APPENDIX C

Cost Effectiveness Analysis
for Proposed Amendments to Rules 4401, 4409, 4455, 4623 and 4624

June 15, 2023

This page intentionally blank.

COST EFFECTIVENESS ANALYSIS FOR PROPOSED RULES 4401, 4409, 4455, 4623, and 4624

I. SUMMARY

The California Health and Safety Code (CH&SC) Section 40920.6(a) requires the San Joaquin Valley Air Pollution Control District (District) to conduct both an absolute cost effectiveness analysis and an incremental cost effectiveness analysis of available emission control options before adopting Best Available Retrofit Control Technology (BARCT) rules. The purpose of conducting a cost effectiveness analysis is to evaluate the economic reasonableness of the pollution control measure or rule. The analysis also serves as a guideline in developing the control requirements of a rule.

Absolute cost effectiveness (ACE) is the added annual compliance cost to meet the proposed rule's requirements, in dollars per year, divided by the emission reduction achieved in tons of pollutant reduced per year.

Incremental cost effectiveness (ICE) is intended to measure the change in costs (in $/year) and emissions reductions (in tons reduced/year) between two progressively more effective control options or technologies. ICE compares the differences in costs and the differences in emissions reductions of candidate control options. ICE does not reveal the emission reduction potential of the control options. Unlike the ACE analysis that identifies the control option with the greatest emission reduction, ICE does not present any correlation between emissions reductions and cost effectiveness. Therefore, the relative values produced in the ICE analysis and the ACE values are not comparable and cannot be evaluated in the same way as absolute cost effectiveness numbers.

The results of the cost effectiveness analysis for the proposed amendments of Rules 4401 4409, 4455, 4623, and 4624 are summarized in Table C-1. The cost effectiveness is analyzed by District staff and includes cost information provided by the California Air Resources Board (CARB), industry vendors, and the Western States Petroleum Association (WSPA). As shown in Table C-1, the estimated compliance cost ranges $28,257 per year to $7.4 million per year per rule and the overall cost effectiveness ranges from $19,289 per ton of VOC emissions reduced per year to $209,708 per ton of VOC emissions reduced per year for the proposed rule amendments. The average cost effectiveness for all rules is $59,170 per ton of VOC reduced per year.

Table C-1 Cost Effectiveness Summary for Proposed Amendments

Rule	Cost Increase $/year	One time Equipment Cost	VOC Emissions Reduction tons/year	Cost Effectiveness $/ton VOC reduced
4401	$3,814,894		27	$142,424
4409	$7,432,341		107	$69,436
4455	$28,257		0.13	$209,708
4623	$1,187,083	$312,900	77	$19,537
4624	$148,120		8	$19,289
Total	**$12,610,696**	**$312,900**	**218.42**	**$59,170**

Alternative Leak Limits Evaluated

As shown in the staff report, the District explored several leak limits in the rule amendment process. The District conducted a cost-effectiveness analysis for these leak limits, shown below, and found that the current proposal of 500 ppmv was the most cost effective for the commensurate emissions reduction.

Table C-2 Cost and Cost Effectiveness for Alternative Leak Limits Evaluated

Throughput Limit	Emission Reductions VOC tons/yr	Cost at 500 ppmv Rule	Cost Effectiveness $/ton VOC
1,000 ppmv	67	$2,554,461	$43,033
500 ppmv	218	$12,610,696	$59,744
100 ppmv	245	$27,544,366	$103,286

Comparison of Current Emission Limits and Proposed Emission Limits

Based on CARB data, and current District permits, an estimated total of 2,625,188 components will be impacted by the proposed rule amendments. A summary of these components and their current emission limits are shown in Table C-3.

Table C-3 Summary of Components and Emission Leak Limits

Rule	Total Components	Current Emission Limits	Proposed Emission Limits
4401	893,392	Gas: 2,000 ppmv VOC	Gas: 500 ppmv
4409	1,511,035	Gas: 2,000 ppmv VOC Liquid: 1,000 ppmv VOC	Gas: 500 ppmv Liquid: 500 ppmv
4455	1,708	Gas: 1,000 ppmv VOC *(Pumps, Compressors, and Other)*	Gas: 500 ppmv *(Pumps, Compressors, and Other)*
4623	71,621*	Gas: 10,000 ppmv VOC	Gas: 500 ppmv
4624	40,001	Gas: 1,000 ppmv VOC	Gas: 500 ppmv
Total	**2,625,188**		

**Pre-rule amendment components subject to District rule*

II. Cost Effectiveness Analysis Procedure

To illustrate the cost effectiveness of complying with the proposed limits, the District's analysis provides varying cost effectiveness values depending on potential for a component to leak, the cost of more frequent Leak Detection and Repair (LDAR) inspections, and the eventual cost to replace leaking pieces of equipment in operation. The actual compliance costs and cost effectiveness values depends on several factors such as the type of unit, operating conditions, and the emission limits for the unit.

District staff used cost information from stakeholders to conduct a cost effectiveness analysis of the proposed leak limits, for Rules 4401, 4409, 4455, 4623, and 4624. Specifically, the data used in the analysis came from the following sources:

1. California Air Resources Board (CARB)
2. Western States Petroleum Association (WSPA)
3. Industry vendors

Cost information submitted to the District is used to establish the costs found in Tables C-4 through C-11.

A. Absolute Cost Effectiveness Formula

ACE examines the cost of reaching the proposed emission limits using the current emissions as a baseline. Cost effectiveness is calculated as the added annual cost ($/year) of a technique, in this case, lowering the minor leak emission limit, by dividing by the emissions reductions achieved (in tons of VOC reduced/year). The annual costs include capital equipment replacement costs, the cost of performing LDAR inspections, and the repair cost for affected components.

The absolute cost effectiveness is as follows:

1. Determine an equivalent equipment replacement cost using a capital recovery factor based on current market values for components affected in each rule.
2. Determine the equivalent annual equipment repair cost for equipment that need more than a simple "quick fix" repair without the need to replace the equipment based on current market rates.
3. Determine the equivalent annual cost to perform LDAR requirements on all components subject to Rules 4401, 4409, 4455, 4623, and 4624.
4. Calculate the total annual cost by adding the costs calculated in Step 1, 2, and Step 3.
5. Calculate the emission reduction in tons/year. Appendix B provides a detailed explanation of the calculations performed to determine the emission reductions for the potential rule limits.
6. Calculate the absolute cost effectiveness by dividing the total annual cost in Step 3 by the emissions reduction in Step 5.

B. Incremental Cost Effectiveness Formula

ICE provides the additional cost for further controlling a component from the proposed limit to the lowest possible level. Costs are evaluated similar to absolute costs, but are only calculated for the controls and reductions beyond what is required to comply with the rule. ICE does not reveal the emission reduction potential of the control options, but examines the more stringent options that were not considered cost effective. Due to the increased costs and marginal emission reductions, the ICE calculations typically show a higher cost effectiveness than the absolute cost effectiveness values, and are therefore not directly comparable.

The incremental cost effectiveness of a control is calculated as follows:

1. Identify the complying control options appropriate for the existing equipment.
2. Estimate the annual average cost of each control option by using Steps 1 to 3 of the ACE calculation method.
3. Calculate the potential emission reduction for each control option. The potential emission reductions are the difference between the current emissions and the potential emissions using the new requirements.

For the ICE analysis, the emission reduction is the difference between the current rule emission limits to the proposed emission limits.

III. Absolute Cost Effectiveness Analysis

There are three main factors that are quantified to accurately calculate the absolute cost effectiveness.

A. Repair/Replace Labor Cost for LDAR Rules

The labor cost associated with the repair/replace of leaking components is one factor taken into consideration. The District worked with stakeholders, CARB, and independent LDAR companies to obtain and determine the labor cost to repair/replace a leaking piece of equipment. Using the information provided, the District calculated the average cost of labor rates, and the average time to repair a leaking piece of equipment. Table C-4 below identifies the fixed cost used in the calculation of repairing/replacing equipment.

B. Replacement Cost for LDAR Rules

The District calculated the replacement cost of leaking equipment. The cost associated with replacement can be found in Table C-4. The District worked with information provided by stakeholders and independent LDAR companies to obtain and determine the cost of replacing a piece of equipment. Additionally, understanding a component's potential to leak, and the probability of when the component can no longer function, is also critical to calculating the cost effectiveness.

Table C-4 Constant in Quantifying Repairing and Replacing Components

Component Type	Leak Fraction at 500 ppmv[1]	Component Replacement Cost ($)[2]	Percentage Needing Repair at 500 ppmv[3]	Percentage of Leaking Components Needing Replacing at 500 ppmv[4]	Repair Labor Cost[5]	Average Repair times (hr)[6]	Average replace time (hr)[7]
Valves	0.0075	$150.00	70%	30%	$133/hr	0.17	4
Flanges	0.0075	$83.00	70%	30%	$133/hr	0.17	4
Connectors	0.0075	$55.40	70%	30%	$133/hr	0.17	4
Pumps*	0.0075	$166.10	-	30%	$133/hr	0	40
Open-ended Lines	0.0075	$20.00	70%	30%	$133/hr	0.17	4
Other Components*	0.0075	$221.40	-	30%	$133/hr	0	40

*Pumps and Other Components are determined by the District as components that cannot be easily repaired. All Pumps and Other Components found leaking when the leak fraction is applied to the total number of components are deemed as needing replacing.

[1] Leak Fraction = Estimated percentage of leaking components based on Rule 4409 section 5.1.4.4, district inspection experience, and discussions with industry vendors.
[2] Component Replacement Cost = average cost per component (Source: CARB, Industry Vendors)
[3] Percentage of Leaking Equipment Needing Replacing = Consistent with Subpart OOOOa at 500 ppmv (https://www.epa.gov/sites/default/files/2016-08/documents/2016-compliance-guide-oil-natural-gas-emissions.pdf)
[4] Percentage of Leaking Equipment Needing Replacing = Consistent with Subpart OOOOa at 500 ppmv
[5] Labor Cost = Average cost per hour (Source : CARB, Industry Vendors)
[6] Average Repair Time (hr)= Consistent with Subpart OOOOa (https://www.epa.gov/sites/default/files/2016-08/documents/2016-compliance-guide-oil-natural-gas-emissions.pdf)
[7] Average Replacement Time (hr) = Based on average of 3 independent vendors

Tables C-5 through C-12 calculate the cost of repairing and replacing leaking components under the proposed 500 ppmv leak threshold.

The table below represents costs for components currently subject to the current leak threshold in Rule 4401 of 2,000 ppmv to comply with the proposed leak threshold of 500 ppmv.

Table C-5 Repair and Replacement Cost Analysis for Rule 4401 at 500 ppmv from 2,000 ppmv

Component Type	Number Components [8]	Leaking Components at 500 ppm [9]	Average Replacement Time (hr/leak) [10]	Average Repair Time (hr/leak)[11]	Repair and Replacement Time at 500 ppmv (hrs/yr)[12]	Annual Repair and Replacement Labor Cost[13]	Annual Replacement Part Cost at 500 ppm[14]	Total Annual Repair and Replacement Cost at 500 ppmv[15]
Valves	15,809	79.05	4.00	0.17	111.83	$14,762	$3,853	$18,615
Flanges	11,511	57.55	4.00	0.17	81.42	$10,748	$1,553	$12,301
Connectors	59,720	298.60	4.00	0.17	422.45	$55,763	$5,376	$61,139
Pumps	92	0.46	40.00	0.00	18.44	$2,434	$77	$2,511
Open-ended Lines	286	0.14	4.00	0.17	0.20	$27	$1	$28
Other Components	2,178	10.89	40.00	0.00	435.62	$57,502	$2,411	$59,913
Total	**89,339**	**446.70**			**1,069.96**	**$141,235**	**$13,271**	**$154,506**

The proposed changes to Rule 4401 introduces 804,053 components to District requirements. These components, previously subject to CARB's Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities[16] (COGR), would now be subject to District requirements under Rule 4401. The costs in Table C-6 are associated with these components being subject to the proposed 500 ppmv leak threshold, instead of the 1,000 ppmv leak threshold in COGR.

[8] Number of components affected
[9] Number of leaking components = (Number of components) x (Leak Fraction in Table C-4)
[10] Average Replacement time is based on EPA rulemaking Subpart OOOOa (https://www.epa.gov/sites/default/files/2016-08/documents/2016-compliance-guide-oil-natural-gas-emissions.pdf)
[11] Average Repair time is based on EPA rulemaking Subpart OOOOa (https://www.epa.gov/sites/default/files/2016-08/documents/2016-compliance-guide-oil-natural-gas-emissions.pdf)
[12] Repair and Replacement Time = Number of Leaking Components x (Average Repair Time and Average Replacement Time)
[13] Annual Repair and Replacement Labor Cost = (Repair and Replacement Time) x ($133/hour)
[14] Annual Replacement Parts Cost = (Number of leaking component x replacement %) x (Cost of Part)
[15] Total Annual Repair and Replacement Cost = Annual Repair and Replacement Labor Cost + Annual Replacement Parts Cost
[16] California Code of Regulations, Title 17, Division 3, Chapter 1, Subchapter 10 Climate Change, Article 4, Subarticle 13: Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities, October 2018, https://ww2.arb.ca.gov/sites/default/files/2020-03/2017%20Final%20Reg%20Orders%20GHG%20Emission%20Standards.pdf

Table C-6 Repair and Replacement Cost Analysis for Rule 4401 at 500 ppmv from 1,000 ppmv

Component Type	Number Components	Leaking Components at 500 ppm	Average Replacement Time (hr/leak)	Average Repair Time (hr/leak)	Repair and Replacement Time at 500 ppmv (hrs/yr)	Annual Repair and Replacement Labor Cost	Annual Replacement Part Cost at 500 ppm	Total Annual Repair and Replacement Cost at 500 ppmv
Valves	142,282	355.70	4.00	0.17	605.41	605.41	$21,342	$101,256
Flanges	103,597	258.99	4.00	0.17	440.81	440.81	$8,599	$66,785
Connectors	537,484	1,343.71	4.00	0.17	2,286.99	2,286.99	$29,777	$331,660
Pumps	830	2.07	40.00	0.00	82.98	82.98	$345	$11,298
Open-ended Lines	257	0.64	4.00	0.17	1.10	1.10	$5	$150
Other Components	19,603	49.01	40.00	0.00	1,960.29	1,960.29	$10,850	$269,608
Total	**804,053**	**2,010.13**			**5,377.57**	**5,377.57**	**$70,917**	**$780,757**

Table C-7 Repair and Replacement Cost Analysis for Rule 4409 at 500 ppmv from 2000 ppmv (gas) and 1,000 ppmv (liquid)

Component Type	Number Components [17]	Leaking Components at 500 ppm [18]	Average Replacement Time (hr/leak) [19]	Average Repair Time (hr/leak)[20]	Repair and Replacement Time at 500 ppmv (hrs/yr)[21]	Annual Repair and Replacement Labor Cost[22]	Annual Replacement Part Cost at 500 ppm[23]	Total Annual Repair and Replacement Cost at 500 ppmv[24]
Valves	272,953	1,365	4.00	0.17	1,861.20	$254,866	$66,532	$321,398
Flanges	286,622	1,433	4.00	0.17	1,954.40	$267,629	$38,658	$306,287
Connectors	906,223	4,531	4.00	0.17	6,179.31	$846,172	$81,583	$927,755
Pumps	3,577	18	40.00	0.00	715.40	$94,433	$2,971	$97,403
Open-ended Lines	-	0	4.00	0.17	0	$-	$0	$-
Other Components	41,660	208	40.00	0.00	8,332.00	$1,099,824	$46,118	$1,145,942
Total	**1,511,035**	**7,555**			**19,042.31**	**$2,562,924**	**$235,861**	**$2,798,785**

[17] Number of components affected
[18] Number of leaking components = (Number of components) x (Leak Fraction in Table C-4)
[19] Average Replacement time is based on EPA rulemaking Subpart OOOOa (https://www.epa.gov/sites/default/files/2016-08/documents/2016-compliance-guide-oil-natural-gas-emissions.pdf)
[20] Average Repair time is based on EPA rulemaking Subpart OOOOa (https://www.epa.gov/sites/default/files/2016-08/documents/2016-compliance-guide-oil-natural-gas-emissions.pdf)
[21] Repair and Replacement Time = Number of Leaking Components x (Average Repair Time and Average Replacement Time)
[22] Annual Repair and Replacement Labor Cost = (Repair and Replacement Time) x ($133/hour)
[23] Annual Replacement Parts Cost = (Number of leaking component x replacement %) x (Cost of Part)
[24] Total Annual Repair and Replacement Cost = Annual Repair and Replacement Labor Cost + Annual Replacement Parts Cost

Table C-8 Repair and Replacement Cost Analysis for Rule 4455 at 500 ppmv

Component Type	Number Components [25]	Leaking Components at 500 ppm [26]	Average Replacement Time (hr/leak) [27]	Average Repair Time (hr/leak)[28]	Repair and Replacement Time at 500 ppmv (hrs/yr)[29]	Annual Repair and Replacement Labor Cost[30]	Annual Replacement Part Cost at 500 ppm[31]	Total Annual Repair and Replacement Cost at 500 ppmv[32]
Valves	-	-	4.00	0.17	-	-	-	-
Flanges	-	-	4.00	0.17	-	-	-	-
Connectors	-	-	4.00	0.17	-	-	-	-
Pumps	-	-	40.00	0.00	-	-	-	-
Open-ended Lines	-	-	4.00	0.17	-	-	-	-
Other Components	1,708	9	40.00	0.00	171	$22,546	$945	$491
Total	**1,708**	**9**			**171**	**$22,546**	**$945**	**$23,491**

The table below represents costs for components currently subject to the current leak threshold in Rule 4623 of 10,000 ppmv to comply with the proposed leak threshold of 500 ppmv.

Table C-9 Repair and Replacement Cost Analysis for Rule 4623 at 500 ppmv from 10,000 ppmv

Component Type	Number Components [33]	Leaking Components at 500 ppm [34]	Average Replacement Time (hr/leak) [35]	Average Repair Time (hr/leak)[36]	Repair and Replacement Time at 500 ppmv (hrs/yr)[37]	Annual Repair and Replacement Labor Cost[38]	Annual Replacement Part Cost at 500 ppm[39]	Total Annual Repair and Replacement Cost at 500 ppmv[40]
Valves	12,369	80.40	4.00	0.17	9.07	$1,197	$3,803.41	$5,000
Flanges	14,057	91.37	4.00	0.17	125.90	$16,619	$2,391.76	$19,011
Connectors	41,274	268.28	4.00	0.17	369.67	$48,797	$4,687.49	$53,484
Pumps	67	0.44	40.00	0.00	10.92	$1,441	$45.35	$1,487
Open-ended Lines	1	0.01	4.00	0.17	0.00	$-	$-	$-
Other Components	3,853	25.04	40.00	0.00	1,001.73	$132,228	$5,544.56	$137,773
Total	**71,621**	**465.54**			**1,517.29**	**$200,282**	**$16,472.57**	**$216,754**

---

[25] Number of components affected
[26] Number of leaking components = (Number of components) x (Leak Fraction in Table C-4)
[27] Average Replacement time is based on EPA rulemaking Subpart OOOOa (https://www.epa.gov/sites/default/files/2016-08/documents/2016-compliance-guide-oil-natural-gas-emissions.pdf)
[28] Average Repair time is based on EPA rulemaking Subpart OOOOa (https://www.epa.gov/sites/default/files/2016-08/documents/2016-compliance-guide-oil-natural-gas-emissions.pdf)
[29] Repair and Replacement Time = Number of Leaking Components x (Average Repair Time and Average Replacement Time)
[30] Annual Repair and Replacement Labor Cost = (Repair and Replacement Time) x ($133/hour)
[31] Annual Replacement Parts Cost = (Number of leaking component x replacement %) x (Cost of Part)
[32] Total Annual Repair and Replacement Cost = Annual Repair and Replacement Labor Cost + Annual Replacement Parts Cost

The proposed changes to Rule 4623 introduces 107,431 components to District requirements. These components, previously subject to COGR, would now be subject to District requirements under Rule 4623. The costs in Table C-10 are associated with these components being subject to the proposed 500 ppmv leak threshold, instead of the 1,000 ppmv leak threshold in COGR.

Table C-10 Repair and Replacement Cost Analysis for Rule 4623 at 500 ppmv from 1,000 ppmv

Component Type	Number Component	Leaking Components at 500 ppm	Average Replacement Time (hr/leak)	Average Repair Time (hr/leak)	Repair and Replacement Time at 500 ppmv (hrs/yr)	Annual Repair and Replacement Labor Cost	Annual Replacement Part Cost at 500 ppm	Total Annual Repair and Replacement Cost at 500 ppmv
Valves	18,553	46.38	4.00	0.17	78.94	$10,421	$2,782.98	$13,204
Flanges	21,085	52.71	4.00	0.17	89.72	$11,843	$1,750.07	$13,593
Connectors	61,911	154.78	4.00	0.17	263.43	$34,773	$3,429.87	$38,203
Pumps	101	0.25	40.00	0.00	10.08	$1,331	$41.86	$1,372
Open-ended Lines	2	0.00	4.00	0.17	0.01	$1	$0.04	$1
Other Components	5,779	14.45	40.00	0.00	577.92	$76,285	$3,198.79	$79,484
Total	**107,431**	**268.58**			**1,084.84**	**$134,653**	**$11,203.60**	**$145,857**

The modification of exemption 4.4 of Rule 4623 has introduced 811 tanks that were previously exempt. The District identified 210 of these tanks that will now be required to comply with Table 4 or Table 5 of proposed Rule 4623. Table C-11 illustrates the cost to retrofit these with a minimum form of control.

Table C-11 Addition of Pressure Vacuum Relief Valve for Tanks Subject to 4623

Component Type	Number of Tanks[41]	Annualized Cost of a PVRV [42]	Total
PVRV	210	$1,490	$312,900

33 Number of components affected
34 Number of leaking components = (Number of components) x (Leak Fraction in Table C-4)
35 Average Replacement time is based on EPA rulemaking Subpart OOOOa (https://www.epa.gov/sites/default/files/2016-08/documents/2016-compliance-guide-oil-natural-gas-emissions.pdf)
36 Average Repair time is based on EPA rulemaking Subpart OOOOa (https://www.epa.gov/sites/default/files/2016-08/documents/2016-compliance-guide-oil-natural-gas-emissions.pdf)
37 Repair and Replacement Time = Number of Leaking Components x (Average Repair Time and Average Replacement Time)
38 Annual Repair and Replacement Labor Cost = (Repair and Replacement Time) x ($133/hour)
39 Annual Replacement Parts Cost = (Number of leaking component x replacement %) x (Cost of Part)
40 Total Annual Repair and Replacement Cost = Annual Repair and Replacement Labor Cost + Annual Replacement Parts Cost
41 Number of tanks from exemption 4.4 (210) of Rule 4623 required to install a PVRV.
42 Annualized cost over 10 years

Table C-12 Repair and Replacement Cost Analysis for Rule 4624 at 500 ppmv

Component Type	Number Components [43]	Leaking Components at 500 ppm [44]	Average Replacement Time (hr/leak) [45]	Average Repair Time (hr/leak)[46]	Repair and Replacement Time at 500 ppmv (hrs/yr)[47]	Annual Repair and Replacement Labor Cost[48]	Annual Replacement Part Cost at 500 ppm[49]	Total Annual Repair and Replacement Cost at 500 ppmv[50]
Valves	6,438	32.19	4.00	0.17	27.39	$3,616	$966	$4,582
Flanges	6,317	31.59	4.00	0.17	26.88	$3,548	$524	$4,072
Connectors	26,406	132.03	4.00	0.17	112.36	$14,831	$1,463	$16,294
Pumps	84	0.42	40.00	0.00	8.40	$1,109	$35	$1,144
Open-ended Lines	-	0.00	4.00	0.17	0.00	$-	$-	$-
Other Components	756	3.78	40.00	0.00	75.60	$9,979	$418	$10,398
Total	**40,001**	**200.01**			**250.63**	**$33,083**	**$3,406**	**$36,489**

C. Inspection Cost for LDAR Rules

The District concludes that under current rules, the majority of facilities are conducting quarterly LDAR inspections for current District requirements, COGR, or Best Management Practices. Table C-13 presents the total components affected by the proposed leak limit change. Table C-13 also uses labor information provided to the District.

---

[43] Number of components affected
[44] Number of leaking components = (Number of components) x (Leak Fraction in Table C-4)
[45] Average Replacement time is based on EPA rulemaking Subpart OOOOa (https://www.epa.gov/sites/default/files/2016-08/documents/2016-compliance-guide-oil-natural-gas-emissions.pdf)
[46] Average Repair time is based on EPA rulemaking Subpart OOOOa (https://www.epa.gov/sites/default/files/2016-08/documents/2016-compliance-guide-oil-natural-gas-emissions.pdf)
[47] Repair and Replacement Time = Number of Leaking Components x (Average Repair Time and Average Replacement Time)
[48] Annual Repair and Replacement Labor Cost = (Repair and Replacement Time) x ($133/hour)
[49] Annual Replacement Parts Cost = (Number of leaking component x replacement %) x (Cost of Part)
[50] Total Annual Repair and Replacement Cost = Annual Repair and Replacement Labor Cost + Annual Replacement Parts Cost

Table C-13 Cost of LDAR Inspection at 500 ppmv

Rule	Total Components[51]	Component Check (hr)[52]	Inspection (hr)[53]	Labor Cost (hr)[54]	Increase Cost of Inspection at 500 ppmv (Quarter)[55]	Total Increased Annual Cost of LDAR Inspections[56]
4401	893,392	63	14,166	$133.00	$1,771,013	$2,879,631
4409	1,511,035	63	23,959	$133.00	$1,167,165	$4,633,556
4455	1,708	63	27	$133.00	$1,201	$4,767
4623	179,052	63	2,839	$133.00	$151,040	$824,472
4624	40,001	63	634	$133.00	$28,119	$111,631
Total	**2,625,188**	**-**	**41,626**	**-**	**$3,095,089**	**$8,454,056**

Table C-6 and Table C-10 identify components subject to COGR that will now be subject to District Rules 4401 and Rules 4623 respectively. Additionally, those same components are also used to calculate the cost of performing LDAR inspections at 500 ppmv. However, those components only saw a cost increase from lowering the leak threshold from 1,000 ppmv to 500 ppmv.

IV. Incremental Cost Effectiveness Analysis

The CH&SC section 40920.6(a) requires an incremental cost-effectiveness analysis for BARCT rules or emission reduction strategies when there is more than one control option that would achieve the emission reduction objective of the proposed amendments. The incremental cost effectiveness is the difference in cost between more effective controls divided by the additional emission reductions achieved. Incremental cost-effectiveness is calculated as follows:

$$\textit{Incremental Cost Effectiveness} = (C_{alt} - C_{proposed}) / (E_{alt} - E_{proposed})$$

Where:
$C_{proposed}$ is the present worth value of the proposed control option;
$E_{proposed}$ are the emission reductions of the proposed control option;
C_{alt} is the present worth value of the alternative control option; and
E_{alt} are the emission reductions of the alternative control option

[51] Total components affected
[52] Component Check = (CARB information (34)+Company1 (100)+Company2 (150) / 3) x (1.5))*
[53] Inspected components per hour = (Total Components)/(Components Checked (hr))
[54] Labor Cost = (Company1 ($120) +Company2($120) + Company3($120) + Company4($170)) / 4
[55] Cost of Inspection Quarter= (Inspected components (hr)) x (Labor cost) – (Current Cost)
[56] Total Cost = (Cost of Inspection Quarter x 4) – (Current Cost)

A. 100 ppmv Leak Limit

The District evaluated the potential of lowering the LDAR threshold to 100 ppmv as shown in Table C-14 below. District staff estimates that a leak limit of 100 ppmv will likely result in more leaking components that need replacement when compared to a 500 ppmv limit.

Table C-14 Incremental Cost Effectiveness at 100 ppmv

Incremental Cost Effectiveness from 500 ppmv to 100 ppmv			
Rule	**Emission Reductions from 500 ppmv to 100 ppmv VOC tons/yr**[57]	**Cost Increase from 500 ppmv to 100 ppmv**[58]	**Incremental Cost Effectiveness $/ton VOC**[59]
4401	7.88	$4,277,845	$543,004
4409	16.39	$7,327,239	$447,095
4455	0.05	$28,464	$630,797
4623	1.93	$754,804	$392,080
4624	0.43	$189,293	$435,826
Total	**26.67**	**$12,577,645**	**$471,581**

While the emission reductions of requiring a leak threshold of 100 ppmv are higher than the 500 ppmv threshold, the component replacement cost, along with the extra hours of labor needed to replace the faulty components, results in higher costs and cost-effectiveness. The incremental cost effectiveness analysis did not demonstrate that alternate leak levels were more cost effective, therefore this leak level was not chosen.

[57] Incremental Emissions Reduction= (Emissions Reduction at 100 ppmv) – (Emissions Reduction at 500 ppmv)
[58] Cost Increase = (Cost at 100 ppmv) – (Cost at 500 ppmv)
[59] Incremental Cost Effectiveness = (Cost Increase[58])/(Incremental Emissions Reduction[57])

This page intentionally blank.