Category: 23 – Leaks at Petroleum Refineries

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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SUBJECT: Cost Effectiveness for RACT Application to Leaks from Petroleum Refinery Equipment

FROM: G. T. Helms, Chief
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TO: Chief, Air Branch, Regions I-X

At the time the CTG for "Control of Volatile Organic Compound Leaks from Petroleum Refinery Equipment" (EPA 450/2-78-036) was issued, emission factors were in the process of being revised. Therefore, the emission reductions, recovered product savings, and cost effectiveness of controlled VOC could not be determined for this CTG category. The emission factors have now been quantified and the cost effectiveness of applying RACT to leaks from a model refinery has been calculated. The CTG indicates that a medium-size model refinery has a capacity of 15,900 m(3)/day (100,000 bbl/day). Please note that the emission reduction and cost are a function of the number of components and not simply a function of the throughput.

The uncontrolled and controlled emissions are listed in Attachment 1. The calculation of the quantity of recovered product is presented in Attachment 2. The calculation of cost effectiveness is presented in Attachment 3.

Attachments 2 and 3 show that RACT, as applied to a medium-sized model refinery in this VOC source category, is estimated to prevent the release of approximately 2200 Mg of VOC per year, with an estimated value of $330,000. Deducting the annualized costs of capital, monitoring and maintenance labor, and overhead result in a first year savings of $205,000 and subsequent year savings of $275,000 per year. This equates to a cost effectiveness credit of about $93 and $125 per Mg of recovered product.

This information may be helpful to the States in developing regulations for controlling leaks from petroleum refineries. If there are additional questions, please call Tom Williams at 629-5226.

Attachments

cc: VOC Contact, Regions I-X

Attachment I

Emission Factors [a]

Source	Uncontrolled [1] Emission Factor kg/day	Controlled [1,2] Emission Factor kg/day	Number of sources [3] at model refinery
Pumps			
Light liquid [b]	2.7	0.86	125
[4] Heavy liquid [c]	0.50	0.50	125
Compressors [d]	15	3.2	14
Valves			
Gas [e]	0.64	0.091	6,000
Light liquid [b]	0.26	0.091	9,750
[4] Heavy liquid [c]	0.005	0.005	9,750
Drains	0.77	0.50	1,400
Pressure relief devices (gas)	3.9	1.4	130
[4] Flanges	0.007	0.007	64,000

[a] Average emissions from each source
[b] Defined as lighter than kerosene
[c] Defined as kerosene and heavier
[d] Hydrocarbon service
[e] Gas at operating conditions

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[1] Assessment of Atmospheric Emissions from Petroleum Refining, Volume 3, Appendix B. EPA 600/2-80-075c, April 1980.

[2] Proceedings: Symposium on Atmospheric Emissions from Petroleum Refineries (November 1979, Austin, TX). EPA 600/9-80-013, March 1980, pp. 421-440.

[3] Control of Volatile Organic Compound Leaks from Petroleum Refinery Equipment. EPA 450/2-78-036, June 1978.

[4] Cost of monitoring is not included in the cost figures because it is assumed these components will be exempt from the monitoring provisions.

Attachment 2

Calculation of Recovered product for a Medium-Size
Model Refinery (15,900 m(3)/day) (100,000 bbl/day)

Operating Factor = 365 days/year

Emissions

$$\left(\text{Emission Factor}, \frac{\text{kg}}{\text{day}}\right) \times \left(\frac{1\ \text{Mg}}{1000\ \text{kg}}\right) \times \left(\frac{\text{Operating days}}{\text{year}}\right) \times \left(\begin{matrix}\text{Number of}\\ \text{Sources}\end{matrix}\right) = \left(\text{Emissions}, \frac{\text{Mg}}{\text{yr}}\right)$$

Source	Uncontrolled Emissions Mg/yr	Controlled Emissions Mg/yr	Recovered Product Mg/yr
Pumps			
Light Liquid	123	39	84
Heavy Liquid	23	23	0
Compressors	77	16	61
Valves			
Gas	1,402	199	1,203
Light Liquid	925	324	601
Heavy Liquid	18	18	0
Drains	393	256	137
Pressure Relief Devices (Gas)	185	66	119
Flanges	164	164	0
TOTALS	3,310	1,105	2,205

NOTE: Conversion - Mg/yr x 1.1 = tons/yr

Attachment 3

Cost Effectiveness Calculations

$$\begin{pmatrix}\text{Annual Product}\\ \text{Recovery Credits}\end{pmatrix} = \begin{pmatrix}\text{Annual Emission}\\ \text{Reduction}\end{pmatrix} \times \begin{pmatrix}\text{Recovered}\\ \text{Product Value}\end{pmatrix}$$

= 2205 Mg/yr x $150/Mg [5]
= $330,000/yr

$$\begin{pmatrix}\text{Total Annualized}\\ \text{Cost}\end{pmatrix} - \begin{pmatrix}\text{Annual Product}\\ \text{Recovery Credit}\end{pmatrix} = \begin{pmatrix}\text{Savings}\end{pmatrix}$$

First year cost $125,000/yr [6] – $330,000 = ($205,000) [7]
Ongoing annual cost $55,000/yr [2] – $330,000 = ($275,000)

$$\begin{pmatrix}\text{Cost Effectiveness}\end{pmatrix} = \begin{pmatrix}\dfrac{\text{Total Annualized Cost}}{\text{Annual Emission Reduction}}\end{pmatrix}$$

First year = ($205,000)/2205 Mg = ($92.97/Mg) or ($84.34/T)
Ongoing year = ($275,000)/2205 Mg = ($124.72/Mg) or ($113.14/T)

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[5] From CTG - basis 1977 fourth quarter. (The recovered product value has increased substantially from 1977 and the cost of the monitoring and repair program has also increased.

[6] Developed using the CTG and the preliminary Draft of Background Information for Proposed Standards for VOC Fugitive Emissions in Synthetic Organic Chemical Manufacturing Industry, page 7-3, EPA, RTP, North Carolina, March 1980.

[7] ( ) indicates savings