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CALIFORNIA AIR POLLUTION CONTROL OFFICERS ASSOCIATION

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May 26, 1998

Air Pollution Control Officers

Subject: **Incremental Cost-Effectiveness Guidance Document for Rule Development**

At the direction of the Board, the CAPCOA Engineering Managers Committee formed a subcommittee to address the issue of how districts should comply with the mandate to perform an incremental cost-effectiveness analysis for the adoption of certain district rules. This subcommittee developed the attached guidance document, which has been reviewed by the CAPCOA Engineering managers Committee. The document has also been reviewed by members of the CAPCOA Legal Committee and by CARB legal staff. Drafts of the document have also been provided on an ongoing basis to the California Council for Environmental Balance (CCEEB) and the Western States Petroleum Association. CCEEB provided comments on November 7, 1997, which have been addressed and CCEEB has been complementary of the document.

On March 26, 1998, the CAPCOA Board approved this guidance document, and it is now being distributed to all Districts. Any questions regarding the document can be addressed to Mike Villegas, of the Ventura County APCD, at (805) 645-1412.

Sincerely,

Mike Kussow
CAPCOA President

Attachment

California Air Pollution Control Officers Association Guidance Document: Incremental Cost-Effectiveness Calculation Procedures for Rule Adoption

Approved: March 26, 1998

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INCREMENTAL COST EFFECTIVENESS CALCULATION PROCEDURES FOR RULE ADOPTION
3/26/98

Background:

Health and Safety Code Section 40920.6(a) requires districts to identify one or more potential control options that achieves the emission reduction objectives for the regulation. The districts are required to assess the cost-effectiveness of all potential control options, and calculate the incremental cost-effectiveness (IC/E) for the options. Section 40920.6(a)(3) states that incremental cost-effectiveness shall be calculated as *"the difference in the dollar costs divided by the difference in the emission reduction potentials between each progressively more stringent potential control option as compared to the next less expensive control option."*

This requirement to perform IC/E analyses applies to regulations that are adopted or amended to meet the California Clean Air Act requirements for BARCT or all feasible measures to control ROC/VOC, NOx, or SOx. These measures do not include PM_{10} or toxics rules.

District staff must identify at least one potential control option that can achieve the emission reduction objective of the regulation. If only one control option can achieve the emission reduction objective of the regulation, only one must be identified. The absolute cost-effectiveness must be calculated for all identified options. If more than one option is identified, then the IC/E should be calculated between each more progressively effective (from an emission reduction standpoint) control option. If only one option has been identified, it is not necessary to calculate IC/E. Districts are not required to calculate IC/E for the option of allowing ERCs in lieu of complying with a prohibitory rule. Districts may choose to calculate IC/E for the option of allowing ERCs in lieu of complying with a prohibitory rule, at the District's discretion. If a control option would not achieve the emission reduction objectives, districts can reject it without having to present the IC/E between the insufficient option and an option that would achieve the needed emission reductions. Although the legislation does not require districts to analyze options that do not achieve the emission reduction objective of the regulation, if options are provided by industry it may be advisable to analyze their absolute and incremental cost-effectiveness and present them as options for the governing Board to consider. The governing Board should be made aware when any option discussed does not meet the emission reduction objective of the regulation.

When adopting or amending a rule to implement a measure, the findings should include a statement that absolute cost-effectiveness and incremental cost-effectiveness were considered. It is probably easiest to reference the actual data (which could be in the staff report) in the findings.

Results of an IC/E analysis may persuade a district's governing board to adopt a rule that does not meet the emission reduction objective for the regulation. The District must consider the effectiveness of the rule in meeting the requirements of Chapter 10 of the California Health and

Safety Code. Any emission reduction shortfall should be disclosed at the adoption hearing, and it should be addressed as part of the district's air quality planning process.

Another issue raised was the discussion of IC/E analyses at a meeting (workshop or advisory committee meeting) preceding the rule adoption hearing. There is no legal requirement for IC/E discussion at such a pre-meeting, but it would probably be beneficial and preferable. The staff report could then summarize the results of the pre-meeting(s) and include discussion of the considerations required by Section 40920.6.

The sections that follow explain how a district may: 1) calculate the absolute cost-effectiveness for a particular control option; and 2) calculate the incremental cost-effectiveness between control options. The district must consider and review the results of both calculations as part of the overall cost-effectiveness analysis.

IC/E data represents the added cost to achieve an incremental emission reduction between two control options. It should be pointed out that IC/E should not be compared directly to a cost-effectiveness threshold that was developed for absolute cost-effectiveness analysis. Historically, air districts have utilized absolute cost-effectiveness to assess the economic feasibility of new and amended regulations. The IC/E values provide another measure for economic assessment. However, the data from these two methods of economic assessment should not be confused, and a comparison of an incremental cost-effectiveness value with an air district's absolute cost-effectiveness threshold could be inappropriate. The IC/E calculations, by design, yield values that can be significantly greater than the values from the absolute cost-effectiveness calculations. Such comparisons may erroneously make a cost-effective alternative seem exceedingly expensive.

The district should review the IC/E values to determine if the added cost for a more effective control option is reasonable when compared to the additional emission reductions that would be achieved by the more effective control option. For example, option A might achieve an 80 percent reduction and option B might achieve an 85 percent reduction, but at a higher cost. The district will have to consider if the additional cost of option B is warranted by the additional emission reduction.

<u>Absolute Cost-Effectiveness</u>:

The absolute cost-effectiveness should be calculated taking into account both capital and operating costs, to the extent that data is available. Capital costs may include: 1) purchased equipment cost, and 2) direct and indirect installation costs. Operating costs may include: 1) direct and indirect costs, and 2) cost savings. It is not necessary to provide individual cost estimates for each of the elements that make up both capital and operating costs, as overall estimates for capital and operating costs can be sufficient.

The absolute cost may be calculated using the levelized cash flow (LCF) method or the discounted cash flow (DCF) method. The LCF method is also referred to as the annualized cash flow method, and the DCF method is also referred to as the present value method.

Using the LCF (annualized) method:

Step 1: Calculate total annualized costs.

$$\text{Total Annualized Costs (\$/yr)} = A_c + C_c\left[\frac{i(1+i)^n}{(1+i)^n - 1}\right]$$

where:
A_c = Annual Operating Costs
C_c = Total Capital Costs
i = interest rate (see discussion on page 5)
n = number of years in amortization period (useful life of project)

$$\text{Note: Capital Recovery Factor} = \left[\frac{i(1+i)^n}{(1+i)^n - 1}\right]$$

Note: Annual operating costs (A_c) are assumed to be constant. If annual operating costs are not constant, A_c would be calculated by finding the present value of the varying annual costs (use present value factor), and then multiplying the present value by a capital recovery factor to annualize the cost.

Step 2: Emission Reduction

Calculate annual emission reduction in tons per year.

Annual emission reduction (tons/yr) = Current Emissions - Controlled Emissions

Step 3: Calculate absolute cost-effectiveness by dividing total annualized costs by annual emission reduction (result in \$/ton)

Using the DCF (present value) method:

Step 1: Calculate present value of control costs.

$$\text{Present Value of Control Cost (\$)} = C_c + A_c\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$$

where:
A_c = Annual Operating Costs
C_c = Total Capital Costs
i = interest rate (see discussion on page 5)
n = number of years in amortization period (useful life of project)

Note: $\text{Present Value Factor} = \left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$

Step 2: Emission Reduction

Calculate total emission reduction over life of project, in tons.

Total Emission Reduction = (Annual Emission Reduction)(n)

where:
n = useful life of project (amortization period) in years

Step 3: Calculate absolute cost-effectiveness by dividing present value of control costs by total emission reduction (result in \$/ton).

Incremental Cost-Effectiveness:

In cases where there is more than one control option for a proposed rule, the absolute cost-effectiveness must be calculated for each option. Then calculate the incremental cost-effectiveness for each progressively more effective control option. When evaluating various control options consistent economic and financial assumptions, and cost-effectiveness methods should be utilized.

For the LCF method:

$$\text{IC/E (\$/ton)} = \frac{\left(TAC_{option2} - TAC_{option1}\right)}{\left(AER_{option2} - AER_{option1}\right)}$$

where:
TAC = total annualized costs ($/yr)
AER = annual emission reduction (tons/yr)

For the DCF method:

$$\text{IC/E (\$/ton)} = \frac{\left(PV_{option2} - PV_{option1}\right)}{\left(TER_{option2} - TER_{option1}\right)}$$

where:

PV = present value of control costs ($)
TER = total emission reduction (tons)

Note: This DCF formula for calculating the IC/E assumes that the useful life of the projects (option 1 and option 2) is the same. If the two options being compared have different useful life periods, then: 1) the numerator of the formula would be modified by multiplying each of the present values for the options by the appropriate cost recovery factor ("n" would vary in cost recovery factor), and 2) the denominator would be modified by dividing each of the total emission reduction values by the useful life of the respective project option (n).

Use of LCF or DCF Methods:

The calculation procedures presented here are for both the LCF and DCF methods, and it is important to note the use of these methods should be consistent in both a district's AQMP and rule development process. For example, if DCF is used in development of the AQMP, then DCF should also be used in the rule development process. For a detailed discussion of the LCF and DCF methods see References.

Interest Rates:

There are two recommended options for estimating interest rates: the market interest rate and the real interest rate.

The market interest rate can be estimated by many methods. For example, the market rate could be estimated as the U.S Treasury security rate plus two percent. In this example, the term of the U.S. Treasury security should correspond to the useful life of the equipment/project. For example, a U.S. Treasury security maturing in 10 years (plus 2 percent as a risk factor) would be used to set the market interest rate for equipment with a useful life of 10 years. It is advisable to use a recent average rate for Treasury securities. For example, the average rate for a 10-year U.S. Treasury security for 1996 was 6.3 percent; therefore, the market rate could be estimated to be 8.3 percent (assuming 10-year project life).

Another option is the use of the real interest rate, which generally is between four and six percent.

Appendix:

"Chapter V, Cost Effectiveness , and Appendix II, Rule 1176, Cost Effectiveness Calculations," *Final Staff Report for Proposed Amended Rule 1176 - VOC Emissions from Wastewater Systems,* South Coast Air Quality Management District, September 13, 1996.

References:

Appendix IV-D Discount Cash Flow method as Applied to the Cost Analysis of Control Measures, South Coast Air Quality Management District, March 1989.

APPENDIX A

"Chapter V, Cost Effectiveness , and Appendix II, Rule 1176, Cost Effectiveness Calculations," *Final Staff Report for Proposed Amended Rule 1176 - VOC Emissions from Wastewater Systems*, South Coast Air Quality Management District, September 13, 1996.

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

FINAL STAFF REPORT FOR

PROPOSED AMENDED RULE 1176 - VOC EMISSIONS FROM WASTEWATER SYSTEMS

Dated: September 13, 1996

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CHAPTER V

COST-EFFECTIVENESS

CHAPTER V COST-EFFECTIVENESS

Pursuant to Health and Safety Code Section 40920.6, prior to adopting rules or regulations to meet the requirement for BARCT technology pursuant to Sections 40918, 40919, 40920, and 40920.5, or for a feasible measure pursuant to Section 40914, AQMD is required by the Health and Safety Code to identify one or more potential control options which achieve emission reduction objectives, determine the cost-effectiveness of each potential control option and determine the incremental cost-effectiveness of potential control options.

In order to determine cost-effectiveness, the cost of a potential control option is divided by the estimated emission reduction potential for such control option. Therefore, emission reduction estimates from Chapter III along with the cost of utilizing each option are used to calculate cost-effectiveness. Staff chose carbon adsorption as a control option representing high cost because of the high replacement cost of the carbon even though the initial cost and installation cost are low compared to other control devices. The flameless thermal oxidizer was chosen because it represents a more reasonable cost-effective option similar to catalytic and thermal oxidation.

A total of 23 junction boxes are projected to require controls. This includes 18 junction boxes that may have "positive flow" from their vents and an additional five to handle variations in flow pattern as observed during the AQMD surveys. The actual number of APC devices required to control these junction box vents will vary depending on the specific situation at each site. However, for purposes of determining cost-effectiveness of this rule, staff takes a conservative approach by assuming each of these 23 junction boxes will be equipped with an individual APC device. In addition, staff assumes that the refinery which has already installed controls on all DSCs (identified as Refinery 3 in this report) will eventually install 4 additional APC devices under the control option of flameless thermal oxidizer (see Table II-2 of Appendix II). These additional APC devices may be required at Refinery 3 because the refinery has indicated that modifications on their existing control devices may be necessary to meet the proposed rule requirements. The additional APC devices are not required for the option of activated carbon (Table II-3, Appendix II) because Refinery 3 has already controlled these junction boxes with the same technology. Since the number of carbon replacements is dependent on emissions, the additional replacement costs will not significantly affect the overall cost-effectiveness, especially after controls of all other DSCs are considered.

The overall cost-effectiveness (discounted cash-flow method) of the proposed amendments is estimated to be $572 per ton of VOC emission reduction using a combination of controls and flameless thermal oxidizers as APC equipment. If a company chooses to use a different type of APC equipment, this cost-effectiveness could be as high as $4,386 per ton of VOC emission reduction (using carbon adsorbers).

Incremental cost-effectiveness is calculated using the difference in the dollar costs divided by the difference in the emission reduction potentials between each progressively more stringent potential control option as compared to the next less expensive control option. Four control options are identified for incremental cost-effectiveness analysis. These options are listed below in the order of increasing stringency:

Option 1: Control Emissions from Drains Only.

Option 2: Control Emissions from Drains and Junction Box Vents.

Option 3: Control Emissions from Drains, Junction Box Vents, and Manhole Covers.

Option 4: Control Emissions from Totally Enclosed Drainage and Sewer System.

Although Option 4 has the highest level of potential emission reductions, it is not recommended for the purposes of this rule amendment. As indicated earlier, there are concerns over safety issues when an existing open drainage system is to be enclosed completely. The engineering complexity and thus the costs of the conversion may also be prohibitive. Therefore, Option 3 has been recommended as the cost-effective option for the rule amendments.

The detailed cost-effectiveness calculations for each control option and the overall cost-effectiveness of the proposed rule are presented in Appendix II, Tables II-1 through II-4 in this document. The summary of cost-effectiveness analysis is shown in Appendix II, Table II-5. The incremental cost-effectiveness analysis of the control options and an overall summary are given in Appendix II, Table II-6.

The proposed amendments reduce the inspection and monitoring frequencies for DSCs in general. For DSCs equipped with controls, the inspection and monitoring frequency is reduced from monthly to semi-annually. The proposed amendments also reduce the source test frequency and provide cheaper alternative methods to determine compliance for air pollution control devices. For example, cost savings due to the reduced monitoring and source test frequencies could amount to about $148,000 per year just for one of the large refineries alone. Cost savings due to reduced monitoring for other non-refinery facilities such as oil production fields, chemical plants, and other industrial facilities, altogether are estimated to exceed $73,000 per year. The exclusion of the bulk loading terminals from this rule results in an additional monitoring cost savings of in excess of $57,000 per year for the affected facilities. Summary of these cost saving estimates are provided in Appendix II, Table II-7.

However, in order to provide conservative cost estimates, none of the above cost savings due to reduced monitoring and source test frequencies were incorporated in the overall rule cost-effectiveness calculations presented in Appendix II, Tables II-1 through II-6.

Appendix II

Rule 1176 Cost-Effectiveness Calculations

Table II-1: Cost Effectiveness Calculations for All Drains

DISCOUNTED CASH FLOW (DCF) METHOD
COST OF CONTROL = Present Value / Emissions Reduced Over the Equipment Life

Present Value = C + A* PVF (n, r-i)
where: C = upfront capital outlay, A = annual operating & maint. cost
n = economic life of the project, r = market interest rate
i = inflation rate, and
PVF1 = present value factor 1, calculated from the formula in the table
(e.g. if n = 10 years, (r-i) = 4%, ; PVF1 = 8.11)

Total No. of Refinery drains in the District (Based on 1994 Emission Fee Billing Reports)	18,292
No. of controlled drains from 3 Refineries	6,676
Remaining no. of Refinery drains to be controlled	11,616
Emission inventory for Refinery drains (Based on the 1994 EFB data), in tons/day	2.27
Emissions from controlled drains from 3 Refineries, in ton/day	0.80
Remaining uncontrolled Refinery drain emissions, in tons/day	1.47
No. of drains from other sources in the District	305
Default zero emission from each drain, in lb/yr	28.87
Total emissions from drains - other sources, in ton/day	0.012
Total emissions from drains - all sources, in tons/day	1.49
Assumed control efficiency of water seal, in percent	65.0
Estimated drain emissions controlled, in ton/day	0.97
Current I & M program (Monthly inspections):	
No. of inspections required for the total drain population @ 12 insp./yr	223,164
No. of inspections per operator (Assume 100 inspections/day, 5 days/wk, 48 wks/yr)	24,000
No. of operators required for current I & M program	9.30
Annual cost of operator (including salary and benefits)	$ 50,000
Annual cost of OVA operation	$ 2,500
Annual cost of current I & M program	$ 488,171
Future I & M program requirements (Semi-annual inspections):	
No. of inspections required for the total drain population of 18,292 @ 2 insp./yr	36,584
No. of inspections per operator (Assume 100 inspections/day, 5 days/wk, 48 wks/yr)	24,000
No. of operators required for future I & M program	1.52
Annual cost of operator (including salary and benefits)	$ 50,000
Annual cost of OVA operation per operator	$ 2,500
Annual cost of future I & M program	$ 80,028
Annual savings in operation and maintenance costs	$ (408,144)
Present Value (PV) = C + A* PVF (n, r-i)	
Capital cost for each drain (Based on actual cost of $360/drain incurred by a refinery)	$ 400
Capital cost of control for all remaining uncontrolled drains	$ 4,768,400
Equipment Life (n) = 10 years, Real interest (r-i) = 4%, therefore PVF1 =	8.11
Present Value	$ 1,458,354
Cost Effectiveness ($/ ton reduced)	$ 414

Table II-2: Cost Effectiveness Calculations for Junction Boxes with Positive Flow Using Flameless Thermal Oxidizer

No. of JBs with positive flow in the District		18
No. of additional JBs to be controlled due to flow variations		5
No. of JBs from Refinery 3 requiring additional controls		4
Total No. of JBs in the District requiring controls		27
Ave. Emissions for each positive flow JB, in lb/yr		37,789
Total emissions inventory, in tons/yr		340.10
Total emission inventory, in tons/day		0.93
Control Efficiency of flameless thermal oxidizers, in percent		95
Total controlled emissions		0.89
Capital cost of a 5-scfm flameless thermal oxidizer (Includes oxidizer, electric heater, power controller & panel, knockout pot, air eductor, and all instrumentation)	$	55,000
Capital cost of Fume blower		5,000
Sales Tax (8%)		4,800
Freight		1,500
Total Purchased Equipment Cost (PEC)		66,300
Total Capital Cost = 1.61 PEC (From Table 4.2-6, Capital Cost for Thermal Incinerators, EPA Handbook- Control Technologies for HAPs, June 1991)		106,743
Total capital cost for all JBs requiring control		2,882,061
Annual operating and maintenance costs for each thermal oxidizer:		
Cost of electricity for Oxidizer (3kW), blower (1kW), and control panel (1kW) (5kWh total, $0.10/kWh, 50% average usage)	$	2,190
Maintenance cost		1,000
Source test cost (Annual Performance test)		3,000
Total operating & maintenance costs per unit	$	6,190
Total cost of annual operation and maintenance for all JBs requiring controls	$	167,130
Cost of I & M program		none
Present Value (PV) = C + A* PVF (n, r-i)		
Equipment Life (n) = 10 years, Real interest (r-i) = 4%, therefore PVF1 =		8.11
Present value	$	4,237,485
Cost Effectiveness ($/ ton reduced)	$	1,312

Table II-3: Cost Effectiveness Calculations for Junction Boxes with Positive Flow Using Activated Carbon

No. of JBs with positive flow in the District		18
No. of additional JBs to be controlled due to flow variations		5
No. of JBs from Refinery 3 requiring additional controls		0
Total No. of JBs in the District requiring controls		23
Ave. Emissions for each JB with positive flow (lb/yr)		37,789
Ave. Emissions for each positive flow JB (lb/day)		103.53
Wt. of Carbon Required for one day emissions (Assume 15% wt. adsorption capacity)		690
Recommended weight/size of carbon canister (lbs)		2,000
Estimated Life of a 2000-lb canister (days)		2.9
Initial cost of a 2000-lb canister (including vessels)	$	4,000
Total capital cost for all JBs requiring controls	$	92,000
Replacement cost per lb carbon (Based on a manufacturer's carbon reactivation charge of $0.65/lb plus estimated labor cost of $0.35/lb)	$	1.00
Adsorption capacity of a 2000 lb carbon canister (lb)		300
Annual replacement weight of carbon for each positive flow JB (lb)		249,927
Operating cost for each JB	$	249,927
Operating cost for all JBs requiring controls	$	5,748,315
Total no. of inspections/yr (based on monitoring frequency of once every 2 days/ carbon)		4,198
No. of inspections/operator @ 100 insp/day, 5days/wk, 48 wks/yr		24,000
Cost of I & M program/yr (Based on $50,000/operator & $2,500 OVA maint./operator)	$	9,182
Total Annual Operating and Maintenance cost	$	5,757,497
Present Value (PV) = C + A* PVF (n, r-i)		
Capital cost for the initial carbon canisters	$	92,000
Equipment Life (n) = 10 years, Real interest (r-i) = 4%, therefore PVF1 =		8.11
Present value	$	46,785,300
Annual emissions from JBs with positive flow, in tons/day		0.93
Control efficiency of carbon, in percent		95
Annual controlled emissions		0.89
Cost Effectiveness ($/ ton reduced)	$	14,480

Table II-4: Cost Effectiveness Calculations for Junction Boxes with Regular Flow and All Manhole Covers

		Junction Box (Reg. Flow)	*Manhole Covers*
DISCOUNTED CASH FLOW (DCF) METHOD			
COST OF CONTROL = Present Value / Emissions Reduced Over the Equipment Life			
Present Value = C + A* PVF (n, r-i)			
where: C = upfront capital outlay, A = annual op'tng.& maint. cost			
n = economic life of the project, r = market interest rate			
i = inflation rate, and			
PVF1 = present value factor 1, calculated from the formula in the table (e.g. if n = 10 years, (r-i) = 4%; PVF1 = 8.11)			
Total no. of components in the District		158	1,410
Total emissions, in tons/day		0.004	1.85
Assumed control efficiency of water seal for JBs and plugs for MHCs		65.0	65.0
Estimated emissions controlled, in ton/day		0.003	1.203
Future I & M program requirements (Semi-annual inspections):			
No. of inspections required @ 2 insp./yr		316	2,820
No. of inspections per operator (Assume 100 inspections/day, 5 days/wk, 48 wks/yr)		24,000	24,000
No. of operators required for future I & M program		0.01	0.12
Annual cost of operator (including salary and benefits)	$	50,000	50,000
Annual cost of OVA operation per operator	$	2,500	2,500
Annual cost of future I & M program	$	691	6,169
Present Value (PV) = C + A* PVF (n, r-i)			
Capital cost for each unit (Based on actual cost of $360/unit incurred by a refinery)	$	400	400
Total Capital cost of control	$	63,200	564,000
Equipment Life (n) = 10 years, Real interest (r-i) = 4%, therefore PVF1 =		8.11	8.11
Present Value	$	68,806	614,029
Cost Effectiveness ($/ ton reduced)	$	7,250	$ 140

Table II-5: Summary of Cost Effectiveness Calculations
for Drains, Junction Boxes & Manhole Covers

SCENARIO 1: Using Flameless Oxidizer for Positive Flow Junction Box	*All Drains*	*Junction Box (Positive Flow)*	*Junction Box (Regular Flow)*	*All Manhole Covers*	*Total*
Control Options	Water seal / Cap / Plug / Source Reduction	Flameless Oxidizer	Water seal / Cap / Plug / Source Reduction	Plug / Gasket / Caulk	
Emission Inventory (tons/day)	1.49	0.93	0.004	1.85	4.27
Control Efficiency, in percent	65	95	65	65	
Emission Reduction (tons/day)	0.97	0.89	0.003	1.20	3.06
Capital & Installation Costs	4,768,400	2,882,061	63,200	564,000	8,277,661
*Annual Op'tg. & Maint. Costs**	(408,144)	167,130	691	6,169	(234,154)
Present Value (10 yr. lifetime)	1,458,354	4,237,485	68,806	614,029	6,378,674
Cost Effectiveness ($ / Ton Reduced)	$ 414	$ 1,312	$ 7,250	$ 140	$ 572

SCENARIO 2: Using Activated Carbon for Positive Flow Junction Box	*All Drains*	*Junction Box (Positive Flow)*	*Junction Box (Regular Flow)*	*All Manhole Covers*	*Total*
Control Options	Water seal / Cap / Plug / Source Reduction	Activated Carbon	Water seal / Cap / Plug / Source Reduction	Plug / Gasket / Caulk	
Emission Inventory (tons/day)	1.49	0.93	0.004	1.85	4.27
Control Efficiency, in percent	65	95	65	65	
Emission Reduction (tons/day)	0.97	0.89	0.003	1.20	3.06
Capital & Installation Costs	4,768,400	92,000	63,200	564,000	5,487,600
*Annual Op'tg. & Maint. Costs**	(408,144)	5,748,315	691	6,169	5,347,031
Present Value (10 yr. lifetime)	1,458,354	46,785,300	68,806	614,029	48,926,489
Cost Effectiveness ($ / Ton Reduced)	$ 414	$ 14,480	$ 7,250	$ 140	$ 4,386

Note: * Annual operating & maintenance costs for all drains show a reduction due to lesser monitoring frequency.

Table II-6: Summary of Incremental Cost Effectiveness of Control Options

SCENARIO 1: *Using Flameless Oxidizer for Positive Flow Junction Box*	*Option 1* *Drains Only*	*Diff. of Option 1 & 2*	*Option 2* *Drains & JBs*	*Diff. of Option 2 & 3*	*Option 3* *Drains, JBs & MHCs*	*Option 4* *Enclosed Drainage System*
Emission Inventory (tons/day)	1.49	0.94	2.42	1.85	4.27	4.27
Emission Reduction (tons/day)	0.97	0.89	1.85	1.20	3.06	4.27
Present Value (10 yr. lifetime)	1,458,354	4,306,291	5,764,646	614,029	6,378,674	Not Cost Eff.
Cost Effectiveness ($ / Ton Reduced)	$ 414		$ 852		$ 572	Not Cost Eff.
Incremental Cost Effectiveness ($ / Ton Reduced)		$ 1,329		$ 140		

Option 1: Controlling Drains Only
Option 2: Controlling Drains & Junction Boxes
Option 3: Controlling Drains, Junction Boxes & Manhole Covers
Option 4: Enclosing the drainage system totally. This was not evaluated in detail because of cost and technical infeasibility.

SCENARIO 2: *Using Activated Carbon for Positive Flow Junction Box*	*Option 1* *Drains Only*	*Diff. of Option 1 & 2*	*Option 2* *Drains & JBs*	*Diff. of Option 2 & 3*	*Option 3* *Drains, JBs & MHCs*	*Option 4* *Enclosed Drainage System*
Emission Inventory (tons/day)	1.49	0.94	2.42	1.85	4.27	4.27
Emission Reduction (tons/day)	0.97	0.89	1.85	1.20	3.06	4.27
Present Value (10 yr. lifetime)	1,458,354	46,854,106	48,312,460	614,029	48,926,489	Not Cost Eff.
Cost Effectiveness ($ / Ton Reduced)	$ 414		$ 7,139		$ 4,386	Not Cost Eff.
Incremental Cost Effectiveness ($ / Ton Reduced)		$ 14,459		$ 140		

Table II-7: Annual Cost Savings Due to Reduced Monitoring

Facility	No.	Current Monitoring		Future Monitoring		Annual Savings
		Frequency	Annual Cost	Frequency	Annual Cost	
Bulk Terminals[1]	32	Monthly	57,600	None	0	$ 57,600
Chemical Plants[2]	61	Monthly	109,800	Quarterly	36,600	73,200
Refinery 3						
Drains[3]	3,184	Monthly	83,676	Semi-Annual	13,946	69,730
APC Device S.Tests[4]	15	Semi-Annual	90,000	Annual	12,000	78,000
Total			173,676		25,946	147,730

Notes:

[1] There are at least 32 Bulk Terminals which are definitely subject to the monitoring requirements of the current rule. It is assumed that there are 10 drains per terminal and that it will cost $150 per visit to monitor each site.

[2] There are 61 Chemical Plants covered by the current rule. It is assumed that there are 5 drains per chemical plant and that it will cost $150 per visit to monitor each site.

[3] Cost of inspection per drain was calculated based on the following assumptions:
- No. of inspections per operator per year = 24,000
- Annual Cost of operator (salary & benefits) = $50,000
- Annual cost of OVA operation = $2,500
- Therefore cost of monitoring for each drain is $2.19.

[4] There are 15 APC Devices in Refinery 3 which require semi-annual performance tests by the current rule. Based on available data, it is assumed that 11 APC Devices will only require monitoring and no more performance tests. The remaining four APC Devices will still require annual performance test. It is assumed that the cost of each performance test is $3,000.