.
V-58	PEG	
V-59	PEG	
V-60	PEG	
V-61		
V-62	PEG	
V-63		Liquid sample V068 taken.
V-64	DINV	Final O2 concentration is greater than 5% (5.2%). Liquid sample V068 taken.
V-65		Liquid sample V069 taken.
V-66	PEG/DRIP	Varying N2 flow. Dripping. Drip rate = 12ml/16min. Liquid sample V068 taken.
V-67	INV	Large change in N2 flow
V-68	L	Reported with samples V063, V064 and V066.
V-69	L	Reported with samples V065 and V071.
V-70	L	Reported with sample V072.
V-71		Liquid sample V069 taken.
V-72		O2 concentration high (5.1). Liquid sample V070 taken.
V-73		Liquid sample V079 taken.

Page 3a

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ("Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
V-74		2.5	66	30.25	VALVE	4.00	GLOBE		Y	HL	Kerosene
V-75	DUP	2.5	66	30.25	VALVE	4.00	GLOBE		Y	HL	Kerosene
V-76	DZ	2.5	66	30.25	VALVE	1.00	GLOBE		Y	HL	Kerosene
V-77	PEG/DRIP	2.5	66	30.25	OEL	0.50	OEL		Y	HL	Kerosene
V-78	PEG	2.5	67	30.24	VALVE	3.00	GATE		Y	GAS	Fuel Gas
V-79	L	2.5	65	30.25					Y		
V-80	L	2.5	66	30.25					Y		
V-81	PEG	2.5	71	30.24	OEL	0.75	OEL		Y	GAS	Fuel Gas
V-82	PEG	2.5	72	30.24	OEL	0.75	OEL		Y	GAS	Fuel Gas
V-83		2.5	70	30.24	OEL	1.00	OEL		Y	GAS	Fuel Gas
V-84		2.5	70	30.21	VALVE	4.00	GATE		Y	GAS	H2
V-85	DZ	2.5	73	30.21	VALVE	2.00	GLOBE		Y	GAS	
V-86	BL										
V-87		7.5	60	30.20	VALVE	3.00	GATE		Y	GAS	Fuel Gas
V-88	INV	2.5	70	30.20	PUMP		HC		Y	HL	
V-89	DZ	2.5	70	30.20	VALVE	2.00	GATE		Y	HL	R Diesel
V-90	PEG	2.5	72	30.21	VALVE	2.00	GLOBE		Y	GAS	Comp. Gasses
V-91	PEG	2.5	70	30.21	VALVE	2.00	GLOBE		Y	GAS	Comp. Gasses
V-92		2.5	71	30.21	C	1.00	TH		Y	LL	Diesel
V-93	PEG	2.5	59	30.28	C	24.00	FL		Y	GAS	Comp. Gasses
V-94		2.5	58	30.28	VALVE	1.00	GATE		Y	LL	H2
V-95	PEG	7.5	58	30.28	C	4.00	FL		Y	GAS	Propane
V-96	DZ/DINV	7.5	59	30.28	C	4.00	FL		Y	GAS	
V-97		2.5	60	30.30	VALVE	2.00	GATE		Y	LL	H2 Naptha
V-98	DUP	2.5	60	30.30	VALVE	2.00	GATE		Y	LL	H2 Naptha
V-99	INV	2.5	62	30.28	VALVE	1.00	GATE		Y	LL	
V-100		7.5	56	30.28	C	1.00	TH		Y	GAS	Comp. Gasses
V-101	DZ	7.5	54	30.28	C	1.00	TH		Y	GAS	Comp. Gasses
V-102	DZ	12.5	57	30.28	PRV	3.00	PRV		Y	GAS	Butane/Propane
V-103	DZ	2.5	53	30.30	PRV	1.50	PRV		Y	GAS	Butane/Propane
V-104	DZ	2.5	57	30.30	PRV	1.50	PRV		Y	GAS	Butane/Propane
V-105	DZ	7.5	55	30.30	VALVE	6.00	GATE		N	GAS	
V-106	PEG	2.5	62	30.30	VALVE	3.00	GLOBE		Y	GAS	H2
V-107	PEG	2.5	66	30.30	VALVE	4.00	MC		Y	GAS	H2
V-108	PEG	2.5	70	30.30	VALVE	4.00	MC		Y	GAS	H2
V-109		2.5	63	30.26	OEL	1.00	OEL		N	LL	Propane
V-110		7.5	63	30.24	VALVE	9.00	GLOBE		Y	LL	Propane

Page 3b

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
V-74			230				390				310	20	290
V-75	DUP		230				390				310	20	290
V-76	DZ		15				7				11	11	0
V-77	PEG/DRIP		700				700				700	7	693
V-78	PEG	100,000	67,000				100,000				83,500	25	83,475
V-79	L												
V-80	L												
V-81	PEG		110,000				110,000				110,000	10	109,990
V-82	PEG	300.0	119,000				119,000				119,000	20	118,980
V-83			13,400				16,750				15,075	7	15,068
V-84		300	700				1,000				850	20	830
V-85	DZ		20				12				16	16	0
V-86	BL												
V-87		2,000	200				300				250	10	240
V-88	INV												
V-89	DZ		4				4				4	4	0
V-90	PEG	100,000	77,000				77,000				77,000	6	76,994
V-91	PEG	100,000	80,000				80,000				80,000	5	79,996
V-92			1,200				1,500				1,350	15	1,335
V-93	PEG	100,000	86,000				86,000				86,000	13	85,987
V-94			7				12				10	4	6
V-95	PEG	10,050	86,000				86,000				86,000	10	85,990
V-96	DZ/DINV		5				7				6	6	0
V-97			80,000				80,000				80,000	3	79,997
V-98	DUP		80,000				80,000				80,000	3	79,997
V-99	INV		7				90				49	7	
V-100			48,000				40,000				44,000	5	43,995
V-101	DZ		4				3				4	4	0
V-102	DZ		4				4				4	4	0
V-103	DZ		2				2				2	2	0
V-104	DZ		2				2				2	2	0
V-105	DZ		1				1				1	1	0
V-106	PEG	30,000	100,000				100,000				100,000	5	99,995
V-107	PEG	10,050	71,400				71,400				71,400	3	71,397
V-108	PEG	10,050	78,000				78,000				78,000	4	77,996
V-109			1,300				1,600				1,450	2	1,448
V-110			400				500				450	3	448

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
V-74		138	110	124	3,340	3,356	3,348	3.35	2.50	0.80	1.65	0.22
V-75	DUP	138	110	124	3,340	3,356	3,348	3.35	2.50	0.80	1.65	0.22
V-76	DZ	85	85	85	1,960	1,980	1,970	1.97	0.50	0.40	0.45	0.12
V-77	PEG/DRIP	1,875	1,000	1,438	1,164	1,168	1,166	1.17	2.00	2.00	2.00	0.08
V-78	PEG	3,850	3,620	3,735	3,665	3,671	3,668	3.67	3.20	2.30	2.75	0.25
V-79	L											
V-80	L											
V-81	PEG	49,500	49,500	49,500	710	703	707	0.71	1.30	2.00	1.65	0.05
V-82	PEG	95,200	119,000	107,100	718	713	716	0.72	0.20	0.60	0.40	0.04
V-83		5,360	2,680	4,020	750	768	759	0.76	2.40	1.40	1.90	0.05
V-84		635	592	614	3,418	3,452	3,435	3.44	2.50	1.20	1.85	0.23
V-85	DZ	133	78	105	3,351	3,345	3,348	3.35	5.00	1.20	3.10	0.24
V-86	BL											
V-87		278	760	519	3,630	3,610	3,620	3.62	2.80	0.80	1.80	0.24
V-88	INV											
V-89	DZ	42	32	37	3,286	3,261	3,274	3.27	4.00	0.40	2.20	0.22
V-90	PEG	15,400	15,400	15,400	3,430	3,452	3,441	3.44	0.40	0.40	0.40	0.21
V-91	PEG	13,600	15,200	14,400	3,600	3,820	3,710	3.71	5.00	3.80	4.40	0.28
V-92		200	200	200	754	756	755	0.76	2.00	2.20	2.10	0.05
V-93	PEG	2,580	241	1,411	8,246	8,246	8,246	8.25	4.00	4.00	4.00	0.61
V-94		44	59	52	1,552	1,576	1,564	1.56	1.20	0.60	0.90	0.10
V-95	PEG	86,000	86,000	86,000	1,295	1,310	1,303	1.30	0.60	0.30	0.45	0.08
V-96	DZ/DINV	23	31	27	1,486	1,502	1,494	1.49	0.20	0.20	0.20	0.09
V-97		6,000	5,000	5,500	3,870	3,904	3,887	3.89	3.20	0.70	1.95	0.26
V-98	DUP	6,000	5,000	5,500	3,870	3,904	3,887	3.89	3.20	0.70	1.95	0.26
V-99	INV	56	35		1,806	1,832			2.10	1.40		
V-100		20,000	17,600	18,800	1,090	1,111	1,101	1.10	1.00	0.80	0.90	0.07
V-101	DZ	59	50	55	708	726	717	0.72	0.40	0.40	0.40	0.04
V-102	DZ	41	36	38	2,187	2,206	2,197	2.20	0.30	0.20	0.25	0.13
V-103	DZ	26	26	26	1,557	1,598	1,578	1.58	0.20	0.10	0.15	0.10
V-104	DZ	11	7	9	1,390	1,395	1,393	1.39	0.40	0.20	0.30	0.08
V-105	DZ	20	20	20	4,220	4,170	4,195	4.20	4.00	2.00	3.00	0.29
V-106	PEG	60,000	90,000	75,000	2,274	2,365	2,320	2.32	2.80	2.20	2.50	0.16
V-107	PEG	71,400	71,400	71,400	2,410	2,341	2,376	2.38	0.20	0.20	0.20	0.14
V-108	PEG	24,960	26,520	25,740	2,415	2,427	2,421	2.42	1.50	0.80	1.15	0.15
V-109		137	137	137	1,800	1,790	1,795	1.80	2.00	1.00	1.50	0.12
V-110		66	57	62	4,116	4,102	4,109	4.11	3.50	3.20	3.35	0.29

Page 3d

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
V-74		73	80	77	536	640.00	1,004.93	0.00	0.00	NA	1,004.93
V-75	DUP	73	80	77	536	380.00	596.67	0.00	0.00	NA	596.67
V-76	DZ	68	67	68	527	NA	204.46	0.00	0.00	130.00	204.46
V-77	PEG/DRIP	69	68	69	528	970.00	1,522.33	0.00	0.00	NA	1,522.33
V-78	PEG	73	76	75	534	5,000.00	7,838.76	3,500.00	1,990.80	NA	9,829.56
V-79	L										
V-80	L										
V-81	PEG	74	74	74	534	59,000.00	92,641.55	30,000.00	17,090.57	NA	109,732.12
V-82	PEG	73	73	73	533	29,000.00	45,616.48	13,000.00	7,419.05	NA	53,035.53
V-83		72	70	71	531	360.00	565.07	260.00	148.07	NA	713.14
V-84		74	85	80	539	490.00	769.18	5.30	3.02	NA	772.20
V-85	DZ	80	80	80	540	NA	57.98	0.00	0.00	37.00	57.98
V-86	BL					NA		0.00		61.00	
V-87		64	68	66	526	9.20	14.44	38.00	21.64	NA	36.09
V-88	INV										
V-89	DZ	71	71	71	531	NA	58.05	0.00	0.00	37.00	58.05
V-90	PEG	77	80	79	538	7,600.00	11,954.66	3,900.00	2,225.72	NA	14,180.38
V-91	PEG	80	79	80	539	5,800.00	9,071.78	3,100.00	1,759.17	NA	10,830.95
V-92		76	76	76	536	12.00	18.83	8.90	5.07	NA	23.90
V-93	PEG	109	120	115	574	18.00	28.17	160.00	90.85	NA	119.02
V-94		58	60	59	519	6.80	10.69	0.00	0.00	NA	10.69
V-95	PEG	58	57	58	517	20,000.00	31,457.41	14,000.00	7,989.18	NA	39,446.59
V-96	DZ/DINV	59	59	59	519	NA	87.73	42.00	23.98	71.00	111.71
V-97		65	62	64	523	2,400.00	3,766.87	1,200.00	683.33	NA	4,450.20
V-98	DUP	65	62	64	523	2,400.00	3,766.87	1,200.00	683.33	NA	4,450.20
V-99	INV	71	71			6.10		0.00			
V-100		57	56	57	516	17,000.00	26,721.73	110.00	62.73	NA	26,784.46
V-101	DZ	75	81	78	538	NA	72.36	0.00	0.00	46.00	72.36
V-102	DZ	56	57	57	516	NA	0.07	0.00	0.00	0.05	0.07
V-103	DZ	55	54	55	514	NA	0.07	0.00	0.00	0.05	0.07
V-104	DZ	60	60	60	520	NA	0.07	0.00	0.00	0.05	0.07
V-105	DZ	56	53	55	514	NA	0.08	0.00	0.00	0.05	0.08
V-106	PEG	78	82	80	540	25,000.00	39,207.67	36,000.00	20,484.01	NA	59,691.67
V-107	PEG	97	96	97	556	67,000.00	105,419.73	93,000.00	53,089.84	NA	158,509.57
V-108	PEG	93	96	95	554	13,000.00	20,427.02	17,000.00	9,691.52	NA	30,118.54
V-109		63	65	64	524	8.00	12.56	13.00	7.41	NA	19.97
V-110		67	70	69	528	94.00	147.24	0.00	0.00	NA	147.24

WSPA EMISSION RATE CALCULATION SPREADSHEET SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
		MW fraction	MW fraction	% fraction	MW fraction	MW	NMOC		Methane		THC	
ID	Code	O2	C3H8	N2	N2	Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
V-74		0.5	0.0000	98.4	27.6	28.09	5.55E-04	4.86E+00	0.00E+00	0.00E+00	5.55E-04	4.86E+00
V-75	DUP	0.5	0.0000	98.4	27.6	28.09	3.30E-04	2.89E+00	0.00E+00	0.00E+00	3.30E-04	2.89E+00
V-76	DZ	0.1	0.0057	99.5	27.9	28.04	6.35E-05	5.56E-01	0.00E+00	0.00E+00	6.35E-05	5.56E-01
V-77	PEG/DRIP	0.6	0.0000	98.0	27.5	28.10	1.03E-02	9.03E+01	0.00E+00	0.00E+00	1.03E-02	9.03E+01
V-78	PEG	0.9	0.0000	97.3	27.2	28.13	5.06E-03	4.43E+01	1.28E-03	1.12E+01	6.34E-03	5.55E+01
V-79	L											
V-80	L											
V-81	PEG	0.5	0.0000	98.4	27.6	28.09	1.08E-02	9.50E+01	2.00E-03	1.75E+01	1.28E-02	1.13E+02
V-82	PEG	0.1	0.0000	99.6	27.9	28.04	5.08E-03	4.45E+01	8.26E-04	7.24E+00	5.91E-03	5.18E+01
V-83		0.6	0.0000	98.1	27.5	28.10	7.24E-05	6.35E-01	1.90E-05	1.66E-01	9.14E-05	8.01E-01
V-84		0.6	0.0000	98.2	27.5	28.09	4.38E-04	3.84E+00	1.72E-06	1.51E-02	4.40E-04	3.85E+00
V-85	DZ	1.0	0.0016	96.9	27.2	28.14	3.45E-05	3.02E-01	0.00E+00	0.00E+00	3.45E-05	3.02E-01
V-86	BL		0.0027									
V-87		0.6	0.0000	98.2	27.5	28.09	8.87E-06	7.77E-02	1.33E-05	1.16E-01	2.22E-05	1.94E-01
V-88	INV											
V-89	DZ	0.7	0.0016	97.8	27.4	28.11	3.26E-05	2.86E-01	0.00E+00	0.00E+00	3.26E-05	2.86E-01
V-90	PEG	0.1	0.0000	99.6	27.9	28.04	6.34E-03	5.55E+01	1.18E-03	1.03E+01	7.52E-03	6.59E+01
V-91	PEG	1.4	0.0000	95.6	26.8	28.20	6.46E-03	5.66E+01	1.25E-03	1.10E+01	7.71E-03	6.76E+01
V-92		0.7	0.0000	97.9	27.4	28.10	2.40E-06	2.11E-02	6.47E-07	5.67E-03	3.05E-06	2.67E-02
V-93	PEG	1.3	0.0000	96.0	26.9	28.18	4.09E-05	3.58E-01	1.32E-04	1.15E+00	1.73E-04	1.51E+00
V-94		0.3	0.0000	99.1	27.8	28.06	2.74E-06	2.40E-02	0.00E+00	0.00E+00	2.74E-06	2.40E-02
V-95	PEG	0.1	0.0000	99.6	27.9	28.04	6.59E-03	5.77E+01	1.67E-03	1.47E+01	8.26E-03	7.24E+01
V-96	DZ/DINV	0.1	0.0031	99.8	28.0	28.03	2.08E-05	1.82E-01	5.67E-06	4.97E-02	2.64E-05	2.31E-01
V-97		0.6	0.0000	98.1	27.5	28.10	2.52E-03	2.20E+01	4.56E-04	4.00E+00	2.97E-03	2.60E+01
V-98	DUP	0.6	0.0000	98.1	27.5	28.10	2.52E-03	2.20E+01	4.56E-04	4.00E+00	2.97E-03	2.60E+01
V-99	INV											
V-100		0.3	0.0000	99.1	27.8	28.06	4.85E-03	4.24E+01	1.14E-05	9.96E-02	4.86E-03	4.25E+01
V-101	DZ	0.1	0.0020	99.6	27.9	28.04	8.00E-06	7.01E-02	0.00E+00	0.00E+00	8.00E-06	7.01E-02
V-102	DZ	0.1	0.0000	99.7	27.9	28.03	2.48E-08	2.17E-04	0.00E+00	0.00E+00	2.48E-08	2.17E-04
V-103	DZ	0.0	0.0000	99.8	28.0	28.03	1.78E-08	1.56E-04	0.00E+00	0.00E+00	1.78E-08	1.56E-04
V-104	DZ	0.1	0.0000	99.7	27.9	28.03	1.57E-08	1.37E-04	0.00E+00	0.00E+00	1.57E-08	1.37E-04
V-105	DZ	1.0	0.0000	97.0	27.2	28.14	6.09E-08	5.33E-04	0.00E+00	0.00E+00	6.09E-08	5.33E-04
V-106	PEG	0.8	0.0000	97.5	27.3	28.12	1.56E-02	1.37E+02	8.15E-03	7.14E+01	2.38E-02	2.08E+02
V-107	PEG	0.1	0.0000	99.8	28.0	28.03	3.70E-02	3.24E+02	1.86E-02	1.63E+02	5.56E-02	4.87E+02
V-108	PEG	0.4	0.0000	98.9	27.7	28.07	7.69E-03	6.73E+01	3.65E-03	3.20E+01	1.13E-02	9.93E+01
V-109		0.5	0.0000	98.5	27.6	28.08	3.78E-06	3.31E-02	2.23E-06	1.95E-02	6.01E-06	5.26E-02
V-110		1.1	0.0000	96.7	27.1	28.15	1.11E-04	9.75E-01	0.00E+00	0.00E+00	1.11E-04	9.75E-01

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
V-74		Liquid sample V079 taken.
V-75	DUP	Liquid sample V079 taken. Duplicate of V074.
V-76	DZ	
V-77	PEG/DRIP	Dripping. Liquid sample V080 taken from bag. Drip rate = 10.2ml/18min.
V-78	PEG	
V-79	L	Reported with samples V073, V074 and V075.
V-80	L	Reported with sample V077.
V-81	PEG	
V-82	PEG	Variable bagged THC and O2 concentration.
V-83		
V-84		
V-85	DZ	
V-86	BL	
V-87		Variable bagged THC and O2 concentration.
V-88	INV	Unable to get adequate seal.
V-89	DZ	O2 concentration varied by a factor of 10.
V-90	PEG	
V-91	PEG	
V-92		
V-93	PEG	Bagged THC varies by a factor of 11.
V-94		
V-95	PEG	
V-96	DZ/DINV	Possible contamination in field; followed a pegged source.
V-97		
V-98	DUP	Duplicate of V097.
V-99	INV	Unstable THC reading.
V-100		
V-101	DZ	
V-102	DZ	
V-103	DZ	
V-104	DZ	
V-105	DZ	
V-106	PEG	
V-107	PEG	
V-108	PEG	
V-109		
V-110		

Page 4a

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ('Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
V-111		7.5	65	30.24	VALVE	8.00	GATE		Y	GAS	H2 – Propane
V-112	BL										
W-1	ACCY	0.0	62		OEL	3.00	OEL			LL	Water
W-2	INV	2.5	68		VALVE	2.00	GLOBE	M		GAS	VRU
W-3	SINV	2.5	70		VALVE	3.00	MC	C		GAS	VRU
W-4	PEG	2.5	74		C	3.00	TH			GAS	SRU
W-5		2.5	71		C	1.00	TH			HL	Sour water
W-6		1.5	70		VALVE	3.00	MC	C		LL	
W-7	PEG	1.5	63		VALVE	6.00	MC	C		GAS	Fuel gas
W-8		0.0	65		VALVE	1.00	GLOBE	M		GAS	VRU
W-9	PEG	0.0	70		C	1.00	FL			GAS	
W-10	PEG	0.0	67		VALVE	1.50	DIA	M		GAS	Fuel gas
W-11	INV	0.0	72		C	1.00	TH			GAS	Fuel gas
W-12		2.5	72		OEL	0.375	OEL			GAS	VRU
W-13	DZ	2.5	73		OEL	0.50	OEL			GAS	VRU
W-14	DZ	1.5	72		C	1.00	U			GAS	
W-15	BL										
W-16	DZ	0.0	62		C	0.50	FL			GAS	VRU
W-17	L		63								
W-18		0.0	63		OEL	1.00	OEL			GAS	
W-19		0.0	63		VALVE	1.00	GATE	M		LL	Propane
W-20	PEG	0.0	67		OEL	0.50	OEL			LL	Propane
W-21		1.5	80		PUMP	4.00	VC		N	LL	Propane (LPG)
W-22	DUP	1.5	80		PUMP	4.00	VC		N	LL	Propane (LPG)
W-23		2.5	80		C	3.00	FL			GAS	Propane (LPG)
W-24		4.5	79		C	2.00	FL			GAS	Propane (LPG)
W-25	DZ	4.0	79		C	1.00	TH			GAS	Propane (LPG)
W-26	SINV	1.5	64		C	1.00	FL			GAS	Fuel gas
W-27	DZ	1.5	66		C	1.00	FL			GAS	Fuel gas
W-28	SINV	0.0	75		PUMP	4.00	HC			LL	Crude
W-29		4.5	80		VALVE	4.00	GLOBE	M		HL	Crude
W-30	L/INV		75								
W-31	L		80								
W-32	L		82								
W-33	SINV	1.5	82		VALVE	3.00	GLOBE	M		HL	Crude
W-34	PEG	0.0	77		C	1.00	TH			GAS	Fuel gas
W-35		0.0	67		VALVE	2.00	GATE	M		LL	D B

Page 4b

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
V-111		50	150				250				200	3	198
V-112	BL												
W-1	ACCY		5				5				5	5	0
W-2	INV	100	25				25				25	5	20
W-3	SINV	8,000	2,000				400				1,200	6	1,195
W-4	PEG	100,000	100,000				100,000				100,000	4	99,996
W-5		8,000	9,000				9,000				9,000	6	8,994
W-6			50				60				55	5	50
W-7	PEG	10,000	100,000				100,000				100,000	9	99,991
W-8			28				30				29	7	23
W-9	PEG	100,000	100,000				100,000				100,000	5	99,995
W-10	PEG	10,000	100,000				100,000				100,000	5	99,995
W-11	INV	2,500	5,000				4,000				4,500	4	4,496
W-12			60				70				65	5	61
W-13	DZ		4				4				4	4	0
W-14	DZ		4				4				4	4	0
W-15	BL												
W-16	DZ		6				6				6	6	0
W-17	L												
W-18			6,000				10,000				8,000	5	7,995
W-19		80,000	24,000				24,000				24,000	6	23,995
W-20	PEG		100,000				100,000				100,000	5	99,995
W-21		5,000	5,000				8,000				6,500	5	6,496
W-22	DUP	5,000	5,000				8,000				6,500	5	6,496
W-23		5,000	5,000				5,000				5,000	4	4,996
W-24			80				90				85	4	81
W-25	DZ		5				5				5	5	0
W-26	SINV	400	500				200				350	6	345
W-27	DZ		8				5				7	7	0
W-28	SINV	200	80				300				190	7	184
W-29		150	600				500				550	10	540
W-30	L/INV												
W-31	L												
W-32	L												
W-33	SINV		250				700				475	11	464
W-34	PEG	10,000	100,000				100,000				100,000	5	99,995
W-35			40				45				43	11	32

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
V-111		27	28	27	13,090	13,090	13,090	13.09	5.00	4.00	4.50	1.00
V-112	BL											
W-1	ACCY	1,100	1,100	1,100	1,036	1,004	1,020	1.02	2.50	2.70	2.60	0.07
W-2	INV	50	50	50	1,961	1,911	1,936	1.94	1.00	1.00	1.00	0.12
W-3	SINV	420	350	385	1,989	1,955	1,972	1.97	0.80	0.60	0.70	0.12
W-4	PEG	100,000	100,000	100,000	1,217	1,165	1,191	1.19	0.50	0.10	0.30	0.07
W-5		7,600	6,650	7,125	1,250	1,237	1,244	1.24	0.20	0.20	0.20	0.08
W-6		49	97	73	1,221	1,206	1,214	1.21	2.40	1.30	1.85	0.08
W-7	PEG	20,800	19,200	20,000	1,429	1,390	1,410	1.41	1.60	0.40	1.00	0.09
W-8		76	64	70	1,350	1,257	1,304	1.30	0.50	0.60	0.55	0.08
W-9	PEG	100,000	100,000	100,000	467	370	419	0.42	4.00	4.20	4.10	0.03
W-10	PEG	37,500	36,000	36,750	1,296	1,276	1,286	1.29	1.80	0.40	1.10	0.08
W-11	INV	50	50	50	1,047	1,030	1,039	1.04	3.40	2.40	2.90	0.07
W-12		80	90	85	1,245	1,252	1,249	1.25	0.20	0.10	0.15	0.08
W-13	DZ	33	33	33	1,232	1,263	1,248	1.25	1.50	1.50	1.50	0.08
W-14	DZ	33	33	33	1,035	1,035	1,035	1.04	3.60	3.50	3.55	0.07
W-15	BL											
W-16	DZ	46	46	46	1,126	1,125	1,126	1.13	1.80	1.60	1.70	0.07
W-17	L											
W-18		2,500	2,100	2,300	1,534	1,512	1,523	1.52	0.10	0.10	0.10	0.09
W-19		2,000	3,500	2,750	1,514	1,482	1,498	1.50	0.30	0.20	0.25	0.09
W-20	PEG	8,800	8,800	8,800	1,463	1,354	1,409	1.41	0.10	0.10	0.10	0.08
W-21		78,000	78,000	78,000	2,620	2,627	2,624	2.62	4.50	2.30	3.40	0.19
W-22	DUP	78,000	78,000	78,000	2,620	2,627	2,624	2.62	4.50	2.30	3.40	0.19
W-23		100,000	100,000	100,000	1,411	1,332	1,372	1.37	0.50	0.60	0.55	0.08
W-24		630	630	630	1,350	1,375	1,363	1.36	2.00	1.50	1.75	0.09
W-25	DZ	34	34	34	1,164	1,165	1,165	1.16	2.80	2.00	2.40	0.08
W-26	SINV	60	75	68	1,225	1,222	1,224	1.22	2.50	1.50	2.00	0.08
W-27	DZ	61	61	61	1,173	1,175	1,174	1.17	2.60	1.50	2.05	0.08
W-28	SINV	1,540	1,540	1,540	4,088	4,088	4,088	4.09	4.50	4.50	4.50	0.31
W-29		825	880	853	2,995	2,937	2,966	2.97	1.00	0.10	0.55	0.18
W-30	L/INV											
W-31	L											
W-32	L											
W-33	SINV	720	720	720	2,935	2,850	2,893	2.89	1.20	1.60	1.40	0.19
W-34	PEG	70,000	63,000	66,500	1,313	1,361	1,337	1.34	0.10	0.10	0.10	0.08
W-35		88	94	91	1,645	1,600	1,623	1.62	0.30	0.20	0.25	0.10

Page 4d

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
V-111		155	164	160	619	59.00	92.27	7.10	4.03	NA	96.30
V-112	BL					NA		9.70		22.00	
W-1	ACCY	64	69	67	526	NA	0.00	260.00	147.92	35.00	54.88
W-2	INV	71	70	70	530	NA	0.00	3.80	2.17	0.64	1.01
W-3	SINV	70	71	70	530	NA	44.75	120.00	68.45	72.00	113.20
W-4	PEG	81	81	81	541	9,500.00	14,945.45	400,000.00	228,310.99	NA	243,256.44
W-5		72	71	72	531	5,500.00	8,653.86	4,600.00	2,625.95	NA	11,279.81
W-6		72	72	72	531	7.60	11.93	15.00	8.54	NA	20.47
W-7	PEG	69	68	69	528	1,100.00	1,728.81	7,300.00	4,162.54	NA	5,891.35
W-8		68	69	68	528	16.00	25.16	80.00	45.65	NA	70.81
W-9	PEG	75	75	75	534	270,000.00	422,486.04	470,000.00	266,825.82	NA	689,311.85
W-10	PEG	71	67	69	529	6,400.00	10,057.09	6,200.00	3,534.81	NA	13,591.90
W-11	INV	80	84	82	542	12.00	18.81	6.60	3.75	NA	22.56
W-12		74	75	74	534	13.00	20.46	0.00	0.00	NA	20.46
W-13	DZ	77	73	75	535	NA	0.07	0.00	0.00	0.0475	0.07
W-14	DZ	78	82	80	540	NA	0.07	0.00	0.00	0.0475	0.07
W-15	BL					NA	0.00	0.00	0.00	0.0000	0.00
W-16	DZ	66	66	66	526	NA	0.07	0.00	0.00	0.0475	0.07
W-17	L										
W-18		66	65	66	525	1,400.00	2,203.11	13.00	7.42	NA	2,210.54
W-19		61	62	62	521	3,600.00	5,663.94	0.00	0.00	NA	5,663.94
W-20	PEG	66	66	66	526	5,500.00	8,655.09	0.00	0.00	NA	8,655.09
W-21		86	90	88	548	30,000.00	46,989.34	6.50	3.69	NA	46,993.04
W-22	DUP	86	90	88	548	26,000.00	40,724.10	3.50	1.99	NA	40,726.09
W-23		88	89	89	548	18,000.00	28,307.65	10.00	5.71	NA	28,313.36
W-24		87	88	88	547	240.00	376.79	0.00	0.00	NA	376.79
W-25	DZ	78	78	78	538	NA	0.28	0.00	0.00	0.18	0.28
W-26	SINV	77	82	80	539	9.20	14.44	0.00	0.00	NA	14.44
W-27	DZ	69	76	73	532	NA	0.08	0.00	0.00	0.05	0.08
W-28	SINV	112	112	112	572	2,900.00	4,535.25	18.00	10.21	NA	4,545.46
W-29		213	231	222	682	1,200.00	1,887.18	0.00	0.00	NA	1,887.18
W-30	L/INV										
W-31	L										
W-32	L										
W-33	SINV	163	180	172	631	1,000.00	1,570.75	0.00	0.00	NA	1,570.75
W-34	PEG	82	83	83	542	1,200.00	1,888.38	35,000.00	19,982.89	NA	21,871.27
W-35		81	77	79	539	8.90	14.00	0.00	0.00	NA	14.00

WSPA EMISSION RATE CALCULATION SPREADSHEET SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
							NMOC		Methane		THC	
ID	Code	MW fraction O2	MW fraction C3H8	% fraction N2	MW fraction N2	MW Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
V-111		1.4	0.0000	95.5	26.8	28.20	2.03E-04	1.78E+00	8.87E-06	7.77E-02	2.12E-04	1.86E+00
V-112	BL											
W-1	ACCY	0.8	0.0015	97.4	27.3	28.12	0.00E+00	0.00E+00	2.67E-05	2.34E-01	9.91E-06	8.68E-02
W-2	INV	0.3	0.0000	99.0	27.7	28.06	0.00E+00	0.00E+00	6.77E-07	5.93E-03	3.14E-07	2.75E-03
W-3	SINV	0.2	0.0032	99.3	27.8	28.05	1.40E-05	1.23E-01	2.14E-05	1.88E-01	3.55E-05	3.11E-01
W-4	PEG	0.1	0.0000	99.7	27.9	28.03	2.72E-03	2.38E+01	4.15E-02	3.64E+02	4.42E-02	3.87E+02
W-5		0.1	0.0000	99.8	28.0	28.03	1.66E-03	1.46E+01	5.05E-04	4.42E+00	2.17E-03	1.90E+01
W-6		0.6	0.0000	98.2	27.5	28.09	2.44E-06	2.13E-02	1.74E-06	1.53E-02	4.18E-06	3.66E-02
W-7	PEG	0.3	0.0000	99.0	27.7	28.06	3.94E-04	3.46E+00	9.50E-04	8.32E+00	1.34E-03	1.18E+01
W-8		0.2	0.0000	99.5	27.9	28.04	5.19E-06	4.55E-02	9.42E-06	8.25E-02	1.46E-05	1.28E-01
W-9	PEG	1.3	0.0000	95.9	26.9	28.18	3.36E-02	2.94E+02	2.12E-02	1.86E+02	5.48E-02	4.80E+02
W-10	PEG	0.4	0.0000	98.9	27.7	28.06	2.10E-03	1.84E+01	7.39E-04	6.47E+00	2.84E-03	2.49E+01
W-11	INV	0.9	0.0000	97.1	27.2	28.14	3.42E-06	2.99E-02	6.82E-07	5.97E-03	4.10E-06	3.59E-02
W-12		0.0	0.0000	99.9	28.0	28.03	3.92E-06	3.43E-02	0.00E+00	0.00E+00	3.92E-06	3.43E-02
W-13	DZ	0.5	0.0000	98.5	27.6	28.08	1.53E-08	1.34E-04	0.00E+00	0.00E+00	1.53E-08	1.34E-04
W-14	DZ	1.1	0.0000	96.4	27.0	28.16	1.40E-08	1.23E-04	0.00E+00	0.00E+00	1.40E-08	1.23E-04
W-15	BL	0.0	0.0000	100.0	28.0	28.02						
W-16	DZ	0.5	0.0000	98.3	27.5	28.09	1.42E-08	1.24E-04	0.00E+00	0.00E+00	1.42E-08	1.24E-04
W-17	L											
W-18		0.0	0.0000	99.9	28.0	28.02	5.22E-04	4.57E+00	1.76E-06	1.54E-02	5.24E-04	4.59E+00
W-19		0.1	0.0000	99.8	27.9	28.03	1.34E-03	1.17E+01	0.00E+00	0.00E+00	1.34E-03	1.17E+01
W-20	PEG	0.0	0.0000	99.9	28.0	28.02	1.89E-03	1.66E+01	0.00E+00	0.00E+00	1.89E-03	1.66E+01
W-21		1.1	0.0000	96.6	27.1	28.16	2.19E-02	1.92E+02	1.72E-06	1.51E-02	2.19E-02	1.92E+02
W-22	DUP	1.1	0.0000	96.6	27.1	28.16	1.90E-02	1.67E+02	9.29E-07	8.14E-03	1.90E-02	1.67E+02
W-23		0.2	0.0000	99.5	27.9	28.04	5.92E-03	5.18E+01	1.19E-06	1.04E-02	5.92E-03	5.18E+01
W-24		0.6	0.0000	98.3	27.5	28.09	8.34E-05	7.31E-01	0.00E+00	0.00E+00	8.34E-05	7.31E-01
W-25	DZ	0.8	0.0000	97.6	27.3	28.12	5.63E-08	4.93E-04	0.00E+00	0.00E+00	5.63E-08	4.93E-04
W-26	SINV	0.6	0.0000	98.0	27.5	28.10	2.95E-06	2.59E-02	0.00E+00	0.00E+00	2.95E-06	2.59E-02
W-27	DZ	0.7	0.0000	97.9	27.4	28.10	1.56E-08	1.37E-04	0.00E+00	0.00E+00	1.56E-08	1.37E-04
W-28	SINV	1.4	0.0000	95.5	26.8	28.20	3.38E-03	2.96E+01	7.61E-06	6.66E-02	3.38E-03	2.97E+01
W-29		0.2	0.0000	99.5	27.9	28.04	6.86E-04	6.01E+00	0.00E+00	0.00E+00	6.86E-04	6.01E+00
W-30	L/INV											
W-31	L											
W-32	L											
W-33	SINV	0.4	0.0000	98.6	27.6	28.08	6.28E-04	5.50E+00	0.00E+00	0.00E+00	6.28E-04	5.50E+00
W-34	PEG	0.0	0.0000	99.9	28.0	28.02	3.80E-04	3.33E+00	4.03E-03	3.53E+01	4.41E-03	3.86E+01
W-35		0.1	0.0000	99.8	27.9	28.03	3.47E-06	3.04E-02	0.00E+00	0.00E+00	3.47E-06	3.04E-02

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
V-111		
V-112	BL	
W-1	ACCY	Leaking canister.
W-2	INV	Probable canister leak.
W-3	SINV	Screening concentration not steady. SV varied by a factor of 5.
W-4	PEG	
W-5		
W-6		
W-7	PEG	
W-8		
W-9	PEG	
W-10	PEG	
W-11	INV	Appears canister leaked.
W-12		Final screening value fluctuating.
W-13	DZ	
W-14	DZ	
W-15	BL	
W-16	DZ	
W-17	L	Reported with sample WO18.
W-18		Liquid sample W017 taken.
W-19		
W-20	PEG	
W-21		SV 2 inches away from seal.
W-22	DUP	Duplicate of W021.
W-23		
W-24		
W-25	DZ	Plug.
W-26	SINV	SV varied by a factor of 2.5.
W-27	DZ	
W-28	SINV	SV varied by a factor of 3.75. Liquid sample W030 taken.
W-29		Liquid sample W031 taken.
W-30	L/INV	Reported with sample W028.
W-31	L	Reported with sample WO29.
W-32	L	Reported with sample WO33.
W-33	SINV	SV varied by a factor of 2.8. Liquid sample W032 taken.
W-34	PEG	
W-35		Liquid sample W037 taken.

Page 5a

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ("Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
W-36	DZ	0.0	67		VALVE	0.50	GATE	M		LL	
W-37	L		67								
W-38		1.5	71		VALVE	2.00	GATE	M		LL	D B
W-39	L		71								
W-40	DZ	5.5	71		VALVE	10.00	GATE	M		LL	
W-41	SINV	5.5	70		VALVE	10.00	GATE	M		LL	
W-42		0.0	76		PUMP	3.00	HC			HL	
W-43	DZ	0.0	76		VALVE	0.50	GATE	M		HL	
W-44		0.0	70		VALVE	0.50	GATE	M		LL	Crude naptha
W-45	DZ	0.0	71		OEL	0.50	OEL			HL	
W-46	L		70								
W-47	L		68								
W-48		1.5	68		VALVE	3.00	GATE	M		LL	Crude naptha
W-49	DZ	2.5	71		VALVE	1.00	GATE	M		HL	
W-50	DZ/DUP	2.5	71		VALVE	1.00	GATE	M		HL	
W-51	DZ	4.5	70		PUMP	4.00	VERT			HL	Gas oil
W-52		2.5	74		VALVE	8.00	GATE	M		GAS	Sour gas
W-53		2.5	71		VALVE	8.00	MC	C		GAS	Sour gas
W-54	DZ	1.5	65		VALVE	0.75	GATE	M		LL	
W-55		2.5	68		VALVE	8.00	MC	C		HL	
W-56	L		68								
W-57		1.5	70		VALVE	8.00	GATE	M		HL	
W-58	L/INV		70								
W-59	L		70								
W-60	DZ	2.5	75		VALVE	0.75	GATE	M		HL	Diesel
W-61	DZ	2.5	71		VALVE	0.75	GATE	M		HL	Diesel
W-62		0.0	62		VALVE	4.00	GATE	M		HL	Diesel
W-63		1.5	71		VALVE	0.75	GATE	M		HL	Diesel
W-64	DINV	1.5	71		OEL	0.50	OEL			HL	Diesel
W-65	L		62								
W-66	L		71								
W-67	L		71								
W-68	SINV	0.0	71		PUMP	4.00	HC			HL	Jet fuel
W-69	L		71								
W-70		0.0	71		VALVE	8.00	GATE	M		LL	Reg UL
W-71	L		71								
W-72	PEGF/SINV	1.5	74		C	8.00	TH			LL	Reg UL

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
W-36	DZ		9				8				9	9	0
W-37	L												
W-38			30				40				35	9	26
W-39	L												
W-40	DZ		6				5				6	6	0
W-41	SINV		10				30				20	5	15
W-42			13				16				15	5	10
W-43	DZ		8				3				5	5	0
W-44			50				65				58	11	47
W-45	DZ		14				15				15	15	0
W-46	L												
W-47	L												
W-48			90				90				90	10	80
W-49	DZ		7				7				7	7	0
W-50	DZ/DUP		7				7				7	7	0
W-51	DZ		7				7				7	7	0
W-52			30				50				40	7	33
W-53			3,000				4,000				3,500	7	3,493
W-54	DZ		9				8				9	9	0
W-55		200	25				35				30	7	24
W-56	L												
W-57		300	40				30				35	7	28
W-58	L/INV												
W-59	L												
W-60	DZ		6				6				6	6	0
W-61	DZ		6				6				6	6	0
W-62			40				40				40	9	31
W-63			25				35				30	8	22
W-64	DINV		110				100				105	6	99
W-65	L												
W-66	L												
W-67	L												
W-68	SINV		130				450				290	9	281
W-69	L												
W-70			17,000				34,000				25,500	10	25,490
W-71	L												
W-72	PEGF/SINV		48,000				100,000				74,000	8	73,992

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
W-36	DZ	80	80	80	1,980	1,983	1,982	1.98	0.50	0.20	0.35	0.12
W-37	L											
W-38		90	80	85	2,009	2,034	2,022	2.02	0.50	0.20	0.35	0.12
W-39	L											
W-40	DZ	65	65	65	3,535	3,550	3,543	3.54	4.00	3.80	3.90	0.26
W-41	SINV	45	50	48	3,574	3,539	3,557	3.56	3.60	2.10	2.85	0.25
W-42		100	140	120	4,245	4,245	4,245	4.25	4.40	4.80	4.60	0.33
W-43	DZ	33	24	29	1,527	1,519	1,523	1.52	2.50	2.30	2.40	0.10
W-44		272	306	289	2,026	2,016	2,021	2.02	0.50	0.20	0.35	0.12
W-45	DZ	140	160	150	975	972	974	0.97	2.30	2.10	2.20	0.07
W-46	L											
W-47	L											
W-48		63	144	104	2,973	3,002	2,988	2.99	2.70	1.10	1.90	0.20
W-49	DZ	126	126	126	2,041	2,033	2,037	2.04	0.30	0.20	0.25	0.12
W-50	DZ/DUP	126	126	126	2,041	2,033	2,037	2.04	0.30	0.20	0.25	0.12
W-51	DZ	114	114	114	4,085	4,088	4,087	4.09	5.00	4.00	4.50	0.31
W-52		108	108	108	3,704	3,687	3,696	3.70	4.80	1.10	2.95	0.26
W-53		4,000	4,000	4,000	2,409	2,402	2,406	2.41	4.70	0.50	2.60	0.16
W-54	DZ	60	60	60	853	867	860	0.86	0.80	0.80	0.80	0.05
W-55		50	50	50	3,070	3,070	3,070	3.07	4.20	1.20	2.70	0.21
W-56	L											
W-57		90	60	75	3,050	3,170	3,110	3.11	4.20	1.60	2.90	0.22
W-58	L/INV											
W-59	L											
W-60	DZ	55	66	61	1,178	1,189	1,184	1.18	1.30	0.30	0.80	0.07
W-61	DZ	78	78	78	1,215	1,231	1,223	1.22	0.50	0.20	0.35	0.07
W-62		70	70	70	2,211	2,218	2,215	2.21	1.20	0.10	0.65	0.14
W-63		91	91	91	947	946	947	0.95	3.00	3.70	3.35	0.07
W-64	DINV	150	150	150	947	939	943	0.94	4.00	3.80	3.90	0.07
W-65	L											
W-66	L											
W-67	L											
W-68	SINV	160	144	152	2,407	2,407	2,407	2.41	0.40	0.30	0.35	0.15
W-69	L											
W-70		27,200	40,800	34,000	3,820	3,830	3,825	3.83	4.60	2.00	3.30	0.27
W-71	L											
W-72	PEGF/SINV	1,680	1,960	1,820	2,009	1,985	1,997	2.00	1.10	0.30	0.70	0.12

Page 5d

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
W-36	DZ	70	70	70	530	NA	0.08	0.00	0.00	0.05	0.08
W-37	L										
W-38		74	74	74	534	9.10	14.32	0.00	0.00	NA	14.32
W-39	L										
W-40	DZ	72	71	72	531	NA	0.07	0.00	0.00	0.05	0.07
W-41	SINV	74	76	75	535	4.70	7.37	0.00	0.00	NA	7.37
W-42		115	115	115	575	4.40	6.88	0.00	0.00	NA	6.88
W-43	DZ	79	79	79	539	13.00	20.39	0.00	0.00	NA	20.39
W-44		74	74	74	534	3.00	4.72	0.00	0.00	NA	4.72
W-45	DZ	86	93	90	549	NA	0.08	0.00	0.00	0.05	0.08
W-46	L										
W-47	L										
W-48		70	74	72	532	14.00	21.97	0.00	0.00	NA	21.97
W-49	DZ	77	78	78	537	NA	0.07	0.00	0.00	0.05	0.07
W-50	DZ/DUP	77	78	78	537	NA	0.08	0.00	0.00	0.05	0.08
W-51	DZ	120	128	124	584	NA	0.08	0.00	0.00	0.05	0.08
W-52		137	137	137	597	7.70	12.07	0.00	0.00	NA	12.07
W-53		84	91	88	547	2,100.00	3,292.98	540.00	307.22	NA	3,600.19
W-54	DZ	67	69	68	528	NA	0.07	0.00	0.00	0.05	0.07
W-55		78	81	80	539	11.00	17.25	0.00	0.00	NA	17.25
W-56	L										
W-57		79	80	80	539	9.90	15.52	0.00	0.00	NA	15.52
W-58	L/INV										
W-59	L										
W-60	DZ	81	82	82	541	NA	0.08	0.00	0.00	0.05	0.08
W-61	DZ	82	84	83	543	NA	0.08	0.00	0.00	0.05	0.08
W-62		74	73	74	533	NA	1.57	0.00	0.00	1.00	1.57
W-63		78	78	78	538	NA	0.96	0.00	0.00	0.61	0.96
W-64	DINV	81	81	81	541	6.90	10.80	0.00	0.00	NA	10.80
W-65	L										
W-66	L										
W-67	L										
W-68	SINV	73	76	75	534	3.40	5.35	0.00	0.00	NA	5.35
W-69	L										
W-70		72	74	73	533	35,000.00	54,828.65	0.00	0.00	NA	54,828.65
W-71	L										
W-72	PEGF/SINV	82	83	83	542	2,800.00	4,402.47	9.50	5.42	NA	4,407.89

WSPA EMISSION RATE CALCULATION SPREADSHEET SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
							NMOC		Methane		THC	
ID	Code	MW fraction O2	MW fraction C3H8	% fraction N2	MW fraction N2	MW Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
W-36	DZ	0.1	0.0000	99.6	27.9	28.03	2.43E-08	2.13E-04	0.00E+00	0.00E+00	2.43E-08	2.13E-04
W-37	L											
W-38		0.1	0.0000	99.7	27.9	28.03	4.49E-06	3.93E-02	0.00E+00	0.00E+00	4.49E-06	3.93E-02
W-39	L											
W-40	DZ	1.2	0.0000	96.1	26.9	28.18	4.72E-08	4.13E-04	0.00E+00	0.00E+00	4.72E-08	4.13E-04
W-41	SINV	0.9	0.0000	97.2	27.2	28.13	4.63E-06	4.05E-02	0.00E+00	0.00E+00	4.63E-06	4.05E-02
W-42		1.5	0.0000	95.4	26.7	28.20	5.33E-06	4.67E-02	0.00E+00	0.00E+00	5.33E-06	4.67E-02
W-43	DZ	0.8	0.0000	97.6	27.3	28.12	5.31E-06	4.65E-02	0.00E+00	0.00E+00	5.31E-06	4.65E-02
W-44		0.1	0.0000	99.7	27.9	28.03	1.48E-06	1.30E-02	0.00E+00	0.00E+00	1.48E-06	1.30E-02
W-45	DZ	0.7	0.0000	97.8	27.4	28.11	1.27E-08	1.11E-04	0.00E+00	0.00E+00	1.27E-08	1.11E-04
W-46	L											
W-47	L											
W-48		0.6	0.0000	98.1	27.5	28.10	1.11E-05	9.70E-02	0.00E+00	0.00E+00	1.11E-05	9.70E-02
W-49	DZ	0.1	0.0000	99.7	27.9	28.03	2.33E-08	2.04E-04	0.00E+00	0.00E+00	2.33E-08	2.04E-04
W-50	DZ/DUP	0.1	0.0000	99.7	27.9	28.03	2.46E-08	2.15E-04	0.00E+00	0.00E+00	2.46E-08	2.15E-04
W-51	DZ	1.4	0.0000	95.5	26.8	28.20	5.70E-08	4.99E-04	0.00E+00	0.00E+00	5.70E-08	4.99E-04
W-52		0.9	0.0000	97.1	27.2	28.14	7.10E-06	6.22E-02	0.00E+00	0.00E+00	7.10E-06	6.22E-02
W-53		0.8	0.0000	97.4	27.3	28.12	1.35E-03	1.18E+01	1.26E-04	1.10E+00	1.47E-03	1.29E+01
W-54	DZ	0.3	0.0000	99.2	27.8	28.05	1.03E-08	9.02E-05	0.00E+00	0.00E+00	1.03E-08	9.02E-05
W-55		0.9	0.0000	97.3	27.3	28.13	9.20E-06	8.06E-02	0.00E+00	0.00E+00	9.20E-06	8.06E-02
W-56	L											
W-57		0.9	0.0000	97.1	27.2	28.14	8.48E-06	7.43E-02	0.00E+00	0.00E+00	8.48E-06	7.43E-02
W-58	L/INV											
W-59	L											
W-60	DZ	0.3	0.0000	99.2	27.8	28.05	1.45E-08	1.27E-04	0.00E+00	0.00E+00	1.45E-08	1.27E-04
W-61	DZ	0.1	0.0000	99.6	27.9	28.03	1.47E-08	1.28E-04	0.00E+00	0.00E+00	1.47E-08	1.28E-04
W-62		0.2	0.0000	99.3	27.8	28.05	5.48E-07	4.80E-03	0.00E+00	0.00E+00	5.48E-07	4.80E-03
W-63		1.1	0.0000	96.6	27.1	28.15	1.63E-07	1.43E-03	0.00E+00	0.00E+00	1.63E-07	1.43E-03
W-64	DINV	1.2	0.0000	96.1	26.9	28.18	1.89E-06	1.66E-02	0.00E+00	0.00E+00	1.89E-06	1.66E-02
W-65	L											
W-66	L											
W-67	L											
W-68	SINV	0.1	0.0000	99.7	27.9	28.03	1.99E-06	1.75E-02	0.00E+00	0.00E+00	1.99E-06	1.75E-02
W-69	L											
W-70		1.1	0.0000	96.7	27.1	28.15	3.82E-02	3.34E+02	0.00E+00	0.00E+00	3.82E-02	3.34E+02
W-71	L											
W-72	PEGF/SINV	0.2	0.0000	99.3	27.8	28.05	1.37E-03	1.20E+01	1.68E-06	1.47E-02	1.37E-03	1.20E+01

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
W-36	DZ	
W-37	L	Reported with sample WO35.
W-38		Liquid sample W039 taken.
W-39	L	Reported with sample WO38.
W-40	DZ	
W-41	SINV	SV varied by a factor of 3.
W-42		
W-43	DZ	SV varied by a factor of 3.2.
W-44		Liquid sample W046 taken.
W-45	DZ	
W-46	L	Reported with sample WO44.
W-47	L	Reported with sample WO48.
W-48		Variable bagged THC and O2 concentration. Liquid sample W047 taken.
W-49	DZ	
W-50	DZ/DUP	Duplicate of W049.
W-51	DZ	
W-52		
W-53		
W-54	DZ	
W-55		Liquid sample W056 taken.
W-56	L	Reported with sample WO55.
W-57		Changed product half way through bag. Diesel running through during bag sample (1204 – 1205). Liquid samples W058 and W059 taken.
W-58	L/INV	Not enough liquid to fill vial. Reported with sample W057.
W-59	L	Reported with sample WO57.
W-60	DZ	
W-61	DZ	
W-62		O2 went from 1.2% to 0.1%. Liquid sample W065 taken.
W-63		Liquid sample W066 taken.
W-64	DINV	Appears Nitrogen flow is preventing THC emissions. Liquid sample W067 taken.
W-65	L	Reported with sample WO62.
W-66	L	Reported with sample WO63.
W-67	L	Reported with sample WO64.
W-68	SINV	SV varied by a factor of 3.5. Liquid sample W069 taken.
W-69	L	Reported with sample WO68. Not enough liquid to fill.
W-70		SV varied by a factor of 2. Liquid sample W071 taken.
W-71	L	Reported with sample WO70.
W-72	PEGF/SINV	SV varied by more than a factor of 2.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ('Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
W-73	L		74								
W-74		3.5	75		PUMP	2.00	VERT			LL	D B
W-75	DZ	4.5	77		C	1.00	TH			LL	D B/Gasoline/LCO
W-76		5.5	72		PUMP	2.00	VERT		N	LL	D B/LCO
W-77		12.5	65		PUMP	6.00	HC			LL	Naptha
W-78	DZ	12.5	69		VALVE	3.00	GATE	M		LL	Butane
W-79	DZ	12.5	67		OEL	0.50	OEL			LL	Butane
W-80		12.5	67		VALVE	3.00	GATE	M		LL	Butane
W-81	DZ	12.5	69		OEL	0.75	OEL			HL	
W-82		1.5	58		VALVE	8.00	GATE	M		LL	Naptha
W-83	DUP	1.5	58		VALVE	8.00	GATE	M		LL	Naptha
W-84	AUDTD	1.5	58		VALVE	8.00	GATE	M		LL	Naptha
W-85	L	1.5	58							LL	Naptha
W-86		3.5	57		VALVE	6.00	GATE	M		LL	Naptha
W-87	L	3.5	57							LL	Naptha
W-88		5.5	61		VALVE	4.00	GATE	M		LL	Naptha
W-89	L										
W-90	SINV	5.5	63		OEL	0.75	OEL			LL	Platformate
W-91	SINV	5.5	64		OEL	0.50	OEL			LL	Platformate
W-92	L	5.5	64							LL	Platformate
W-93		3.5	64		C	0.50	TH			LL	HC
W-94		5.5	67		VALVE	0.75	GATE	M		GAS	OVHD gas
W-95	DZ	0.0	66		VALVE	4.00	MC	C		GAS	Fuel gas
W-96		1.5	58		VALVE	4.00	MC	C		HL	Jet fuel
W-97		1.5	64		VALVE	1.00	MC	C		LL	Naptha
W-98		5.5	64		VALVE	3.00	MC	C		GAS	Fuel gas
W-99	AUDTD	5.5	64		VALVE	3.00	MC	C		GAS	Fuel gas
W-100	DZ	5.5	63		VALVE	3.00	MC	C		GAS	Fuel gas
W-101		4.5	66		PUMP	1.50	VERT			LL	Naptha
W-102		4.5	64		OEL	0.50	OEL			LL	Naptha
W-103	L	4.5	66							LL	Naptha
W-104	L	4.5	64							LL	Naptha
W-105	BL										
W-106	PEGI	1.5	59		VALVE	3.00	MC	C		GAS	Treated fuel gas
W-107	DZ	0.0	64		VALVE	6.00	GATE	M		GAS	Treated fuel gas
W-108	DZ	0.0	65		OEL	0.50	OEL			GAS	Treated fuel gas
W-109	PEG	0.0	63		C	0.75	TH			LL	LPG (butane)

Page 6b

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
W-73	L												
W-74			6,000				5,500				5,750	5	5,746
W-75	DZ		8				5				6	6	0
W-76			120				140				130	4	126
W-77			50				90				70	4	66
W-78	DZ		5				4				5	5	0
W-79	DZ		4				4				4	4	0
W-80			42,000				28,000				35,000	4	34,997
W-81	DZ		4				4				4	4	0
W-82			3,000	700	300	350	2,500	1,000	1,000	300	2,750	14	2,736
W-83	DUP		3,000	700	300	350	2,500	1,000	1,000	300	2,750	14	2,736
W-84	AUDTD		3,000	700	300	350	2,500	1,000	1,000	300	2,750	14	2,736
W-85	L												
W-86			700	140	25	25	1,100	700	160	50	900	6	894
W-87	L												
W-88			50	9	5	10	80	10	7	12	65	5	60
W-89	L												
W-90	SINV		150				60				105	5	100
W-91	SINV		2,000				4,500				3,250	7	3,243
W-92	L												
W-93			49,700	31,500	17,500	21,700	56,000	38,500	38,500	42,000	52,850	7	52,843
W-94			14	8	8	14	20	20	14	20	17	6	11
W-95	DZ		4	4	4	4	4	4	4	4	4	4	0
W-96			650	400	350	400	400	400	300	400	525	20	505
W-97			500	400	250	250	800	100	120	100	650	4	646
W-98			110	100	80	35	100	40	35	35	105	5	100
W-99	AUDTD		110	100	80	35	100	40	35	35	105	5	100
W-100	DZ		4	4	4	4	3	3	3	3	3	3	0
W-101			8	8	4	8	7	6	5	7	8	3	5
W-102			600				450				525	3	523
W-103	L												
W-104	L												
W-105	BL												
W-106	PEGI		80,000	32,000	9,600	1,280	48,000	8,000	16,000	400	64,000	5	63,996
W-107	DZ		4	4	4	4	4	4	4	4	4	4	0
W-108	DZ		3	3	3	3	3				3	3	0
W-109	PEG		100,000	20,000	100,000	50,000	100,000	60,000	90,000	20,000	100,000	3	99,997

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
W-73	L											
W-74		8,400	9,800	9,100	3,635	3,603	3,619	3.62	4.50	2.30	3.40	0.26
W-75	DZ	84	84	84	1,047	1,043	1,045	1.05	2.80	3.00	2.90	0.07
W-76		144	120	132	3,969	4,082	4,026	4.03	3.10	1.20	2.15	0.27
W-77		1,200	1,200	1,200	4,256	4,241	4,249	4.25	0.80	0.30	0.55	0.26
W-78	DZ	50	35	43	3,176	3,145	3,161	3.16	3.60	0.30	1.95	0.21
W-79	DZ	40	30	35	832	826	829	0.83	4.00	4.40	4.20	0.06
W-80		1,000	1,000	1,000	3,464	3,450	3,457	3.46	2.10	0.40	1.25	0.22
W-81	DZ	35	35	35	1,297	1,297	1,297	1.30	0.40	0.10	0.25	0.08
W-82		306	324	315	6,192	6,192	6,192	6.19	2.30	0.80	1.55	0.40
W-83	DUP	306	324	315	6,192	6,192	6,192	6.19	2.30	0.80	1.55	0.40
W-84	AUDTD	306	324	315	6,192	6,192	6,192	6.19	2.30	0.80	1.55	0.40
W-85	L											
W-86		230	270	250	4,901	4,829	4,865	4.87	3.90	1.60	2.75	0.34
W-87	L											
W-88		90	54	72	4,763	4,694	4,729	4.73	1.40	0.30	0.85	0.30
W-89	L											
W-90	SINV	50	55	52	988	983	986	0.99	0.60	0.60	0.60	0.06
W-91	SINV	675	648	662	1,131	1,131	1,131	1.13	0.30	0.20	0.25	0.07
W-92	L											
W-93		8,000	13,600	10,800	1,124	1,126	1,125	1.13	0.20	0.20	0.20	0.07
W-94		64	44	54	1,156	1,130	1,143	1.14	0.50	0.30	0.40	0.07
W-95	DZ	36	36	36	3,859	3,851	3,855	3.86	1.30	0.20	0.75	0.24
W-96		504	441	473	2,069	2,051	2,060	2.06	1.30	0.30	0.80	0.13
W-97		126	144	135	1,502	1,498	1,500	1.50	0.90	0.80	0.85	0.09
W-98		72	72	72	2,373	2,373	2,373	2.37	1.30	0.30	0.80	0.15
W-99	AUDTD	72	72	72	2,373	2,373	2,373	2.37	1.30	0.30	0.80	0.15
W-100	DZ	29	27	28	2,373	2,368	2,371	2.37	0.30	0.20	0.25	0.14
W-101		45	41	43	4,926	4,951	4,939	4.94	3.40	1.80	2.60	0.34
W-102		63	49	56	1,001	1,015	1,008	1.01	0.60	0.30	0.45	0.06
W-103	L											
W-104	L											
W-105	BL											
W-106	PEGI	7,200	7,200	7,200	2,276	2,270	2,273	2.27	1.60	0.30	0.95	0.14
W-107	DZ	32	24	28	4,601	4,625	4,613	4.61	1.40	0.30	0.85	0.29
W-108	DZ	27	27	27	902	912	907	0.91	4.60	4.70	4.65	0.07
W-109	PEG	24,000	26,000	25,000	1,166	1,166	1,166	1.17	0.60	0.40	0.50	0.07

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
W-73	L										
W-74		94	94	94	554	15,000.00	23,494.67	0.00	0.00	NA	23,494.67
W-75	DZ	78	79	79	538	NA	56.43	0.00	0.00	36.00	56.43
W-76		72	72	72	532	84.00	131.80	0.00	0.00	NA	131.80
W-77		107	107	107	567	1,400.00	2,201.71	5.50	3.14	NA	2,204.84
W-78	DZ	69	68	69	528	NA	2.20	0.00	0.00	1.40	2.20
W-79	DZ	68	70	69	529	NA	0.07	0.00	0.00	0.05	0.07
W-80		68	69	69	528	870.00	1,366.85	16.00	9.12	NA	1,375.97
W-81	DZ	69	69	69	529	NA	1.07	0.00	0.00	0.68	1.07
W-82		87	88	88	547	NA	580.93	0.00	0.00	370.00	580.93
W-83	DUP	87	88	88	547	NA	628.02	0.00	0.00	400.00	628.02
W-84	AUDTD	87	88	88	547	NA	580.93	0.00	0.00	370.00	580.93
W-85	L										
W-86		63	64	64	523	NA	423.23	0.00	0.00	270.00	423.23
W-87	L										
W-88		73	74	74	533	NA	31.44	0.00	0.00	20.00	31.44
W-89	L										
W-90	SINV	76	77	77	536	NA	11.32	0.00	0.00	7.20	11.32
W-91	SINV	64	64	64	524	NA	990.83	0.00	0.00	630.00	990.83
W-92	L										
W-93		66	68	67	527	NA	41,834.15	0.00	0.00	27,000.00	41,834.15
W-94		68	68	68	528	NA	58.20	0.00	0.00	37.00	58.20
W-95	DZ	69	69	69	529	NA	2.20	0.00	0.00	1.40	2.20
W-96		80	88	84	544	NA	220.07	0.00	0.00	140.00	220.07
W-97		65	66	66	525	NA	267.21	0.00	0.00	170.00	267.21
W-98		66	66	66	526	NA	144.08	23.00	13.12	100.00	157.20
W-99	AUDTD	66	66	66	526	NA	40.76	25.00	14.26	35.00	55.02
W-100	DZ	64	63	64	523	NA	69.22	0.00	0.00	44.00	69.22
W-101		78	81	80	539	NA	156.80	0.00	0.00	100.00	156.80
W-102		66	65	66	525	NA	188.73	0.00	0.00	120.00	188.73
W-103	L										
W-104	L										
W-105	BL										
W-106	PEGI	55	57	56	516	NA	3,085.10	3,400.00	1,935.30	3,200.00	5,020.40
W-107	DZ	73	74	74	533	NA	0.11	0.00	0.00	0.07	0.11
W-108	DZ	70	66	68	528	NA	17.20	0.00	0.00	11.00	17.20
W-109	PEG	65	71	68	528	NA	32,634.68	0.00	0.00	21,000.00	32,634.68

WSPA EMISSION RATE CALCULATION SPREADSHEET SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
		MW fraction	MW fraction	% fraction	MW fraction	MW	NMOC		Methane		THC	
ID	Code	O2	C3H8	N2	N2	Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
W-73	L											
W-74		1.1	0.0000	96.6	27.1	28.16	1.50E-02	1.31E+02	0.00E+00	0.00E+00	1.50E-02	1.31E+02
W-75	DZ	0.9	0.0016	97.1	27.2	28.14	1.04E-05	9.09E-02	0.00E+00	0.00E+00	1.04E-05	9.09E-02
W-76		0.7	0.0000	97.9	27.4	28.11	9.07E-05	7.94E-01	0.00E+00	0.00E+00	9.07E-05	7.94E-01
W-77		0.2	0.0000	99.5	27.9	28.04	1.38E-03	1.21E+01	1.97E-06	1.72E-02	1.38E-03	1.21E+01
W-78	DZ	0.6	0.0001	98.0	27.5	28.10	1.18E-06	1.04E-02	0.00E+00	0.00E+00	1.18E-06	1.04E-02
W-79	DZ	1.3	0.0000	95.8	26.8	28.19	1.19E-08	1.04E-04	0.00E+00	0.00E+00	1.19E-08	1.04E-04
W-80		0.4	0.0000	98.8	27.7	28.07	7.75E-04	6.79E+00	5.17E-06	4.53E-02	7.80E-04	6.83E+00
W-81	DZ	0.1	0.0000	99.7	27.9	28.03	2.16E-07	1.89E-03	0.00E+00	0.00E+00	2.16E-07	1.89E-03
W-82		0.5	0.0163	98.4	27.6	28.09	5.78E-04	5.07E+00	0.00E+00	0.00E+00	5.78E-04	5.07E+00
W-83	DUP	0.5	0.0176	98.4	27.6	28.09	6.25E-04	5.48E+00	0.00E+00	0.00E+00	6.25E-04	5.48E+00
W-84	AUDTD	0.5	0.0163	98.4	27.6	28.09	5.78E-04	5.07E+00	0.00E+00	0.00E+00	5.78E-04	5.07E+00
W-85	L											
W-86		0.9	0.0119	97.2	27.2	28.13	3.70E-04	3.24E+00	0.00E+00	0.00E+00	3.70E-04	3.24E+00
W-87	L											
W-88		0.3	0.0009	99.1	27.8	28.05	2.37E-05	2.07E-01	0.00E+00	0.00E+00	2.37E-05	2.07E-01
W-89	L											
W-90	SINV	0.2	0.0003	99.4	27.9	28.04	1.74E-06	1.53E-02	0.00E+00	0.00E+00	1.74E-06	1.53E-02
W-91	SINV	0.1	0.0278	99.7	27.9	28.04	1.76E-04	1.54E+00	0.00E+00	0.00E+00	1.76E-04	1.54E+00
W-92	L											
W-93		0.1	1.1910	97.1	27.2	28.46	7.45E-03	6.53E+01	0.00E+00	0.00E+00	7.45E-03	6.53E+01
W-94		0.1	0.0016	99.6	27.9	28.04	1.05E-05	9.16E-02	0.00E+00	0.00E+00	1.05E-05	9.16E-02
W-95	DZ	0.2	0.0001	99.2	27.8	28.05	1.35E-06	1.19E-02	0.00E+00	0.00E+00	1.35E-06	1.19E-02
W-96		0.3	0.0062	99.2	27.8	28.05	7.06E-05	6.18E-01	0.00E+00	0.00E+00	7.06E-05	6.18E-01
W-97		0.3	0.0075	99.1	27.8	28.06	6.48E-05	5.67E-01	0.00E+00	0.00E+00	6.48E-05	5.67E-01
W-98		0.3	0.0044	99.2	27.8	28.05	5.50E-05	4.82E-01	5.01E-06	4.39E-02	6.01E-05	5.26E-01
W-99	AUDTD	0.3	0.0015	99.2	27.8	28.05	1.56E-05	1.36E-01	5.45E-06	4.77E-02	2.10E-05	1.84E-01
W-100	DZ	0.1	0.0019	99.7	27.9	28.03	2.58E-05	2.26E-01	0.00E+00	0.00E+00	2.58E-05	2.26E-01
W-101		0.8	0.0044	97.4	27.3	28.13	1.34E-04	1.17E+00	0.00E+00	0.00E+00	1.34E-04	1.17E+00
W-102		0.1	0.0053	99.5	27.9	28.04	3.01E-05	2.64E-01	0.00E+00	0.00E+00	3.01E-05	2.64E-01
W-103	L											
W-104	L											
W-105	BL											
W-106	PEGI	0.3	0.1412	98.7	27.7	28.11	1.16E-03	1.02E+01	7.29E-04	6.38E+00	1.89E-03	1.66E+01
W-107	DZ	0.3	0.0000	99.1	27.8	28.05	8.08E-08	7.08E-04	0.00E+00	0.00E+00	8.08E-08	7.08E-04
W-108	DZ	1.5	0.0005	95.3	26.7	28.21	3.11E-06	2.72E-02	0.00E+00	0.00E+00	3.11E-06	2.72E-02
W-109	PEG	0.2	0.9263	97.4	27.3	28.38	6.08E-03	5.33E+01	0.00E+00	0.00E+00	6.08E-03	5.33E+01

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
W-73	L	Reported with sample WO72.
W-74		
W-75	DZ	Plug.
W-76		
W-77		
W-78	DZ	High O2 variability (factor of 12).
W-79	DZ	
W-80		Initial screening value fluctuating. Final screening is intermittent emitter.
W-81	DZ	
W-82		Liquid sample W085 taken.
W-83	DUP	Duplicate of W082.
W-84	AUDTD	Sample to RTI. Duplicate of W082.
W-85	L	Reported with sample W082.
W-86		Intermittent emitter. Liquid sample W087 taken.
W-87	L	Reported with sample W086.
W-88		Liquid sample W089 taken.
W-89	L	Reported with sample W088.
W-90	SINV	SV varied by a factor of 2.5.
W-91	SINV	Liquid sample W092 taken. SV varied by a factor of 2.25
W-92	L	Reported with sample W091.
W-93		Plug.
W-94		
W-95	DZ	
W-96		Initial screening response time very slow – HL.
W-97		
W-98		Restart bag due to emergency.
W-99	AUDTD	Sample to RTI. Duplicate of W098.
W-100	DZ	
W-101		Liquid sample W103 taken.
W-102		Liquid sample W104 taken. Final QC 1000ppm.
W-103	L	Reported with sample W101.
W-104	L	Reported with sample W102.
W-105	BL	
W-106	PEGI	Intermittent emitter.
W-107	DZ	
W-108	DZ	
W-109	PEG	

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ("Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
W-110		1.5	66		C	1.00	TH			LL	LPG
W-111		1.5	62		VALVE	8.00	GATE	M		LL	LPG
W-112	DUP	1.5	62		VALVE	8.00	GATE	M		LL	LPG
W-113	AUDTD	1.5	62		VALVE	8.00	GATE	M		LL	LPG
W-114	PEGI/SINV	1.5	65		VALVE	8.00	GATE	M		LL	Gasoline
W-115		1.5	65		VALVE	8.00	GATE	M		LL	Gasoline
W-116	L	1.5	65		VALVE	8.00	GATE	M		LL	Gasoline
W-117	L	1.5	65		VALVE	8.00	GATE	M		LL	Gasoline
W-118	SINV	1.5	55		PUMP	4.00	HC		N	LL	Coker naptha
W-119		1.5	54		VALVE	1.50	MC	C		HL	Coker naptha
W-120		1.5	57		VALVE	3.00	MC	C		HL	QT slop
W-121	DINV	1.5	62		VALVE	1.50	MC	C		HL	
W-122	DZ	1.5	67		VALVE	3.00	GATE	M		HL	
W-123	DZ	0.0	71		VALVE	3.00	GATE	M		HL	
W-124	DINV	1.5	70		PUMP	4.00	HC			HL	Heavy vac. oil
W-125		1.5	65		OEL	1.00	OEL			HL	Coker naptha
W-126	AUDTD	1.5	65		OEL	1.00	OEL			LL	Coker naptha
W-127	PEGF/SINV	9.0	54		VALVE	3.00	MC	C		GAS	Propane gas
W-128		9.0	56		PUMP	6.00	VERT		Y	LL	LPG
W-129	DZ	9.0	56		PUMP	6.00	VERT		N	LL	LPG
W-130	DZ	5.5	57		OEL	0.75	OEL			LL	Butane
W-131	SINV	5.5	60		VALVE	4.00	GATE	M		LL	Butane
W-132		5.5	60		VALVE	2.00	GATE	M		LL	Butane (LPG)
W-133	DZ	1.5	52		VALVE	1.50	GATE	M		LL	Naptha
W-134		1.5	54		OEL	0.50	OEL			LL	Naptha
W-135	SINV	2.5	55		VALVE	3.00	MC	C		LL	Naptha
W-136		3.5	63		VALVE	0.50	BALL	M		LL	Naptha
W-137	DUP	3.5	63		VALVE	0.50	BALL	M		LL	Naptha
W-138		3.5	57		C	1.00	TH			LL	Platformate
W-139	PEGI	3.5	58		VALVE	6.00	GATE	M		GAS	HC & H2
W-140	BL										
W-141		1.5	52		PUMP	2.00	VERT		N	LL	Naptha
W-142		3.5	60		OEL	0.75	OEL			LL	Platformate
W-143	SINV	3.5	64		OEL	0.75	OEL			LL	Platformate
W-144	DZ	5.5	64		OEL	0.75	OEL			LL	Platformate
W-145		4.5	65		PUMP	3.00	VERT		Y	LL	Propane
W-146		3.5	64		VALVE	4.00	GATE	M		GAS	HC & H2

Page 7b

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South. (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
W-110			90,000	50	500	80,000	90,000	600	1,000	20,000	90,000	4	89,997
W-111			250	80	25	110	140	35	30	50	195	3	192
W-112	DUP		250	80	25	110	140	35	30	50	195	3	192
W-113	AUDTD		250	80	25	110	140	35	30	50	195	3	192
W-114	PEGI/SINV		80,000	55	60	900	32,000	80	100	800	56,000	5	55,996
W-115			21	16	12	7	20	16	10	4	21	4	17
W-116	L												
W-117	L												
W-118	SINV		2,000	30	40	110	800	30	70	80	1,400	6	1,394
W-119			10,000	4,000	2,400	6,000	16,000	9,000	11,200	6,000	13,000	9	12,991
W-120			25	20	14	20	24	20	13	10	25	6	19
W-121	DINV		26	22	22	12	40	35	31	27	33	4	30
W-122	DZ		4	4	4	4	3	3	3	3	3	3	0
W-123	DZ		4	4	4	4	4	4	4	4	4	4	0
W-124	DINV		12	8	6	8	8	6	6	7	10	3	7
W-125			50				90				70	4	67
W-126	AUDTD		50				90				70	4	67
W-127	PEGF/SINV		16,000	6,000	5,000	3,000	80,000	64,000	40,000	500	48,000	4	47,997
W-128			2,000	500	160	500	1,400	50	50	350	1,700	3	1,697
W-129	DZ		3	3	3	3	3	3	3	3	3	3	0
W-130	DZ		3	3	3	3	3	3	3	3	3	3	0
W-131	SINV		5,000	4	30	200	300	10	35	150	2,650	5	2,646
W-132			600	120	500	50	1,000	900	100	1,000	800	4	797
W-133	DZ		6	6	6	6	4	4	4	4	5	5	0
W-134			12,000				13,000				12,500	7	12,494
W-135	SINV		610	50	20	90	200	50	16	12	405	5	401
W-136			24,500	21,700	5,600	21,000	27,300	24,500	8,400	26,600	25,900	5	25,896
W-137	DUP		24,500	21,700	5,600	21,000	27,300	24,500	8,400	26,600	25,900	5	25,896
W-138			1,200	30	180	800	1,500	80	120	450	1,350	5	1,346
W-139	PEGI		70,000	105	14,000	8,400	63,000	560	9,800	840	66,500	5	66,496
W-140	BL												
W-141			40,500	1,600	90	1,800	27,000	1,300	140	2,000	33,750	6	33,745
W-142			14,000				12,000				13,000	10	12,990
W-143	SINV		80				1,000				540	5	535
W-144	DZ		4	3.5	3.5	3.5	4				4	4	0
W-145			150	80	9	20	130	25	18	25	140	4	136
W-146			1,000	120	600	750	1,000	275	225	600	1,000	4	996

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
W-110		12,000	12,000	12,000	1,171	1,161	1,166	1.17	0.10	0.10	0.10	0.07
W-111		184	176	180	4,739	4,730	4,735	4.73	1.60	0.30	0.95	0.30
W-1.12	DUP	184	176	180	4,739	4,730	4,735	4.73	1.60	0.30	0.95	0.30
W-113	AUDTD	184	176	180	4,739	4,730	4,735	4.73	1.60	0.30	0.95	0.30
W-114	PEGI/SINV	280	280	280	4,647	4,689	4,668	4.67	1.60	0.30	0.95	0.29
W-115		40	40	40	4,647	4,705	4,676	4.68	2.50	0.40	1.45	0.30
W-116	L											
W-117	L											
W-118	SINV	1,760	1,720	1,740	4,541	4,541	4,541	4.54	4.60	5.40	5.00	0.36
W-119		1,600	2,080	1,840	1,935	1,913	1,924	1.92	1.80	0.30	1.05	0.12
W-120		88	88	88	1,920	1,920	1,920	1.92	2.60	4.00	3.30	0.14
W-121	DINV	36	36	36	2,944	2,944	2,944	2.94	0.90	0.50	0.70	0.18
W-122	DZ	41	32	36	3,004	3,006	3,005	3.01	0.30	0.20	0.25	0.18
W-123	DZ	32	24	28	2,474	2,483	2,479	2.48	0.40	0.10	0.25	0.15
W-124	DINV	48	48	48	6,944	6,944	6,944	6.94	7.80	7.80	7.80	0.66
W-125		270	270	270	1,029	1,017	1,023	1.02	0.30	0.30	0.30	0.06
W-126	AUDTD	270	270	270	1,029	1,017	1,023	1.02	0.30	0.30	0.30	0.06
W-127	PEGF/SINV	80,000	80,000	80,000	2,015	1,959	1,987	1.99	1.90	1.60	1.75	0.13
W-128		2,480	2,400	2,440	5,770	5,770	5,770	5.77	4.60	2.70	3.65	0.42
W-129	DZ	23	23	23	5,750	5,750	5,750	5.75	4.50	2.10	3.30	0.41
W-130	DZ	23	23	23	900	903	902	0.90	0.30	0.30	0.30	0.05
W-131	SINV	315	396	356	2,327	2,333	2,330	2.33	1.50	0.20	0.85	0.15
W-132		855	855	855	2,053	2,036	2,045	2.04	0.50	0.40	0.45	0.13
W-133	DZ	32	28	30	1,886	1,848	1,867	1.87	0.50	0.10	0.30	0.11
W-134		7,000	6,000	6,500	1,043	1,025	1,034	1.03	0.30	0.20	0.25	0.06
W-135	SINV	201	225	213	1,716	1,722	1,719	1.72	1.70	0.60	1.15	0.11
W-136		21,000	17,500	19,250	1,934	1,932	1,933	1.93	0.40	0.10	0.25	0.12
W-137	DUP	21,000	17,500	19,250	1,934	1,932	1,933	1.93	0.40	0.10	0.25	0.12
W-138		154	119	137	1,319	1,315	1,317	1.32	0.20	0.10	0.15	0.08
W-139	PEGI	17,500	14,700	16,100	4,857	4,810	4,834	4.83	1.00	0.40	0.70	0.30
W-140	BL											
W-141		1,200	1,120	1,160	4,233	4,126	4,180	4.18	2.50	0.90	1.70	0.27
W-142		5,400	4,950	5,175	1,064	1,006	1,035	1.04	0.40	0.40	0.40	0.06
W-143	SINV	400	640	520	1,036	965	1,001	1.00	0.40	0.30	0.35	0.06
W-144	DZ	32	28	30	1,012	972	992	0.99	0.20	0.20	0.20	0.06
W-145		352	352	352	5,436	5,436	5,436	5.44	4.00	1.00	2.50	0.37
W-146		840	840	840	3,700	3,648	3,674	3.67	2.50	0.40	1.45	0.24

Page 7d

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
W-110		67	66	67	526	NA	10,034.50	0.00	0.00	6,400.00	10,034.50
W-111		65	64	65	524	NA	251.46	0.00	0.00	160.00	251.46
W-112	DUP	65	64	65	524	NA	235.74	0.00	0.00	150.00	235.74
W-113	AUDTD	65	64	65	524	NA	267.17	0.00	0.00	170.00	267.17
W-114	PEGI/SINV	67	69	68	528	NA	267.17	0.00	0.00	170.00	267.17
W-115		120	122	121	581	NA	36.12	0.00	0.00	23.00	36.12
W-116	L										
W-117	L										
W-118	SINV	55	53	54	514	NA	2,808.19	3.40	1.93	1,800.00	2,810.11
W-119		56	55	56	515	NA	2,979.30	5.90	3.36	1,900.00	2,982.66
W-120		60	63	62	521	NA	36.03	0.00	0.00	23.00	36.03
W-121	DINV	60	62	61	521	NA	0.08	0.00	0.00	0.05	0.08
W-122	DZ	78	80	79	539	NA	0.08	0.00	0.00	0.05	0.08
W-123	DZ	81	82	82	541	NA	0.08	0.00	0.00	0.05	0.08
W-124	DINV	169	163	166	626	NA	45.14	0.00	0.00	29.00	45.14
W-125		66	63	65	524	NA	456.15	0.00	0.00	290.00	456.15
W-126	AUDTD	66	63	65	524	NA	723.48	0.00	0.00	460.00	723.48
W-127	PEGF/SINV	54	53	54	513	NA	85,183.76	4.00	2.21	56,000.00	85,185.97
W-128		81	84	83	542	NA	3,752.67	0.00	0.00	2,400.00	3,752.67
W-129	DZ	57	57	57	517	NA	1.10	0.00	0.00	0.70	1.10
W-130	DZ	59	61	60	520	NA	0.08	0.00	0.00	0.05	0.08
W-131	SINV	64	68	66	526	NA	455.80	0.00	0.00	290.00	455.80
W-132		61	61	61	521	NA	1,018.50	6.10	3.48	650.00	1,021.98
W-133	DZ	64	64	64	524	NA	0.07	0.00	0.00	0.05	0.07
W-134		57	58	58	517	NA	7,531.17	0.00	0.00	4,800.00	7,531.17
W-135	SINV	122	130	126	586	NA	377.06	0.00	0.00	240.00	377.06
W-136		68	70	69	529	NA	43,356.03	0.00	0.00	28,000.00	43,356.03
W-137	DUP	68	70	69	529	NA	49,438.02	0.00	0.00	32,000.00	49,438.02
W-138		61	62	62	521	NA	130.60	0.00	0.00	83.00	130.60
W-139	PEGI	59	58	59	518	NA	17,265.71	2,600.00	1,473.04	12,000.00	18,738.75
W-140	BL					NA	7.40	0.00	0.00	4.70	7.40
W-141		58	60	59	519	NA	2,657.44	16.00	9.11	1,700.00	2,666.55
W-142		59	60	60	519	NA	12,210.43	7.30	4.15	7,800.00	12,214.58
W-143	SINV	63	62	63	522	NA	1,886.41	0.00	0.00	1,200.00	1,886.41
W-144	DZ	64	64	64	524	NA	10.86	0.00	0.00	6.90	10.86
W-145		75	77	76	536	NA	795.96	6.40	3.64	510.00	799.60
W-146		75	75	75	535	NA	962.54	460.00	262.01	780.00	1,224.55

WSPA EMISSION RATE CALCULATION SPREADSHEET SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
							NMOC		Methane		THC	
ID	Code	MW fraction O2	MW fraction C3H8	% fraction N2	MW fraction N2	MW Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
W-110		0.0	0.2823	99.3	27.8	28.13	1.82E-03	1.60E+01	0.00E+00	0.00E+00	1.82E-03	1.60E+01
W-111		0.3	0.0071	99.0	27.7	28.06	1.94E-04	1.70E+00	0.00E+00	0.00E+00	1.94E-04	1.70E+00
W-112	DUP	0.3	0.0066	99.0	27.7	28.06	1.82E-04	1.59E+00	0.00E+00	0.00E+00	1.82E-04	1.59E+00
W-113	AUDTD	0.3	0.0075	99.0	27.7	28.06	2.06E-04	1.80E+00	0.00E+00	0.00E+00	2.06E-04	1.80E+00
W-114	PEGI/SINV	0.3	0.0075	99.0	27.7	28.06	2.02E-04	1.77E+00	0.00E+00	0.00E+00	2.02E-04	1.77E+00
W-115		0.5	0.0010	98.5	27.6	28.08	2.55E-05	2.23E-01	0.00E+00	0.00E+00	2.55E-05	2.23E-01
W-116	L											
W-117	L											
W-118	SINV	1.6	0.0794	94.8	26.6	28.25	2.67E-03	2.34E+01	1.83E-06	1.60E-02	2.67E-03	2.34E+01
W-119		0.3	0.0838	98.8	27.7	28.09	9.55E-04	8.36E+00	1.08E-06	9.43E-03	9.56E-04	8.37E+00
W-120		1.1	0.0010	96.7	27.1	28.15	1.29E-05	1.13E-01	0.00E+00	0.00E+00	1.29E-05	1.13E-01
W-121	DINV	0.2	0.0000	99.3	27.8	28.05	3.74E-08	3.28E-04	0.00E+00	0.00E+00	3.74E-08	3.28E-04
W-122	DZ	0.1	0.0000	99.7	27.9	28.03	3.61E-08	3.16E-04	0.00E+00	0.00E+00	3.61E-08	3.16E-04
W-123	DZ	0.1	0.0000	99.7	27.9	28.03	2.97E-08	2.60E-04	0.00E+00	0.00E+00	2.97E-08	2.60E-04
W-124	DINV	2.5	0.0013	92.2	25.8	28.33	6.55E-05	5.74E-01	0.00E+00	0.00E+00	6.55E-05	5.74E-01
W-125		0.1	0.0128	99.7	27.9	28.04	7.35E-05	6.44E-01	0.00E+00	0.00E+00	7.35E-05	6.44E-01
W-126	AUDTD	0.1	0.0203	99.7	27.9	28.04	1.17E-04	1.02E+00	0.00E+00	0.00E+00	1.17E-04	1.02E+00
W-127	PEGF/SINV	0.6	2.4702	92.7	26.0	28.99	3.03E-02	2.65E+02	7.84E-07	6.87E-03	3.03E-02	2.65E+02
W-128		1.2	0.1059	96.1	26.9	28.20	3.96E-03	3.47E+01	0.00E+00	0.00E+00	3.96E-03	3.47E+01
W-129	DZ	1.1	0.0000	96.7	27.1	28.15	1.18E-06	1.04E-02	0.00E+00	0.00E+00	1.18E-06	1.04E-02
W-130	DZ	0.1	0.0000	99.7	27.9	28.03	1.13E-08	9.86E-05	0.00E+00	0.00E+00	1.13E-08	9.86E-05
W-131	SINV	0.3	0.0128	99.1	27.8	28.06	1.71E-04	1.50E+00	0.00E+00	0.00E+00	1.71E-04	1.50E+00
W-132		0.1	0.0287	99.5	27.9	28.05	3.33E-04	2.91E+00	1.14E-06	9.95E-03	3.34E-04	2.92E+00
W-133	DZ	0.1	0.0000	99.7	27.9	28.03	2.20E-08	1.93E-04	0.00E+00	0.00E+00	2.20E-08	1.93E-04
W-134		0.1	0.2117	99.3	27.8	28.11	1.24E-03	1.09E+01	0.00E+00	0.00E+00	1.24E-03	1.09E+01
W-135	SINV	0.4	0.0106	98.8	27.7	28.07	9.54E-05	8.35E-01	0.00E+00	0.00E+00	9.54E-05	8.35E-01
W-136		0.1	1.2351	97.0	27.2	28.48	1.33E-02	1.16E+02	0.00E+00	0.00E+00	1.33E-02	1.16E+02
W-137	DUP	0.1	1.4115	96.6	27.1	28.54	1.52E-02	1.33E+02	0.00E+00	0.00E+00	1.52E-02	1.33E+02
W-138		0.0	0.0037	99.8	28.0	28.03	2.70E-05	2.37E-01	0.00E+00	0.00E+00	2.70E-05	2.37E-01
W-139	PEGI	0.2	0.5293	98.1	27.5	28.24	1.37E-02	1.20E+02	1.16E-03	1.02E+01	1.48E-02	1.30E+02
W-140	BL	0.0	0.0002	100.0	28.0	28.02						
W-141		0.5	0.0750	98.1	27.5	28.12	1.90E-03	1.67E+01	6.51E-06	5.71E-02	1.91E-03	1.67E+01
W-142		0.1	0.3441	98.8	27.7	28.16	2.03E-03	1.78E+01	6.89E-07	6.03E-03	2.03E-03	1.78E+01
W-143	SINV	0.1	0.0529	99.5	27.9	28.05	2.99E-04	2.62E+00	0.00E+00	0.00E+00	2.99E-04	2.62E+00
W-144	DZ	0.1	0.0003	99.8	28.0	28.03	1.69E-06	1.48E-02	0.00E+00	0.00E+00	1.69E-06	1.48E-02
W-145		0.8	0.0225	97.4	27.3	28.13	7.48E-04	6.56E+00	3.42E-06	3.00E-02	7.52E-04	6.59E+00
W-146		0.5	0.0344	98.5	27.6	28.09	5.79E-04	5.07E+00	1.58E-04	1.38E+00	7.37E-04	6.45E+00

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
W-110		Plug.
W-111		
W-112	DUP	Duplicate of W111.
W-113	AUDTD	Sample to RTI. Duplicate of W111.
W-114	PEGI/SINV	Liquid sample W116 taken. SV varied by more than a factor of 2.
W-115		Liquid sample W117 taken.
W-116	L	Reported with sample W114.
W-117	L	Reported with sample W115.
W-118	SINV	Oil/air mist supply hose running into pump seal. SV varied by a factor of 2.5
W-119		
W-120		
W-121	DINV	Non-detect THC value for non-default zero. Statistical outlier.
W-122	DZ	
W-123	DZ	
W-124	DINV	Tried equilibrium O2 several times (<5%). Average O2 = 7.8%.
W-125		Final QC at 1426 = 1000ppm.
W-126	AUDTD	Sample to RTI. Duplicate of W125.
W-127	PEGF/SINV	Intermittent emitter. SV varied by a factor of 5.
W-128		
W-129	DZ	
W-130	DZ	
W-131	SINV	SV varied by a factor 16.7.
W-132		Final QC at 1415 = 1100ppm.
W-133	DZ	
W-134		
W-135	SINV	Seal came loose at 1142 - redid. SV varied by a factor of 3.1.
W-136		
W-137	DUP	Duplicate of W136.
W-138		Plug.
W-139	PEGI	Final QC at 1412 = 1100ppm.
W-140	BL	
W-141		
W-142		
W-143	SINV	Intermittent emitter. SV varied by a factor of 12.5.
W-144	DZ	
W-145		
W-146		

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ("Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
W-147		2.5	62		VALVE	0.50	GATE	M		GAS	HC & H2
W-148	AUDTC	3.5	62							GAS	Fuel gas
W-149	AUDTC										
W-150	DZ	5.5	62		VALVE	1.00	GATE	M		LL	Naptha
W-151	AUDTT	5.5	62		VALVE	1.00	GATE	M		LL	Naptha
W-152	AUDTT	5.5	62		VALVE	1.00	GATE	M		LL	Naptha
W-153	AUDTT	5.5	62		VALVE	1.00	GATE	M		LL	Naptha
W-154	DZ	3.5	65		VALVE	10.00	GATE	M		LL	Light naptha
W-155		2.5	64		PUMP	4.00	VERT		Y	LL	Light naptha
W-156		2.5	69		PUMP	4.00	VERT		N	LL	Light naptha
W-157	DZ	2.5	63		VALVE	8.00	GATE	M		LL	Light naptha
X-1	ACCY	2.5	72		VALVE	2.50		M		H2O	Water
X-2	DRIP/INV		75	30.22	VALVE	2.00		C		LL	Reformate
X-3		2.5	80	30.22	OEL	0.75				LL	
X-4	PEGI/DRIP/INV	7.5	78	30.20	OEL	0.50	OEL		Y	LL	Stripper overhead
X-5	PEG/DRIP	7.5	82	30.20	PUMP	0.50	CENT			LL	Stripper overhead
X-6	INV	7.5	78	30.20	VALVE	4.00	GATE	C		LL	
X-7	L/INV										
X-8		2.5	68	30.25	VALVE	4.00	GATE	C		LL	Fuel Gas
X-9	PEG/DRIP	2.5	69	30.25	VALVE	3.00	GATE	C		LL	Reformate
X-10	PEG/DRIP	2.5	68	30.25	OEL	0.50	OEL			LL	
X-11	INV	5.0	68	30.20	VALVE	3.00	GATE	M			
X-12	PEG	2.5	68	30.20	VALVE	3.00	GATE	C		LL	LPG
X-13		7.5	70	30.25	VALVE	6.00	GATE	M		LL	Naptha feed
X-14	L										
X-15		2.5	69	30.20	C	1.00	TH			GAS	Fuel gas
X-16		2.5	70	30.20	VALVE	6.00	GATE	M		LL	Hydro bate
X-17	PEG/DRIP	2.5	72	30.20	VALVE	6.00	GATE	M		LL	Hydro bate
X-18		2.5	70	30.20	VALVE	4.00	GATE	M		LL	Lt. Gasoline
X-19	PEG	7.5	65	30.20	VALVE	6.00	GATE	M		LL	Naptha feed
X-20	INV	7.5	66	30.25	C	6.00	FL			LL	
X-21		7.5	73	30.25	C	6.00	FL			LL	Gasoline
X-22		12.5	64	30.20	C	4.00	FL			LL	Gasoline
X-23	PEG	4.0	60	30.25	VALVE	6.00	GATE	M		LL	Lt. Gasoline
X-24		10.0	58	30.25	VALVE	10.00	GATE	M		LL	Naptha feed
X-25		7.5	61	30.25	C	1.00	TH			LL	Naptha Feed
X-26	SINV	2.5	64	30.25	VALVE	4.00	GATE	M		LL	Naptha Feed

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
W-147			1,300	550	700	650	1,500	500	700	1,000	1,400	3	1,397
W-148	AUDTC		36,000	24,000	5,200	5,600					18,000	4	17,996
W-149	AUDTC												
W-150	DZ		5	5	5	5	5	5	5	5	5	5	0
W-151	AUDTT											5	
W-152	AUDTT											5	
W-153	AUDTT						5				2	2	0
W-154	DZ		4	4	4	4	3	3	3	3	3	3	0
W-155			900	700	200	550	1,000	120	250	400	950	3	947
W-156			120	4	30	35	100	25	30	100	110	3	107
W-157	DZ		3	3	3	3	3	3	3	3	3	3	0
X-1	ACCY		5				5				5	5	0
X-2	DRIP/INV		5,000				12,600				8,800	12	8,788
X-3			500				500				500	12	488
X-4	PEGI/DRIP/INV		47,000				100				23,550	8	
X-5	PEG/DRIP		77,000				47,000				62,000	12	61,988
X-6	INV		800				400				600	8	
X-7	L/INV												
X-8		12	6,160				3,850				5,005	5	5,000
X-9	PEG/DRIP	11,998	70,000				70,000				70,000	10	69,990
X-10	PEG/DRIP		73,000				73,000				73,000	13	72,987
X-11	INV		70,000								35,000		35,000
X-12	PEG	2,358	70,000				70,000				70,000	5	69,995
X-13		40	11,000				11,000				11,000	3	10,997
X-14	L												
X-15			8,000				7,500				7,750	5	7,745
X-16		698	2,000				2,500				2,250	10	2,240
X-17	PEG/DRIP	99,998	87,500				87,500				87,500	5	87,495
X-18		30	900				700				800	6	794
X-19	PEG	10,000	70,000				70,000				70,000	5	69,995
X-20	INV		600								300	5	295
X-21			600				750				675	4	671
X-22			25				22				24	4	20
X-23	PEG	100,000	39,000				39,000				39,000	2	38,998
X-24		318	900				900				900	7	893
X-25			1,100				1,700				1,400	7	1,393
X-26	SINV	20,098	80				200				140	4	136

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
W-147		495	495	495	1,455	1,440	1,448	1.45	0.90	0.20	0.55	0.09
W-148	AUDTC	18,000	32,400	25,200	2,933	2,933	2,933	2.93	0.50	0.20	0.35	0.18
W-149	AUDTC											
W-150	DZ	36	32	34	1,578	1,558	1,568	1.57	0.60	0.20	0.40	0.10
W-151	AUDTT	144	168	156	1,361	1,486	1,424	1.42	2.40	0.20	1.30	0.09
W-152	AUDTT	144	168	156	1,361	1,486	1,424	1.42	2.40	0.20	1.30	0.09
W-153	AUDTT	392	392	392	1,240	1,156	1,198	1.20	1.60	0.20	0.90	0.08
W-154	DZ	32	27	29	3,985	3,959	3,972	3.97	2.00	0.70	1.35	0.25
W-155		2,100	2,500	2,300	5,009	4,969	4,989	4.99	3.60	2.50	3.05	0.35
W-156		50	50	50	5,009	5,085	5,047	5.05	2.60	1.30	1.95	0.33
W-157	DZ	18	18	18	3,657	3,632	3,645	3.64	1.80	0.60	1.20	0.23
X-1	ACCY	900	900	900	1,547	1,550	1,549	1.55	3.20	2.30	2.75	0.11
X-2	DRIP/INV	18,900	12,600	15,750	2,340	2,330	2,335	2.34	5.00	5.00	5.00	0.18
X-3		385	385	385	1,831	1,839	1,835	1.84	0.20	0.20	0.20	0.11
X-4	PEGI/DRIP/INV	1,750	1,150	1,450	778	785	782	0.78	0.60	2.20	1.40	0.05
X-5	PEG/DRIP	47,000	46,000	46,500	1,374	1,385	1,380	1.38	1.30	0.60	0.95	0.09
X-6	INV	405	1,215	810	2,265	2,320	2,293	2.29	0.30	0.30	0.30	0.14
X-7	L/INV											
X-8		616	616	616	1,785	1,785	1,785	1.79	0.50	0.50	0.50	0.11
X-9	PEG/DRIP	70,000	70,000	70,000	2,305	2,290	2,298	2.30	3.70	0.50	2.10	0.15
X-10	PEG/DRIP	73,000	73,000	73,000	883	890	887	0.89	0.80	0.50	0.65	0.05
X-11	INV	70,000	70,000	70,000	4,120	1,990	3,055	3.06	4.50	1.70	3.10	0.22
X-12	PEG	70,000	70,000	70,000	3,410	3,420	3,415	3.42	2.40	1.10	1.75	0.22
X-13		1,332	1,332	1,332	5,577	5,615	5,596	5.60	0.70	0.30	0.50	0.34
X-14	L											
X-15		616	2,310	1,463	872	821	847	0.85	0.80	1.00	0.90	0.05
X-16		444	666	555	4,450	4,410	4,430	4.43	3.20	0.30	1.75	0.29
X-17	PEG/DRIP	26,250	56,875	41,563	4,380	4,410	4,395	4.40	2.30	1.90	2.10	0.29
X-18		502	531	517	3,015	3,200	3,108	3.11	1.00	0.70	0.85	0.19
X-19	PEG	6,300	14,000	10,150	5,020	5,100	5,060	5.06	3.30	3.80	3.55	0.37
X-20	INV	350		175	3,010		3,010	3.01	0.40	15.00	7.70	0.29
X-21		2,275	2,730	2,503	2,268	2,307	2,288	2.29	0.20	0.20	0.20	0.14
X-22		87	80	84	1,960	1,970	1,965	1.97	0.20	0.15	0.18	0.12
X-23	PEG	6,500	6,500	6,500	4,790	4,730	4,760	4.76	0.40	0.30	0.35	0.29
X-24		600	600	600	5,190	5,170	5,180	5.18	0.50	0.40	0.45	0.32
X-25		300	300	300	1,510	1,470	1,490	1.49	0.40	0.60	0.50	0.09
X-26	SINV	232	232	232	4,810	4,830	4,820	4.82	2.15	3.00	2.58	0.33

Page 8d

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
W-147		66	66	66	526	NA	873.42	150.00	85.56	610.00	958.98
W-148	AUDTC	64	64	64	524	NA	290.30	15.00	8.56	190.00	298.86
W-149	AUDTC					NA		0.00		720.00	
W-150	DZ	69	68	69	528	NA	0.07	0.00	0.00	0.05	0.07
W-151	AUDTT	66	67	67	526	NA	259.06	14.00	7.98	170.00	267.04
W-152	AUDTT	66	67	67	526	NA	273.63	16.00	9.12	180.00	282.75
W-153	AUDTT	67	68	68	527	NA	1,084.16	0.00	0.00	690.00	1,084.16
W-154	DZ	74	75	75	534	NA	0.07	0.00	0.00	0.05	0.07
W-155		93	96	95	554	NA	5,629.92	0.00	0.00	3,600.00	5,629.92
W-156		68	66	67	527	NA	62.78	0.00	0.00	40.00	62.78
W-157	DZ	72	72	72	532	NA	0.07	0.00	0.00	0.05	0.07
X-1	ACCY	87	83	85	545	5.80	9.09	660.00	375.41	NA	384.50
X-2	DRIP/INV	72	72	72	532						
X-3		85	80	83	542	20.00	31.47	0.00	0.00	NA	31.47
X-4	PEGI/DRIP/INV	83	83	83	543						
X-5	PEG/DRIP	81	78	80	539	220,000.00	345,786.08	100.00	57.03	NA	345,843.10
X-6	INV	78	78	78	538						
X-7	L/INV										
X-8		68	68	68	528	600.00	943.66	0.00	0.00	NA	943.66
X-9	PEG/DRIP	68	70	69	529	100,000.00	156,919.51	590.00	335.90	NA	157,255.41
X-10	PEG/DRIP	68	68	68	528	44,000.00	69,186.66	240.00	136.92	NA	69,323.58
X-11	INV	70	71	71	530						
X-12	PEG	71	70	71	530	460,000.00	722,187.71	2,200.00	1,253.13	NA	723,440.84
X-13		71	70	71	530	1,800.00	2,830.97	17.00	9.70	NA	2,840.67
X-14	L										
X-15		69	72	71	530	3,500.00	5,501.53	1,700.00	969.50	NA	6,471.03
X-16		74	75	75	534	680.00	1,067.58	14.00	7.97	NA	1,075.56
X-17	PEG/DRIP	74	73	74	533	20,000.00	31,383.90	190.00	108.17	NA	31,492.07
X-18		72	76	74	534	850.00	1,336.18	0.00	0.00	NA	1,336.18
X-19	PEG	100	92	96	556	4,300.00	6,733.71	3,100.00	1,761.28	NA	8,494.99
X-20	INV	77		77	537						
X-21		77	76	77	536	1,200.00	1,888.11	0.00	0.00	NA	1,888.11
X-22		65	65	65	525	9.40	14.79	0.00	0.00	NA	14.79
X-23	PEG	73	72	73	532	49,000.00	77,081.59	0.00	0.00	NA	77,081.59
X-24		77	73	75	535	790.00	1,242.57	0.00	0.00	NA	1,242.57
X-25		63	70	67	526	15.00	23.59	0.00	0.00	NA	23.59
X-26	SINV	64	65	65	524	6.60	10.35	0.00	0.00	NA	10.35

Page 8e

WSPA EMISSION RATE CALCULATION SPREADSHEET SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
		MW fraction	MW fraction	% fraction	MW fraction	MW	NMOC		Methane		THC	
ID	Code	O2	C3H8	N2	N2	Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
W-147		0.2	0.0269	99.4	27.8	28.05	2.01E-04	1.76E+00	1.97E-05	1.72E-01	2.21E-04	1.93E+00
W-148	AUDTC	0.1	0.0084	99.6	27.9	28.04	1.35E-04	1.18E+00	3.97E-06	3.47E-02	1.38E-04	1.21E+00
W-149	AUDTC		0.0318		0.0	0.03						
W-150	DZ	0.1	0.0000	99.6	27.9	28.04	1.84E-08	1.61E-04	0.00E+00	0.00E+00	1.84E-08	1.61E-04
W-151	AUDTT	0.4	0.0075	98.7	27.7	28.07	6.09E-05	5.33E-01	1.87E-06	1.64E-02	6.27E-05	5.50E-01
W-152	AUDTT	0.4	0.0079	98.7	27.7	28.07	6.43E-05	5.63E-01	2.14E-06	1.88E-02	6.64E-05	5.82E-01
W-153	AUDTT	0.3	0.0304	99.0	27.7	28.07	2.10E-04	1.84E+00	0.00E+00	0.00E+00	2.10E-04	1.84E+00
W-154	DZ	0.4	0.0000	98.6	27.6	28.07	4.83E-08	4.23E-04	0.00E+00	0.00E+00	4.83E-08	4.23E-04
W-155		1.0	0.1588	96.6	27.1	28.20	4.85E-03	4.25E+01	0.00E+00	0.00E+00	4.85E-03	4.25E+01
W-156		0.6	0.0018	98.0	27.5	28.10	5.41E-05	4.74E-01	0.00E+00	0.00E+00	5.41E-05	4.74E-01
W-157	DZ	0.4	0.0000	98.8	27.7	28.07	4.42E-08	3.87E-04	0.00E+00	0.00E+00	4.42E-08	3.87E-04
X-1	ACCY	0.9	0.0000	97.3	27.2	28.13	2.43E-06	2.13E-02	1.00E-04	8.78E-01	1.03E-04	8.99E-01
X-2	DRIP/INV	1.6	0.0000	95.0	26.6	28.22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
X-3		0.1	0.0000	99.8	28.0	28.03	8.75E-06	7.66E-02	0.00E+00	0.00E+00	8.75E-06	7.66E-02
X-4	PEGI/DRIP/INV	0.4	0.0000	98.6	27.6	28.08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
X-5	PEG/DRIP	0.3	0.0000	99.1	27.8	28.06	8.54E-02	7.48E+02	1.24E-05	1.09E-01	8.55E-02	7.49E+02
X-6	INV	0.1	0.0000	99.7	27.9	28.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
X-7	L/INV											
X-8		0.2	0.0000	99.5	27.9	28.04	2.66E-04	2.33E+00	0.00E+00	0.00E+00	2.66E-04	2.33E+00
X-9	PEG/DRIP	0.7	0.0000	97.9	27.4	28.10	6.63E-02	5.81E+02	1.32E-04	1.16E+00	6.64E-02	5.82E+02
X-10	PEG/DRIP	0.2	0.0000	99.4	27.8	28.05	2.98E-02	2.61E+02	1.93E-05	1.69E-01	2.98E-02	2.61E+02
X-11	INV	1.0	0.0000	96.9	27.2	28.14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
X-12	PEG	0.6	0.0000	98.3	27.5	28.09	4.14E-01	3.62E+03	7.18E-04	6.29E+00	4.14E-01	3.63E+03
X-13		0.2	0.0000	99.5	27.9	28.04	2.49E-03	2.18E+01	8.53E-06	7.48E-02	2.50E-03	2.19E+01
X-14	L											
X-15		0.3	0.0000	99.1	27.8	28.06	7.47E-04	6.54E+00	1.32E-04	1.15E+00	8.79E-04	7.70E+00
X-16		0.6	0.0000	98.3	27.5	28.09	7.87E-04	6.90E+00	5.88E-06	5.15E-02	7.93E-04	6.95E+00
X-17	PEG/DRIP	0.7	0.0000	97.9	27.4	28.10	5.34E-02	4.68E+02	8.08E-05	7.08E-01	5.35E-02	4.69E+02
X-18		0.3	0.0000	99.2	27.8	28.05	6.60E-04	5.78E+00	0.00E+00	0.00E+00	6.60E-04	5.78E+00
X-19	PEG	1.1	0.0000	96.5	27.0	28.16	6.03E-03	5.28E+01	1.58E-03	1.38E+01	7.61E-03	6.66E+01
X-20	INV	2.5	0.0000	92.3	25.9	28.33	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
X-21		0.1	0.0000	99.8	28.0	28.03	6.61E-04	5.79E+00	0.00E+00	0.00E+00	6.61E-04	5.79E+00
X-22		0.1	0.0000	99.8	28.0	28.03	4.54E-06	3.98E-02	0.00E+00	0.00E+00	4.54E-06	3.98E-02
X-23	PEG	0.1	0.0000	99.7	27.9	28.03	5.70E-02	5.00E+02	0.00E+00	0.00E+00	5.70E-02	5.00E+02
X-24		0.1	0.0000	99.6	27.9	28.04	1.00E-03	8.77E+00	0.00E+00	0.00E+00	1.00E-03	8.77E+00
X-25		0.2	0.0000	99.5	27.9	28.04	5.57E-06	4.88E-02	0.00E+00	0.00E+00	5.57E-06	4.88E-02
X-26	SINV	0.8	0.0000	97.4	27.3	28.12	8.85E-06	7.75E-02	0.00E+00	0.00E+00	8.85E-06	7.75E-02

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
W-147		
W-148	AUDTC	Dead battery at final screening. RTI audit.
W-149	AUDTC	
W-150	DZ	
W-151	AUDTT	EPA audit.
W-152	AUDTT	EPA audit.
W-153	AUDTT	EPA audit.
W-154	DZ	
W-155		
W-156		
W-157	DZ	Final QC at 1311 850ppm.
X-1	ACCY	
X-2	DRIP/INV	Screening value difference too large. Dripping.
X-3		Liquid sample X007 taken.
X-4	PEGI/DRIP/INV	Screening value difference too large. Dripping.
X-5	PEG/DRIP	Dripping. Drip rate = 1ml/15min. Liquid sample X007 taken.
X-6	INV	Failed QC check.
X-7	L/INV	Reported with samples X003 and X005. Failed QC check.
X-8		Liquid sample X014 taken.
X-9	PEG/DRIP	Dripping. Liquid sample X014 taken. Drip rate = 2ml/44min.
X-10	PEG/DRIP	Dripping. Drip rate = 2.5ml/16min
X-11	INV	Change in nitrogen flow rate too high.
X-12	PEG	
X-13		SV over 10,000 ppm without dilution probe.
X-14	L	Reported with samples X008 and X009.
X-15		Bagged THC concentration varied by a factor of 3.75.
X-16		Variable oxygen readings. May not be at equilibrium (3.2%/0.3%).
X-17	PEG/DRIP	Dripping. Drip rate = 14ml/40min.
X-18		
X-19	PEG	
X-20	INV	Change in oxygen concentration too large.
X-21		Not dripping.
X-22		Reformate 100 octane gasoline.
X-23	PEG	Leak at stem (1.25 in. shaft) shows marks of wrench tightening recently. Liquid sample X029 taken.
X-24		Liquid sample X028 taken.
X-25		Liquid sample X030 taken.
X-26	SINV	SV varied by a factor of 2.5. Liquid sample X028 taken.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ('Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
X-27		10.0	66	30.27	PUMP		HC		N	LL	Hydro bate
X-28	L										
X-29	L										
X-30	L										
X-31	L										
X-32	PEG	2.5	70	30.28	VALVE	6.00	GATE	M		LL	Naptha feed
X-33	PEG/DRIP/INV	7.5	50	30.40	VALVE	6.00	GATE	M		LL	Reformate
X-34	PEG/DRIP/DUP	7.5	50	30.40	VALVE	6.00	GATE	M		LL	Reformate
X-35	PEG	2.5	56	30.40	C	1.00	TH			LL	Hydrocarbons
X-36		2.5	65	30.40	C	4.00	FL			LL	S/C Penhex
X-37		2.5	68	30.38	PUMP		CENT		Y	LL	
X-38		10.0	68	30.38	VALVE	2.00	GATE	M		GAS	LPG
X-39	PEG	2.5	72	30.32	VALVE	2.00	GATE	M		GAS	
X-40	PEG	2.5	65	30.19	VALVE	2.00	GATE	M		LL	LPG
X-41	PEG	2.5	65	30.19	VALVE	2.00	GATE	C		LL	LPG
X-42		2.5	67	30.19	PUMP	2.00	HC		N	LL	LPG
X-43	PEGI/SINV	2.5	70	30.19	VALVE	1.00	GATE	M		LL	LPG
X-44	DZ/DINV	2.5	65	30.28	VALVE	0.75	GATE	M		LL	Polymer
X-45	SINV	2.5	61	30.28	VALVE	1.50	GATE	M		LL	Polymer
X-46	DUP/SINV	2.5	61	30.28	VALVE	1.50	GATE	M		LL	Polymer
X-47	DZ	2.5	64	30.28	C	2.00	FL			LL	Diesel
X-48	DINV	5.0	73	30.28	VALVE	3.00	GATE	M		LL	Diesel
X-49	DZ	2.5	79	30.25	VALVE	4.00	GLOBE	M		LL	Polymer
X-50		5.0	72	30.25	PUMP		HC		Y	LL	
X-51	DZ	2.5	65	30.25	VALVE	3.00	GATE	M		LL	Propane
X-52		7.5	65	30.25	OEL	0.25	OEL			LL	
X-53	DZ	5.0	65	30.25	C	2.00	FL			LL	
X-54	SINV	5.0	62	30.26	C	1.00	TH			GAS	
X-55	PEGI	5.0	56	30.25	VALVE	4.00	GATE	M		GAS	Reactor feed
X-56		7.5	56	30.25	C	1.00	TH			GAS	
X-57	DZ	2.5	56	30.25	C	2.00	FL			GAS	
X-58	PEG	7.5	58	30.23	C	1.00	TH			GAS	
X-59		6.0	67	30.23	PUMP		HC		Y	LL	
X-60	PEG	2.5	64	30.25	C	1.00	TH			LL	LPG
X-61		7.5	62	30.25	C	4.00	FL			LL	LPG
X-62	PEG	2.5	55	30.20	C	0.75	TH			GAS	Propane
X-63	DINV	2.5	54	30.20	VALVE	0.75	GATE	M		GAS	Propane

Page 9b

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
X-27		26	1,800				1,800				1,800	20	1,780
X-28	L												
X-29	L												
X-30	L												
X-31	L												
X-32	PEG	14,000	70,000				70,000				70,000	7	69,993
X-33	PEG/DRIP/INV	2,309	10,000				10,000				10,000	7	9,993
X-34	PEG/DRIP/DUP	2,309	10,000				10,000				10,000	7	9,993
X-35	PEG	10	47,000				47,000				47,000	10	46,990
X-36			700				500				600	7	593
X-37			400				400				400	5	395
X-38			100				190				145	3	142
X-39	PEG		58,000				58,000				58,000	10	57,990
X-40	PEG		58,000				58,000				58,000	10	57,990
X-41	PEG		140,000				140,000				140,000	7	139,993
X-42			35,000				21,000				28,000	4	27,996
X-43	PEGI/SINV		70,000				35,000				52,500	10	52,490
X-44	DZ/DINV	0	4				4				4	4	0
X-45	SINV	0	28				80				54	3	51
X-46	DUP/SINV	0	28				80				54	3	51
X-47	DZ		3				3				3	3	0
X-48	DINV		40				45				43	3	40
X-49	DZ	0	3				3				3	3	0
X-50			600				650				625	4	621
X-51	DZ	0	3				3				3	3	0
X-52			2,000				2,000				2,000	4	1,996
X-53	DZ		3				3				3	3	0
X-54	SINV		12,500				29,000				20,750	10	20,740
X-55	PEGI	0	58,000				35,000				46,500	5	46,495
X-56			11,000				11,000				11,000	5	10,995
X-57	DZ		2				2				2	2	0
X-58	PEG		55,000				55,000				55,000	4	54,996
X-59			900				1,100				1,000	4	996
X-60	PEG		66,000				66,000				66,000	4	65,996
X-61			13,200				9,900				11,550	3	11,547
X-62	PEG		100,000				100,000	100,000	10,000	10,000	100,000	2	99,998
X-63	DINV	1,170	10				10				10	4	6

Page 9c

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
X-27		1,250	900	1,075	3,510	3,520	3,515	3.52	3.50	3.20	3.35	0.25
X-28	L											
X-29	L											
X-30	L											
X-31	L											
X-32	PEG	12,500	12,500	12,500	5,870	5,800	5,835	5.84	0.30	0.20	0.25	0.35
X-33	PEG/DRIP/INV	1,150	2,000	1,575	6,670	6,700	6,685	6.69	1.60	2.00	1.80	0.44
X-34	PEG/DRIP/DUP	1,150	2,000	1,575	6,670	6,700	6,685	6.69	1.60	2.00	1.80	0.44
X-35	PEG	4,300	4,730	4,515	1,552	1,555	1,554	1.55	0.20	0.20	0.20	0.09
X-36		330	440	385	1,780	1,745	1,763	1.76	0.20	0.20	0.20	0.11
X-37		2,360	2,065	2,213	15,800	15,800	15,800	15.80	3.50	3.60	3.55	1.14
X-38		1,541	1,943	1,742	2,222	2,208	2,215	2.22	0.20	0.20	0.20	0.13
X-39	PEG	58,000	58,000	58,000	5,808	5,836	5,822	5.82	2.40	0.30	1.35	0.37
X-40	PEG	5,800	6,670	6,235	2,520	2,500	2,510	2.51	0.30	0.30	0.30	0.15
X-41	PEG	31,860	31,860	31,860	5,118	5,120	5,119	5.12	0.30	0.30	0.30	0.31
X-42		500	500	500	3,420	3,367	3,394	3.39	0.70	1.10	0.90	0.21
X-43	PEGI/SINV	1,675	1,876	1,776	3,200	3,215	3,208	3.21	0.10	0.10	0.10	0.19
X-44	DZ/DINV	7	7	7	1,525	1,500	1,513	1.51	1.90	0.20	1.05	0.10
X-45	SINV	21	28	25	1,340	1,340	1,340	1.34	0.20	0.20	0.20	0.08
X-46	DUP/SINV	21	28	25	1,340	1,340	1,340	1.34	0.20	0.20	0.20	0.08
X-47	DZ	0	8	4	1,660	1,634	1,647	1.65	0.30	0.20	0.25	0.10
X-48	DINV	198	198	198	1,750	1,700	1,725	1.73	0.50	0.30	0.40	0.11
X-49	DZ	13	10	11	3,360	3,350	3,355	3.36	0.40	0.20	0.30	0.20
X-50		8,400	10,500	9,450	2,000	1,970	1,985	1.99	1.60	1.40	1.50	0.13
X-51	DZ	8	8	8	1,600	1,600	1,600	1.60	0.50	0.35	0.43	0.10
X-52		5,880	3,360	4,620	1,140	1,160	1,150	1.15	1.70	1.40	1.55	0.07
X-53	DZ	16	16	16	1,090	1,210	1,150	1.15	0.20	0.30	0.25	0.07
X-54	SINV	60,000	60,000	60,000	2,080	2,100	2,090	2.09	0.30	0.30	0.30	0.13
X-55	PEGI	16,800	5,600	11,200	3,470	3,450	3,460	3.46	1.40	1.50	1.45	0.22
X-56		1,290	840	1,065	3,050	3,025	3,038	3.04	0.30	0.30	0.30	0.18
X-57	DZ	3	0	1	2,410	2,565	2,488	2.49	0.30	0.70	0.50	0.15
X-58	PEG	55,000	55,000	55,000	3,740	3,510	3,625	3.63	0.30	0.30	0.30	0.22
X-59		11,000	11,000	11,000	3,240	3,410	3,325	3.33	1.40	1.50	1.45	0.21
X-60	PEG	66,000	66,000	66,000	2,320	2,330	2,325	2.33	0.20	0.20	0.20	0.14
X-61		66,000	66,000	66,000	2,760	2,760	2,760	2.76	0.30	0.50	0.40	0.17
X-62	PEG	100,000	100,000	100,000	1,182	1,155	1,169	1.17	0.20	0.20	0.20	0.07
X-63	DINV	60	40	50	2,681	2,683	2,682	2.68	0.20	0.20	0.20	0.16

Page 9d

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
X-27		66	67	67	526	1,300.00	2,036.35	0.00	0.00	NA	2,036.35
X-28	L										
X-29	L										
X-30	L										
X-31	L										
X-32	PEG	105	105	105	565	6,700.00	10,541.22	4,600.00	2,625.76	NA	13,166.99
X-33	PEG/DRIP/INV	56	53	55	514	NA		NA		NA	
X-34	PEG/DRIP/DUP	56	53	55	514	2,400.00	3,767.67	0.00	0.00	NA	3,767.67
X-35	PEG	54	54	54	514	16,000.00	25,174.86	38.00	21.69	NA	25,196.55
X-36		262	243	253	712	870.00	1,368.88	0.00	0.00	NA	1,368.88
X-37		79	83	81	541	2,400.00	3,758.35	0.00	0.00	NA	3,758.35
X-38		68	69	69	528	810.00	1,274.48	0.00	0.00	NA	1,274.48
X-39	PEG	79	76	78	537	1,200.00	1,885.04	66,000.00	37,615.24	NA	39,500.27
X-40	PEG	72	68	70	530	11,000.00	17,305.26	6.80	3.88	NA	17,309.14
X-41	PEG	64	66	65	525	24,000.00	37,756.93	0.00	0.00	NA	37,756.93
X-42		67	67	67	527	2,100.00	3,300.92	0.00	0.00	NA	3,300.92
X-43	PEGI/SINV	71	69	70	530	1,300.00	2,045.75	0.00	0.00	NA	2,045.75
X-44	DZ/DINV	59	65	62	522	NA	15.40	0.00	0.00	9.80	15.40
X-45	SINV	61	65	63	523	6.50	10.23	0.00	0.00	NA	10.23
X-46	DUP/SINV	61	65	63	523	NA	2.83	0.00	0.00	1.80	2.83
X-47	DZ	78	62	70	530	NA	1.89	0.00	0.00	1.20	1.89
X-48	DINV	185	185	185	645	94.00	147.86	0.00	0.00	NA	147.86
X-49	DZ	97	97	97	557	NA	13.84	0.00	0.00	8.80	13.84
X-50		78	76	77	537	5,300.00	8,323.81	0.00	0.00	NA	8,323.81
X-51	DZ	69	68	69	528	NA	20.45	0.00	0.00	13.00	20.45
X-52		67	65	66	526	2,600.00	4,083.09	0.00	0.00	NA	4,083.09
X-53	DZ	65	63	64	524	NA	2.67	0.00	0.00	1.70	2.67
X-54	SINV	59	62	61	520	150,000.00	235,980.81	0.00	0.00	NA	235,980.81
X-55	PEGI	58	57	58	517	10,000.00	15,706.41	0.00	0.00	NA	15,706.41
X-56		56	50	53	513	2,700.00	4,247.65	0.00	0.00	NA	4,247.65
X-57	DZ	57	57	57	517	NA	4.40	0.00	0.00	2.80	4.40
X-58	PEG	57	53	55	515	130,000.00	204,516.70	0.00	0.00	NA	204,516.70
X-59		77	78	78	537	7,800.00	12,251.00	0.00	0.00	NA	12,251.00
X-60	PEG	62	62	62	522	110,000.00	173,077.17	10.00	5.71	NA	173,082.88
X-61		62	61	62	521	11,000.00	17,302.80	0.00	0.00	NA	17,302.80
X-62	PEG	51	52	52	511	NA	355,961.38	0.00	0.00	260,000.00	355,961.38
X-63	DINV	59	57	58	518	NA	1,258.17	0.00	0.00	800.00	1,258.17

WSPA EMISSION RATE CALCULATION SPREADSHEET SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
							NMOC		Methane		THC	
ID	Code	MW fraction O2	MW fraction C3H8	% fraction N2	MW fraction N2	MW Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
X-27		1.1	0.0000	96.7	27.1	28.15	1.32E-03	1.16E+01	0.00E+00	0.00E+00	1.32E-03	1.16E+01
X-28	L											
X-29	L											
X-30	L											
X-31	L											
X-32	PEG	0.1	0.0000	99.8	27.9	28.03	8.97E-03	7.85E+01	2.23E-03	1.96E+01	1.12E-02	9.81E+01
X-33	PEG/DRIP/INV	0.6	0.0000	98.2	27.5	28.09	6.93E-03	6.07E+01	0.00E+00	0.00E+00	6.93E-03	6.07E+01
X-34	PEG/DRIP/DUP	0.6	0.0000	98.2	27.5	28.09	4.37E-03	3.83E+01	0.00E+00	0.00E+00	4.37E-03	3.83E+01
X-35	PEG	0.1	0.0000	99.8	28.0	28.03	6.25E-03	5.48E+01	5.39E-06	4.72E-02	6.26E-03	5.48E+01
X-36		0.1	0.0000	99.8	28.0	28.03	2.78E-04	2.44E+00	0.00E+00	0.00E+00	2.78E-04	2.44E+00
X-37		1.1	0.0000	96.5	27.0	28.16	1.08E-02	9.46E+01	0.00E+00	0.00E+00	1.08E-02	9.46E+01
X-38		0.1	0.0000	99.8	28.0	28.03	4.39E-04	3.84E+00	0.00E+00	0.00E+00	4.39E-04	3.84E+00
X-39	PEG	0.4	0.0000	98.7	27.6	28.07	1.78E-03	1.56E+01	3.55E-02	3.11E+02	3.73E-02	3.26E+02
X-40	PEG	0.1	0.0000	99.7	27.9	28.03	6.77E-03	5.93E+01	1.52E-06	1.33E-02	6.77E-03	5.93E+01
X-41	PEG	0.1	0.0000	99.7	27.9	28.03	3.04E-02	2.66E+02	0.00E+00	0.00E+00	3.04E-02	2.66E+02
X-42		0.3	0.0000	99.1	27.8	28.06	1.81E-03	1.58E+01	0.00E+00	0.00E+00	1.81E-03	1.58E+01
X-43	PEGI/SINV	0.0	0.0000	99.9	28.0	28.02	1.01E-03	8.87E+00	0.00E+00	0.00E+00	1.01E-03	8.87E+00
X-44	DZ/DINV	0.3	0.0004	98.9	27.7	28.06	3.83E-06	3.35E-02	0.00E+00	0.00E+00	3.83E-06	3.35E-02
X-45	SINV	0.1	0.0000	99.8	28.0	28.03	2.15E-06	1.89E-02	0.00E+00	0.00E+00	2.15E-06	1.89E-02
X-46	DUP/SINV	0.1	0.0001	99.8	28.0	28.03	5.96E-07	5.22E-03	0.00E+00	0.00E+00	5.96E-07	5.22E-03
X-47	DZ	0.1	0.0001	99.7	27.9	28.03	4.83E-07	4.23E-03	0.00E+00	0.00E+00	4.83E-07	4.23E-03
X-48	DINV	0.1	0.0000	99.6	27.9	28.04	3.28E-05	2.87E-01	0.00E+00	0.00E+00	3.28E-05	2.87E-01
X-49	DZ	0.1	0.0004	99.7	27.9	28.03	6.88E-06	6.03E-02	0.00E+00	0.00E+00	6.88E-06	6.03E-02
X-50		0.5	0.0000	98.5	27.6	28.08	2.70E-03	2.37E+01	0.00E+00	0.00E+00	2.70E-03	2.37E+01
X-51	DZ	0.1	0.0006	99.6	27.9	28.04	5.14E-06	4.51E-02	0.00E+00	0.00E+00	5.14E-06	4.51E-02
X-52		0.5	0.0000	98.5	27.6	28.08	7.86E-04	6.88E+00	0.00E+00	0.00E+00	7.86E-04	6.88E+00
X-53	DZ	0.1	0.0001	99.7	27.9	28.03	4.83E-07	4.24E-03	0.00E+00	0.00E+00	4.83E-07	4.24E-03
X-54	SINV	0.1	0.0000	99.7	27.9	28.03	7.82E-02	6.85E+02	0.00E+00	0.00E+00	7.82E-02	6.85E+02
X-55	PEGI	0.5	0.0000	98.6	27.6	28.08	9.20E-03	8.06E+01	0.00E+00	0.00E+00	9.20E-03	8.06E+01
X-56		0.1	0.0000	99.7	27.9	28.03	2.08E-03	1.82E+01	0.00E+00	0.00E+00	2.08E-03	1.82E+01
X-57	DZ	0.2	0.0001	99.5	27.9	28.04	1.77E-06	1.55E-02	0.00E+00	0.00E+00	1.77E-06	1.55E-02
X-58	PEG	0.1	0.0000	99.7	27.9	28.03	1.19E-01	1.04E+03	0.00E+00	0.00E+00	1.19E-01	1.04E+03
X-59		0.5	0.0000	98.6	27.6	28.08	6.64E-03	5.81E+01	0.00E+00	0.00E+00	6.64E-03	5.81E+01
X-60	PEG	0.1	0.0000	99.8	28.0	28.03	6.33E-02	5.55E+02	2.09E-06	1.83E-02	6.33E-02	5.55E+02
X-61		0.1	0.0000	99.6	27.9	28.04	7.60E-03	6.66E+01	0.00E+00	0.00E+00	7.60E-03	6.66E+01
X-62	PEG	0.1	11.4686	73.8	20.7	32.21	7.68E-02	6.73E+02	0.00E+00	0.00E+00	7.68E-02	6.73E+02
X-63	DINV	0.1	0.0353	99.7	27.9	28.04	5.35E-04	4.69E+00	0.00E+00	0.00E+00	5.35E-04	4.69E+00

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
X-27		Liquid sample X031 taken.
X-28	L	Reported with sample X024 and X026.
X-29	L	Reported with sample X023.
X-30	L	Reported with sample X025.
X-31	L	Reported with sample X027.
X-32	PEG	
X-33	PEG/DRIP/INV	Dripping. Drip rate = .7ml/100min. Not analyzed because of leaking canister (poor seal).
X-34	PEG/DRIP/DUP	Dripping. Drip rate = .7ml/100min. Duplicate of X033.
X-35	PEG	
X-36		
X-37		
X-38		
X-39	PEG	
X-40	PEG	
X-41	PEG	
X-42		Diluter repaired during test.
X-43	PEGI/SINV	Screening value varied by a factor of more than 2. Pegged initially, but not at end.
X-44	DZ/DINV	Final background = 3 ppm. Possible contamination in field; followed a pegged source.
X-45	SINV	Screening value varied by a factor of 2.9.
X-46	DUP/SINV	Screening value varied by a factor of 2.9. Duplicate of X045.
X-47	DZ	
X-48	DINV	Failed QC check.
X-49	DZ	
X-50		
X-51	DZ	
X-52		Bagged concentration varied by a factor of 1.75.
X-53	DZ	
X-54	SINV	Raining. SV varied by a factor of 2.3.
X-55	PEGI	Raining.
X-56		Raining. SV over 10,000 ppm without dilution probe.
X-57	DZ	
X-58	PEG	
X-59		
X-60	PEG	
X-61		
X-62	PEG	
X-63	DINV	Bagged THC readings at near background levels. Possible contamination in field; followed a pegged source.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ("Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
X-64	PEG/INV	2.5	53	30.20	C	1.00	TH			GAS	Propane
X-65		2.5	65	30.15	VALVE	3.00	GATE	M		HL	MEK/Toluene
X-66		2.5	65	30.15	OEL	0.25	OEL			HL	MEK/Toluene
X-67		2.5	63	30.15	PUMP		VERT		Y	HL	MEK/Toluene
X-68	DZ	2.5	58	30.22	VALVE	4.00	GATE	M		LL	Naptha
X-69	DZ	2.5	58	30.22	VALVE	4.00	GATE	M		LL	Naptha
X-70	DZ	2.5	66	30.22	VALVE	1.00	GATE	M		LL	Naptha
X-71	DZ/AUDTD	2.5	66	30.22	VALVE	1.00	GATE	M		LL	Naptha
X-72	DZ	2.5	62	30.22	VALVE	0.75	GATE	M		HL	
X-73		2.5	60	30.22	PUMP		HC		N	HL	
X-74	INV										
X-75		2.5	61	30.10	VALVE	4.00	GATE	M		HL	
X-76		2.5	57	30.10	VALVE	0.75	GATE	M		HL	
X-77		2.5	60	30.10	VALVE	4.00	GATE	M		LL	Gasoline
X-78	DZ	2.5	59	30.15	VALVE	2.00	GATE	C		HL	
X-79		2.5	61	30.10	PUMP		HC		Y	HL	
X-80	DZ/DINV	2.0	64	30.10	OEL	0.75	OEL			HL	
X-81	BL										
X-82		2.0	53	30.15	VALVE	0.75	GATE	M		GAS	Relief HC
X-83	DZ/DINV	5.0	52	30.15	VALVE	0.75	BTFLY	M		GAS	Fuel gas
X-84	DZ/DINV	2.0	64	30.15	VALVE	0.75	BTFLY	M		GAS	Fuel gas
X-85	AUDTT	2.0	67	30.15	VALVE	0.75	BALL	M		GAS	Fuel gas
X-86	AUDTT	2.0	67	30.15	VALVE	0.75	BALL	M		GAS	Fuel gas
X-87	AUDTT	2.0	45	30.04	VALVE	2.50	GLOBE	M		H2O	Water
X-88	AUDTC										
X-89	AUDTC										
X-90	PEGF/SINV	10.0	41	30.04	VALVE	2.00	GLOBE	M		GAS	
X-91	PEG	10.0	39	30.04	VALVE	3.00	ORBIT	M		GAS	
X-92	PEG	2.0	50	29.84	PUMP	3.00	CENT				
X-93		2.0	49	29.84	PUMP	3.00	VC		N	LL	
X-94		5.0	53	29.84	PUMP	3.00	VC		N	LL	
X-95	PEG	10.0	50	29.84	VALVE	8.00	ORBIT	M		LL	LPG
X-96	PEG/N2-1	5.0	54	30.48	VALVE	2.00	ORBIT	M		LL	Propane
X-97	PEG/AUDTD	5.0	54	30.48	VALVE	2.00	ORBIT	M		LL	Propane
X-98	PEG/N2-1	5.0	52	30.48	VALVE	2.00	ORBIT	M		LL	Propane
X-99	PEG/N2-1	8.0	53	30.48	VALVE	2.00	ORBIT	M		LL	Propane
X-100	PEG/N2-1	8.0	51	30.48	VALVE	2.00	ORBIT	M		LL	Propane

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
X-64	PEG/INV	0	106,000				106,000	2	2	2	106,000	4	105,996
X-65		970	950				970	500	300		960	4	957
X-66			15,000				16,000				15,500	4	15,497
X-67			11,000	9,000	10,000	7,000	8,000				9,500	4	9,497
X-68	DZ		4				5				4	4	0
X-69	DZ		2				2				2	2	0
X-70	DZ		2				2				2	2	0
X-71	DZ/AUDTD		2				2				2	2	0
X-72	DZ		2				1				1	1	0
X-73			35				65				50	5	46
X-74	INV												
X-75			90	50	80	70	100				95	3	92
X-76			30	30	30	30	60				45	3	42
X-77			6,000	6,000	6,000	6,000	9,000				7,500	3	7,497
X-78	DZ		10				20				15	15	0
X-79			250				310				280	3	277
X-80	DZ/DINV		7				8				8	8	0
X-81	BL												
X-82		0	3,800	1,500	3,200	1,200	4,000	1,400	1,600	2,200	3,900	2	3,898
X-83	DZ/DINV	0	1				1				1	1	0
X-84	DZ/DINV	10,000	2				5				4	4	0
X-85	AUDTT		2				5				4	4	0
X-86	AUDTT		2				5				4	4	0
X-87	AUDTT		1				1				1	1	0
X-88	AUDTC												
X-89	AUDTC												
X-90	PEGF/SINV	10,000	50,000	500	10,000	15,000	100,000	100,000	100,000	500	75,000	1	74,999
X-91	PEG	10,000	100,000	100,000	4	200	100,000	500	100	2,000	100,000	4	99,997
X-92	PEG												
X-93			140	120	120	100	250	120	80	20	195	3	192
X-94			60	10	10	40	75	50		50	68	1	67
X-95	PEG		100,000	100,000	100,000	1	100,000	10,000	100,000	10,000	100,000	1	99,999
X-96	PEG/N2-1	10,000	100,000	3	3	2,000	100,000	100,000	3	2,000	100,000	3	99,997
X-97	PEG/AUDTD	10,000	100,000	3	3	2,000	100,000	100,000	3	2,000	100,000	3	99,997
X-98	PEG/N2-1	10,000	100,000	3	3	2,000	100,000	100,000	3	2,000	100,000	3	99,997
X-99	PEG/N2-1	10,000	100,000	3	3	2,000	100,000	100,000	3	2,000	100,000	3	99,997
X-100	PEG/N2-1	10,000	100,000	3	3	2,000	100,000	100,000	3	2,000	100,000	3	99,997

Page 10c

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
X-64	PEG/INV	50	40	45	1,915	1,962	1,939	1.94	0.20	0.20	0.20	0.12
X-65		1,500	1,600	1,550	3,540	3,570	3,555	3.56	0.20	0.20	0.20	0.22
X-66		1,400	1,700	1,550	1,480	1,485	1,483	1.48	0.60	0.60	0.60	0.09
X-67		16,000	15,000	15,500	13,100	13,100	13,100	13.10	0.10	0.10	0.10	0.79
X-68	DZ	45	35	40	4,750	4,720	4,735	4.74	0.50	0.30	0.40	0.29
X-69	DZ	25	25	25	5,802	5,830	5,816	5.82	1.80	0.30	1.05	0.37
X-70	DZ	20	23	22	1,944	1,950	1,947	1.95	0.50	0.20	0.35	0.12
X-71	DZ/AUDTD	20	23	22	1,944	1,950	1,947	1.95	0.50	0.20	0.35	0.12
X-72	DZ	21	16	19	2,101	2,140	2,121	2.12	0.40	0.30	0.35	0.13
X-73		350	350	350	4,040	4,027	4,034	4.03	0.20	0.40	0.30	0.25
X-74	INV											
X-75		120	90	105	4,530	4,530	4,530	4.53	0.50	0.20	0.35	0.28
X-76		80	200	140	1,750	1,745	1,748	1.75	0.30	0.20	0.25	0.11
X-77		1,600	1,700	1,650	4,820	4,807	4,814	4.81	0.20	0.20	0.20	0.29
X-78	DZ	45	70	58	2,615	2,628	2,622	2.62	0.90	0.90	0.90	0.16
X-79		3,100	3,500	3,300	4,513	4,522	4,518	4.52	0.20	0.20	0.20	0.27
X-80	DZ/DINV	700	600	650	1,330	1,341	1,336	1.34	0.50	0.60	0.55	0.08
X-81	BL											
X-82		1,820	1,911	1,866	1,894	1,886	1,890	1.89	0.30	0.30	0.30	0.12
X-83	DZ/DINV	36	32	34	2,113	2,110	2,112	2.11	0.20	0.20	0.20	0.13
X-84	DZ/DINV	2	32	17	1,882	1,805	1,844	1.84	0.20	0.20	0.20	0.11
X-85	AUDTT	320	320	320	1,678	1,354	1,516	1.52	0.20	0.20	0.20	0.09
X-86	AUDTT	320	320	320	1,678	1,354	1,516	1.52	0.20	0.20	0.20	0.09
X-87	AUDTT	128	128	128	3,424	3,600	3,512	3.51	0.30	0.60	0.45	0.22
X-88	AUDTC											
X-89	AUDTC											
X-90	PEGF/SINV	16,000	19,000	17,500	6,600	6,829	6,715	6.71	0.30	0.30	0.30	0.41
X-91	PEG	3,000	3,000	3,000	6,150	6,230	6,190	6.19	0.30	0.30	0.30	0.38
X-92	PEG											
X-93		208	208	208	2,288	2,288	2,288	2.29	0.20	0.10	0.15	0.14
X-94		274	274	274	2,237	2,242	2,240	2.24	0.40	0.30	0.35	0.14
X-95	PEG	45,000	45,000	45,000	7,709	7,681	7,695	7.70	0.60	0.30	0.45	0.47
X-96	PEG/N2-1	24,000	21,000	22,500	4,960	4,975	4,968	4.97	0.20	0.20	0.20	0.30
X-97	PEG/AUDTD	24,000	21,000	22,500	4,960	4,975	4,968	4.97	0.20	0.20	0.20	0.30
X-98	PEG/N2-1	34,000	44,000	39,000	2,925	2,944	2,935	2.93	0.20	0.20	0.20	0.18
X-99	PEG/N2-1	8,000	8,800	8,400	10,300	10,300	10,300	10.30	0.20	0.20	0.20	0.62
X-100	PEG/N2-1	3,400	3,500	3,450	24,300	24,300	24,300	24.30	0.15	0.15	0.15	1.47

Page 10d

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
X-64	PEG/INV	55	66	61	520	NA	0.11	0.00	0.00	0.07	0.11
X-65		120	128	124	584	NA	1,886.81	0.00	0.00	1,200.00	1,886.81
X-66		66	64	65	525	NA	1,728.70	0.00	0.00	1,100.00	1,728.70
X-67		130	143	137	596	NA	15,491.10	0.00	0.00	9,900.00	15,491.10
X-68	DZ	62	62	62	522	NA	48.76	0.00	0.00	31.00	48.76
X-69	DZ	58	63	61	520	NA	15.72	0.00	0.00	10.00	15.72
X-70	DZ	73	67	70	530	NA	0.07	0.00	0.00	0.05	0.07
X-71	DZ/AUDTD	73	67	70	530	NA	10.70	0.00	0.00	6.80	10.70
X-72	DZ	78	92	85	545	NA	0.07	0.00	0.00	0.05	0.07
X-73		134	160	147	607	NA	1,319.71	2.00	1.14	840.00	1,320.86
X-74	INV					NA		0.00		0.00	
X-75		84	93	89	548	NA	408.94	0.00	0.00	260.00	408.94
X-76		65	78	72	531	NA	377.54	0.00	0.00	240.00	377.54
X-77		60	60	60	520	NA	3,927.93	0.00	0.00	2,500.00	3,927.93
X-78	DZ	69	70	70	529	NA	188.61	0.00	0.00	120.00	188.61
X-79		105	105	105	565	NA	9,720.66	0.00	0.00	6,200.00	9,720.66
X-80	DZ/DINV	69	68	69	528	NA	2,670.89	0.00	0.00	1,700.00	2,670.89
X-81	BL					NA		0.00		0.00	
X-82		81	81	81	541	NA	1,516.34	1,200.00	684.38	1,400.00	2,200.72
X-83	DZ/DINV	60	61	61	520	NA	314.65	0.00	0.00	200.00	314.65
X-84	DZ/DINV	79	84	82	541	NA	471.95	0.00	0.00	300.00	471.95
X-85	AUDTT	85	81	83	543	NA	1,195.28	0.00	0.00	760.00	1,195.28
X-86	AUDTT	85	81	83	543	NA	1,053.79	0.00	0.00	670.00	1,053.79
X-87	AUDTT	46	49	48	507	NA	305.98	15.00	8.56	200.00	314.54
X-88	AUDTC					NA	257.83	17.00	9.71	170.00	267.53
X-89	AUDTC					NA	928.27	0.00	0.00	590.00	928.27
X-90	PEGF/SINV	41	40	41	500	NA	26,484.12	3.40	1.92	17,000.00	26,486.05
X-91	PEG	39	38	39	498	NA	3,456.69	0.00	0.00	2,200.00	3,456.69
X-92	PEG										
X-93		49	51	50	510	NA	251.74	0.00	0.00	160.00	251.74
X-94		53	54	54	513	NA	314.58	0.00	0.00	200.00	314.58
X-95	PEG	50	49	50	509	NA	32,636.97	0.00	0.00	21,000.00	32,636.97
X-96	PEG/N2-1	58	58	58	518	NA	28,032.06	0.00	0.00	18,000.00	28,032.06
X-97	PEG/AUDTD	58	58	58	518						
X-98	PEG/N2-1	58	55	57	516	NA	41,834.15	0.00	0.00	27,000.00	41,834.15
X-99	PEG/N2-1	57	64	61	520	NA	14,243.79	0.00	0.00	9,100.00	14,243.79
X-100	PEG/N2-1	56	55	56	515	NA	4,085.11	0.00	0.00	2,600.00	4,085.11

WSPA EMISSION RATE CALCULATION SPREADSHEET   SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
							NMOC		Methane		THC	
ID	Code	MW fraction O2	MW fraction C3H8	% fraction N2	MW fraction N2	MW Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
X-64	PEG/INV	0.1	0.0000	99.8	28.0	28.03	3.37E-08	2.95E-04	0.00E+00	0.00E+00	3.37E-08	2.95E-04
X-65		0.1	0.0529	99.7	27.9	28.05	9.44E-04	8.27E+00	0.00E+00	0.00E+00	9.44E-04	8.27E+00
X-66		0.2	0.0485	99.3	27.8	28.06	4.09E-04	3.59E+00	0.00E+00	0.00E+00	4.09E-04	3.59E+00
X-67		0.0	0.4367	98.9	27.7	28.18	2.80E-02	2.45E+02	0.00E+00	0.00E+00	2.80E-02	2.45E+02
X-68	DZ	0.1	0.0014	99.6	27.9	28.04	3.67E-05	3.22E-01	0.00E+00	0.00E+00	3.67E-05	3.22E-01
X-69	DZ	0.3	0.0004	98.9	27.7	28.06	1.51E-05	1.32E-01	0.00E+00	0.00E+00	1.51E-05	1.32E-01
X-70	DZ	0.1	0.0000	99.6	27.9	28.03	2.15E-08	1.89E-04	0.00E+00	0.00E+00	2.15E-08	1.89E-04
X-71	DZ/AUDTD	0.1	0.0003	99.6	27.9	28.03	3.25E-06	2.85E-02	0.00E+00	0.00E+00	3.25E-06	2.85E-02
X-72	DZ	0.1	0.0000	99.6	27.9	28.03	2.28E-08	2.00E-04	0.00E+00	0.00E+00	2.28E-08	2.00E-04
X-73		0.1	0.0371	99.6	27.9	28.05	7.24E-04	6.35E+00	6.26E-07	5.49E-03	7.25E-04	6.35E+00
X-74	INV											
X-75		0.1	0.0115	99.6	27.9	28.04	2.80E-04	2.45E+00	0.00E+00	0.00E+00	2.80E-04	2.45E+00
X-76		0.1	0.0106	99.7	27.9	28.03	1.02E-04	8.96E-01	0.00E+00	0.00E+00	1.02E-04	8.96E-01
X-77		0.1	0.1103	99.6	27.9	28.07	2.99E-03	2.62E+01	0.00E+00	0.00E+00	2.99E-03	2.62E+01
X-78	DZ	0.3	0.0053	99.1	27.8	28.06	7.95E-05	6.96E-01	0.00E+00	0.00E+00	7.95E-05	6.96E-01
X-79		0.1	0.2735	99.2	27.8	28.13	6.41E-03	5.61E+01	0.00E+00	0.00E+00	6.41E-03	5.61E+01
X-80	DZ/DINV	0.2	0.0750	99.3	27.8	28.07	5.65E-04	4.95E+00	0.00E+00	0.00E+00	5.65E-04	4.95E+00
X-81	BL											
X-82		0.1	0.0618	99.6	27.9	28.05	4.38E-04	3.83E+00	1.98E-04	1.73E+00	6.35E-04	5.57E+00
X-83	DZ/DINV	0.1	0.0088	99.8	28.0	28.03	1.05E-04	9.19E-01	0.00E+00	0.00E+00	1.05E-04	9.19E-01
X-84	DZ/DINV	0.1	0.0132	99.8	28.0	28.03	1.32E-04	1.16E+00	0.00E+00	0.00E+00	1.32E-04	1.16E+00
X-85	AUDTT	0.1	0.0335	99.7	27.9	28.04	2.74E-04	2.40E+00	0.00E+00	0.00E+00	2.74E-04	2.40E+00
X-86	AUDTT	0.1	0.0296	99.7	27.9	28.04	2.42E-04	2.12E+00	0.00E+00	0.00E+00	2.42E-04	2.12E+00
X-87	AUDTT	0.1	0.0088	99.5	27.9	28.04	1.76E-04	1.54E+00	4.93E-06	4.32E-02	1.81E-04	1.59E+00
X-88	AUDTC	0.0	0.0075	100.0	28.0	28.02						
X-89	AUDTC	0.0	0.0260	99.9	28.0	28.03						
X-90	PEGF/SINV	0.1	0.7499	98.0	27.5	28.31	2.96E-02	2.60E+02	2.15E-06	1.88E-02	2.96E-02	2.60E+02
X-91	PEG	0.1	0.0970	99.5	27.9	28.07	3.55E-03	3.11E+01	0.00E+00	0.00E+00	3.55E-03	3.11E+01
X-92	PEG											
X-93		0.0	0.0071	99.8	28.0	28.03	9.26E-05	8.11E-01	0.00E+00	0.00E+00	9.26E-05	8.11E-01
X-94		0.1	0.0088	99.6	27.9	28.04	1.14E-04	9.95E-01	0.00E+00	0.00E+00	1.14E-04	9.95E-01
X-95	PEG	0.1	0.9263	97.5	27.3	28.38	4.15E-02	3.64E+02	0.00E+00	0.00E+00	4.15E-02	3.64E+02
X-96	PEG/N2-1	0.1	0.7940	98.0	27.5	28.32	2.23E-02	1.95E+02	0.00E+00	0.00E+00	2.23E-02	1.95E+02
X-97	PEG/AUDTD	0.1	0.0000	99.8	28.0	28.03						
X-98	PEG/N2-1	0.1	1.1910	97.1	27.2	28.46	1.98E-02	1.74E+02	0.00E+00	0.00E+00	1.98E-02	1.74E+02
X-99	PEG/N2-1	0.1	0.4014	98.9	27.7	28.17	2.33E-02	2.04E+02	0.00E+00	0.00E+00	2.33E-02	2.04E+02
X-100	PEG/N2-1	0.0	0.1147	99.6	27.9	28.07	1.58E-02	1.38E+02	0.00E+00	0.00E+00	1.58E-02	1.38E+02

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
X-64	PEG/INV	Plug. Appears Nitrogen flow is preventing THC emissions.
X-65		
X-66		
X-67		
X-68	DZ	
X-69	DZ	
X-70	DZ	
X-71	DZ/AUDTD	Sample went to RTI. Duplicate of X070.
X-72	DZ	
X-73		
X-74	INV	
X-75		Raining.
X-76		Raining. SV varied by a factor of 2.
X-77		
X-78	DZ	
X-79		Raining.
X-80	DZ/DINV	Bagged THC much greater than lab concentration. Statistical outlier.
X-81	BL	
X-82		
X-83	DZ/DINV	Sample thought to be contaminated. Laboratory concentration much greater than bag THC Concentration.
X-84	DZ/DINV	Sample thought to be contaminated. Laboratory concentration much greater than bag THC Concentration.
X-85	AUDTT	
X-86	AUDTT	Sample to RTI.
X-87	AUDTT	RTI audit – direct to canister.
X-88	AUDTC	Sample to RTI.
X-89	AUDTC	Sample to RTI.
X-90	PEGF/SINV	Intermittent emitter (initial SV, North). SV varied by more than a factor of 2.
X-91	PEG	Light rain.
X-92	PEG	
X-93		
X-94		
X-95	PEG	Orbit valve.
X-96	PEG/N2-1	Nitrogen flow test #1.
X-97	PEG/AUDTD	Sample to RTI. Duplicate of X096.
X-98	PEG/N2-1	Nitrogen flow test #1.
X-99	PEG/N2-1	Nitrogen flow test #1.
X-100	PEG/N2-1	Nitrogen flow test #1.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ("Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
X-101	PEG/N2-1	8.0	52	30.48	VALVE	2.00	ORBIT	M		LL	Propane
X-102	N2-2	8.0	54	30.48	C	3.00	FL			LL	
X-103	N2-2	8.0	54	30.48	C	3.00	FL			LL	
X-104	N2-2	8.0	55	30.48	C	3.00	FL			LL	
X-105	N2-2	8.0	54	30.48	C	3.00	FL			LL	
X-106	N2-2	8.0	55	30.48	C	3.00	FL			LL	
X-107		10.0	52	30.48	VALVE	3.00	ORBIT	M		LL	LPG
X-108	BL			30.16							
X-109	PEG/N2-3	3.0	50	30.16	VALVE	2.00	ORBIT	M		LL	Propane
X-110	PEG/N2-3	5.0	49	30.16	VALVE	2.00	ORBIT	M		LL	Propane
X-111	PEG/N2-3	10.0	49	30.16	VALVE	2.00	ORBIT	M		LL	Propane
X-112	PEG/N2-3	10.0	51	30.16	VALVE	2.00	ORBIT	M		LL	Propane
X-113	PEG/N2-3	10.0	51	30.16	VALVE	2.00	ORBIT	M		LL	Propane
X-114		5.0	53	30.16	C	8.00	FL			LL	
X-115	N2-4	3.0	51	30.16	C	4.00	FL			LL	
X-116	N2-4	5.0	52	30.16	C	4.00	FL			LL	
X-117	N2-4	5.0	50	30.16	C	4.00	FL			LL	
X-118	N2-4	5.0	50	30.16	C	4.00	FL			LL	
X-119	N2-4	5.0	49	30.16	C	4.00	FL			LL	
X-120		5.0	49	30.32	VALVE	8.00	ORBIT	M		LL	Propane
X-121	PEG	10.0	48	30.32	VALVE	4.00	GATE	M		LL	Butane
X-122	PEGF	10.0	48	30.32	VALVE	8.00	BTF	M		LL	Propane
X-123	DZ	5.0	54	30.32	VALVE	3.00	ORBIT	M		LL	Propane
Y-1	ACCY	2.5	73		VALVE	2.00	GATE	M		H2O	Steam
Y-2		1.5	58		VALVE	3.00	GATE	M		GAS	Waste gas
Y-3	DZ	1.5	62		C	2.00	FL			GAS	Waste gas
Y-4	DZ	2.5	66		PUMP	4.00	HC			LL	Strip reflux
Y-5		1.5	72		VALVE	6.00	GATE	C		GAS	Strip gas
Y-6	PEG	1.5	75		VALVE	1.00	GATE	C		GAS	H2 & HC Mix
Y-7	DZ/DINV	0.0			OEL	0.25	OEL			HL	Lube oil
Y-8		0.0	74		OEL	0.75	OEL			GAS	Desulf gas
Y-9		1.5	59		VALVE	3.00	GATE	M		GAS	Waste gas
Y-10		4.5	61		VALVE	4.00	GATE	M		GAS	Waste gas
Y-11		4.5	61		C	1.00	TH			LL	Reflux
Y-12	L	4.5	61		C	1.00	TH			LL	Reflux
Y-13		2.5	62		C	0.25	TH			LL	Reflux
Y-14	L	2.5	62		C	0.25	TH			LL	Reflux

Page 11b

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
X-101	PEG/N2-1	10,000	100,000	3	3	2,000	100,000	100,000	3	2,000	100,000	3	99,997
X-102	N2-2		3,000	50	20	70	5,000				4,000	2.5	3,998
X-103	N2-2		3,000	50	20	70	5,000				4,000	2.5	3,998
X-104	N2-2		3,000	50	20	70	5,000				4,000	2.5	3,998
X-105	N2-2		3,000	50	20	70	5,000				4,000	2.5	3,998
X-106	N2-2		3,000	50	20	70	5,000				4,000	2.5	3,998
X-107			76,000	2,000	1,480	15,200	69,850	6,350	1	254	72,925	1	72,924
X-108	BL										0	0	0
X-109	PEG/N2-3	100,000	100,000	80	500	7,000	100,000	3,500	100,000	2,000	100,000	2	99,999
X-110	PEG/N2-3	100,000	100,000	80	500	7,000	100,000	3,500	100,000	2,000	100,000	2	99,999
X-111	PEG/N2-3	100,000	100,000	80	500	7,000	100,000	3,500	100,000	2,000	100,000	2	99,999
X-112	PEG/N2-3	100,000	100,000	80	500	7,000	100,000	3,500	100,000	2,000	100,000	2	99,999
X-113	PEG/N2-3	100,000	100,000	80	500	7,000	100,000	3,500	100,000	2,000	100,000	2	99,999
X-114			30,000	5	2,000	5	40,000	500	500	5	35,000	5	34,996
X-115	N2-4		3,500	100	1,000	100	3,000	1,000	700	1,500	3,250	5.5	3,245
X-116	N2-4		3,500	100	1,000	100	3,000	1,000	700	1,500	3,250	5.5	3,245
X-117	N2-4		3,500	100	1,000	100	3,000	1,000	700	1,500	3,250	5.5	3,245
X-118	N2-4		3,500	100	1,000	100	3,000	1,000	700	1,500	3,250	5.5	3,245
X-119	N2-4		3,500	100	1,000	100	3,000	1,000	700	1,500	3,250	5.5	3,245
X-120		10,000	25,000	200	2,000	5,000	18,000	200	2,000	1,000	21,500	5	21,495
X-121	PEG	10,000	100,000	1,000	10,000	3	100,000	3	15,000	3	100,000	3	99,997
X-122	PEGF	1,000	55,000	20,000	1,000	12,000	100,000	20,000	7,000	5,000	77,500	6	77,494
X-123	DZ	0	2				2	2	2	2	2	2	0
Y-1	ACCY		4	4	4	4	4	4	4	4	4	4	0
Y-2			30	5	5	10	25	5	5	5	28	5	23
Y-3	DZ		5	5	5	5	4	4	4	4	4	4	0
Y-4	DZ		5	5	5	5	4	4	4	4	4	4	0
Y-5			500	80	100	50	500	100	200	500	500	4	497
Y-6	PEG	100,000	90,000	81,000	90,000	90,000	90,000	90,000	10,000	90,000	90,000	7	89,994
Y-7	DZ/DINV		7	6.5	6.5	6.5	5	5	5	5	6	6	0
Y-8			20				25				23	6	17
Y-9		2,000	3,000	500	50	12	3,000	500	500	1,000	3,000	7	2,993
Y-10			30	16	10	8	30	30	10	20	30	4	26
Y-11			30	10	5	20	30	10	5	7	30	4	27
Y-12	L												
Y-13			50	10	18	25	30	9	7	10	40	4	37
Y-14	L												

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
X-101	PEG/N2-1	19,000	19,000	19,000	5,047	5,056	5,052	5.05	0.20	0.15	0.18	0.31
X-102	N2-2	2,220	2,405	2,313	2,169	2,193	2,181	2.18	0.20	0.20	0.20	0.13
X-103	N2-2	1,258	1,332	1,295	4,883	4,881	4,882	4.88	0.18	0.19	0.19	0.30
X-104	N2-2	407	392	400	10,300	9,890	10,095	10.10	0.15	0.15	0.15	0.61
X-105	N2-2	133	130	132	24,300	24,300	24,300	24.30	0.15	0.15	0.15	1.47
X-106	N2-2	2,035	2,220	2,128	2,123	2,133	2,128	2.13	0.20	0.20	0.20	0.13
X-107		29,000	100,000	64,500	4,038	4,049	4,044	4.04	0.20	0.20	0.20	0.24
X-108	BL			0								
X-109	PEG/N2-3	9,135	10,005	9,570	4,729	4,750	4,740	4.74	0.20	0.20	0.20	0.29
X-110	PEG/N2-3	23,925	23,925	23,925	2,047	2,066	2,057	2.06	0.20	0.15	0.18	0.12
X-111	PEG/N2-3	3,480	3,480	3,480	9,890	9,890	9,890	9.89	0.15	0.15	0.15	0.60
X-112	PEG/N2-3	1,305	1,305	1,305	24,300	24,300	24,300	24.30	0.12	0.15	0.14	1.47
X-113	PEG/N2-3	7,830	6,960	7,395	4,665	4,600	4,633	4.63	0.20	0.20	0.20	0.28
X-114		2,407	2,241	2,324	4,927	5,070	4,999	5.00	0.15	0.15	0.15	0.30
X-115	N2-4	581	581	581	1,955	1,998	1,977	1.98	0.20	0.20	0.20	0.12
X-116	N2-4	2,490	1,909	2,200	1,118	1,133	1,126	1.13	0.20	0.20	0.20	0.07
X-117	N2-4	108	108	108	4,545	4,634	4,590	4.59	0.20	0.20	0.20	0.28
X-118	N2-4	42	39	41	9,900	10,500	10,200	10.20	0.20	0.20	0.20	0.62
X-119	N2-4	979	996	988	1,962	1,954	1,958	1.96	0.20	0.20	0.20	0.12
X-120		2,600	2,700	2,650	7,000	7,000	7,000	7.00	0.25	0.25	0.25	0.43
X-121	PEG	47,000	49,000	48,000	4,864	4,864	4,864	4.86	0.20	0.20	0.20	0.29
X-122	PEGF	23,000	24,500	23,750	3,829	3,821	3,825	3.83	0.20	0.20	0.20	0.23
X-123	DZ	2	5	3	1,800	1,875	1,838	1.84	0.15	0.20	0.18	0.11
Y-1	ACCY	1,000	1,200	1,100	4,956	4,862	4,909	4.91	2.70	2.30	2.50	0.33
Y-2		330	660	495	2,006	1,910	1,958	1.96	3.00	0.30	1.65	0.13
Y-3	DZ	32	32	32	1,990	1,981	1,986	1.99	0.10	0.10	0.10	0.12
Y-4	DZ	45	35	40	2,000	1,935	1,968	1.97	0.40	0.10	0.25	0.12
Y-5		250	250	250	2,475	2,395	2,435	2.44	0.40	0.10	0.25	0.15
Y-6	PEG	45,000	40,500	42,750	2,053	2,030	2,042	2.04	3.80	4.00	3.90	0.15
Y-7	DZ/DINV	55	50	53	1,944	1,982	1,963	1.96	0.10	0.10	0.10	0.12
Y-8		72	72	72	1,908	1,913	1,911	1.91	0.10	0.10	0.10	0.12
Y-9		58,500	54,000	56,250	3,013	2,982	2,998	3.00	1.60	0.30	0.95	0.19
Y-10		45	45	45	2,976	2,925	2,951	2.95	3.20	0.40	1.80	0.19
Y-11		49	42	46	931	913	922	0.92	1.20	1.00	1.10	0.06
Y-12	L											
Y-13		30	30	30	1,270	1,270	1,270	1.27	0.20	0.20	0.20	0.08
Y-14	L											

Page 11d

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
X-101	PEG/N2-1	55	55	55	515	NA	23,400.76	0.00	0.00	15,000.00	23,400.76
X-102	N2-2	55	54	55	514	NA	10,657.71	0.00	0.00	6,800.00	10,657.71
X-103	N2-2	56	55	56	515	NA	1,399.67	0.00	0.00	890.00	1,399.67
X-104	N2-2	55	55	55	515	NA	613.54	0.00	0.00	390.00	613.54
X-105	N2-2	55	55	55	515	NA	157.35	0.00	0.00	100.00	157.35
X-106	N2-2	54	54	54	514	NA	6,435.91	0.00	0.00	4,100.00	6,435.91
X-107		53	51	52	512	NA	67,525.24	0.00	0.00	44,000.00	67,525.24
X-108	BL					NA	0.00	0.00	0.00	0.00	0.00
X-109	PEG/N2-3	50	49	50	509	NA	17,199.11	0.00	0.00	11,000.00	17,199.11
X-110	PEG/N2-3	50	50	50	510	NA	29,573.63	0.00	0.00	19,000.00	29,573.63
X-111	PEG/N2-3	50	51	51	510	NA	3,928.21	0.00	0.00	2,500.00	3,928.21
X-112	PEG/N2-3	52	51	52	511	NA	1,462.64	0.00	0.00	930.00	1,462.64
X-113	PEG/N2-3	51	53	52	512	NA	9,564.42	0.00	0.00	6,100.00	9,564.42
X-114		52	52	52	512	NA	3,457.42	0.00	0.00	2,200.00	3,457.42
X-115	N2-4	54	55	55	514	NA	1,729.68	0.00	0.00	1,100.00	1,729.68
X-116	N2-4	54	53	54	513	NA	4,084.82	0.00	0.00	2,600.00	4,084.82
X-117	N2-4	53	52	53	512	NA	597.77	0.00	0.00	380.00	597.77
X-118	N2-4	52	51	52	511	NA	113.28	0.00	0.00	72.00	113.28
X-119	N2-4	51	49	50	510	NA	2,986.26	0.00	0.00	1,900.00	2,986.26
X-120		48	49	49	508	NA	2,986.05	0.00	0.00	1,900.00	2,986.05
X-121	PEG	49	50	50	509	NA	69,011.80	17.00	9.46	45,000.00	69,021.26
X-122	PEGF	50	53	52	511	NA	32,648.41	0.00	0.00	21,000.00	32,648.41
X-123	DZ	58	60	59	519	NA	14.63	0.00	0.00	9.30	14.63
Y-1	ACCY	73	74	74	533	NA	99.52	900.00	511.99	390.00	611.50
Y-2		103	106	105	564	NA	289.96	180.00	102.53	250.00	392.49
Y-3	DZ	155	155	155	615	NA	0.66	0.00	0.00	0.42	0.66
Y-4	DZ	61	60	61	520	NA	0.47	0.00	0.00	0.30	0.47
Y-5		81	83	82	542	NA	336.20	100.00	57.07	250.00	393.27
Y-6	PEG	96	97	97	556	NA	47,027.72	12,000.00	6,680.96	35,000.00	53,708.68
Y-7	DZ/DINV	91	91	91	551	NA	43.66	20.00	11.42	35.00	55.08
Y-8		81	80	81	540	NA	27.16	4.80	2.74	19.00	29.90
Y-9		106	104	105	565	NA	47,523.80	25,000.00	13,936.60	40,000.00	61,460.40
Y-10		95	98	97	556	NA	62.39	20.00	11.39	47.00	73.78
Y-11		62	62	62	522	NA	20.43	0.00	0.00	13.00	20.43
Y-12	L										
Y-13		64	65	65	524	NA	0.35	0.00	0.00	0.22	0.35
Y-14	L										

WSPA EMISSION RATE CALCULATION SPREADSHEET SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
							NMOC		Methane		THC	
ID	Code	MW fraction O2	MW fraction C3H8	% fraction N2	MW fraction N2	MW Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
X-101	PEG/N2-1	0.1	0.6617	98.3	27.6	28.27	1.90E-02	1.66E+02	0.00E+00	0.00E+00	1.90E-02	1.66E+02
X-102	N2-2	0.1	0.2999	99.1	27.8	28.14	3.73E-03	3.26E+01	0.00E+00	0.00E+00	3.73E-03	3.26E+01
X-103	N2-2	0.1	0.0393	99.7	27.9	28.04	1.09E-03	9.54E+00	0.00E+00	0.00E+00	1.09E-03	9.54E+00
X-104	N2-2	0.0	0.0172	99.8	28.0	28.03	9.86E-04	8.64E+00	0.00E+00	0.00E+00	9.86E-04	8.64E+00
X-105	N2-2	0.0	0.0044	99.8	28.0	28.03	6.09E-04	5.33E+00	0.00E+00	0.00E+00	6.09E-04	5.33E+00
X-106	N2-2	0.1	0.1809	99.4	27.8	28.09	2.19E-03	1.92E+01	0.00E+00	0.00E+00	2.19E-03	1.92E+01
X-107		0.1	1.9408	95.4	26.7	28.74	4.49E-02	3.94E+02	0.00E+00	0.00E+00	4.49E-02	3.94E+02
X-108	BL	0.0	0.0000	100.0	28.0	28.02						
X-109	PEG/N2-3	0.1	0.4852	98.7	27.7	28.20	1.32E-02	1.16E+02	0.00E+00	0.00E+00	1.32E-02	1.16E+02
X-110	PEG/N2-3	0.1	0.8381	97.9	27.4	28.33	9.89E-03	8.67E+01	0.00E+00	0.00E+00	9.89E-03	8.67E+01
X-111	PEG/N2-3	0.0	0.1103	99.6	27.9	28.07	6.25E-03	5.47E+01	0.00E+00	0.00E+00	6.25E-03	5.47E+01
X-112	PEG/N2-3	0.0	0.0410	99.8	28.0	28.04	5.69E-03	4.99E+01	0.00E+00	0.00E+00	5.69E-03	4.99E+01
X-113	PEG/N2-3	0.1	0.2691	99.2	27.8	28.13	7.13E-03	6.25E+01	0.00E+00	0.00E+00	7.13E-03	6.25E+01
X-114		0.0	0.0970	99.6	27.9	28.06	2.77E-03	2.43E+01	0.00E+00	0.00E+00	2.77E-03	2.43E+01
X-115	N2-4	0.1	0.0485	99.7	27.9	28.05	5.46E-04	4.79E+00	0.00E+00	0.00E+00	5.46E-04	4.79E+00
X-116	N2-4	0.1	0.1147	99.5	27.9	28.07	7.37E-04	6.45E+00	0.00E+00	0.00E+00	7.37E-04	6.45E+00
X-117	N2-4	0.1	0.0168	99.8	28.0	28.03	4.40E-04	3.85E+00	0.00E+00	0.00E+00	4.40E-04	3.85E+00
X-118	N2-4	0.1	0.0032	99.8	28.0	28.03	1.86E-04	1.63E+00	0.00E+00	0.00E+00	1.86E-04	1.63E+00
X-119	N2-4	0.1	0.0838	99.6	27.9	28.06	9.43E-04	8.26E+00	0.00E+00	0.00E+00	9.43E-04	8.26E+00
X-120		0.1	0.0838	99.6	27.9	28.06	3.39E-03	2.97E+01	0.00E+00	0.00E+00	3.39E-03	2.97E+01
X-121	PEG	0.1	1.9850	95.3	26.7	28.75	5.55E-02	4.86E+02	7.61E-06	6.67E-02	5.55E-02	4.86E+02
X-122	PEGF	0.1	0.9263	97.7	27.4	28.37	2.03E-02	1.78E+02	0.00E+00	0.00E+00	2.03E-02	1.78E+02
X-123	DZ	0.1	0.0004	99.8	28.0	28.03	4.25E-06	3.72E-02	0.00E+00	0.00E+00	4.25E-06	3.72E-02
Y-1	ACCY	0.8	0.0172	97.5	27.3	28.13	8.49E-05	7.44E-01	4.37E-04	3.83E+00	5.22E-04	4.57E+00
Y-2		0.5	0.0110	98.3	27.6	28.09	8.90E-05	7.80E-01	3.15E-05	2.76E-01	1.20E-04	1.06E+00
Y-3	DZ	0.0	0.0000	99.9	28.0	28.02	1.74E-07	1.53E-03	0.00E+00	0.00E+00	1.74E-07	1.53E-03
Y-4	DZ	0.1	0.0000	99.7	27.9	28.03	1.47E-07	1.29E-03	0.00E+00	0.00E+00	1.47E-07	1.29E-03
Y-5		0.1	0.0110	99.7	27.9	28.03	1.24E-04	1.09E+00	2.11E-05	1.85E-01	1.46E-04	1.27E+00
Y-6	PEG	1.2	1.5439	92.6	25.9	28.74	1.77E-02	1.55E+02	2.51E-03	2.20E+01	2.02E-02	1.77E+02
Y-7	DZ/DINV	0.0	0.0015	99.9	28.0	28.02	1.27E-05	1.11E-01	3.33E-06	2.91E-02	1.60E-05	1.41E-01
Y-8		0.0	0.0008	99.9	28.0	28.02	7.85E-06	6.88E-02	7.92E-07	6.94E-03	8.64E-06	7.57E-02
Y-9		0.3	1.7644	95.1	26.6	28.70	2.20E-02	1.93E+02	6.45E-03	5.65E+01	2.85E-02	2.49E+02
Y-10		0.6	0.0021	98.2	27.5	28.09	2.95E-05	2.58E-01	5.39E-06	4.72E-02	3.49E-05	3.06E-01
Y-11		0.4	0.0006	98.9	27.7	28.06	3.10E-06	2.72E-02	0.00E+00	0.00E+00	3.10E-06	2.72E-02
Y-12	L											
Y-13		0.1	0.0000	99.8	28.0	28.03	6.89E-08	6.03E-04	0.00E+00	0.00E+00	6.89E-08	6.03E-04
Y-14	L											

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
X-101	PEG/N2-1	Nitrogen flow test #1.
X-102	N2-2	Nitrogen flow test #2. Intermittent emitter (initial SV).
X-103	N2-2	Nitrogen flow test #2.
X-104	N2-2	Nitrogen flow test #2.
X-105	N2-2	Nitrogen flow test #2.
X-106	N2-2	Nitrogen flow test #2.
X-107		
X-108	BL	Field blank. Shot 0 air through gauge and T to insure no contamination.
X-109	PEG/N2-3	Nitrogen flow test #3.
X-110	PEG/N2-3	Nitrogen flow test #3.
X-111	PEG/N2-3	Nitrogen flow test #3.
X-112	PEG/N2-3	Nitrogen flow test #3.
X-113	PEG/N2-3	Nitrogen flow test #3.
X-114		
X-115	N2-4	Nitrogen flow test #4.
X-116	N2-4	Nitrogen flow test #4.
X-117	N2-4	Nitrogen flow test #4.
X-118	N2-4	Nitrogen flow test #4.
X-119	N2-4	Nitrogen flow test #4.
X-120		Intermittent emitter.
X-121	PEG	
X-122	PEGF	
X-123	DZ	
Y-1	ACCY	
Y-2		Intermittent emitter.
Y-3	DZ	
Y-4	DZ	
Y-5		Final QC at 1132; 1000 ppm.
Y-6	PEG	
Y-7	DZ/DINV	Possible contamination in field; followed a pegged source.
Y-8		Final QC at 1440; 900 ppm.
Y-9		Intermittent emitter. Statistical Outlier.
Y-10		
Y-11		Plug. Liquid sample Y012 taken.
Y-12	L	Reported with sample Y011.
Y-13		Plug. Liquid sample Y014 taken.
Y-14	L	Reported with sample Y013.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ("Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
Y-15	SINV	2.5	64		VALVE	1.50	GATE	C		LL	Sour water
Y-16	DZ	2.5	63		VALVE	3.00	GATE	M		LL	Reflux
Y-17	DZ	2.5	63		VALVE	1.00	GATE	M		LL	Reflux
Y-18	BL										
Y-19		0.0	60		VALVE	8.00	GATE	M		GAS	Butane
Y-20	SINV	0.0	63		VALVE	8.00	GATE	M		LL	DIB Reflux
Y-21	DZ	0.0	62		C	1.00	TH			GAS	Butane/propane
Y-22		0.0	64		VALVE	2.00	GATE	M		GAS	Butane
Y-23		4.5	63		VALVE	1.00	GATE	C		LL	Butane/propane
Y-24	DUP	4.5	63		VALVE	1.00	GATE	C		LL	Butane/propane
Y-25	DZ	2.5	63		VALVE	2.00	GATE	M		GAS	Butane alkylate
Y-26	AUDTT	2.5	63		VALVE	2.00	GATE	M		GAS	Butane alkylate
Y-27	AUDTT	2.5	63		VALVE	2.00	GATE	M		GAS	Butane alkylate
Y-28	AUDTT	2.5	63		VALVE	2.00	GATE	M		GAS	Butane alkylate
Y-29	AUDTT	2.5	63		VALVE	2.00	GATE	M		GAS	Butane alkylate
Y-30	AUDTC										
Y-31	AUDTC										
Y-32	AUDTC										
Y-33	AUDTC										
Y-34	AUDTC										
Y-35		1.5	58		VALVE	4.00	GATE	M		LL	BTMS (raw gasoline)
Y-36	L	1.5	58		VALVE	4.00	GATE	M		LL	BTMS (raw gasoline)
Y-37		1.5	58		VALVE	4.00	GATE	M		LL	BTMS
Y-38	L	1.5	58		VALVE	4.00	GATE	M		LL	BTMS
Y-39		1.5	61		C	1.00	TH			LL	BTMS
Y-40	L	1.5	61		C	1.00	TH			LL	BTMS
Y-41		1.5	59		C	1.00	TH			LL	BTMS
Y-42	L	1.5	59		C	1.00	TH			LL	BTMS
Y-43	SINV	1.5	62		VALVE	6.00	GATE	C		LL	Splitter
Y-44		2.5	61		C	0.25	TH			LL	Pentane
Y-45		1.5	71		VALVE	3.00	GATE	C		GAS	Butane/pentane
Y-46	L	2.5	61		C	0.25	TH			LL	Pentane
Y-47	DZ	1.5	65		VALVE	1.50	GATE	M		GAS	Fuel gas
Y-48	DZ	0.0	61		PUMP	2.00	HC		Y	LL	Butane
Y-49	AUDTD	0.0	61		PUMP	2.00	HC		Y	LL	Butane
Y-50		1.5	65		PUMP	4.00	HC		Y	LL	Hexane
Y-51	DINV	1.5	61		PUMP	3.00	HC			LL	Butane

Page 12b

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
Y-15	SINV		14	7	7	7	40	12	16	16	27	4	24
Y-16	DZ		3	3	3	3	3	3	3	3	3	3	0
Y-17	DZ		3	3	3	3	3	3	3	3	3	3	0
Y-18	BL												
Y-19			50	6	6	20	60	50	50	50	55	5	50
Y-20	SINV		25	5	5	10	80	40	5	50	53	5	48
Y-21	DZ		5	5	5	5	5	5	5	5	5	5	0
Y-22			400	200	100	250	450	300	80	300	425	5	420
Y-23			200	120	120	120	160	120	70	120	180	4	176
Y-24	DUP		200	120	120	120	160	120	70	120	180	4	176
Y-25	DZ		5	5	5	5	10	7	7	7	7	7	0
Y-26	AUDTT												
Y-27	AUDTT												
Y-28	AUDTT												
Y-29	AUDTT												
Y-30	AUDTC												
Y-31	AUDTC												
Y-32	AUDTC												
Y-33	AUDTC												
Y-34	AUDTC												
Y-35			120	90	100	20	130	30	12	30	125	6	120
Y-36	L												
Y-37			9	4	4	4	10	4	4	4	10	4	6
Y-38	L												
Y-39			8	6	4	4	12	4	4	4	10	4	7
Y-40	L												
Y-41			90	4	4	30	100	5	5	30	95	4	91
Y-42	L												
Y-43	SINV		10,000	3,000	3,000	3,000	24,000	2,500	2,500	6,000	17,000	5	16,995
Y-44			5,000	3,000	4,000	2,000	8,000	4,000	8,000	3,000	6,500	8	6,493
Y-45			180	120	160	160	220	200	220	220	200	5	196
Y-46	L												
Y-47	DZ		4	4	4	4	4	4	4	4	4	4	0
Y-48	DZ		5	5	5	5	5	5	5	5	5	5	0
Y-49	AUDTD		5	5	5	5	5	5	5	5	5	5	0
Y-50			18,000	5,000	3,000	3,000	17,400	7,000	3,500	5,600	17,700	6	17,695
Y-51	DINV		500	225	450	200	700	500	400	450	600	4	596

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
Y-15	SINV	54	54	54	2,040	2,004	2,022	2.02	3.00	0.20	1.60	0.13
Y-16	DZ	77	77	77	2,050	2,053	2,052	2.05	1.60	0.50	1.05	0.13
Y-17	DZ	77	69	73	1,200	1,190	1,195	1.20	0.30	0.20	0.25	0.07
Y-18	BL											
Y-19		72	78	75	4,001	3,899	3,950	3.95	4.40	0.30	2.35	0.27
Y-20	SINV	85	85	85	3,896	3,826	3,861	3.86	3.50	1.10	2.30	0.26
Y-21	DZ	88	88	88	858	842	850	0.85	0.30	0.15	0.23	0.05
Y-22		560	352	456	1,878	1,852	1,865	1.87	1.90	0.20	1.05	0.12
Y-23		120	135	128	1,900	1,891	1,896	1.90	2.40	1.70	2.05	0.13
Y-24	DUP	120	135	128	1,900	1,891	1,896	1.90	2.40	1.70	2.05	0.13
Y-25	DZ	72	80	76	1,940	1,954	1,947	1.95	0.20	0.20	0.20	0.12
Y-26	AUDTT	144	128	136	1,955	1,989	1,972	1.97	0.30	0.20	0.25	0.12
Y-27	AUDTT	144	128	136	1,955	1,989	1,972	1.97	0.30	0.20	0.25	0.12
Y-28	AUDTT	400	288	344	2,014	2,025	2,020	2.02	0.15	0.10	0.13	0.12
Y-29	AUDTT	400	288	344	2,014	2,025	2,020	2.02	0.15	0.10	0.13	0.12
Y-30	AUDTC											
Y-31	AUDTC											
Y-32	AUDTC											
Y-33	AUDTC											
Y-34	AUDTC											
Y-35		42	42	42	3,220	3,245	3,233	3.23	1.30	0.20	0.75	0.20
Y-36	L											
Y-37		21	21	21	2,145	2,126	2,136	2.14	0.70	0.20	0.45	0.13
Y-38	L											
Y-39		40	40	40	966	965	966	0.97	0.50	0.50	0.50	0.06
Y-40	L											
Y-41		54	126	90	1,484	1,477	1,481	1.48	0.20	0.20	0.20	0.09
Y-42	L											
Y-43	SINV	840	1,120	980	4,113	4,109	4,111	4.11	3.90	2.20	3.05	0.29
Y-44		14,000	9,100	11,550	1,085	1,085	1,085	1.09	0.40	0.20	0.30	0.07
Y-45		350	385	368	2,241	2,251	2,246	2.25	3.40	0.90	2.15	0.15
Y-46	L											
Y-47	DZ	56	35	46	1,844	1,839	1,842	1.84	0.50	0.30	0.40	0.11
Y-48	DZ	52	52	52	5,353	5,353	5,353	5.35	4.40	4.60	4.50	0.41
Y-49	AUDTD	52	52	52	5,353	5,353	5,353	5.35	4.40	4.60	4.50	0.41
Y-50		54,000	54,000	54,000	4,888	4,848	4,868	4.87	2.20	2.20	2.20	0.33
Y-51	DINV	3,200	4,000	3,600	5,961	5,961	5,961	5.96	12.50	10.00	11.25	0.77

Page 12d

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
Y-15	SINV	64	66	65	525	NA	15.07	0.00	0.00	9.60	15.07
Y-16	DZ	64	63	64	523	NA	0.08	0.00	0.00	0.05	0.08
Y-17	DZ	69	69	69	529	NA	0.08	0.00	0.00	0.05	0.08
Y-18	BL							0.00		0.31	
Y-19		69	72	71	530	NA	18.82	0.00	0.00	12.00	18.82
Y-20	SINV	85	90	88	547	NA	62.75	0.00	0.00	40.00	62.75
Y-21	DZ	63	65	64	524	NA	0.08	0.00	0.00	0.05	0.08
Y-22		65	66	66	525	NA	549.93	0.00	0.00	350.00	549.93
Y-23		63	64	64	523	NA	219.69	0.00	0.00	140.00	219.69
Y-24	DUP	63	64	64	523	NA	219.69	0.00	0.00	140.00	219.69
Y-25	DZ	63	65	64	524	NA	2.36	0.00	0.00	1.50	2.36
Y-26	AUDTT	65	65	65	525	NA	227.42	15.00	8.56	150.00	235.98
Y-27	AUDTT	65	65	65	525	NA	291.48	13.00	7.42	190.00	298.90
Y-28	AUDTT	65	64	65	524	NA	707.94	0.00	0.00	450.00	707.94
Y-29	AUDTT	65	64	65	524	NA	1,179.69	0.00	0.00	750.00	1,179.69
Y-30	AUDTC							9.10		210.00	
Y-31	AUDTC							15.00		160.00	
Y-32	AUDTC							4.20		97.00	
Y-33	AUDTC							0.00		720.00	
Y-34	AUDTC							0.00		490.00	
Y-35		61	63	62	522	NA	37.73	0.00	0.00	24.00	37.73
Y-36	L										
Y-37		61	64	63	522	NA	6.29	0.00	0.00	4.00	6.29
Y-38	L										
Y-39		63	64	64	523	NA	5.66	0.00	0.00	3.60	5.66
Y-40	L										
Y-41		61	62	62	521	NA	34.61	0.00	0.00	22.00	34.61
Y-42	L										
Y-43	SINV	153	147	150	610	NA	2,035.70	0.00	0.00	1,300.00	2,035.70
Y-44		63	64	64	523	NA	11,592.48	0.00	0.00	7,400.00	11,592.48
Y-45		71	79	75	535	NA	298.09	0.00	0.00	190.00	298.09
Y-46	L										
Y-47	DZ	69	70	70	529	NA	1.57	0.00	0.00	1.00	1.57
Y-48	DZ	116	117	117	576	NA	46.92	0.00	0.00	30.00	46.92
Y-49	AUDTD	116	117	117	576	NA	57.86	0.00	0.00	37.00	57.86
Y-50		116	121	119	578	NA	95,261.77	260.00	142.85	63,000.00	95,404.62
Y-51	DINV	84	85	85	544	NA	4,019.17	4.70	2.64	2,600.00	4,021.81

WSPA EMISSION RATE CALCULATION SPREADSHEET SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
		MW fraction	MW fraction	% fraction	MW fraction	MW	NMOC		Methane		THC	
ID	Code	O2	C3H8	N2	N2	Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
Y-15	SINV	0.5	0.0004	98.4	27.6	28.08	5.12E-06	4.49E-02	0.00E+00	0.00E+00	5.12E-06	4.49E-02
Y-16	DZ	0.3	0.0000	98.9	27.7	28.06	2.64E-08	2.31E-04	0.00E+00	0.00E+00	2.64E-08	2.31E-04
Y-17	DZ	0.1	0.0000	99.7	27.9	28.03	1.46E-08	1.28E-04	0.00E+00	0.00E+00	1.46E-08	1.28E-04
Y-18	BL											
Y-19		0.8	0.0005	97.6	27.4	28.11	1.29E-05	1.13E-01	0.00E+00	0.00E+00	1.29E-05	1.13E-01
Y-20	SINV	0.7	0.0018	97.7	27.4	28.11	4.06E-05	3.55E-01	0.00E+00	0.00E+00	4.06E-05	3.55E-01
Y-21	DZ	0.1	0.0000	99.8	28.0	28.03	1.05E-08	9.20E-05	0.00E+00	0.00E+00	1.05E-08	9.20E-05
Y-22		0.3	0.0154	98.9	27.7	28.07	1.67E-04	1.47E+00	0.00E+00	0.00E+00	1.67E-04	1.47E+00
Y-23		0.7	0.0062	97.9	27.4	28.10	7.19E-05	6.30E-01	0.00E+00	0.00E+00	7.19E-05	6.30E-01
Y-24	DUP	0.7	0.0062	97.9	27.4	28.10	7.19E-05	6.30E-01	0.00E+00	0.00E+00	7.19E-05	6.30E-01
Y-25	DZ	0.1	0.0001	99.8	28.0	28.03	7.20E-07	6.31E-03	0.00E+00	0.00E+00	7.20E-07	6.31E-03
Y-26	AUDTT	0.1	0.0066	99.7	27.9	28.03	7.04E-05	6.16E-01	2.65E-06	2.32E-02	7.30E-05	6.40E-01
Y-27	AUDTT	0.1	0.0084	99.7	27.9	28.03	9.02E-05	7.90E-01	2.30E-06	2.01E-02	9.25E-05	8.10E-01
Y-28	AUDTT	0.0	0.0198	99.8	28.0	28.03	2.23E-04	1.96E+00	0.00E+00	0.00E+00	2.23E-04	1.96E+00
Y-29	AUDTT	0.0	0.0331	99.8	28.0	28.04	3.72E-04	3.26E+00	0.00E+00	0.00E+00	3.72E-04	3.26E+00
Y-30	AUDTC											
Y-31	AUDTC											
Y-32	AUDTC											
Y-33	AUDTC											
Y-34	AUDTC											
Y-35		0.2	0.0011	99.2	27.8	28.05	1.97E-05	1.73E-01	0.00E+00	0.00E+00	1.97E-05	1.73E-01
Y-36	L											
Y-37		0.1	0.0002	99.5	27.9	28.04	2.14E-06	1.87E-02	0.00E+00	0.00E+00	2.14E-06	1.87E-02
Y-38	L											
Y-39		0.2	0.0002	99.5	27.9	28.04	8.71E-07	7.63E-03	0.00E+00	0.00E+00	8.71E-07	7.63E-03
Y-40	L											
Y-41		0.1	0.0010	99.8	28.0	28.03	8.07E-06	7.07E-02	0.00E+00	0.00E+00	8.07E-06	7.07E-02
Y-42	L											
Y-43	SINV	1.0	0.0573	96.8	27.1	28.16	1.31E-03	1.15E+01	0.00E+00	0.00E+00	1.31E-03	1.15E+01
Y-44		0.1	0.3264	99.0	27.7	28.15	1.99E-03	1.75E+01	0.00E+00	0.00E+00	1.99E-03	1.75E+01
Y-45		0.7	0.0084	97.8	27.4	28.11	1.14E-04	9.97E-01	0.00E+00	0.00E+00	1.14E-04	9.97E-01
Y-46	L											
Y-47	DZ	0.1	0.0000	99.6	27.9	28.04	4.54E-07	3.98E-03	0.00E+00	0.00E+00	4.54E-07	3.98E-03
Y-48	DZ	1.4	0.0013	95.5	26.8	28.20	4.54E-05	3.98E-01	0.00E+00	0.00E+00	4.54E-05	3.98E-01
Y-49	AUDTD	1.4	0.0016	95.5	26.8	28.20	5.60E-05	4.90E-01	0.00E+00	0.00E+00	5.60E-05	4.90E-01
Y-50		0.7	2.7789	91.5	25.6	29.12	7.57E-02	6.63E+02	1.14E-04	9.94E-01	7.58E-02	6.64E+02
Y-51	DINV	3.6	0.1147	88.5	24.8	28.51	7.84E-03	6.87E+01	5.15E-06	4.51E-02	7.85E-03	6.88E+01

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
Y-15	SINV	SV varied by a factor of 2.9.
Y-16	DZ	
Y-17	DZ	
Y-18	BL	
Y-19		
Y-20	SINV	SV varied by a factor of 3.2. Intermittent emitter.
Y-21	DZ	Plug.
Y-22		
Y-23		
Y-24	DUP	Duplicate of Y023
Y-25	DZ	
Y-26	AUDTT	Sample to RTI.
Y-27	AUDTT	Sample to RTI. Dup of Y026.
Y-28	AUDTT	Sample to RTI.
Y-29	AUDTT	Sample to RTI. Dup of Y028.
Y-30	AUDTC	Sample to RTI.
Y-31	AUDTC	Dup of Y030.
Y-32	AUDTC	Dup of Y030.
Y-33	AUDTC	Sample to RTI.
Y-34	AUDTC	Dup of Y033.
Y-35		Liquid sample Y036 taken.
Y-36	L	Reported with sample Y035.
Y-37		Liquid sample Y038 taken.
Y-38	L	Reported with sample Y037.
Y-39		Liquid sample Y040 taken.
Y-40	L	Reported with sample Y039.
Y-41		Plug. Liquid sample Y042 taken.
Y-42	L	Reported with sample Y041.
Y-43	SINV	SV varied by a factor of 2.4.
Y-44		Plug. Liquid sample Y046 taken.
Y-45		
Y-46	L	Reported with sample Y044.
Y-47	DZ	Final QC at 1404; 950 ppm.
Y-48	DZ	
Y-49	AUDTD	To RTI. Duplicate of Y048.
Y-50		
Y-51	DINV	Pump very oily, seal not tight. Tried several times to lower O2. Average O2 = 16.25%.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ("Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
Y-52		2.5	63		VALVE	2.00	GATE	C		LL	Butane/pentane
Y-53	DZ	0.0	67		VALVE	8.00	GATE	M		GAS	Butane/pentane
Y-54		1.5	61		VALVE	2.00	ORBIT	M		GAS	Butane/pentane
Y-55	DZ	1.5	64		C	1.00	TH			GAS	Butane/pentane
Y-56		0.0	64		PUMP	6.00	HC		Y	LL	Debut reflux
Y-57		1.5	66		PUMP	6.00	HC		Y	LL	Deprop reflux
Y-58	PEG	0.0	65		C	1.00	TH			LL	Deprop reflux
Y-59		0.0	75		VALVE	3.00	GATE	C		LL	Deprop
Y-60		0.0	71		VALVE	8.00	GATE	M		LL	Propane
Y-61	DUP	0.0	71		VALVE	8.00	GATE	M		LL	Propane
Y-62		0.0	71		C	1.00	TH			GAS	Deprop
Y-63	SINV	0.0	74		OEL	1.00	OEL			LL	Sour water
Y-64		0.0	76		VALVE	1.00	GATE	C		LL	Sour water
Y-65	L										
Y-66	L										
Y-67		0.0	60		VALVE	6.00	GATE	M		HL	Lean oil
Y-68		1.5	62		OEL	1.00	OEL			LL	Sour water
Y-69	DZ	1.5	63		C	1.00	TH			LL	Sour water
Y-70	DZ	1.5	60		PUMP	2.00	HC			HL	Recycle oil
Y-71		0.0	60		VALVE	1.50	GATE	C		GAS	Surge pressure to fuel
Y-72		0.0	62		PUMP	4.00	HC			LL	
Y-73		2.5	51		VALVE	4.00	GATE	C		HL	Olefin
Y-74	SINV	1.5	52		VALVE	6.00	GATE	M		HL	Olefin
Y-75		4.5	53		C	4.00	FL			HL	Olefin
Y-76		4.5	52		PUMP	3.00	HC		Y	LL	Deprop reflux
Y-77	DZ	1.5	56		C	1.50	TH			LL	MTBE DEB REF
Y-78	DZ	1.5	57		C	1.50	TH			LL	MTBE DEB REF
Y-79	DZ	1.5	64		PUMP	6.00	HC		N	LL	Isobutane
Y-80	DZ	1.5	65		PUMP	6.00	HC		Y	LL	Isobutane
Y-81	PEGI/SINV	1.5	63		PUMP	3.00	HC		N	LL	Propane
Y-82		2.5	64		VALVE	2.00	GATE	C		GAS	Sour fuel
Y-83		1.5	62		VALVE	0.50	NEDL	M		LL	Benzene
Y-84	DUP	1.5	62		VALVE	0.50	NEDL	M		LL	Benzene
Y-85		2.5	63		VALVE	8.00	GATE	C		LL	Desorp
Y-86		1.5	64		C	0.50	TH			GAS	Purge gas
Y-87	DZ	1.5	63		VALVE	0.75	GATE	M		GAS	Purge gas
Y-88	DZ	5.5	64		VALVE	0.75	GATE	M		GAS	Purge gas

Page 13b

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
Y-52			16,000	4,500	900	4,500	32,000	4,500	5,400	4,500	24,000	4	23,996
Y-53	DZ		5	5	5	5	5	5	5	5	5	5	0
Y-54			18,000	2,000	300	50	15,000	500	5	100	16,500	4	16,496
Y-55	DZ		4	4	4	4	4	4	4	4	4	4	0
Y-56			56,000	24,000	16,000	40,000	28,000	24,000	24,000	24,000	42,000	5	41,995
Y-57			12,000	4,000	8,000	4,000	16,000	5,600	9,600	9,600	14,000	5	13,995
Y-58	PEG		72,000	4,000	3,000	32,000	80,000	1,000	100	80,000	76,000	8	75,992
Y-59			13,500	500	800	1,000	10,800	36	900	9,000	12,150	5	12,146
Y-60			7	4	4	4	8	4	6	6	8	4	4
Y-61	DUP		7	4	4	4	8	4	6	6	8	4	4
Y-62			1,000	900	325	400	1,400	900	100	500	1,200	4	1,197
Y-63	SINV		12				25				19	4	15
Y-64			50	30	30	30	60	25	40	40	55	4	51
Y-65	L												
Y-66	L												
Y-67			500	230	160	120	400	400	130	16	450	4	446
Y-68			20,000				33,600				26,800	5	26,795
Y-69	DZ		3	3	3	3	3	3	3	3	3	3	0
Y-70	DZ		4	4	4	4	4	4	4	4	4	4	0
Y-71			850	750	750	650	1,000	750	800	400	925	3	922
Y-72			25	10	20	20	25	20	25	20	25	3	22
Y-73			130	20	120	120	120	120	90	90	125	3	123
Y-74	SINV		16	3	10	12	50	25	3	25	33	3	31
Y-75			30	15	3	3	20	4	4	10	25	3	23
Y-76			18	18	6	12	30	20	20	12	24	3	22
Y-77	DZ		3	3	3	3	3	3	3	3	3	3	0
Y-78	DZ		4	4	4	4	4	4	4	4	4	4	0
Y-79	DZ		3	3	3	3	4	4	4	4	3	3	0
Y-80	DZ		4	4	4	4	4	4	4	4	4	4	0
Y-81	PEGI/SINV		90,000	4,000	250	35	450	30	25	6	45,225	4	45,222
Y-82			1,000	200	950	1,000	1,000	400	800	900	1,000	4	996
Y-83		5,000	49,500	10,800	3,000	1,800	36,000	31,500	18,000	12,600	42,750	5	42,746
Y-84	DUP	5,000	49,500	10,800	3,000	1,800	36,000	31,500	18,000	12,600	42,750	5	42,746
Y-85			18,000	1,000	1,000	4,000	22,500	2,000	1,000	22,500	20,250	4	20,247
Y-86			300	100	30	90	250	120	50	140	275	8	267
Y-87	DZ		4	4	4	4	7	7	7	7	5	5	0
Y-88	DZ		5	5	5	5	3	3	3	3	4	4	0

Page 13c

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
Y-52		1,530	3,150	2,340	1,444	1,427	1,436	1.44	0.50	0.20	0.35	0.09
Y-53	DZ	32	32	32	4,144	4,116	4,130	4.13	3.20	0.50	1.85	0.27
Y-54		1,470	1,575	1,523	3,143	3,123	3,133	3.13	0.40	0.20	0.30	0.19
Y-55	DZ	36	32	34	979	971	975	0.98	0.40	0.60	0.50	0.06
Y-56		80,000	80,000	80,000	3,502	3,483	3,493	3.49	0.40	0.70	0.55	0.22
Y-57		28,800	24,800	26,800	3,521	3,512	3,517	3.52	3.50	4.20	3.85	0.26
Y-58	PEG	19,200	14,400	16,800	1,133	1,133	1,133	1.13	0.20	0.20	0.20	0.07
Y-59		2,250	1,440	1,845	2,068	2,060	2,064	2.06	4.20	2.40	3.30	0.15
Y-60		32	28	30	5,171	5,255	5,213	5.21	4.20	0.90	2.55	0.36
Y-61	DUP	32	28	30	5,171	5,255	5,213	5.21	4.20	0.90	2.55	0.36
Y-62		320	400	360	949	944	947	0.95	0.40	3.70	2.05	0.06
Y-63	SINV	40	32	36	943	933	938	0.94	0.40	0.30	0.35	0.06
Y-64		56	76	66	1,167	1,178	1,173	1.17	2.60	1.00	1.80	0.08
Y-65	L											
Y-66	L											
Y-67		480	550	515	4,071	3,874	3,973	3.97	1.60	0.40	1.00	0.25
Y-68		44,000	28,000	36,000	1,189	1,173	1,181	1.18	0.50	0.35	0.43	0.07
Y-69	DZ	40	32	36	1,340	1,345	1,343	1.34	0.60	0.50	0.55	0.08
Y-70	DZ	28	32	30	3,767	3,707	3,737	3.74	2.50	2.70	2.60	0.26
Y-71		440	240	340	2,030	2,030	2,030	2.03	1.10	1.90	1.50	0.13
Y-72		280	280	280	4,085	4,075	4,080	4.08	0.20	2.90	1.55	0.26
Y-73		80	72	76	3,021	2,935	2,978	2.98	2.80	2.80	2.80	0.21
Y-74	SINV	24	24	24	4,102	4,031	4,067	4.07	1.00	0.30	0.65	0.25
Y-75		36	36	36	1,174	1,155	1,165	1.16	0.80	0.50	0.65	0.07
Y-76		252	270	261	5,436	5,436	5,436	5.44	3.50	5.00	4.25	0.41
Y-77	DZ	24	24	24	1,402	1,391	1,397	1.40	0.20	0.20	0.20	0.08
Y-78	DZ	23	23	23	1,400	1,386	1,393	1.39	0.10	0.10	0.10	0.08
Y-79	DZ	24	24	24	4,390	4,359	4,375	4.37	0.60	0.60	0.60	0.27
Y-80	DZ	36	36	36	4,872	4,901	4,887	4.89	2.60	1.70	2.15	0.33
Y-81	PEGI/SINV	36	4,500	2,268	6,027	6,027	6,027	6.03	1.50	1.60	1.55	0.39
Y-82		315	315	315	3,289	3,289	3,289	3.29	4.20	3.00	3.60	0.24
Y-83		3,600	4,725	4,163	1,235	1,235	1,235	1.24	0.10	0.20	0.15	0.07
Y-84	DUP	3,600	4,725	4,163	1,235	1,235	1,235	1.24	0.10	0.20	0.15	0.07
Y-85		495	495	495	5,394	5,394	5,394	5.39	3.80	3.00	3.40	0.39
Y-86		160	200	180	1,562	1,663	1,613	1.61	0.20	0.20	0.20	0.10
Y-87	DZ	50	63	56	1,380	1,395	1,388	1.39	0.30	0.30	0.30	0.08
Y-88	DZ	56	32	44	1,545	1,544	1,545	1.54	0.30	0.20	0.25	0.09

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
Y-52		67	74	71	530	NA	1,352.19	0.00	0.00	860.00	1,352.19
Y-53	DZ	70	70	70	530	NA	28.26	0.00	0.00	18.00	28.26
Y-54		63	70	67	526	NA	1,728.24	2.10	1.20	1,100.00	1,729.43
Y-55	DZ	66	65	66	525	NA	5.50	0.00	0.00	3.50	5.50
Y-56		83	84	84	543	NA	38,760.18	0.00	0.00	25,000.00	38,760.18
Y-57		133	135	134	594	NA	35,535.48	0.00	0.00	23,000.00	35,535.48
Y-58	PEG	67	65	66	.526	NA	14,555.18	0.00	0.00	9,300.00	14,555.18
Y-59		79	76	78	537	NA	1,534.34	0.00	0.00	980.00	1,534.34
Y-60		77	73	75	535	NA	29.80	0.00	0.00	19.00	29.80
Y-61	DUP	77	73	75	535	NA	29.80	0.00	0.00	19.00	29.80
Y-62		73	74	74	533	NA	909.90	0.00	0.00	580.00	909.90
Y-63	SINV	74	75	75	534	NA	40.90	0.00	0.00	26.00	40.90
Y-64		75	76	76	535	NA	87.92	11.00	6.26	60.00	94.19
Y-65	L										
Y-66	L										
Y-67		64	66	65	525	NA	1,382.35	0.00	0.00	880.00	1,382.35
Y-68		64	62	63	523	NA	100,024.55	0.00	0.00	66,000.00	100,024.55
Y-69	DZ	65	64	65	524	NA	0.08	0.00	0.00	0.05	0.08
Y-70	DZ	61	62	62	521	NA	0.07	0.00	0.00	0.0475	0.07
Y-71		63	64	64	523	NA	580.97	0.00	0.00	370.00	580.97
Y-72		108	110	109	569	NA	502.44	0.00	0.00	320.00	502.44
Y-73		52	52	52	512	NA	145.78	0.00	0.00	93.00	145.78
Y-74	SINV	60	61	61	520	NA	17.30	0.00	0.00	11.00	17.30
Y-75		53	52	53	512	NA	67.61	0.00	0.00	43.00	67.61
Y-76		83	84	84	543	NA	406.69	0.00	0.00	260.00	406.69
Y-77	DZ	66	67	67	526	NA	0.07	0.00	0.00	0.0475	0.07
Y-78	DZ	62	64	63	523	NA	0.08	0.00	0.00	0.05	0.08
Y-79	DZ	64	61	63	522	NA	0.08	0.00	0.00	0.05	0.08
Y-80	DZ	120	125	123	582	NA	0.08	0.00	0.00	0.05	0.08
Y-81	PEGI/SINV	68	67	68	527	NA	42.40	0.00	0.00	27.00	42.40
Y-82		64	58	61	521	NA	327.41	30.00	17.04	220.00	344.45
Y-83		64	58	61	521	NA	5,026.10	0.00	0.00	3,200.00	5,026.10
Y-84	DUP	64	58	61	521	NA	5,026.10	0.00	0.00	3,200.00	5,026.10
Y-85		79	89	84	544	NA	1,038.80	18.00	10.23	670.00	1,049.03
Y-86		65	66	66	525	NA	409.03	0.00	0.00	260.00	409.03
Y-87	DZ	67	68	68	527	NA	0.08	0.00	0.00	0.05	0.08
Y-88	DZ	65	64	65	524	NA	0.08	0.00	0.00	0.05	0.08

WSPA EMISSION RATE CALCULATION SPREADSHEET SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
							NMOC		Methane		THC	
ID	Code	MW fraction O2	MW fraction C3H8	% fraction N2	MW fraction N2	MW Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
Y-52		0.1	0.0379	99.6	27.9	28.05	3.03E-04	2.65E+00	0.00E+00	0.00E+00	3.03E-04	2.65E+00
Y-53	DZ	0.6	0.0008	98.1	27.5	28.09	1.97E-05	1.73E-01	0.00E+00	0.00E+00	1.97E-05	1.73E-01
Y-54		0.1	0.0485	99.6	27.9	28.05	8.50E-04	7.44E+00	5.89E-07	5.16E-03	8.50E-04	7.45E+00
Y-55	DZ	0.2	0.0002	99.5	27.9	28.04	8.52E-07	7.46E-03	0.00E+00	0.00E+00	8.52E-07	7.46E-03
Y-56		0.2	1.1028	97.0	27.2	28.44	2.11E-02	1.85E+02	0.00E+00	0.00E+00	2.11E-02	1.85E+02
Y-57		1.2	1.0145	93.9	26.3	28.54	2.13E-02	1.87E+02	0.00E+00	0.00E+00	2.13E-02	1.87E+02
Y-58	PEG	0.1	0.4102	98.9	27.7	28.18	2.59E-03	2.27E+01	0.00E+00	0.00E+00	2.59E-03	2.27E+01
Y-59		1.1	0.0432	96.6	27.1	28.17	5.72E-04	5.01E+00	0.00E+00	0.00E+00	5.72E-04	5.01E+00
Y-60		0.8	0.0008	97.4	27.3	28.12	2.70E-05	2.36E-01	0.00E+00	0.00E+00	2.70E-05	2.36E-01
Y-61	DUP	0.8	0.0008	97.4	27.3	28.12	2.70E-05	2.36E-01	0.00E+00	0.00E+00	2.70E-05	2.36E-01
Y-62		0.7	0.0256	97.9	27.4	28.11	1.46E-04	1.28E+00	0.00E+00	0.00E+00	1.46E-04	1.28E+00
Y-63	SINV	0.1	0.0011	99.6	27.9	28.03	5.94E-06	5.20E-02	0.00E+00	0.00E+00	5.94E-06	5.20E-02
Y-64		0.6	0.0026	98.2	27.5	28.09	1.72E-05	1.50E-01	1.22E-06	1.07E-02	1.84E-05	1.61E-01
Y-65	L											
Y-66	L											
Y-67		0.3	0.0388	98.9	27.7	28.07	8.95E-04	7.84E+00	0.00E+00	0.00E+00	8.95E-04	7.84E+00
Y-68		0.1	2.9113	93.0	26.1	29.10	1.95E-02	1.71E+02	0.00E+00	0.00E+00	1.95E-02	1.71E+02
Y-69	DZ	0.2	0.0000	99.4	27.9	28.04	1.68E-08	1.47E-04	0.00E+00	0.00E+00	1.68E-08	1.47E-04
Y-70	DZ	0.8	0.0000	97.4	27.3	28.12	4.97E-08	4.36E-04	0.00E+00	0.00E+00	4.97E-08	4.36E-04
Y-71		0.5	0.0163	98.5	27.6	28.09	1.98E-04	1.73E+00	0.00E+00	0.00E+00	1.98E-04	1.73E+00
Y-72		0.5	0.0141	98.4	27.6	28.09	3.17E-04	2.78E+00	0.00E+00	0.00E+00	3.17E-04	2.78E+00
Y-73		0.9	0.0041	97.2	27.2	28.13	7.99E-05	7.00E-01	0.00E+00	0.00E+00	7.99E-05	7.00E-01
Y-74	SINV	0.2	0.0005	99.3	27.8	28.05	1.14E-05	9.95E-02	0.00E+00	0.00E+00	1.14E-05	9.95E-02
Y-75		0.2	0.0019	99.3	27.8	28.05	1.29E-05	1.13E-01	0.00E+00	0.00E+00	1.29E-05	1.13E-01
Y-76		1.4	0.0115	95.7	26.8	28.19	4.17E-04	3.66E+00	0.00E+00	0.00E+00	4.17E-04	3.66E+00
Y-77	DZ	0.1	0.0000	99.8	28.0	28.03	1.63E-08	1.43E-04	0.00E+00	0.00E+00	1.63E-08	1.43E-04
Y-78	DZ	0.0	0.0000	99.9	28.0	28.02	1.71E-08	1.50E-04	0.00E+00	0.00E+00	1.71E-08	1.50E-04
Y-79	DZ	0.2	0.0000	99.4	27.9	28.04	5.52E-08	4.83E-04	0.00E+00	0.00E+00	5.52E-08	4.83E-04
Y-80	DZ	0.7	0.0000	97.8	27.4	28.11	5.98E-08	5.24E-04	0.00E+00	0.00E+00	5.98E-08	5.24E-04
Y-81	PEGI/SINV	0.5	0.0012	98.4	27.6	28.08	4.26E-05	3.74E-01	0.00E+00	0.00E+00	4.26E-05	3.74E-01
Y-82		1.2	0.0097	96.4	27.0	28.17	2.04E-04	1.79E+00	1.06E-05	9.30E-02	2.15E-04	1.88E+00
Y-83		0.0	0.1412	99.5	27.9	28.08	9,78E-04	8.57E+00	0.00E+00	0.00E+00	9.78E-04	8.57E+00
Y-84	DUP	0.0	0.1412	99.5	27.9	28.08	9.78E-04	8.57E+00	0.00E+00	0.00E+00	9.78E-04	8.57E+00
Y-85		1.1	0.0296	96.5	27.0	28.17	1.01E-03	8.80E+00	9.89E-06	8.67E-02	1.01E-03	8.89E+00
Y-86		0.1	0.0115	99.8	28.0	28.03	1.03E-04	9.03E-01	0.00E+00	0.00E+00	1.03E-04	9.03E-01
Y-87	DZ	0.1	0.0000	99.7	27.9	28.03	1.71E-08	1.50E-04	0.00E+00	0.00E+00	1.71E-08	1.50E-04
Y-88	DZ	0.1	0.0000	99.7	27.9	28.03	1.91E-08	1.67E-04	0.00E+00	0.00E+00	1.91E-08	1.67E-04

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

Page 13f

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
Y-52		Intermittent emitter. SV varied by a factor of 2.
Y-53	DZ	
Y-54		
Y-55	DZ	Plug. Final QC at 1440; 1250 ppm.
Y-56		SV varied by a factor of 2.
Y-57		
Y-58	PEG	Plug. Intermittent emitter.
Y-59		Intermittent emitter.
Y-60		
Y-61	DUP	Duplicate of Y060.
Y-62		Plug.
Y-63	SINV	Liquid sample Y065 taken. SV varied by a factor of 2.
Y-64		Liquid sample Y066 taken. Final QC at 1434; 1000 ppm.
Y-65	L	Reported with sample Y063.
Y-66	L	Reported with sample Y064.
Y-67		
Y-68		
Y-69	DZ	Plug.
Y-70	DZ	
Y-71		
Y-72		Final QC at 1452; 950 ppm.
Y-73		
Y-74	SINV	Intermittent emitter. SV varied by a factor of 3.125.
Y-75		
Y-76		
Y-77	DZ	Plug.
Y-78	DZ	Plug.
Y-79	DZ	Plug. Battery died during log; re-tested.
Y-80	DZ	
Y-81	PEGI/SINV	Intermittent emitter. Pegged hard. SV varied by a factor of 200.
Y-82		Final QC at 1435; 1150 ppm.
Y-83		
Y-84	DUP	Dupicate of Y083.
Y-85		
Y-86		Plug.
Y-87	DZ	
Y-88	DZ	

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ("Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
Y-89		2.5	65		VALVE	0.50	NEDL	M		GAS	Purge gas
Y-90		2.5	63		C	4.00	FL			LL	Benzene
Y-91		0.0	64		C	3.00	FL			LL	Isohexane
Y-92	BL										
Y-93	SINV	1.5	65		PUMP	4.00	HC		Y	LL	Naptha
Y-94	PEG	1.5	66		PUMP	3.00	HC		N	LL	Stab reflux
Y-95		1.5	66		C	4.00	FL			LL	Gasoline
Y-96	AUDTD	1.5	66		C	4.00	FL			LL	Gasoline
Y-97	DZ	1.5	66		VALVE	6.00	GATE	C		GAS	Fuel gas
Y-98		1.5	65		OEL	0.50	OEL			LL	Naptha
Y-99		2.5	60		C	6.00	FL			LL	Reflux
Y-100	DZ	5.5	60		VALVE	1.00	PLUG	M		LL	Reflux
Y-101	DZ/DINV	5.5	59		PUMP	4.00	HC		N	LL	Reflux
Y-102	SINV	2.5	61		VALVE	1.00	GATE	M		GAS	Recycle gas
Y-103	PGAC/SINV	2.5	61		VALVE	1.00	GATE	M		GAS	Recycle gas
Y-104		1.5	62		VALVE	1.50	GATE	C		GAS	Propane
Y-105	DZ	1.5	63		VALVE	1.00	GATE	C		GAS	Propane
Y-106	PEG	1.5	66		C	0.50	TH			LL	Propane
Y-107	SINV	3.5	66		VALVE	4.00	GATE	M		LL	Reformate
Y-108	SINV/DUP	3.5	66		VALVE	4.00	GATE	M		LL	Reformate
Y-109	SINV/AUDTD	3.5	66		VALVE	4.00	GATE	M		LL	Reformate
Y-110	DZ	3.5	70		VALVE	4.00	GATE	M		LL	Reformate
Y-111	INV	1.5	73		C	0.75	TH			LL	Reformate
Y-112	DZ	0.0	78		VALVE	3.00	PLUG			GAS	Fuel gas
Y-113		1.5	81		C	0.50	COUP			LL	Reformate
Y-114	DZ/INV	1.5	81		VALVE	3.00	PLUG	M		GAS	Fuel gas
Y-115	INV	1.5	79		PUMP	2.00	HC		N	LL	Reflux
Y-116		1.5	73		PUMP	4.00	HC		Y	HL	Reflux (heavy)
Y-117		1.5	74		PUMP	4.00	HC		N	HL	Light gas oil
Y-118		2.5	79		PUMP	3.00	HC		N	HL	Slop oil
Y-119	AUDTD	2.5	79		PUMP	3.00	HC		N	HL	Slop oil
Y-120	DZ	0.0	79		PUMP	4.00	HC		N	HL	Blowdown oil
Y-121	SINV	1.5	79		OEL	0.50	OEL			GAS	Purge gas
Y-122	PGAC/SINV	1.5	79		OEL	0.50	OEL			GAS	Purge gas
Y-123	BL										
Y-124		0.0	63		PUMP	3.00	HC		N	LL	Butane
Y-125	DZ	1.5	67		PUMP	8.00	HC		N	LL	MTBE Transfer

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
Y-89			220	170	120	130	400	250	300	300	310	4	306
Y-90			65	20	6	7	80	30	7	15	73	3	70
Y-91			18,000	50	20	200	22,500	700	40	2,000	20,250	4	20,246
Y-92	BL												
Y-93	SINV		40	18	35	35	220	70	80	120	130	5	127
Y-94	PEG		76,500	1,600	8,500	160	90,000	9,000	1,200	40,500	83,250	3	83,248
Y-95			250	100	30	50	200	120	25	30	225	3	223
Y-96	AUDTD		250	100	30	50	200	120	25	30	225	3	223
Y-97	DZ		3	3	3	3	3	3	3	3	3	3	0
Y-98			13,200				16,500				14,850	4	14,846
Y-99			11	6	6	6	11	4	4	4	11	6	5
Y-100	DZ		5	5	5	5	4	4	4	4	5	5	0
Y-101	DZ/DINV		4	4	4	4	4	4	4	4	4	4	0
Y-102	SINV		20,000	4,000	2,500	2,500	2,000	1,500	2,000	2,000	11,000	4	10,996
Y-103	PGAC/SINV		20,000	4,000	2,500	2,500	2,000	1,500	2,000	2,000	11,000	4.0	10,996
Y-104			22,500	22,500	1,800	9,000	22,500	18,000	2,700	7,200	22,500	5	22,495
Y-105	DZ		4	4	4	4	3	3	3	3	3	3	0
Y-106	PEG		90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	3	89,997
Y-107	SINV		800	70	100	400	350	170	100	200	575	7	568
Y-108	SINV/DUP		800	70	100	400	350	170	100	200	575	7	568
Y-109	SINV/AUDTD		800	70	100	400	350	170	100	200	575	7	568
Y-110	DZ		6	6	6	6	4	4	4	4	5	5	0
Y-111	INV		700	20	16	120	700	40	15	700	700	6	694
Y-112	DZ		4	4	4	4	4	4	4	4	4	4	0
Y-113			16,500	1,200	13,200	13,200	27,500	2,000	8,000	10,000	22,000	4	21,996
Y-114	DZ/INV		6	6	6	6	6	6	6	6	6	6	0
Y-115	INV		10,000	3,000	20	20	10,000	1,200	18	18	10,000	11	9,989
Y-116			14	10	7	7	11	10	6	10	13	3	10
Y-117			9	8	8	7	13	10	10	10	11	4	7
Y-118			1,400	140	450	250	900	120	170	250	1,150	5	1,146
Y-119	AUDTD		1,400	140	450	250	900	120	170	250	1,150	5	1,146
Y-120	DZ		5	5	5	5	4	4	4	4	4	4	0
Y-121	SINV		600				2,000				1,300	5	1,295
Y-122	PGAC/SINV		600				2,000				1,300	5	1,295
Y-123	BL												
Y-124			21,000	10,000	20,000	11,000	25,000	3,000	8,000	9,000	23,000	5	22,995
Y-125	DZ		8	8	8	8	5	5	5	5	7	7	0

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
Y-89		108	99	104	1,535	1,532	1,534	1.53	0.30	0.10	0.20	0.09
Y-90		126	135	131	1,520	1,579	1,550	1.55	0.20	0.20	0.20	0.09
Y-91		12,600	12,600	12,600	1,585	1,561	1,573	1.57	0.40	1.80	1.10	0.10
Y-92	BL											
Y-93	SINV	600	576	1,960	4,777	4,772	4,775	4.77	0.20	0.20	0.20	0.29
Y-94	PEG	1,920	2,000	1,320	4,817	4,800	4,809	4.81	0.30	0.15	0.23	0.29
Y-95		1,360	1,280	1,320	1,116	1,112	1,114	1.11	0.60	0.30	0.45	0.07
Y-96	AUDTD	1,360	1,280	1,320	1,116	1,112	1,114	1.11	0.60	0.30	0.45	0.07
Y-97	DZ	24	24	24	1,694	1,696	1,695	1.70	1.90	0.70	1.30	0.11
Y-98		630	630	630	1,070	1,072	1,071	1.07	0.30	0.20	0.25	0.07
Y-99		56	56	56	1,132	1,128	1,130	1.13	0.30	0.20	0.25	0.07
Y-100	DZ	40	40	40	1,105	1,101	1,103	1.10	0.20	1.20	0.70	0.07
Y-101	DZ/DINV	36	40	38	6,398	6,398	6,398	6.40	5.60	6.60	6.10	0.54
Y-102	SINV	3,200	2,400	2,800	967	962	965	0.96	0.40	0.20	0.30	0.06
Y-103	PGAC/SINV	3,200	2,400	2,800	967	962	965	0.96	0.40	0.20	0.30	0.06
Y-104		1,800	1,800	1,800	1,720	1,725	1,723	1.72	0.90	0.20	0.55	0.11
Y-105	DZ	36	36	36	1,737	1,907	1,822	1.82	0.50	0.20	0.35	0.11
Y-106	PEG	90,000	90,000	90,000	1,277	1,279	1,278	1.28	0.20	0.20	0.20	0.08
Y-107	SINV	650	700	675	2,165	2,192	2,179	2.18	0.80	0.20	0.50	0.13
Y-108	SINV/DUP	650	700	675	2,165	2,192	2,179	2.18	0.80	0.20	0.50	0.13
Y-109	SINV/AUDTD	650	700	675	2,165	2,192	2,179	2.18	0.80	0.20	0.50	0.13
Y-110	DZ	40	80	60	4,005	3,988	3,997	4.00	0.10	0.10	0.10	0.24
Y-111	INV	210	200	205	1,983	2,038	2,011	2.01	0.80	0.80	0.80	0.13
Y-112	DZ	50	35	43	3,235	3,205	3,220	3.22	0.10	0.10	0.10	0.19
Y-113		275	330	303	1,162	1,163	1,163	1.16	0.70	0.80	0.75	0.07
Y-114	DZ/INV	70	60	65	2,588	2,577	2,583	2.58	0.30	0.20	0.25	0.16
Y-115	INV	660	660	660	5,210	5,204	5,207	5.21	0.30	0.10	0.20	0.32
Y-116		136	216	176	4,833	4,805	4,819	4.82	0.20	0.20	0.20	0.29
Y-117		55	35	45	4,241	4,237	4,239	4.24	0.20	0.20	0.20	0.26
Y-118		1,250	1,200	1,225	4,956	4,956	4,956	4.96	0.20	0.10	0.15	0.30
Y-119	AUDTD	1,250	1,200	1,225	4,956	4,956	4,956	4.96	0.20	0.10	0.15	0.30
Y-120	DZ	35	40	38	4,095	4,123	4,109	4.11	0.20	0.10	0.15	0.25
Y-121	SINV	400	1,250	825	1,464	1,464	1,464	1.46	0.20	0.10	0.15	0.09
Y-122	PGAC/SINV	400	1,250	825	1,464	1,464	1,464	1.46	0.20	0.10	0.15	0.09
Y-123	BL											
Y-124		1,800	1,800	1,800	4,237	4,241	4,239	4.24	0.20	0.30	0.25	0.26
Y-125	DZ	60	50	55	5,329	5,347	5,338	5.34	0.70	0.20	0.45	0.33

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
Y-89		68	67	68	527	NA	144.75	0.00	0.00	92.00	144.75
Y-90		75	77	76	536	NA	314.65	0.00	0.00	200.00	314.65
Y-91		65	67	66	526	NA	8,147.10	0.00	0.00	5,200.00	8,147.10
Y-92	BL					NA	0.00	0.00	0.00	0.00	0.00
Y-93	SINV	75	78	77	536	NA	1,462.51	0.00	0.00	930.00	1,462.51
Y-94	PEG	70	70	70	530	NA	3,140.17	5.20	2.96	2,000.00	3,143.14
Y-95		65	63	64	524	NA	877.98	280.00	159.72	660.00	1,037.70
Y-96	AUDTD	65	63	64	524	NA					
Y-97	DZ	68	72	70	530	NA	0.07	0.00	0.00	0.05	0.07
Y-98		67	68	68	527	NA	1,273.79	0.00	0.00	810.00	1,273.79
Y-99		61	62	62	521	NA	10.38	0.00	0.00	6.60	10.38
Y-100	DZ	61	59	60	520	NA	0.08	0.00	0.00	0.05	0.08
Y-101	DZ/DINV	60	59	60	519	NA	171.63	0.00	0.00	110.00	171.63
Y-102	SINV	62	60	61	521	NA	3,427.04	52.00	29.64	2,200.00	3,456.69
Y-103	PGAC/SINV	62	60	61	521	NA	578,041.80	140,000.00	61,269.75	530,000.00	639,311.55
Y-104		63	64	64	523	NA	2,822.37	9.60	5.47	1,800.00	2,827.84
Y-105	DZ	67	69	68	528	NA	0.08	0.00	0.00	0.05	0.08
Y-106	PEG	66	67	67	526	NA	76,476.30	0.00	0.00	50,000.00	76,476.30
Y-107	SINV	76	79	78	537	NA	1,493.31	0.00	0.00	950.00	1,493.31
Y-108	SINV/DUP	76	79	78	537	NA	1,509.02	0.00	0.00	960.00	1,509.02
Y-109	SINV/AUDTD	76	79	78	537	NA	0.00		0.00		0.00
Y-110	DZ	69	70	70	529	NA	1.73	0.00	0.00	1.10	1.73
Y-111	INV	90	84	87	547	NA	0.00	NA	0.00	NA	0.00
Y-112	DZ	83	84	84	543	NA	1.49	0.00	0.00	0.95	1.49
Y-113		82	82	82	542	NA	770.16	0.00	0.00	490.00	770.16
Y-114	DZ/INV	82	85	84	543	NA	0.00	NA	0.00	NA	0.00
Y-115	INV	83	83	83	543	NA	0.00	NA	0.00	NA	0.00
Y-116		83	80	82	541	NA	204.53	0.00	0.00	130.00	204.53
Y-117		70	70	70	530	NA	15.10	0.00	0.00	9.60	15.10
Y-118		91	87	89	549	NA	2,670.47	3.40	1.94	1,700.00	2,672.41
Y-119	AUDTD	91	87	89	549	NA	0.00		0.00		0.00
Y-120	DZ	79	79	79	539	NA	3.15	0.00	0.00	2.00	3.15
Y-121	SINV	81	81	81	541	NA	321.84	15.00	8.56	210.00	330.40
Y-122	PGAC/SINV	81	81	81	541	NA	131,444.86	3,300.00	1,792.38	89,000.00	133,237.24
Y-123	BL					NA		0.00		1.70	
Y-124		61	62	62	521	NA	3,927.66	0.00	0.00	2,500.00	3,927.66
Y-125	DZ	67	64	66	525	NA	4.88	0.00	0.00	3.10	4.88

WSPA EMISSION RATE CALCULATION SPREADSHEET SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
							NMOC		Methane		THC	
ID	Code	MW fraction O2	MW fraction C3H8	% fraction N2	MW fraction N2	MW Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
Y-89		0.1	0.0041	99.8	28.0	28.03	3.46E-05	3.03E-01	0.00E+00	0.00E+00	3.46E-05	3.03E-01
Y-90		0.1	0.0088	99.8	28.0	28.03	7.47E-05	6.55E-01	0.00E+00	0.00E+00	7.47E-05	6.55E-01
Y-91		0.4	0.2294	98.4	27.6	28.15	2.10E-03	1.84E+01	0.00E+00	0.00E+00	2.10E-03	1.84E+01
Y-92	BL	0.0	0.0000	100.0	28.0	28.02						
Y-93	SINV	0.1	0.0410	99.7	27.9	28.04	1.07E-03	9.37E+00	0.00E+00	0.00E+00	1.07E-03	9.37E+00
Y-94	PEG	0.1	0.0882	99.6	27.9	28.06	2.35E-03	2.06E+01	2.22E-06	1.94E-02	2.35E-03	2.06E+01
Y-95		0.1	0.0291	99.5	27.9	28.05	1.55E-04	1.36E+00	2.83E-05	2.48E-01	1.84E-04	1.61E+00
Y-96	AUDTD	0.1	0.0000	99.6	27.9	28.04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-97	DZ	0.4	0.0000	98.7	27.7	28.07	2.07E-08	1.82E-04	0.00E+00	0.00E+00	2.07E-08	1.82E-04
Y-98		0.1	0.0357	99.7	27.9	28.04	2.13E-04	1.87E+00	0.00E+00	0.00E+00	2.13E-04	1.87E+00
Y-99		0.1	0.0003	99.7	27.9	28.03	1.85E-06	1.62E-02	0.00E+00	0.00E+00	1.85E-06	1.62E-02
Y-100	DZ	0.2	0.0000	99.3	27.8	28.05	1.40E-08	1.23E-04	0.00E+00	0.00E+00	1.40E-08	1.23E-04
Y-101	DZ/DINV	2.0	0.0049	93.9	26.3	28.26	2.44E-04	2.14E+00	0.00E+00	0.00E+00	2.44E-04	2.14E+00
Y-102	SINV	0.1	0.0970	99.5	27.9	28.07	5.25E-04	4.59E+00	4.54E-06	3.97E-02	5.29E-04	4.63E+00
Y-103	PGAC/SINV	0.1	23.3783	46.7	13.1	36.56	1.15E-01	1.01E+03	1.22E-02	1.07E+02	1.27E-01	1.12E+03
Y-104		0.2	0.0794	99.3	27.8	28.07	7.77E-04	6.81E+00	1.51E-06	1.32E-02	7.79E-04	6.82E+00
Y-105	DZ	0.1	0.0000	99.6	27.9	28.03	2.25E-08	1.97E-04	0.00E+00	0.00E+00	2.25E-08	1.97E-04
Y-106	PEG	0.1	2.2055	94.8	26.6	28.83	1.57E-02	1.37E+02	0.00E+00	0.00E+00	1.57E-02	1.37E+02
Y-107	SINV	0.2	0.0419	99.4	27.9	28.06	5.05E-04	4.42E+00	0.00E+00	0.00E+00	5.05E-04	4.42E+00
Y-108	SINV/DUP	0.2	0.0423	99.4	27.9	28.06	5.10E-04	4.47E+00	0.00E+00	0.00E+00	5.10E-04	4.47E+00
Y-109	SINV/AUDTD	0.2	0.0000	99.5	27.9	28.04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-110	DZ	0.0	0.0000	99.9	28.0	28.02	1.07E-06	9.36E-03	0.00E+00	0.00E+00	1.07E-06	9.36E-03
Y-111	INV	0.3	0.0000	99.2	27.8	28.05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-112	DZ	0.0	0.0000	99.9	28.0	28.02	7.24E-07	6.34E-03	0.00E+00	0.00E+00	7.24E-07	6.34E-03
Y-113		0.2	0.0216	99.2	27.8	28.06	1.40E-04	1.22E+00	0.00E+00	0.00E+00	1.40E-04	1.22E+00
Y-114	DZ/INV	0.1	0.0000	99.8	27.9	28.03						
Y-115	INV	0.1	0.0000	99.8	28.0	28.03						
Y-116		0.1	0.0057	99.8	28.0	28.03	1.50E-04	1.31E+00	0.00E+00	0.00E+00	1.50E-04	1.31E+00
Y-117		0.1	0.0004	99.8	28.0	28.03	9.93E-06	8.69E-02	0.00E+00	0.00E+00	9.93E-06	8.69E-02
Y-118		0.0	0.0750	99.7	27.9	28.05	1.98E-03	1.73E+01	1.44E-06	1.26E-02	1.98E-03	1.73E+01
Y-119	AUDTD	0.0	0.0000	99.9	28.0	28.03						
Y-120	DZ	0.0	0.0001	99.8	28.0	28.03	1.97E-06	1.72E-02	0.00E+00	0.00E+00	1.97E-06	1.72E-02
Y-121	SINV	0.0	0.0093	99.8	28.0	28.03	7.14E-05	6.25E-01	1.90E-06	1.66E-02	7.33E-05	6.42E-01
Y-122	PGAC/SINV	0.0	3.9258	91.0	25.5	29.46	3.06E-02	2.68E+02	4.18E-04	3.66E+00	3.11E-02	2.72E+02
Y-123	BL											
Y-124		0.1	0.1103	99.5	27.9	28.07	2.63E-03	2.31E+01	0.00E+00	0.00E+00	2.63E-03	2.31E+01
Y-125	DZ	0.1	0.0001	99.5	27.9	28.04	4.12E-06	3.61E-02	0.00E+00	0.00E+00	4.12E-06	3.61E-02

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
Y-89		
Y-90		
Y-91		Final QC at 1411; 1150 ppm.
Y-92	BL	
Y-93	SINV	SV varied by a factor of 5.5.
Y-94	PEG	Intermittent emitter.
Y-95		
Y-96	AUDTD	Duplicate of Y095.
Y-97	DZ	
Y-98		Final QC at 1430; 950 ppm.
Y-99		
Y-100	DZ	
Y-101	DZ/DINV	Tried several times to get O2 <5%. Average O2 = 6.1%.
Y-102	SINV	SV varied by a factor of 10.
Y-103	PGAC/SINV	Pure gas sample.
Y-104		
Y-105	DZ	
Y-106	PEG	Plug. Pegged hard. Final QC at 1438; 850 ppm.
Y-107	SINV	SV varied by a factor of 2.3.
Y-108	SINV/DUP	SV varied by a factor of 2.3. Duplicate of Y107.
Y-109	SINV/AUDTD	Sample to RTI. SV varied by a factor of 2.3. Duplicate of Y107.
Y-110	DZ	Bagged THC concentration large due to fluctuating THC background (charcoal tube not on dil. probe).
Y-111	INV	Canister leaked at lab.
Y-112	DZ	
Y-113		Snap coupler.
Y-114	DZ/INV	Canister leaked at lab.
Y-115	INV	Final QC at 1421; 950ppm. Canister leaked at lab.
Y-116		
Y-117		
Y-118		Leaking 3-4 drops/min.
Y-119	AUDTD	Sample to RTI. Duplicate of Y118.
Y-120	DZ	
Y-121	SINV	Final QC at 1404; 950ppm.
Y-122	PGAC/SINV	Pure gas sample. SV varied by a factor of 3.33.
Y-123	BL	
Y-124		Intermittent emitter (final SV, East).
Y-125	DZ	

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ("Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
Y-126		1.5	73		VALVE	8.00	GATE	M		LL	Reformate
Y-127		1.5	82		VALVE	4.00	GATE	M		HL	Jet fuel
Y-128		0.0	71		PUMP	3.00	HC		N	HL	Jet fuel
Y-129		1.5	75		VALVE	3.00	GLOBE	M		GAS	Butane
Y-130	DUP	1.5	75		VALVE	3.00	GLOBE	M		GAS	Butane
Y-131	AUDTD	1.5	75		VALVE	3.00	GLOBE	M		GAS	Butane
Y-132	DZ	1.5	58		PUMP	3.00	HC		N	HL	Coker cond.
Y-133		1.5	64		VALVE	6.00	GATE	C		GAS	Fuel gas
Y-134		1.5	68		PUMP	3.00	HC		Y	HL	Blowdown oil
Y-135	DZ	1.5	76		PUMP	2.00	HC		N	HL	Light gas oil
Y-136		1.5	70		VALVE	1.50	GATE	C		GAS	Fuel gas
Y-137		1.5	74		VALVE	3.00	GATE	C		GAS	Fuel gas
Y-138	DZ	2.5	56		VALVE	4.00	GATE	C		GAS	Fuel gas
Y-139	DZ	2.5	57		VALVE	3.00	GATE	C		GAS	Fuel gas
Y-140	PEG/DINV	1.5	65		OEL	0.50	OEL			GAS	H2 & HC
Y-141	DZ	0.0	62		VALVE	8.00	GATE	C		LL	FD BTMS
Z-1	ACCY	3.0	65		VALVE	1.00	GATE	M		LL	Water
Z-2	INV	3.0	59		VALVE	4.00	GATE	M		LL	
Z-3		3.0	59	30.26	VALVE	3.00	GATE	M		LL	
Z-4		4.5	59	30.26	VALVE	4.00	GATE	M		LL	
Z-5	SINV	4.5	59	30.20	VALVE	3.00	GATE	M		LL	
Z-6	SINV	3.0	64	30.20	VALVE	2.00	GATE	M		LL	
Z-7		7.5	56	29.85	VALVE	4.00	GATE	M		LL	Naptha
Z-8		7.5	53	29.80	VALVE	10.00	GATE	M		LL	Naptha
Z-9	L	7.5	56	29.85						LL	Naptha
Z-10	L	7.5	53	29.80						LL	Naptha
Z-11		7.5	59	29.82	VALVE	2.00	GATE	M		LL	Naptha to heater 601
Z-12		7.5	58	29.82	C	1.00	TH			LL	Naptha
Z-13		7.5	57	29.80	VALVE	0.50	BALL	M		GAS	Propane
Z-14		7.5	53		VALVE	0.50	NEDL	M		GAS	Propane
Z-15	PEG	2.5	54	29.90	VALVE	0.50	NEDL	M		GAS	Propane
Z-16	PEG	7.5	56	30.00	OEL	0.50	OEL			GAS	Propane
Z-17	PEG	2.5	57	30.00	OEL	0.25	OEL			GAS	Propane
Z-18		7.5	59	30.00	VALVE	2.00	GATE	M		GAS	Propane
Z-19	INV	7.5	60	30.20	OEL	0.50	OEL			LL	Water & propane gas
Z-20		7.5	65	30.20	VALVE	2.00	GATE	M		GAS	Propane
Z-21		2.5	65	30.10	VALVE	4.00	GATE	M		LL	Propane

Page 15b

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
Y-126			800	350	180	160	800	200	160	160	800	7	793
Y-127			3,000	800	500	1,400	3,000	800	1,000	2,500	3,000	7	2,993
Y-128			20	20	16	16	30	8	12	25	25	7	18
Y-129			500	140	16	20	550	120	20	30	525	10	515
Y-130	DUP		500	140	16	20	550	120	20	30	525	10	515
Y-131	AUDTD		500	140	16	20	550	120	20	30	525	10	515
Y-132	DZ		5	5	5	5	5	5	5	5	5	5	0
Y-133			1,000	50	30	250	1,100	600	70	400	1,050	5	1,045
Y-134			18	10	10	10	30	25	14	25	24	5	19
Y-135	DZ		5	5	5	5	5	5	5	5	5	5	0
Y-136			110	100	100	95	110	100	100	90	110	5	105
Y-137			25	25	25	205	30	30	25	20	28	4	24
Y-138	DZ		3	3	3	3	3	3	3	3	3	3	0
Y-139	DZ		3	3	3	3	3	3	3	3	3	3	0
Y-140	PEG/DINV		100,000				100,000				100,000	4	99,997
Y-141	DZ		5	5	5	5	4	4	4	4	4	4	0
Z-1	ACCY		5				8				6	6	0
Z-2	INV	20	40				300				170	7	163
Z-3		20	30				25				28	1	27
Z-4		100	250				500				375	3	373
Z-5	SINV	0	2,000				10,000				6,000	1	5,999
Z-6	SINV	20	5,000				40,000				22,500	1	22,499
Z-7		50	175				150				163	3	160
Z-8			1,000				1,000				1,000	5	995
Z-9	L												
Z-10	L												
Z-11		0	2,000				3,000				2,500	2	2,498
Z-12			500				800				650	1	649
Z-13		10,000	8,000				8,000				8,000	5	7,996
Z-14		10,000	100				200				150	0	150
Z-15	PEG	10,000	100,000				100,000				100,000	1	99,999
Z-16	PEG		140,000				140,000				140,000	0	140,000
Z-17	PEG		140,000				140,000				140,000	0	140,000
Z-18		0	250				350				300	3	297
Z-19	INV		100				200				150	2	148
Z-20		75	5,000				3,500				4,250	4	4,246
Z-21		0	1,000				1,100				1,050	6	1,044

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
Y-126		140	130	135	5,522	5,454	5,488	5.49	0.40	0.20	0.30	0.33
Y-127		650	620	635	4,187	4,234	4,211	4.21	0.30	0.10	0.20	0.26
Y-128		55	75	65	4,843	4,882	4,863	4.86	0.20	0.10	0.15	0.29
Y-129		200	200	200	3,616	3,629	3,623	3.62	0.20	0.20	0.20	0.22
Y-130	DUP	200	200	200	3,616	3,629	3,623	3.62	0.20	0.20	0.20	0.22
Y-131	AUDTD	200	200	200	3,616	3,629	3,623	3.62	0.20	0.20	0.20	0.22
Y-132	DZ	50	50	50	4,309	4,324	4,317	4.32	0.10	0.20	0.15	0.26
Y-133		310	320	315	2,951	2,918	2,935	2.93	0.20	0.20	0.20	0.18
Y-134		75	75	75	5,365	5,388	5,377	5.38	0.10	0.10	0.10	0.32
Y-135	DZ	50	50	50	3,643	3,673	3,658	3.66	0.20	0.20	0.20	0.22
Y-136		65	65	65	3,970	3,978	3,974	3.97	0.10	0.10	0.10	0.24
Y-137		45	45	45	1,906	1,964	1,935	1.94	1.20	2.60	1.90	0.13
Y-138	DZ	30	30	30	1,843	1,831	1,837	1.84	0.20	0.10	0.15	0.11
Y-139	DZ	30	30	30	2,660	2,653	2,657	2.66	0.10	0.10	0.10	0.16
Y-140	PEG/DINV	450	500	475	1,260	1,265	1,263	1.26	0.10	0.10	0.10	0.08
Y-141	DZ	30	30	30	4,335	4,335	4,335	4.34	4.40	4.20	4.30	0.33
Z-1	ACCY	875	1,042	959	1,029	1,060	1,045	1.04	2.10	2.10	2.10	0.07
Z-2	INV	1,577	1,162	1,370	2,404	2,439	2,422	2.42	3.00	4.00	3.50	0.17
Z-3		145	130	138	2,429	2,512	2,471	2.47	4.50	3.00	3.75	0.18
Z-4		375	400	388	2,524	2,621	2,573	2.57	4.00	0.60	2.30	0.17
Z-5	SINV	900	1,750	1,325	2,587	2,614	2,601	2.60	3.50	1.00	2.25	0.17
Z-6	SINV	7,500	9,000	8,250	2,379	2,421	2,400	2.40	4.00	0.80	2.40	0.16
Z-7		400	550	475	2,887	2,924	2,906	2.91	2.50	0.40	1.45	0.19
Z-8		350	320	335	4,911	4,857	4,884	4.88	2.50	2.50	2.50	0.33
Z-9	L											
Z-10	L											
Z-11		8,000	13,000	10,500	2,132	2,104	2,118	2.12	4.50	4.50	4.50	0.16
Z-12		80	35	58	975	1,040	1,008	1.01	0.90	0.70	0.80	0.06
Z-13		750	750	750	1,112	1,136	1,124	1.12	0.20	0.20	0.20	0.07
Z-14		20	20	20	557	536	547	0.55	3.20	3.00	3.10	0.04
Z-15	PEG	100,000	100,000	100,000	564	568	566	0.57	0.30	0.40	0.35	0.03
Z-16	PEG	63,000	98,000	80,500	1,107	1,096	1,102	1.10	0.30	0.20	0.25	0.07
Z-17	PEG	130,000	130,000	130,000	960	954	957	0.96	0.50	0.20	0.35	0.06
Z-18		400	400	400	2,525	2,533	2,529	2.53	4.00	2.00	3.00	0.18
Z-19	INV	150	220	185	807	837	822	0.82	0.40	0.70	0.55	0.05
Z-20		900	950	925	2,187	2,212	2,200	2.20	2.50	0.20	1.35	0.14
Z-21		1,500	1,400	1,450	2,280	2,303	2,292	2.29	3.00	2.50	2.75	0.16

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
Y-126		78	81	80	539	NA	157.31	0.00	0.00	100.00	157.31
Y-127		86	89	88	547	NA	1,729.68	0.00	0.00	1,100.00	1,729.68
Y-128		72	75	74	533	NA	77.10	0.00	0.00	49.00	77.10
Y-129		83	87	85	545	NA	251.73	0.00	0.00	160.00	251.73
Y-130	DUP	83	87	85	545	NA	220.26	0.00	0.00	140.00	220.26
Y-131	AUDTD	83	87	85	545	NA	0.00		0.00		0.00
Y-132	DZ	58	58	58	518	NA	0.07	0.00	0.00	0.0475	0.07
Y-133		65	68	67	526	NA	246.66	64.00	36.53	180.00	283.19
Y-134		82	90	86	546	NA	29.90	0.00	0.00	19.00	29.90
Y-135	DZ	74	74	74	534	NA	0.08	0.00	0.00	0.05	0.08
Y-136		72	72	72	532	NA	30.62	7.00	4.00	22.00	34.62
Y-137		74	76	75	535	NA	20.27	3.00	1.71	14.00	21.97
Y-138	DZ	56	55	56	515	NA	0.07	0.00	0.00	0.0475	0.07
Y-139	DZ	58	59	59	518	NA	0.07	0.00	0.00	0.0475	0.07
Y-140	PEG/DINV	74	74	74	534	NA	260.53	150.00	85.63	220.00	346.16
Y-141	DZ	76	81	79	538	NA	0.07	0.00	0.00	0.0475	0.07
Z-1	ACCY	69	62	66	525	NA	267.69	770.00	438.27	450.00	705.96
Z-2	INV	140	152	146	606	NA	626.29	0.00	0.00	400.00	626.29
Z-3		99	115	107	567	NA	438.28	0.00	0.00	280.00	438.28
Z-4		111	123	117	577	NA	1,567.85	0.00	0.00	1,000.00	1,567.85
Z-5	SINV	120	153	137	596	NA	3,134.14	0.00	0.00	2,000.00	3,134.14
Z-6	SINV	132	143	138	597	NA	29,481.48	0.00	0.00	19,000.00	29,481.48
Z-7		75	93	84	544	NA	2,353.94	0.00	0.00	1,500.00	2,353.94
Z-8		56	58	57	517	NA	1,722.52	2.70	1.54	1,100.00	1,724.05
Z-9	L										
Z-10	L										
Z-11		68	75	72	531	NA	24,790.08	10.00	5.62	16,000.00	24,795.71
Z-12		63	63	63	523	NA	208.10	21.00	11.98	140.00	220.07
Z-13		55	53	54	514	NA	4,084.82	0.00	0.00	2,600.00	4,084.82
Z-14		56	54	55	515	NA	23.50	0.00	0.00	15.00	23.50
Z-15	PEG	56	55	56	515	NA	111,666.24	0.00	0.00	74,000.00	111,666.24
Z-16	PEG	63	57	60	520	NA	141,735.88	0.00	0.00	95,000.00	141,735.88
Z-17	PEG	59	60	60	519	NA	256,642.96	0.00	0.00	180,000.00	256,642.96
Z-18		60	61	61	520	NA	1,065.28	0.00	0.00	680.00	1,065.28
Z-19	INV	64	64	64	524	NA	0.08	0.00	0.00	0.05	0.08
Z-20		73	75	74	534	NA	1,365.97	0.00	0.00	870.00	1,365.97
Z-21		74	74	74	534	NA	846.32	0.00	0.00	540.00	846.32

WSPA EMISSION RATE CALCULATION SPREADSHEET SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
		MW fraction	MW fraction	% fraction	MW fraction	MW	NMOC		Methane		THC	
ID	Code	O2	C3H8	N2	N2	Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
Y-126		0.1	0.0044	99.7	27.9	28.03	1.32E-04	1.16E+00	0.00E+00	0.00E+00	1.32E-04	1.16E+00
Y-127		0.1	0.0485	99.7	27.9	28.05	1.09E-03	9.58E+00	0.00E+00	0.00E+00	1.09E-03	9.58E+00
Y-128		0.0	0.0022	99.8	28.0	28.03	5.76E-05	5.05E-01	0.00E+00	0.00E+00	5.76E-05	5.05E-01
Y-129		0.1	0.0071	99.8	28.0	28.03	1.37E-04	1.20E+00	0.00E+00	0.00E+00	1.37E-04	1.20E+00
Y-130	DUP	0.1	0.0062	99.8	28.0	28.03	1.20E-04	1.05E+00	0.00E+00	0.00E+00	1.20E-04	1.05E+00
Y-131	AUDTD	0.1	0.0000	99.8	28.0	28.03						
Y-132	DZ	0.0	0.0000	99.8	28.0	28.03	5.10E-08	4.47E-04	0.00E+00	0.00E+00	5.10E-08	4.47E-04
Y-133		0.1	0.0079	99.8	28.0	28.03	1.13E-04	9.90E-01	1.67E-05	1.47E-01	1.30E-04	1.14E+00
Y-134		0.0	0.0008	99.9	28.0	28.02	2.41E-05	2.11E-01	0.00E+00	0.00E+00	2.41E-05	2.11E-01
Y-135	DZ	0.1	0.0000	99.8	28.0	28.03	4.43E-08	3.88E-04	0.00E+00	0.00E+00	4.43E-08	3.88E-04
Y-136		0.0	0.0010	99.9	28.0	28.02	1.87E-05	1.64E-01	2.44E-06	2.14E-02	2.11E-05	1.85E-01
Y-137		0.6	0.0006	98.1	27.5	28.10	6.57E-06	5.76E-02	5.54E-07	4.85E-03	7.13E-06	6.24E-02
Y-138	DZ	0.0	0.0000	99.8	28.0	28.03	2.18E-08	1.91E-04	0.00E+00	0.00E+00	2.18E-08	1.91E-04
Y-139	DZ	0.0	0.0000	99.9	28.0	28.02	3.13E-08	2.74E-04	0.00E+00	0.00E+00	3.13E-08	2.74E-04
Y-140	PEG/DINV	0.0	0.0097	99.9	28.0	28.03	5.04E-05	4.41E-01	1.66E-05	1.45E-01	6.69E-05	5.86E-01
Y-141	DZ	1.4	0.0000	95.7	26.8	28.19	6.16E-08	5.39E-04	0.00E+00	0.00E+00	6.16E-08	5.39E-04
Z-1	ACCY	0.7	0.0198	97.9	27.4	28.11	4.83E-05	4.23E-01	7.90E-05	6.92E-01	1.27E-04	1.11E+00
Z-2	INV	1.1	0.0176	96.5	27.0	28.17	2.46E-04	2.15E+00	0.00E+00	0.00E+00	2.46E-04	2.15E+00
Z-3		1.2	0.0124	96.2	27.0	28.17	1.90E-04	1.67E+00	0.00E+00	0.00E+00	1.90E-04	1.67E+00
Z-4		0.7	0.0441	97.6	27.3	28.13	6.41E-04	5.62E+00	0.00E+00	0.00E+00	6.41E-04	5.62E+00
Z-5	SINV	0.7	0.0882	97.6	27.3	28.14	1.25E-03	1.10E+01	0.00E+00	0.00E+00	1.25E-03	1.10E+01
Z-6	SINV	0.8	0.8381	95.7	26.8	28.42	1.10E-02	9.66E+01	0.00E+00	0.00E+00	1.10E-02	9.66E+01
Z-7		0.5	0.0662	98.4	27.6	28.10	1.10E-03	9.65E+00	0.00E+00	0.00E+00	1.10E-03	9.65E+00
Z-8		0.8	0.0485	97.4	27.3	28.14	1.51E-03	1.32E+01	1.35E-06	1.18E-02	1.51E-03	1.32E+01
Z-9	L											
Z-10	L											
Z-11		1.4	0.7058	93.9	26.3	28.46	1.04E-02	9.10E+01	2.36E-06	2.06E-02	1.04E-02	9.10E+01
Z-12		0.3	0.0062	99.2	27.8	28.05	3.39E-05	2.97E-01	1.95E-06	1.71E-02	3.59E-05	3.14E-01
Z-13		0.1	0.1147	99.5	27.9	28.07	7.35E-04	6.44E+00	0.00E+00	0.00E+00	7.35E-04	6.44E+00
Z-14		1.0	0.0007	96.9	27.2	28.14	2.39E-06	2.09E-02	0.00E+00	0.00E+00	2.39E-06	2.09E-02
Z-15	PEG	0.1	3.2641	92.3	25.8	29.22	1.06E-02	9.27E+01	0.00E+00	0.00E+00	1.06E-02	9.27E+01
Z-16	PEG	0.1	4.1905	90.3	25.3	29.56	2.61E-02	2.28E+02	0.00E+00	0.00E+00	2.61E-02	2.28E+02
Z-17	PEG	0.1	7.9398	81.7	22.9	30.93	4.32E-02	3.78E+02	0.00E+00	0.00E+00	4.32E-02	3.78E+02
Z-18		1.0	0.0300	96.9	27.2	28.15	4.94E-04	4.32E+00	0.00E+00	0.00E+00	4.94E-04	4.32E+00
Z-19	INV	0.2	0.0000	99.4	27.9	28.04	1.03E-08	9.03E-05	0.00E+00	0.00E+00	1.03E-08	9.03E-05
Z-20		0.4	0.0384	98.6	27.6	28.09	4.90E-04	4.30E+00	0.00E+00	0.00E+00	4.90E-04	4.30E+00
Z-21		0.9	0.0238	97.2	27.2	28.14	3.41E-04	2.99E+00	0.00E+00	0.00E+00	3.41E-04	2.99E+00

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
Y-126		
Y-127		
Y-128		
Y-129		Final QC at 1420; 1000ppm.
Y-130	DUP	Duplicate of Y129.
Y-131	AUDTD	Sample to RTI. Duplicate of Y129.
Y-132	DZ	
Y-133		Intermittent emitter (initial SV, North).
Y-134		
Y-135	DZ	
Y-136		
Y-137		Final QC at 1344; 1000ppm.
Y-138	DZ	
Y-139	DZ	
Y-140	PEG/DINV	N2 flow preventing THC emissions.
Y-141	DZ	Final QC at 1148; 1100ppm.
Z-1	ACCY	Final background = 8.
Z-2	INV	Instrument drift.
Z-3		
Z-4		SV varied by a factor of 2.
Z-5	SINV	SV varied by a factor of 5.
Z-6	SINV	SV varied by a factor of 8.
Z-7		Liquid sample Z009 taken.
Z-8		Raining. Liquid sample Z010 taken.
Z-9	L	Reported with sample Z007.
Z-10	L	Reported with sample Z008.
Z-11		
Z-12		Plug.
Z-13		
Z-14		SV varied by a factor of 2.
Z-15	PEG	
Z-16	PEG	
Z-17	PEG	
Z-18		
Z-19	INV	SV varied by a factor of 2. Appears Nitrogen flow is Preventing THC Emissions.
Z-20		
Z-21		

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ("Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
Z-22	PEGI	2.5	65	30.00	PUMP	2.00	HC		N	LL	Propane
Z-23		7.5	53	29.80	PUMP	4.00	HC		Y	LL	Propane
Z-24	DUP	7.5	53	29.80	PUMP	4.00	HC		Y	LL	Propane
Z-25	SINV	2.5	53	29.92	VALVE	1.00	GATE	M		LL	Naptha
Z-26	PEG	3.0	54	29.96	C	1.00	TH			LL	Naptha
Z-27	PEG	3.0	56	29.92	C	1.00	TH			LL	Naptha
Z-28	L										
Z-29	L										
Z-30	L										
Z-31		3.0	58	29.92	VALVE	4.00	GATE	M		LL	Naptha
Z-32		7.5	59	29.92	C	4.00	FL			LL	Naptha
Z-33		2.5	55		VALVE	4.00	GATE	M		LL	
Z-34	DUP	2.5	55		VALVE	4.00	GATE	M		LL	
Z-35	L	2.5	55							LL	
Z-36		7.5	61		C	8.00	FL			LL	Naptha
Z-37	PEG	2.0	58		OEL	0.50	OEL			LL	LPG
Z-38		4.0	57		VALVE	12.00	GATE	M		LL	Naptha
Z-39		10.0	56		C	1.00	TH			LL	Naptha
Z-40		7.5	56	30.00	VALVE	3.00	GATE	M		LL	Ethane
Z-41	DZ	12.5	55	30.00	VALVE	0.75	GATE	M		LL	Naptha
Z-42	DZ/AUDTT	12.5	55	30.00	VALVE	0.75	GATE	M		LL	Naptha
Z-43	DZ/AUDTT	12.5	55	30.00	VALVE	0.75	GATE	M		LL	Naptha
Z-44	DZ/AUDTT	12.5	54	30.00	VALVE	0.75	GATE	M		LL	Naptha
Z-45	DZ/AUDTT	12.5	54	30.00	VALVE	0.75	GATE	M		LL	Naptha
Z-46	AUDTC										
Z-47	AUDTC										
Z-48	DZ	2.5	59		C	3.00	FL			LL	C1-C5 Predom. butane
Z-49	DZ	2.5	57		C	3.00	FL			LL	C1-C5 Predom. butane
Z-50	DZ	2.5	56		C	3.00	FL			LL	C1-C5 Predom. butane
Z-51	PEGF	7.5	55	30.20	VALVE	3.00	GATE	M		LL	C1-C5 Predom. butane
Z-52	SINV	2.5	62		VALVE	0.50	BALL	M		HL	Diesel
Z-53		7.5	63		VALVE	0.50	BALL	M		HL	Diesel
Z-54		7.5	63		OEL	1.00	OEL			HL	Diesel
Z-55	AUDTD	7.5	63		OEL	1.00	OEL			HL	Diesel
Z-56		7.5	59	30.10	VALVE	4.00	GATE	M		LL	Heavy naptha
Z-57		7.5	64	30.10	C	3.00	FL			LL	Platformer
Z-58		7.5	66	30.10	VALVE	3.00	GATE	M		HL	Strip btms to stg

Page 16b

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
Z-22	PEGI	0	109,000				98,100				103,550	10	103,540
Z-23		30	8,000				8,000				8,000	1	7,999
Z-24	DUP	30	8,000				8,000				8,000	1	7,999
Z-25	SINV	75	75				190				133	4	129
Z-26	PEG		117,000				117,000				117,000	5	116,995
Z-27	PEG		117,000				117,000				117,000	4	116,996
Z-28	L												
Z-29	L												
Z-30	L												
Z-31		0	150				125				138	4	134
Z-32			2,000				2,000				2,000	4	1,996
Z-33		50	60				90	25	50	20	75	1	74
Z-34	DUP	50	60				90	25	50	20	75	1	74
Z-35	L												
Z-36			500				700	500	10	15	600	5	596
Z-37	PEG		140,000				140,000				140,000	2	139,998
Z-38		100	1,000	150	150	100	1,500				1,250	7	1,243
Z-39			21,060	3,000	100	140	17,550				19,305	1	19,304
Z-40		60	40	20	5	20	30				35	2	34
Z-41	DZ	0	1				2	2	2	2	1	1	0
Z-42	DZ/AUDTT	0	1				2	2	2	2	1	1	0
Z-43	DZ/AUDTT	0	1				2	2	2	2	1	1	0
Z-44	DZ/AUDTT	0	1				2	2	2	2	1	1	0
Z-45	DZ/AUDTT	0	1				2	2	2	2	1	1	0
Z-46	AUDTC												
Z-47	AUDTC												
Z-48	DZ		1				1	1	1	1	1	1	0
Z-49	DZ		1				1	1	1	1	1	1	0
Z-50	DZ		1				1	1	1	1	1	1	0
Z-51	PEGF	40	131,400				146,000				138,700	1	138,699
Z-52	SINV		1,000				3,000				2,000	4	1,996
Z-53			11,000				12,000				11,500	6	11,494
Z-54			1,000				1,200				1,100	3	1,098
Z-55	AUDTD		1,000				1,200				1,100	3	1,098
Z-56			450				750				600	5	595
Z-57			1,500				1,600				1,550	2	1,548
Z-58			100				150				125	4	121

Page 16c

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
Z-22	PEGI	2,000	2,800	2,400	3,997	4,007	4,002	4.00	2.00	1.50	1.75	0.26
Z-23		1,200	1,200	1,200	13,100	13,100	13,100	13.10	4.50	4.00	4.25	0.99
Z-24	DUP	1,200	1,200	1,200	13,100	13,100	13,100	13.10	4.50	4.00	4.25	0.99
Z-25	SINV	250	180	215	2,673	2,651	2,662	2.66	0.60	0.20	0.40	0.16
Z-26	PEG	100,000	100,000	100,000	695	700	698	0.70	0.50	0.30	0.40	0.04
Z-27	PEG	100,000	100,000	100,000	779	790	785	0.78	0.30	0.50	0.40	0.05
Z-28	L											
Z-29	L											
Z-30	L											
Z-31		120	110	115	4,007	4,057	4,032	4.03	2.50	3.00	2.75	0.28
Z-32		1,400	1,400	1,400	1,988	2,056	2,022	2.02	0.20	0.20	0.20	0.12
Z-33		70	70	70	4,670	4,828	4,749	4.75	1.40	0.20	0.80	0.30
Z-34	DUP	80	80	80	4,670	4,828	4,749	4.75	1.40	0.40	0.90	0.30
Z-35	L											
Z-36		20	12	16	4,309	4,359	4,334	4.33	0.20	0.20	0.20	0.26
Z-37	PEG	45,000	50,000	47,500	4,095	4,095	4,095	4.10	0.20	0.20	0.20	0.25
Z-38		800	900	850	8,658	8,658	8,658	8.66	3.50	3.50	3.50	0.62
Z-39		70	50	60	1,839	1,835	1,837	1.84	0.20	0.20	0.20	0.11
Z-40		21	23	22	2,466	2,494	2,480	2.48	2.60	0.50	1.55	0.16
Z-41	DZ	13	12	13	2,263	2,236	2,250	2.25	2.50	4.00	3.25	0.16
Z-42	DZ/AUDTT	100	120	110	2,232	2,308	2,270	2.27	1.50	3.00	2.25	0.15
Z-43	DZ/AUDTT	100	120	110	2,232	2,308	2,270	2.27	1.50	3.00	2.25	0.15
Z-44	DZ/AUDTT	380	420	400	2,217	2,241	2,229	2.23	2.00	3.50	2.75	0.15
Z-45	DZ/AUDTT	380	420	400	2,217	2,241	2,229	2.23	2.00	3.50	2.75	0.15
Z-46	AUDTC											
Z-47	AUDTC											
Z-48	DZ	22	20	21	1,926	1,911	1,919	1.92	0.40	0.20	0.30	0.12
Z-49	DZ	16	16	16	1,915	1,933	1,924	1.92	0.20	0.20	0.20	0.12
Z-50	DZ	19	19	19	3,220	2,255	2,738	2.74	0.80	0.40	0.60	0.17
Z-51	PEGF	10,000	11,000	10,500	4,010	4,004	4,007	4.01	2.00	0.20	1.10	0.25
Z-52	SINV	110,000	110,000	110,000	1,675	1,619	1,647	1.65	0.20	0.20	0.20	0.10
Z-53		7,000	12,000	9,500	1,741	1,718	1,730	1.73	0.20	0.20	0.20	0.10
Z-54		600	700	650	1,557	1,535	1,546	1.55	1.50	1.30	1.40	0.10
Z-55	AUDTD	600	700	650	1,557	1,535	1,546	1.55	1.50	1.30	1.40	0.10
Z-56		270	260	265	3,050	3,007	3,029	3.03	3.20	1.00	2.10	0.20
Z-57		350	350	350	2,038	1,538	1,788	1.79	0.40	0.40	0.40	0.11
Z-58		80	90	85	3,466	3,505	3,486	3.49	2.80	0.60	1.70	0.23

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
Z-22	PEGI	68	68	68	528	NA	3,449.59	0.00	0.00	2,200.00	3,449.59
Z-23		81	71	76	536	NA	32.85	0.00	0.00	21.00	32.85
Z-24	DUP	81	71	76	536	NA	250.29	0.00	0.00	160.00	250.29
Z-25	SINV	74	89	82	541	NA	34.61	0.00	0.00	22.00	34.61
Z-26	PEG	57	57	57	517	NA	23,393.35	0.00	0.00	15,000.00	23,393.35
Z-27	PEG	60	59	60	519	NA	52,457.79	0.00	0.00	34,000.00	52,457.79
Z-28	L										
Z-29	L										
Z-30	L										
Z-31		67	66	67	526	NA	2,036.56	0.00	0.00	1,300.00	2,036.56
Z-32		74	77	76	535	NA	563.63	4.70	2.68	360.00	566.32
Z-33		101	96	99	558	NA	298.66	0.00	0.00	190.00	298.66
Z-34	DUP	101	107	104	564	NA	308.06	11.00	6.27	200.00	314.34
Z-35	L										
Z-36		191	201	196	656	NA	42.48	0.00	0.00	27.00	42.48
Z-37	PEG	64	64	64	524	NA	138,153.85	1,400.00	758.70	93,000.00	138,912.55
Z-38		60	64	62	522	NA	4,220.17	3.10	1.76	2,700.00	4,221.93
Z-39		56	55	56	515	NA	141.60	0.00	0.00	90.00	141.60
Z-40		59	60	60	519	NA	13.03	0.00	0.00	8.30	13.03
Z-41	DZ	56	54	55	515	NA	0.39	0.00	0.00	0.25	0.39
Z-42	DZ/AUDTT	55	53	54	514	NA	310.72	5.30	3.02	200.00	313.74
Z-43	DZ/AUDTT	55	53	54	514	NA	282.37	0.00	0.00	180.00	282.37
Z-44	DZ/AUDTT	53	51	52	512	NA	1,143.98	0.00	0.00	730.00	1,143.98
Z-45	DZ/AUDTT	53	51	52	512	NA	1,090.16	12.00	6.82	700.00	1,096.99
Z-46	AUDTC					NA	358.97	5.20	2.97	230.00	361.94
Z-47	AUDTC					NA	314.74	0.00	0.00	200.00	314.74
Z-48	DZ	68	68	68	528	NA	3.46	0.00	0.00	2.20	3.46
Z-49	DZ	71	69	70	530	NA	0.07	0.00	0.00	0.05	0.07
Z-50	DZ	58	54	56	516	NA	0.94	0.00	0.00	0.60	0.94
Z-51	PEGF	56	56	56	516	NA	21,745.52	140.00	79.18	14,000.00	21,824.71
Z-52	SINV	78	80	79	539	NA	85,367.62	0.00	0.00	56,000.00	85,367.62
Z-53		82	86	84	544	NA	18,751.97	0.00	0.00	12,000.00	18,751.97
Z-54		65	65	65	525	NA	957.82	0.00	0.00	610.00	957.82
Z-55	AUDTD	65	65	65	525	NA	832.25	0.00	0.00	530.00	832.25
Z-56		75	75	75	535	NA	486.36	0.00	0.00	310.00	486.36
Z-57		75	70	73	532	NA	1,336.38	0.00	0.00	850.00	1,336.38
Z-58		65	65	65	525	NA	105.19	0.00	0.00	67.00	105.19

WSPA EMISSION RATE CALCULATION SPREADSHEET SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
							NMOC		Methane		THC	
ID	Code	MW fraction O2	MW fraction C3H8	% fraction N2	MW fraction N2	MW Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
Z-22	PEGI	0.6	0.0970	98.0	27.5	28.13	2.33E-03	2.04E+01	0.00E+00	0.00E+00	2.33E-03	2.04E+01
Z-23		1.4	0.0009	95.7	26.8	28.19	8.24E-05	7.22E-01	0.00E+00	0.00E+00	8.24E-05	7.22E-01
Z-24	DUP	1.4	0.0071	95.7	26.8	28.19	6.28E-04	5.50E+00	0.00E+00	0.00E+00	6.28E-04	5.50E+00
Z-25	SINV	0.1	0.0010	99.6	27.9	28.04	1.41E-05	1.24E-01	0.00E+00	0.00E+00	1.41E-05	1.24E-01
Z-26	PEG	0.1	0.6617	98.1	27.5	28.28	2.64E-03	2.31E+01	0.00E+00	0.00E+00	2.64E-03	2.31E+01
Z-27	PEG	0.1	1.4997	96.2	27.0	28.58	6.70E-03	5.87E+01	0.00E+00	0.00E+00	6.70E-03	5.87E+01
Z-28	L											
Z-29	L											
Z-30	L											
Z-31		0.9	0.0573	97.1	27.2	28.15	1.47E-03	1.28E+01	0.00E+00	0.00E+00	1.47E-03	1.28E+01
Z-32		0.1	0.0159	99.8	28.0	28.03	1.75E-04	1.53E+00	8.32E-07	7.29E-03	1.76E-04	1.54E+00
Z-33		0.3	0.0084	99.2	27.8	28.05	2.15E-04	1.88E+00	0.00E+00	0.00E+00	2.15E-04	1.88E+00
Z-34	DUP	0.3	0.0088	99.1	27.8	28.06	2.21E-04	1.93E+00	4.50E-06	3.94E-02	2.25E-04	1.97E+00
Z-35	L											
Z-36		0.1	0.0012	99.8	28.0	28.03	2.31E-05	2.02E-01	0.00E+00	0.00E+00	2.31E-05	2.02E-01
Z-37	PEG	0.1	4.1022	90.5	25.4	29.52	9.34E-02	8.19E+02	5.13E-04	4.50E+00	9.40E-02	8.23E+02
Z-38		1.1	0.1191	96.2	27.0	28.20	6.88E-03	6.03E+01	2.87E-06	2.51E-02	6.88E-03	6.03E+01
Z-39		0.1	0.0040	99.8	28.0	28.03	4.15E-05	3.63E-01	0.00E+00	0.00E+00	4.15E-05	3.63E-01
Z-40		0.5	0.0004	98.4	27.6	28.08	5.48E-06	4.80E-02	0.00E+00	0.00E+00	5.48E-06	4.80E-02
Z-41	DZ	1.0	0.0000	96.7	27.1	28.15	1.65E-07	1.45E-03	0.00E+00	0.00E+00	1.65E-07	1.45E-03
Z-42	DZ/AUDTT	0.7	0.0088	97.7	27.4	28.11	1.25E-04	1.10E+00	1.22E-06	1.07E-02	1.27E-04	1.11E+00
Z-43	DZ/AUDTT	0.7	0.0079	97.7	27.4	28.11	1.14E-04	9.99E-01	0.00E+00	0.00E+00	1.14E-04	9.99E-01
Z-44	DZ/AUDTT	0.9	0.0322	97.2	27.2	28.14	4.68E-04	4.10E+00	0.00E+00	0.00E+00	4.68E-04	4.10E+00
Z-45	DZ/AUDTT	0.9	0.0309	97.2	27.2	28.14	4.46E-04	3.91E+00	2.79E-06	2.45E-02	4.49E-04	3.93E+00
Z-46	AUDTC	0.0	0.0101	100.0	28.0	28.02						
Z-47	AUDTC	0.0	0.0088	100.0	28.0	28.02						
Z-48	DZ	0.1	0.0001	99.7	27.9	28.03	1.04E-06	9.10E-03	0.00E+00	0.00E+00	1.04E-06	9.10E-03
Z-49	DZ	0.1	0.0000	99.8	28.0	28.03	2.11E-08	1.85E-04	0.00E+00	0.00E+00	2.11E-08	1.85E-04
Z-50	DZ	0.2	0.0000	99.4	27.9	28.04	4.20E-07	3.68E-03	0.00E+00	0.00E+00	4.20E-07	3.68E-03
Z-51	PEGF	0.4	0.6175	97.5	27.3	28.29	1.46E-02	1.28E+02	5.33E-05	4.67E-01	1.47E-02	1.29E+02
Z-52	SINV	0.1	2.4702	94.2	26.4	28.93	2.21E-02	1.94E+02	0.00E+00	0.00E+00	2.21E-02	1.94E+02
Z-53		0.1	0.5293	98.6	27.6	28.22	4.93E-03	4.32E+01	0.00E+00	0.00E+00	4.93E-03	4.32E+01
Z-54		0.4	0.0269	98.5	27.6	28.09	2.46E-04	2.16E+00	0.00E+00	0.00E+00	2.46E-04	2.16E+00
Z-55	AUDTD	0.4	0.0234	98.5	27.6	28.08	2.14E-04	1.88E+00	0.00E+00	0.00E+00	2.14E-04	1.88E+00
Z-56		0.7	0.0137	97.9	27.4	28.11	2.50E-04	2.19E+00	0.00E+00	0.00E+00	2.50E-04	2.19E+00
Z-57		0.1	0.0375	99.5	27.9	28.05	3.73E-04	3.26E+00	0.00E+00	0.00E+00	3.73E-04	3.26E+00
Z-58		0.5	0.0030	98.3	27.5	28.09	6.20E-05	5.43E-01	0.00E+00	0.00E+00	6.20E-05	5.43E-01

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

Page 16f

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
Z-22	PEGI	
Z-23		Duplicate sample had THC concentration 7.6 times higher.
Z-24	DUP	Used Duplicate result in the statistical analysis, because analysis suggests the first result is not as accurate. Duplicate of Z023.
Z-25	SINV	SV varied by a factor of 2.5. Liquid sample Z028 taken.
Z-26	PEG	Plug. Liquid sample Z029 taken.
Z-27	PEG	Liquid sample Z030 taken.
Z-28	L	Reported with sample Z025.
Z-29	L	Reported with sample Z026.
Z-30	L	Reported with sample Z027.
Z-31		
Z-32		
Z-33		Liquid sample ID Z035 taken.
Z-34	DUP	
Z-35	L	Reported with sample ID Z033.
Z-36		
Z-37	PEG	
Z-38		
Z-39		
Z-40		
Z-41	DZ	
Z-42	DZ/AUDTT	RTI audit gas test.
Z-43	DZ/AUDTT	RTI audit gas test.
Z-44	DZ/AUDTT	RTI audit gas test.
Z-45	DZ/AUDTT	RTI audit gas test.
Z-46	AUDTC	RTI audit gas test.
Z-47	AUDTC	RTI audit gas test.
Z-48	DZ	
Z-49	DZ	
Z-50	DZ	Light rain.
Z-51	PEGF	O2 concentration varied by a factor of 10.
Z-52	SINV	SV varied by a factor of 3.
Z-53		
Z-54		
Z-55	AUDTD	Duplicate of Z054.
Z-56		Liquid sample Z064 taken.
Z-57		Liquid sample Z065 taken. Throttle turned off for final N2 reading.
Z-58		

Page 17a

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure (°Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
Z-59	SINV	12.5	66	30.00	C	4.00	TH			HL	Strip btms to stg
Z-60		7.5	68	30.00	C	1.50	U			GAS	Propane
Z-61		7.5	59	30.00	OEL		OEL			GAS	Propane
Z-62	SINV	12.5	59	30.00	PRV	1.00	PRV			GAS	Propane
Z-63		7.5	58	29.90	VALVE	1.00	GLOBE	M		GAS	Propane
Z-64	L	7.5	59	30.10						GAS	Propane
Z-65	L	7.5	64	30.10						GAS	Propane
Z-66	PEG	3.0	57	29.98	C	1.50	U			GAS	Propane
Z-67	PEG/DUP	3.0	57	29.98	C	1.50	U			GAS	Propane
Z-68	PEG/AUDTD	3.0	57	29.98	C	1.50	U			GAS	Propane
Z-69		7.5	55	30.00	VALVE	4.00	GATE	M		LL	Naptha
Z-70		7.5	56		C	1.00	TH			LL	Naptha
Z-71	SINV	7.5	57	30.00	VALVE	3.00	GATE	M		LL	Naptha
Z-72		7.5	57	30.00	PUMP	6.00	HC			LL	Naptha
Z-73	SINV	12.5	57	29.95	VALVE	8.00	GATE	M	Y	LL	Propane/butane
Z-74		12.5	55	29.98	VALVE	3.00	GATE	M		LL	Naptha
Z-75	L	7.5	56							LL	Naptha
Z-76	L	7.5	55	30.00						LL	Naptha
Z-77	L	12.5	57	29.95						LL	Naptha
Z-78	BL										
Z-79	PEG	5.0	60	30.33	VALVE	1.00	GLOBE	M		GAS	Fuel stream
Z-80	PEG	5.0	65	30.33	VALVE	1.00	GLOBE	M		GAS	Fuel stream
Z-81	PEG	7.5	56	30.33	VALVE	3.00	GLOBE	M		GAS	Fuel stream
Z-82	PEG/AUDTD	7.5	56	30.33	VALVE	3.00	GLOBE	M		GAS	Fuel stream
Z-83	DZ	7.5	54	30.12	VALVE	1.00	GLOBE	M		GAS	Fuel gas
Z-84	DZ	7.5	51	30.12	VALVE	6.00	GATE	M		GAS	Fuel gas
Z-85		7.5	53	30.12	VALVE	6.00	GATE	M		GAS	Fuel gas
Z-86		7.5	57	30.12	VALVE	8.00	GATE	M		GAS	
Z-87		7.5	58	30.12	VALVE	8.00	GATE	M		GAS	Fuel gas
Z-88		7.5	58	30.12	VALVE	3.00	GATE	M		HL	Platformate to storage
Z-89	DZ	10.0	55	30.08	VALVE	6.00	GATE	M		GAS	Fuel gas
Z-90	DZ	7.5	53	30.08	VALVE	6.00	GATE	M		GAS	Fuel gas
Z-91		7.5	54	30.08	VALVE	6.00	GATE	M		GAS	PG&E natural gas
Z-92	PEG	7.5	56		VALVE	4.00	GATE	M		LL	Propane
Z-93	DZ	7.5	54	30.02	VALVE	8.00	GATE	M		HL	Gas oil
Z-94	DZ	7.5	56	30.02	VALVE	8.00	GATE	M	Y	HL	Fuel oil
Z-95	DZ	7.5	56	30.02	VALVE	6.00	GATE	M	Y	HL	Jet fuel

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
Z-59	SINV		76,650				21,900				49,275	4	49,272
Z-60			400				500				450	4	446
Z-61			800				1,000				900	7	893
Z-62	SINV		1,200				4,000				2,600	5	2,595
Z-63			65,700				65,700				65,700	1	65,699
Z-64	L												
Z-65	L												
Z-66	PEG		100,000				100,000				100,000	10	99,990
Z-67	PEG/DUP		100,000				100,000				100,000	10	99,990
Z-68	PEG/AUDTD		100,000				100,000				100,000	10	99,990
Z-69		30	1,400				2,000				1,700	5	1,695
Z-70			20,000				35,000				27,500	7	27,493
Z-71	SINV	50	30,000				70,000				50,000	5	49,995
Z-72		400	5,000				5,000				5,000	3	4,997
Z-73	SINV	60	50				180				115	10	105
Z-74		50	50,000				30,000				40,000	4	39,997
Z-75	L												
Z-76	L												
Z-77	L												
Z-78	BL												
Z-79	PEG		100,000				100,000				100,000	10	99,990
Z-80	PEG		100,000	500	4,000	1,000	100,000	500	1,000	1,000	100,000	10	99,990
Z-81	PEG		100,000	50,000	250	7,500	100,000	20,000	500	100,000	100,000	3	99,997
Z-82	PEG/AUDTD		100,000	50,000	250	7,500	100,000	20,000	500	100,000	100,000	3	99,997
Z-83	DZ		1	1	1	1	1	1	1	1	1	1	0
Z-84	DZ		1	1	1	1	1	1	1	1	1	1	0
Z-85			1,900	1,700	700	800	2,000	1,000	700	1,000	1,950	1	1,949
Z-86			400	200	400	75	400	100	400	300	400	4	397
Z-87			350	200	300	150	320	70	160	275	335	4	332
Z-88			2,000	100	400	200	2,200	300	400	500	2,100	3	2,098
Z-89	DZ		1	1	1	1	1	1	1	1	1	1	0
Z-90	DZ		1	1	1	1	1	1	1	1	1	1	0
Z-91			2,500	2,000	900	100	2,200	1,800	200	900	2,350	7	2,343
Z-92	PEG		100,000	100,000	100,000	100,000	100,000				100,000	5	99,995
Z-93	DZ		1	1	1	1	1	1	1	1	1	1	0
Z-94	DZ		1	1	1	1	1	1	1	1	1	1	0
Z-95	DZ		1	1	1	1	1	1	1	1	1	1	0

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
Z-59	SINV	16,000	19,000	17,500	2,360	2,311	2,336	2.34	0.30	0.30	0.30	0.14
Z-60		500	450	475	1,830	1,854	1,842	1.84	0.20	0.20	0.20	0.11
Z-61		180	160	170	1,420	1,490	1,455	1.46	0.30	0.20	0.25	0.09
Z-62	SINV	35	24	30	3,964	3,983	3,974	3.97	0.60	0.20	0.40	0.24
Z-63		3,000	2,700	2,850	3,133	3,208	3,171	3.17	0.50	0.30	0.40	0.19
Z-64	L											
Z-65	L											
Z-66	PEG	3,500	3,500	3,500	2,135	2,105	2,120	2.12	0.20	0.20	0.20	0.13
Z-67	PEG/DUP	3,500	3,500	3,500	2,135	2,105	2,120	2.12	0.20	0.20	0.20	0.13
Z-68	PEG/AUDTD	3,500	3,500	3,500	2,135	2,105	2,120	2.12	0.20	0.20	0.20	0.13
Z-69		2,450	2,350	2,400	2,353	2,325	2,339	2.34	0.30	0.30	0.30	0.14
Z-70		58,100	50,000	54,050	1,241	1,267	1,254	1.25	1.00	1.30	1.15	0.08
Z-71	SINV	11,800	11,000	11,400	4,410	4,380	4,395	4.40	2.60	0.60	1.60	0.29
Z-72		4,000	4,000	4,000	13,100	13,100	13,100	13.10	4.00	2.00	3.00	0.92
Z-73	SINV	480	450	465	4,147	4,183	4,165	4.17	2.00	1.90	1.95	0.28
Z-74		1,600	1,800	1,700	4,370	4,410	4,390	4.39	2.40	0.40	1.40	0.28
Z-75	L											
Z-76	L											
Z-77	L											
Z-78	BL											
Z-79	PEG	100,000	100,000	100,000	5,334	5,270	5,302	5.30	0.20	0.20	0.20	0.32
Z-80	PEG	34,000	34,000	34,000	9,900	10,300	10,100	10.10	0.20	0.20	0.20	0.61
Z-81	PEG	100,000	100,000	100,000	20,000	19,990	19,995	20.00	0.15	0.15	0.15	1.21
Z-82	PEG/AUDTD	100,000	100,000	100,000	20,000	19,990	19,995	20.00	0.15	0.15	0.15	1.21
Z-83	DZ	1	1	1	2,104	2,058	2,081	2.08	0.20	0.20	0.20	0.13
Z-84	DZ	1	1	1	10,300	9,900	10,100	10.10	0.15	0.15	0.15	0.61
Z-85		2,800	2,800	2,800	11,100	12,700	11,900	11.90	0.20	0.15	0.18	0.72
Z-86		214	264	239	9,900	9,900	9,900	9.90	0.20	0.20	0.20	0.60
Z-87		178	196	187	9,900	9,900	9,900	9.90	0.20	0.20	0.20	0.60
Z-88		428	335	382	7,900	7,900	7,900	7.90	0.15	0.15	0.15	0.48
Z-89	DZ	1	1	1	8,300	8,300	8,300	8.30	0.10	0.10	0.10	0.50
Z-90	DZ	2.50	1.75	2	7,336	7,336	7,336	7.34	0.15	0.15	0.15	0.44
Z-91		1,530	784	1,157	8,300	8,300	8,300	8.30	0.15	0.15	0.15	0.50
Z-92	PEG	14,973	14,973	14,973	13,100	5,100	9,100	9.10	0.15	0.15	0.15	0.55
Z-93	DZ	1.0	1.0	1	9,980	10,500	10,240	10.24	0.15	0.15	0.15	0.62
Z-94	DZ	2.6	2.7	3	9,900	11,300	10,600	10.60	0.20	0.15	0.18	0.64
Z-95	DZ	4.25	4.25	4	9,800	9,800	9,800	9.80	0.15	0.15	0.15	0.59

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
Z-59	SINV	63	67	65	525	NA	79,435.73	0.00	0.00	52,000.00	79,435.73
Z-60		69	67	68	528	NA	320.49	100.00	57.08	240.00	377.57
Z-61		68	54	61	521	NA	99.03	47.00	26.83	80.00	125.86
Z-62	SINV	64	64	64	524	NA	6.45	0.00	0.00	4.10	6.45
Z-63		67	69	68	528	NA	2,397.80	480.00	273.67	1,700.00	2,671.46
Z-64	L										
Z-65	L										
Z-66	PEG	61	61	61	521	NA	894.50	720.00	410.82	830.00	1,305.32
Z-67	PEG/DUP	61	61	61	521	NA	1,014.56	730.00	416.51	910.00	1,431.07
Z-68	PEG/AUDTD	61	61	61	521	NA	758.06	1,400.00	798.75	990.00	1,556.81
Z-69		160	153	157	616	NA	6,903.41	2.20	1.25	4,400.00	6,904.67
Z-70		56	60	58	518	NA	203,638.92	0.00	0.00	140,000.00	203,638.92
Z-71	SINV	61	66	64	523	NA	24,845.88	90.00	50.81	16,000.00	24,896.69
Z-72		69	66	68	527	NA	7,013.31	37.00	20.98	4,500.00	7,034.29
Z-73	SINV	100	104	102	562	NA	988.45	0.00	0.00	630.00	988.45
Z-74		51	58	55	514	NA	2,815.90	15.00	8.54	1,800.00	2,824.44
Z-75	L										
Z-76	L										
Z-77	L										
Z-78	BL					NA	10.07	0.00	0.00	6.40	10.07
Z-79	PEG	62	63	63	522	NA	62,849.32	240,000.00	127,491.48	130,000.00	190,340.79
Z-80	PEG	66	65	66	525	NA	1,988.39	18,000.00	10,229.65	7,800.00	12,218.04
Z-81	PEG	58	56	57	517	NA	264.42	5,600.00	3,193.00	2,200.00	3,457.42
Z-82	PEG/AUDTD	58	56	57	517		0.00		0.00		0.00
Z-83	DZ	53	51	52	512	NA	5.51	0.00	0.00	3.50	5.51
Z-84	DZ	54	54	54	514	NA	2.99	0.00	0.00	1.90	2.99
Z-85		54	55	55	514	NA	133.81	620.00	353.88	310.00	487.69
Z-86		58	57	58	517	NA	12.85	96.00	54.80	43.00	67.66
Z-87		58	58	58	518	NA	12.73	110.00	62.79	48.00	75.52
Z-88		63	63	63	523	NA	849.45	0.00	0.00	540.00	849.45
Z-89	DZ	56	57	57	516	NA	0.07	0.00	0.00	0.0475	0.07
Z-90	DZ	54	54	54	514	NA	0.07	0.00	0.00	0.0475	0.07
Z-91		55	55	55	515	NA	40.67	480.00	274.00	200.00	314.67
Z-92	PEG	56	55	56	515	NA	31,113.56	0.00	0.00	20,000.00	31,113.56
Z-93	DZ	55	54	55	514	NA	0.07	0.00	0.00	0.0475	0.07
Z-94	DZ	58	58	58	518	NA	0.07	0.00	0.00	0.045	0.07
Z-95	DZ	57	57	57	517	NA	0.07	0.00	0.00	0.045	0.07

WSPA EMISSION RATE CALCULATION SPREADSHEET SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
		MW fraction	MW fraction	% fraction	MW fraction	MW	NMOC		Methane		THC	
ID	Code	O2	C3H8	N2	N2	Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
Z-59	SINV	0.1	2.2937	94.5	26.5	28.87	3.00E-02	2.63E+02	0.00E+00	0.00E+00	3.00E-02	2.63E+02
Z-60		0.1	0.0106	99.8	28.0	28.03	9.19E-05	8.05E-01	1.64E-05	1.43E-01	1.08E-04	9.48E-01
Z-61		0.1	0.0035	99.7	27.9	28.03	2.28E-05	2.00E-01	6.17E-06	5.41E-02	2.90E-05	2.54E-01
Z-62	SINV	0.1	0.0002	99.6	27.9	28.04	4.06E-06	3.55E-02	0.00E+00	0.00E+00	4.06E-06	3.55E-02
Z-63		0.1	0.0750	99.4	27.9	28.06	1.20E-03	1.05E+01	1.36E-04	1.20E+00	1.33E-03	1.17E+01
Z-64	L											
Z-65	L											
Z-66	PEG	0.1	0.0366	99.7	27.9	28.04	2.99E-04	2.62E+00	1.37E-04	1.20E+00	4.37E-04	3.82E+00
Z-67	PEG/DUP	0.1	0.0401	99.7	27.9	28.04	3.39E-04	2.97E+00	1.39E-04	1.22E+00	4.79E-04	4.19E+00
Z-68	PEG/AUDTD	0.1	0.0437	99.7	27.9	28.04	2.54E-04	2.22E+00	2.67E-04	2.34E+00	5.21E-04	4.56E+00
Z-69		0.1	0.1941	99.3	27.8	28.10	2.17E-03	1.90E+01	3.93E-07	3.45E-03	2.17E-03	1.90E+01
Z-70		0.4	6.1754	84.9	23.8	30.32	4.59E-02	4.02E+02	0.00E+00	0.00E+00	4.59E-02	4.02E+02
Z-71	SINV	0.5	0.7058	96.8	27.1	28.34	1.86E-02	1.63E+02	3.80E-05	3.33E-01	1.86E-02	1.63E+02
Z-72		1.0	0.1985	96.6	27.1	28.21	1.66E-02	1.46E+02	4.98E-05	4.36E-01	1.67E-02	1.46E+02
Z-73	SINV	0.6	0.0278	98.0	27.5	28.11	6.59E-04	5.77E+00	0.00E+00	0.00E+00	6.59E-04	5.77E+00
Z-74		0.4	0.0794	98.4	27.6	28.10	2.10E-03	1.84E+01	6.37E-06	5.58E-02	2.11E-03	1.85E+01
Z-75	L											
Z-76	L											
Z-77	L											
Z-78	BL	0.0	0.0003	100.0	28.0	28.02						
Z-79	PEG	0.1	5.7343	86.8	24.3	30.12	5.63E-02	4.93E+02	1.14E-01	1.00E+03	1.71E-01	1.49E+03
Z-80	PEG	0.1	0.3441	99.0	27.7	28.15	3.15E-03	2.76E+01	1.62E-02	1.42E+02	1.94E-02	1.70E+02
Z-81	PEG	0.0	0.0970	99.6	27.9	28.06	8.39E-04	7.35E+00	1.01E-02	8.88E+01	1.10E-02	9.61E+01
Z-82	PEG/AUDTD	0.0	0.0000	99.9	28.0	28.03						
Z-83	DZ	0.1	0.0002	99.8	28.0	28.03	1.84E-06	1.61E-02	0.00E+00	0.00E+00	1.84E-06	1.61E-02
Z-84	DZ	0.0	0.0001	99.8	28.0	28.03	4.81E-06	4.22E-02	0.00E+00	0.00E+00	4.81E-06	4.22E-02
Z-85		0.1	0.0137	99.8	28.0	28.03	2.54E-04	2.23E+00	6.72E-04	5.88E+00	9.26E-04	8.11E+00
Z-86		0.1	0.0019	99.8	28.0	28.03	2.02E-05	1.77E-01	8.61E-05	7.55E-01	1.06E-04	9.32E-01
Z-87		0.1	0.0021	99.8	28.0	28.03	2.00E-05	1.75E-01	9.86E-05	8.64E-01	1.19E-04	1.04E+00
Z-88		0.0	0.0238	99.8	28.0	28.03	1.05E-03	9.21E+00	0.00E+00	0.00E+00	1.05E-03	9.21E+00
Z-89	DZ	0.0	0.0000	99.9	28.0	28.02	9.82E-08	8.60E-04	0.00E+00	0.00E+00	9.82E-08	8.60E-04
Z-90	DZ	0.0	0.0000	99.8	28.0	28.03	8.74E-08	7.66E-04	0.00E+00	0.00E+00	8.74E-08	7.66E-04
Z-91		0.0	0.0088	99.8	28.0	28.03	5.37E-05	4.71E-01	3.62E-04	3.17E+00	4.16E-04	3.64E+00
Z-92	PEG	0.0	0.8822	97.9	27.4	28.35	4.55E-02	3.99E+02	0.00E+00	0.00E+00	4.55E-02	3.99E+02
Z-93	DZ	0.0	0.0000	99.8	28.0	28.03	1.22E-07	1.07E-03	0.00E+00	0.00E+00	1.22E-07	1.07E-03
Z-94	DZ	0.1	0.0000	99.8	28.0	28.03	1.19E-07	1.04E-03	0.00E+00	0.00E+00	1.19E-07	1.04E-03
Z-95	DZ	0.0	0.0000	99.8	28.0	28.03	1.10E-07	9.64E-04	0.00E+00	0.00E+00	1.10E-07	9.64E-04

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
Z-59	SINV	SV varied by a factor of 3.5. Plug.
Z-60		
Z-61		Heavy rain.
Z-62	SINV	SV varied by a factor of 3.3. Final SV fluctuating betw. 30 and 4000 ppm.
Z-63		
Z-64	L	Reported with sample Z056.
Z-65	L	Reported with sample Z057.
Z-66	PEG	
Z-67	PEG/DUP	Duplicate of Z066.
Z-68	PEG/AUDTD	Sample to RTI. Duplicate of Z066.
Z-69		Liquid sample Z076 taken.
Z-70		Liquid sample Z075 taken. Plug.
Z-71	SINV	SV varied by a factor of 2.3. Final SV fluctuating between 10,000 and 100,000.
Z-72		
Z-73	SINV	SV varied by a factor of 3.6. Liquid sample ID Z077 taken.
Z-74		
Z-75	L	Reported with sample ID Z070.
Z-76	L	Reported with sample ID Z069.
Z-77	L	Reported with sample ID Z073.
Z-78	BL	
Z-79	PEG	Increased N2 flow in an attempt to get a THC reading <100,000.
Z-80	PEG	
Z-81	PEG	Increased N2 flow in an attempt to get a THC reading <100,000.
Z-82	PEG/AUDTD	RTI dup. Increased N2 flow in an attempt to get a THC reading <100,000. Duplicate of Z081.
Z-83	DZ	Sample line has been checked and zero contamination was observed.
Z-84	DZ	
Z-85		Dilution factor altered 35000 ppm STD.
Z-86		
Z-87		
Z-88		
Z-89	DZ	
Z-90	DZ	
Z-91		Battery changed & FID recalibrated before final bag reading. QC 998 std > 1000ppm.
Z-92	PEG	
Z-93	DZ	
Z-94	DZ	Bag THC concentration fluctuated.
Z-95	DZ	

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ("Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
Z-96	DZ	7.5	57	30.02	OEL	6.00	OEL			HL	Jet fuel
Z-97	INV	7.5	60		VALVE	8.00	GATE	M		GAS	Gas
Z-98	AUDTD	7.5	60		VALVE	8.00	GATE	M		GAS	Gas
Z-99	BL										
Z-100	PEG	2.0	47		PUMP				N	LL	
Z-101	PEG/AUDTD	2.0	47		PUMP				N	LL	
Z-102		2.5	50		PUMP				N	LL	
Z-103	DUP	2.5	50		PUMP				N	LL	
Z-104	N2-5/SINV	2.0	57		PUMP		CENT			HL	Jet fuel
Z-105	N2-5/SINV	2.5	55		PUMP					HL	Jet fuel
Z-106	N2-5/SINV	2.5	57		PUMP					HL	Jet fuel
Z-107	N2-5/SINV	2.5	59		PUMP					HL	Jet fuel
Z-108	N2-5/SINV	2.5	60		PUMP					HL	Jet fuel
Z-109	DZ	2.5	53		PUMP					LL	Naptha
Z-110	DZ/AUDTD	2.5	53		PUMP					LL	Naptha
Z-111	DZ	2.5	57	30.04	OEL	6.00	OEL			HL	Jet fuel
Z-112	DZ	2.5	53	30.04	C	1.00	TH			LL	Gasoline
Z-113	DZ	2.5	58	30.04	VALVE	1.00	GATE	M		LL	Gasoline
Z-114	DZ	2.5	56	30.04	C	2.00	C			LL	Gasoline
Z-115	PEG	2.5	60	30.04	VALVE	2.00	GATE	M		GAS	Gasoline
Z-116	PEG/AUDTD	6.0	57	30.04	VALVE	2.00	GATE	M		GAS	Gasoline
Z-117	DZ	2.5	47	30.04	C	2.00	TH			GAS	Fuel Gas
Z-118		2.5	53	30.05	VALVE	1.00	GATE	M		LL	Naptha
Z-119		2.5	55	30.10	VALVE	1.00	GATE	M		LL	Naptha
Z-120	SINV	2.5	54	30.00	VALVE	4.00	GATE	M		LL	Naptha
Z-121		2.5	53	30.05	VALVE	4.00	GATE	M		LL	Naptha
Z-122		2.5	49	30.00	VALVE	4.00	GATE	M		LL	Naptha
Z-123	N2-6	2.5	49		VALVE	0.75	GATE	M		GAS	
Z-124	N2-6	2.5	49		VALVE	0.75	GATE	M		GAS	
Z-125	N2-6	2.5	49		VALVE	0.75	GATE	M		GAS	
Z-126	N2-6	2.5	49		VALVE	0.75	GATE	M		GAS	
Z-127	N2-6	2.5	50		VALVE	0.75	GATE	M		GAS	
Z-128	N2-6	2.5	48		VALVE	0.75	GATE	M		GAS	
Z-129	N2-6	2.5	53		VALVE	0.75	GATE	M		GAS	
Z-130	N2-7	2.5	53		VALVE	0.75	GATE	M		GAS	
Z-131	N2-7	2.5	49		VALVE	0.75	GATE	M		GAS	
Z-132	N2-7	2.5	49		VALVE	0.75	GATE	M		GAS	

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
Z-96	DZ		1	1	1	1	1	1	1	1	1	1	0
Z-97	INV		60	25	25	50	80	30	50	50	70	18	53
Z-98	AUDTD		60	25	25	50	80	30	50	50	70	18	53
Z-99	BL												
Z-100	PEG		100,000	10,000		100,000	100,000	100,000		100,000	100,000	5	99,995
Z-101	PEG/AUDTD		100,000	10,000		100,000	100,000	100,000		100,000	100,000	5	99,995
Z-102			5,000	450	500		7,000		4,000	300	6,000	30	5,970
Z-103	DUP		5,000	450	500		7,000		4,000	300	6,000	30	5,970
Z-104	N2-5/SINV		300	50	70	70	1,000	250	70	200	650	6.5	644
Z-105	N2-5/SINV		300	50	70	70	1,000	250	70	200	650	6.5	644
Z-106	N2-5/SINV		300	50	70	70	1,000	250	70	200	650	6.5	644
Z-107	N2-5/SINV		300	50	70	70	1,000	250	70	200	650	6.5	644
Z-108	N2-5/SINV		300	50	70	70	1,000	250	70	200	650	6.5	644
Z-109	DZ		1	1	1	1	1	1	1	1	1	1	0
Z-110	DZ/AUDTD		1	1	1	1	1	1	1	1	1	1	0
Z-111	DZ		1	1	1	1	1	1	1	1	1	1	0
Z-112	DZ		1	1	1	1	1	1	1	1	1	1	0
Z-113	DZ		1	1	1	1	1	1	1	1	1	1	0
Z-114	DZ		1	1	1	1	1	1	1	1	1	1	0
Z-115	PEG		100,000	5,000	2,000	750	100,000				100,000	3	99,998
Z-116	PEG/AUDTD		100,000	5,000	2,000	750	100,000				100,000	3	99,998
Z-117	DZ		1	1	1	1	1	1	1	1	1	1	0
Z-118			150				300	200	160	60	225	1	224
Z-119			1,100	160	180	140	1,400	1,400	700	700	1,250	2	1,248
Z-120	SINV		350	35	100	120	1,000	300	200	750	675	1	674
Z-121			600	100	200	70	350	80	50	30	475	1	474
Z-122			2,000	1,400	500	1,000	2,200	1,200	25	1,500	2,100	4	2,097
Z-123	N2-6		750				850				800	1.5	799
Z-124	N2-6		750				850				800	1.5	799
Z-125	N2-6		750				850				800	1.5	799
Z-126	N2-6		750				850				800	1.5	799
Z-127	N2-6		750				850				800	1.5	799
Z-128	N2-6		750				850				800	1.5	799
Z-129	N2-6		750				850				800	1.5	799
Z-130	N2-7		90,000	10,000	75,000	50,000	70,000	25,000	40,000	16,000	80,000	1	79,999
Z-131	N2-7		90,000	10,000	75,000	50,000	70,000	25,000	40,000	16,000	80,000	1	79,999
Z-132	N2-7		90,000	10,000	75,000	50,000	70,000	25,000	40,000	16,000	80,000	1	79,999

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
Z-96	DZ	1	0	1	1,008	1,174	1,091	1.09	0.15	0.15	0.15	0.07
Z-97	INV	107	129	118	9,800	11,100	10,450	10.45	0.20	0.15	0.18	0.63
Z-98	AUDTD	107	129	118	9,800	11,100	10,450	10.45	0.20	0.15	0.18	0.63
Z-99	BL											
Z-100	PEG	100,000	100,000	100,000	9,800	9,800	9,800	9.80	0.30	0.50	0.40	0.60
Z-101	PEG/AUDTD	100,000	100,000	100,000	9,800	9,800	9,800	9.80	0.30	0.50	0.40	0.60
Z-102		1,600	2,500	2,050	4,988	4,988	4,988	4.99	3.00	1.50	2.25	0.34
Z-103	DUP	1,600	2,500	2,050	4,988	4,988	4,988	4.99	3.00	1.50	2.25	0.34
Z-104	N2-5/SINV	550	550	550	2,004	2,064	2,034	2.03	0.20	0.20	0.20	0.12
Z-105	N2-5/SINV	450	450	450	4,637	4,881	4,759	4.76	0.15	0.15	0.15	0.29
Z-106	N2-5/SINV	900	600	750	9,800	9,800	9,800	9.80	0.10	0.10	0.10	0.59
Z-107	N2-5/SINV	500	450	475	21,900	21,000	21,450	21.45	0.10	0.10	0.10	1.29
Z-108	N2-5/SINV	1,700	1,700	1,700	2,044	1,893	1,969	1.97	0.15	0.15	0.15	0.12
Z-109	DZ	0	1	1	11,100	10,300	10,700	10.70	0.15	0.15	0.15	0.65
Z-110	DZ/AUDTD	0.1	1	1	11,100	10,300	10,700	10.70	0.15	0.15	0.15	0.65
Z-111	DZ	1	1	1	2,000	2,097	2,049	2.05	0.15	0.15	0.15	0.12
Z-112	DZ	1	1	1	723	1,241	982	0.98	0.15	0.15	0.15	0.06
Z-113	DZ	1	1	1	1,272	1,288	1,280	1.28	0.15	0.15	0.15	0.08
Z-114	DZ	1	1	1	1,420	714	1,067	1.07	0.15	0.15	0.15	0.06
Z-115	PEG	39,000	35,000	37,000	3,007	1,944	2,476	2.48	0.15	0.15	0.15	0.15
Z-116	PEG/AUDTD	39,000	35,000	37,000	3,007	1,944	2,476	2.48	0.15	0.15	0.15	0.15
Z-117	DZ	1	1	1	2,099	2,134	2,117	2.12	0.15	0.15	0.15	0.13
Z-118		420	410	415	3,290	3,231	3,261	3.26	0.15	0.15	0.15	0.20
Z-119		810	800	805	2,964	3,016	2,990	2.99	0.15	0.15	0.15	0.18
Z-120	SINV	550	470	510	10,250	10,250	10,250	10.25	0.20	0.18	0.19	0.62
Z-121		1,400	950	1,175	10,250	10,250	10,250	10.25	0.15	0.15	0.15	0.62
Z-122		290	280	285	10,500	10,500	10,500	10.50	0.20	0.20	0.20	0.64
Z-123	N2-6	590	600	595	2,022	2,000	2,011	2.01	0.15	0.18	0.17	0.12
Z-124	N2-6	125	125	125	10,700	10,700	10,700	10.70	0.10	0.10	0.10	0.65
Z-125	N2-6	74	73	74	19,250	19,250	19,250	19.25	0.10	0.10	0.10	1.16
Z-126	N2-6	950	930	940	1,074	1,108	1,091	1.09	2.80	2.00	2.40	0.07
Z-127	N2-6	1,600	1,500	1,550	534	532	533	0.53	4.70	3.70	4.20	0.04
Z-128	N2-6	230	260	245	4,906	4,886	4,896	4.90	0.20	0.20	0.20	0.30
Z-129	N2-6	600	610	605	1,964	1,947	1,956	1.96	0.45	0.30	0.38	0.12
Z-130	N2-7	2,600	2,600	2,600	19,250	19,250	19,250	19.25	0.15	0.15	0.15	1.16
Z-131	N2-7	5,500	5,100	5,300	10,300	10,300	10,300	10.30	0.15	0.15	0.15	0.62
Z-132	N2-7	50,000	50,000	50,000	1,097	1,100	1,099	1.10	2.70	3.10	2.90	0.08

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
Z-96	DZ	60	60	60	520	NA	0.07	0.00	0.00	0.0475	0.07
Z-97	INV	66	67	67	526	NA	26.78	22.00	12.56	25.00	39.34
Z-98	AUDTD	66	67	67	526						
Z-99	BL										
Z-100	PEG	46	44	45	505	NA	202,888.75	1,800.00	950.86	140,000.00	203,839.61
Z-101	PEG/AUDTD	46	44	45	505		0.00		0.00		0.00
Z-102		49	50	50	509	NA	2,350.65	1.10	0.63	1,500.00	2,351.27
Z-103	DUP	49	50	50	509	NA	2,350.65	1.10	0.63	1,500.00	2,351.27
Z-104	N2-5/SINV	56	56	56	516	NA	660.68	0.00	0.00	420.00	660.68
Z-105	N2-5/SINV	55	57	56	516	NA	440.52	0.00	0.00	280.00	440.52
Z-106	N2-5/SINV	56	57	57	516	NA	755.14	0.00	0.00	480.00	755.14
Z-107	N2-5/SINV	57	58	58	517	NA	409.09	0.00	0.00	260.00	409.09
Z-108	N2-5/SINV	58	59	59	518	NA	2,201.19	0.00	0.00	1,400.00	2,201.19
Z-109	DZ	53	54	54	513	NA	0.07	0.00	0.00	0.045	0.07
Z-110	DZ/AUDTD	53	54	54	513	NA					0.00
Z-111	DZ	59	60	60	519	NA	0.07	0.00	0.00	0.0475	0.07
Z-112	DZ	56	56	56	516	NA	0.07	0.00	0.00	0.045	0.07
Z-113	DZ	56	54	55	515	NA	0.07	0.00	0.00	0.0475	0.07
Z-114	DZ	56	57	57	516	NA	0.07	0.00	0.00	0.045	0.07
Z-115	PEG	62	62	62	522	NA	24,904.96	11,000.00	6,208.60	20,000.00	31,113.56
Z-116	PEG/AUDTD	62	62	62	522						
Z-117	DZ	65	64	65	524	NA	1.57	0.00	0.00	1.00	1.57
Z-118		64	90	77	537	NA	534.90	0.00	0.00	340.00	534.90
Z-119		68	87	78	537	NA	1,396.20	6.20	3.54	890.00	1,399.74
Z-120	SINV	147	171	159	619	NA	928.02	0.00	0.00	590.00	928.02
Z-121		87	108	98	557	NA	1,572.64	0.00	0.00	1,000.00	1,572.64
Z-122		63	66	65	524	NA	187.41	30.00	17.12	130.00	204.53
Z-123	N2-6	55	53	54	514	NA	101.79	180.00	102.75	130.00	204.54
Z-124	N2-6	55	54	55	514	NA	23.08	34.00	19.41	27.00	42.49
Z-125	N2-6	54	54	54	514	NA	13.33	18.00	10.28	15.00	23.60
Z-126	N2-6	54	54	54	514	NA	178.63	320.00	182.08	230.00	360.71
Z-127	N2-6	55	54	55	514	NA	(2,609.10)	5,700.00	3,234.78	400.00	625.67
Z-128	N2-6	55	54	55	514	NA	45.44	72.00	41.10	55.00	86.54
Z-129	N2-6	55	55	55	515	NA	96.05	190.00	108.43	130.00	204.48
Z-130	N2-7	56	57	57	516	NA	385.64	730.00	416.63	510.00	802.27
Z-131	N2-7	53	52	53	512	NA	816.94	1,600.00	912.86	1,100.00	1,729.80
Z-132	N2-7	59	52	56	515	NA	11,338.40	13,000.00	7,342.43	12,000.00	18,680.83

WSPA EMISSION RATE CALCULATION SPREADSHEET   SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
		MW fraction	MW.fraction	% fraction	MW fraction	MW	NMOC		Methane		THC	
ID	Code	O2	C3H8	N2	N2	Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
Z-96	DZ	0.0	0.0000	99.8	28.0	28.03	1.29E-08	1.13E-04	0.00E+00	0.00E+00	1.29E-08	1.13E-04
Z-97	INV	0.1	0.0011	99.8	28.0	28.03	4.36E-05	3.82E-01	2.05E-05	1.79E-01	6.41E-05	5.61E-01
Z-98	AUDTD	0.1	0.0000	99.8	28.0	28.03						
Z-99	BL											
Z-100	PEG	0.1	6.1754	85.6	24.0	30.29	3.53E-01	3.09E+03	1.65E-03	1.45E+01	3.55E-01	3.11E+03
Z-101	PEG/AUDTD	0.1	0.0000	99.6	27.9	28.04						
Z-102		0.7	0.0662	97.6	27.3	28.13	2.11E-03	1.84E+01	5.60E-07	4.91E-03	2.11E-03	1.84E+01
Z-103	DUP	0.7	0.0662	97.6	27.3	28.13	2.11E-03	1.84E+01	5.60E-07	4.91E-03	2.11E-03	1.84E+01
Z-104	N2-5/SINV	0.1	0.0185	99.8	28.0	28.03	2.14E-04	1.87E+00	0.00E+00	0.00E+00	2.14E-04	1.87E+00
Z-105	N2-5/SINV	0.0	0.0124	99.8	28.0	28.03	3.33E-04	2.92E+00	0.00E+00	0.00E+00	3.33E-04	2.92E+00
Z-106	N2-5/SINV	0.0	0.0212	99.9	28.0	28.03	1.17E-03	1.03E+01	0.00E+00	0.00E+00	1.17E-03	1.03E+01
Z-107	N2-5/SINV	0.0	0.0115	99.9	28.0	28.03	1.39E-03	1.21E+01	0.00E+00	0.00E+00	1.39E-03	1.21E+01
Z-108	N2-5/SINV	0.0	0.0618	99.7	27.9	28.05	6.85E-04	6.00E+00	0.00E+00	0.00E+00	6.85E-04	6.00E+00
Z-109	DZ	0.0	0.0000	99.8	28.0	28.03	1.21E-07	1.06E-03	0.00E+00	0.00E+00	1.21E-07	1.06E-03
Z-110	DZ/AUDTD	0.0	0.0000	99.9	28.0	28.03						
Z-111	DZ	0.0	0.0000	99.8	28.0	28.03	2.42E-08	2.12E-04	0.00E+00	0.00E+00	2.42E-08	2.12E-04
Z-112	DZ	0.0	0.0000	99.8	28.0	28.03	1.10E-08	9.67E-05	0.00E+00	0.00E+00	1.10E-08	9.67E-05
Z-113	DZ	0.0	0.0000	99.8	28.0	28.03	1.52E-08	1.33E-04	0.00E+00	0.00E+00	1.52E-08	1.33E-04
Z-114	DZ	0.0	0.0000	99.8	28.0	28.03	1.20E-08	1.05E-04	0.00E+00	0.00E+00	1.20E-08	1.05E-04
Z-115	PEG	0.0	0.8822	97.9	27.4	28.35	9.79E-03	8.58E+01	2.44E-03	2.14E+01	1.22E-02	1.07E+02
Z-116	PEG/AUDTD	0.0	0.0000	99.9	28.0	28.03						
Z-117	DZ	0.0	0.0000	99.8	28.0	28.03	5.20E-07	4.56E-03	0.00E+00	0.00E+00	5.20E-07	4.56E-03
Z-118		0.0	0.0150	99.8	28.0	28.03	2.66E-04	2.33E+00	0.00E+00	0.00E+00	2.66E-04	2.33E+00
Z-119		0.0	0.0393	99.8	28.0	28.04	6.37E-04	5.58E+00	1.61E-06	1.41E-02	6.38E-04	5.59E+00
Z-120	SINV	0.1	0.0260	99.8	28.0	28.04	1.26E-03	1.11E+01	0.00E+00	0.00E+00	1.26E-03	1.11E+01
Z-121		0.0	0.0441	99.8	27.9	28.04	2.37E-03	2.08E+01	0.00E+00	0.00E+00	2.37E-03	2.08E+01
Z-122		0.1	0.0057	99.8	28.0	28.03	3.08E-04	2.70E+00	2.82E-05	2.47E-01	3.36E-04	2.95E+00
Z-123	N2-6	0.1	0.0057	99.8	28.0	28.03	3.27E-05	2.86E-01	3.30E-05	2.89E-01	6.56E-05	5.75E-01
Z-124	N2-6	0.0	0.0012	99.9	28.0	28.02	3.92E-05	3.44E-01	3.30E-05	2.89E-01	7.22E-05	6.33E-01
Z-125	N2-6	0.0	0.0007	99.9	28.0	28.02	4.08E-05	3.57E-01	3.15E-05	2.76E-01	7.23E-05	6.33E-01
Z-126	N2-6	0.8	0.0101	97.6	27.3	28.12	3.50E-05	3.06E-01	3.56E-05	3.12E-01	7.06E-05	6.18E-01
Z-127	N2-6	1.3	0.0176	95.8	26.8	28.19	-2.77E-04	-2.42E+00	3.43E-04	3.00E+00	6.63E-05	5.81E-01
Z-128	N2-6	0.1	0.0024	99.8	28.0	28.03	3.55E-05	3.11E-01	3.21E-05	2.82E-01	6.77E-05	5.93E-01
Z-129	N2-6	0.1	0.0057	99.6	27.9	28.04	3.02E-05	2.65E-01	3.41E-05	2.99E-01	6.44E-05	5.64E-01
Z-130	N2-7	0.0	0.0225	99.8	28.0	28.03	1.18E-03	1.03E+01	1.27E-03	1.12E+01	2.45E-03	2.15E+01
Z-131	N2-7	0.0	0.0485	99.7	27.9	28.04	1.35E-03	1.18E+01	1.50E-03	1.32E+01	2.85E-03	2.50E+01
Z-132	N2-7	0.9	0.5293	95.9	26.9	28.33	2.31E-03	2.02E+01	1.49E-03	1.31E+01	3.80E-03	3.33E+01

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
Z-96	DZ	
Z-97	INV	QC Check 998=1500ppm. QC check failed.
Z-98	AUDTD	Sample to RTI. Duplicate of Z097.
Z-99	BL	
Z-100	PEG	QC=1050ppm
Z-101	PEG/AUDTD	Duplicate of Z100.
Z-102		Maxium SV shifted from N. to S. for Pre and Post SV.
Z-103	DUP	Field Dup of Z102. Pump off.
Z-104	N2-5/SINV	SV varied by a factor of 3.3. Nitrogen flow test #5.
Z-105	N2-5/SINV	SV varied by a factor of 3.3. Nitrogen flow test #5.
Z-106	N2-5/SINV	SV varied by a factor of 3.3. Nitrogen flow test #5.
Z-107	N2-5/SINV	SV varied by a factor of 3.3. Nitrogen flow test #5.
Z-108	N2-5/SINV	SV varied by a factor of 3.3. Nitrogen flow test #5.
Z-109	DZ	
Z-110	DZ/AUDTD	Duplicate of Z109.
Z-111	DZ	
Z-112	DZ	
Z-113	DZ	
Z-114	DZ	
Z-115	PEG	
Z-116	PEG/AUDTD	Duplicate of Z115.
Z-117	DZ	
Z-118		Repeat because of high variability of O2 in last test. SV varied by a factor of 2.
Z-119		Checked gauge and OVA--No contamination--no leaks
Z-120	SINV	SV varied by a factor of 2.9.
Z-121		
Z-122		Checked pressure gauge with OVA – No contamination
Z-123	N2-6	Nitrogen flow test #6.
Z-124	N2-6	Very Steady flow of Hydrocarbons from leak. Nitrogen flow test #6.
Z-125	N2-6	Nitrogen flow test #6.
Z-126	N2-6	Nitrogen flow test #6.
Z-127	N2-6	Nitrogen flow test #6.
Z-128	N2-6	Nitrogen flow test #6.
Z-129	N2-6	Raining. Nitrogen flow test #6.
Z-130	N2-7	Light rain, but value is dry. Nitrogen flow test #7.
Z-131	N2-7	Raining. Nitrogen flow test #7.
Z-132	N2-7	Raining. Nitrogen flow test #7.

Page 19a

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ("Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
Z-133	N2-7	2.5	49		VALVE	0.75	GATE	M		GAS	
Z-134	N2-7	2.5	50		VALVE	0.75	GATE	M		GAS	
Z-135	N2-7	2.5	49		VALVE	0.75	GATE	M		GAS	
Z-136	N2-7	2.5	49		VALVE	0.75	GATE	M		GAS	
Z-137	ACCY/N2-8	5.0	50		VALVE	1.00	GATE	M		H20	
Z-138	ACCY/N2-8	2.5	50		VALVE	1.00	GATE	M		H20	
Z-139	ACCY/N2-8	2.5	50		VALVE	1.00	GATE	M		H20	
Z-140	ACCY/N2-8	2.5	50		VALVE	1.00	GATE	M		H20	
Z-141	ACCY/N2-8	2.5	50		VALVE	1.00	GATE	M		H20	
Z-142	ACCY/N2-8	2.5	57		VALVE	1.00	GATE	M		H20	
Z-143	ACCY/N2-8	2.5	50		VALVE	1.00	GATE	M		H20	
Z-144		5.0	52		VALVE	0.75	GATE	M		GAS	Fuel Gas
Z-145	L	5.0	52		VALVE	0.75	GATE	M		LL	
Z-146	N2-9	5.0	61		C	1.00	TH			LL	
Z-147	N2-9	5.0	63		C	1.00	TH			LL	
Z-148	N2-9	2.0	66		C	1.00	TH			LL	
Z-149	N2-9	2.0	64		C	1.00	TH			LL	
Z-150	N2-9	2.0	63		C	1.00	TH			LL	
Z-151	N2-9	5.0	63		C	1.00	TH			LL	
Z-152	N2-9	2.0	62		C	1.00	TH			LL	
Z-153	N2-10	7.0	67		VALVE	4.00	GATE	M		LL	
Z-154	N2-10	7.0	69		VALVE	4.00	GATE	M		LL	
Z-155	N2-10	10.0	63		VALVE	4.00	GATE	M		LL	
Z-156	N2-10	10.0	62		VALVE	4.00	GATE	M		LL	
Z-157	N2-10	10.0	64		VALVE	4.00	GATE	M		LL	
Z-158	N2-11	2.0	57		C	0.75	TH			LL	
Z-159	N2-11	2.0	65		C	0.75	TH			LL	
Z-160	N2-11	1.0	60		C	0.75	TH				
Z-161	N2-11	1.0	61		C	0.75	TH			LL	
Z-162	N2-11	1.0	64		C	0.75	TH			LL	
Z-163	N2-11	0.0	65		C	0.75	TH			LL	
Z-164	N2-11	2.0	62		C	0.75	TH			LL	
Z-165	PEGF	5.0	67		OEL	0.25	OEL			LL	
Z-166	DZ	5.0	68		VALVE	3.00	GATE			LL	
Z-167	DZ	5.0	68		VALVE	1.00	GATE			LL	
Z-168	BL									LL	
Z-169	DZ	2.0	56		VALVE	3.00	GATE			LL	

Page 19b

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
Z-133	N2-7		90,000	10,000	75,000	50,000	70,000	25,000	40,000	16,000	80,000	1	79,999
Z-134	N2-7		90,000	10,000	75,000	50,000	70,000	25,000	40,000	16,000	80,000	1	79,999
Z-135	N2-7		90,000	10,000	75,000	50,000	70,000	25,000	40,000	16,000	80,000	1	79,999
Z-136	N2-7		90,000	10,000	75,000	50,000	70,000	25,000	40,000	16,000	80,000	1	79,999
Z-137	ACCY/N2-8		1	1	1	1	1	1	1	1	1	1	0
Z-138	ACCY/N2-8		1	1	1	1	1	1	1	1	1	1	0
Z-139	ACCY/N2-8		1	1	1	1	1	1	1	1	1	1	0
Z-140	ACCY/N2-8		1	1	1	1	1	1	1	1	1	1	0
Z-141	ACCY/N2-8		1	1	1	1	1	1	1	1	1	1	0
Z-142	ACCY/N2-8		1	1	1	1	1	1	1	1	1	1	0
Z-143	ACCY/N2-8		1	1	1	1	1	1	1	1	1	1	0
Z-144			900	700	10	60	1,200	300	200	500	1,050	1	1,049
Z-145	L		900	700	10	60							
Z-146	N2-9		10,000	9,000	1,000	5,000	9,500	6,500	7,000	4,500	9,750	2.5	9,748
Z-147	N2-9		10,000	9,000	1,000	5,000	9,500	6,500	7,000	4,500	9,750	2.5	9,748
Z-148	N2-9		10,000	9,000	1,000	5,000	9,500	6,500	7,000	4,500	9,750	2.5	9,748
Z-149	N2-9		10,000	9,000	1,000	5,000	9,500	6,500	7,000	4,500	9,750	2.5	9,748
Z-150	N2-9		10,000	9,000	1,000	5,000	9,500	6,500	7,000	4,500	9,750	2.5	9,748
Z-151	N2-9		10,000	9,000	1,000	5,000	9,500	6,500	7,000	4,500	9,750	2.5	9,748
Z-152	N2-9		10,000	9,000	1,000	5,000	9,500	6,500	7,000	4,500	9,750	2.5	9,748
Z-153	N2-10		1,100	120	300	500	2,100	800	800	500	1,600	2.0	1,598
Z-154	N2-10		1,100	120	300	500	2,100	800	800	500	1,600	2.0	1,598
Z-155	N2-10		1,100	120	300	500	2,100	800	800	500	1,600	2.0	1,598
Z-156	N2-10		1,100	120	300	500	2,100	800	800	500	1,600	2.0	1,598
Z-157	N2-10		1,100	120	300	500	2,100	800	800	500	1,600	2.0	1,598
Z-158	N2-11		80,000	5,000	20,000	70,000	45,000	5,000	5,000	25,000	62,500	17.5	62,483
Z-159	N2-11		80,000	5,000	20,000	70,000	45,000	5,000	5,000	25,000	62,500	17.5	62,483
Z-160	N2-11		80,000	5,000	20,000	70,000	45,000	5,000	5,000	25,000	62,500	17.5	62,483
Z-161	N2-11		80,000	5,000	20,000	70,000	45,000	5,000	5,000	25,000	62,500	17.5	62,483
Z-162	N2-11		80,000	5,000	20,000	70,000	45,000	5,000	5,000	25,000	62,500	17.5	62,483
Z-163	N2-11		80,000	5,000	20,000	70,000	45,000	5,000	5,000	25,000	62,500	17.5	62,483
Z-164	N2-11		80,000	5,000	20,000	70,000	45,000	5,000	5,000	25,000	62,500	17.5	62,483
Z-165	PEGF		95,000				100,000				97,500	4.5	97,496
Z-166	DZ		2	2	2	2	8				5	5.0	0
Z-167	DZ		1.2	1.2	1.2	1.2	1.2	1	1	1	1	1.2	0
Z-168	BL												0
Z-169	DZ		1	1	1	1	1	1	1	1	1	1.0	0

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
Z-133	N2-7	68,000	70,000	69,000	588	605	597	0.60	4.60	5.00	4.80	0.05
Z-134	N2-7	11,000	11,000	11,000	4,748	4,710	4,729	4.73	0.20	0.30	0.25	0.29
Z-135	N2-7	28,000	28,000	28,000	1,968	1,979	1,974	1.97	1.40	1.60	1.50	0.13
Z-136	N2-7	2,900	3,300	3,100	19,250	19,500	19,375	19.38	0.15	0.15	0.15	1.17
Z-137	ACCY/N2-8	500	500	500	1,889	1,847	1,868	1.87	5.80	5.90	5.85	0.16
Z-138	ACCY/N2-8	160	160	160	10,700	10,700	10,700	10.70	1.50	1.50	1.50	0.69
Z-139	ACCY/N2-8	280	280	280	5,031	5,020	5,026	5.03	2.60	2.70	2.65	0.35
Z-140	ACCY/N2-8	90	85	88	20,000	20,000	20,000	20.00	0.77	0.77	0.77	1.25
Z-141	ACCY/N2-8	800	800	800	952	935	943	0.94	8.00	8.00	8.00	0.09
Z-142	ACCY/N2-8	990	990	990	535	539	537	0.54	10.60	10.40	10.50	0.06
Z-143	ACCY/N2-8	510	400	455	2,148	2,146	2,147	2.15	4.80	4.90	4.85	0.17
Z-144		1,200	1,050	1,125	2,059	2,017	2,038	2.04	0.15	0.15	0.15	0.12
Z-145	L											
Z-146	N2-9	6,200	6,500	6,350	2,047	2,046	2,047	2.05	0.15	0.15	0.15	0.12
Z-147	N2-9	2,500	2,300	2,400	10,500	10,500	10,500	10.50	0.30	0.18	0.24	0.64
Z-148	N2-9	1,400	1,400	1,400	20,000	20,000	20,000	20.00	0.08	0.09	0.09	1.20
Z-149	N2-9	3,500	3,300	3,400	4,904	4,934	4,919	4.92	0.15	0.15	0.15	0.30
Z-150	N2-9	12,000	11,500	11,750	634	634	634	0.63	1.40	0.80	1.10	0.04
Z-151	N2-9	12,000	11,000	11,500	1,179	1,170	1,175	1.17	0.35	0.42	0.39	0.07
Z-152	N2-9	9,000	8,500	8,750	2,113	2,109	2,111	2.11	0.15	0.15	0.15	0.13
Z-153	N2-10	1,700	1,700	1,700	5,034	5,038	5,036	5.04	0.20	0.20	0.20	0.31
Z-154	N2-10	2,600	2,400	2,500	2,044	2,061	2,053	2.05	0.95	0.85	0.90	0.13
Z-155	N2-10	600	600	600	20,000	20,000	20,000	20.00	0.15	0.15	0.15	1.21
Z-156	N2-10	780	750	765	10,500	10,500	10,500	10.50	0.10	0.10	0.10	0.63
Z-157	N2-10	1,100	1,050	1,075	5,021	5,051	5,036	5.04	0.20	0.18	0.19	0.30
Z-158	N2-11	3,000	3,000	3,000	2,140	2,092	2,116	2.12	0.10	0.10	0.10	0.13
Z-159	N2-11	650	700	675	20,000	20,000	20,000	20.00	0.02	0.07	0.05	1.20
Z-160	N2-11	1,600	1,600	1,600	5,115	5,160	5,138	5.14	0.10	0.10	0.10	0.31
Z-161	N2-11	12,000	11,500	11,750	590	599	595	0.59	0.50	0.60	0.55	0.04
Z-162	N2-11	6,200	6,200	6,200	1,031	995	1,013	1.01	0.10	0.10	0.10	0.06
Z-163	N2-11	780	800	790	10,500	10,500	10,500	10.50	0.07	0.07	0.07	0.63
Z-164	N2-11	2,500	2,600	2,550	2,114	2,137	2,126	2.13	0.10	0.10	0.10	0.13
Z-165	PEGF	2,500	2,400	2,450	2,125	2,112	2,119	2.12	0.10	0.10	0.10	0.13
Z-166	DZ	190	150	170	5,015	5,082	5,049	5.05	0.10	0.10	0.10	0.30
Z-167	DZ	35	33	34	1,681	1,691	1,686	1.69	0.08	0.08	0.08	0.10
Z-168	BL											
Z-169	DZ	2	1.2	2	5,120	5,083	5,102	5.10	0.30	0.25	0.28	0.31

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
Z-133	N2-7	53	52	53	512	NA	16,208.78	18,000.00	10,110.74	17,000.00	26,319.51
Z-134	N2-7	53	53	53	513	NA	1,575.61	3,300.00	1,881.32	2,200.00	3,456.93
Z-135	N2-7	53	53	53	513	NA	5,401.95	8,400.00	4,768.61	6,500.00	10,170.56
Z-136	N2-7	53	53	53	513	NA	412.91	820.00	467.99	560.00	880.90
Z-137	ACCY/N2-8	54	56	55	515	NA	60.79	160.00	90.61	97.00	151.40
Z-138	ACCY/N2-8	57	59	58	518	NA	25.89	40.00	22.79	31.00	48.69
Z-139	ACCY/N2-8	60	59	60	519	NA	35.30	73.00	41.53	49.00	76.83
Z-140	ACCY/N2-8	60	58	59	519	NA	14.89	18.00	10.27	16.00	25.15
Z-141	ACCY/N2-8	61	65	63	523	NA	93.65	220.00	124.20	140.00	217.85
Z-142	ACCY/N2-8	64	66	65	525	NA	121.59	280.00	157.52	180.00	279.11
Z-143	ACCY/N2-8	65	62	64	523	NA	59.72	140.00	79.39	89.00	139.11
Z-144		55	55	55	515	NA	206.35	300.00	171.25	240.00	377.60
Z-145	L	55	55	55	515	NA	346,311.03	140,000.00	67,862.54	310,000.00	414,173.58
Z-146	N2-9	66	68	67	527	NA	44,883.63	3.10	1.74	29,000.00	44,885.37
Z-147	N2-9	68	64	66	526	NA	6,592.13	0.00	0.00	4,200.00	6,592.13
Z-148	N2-9	66	67	67	526	NA	2,986.74	0.00	0.00	1,900.00	2,986.74
Z-149	N2-9	69	67	68	528	NA	12,216.11	4.90	2.78	7,800.00	12,218.90
Z-150	N2-9	72	69	71	530	NA	92,613.80	6.70	3.69	61,000.00	92,617.49
Z-151	N2-9	68	69	69	528	NA	67,505.11	5.10	2.84	44,000.00	67,507.95
Z-152	N2-9	68	72	70	530	NA	52,473.71	4.20	2.35	34,000.00	52,476.06
Z-153	N2-10	68	68	68	528	NA	1,718.27	20.00	11.41	1,100.00	1,729.68
Z-154	N2-10	68	66	67	527	NA	3,729.14	67.00	38.16	2,400.00	3,767.29
Z-155	N2-10	68	67	68	527	NA	464.56	13.00	7.42	300.00	471.98
Z-156	N2-10	67	68	68	527	NA	778.61	14.00	7.99	500.00	786.60
Z-157	N2-10	67	66	67	526	NA	1,158.21	65.00	37.09	760.00	1,195.30
Z-158	N2-11	64	64	64	524	NA	5,764.59	80.00	45.58	3,700.00	5,810.17
Z-159	N2-11	68	67	68	527	NA	716.32	13.00	7.42	460.00	723.75
Z-160	N2-11	65	68	67	526	NA	2,179.67	38.00	21.68	1,400.00	2,201.34
Z-161	N2-11	69	84	77	536	NA	31,017.12	140.00	78.97	20,000.00	31,096.10
Z-162	N2-11	70	68	69	529	NA	17,110.76	160.00	90.78	11,000.00	17,201.54
Z-163	N2-11	71	70	71	530	NA	1,324.45	22.00	12.56	850.00	1,337.01
Z-164	N2-11	68	68	68	528	NA	5,163.86	34.00	19.38	3,300.00	5,183.23
Z-165	PEGF	65	64	65	524	NA	6,750.04	0.00	0.00	4,300.00	6,750.04
Z-166	DZ	67	67	67	527	NA	6.61	0.00	0.00	4.20	6.61
Z-167	DZ	74	75	75	534	NA	59.80	0.00	0.00	38.00	59.80
Z-168	BL					NA		0.00		0.00	
Z-169	DZ	57	58	58	517	NA	18.88	0.00	0.00	12.00	18.88

WSPA EMISSION RATE CALCULATION SPREADSHEET   SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
							NMOC		Methane		THC	
ID	Code	MW fraction O2	MW fraction C3H8	% fraction N2	MW fraction N2	MW Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
Z-133	N2-7	1.5	0.7499	93.5	26.2	28.48	2.02E-03	1.77E+01	1.26E-03	1.11E+01	3.28E-03	2.88E+01
Z-134	N2-7	0.1	0.0970	99.5	27.9	28.07	1.20E-03	1.05E+01	1.43E-03	1.25E+01	2.63E-03	2.30E+01
Z-135	N2-7	0.5	0.2867	97.9	27.4	28.18	1.83E-03	1.60E+01	1.62E-03	1.42E+01	3.45E-03	3.02E+01
Z-136	N2-7	0.0	0.0247	99.8	28.0	28.03	1.28E-03	1.12E+01	1.45E-03	1.27E+01	2.73E-03	2.39E+01
Z-137	ACCY/N2-8	1.9	0.0043	94.1	26.4	28.25	2.51E-05	2.20E-01	3.74E-05	3.27E-01	6.24E-05	5.47E-01
Z-138	ACCY/N2-8	0.5	0.0014	98.5	27.6	28.08	4.70E-05	4.11E-01	4.13E-05	3.62E-01	8.83E-05	7.73E-01
Z-139	ACCY/N2-8	0.8	0.0022	97.3	27.3	28.13	3.19E-05	2.80E-01	3.75E-05	3.29E-01	6.95E-05	6.08E-01
Z-140	ACCY/N2-8	0.2	0.0007	99.2	27.8	28.05	4.85E-05	4.25E-01	3.34E-05	2.93E-01	8.20E-05	7.18E-01
Z-141	ACCY/N2-8	2.6	0.0062	92.0	25.8	28.34	2.25E-05	1.97E-01	2.98E-05	2.61E-01	5.22E-05	4.58E-01
Z-142	ACCY/N2-8	3.4	0.0079	89.5	25.1	28.44	2.05E-05	1.80E-01	2.66E-05	2.33E-01	4.71E-05	4.13E-01
Z-143	ACCY/N2-8	1.6	0.0039	95.1	26.7	28.21	2.61E-05	2.29E-01	3.47E-05	3.04E-01	6.08E-05	5.32E-01
Z-144		0.0	0.0106	99.8	28.0	28.03	6.69E-05	5.86E-01	5.55E-05	4.87E-01	1.22E-04	1.07E+00
Z-145	L	0.0	13.6741	69.0	19.3	33.01						
Z-146	N2-9	0.0	1.2792	97.0	27.2	28.49	1.45E-02	1.27E+02	5.63E-07	4.93E-03	1.45E-02	1.27E+02
Z-147	N2-9	0.1	0.1853	99.3	27.8	28.10	1.09E-02	9.51E+01	0.00E+00	0.00E+00	1.09E-02	9.51E+01
Z-148	N2-9	0.0	0.0838	99.7	27.9	28.05	9.28E-03	8.13E+01	0.00E+00	0.00E+00	9.28E-03	8.13E+01
Z-149	N2-9	0.0	0.3441	99.1	27.8	28.15	9.37E-03	8.21E+01	2.14E-06	1.87E-02	9.37E-03	8.21E+01
Z-150	N2-9	0.4	2.6907	92.8	26.0	29.05	9.85E-03	8.63E+01	3.93E-07	3.44E-03	9.85E-03	8.63E+01
Z-151	N2-9	0.1	1.9408	95.2	26.7	28.74	1.28E-02	1.12E+02	5.36E-07	4.70E-03	1.28E-02	1.12E+02
Z-152	N2-9	0.0	1.4997	96.5	27.0	28.57	1.75E-02	1.53E+02	7.83E-07	6.86E-03	1.75E-02	1.53E+02
Z-153	N2-10	0.1	0.0485	99.7	27.9	28.05	1.35E-03	1.18E+01	8.95E-06	7.84E-02	1.36E-03	1.19E+01
Z-154	N2-10	0.3	0.1059	98.9	27.7	28.09	1.24E-03	1.08E+01	1.27E-05	1.11E-01	1.25E-03	1.10E+01
Z-155	N2-10	0.0	0.0132	99.8	28.0	28.03	1.44E-03	1.26E+01	2.31E-05	2.02E-01	1.47E-03	1.28E+01
Z-156	N2-10	0.0	0.0221	99.9	28.0	28.03	1.27E-03	1.11E+01	1.30E-05	1.14E-01	1.28E-03	1.12E+01
Z-157	N2-10	0.1	0.0335	99.7	27.9	28.04	9.10E-04	7.97E+00	2.91E-05	2.55E-01	9.39E-04	8.23E+00
Z-158	N2-11	0.0	0.1632	99.5	27.9	28.08	1.91E-03	1.67E+01	1.51E-05	1.32E-01	1.92E-03	1.68E+01
Z-159	N2-11	0.0	0.0203	99.9	28.0	28.03	2.21E-03	1.94E+01	2.29E-05	2.01E-01	2.24E-03	1.96E+01
Z-160	N2-11	0.0	0.0618	99.8	28.0	28.05	1.74E-03	1.52E+01	1.73E-05	1.52E-01	1.76E-03	1.54E+01
Z-161	N2-11	0.2	0.8822	97.5	27.3	28.36	2.91E-03	2.55E+01	7.40E-06	6.48E-02	2.91E-03	2.55E+01
Z-162	N2-11	0.0	0.4852	98.8	27.7	28.20	2.70E-03	2.36E+01	1.43E-05	1.25E-01	2.71E-03	2.37E+01
Z-163	N2-11	0.0	0.0375	99.8	28.0	28.04	2.14E-03	1.88E+01	2.03E-05	1.78E-01	2.16E-03	1.89E+01
Z-164	N2-11	0.0	0.1456	99.6	27.9	28.08	1.70E-03	1.49E+01	6.39E-06	5.60E-02	1.71E-03	1.50E+01
Z-165	PEGF	0.0	0.1897	99.5	27.9	28.09	2.23E-03	1.96E+01	0.00E+00	0.00E+00	2.23E-03	1.96E+01
Z-166	DZ	0.0	0.0002	99.9	28.0	28.02	5.18E-06	4.53E-02	0.00E+00	0.00E+00	5.18E-06	4.53E-02
Z-167	DZ	0.0	0.0017	99.9	28.0	28.02	1.54E-05	1.35E-01	0.00E+00	0.00E+00	1.54E-05	1.35E-01
Z-168	BL											
Z-169	DZ	0.1	0.0005	99.7	27.9	28.03	1.53E-05	1.34E-01	0.00E+00	0.00E+00	1.53E-05	1.34E-01

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
Z-133	N2-7	O2 analyzer on medium range pulling 668. Raining. Nitrogen flow test #7.
Z-134	N2-7	Raining. Nitrogen flow test #7.
Z-135	N2-7	Raining. Nitrogen flow test #7.
Z-136	N2-7	Light rain, but value is dry. Nitrogen flow test #7.
Z-137	ACCY/N2-8	Methane is 99.9% air; High O2 expected. Accuracy check. Nitrogen flow test #8. O2 too high (5.85%).
Z-138	ACCY/N2-8	Checked methane flow. Accuracy check. Nitrogen flow test #8
Z-139	ACCY/N2-8	Checked methane flow. Accuracy check. Nitrogen flow test #8
Z-140	ACCY/N2-8	Checked methane flow. Accuracy check. Nitrogen flow test #8.
Z-141	ACCY/N2-8	Checked methane flow. Accuracy check. Nitrogen flow test #8. O2 too high (8%).
Z-142	ACCY/N2-8	Ferrule broken on methane line. Methane flow in question. Accuracy check. Nitrogen flow test #8.O2 too high (10.5%)
Z-143	ACCY/N2-8	Ferrule broken on methane line. Methane flow in question. Accuracy check. Nitrogen flow test #8.
Z-144		Closed canister at 10.0" Hg.
Z-145	L	
Z-146	N2-9	Liquid visible on connector, but not dripping. Nitrogen flow test #9.
Z-147	N2-9	Nitrogen flow test #9.
Z-148	N2-9	Nitrogen flow test #9.
Z-149	N2-9	Nitrogen flow test #9.
Z-150	N2-9	O2 pump rate exceeds N2 flow rate. Nitrogen flow test #9.
Z-151	N2-9	Nitrogen flow test #9.
Z-152	N2-9	No liquid build up in bag. Nitrogen flow test #9.
Z-153	N2-10	Large bag (15L) Nitrogen flow test #10.
Z-154	N2-10	Nitrogen flow test #10.
Z-155	N2-10	Nitrogen flow test #10.
Z-156	N2-10	Nitrogen flow test #10.
Z-157	N2-10	Nitrogen flow test #10.
Z-158	N2-11	Bag size 1L. Nitrogen flow test #11.
Z-159	N2-11	Nitrogen flow test #11.
Z-160	N2-11	Nitrogen flow test #11.
Z-161	N2-11	Nitrogen flow test #11.
Z-162	N2-11	Nitrogen flow test #11.
Z-163	N2-11	Nitrogen flow test #11.
Z-164	N2-11	Nitrogen flow test #11.
Z-165	PEGF	
Z-166	DZ	
Z-167	DZ	
Z-168	BL	
Z-169	DZ	

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		AMBIENT CONDITIONS			COMPONENT DATA				STREAM CHARACTERISTICS		
ID	Code	Windspeed (mph)	Temp. (F)	Barometric Pressure ("Hg)	Category	Size (Inches)	Type	Valve Actuation	Load Y/N	Service	Product
Z-170	N2-12	5.0	59		VALVE	6.00	GATE	M		LL	
Z-171	N2-12	2.0	64		VALVE	6.00	GATE	M		LL	
Z-172	N2-12	2.0	67		VALVE	6.00	GATE	M		LL	
Z-173	N2-12	2.0	67		VALVE	6.00	GATE	M		LL	
Z-174	N2-12	2.0	65		VALVE	6.00	GATE	M		LL	
Z-175	N2-12	2.0	63		VALVE	6.00	GATE	M		LL	
Z-176	DZ	2.0	60		VALVE	6.00	GATE	M		LL	

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		SCREENING DATA											
ID	Code	I & M (ppm)	Initial (ppm)	East (ppm)	South (ppm)	West (ppm)	Final (ppm)	East (ppm)	South (ppm)	West (ppm)	Avg. (ppm)	Bkgrnd (ppm)	Corrected (ppm)
Z-170	N2-12		20,000	2,500	2,500	100	12,000	1,000	300	8,000	16,000	1.5	15,999
Z-171	N2-12		20,000	2,500	2,500	100	12,000	1,000	300	8,000	16,000	1.5	15,999
Z-L72	N2-12		20,000	2,500	2,500	100	12,000	1,000	300	8,000	16,000	1.5	15,999
Z-173	N2-12		20,000	2,500	2,500	100	12,000	1,000	300	8,000	16,000	1.5	15,999
Z-174	N2-12		20,000	2,500	2,500	100	12,000	1,000	300	8,000	16,000	1.5	15,999
Z-175	N2-12		20,000	2,500	2,500	100	12,000	1,000	300	8,000	16,000	1.5	15,999
Z-176	DZ		1	1	1	1	1	1	1	1	1	1.0	0

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG CONCENTRATION			NITROGEN FLOW				OXYGEN CONCENTRATION			
ID	Code	Initial (ppm)	Final (ppm)	Avg ppm	Initial ml/min	Final ml/min	Average ml/min	N2 l/min	Initial %	Final %	Average %	Q m3/hr
Z-170	N2-12	1,300	1,250	1,275	10,700	10,700	10,700	10.70	0.05	0.09	0.07	0.64
Z-171	N2-12	580	600	590	24,300	24,300	24,300	24.30	0.06	0.10	0.08	1.46
Z-172	N2-12	700	680	690	19,600	19,600	19,600	19.60	0.03	0.08	0.06	1.18
Z-173	N2-12	2,200	2,600	2,400	4,738	4,780	4,759	4.76	0.05	0.08	0.07	0.29
Z-174	N2-12	4,500	4,500	4,500	1,962	2,016	1,989	1.99	0.50	0.50	0.50	0.12
Z-175	N2-12	1,050	1,050	1,050	10,700	10,700	10,700	10.70	0.15	0.15	0.15	0.65
Z-176	DZ	1.6	1.5	2	10,700	10,700	10,700	10.70	0.20	0.18	0.19	0.65

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		BAG TEMPERATURE				LABORATORY DATA					
						NMOC		METHANE		THC	
ID	Code	Initial (F)	Final (F)	Avg. (F)	Temp deg R	ppmv (as C3H8)	ppmw (as C3H8)	ppmv (as CH4)	ppmw (as CH4)	ppmv (as C3H8)	ppmw (as C3H8)
Z-170	N2-12	64	65	65	524	NA	2,814.94	26.00	14.83	1,800.00	2,829.77
Z-171	N2-12	64	68	66	526	NA	1,220.09	12.00	6.85	780.00	1,226.93
Z-172	N2-12	69	69	69	529	NA	1,564.29	15.00	8.56	1,000.00	1,572.85
Z-173	N2-12	70	72	71	531	NA	6,408.66	50.00	28.48	4,100.00	6,437.14
Z-174	N2-12	72	73	73	532	NA	15,431.86	89.00	50.50	9,900.00	15,482.36
Z-175	N2-12	73	70	72	531	NA	2,502.81	22.00	12.55	1,600.00	2,515.35
Z-176	DZ	62	64	63	523	NA	0.07	0.00	0.00	0.0475	0.07

WSPA EMISSION RATE CALCULATION SPREADSHEET SORTED BY CATEGORY AND CORRECTED SCREENING VALUE

SAMPLE CONTROL		MOLECULAR WEIGHT DETERMINATION					EMISSION RATE					
							NMOC		Methane		THC	
ID	Code	MW fraction O2	MW fraction C3H8	% fraction N2	MW fraction N2	MW Bag	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)
Z-170	N2-12	0.0	0.0794	99.8	27.9	28.05	4.69E-03	4.11E+01	2.47E-05	2.17E-01	4.72E-03	4.13E+01
Z-171	N2-12	0.0	0.0344	99.8	28.0	28.04	4.61E-03	4.03E+01	2.59E-05	2.26E-01	4.63E-03	4.06E+01
Z-172	N2-12	0.0	0.0441	99.8	28.0	28.04	4.73E-03	4.14E+01	2.59E-05	2.27E-01	4.76E-03	4.17E+01
Z-173	N2-12	0.0	0.1809	99.5	27.9	28.09	4.70E-03	4.12E+01	2.09E-05	1.83E-01	4.72E-03	4.13E+01
Z-174	N2-12	0.2	0.4367	98.5	27.6	28.20	4.83E-03	4.23E+01	1.58E-05	1.39E-01	4.85E-03	4.25E+01
Z-175	N2-12	0.0	0.0706	99.7	27.9	28.05	4.13E-03	3.62E+01	2.07E-05	1.82E-01	4.15E-03	3.64E+01
Z-176	DZ	0.1	0.0000	99.8	28.0	28.03	1.26E-07	1.10E-03	0.00E+00	0.00E+00	1.26E-07	1.10E-03

Response factor = 1.0 and gas constant = 4.836E-05 for emission rate calculation.

WSPA EMISSION RATE CALCULATION SPREADSHEET

SAMPLE CONTROL		COMMENTS
ID	Code	Comments
Z-170	N2-12	20L bag. Variable initial SV. Maximum SV shifted from N. to E. for pre and post. Nitrogen flow test #12.
Z-171	N2-12	20L bag. Variable initial SV. Maximum SV shifted from N. to E. for pre and post. Nitrogen flow test #12.
Z-172	N2-12	Maximum SV shifted from N. to E. for pre and post. Nitrogen flow test #12.
Z-173	N2-12	Maximum SV shifted from N. to E. for pre and post. Nitrogen flow test #12.
Z-174	N2-12	Maximum SV shifted from N. to E. for pre and post. Nitrogen flow test #12.
Z-175	N2-12	Maximum SV shifted from N. to E. for pre and post. Nitrogen flow test #12.
Z-176	DZ	

A.2

EMISSION CORRELATION EQUATIONS DATA

------------------------- Source*Type=C Service=FL -------------------------

Site	Sample Id	Phase	Component Category	Size	Screening Value (ppm)	THC Emission Rate (lbs/hr)
Y	99	LL	FL	6.0	5.0	1.8532E-06
X	22	LL	FL	4.0	19.5	4.5427E-06
Y	75	HL	FL	4.0	22.5	1.2910E-05
Y	90	LL	FL	4.0	69.5	7.4741E-05
W	24	GAS	FL	2.0	81.0	8.3424E-05
V	35	GAS	FL	1.5	97.0	7.6674E-06
Y	95	LL	FL	4.0	222.5	1.8359E-04
X	36	LL	FL	4.0	593.0	2.7816E-04
Z	36	LL	FL	8.0	595.5	2.3057E-05
X	21	LL	FL	6.0	671.0	6.6141E-04
V	43	LL	FL	4.0	1495.0	8.4433E-03
Z	57	LL	FL	3.0	1548.0	3.7253E-04
Z	32	LL	FL	4.0	1996.0	1.7572E-04
X	115	LL	FL	4.0	3244.5	5.4628E-04
X	102	LL	FL	3.0	3997.5	3.7264E-03
W	23	GAS	FL	3.0	4996.0	5.9189E-03
X	61	LL	FL	4.0	11547.0	7.5989E-03
Y	91	LL	FL	3.0	20246.0	2.1012E-03
X	114	LL	FL	8.0	34995.5	2.7699E-03

N = 19

-------------------------- Source*Type=C Service=O --------------------------

Site	Sample Id	Phase	Component Category	Size	Screening Value (ppm)	THC Emission Rate (lbs/hr)
Y	39	LL	TH	1.00	6.5	8.7087E-07
V	34	GAS	U	1.00	13.0	1.1205E-06
V	38	LL	U	1.00	18.0	1.5408E-06
Y	11	LL	TH	1.00	26.5	3.1026E-06
Y	13	LL	TH	0.25	36.5	6.8863E-08
V	42	LL	TH	1.00	38.0	7.0841E-07
V	71	HL	TH	0.75	58.5	1.2656E-06
Y	41	LL	TH	1.00	91.0	8.0739E-06
Y	86	GAS	TH	0.50	267.0	1.0313E-04
V	25	GAS	TH	1.00	271.0	4.3557E-04
Z	60	GAS	U	1.50	446.0	1.0824E-04
Z	12	LL	TH	1.00	649.0	3.5900E-05
Y	62	GAS	TH	1.00	1196.5	1.4601E-04
V	92	LL	TH	1.00	1335.0	3.0518E-06
W	138	LL	TH	1.00	1345.5	2.7032E-05
X	25	LL	TH	1.00	1393.0	5.5679E-06
V	48	LL	TH	1.00	3595.5	5.8294E-04
Y	44	LL	TH	0.25	6492.5	1.9922E-03
X	15	GAS	TH	1.00	7745.0	8.7876E-04
W	5	HL	TH	1.00	8994.0	2.1680E-03
Z	146	LL	TH	1.00	9747.5	1.4523E-02
X	56	GAS	TH	1.00	10995.0	2.0767E-03
Z	39	LL	TH	1.00	19304.0	4.1460E-05
Y	113	LL	COUP	0.50	21996.0	1.3955E-04
Z	70	LL	TH	1.00	27493.0	4.5910E-02
V	100	GAS	TH	1.00	43995.0	4.8570E-03
W	93	LL	TH	0.50	52843.0	7.4509E-03
Z	158	LL	TH	0.75	62482.5	1.9222E-03
W	110	LL	TH	1.00	89996.5	1.8235E-03

N = 29

------------------------- Source*Type=OEL Service=All -------------------------

Site	Sample Id	Phase	Component Category	Size	Screening Value (ppm)	THC Emission Rate (lbs/hr)
Y	8	GAS	OEL	0.750	16.5	8.6401E-06
V	23	GAS	OEL	0.500	20.3	1.7117E-06
W	12	GAS	OEL	0.375	60.5	3.9178E-06
W	125	LL	OEL	1.000	66.5	7.3473E-05
V	63	HL	OEL	0.500	195.0	3.0420E-06
V	19	LL	OEL	0.500	247.0	1.7860E-05
X	3	LL		0.750	488.0	8.7451E-06
W	102	LL	OEL	0.500	522.5	3.0118E-05
Z	61	GAS	OEL	.	893.0	2.8951E-05
Z	54	HL	OEL	1.000	1097.5	2.4643E-04
V	109	LL	OEL	1.000	1448.0	6.0067E-06
V	18	LL	OEL	0.500	1493.0	6.9870E-05
X	52	LL	OEL	0.250	1996.0	7.8584E-04
W	18	GAS	OEL	1.000	7995.0	5.2377E-04
W	134	LL	OEL	0.500	12493.5	1.2428E-03
W	142	LL	OEL	0.750	12990.0	2.0284E-03
Y	98	LL	OEL	0.500	14846.0	2.1311E-04
V	83	GAS	OEL	1.000	15068.0	9.1422E-05
X	66	HL	OEL	0.250	15496.5	4.0942E-04
Y	68	LL	OEL	1.000	26795.0	1.9477E-02
V	32	GAS	OEL	1.000	44998.0	1.9261E-03
Z	165	LL	OEL	0.250	94995.5	2.2345E-03

N = 22

------------------------- Source*Type=PUMP Service=HL -------------------------

Site	Sample Id	Phase	Component Category	Size	Screening Value (ppm)	THC Emission Rate (lbs/hr)
Y	117	HL	HC	4	6.75	9.9257E-06
Y	116	HL	HC	4	9.50	1.4955E-04
W	42	HL	HC	3	10.00	5.3255E-06
Y	128	HL	HC	3	18.00	5.7594E-05
Y	134	HL	HC	3	19.00	2.4070E-05
X	73	HL	HC	.	45.50	7.2499E-04
X	79	HL	HC	.	277.00	6.4081E-03
V	72	HL	HC	.	323.00	1.8208E-03
Y	118	HL	HC	3	1145.50	1.9791E-03
X	67	HL	VERT	.	9496.50	2.7970E-02

N = 10

------------------------ Source*Type=PUMP Service=LL ------------------------

Site	Sample Id	Phase	Component Category	Size	Screening Value (ppm)	THC Emission Rate (lbs/hr)
W	101	LL	VERT	1.5	4.5	1.3377E-04
V	37	LL	HC	12.0	15.5	1.1569E-03
Y	76	LL	HC	3.0	21.5	4.1744E-04
Y	72	LL	HC	4.0	22.0	3.1719E-04
W	77	LL	HC	6.0	66.0	1.3812E-03
X	94	LL	VC	3.0	66.5	1.1358E-04
W	156	LL	VERT	4.0	107.0	5.4070E-05
W	76	LL	VERT	2.0	126.0	9.0665E-05
W	145	LL	VERT	3.0	136.0	7.5175E-04
X	93	LL	VC	3.0	192.0	9.2571E-05
X	37	LL	CENT	.	395.0	1.0800E-02
X	50	LL	HC	.	621.0	2.7014E-03
W	155	LL	VERT	4.0	947.0	4.8518E-03
X	59	LL	HC	.	996.0	6.6363E-03
W	128	LL	VERT	6.0	1697.0	3.9559E-03
X	27	LL	HC	.	1780.0	1.3222E-03
Z	72	LL	HC	6.0	4997.0	1.6694E-02
W	74	LL	VERT	2.0	5745.5	1.4970E-02
Z	102	LL		.	5970.0	2.1060E-03
Z	24	LL	HC	4.0	7999.0	6.2773E-04
Y	57	LL	HC	6.0	13995.0	2.1346E-02
Y	50	LL	HC	4.0	17694.5	7.5818E-02
Y	124	LL	HC	3.0	22995.0	2.6333E-03
X	42	LL	HC	2.0	27996.0	1.8090E-03
W	141	LL	VERT	2.0	33744.5	1.9073E-03
Y	56	LL	HC	6.0	41995.0	2.1122E-02
Z	22	LL	HC	2.0	98090.0	2.3292E-03

N = 27

------------------------ Source*Type=VALVE Service=All ------------------------

Site	Sample Id	Phase	Component Category	Size	Screening Value (ppm)	THC Emission Rate (lbs/hr)
Y	60	LL	GATE	8.00	3.5	2.6981E-05
V	94	LL	GATE	1.00	5.5	2.7413E-06
Y	37	LL	GATE	4.00	5.5	2.1391E-06
W	94	GAS	GATE	0.75	11.0	1.0455E-05
V	56	GAS	GATE	3.00	13.0	5.5121E-05
W	115	LL	GATE	8.00	17.0	2.5458E-05
W	120	HL	MC	3.00	18.5	1.2864E-05
W	63	HL	GATE	0.75	22.0	1.6349E-07
W	8	GAS	GLOBE	1.00	22.5	1.4612E-05
Y	2	GAS	GATE	3.00	22.5	1.2049E-04
W	55	HL	MC	8.00	23.5	9.1971E-06
Y	137	GAS	GATE	3.00	23.5	7.1283E-06
W	38	LL	GATE	2.00	26.0	4.4856E-06
Y	10	GAS	GATE	4.00	26.0	3.4896E-05
Z	3	LL	GATE	3.00	26.5	1.9016E-04
W	57	HL	GATE	8.00	28.0	8.4779E-06
W	62	HL	GATE	4.00	31.0	5.4845E-07
W	35	LL	GATE	2.00	31.5	3.4716E-06
W	52	GAS	GATE	8.00	33.0	7.0998E-06
Z	40	LL	GATE	3.00	33.5	5.4777E-06
X	76	HL	GATE	0.75	42.0	1.0225E-04
W	44	LL	GATE	0.50	46.5	1.4784E-06
W	6	LL	MC	3.00	50.0	4.1787E-06
Y	19	GAS	GATE	8.00	50.0	1.2882E-05
Y	64	LL	GATE	1.00	51.0	1.8398E-05
W	88	LL	GATE	4.00	60.0	2.3654E-05
V	20	GAS	GATE	1.00	66.0	2.8951E-05
V	27	GAS	GATE	2.00	68.5	1.2492E-05
Z	33	LL	GATE	4.00	74.0	2.1505E-04
V	61	GAS	GATE	1.00	78.0	3.5786E-06
W	48	LL	GATE	3.00	80.0	1.1068E-05
X	75	HL	GATE	4.00	92.0	2.7960E-04
V	15	LL	GATE	0.75	100.0	1.3564E-04
W	98	GAS	MC	3.00	100.0	6.0052E-05
Y	136	GAS	GATE	1.50	105.0	2.1143E-05
Y	35	LL	GATE	4.00	119.5	1.9734E-05
Z	58	HL	GATE	3.00	121.0	6.1971E-05
Y	73	HL	GATE	4.00	122.5	7.9917E-05
Z	31	LL	GATE	4.00	133.5	1.4668E-03
X	38	GAS	GATE	2.00	142.0	4.3885E-04
Z	14	GAS	NEDL	0.50	150.0	2.3911E-06
Z	7	LL	GATE	4.00	159.5	1.1019E-03
V	65	HL	GLOBE	0.75	167.0	1.6268E-04
V	17	LL	GATE	2.00	173.0	3.6643E-05
Y	23	LL	GATE	1.00	176.0	7.1928E-05
V	73	HL	GLOBE	3.00	183.0	5.0012E-04
W	111	LL	GATE	8.00	192.0	1.9369E-04
Y	45	GAS	GATE	3.00	195.5	1.1378E-04
V	111	GAS	GATE	8.00	197.5	2.1201E-04
Z	118	LL	GATE	1.00	224.0	2.6622E-04

------------------------ Source*Type=VALVE Service=All ------------------------
(continued)

Site	Sample Id	Phase	Component Category	Size	Screening Value (ppm)	THC Emission Rate (lbs/hr)
V	87	GAS	GATE	3.00	240.0	2.2155E-05
V	74	HL	GLOBE	4.00	290.0	5.5498E-04
Z	18	GAS	GATE	2.00	297.0	4.9355E-04
V	36	GAS	GATE	0.75	297.0	7.3199E-05
Y	89	GAS	NEDL	0.50	306.0	3.4574E-05
Z	87	GAS	GATE	8.00	331.5	1.1859E-04
Z	4	LL	GATE	4.00	372.5	6.4104E-04
Z	86	GAS	GATE	8.00	396.5	1.0634E-04
Y	22	GAS	GATE	2.00	420.0	1.6742E-04
Y	67	HL	GATE	6.00	446.0	8.9521E-04
V	110	LL	GLOBE	9.00	447.5	1.1134E-04
Z	121	LL	GATE	4.00	474.0	2.3710E-03
Y	5	GAS	GATE	6.00	496.5	1.4554E-04
W	96	HL	MC	4.00	505.0	7.0567E-05
Y	129	GAS	GLOBE	3.00	515.0	1.3748E-04
W	29	HL	GLOBE	4.00	540.0	6.8609E-04
Z	56	LL	GATE	4.00	595.0	2.4965E-04
W	97	LL	MC	1.00	646.0	6.4753E-05
V	28	GAS	GATE	2.00	724.0	4.3039E-05
V	30	GAS	GATE	0.75	735.0	5.0869E-04
Y	126	LL	GATE	8.00	793.0	1.3213E-04
X	18	LL	GATE	4.00	794.0	6.6005E-04
V	8	LL	MC	1.00	796.0	1.0347E-03
W	132	LL	GATE	2.00	796.5	3.3375E-04
Z	123	GAS	GATE	0.75	798.5	6.5641E-05
V	84	GAS	GATE	4.00	830.0	4.3977E-04
X	24	LL	GATE	10.00	893.0	1.0008E-03
W	86	LL	GATE	6.00	894.0	3.6969E-04
Y	71	GAS	GATE	1.50	922.0	1.9784E-04
X	65	HL	GATE	3.00	956.5	9.4425E-04
Z	8	LL	GATE	10.00	995.0	1.5104E-03
W	146	GAS	GATE	4.00	996.0	7.3671E-04
Y	82	GAS	GATE	2.00	996.0	2.1462E-04
Z	21	LL	GATE	4.00	1044.0	3.4141E-04
Y	133	GAS	GATE	6.00	1045.0	1.2969E-04
Z	144	GAS	GATE	0.75	1049.0	1.2248E-04
Z	38	LL	GATE	12.00	1243.0	6.8809E-03
Z	119	LL	GATE	1.00	1248.0	6.3847E-04
V	3	LL	GLOBE	1.50	1348.0	4.7683E-04
W	147	GAS	GATE	0.50	1397.0	2.2072E-04
V	26	GAS	GLOBE	0.75	1495.0	6.5346E-05
Z	153	LL	GATE	4.00	1598.0	1.3563E-03
Z	69	LL	GATE	4.00	1695.0	2.1682E-03
Z	85	GAS	GATE	6.00	1949.0	9.2579E-04
Z	122	LL	GATE	4.00	2096.5	3.3643E-04
Z	88	HL	GATE	3.00	2097.5	1.0519E-03
X	16	LL	GATE	6.00	2240.0	7.9310E-04
Z	91	GAS	GATE	6.00	2343.0	4.1569E-04
V	13	LL	GATE	0.75	2496.0	1.3862E-04

------------------------ Source*Type=VALVE Service=All ------------------------
(continued)

Site	Sample Id	Phase	Component Category	Size	Screening Value (ppm)	THC Emission Rate (lbs/hr)
Z	11	LL	GATE	2.00	2498.0	1.0390E-02
W	82	LL	GATE	8.00	2736.0	5.7848E-04
V	2	LL	GATE	4.00	2992.0	1.3916E-03
Y	9	GAS	GATE	3.00	2993.0	2.8458E-02
Y	127	HL	GATE	4.00	2993.0	1.0935E-03
V	44	LL	GATE	1.00	3493.0	4.9778E-04
W	53	GAS	MC	8.00	3493.0	1.4741E-03
X	82	GAS	GATE	0.75	3898.4	6.3531E-04
V	9	LL	MC	1.00	3996.0	1.0570E-03
Z	20	GAS	GATE	2.00	4246.0	4.9035E-04
V	53	LL	GATE	2.00	4997.5	7.1885E-04
X	8	LL	GATE	4.00	5000.0	2.6605E-04
V	10	LL	MC	4.00	6690.0	4.0400E-03
X	77	LL	GATE	4.00	7497.0	2.9916E-03
Z	13	GAS	BALL	0.50	7995.5	7.3500E-04
V	24	GAS	MC	4.00	7998.0	2.9210E-03
V	5	LL	GATE	4.00	8490.0	1.0417E-03
X	13	LL	GATE	6.00	10997.0	2.4990E-03
Z	53	HL	BALL	0.50	11494.0	4.9317E-03
Y	59	LL	GATE	3.00	12145.5	5.7167E-04
W	119	HL	MC	1.50	12991.0	9.5579E-04
Z	170	LL	GATE	6.00	15998.5	4.7175E-03
Y	54	GAS	ORBIT	2.00	16496.0	8.5026E-04
Y	85	LL	GATE	8.00	20246.5	1.0149E-03
X	120	LL	ORBIT	8.00	21495.0	3.3894E-03
Y	104	GAS	GATE	1.50	22495.0	7.7874E-04
W	19	LL	GATE	1.00	23994.5	1.3400E-03
Y	52	LL	GATE	2.00	23996.0	3.0301E-04
W	70	LL	GATE	8.00	25490.0	3.8156E-02
W	136	LL	BALL	0.50	25895.5	1.3258E-02
X	55	GAS	GATE	4.00	34995.0	9.1958E-03
W	80	LL	GATE	3.00	34996.5	7.7994E-04
Z	74	LL	GATE	3.00	39996.5	2.1070E-03
Y	83	LL	NEDL	0.50	42745.5	9.7824E-04
W	106	GAS	MC	3.00	47995.5	1.8904E-03
X	122	LL	BTFY	8.00	54994.0	2.0301E-02
W	139	GAS	GATE	6.00	62995.5	1.4817E-02
Z	63	GAS	GLOBE	1.00	65699.0	1.3324E-03
X	107	LL	ORBIT	3.00	72924.0	4.4921E-02
V	97	LL	GATE	2.00	79997.0	2.9715E-03
Z	130	GAS	GATE	0.75	79998.8	2.4513E-03
Z	51	LL	GATE	3.00	131398.6	1.4690E-02

N = 141

A.3

ZERO COMPONENT EMISSIONS DATA

------------------------------ Type=C T_PHASE=FL ------------------------------

Site	Sample ID	Code	Phase	Subtype	Size	OVA -SV (ppm)	THC ER (lbs/hr)
Y	3	DZ	GAS	FL	2.0	0	1.7443E-07
X	57	DZ	GAS	FL	2.0	0	1.7671E-06
W	16	DZ	GAS	FL	0.5	0	1.4160E-08
W	27	DZ	GAS	FL	1.0	0	1.5641E-08
X	47	DZ	LL	FL	2.0	0	4.8322E-07
X	53	DZ	LL	FL	2.0	0	4.8347E-07
Z	48	DZ	LL	FL	3.0	0	1.0384E-06
Z	49	DZ	LL	FL	3.0	0	2.1118E-08
Z	50	DZ	LL	FL	3.0	0	4.1956E-07

N = 9

------------------------------ Type=C T_PHASE=O ------------------------------

Site	Sample ID	Code	Phase	Subtype	Size	OVA SV (ppm)	THC ER (lbs/hr)
Y	21	DZ	GAS	TH	1.0	0	1.0497E-08
Y	55	DZ	GAS	TH	1.0	0	8.5175E-07
V	101	DZ	GAS	TH	1.0	0	8.0018E-06
Z	117	DZ	GAS	TH	2.0	0	5.2040E-07
W	14	DZ	GAS	U	1.0	0	1.4023E-08
W	25	DZ	GAS	TH	1.0	0	5.6322E-08
Y	69	DZ	LL	TH	1.0	0	1.6827E-08
Y	77	DZ	LL	TH	1.5	0	1.6287E-08
Y	78	DZ	LL	TH	1.5	0	1.7133E-08
Z	112	DZ	LL	TH	1.0	0	1.1044E-08
Z	114	DZ	LL	C	2.0	0	1.1986E-08
W	75	DZ	LL	TH	1.0	0	1.0378E-05

N = 12

---------------------------- Type=OEL T_PHASE=All ----------------------------

Site	Sample ID	Code	Phase	Subtype	Size	OVA SV (ppm)	THC ER (lbs/hr)
W	13	DZ	GAS	OEL	0.50	0	1.5272E-08
W	108	DZ	GAS	OEL	0.50	0	3.1075E-06
Z	96	DZ	HL	OEL	6.00	0	1.2852E-08
Z	111	DZ	HL	OEL	6.00	0	2.4155E-08
W	45	DZ	HL	OEL	0.50	0	1.2669E-08
W	81	DZ	HL	OEL	0.75	0	2.1604E-07
W	79	DZ	LL	OEL	0.50	0	1.1914E-08
W	130	DZ	LL	OEL	0.75	0	1.1260E-08
W	144	DZ	LL	OEL	0.75	0	1.6886E-06

N = 9

---------------------------- Type=PRV T_PHASE=GAS ----------------------------

Site	Sample ID	Code	Phase	Subtype	Size	OVA SV (ppm)	THC ER (lbs/hr)
V	102	DZ	GAS	PRV	3.0	0	2.4799E-08
V	103	DZ	GAS	PRV	1.5	0	1.7794E-08
V	104	DZ	GAS	PRV	1.5	0	1.5653E-08

N = 3

---------------------------- Type=PUMP T_PHASE=HL ----------------------------

Site	Sample ID	Code	Phase	Subtype	Size	OVA SV (ppm)	THC ER (lbs/hr)
Y	70	DZ	HL	HC	2	0	4.9741E-08
Y	120	DZ	HL	HC	4	0	1.9662E-06
Y	132	DZ	HL	HC	3	0	5.1046E-08
Y	135	DZ	HL	HC	2	0	4.4276E-08
W	51	DZ	HL	VERT	4	0	5.7012E-08

N = 5

----------------------------- Type=PUMP T_PHASE=LL -----------------------------

Site	Sample ID	Code	Phase	Subtype	Size	OVA SV (ppm)	THC ER (lbs/hr)
Y	4	DZ	LL	HC	4	0	1.4695E-07
Y	48	DZ	LL	HC	2	0	4.5392E-05
Y	79	DZ	LL	HC	6	0	5.5176E-08
Y	80	DZ	LL	HC	6	0	5.9828E-08
Y	125	DZ	LL	HC	8	0	4.1203E-06
Z	109	DZ	LL		.	0	1.2093E-07
W	129	DZ	LL	VERT	6	0	1.1827E-06

N = 7

---------------------------- Type=VALVE T_PHASE=All ----------------------------

Site	Sample ID	Code	Phase	Subtype	Size	OVA SV (ppm)	THC ER (lbs/hr)
Y	25	DZ	GAS	GATE	2.00	0	7.2050E-07
Y	47	DZ	GAS	GATE	1.50	0	4.5395E-07
Y	53	DZ	GAS	GATE	8.00	0	1.9694E-05
Y	87	DZ	GAS	GATE	0.75	0	1.7084E-08
Y	88	DZ	GAS	GATE	0.75	0	1.9079E-08
Y	97	DZ	GAS	GATE	6.00	0	2.0734E-08
Y	105	DZ	GAS	GATE	1.00	0	2.2466E-08
Y	112	DZ	GAS	PLUG	3.00	0	7.2409E-07
Y	138	DZ	GAS	GATE	4.00	0	2.1829E-08
Y	139	DZ	GAS	GATE	3.00	0	3.1310E-08
V	85	DZ	GAS	GLOBE	2.00	0	3.4459E-05
V	105	DZ	GAS	GATE	6.00	0	6.0900E-08
Z	83	DZ	GAS	GLOBE	1.00	0	1.8390E-06
Z	84	DZ	GAS	GATE	6.00	0	4.8148E-06
Z	89	DZ	GAS	GATE	6.00	0	9.8204E-08
Z	90	DZ	GAS	GATE	6.00	0	8.7430E-08
W	95	DZ	GAS	MC	4.00	0	1.3547E-06
W	100	DZ	GAS	MC	3.00	0	2.5818E-05
W	107	DZ	GAS	GATE	6.00	0	8.0767E-08
V	76	DZ	HL	GLOBE	1.00	0	6.3525E-05
V	89	DZ	HL	GATE	2.00	0	3.2623E-05
X	72	DZ	HL	GATE	0.75	0	2.2798E-08
X	78	DZ	HL	GATE	2.00	0	7.9476E-05
Z	93	DZ	HL	GATE	8.00	0	1.2192E-07
Z	94	DZ	HL	GATE	8.00	0	1.1890E-07
Z	95	DZ	HL	GATE	6.00	0	1.1001E-07
W	43	DZ	HL	GATE	0.50	0	5.3101E-06
W	49	DZ	HL	GATE	1.00	0	2.3327E-08
W	60	DZ	HL	GATE	0.75	0	1.4546E-08
W	61	DZ	HL	GATE	0.75	0	1.4663E-08
W	122	DZ	HL	GATE	3.00	0	3.6122E-08
W	123	DZ	HL	GATE	3.00	0	2.9655E-08
Y	16	DZ	LL	GATE	3.00	0	2.6409E-08
Y	17	DZ	LL	GATE	1.00	0	1.4636E-08

--------------------------- Type=VALVE T_PHASE=All ---------------------------
(continued)

Site	Sample ID	Code	Phase	Subtype	Size	OVA SV (ppm)	THC ER (lbs/hr)
Y	100	DZ	LL	PLUG	1.00	0	1.4048E-08
Y	110	DZ	LL	GATE	4.00	0	1.0681E-06
Y	141	DZ	LL	GATE	8.00	0	6.1566E-08
X	49	DZ	LL	GLOBE	4.00	0	6.8850E-06
X	51	DZ	LL	GATE	3.00	0	5.1433E-06
X	68	DZ	LL	GATE	4.00	0	3.6704E-05
X	69	DZ	LL	GATE	4.00	0	1.5060E-05
X	70	DZ	LL	GATE	1.00	0	2.1525E-08
X	123	DZ	LL	ORBIT	3.00	0	4.2514E-06
Z	41	DZ	LL	GATE	0.75	0	1.6542E-07
Z	113	DZ	LL	GATE	1.00	0	1.5225E-08
Z	166	DZ	LL	GATE	3.00	0	5.1763E-06
Z	167	DZ	LL	GATE	1.00	0	1.5406E-05
Z	169	DZ	LL	GATE	3.00	0	1.5348E-05
Z	176	DZ	LL	GATE	6.00	0	1.2557E-07
W	36	DZ	LL	GATE	0.50	0	2.4341E-08
W	40	DZ	LL	GATE	10.00	0	4.7162E-08
W	54	DZ	LL	GATE	0.75	0	1.0298E-08
W	78	DZ	LL	GATE	3.00	0	1.1817E-06
W	133	DZ	LL	GATE	1.50	0	2.1984E-08
W	150	DZ	LL	GATE	1.00	0	1.8395E-08
W	154	DZ	LL	GATE	10.00	0	4.8301E-08
W	157	DZ	LL	GATE	8.00	0	4.4190E-08

N = 57

A.4

PEGGED COMPONENT EMISSIONS DATA

------------------------------ Type=C Phase=FL ------------------------------

Site	Sample ID	Code	Phase	Subtype	Size	OVA SV (ppm)	THC ER (lbs/hr)
V	93	PEG	GAS	FL	24	85987	1.7264E-04
V	95	PEG	GAS	FL	4	85990	8.2593E-03
W	9	PEG	GAS	FL	1	99995	5.4846E-02

N = 3

------------------------------ Type=C Phase=O ------------------------------

Site	Sample ID	Code	Phase	Subtype	Size	OVA SV (ppm)	THC ER (lbs/hr)
Y	58	PEG	LL	TH	1.00	75992.0	2.5896E-03
Y	106	PEG	LL	TH	0.50	89997.0	1.5689E-02
V	62	PEG	GAS	TH	1.00	90997.5	2.7638E-03
V	66	PEG/DRIP	HL	TH	1.00	1434.0	7.4962E-02
X	35	PEG	LL	TH	1.00	46990.0	6.2568E-03
X	58	PEG	GAS	TH	1.00	54996.0	1.1886E-01
X	60	PEG	LL	TH	1.00	65996.0	6.3338E-02
X	62	PEG	GAS	TH	0.75	99998.0	7.6784E-02
Z	26	PEG	LL	TH	1.00	116995.0	2.6415E-03
Z	27	PEG	LL	TH	1.00	116996.0	6.7018E-03
Z	66	PEG	GAS	U	1.50	99990.0	4.3660E-04
W	4	PEG	GAS	TH	3.00	99996.0	4.4216E-02
W	34	PEG	GAS	TH	1.00	99995.0	4.4067E-03
W	109	PEG	LL	TH	0.75	99997.0	6.0827E-03

N = 14

---------------------------- Type=OEL Phase=All ----------------------------

Site	Sample ID	Code	Phase	Subtype	Size	OVA SV (ppm)	THC ER (lbs/hr)
V	12	PEG	GAS	OEL	0.50	88995.0	9.0946E-03
V	58	PEG	GAS	OEL	0.75	99997.5	3.0630E-04
V	77	PEG/DRIP	HL	OEL	0.50	693.0	5.6403E-02
V	81	PEG	GAS	OEL	0.75	109990.0	1.2848E-02
V	82	PEG	GAS	OEL	0.75	118980.0	5.9078E-03
X	10	PEG/DRIP	LL	OEL	0.50	72987.0	2.5249E-02
Z	16	PEG	GAS	OEL	0.50	140000.0	2.6077E-02
Z	17	PEG	GAS	OEL	0.25	140000.0	4.3177E-02
Z	37	PEG	LL	OEL	0.50	139998.2	9.3953E-02
Z	165	PEGF	LL	OEL	0.25	99995.5	2.2345E-03
W	20	PEG	LL	OEL	0.50	99995.0	1.8948E-03

N = 11

Data for Pegged Component Emission Factors

------------------------------ Type=PUMP Phase=LL ------------------------------

Site	Sample ID	Code	Phase	Subtype	Size	OVA SV (ppm)	THC ER (lbs/hr)
Y	94	PEG	LL	HC	3.0	83247.5	2.3485E-03
X	5	PEG/DRIP	LL	CENT	0.5	61988.0	8.2052E-02
X	92	PEG	LL	CENT	3.0	99955.0	2.7577E+00
Z	22	PEGI	LL	HC	2.0	108990.0	2.3292E-03
Z	100	PEG	LL		.	99995.0	3.5463E-01

N = 5

---------------------------- Type=VALVE Phase=All ----------------------------

Site	Sample ID	Code	Phase	Subtype	Size	OVA SV (ppm)	THC ER (lbs/hr)
Y	6	PEG	GAS	GATE	1.0	89993.5	2.0189E-02
V	14	PEG	LL	MC	1.0	66988.0	2.9084E-02
V	31	PEG	GAS	MC	1.0	119996.0	4.1444E-02
V	59	PEG	GAS	GATE	0.5	99998.5	4.5223E-03
V	60	PEG	GAS	MC	3.0	108998.8	3.9373E-03
V	78	PEG	GAS	GATE	3.0	83475.0	6.3393E-03
V	90	PEG	GAS	GLOBE	2.0	76994.0	7.5190E-03
V	91	PEG	GAS	GLOBE	2.0	79995.5	7.7133E-03
V	106	PEG	GAS	GLOBE	3.0	99995.0	2.3761E-02
V	107	PEG	GAS	MC	4.0	71397.0	5.5589E-02
V	108	PEG	GAS	MC	4.0	77996.0	1.1336E-02
X	9	PEG/DRIP	LL	GATE	3.0	69990.0	6.6420E-02
X	12	PEG	LL	GATE	3.0	69995.0	4.1433E-01
X	17	PEG/DRIP	LL	GATE	6.0	87495.0	5.8171E-02
X	19	PEG	LL	GATE	6.0	69995.0	7.6070E-03
X	23	PEG	LL	GATE	6.0	38998.0	5.7033E-02
X	32	PEG	LL	GATE	6.0	69993.0	1.1199E-02
X	39	PEG	GAS	GATE	2.0	57990.0	3.7270E-02
X	40	PEG	LL	GATE	2.0	57990.0	6.7684E-03
X	41	PEG	LL	GATE	2.0	139993.0	3.0397E-02
X	55	PEGI	GAS	GATE	4.0	57995.0	9.1958E-03
X	91	PEG	GAS	ORBIT	3.0	99996.5	3.5486E-03
X	95	PEG	LL	ORBIT	8.0	99999.0	4.1500E-02
X	96	PEG	LL	ORBIT	2.0	99997.0	2.2315E-02
X	109	PEG	LL	ORBIT	2.0	99998.5	1.3228E-02
X	121	PEG	LL	GATE	4.0	99997.0	5.5536E-02
X	122	PEGF	LL	BTFY	8.0	99994.0	2.0301E-02
Z	15	PEG	GAS	NEDL	0.5	99999.0	1.0580E-02
Z	51	PEGF	LL	GATE	3.0	145998.6	1.4690E-02
Z	79	PEG	GAS	GLOBE	1.0	99990.0	1.7053E-01
Z	80	PEG	GAS	GLOBE	1.0	99990.0	1.9380E-02
Z	81	PEG	GAS	GLOBE	3.0	99997.0	1.0973E-02
Z	92	PEG	LL	GATE	4.0	99995.0	4.5531E-02
Z	115	PEG	GAS	GATE	2.0	99997.5	1.2232E-02
W	7	PEG	GAS	MC	6.0	99991.0	1.3441E-03
W	10	PEG	GAS	DIA	1.5	99995.0	2.8411E-03
W	106	PEGI	GAS	MC	3.0	79995.5	1.8904E-03
W	139	PEGI	GAS	GATE	6.0	69995.5	1.4817E-02

N = 38

APPENDIX B

COMPARISON OF VAPOR LEAK COMPOSITION TO LIQUID STREAM COMPOSITION DATA AND CALCULATIONS

TABLE V-1

FUGITIVE GAS SAMPLES FROM REFINERY "V"

molar volume = 24.45 liters

Bag Sample Number	Product	Hexane ppmv	Propyl-ene ppmv	Iso octane ppmv	Benzene ppmv	Toluene ppmv	Total Xylenes ppmv	Ethyl Benzene ppmv	Cumene ppmv	Total Spec. ppmv	Total Spec. ug/l	FID non-CH4 ppmv	FID non-CH4 ug/l	Component
V034	H2 Purg	NA	NA	NA	NA	0.026	0.011	0.008	NA	0.05	0.2	4.9	8.8	1" Connector
V036	H2 Syst	1.6	0.19	0.077	2.9	2	0.41	0.09	NA	7.27	25.3	130	234.4	3/4" Valve
V047	LL	4.2	NA	4.4	1.2	3.4	3.6	0.61	1.2	18.61	76.2	120	216.4	3" Gate Valve
V048	LL	49	NA	53	11	35	40	8	9.8	205.80	843.9	2700	4868.8	1" Connector
V049	LL	5.5	0.032	5.8	1.5	4	3.2	0.63	0.9	21.56	87.5	240	432.8	2" Gate Valve
V063	HL	0.38	1.3	1.5	0.38	1.3	1.7	0.33	0.41	7.30	27.5	12	39.3	1/2" OEL
V064	HL	0.093	0.16	0.16	0.039	0.19	0.53	0.094	0.21	1.48	5.9	5.7	10.3	3/4" Threaded Conn.
V065	HL	0.069	0.12	0.13	NA	0.18	0.7	0.1	0.3	1.60	6.7	370	667.2	3/4" Globe Valve
V071	HL	0.84	0.75	1.4	0.22	1.4	2.8	0.64	0.76	8.81	35.4	4.5	8.1	3/4" Connector
V066	HL	7.4	9	15	2.9	17	28	6.7	8.4	94.40	376.9	1400	2524.6	1" Threaded Conn.
V072	HL	0.71	NA	1.3	0.52	2.4	8.9	1.6	4	19.43	84.5	720	1298.4	Pump
		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
AVG		NA	NA	NA	NA	6.08	8.17	1.71	NA	35.12	142.74	518.83	937.19	
MDL														

Notes:

"NA" indicates a non-detect. Detection limits vary sample to sample.

All bag sample results speciated using EPA Method TO-3 (GC/PID-FID)

NMHC for samples V034-VO49 is EPA Method 18 THC minus ASTM D-3416 methane.

NMHC for samples V063-V072 is ASTM D-3416 NMHC.

TABLE V-2

REFINERY "V" FUGITIVE GAS GC RESULTS in ug/l

Bag Sample Number	Product	Hexane ug/l	Propyl-ene ug/l	Iso octane ug/l	Benzene ug/l	Toluene ug/l	Total Xylenes ug/l	Ethyl Benzene ug/l	Cumene ug/l	Total Speciate ug/l	FID THC ug/l	Percent Speciated
V034	H2 Purg	NA	NA	NA	NA	0.098	0.048	0.035	NA	0.18	8.84	2%
V036	H2 Syst	5.64	0.33	0.36	9.26	7.54	1.78	0.39	NA	25.30	234	11%
V047	LL	14.80	NA	20.55	3.83	12.81	15.63	2.65	5.90	76.18	216	35%
V048	LL	172.71	NA	247.59	35.14	131.88	173.69	34.74	48.17	843.93	4869	17%
V049	LL	19.39	0.06	27.10	4.79	15.07	13.90	2.74	4.42	87.46	433	20%
V063	HL	1.34	2.24	7.01	1.21	4.90	7.38	1.43	2.02	27.53	39	70%
V064	HL	0.33	0.28	0.75	0.12	0.72	2.30	0.41	1.03	5.93	10	58%
V065	HL	0.24	0.21	0.61	NA	0.68	3.04	0.43	1.47	6.68	667	1%
V071	HL	2.96	1.29	6.54	0.70	5.28	12.16	2.78	3.74	35.44	8	437%
V066	HL	26.08	15.49	70.07	9.26	64.06	121.58	29.09	41.29	376.93	2525	15%
V072	HL	2.50	NA	6.07	1.66	9.04	38.65	6.95	19.66	84.54	1298	7%
		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
@AVG		NA	NA	NA	NA	22.92	35.47	7.42	NA	142.74	937.19	

Notes:

All bag sample results speciated using Method TO-3 (GC/PID-FID)

TABLE V-3

REFINERY "V" LIQUID SAMPLES

Liquid Sample Number	Product	Hexane mg/l	Propylene mg/l	Iso octane mg/l	Benzene mg/l	Toluene mg/l	Total Xylenes mg/l	Ethyl Benzene mg/l	Cumene mg/l	m,p-Xylene mg/l	o-Xylene mg/l	Total Speciat. mg/l	Approx. Percent Speciat.	Method
V040	H2 Purg	10000	NA	NA	38000	130000	155000	26000	NA	110000	45000	359000	47.9%	8240
V041	H2 Syst	13000	NA	NA	45000	150000	167000	27000	1700	120000	47000	403700	53.8%	8240
V050	LL	7700	NA	NA	4400	15000	21200	3200	330	16000	5200	51830	6.9%	8240
V050	LL	7700	NA	NA	4400	15000	21200	3200	330	16000	5200	51830	6.9%	8240
V051	LL	10000	NA	NA	3900	15000	24600	3500	410	19000	5600	57410	7.7%	8240
V068	HL	NA	NA	NA	NA	300	1280	NA	66	900	380	1646	0.2%	8240
V068	HL	NA	NA	NA	NA	300	1280	NA	66	900	380	1646	0.2%	8240
V069	HL	NA	NA	NA	40	220	1100	140	41	790	310	1541	0.2%	8240
V069	HL	NA	NA	NA	40	220	1100	140	41	790	310	1541	0.2%	8240
V070	HL	NA	NA	NA	NA	200	870	110	NA	620	250	1180	0.2%	8240
V070	HL	NA	NA	NA	NA	200	870	110	NA	620	250	1180	0.2%	8240
		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
@AVG		NA	NA	NA	NA	29676	35955	NA	NA	25965	9989	84773	11.3%	

NOTES:

"NA" indicates a non-detect. Detection limits vary sample to sample.

Liquid stream speciation done using SW-846 Method 8240.

TABLE V-4

FUGITIVE/STREAM COMPARISONS (MASS FRACTION)/(MASS FRACTION) BASIS

Bag Sample Numbe	Liquid Sample Number	OVA Screen ppmv	Hexane	Propyl-ene	Iso octane	Benzene	Toluene	Total Xylenes	Ethyl Benzene	Cumene	All Speciated Compounds	Percent Speciated	Prod.	Compon. Type
V034	V040	13					0.1	0.03	0.11		0.14	2.0%	H2 Purge	1" Connector
V036	V041	297	1.39			0.7	0.2	0.03	0.05		0.67	10.8%	H2 Syste	3/4" Valve
V047	V050	109	6.66			3.0	3.0	2.56	2.87	61.95	16.50	35.2%	LL	3" Gate Valve
V048	V050	3596	3.46			1.2	1.4	1.26	1.67	22.49	8.12	17.3%	LL	1" Connector
V049	V051	1196	3.36			2.1	1.7	0.98	1.35	18.70	7.98	20.2%	LL	2" Gate Valve
V063	V068	195					311.5	110.03		582.65	583.57	70.0%	HL	1/2" OEL
V064	V068	460					174.1	131.19		1141	481.01	57.7%	HL	3/4" Threaded Co
V065	V069	167					3.5	3.11	3.49	40.43	9.51	1.0%	HL	3/4" Globe Valve
V071	V069	59				1624	2216	1022	1835	8422	4147	436.8%	HL	3/4" Connector
V066	V070	1434					95.2	41.52	78.57		180.61	14.9%	HL	1" Threaded Con
V072	V070	323					26.12	25.66	36.48		78.76	6.5%	HL	Pump
MEAN			3.7			326.2	257.5	121.6	217.7	1469.9	501.2			
SAMPLE STANDARD			2.2			725.5	657.2	302.1	606.9	3094.4	1226.5			
LOWER 95% CONFID.			0.2			-574.5	-184.0	-81.3	-248.8	-1392	-322.7			
UPPER 95% CONFID. F			7.2			1226.9	699.0	324.6	684.2	4332	1325.1			
DATA POINTS			4			5	11	11	9	7	11			
"T" STATISTIC USED			3.18			2.78	2.23	2.23	2.31	2.45	2.23			

NOTES:

1) All bag sample results speciated using Method TO-3 (GC/PID-FID)

2) Results are erratic and of low confidence. Therefore, it is not recommended to use these mass fraction relationships to estimate specific individual species emissions.
Results are impacted by liquid samples #68 through #70. In these samples, the sum of all compounds quantified totaled only 0.2% of the liquid stream.
Gas bag sample #71 was also problematic in that the sum of the speciated compounds exceeds the reported NMHC by a factor of four.

3) Mass fraction ratios are computed as:

$$\frac{\text{(fugitive compound ug/l)/(total fugitive NMHC ug/l)}}{\text{(liquid stream compound mg/l)/(total liquid stream ug/l)}}$$

4) Confidence intervals are computed a INTERVAL = MEAN +/-[@STDS(data)*('T' statistic)/(@SQRT(n)
Where the 'T' statistic for 14 data points and a 2 sided 95% confidence interval is 2.16.
Ref: Table V, Page 514, "Probability and Statistics for Engineers and Scientists," Ronald Walpole, 2nd Ed. 1978.

TABLE W-1

FUGITIVE GAS SAMPLES FROM REFINERY "W"

molar volume = 24.45 liters

Bag Sample Number	Product	Hexane ppmv	Propyl-ene ppmv	Iso octane ppmv	Benzene ppmv	Toluene ppmv	Total Xylenes ppmv	Ethyl Benzene ppmv	Cumene ppmv	Total Spec. ppmv	Total Spec. ug/l	FID non-CH ppmv	FID non-CH4 ug/l	Component
W018	Not Given	120	NA	97	56	64	9.1	2.1	NA	348.20	1344.8	1400	2525	OEL
W018*	Not Given	170	NA	NA	65	82	19	4.8	NA	340.80	1219.2	1400	2525	OEL
W028	Crude	63	NA	38	11	21	14	4.7	1.2	152.90	600.9	2900	5229	Pump
W028*	Crude	57	NA	NA	18	18	NA	NA	NA	93.00	326.2	2900	5229	Pump
W035	Debut BTMs	NA	NA	NA	0.015	0.034	0.03	NA	NA	0.08	0.3	8.9	16	Valve
W038	Debut BTMs	0.21	NA	0.13	0.2	0.51	0.4	0.092	0.005	1.55	6.1	9.1	16	Valve
W044	Crude Naptha	1.8	NA	0.89	0.22	0.47	0.22	0.082	0.018	3.70	14.4	3	5	Valve
W044*	Crude Naptha	1.7	NA	NA	0.35	0.59	0.36	0.12	0.017	3.14	11.5	3	5	Valve
W048	Crude Naptha	1	NA	0.45	0.1	0.2	0.073	0.032	0.006	1.86	7.2	14	25	Valve
W048*	Crude Naptha	0.78	NA	NA	0.15	0.22	0.11	0.032	0.0066	1.30	4.7	14	25	Valve
W070	Reg UL	190	NA	80	180	98	33	7.7	NA	588.70	2164.5	35000	63115	Valve
W070*	Reg UL	390	NA	820	220	300	170	32	NA	1932.00	7915.7	35000	63115	Valve
W072	Reg UL	15	7.7	2	7.3	2.5	0.54	NA	NA	35.04	110.6	2800	5049	Connection
W072*	Reg UL	20	1.9	18	13	7.4	3.7	0.69	NA	64.69	246.3	2800	5049	Connection
		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
AVG		NA	NA	NA	40.81	42.49	NA	NA	NA	254.78	998.0	6018	10852	

Notes:

Bag sample results flagged * are EPA Method TO-14 (GC/MS), others are EPA Method TO-3 (GC/PID-FID)

Non-CH4 hydrocarbons determined by ASTM D-3416.

TABLE W-2

REFINERY FUGITIVE GAS GC RESULTS

Bag Sample Number	Product	Hexane ug/l	Propyl-ene ug/l	Iso octane ug/l	Benzene ug/l	Toluene ug/l	Total Xylenes ug/l	Ethyl Benzene ug/l	Cumene ug/l	Total Speciat. ug/l	FID non-CH ug/l	Percent Speciated
W018	Not Given	422.97	NA	453.14	178.90	241.16	39.51	9.12	NA	1344.8	2525	53%
W018*	Not Given	599.21	NA	NA	207.65	308.98	82.50	20.84	NA	1219.2	2525	48%
W028	Crude	222.06	NA	177.52	35.14	79.13	60.79	20.41	5.90	600.9	5229	11%
W028*	Crude	200.91	NA	NA	57.50	67.83	NA	NA	NA	326.2	5229	6%
W035	Debut BTMs	NA	NA	NA	0.05	0.13	0.13	NA	NA	0.3	16	2%
W038	Debut BTMs	0.74	NA	0.61	0.64	1.92	1.74	0.40	0.02	6.1	16	37%
W044	Crude Naptha	6.34	NA	4.16	0.70	1.77	0.96	0.36	0.09	14.4	5	266%
W044*	Crude Naptha	5.99	NA	NA	1.12	2.22	1.56	0.52	0.08	11.5	5	213%
W048	Crude Naptha	3.52	NA	2.10	0.32	0.75	0.32	0.14	0.03	7.2	25	28%
W048*	Crude Naptha	2.75	NA	NA	0.48	0.83	0.48	0.14	0.03	4.7	25	19%
W070	Reg UL	669.70	NA	373.73	575.04	369.27	143.29	33.43	NA	2164.5	63115	3%
W070*	Reg UL	1374.65	NA	3830.69	702.83	1130.43	738.17	138.94	NA	7915.7	63115	13%
W072	Reg UL	52.87	13.25	9.34	23.32	9.42	2.34	NA	NA	110.6	5049	2%
W072*	Reg UL	70.49	3.27	84.09	41.53	27.88	16.07	3.00	NA	246.3	5049	5%
		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
@AVG		NA	NA	NA	130.37	160.12	NA	NA	NA	998.0	10852	50%

Notes:

Bag sample results flagged * are TO-14 (GC/MS), others are TO-3 (GC/PID-FID)

TABLE W-3

REFINERY LIQUID SAMPLES

Liquid Sample Number	Product	Hexane mg/l	Propyl-ene mg/l	Iso octane mg/l	Benzene mg/l	Toluene mg/l	Total Xylenes mg/l	Ethyl Benzene mg/l	Cumene mg/l	m,p-Xylene mg/l	o-Xylene mg/l	Total Speciat. mg/l	Approx. Percent Speciat.
W017	Not Given	72000	NA	NA	26000	28000	9400	2100	NA	7000	2400	137500	18.3%
W017	Not Given	72000	NA	NA	26000	28000	9400	2100	NA	7000	2400	137500	18.3%
W030L	Crude	43000	NA	NA	6200	16000	75000	6000	NA	14000	61000	146200	19.5%
W030L	Crude	43000	NA	NA	6200	16000	75000	6000	NA	14000	61000	146200	19.5%
W037	Debut BTMs	5000	NA	NA	5700	26000	40000	7200	330	29000	11000	84230	11.2%
W039	Debut BTMs	5400	NA	NA	6000	28000	44000	7300	370	32000	12000	91070	12.1%
W046	Crude Naptha	19000	NA	NA	4000	13000	17000	4600	760	12000	5000	58360	7.8%
W046	Crude Naptha	19000	NA	NA	4000	13000	17000	4600	760	12000	5000	58360	7.8%
W047	Crude Naptha	19000	NA	NA	3800	12000	15500	4200	750	11000	4500	55250	7.4%
W047	Crude Naptha	19000	NA	NA	3800	12000	15500	4200	750	11000	4500	55250	7.4%
W071	Reg UL	7400	NA	30000	5300	15000	23800	4400	NA	17000	6800	85900	11.5%
W071	Reg UL	7400	NA	30000	5300	15000	23800	4400	NA	17000	6800	85900	11.5%
W073	Reg UL	8600	NA	36000	5700	17000	27500	4500	NA	20000	7500	99300	13.2%
W073	Reg UL	8600	NA	36000	5700	17000	27500	4500	NA	20000	7500	99300	13.2%
		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
@AVG		24886	NA	NA	8121	18286	30029	4721	NA	15929	14100	95737	13%

NOTES:

"NA" indicates a non-detect. Detection limits vary sample to sample.

Liquid stream speciation done using SW-846 Method 8240.

TABLE W-4
REFINERY FUGITIVE/STREAM COMPARISONS (MASS FRACTION)/(MASS FRACTION) BASIS

Bag Sample Number	Product	Liquid Sample Number	Compon Type	OVA Screen ppmv	Hexane	Propyl-ene	Iso octane	Benzene	Toluene	Total Xylenes	Ethyl Benzene	Cumene	All Speciated Compounds	Percent Speciated
W018	Not Given	W017	OEL	8000	1.75			2.04	2.56	1.25	1.29		2.91	53.3%
W018*	Not Given	W017	OEL	8000	2.47			2.37	3.28	2.61	2.95		2.63	48.3%
W028	Crude	W030L	Pump	184	0.74			0.81	0.71	0.12	0.49		0.59	11.5%
W028*	Crude	W030L	Pump	184	0.67			1.33	0.61				0.32	6.2%
W035	Debut BTMs	W037	Valve	32				0.39	0.23	0.15			0.17	1.9%
W038	Debut BTMs	W039	Valve	26	6.26			4.87	3.14	1.80	2.50	3.04	3.05	37.0%
W044	Crude Naptha	W046	Valve	47	46.29			24.36	18.89	7.79	10.73	16.14	34.15	265.7%
W044*	Crude Naptha	W046	Valve	47	43.72			38.75	23.71	12.75	15.70	15.24	27.32	212.6%
W048	Crude Naptha	W047	Valve	80	5.51			2.50	1.87	0.61	0.98	1.17	3.86	28.5%
W048*	Crude Naptha	W047	Valve	80	4.30			3.75	2.05	0.92	0.98	1.29	2.53	18.6%
W070	Reg UL	W071	Valve	23000	1.08		0.15	1.29	0.29	0.07	0.09		0.30	3.4%
W070*	Reg UL	W071	Valve	23000	2.21		1.52	1.58	0.90	0.37	0.38		1.10	12.5%
W072	Reg UL	W073	Connect	74000	0.91		0.04	0.61	0.08	0.01			0.17	2.2%
W072*	Reg UL	W073	Connect	74000	1.22		0.35	1.08	0.24	0.09	0.10		0.37	4.9%
MEAN					9.0		0.51	6.12	4.18	2.19	3.29	7.37	5.68	
SAMPLE STANDARD DEVIATION					16.1		0.7	11.2	7.4	3.8	5.1	7.6	10.8	
LOWER 95% CONFID. FOR POP. MEAN					-0.7		-0.6	-0.3	-0.1	-0.1	-0.1	-2.1	-0.5	
UPPER 95% CONFID. FOR POP. MEAN					18.7		1.6	12.6	8.5	4.5	6.7	16.9	11.9	
DATA POINTS					13		4	14	14	13	11	5	14	
"T" STATISTIC USED					2.18		3.18	2.16	2.16	2.18	2.23	2.78	2.16	

Notes:

1) Bag sample results flagged * are TO-14 (GC/MS), others are TO-3 (GC/PID-FID)

2) Results are erratic and of low confidence. Therefore, it is not recommended to use these mass fraction relationships to estimate specific individual species emissions.
Results are heavily impacted by the results from bag sample #44. These data are obviously of poor quality because the sum of the speciated components exceeded the reported NMHC. If these data were to be dropped from the data set, the leak composition /stream composition results would be in the range of 0.5 to 2.0.

3) Mass fraction ratios are computed as:

$$\frac{\text{(fugitive compound ug/l)/(total fugitive NMHC ug/l)}}{\text{(liquid stream compound mg/l)/(total liquid stream ug/l)}}$$

4) Confidence intervals are computed as: INTERVAL = MEAN +/-[@STDS(data)*('T' statistic)/(@SQRT(n)
Where the 'T' statistic for 14 data points and a 2 sided 95% confidence interval is 2.16.
Ref: Table V, Page 514, "Probability and Statistics for Engineers and Scientists," Ronald Walpole, 2nd Ed. 1978.

TABLE X-1

FUGITIVE GAS SAMPLES FROM REFINERY "X"

molar volume = 24.45 liters

Bag Sample Number	Product	Hexane ppmv	Propyl-ene ppmv	Iso octane ppmv	Benzene ppmv	Toluene ppmv	Total Xylenes ppmv	Ethyl Benzene ppmv	Cumene ppmv	Total Spec. ppmv	Total Spec. ug/l	FID NMHC ppmv	FID NMHC ug/l	Component
X023	Lt Gasoline	2700	NA	220	640	95	NA	NA	NA	3655.0	12947.1	49000	88360	6" Valve
X023*	Lt Gasoline	3600			940	120				4660.0	6768.4	49000	88360	6" Valve
X024	Naptha Feed	33	NA	8.3	14	14	6.4	1.6	NA	77.3	287.3	790	1425	10" Valve
X025	Naptha Feed	1.3	NA	0.62	0.98	2.3	1.3	0.38	NA	6.9	26.6	15	27	1" Connector
X026	Naptha Feed	1.3	NA	2.3	0.38	1.7	0.9	0.37	0.062	7.0	28.8	6.6	12	4" Valve
X027	Reactor Feed	40	NA	24	23	40	13	3.7	NA	143.7	549.8	1300	2344	Pump
		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
AVG		1063	NA	51.04	269.73	45.50	NA	NA	NA	1425.0	3434.7	16685	30088	

Notes:

NA means not detected. Detection limits vary by sample.

Bag sample flagged with * analyzed with EPA Method TO-14 (GC/MS). All others analyzed with EPA Method TO-3 (GC/PID-FID)

Non-CH4 hydrocarbons determined by ASTM D-3416.

TABLE X-2

REFINERY FUGITIVE GAS GC RESULTS in ug/l

Bag Sample Number	Product	Hexane ug/l	Propyl-ene ug/l	Iso octane ug/l	Benzene ug/l	Toluene ug/l	Total Xylenes ug/l	Ethyl Benzene ug/l	Cumene ug/l	Total Speciate ug/l	FID NMHC ug/l	Percent Speciated
X023	Lt Gasoline	9516.8	NA	1027.75	2044.60	357.97	NA	NA	NA	12947.1	88360	15%
X023*	Lt Gasoline	3313.3			3003.00	452.17				6768.4	88360	8%
X024	Naptha Feed	116.3	NA	38.77	44.73	52.75	27.79	6.95	NA	287.3	1425	20%
X025	Naptha Feed	4.6	NA	2.90	3.13	8.67	5.64	1.65	NA	26.6	27	98%
X026	Naptha Feed	4.6	NA	10.74	1.21	6.41	3.91	1.61	0.30	28.8	12	242%
X027	Reactor Feed	141.0	NA	112.12	73.48	150.72	56.45	16.07	NA	549.8	2344	23%
		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
@AVG		2183	NA	238	862	171	NA	NA	NA	3435	30088	

Notes:

NA means not detected. Detection limits vary by sample.

Bag sample flagged with * analyzed with Method TO-14 (GC/MS). All others analyzed with Method TO-3 (GC/PID-FID)

TABLE X-3

REFINERY LIQUID SAMPLES

Liquid Sample Product Number	Hexane mg/l	Propyl-ene mg/l	Iso octane mg/l	Benzene mg/l	Toluene mg/l	Total Xylenes mg/l	Ethyl Benzene mg/l	Cumene mg/l	m,p-Xylene mg/l	o-Xylene mg/l	Total Speciat. mg/l	Approx. Percent Speciat.
X029L Lt Gasoline	91000	NA	NA	22000	5900	NA	NA	NA	NA	NA	118900	15.9%
X029L Lt Gasoline	91000	NA	NA	22000	5900	NA	NA	NA	NA	NA	118900	15.9%
X028L Naptha Feed	63000	NA	NA	18000	37000	30900	7200	ND	23000	7900	156100	20.8%
X030L Naptha Feed	59000	NA	NA	17000	35000	29000	6800	ND	22000	7000	146800	19.6%
X028L Naptha Feed	63000	NA	NA	18000	37000	30900	7200	ND	23000	7900	156100	20.8%
X031L Reactor Feed	21000	NA	NA	9400	38000	34500	9000	ND	26000	8500	111900	14.9%
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
@AVG	64667	NA	NA	17733	26467	NA	NA	NA	NA	NA	134783	ERR

NOTES:
NA means not detected.

TABLE X-4

REFINERY FUGITIVE/STREAM COMPARISONS (MASS FRACTION)/(MASS FRACTION) BASIS

Bag Sample Number	Product	Liquid Sample Number	OVA Screen ppmv	Hexane	Propyl-ene	Iso octane	Benzene	Toluene	Total Xylenes	Ethyl Benzene	Cumene	All Speciate Compou	Percent Speciated in bag	Compon. Type
X023	Lt Gasoline	X029L	39000	0.89			0.79	0.51				0.92	14.7%	6" Valve
X023*	Lt Gasoline	X029L	39000	0.31			1.16	0.65			Not	0.48	7.7%	6" Valve
X024	Naptha Feed	X028L	893	0.97	Not detected		1.31	0.75	0.47	0.51	detected	0.97	20.2%	10" Valve
X025	Naptha Feed	X030L	1393	2.15	in liquid		5.11	6.87	5.40	6.73	in	5.02	98.2%	1" Connector
X026	Naptha Feed	X028L	136	4.58	or gas		4.25	10.91	7.97	14.06	liquid	11.61	241.7%	4" Valve
X027	Reactor Feed	X031L	1780	2.15			2.50	1.27	0.52	0.57		1.57	23.5%	Pump
MEAN				1.8			2.5	3.5	3.6	5.5		3.4		
SAMPLE STD DEV.				1.5			1.8	4.4	3.7	6.4		4.3		
LOWER 95% CONFID.				0.2			0.6	-1.1	-2.3	-4.8		-1.1		
UPPER 95% CONFID.				3.4			4.4	8.1	9.5	15.7		8.0		
DATA POINTS				6			6	6	4	4		6		
"T" STATISTIC USED				2.57			2.57	2.57	3.18	3.18		2.57		

NOTES:

1) Bag sample flagged with * analyzed with Method TO-14 (GC/MS). All others analyzed with Method TO-3 (GC/PID-FID)

2) Results are erratic and of low confidence. Therefore, it is not recommended to use these mass fraction relationships to estimate specific individual species emissions.
Results are impacted by bag samples #26 in which the sum of all compounds quantified exceeds the reported NMHC by more than a factor of two.

3) Mass fraction ratios are computed as:

$$\frac{\text{(fugitive compound ug/l)/(total fugitive NMHC ug/l)}}{\text{(liquid stream compound mg/l)/(total liquid stream ug/l)}}$$

4) Confidence intervals are computed as: INTERVAL = MEAN +/-[@STDS(data)*('T' statistic)/(@SQRT(n)
Where the 'T' statistic for 14 data points and a 2 sided 95% confidence interval is 2.16.
Ref: Table V, Page 514, "Probability and Statistics for Engineers and Scientists," Ronald Walpole, 2nd Ed. 1978.

TABLE Z-1

FUGITIVE GAS SAMPLES FROM REFINERY "Z"

molar volume 24.45 liters

Bag Sample Number	Product	Hexane ppmv	Propylene ppmv	Iso octane ppmv	Benzene ppmv	Toluene ppmv	Total Xylenes ppmv	Ethyl Benzene ppmv	Cumene ppmv	Total Spec. ppmv	Total Spec. ug/l	FID non-CH ppmv	FID non-CH4 ug/l	Component
Z033	unknown	4.9	NA	4.5	2	4.3	3.3	0.66	0.27	19.93	79.4	190	342.6	4" Valve
Z144	Fuel gas	0.074	NA	NA	0.14	0.14	0.043	NA	NA	NA	1.4	131.0	236.2	3/4" Valve
		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
AVG		2.49	NA	NA	1.07	2.22	1.67	NA	NA	NA	40.42	161	289	

Notes:

"NA" indicates a non-detect. Detection limits vary sample to sample.

Bag Z033 speciated using EPA Method TO-3 (GC/PID-FID). Bag Z144 speciated using EPA Method TO-14 (GC/MS).

Non-CH4 hydrocarbons determined by subtracting ASTM D-3416 methane from EPA Method 18 THC.

TABLE Z-2

REFINERY "Z" FUGITIVE GAS GC RESULTS in ug/l

Bag Sample Number	Product	Hexane ug/l	Propylene ug/l	Iso octane ug/l	Benzene ug/l	Toluene ug/l	Total Xylenes ug/l	Ethyl Benzene ug/l	Cumene ug/l	Total Speciate ug/l	FID THC ug/l	Percent Speciated
Z033	unknown	17.271	NA	21.022	6.389	16.203	14.329	2.866	1.327	79.41	343	23%
Z144	Fuel gas	0.261	NA	NA	0.447	0.528	0.187	NA	NA	1.42	236	0.60%
		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
@AVG		8.77	NA	NA	3.42	8.37	7.26	NA	NA	40.42	289.43	

Notes:

"NA" indicates a non-detect. Detection limits vary sample to sample.

Bag Z033 speciated using Method TO-3 (GC/PID-FID). Bag Z144 speciated using Method TO-14 (GC/MS).

TABLE Z-3

REFINERY "Z" PRODUCT STREAM SAMPLES

Product Sample Number	Product	Hexane mg/l	Propylene mg/l	Iso octane mg/l	Benzene mg/l	Toluene mg/l	Total Xylenes mg/l	Ethyl Benzene mg/l	Cumene mg/l	m,p-Xylene mg/l	o-Xylene mg/l	Total Speciat. mg/l	Approx. Percent Speciat.	Method	
Z035	unknown	56000	NA	NA	16000	39000	74000	8100	1200	64000	10000	194300	25.9%	8240	
Z145	Fuel gas	257.31	NA	NA	383.36	452.17	95.53	NA	NA			1188	0.3%	TO-14	Gas sam
		-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----		
@AVG		28129	NA	NA	8192	19726	37048	NA	NA	64000	10000	97744	13.1%		

NOTES:

"NA" indicates a non-detect. Detection limits vary sample to sample.

Liquid stream speciation done using SW-846 Method 8240.

TABLE Z-4

REFINERY "Z" FUGITIVE/STREAM COMPARISONS (MASS FRACTION)/(MASS FRACTION) BASIS

Bag Sample Number	Prod.	Product Sample Number	OVA Screen ppmv	Hexane	Propylene	Iso octane	Benzene	Toluene	Total Xylenes	Ethyl Benzene	Cumene	All Speciate Compou	Percent Speciated in Bag	Compon. Type
Z033	unknown	Z035	75	0.68			0.87	0.91	0.42	0.77	2.42	0.89	23.2%	4" Valve
Z144	Fuel gas	Z145	1050	2.00			2.31	2.31	3.86			2.37	0.6%	3/4" Valv
MEAN				1.3			1.6	1.6	2.1	NA	NA	1.6		
SAMPLE STD DEV.				0.9			1.0	1.0	2.4	NA	NA	1.0		
LOWER 95% CONFID. FOR POP.				-7.1			-7.5	-7.3	-19.7	NA	NA	-7.7		
UPPER 95% CONFID. FOR POP.				9.8			10.7	10.5	24.0	NA	NA	11.0		
DATA POINTS				2			2	2	2			2		
"T" STATISTIC USED				12.71			12.71	12.71	12.71			12.71		

NOTES:

1) Bag Z033 speciated using Method TO-3 (GC/PID-FID). Bag Z144 speciated using Method TO-14 (GC/MS).

2) Results are erratic and of low confidence. Therefore, it is not recommended to use these mass fraction relationships to estimate specific individual species emissions.

3) Mass fraction ratios are computed as:

$$\frac{\text{(fugitive compound ug/l)/(total fugitive NMHC ug/l)}}{\text{(liquid stream compound mg/l)/(total liquid stream ug/l)}}$$

4) Confidence intervals are computed as: INTERVAL = MEAN +/-[@STDS(data)*('T' statistic)/(@SQRT(n)
Where the 'T' statistic for 14 data points and a 2 sided 95% confidence interval is 2.16.
Ref: Table V, Page 514, "Probability and Statistics for Engineers and Scientists," Ronald Walpole, 2nd Ed. 1978.

APPENDIX C

STATISTICAL EVALUATIONS AND CORRELATION DETAILS

C.1 LEAST SQUARES ESTIMATE OF A LINEAR REGRESSION

The fitting of a line to describe the relationship between two variables (X and Y) via the method of least squares involves estimating a Y-intercept (β_0) and a slope (β_1). The method of least squares chooses the parameter estimates for β_0 and β_1, as those values which minimize the sum of squares of the vertical distances from the data points to the presumed regression line. In addition, these parameters are estimated so that the average residual ($r_i = Y_i - \beta_0 - \beta_1 X_i$, i=1, . . . , n) is zero.

Let

$$Y_i = \text{Log}_{10}\ (\text{Leak Rate determined by bagging component i}),$$

and

$$X_i = \text{Log}_{10}\ (\text{Maximum Screening Value for component i}).$$

So that:

$$\text{Log}_{10}\ (\text{Leak Rate}) = \beta_0 + \beta_1\ \text{Log}_{10}\ (\text{Screening Value}),$$

or

$$Y_i = \beta_0 + \beta_1 X_i$$

describes the regression line.

Then the least square regression estimators can be given by:

$$\beta_1 = \frac{(\overline{XY}) - (\overline{X})\ (\overline{Y})}{\overline{X^2} - (\overline{X})^2} \quad ,$$

and

$$\beta_0 = \overline{Y} - \beta_1 \overline{X} \quad ,$$

where:

$$\bar{X} = \frac{\Sigma X_i}{n}$$

$$\bar{Y} = \frac{\Sigma Y_i}{n}$$

$$\overline{XY} = \frac{\Sigma X_i Y_i}{n}$$

$$\bar{X}^2 = \frac{\Sigma X_i^2}{n}$$

n = number of parameters.

Once these have been calculated, then the Mean Squared Error (MSE) can be given by:
where:

$$r_i = Y_i - \beta_0 - \beta_1 X_i \quad .$$

The MSE is a measure of how well the data fit the predicted values of the least-squares regression equation.

C.2 SCALE-BIAS CORRECTION FACTOR

In order to predict the mean emission rate for a given screening value, one must first transform the results of the least-squares analysis from log-log space back to arithmetic scales. To do this, a scale bias correction factor (SBCF) is required to obtain the following predictive correlation equation:

$$\text{Mean Leak Rate} = \text{SBCF} \times 10^{\beta_0} \times (\text{ScreeningValue})^{\beta_1}$$

The SBCF is obtained by summing a sufficient number (generally 10-15) of terms of the infinite series given below. Specifically, the SBCF is estimated by:

$$g(t) = 1 + \frac{(m-1)\,t}{m} + \frac{(m-1)^3 t^2}{m^2 2!\,(m+1)} + \frac{(m-1)^5 t^3}{m^3 3!\,(m+1)\,(m+3)} + \ldots,$$

where:

$$t = \left(\frac{MSE}{2}\,(\ln 10)^2\right)$$

and

$$m = \text{number of sources bagged} - 1 \quad .$$

The SBCF given above is a generalization of the SBCF developed by Finney (1941) for log-normal averages. Finney's SBCF was developed for averages only, but was extended to regression analysis for this application, as discussed in the U.S. EPA Protocols Document (U.S. EPA, 1993). The SBCF given above may not be mathematically exact and it does not account for errors in $\hat{\beta}_0$ and $\hat{\beta}_1$. However, the Finney SBCF performed well in simulations when the errors in x (the screening values) were small. If the errors in x are not negligible, then the Finney SBCF is biased high. It is noted that this SBCF is given in the U.S. EPA Protocols Document (U.S. EPA, 1993) as the recommended SBCF.

C.3 STANDARD ERROR

The standard error of an estimate is a statistical measure of the amount of variation of the actual values of the dependent variable from their predicted values, as estimated by the regression equation. Its formula may be written:

$$SE_Y = \sqrt{MSE}$$

The SE_Y possesses the same units as the response variable, Y_i (for emission rates, this is lbs/hr). The standard error is also used in developing confidence intervals around the mean predicted values.

C.4 CONFIDENCE INTERVALS

A confidence interval for a parameter Θ is an interval:

$$a < \Theta < b,$$

where:

a and b are numbers calculated partially from sample data, within which we feel reasonably certain the unknown parameter lies. A confidence interval is derived from a probability statement that involves the unknown parameter Θ. These confidence intervals should be interpreted as follows:

When we state that the parameter falls within the computed confidence limits, we expect to be correct about 100 x (1-α) percent of the time.

For example, suppose a sample is drawn from some population and a 95% confidence interval (α = 0.05) is computed for some parameter, say the mean. If 100 samples are drawn from that population, and 100 of these confidence intervals for the mean are computed, then 95 of these intervals should contain the true population mean Θ as an interior point.

Confidence intervals for the intercept of the least-squares regression equation can be specified as:

$$\hat{\beta}_0 \pm t_{(1 - \alpha/2,\, n - 2)} \hat{\sigma}_{\beta_0} \quad .$$

Confidence intervals for the slope of the least-squares regression equation can be specified as:

$$\hat{\beta}_1 \pm t_{(1 - \alpha/2,\, n - 2)} \hat{\sigma}_{\beta_1} \quad ,$$

where:

$$SXX = \Sigma(X_i - \bar{X})^2$$

$$\bar{X} = \frac{\Sigma X_i}{n}$$

$$MSE = \frac{\Sigma(Y_i - \hat{\beta}_0 - \hat{\beta}_1 X_i)^2}{n - 2}$$

$$\hat{\sigma}_{\beta_0} = \sqrt{MSE}\left(\frac{1}{n} + \frac{(\bar{X})^2}{SXX}\right)^{1/2}$$

$$\hat{\sigma}_{\beta_1} = \left(\frac{MSE}{SXX}\right)^{1/2} ,$$

and

$$t_{\left(1 - \frac{\alpha}{2}, n-2\right)}$$

is the 1- $\alpha/2$ probability point of the student's t distribution with (n-2) degrees of freedom.

Confidence intervals for the predicted mean value of Y for a given X_k can be specified as:

$$\hat{Y}_K \pm t_{(1 - \alpha/2, n - 2)}\hat{\sigma}_{Y_K} ,$$

where:

$$\hat{\sigma}_{Y_x} = SE_Y \left(\frac{1}{n} + \frac{\left(X_K - \bar{X}\right)^2}{\Sigma(X_i - \bar{X})^2} \right)^{1/2}$$

$$\hat{Y}_K = \hat{\beta}_0 + \hat{\beta}_1 X_K \quad ,$$

and

$$SE_Y = \sqrt{MSE} \quad \text{as given in Appendix A.1.}$$

The confidence intervals for the predicted values are smallest when $X_k = \bar{X}$ and increase as X_k moves away from $\bar{X}$ in either direction. That is, the greater the distance an X_k is (in either direction) from $\bar{X}$, the larger the expected error is when predicting the mean value of Y at X_k.

C.5 CORRELATION COEFFICIENT

The sample correlation coefficient is a statistical measure of the linear relationship between two variables. The correlation between two variables, X and Y, is computed as:

$$r_{XY} = \frac{\Sigma\,(X_i - \bar{X})\cdot(Y_i - \bar{Y})}{\sqrt{\Sigma\,(X_i - \bar{X})^2 \cdot \Sigma\,(Y_I - \bar{Y})^2}} \quad ,$$

and is bounded:

$$-1 \leq r_{XY} \leq 1 \quad .$$

The correlation coefficient squared (r_{XY}^2) can be interpreted as the fraction of the total variation which is explained by the least-squares regression line. In other words, r_{XY} measures how well the least-squares regression line fits the sample data. If the total variation is all explained by the regression line, i.e., if $r_{XY}^2 = 1$ or $r_{XY} = \pm 1$, we say there is a perfect linear correlation. On the other hand, if there is no linear relationship between sample values of X and Y, then r_{XY} will have a value near zero. In addition, if $r_{XY} > 0$, then the response variable (Y) increases as the independent variable (X) does. If $r_{XY} < 0$, the response decreases as the independent variable increases.

C.6 CALCULATION OF ZERO COMPONENT EMISSION FACTORS AND PEGGED COMPONENT EMISSION FACTORS AND THE 95% CONFIDENCE LIMITS

The zero component emission factor is calculated as the average emission factor for screening values that screen at background levels. The pegged component emission factor is calculated as the average emission factor for screening values that "peg" the instrument screening device (i.e., the screening value is greater than the measurable range of the instrument).

These emission factors can be calculated as an arithmetic average or a log-normal average depending on the distribution of the data. It is noted that the arithmetic average provides a statistically unbiased estimate of the mean, regardless of the underlying distribution (i.e., normal, log-normal, gamma, etc.). If the data are normally distributed then the arithmetic mean also provides a minimum-variance unbiased estimator. If the data are log-normally distributed, the log-normal mean provides the minimum-variance unbiased estimator.

The arithmetic average is calculated as follows:

$$\bar{y} = \frac{\sum_{i=1}^{n} y_i}{n}$$

n = number of sources bagged

where: y_i = the leak rate determined by bagging component i.

The 95% confidence limits for the arithmetic average emission factors are calculated as follows:

$$\bar{y} \pm \frac{t_{(1-\alpha/2,\, n-1)} S_y}{\sqrt{n}}$$

where: S_y = the standard deviation of y = $\sqrt{S_y^2}$,

and $t_{\left(1-\frac{\alpha}{2},\, n-1\right)}$

is the 1-α/2 probability point of the student's t distribution with (n-1) degrees of freedom.

The log-normal average, μ, is calculated as follows:

$$\mu = SBCF\,(\bar{Y}) \quad ,$$

where:

$$\bar{Y} = \frac{\sum_{i=1}^{n} Y_i}{n}$$

n = number of sources bagged.

$Y_i = Log_{10}\,(u_i) = Log_{10}$ (leak rate determined by bagging component i).

The SBCF is obtained by summing a sufficient number (generally 10-15) of terms of the infinite series given below as shown in A.2. Specifically, the SBCF is estimated by:

$$g(t) = 1 + \frac{(n-1)\,t}{n} + \frac{(n-1)^3 t^2}{n^2 2!\,(n+1)} + \frac{(n-1)^5 t^3}{n^3 3!\,(n+1)(n+3)} + \ldots,$$

where:

$$t = \left(\frac{S^2}{2}(\ln 10)^2\right)$$

$$S^2 = \frac{\sum_{i=1}^{n}\left(Y_i - \bar{Y}\right)^2}{n-1}.$$

and

n = number of sources bagged .

Note that the value for t used in the calculation of the SBCF for the log-normal average emission factors is different than the value of t used in the calculation of the SBCF for the regression analysis. To calculate the log-normal average emission factors, the mean-squared-error (MSE) of the regression is replaced by the variance (S_y^2) of the emission rates, and the degrees of freedom are n-1 (instead of n-2).

The equation for the mean emission rate, given above, is the best, unbiased estimator and also provides an efficient estimate for the mean of a log-normal distribution [Finney (1941), Atchinson (1955)].

The 95% confidence limits for the log-normal average emission factors are calculated as follows:

$$SBCF\ 10^{\left(\bar{Y} \pm \frac{t_{(1-\alpha/2,\ n-1)} S_y}{\sqrt{n}}\right)}.$$

where:

$$S_Y = \text{the standard deviation of } Y = \sqrt{S^2},$$

and

$$t_{\left(1 - \frac{\alpha}{2},\ n-1\right)}$$

is the 1- $\alpha/2$ probability point of the student's t distribution with (n-1) degrees of freedom.

C.7 REGRESSION ESTIMATES FOR EMISSION RATES FROM THE 1980 REFINERY STUDY (RADIAN, 1980)

Note:

TLV0=TLV screening value obtained at the surface of the component

- Flanges

Equation for predicted mean emission rate is:

Emission Rate = $(1.275)(10^{-5})(TLV0)^{0.88}$

Least-Square Results (in log-log space) using TLV Screening Instrument:

Log_{10} (Emission Rate) = -5.20 + 0.88 Log_{10} (TLV0);
Correlation Coefficient (r) = 0.77;
Number of Data Pairs = 52;
Standard Error of Estimate = 0.52;
95% Confidence Interval for Intercept (-5.9, -4.5);
95% Confidence Interval for Slope = (0.68, 1.08); and
Scale Bias Correction Factor = 2.02.

- <u>Valves - Light Liquid Service</u>

Equation for predicted mean emission rate is:

Emission Rate = $(3.19)(10^{-5})(TLV0)^{0.80}$

Least-Square Results (in log-log space) using TLV Screening Instrument:

Log_{10} (Emission Rate) = -4.90 + 0.80 Log_{10} (TLV0);
Correlation Coefficient (r) = 0.79;
Number of Data Pairs = 119;
Standard Error of Estimate = 0.60;
95% Confidence Interval for Intercept (-5.3, -4.5);
95% Confidence Interval for Slope = (0.69, 0.91); and
Scale Bias Correction Factor = 2.53.

- <u>Valves - Gas Vapor Service</u>

Equation for predicted mean emission rate is:

Emission Rate = $(4.81)(10^{-7})(TLV0)^{1.23}$

Least-Square Results (in log-log space) using TLV Screening Instrument:

Log_{10} (Emission Rate) = -7.00 + 1.23 Log_{10} (TLV0);
Correlation Coefficient (r) = 0.76;
Number of Data Pairs = 79;
Standard Error of Estimate = 0.78;
95% Confidence Interval for Intercept (-8.1, -5.9);
95% Confidence Interval for Slope = (0.99, 1.47) ; and
Scale Bias Correction Factor = 4.81.

- <u>Pump Seals - Light Liquid Service</u>

Equation for predicted mean emission rate is:

Emission Rate = $(1.823)(10^{-4})(TLV0)^{0.830}$

Least-Square Results (in log-log space) using TLV Screening Instrument:

Log_{10} (Emission Rate) = -4.40 + 0.830 Log_{10} (TLV0);
Correlation Coefficient (r) = 0.68;
Number of Data Pairs = 259;
Standard Error of Estimate = 0.760
95% Confidence Interval for Intercept (-4.9, -3.9);
95% Confidence Interval for Slope = (0.72, 0.94) ; and
Scale Bias Correction Factor = 4.58.

C.8 REGRESSION ESTIMATES FROM THE PETROLEUM MARKETING TERMINALS STUDY

Note:
OVA0=OVA screening value obtained at the surface of the component
OVA1=OVA screening value obtained at <1 cm from component

- Connectors (Flanges and Non-Flanges) - All Services

Equation for predicted mean emission rate is:

Emission Rate = $(4.652)(10^{-5})(OVA0)^{0.426}$

Least-Square Results (in log-log space):

Log_{10} (Emission Rate) = -4.73 + 0.426 Log_{10} (OVA0);
Correlation Coefficient (r) = 0.41;
Number of Data Pairs = 36;
Standard Error of Estimate = 0.604;
95% Confidence Interval for Intercept (-5.48 -3.98);
95% Confidence Interval for Slope = (0.097, 0.754); and
Scale Bias Correction Factor = 2.50.

- Valves - Light Liquid Service

Equation for predicted mean emission rate is:

Emission Rate = $(6.34)(10^{-6})(OVA0)^{0.708}$

Least-Square Results (in log-log space):

Log_{10} (Emission Rate) = -5.433 + 0.708 Log_{10} (OVA0);
Correlation Coefficient (r) = 0.845;
Number of Data Pairs = 46;
Standard Error of Estimate = 0.460;
95% Confidence Interval for Intercept (-5.81, -5.06);
95% Confidence Interval for Slope = (0.57, 0.84); and
Scale Bias Correction Factor = 1.72

- Loading Arm Valves - All Services

Equation for predicted mean emission rate is:

Emission Rate = $(8.24)(10^{-6})(OVA0)^{0.955}$

Least-Square Results (in log-log space):

Log_{10} (Emission Rate) = -5.469 + 0.955 Log_{10} (OVA0);
Correlation Coefficient (r) = 0.825;
Number of Data Pairs = 24;
Standard Error of Estimate = 0.601;
95% Confidence Interval for Intercept (-6.03, -4.91);
95% Confidence Interval for Slope = (0.67, 1.24); and
Scale Bias Correction Factor = 2.43

- Open-Ended Lines - All Services

Equation for predicted mean emission rate is:

Emission Rate = $(5.69)(10^{-6})(OVA0)^{0.995}$

Least-Square Results (in log-log space):

Log_{10} (Emission Rate) = -5.743 + 0.995 Log_{10} (OVA0);
Correlation Coefficient (r) = 0.859;
Number of Data Pairs = 16;
Standard Error of Estimate = 0.701;
95% Confidence Interval for Intercept (-6.53, -4.95);
95% Confidence Interval for Slope = (0.65, 1.34); and
Scale Bias Correction Factor = 3.14

- Pump Seals - Light Liquid Service

Equation for predicted mean emission rate is:

Emission Rate = $(6.567)(10^{-5})(OVA1)^{0.534}$

Least-Square Results (in log-log space):

Log_{10} (Emission Rate) = -4.619 + 0.534 Log_{10} (OVA1);
Correlation Coefficient (r) = 0.757;
Number of Data Pairs = 12;
Standard Error of Estimate = 0.667;
95% Confidence Interval for Intercept (-5.43, -3.81);
95% Confidence Interval for Slope = (0.209, 0.859) ; and
Scale Bias Correction Factor = 2.729.

- Valves (Light Liquid Services) and Connectors (All Services), Combined

Equation for predicted mean emission rate is:

Emission Rate = $(1.255)(10^{-5})(OVA0)^{0.635}$

Least-Square Results (in log-log space):

Log_{10} (Emission Rate) = -5.22 + 0.635 Log_{10} (OVA0);
Correlation Coefficient (r) = 0.729;
Number of Data Pairs = 82;
Standard Error of Estimate = 0.532;
95% Confidence Interval for Intercept (-5.56, -4.88);
95% Confidence Interval for Slope = (0.502, 0.768) ; and
Scale Bias Correction Factor = 2.083.

- Loading Arm Valves (All Services) and Open-Ended Lines (All Services), Combined

Equation for predicted mean emission rate is:

Emission Rate = $(7.663)(10^{-6})(OVA0)^{0.959}$

Least-Square Results (in log-log space):

Log_{10} (Emission Rate) = -5.55 + 0.959 Log_{10} (OVA0);
Correlation Coefficient (r) = 0.838;
Number of Data Pairs = 40;
Standard Error of Estimate = 0.632;
95% Confidence Interval for Intercept (-5.98, -5.12);
95% Confidence Interval for Slope = (0.755, 1.164) ; and
Scale Bias Correction Factor = 2.743.

C.9 REGRESSION ESTIMATES FROM THE 1993 REFINERY FUGITIVE EMISSIONS STUDY

Note:
OVA0=OVA screening value obtained at the surface of the component
OVA1=OVA screening value obtained at < 1 cm from component

- Connectors (Flanges) - All Services

Equation for predicted mean emission rate is:

Emission Rate = $(1.25)(10^{-6})(OVA0)^{0.928}$

Least-Square Results (in log-log space):

Log_{10} (Emission Rate) = -6.23 + 0.928 Log_{10} (OVA0);
Correlation Coefficient (r) = 0.879;
Number of Data Pairs = 19;
Standard Error of Estimate = 0.557;
95% Confidence Interval for Intercept (-6.99 -5.46);
95% Confidence Interval for Slope = (0.671, 1.185); and
Scale Bias Correction Factor = 2.11.

- Connectors (Non-Flanges) - All Services

Equation for predicted mean emission rate is:

Emission Rate = $(2.80)(10^{-7})(OVA0)^{1.035}$

Least-Square Results (in log-log space):

Log_{10} (Emission Rate) = -7.28 + 1.035 Log_{10} (OVA0);
Correlation Coefficient (r) = 0.847;
Number of Data Pairs = 29;
Standard Error of Estimate = 0.830;
95% Confidence Interval for Intercept (-8.13, -6.42);
95% Confidence Interval for Slope = (0.779, 1.29); and
Scale Bias Correction Factor = 5.30

- Open-Ended Lines - All Services

Equation for predicted mean emission rate is:

Emission Rate = $(5.34)(10^{-7})(OVA0)^{0.841}$

Least-Square Results (in log-log space):

Log_{10} (Emission Rate) = -6.693 + 0.841 Log_{10} (OVA0);
Correlation Coefficient (r) = 0.831;
Number of Data Pairs = 22;
Standard Error of Estimate = 0.632;
95% Confidence Interval for Intercept (-7.58, -5.81);
95% Confidence Interval for Slope = (0.580, 1.10); and
Scale Bias Correction Factor = 2.63

- Pump Seals - Heavy Liquid Service

Equation for predicted mean emission rate is:

Emission Rate = $(5.56)(10^{-6})(OVA1)^{1.07}$

Least-Square Results (in log-log space):

Log_{10} (Emission Rate) = -5.57 + 1.07 Log_{10} (OVA1)
Correlation Coefficient (r) = 0.903;
Number of Data Pairs = 10;
Standard Error of Estimate = 0.572;
95% Confidence Interval for Intercept (-6.45, -4.69);
95% Confidence Interval for Slope = (0.664, 1.48); and
Scale Bias Correction Factor = 2.06

- Pump Seals - Light Liquid Service

Equation for predicted mean emission rate is:

Emission Rate = $(2.60^{-4})(\text{OVA1})^{0.438}$

Least-Square Results (in log-log space):

Log_{10} (Emission Rate) = -4.09 + 0.438 Log_{10} (OVA1);
Correlation Coefficient (r) = 0.646;
Number of Data Pairs = 27;
Standard Error of Estimate = 0.644;
95% Confidence Interval for Intercept (-4.78, -3.40);
95% Confidence Interval for Slope = (0.225, 0.651) ; and
Scale Bias Correction Factor = 2.77.

- Valves - All Services.

Equation for predicted mean emission rate is:

Emission Rate = $(3.65)(10^{-6})(\text{OVA0})^{0.778}$

Least-Square Results (in log-log space):

Log_{10} (Emission Rate) = -5.85 + 0.778 Log_{10} (OVA0);
Correlation Coefficient (r) = 0.810;
Number of Data Pairs = 141;
Standard Error of Estimate = 0.603;
95% Confidence Interval for Intercept (-6.14, -5.56);
95% Confidence Interval for Slope = (0.683, 0.872) ; and
Scale Bias Correction Factor = 2.59.

APPENDIX D

DEVELOPMENT OF EMISSION CORRELATION EQUATIONS USING THE MEASUREMENT ERROR METHOD (MEM) STATISTICAL ANALYSIS METHOD

D.1 INTRODUCTION

In Appendix C certain issues pertaining to the estimation of emission rate are discussed. For components that are screened but not bagged, no direct measurement of emission rate is made. Measurements from the less elaborate screening process, however, can be used to estimate emission rate. This can only be performed, however, if there exists an equation by which emission rate can be estimated as a function of the screening value. Thus, the entire process is no better than the predictive equation. (Note: predictive equations are called emission correlation equations throughout this report.) In this appendix, statistical issues pertaining to the development and use of this equation are discussed.

Regression analysis is a reasonable method for developing the predictive equation. In conventional regression analysis, however, the assumption is that the dependent variable has an error, but the independent variable has no error. This assumption is not satisfied here, because screening value and emission rate are both measured with error. In this appendix, an approach that accounts for the errors in both variables is discussed.

In Section D.2 simulation results based on various levels of errors in the screening value and emission rate measurements are presented. Inverse regression analysis is basically conventional regression analysis, except that the roles of the dependent and independent variables are reversed in performing the regression analysis; this approach is described more explicitly in Section D.2. Both conventional and inverse regression analysis produced severe biases in some of the simulated conditions. In the new approach, here referred to as the "Measurement Error Method" (MEM), negligible or zero biases were obtained in all conditions simulated.

A literature search did not reveal any references with a complete solution of the problem addressed here. Where needed, the necessary mathematical relationships were derived for this application. Because this information is not believed to be available elsewhere in the literature, it was felt that a thorough documentation of the mathematics was needed. Section D.3 provides this documentation.

Section D.2 and a referenced report, also written for this project, provide the information necessary to understand why the new method is needed and to compare the performance of the new method with that of other approaches. For these purposes, it is not necessary to follow the derivations given in Section D.3. Nevertheless, it is believed that Section D.3 will be of interest to some readers and that the detailed background will be useful in future developments.

D.2 SIMULATION RESULTS AND ANALYSES OF REAL DATA

The basic issues pertaining to the calibration process required to predict emission rate as a function of screening value are known to the community and are summarized in Appendix C. In that appendix, the regression of the logarithm of emission rate on the logarithm of screening value and the scale bias correction needed to obtain an unbiased estimate of emission rate when the errors in the screening values are negligible are summarized.

Simulations and analyses of real data documented in an earlier project report are summarized in Section D.2.1. These results strongly indicated the need for a method that accounted for the errors in both emission rate and screening value. New simulations involving the MEM technique are discussed in Section D.2.2.

D.2.1 Summary of Earlier Results

In a report written for this project, Williamson and Hall (1993) have shown that both conventional and inverse regression can produce biased estimates of emission rate. In conventional regression analysis, the logarithm of the emission rate is regressed on the logarithm of the screening value. In inverse regression, the roles of the two variables are reversed; the logarithm of the screening value is regressed on the logarithm of the emission rate. Inverse regression is based on the assumption that the relative errors in the emission rate measurements are small compared to those in the screening value measurements. Inverse regression analysis produces an equation that predicts the logarithm of screening value as a function of the logarithm of emission rate, but it is possible to solve for the logarithm of emission rate as a function of the logarithm of screening value.

Both regression analyses were performed in log-log space, and a scale bias correction factor was employed in both cases; again, the use of a scale bias correction factor when a regression analysis is performed in log-log space is discussed in Appendix C.

The earlier project report provides a variety of simulations in which conventional and inverse regression are compared. Conventional regression analysis performs well in the hypothetical case in which there is no error in the screening value, but this case is not realistic for the emission rate, screening value relationship. If the relative error in the screening value is much larger than the relative error in the emission rate, then inverse regression performs better than conventional regression.

In addition to the simulations, the earlier project report documents analyses based on real data. An analysis of replicate pairs of screening and bagging values is presented. The data base is not large enough to quantify the error variance accurately for all combinations of component types (connectors, pump seals, valves, and open-ended lines) and service categories (light liquid and gas) listed. The preliminary results suggest, however, that the relative error in neither type of measurement is negligible compared to the relative error in the other. This indicates that neither conventional nor inverse regression is fully adequate, and a method that accounts for the error in both variables is needed.

Additionally, results obtained by applying both conventional and inverse regression to real data sets were compared. Considerable differences between the two regression lines were observed. Differences of more than a factor of ten between the emission rates predicted by the two methods were observed for some screening values for all four data sets analyzed.

In the earlier project report it was recommended that a new approach based on the MEM technique be developed. That development has now been performed.

D.2.2 Simulations

Because the MEM approach had not yet been developed when the earlier report was published, that report contains no simulations demonstrating the performance of the MEM technique. This section supplements the earlier report by presenting simulations in which results produced by the MEM technique, conventional regression, and inverse regression are compared.

On the basis of Radian's experience in developing regression models to predict emission rate as a function of screening value, a standard error (or root-mean-square error) of 0.6 is realistic. The standard error in this context characterizes the scatter of the points about the conventional regression line when the common logarithm of emission rate is regressed on the common logarithm of screening value.

In this section, data sets with different relative errors in emission rate and screening value have been analyzed. The errors were adjusted, however, so that the conventional regression analysis described above would produce approximately a standard error of 0.6 (the actual standard errors in the cases analyzed varied only from 0.60 to 0.62). The same synthetic data sets analyzed here are also discussed in the earlier report. The actual mathematical process for synthesizing the data with errors is discussed in Section D.3.

Consider, then, the analyses performed for a given standard deviation of the logarithm of emission rate and the corresponding standard deviation of the logarithm of screening value. First, a set of 30 screening values and 30 corresponding emission rates were generated. The random error in any one of these values was independent of each other error. Using these data, a predictive equation was developed using each of the three methods to be compared. Subsequently, an independent set of 30 screening values was synthetically generated. The errors in these screening values had the same statistical parameters but were statistically independent of the errors in the values used to develop the regression models. Each model was used to predict the emission rate for each screening value. The process just described constitutes one Monte Carlo trial.

The process was performed for 1,000 Monte Carlo trials, such that the errors in any trial were statistically independent of those in any other trial. The 1,000 estimated emission rates for a given method and screening value were averaged. Each average was compared to the corresponding true emission rate to determine whether a bias existed.

Figure D-1 presents the results for the case in which there was no error in the screening value. This case is not realistic but is presented for illustration. In this instance, the assumptions associated with conventional regression were satisfied. The assumptions associated with the MEM technique were also satisfied, because this approach is designed to handle any level of errors in the dependent and independent variables.

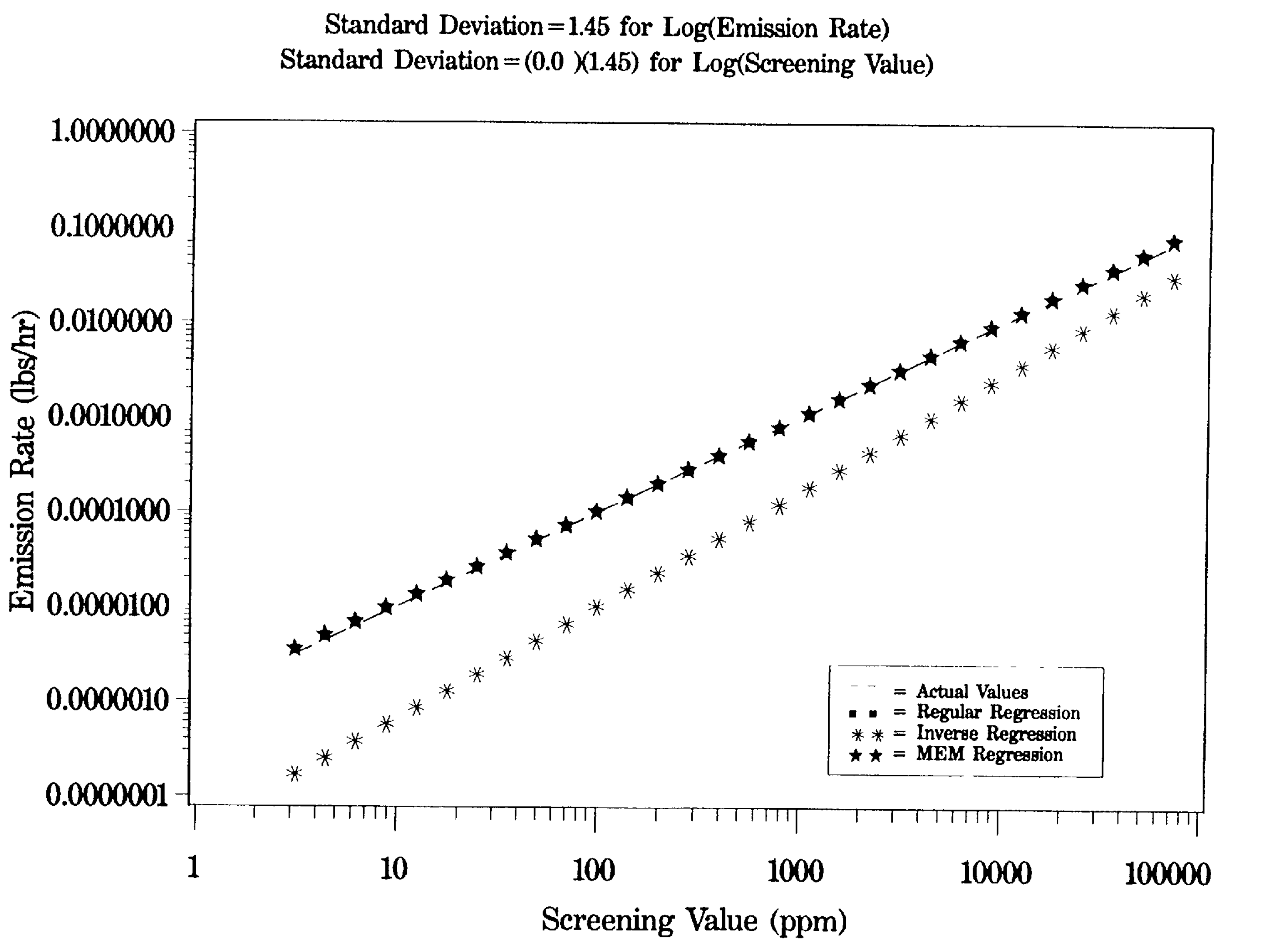

Figure D-1. Simulation Results for Average Emission Rates versus True Screening Values. Standard Error of Log(Screening Values) = 0

Each symbol (asterisk, square, or star) in Figure D-1 represents the average of 1,000 estimates of emission rate for a given method and true screening value. This figure shows that both the conventional regression line and the MEM regression line fall very nearly on the dashed line indicating the true values, as expected on the basis of the comments above.

The assumptions for inverse regression would be strictly satisfied if there were no error in the emission rate. This condition is not satisfied, and Figure D-1 shows that the results of inverse regression are severely biased in this case.

Figure D-2 illustrates the case in which the logarithms of the emission rates and screening values have the same error variances. Notice that these two types of measurements have different physical units, and so their standard errors in linear space cannot be compared. The standard errors in log space (i.e., the standard deviations of the errors in their logarithms) can be compared, however.

In Figures D-2, D-3, and D-4 there are errors in the screening values. Each averaged predicted emission rate, however, is plotted with the true screening value as an abscissa; this scheme facilitates comparison of the averaged emission rates with the dashed line representing the true values.
In the case shown in Figure D-2, the assumptions for neither conventional nor inverse regression analysis are satisfied. Both of these methods produce markedly biased results, especially for smaller screening values. Again, the MEM predictions lie approximately on the dashed line indicating the true values. Even though the results from 1,000 Monte Carlo trials were averaged, a slight point-to-point random variability is seen in Figure D-2.

Figures D-3 and D-4 present the cases in which the standard error in the logarithm of screening value is 1.5 times and twice that in the logarithm of emission rate, respectively. As the error in the logarithm of screening value increases relative to the error in the logarithm of the emission rate, the performance of the conventional regression analysis should degrade, and the performance of inverse regression should improve. The figures clearly reveal that this occurred. Nevertheless, a slight bias in the results for inverse regression still appears in Figure D-4.

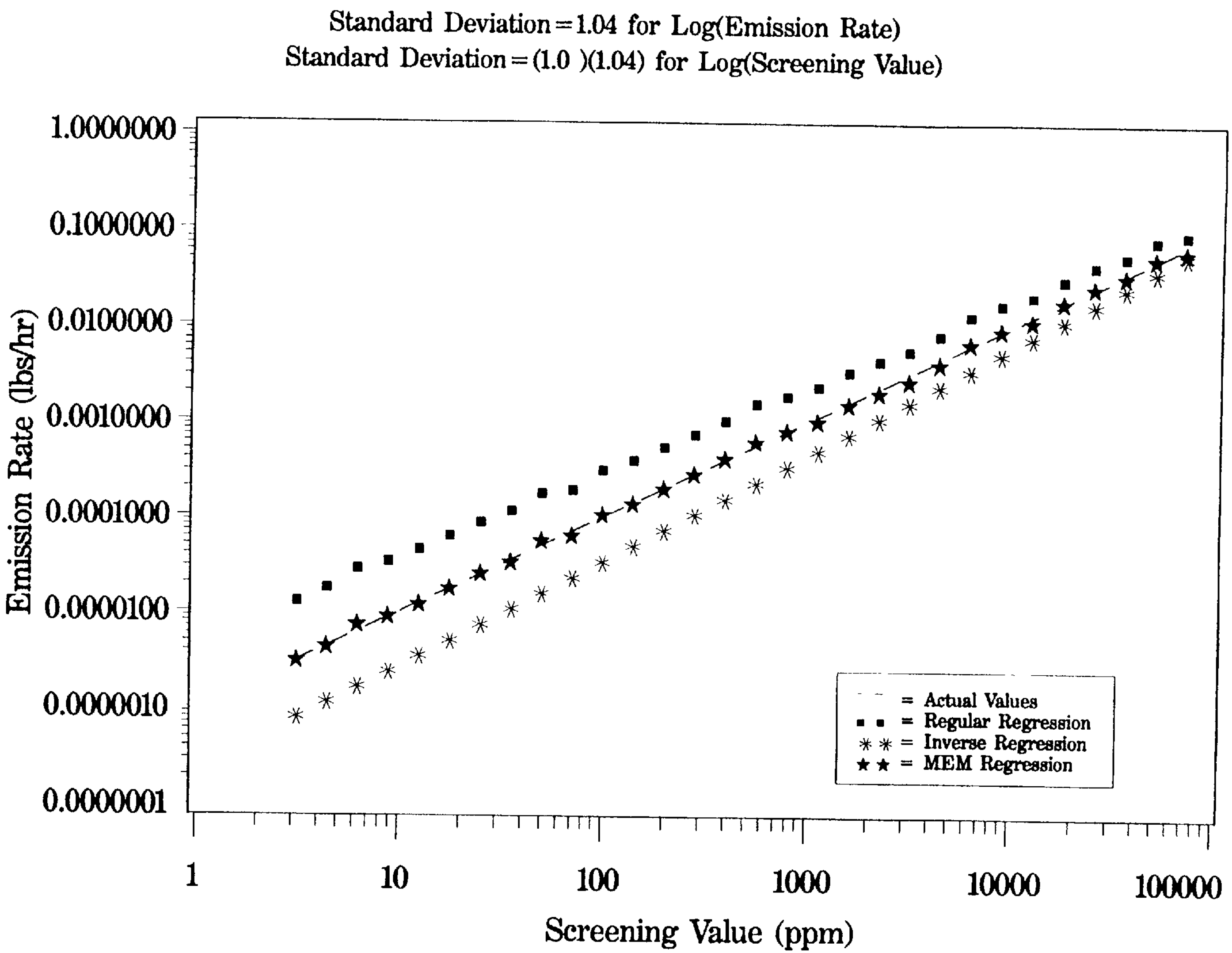

Figure D-2. Simulation Results for Average Emission Rates versus True Screening Values. Standard Error of Log(Emission Rate) = Standard Error of Log(Screening Value)

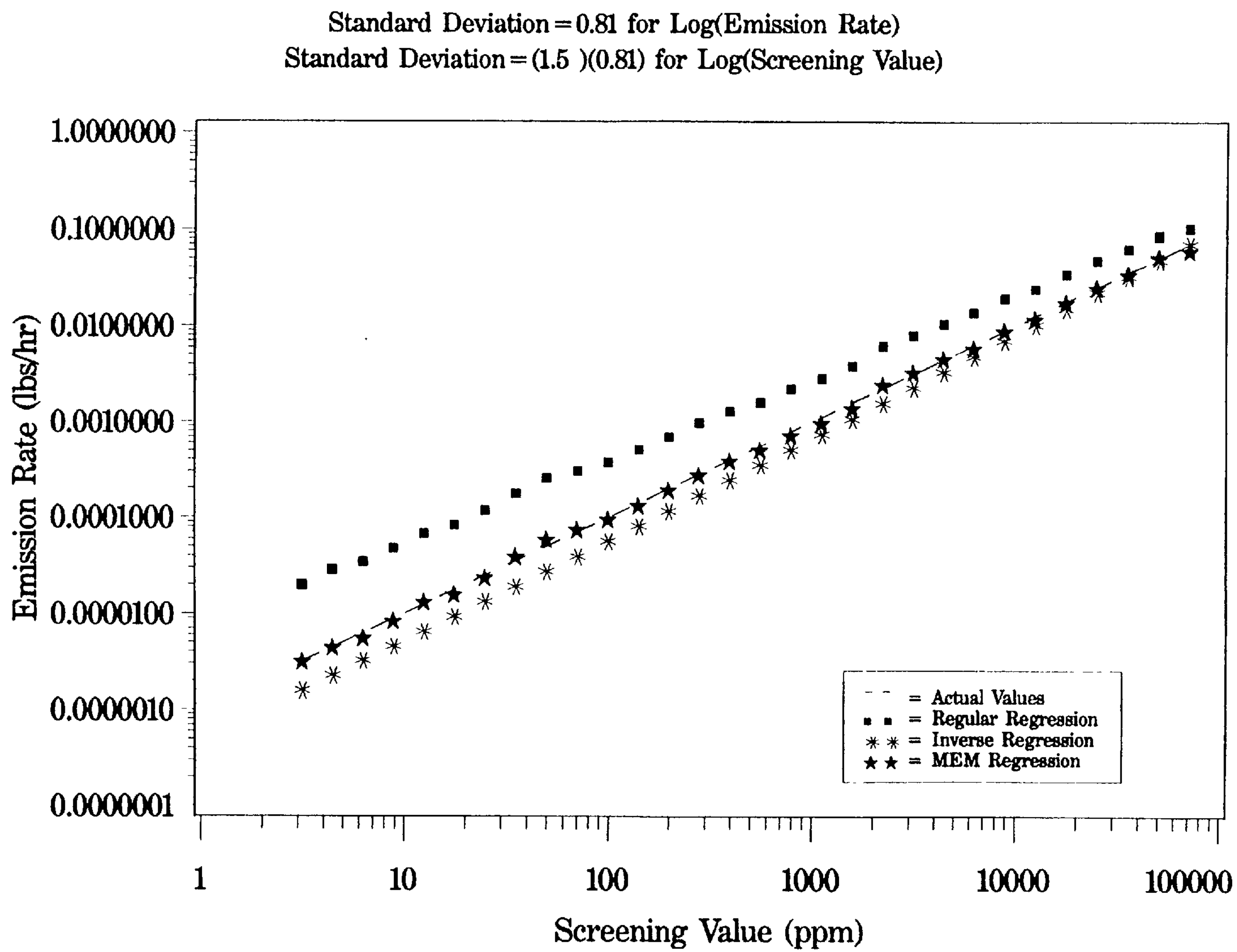

Figure D-3. Simulation Results for Average Emission Rates versus True Screening Values. Standard Error of Log(Emission Rate) = 1.5 x Standard Error of Log(Screening Value)

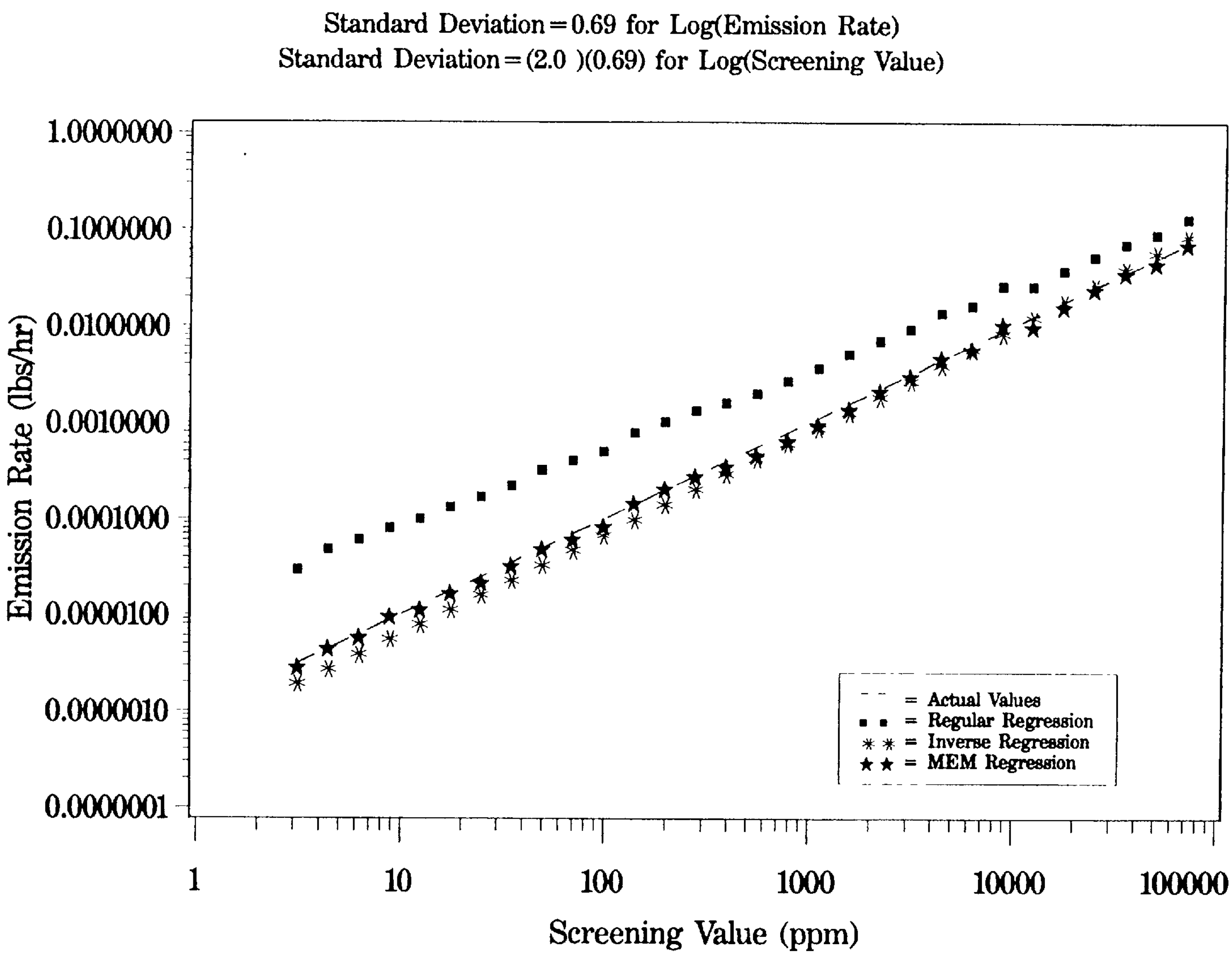

Figure D-4. Simulation Results for Average Emission Rates versus True Screening Values.
Standard Error of Log(Emission Rate) = 2.0 x Standard Error of Log(Screening Value)

The predictions made by the MEM technique lie very nearly on the line indicating the true values in all four cases. These results strongly indicate that the MEM technique produces estimates of emission rate with negligible or zero bias under the conditions simulated. Moreover, a wide range of relative errors in the two variables were included in the simulations.

Williamson and Hall (1993) also discuss the fact that the relative errors in the screening values used to develop the predictive equations and the relative errors in the screening values used later to predict emission rates may be different. These conditions change the mathematical problem somewhat. The equations necessary to use the MEM technique in this situation have been developed, and the methodology is discussed in Section D.3. Simulations again confirmed that the MEM technique was the only one of the three regression approaches that produced estimates with little or no bias under all conditions tested. The results are essentially the same as those discussed above, except there was somewhat more scatter in the plotted data points because of the increased variance in the screening values used to make the predictions.

D.3 STATISTICAL METHODOLOGY

The preceding sections provide a qualitative overview of the new approach. The purpose of this section is to provide a technical discussion of the statistical details.

The fact has been recognized that conventional regression analysis produces biased results when there are errors in both the dependent and independent variables. Under these conditions, conventional regression analysis produces a slope estimate whose absolute value is low-biased (Bloch, 1978).

Regression techniques that account for the errors in both the dependent and independent variables have been employed in other applications, but the analysis presented in this report represents a new application for this statistical methodology. Moreover, a literature search did not reveal the use of this methodology in log-log space together with the necessary scale bias correction to produce unbiased estimates in linear space or quantification of the uncertainties of the estimates in linear space. Thus, aspects of the methodology were derived for this application. For these reasons, it was felt that a thorough documentation of the new methodology was needed. A step-by-step description of the statistical issues and calculations is provided in the following subsections.

D.3.1 Preliminary Description of the Problem

Suppose we have a set of emission rates, y_i, and a set of screening values, x_i, i=1 to n. The pronounced skewness of both types of variables have been consistently observed in analyses of real data. Moreover, if y is regressed on x, the residuals are skewed, and the error variance increases as x increases. Because of the inhomogeneous variance and non-normal errors, the assumptions of conventional regression analysis are not satisfied in linear space. Weighted regression analysis (Draper and Smith, 1981) can be used to address the inhomogeneous variance, but pronounced non-normality of the errors remains an issue.

It has been observed in many studies that taking the logarithm of both x and y stabilizes the error variance and removes the skewness from both the data and the regression residuals. Thus, it is felt that the regression analysis is best performed in log-log space. This approach introduces the requirement to perform an anti-log (exponential) transformation to obtain estimates of emission rate in linear space. Because of this nonlinear transformation, a scale bias correction factor is required to obtain unbiased estimates of emission rate.

The first step before performing the regression analysis is to take the logarithms of the data:

$$X_i = \ln (x_i)$$
$$Y_i = \ln (y_i)$$

The use of natural logarithms is the natural approach. If common logarithms are used, a correction factor of ln(10) appears at various points throughout the analysis; this needless complication is avoided by using natural logarithms.

D.3.2 Generation of Values Used in the Simulation

In the simulations, normally distributed X values were generated directly in log space such that

$$E\,(X_i) = \ln(E(x_i)) - \sigma_X^2/2$$
$$\mathrm{var}\,(X_i) = \sigma_X^2$$

where

E ( ) denotes the expected value, and

var ( ) denotes the variance.

Because the error variance is assumed to be homogenous in log space, the quantity σ_X^2 does not involve the subscript i.

The X_i were actually generated as follows:

$$X_i = \ln(E(x_i)) - \sigma_X^2/2 + e_{X_i}$$

where e_{X_i} is normally distributed with mean zero and variance σ_X^2.

It is possible to show that this method for generating the X_i values does, in fact, produce the specified mean, $E(x_i)$, in linear space. Because X_i (log space) is normally distributed, e^{X_i} (linear space) is log-normally distributed. From a known relationship between normal and log-normal random variables (Mood, Graybill, and Boes, 1974, p.117), the expected value of the log-normally distributed variable e^{X_i} equals the exponential of the following: the expected value of the normally distributed variable X_i plus half the variance of X_i. From this property the proof follows:

$$\begin{aligned} E(e^{X_i}) &= e^{E(X_i) + Var(X_i)/2} \\ &= e^{\ln(E(x_i)) - \sigma_X^2/2 + \sigma_X^2/2} \\ &= E(x_i) \end{aligned}$$

Thus, it was possible to select a set of true screening values $E(x_i)$ for inclusion in the analysis and synthesize the corresponding values with added errors in log space. The fundamental equations indicated above regarding the relationships between mean and variances in log and linear space are fundamental to the analysis reported here. These relationships are employed at various points throughout the remainder of this appendix.

Further comments apply regarding the relationship between the emission rates and screening values in the simulations. Suppose the intercept a and slope b relating X and Y have been selected. Then

$$E(Y_i) = a+b\,E(X_i)$$

After an error has been added, we have

$$Y_i = a+b\,E(X_i)+e_{Y_i}$$

where e_{Y_i} is a normally distributed error with a mean of 0 and a variance of σ_Y^2. This equation can be used to generate the needed values of Y_i. To evaluate the accuracy of the estimation of emission rates in the simulations, we need the true emission rate $E(y_i)$ corresponding to a given Y_i. An expression for $E(y_i)$ will now be derived. We now have two equations for Y_i:

$$Y_i = a+b\,E(X_i)+e_{Y_i}$$

and

$$Y_i = \ln(E(y_i)) - \sigma_Y^2/2 + e_{Y_i}$$

where $E(y_i)$ is the expected value of emission rate in linear space.

The last equation follows from the same known relationship between normal and log-normal random variables mentioned earlier.

It follows that

$$a+b\,E(X_i) = \ln(E(y_i)) - \sigma_Y^2/2$$
$$\ln(E(y_i)) = a+b\,E(X_i)+\sigma_Y^2/2$$
$$= E(Y_i)+\sigma_Y^2/2$$

Exponentiating both sides of the equation, we obtain

$$e^{\ln(E(y_i))} = e^{E(Y_i)+\sigma_Y^2/2}$$
$$E(y_i) = e^{E(Y_i)+\sigma_Y^2/2}$$

Thus, the method for generating the variables with normally distributed errors in log-log space has been demonstrated. The correct expected values in linear space have also been derived. Having the true values of the screening values, emission rates, and regression slope and intercept allowed the simulation results to be compared to the correct values.

D.3.3 Regression Analysis with Errors in Both X and Y

The next issue pertains to the regression analysis performed in log-log space. The methodology is discussed by Mandel (1964). In conventional regression analysis, the slope and intercept, a and b, are determined so as to minimize the following:

$$S = \sum_{i=1}^{n} (Y_i - \hat{Y}_i)^2$$

where

$$\hat{Y}_i = \hat{a} + \hat{b}\,\hat{X}_i\ ,$$

and the "hat" notation has been used to indicate the estimate of a given quantity; e.g., â is an estimate of a.

As discussed earlier, however, this approach produces biased results when there is an error in X as well as Y. In this case, the correct approach is to determine the values of $\hat{a}$, $\hat{b}$, and $\hat{X}_i$, i=1 to n, that minimize the following:

$$S' = \sum_{i=1}^{n} \frac{(X_i - \hat{X}_i)^2}{\sigma_X^2} + \sum_{i=1}^{n} \frac{(Y_i - \hat{Y}_i)^2}{\sigma_Y^2}$$

The quantities $X_i - \hat{X}_i$ and $Y_i - \hat{Y}_i$ are estimates of the errors in X_i and Y_i, respectively. In the case of linear regression with no errors in the X_i values and normally distributed errors in the Y_i values, minimizing S produces the maximum likelihood estimates of the regression coefficients (Mood, Graybill, and Boes, 1974), assuming the errors are independent and have a homogeneous variance. It is easily shown that minimizing S' produces the maximum likelihood solution for the more general case in which there are normally distributed errors in both the X_i and Y_i, again assuming all errors are independent and assuming the X and Y error variances are both homogeneous.

We define the variable λ:

$$\lambda = \frac{\sigma_X^2}{\sigma_Y^2}$$

In the development here, we assume that λ is accurately known. Further testing to obtain the data necessary to determine whether λ varies among component types and to obtain accurate estimates of λ is needed. Analyses to evaluate the sensitivity of the MEM technique to realistic errors in λ would be beneficial.

Maximizing S' is equivalent to minimizing S'':

$$S'' = \sum_{i=1}^{n} [(X_i - \hat{X}_i)^2 + \lambda(Y_i - \hat{Y}_i)^2]$$

$$= \sum_{i=1}^{n} [(X_i - \hat{X}_i)^2 + \lambda(Y_i - (\hat{a} + \hat{b}\hat{X}_i))^2]$$

While the $\hat{X}_i$ values come into play in the optimization process, their values are not of primary interest here. Expressions for the estimates of the slope and intercept, which are of primary interest, are available in closed form.

Define

$$v = n \sum_{i=1}^{n} (X_i - \bar{X})^2$$

$$w = n \sum_{i=1}^{n} (Y_i - \bar{Y})^2$$

$$p = n \sum_{i=1}^{n} (X_i - \bar{X})(Y_i - \bar{Y})$$

where $\bar{X}$ is the mean of X_i, i=1 to n, and
$\bar{Y}$ is the mean of Y_i, i=1 to n

Then the estimates of the slope and intercept are as follows:

$$\hat{b} = \frac{\lambda w - v + \sqrt{(v - \lambda w)^2 + 4\lambda p^2}}{2\lambda p}$$

$$\hat{a} = \bar{Y} - \hat{b}\,\bar{X}$$

D.3.4 Estimation of Emission Rate and Scale Bias Correction

As is discussed in Appendix C, Finney's SBCF has been used as an approximation in this application. Finney's method, however, was originally derived for the purpose of estimating the mean of a log-normal distribution. In this section, an SBCF is derived specifically for the application of concern in this appendix. It can be shown that the SBCF based on Finney's method approaches the SBCF derived here as the sample size increases without bound.

The intention is to use the regression equation to estimate the emission rate for a component not involved in the original regression analysis. The regression model is used to estimate the emission rate for a component that was screened but not bagged; thus, a measured value of X but not of Y will be available. Then the log of the emission rate is estimated as follows:

$$\hat{Y} = \hat{a} + \hat{b}\,X$$

The next step is to consider the scale bias correction factor required to obtain an estimate of emission rate in linear space. To accomplish this, we will use the same relationships between normal and log-normal variables employed earlier. To derive an expression for the mean emission rate in linear space, we require the mean and variance in log space.

If the true values of the slope and intercept were known, then we would estimate Y as follows:

$$\hat{Y} = a + b\,X$$

Then

$$\mathrm{var}(\hat{Y}) = b^2 \sigma_X^2$$

Substituting the estimated value of the slope, we obtain

$$\mathrm{var}(\hat{Y}) \cong \hat{b}^2 \sigma_X^2$$

Assuming $\hat{Y}$ has zero or negligible bias (this is indicated by the simulations), it follows that:

$$E(\hat{Y}) = E(Y)$$

If E(y) is the expected value of emission rate in linear space, then

$$E(\hat{Y}) = E(Y) = \ln(E(y)) - \sigma_Y^2 /2$$

For now we are disregarding the error variances in $\hat{a}$ and $\hat{b}$; this point is discussed below.

It follows that

$$\begin{aligned} E(e^{\hat{Y}}) &= e^{E(\hat{Y}) + var(\hat{Y})/2} \\ &\cong e^{\ln E(y) - \sigma_Y^2/2 + \hat{b}^2\sigma_X^2/2} \\ &= E(y)e^{-\sigma_Y^2/2 + \hat{b}^2\sigma_X^2/2} \end{aligned}$$

Thus, we define the scale bias connection factor as follows:

$$SBCF = e^{(\sigma_Y^2 - \hat{b}^2\sigma_X^2)/2}$$

It follows that

$$E\ (e^{\hat{Y}}SBCF) \approx E(y)$$

Recall that E(y) is the expected value of emission rate in linear space. The estimate of emission rate, then is as follows:

$$\hat{y} = (e^{\hat{Y}})SBCF$$

A more rigorous derivation would account for the errors in $\hat{a}$ and $\hat{b}$ as well as the sources of random variability discussed above. Notice, however, that $\hat{a}$ and $\hat{b}$ are regression coefficients estimated on the basis of a sample of size n. An "error averaging" effect achieved in the regression analysis tends to reduce the error variance in $\hat{a}$ and $\hat{b}$. The term "error averaging" here simply refers to the fact that the errors in a sample of size n tend to counterbalance to an extent where regression coefficients are estimated. The greater the sample size is, the more the errors tend to counterbalance and, consequently, the more accurate the regression coefficients tend to be. The variances σ_X^2 and σ_Y^2 refer to errors that are not reduced in this manner. Thus, it is believed that any error introduced by the handling of $\hat{a}$ and $\hat{b}$ is likely to be small compared to the effect of the error in the individual screening value used to estimate an emission rate. Moreover, the simulations discussed earlier in the appendix indicate that the MEM technique with the scale bias correction factor described above produces results with little or no bias in a variety of cases.

In the simulation discussed here, the sample size used to estimate the regression coefficients was 30. It would be of interest to perform further simulations to investigate the role of the errors in $\hat{a}$ and $\hat{b}$ in cases with smaller sample sizes.

The analysis discussed here applies in the case in which the X values used in the regression analysis and X values used later for predictive purposes have the same error variances. This condition would not be satisfied if the screening measurements used to develop the model and screening measurements used later for predictive purposes produced unequal error variances in log space. This situation, which may occur in practice, is discussed in the following section.

D.3.5 Estimation of Emission Rate When ln (Screening Value) has a Different Error Variance than it had in the Regression Analysis

Suppose the regression model has been developed as described in an earlier section. Given a screening measurement u, we want to estimate the emission rate. Define

$$U = \ln u$$

Now suppose

$$\sigma_U^2 = k\sigma_X^2$$

We want to investigate the adjustment required if $k \neq 1$. Consider, for the basis of discussion, a hypothetical screening measurement x whose expected value is the same as that of u:

$$E(x) = E(u)$$

Suppose y is an emission rate measurement whose expected value, E(y), is the true emission rate corresponding to either screening value (u or x). Further, the error variance of X = ln(x) is the same as the corresponding variance in the regression analysis. While the value x is not actually measured, it serves as a basis for discussion.

The expected value of U is

$$E(U)=\ln(E(u))-\sigma_U^2/2=\ln(E(x))-\sigma_U^2/2$$

and the expected value of X is

$$E(X)=\ln(E(x))-\sigma_X^2/2$$

The values X and Y are related by

$$Y = a + b\,X$$

The issue is to determine the relationship between Y and U, and how can we use the regression model to estimate emission rate as a function of U.

It is clear that, if $k \neq 1$, the expected value of U differs from that of X. To account for the mean shift, we compute

$$U'=U+(\sigma_U^2-\sigma_X^2)/2$$

Then

$$\begin{aligned} E(U') &= E(U)+(\sigma_U^2-\sigma_X^2)/2 \\ &= \ln(E(x))-\sigma_U^2/2+(\sigma_U^2-\sigma_X^2)/2 \\ &= \ln(E(x))-\sigma_X^2/2 \\ &= E\,(X) \end{aligned}$$

It will be shown that the emission rate can be predicted as a function of U', but an adjustment to the scale bias correction factor will be required. First consider the following predictive equation (initially, we ignore the errors in the estimates of a and b):

$$\hat{Y}= a+b\,U'$$

Because U' has the same mean as does X,

$$
\begin{aligned}
E(\hat{Y}) &= E(a+bU') \\
&= E(a+bX) \\
&= \ln(E(y)) - \sigma_Y^2/2
\end{aligned}
$$

Further, we require the variance of $\hat{Y}$ as computed as a function of U'.

$$
\begin{aligned}
var(\hat{Y}) &= var(a+bU') \\
&= b^2\ var(U') \\
&= b^2\ var(U)
\end{aligned}
$$

The last line follows from the fact that U' equals U plus a constant:

$$
\begin{aligned}
\text{Thus, } E(e^{\hat{Y}}) &= e^{E(\hat{Y})+var(\hat{Y})/2} \\
&= e^{\ln(E(y))-\sigma_Y^2/2+b^2 var(U)/2} \\
&= E(y)e^{(b^2 var(U)-\sigma_Y^2)/2}
\end{aligned}
$$

If we define

$$SBCF = e^{(\sigma_Y^2 - b^2\ var(U))/2}$$

Then

$$E(SBCF\ e^{\hat{Y}}) = E(y)$$

It follows that

$$\hat{y} = (SBCF)e^{\hat{Y}}$$

is the required estimator of emission rate. In practice, the estimates $\hat{a}$ and $\hat{b}$ can be substituted for a and b, respectively.

Again, a more rigorous derivation would account for the error variances in $\hat{a}$ and $\hat{b}$. In simulations, however, the estimation process described above has produced estimations of emission rate with negligible or zero bias. In these simulations, the regression coefficients were again based on a sample size of 30. As before, the simulations showed that any error introduced by the handling of $\hat{a}$ and $\hat{b}$ is likely to be small compared to errors from other causes in cases with sample sizes of 30 or greater. It would be of interest to perform further simulations to investigate the effect of a smaller sample size.

D.3.6 Uncertainty of Estimated Emission Rate

In this section, we discuss the uncertainty involved in estimating the emission rate. As a first step, we need the error variance of the estimate $\hat{Y}$ in log space:

$$\hat{Y} = \hat{a}+\hat{b}X$$

Then,

$$var(\hat{Y}) = var(\hat{a}) + var(\hat{b}X) + 2\ cov(\hat{a},\hat{b}X)$$

where cov ( ) denotes covariance.

A rigorous error analysis that accounts for the errors in $\hat{a}$ and $\hat{b}$ as well as the error in X will require the covariance matrix of $\hat{a}$ and $\hat{b}$. This covariance matrix can be computed by methods such as bootstrapping or jackknifing (Efron and Gong, 1983). While both are valid methods, bootstrapping depends on random number generation, and analysts working on different computers with different random number generators might calculate different covariance matrices from the same data. Thus, the authors have a slight preference for jackknifing, which does not depend on random number generation.

The limiting distribution of the errors in the regression coefficients when (1) Y is regressed on X, (2) both have normally distributed errors, and (3) the errors are independent is given by Fuller and Hidiroglou (1978). The limiting distribution is normal, and an expression for the covariance matrix is given. In the past, however, the samples used to develop predictive equations for emission rate have not always been large. Thus, while the existence of the theoretical limiting distribution is interesting, these results may not be applicable for our purposes.

The next step is to express var ($\hat{Y}$) in terms of known or estimable quantities. To accomplish this, we need expressions for var ($\hat{b}$ X) and cov ($\hat{a}$, $\hat{b}$ X).

An expression for the variance of the product of independent random variables is given by Mood, Graybill, and Boes (1974, p. 180), from which we obtain

$$var(\hat{b}X)=X^2var(\hat{b})+\hat{b}^2var(X)+var(\hat{b})var(X)$$

where $\hat{b}$ and X have been used as estimates of their respective means.

The assumption that X and $\hat{b}$ are independent is used above, and the assumption that X and $\hat{a}$ are independent is employed below. Here X represents the logarithm of a screening value not used in the development of the regression model. Thus, the assumption that X is independent of both $\hat{a}$ and $\hat{b}$ is justified.

Now we consider the term cov ($\hat{a}$, $\hat{b}$ X):

$$\begin{aligned}
&cov(\hat{a},\hat{b}X) = \\
&\quad E[(\hat{a}-a)(\hat{b}X-E(\hat{b}X))] = \\
&\quad E[(\hat{a}-a)(\hat{b}X-bE(X))] = \\
&\quad E[(\hat{a}-a)(\hat{b}X-bX+bX-bE(X))] = \\
&\quad E[(\hat{a}-a)(\hat{b}X-bX)]+E[(\hat{a}-a)b(X-E(X))]
\end{aligned}$$

By the independence of $\hat{a}$ and X, the second expectation above is zero. The substitution of bE(X) for E($\hat{b}$ X) in the deviation above is justified by the independence of $\hat{b}$ and X:

$$E(\hat{b}X)=E(\hat{b})E(X)=bE(X)$$

Again, see Mood, Graybill, and Boes.

Thus,

$$\begin{aligned}
cov(\hat{a},\hat{b}X) &= E\ [(\hat{a}-a)(\hat{b}X-bX)] \\
&= X\ E[(\hat{a}-a)(\hat{b}-b)] \\
&= X\ cov(\hat{a},\hat{b})
\end{aligned}$$

The fact that

$$E[(\hat{a}-a)(\hat{b}X-bX)] = X\ cov(\hat{a},\hat{b}),$$

and especially the fact that X can be "factored out," may be more easily seen if we express the expectation as an integral.

$$
\begin{aligned}
&E\,[(\hat{a}-a)(\hat{b}X-bX)]= \\
&\quad \int_{-\infty}^{\infty}\int_{-\infty}^{\infty}(\hat{a}-a)(\hat{b}X-bX)f(\hat{a},\hat{b})d\hat{a}d\hat{b}= \\
&X\int_{-\infty}^{\infty}\int_{-\infty}^{\infty}(\hat{a}-a)(\hat{b}-b)f(\hat{a},\hat{b})d\hat{a}d\hat{b}= \\
&X\,E[(\hat{a}-a)(\hat{b}-b)]= \\
&X\,\mathrm{cov}(\hat{a},\hat{b})
\end{aligned}
$$

where f ( ) is the joint probability density of $\hat{a}$ and $\hat{b}$.

Now we are in a position to write an expression for var ($\hat{Y}$) in terms of known or estimable quantities.

$$
\begin{aligned}
\mathrm{var}(\hat{Y}) &= \mathrm{var}(\hat{a})+\mathrm{var}(\hat{b}X)+2\mathrm{cov}(\hat{a},\hat{b}X) \\
&= \mathrm{var}(\hat{a})+ \\
X^2 &\ \mathrm{var}(\hat{b})+\hat{b}^2\mathrm{var}(X)+\mathrm{var}(X)\mathrm{var}(\hat{b})+ \\
2 &\ X\mathrm{cov}(\hat{a},\hat{b})
\end{aligned}
$$

The variances and covariances involving $\hat{a}$ and $\hat{b}$ were estimated by using the jackknifing method discussed earlier in this section.

The next issue pertains to the calculation of a confidence interval for $\hat{Y}$ in log space. The situation here is obviously not as simple as in the conventional case, in which the only error is in the dependent variable. The expression for $\hat{Y}$,

$$\hat{Y}=\hat{a}+\hat{b}X$$

involves a nonlinear function (multiplication) of random variables, and the theory of conventional regression does not apply.

Further analysis of the sampling properties of $\hat{Y}$ would be very beneficial in order to formulate a confidence interval for E($\hat{Y}$). If such a confidence interval were formulated, then a scheme suggested by Patterson (1966) could be used to obtain an approximate confidence interval for emission rate in linear space. Suppose

$$P(L \leq E(\hat{Y}) \leq M) = 1 - \alpha$$

Then

$$P(SBCF\ e^{L} \leq E(y) \leq SBCF\ e^{M}) \cong 1 - \alpha$$

where SBCF is the scale bias correction factor required to estimate emission rate given $\hat{Y}$.

The problem of obtaining a confidence interval in log space remains. It is evident that

$$t' = \frac{\hat{Y}}{\sqrt{var(\hat{Y})}}$$

is not a simple z- or t-statistic. It is argued earlier, however, that the error in X will typically be the dominant error in

$$\hat{Y} = \hat{a} + \hat{b}X$$

If so, the statistic t' above may have an approximate t-distribution, such that the number of degrees of freedom depends on the manner in which var(X) was estimated. Under this assumption, then, the following would be an approximate confidence interval for the emission rate in log space:

$$P\left(\hat{Y} - t\sqrt{var(\hat{Y})} \leq E(Y) \leq \hat{Y} + t\sqrt{var(\hat{Y})}\right) = 1 - \alpha$$

where t is the appropriate t-statistic for the confidence level 1-α; the number of degrees of freedom is the same as the number of degrees of freedom associated with the estimated error variance var(X).

According to Patterson's method, the corresponding confidence interval for the emission rate in linear space would be:

$$P\left(SBCF\ \exp(\hat{Y} - t\ var(\hat{Y})) \leq E(y) \leq SBCF\ \exp(\hat{Y} + t\ var(\hat{Y}))\right) = 1 - \alpha$$

Further investigation of this and other approaches for estimating the confidence interval for emission rate would be very beneficial.

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APPENDIX E

INDEPENDENT AUDIT RESULTS

RTI

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Center for Environmental Measurements and Qualit...

OPTIONAL FORM 99 (7-90)

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To Ron Ricks	From Ron Ryan
Dept./Agency Radian	Phone # 919-541-4330
Fax # 916-362-2318	Fax #

NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

PRELIMINARY REPORT ON THE SITE VISIT AND TECHNICAL SYSTEMS AUDIT CONDUCTED AT ARCO AND PACIFIC REFINERIES

RTI Project No.: 5500-042

From: James B. Flanagan (919/541-6417) FAX: (919/541-7215)
Lori L. Pearce (919/541-7182)

Date: December 14, 1992

1. a) Finding: The probes and connectors for the OVA Model 108 used at both plants were found to be leaking.

   b) Effect on Data: Leakage will change the overall dilution of the pollutant as well as the flow characteristics at the inlet. This can result in erroneously low screening values. All data taken to date are suspect because leak checks were not routinely conducted.

   c) Recommendation: It is recommended that frequent leak checks be conducted as described in the video tape, "VOC Fugitive Emissions Procedures and Equipment," by E.J. Richards.

   d) Urgency of Implementation: This recommendation was communicated to the Radian field staff at the time of the audit. This is a critical recommendation that should be implemented immediately.

2. a) Finding: At both plants the gas flow rates into the probe inlet of the OVA Model 108 were not being measured and recorded. When measured directly, the actual flows into the OVA probe were a factor of 2 or 3 lower than indicated by the built-in flow indicator.

Post Office Box 12194 Research Triangle Park, North Carolina 27709-2194
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b) Effect on Data: The effect of sample flow rate on OVA response is a matter of debate. The impact of sample flow rate on individual samples will vary depending on the nature of the source; i.e., whether it is diffuse or concentrated. A diffuse source will be less sensitive to variations in sample flow rate than a point source.

c) Recommendation: It is recommended that sample flow rate at the inlet of the OVA probe be measured and recorded during calibration and before and after each battery change. These data should be added to the data base for evaluation as part of the emission rate model.

d) Urgency of Implementation: This recommendation should be communicated to Radian for implementation as soon as possible.

3. a) Finding: Dilution factors obtained with the OVA dilution probe varied significantly between calibration gases at two different concentrations. This was observed at both plants. For example, at the Pacific refinery on 12/18/92, the 1000-ppm calibration standard gave a dilution factor of 10:1, whereas the 35,000-ppm standard gave a dilution factor of 18.4:1. Based on limited observations during the two audits, inconsistent dilution factors appeared to be correlated with the probe leakage observed in Finding 1.

b) Effect on Data: Uncertainty in the true dilution factor will directly impact the hydrocarbon concentration, which is calculated as OVA readout times the dilution factor. In the case of very high leakers (>10,000 ppm), where the dilution probe must be used to obtain the screening value, this is a critical measurement for development of the emission rate model.

c) Recommendation:
(1) Ensure that the OVA probe assembly is free of leaks (see Finding 1).
(2) Radian should investigate the origin of this variability and make any necessary procedural or equipment modifications to control it.

(3) Field operators should be instructed to make sure that the dilution ratios obtained with the two different standards agree within a target goal, such as ± 20%. Corrective measures should be taken if the goal is not achieved.

d) Urgency of Implementation:

(1) Leak-checking should be implemented immediately.

(2) Operation of the dilution probe should be investigated. Modified procedures should be in place by January.

(3) Field operators should try to minimize the observed discrepancy, if possible, by checking for leaks, etc. This should be started as soon as possible.

4. a) Finding: O_2 Calibration checks at the Pacific plant often read higher than the 5% standard gas level. Calibration gas bags used for the OVA and O_2 analyzer were not thoroughly purged prior to refilling at the Pacific plant. Tedlar bags are filled from standard cylinders prior to calibration. The operator squeezes the old gas from the bag and refills it only once. Oxygen calibration checks at the 5% level read as high as 7% at the Pacific plant. Checks at the ARCO plant for the 5% O_2 standard did not exceed 5.3%.

b) Effect on Data: This error could mask a true malfunction of the instrument. Effect on OVA calibration is unknown.

c) Recommendation:

(1) Calibration bags should be purged more effectively by repeatedly emptying and refilling the bag with standard gas. This is particularly important after long periods between bagging (e.g., weekends or delays due to bad weather).

(2) Field personnel should not accept an O_2 calibration check unless the reading is between 4 and 6% on the 5% gas.

d) Urgency of Implementation: These recommendations should be implemented as soon as possible.

5. a) Finding: Radian technicians at both plants are currently evaluating the multipoint OVA calibrations by fitting the OVA results to a linear regression equation and determining whether the correlation coefficient, r, is high enough (> 0.995). Calibration gas concentration is the independent (x) variable, and the OVA response is the dependent (y) variable. Calibration gases are in a geometric series of 10, 100, 1,000, and 10,000 ppm. This spacing is unequal and results in the correlation being dominated by the higher-level points. Use of a logarithmic transform of both the x and y variables prior to the linear regression would make the points more equally spaced.

b) Effect on Data: Using the linear scale rather than a log-log scale for evaluating linearity of the calibration curve causes a loss of information about the lower concentration points. Misleadingly high values for the correlation coefficient, r, can result. This can result in failing to detect noisy or nonlinear calibrations.

c) Recommendation: The linear regression/correlation should be done with log-transformed concentration values.

d) Urgency of Implementation: This procedure should be implemented as soon as possible.

6. a) Finding: There was air in the "TEE" joint used to monitor pressure while the canister is being filled. This was observed only at the ARCO plant. Radian alerted operators to purge the joint on 12/4/92, consequently, the operators at the Pacific refinery were using a revised procedure when audited on 12/7 and 12/8/92.

b) Effect on Data: The volume of the joint is small relative to the total canister volume, so dilution of the sample by air will probably make only a slightly low bias if the joint contains only ambient air. If a high concentration of hydrocarbon is present in the joint from a previous sample, however, carryover could result.

c) Recommendation: The joint should be cleared of gas prior to using it to fill a canister. This can be done in two alternative ways:

(1) Evacuate the joint to a high vacuum prior to opening the canister valve, OR

(2) Flush the joint with gas directly from the bag before the canister valve is opened. NOTE: This may require use of a pump to pull the bag gas through the joint, because there may not be sufficient pressure in the bag to force gas through the joint.

d) Urgency of Implementation: Radian has already (as of 12/4/92) told the operators to flush the TEE joint prior to sampling by connecting the joint to the bag and opening the valve on the joint before connecting it to the canister. Because a pump is not used, however, this procedure may not be effective due to insufficient bag pressure to force gas through the joint. A modified procedure should be investigated and implemented by January.

7. a) Finding: The OVA used at Pacific appeared to be in poor condition.

(1) There were leaks in the connector between the probe and the OVA due to a missing Swagelok ferrule. It was found that the field personnel at the Pacific refinery did not have Swagelok hardware of the correct size to repair the OVA.

(2) Ambient hydrocarbon measurements with the Radian instrument were consistently <1 ppm, while two OVAs from the Bay Area AQMD which were on-site on 12/8/92 read about 2 ppm.

b) Effect on Data:

(1) See Finding 1 for the effect of leaks on OVA response.

(2) Screening data below 10 ppm may be biased low due to the low response observed at ambient levels.

c) Recommendations:

(1) Field crews at both sites should be provided with necessary supplies to repair OVA leaks. These supplies should include spare Swagelok hardware of the appropriate size for the instrument.

(2) The instrument used at Pacific should be checked and serviced if necessary to improve low-end accuracy.

d) Urgency of Implementation: These recommendations should be followed prior to the next sampling session in January.

Minor Findings and Recommendations

1. Operator names should be recorded daily in the logbook.

2. All operators should view E.J. Richards' videotape, "VOC Fugitive Emissions Procedures and Equipment." This videotape is available from Kirk Foster in the Air Pollution Training Institute of OAQPS.

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209-081-07-01
January 19, 1992

Mr. Ron Ryan
EPA-OAQPS, MD-14
Emissions Factor and Methods Section
Research Triangle Park, NC 27711

Subject: Response to Preliminary Report on the Site Visit and Technical Systems Audit Conducted at ARCO and Pacific Refineries

Dear Ron:

Radian appreciates the opportunity to review the preliminary audit report prepared by Research Triangle Institute (RTI) on behalf of the U.S. EPA in conjunction with the WSPA/API refinery fugitives study. We would like to respond to the issues raised in this preliminary audit report. Changes have been made to address nearly all of the identified issues. This letter explains the effects that audit observations might have had on the previous data and the actions that Radian has taken to implement procedural changes in response to audit findings.

1. Audit Finding: The probes and connectors for the OVA Model 108 used at both refineries were found to be leaking.

   Technical Response: There is no evidence to date that the data that we have collected are biased high or low based on the probe and connector leaks. Unfortunately, there is no way to verify when leaks occurred or the exact magnitude of the leaks. Previous field procedure was to check for leaks on a non-routine basis and records of these checks were not made.

   Radian is planning to pursue the following actions to determine if the data collected were biased:

   - Compare screening data collected by the Bay Area Air Quality Management District (BAAQMD) to the screening data collected by Radian both before and after discovery of the probe leaks. The BAAQMD and Radian screened many of the same components both before and after bagging the components.

   - Compare, on a statistical basis, data collected before and after discovering and eliminating probe leaks.

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It should be noted that the OVA was calibrated with the leaks in existence, on days when the OVA was leaking.

In addition to daily multipoint calibrations, a quality control check against a known hydrocarbon concentration was performed after taking every sample to confirm that the OVA had not drifted significantly. If concentrations varied by more than 20% from the calibrated value of the known hydrocarbon concentration, these samples were considered invalid and results from these samples will not be used in development of the emission correlation equations.

RTI has indicated that the leakage can result in erroneously low screening values. If these erroneously low screening values were correlated to mass emissions, higher mass emissions would be tied to specific screening values. The result of this would be artificially high emission correlation equations which would provide an over-estimate of actual emissions.

Action Taken: All of our OVAs are now being leak checked on a frequent basis (at least with every daily calibration). Results of these leak checks will be documented in our field notebooks.

2. Audit Finding: At both refineries the gas flow rates into the probe inlet of the OVA Model 108 were not being measured and recorded. When measured directly, the actual flows into the OVA probe were a factor of two or three lower than indicated by the built-in flow indicator.

   Technical Response: The built-in OVA flow indicator is not a calibrated flow meter. The built-in flow indicator on the OVA is not designed to be an accurate representations of actual flow. EPA Method 21 indicates that the analyzer internal pump needs to be capable of pulling 0.1 to 3 L/min. Both of our OVAs tested well within the EPA Method 21 guidelines.

   Action: Radian now records the OVA pump flow rate with every multipoint calibration and before replacing batteries (unless the battery is being replaced because of a failed quality control check).

3. Audit Finding: Dilution factors obtained with the dilution probe varied significantly between calibration gases at two different concentrations. This was observed at both refineries. For example, at Pacific Refining on 12/18/92, the 1,000-ppm calibration gave a dilution factor of 10:1, whereas the 35,000-ppm standard gave a dilution factor of 18.4:1. Based on limited

RADIAN

Mr. Ron Ryan
January 19, 1992
Page 3

observations during the two audits, inconsistent dilution factors appeared to be correlated with the probe leakage observed in Finding 1.

Technical Response: A unified approach to deal with varying dilution factors based on hydrocarbon concentrations will be developed during the data analysis phase of this project.

Action: Elimination of probe leaks, which is being documented in current testing, could reduce this variability. To further address this issue, dilution probe testing will also be conducted at a hydrocarbon concentration of 10,000-ppm. This will provide a three point calibration that may be used to more accurately identify actual hydrocarbon concentrations measured in the field that fall between the calibration standard gas concentrations.

In addition, if the dilution ratio for any of the three calibration standards is less than 5 or more than 15, the dilution probe will be repaired or replaced.

4. Audit Finding: Oxygen analyzer calibration checks at 5% O_2 read as high as 7% at Pacific Refining. Calibration readings at ARCO at 5% O_2 did not exceed 5.3%. Tedlar™ calibration gas bags used for the OVA and oxygen analyzer were not thoroughly purged prior to refilling at Pacific Refining. Prior to calibration, the operator squeezed the old gas from the bag and refilled it only once from standard cylinders.

Technical Response: Calibration gases are placed in Tedlar™ bags that are dedicated to single concentrations of hydrocarbon or oxygen during all field testing. These Tedlar™ bags remain filled during the test day and maintain positive pressure that would tend to force any gases out of the Tedlar™ bags rather than allow contamination into the Tedlar™ bags. These Tedlar™ bags are emptied and refilled at least daily. Therefore, significant contamination of the Tedlar™ bags is not likely.

The previous procedure to calibrate the oxygen analyzer was to calibrate the instrument at ambient air concentrations and simply record what the instrument read against the 5% O_2 calibration standard. The instrument occasionally read higher than 5%. The purpose of the O_2 analyzer is to confirm that concentrations in the constructed sampling bag are less than 5% and that the bag is at steady state. Because the instrument, on occasion, read a true concentration of 5% as something higher, an actual reading of 5% on the instrument was certain to be 5% or below. The quality control objective of maintaining a concentration below 5% in the bag during sampling was achieved.

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Action: To reduce the potential for error, each Tedlar™ bag is now purged and filled at least twice before using the bag for calibration purposes.

The oxygen analyzer is now calibrated at the 5% concentration, instead of at the ambient air concentration. If the O_2 analyzer measures ambient air at greater than 24% or less than 18%, then the analyzer will be repaired.

5. Audit Finding: Radian technicians at both refineries were evaluating the multipoint OVA calibrations by fitting the OVA results to a linear regression equation and determining whether the correlation coefficient, r, is high enough (>0.995). Calibration gas concentration is the independent (x) variable, and the OVA response is the dependent (y) variable. Calibration gases are in a geometric series of 10, 100, 1,000, and 10,000 ppm. This spacing is unequal and results in the correlation being dominated by the higher-level points. Use of a logarithmic transform of both the x and y variables prior to the linear regression would make the points more equally spaced.

   Technical Response: Radian selected the performance standard of using the linear regression correlation coefficient of r=0.995 based on experience with the OVA on other field assignments. This performance standard was reviewed and accepted by the project participants at the beginning of the study.

6. Audit Finding: There was ambient air in the vacuum gauge T-joint used to monitor pressure while the canister was being filled. This was observed only at ARCO. Radian alerted operators to purge the joint on 12/4/92, consequently, the operators at Pacific Refining were using a revised procedure when audited on 12/7 and 12/8/92.

   Technical Response: There is a small amount of air in the T-joint before the canister is filled. Operators in the northern California refineries had instituted a procedure to flush this joint several weeks prior to any audit. This procedure was not being implemented in southern California prior to the audit. The exact impact of the air or any residual hydrocarbon concentrations in the joint is unknown. As pointed out by RTI, the volume of the joint is small relative to the total canister volume, so dilution of the sample by air will probably be small. Of potentially more impact is the potential for residual hydrocarbons from previous testing to artificially increase hydrocarbon concentrations, thereby artificially increasing mass emissions and emission correlation equations.

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Action: To help ensure that the joint is adequately flushed of air and residual hydrocarbons, the joint is now open to sample flow throughout the testing period. The internal pumps in the O_2 analyzer and the OVA are used to flush the joint with gas from the bagged component.

7. Audit Finding: The OVA [Radian's] used at Pacific Refining appeared to be in poor condition.

   A. There were leaks in the connector between the probe and the OVA ([Radian's] sidepack due to a missing SwageLock™ ferrule. [Radian] Operators at Pacific Refining did not have SwageLock™ hardware of the correct size to repair the OVA.

   B. Ambient hydrocarbon readings with the Radian OVA were consistently < 1 ppm, while two OVAs from the BAAQMD, which were on-site on 12/8/92, read about 2 ppm.

Technical Response: At all field test sites back-up OVAs have been available on-site or within easy access. When it was determined that Radian's probe at Pacific Refining had a missing SwageLock™ ferrule, the probe was replaced with a non-leaking probe from the back-up OVA. Our response to audit finding #1 discusses the probe leak issue.

Although the Radian OVA at Pacific Refining was reading ambient concentrations at <1 ppm, the instrument read very close to the calibration gas standard at 9.5 ppm hydrocarbons. The impact of low readings of ambient concentrations is considered minimal given the reasonably accurate readings at 9.5 ppm. Few of the components selected for bagging screened at less than 9.5 ppm. Also, erroneously low screening values will cause an increase in emission correlation equations which would increase emission estimates. Action: Two Radian OVAs, each with non-leaking probes, are currently in the field or within easy access of the field crews in both northern and southern California. The Radian OVA used at Pacific Refining was serviced in December 1992. Ambient hydrocarbon readings after service are typically above the 1 ppm level.

8. Audit Recommendations:

   A. Operator names should be recorded daily in the logbook.

   B. All operators should view E.J. Richards' videotape, "VOC Fugitive Emissions Procedures and Equipment." This videotape is available from Kirk Foster in the Air Pollution Training Institute of OAQPS.

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Technical Response: Operator names have always been recorded on the bagging forms for every sample taken. Operator names have also always been recorded on laboratory tags submitted with all samples.

Actions: Operator names will also now be recorded daily in the logbook. All operators have now seen the recommended videotape.

If you have additional questions on these issues or the actions designed to address these issues, please give me a call at (916) 362-5332.

Sincerely,

Ronald D. Ricks
Assistant Project Director

RDR:sdm

Attachments

c: M. Luthin, WSPA
M. Lev-On, ARCO
D. Van Der Zanden, Chevron
K. Ritter, API
G. Harris, Radian
S. Peoples, Radian

South Coast
AIR QUALITY MANAGEMENT DISTRICT
21865 E. Copley Drive, Diamond Bar, CA 91765-4182 (909) 396-2000

April 27, 1993

Mr. Michael D. Wang
Western States Petroleum Association
505 North Brand Blvd. Suite 1400
Glendale, CA 91203

Subject : WSPA/API Refinery Fugitive Emission Study Meeting

Dear ~~Mr. Wang~~ Mike:

Thank you for the opportunity to attend the meeting regarding the progress of the WSPA/API Refinery Fugitive Emission Test Program on February 16, 1993 at the WSPA office in Glendale. We found the meeting to be informative, touching on a number of important technical issues. Prior to the Glendale meeting, the District had not participated in any field observations for OVA screening and bag sampling.

Based on the U.S. EPA preliminary report dated December 14, 1992 regarding the site visit and technical systems audit conducted at ARCO and Pacific Refineries, seven major findings of various screening and testing deficiencies were reported. Radian responded immediately to the issues raised, changing screening and testing procedures as suggested in the audit recommendations.

During a field observation conducted at Pacific Refining on February 24, 1993, District staff noted continuing problems in some OVA screening procedures including use of calibration gases not within Method 21 specifications. These technical findings and procedural problems may have some impact on the quality of the data. Consequently, the accuracy of the final emission rate correlation equations derived from the collected data may be affected. While the District will review and evaluate the final project report when it becomes available, we are not committed to using the results or data generated from this study unless we find the results to be acceptable.

District staff recognize that the correlation method is the most appropriate approach for determining mass emission rates for refinery fugitive components. The District also supports WSPA's efforts to establish new correlations through a bagging program. However, the current bagging matrix does not include enough samples to be representative and reliable for the scope and objectives of the project. Additionally, this study does not address emissions from compressors, pressure relief devices, and drains which may contribute a significant portion of total facility fugitive emissions. The issues surrounding toxic fugitive emissions are also significant and should be addressed. As we discussed at the Glendale meeting, the District is developing an expanded bagging program which would include completion of an expanded bagging matrix at a minimum of three District refineries.

The details of this program will be available for your review and comments in the near future.

We plan to continue to work closely with WSPA and its members to develop the best possible estimate of fugitive emissions from all facilities subject to the District's fugitive emission control rules. I will be in contact with you again to discuss the details of such work leading to a quantification method for fugitive emissions which is representative, reliable and accurate.

If you have any questions, please call Peter Tong at (909) 396-2589.

Sincerely,

Anupom Ganguli, Ph.D.
Senior Manager
Refinery/OCS Team
Stationary Source Compliance

AG:PT/MB:pl

cc: Ron Ricks, Radian
Ed Camarena
Pat Leyden
Chung Liu
Bill Leyden

(rad427)

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209-081-07-01
April 27, 1993

Ms. Melinda Luthin
Western States Petroleum Association
505 North Brand Avenue, Suite 1400
Glendale, CA 91203

Subject: WSPA/API Refinery Fugitive Emissions Study, Phase III - Contract No. ET 302-08 - SCAQMD Audit of Bagging Testing

Dear Melinda:

On February 24 and 25, 1993, four auditors from the South Coast Air Quality Management District (SCAQMD) visited the Pacific Refinery in Hercules, CA to audit the bagging activities associated with the WSPA/API Refinery Fugitive Emissions Study. The Radian personnel performing the bagging at this time were Richard Howell and myself (Ron Ricks). The SCAQMD personnel performing the audit were Victor Reyes, Scott Wilson, Philip Szymanski, and Mike Buckantz. Also present for most of February 24, 1993 were inspectors and source testers from the Bay Area Air Quality Management District (BAAQMD).

In general, the SCAQMD auditors appeared favorably impressed with the testing procedures and quality controls used during the audit. However, a few items were identified by the auditors as concerns or areas that could improve the study. This letter is intended to address these issues raised by the SCAQMD during and immediately after the audit.

Issue 1 - Insufficient Carbon in OVA Dilution Probe Scrubber

The SCAQMD commented that there appeared to be insufficient carbon in the OVA dilution probe scrubber.

Response to Issue 1

No exact amount of carbon in the OVA dilution probe scrubber is specified as being required in bagging or screening protocols. There needs to be sufficient carbon in the dilution probe scrubber to filter out background hydrocarbons when the dilution probe is used. The dilution probe scrubber used during the audit and throughout the testing did include carbon. The dilution probe scrubber that was observed during this audit and the carbon in the scrubber had been replaced more than once during this testing. There is no reason to believe that the carbon in this dilution probe scrubber was insufficient to filter out background hydrocarbons.

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The screening value to mass emission rate correlation equations that will be developed for this study do include screening values used with the dilution probe if the component screened greater than 10,000 ppmv (which would read 1000 ppmv with the dilution probe). Background readings while testing these high leaking components seldom exceeded 20 ppmv, and generally were less than 5 ppmv. Even with no carbon in the dilution probe scrubber the amount of impact from these background hydrocarbon readings would be slight.

Issue 2 - Inaccurate Screening Value Obtained by Radian Inspector

During testing of one of the components the Radian inspector (Ron Ricks) initially obtained a screening value of 550 ppmv. The SCAQMD inspector obtained a reading of approximately 1500 ppmv. The Radian inspector asked where the higher reading was found. At first the Radian inspector misunderstood the location mentioned by the SCAQMD inspector (the correct side of the valve was rescreened, but the Radian inspector inspected the interface between the packing gland and valve body instead of the interface between the valve stem and packing gland). The magnitude of the leak at this location was again comparable to the original value screened by the Radian inspector. The Radian inspector performed a quality control check of the OVA and checked the OVA for any leaks. The OVA did not have any leaks and the quality control check was acceptable. Finally, the Radian inspector screened in the exact location identified by the SCAQMD inspector as the highest leak. The Radian inspector measured a screening value of 1100 ppm at this location at this time. A BAAQMD inspector also measured the leak at this location at this time and obtained a screening value of approximately 1100 ppm.

Response to Issue 2

There are two possibilities for these different readings. The first possibility is that the component leak rate varied between the time that the Radian inspector screened the component and the time that the SCAQMD inspector originally screened the component. The second possibility is that the Radian inspector passed by the area of highest leak on the first screening attempt. The second possibility is more likely considering the short period of time between the Radian screening and the SCAQMD screening.

The impact of missing the highest leak on a component is that the screening value for a component would be low (compared with other components with accurate screening values) for the resulting mass emission rate. This would result in a higher mass emission to screening value correlation which could overstate emissions.

Screening values are taken both before and after bagging. If the initial screening value differs from the final screening value by more than a factor of two, the screening value will not be used in development of the emission correlation equations. This procedure is used to

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Ms. Luthin
April 27, 1993
Page 3

reduce the variability of the emission correlation equations. The final screening value for this component, as measured by Radian, was 1400 ppmv. Without the rescreening by Radian for the initial value before the bag was put in place, this screening value to mass emission rate would have varied by a factor of 2.5 and would not have been used in emission correlation equation development. The chance of missing the highest leaking point in both the initial and final screening measurements is considered remote.

Six components were screened and bagged with the SCAQMD auditors and Radian inspectors taking side-by-side screening measurements. Each component was screened both before and after taking a bag sample. The screening values that were taken by the SCAQMD, Radian, and the BAAQMD were freely shared orally after testing. Of the total of twelve screening value measurements taken by both the SCAQMD and Radian, the initial reading on this component and the final reading on one other component were the only two that differed by more than a factor of two. The second component had a very high screening value variability that was component related, not inspection related. For the other ten screening values taken, screening value differences were minor, usually within 10 - 25% of each other. The written screening values of the SCAQMD have not been transmitted to Radian to date. However, the average of the before and after bagging screening values of the Radian inspector (Ron Ricks in each case) and the BAAQMD inspector during this audit are shown below.

Component ID	BAAQMD Screening Value (ppmv)	Radian Screening Value (ppmv)
P-118	220	225
P-119	1250	1250
P-120	600	675

The conclusion reached by the SCAQMD inspectors, the BAAQMD inspectors and the Radian inspectors that was communicated to Radian was that the screening value differences during the audit were within the accuracy of the OVA. The potentially missed highest leak point is considered anomalous, and even if it had not been corrected would have resulted in the data point being deleted as having a screening value variability that was too high. Even in the remote possibility that the point of highest leak could have been missed in both the before and after measurement, the impact of this would be that the resulting emission correlation equations would be too high and emissions over-estimated.

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Ms. Luthin
April 27, 1993
Page 4

Issue 3 - The 1000 ppmv Calibration Gas Used by Radian Was Not Within Accuracy Identified in EPA Method 21

One of the calibration gas standards used in the multi-point calibrations of the OVA was labeled at plus or minus 5% instead of the EPA Method 21 specification of plus or minus 2%. This calibration gas standard had been in use since February 1, 1993.

Response to Issue 3

EPA Method 21 (Section 3.2) specifies that the calibration gases (air, less than 10 ppmv VOC, and a second calibration gas) must by analyzed and certified by the manufacturer to be within plus or minus 2% accuracy.

The zero air standard gas and the calibration gas (100 ppmv) that was used to calibrate the OVA were certified at within the plus or minus 2% accuracy. The OVA has a calibration knob or screw to adjust the OVA reading to the calibration gas. The calibration gas used to make this adjustment was the 100 ppmv standard, not the 1000 ppmv standard. Even if the 1000 ppmv standard had been 5% off (the maximum possible) the OVA would not have been adjusted any differently because adjustments were made based on the 100 ppmv standard only.

The remaining calibration gases used in this study were used as supplemental information to that specified in EPA Method 21. They were used in this study to verify that the OVA was responding accurately over all ranges of potential screening values. The entire set of calibration gases that was used in this multi-point calibration included zero air, 10 ppmv, 100 ppmv, 1000 ppmv, and 10,000 ppmv. A 25,000 ppmv or 35,000 ppmv calibration gas was also used to calibrate the OVA dilution probe. In all cases in this study, the multi-point calibration curve yielded a correlation coefficient of greater than 0.995 (the specified acceptability standard for this study). While the 1000 ppmv calibration gas standard (certified at plus or minus 5%) was being used the correlation coefficient was never lower than 0.9998.

The 1000 ppmv calibration gas used by Radian for the months of February and early March at one of the five refineries in this study was erroneously sent to Radian by the calibration gas supplier at plus or minus 5% instead of plus or minus 2%. This error was not noticed by Radian until pointed out by the SCAQMD after the SCAQMD audit. All of the calibration gases that were in use during the audit and those that had been in use in any northern California testing prior to the audit were at the Pacific refinery and were inspected by the SCAQMD. All of the remaining calibration gases at all concentrations, including spent gas cylinders, were found to be within the required plus or minus 2% accuracy.

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The certificate of analysis from the calibration gas supplier is attached. This certification of analysis indicates that the 1000 ppm methane gas was actually 1024 ppm. This calibration gas was off by 2.4% of the requested concentration. The limited error introduced by this calibration gas would not have reduced the calculated correlation coefficient significantly. In fact, use of 1024 ppm in the multi-point calibration for the day with the worst correlation coefficient would result in a reduction of the correlation coefficient from 0.99982 to 0.99977. The revised correlation coefficient is still well above the 0.995 required for acceptability.

Issue 4 - Dilution Probe Screening Value Differences between the SCAQMD and Radian

The screening value readings of Radian's OVA with the dilution probe and the SCAQMD's OVA with the dilution probe occasionally differed widely (nearly a factor of 2).

Response to Issue 4

Radian calibrated the dilution probe used in this study at this refinery at 35,000 ppmv. The Radian dilution probe is set so that the OVA reads 0.1 times the calibration gas, or to read 3,500 ppmv with the 35,000 ppmv standard. It is not known exactly how the SCAQMD calibrated their dilution probe. For information purposes, Radian then checked the dilution probe readings at 1000 ppmv and 10,000 ppmv. The ratios generally varied at each concentration.

During the bagging conducted while the SCAQMD was performing the audit, the dilution probe was only used to determine when the gases within the bag were at equilibrium. These intermediate screening values are not used in the development of the mass emission rate to screening value correlations.

The screening values measured by Radian with the dilution probe during the audit ranged from 7.3 to 140 (approximately 73 to 1400 ppmv). None of these screening values is close to the 35,000 ppmv value for which the dilution probe was calibrated. It is not surprising that differences existed between the SCAQMD and Radian's readings with dilution probes at these low screening values. Because of the calibration at 35,000 ppmv it is unlikely that large differences would have existed at screening values > 10,000 ppmv. Only those components with screening values > 10,000 ppmv use the dilution probe in the initial and final screenings (without the bag in place) that will be used in the development of emission correlation equations or pegged component factors.

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Issue 5 - Interim Observations Were Seldom Recorded by Radian During Bagging

During bagging many of the interim observations, such as oxygen and total hydrocarbon measurements demonstrating that the bag has come to equilibrium, were not being recorded by Radian.

Response to Issue 5

In the bagging procedure, Radian takes multiple oxygen readings to verify that the oxygen content in the bag is less than 5%. This substantiates that there are minimal leaks into the bag. Multiple readings are also used to demonstrate equilibrium within the bag. Multiple total hydrocarbon (OVA readings) are also taken to demonstrate that equilibrium/steady-state has occurred in the bag. Both the final oxygen content and the final total hydrocarbon readings before taking a test sample are recorded on the bagging form. After the test sample is taken, the oxygen content and total hydrocarbon content are measured again and recorded on the bagging form. The after-sampling readings demonstrate that no new leaks occurred during sampling and give an indication of the total hydrocarbon variability during testing. Most of the interim measurements to establish that the bag was at equilibrium were not recorded by Radian.

The amount of time to establish equilibrium in the bag is recorded. From the time that the nitrogen flow rate is initiated until the time that the oxygen and total hydrocarbon readings are recorded intermediate measurements are taken. The bagging forms document the time the intermediate testing took place. The before-sample versus the after-sample oxygen and total hydrocarbon readings give additional documentation on the sample/equilibrium variability during testing.

Based on recommendations from the SCAQMD auditors, intermediate readings of oxygen and total hydrocarbon that supply additional evidence that equilibrium was obtained were recorded from the audit date until the end of the field testing. Also recorded from that date was the fact that the sampling equipment (in particular the vacuum gauge tee) was purged with nitrogen and measured with the OVA to reduce the potential for sample contamination.

Sincerely,

Ronald D. Ricks

Ronald D. Ricks
Assistant Project Director

Attachments

c: K. Ritter (API)
G.E. Harris
S.H. Peoples

To: ˈugitives S.C., FYI - M. Luthin 5-28-93

WSPA
Western States Petroleum Association

010325

Michael D. Wang
Manager
Operating and Environmental Issues

May 28, 1993

Mr. Anupom Gangouli
South Coast AQMD
21865 Copley Drive
Diamond Bar, California 91765

Dear Mr. Gangouli:

Thank you for your letter of April 27 outlining your visit to one of the refineries involved in the WSPA/API Refinery Fugitive Emissions Test Program. WSPA appreciates the cooperative input that the South Coast Air Quality Management District (SCAQMD) has given to this project.

There are a few concerns listed in your letter that WSPA would like to address.

1. **Calibration Gases**

   The SCAQMD team found one of the standard gases used in the OVA calibration check exceeded the 2 percent error range required by Method 21. Because this gas was not used for the actual instrument calibration, the quality of the gas is not required by Method 21 to be within the 2 percent error range. In addition, Radian had the gas analyzed for our own information, and the gas concentration was within 2.4% of its listed value of 1000 ppm.

2. **Testing Matrix**

   The SCAQMD is concerned with the testing matrix and the statistical significance of the program with respect to all refineries in California. Radian created this matrix with the input of their statistical experts and found this testing matrix to be statistically valid. Radian is currently evaluating the statistical relevance of expanding the matrix.

In addition, enclosed is a copy of a letter written by Radian regarding the technical aspects of the SCAQMD's visit to the refinery. Any additional questions will be taken at the upcoming Regulatory Advisory Committee meeting on June 3, at the WSPA office

... Brand Blvd., Suite 1400 • Glendale, California 91203 • (818) 545-4105

in Concord, California

It is my understanding that the SCAQMD had recorded OVA screening values in coordination with the Radian technicians for each component tested. I would like to take this opportunity to request that the SCAQMD share this information with Radian for Quality Assurance/Quality Control purposes.

Thank you again for you support of this study. We look forward to seeing you and your staff at the March 3 meeting. If you have any questions, please feel free to call Melinda Luthin at (818) 543-5333.

Sincerely,

Michael Day

RESEARCH TRIANGLE INSTITUTE

Center for Environmental Measurements and Quality Assurance

March 17, 1993

Mr. Darryl Von Lehmden
Principal Environmental Engineer
Midwest Research Institute
401 Harrison Oaks Boulevard
Cary, NC 27513-2412

Subject: Independent QA Audit of Refinery Fugitives Testing Project.

Dear Mr. Von Lehmden:

Due to an oversight, data for canister P034 were not reported in our letter of March 2, 1993. These data are as follows:

Sample Number	Canister Number	Initial Pressure (mmHg)	Final Pressure (mmHg)	Dilution Factor	Total HC Concentration (ppmC)
P034	11897	-218	708	2.72	672

We regret any inconvenience caused by this oversight. Please transmit this information to Mr. Ron Ryan of EPA.

Sincerely,

James B. Flanagan

James B. Flanagan, Ph.D.
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cc: S. Kulkarni
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File: 5500-042\4569

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RESEARCH TRIANGLE INSTITUTE

Center for Environmental Measurements and Quality Assurance

March 2, 1993

Mr. Darryl Von Lehmden
Principal Environmental Engineer
Midwest Research Institute
401 Harrison Oaks Boulevard
Cary, NC 27513-2412

Subject: Independent QA Audit of Refinery Fugitives Testing Project. Report of RTI analytical results for field duplicates and confirmatory analyses for QA gas cylinders supplied by Scott Specialty Gases.

Dear Mr. Von Lehmden:

Enclosed you will find summary reports of RTI's analyses of the field duplicates provided by Radian for the referenced project. Because these samples are taken from actual leaking components, neither RTI nor Air Toxics, Limited (ATL) knows the true values. These data will provide the following valuable information: (1) an estimate of the interlaboratory agreement and (2) raw data sets for duplicate samples analyzed by two different laboratories that can be compared for the data audit.

EPA Method 18 (GC/FID) was used by RTI for total hydrocarbons. For the December data, GC/FID was also used to detect and quantify methane; however, none of the December samples were found to have a significant level of methane. For the January/February report, methane was measured using a pre-column backflush technique, which is more selective and accurate because it separates the methane and non-methane portions prior to analysis. The equipment to perform this method was installed at RTI in January, after the first set of analyses had been completed.

Also enclosed are results of RTI's analyses of the Scott gas cylinders used as the QA samples for this project. These cylinders were analyzed in the same timeframe as the January/February duplicates, and serve to document RTI's laboratory performance for that data set. One analysis (toluene in cylinder BLM-002842) was found to be outside our accuracy goal of ±10%; however, after the GC was checked against a benzene SRM, good agreement with Scott's certified value was obtained.

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Von Lehmden - March 2, 1993
Page 2

Because of variations in shipping and laboratory schedules, the time between sampling and analysis varies from less than one week to about 4 weeks. Holding times are not thought to have a significant impact on analytical results for these volatile compounds, but we will investigate any statistical correlation between holding time and concentration. Calibrations, holding times, and other supporting data for all RTI analyses are available upon request.

We have requested that Radian send the results of corresponding analyses and the cross-reference between the duplicate canister IDs directly to Ron Ryan at EPA. As always, I will be happy to answer any questions regarding these data.

Sincerely,

James B. Flanagan

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Enclosure

File: 5500-042\4552

RTI Canister Analysis for WSPA Fugitive Emissions Project
Field Duplicates Supplied by Radian - December 1993

Sample Number	Canister Number	Initial Pressure (mmHg)	Final Pressure (mmHg)	Dilution Factor[1]	Total HC Concentration[2] (ppm C)
P055	12380	-206	746	2.72	1280.0
P068	12368	-204	732	2.68	2980.0
A049	12287	-232	710	2.78	49.1
U071	12039	-204	784	2.76	2.8
U084	11444	-232	708	2.78	1350.0
U099	12360	-234	724	2.82	83.4
U113	11630	-222	1517	4.23	435.0
U126	12364	-238	714	2.82	1090.0

Notes:

1 Dilution Factor = (barometric pressure + final pressure) / (barometric pressure + initial pressure)

2 EPA Method 18 GC/FID

RTI Canister Analysis for WSPA Fugitive Emissions Project
Field Duplicates Supplied by Radian - January/February 1993

Sample Number	Canister Number	Initial Press[1]	Final Press[1]	Dilution Factor[2]	Total Concentration[3] (ppm C)	Methane[4] (ppm C)	Concentration[5] (ppm C)
P098	RTI #14	-248	753	2.97	48.6	6.7	42.0
C097	RTI #12	-218	2084	28.78[6]	43600	0.0	43600
P082	RTI #10	-190	963	3.032	7320	1820	5500
A096	RTI #03	-256	830	3.166	1060	95.2	965
A109	RTI #04	-262	765	3.092	3440	0.0	3440
A119	RTI #02	-278	792	3.243	6000	0.0	6000
A131	RTI #01	-272	816	3.252	467	0.0	467
P101	RTI #13	-215	1956	271.1[6]	409000	9.4	409000

Notes:

1 mmHg gauge

2 Dilution factor = $\frac{\text{(barometric pressure + final pressure)}}{\text{(barometric pressure + initial pressure)}}$

3 Method 18 GC/FID

4 Method 25D

5 Concentration ppm C = total ppm C - ppm C methane

6 Multiple dilutions

RTI Cylinder Gas Analysis for WSPA Fugitive Emissions Project
Scott Gases · Analyzed January 1993 by EPA Method 18

Cylinder Number	Component	Scott Value[1]	RTI Value[2]	Relative % Difference
BLM-002842	Isooctane	20.6	21.2	+2.9%
BLM-002842	Toluene	24.6	21.0[3] 24.7[4]	-14.6%[3] +0.34%[4]
BLM-002842	Cumene	18.8	18.9	+0.5%
BLM-002843	Propylene	226.0	244.0	+7.7%
BLM-002843	Hexane	121.0	115.0	-4.9%
BLM-002843	Ethylbenzene	84.6	87.7	+3.7%

Notes:
1 Manufacturer's certified value, ppm C, rounded to 3 significant figures
2 EPA Method 18 GC/FID, ppm C, rounded to 3 significant figures
3 Initial analysis using propane calibration standard
4 Reanalysis using benzene SRM as reference

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RTI

Center for Environmental Measurements and Quality Assurance

January 12, 1993

Mr. Ronald Ryan
Emission Factor and Methodologies Section
Emission Inventory Branch (MD-14)
Office of Air Quality Planning and Standards
U. S. Environmental Protection Agency
Research Triangle Park, NC 27711

Dear Mr. Ryan:

Enclosed you will find an update of the table of RTI's analyses for seven QA canisters collected during the first two on-site audits. This table was first delivered on December 29, 1992, and has been amended as follows:

(1) The results from corresponding samples from Air Toxics Limited (ATL) have been added to the table based on the data telefaxed by Ron Ricks on December 29, 1992. A factor of three has been used to change the ATL units from "ppm as propane" to "ppm as carbon," so that the results from both laboratories are in a common set of units.

(2) The "% RPD" column has been changed to "% Bias." Bias is the difference between the analytical result and the certified concentration, divided by the certified concentration. Footnote (6) provides the definition of percent bias.

For canisters filled directly from the QA cylinder, % bias represents analytical laboratory bias alone; for canisters filled via a tented non-leaker, bias includes a component of error due to sampling. The analysis results for the bagged component are generally lower than for corresponding samples prepared by filling the canisters directly. This is consistent with decrease of concentration of the hydrocarbon due to dilution from bag leaks and/or other sampling losses.

Please do not hesitate to call if you have any questions regarding this revised information.

Sincerely,

James B. Flanagan

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Results of Analysis of QA Samples

Refinery	Sample sent to RTI	QA [1] Gas Cylinder	Bagged [2] or Direct	%O_2	Duplicate Sample sent to Radian/AT	THC Concentration [4] (corrected) [5]			RTI % Bias [6]	Radian/AT % Bias [6]	Remarks
						Certified	RTI	Radian/AT			
ARCO	A027	1	B	.3	A026	506	499 (506)	460 (457)	-1.4 (0)	-11.1 (-9.7)	
ARCO	A029	2	B	.1	A028	2061	1980 (1989)	1350 (1356)	-4.9 (-4.4)	-35.1 (-34.8)	
ARCO	A030	1	D	-	A031,A032	506	517	480,291	+2.2	-5.1,-42.5	Canisters A031 and A032 were filled at the same time, but were sent to AT on different days.
ARCO	A033	2	D	-	A034	2081	1970	1470	-5.3	-28.3	
Pacific	P043	1	B	2.3	P042	506	464 (521)	600	-8.3 (+3.0)	+18.6	
Pacific	P045	2	B	2.8	P044	2081	1920 (2216)	3600 (4164)	-7.7 (+6.4)	+73.0 (+99.6)	
Pacific	P047	1	D	-	P046	506	540	690,720	+6.7	+36.3,+42.3	Duplicate analysis of P046 by AT

Notes

(1) QA gas cylinder #1 contains:

Cumene	169.2 ppm C
Iso-octane	164.8 ppm C
Toluene	172.2 ppm C
Total	506.2 ppm C

QA gas cylinder #2 contains:

Ethylbenzene	676.8 ppm C
n-Hexane	726.0 ppm C
Propylene	678.0 ppm C
Total	2080.8 ppm C

(2) B = bagged - filled through a bag around a non-leaking component
D = direct - gas transferred directly from cylinder into a canister via teflon tubing

(3) Corresponding samples sent to Radian's contract lab, Air Toxics, Ltd. (AT)

(4) Reported units are ppm C = ppmv (mole/mole) x number of carbons in molecule

(5) Bagged samples are corrected for dilution as follows:

$$C_{corr} = C_{meas} \times \frac{1}{1 - \frac{\%O_2}{21}}$$

(6) $$\%\ Bias = \frac{\text{Analytical Value - Certified Value}}{\text{Certified Value}}$$

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209-081-07-01
July 14, 1993

Ron Ryan
EPA-OAQPS, MD-14
Emissions Factor and Methods Section
Research Triangle Park, NC 27711

Subject: Response to Independent Quality Assurance of Refinery Fugitives Testing by Western States Petroleum Association Draft Audit Report

Dear Ron:

Radian has reviewed the Draft Audit Report prepared by Research Triangle Institute (RTI) on behalf of the U.S. EPA in conjunction with the 1993 WSPA/API Refinery Fugitive Emissions Study. Overall, we believe that RTI's findings support Radian's contention that the data collection and analysis conducted by Radian in this investigation were of the highest quality. There were many positive findings in RTI's Draft Audit Report including: data demonstrating the accuracy of Radian's bagging technique, data supporting the stability of nitrogen flow rates, data showing that the laboratory used for this study's data analysis correctly identified all six of the unknown compounds using Method TO-14, Mini Buck® calibrator results (used for nitrogen flow rate measurements) that were "adequate and satisfactory," etc. This list is only a sample of the positive findings in RTI's Draft Audit Report. These positive findings are acknowledged and need no further mention. We would, however, like to respond to some of the issues and concerns raised in this Draft Audit Report. As with the Preliminary Audit Report, dated December 14, 1992, we believe that the impact of these other findings in the Draft Audit Report will have minimal impact on the assessment of data quality in this investigation.

Many of the issues raised in the Draft Audit Report are the same as those raised in the Preliminary Audit Report. These issues were addressed in Radian's response to the Preliminary Audit Report, dated January 19, 1993. The issues addressed in Radian's January 19, 1993 letter include:

- Potentially leaking OVA probes;
- OVA flow rates less than the apparent reading on the OVA built-in flow indicator;
- Dilution factor variability;
- Oxygen analyzer calibration methodology;

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- The linear regression equation used to determine the correlation coefficient;
- Ambient air in the gauge T-joint used to monitor pressure while the canister was being filled;
- Apparent poor condition of Radian's OVA used at the Pacific Refinery;
- Operator names not recorded daily in the logbook; and
- Recommendation to have operators view E.J. Richards' videotape, "VOC Fugitive Emissions Procedures and Equipment."

A more detailed response was determined to be useful for two of the issues raised in the Preliminary Audit Report. These two issues are:

- Potentially leaking OVA probes; and
- Dilution factor variability.

Each of these two issues is addressed at length in the 1993 Refinery Fugitive Emissions Study Draft Report. The conclusion for the issue of potentially leaking OVA probes is that no systematic bias is evident from use of data collected by these OVAs. The dilution factor variability is addressed by looking at data collected with and without the dilution probe to determine if there are statistical differences in the resulting emission correlation equations. The conclusion for the dilution probe issue is that there is no statistically significant difference between the emission correlation equations developed without the dilution probe data and the emission correlation equations developed with the dilution probe data.

There are a number of additional issues that are raised by RTI in their June 9, 1993 Draft Audit Report. The response to what Radian perceives to be the remaining potentially key issues is provided in this letter.

Issue 1 - OVA Flow Rate Continued

Audit Finding

(Page 18, 2nd paragraph). "By the second audit trip to Chevron and Ultramar, Radian operators had implemented the measuring and recording of OVA flow rates. The flow rates were recorded in the logbook only once at the beginning of the day at Chevron. At Ultramar, the flow rates were recorded twice, once at the beginning and once at the end of the day. Upon comparison between start and end flow rates, flow rates revealed a

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decreasing trend (see Appendix D). This was an indication of a battery losing its charge over a days use. Example flow rates of a new battery can be seen on 12/15/92. The flow rate increased by the end of the day from 785 mL/min to 790 mL/min. From 12/16/92 to 12/18/92, the initial and final sample flow rate resulted in a decreasing trend until the battery is completely discharged on 1/5/93. As a result, these measurements proved to be valuable indicators of a low battery and also provided an explanation for the instrument losing its calibration over the course of the day."

(Page 54, first paragraph). "..... The major factor affecting calibration was the OVA flow rate. As the battery providing power for the gas pump discharged, the OVA flow rate decreased, affecting calibration. Use of the check standard alerted field personnel to the battery status and prevented loss of calibration from becoming a factor in data usability."

Technical Response

The RTI audit at Chevron took place on 1/4-5/93. On both 1/4/93 and 1/5/93 Radian recorded the initial and final flow rates from the OVA in the field logbook at Chevron.

The change in battery flow rate from the start of the day to the end of the day was usually quite minor. The change identified by RTI for 12/15/92 at Ultramar is fairly indicative of the typical change in daily flow rate (from 785 mL/min to 790 mL/min, or +0.6%). The change in flow rate was not consistently decreasing during the day as an indication that the battery was losing its charge. Of the 43 recorded readings that included the start of day OVA flow rate and the end of day OVA flow rate, 18 showed increasing flow rate as the day progressed, 24 showed decreasing flow rate as the day progressed, and one had no change whatsoever.

The OVA batteries were always recharged over night while testing or between testing activities. The OVA batteries were not slowly losing charge over a several day period.

There is a loss of battery charge during a day's testing. This loss of charge can result in the inability of the OVA to accurately measure hydrocarbon concentrations. As indicated by RTI, the OVA was checked for accuracy after every bagging measurement to ensure that the OVA was still reading a known hydrocarbon standard within 20% of the actual value. However, based on the data collected for this study, this loss of battery charge does not appear to have significantly reduced the OVA flow rate over time.

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Issue 2 - Establishing Equilibrium by Using the Oxygen Analyzer

Audit Finding

(Page 20, last two sentences through Page 21 first sentence). "At Chevron, the oxygen concentration was monitored to very low concentrations, approximately 0.2 to 0.4 percent oxygen and a reading was measured every other minute for three minutes to get an average oxygen concentration. At other sites, oxygen was allowed to fall below 5%, then sampling commenced without waiting for equilibrium.

The leak was then screened using the OVA Model 108 with a dilution probe in order to get a reading for the total hydrocarbon concentration at equilibrium."

(Page 54, last sentence through Page 56 first paragraph). "Some of the operators took readings until the oxygen levels fell below 5%, then proceeded with sampling, while others waited until the oxygen concentration stabilized at a low value before recording the first reading......It is obvious from these figures that equilibrium had not been fully established for the tents whose oxygen concentrations continued to fall, and that leaks may have been a concern for the 6 episodes in which the oxygen never fell below 1%."

Technical Response

The primary function of the oxygen analyzer was to determine that the oxygen concentration was below 5% in the bag. It was desirable to be below 5% to reduce the impact of background hydrocarbons and to have some indication that the bag did not have substantial leakage.

Another test, by the OVA, was used to verify that the bag was at equilibrium. As indicated by RTI, the leak was screened by the OVA for total hydrocarbon concentration after completing the testing by the oxygen analyzer. Multiple measurements were taken by the OVA with the bag in place to ensure that the bag was at equilibrium. Hydrocarbon concentration measurements with the OVA had to be constant or at least not show a consistent trend up or down to determine that equilibrium had occurred. This process of using the OVA to ensure equilibrium usually took several minutes of testing, with OVA testing occurring at approximately one minute intervals. All of this testing occurred after using the oxygen analyzer. The canister sample is taken after equilibrium is established.

The northern California bagging team used the oxygen analyzer for an additional, redundant, check of the equilibrium in the bag. The southern California bagging team did not use the oxygen analyzer for this redundant check of equilibrium.

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Accuracy checks for both the northern California and the southern California bagging teams and bagging equipment established that acceptable accuracy was obtained. These accuracy checks were conducted by inserting a known concentration of a certified hydrocarbon gas standard into a typical bag arrangement. The concentration measured in the canister was then compared to the known concentration. These accuracy checks established accuracy within a relative percent difference of 32% for both total hydrocarbon and methane measurements. Additional accuracy checks were also conducted by RTI in the field by inserting a known (to RTI only) concentration of a certified hydrocarbon gas into a typical bag arrangement. These accuracy checks also showed acceptable accuracy, generally with even better results than the accuracy checks conducted with the hydrocarbon standard that Radian used in their accuracy checks. Both RTI and Air Toxics Limited laboratories verified the accuracy of the bagging procedure. These accuracy checks indicate that procedures used at every site tested were able to achieve an acceptable equilibrium.

Issue 3 - OVA Challenge

Audit Finding (A)

(Page 25, last paragraph through Page 28 end of paragraph). "Audit results from ARCO Refinery were well within the specified quality assurance objective of plus or minus 20% for the accuracy of the OVA with exception of the OVA response to the 7850 ppm audit gas. The OVA response resulted in a negative bias of 60.7% with a standard deviation from the mean OVA response of 91.0. During this audit, it was observed by auditors that the OVA connectors and probes were leaking which may have contributed to the significant variation between OVA readings. Problems establishing the 10:1 dilution ratio while calibrating the dilution probe also contributed to the large negative bias obtained while screening the 7850 ppm audit gas with the dilution probe attached to the OVA. This problem in conjunction with air-inleakage from the OVA connectors and probe may have diluted the gas from the original audit concentration, 7850 ppm, to the mean OVA response of 3082 ppm."

Technical Response to (A)

The audit gas used at the ARCO site at 9034 ppm (CH_4 in air) and at 1094 ppm (CH_4 in air) both with and without the dilution probe measured within a 9.1% bias of the audit gases. An anomaly occurred at this first audit visit at any refinery when RTI made measurements with Radian's OVA. At this time, it cannot be explained why the audit gas at 7850 ppm (C_2H_6/CH_4 in nitrogen) was measured and recorded by RTI as an OVA response of 3082 ppm. This information was not passed on to Radian at that time, or at any time until the Draft Audit Report was published. In fact, Radian's field technician present at this audit recorded in the field notebook that day that, "all instruments performed well for the audit." There is no way at this time for Radian to confirm, correct, or refute RTI's reading of the OVA. If

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this anomalous reading was performed at the same time as the audit with the other audit gases, then there appear to be inconsistencies. If, as suggested, this result is related to a potential OVA leak then it would seem reasonable that the other audit gases (9034 ppm and 1094 ppm), that responded very well to the audit, would have had inaccurate readings as well. The accuracy of the dilution probe readings for both of these other audit gases argues against a problem with establishing an acceptably accurate dilution ratio or with any problem with a potential probe leak.

Radian checked the OVA twice immediately before the audit with multi-point calibrations. The second multi-point was performed after the OVA probe was reseated in its housing. These multi-point calibrations indicate that the OVA was working well within accepted standards when the audit was performed. The results of these multi-point calibrations were as follows:

Time	0 ppm	10 ppm CH_4	100 ppm CH_4	1,000 ppm CH_4	9520 ppm CH_4	R
0720	3.75	15	100	900	9,500	0.99994
0745	<1	11	100	950	10,000	0.99995

It is conceivable that some of the differences observed during testing of the 7850 ppm standard versus the other standards were caused by the 7850 ppm standard being in nitrogen versus being in air. The response of the OVA to hydrocarbons in air versus being in nitrogen may differ to some extent. It needs to be pointed out that when Radian uses the OVA to screen components for bagging purposes that the OVA is pulling in ambient air with the hydrocarbon readings. The only time that the OVA would be pulling in pure nitrogen with the hydrocarbons is when the bag is in place and equilibrium is being established. None of these hydrocarbon readings in the nearly pure nitrogen atmosphere are used for any quantification purposes for the 1993 Refinery Fugitive Emissions Study. Even the potential for the different environments, nitrogen versus air, to affect results is suspect. The response to the 7850 ppm standard in nitrogen was much closer to the other standards in air at the remaining three refineries. At Ultramar, for example, the 7850 ppm standard in nitrogen read 7496 ppm (-4.5% bias) compared with the 9034 ppm standard in air measured at 8993 ppm with the dilution probe (-0.5% bias). No significant difference by using a ethane/methane mixture in nitrogen standard versus a methane in air standard is evident at Ultramar.

The range of the average OVA response for the ethane/methane mixture in nitrogen for the eight other measurements at the three other refinery test sites audited was from -4.5% bias to +38.4% bias. The -60.7% bias at ARCO appears to be anomalous. Other concurrent

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testing suggests that there was no systematic error or bias in the OVA results and that this finding would have little, or no significance to overall data quality.

Audit Finding (B)

(Page 28 last paragraph to Page 29 end of sentence). "OVA, serial number 2254, was used at Pacific and Chevron Refineries. At Pacific, the OVA performed unsatisfactorily with bias results as large as +51.5 with the dilution probe and +61.9 without the dilution probe for the 1094 ppm audit concentration. The OVA screened as high as 1657 ppm with and 1771 ppm without the dilution probe."

Technical Response to (B)

It is unknown why RTI recorded measurements using Radian's the OVA as high as 1657 ppm with and 1771 ppm without the dilution probe. There appear to be inconsistencies in these results compared with measurements taken by Radian for the same OVA at approximately the same time that these measurements were made. According to Radian's records the OVA challenge at the Pacific Refinery took place on 12/8/92. On this date Radian checked the accuracy of the OVA, number 2254, at four separate times spread throughout the day without the dilution probe and twice with the dilution probe. The accuracy was checked against a known concentration of a 1000 ppm ±2% certified methane in air standard. The results of these checks are listed below:

without dilution probe:

- 1000 ppm at time of 0830;
- 800 ppm at time of 0950;
- 1000 ppm at time of 1000; and
- 1000 ppm at time of 1130.

with dilution probe:

- 100 ppm (10:1 dilution ratio) at time 0830; and
- 100 ppm (10:1 dilution ratio) at time 1130.

On the day following the OVA challenge the 1000 ppm standard read on OVA 2254 as follows:

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without dilution probe:

- 1000 ppm at time of 0817;
- 1100 ppm at time of 0916;
- 1200 ppm at time of 0943;
- 1200 ppm at time of 1031;
- 1000 ppm at time of 1240;
- 1100 ppm at time of 1342;
- 1100 ppm at time of 1411; and
- 1100 ppm at time of 1447.

with dilution probe:

- 100 ppm (10:1 dilution ratio) at time 0817;
- 100 ppm (10:1 dilution ration) at time 0916;
- 100 ppm (10:1 dilution ratio) at time 0943;
- 100 ppm (10:1 dilution ration) at time 1031;
- 100 ppm (10:1 dilution ratio) at time 1342; and
- 110 ppm (9.1:1 dilution ratio) at time 1447.

These readings bracket the time that the OVA 2254 was analyzed by RTI using the 1094 ppm audit gas standard. As these data show, the OVA was responding within 20% for every test. Most of these tests were conducted as quality control checks after collecting a bag sample. The tests verify that during sampling the OVA was responding with acceptable accuracy.

One possibility for the differences between Radian's OVA reading and the audit gas value is that one of the standards used was incorrect. However, independent tests by the Bay Area Air Quality Management District (BAAQMD) substantiated the accuracy of the methane standard used by Radian during testing at this time. Furthermore, the 1094 ppm standard used by RTI was read by Radian OVAs at within ±27.6% bias at the other three refineries. No evidence of a faulty standard is suggested by these other tests.

Another possibility for why the audit gas standard read at +51.5% and +61.9% bias at one refinery is that the battery of the OVA had failed between the acceptable 11:30 AM reading on 12/8/92 and the afternoon challenge of the OVA by RTI. However, if the OVA battery had failed it is not known why the 7850 ppm standard was still able to read at +17.5% bias.

Issue 4 - Dilution Factor Variability Continued

Audit Finding

(Page 51, first two paragraphs). "....On this day it was discovered that the probe was not fully seated and secured in the probe holding device of the OVA. After reinserting and tightening down the probe, the dilution factors reverted to 9 for both low and high concentrations. That the dilution factor could change from 21 to 9, a 233% difference, by correcting leakage illustrates the magnitude of the error that may have occurred during early screening measurements for this project. Early screening data should therefore be carefully examined for usability.

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Figures 4-1 and 4-2 illustrate this point. Figure 4-1 shows dilution factors at ARCO and Pacific taken prior to the recommendation regarding leak checking. Figure 4-2 shows the same information for the Chevron and Ultramar sites after leak checking had been in practice. Clearly, there is less scatter with leak checking than without. In both figures, dilution factors taken during a single calibration are connected."

Technical Response

As explained in the introduction to this letter, the 1993 Refinery Fugitive Emissions Study Draft Report explains how using data from the potentially leaking OVA probes does not result in a systematic statistical bias in the development of the emission correlation equations. The 1993 Refinery Fugitive Emissions Study Draft Report also demonstrates that use of dilution probe data does not result in statistically different emission correlation equations than if these data were deleted from the analysis. The technical response for this audit finding in this letter is focused on the specific data and conclusions presented by RTI to highlight this area of concern.

The day referred to by RTI for the audit in this section of their report is December 4, 1992. It should be pointed out that no testing, other than the audit, took place on this day. Any concerns for 12/4/92 do not affect any particular data collected on that day because no samples were collected.

When sampling, the dilution ratio is determined at the start of the day and generally whenever a high leaking sample was tested (one requiring a dilution probe at screening values > 10,000 ppm). The dilution ratio was revised as needed during the day to account for variability in dilution probe readings. In addition, a known hydrocarbon standard was checked after every bag sample taken to verify that the OVA, without the dilution probe, had not changed in accuracy within plus or minus 20% of a certified standard. It is highly unlikely that a 233% difference with the dilution probe could have occurred during testing and have the certified standard quality control check within plus or minus 20%. These quality control procedures support the accuracy of all readings before and after the original audits in December, 1992.

Figures 4-1 and 4-2 illustrate differences in dilution probe readings prior to and after January, 1993. They do not illustrate solely, or possibly at all, the differences in leak checking versus not leak checking the OVA. In part as a result of the audit, and in part as a result of on-going efforts to reduce variability, both the dilution probe in northern California and in southern California were modified prior to testing in January, 1993. The dilution probe in northern California was replaced because of the variability at the different hydrocarbon concentrations. The dilution probe in southern California was not as variable and was simply repaired. It is unknown if the potential leaks contributed much, if anything, to the change in dilution ratios illustrated in Figures 4-1 and 4-2. It is more likely that the change in variability is more a function of the repairs/replacement of the dilution probes themselves. One indication that the potential for leaks was not the reason for the change is by looking at the variability of the dilution ratios on 12/9/92 and 12/10/92 at the Pacific Refinery. On 12/9/92 the dilution variability was 10:1 at 1000 ppm and 14.6:1 at 35,000 ppm. On 12/10/92 the dilution variability was 10:1 at 1000 ppm and 21.9 at 35,000 ppm. The variability on 12/10/92 was the highest variability observed in northern California. However, on both of these days the OVAs were checked for leakage and any leaks repaired prior to calibrations or testing. On these dates the dilution probe variability was strictly a function of the dilution probes themselves and not a function of any potential probe leaks.

The fact that the dilution probes demonstrated high variability, primarily in the early parts of the study, whether it is probe leak related or not, is a matter of concern. This fact does add an element of variability to study results. This fact motivated the repair/replacement of the dilution probes. This is a concern of use of all dilution probe data collected by refineries, not simply the data collected for this study. However, as previously explained, several efforts were made even prior to this repair/replacement to account for the variability. The dilution ratio at two different concentrations was recorded, at 1000 ppm and at 25,000 or 35,000 ppm. These two dilution ratio measurements assisted in more accurate determination of hydrocarbon concentrations for components from widely varying leak rates. A third standard was included for dilution ratio determination starting in January, 1993 to even more accurately quantify emissions in higher leak ranges. The dilution ratio was, in general, also measured prior to recording screening values for high leaking components. These component by component dilution ratios helped account for variations in dilution ratios that occurred during the day's testing. The quality control checks of plus or minus 20% confirm that the OVA itself did not change significantly during testing.

Radian has carefully examined for usability the early screening data. This examination results in the recommendation that these data be used in data analysis and in the development of the emission correlation equations, zero component emission factors, and pegged component emission factors.

Issue 5 - Difference Between Laboratory Test Results for Test with Highest Variability

<u>Audit Finding</u>

(Page 35, Sample Numbers P100 and P101, with write-up on Page 46, second paragraph) "An extremely large difference (a factor greater than 10) was noted between samples P100 and P101, which were supposed to be field duplicates. However, in view of the extremely high value reported by ATL (140,000 ppm), other phenomena such as condensation or unequal sampling might be involved."

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Mr. Ryan
July 14, 1993
Page 11

Technical Response

From the March 17, 1993 letter from RTI to Mr. Darryl Von Lehmden, RTI reported the total concentration in ppm C (defined as Concentration ppm C = total ppm C - ppm C methane) for sample P101 as 409,000. Radian converts this reading to approximately 140,000 ppmv as propane. The duplicate sample (P100) sent to Air Toxics Limited (ATL) was reported by ATL as 140,000 ppmv as propane. The RTI value, reported on Table 2-5 of the Draft Audit Report, records the concentration of sample P101 as 13,600 ppmv. It appears that a typographical error has occurred in one of the RTI reported values.

Issue 6 - Precision of Nitrogen Flow Rate Sampling

Audit Finding

(Page 57, first paragraph, and Page 58 nitrogen flow rate for sample P037) ....Of the 17 sampling episodes observed by the auditors in which nitrogen flowed through the tent, one flow was mismeasured or misrecorded, and 16 flows were replicated within 5% of the beginning flow rate see (Table 4-4). From this observation, it appears that stability of nitrogen flow rate during sampling is not a large factor in variability of results."

Technical Response

There are two basic criteria for determining the nitrogen flow rate into the bag (or tent) during sampling. The first criteria is the size of the bag. Larger bags require larger flow rates. The second criteria is the measured concentration of hydrocarbons with the bag in place. Occasionally, measured hydrocarbon concentrations with the bag in place are beyond the range of the OVA with the dilution probe (>100,000 ppm). In order to verify that equilibrium has occurred it is desirable to have hydrocarbon concentrations in the measurable range. This allows multiple readings to prove that the bag is at equilibrium and not just multiple readings at >100,000 ppm. Sometimes the initial nitrogen flow rate is chosen without knowing that the bagged hydrocarbon concentration will be >100,000 ppm. In these cases it is common that the nitrogen flow rate will be increased until hydrocarbon readings are in the measurable range. Sample P037 was in this category of extremely high bagged hydrocarbon concentrations. The nitrogen flow rate was deliberately increased to bring the hydrocarbon readings into the measurable range. The flow was increased from 1463 mL/min to approximately 4095 mL/min.

During the field testing the initial nitrogen reading of 1463 mL/min was appropriately crossed out in ink and the marked-out value was initialled by the field technician. However, the revised reading was not recorded prior to the test. The final reading of 4095 mL/min was recorded after the test. As RTI has demonstrated, there is only a minor difference in

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before and after readings of nitrogen during testing. Based on this fact, the final reading of 4095 mL/min was assumed to be equal to the initial, unrecorded reading. The initial reading was neither mismeasured nor misrecorded. The reading was missed, but this omission was not significant to the analysis.

Many of the areas of concern brought up by the audit address variations in OVA response to multi-concentration gas standards, both with and without the dilution probe. It should be noted that EPA Method 21 does not require multi-point linearity and dilution ratio checks. Radian added the multi-point linearity and dilution ratio checks to better define data variability for this important study. The 1993 Refinery Fugitive Emissions Study has more detailed QA/QC data associated with it than any previous fugitive emissions study. It is not unexpected to find some anomalous results when you are dealing with a set of thousands of measurements made by different inspectors, different instruments, and at different times. While the audit report appropriately highlights all of the deviations found, the hundreds of QA/QC checks that were well within data quality objectives also need to be remembered.

In this letter Radian has attempted to address key issues and concerns that were not previously addressed by Radian. The 1993 Refinery Fugitive Emissions Study Draft Report addresses some of the previously raised issues and concerns in much more depth. It is Radian's opinion that the issues and concerns raised by RTI during the audits have enhanced the understanding of the data collection and analysis activities conducted by Radian, but none of these issues or concerns support a lack of confidence in any of the data used by Radian in the development of the emission correlation equations, zero component emission factors and pegged component emission factors prepared for the 1993 Refinery Fugitive Emissions Study.

Sincerely,

Ronald D. Ricks

Ronald D. Ricks
Assistant Project Director

Attachments

c: K. Ritter (API)
M. Luthin (WSPA)
M. Lev-On (ARCO)
G.E. Harris
S.H. Peoples

APPENDIX F

RESPONSE TO REGULATORY AGENCY COMMENTS ON THE FINAL DRAFT OF THE 1993 REFINERY STUDY

RADIAN

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January 17, 1994
209-081-07-01

Mr. Ron Wilkniss
Western States Petroleum Association
505 North Brand Avenue, Suite 1400
Glendale, CA 91203

Subject: WSPA/API Refinery Fugitive Emissions Study, Phase III - Contract No. ET 302-08 - Radian's Response to SCAQMD Comments on the 1993 Final Draft of the 1993 Study of Refinery Fugitive Emissions from Equipment Leaks

Dear Ron:

Radian is in the process of preparing the Final Report of the 1993 Study of Refinery Fugitive Emissions from Equipment Leaks (1993 Refinery Study or Final Report). We have reviewed all of the comments received from WSPA and API committee members as well as those received by regulatory agencies. The Final Report will include several revisions based on the comments received.

This letter is in response to the specific issues raised by the South Coast Air Quality Management District (SCAQMD). The section numbers in the Final Report that are referred to in this letter are expected to be the same as those that were in the Final Draft Report.

Issue 1 - Number of Bagging Samples

SCAQMD comment:

"Out of a proposed 525 samples, only 248 valid samples were used for new correlation equations and emission factors development. Additionally, many of the valid samples were those used to develop new default-zero and pegged component emission factors. Only 10 samples were used to develop the correlation for pumps in heavy liquid service and only 27 samples were used to develop the correlation for pumps in light liquid service. With such small sample sizes, we are not confident that the samples are truly representative and reliable for the scope and objectives of this study."

Final Report reference: See Volume II, Section 3.0.

Radian response:

Radian originally proposed to the Western States Petroleum Association (WSPA) and the American Petroleum Institute (API) to examine 525 samples, including field duplicates, zero components (i.e., those components that screen at background ppm levels), pegged compo-

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nents (i.e., those that screen above the instrument's measurement capability; generally greater than 100,000 ppm), and components that screened at between 1 and 100,000 ppm. Fortunately, Radian was able to complete the study with even more valid samples than originally proposed. Radian completed the study with 540 valid samples. Of the 540 valid samples, 248 were components that screened at between 1 and 100,000 ppm, 102 were zero components, 71 were pegged components, and the remainder were taken to ensure data quality (audit sample duplicates, nitrogen flow test duplicates, and accuracy checks). In addition, 51 samples were excluded from analysis because of high variability in screening measurements taken both before and after bagging. Later analysis indicated that including these additional 51 samples would not have had a significant effect on the development of the emission correlation equations (see Volume II, Section 3 of the Final Report). Table 1 documents all valid samples and the high screening variability samples collected and their use in the data analysis.

The United States Environmental Protection Agency (U.S. EPA) recognizes that facilities or industries may wish to redevelop emission correlation equations based on more applicable data. To assist an industry in developing new emission correlation equations they have recently (June, 1993) updated and published a document entitled *Protocol for Equipment Leak Emission Estimates* (Protocols Document). The Protocols Document gives general guidance for determining the required number of samples recommended for determining new or revised emission correlation equations. Including pegged components, the Protocols Document recommends that at least 30 samples be taken. Excluding pegged components, the Protocols Document recommends that at least 24 samples be taken.

Some of the samples collected had been excluded from the analysis because their "before and after" screening values exceeded the pre-established control limits. Those are referred to as having "high" screening variability. As can be seen from Table 1, the U.S. EPA recommendation to have at least 30 samples (including pegged components) was exceeded in four of the six categories. The U.S. EPA recommendation to have at least 24 samples (excluding pegged components) was exceeded in three of the six categories. The question of whether sufficient samples were taken to meet U.S. EPA recommendations is focused only on two or three of the component categories; heavy liquid pumps, connectors-flanges, and possibly open-ended lines (OELs). The remaining categories clearly exceed the recommendations, and valves exceed the recommendations by a factor of almost six.

We would like to address each of the questionable categories separately, beginning with OELs. Thirty-three (33) OEL samples (including pegged components) were included in pegged components emission factor or emission correlation equation development. Three more samples were collected than the U.S. EPA recommendation. Furthermore, five OEL samples were excluded from analysis simply because they had high screening variability. These samples were excluded in an effort to control one aspect of variability in the study.

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Subsequent analysis indicated that these five samples could easily have been added to the analysis without any significant change to the emission correlation equation (see Figure 3-30, Volume II, Section 3 of the Final Report). Adding these five samples would have virtually no effect on the determination of the emission correlation equation and would also clearly exceed the U.S. EPA recommended number of samples. Given these considerations, it seems that the OEL category reasonably satisfies the U.S. EPA recommendations.

The remaining two categories, connectors-flanges and heavy liquid pumps, do not meet the mentioned U.S. EPA recommendations. The connectors-flanges category is close to meeting the recommendations, especially if including the high screening variability samples (total of 20). The heavy liquid pump category is not close (10–12 samples) to this U.S. EPA recommendations. The reason that additional samples were not taken is easily explained. Radian was attempting to obtain samples in all screening value ranges. A deliberate attempt was made to not skew the analysis by having a disproportionate number of samples in either low or high screening value ranges. Efforts were made by the five host refineries and Radian to find these components. Testing at these refineries was performed over approximately 20 weeks. For connectors-flanges and heavy liquid pumps, more components in the higher screening value ranges could not be located.

Prior to commencing the data analysis for the 1993 Refinery Study it was not known that the connectors category should be split into two categories, flanges and non-flanges (other). In fact, the 1980 Refinery Study did not split the connectors into two categories. If the 1993 Refinery Study connector categories were merged, 48 samples would be available to develop an emission correlation equation which far exceeds the U.S. EPA recommendation. However, statistical analysis revealed that connectors-flanges and connectors-other were two distinct categories. Splitting the connectors into two categories improves the correlation coefficient from 0.82, for the combined grouping, to 0.88 for connectors-flanges and 0.85 for connectors-other. Even though this meant that one of the U.S. EPA's recommendations for sample size would not be precisely met for one of the connector categories, it was felt that the superior applicability of the results by dividing into two categories outweighed the possible limitation of reduced sample sizes.

Similarly, if the heavy liquid pump and light liquid pump categories were merged, 37 samples would be used to develop an emission correlation equation. However, the superior applicability of the results by maintaining two categories outweighed the possible limitation of reduced sample size.

The previous version of the Protocols Document, the U.S. EPA's *Protocol for Generating Unit-Specific Emission Estimates for Equipment Leaks of VOC and VHAP* (1988), states that if it can be shown that the estimates are "within 50% of the mean value with 95% confidence", a smaller sample size is acceptable. The 95% confidence interval for the expected

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mean log emission rate at the mean log screening value meets the "plus or minus 50% of the expected value" criterion for all component categories, including connectors-flanges and even heavy liquid pumps. The 95% confidence interval criteria is not met for these two component categories in linear space. The previous version of the Protocols Document is not clear on whether the criterion is for log or linear space.

The 1993 U.S. EPA Protocols Document states, "The above groupings and recommended number of sources are given as guidelines. They are based on experience in measuring leak rates and developing leak rate/screening value correlations. Other source selection strategies can be used if an appropriate rationale is given".

It is clear that the U.S. EPA recognizes that alternate strategies and even potentially smaller sample sizes can be considered for development of emission correlation equations. The issue really should be which emission correlation equations best represent the types of components found in today's refineries.

In comparing the 1980 Refinery Study to the 1993 Refinery Study, it is immediately evident that many of the samples taken in the 1980 Refinery Study were pegged components. When the pegged components are removed from the total number of samples taken for the 1980 Refinery Study, the results are as shown in Table 2. Note that in the 1980 Refinery Study no heavy liquid valves or open-ended lines were sampled (bagged) and that valves were split into the gas valves and light liquid valves categories. The 1993 Refinery Study actually sampled more components than the 1980 Refinery Study in the following categories: gas valves, heavy liquid valves, open-ended lines, and flanges. The number of light liquid valves sampled in both studies are nearly identical. In fact, of the component categories reexamined in the 1993 Refinery Study, only the pump categories had significantly fewer samples collected than in the 1980 Refinery Study. By number of samples alone, the 1993 Refinery Study is superior to the 1980 Refinery Study for the two categories that represent the great majority of components found at any refinery: valves and flanges.

The comparison between the 1980 Refinery Study and the 1993 Refinery Study is even more convincing for the development of zero component emission factors. The zero component emission factors ("default zeros") developed from the 1980 Refinery Study data were based on eleven (11) samples from one component category (gas/vapor valves). In the 1993 Refinery Study, zero component emission factors were developed from each component category using a total of 102 samples. Clearly, the 1993 Refinery Study is more complete than the 1980 Refinery Study for zero components which represent the greatest number of components found at a refinery.

In conclusion, there is compelling evidence that the 1993 Refinery Study provides complete and representative information for the majority of the component categories in refineries.

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The development of the emission correlation equations has been consistent with U.S. EPA recommendations for sample size in four of six component categories. The remaining two categories, connectors-flanges and heavy liquid pumps, meet the statistical test on the mean log emission rate basis and could have met the sample size recommendation by having only one connectors category and one pumps category.

Issue 2 - Combining the Valve Categories into a Single Category

SCAQMD comment:

"The valve service categories (light liquid, heavy liquid, gas/vapor) should not be combined. The initial proposal for this study clearly indicated that distinct correlations would be developed for each valve service type.

In the South Coast Air Quality Management District, we have several heavy liquid refineries and a few re-refiners producing mainly diesel fuels, fuel oils, and asphalt products. Some of these facilities have several thousand valves subject to District inspection and maintenance requirements. Therefore, even a small difference in the mass rate between service types can result in a large difference in annual emissions. Small differences in correlations on a pound per hour basis for a single component are greatly magnified when applied to several thousand components over an entire year.

Because heavy liquid components tend to have a slightly smaller mass emission rate than those in light liquid or gas/vapor services, the aggregation of all service types in a single valve correlation will cause heavy refiners to over-estimate their emissions. If this correlation was further used to complete a toxic health risk assessment, an additional bias against heavy refiners might occur.

Again, a valve sample size of only 141 valid samples for valves in all services is too small to be representative of the vast valve population in any refinery. Valves are one of the most critical sources of fugitive emissions in a refinery and should be thoroughly analyzed in the study."

Final Report reference: See Volume I, Section 2.

Radian response:

Radian approached the 1993 Refinery Study data analysis without allowing previous study results to govern the results of the new study. It had been assumed, based on other studies and hypothesis, that the valve category should be split into multiple sub-categories, including categories for service type (gas/vapor, light liquid and heavy liquid) and size. Testing was

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based on this preliminary assumption. Samples were taken in each service type and in multiple size categories. After the data were collected, an in-depth multi-variate analysis was performed to determine if the splitting into different categories was statistically appropriate. The results of the analysis, documented thoroughly in the Final Report, indicated that there was insufficient justification to split valves into multiple categories based on the data collected for the 1993 Refinery Study. Without additional justification Radian continues to recommend that the valve category remain as a single category.

The similarity of emission correlation equations for valves in different services does not mean that there are comparable numbers or percentages of high leaking heavy liquid and light liquid valves at a refinery. In fact, the screening distribution (i.e. the percentage of components leaking within certain screening value ranges: 1-1000 ppm, 1001-10,000 ppm, >10,000 ppm, etc.) will almost certainly be very different for heavy liquid and light liquid valves. Far lower percentages of heavy liquid components are expected to leak at >1,000 ppm compared with light liquid components. Although a refinery with a high percentage of heavy liquid valves would use an emission correlation equation that is for all valve types, the estimated emissions from these heavy liquid valves would likely be far lower than a refinery with a higher percentage of light liquid valves because of the small number of heavy liquid valves that leak at high rates.

The question of sufficient sample size is thoroughly reviewed earlier in this letter in the response to the first issue. A total of 141 samples (non-pegged components) is far more than recommended in the U.S. EPA's 1993 Protocols Document and is more than what was used to develop the emission factors and emission correlation equations in the 1980 Refinery Study that has been the basis of almost all refinery emission factors and emission correlation equations since 1980 (including in the SCAQMD).

Issue 3 - Compressors, Pressure Relief Devices and Process Drains

SCAQMD comment:

"The study does not include compressors, pressure relief devices (PRDs) and process drains. These components are commonly recognized as having high mass emission rates as compared to other fugitive components and are therefore key contributors to the fugitive emission inventory for any refinery.

As facilities attempt to develop their fugitive emission inventories, the lack of new correlations for compressors, PRDs and drains to accompany those developed for valves, pumps and connectors is likely to cause confusion and result in errors and inconsistencies in emission calculations."

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Final Report reference: See Volume I, Section 1.

Radian response:

Originally Radian proposed to test compressors and pressure relief valves as part of the 1993 Refinery Study. Unfortunately for the study's sake, there were not enough leaking compressors and pressure relief valves found in the five refineries tested to develop statistically significant emission correlation equations or pegged component emission factors. Three pressure relief valves were tested that were zero components. The SCAQMD has suggested that even 141 samples of a component type that screen at between 1 and 100,000 ppm is a sample size that may be too small. Fewer than ten leaking compressors could be found at all five refineries combined. The majority of the compressors at the five refineries either did not leak, or they had control devices applied to them to prohibit emissions (i.e., venting to flares, etc.). Fewer than ten leaking pressure relief valves could be found that were accessible or safe for the bagging crews to sample.

WSPA/API directed Radian not to test process drains. With changes being made to refinery wastewater systems, it was decided to hold-off on process drain testing at this time. There are also problems with applying the bagging test to drains that would have required development of a new method.

Issue 4 - Comparison of 1980 Refinery Study Results to 1993 Refinery Study Results

SCAQMD comment:

"The primary objective of the 1993 study was to develop new correlations for comparison with those developed as a result of the 1980 Refinery Assessment Study. According to Table ES-2, the 1980 correlations were based on TLV readings at "0 cm", with pegged components included in the correlations. These correlations were later converted to OVA readings at 1 cm. However, the 1993 correlations are based on OVA readings at "0 cm" without pegged components included in the correlations. Because so many different factors are involved, it is very confusing and difficult to verify the data and to draw meaningful conclusions on the study as a whole.

It is suggested that the final report include a comparison of 1980 correlations based on OVA readings at 1 cm without pegged components included in the correlations with the 1993 1 cm correlations.

Final Report reference: See Volume I, Section 2.

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Radian response:

In the 1993 Refinery Study, all of the recommended emission correlation equations are based on different basic data collection and data analysis methodologies than those in the 1980 Refinery Study. We recognize that because of these differences direct comparisons between the studies are difficult to make.

In order to address this issue Radian examined, in depth, the light liquid valve component category from 1980 and 1993. The data from both studies were put on a comparable basis [no pegged components, OVA instrument, all measurements at the surface (previously called "0 cm")]. For reference, see Figures 2-27 to 2-29 and the related discussion in the Final Report. As mentioned previously, this analysis shows that the differences between the 1980 and 1993 studies are far less than one would believe without having the data on a comparable basis. The other component categories are comparable to the light liquid valves category. All of the original 1980 Refinery Study valve, pump, and flange categories incorporated pegged components in the development of the emission correlation equations. All of the 1980 Refinery Study samples were taken with the TLV Sniffer® at the surface.

An additional analysis of the other components was not performed because of funding limitations. However, the analysis of the light liquid valve category provides guidance on how to evaluate the differences between the 1980 Refinery Study and the 1993 Refinery Study for other component categories.

Issue 5 - Variability of Screening Distance

SCAQMD comment:

"The variability in screening distance must be addressed. It is unrealistic to assume that, with a hand-held instrument like the OVA, all screenings were taken at the same distance from the source of the leak. During the District's two days of test observation, we noted variations in screening distance from component to component. Given the wide variation in the "0 cm" and 1 cm correlations, it is reasonable to assume that extremely small variations in screening distance are likely to cause large variations in the resulting correlations. Future attempts to conduct this type of study should include a fixed screening distance as a part of the test protocol.

It is suggested that an alternative to the misleading "0 cm" screening distance reference be developed, or that a definition of "0 cm" be included in the Final Report."

Final Report reference: See Volume II, Section 3.

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Radian response:

In the Final Report "0 cm" will be referred to as "at the surface". The terminology of "0 cm" has been in existence at least since the 1980 Refinery Study. However, we acknowledge that this terminology could be confusing. Therefore, we will follow the SCAQMD suggestion and change the terminology. Furthermore, additional discussion of screening distance will be included in earlier sections of the Final Report.

The variability in screening distance has been addressed and continues to be evaluated. In Volume II, Section 3, of the Final Report extensive evaluations are presented that document screening variability issues. Included in this evaluation are:

- Inspector and instrument variability;
- Process variability;
- Refinery inspection/maintenance (I/M) team versus Radian screening variability;
- Bay Area Air Quality Management District (BAAQMD) versus Radian screening variability; and
- SCAQMD versus Radian screening variability.

Screening distance, or the distance away from the surface, is a factor in every one of these variability studies. Additional data collection is anticipated in 1994 to further evaluate the differences between screening at the surface and at 1 cm away.

In following U.S. EPA Method 21, Radian screened as close as possible to the surface. The SCAQMD and BAAQMD inspectors that audited Radian's testing activities also screened as close as possible to the surface. When screening as close as possible to the surface, some variation in the exact screening distance will occur based on obstructions, grease, liquids, etc. This variation is one of the causes in the variability noted in the screening variability studies mentioned previously.

Although it is acknowledged that screening distance variation is inevitable in the screening-at-the-surface methodology, this variation does not appear to have had a significant effect in the total variability of screening measurements taken by Radian and the SCAQMD inspector. The average relative percent difference between the SCAQMD and Radian measurements was only 16.1%. This average relative percent difference included screening distance variability, inspector and instrument variability and process variability. An average relative

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percent difference of 16.1% is minor compared with the inherent variabilities of field testing for a fugitive emission testing program. In other words, either the SCAQMD and Radian consistently measured the same component at the same screening distance, or the differences in screening distance between Radian staff and SCAQMD inspector measurements were not a significant factor in screening variability.

The BAAQMD and Radian likewise had minimal differences in screening values when screening the same components (approximate average relative percent difference of 23%). Again, either the BAAQMD and Radian consistently measured the same component at the same screening distance, or the differences in screening distance between Radian staff and BAAQMD inspector measurements were not a significant factor in screening variability.

Given the reasonably consistent screening values for Radian, SCAQMD, BAAQMD, and refinery I/M teams, it is unlikely that small variations in screening distance, which surely existed as different inspectors screened the same components, are likely to cause large variations in the resulting emission correlation equations.

Issue 6 - Probe Leak Figures

SCAQMD comment:

"The Final Report should include graphs which display the pre-probe leak versus post-probe leak correlations for the valid samples. While the confidence interval graphs are informative, they do not provide a clear representation of the difference in the slopes of the pre and post-probe leak correlations."

Final Report reference: See Volume II, Section 3.

Radian response:

Radian feels that adding these regression lines to the figures makes these figures even more difficult to understand. Therefore, we prefer to not include these regression lines in the main body of the Final Report (Volume II). The regression lines would fall mid-way between the confidence intervals in every case. However, these figures are attached to this letter for your review. A copy of this letter will be included in one of the appendices of the Final Report.

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Issue 7 - Connector Category Anomalies

SCAQMD comment:

"It appears that additional data is needed for flanges and other connectors. The correlation for flanges indicates a higher mass emission rate than the correlation for non-flange connectors. However, the default-zero and pegged-component emission factors for non-flange connectors are higher than the default-zero and pegged-component emission factors for flanges. Because these points at the lowest and highest ends of the connector correlations do not indicate the same trend as the actual correlations, we feel that additional data should be collected to determine whether this result is reproducible."

Final Report reference: See Volume I, Section 2.

Radian response:

The apparent anomaly that the SCAQMD has identified is what the 1993 Refinery Study results indicate. The reason for this apparent anomaly is tied to different statistical methods used to calculate the zero component emission factors, the pegged component emission factors and the emission correlation equations. The emission correlation equations are based on a least-squares method of data analysis. The zero component emission factors and the pegged component emission factors are based on an arithmetic average of the data collected for these particular categories. Furthermore, the confidence intervals for zero components and pegged components are almost always greater than those determined for the emission correlation equations. This is in part due to the different statistical treatment of the data and, in part, due to more potential for variability in the zero component and pegged component categories. For example, the pegged components can have screening values that would range from 100,000 to 1,000,000 ppm (with additions possible if liquids are leaked). Based on laboratory measurements, a zero component can have mass emissions associated with being at one-half of the detection limit (approximately 0.025 ppm) when no hydrocarbons were measured in laboratory analysis of the sample, to mass emissions associated with leaks over 10 ppm. Therefore, it is possible to have confidence intervals for the zero component emission factors vary by over two orders of magnitude. The emission correlation equations are based on screening values that are known within fairly well defined (and lower) screening variability range (on a percentage basis).

The higher emission correlation equation for flanges versus non-flange connectors does appear to make physical sense. Flanges are, in general, much larger with more areas for leaks to occur than are the non-flange connectors. The higher zero component and pegged component emission factors for non-flange connectors than flange connectors may be an anomaly based on the wide confidence limits for these categories, especially for the non-

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flange connectors. The confidence limits for these categories overlap each other. For example, for zero components the confidence limits range from 4.4×10^{-8} to 9.4×10^{-7} for flanges, and 0 to 3.9×10^{-6} for non-flange connectors. Because of the overlap it is not unreasonable that reversals in which factors are higher than other factors would occur. In fact, it would be surprising if some reversals did not take place.

Conclusion

Radian appreciates the comments from the SCAQMD. Revisions will be made to the Final Report based on these comments. Radian believes that the 1993 Refinery Study is representative and appropriate for components in refineries in the South Coast Air Quality Management District and nationwide. Radian continues to recommend that the 1993 Refinery Study be used by refineries and regulatory agencies for the determination of refinery fugitive emissions from equipment leaks for those equipment categories where new correlations were developed.

Sincerely,

Ronald D. Ricks

Ronald D. Ricks
Project Director

Attachments

c: G.E. Harris

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Table 1

Number of Valid Bagged Samples and High Screening Variability Bagged Samples in 1993 Refinery Study

	Number of Samples Used for Equations	Pegged Components	High Screening Variability Non-Pegged Components	High Screening Variability Pegged Components	Zero Components	QA/QC Components[a]
Connectors-Flanges	19	3	1	0	9	10
Connectors-Other	29	14	3	0	12	13
OEL	22	11	5	1	9	4
Pumps-Heavy liquid	10	0	2	0	5	5
Pumps-Light liquid	27	5	4	1	7	6
Valves	141	38	30[b]	4	60[c]	81
TOTALS	248	71	45	6	102	119

OEL = open-ended lines
QA/QC = quality assurance/quality control
[a] Includes test duplicates (20), nitrogen flow sample duplicates (60), audit samples (34), and accuracy checks (5)
[b] Includes three pressure relief valves.
[c] Includes two pressure relief valves.

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Table 2

Comparison of Number of Samples in 1980 Refinery Study and 1993 Refinery Study

Category	Service	Number of Samples[a]	
		1980 Refinery Study	1993 Refinery Study
Valves	Gas	34	52
Valves	Light liquid	74	69
Valves	Heavy liquid	0	20
OEL	All	0	22
Pump seals	Heavy liquid	48	10
Pump seals	Light liquid	127	27
Flanges[b]	All	38	48

[a] Excludes pegged components for both studies and high screening variability components for the 1993 Refinery Study.
[b] Includes connectors-flanges and connectors-other.
OEL = open-ended lines

Figure 3 – 3
Connectors (Flanges)
All Services

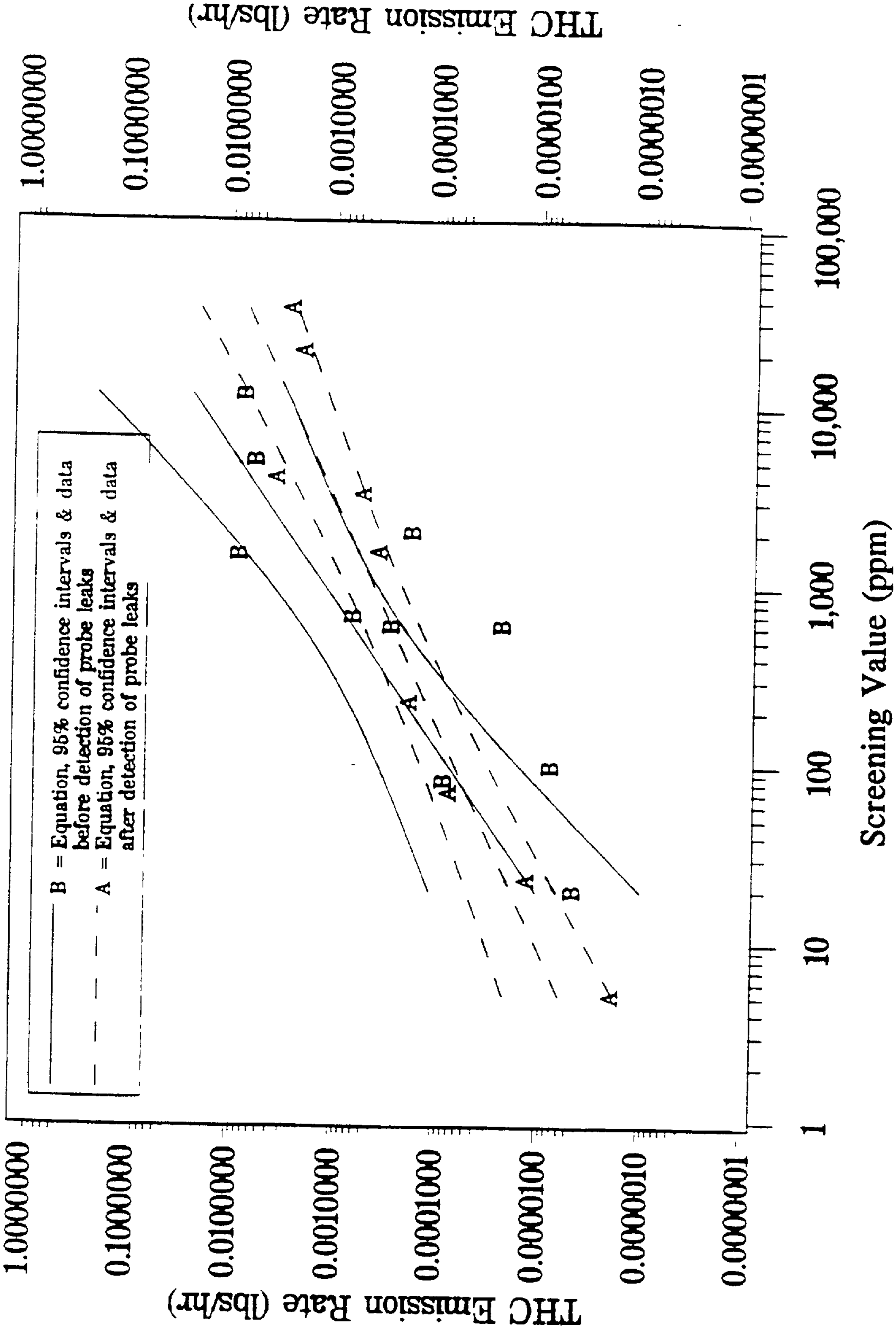


Figure 3 – 4
Connectors (Non – Flanges)
All Services

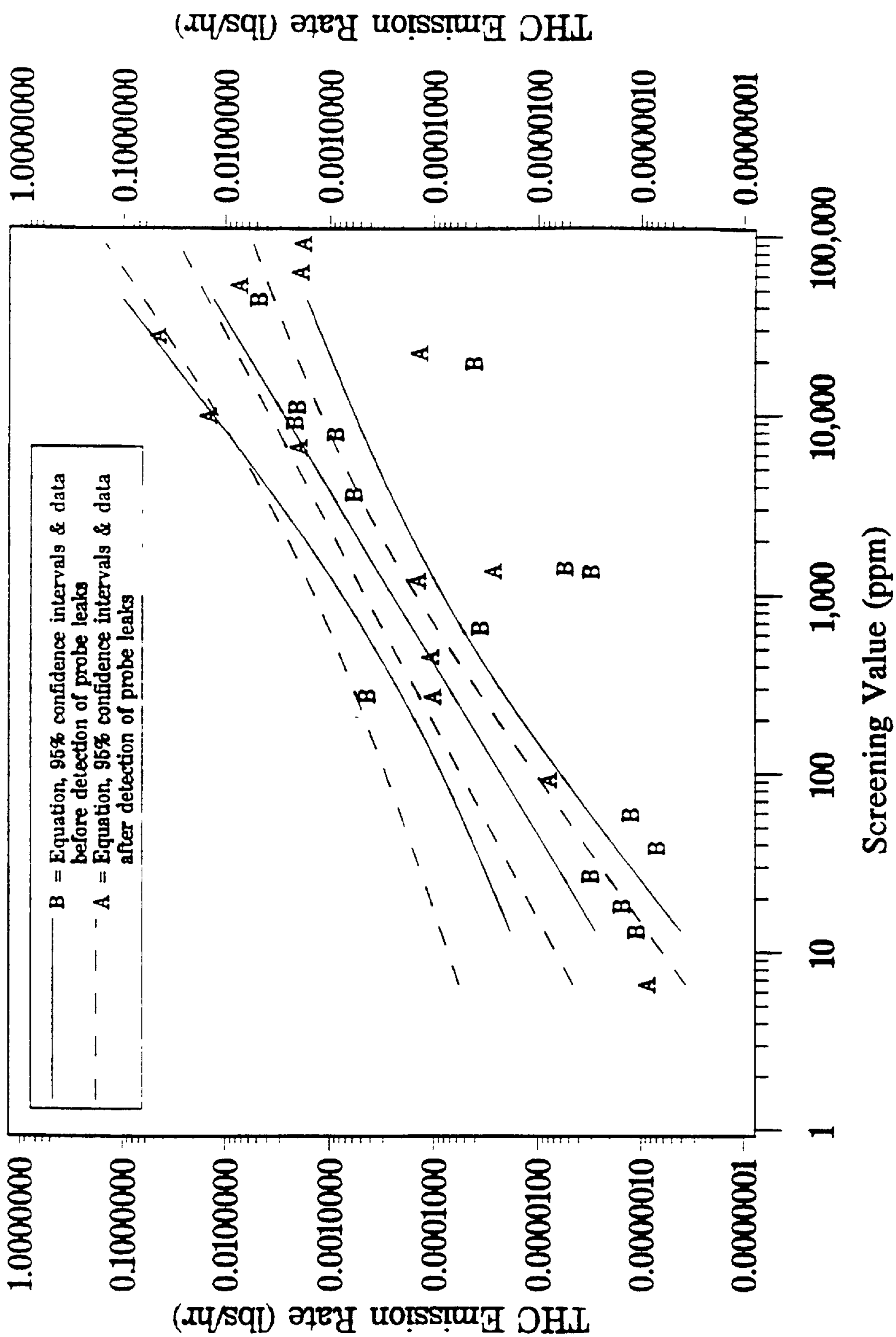


Figure 3 – 5
Open – Ended Lines
All Services

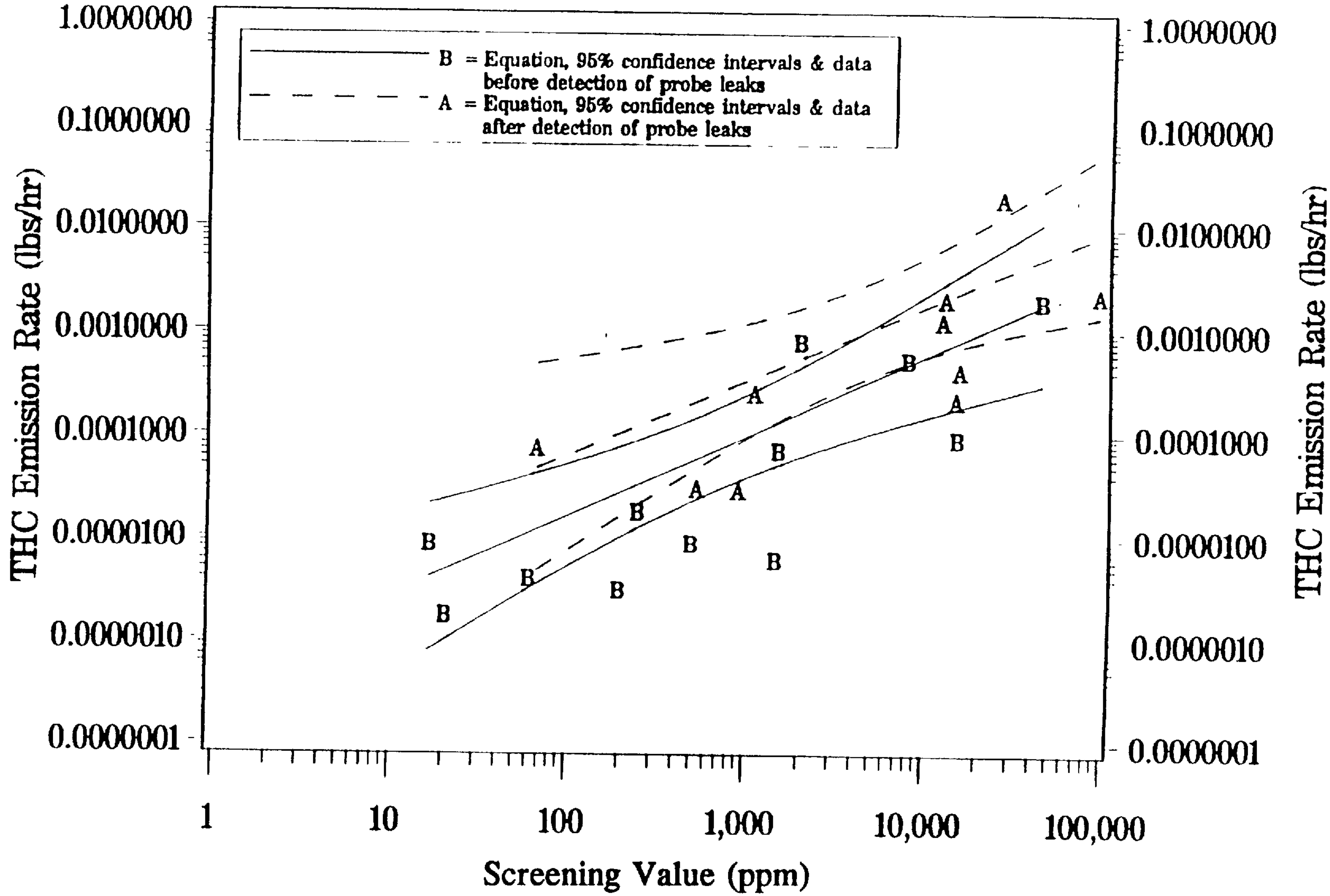


Figure 3 – 6
Pump Seals
Heavy Liquid Service

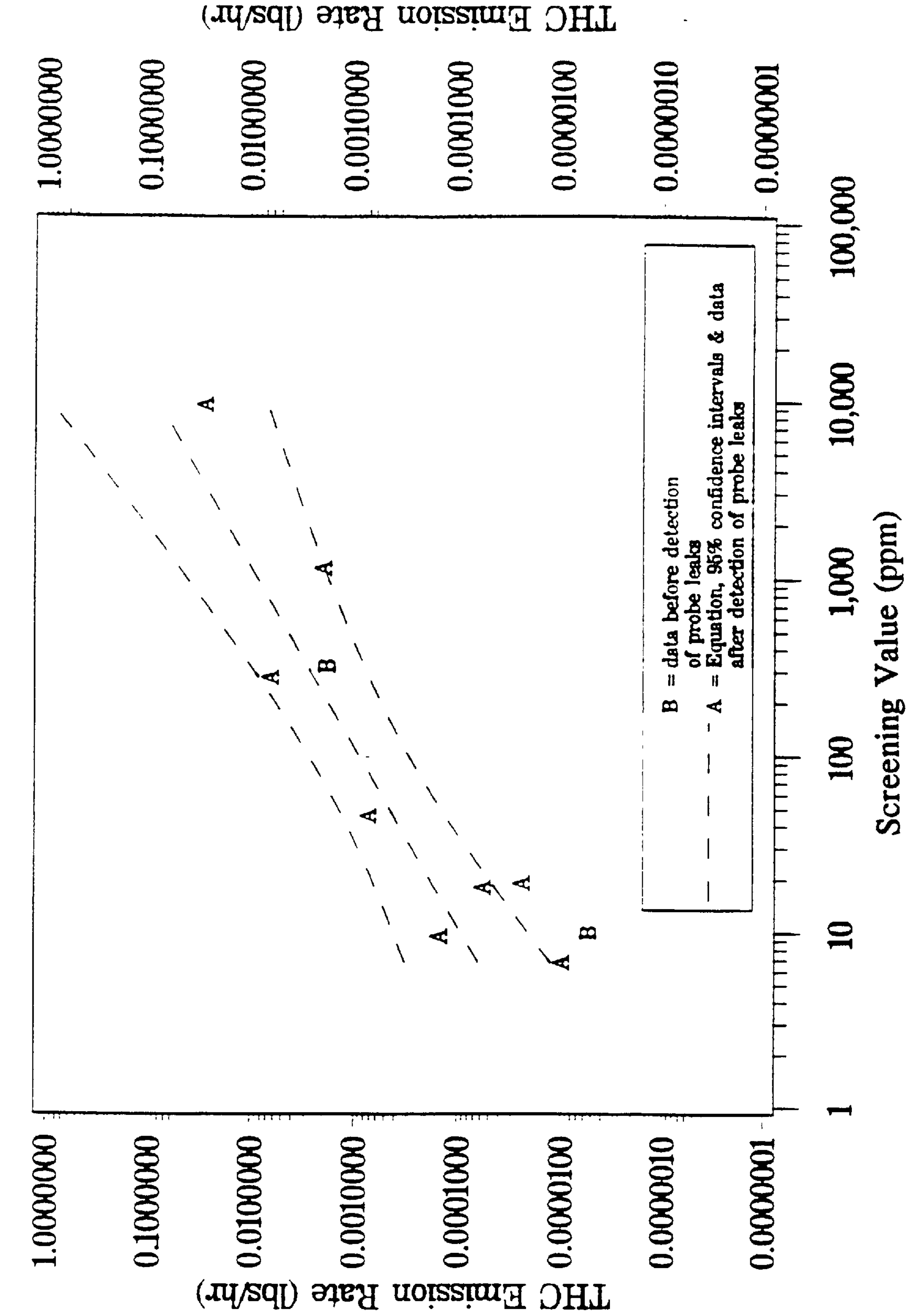


Figure 3 – 7
Pump Seals
Light Liquid Service

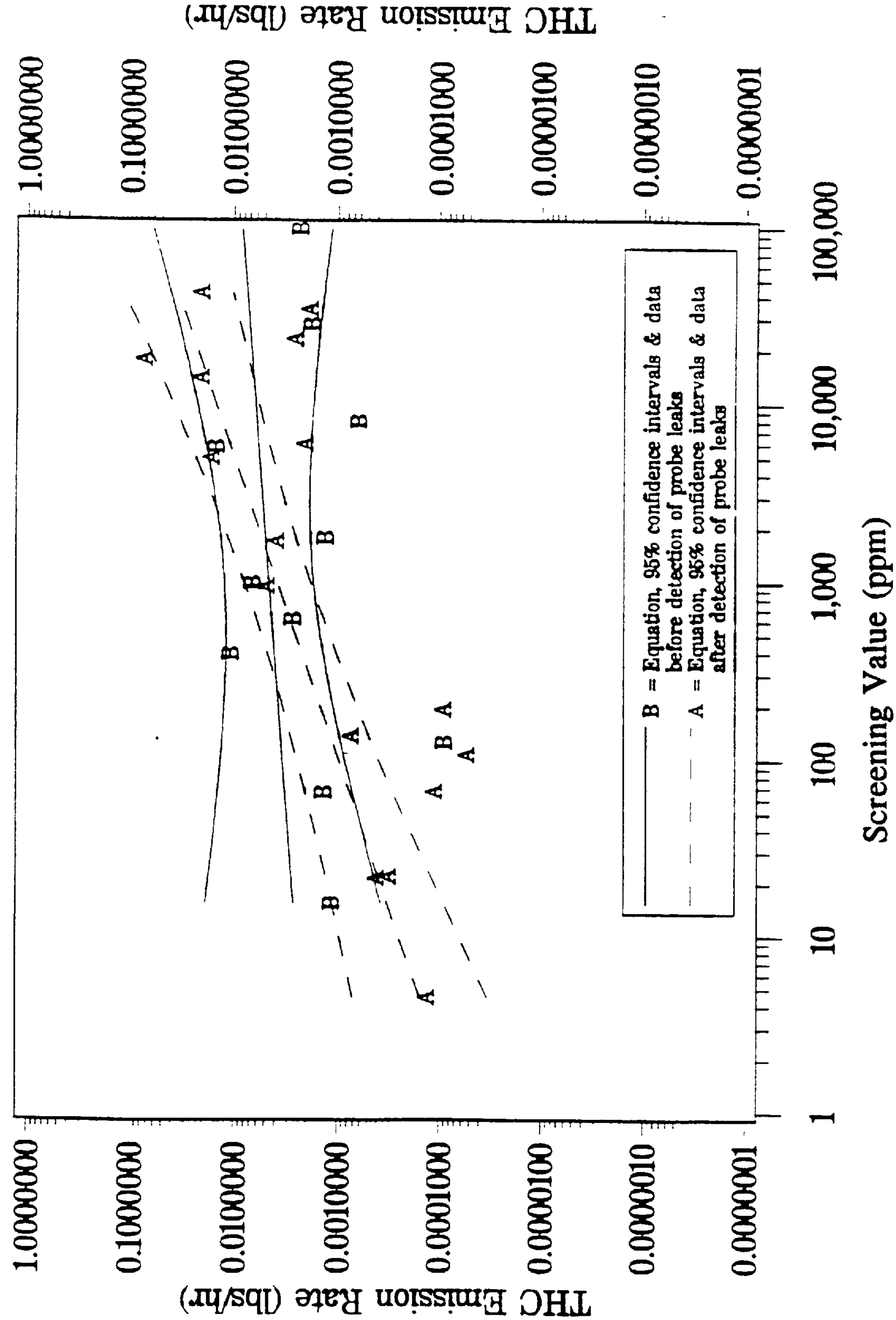
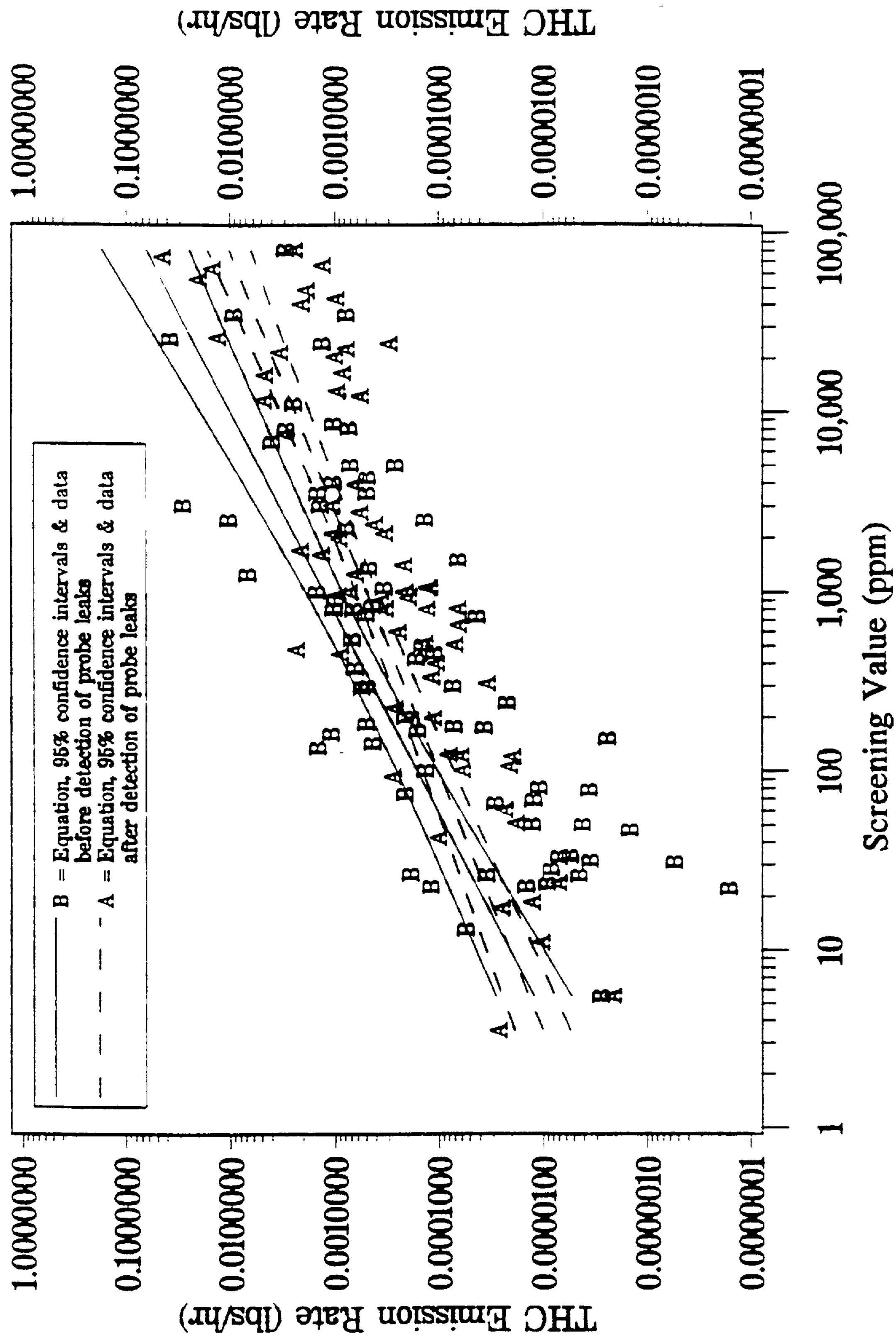


Figure 3-8
Valves
All Services



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January 19, 1994
209-081-07-01

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Subject: WSPA/API Refinery Fugitive Emissions Study, Phase III - Contract No. ET 302-08 - Radian's Response to CARB Comments on the 1993 Final Draft of the 1993 Study of Refinery Fugitive Emissions from Equipment Leaks

Dear Ron:

This letter is in response to the specific issues raised by the California Air Resources Board (CARB) in their "ARB Staff Draft Comments on Radian's Draft Final Report ... August 20, 1993" letter. Some of the comments made by CARB in their letter prompted revisions to the Final Report of the 1993 Study of Refinery Fugitive Emissions from Equipment Leaks (1993 Refinery Study). All of the CARB issues in their letter are addressed in this letter.

Issue 1 - Service Type Emission Correlation

CARB comment:

"The report should provide an explanation for its finding that there is no correlation between the service type a component is in and its emission potential and why only pump seals exhibit this correlation. These findings are quite different from earlier studies from which the U.S. Environmental Protection Agency (EPA) has adopted for use in its reports. We believe that it is important to examine these findings further since it has the potential to affect emissions estimation."

Final Report reference: See Volume I, Section 2.

Radian response:

Radian approached the 1993 Refinery Study data analysis without allowing previous study results to govern the results of the new study. It had been assumed, based on other studies and hypothesis, that the valve category should be split into multiple sub-categories, including categories for service type (gas/vapor, light liquid and heavy liquid) and size. It had also been assumed that the pump seals category could be divided into light liquid and heavy liquid service types. Testing was based on those preliminary assumptions. After the data were collected, an in-depth multi-variate analysis was performed to determine if the splitting into different categories was statistically appropriate. The results of the analysis, documented

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thoroughly in the Final Report, indicated that there was insufficient justification to split valves into multiple categories based on the data collected for the 1993 Refinery Study. The only category that could be divided into multiple service categories was pump seals. Without additional justification Radian continues to recommend that the category divisions found in the 1993 Refinery Study remain as presented.

Issue 2 - Sample Sizes

CARB comment:

"Definitive statements about adequate sample sizes can't be made without a lot more information. The very small sample sizes from which variability of emission rate measurements were determined are particularly questionable. The representativeness of samples of one dozen to a few dozen can certainly be strongly questioned."

Final Report reference: See Volume I, Section 2 and Volume II, Section 3.

Radian response:

Radian originally proposed to the Western States Petroleum Association (WSPA) and the American Petroleum Institute (API) to examine 525 samples, including field duplicates, zero components (i.e., those components that screen at background ppm levels), pegged components (i.e., those that screen above the instrument's measurement capability; generally greater than 100,000 ppm), and components that screened at between 1 and 100,000 ppm. Fortunately, Radian was able to complete the study with even more valid samples than originally proposed. Radian completed the study with 540 valid samples. Of the 540 valid samples, 248 were components that screened at between 1 and 100,000 ppm, 102 were zero components, 71 were pegged components, and the remainder were taken to ensure data quality (audit sample duplicates, nitrogen flow test duplicates, and accuracy checks). In addition, 51 samples were excluded from analysis because of high variability in screening measurements taken both before and after bagging. Later analysis indicated that including these additional 51 samples would not have had a significant effect on the development of the emission correlation equations (see Volume II, Section 3 of the Final Report). Table 1 documents all valid samples and the high screening variability samples collected and their use in the data analysis.

After completion of the 1980 Refinery Study, the United States Environmental Protection Agency (U.S. EPA) recognized that facilities or industries may wish to redevelop emission correlation equations based on more applicable data than that collected for the 1980 Refinery Study. To assist an industry in developing new emission correlation equations they have

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recently (June, 1993) updated and published a document entitled *Protocol for Equipment Leak Emission Estimates* (Protocols Document). The Protocols Document gives general guidance for determining the required number of samples recommended for determining new or revised emission correlation equations. Including pegged components, the Protocols Document recommends that at least 30 samples be taken. Excluding pegged components, the Protocols Document recommends that at least 24 samples be taken.

Some of the samples collected had been excluded from the analysis because their "before and after" screening values exceeded the pre-established control limits. Those are referred to as having "high" screening variability. As can be seen from Table 1, the U.S. EPA recommendation to have at least 30 samples (including pegged components) was exceeded in four of the six categories. The U.S. EPA recommendation to have at least 24 samples (excluding pegged components) was exceeded in three of the six categories. The question of whether sufficient samples were taken to meet U.S. EPA recommendations is focused only on two or three of the component categories; heavy liquid pumps, connectors-flanges, and possibly open-ended lines (OELs). The remaining categories clearly exceed the recommendations, and valves exceed the recommendations by a factor of almost six.

We would like to address each of the questionable categories separately, beginning with OELs. Thirty-three (33) OEL samples (including pegged components) were included in pegged components emission factor or emission correlation equation development. Three more samples were collected than the U.S. EPA recommendation. Furthermore, five OEL samples were excluded from analysis simply because they had high screening variability. These samples were excluded in an effort to control one aspect of variability in the study. Subsequent analysis indicated that these five samples could easily have been added to the analysis without any significant change to the emission correlation equation (see Figure 3-30, Volume II, Section 3 of the Final Report). Adding these five samples would have virtually no effect on the determination of the emission correlation equation and would also clearly exceed the U.S. EPA recommended number of samples. Given these considerations, it seems that the OEL category reasonably satisfies the U.S. EPA recommendations.

The remaining two categories, connectors-flanges and heavy liquid pumps, do not meet the mentioned U.S. EPA recommendations. The connectors-flanges category is close to meeting the recommendations, especially if including the high screening variability samples (total of 20). The heavy liquid pump category is not close (10-12 samples) to this U.S. EPA recommendation. The reason that additional samples were not taken is easily explained. Radian was attempting to obtain samples in all screening value ranges. A deliberate attempt was made to not skew the analysis by having a disproportionate number of samples in either low or high screening value ranges. Efforts were made by the five host refineries and Radian to find these components. Testing at these refineries was performed over approximately 20

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Mr. Wilkniss
January 19, 1994
Page 4

weeks. For connectors-flanges and heavy liquid pumps, more components in the higher screening value ranges could not be located.

Prior to commencing the data analysis for the 1993 Refinery Study it was not known that the connectors category should be split into two categories, flanges and non-flanges (other). In fact, the 1980 Refinery Study did not split the connectors into two categories. If the 1993 Refinery Study connector categories were merged, 48 samples would be available to develop an emission correlation equation which far exceeds the U.S. EPA recommendation. However, statistical analysis revealed that connectors-flanges and connectors-other were two distinct categories. Splitting the connectors into two categories improves the correlation coefficient from 0.82, for the combined grouping, to 0.88 for connectors-flanges and 0.85 for connectors-other. Even though this meant that one of the U.S. EPA's recommendations for sample size would not be precisely met for one of the connector categories, it was felt that the superior applicability of the results by dividing into two categories outweighed the possible limitation of reduced sample sizes.

Similarly, if the heavy liquid pump and light liquid pump categories were merged, 37 samples would be used to develop an emission correlation equation. However, the superior applicability of the results by maintaining two categories outweighed the possible limitation of reduced sample size.

The previous version of the Protocols Document, the U.S. EPA's *Protocol for Generating Unit-Specific Emission Estimates for Equipment Leaks of VOC and VHAP* (1988), states that if it can be shown that the estimates are "within 50% of the mean value with 95% confidence", a smaller sample size is acceptable. The 95% confidence interval for the expected mean log emission rate at the mean log screening value meets the "plus or minus 50% of the expected value" criterion for all component categories, including connectors-flanges and even heavy liquid pumps. The 95% confidence interval criteria is not met for these two component categories in linear space. The previous version of the Protocols Document is not clear on whether the criterion is for log or linear space.

The 1993 U.S. EPA Protocols Document states, "The above groupings and recommended number of sources are given as guidelines. They are based on experience in measuring leak rates and developing leak rate/screening value correlations. Other source selection strategies can be used if an appropriate rationale is given".

It is clear that the U.S. EPA recognizes that alternate strategies and even potentially smaller sample sizes can be considered for development of emission correlation equations. The issue really should be which emission correlation equations best represent the types of components found in today's refineries.

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In comparing the 1980 Refinery Study to the 1993 Refinery Study, it is immediately evident that many of the samples taken in the 1980 Refinery Study were pegged components. When the pegged components are removed from the total number of samples taken for the 1980 Refinery Study, the results are as shown in Table 2. Note that in the 1980 Refinery Study no heavy liquid valves or open-ended lines were sampled (bagged) and that valves were split into the gas valves and light liquid valves categories. The 1993 Refinery Study actually sampled more components than the 1980 Refinery Study in the following categories: gas valves, heavy liquid valves, open-ended lines, and flanges. The number of light liquid valves sampled in both studies are nearly identical. In fact, of the component categories reexamined in the 1993 Refinery Study, only the pump categories had significantly fewer samples collected than in the 1980 Refinery Study. By number of samples alone, the 1993 Refinery Study is superior to the 1980 Refinery Study for the two categories that represent the great majority of components found at any refinery: valves and flanges.

The comparison between the 1980 Refinery Study and the 1993 Refinery Study is even more convincing for the development of zero component emission factors. The zero component emission factors ("default zeros") developed from the 1980 Refinery Study data were based on eleven (11) samples from one component category (gas/vapor valves). In the 1993 Refinery Study, zero component emission factors were developed from each component category using a total of 102 samples. Clearly, the 1993 Refinery Study is more complete than the 1980 Refinery Study for zero components which represent the greatest number of components found at a refinery.

In conclusion, there is compelling evidence that the 1993 Refinery Study provides complete and representative information for the majority of the component categories in refineries. The development of the emission correlation equations has been consistent with U.S. EPA recommendations for sample size in four of six component categories. The remaining two categories, connectors-flanges and heavy liquid pumps, meet the statistical test on the mean log emission rate basis and could have met the sample size recommendation by having only one connectors category and one pumps category.

Furthermore, Radian acknowledged in both the Final Draft Report and the Final Report that the emission rate variability estimates were based on a small sample size. It is explicitly stated in the Reports that "The emission rate CVs . . . are not based on a very large number of duplicate pairs." In fact, a sensitivity analysis was recommended in Volume I, Section 3 in order to determine how the alternate statistical analysis method, the measurement error method (MEM) (called the generalized maximum likelihood [GML] method in the Final Draft Report) is affected by different variability estimates and uncertainty in these variability estimates.

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Issue 3 - The Screening Analysis - Including Connector Size and Type as Factors

CARB comment:

"The assertion on page 2-11 that including both connector size and type as factors would be redundant doesn't necessarily follow as automatically as the authors conclude it does."

Final Report reference: See Volume I, Section 2.

Radian response:

Radian continues to maintain that it is not necessary to include both connector size and type as factors. The results of a partial F-test show that when connector type is included as a factor that connector size is no longer significant. Similarly, if connector size is included as a factor then connector type is no longer significant. Type was included in the connector emission correlation equation and size was not included, because "type" produced a slightly better correlation. Including both size and type would not add any more information, but only serve to unnecessarily complicate the equation.

Issue 4 - The Screening Analysis - Including Valve Size as a Factor

CARB comment:

"The authors' reasoning justifying neglecting size of valve is questionable. Figure 2-5 is too cluttered to be very helpful. Whether or not there is a physical explanation for the size effect, isn't the main point whether or not stratifying valves into separate size classes significantly improves estimation of emission rates?"

Final Report reference: See Volume I, Section 2.

Radian response:

Radian believes that it is undesirable to include a variable in the emission correlation equation if the relationship between the variable and the emission rate has no physical basis. It is possible that such a variable (e.g., valve size) correlates with emission rate only because of a chance relationship involving it and one or more other variables. Hence, such a variable may have a statistically significant effect on mass emission rates, but there may not be a causal relationship between that variable and mass emission rates. As an example, suppose it were known that pump load had a significant effect on emission rates. Suppose further, that when collecting data it happened that pumps under load were collected during the late

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afternoon and pumps not under load were collected early in the morning. For the given scenario, time of day would have a significant correlation with mass emission rates due only to a chance correlation between time of day and pump load. Including a variable in the regression model that lacks physical explanation does not guarantee that the same relationship will exist in future conditions under which the regression model is to be used to estimate emission rates and could lead to spurious estimates of emissions.

Further, valve size was not omitted from the predictive equation merely because there was not a physical explanation for the relationship between valve size and emission rate. The discussion at the bottom of page 2-21 of the Final Draft Report presents additional relevant information. Specifically, multiple range tests and cluster analyses revealed an erratic relationship between emission rate and valve size. The Final Draft Report indicates that the 1.5" and 6" valve sizes were similar with respect to emission rate, as were the 1" and 9" sizes. In view of the erratic nature of the relationship between valve size and emission rate, the physical meaningfulness and repeatability of the relationship in future measurements was questioned. If a monotonic trend with reasonable consistency between valve size and emission rate had been observed, the situation would have been entirely different. Thus, valve size was omitted from the predictive equation for specific reasons beyond the mere fact that the relationship between valve size and emission rate lacked a physical explanation.

Radian believes that component size should continue to be evaluated in future studies as a variable that can potentially affect emission rates. The work performed for the current study, however, does not support including valve size as factor in the valve emission rate correlation equation.

Issue 5 - The Generalized Maximum Likelihood" Estimator - Assumption of a Known Variance Ratio

CARB comment:

"The investigators have chosen to assume that the ratio of the measurement error variances of the screening values and the emission rates is known. There is an exact solution for the regression equation if this assumption is made.

If this assumption is made, the analysis must obtain a credible estimate of the ratio of the measurement error variances and investigate its statistical properties. The analysis is very deficient in these respects. This is the most obvious statistical deficiency in the report."

Final Report reference: See Volume I, Section 2.

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Radian response:

It is true that in the measurement error technique used the ratio of the measurement error variance of the screening values and the emission rates is assumed to be known. Radian states this and also states that the estimated variance for the emission rates is based on a small number of data pairs. Thus, the limitations of the GML method (now called the MEM) were stated in the report. Additional tasks that need to be performed on the GML method were also listed in Volume I, Section 3. One of these recommended tasks was to "perform a sensitivity analysis for the GML method to determine how the GML method is affected by different variability estimates (i.e., of the emission rates and screening values.)" Additional paragraphs have been included in the Volume I, Section 3 explaining in more detail additional work that needs to be performed on the GML method (MEM). Until this work is performed Radian is not recommending that the GML (MEM) equations be used.

Radian, however, does not believe this is a "statistical deficiency in the report" because the assumptions that were made and further work that needs to be performed to investigate the GML method (MEM) are explicitly stated in the report. Radian does not believe that presenting a new idea, stating the limitations to a proposed method, and discussing additional research that needs to be performed on a method can be considered "deficient" or inadequate. On the contrary, Radian believes that important findings were made and reported regarding the use of measurement error models to estimate mass emissions from screening values. Namely, the work performed shows that the current method (i.e., the ordinary least squares methods [OLS]) for estimating emissions results in an over-estimate of emissions. It is has been shown that the GML method (MEM) provides more accurate estimates of emissions. What is not known is how estimates of the emission rate and screening value variability affect the GML (MEM) equations. In summary, Radian believes that an important contribution has been made on the estimate of fugitive emission rates from screening values and has explicitly stated in the report additional work that is recommended regarding this method.

Issue 6 - "The Generalized Maximum Likelihood" Estimator - Assumption of a Known Variance Ratio

CARB comment:

"The specific problems with the report's use of the assumption of known variance ratio are listed below:

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- Emission rate variability not determined by true replicates;
- Assuming that variability of measurement error is constant and not related to the magnitude of the measurement; this assumption was not checked:
- Very inadequate sample sizes for determining emission rate variability of all components, except perhaps valves;
- Unjustified combination of variabilities (emission rate variabilities, at least) from several types of component to estimate the variance ratio;
- Unjustified assumption that the ratio determined by pooling variability is appropriate for all types of components; and
- Failure to assess the effects of variability of the estimated variance ratio of the regression relationships."

Final Report reference: See Volume I, Section 2.

Radian response:

Each of the issues above are addressed separately below.

1) "emission rate variability not determined by true replicates,"

Emission rate variability was evaluated by comparing two different types of replicates. This is discussed in the report and the results of this comparison are shown in Table 2-6 in the report. The first set of replicates were obtained during an earlier study (the Marketing Terminals Study [1993]). These duplicates were obtained by bagging the same component twice and are "true" replicates in the sense that they contain all potential sources of variability. For the 1993 Refinery Study, duplicates were obtained by extracting two samples from the same bag. It has been noted in the report that the overall variability estimate obtained from the "true" bagging duplicates (which potentially include more sources of variability) was actually *smaller* that the overall variability estimate obtained from the duplicate samples collected for the 1993 Refinery Study. Because the emission correlation equations were being developed for refinery data, it was decided that the refinery variability estimates would be more appropriate to use than variability estimates obtained from the Marketing Terminals Study. An additional recommendation has been added for the Final Report that states it would be beneficial to collect additional replicate emission rate data and to further evaluate the emission rate variability.

RADIAN
CORPORATION

Mr. Wilkniss
January 19, 1994
Page 10

2) "assuming that variability of measurement error is constant and not related to the magnitude of the measurement; this assumption was not checked."

This assumption was checked and it is explicitly stated in Volume I, Section 2, page 2-5 of the Final Draft Report and Final Report:

> "One of the assumptions in performing many statistical procedures is that the errors are independent and normally distributed, and that the variances are constant for different factors or ranges. These assumptions were met by taking the natural logarithms (logs) of the emission rate and screening value measurements before performing the statistical analysis.)" Residual plots were evaluated for each of the equations developed. These residual plots showed that the errors from the log regressions were random and normally distributed for every component-specific equation developed.

3) "very inadequate sample sizes for determining emission rate variability of all components, except perhaps valves"

It is stated in the Final Draft Report and Final Report that the emission rate variability estimates were based on a small number of bagging pairs. In Volume I, Section 3, a sensitivity analysis was recommended so that the effect of errors in the emission rate variability estimates could be evaluated. An additional recommendation has been added in the Final Report that states it would also be beneficial to collect additional duplicate measurements so that the emission rate variability can be evaluated in more detail. If the sensitivity analysis shows that fluctuations in the emission rate variability estimate do not have a practical effect on the emission correlation equations, however, evaluating additional duplicate measurement data may not be necessary.

4 & 5) "unjustified combination of variabilities (emission rate variabilities, at least) from several types of components to estimate the variance ratio;

unjustified assumption that the ratio determined by pooling variabilities is appropriate for all types of components;"

Bartlett's test was performed on both the emission rate and the screening value variances to determine if the variances could be pooled over all component types. The results of Bartlett's test showed that there were not significant differences among the screening value variances for each of the component types. Thus, pooling the screening value variability over all component types is justified. Bartlett's test showed that there were differences among the emission rate variabilities for different component types. However, there were

RADIAN
CORPORATION

Mr. Wilkniss
January 19, 1994
Page 11

insufficient data for any one component type to estimate the component specific emission rate variability. Therefore, at the time, pooling the emission rate variabilities over all component types provides the best estimate of emission rate variability for all component types. Until additional duplicate emission rate measurements are obtained or until the sensitivity analysis is performed, Radian believes that this provides the best estimate of the emission rate variability.

The above discussion was not included in the Final Draft Report. Because of CARB comments, the above discussion has been added to the Final Report to clarify this issue.

6) "failure to asses the effects of variability of the estimated variance ratio on the regression relationship"

The need to evaluate the effects of the variability of the estimated variance ratio on the regression equation was explicitly stated in Volume I, Section 3 as work that needs to be performed. For the current report, the GML equations are not recommended for use by refineries until this work has been performed.

Issue 7 - The "Generalized Maximum Likelihood" Estimator

CARB comment:

"The name "generalized maximum likelihood method" is an unfortunate choice, since it could denote any of an extremely wide variety of statistical models. The exposition of the method would be improved it if were stated in terms used in the literature on regression models including measurement error; this literature is very thoroughly summarized in Fuller's Measurement Error Model (Wiley, 1987)."

Final Report reference: See Volume III, Appendix D.

Radian response:

Radian agrees that the term "generalized maximum likelihood" is not sufficiently descriptive and has changed the name of the regression technique used to the "measurement error method."

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Issue 8 - Log-log Plots

CARB comment:

"The report contains many log-log plots of screening value and emission rate data. Including so many plots is a very good idea, and there's no doubt that log-log plots are the best choice. However, they are difficult to read, especially when they span so many orders of magnitude.

The most important information that many of the plots are trying to convey is differences between several log-log regression relationships and differences in positions of regression relationships and data points -- i.e., ratios. As Cleveland's books on graphical representation point out, plotting differences makes graphical information about differences immensely clearer, and plotting differences would have that effect in this case.

We suggest that the information about ratios could be clearly represented by using the 1993 refinery study regression relationship in a plot as the 'basis,' and plotting ratios of other regression relationships and data points to this relationship. (In the plots of regression relationships in volume III, the true values would be the basis.)

Besides presenting the information about ratios with impressively greater clarity, plots of this type would be significantly more readable because the range of value on the y-axes would be orders of magnitude smaller.

These plots cannot be substituted for the log-log plots now in the report. Readers would not a first be able to interpret these plots of unusual type without referring to the conventional plots from which they were derived. A very careful explanation of the ratio plots with examples of their interpretation, would have to be inserted in the text."

Final Report reference: See Volume I, Volume II, and Volume III.

Radian response:

Radian does not believe that adding plots to the report will aid the typical reader of the report. It is not clear exactly which plots the comments are referring to nor is it clear exactly what the reviewer would like to see plotted. In addition, it is not clear which of Cleveland's books are being referenced. If CARB is interested in seeing a plot of the *difference* between the measured and predicted emission rate versus screening values, these are the same as residual plots. Radian did evaluate residual plots for all of the equations developed; however, we did not feel it was necessary to include all of the diagnostic plots in the Final Report. If CARB is interested in seeing *differences* between two different equations (for example, the difference between the flange connector equation and the non-flange connector equation) versus screening value, Radian does not feel such a plot will convey any additional information than conveyed in the plots currently in the Final Report.

For the plots in Volume III (Appendix D) the reviewer does state the true values could be used as the basis for the calculated difference. Radian has plotted the true value minus the average predicted emission rate for each estimation method tested in the simulations (i.e., the GML [MEM], the conventional regression and the inverse regression). These are included as an attachment for the reviewer's examination. Again, these plots do not show any additional information, but rather show the same information from a different perspective and provide further support to Radian's conclusion that the GML method (MEM) provides a better estimate of true mass emissions. In summary, Radian believes that including an additional plot that shows differences or ratios for every log-log plot currently in the report would only serve to confuse the reader. CARB seems to agree that such plots would be difficult for the average reader to interpret and could not be substituted for the plots that are currently in the text.

Issue 9 - Comments on the Statistical Exposition

CARB comment:

"The explanation of the SBCF on page 2-30 is convoluted and unclear. We think many readers won't have sufficient background in statistics to follow it. The assumed basic distributional facts, the need to estimate arithmetic means, and the formula for the arithmetic mean of a lognormal distribution can be more clearly presented. The explanation does not contain any references to volume III."

Final Report reference: See Volume I, Section 2.

Radian response:

Radian has provided a more detailed explanation of the SBCF for the Final Report. Radian has also added a reference to Volume III. In addition, an example illustrating the need for a SBCF has been included.

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Issue 10 - Comments on the Statistical Exposition

CARB comment:

"The explanation on pages 2-34 and 2-35 of the content of Figures 2-9 to 2-14 is much too brief and quite unclear. Likewise, the labeling of Figures 2-9 to 2-14 is not detailed enough. It is very likely that most readers will be confused by the figures and explanation. It's important that readers be able to make sense of these figures.

Final Report reference: See Volume I, Section 2.

Radian response:

The report provides a description of each of the lines (i.e., the regression line, the 95% confidence intervals for the mean, and the 95% confidence intervals for individual values) shown in Figures 2-9 through 2-14. The following interpretation for the confidence intervals is given in the report "the 95% confidence intervals for the mean should be interpreted as meaning that we can expect to be correct at least 95% of the time when we state that the true mean emission rate, for a given screening value, falls within the limits computed. The 95% confidence intervals for individual values should be interpreted as meaning that we can expect to be correct at least 95% of the time when we state that the individual emission rates for a given screening value fall within the limits computed." In addition, the following description of the regression lines is given: "the predicted mean values shown in Figures 2-9 through 2-14 represent the mean emission rate assuming a log-normal distribution." An explanation for why more than 50% of the data may fall below the predictive regression equations is also given. In addition, the labels in each of the figures clearly identify each of the lines and the titles state explicitly the information given in the figure. Radian believes that a thorough description of the information contained in the figures has been provided and that any additional explanation is not necessary.

Issue 11 - Appendices C and D - Verification of the Finney-Type Estimator

CARB comment:

"We think that the derivation of Section C.2 may lack verification of some of the theoretical requirements for validity of a Finney-type estimator. The derivation appears to ignore the contribution of errors in $beta_0$ and $beta_1$; this fact is not noted. Asymptotic variances of errors in the coefficients would be, apparently, all that are available."

Final Report reference: See Volume III, Appendix C.

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Radian response:

Radian does not claim that the Finney SBCF is best for this regression application. In fact, Radian has derived a SBCF which they feel is more appropriate and which is given in Appendix D (along with the derivations). The SBCF given in Appendix C is one that has been historically used and which is recommended in the U.S. EPA Protocols Document. Radian felt that until a new methodology for estimating emissions has been approved and accepted by the U.S. EPA and knowledgeable reviewers, that emission correlation equations should continue to be developed using the widely used and accepted approach that is documented in the U.S. EPA Protocols Document. Finney's original SBCF was derived for univariate applications (i.e., estimating a mean from a single population). The Finney-type SBCF given in the U.S. EPA Protocols Document is a generalization of the Finney SBCF and was not mathematically derived. In fact, it is stated in Appendix C this "SBCF ... may not be mathematically exact." Further explanation has been included in the report which makes it clear that this is the SBCF given in the U.S. EPA Protocols Document and that this SBCF does not account for errors in x and y.

Issue 12 - Appendices C and D Clarity of Section D.3.2

CARB comment:

"We question whether the discussion of generation of random variables for the simulation in section D.3.2 could not be presented more simply. The notation is somewhat confusing."

Final Report reference: See Volume III, Appendix D.

Radian agrees that Section D.3.2 is not simple. Any technical discussion should be as simple as possible, without compromising technical accuracy and correctness. Further, there is a place for presentation of a layman's description of a statistical methodology, together with simulations and plots that illustrate its features; these objectives are achieved in Sections D.1 and D.2. Given the basic importance of the readability of any document and the fact that CARB indicated that Section D.3.5 was also hard to follow, a more explicit response is given here.

Section D.3.2 is included in Section D.3, titled "Statistical Methodology." As is stated in the first paragraph of that section, "The preceding sections provide a qualitative overview of the new approach. The purpose of this section is to provide a technical discussion of the statistical details." Thus, while a layman's discussion of the new methodology was provided, it was also stated that Section D.3 was intended to be a technical section. While Section D.3 is technical, virtually every step is given in the derivations; there is little or no need for the

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reader to "fill in" missing steps between lines. It was thought that this would facilitate reading the section.

In the Final Report, we have added some transition that we believe enhances the readability of the section to some extent. We believe, however, that the complexity of the technical issues precludes a discussion that both (1) documents the mathematical details and (2) is simple to read. Preserving the complete details of the equations was felt to be of value for two reasons. First, this is the only way reviewers can be provided the full information needed to evaluate the new method. Second, further enhancements of the method can be accomplished more efficiently if the full details of the original work, including the method for generating the random values needed for the simulations, are preserved.

In the review, CARB states that the notation in Section D.3.2 is "somewhat confusing." We believe that the underlying complexity of the problem is the reason why the section is not easy to read. We do not believe the notation is the reason.

The fact that certain variances used are error variances is stated explicitly. Certain other variables not listed above are defined explicitly.

In summary, we agree with CARB, that clarity in any discussion is important, and we have tried to explain the mathematics in Section D.3 as clearly and simply as possible, given the goal of documenting the mathematical details. The problem is not simple, however, and we believe the complexity of the problem is why the mathematical discussion cannot be simple.

Issue 13 - Appendices C and D - Uncertainty in Lambda

CARB comment:

"The account in Section D.3.3 does not adequately emphasize the central role of the assumption that the variance ratio lambda is known."

Final Report reference: Volume III, Appendix D; and Volume I, Section 3.

Radian response:

It is true that lambda is treated as known in Appendix D. It is also true that the issues pertaining to the estimation of lambda and errors in this estimation were not discussed in the Final Draft version of that appendix. Radian has incorporated CARB's suggestion in the Final Report by adding a descriptive paragraph to Volume III, Section 3.

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Radian recognized the issue, however, and explicitly stated the need to perform further work regarding the role of lambda. The following was included in Volume I, Section 3 of the Final Draft Report as recommendations for future data analysis: "Perform sensitivity analysis for the GML method to determine how the GML method is affected by different variability estimates (i.e., of the emission rates and screening values)." While the parameter lambda is not explicitly stated, lambda is the ratio of the two specified error variances, and it is stated that these investigations pertain to the GML method.

Issue 14 - Appendices C and D - Variance of the Intercept on p. D-18

CARB comment:

"In section D.3.4, the expression for var(Y HAT) on p. D-18 appears to omit the contribution of the variance of the intercept."

Final Report reference: Volume III, Appendix D.

Radian response:

The development is preceded by the following text, which appears in the second paragraph on page D-18: "If the true values of the slope and intercept were known, then we would estimate Y as follows:" Further, the last sentence on p. D-18, which follows the development under question, states that the error variances of the slope and intercept are being disregarded initially and that this point is discussed later.

Issue 15 - Appendices C and D - Reason for Developing a New SBCF

CARB comment:

"An SBCF derived from Finney's result is presented in Section C.2; it isn't made clear why a theoretical development of a different type is required or appropriate here."

Final Report reference: Volume III, Appendices C and D.

Radian response:

On page C-3 in the Final Draft Report, it is stated that the SBCF traditionally used for this application is an adaptation of Finney's method for estimating the mean of a lognormally distributed random variable. It is further stated that the adaptation may not be

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mathematically exact. It follows from these statements that the derivation of an SBCF specifically for this application is appropriate.

In the Final Report, the discussion in Appendix C pertaining to the adaptation of Finney's method for this application is expanded somewhat. A paragraph has been added to Appendix D reiterating the fact that the SBCF based on Finney's method is an adaptation, and that Appendix D contains a derivation of an SBCF specifically for this application.

Issue 16 - Appendices C and D - Error Variances of A Hat and B Hat

CARB comment:

"The reasoning which justifies neglecting the variances of A HAT and B HAT is not convincing. We did not have time to review the report of the simulations which is stated to provide some justification."

Final Report reference: Volume III, Appendix D.

Radian response:

The simulations discussed in Section D.2 are based on the analysis in Section D.3. The assumption pertaining to the variances of A HAT and B HAT is part of this analysis. The simulations rigorously show that the analysis based on this assumption produces estimates that have little or no bias under all conditions tested. In the simulations, A HAT and B HAT were estimated on the basis of samples of size 30.

If A HAT and B HAT were estimated on the basis of a smaller sample size, however, it is possible that the error variances of these two parameters would not be negligible. Text has been added to Appendix D stating this possibility and suggesting that further simulations to investigate the role of the errors of A HAT and B HAT in cases with smaller sample sizes. It would be possible to extend the SBCF to account for the standard errors in A HAT and B HAT.

Issue 17 - Appendices C and D - Section D.3.5

CARB comment:

"We couldn't follow the derivation of Section D.3.5. There is some plausibility to the result, granting the result of D.3.4, but we could not make sense of the statement 'Suppose x is a hypothetical screening value and y is the emission rate such that E(x) = E(u).'"

RADIAN
CORPORATION

Mr. Wilkniss
January 19, 1994
Page 19

Final Report reference: Volume III, Appendix D.

Radian response:

The methodology of Section D.3.5 has been rigorously tested through simulations, just as the methodology of Section D.3.4 has. In both cases, the new methodology was the only one of the approaches tested that consistently produced results with little or no bias. The quoted sentence has been reworded in the Final Report and hopefully is more clear now. Regarding the readability of Section D.3 in general, see the comments above pertaining to the issue, Clarity of Section D.3.2.

Conclusion

Radian appreciates the comments from the CARB. Revisions have been made to the Final Report based on these comments. Radian believes that the 1993 Refinery Study is representative and appropriate for components in refineries in California and nationwide. Radian continues to recommend that the 1993 Refinery Study be used by refineries and regulatory agencies for the determination of refinery fugitive emissions from equipment leaks.

Sincerely,

Ronald D. Ricks

Ronald D. Ricks
Project Director

Attachments

c: G.E. Harris

Table 1

Number of Valid Bagged Samples and High Screening Variability Bagged Samples in 1993 Refinery Study

	Number of Samples Used for Equations	Pegged Components	High Screening Variability Non-Pegged Components	High Screening Variability Pegged Components	Zero Components	QA/QC Components[a]
Connectors-Flanges	19	3	1	0	9	10
Connectors-Other	29	14	3	0	12	13
OEL	22	11	5	1	9	4
Pumps-Heavy liquid	10	0	2	0	5	5
Pumps-Light liquid	27	5	4	1	7	6
Valves	141	38	30[b]	4	60[c]	81
TOTALS	248	71	45	6	102	119

OEL = open-ended lines
QA/QC = quality assurance/quality control
[a] Includes test duplicates (20), nitrogen flow sample duplicates (60), audit samples (34), and accuracy checks (5)
[b] Includes three pressure relief valves.
[c] *Includes two pressure relief valves.*

Table 2

Comparison of Number of Samples in 1980 Refinery Study and 1993 Refinery Study

Category	Service	Number of Samples[a]	
		1980 Refinery Study	1993 Refinery Study
Valves	Gas	34	52
Valves	Light liquid	74	69
Valves	Heavy liquid	0	20
OEL	All	0	22
Pump seals	Heavy liquid	48	10
Pump seals	Light liquid	127	27
Flanges[b]	All	38	48

[a] Excludes pegged components for both studies and high screening variability components for the 1993 Refinery Study.
[b] Includes connectors-flanges and connectors-other.
OEL = open-ended lines

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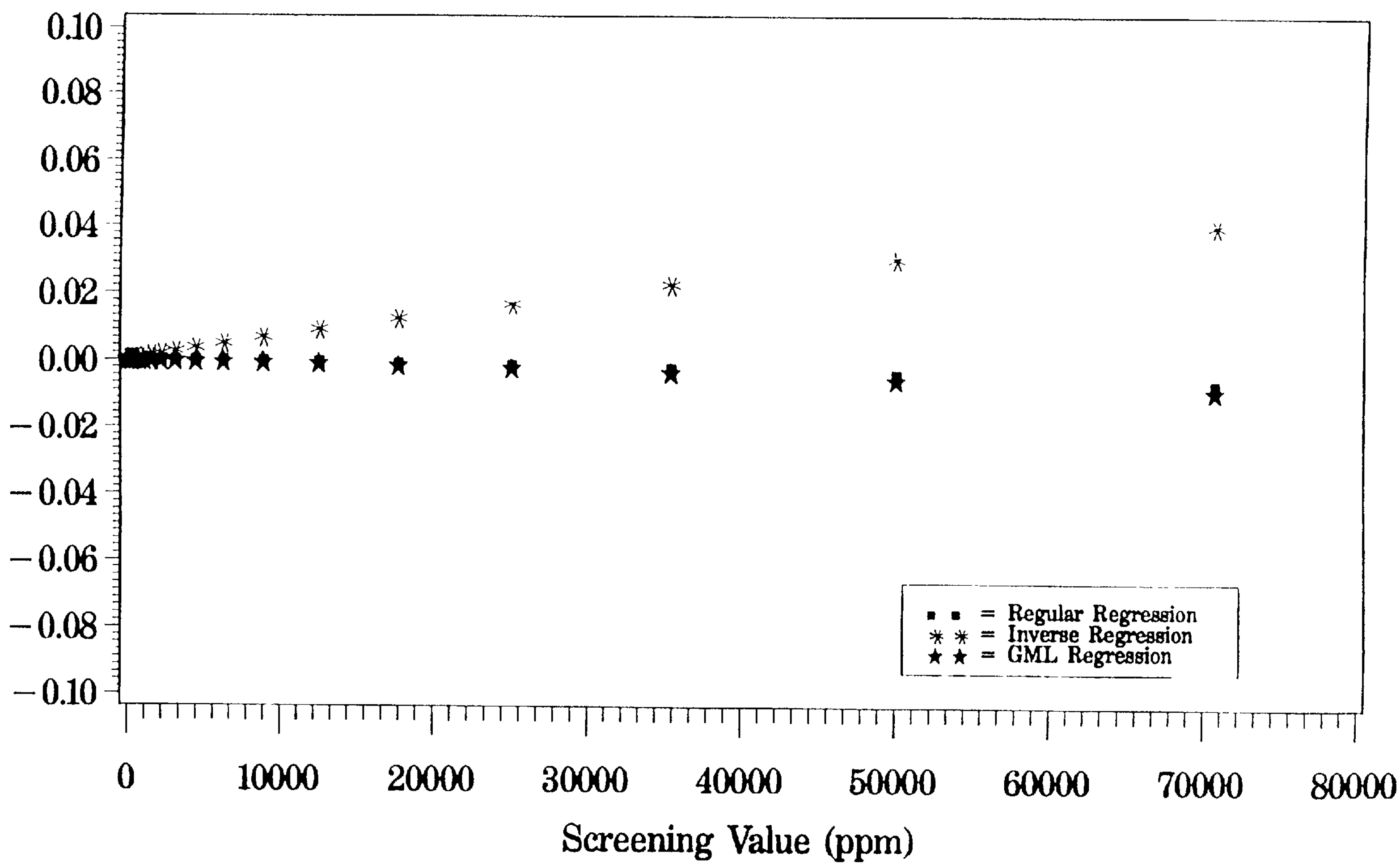
Attachment A

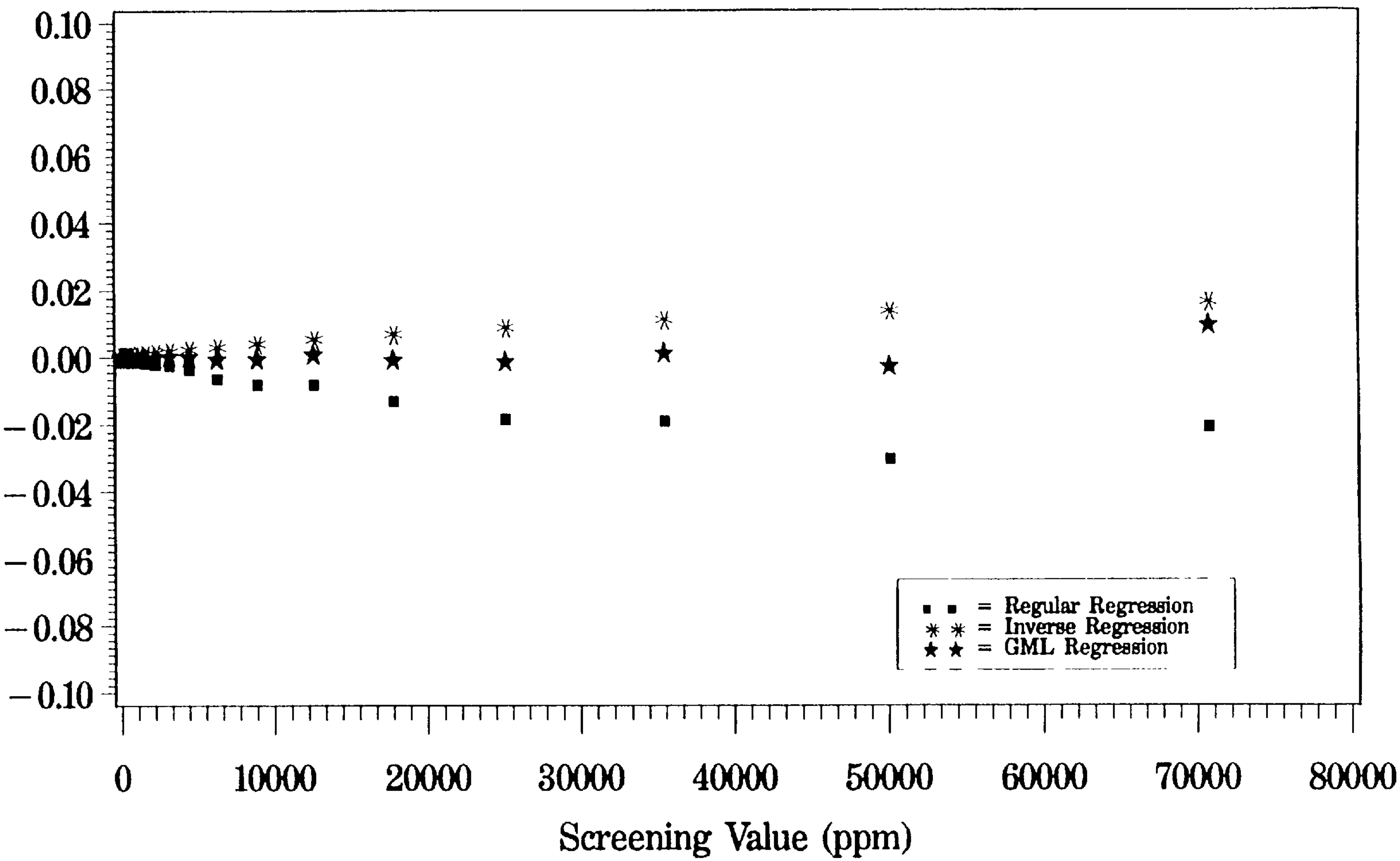
Additional Plots of the Figures in Appendix D Showing Differences Versus the True Screening Values

Figure 1
Comparison of Regression Methods
After Applying Scale Bias Correction Factors



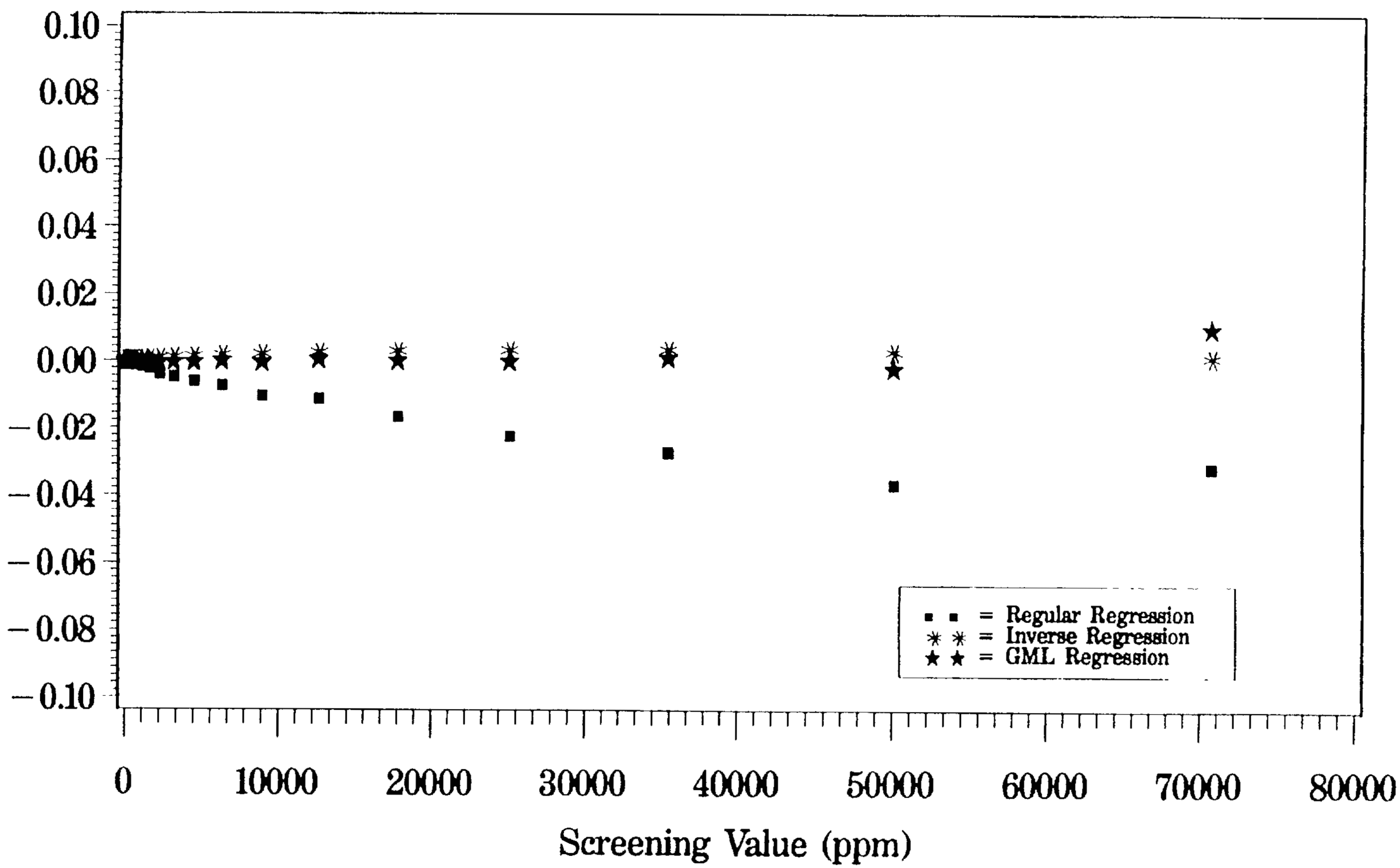
Standard Deviation in X = (0.0)(Standard Deviation in Y)
(Standard Deviation = 0.00 in X Variable)
(Standard Deviation = 1.45 in Y Variable)

Figure 2
Comparison of Regression Methods
After Applying Scale Bias Correction Factors



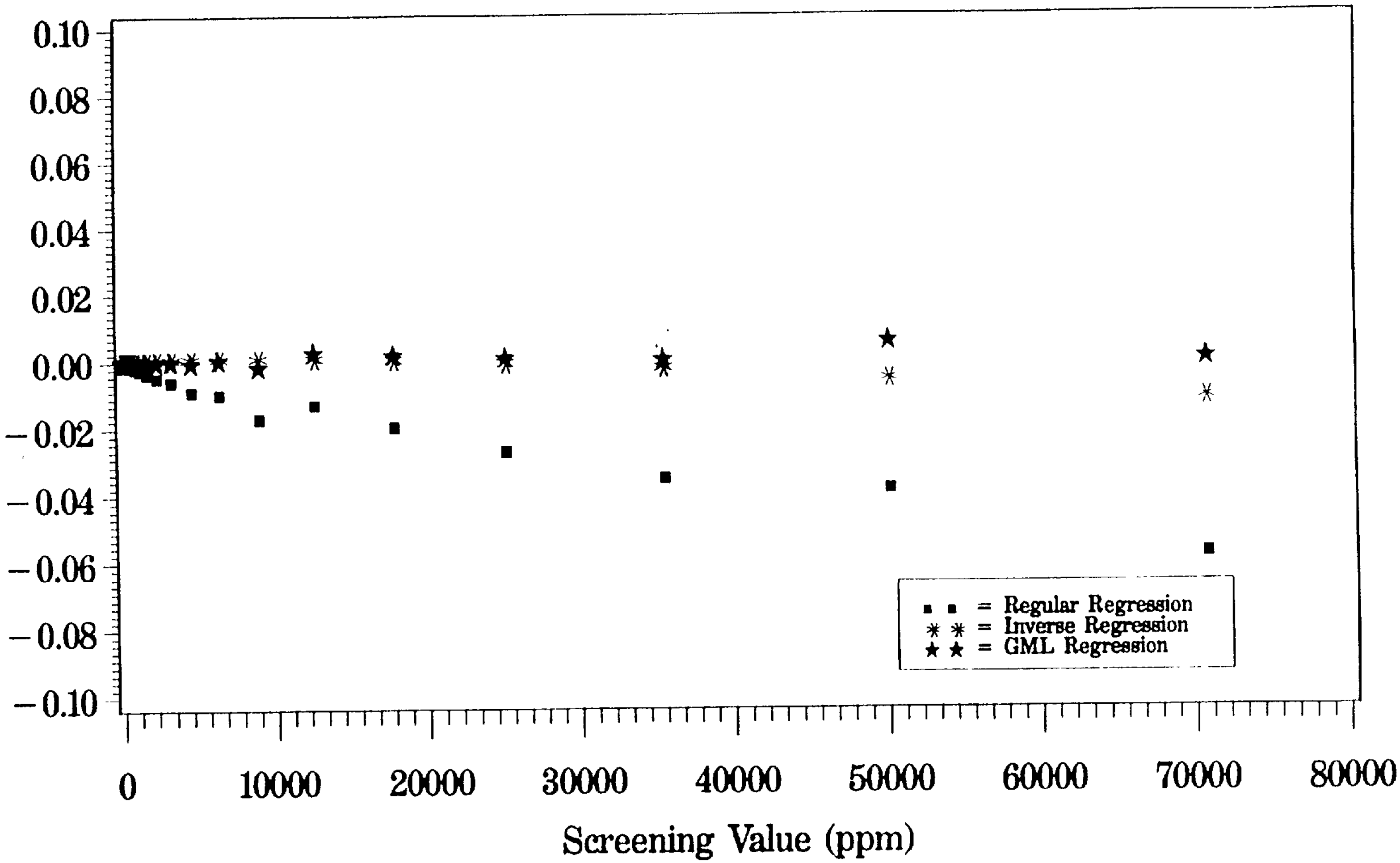
Standard Deviation in X = (1.0)(Standard Deviation in Y)
(Standard Deviation = 1.04 in X Variable)
(Standard Deviation = 1.04 in Y Variable)

Figure 3
Comparison of Regression Methods
After Applying Scale Bias Correction Factors



Standard Deviation in X = (1.5)(Standard Deviation in Y)
(Standard Deviation = 1.21 in X Variable)
(Standard Deviation = 0.81 in Y Variable)

Figure 4
Comparison of Regression Methods
After Applying Scale Bias Correction Factors



Standard Deviation in X = (2.0)(Standard Deviation in Y)
(Standard Deviation = 1.38 in X Variable)
(Standard Deviation = 0.69 in Y Variable)

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February 7, 1994
209-081-07-01

Mr. Ron Wilkniss
Western States Petroleum Association
505 North Brand Avenue, Suite 1400
Glendale, CA 91203

Subject: WSPA/API Refinery Fugitive Emissions Study, Phase III - Contract No. ET 302-08 - Radian's Response to BAAQMD Comments on the 1993 Final Draft of the 1993 Study of Refinery Fugitive Emissions from Equipment Leaks

Dear Ron:

This letter is in response to specific issues raised by the Bay Area Air Quality Management District (BAAQMD) concerning the 1993 Final Draft of the 1993 Study of Refinery Fugitive Emissions from Equipment Leaks (1993 Refinery Study). The issues were raised in a phone conversation between Bob Nishimura of the BAAQMD and myself at the end of October 1993. Written comments were anticipated from the BAAQMD but have not yet been received.

Issue 1 - OVA Probe Leaks

BAAQMD comment:

The BAAQMD is concerned that potential OVA probe leaks that were identified during audits conducted by a contractor for the United States Environmental Protection Agency (U.S. EPA) could affect the results of the 1993 Refinery Study.

Final Report reference: See Volume II, Section 3.

Radian response:

The issue of the impact of potentially leaking OVA probes is reviewed extensively (20 pages of analysis) in Volume II, Section 3 of the Final Report of the 1993 Refinery Study. The conclusion in that study is that, "This analysis gives strong indication that the potentially leaking probes had a minor, if not insignificant impact on the data. Furthermore, this analysis indicates that the potentially leaking probes did not result in a systematic bias in the data analysis. There does not appear to be any reason to invalidate any data prior to the detection of potentially leaking probes." It is important to note that, if any bias were to occur from leaking probes, the bias in the emission correlation equations would be to give

RADIAN
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Mr. Wilkniss
February 7, 1994
Page 2

higher emission estimates than would emission correlation equations derived only from non-leaking probes.

Issue 2 - Sample Sizes

BAAQMD comment:

Insufficient data were collected to satisfy U.S. EPA recommendations.

Final Report reference: See Volume II, Section 3.0.

Radian response:

Radian originally proposed to the Western States Petroleum Association (WSPA) and the American Petroleum Institute (API) to examine 525 samples, including field duplicates, zero components (i.e., those components that screen at background ppm levels), pegged components (i.e., those that screen above the instrument's measurement capability; generally greater than 100,000 ppm), and components that screened at between 1 and 100,000 ppm. Fortunately, Radian was able to complete the study with even more valid samples than originally proposed. Radian completed the study with 540 valid samples. Of the 540 valid samples, 248 were components that screened at between 1 and 100,000 ppm, 102 were zero components, 71 were pegged components, and the remainder were taken to ensure data quality (audit sample duplicates, nitrogen flow test duplicates, and accuracy checks). In addition, 51 samples were excluded from analysis because of high variability in screening measurements taken both before and after bagging. Later analysis indicated that including these additional 51 samples would not have had a significant effect on the development of the emission correlation equations (see Volume II, Section 3 of the Final Report). Table 1 documents all valid samples and the high screening variability samples collected and their use in the data analysis.

After completion of the 1980 Refinery Study, the United States Environmental Protection Agency (U.S. EPA) recognized that facilities or industries may wish to redevelop emission correlation equations based on more applicable data than that collected for the 1980 Refinery Study. To assist an industry in developing new emission correlation equations they have recently (June, 1993) updated and published a document entitled *Protocol for Equipment Leak Emission Estimates* (Protocols Document). The Protocols Document gives general guidance for determining the required number of samples recommended for determining new or revised emission correlation equations. Including pegged components, the Protocols Document recommends that at least 30 samples be taken. Excluding pegged components, the Protocols Document recommends that at least 24 samples be taken.

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Some of the samples collected had been excluded from the analysis because their "before and after" screening values exceeded the pre-established control limits. Those are referred to as having "high" screening variability. As can be seen from Table 1, the U.S. EPA recommendation to have at least 30 samples (including pegged components) was exceeded in four of the six categories. The U.S. EPA recommendation to have at least 24 samples (excluding pegged components) was exceeded in three of the six categories. The question of whether sufficient samples were taken to meet U.S. EPA recommendations is focused only on two or three of the component categories; heavy liquid pumps, connectors-flanges, and possibly open-ended lines (OELs). The remaining categories clearly exceed the recommendations, and valves exceed the recommendations by a factor of almost six.

We would like to address each of the questionable categories separately, beginning with OELs. Thirty-three (33) OEL samples (including pegged components) were included in pegged components emission factor or emission correlation equation development. Three more samples were collected than the U.S. EPA recommendation. Furthermore, five OEL samples were excluded from analysis simply because they had high screening variability. These samples were excluded in an effort to control one aspect of variability in the study. Subsequent analysis indicated that these five samples could easily have been added to the analysis without any significant change to the emission correlation equation (see Figure 3-30, Volume II, Section 3 of the Final Report). Adding these five samples would have virtually no effect on the determination of the emission correlation equation and would also clearly exceed the U.S. EPA recommended number of samples. Given these considerations, it seems that the OEL category reasonably satisfies the U.S. EPA recommendations.

The remaining two categories, connectors-flanges and heavy liquid pumps, do not meet the mentioned U.S. EPA recommendations. The connectors-flanges category is close to meeting the recommendations, especially if including the high screening variability samples (total of 20). The heavy liquid pump category is not close (10-12 samples) to this U.S. EPA recommendation. The reason that additional samples were not taken is easily explained. Radian was attempting to obtain samples in all screening value ranges. A deliberate attempt was made to not skew the analysis by having a disproportionate number of samples in either low or high screening value ranges. Efforts were made by the five host refineries and Radian to find these components. Testing at these refineries was performed over approximately 20 weeks. For connectors-flanges and heavy liquid pumps, more components in the higher screening value ranges could not be located.

Prior to commencing the data analysis for the 1993 Refinery Study it was not known that the connectors category should be split into two categories, flanges and non-flanges (other). In fact, the 1980 Refinery Study did not split the connectors into two categories. If the 1993 Refinery Study connector categories were merged, 48 samples would be available to develop

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an emission correlation equation which far exceeds the U.S. EPA recommendation. However, statistical analysis revealed that connectors-flanges and connectors-other were two distinct categories. Splitting the connectors into two categories improves the correlation coefficient from 0.82, for the combined grouping, to 0.88 for connectors-flanges and 0.85 for connectors-other. Even though this meant that one of the U.S. EPA's recommendations for sample size would not be precisely met for one of the connector categories, it was felt that the superior applicability of the results by dividing into two categories outweighed the possible limitation of reduced sample sizes.

Similarly, if the heavy liquid pump and light liquid pump categories were merged, 37 samples would be used to develop an emission correlation equation. However, the superior applicability of the results by maintaining two categories outweighed the possible limitation of reduced sample size.

The previous version of the Protocols Document, the U.S. EPA's *Protocol for Generating Unit-Specific Emission Estimates for Equipment Leaks of VOC and VHAP* (1988), states that if it can be shown that the estimates are "within 50% of the mean value with 95% confidence", a smaller sample size is acceptable. The 95% confidence interval for the expected mean log emission rate at the mean log screening value meets the "plus or minus 50% of the expected value" criterion for all component categories, including connectors-flanges and even heavy liquid pumps. The 95% confidence interval criteria is not met for these two component categories in linear space. The previous version of the Protocols Document is not clear on whether the criterion is for log or linear space.

The 1993 U.S. EPA Protocols Document states, "The above groupings and recommended number of sources are given as guidelines. They are based on experience in measuring leak rates and developing leak rate/screening value correlations. Other source selection strategies can be used if an appropriate rationale is given".

It is clear that the U.S. EPA recognizes that alternate strategies and even potentially smaller sample sizes can be considered for development of emission correlation equations. The issue really should be which emission correlation equations best represent the types of components found in today's refineries.

In comparing the 1980 Refinery Study to the 1993 Refinery Study, it is immediately evident that many of the samples taken in the 1980 Refinery Study were pegged components. When the pegged components are removed from the total number of samples taken for the 1980 Refinery Study, the results are as shown in Table 2. Note that in the 1980 Refinery Study no heavy liquid valves or open-ended lines were sampled (bagged) and that valves were split into the gas valves and light liquid valves categories. The 1993 Refinery Study actually

RADIAN
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Mr. Wilkniss
February 7, 1994
Page 5

sampled more components than the 1980 Refinery Study in the following categories: gas valves, heavy liquid valves, open-ended lines, and flanges. The number of light liquid valves sampled in both studies are nearly identical. In fact, of the component categories reexamined in the 1993 Refinery Study, only the pump categories had significantly fewer samples collected than in the 1980 Refinery Study. By number of samples alone, the 1993 Refinery Study is superior to the 1980 Refinery Study for the two categories that represent the great majority of components found at any refinery: valves and flanges.

The comparison between the 1980 Refinery Study and the 1993 Refinery Study is even more convincing for the development of zero component emission factors. The zero component emission factors ("default zeros") developed from the 1980 Refinery Study data were based on eleven (11) samples from one component category (gas/vapor valves). In the 1993 Refinery Study, zero component emission factors were developed from each component category using a total of 102 samples. Clearly, the 1993 Refinery Study is more complete than the 1980 Refinery Study for zero components which represent the greatest number of components found at a refinery.

In conclusion, there is compelling evidence that the 1993 Refinery Study provides complete and representative information for the majority of the component categories in refineries. The development of the emission correlation equations has been consistent with U.S. EPA recommendations for sample size in four of six component categories. The remaining two categories, connectors-flanges and heavy liquid pumps, meet the statistical test on the mean log emission rate basis and could have met the sample size recommendation by having only one connectors category and one pumps category.

Issue 3 - Screening Distance

BAAQMD comment:

There is too much uncertainty related to developing emission correlation equations based on screening at a screening distance of 1 cm when the data were collected at the surface of the component.

Final Report reference: None

Radian response:

Most of the discussion related to screening at a 1 cm distance has been removed from the Final Report. The emission correlation equations, developed previously for a 1 cm screening distance in the earlier draft, have been removed from the Final Report.

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Mr. Wilkniss
February 7, 1994
Page 6

Issue 4 - Pegged Components from the 1980 Refinery Study Not Included

BAAQMD comment:

The Final Draft Report does not include pegged components from the 1980 Refinery Study to compare with the pegged components from the 1993 Refinery Study.

Final Report reference: See Volume I, Section 2.

Radian response:

The original 1980 Refinery Study did not develop independent pegged component emission factors. However, the most recent version of the U.S. EPA's Protocol for Equipment Leak/Emission Estimates (U.S. EPA Protocols Document) (June, 1993) does include pegged component emission factors that Radian believes were developed from data collected during the 1980 Refinery Study. In response to the BAAQMD's comment, Radian has included a comparison of the 1993 Refinery Study to these 1980 Refinery Study pegged component emission factors in the Final Report.

Issue 5 - Raw Data Request

BAAQMD comment:

The BAAQMD would like to have a copy of the raw data collected as part of the 1993 Refinery Study.

Final Report reference: See Volume III, Appendix A

Radian response:

A spreadsheet of the raw data collected during this study, the data used for development of emission correlation equations, zero component emission factors, and pegged component emission factors is included in Volume III, Appendix A. This spreadsheet also includes calculations of the mass emission rates from the raw data. An electronic copy of this spreadsheet, with a few minor revisions on coding, will be sent to the BAAQMD.

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Mr. Wilkniss
February 7, 1994
Page 7

Issue 6 - Comparison of Vapor Leak Composition with Liquid Stream Composition

BAAQMD comment:

The BAAQMD is disappointed that the comparison of vapor leak composition with liquid stream composition was inconclusive.

Final Report reference: See Volume I, Section 2.

Radian response:

Radian was also disappointed that the comparison of vapor leak composition with liquid stream composition was inconclusive. Unfortunately, the data gathered in this study were too erratic to reach definitive conclusions. The scatter of the data is believed to be related to the large number of variables in the testing process. Isolating variables in a field setting has proven difficult. Additional analysis in a controlled laboratory setting is recommended.

Until additional testing in a controlled setting takes place, Radian recommends that refineries continue to estimate emissions of individual VOC species by assuming that the mass fractions in emitted VOCs are the same as the mass fractions in the process streams.

Conclusion

Radian appreciates the comments from the BAAQMD. Revisions have been made to the Final Report based on these comments. Radian believes that the 1993 Refinery Study is representative and appropriate for components in refineries in California and nationwide. Radian continues to recommend that the 1993 Refinery Study be used by refineries and regulatory agencies for the determination of refinery fugitive emissions from equipment leaks.

Sincerely,

Ronald D. Ricks

Ronald D. Ricks
Project Director

Attachments

c: G.E. Harris

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Table 1

Number of Valid Bagged Samples and High Screening Variability Bagged Samples in 1993 Refinery Study

	Number of Samples Used for Equations	Pegged Components	Samples Used for Equations Plus Pegged Components	High Screening Variability Non-Pegged Components	High Screening Variability Pegged Components	Zero Components	QA/QC Components[a]
Connectors-Flanges	19	3	22	1	0	9	10
Connectors-Other	29	14	43	3	0	12	13
OEL	22	11	33	5	1	9	4
Pumps-Heavy liquid	10	0	10	2	0	5	5
Pumps-Light liquid	27	5	32	4	1	7	6
Valves	141	38	179	30[b]	4	60[c]	81
TOTALS	248	71	319	45	6	102	119

OEL = open ended lines
QA/QC = quality assurance/quality control
[a] Includes test duplicates (20), nitrogen flow sample duplicates (60), audit samples (34), and accuracy checks (5)
[b] Includes three pressure relief valves.
[c] Includes two pressure relief valves

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