SANTA BARBARA COUNTY

AIR POLLUTION CONTROL DISTRICT

POLICIES AND PROCEDURES

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Topic: Calculation of Fugitive Hydrocarbon Emissions at Oil and Gas Facilities by the CARB/KVB Method - Modified for the Revised ROC Definition

Distribution: APCD Staff

1.0 POLICY

This policy and procedure provides staff with necessary definitions and instructions on calculating fugitive hydrocarbon (FHC) emissions from valves, fittings, sumps, pumps, compressors, oil/water separators, producing wells and well cellars at oil and gas production facilities where no "as-built" component count is available. For this procedure, oil and gas production facilities are defined as any stationary source or facility with a Standard Industrial Classification ID code (SIC#) of 13. These facilities produce crude oil and/or gas from underground wells, and process the oil to separate water, condensable hydrocarbons, and hydrocarbon gas.

This CARB/KVB fugitive hydrocarbon (FHC) calculation method is valid only for calculating FHC emissions from oil and gas treatment facilities that meet all of the following criteria:

1. An existing facility or source with valid PTOs.

2. No other "grand-fathered" method different than the CARB/KVB method was previously used for calculating FHC emissions at the facility.

3. The current facility Net Emissions Increase (NEI) as defined in District Rule 205.C is less than 25 lb/ day for ROC emissions.

4. Any proposed modification (via an ATC or PTO modification) to the facility or source results in a facility NEI for ROC of less than 25 lb/ day.

   This applies to calculated ROC emissions both before and after the Engineering Review process is performed.

If the facility NEI for ROC is shown to meet or exceed 2.5 lb/hr during Engineering Review, the CARB/KVB method is valid only for calculating FHC emissions during the ATC review process. A FHC emission calculation method based on a District verified "as-built" component count will be required prior to SCDP and PTO evaluations.

5. The facility or source does not have a District verified component count.

6. The facility or source is on-shore.

This CARB/KVB FHC emission calculation method is not valid for estimating fugitive emissions at:

1. Offshore oil and gas facilities of any type.

2. Existing on-shore oil and gas facilities where an ATC or PTO Modification indicates the modification is estimated to result in a facility or stationary source NEI of 25 lbs/ day or more ROC emissions.

3. Entirely new on-shore or offshore oil and gas stationary sources proposed by an ATC.

4. Existing or proposed facilities or stationary sources where the emissions from the facility will be used as offsets for emissions at another other facility or stationary source.

5. FHC emissions at refineries as defined by District Rule 331.B.5.

2.0 DEFINITIONS

In order to determine the correct FHC emission factors for equipment in a facility, the following definitions are provided. These definitions are relevant only to use of this procedure and do not constitute District policy with regard to interpretation of other District rules and regulations. The reference source for each definition, and the location within the reference are shown at the end of the definition as follows: {page and paragraph location in the reference} (Reference No.).

1. Gas to Oil Ratio (GOR): The volume ratio of gas to liquid crude oil produced by the facility wells in units of SCF gas to bbl of crude oil {page 2-2, paragraph 5}.(1)

2. Sump: A lined or unlined excavated depression **in the ground** that is in more or less continuous use for separating oil, water, and sand in oil and gas production operations {page 95, paragraph 6}.(2) **Waste water tanks** are considered to be part of this equipment category.(3)

3. Primary Production Sump: A sump that receives a generally continuous stream of oil and produced water directly from oil production wells and/or field gathering systems {page 96, paragraph 1}.(2)

4. Secondary Production Sump: A sump that receives a generally continuous waste water stream from one or more first stage separators (including a first stage sump and/or tank) {page 96, paragraph 2}.(2)

5. Tertiary Production Sump: A sump that receives a generally continuous waste water stream from second stage separation processes (sumps and tanks) upstream of the sump and in general has only a small amount of oil present {page 96, paragraph 3}.(2)

6. Light Oil Service: Sumps and well cellars which contain crude oil having an API gravity of 30 or greater {page 96, paragraph 3}. [2]

7. Heavy Oil Service: Sumps and well cellars which contain crude oil having an API gravity less than 30 {page 96, paragraph 3}. [2]

8. Pit: A lined or unlined excavated depression in the ground used for emergencies or to receive intermittent flows of waste products from drilling and oil production processes which may contain hydrocarbon materials {page 96, paragraph 4}. [2]

9. Wells Heads: Well piping and pumping equipment located above the underground oil and gas well casing.

10. Well Cellars: An access pit surrounding the well head {page 9-2}. [1]

11. Steam Drive Wells: A crude oil production well that relies on stimulating oil production through continuous steam injection into the producing formation via dedicated steam injection wells {page 9-2}. [1]

12. Cyclic Steam Wells: An oil production well which is stimulated periodically (not continuously) by steam injection into dedicated steam injection wells {page 9-1}. [1]

13. "Pseudocyclic" Wells (Tertiary): These wells currently only exist in Kern County, California. [3] Refer to the District 1989 Air Quality Attainment Plan, Appendix C, page R-46-1 for the definition on this type of well.

14. Oil/Water Separators: A class of waste water treatment equipment that processes **known volumes** of waste water on a **continuous** basis for treatment to remove entrained oil. **Waste water tanks** are not considered to be part of this equipment category. [3] API separators and Wemco separators are considered to be part of this equipment category. [4]

15. Active Oil Wells: All oil and gas producing wells not abandoned (eg. not plugged with concrete to block the well).[4] Active oil wells do not include waste water re-injection wells. [4]

3.0 METHODOLOGY

3.1 Required Data

To calculate FHC emissions from an oil and gas facility by the CARB/KVB method requires the following data:

Parameter	Units
1. The total gas production from the facility	SCF/day
2. The total dry crude oil production and API gravity of the crude produced by the facility	bbl/day and °API
3. The number of active oil and gas production wells that are serviced by the facility. Do not count waste water re-injection, or abandoned (plugged) wells	Number of wells
4. The types, quantities and characteristics of the following equipment at the facility:	
4.1 Well cellars (surface area of each)	ft^2
4.2 Oil/water separators (waste water through-put of each)	MM gals/day
4.3 Sumps (surface area, also type of service - light or heavy crude, and primary, secondary, or tertiary, for each	ft^2
4.4 Pumps (facility has them or not)	Yes or no
4.5 Compressors (facility has them or not)	Yes or no
4.6 Well heads (quantity)	Number of wells
4.7 Enhanced oil recovery wells (quantity, type of well - steam drive, or cyclic steam, type of well vent - controlled or uncontrolled)	Number of wells by type, type of well vent (controlled or uncontrolled)
4.7.1 Steam driven wells	
4.7.2 Cyclic steam wells	
4.7.3 "Pseudocyclic" wells (Kern County only)	

3.2 Standard Assumptions

3.2.1 Control Efficiencies: The following control efficiencies are assumed for various types of equipment:

Table 3.2.1
Standard Assumed Control Efficiencies

Equipment Category	Type of Control	ROC Control Efficiency (% by wt.)
1. Oil/Water Separators, sumps and Waste Water Tanks	A) Uncovered, no vapor recovery. [4]	0.0
	B) Cover or roof. [2]	85.0
	C) Cover and vapor recovery.	95.0
2. Well Vents - Steam Drive and Cyclic Steam Drive Wells	A) Open air vents.	0.0
	B) Vent to vapor recovery.	95.0

3.2.2 Facility Operation Factors: FHC emissions from all facility equipment calculated by this method are assumed to occur continuously 24 hours per day, 365 days per year, as long as crude oil production, processing or storage is in progress within the facility.

3.2.3 Reactivity Factors (lb ROC/ lb TOG): The FHC emission calculation worksheets (FHCLC96) presented in Attachment 2 of this policy provide estimates of the ROC hydrocarbon emissions from the facility. In order to calculate the total organic gas (TOG) emissions from the facility, the following ROC/TOG conversion factors are provided.

Table 3.2.3
Standard Assumed ROC/TOG Conversions

FHCLC96 Worksheets Section	Category Description and Data Source	ROC/TOG Factor (lb/lb)
I.	Valves and Fittings [2] [5]	0.391
II.	Sumps and Well Cellars [5]	0.606
III.	Oil/Water Separators [5]	0.606
IV.	Pumps [5]	0.492
IV.	Compressors [5]	0.262
IV.	Wells Heads [5]	0.606
V.	Enhanced Oil Recovery Wells (all classes) [3]	0.912

3.3 Procedure

1. Staff shall gather the data listed in section 3.1. FHCemission calculations are performed using the FHCLC96 worksheets (reference Attachment 2). The FHCLC96 worksheets are divided into six sectionsI to VI. Valve and Fitting ROC emission factors used in Section I of the FHCLC96 worksheets are presented in APPENDIX A of this policy.

2. Calculating NEI FHC Emissions: To calculate NEI FHC emissions, the facility "baseline" FHC emissions from all equipment in place prior to modification and not subject to NEI are calculated by the section I to VI FHCLC96 worksheets. Then a second FHC emission calculation of the proposed or actual post modification equipment is recalculated by section I to VI FHCLC96 worksheets. NEI emissions are thus:

"Post Modification FHC Emissions" - "Baseline FHC Emissions" = NEI FHC Emissions

NOTE: Because ROC emissions are considered to be criteria pollutants, NEI FHC emissions of ROC cannot be less than zero.

4.0 REFERENCES

(1) KVB Inc., Emissions Characteristics of Crude Oil Production Operations in California, Contract No. A8-127-31, January 1983.

(2) California Air Resources Board (CARB), Technical Guidance Document to the Criteria and Guidelines Regulation for AB-2588, pages 92-96, 108, and 118-120, August 1989.

NOTE: All the FHCLC96 worksheet ROC FHC emission factors of this policy were derived from Tables D-1, D-2, and D-3 of this report, as corrected for removal of ethane as an ROC.

(3) Weller, Robert, CARB, Phone conversation between Bob Weller and Steve Sterner (SBCAPCD), January 25, 1990.

(4) SBCAPCD, SBCAPCD policy for use of this procedure, January 1990.

(5) California Air Resources Board (CARB), Technical Guidance Document on Reactivity Profiles, profile numbers 529, 530, 531, 532 and 297.

5.0 ATTACHMENTS

1. **APPENDIX A**: FHC Emission Calculation (FHCLC96) Worksheet Tables I.1 to I.3 for Valve and Fitting Emissions Factors.

2. Wordperfect file FHCLC96.wp5, located in directory wp5\DOCS\ENGR\OIL&GAS\FORMS. This file contains the FHCLC96 worksheet Sections I to VI used to calculate the facility FHC emissions described herein by this policy and procedure. Current paper copies of the FHCLC96 forms are also located in the Engineering Division forms drawer.

APPENDIX A

CARB/KVB FHC EMISSION CALCULATION

WORKSHEETS

(FHCLC96.wp5)

TABLES I.1 to I.3

TABLE I.1

FACILITY MODEL NUMBERS

Model #1	Number of wells on the lease is less than 10 and the GOR is less than 500.
Model #2:	Number of wells on the lease is between 10 and 50 and the GOR is less than 500.
Model #3	Number of wells on the lease is greater than 50 and the GOR is less than 500.
Model #4:	Number of wells on the lease is less than 10 and the GOR is greater than or equal to 500.
Model #5:	Number of wells on the lease is between 10 and 50 and the GOR is greater than or equal to 500.
Model #6:	Number of wells on the lease is greater than 50 and the GOR is greater than or equal to 500.

TABLE I.2

VALVE EMISSION FACTORS

Lease Model	Service	ROC Emission Factor (lb/day-well)*10^{-4}
Model #1	Gas	14171.700
	Liquid	0.982
	Mixture	748.355
	Condensate	0.000
Model #2	Gas	6807.460
	Liquid	0.971
	Mixture	190.993
	Condensate	0.000
Model #3	Gas	62.177
	Liquid	0.260
	Mixture	154.327
	Condensate	0.000
Model #4	Gas	44784.900
	Liquid	1.215
	Mixture	303.513
	Condensate	0.000
Model #5	Gas	8293.500
	Liquid	0.509
	Mixture	334.359
	Condensate	0.000
Model #6	Gas	16839.200
	Liquid	0.084
	Mixture	239.978
	Condensate	0.000

TABLE I.3

FITTING EMISSION FACTORS

Lease Model	Service	ROC Emission Factor (lb/day-well)*10^{-4}
Model #1	Gas	8483.620
	Liquid	323.495
	Mixture	1139.750
	Condensate	0.000
Model #2	Gas	5788.960
	Liquid	0.000
	Mixture	302.830
	Condensate	0.000
Model #3	Gas	166.743
	Liquid	9.719
	Mixture	496.834
	Condensate	0.099
Model #4	Gas	20399.100
	Liquid	0.001
	Mixture	920.142
	Condensate	0.000
Model #5	Gas	17547.300
	Liquid	29.052
	Mixture	1847.850
	Condensate	0.000
Model #6	Gas	24890.200
	Liquid	0.000
	Mixture	115.139
	Condensate	0.243