APPENDIX 3

ENHANCED VAPOR RECOVERY TECHNOLOGY REVIEW

UPDATED ISD EMISSION REDUCTIONS

Appendix 3-1

ISOR Throughput Estimations (Appendix D)

1997	2000	2005	2010
1	1.017	1.094	1.176

1997 State Throughput: 13.481 Billion Gallons (ISOR Appendix D)

Year	StatewideThroughput [1] (Billion Gallons)	Gilbarco (35%) (Billion Gallons)	Wayne (20%) (Billion Gallons)	Balance (45%) (Billion Gallons)
1997	13.48	4.72	2.70	6.07
1998	13.56	4.75	2.71	6.10
1999	13.63	4.77	2.73	6.13
2000	13.71	4.80	2.74	6.17
2001	13.92	4.87	2.78	6.26
2002	14.13	4.95	2.83	6.36
2003	14.33	5.02	2.87	6.45
2004	14.54	5.09	2.91	6.54
2005	14.75	5.16	2.95	6.64
2006	14.97	5.24	2.99	6.74
2007	15.19	5.32	3.04	6.84
2008	15.41	5.39	3.08	6.93
2009	15.63	5.47	3.13	7.03
2010	15.85	5.55	3.17	7.13

[1] Linearly Interpolated Data Between ISOR Estimate Years

Appendix 3-2

2010 Emissions Identified by ISD System (Without ORVR Penetration) - Balance

Assume ISD System Identifies 100% of "Total Blocked Hoses"
Assume ISD System Does Not Identify Any "Partially Blocked Hoses"
Assume ISD System Identifies 50% of "Poor Vapor Collection Due to Excessive Vehicle-Nozzle Gaps"

Failure Cause	Efficiency Reduction (Percent)[1]	ISD Identifies Failure (%)	Emissions (TPD)*
Total Blocked Hose	11.1	100	7.3
Partial Blocked Hose	4.2	0	0.0
Vehicle-Nozzle Gaps	14.4	50	4.2
Total Emissions (TPD)			11.6

[1] Barnard R. McEntire, *Performance of Balance Vapor Recovery Systems at Gasoline Dispensing Facilities* , 2000

* Total Emissions (11.6 TPD) reflects round off error in "Total Blocked Hose" and "Vehicle-Nozzle Gaps" emission estimates

Appendix 3-3

2010 Emissions Identified by ISD System (With ORVR Penetration) - Balance

Year	Throughput (Statewide)	Throughput (Balance)	ORVR Penetration (%)[1]	Emissions Identified By ISD Without ORVR Penetration	Emissions Identified By ISD With ORVR Penetration
2002	14.13	6.36	19.11	10.3	8.4
2003	14.33	6.45	25.11	10.5	7.8
2004	14.54	6.54	31.79	10.6	7.2
2005	14.75	6.64	37.66	10.8	6.7
2006	14.97	6.74	43.04	10.9	6.2
2007	15.19	6.84	47.84	11.1	5.8
2008	15.41	6.93	52.11	11.3	5.4
2009	15.63	7.03	56.15	11.4	5.0
2010	15.85	7.13	60.10	11.6	4.6

[1] ORVR Estimates Based on 2002 Data

Appendix 3-4

2010 Emissions Identified by ISD System (Without ORVR Penetration) - Vacuum-Assist

Assume ISD System Detects A/L Failure Outside +/- 25% of Executive Order A/L Ratio

Wayne

A/L Ratio	Number of Failures[1]	Emissions (#/1000 Gallons)	Percent of Total	Emissions (TPD)	Cumulative Emissions (TPD)
0	16	7.6	1.46	0.5	0.5
0.05	0	7.22	0.00	0.0	0.5
0.15	4	6.46	0.37	0.1	0.6
0.25	2	5.7	0.18	0.0	0.6
0.35	1	4.94	0.09	0.0	0.7
0.45	7	4.18	0.64	0.1	0.8
0.55	17	3.42	1.55	0.2	1.0
0.65	20	2.66	1.83	0.2	1.2
0.75	48	1.9	4.39	0.4	1.6
0.85	87	1.14	7.95	0.4	2.0
0.95	681	0.38	62.25	1.0	3.0
1.05	197	0	18.01	0.0	3.0
1.15	11	0.38	1.01	0.0	3.0
1.25	2	1.14	0.18	0.0	3.0
1.35	1	1.9	0.09	0.0	3.0
Total	1094		100.00	3.0	3.0

Gilbarco

A/L Ratio	Number of Failures[1]	Emissions (#/1000 Gallons)	Percent of Total	Emissions (TPD)	Cumulative Emissions (TPD)
0	43	7.6	4.28	2.5	2.5
0.05	1	7.22	0.10	0.1	2.5
0.15	0	6.46	0.00	0.0	2.5
0.25	0	5.7	0.00	0.0	2.5
0.35	1	4.94	0.10	0.0	2.6
0.45	0	4.18	0.00	0.0	2.6
0.55	3	3.42	0.30	0.1	2.6
0.65	2	2.66	0.20	0.0	2.7
0.75	13	1.9	1.29	0.2	2.9
0.85	20	1.14	1.99	0.2	3.0
0.95	87	0.38	8.66	0.3	3.3
1.05	474	0	47.16	0.0	3.3
1.15	313	0.38	31.14	0.9	4.2
1.25	39	1.14	3.88	0.3	4.5
1.35	8	1.9	0.80	0.1	4.6
Total:	1005		99.90	4.6	4.6

Total Emissions (TPD) Identified By ISD Systems = 3.9

[1] Number of Failures Based on April 1999 ARB Report

Appendix 3-5

2010 Emissions Identified by ISD System (With ORVR Penetration) - Vacuum-Assist

Assume Statewide Throughput Increases Per ISOR Apendix D From 2002 - 2010
Throughputs are in billion gallons per year

Wayne

Year	Throughput (Statewide)	Throughput (Wayne)	ORVR Penetration (%)	Emissions Identified By ISD Without ORVR Penetration	Emissions Identified By ISD With ORVR Penetration
2002	14.13	2.83	19.11	1.1	0.9
2003	14.33	2.87	25.11	1.1	0.8
2004	14.54	2.91	31.79	1.1	0.8
2005	14.75	2.95	37.66	1.1	0.7
2006	14.97	2.99	43.04	1.1	0.6
2007	15.19	3.04	47.84	1.2	0.6
2008	15.41	3.08	52.11	1.2	0.6
2009	15.63	3.13	56.15	1.2	0.5
2010	15.85	3.17	60.10	1.2	0.5

Gilbarco

Year	Throughput (Statewide)	Throughput (Gilbarco)	ORVR Penetration (%)	Emissions Identified By ISD Without ORVR Penetration	Emissions Identified By ISD With ORVR Penetration
2002	14.13	4.95	19.11	2.4	1.9
2003	14.33	5.02	25.11	2.4	1.8
2004	14.54	5.09	31.79	2.5	1.7
2005	14.75	5.16	37.66	2.5	1.6
2006	14.97	5.24	43.04	2.5	1.4
2007	15.19	5.32	47.84	2.6	1.3
2008	15.41	5.39	52.11	2.6	1.2
2009	15.63	5.47	56.15	2.6	1.2
2010	15.85	5.55	60.10	2.7	1.1

Total Emissions (TPD) Identified By ISD Systems (with ORVR penetration) = 1.6

Appendix 3-6

2010 Pressure Integrity Emissions Estimate – Balance

The calculations below estimate the excess hydrocarbon emissions an ISD system will identify when the ISD system detects a failure due to the CP-201 ISD Appendix Pressure Integrity requirement (Section 2.2.1); that is, when the balance vapor recovery system has a leak that is twice the allowable TP-201.3 leak rate:

- Assume a statewide throughput of 15.85 billion gallons in 2010.[1]
- Assume balance vapor recovery systems dispense 45% of the state throughput.[1]
- Assume a 30% equilibrium hydrocarbon concentration.[2]
- Assume an average molecular weight of 65 for hydrocarbons (C4.5).[2]
- Assume an ORVR fleet penetration of 60% in 2010.[1]
- Assume a 6.3% reduction in efficiency for a balance vapor recovery system that fails the TP-201.3 test.[3]
- Since the ISD system, as proposed, detects a failure when the vapor recovery system has a leak twice the TP-201.3 allowable leak rate, assume the excess hydrocarbon emissions attributable to the ISD system is only 50% of the total.

$$\frac{(15.85 \text{ billion gallons/year}) \times (0.45) \times (0.1337 \text{ ft}^3/\text{gallon}) \times (0.30) \times (65\#/385\text{ft}^3) \times (1 - 0.60) \times (0.063) \times (0.50)}{(2000 \#/\text{ton})(365 \text{ days/year})}$$

$$= 0.8 \text{ TPD}$$

[1] CARB Staff Report, *Initial Statement of Reasons for Proposed Amendments to the Vapor Recovery Certification and Test Procedures for Gasoline Loading and Motor Vehicle Gasoline Refueling at Service Stations*, 2000

[2] CARB Memo, *Estimated Hydrocarbon Emissions of Phase II and Onboard Vapor Recovery Systems*, 1994

[3] Barnard R. McEntire, *Performance of Balance Vapor Recovery Systems at Gasoline Dispensing Facilities*, 2000.

Appendix 3-7

2010 UST Ullage Pressure Phase I ISD Emissions Estimate

The calculations below estimate the excess hydrocarbon emissions an ISD system will identify when the ISD system detects a failure due to the CP-201 ISD Appendix Phase I – Vapor transfer Monitoring requirement (Section 2.2.2):

- Assume a statewide throughput of 15.85 billion gallons in 2010.[4]
- Assume an emission factor of 6.77 #/1,000 Gallons.[5]
- Assume one percent of the Phase I deliveries occur with no vapor recovery.

$$\frac{(15.85 \text{ billion gallons/year}) \times (6.77 \text{ \#/1,000 gallons}) \times (0.01)}{(2000 \text{ \#/ton})(365 \text{ days/year})}$$

$$= 1.5 \text{ TPD}$$

[4] CARB Staff Report, *Initial Statement of Reasons for Proposed Amendments to the Vapor Recovery Certification and Test Procedures for Gasoline Loading and Motor Vehicle Gasoline Refueling at Service Stations*, 2000

[5] CARB Memo, *Estimated Hydrocarbon Emissions of Phase II and Onboard Vapor Recvoery Systems*, 1994