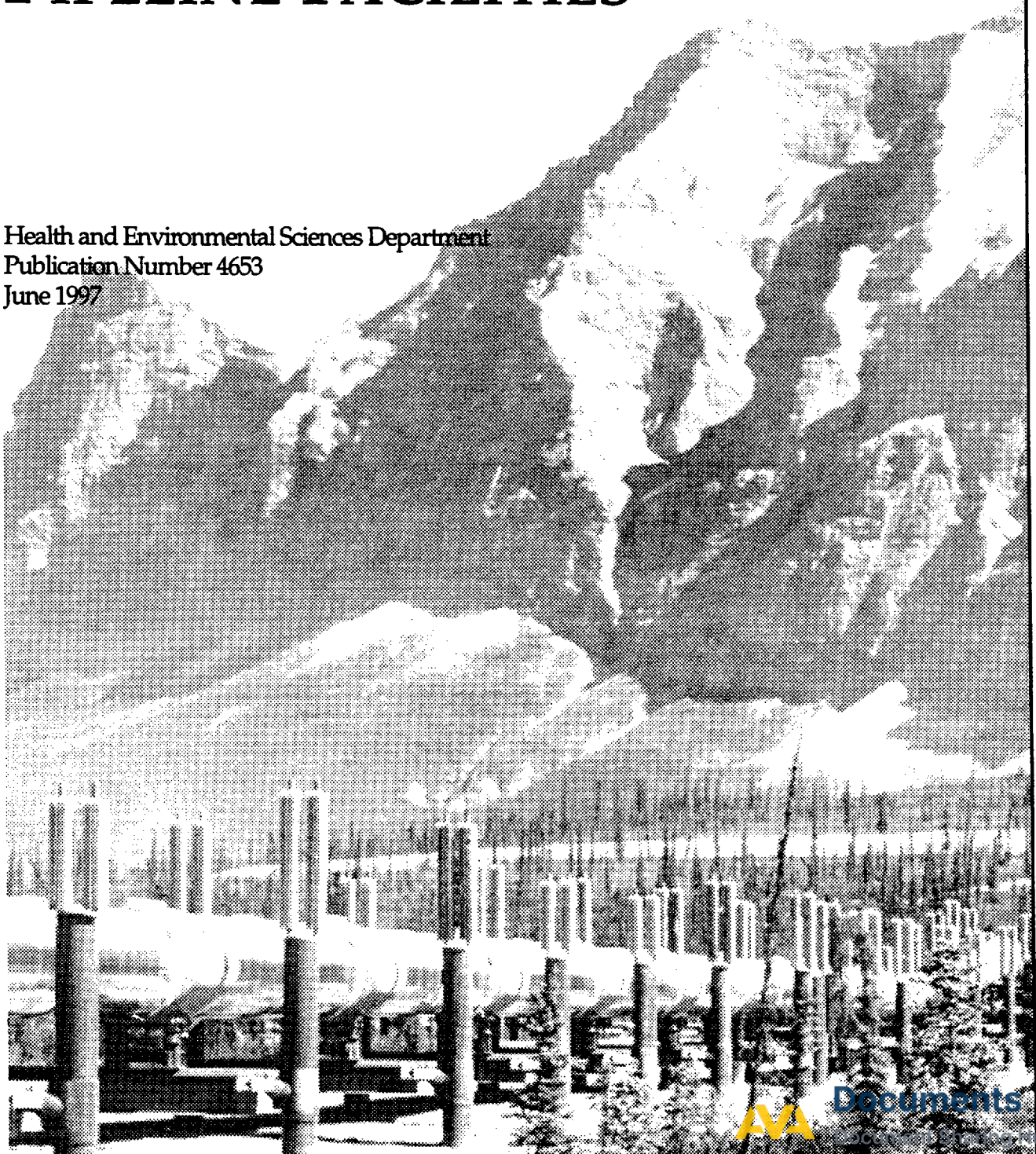


FUGITIVE EMISSION FACTORS FOR CRUDE OIL AND PRODUCT PIPELINE FACILITIES

Health and Environmental Sciences Department
Publication Number 4653
June 1997



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One of the most significant long-term trends affecting the future vitality of the petroleum industry is the public's concerns about the environment, health and safety. Recognizing this trend, API member companies have developed a positive, forward-looking strategy called STEP: Strategies for Today's Environmental Partnership. This initiative aims to build understanding and credibility with stakeholders by continually improving our industry's environmental, health and safety performance; documenting performance; and communicating with the public.

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- ◆ To counsel customers, transporters and others in the safe use, transportation and disposal of our raw materials, products and waste materials.
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- ◆ To extend knowledge by conducting or supporting research on the safety, health and environmental effects of our raw materials, products, processes and waste materials.
- ◆ To commit to reduce overall emission and waste generation.
- ◆ To work with others to resolve problems created by handling and disposal of hazardous substances from our operations.
- ◆ To participate with government and others in creating responsible laws, regulations and standards to safeguard the community, workplace and environment.
- ◆ To promote these principles and practices by sharing experiences and offering assistance to others who produce, handle, use, transport or dispose of similar raw materials, petroleum products and wastes.

Fugitive Emission Factors for Crude Oil and Product Pipeline Facilities

Health and Environmental Sciences Department

API PUBLICATION NUMBER 4653

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ABSTRACT

The objective of this project was to develop a set of emission factors for fugitive hydrocarbon emissions from equipment components at crude oil and product pipeline facilities. To accomplish this, more than 33,000 equipment components were screened on ten pipeline facilities within the United States. Total emissions from the pipelines screened in this study ranged from 0.11 pounds-per-day to 10.34 pounds-per-day when calculated using instrument screening values and 1995 EPA Correlations/Factors. The same sites would be predicted to have total emissions ranging from 0.13 pounds-per-day to 8.45 pounds-per-day using the emission factors developed in this study.

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
EXECUTIVE SUMMARY.....	ES-1
1. STUDY METHODOLOGY	1-1
INTRODUCTION	1-1
Objectives.....	1-1
Scope	1-1
DESCRIPTION OF METHODOLOGY	1-2
Study Site Selection	1-3
Component Counting Procedures	1-4
Emissions Screening Procedures	1-5
DATA MANAGEMENT	1-6
Development of Emissions Factors.....	1-6
Calculation of Site Specific Emissions	1-7
2. RESULTS AND ANALYSIS.....	2-1
DATA COLLECTION	2-1
DEVELOPMENT OF EMISSION FACTORS.....	2-4
Emissions from Default Zero Components	2-4
Emissions from Components with Screening Values Between Background and 100,000 ppmv	2-5
Emissions from Components with Screening Values of 100,000 ppmv or More	2-5
Calculation of Total Emissions and Emission Factors.....	2-6
CALCULATION OF TOTAL EMISSIONS FROM EACH PIPELINE	2-12
Calculation of Total Emissions Using Screening Values and EPA Correlations/Factors	2-12
Calculation of Total Emissions Using Inventories and This Study's Emission Factors	2-13
Comparison of Two Methods for Calculating Site Specific Fugitive Emissions	2-14
3. CONCLUSIONS	3-1
4. REFERENCES	R-1

TABLE OF CONTENTS (Continued)

<u>Section</u>		<u>Page</u>
ATTACHMENT A	COMPONENTS WITH SCREENING VALUES ABOVE BACKGROUND BUT LESS THAN 100,000 PPMV	A-1
ATTACHMENT B	CALCULATION OF SITE SPECIFIC EMISSIONS USING SCREENING VALUES AND 1995 EPA CORRELATIONS/FACTORS.....	B-1

LIST OF TABLES

<u>Table</u>	<u>Page</u>
ES-1 EPA Default Zero Factors, Correlation Equations, and Pegged Source Factors (100,000 ppmv)	ES-2
ES-2 Emission Factors for Uncontrolled Pipelines	ES-3
ES-3 Comparison of Two Methods for Calculating Site Specific Fugitive Emissions from Pipelines.....	ES-3
2-1 Components Screened	2-2
2-2 Number (and percentage) of Components with Screening Values Between Background and 100,000 ppmv	2-2
2-3 Number (and percentage) of Components with Screening Values of 100,000 ppmv or More	2-2
2-4 Frequency of Components with Screening Values Above Background at Uncontrolled Pipelines, Production Sites, and Marketing Terminals (includes pegged sources)	2-3
2-5 EPA Default Zero Factors, Correlation Equations, and Pegged Source Factors (100,000 ppmv)	2-4
2-6 Default Zero Emissions from Uncontrolled Pipelines.....	2-5
2-7 Fugitive Emissions from Pegged Sources (100,000 ppmv) at Uncontrolled Pipelines	2-6
2-8 Calculation of Emission Factors for Uncontrolled Pipelines	2-7
2-9 Comparison of Pipeline Emission Factors to Production Emission Factors (lb/component-day).....	2-8
2-10 Comparison of Pipeline Emission Factors to Marketing Terminal and Refinery Emission Factors(lb/component-day).....	2-8
2-11 Calculation of Total Emissions for Site 1 Using Screening Values and 1995 EPA Correlations/Factors	2-12
2-12 Total Emissions Calculated for Ten Pipelines Using Screening Values and 1995 EPA Correlations/Factors	2-13
2-13 Total Emissions from Light Crude Oil Pipelines Calculated Using This Study's Factors	2-13
2-14 Total Emissions from Heavy Crude Oil Pipelines Calculated Using This Study's Factors	2-14
2-15 Total Emissions from Product Pipelines Calculated Using This Study's Factors	2-14

LIST OF TABLES (Continued)

<u>Table</u>	<u>Page</u>
2-16 Comparison of Two Methods for Calculating Site Specific Fugitive Emissions from Pipelines.....	2-14
3-1 Emission Factors for Uncontrolled Pipelines	3-1

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1-1 Pipeline Study Sites.....	1-3
2-1 Frequency of Components with Screening Values Above Background at Uncontrolled Pipelines, Production Sites, and Marketing Terminals	2-3
2-2 Comparison of Emission Factors for Threaded Connections	2-9
2-3 Comparison of Emission Factors for Flanges.....	2-9
2-4 Comparison of Emission Factors for Valves.....	2-10
2-5 Comparison of Emission Factors for Open Ended Lines.....	2-10
2-6 Comparison of Emission Factors for Pump Seals	2-11
2-7 Comparison of Emission Factors for Other Components	2-11

EXECUTIVE SUMMARY

Emission factors for fugitive hydrocarbon emissions were developed for light crude oil pipelines, heavy crude oil pipelines, and product pipelines. Pipeline facilities included in this study were originating pump stations, booster pump stations, break-out pump stations, central shipping stations, and terminals. This study included both controlled and uncontrolled pipeline facilities. Uncontrolled facilities are facilities that are not regulated by agency enforced fugitive emissions monitoring programs. Facilities that are regulated by agency enforced programs are considered to be controlled facilities.

A total of 33,588 threaded connections, flanges, valves, open ended lines (also referred to as "open ended valves"), pump seals, and other components on ten pipelines across the United States of America were screened with portable hydrocarbon detection equipment. A total of 109 components were found to have instrument screening values above the background concentration but below the pegged value(100,000 ppmv). One component (a pump seal on an uncontrolled light crude oil pipeline) was found to have an instrument screening value higher than 100,000 ppmv.

Pipeline components were grouped into the following categories:

- Light crude oil -- uncontrolled (five pipelines);
- Light crude oil -- controlled (one pipeline);
- Heavy crude oil -- uncontrolled (one pipeline);
- Product -- uncontrolled (two pipelines); and
- Product -- controlled (one pipeline).

Emission frequencies (number of components with measurable hydrocarbon emissions per 100 components screened) of uncontrolled light crude oil and uncontrolled heavy crude oil pipeline facilities are similar to the emission frequencies of light crude and heavy crude production sites, respectively (see Table 2-4 and Figure 2-1 on page 2-3). The emission frequency of uncontrolled product pipeline facilities is between the

emission frequencies of heavy crude production and marketing terminals. Based on the limited number of data points obtained at controlled pipelines, their emission frequencies may be considered similar, though possibly lower, than the emission frequencies of uncontrolled pipeline facilities.

Emission factors were calculated for components at light crude oil, heavy crude oil, and product pipeline facilities using the 1995 Environmental Protection Agency (EPA) default zero factors, correlation equations, and pegged source factors (100,000 ppmv). Emissions from components with screening values equal to background were calculated using the default zero factors. Emissions from components with screening values above background but less than 100,000 ppmv were calculated using correlation equations. The measured screening values were corrected for background if the background was 5% or more of the measured screening values. Emissions from one component that pegged the portable detection instrument at 100,000 ppmv were calculated using a pegged source factor. EPA default zero factors, correlation equations, and pegged source factors (100,000 ppmv) are shown in Table ES-1. The pipeline emission factors developed in this study are shown in Table ES-2.

Table ES-1. EPA Default Zero Factors, Correlation Equations, and Pegged Source Factors (100,000 ppmv)

Component	Default Zero Factor (lb/day)	Correlation Equation	Pegged Source Factor (100,000 ppmv)
Threaded	0.00040	THC (lb/day) = $7.99\text{E-}05(\text{SV})^{0.735}$	1.6 lb/day
Flange	0.00002	THC (lb/day) = $2.35\text{E-}04(\text{SV})^{0.703}$	4.4 lb/day
Valve	0.00041	THC (lb/day) = $1.21\text{E-}04(\text{SV})^{0.746}$	7.4 lb/day
Open-end	0.00011	THC (lb/day) = $1.14\text{E-}04(\text{SV})^{0.704}$	4.2 lb/day
Pump Seal	0.00127	THC (lb/day) = $2.55\text{E-}03(\text{SV})^{0.610}$	8.5 lb/day
Other	0.00021	THC (lb/day) = $6.98\text{E-}04(\text{SV})^{0.589}$	5.8 lb/day

SOURCE: US EPA Protocol for Equipment Leak Emission Estimates (EPA-453/R-95-017), Nov. 1995.

*SV refers to the measured screening value.

Table ES-2. Emission Factors for Uncontrolled Pipeline Facilities
(lb/component-day)

	Threaded	Flanges	Valves	OEL*	Pumps	Others
Light Crude	0.00040	0.00002	0.00043	0.00080	0.12214	0.00021
Heavy Crude	0.00040	0.00002	0.00041	0.00055	0.04175	0.00021
Product	0.00043	0.00002	0.00075	0.00358	0.11062	0.00251

*Open Ended Lines.

Emission factors for components at uncontrolled light crude oil pipeline facilities are generally lower than emission factors for the same components at light crude oil production sites (see Figures 2-2 to 2-7 on pages 2-9 to 2-11). Emission factors for uncontrolled heavy crude oil pipeline facilities are approximately the same as those for heavy crude oil production. For most equipment component types, emission factors for uncontrolled product pipelines are lower than for the same components at marketing terminals.

Total fugitive hydrocarbon emissions were calculated for each pipeline using two methods: 1) site specific screening values with EPA Correlations/Factors, and 2) site specific inventories with emission factors developed in this study. The two sets of emission rates are shown in Table ES-3.

Table ES-3. Comparison of Two Methods for Calculating Site Specific Fugitive Emissions from Pipeline Facilities

Pipeline Number	Pipeline Type	Calculated Emissions (lb/day)		
		Using EPA Correlations/ Factors	Using This Study's Factors	Difference(lb/day) This Study's Factors vs. EPA Correlations/ Factors
1	Light Crude (U)*	5.04	4.51	-0.53
2	Light Crude (U)*	1.92	6.90	4.98
3	Light Crude (U)*	6.45	8.45	2.00
4	Light Crude (U)*	10.34	3.29	-7.05
5	Light Crude (U)*	0.25	0.73	0.48
6	Light Crude (C)**	0.36	0.37	0.01
7	Heavy Crude (U)*	1.32	1.32	0.00
8	Product (U)*	1.35	1.43	0.08
9	Product (U)*	6.34	6.25	-0.09
10	Product(C)**	0.11	0.13	0.02

*U = Uncontrolled.

**C = Controlled.

Total emissions from the pipelines calculated using instrument screening values and 1995 EPA Correlations/Factors range from 0.11 pounds-per-day to 10.34 pounds-per-day; total emissions calculated using component counts (inventories) and the new emission factors developed in this study range from 0.13 pounds-per-day to 8.45 pounds-per-day.