SECTION 9.2

GEOGENIC SOURCES
PETROLEUM SEEPS

(New April 1993)

EMISSION INVENTORY SOURCE CATEGORY
Natural (Non-anthropogenic) Sources / Geogenic Sources

EMISSION INVENTORY CODES (CES CODES) AND DESCRIPTION
920-920-1600-0000 (82206) Petroleum Seeps - Oil

920-920-0100-0000 (82297) Petroleum Seeps - Gas

METHODS AND SOURCES

This methodology is used to estimate the total organic gas (TOG) emissions from ***Petroleum Gas and Oil Seeps***. Some major seeps are located off the coast of Santa Barbara County and the most famous seep is located in Los Angeles County, the La Brea Tar Pits. Other seeps occur throughout the state, primarily in those regions of oil and gas production.

Oil and ***gas seeps*** occur naturally in California and have been active for thousands of years. The Indians used asphaltum and heavy oil from seeps for symbolic, decorative and practical purposes. The Yokuts decorated articles with asphaltum inlaid with chips of abalone shells. These articles included brush handles, death masks, ceremonial staffs, amulet bags, wooden boxes, utensils, knives and bowls. The Chumash used the asphaltum from seeps to caulk their wooden canoes and to waterproof their waterbottles. Yokut shamans painted their faces with the heavy oil from seeps before dancing, believing the oils had supernatural powers.

The Spanish explorers wrote about the oil seeps in the Santa Barbara Channel. As early as 1849, seeps were used by the early immigrants to California who stopped to grease their wagon wheels with the oil from seeps. Some of the early settlers used to mine the oils from seeps and sell it as lubricating oil for farm machinery and other commercial uses. Before the principles of petroleum geology were understood and accepted, seeps were used to locate the drilling site of oil and gas wells.

Oil and gas seeps form where oil or natural gas emerge from subsurface sources to the ground or

water surface. Seeps are associated with water springs in which oil floating to the surface of the water, and gas bubbling out and escaping into the air. Large seeps may be deposits of nearly pure oil, asphaltum, or semisolid bitumens. Most seeps are deposits mixed with different amounts of sand, sticks, clay, leaves, peat, animal bones and debris. When seepage covers a large area it is difficult to determine whether it is a result of one seep or a number of seeps. Seeps do not flow consistently throughout the year. When the weather is warm, seep flow increases. Earthquakes may cause new seeps or existing seeps to increase flow. For example, following the 1971 San Fernando Valley earthquake, dormant seeps in the Los Angeles Basin became active.

The location data and process rates used in this methodology came from the California Department of Conservation Division of Oil & Gas report "Onshore Oil & Gas Seeps in California" [1], the State Lands Commission's report "California Offshore Gas, Oil, and Tar Seeps" [2] and the Santa Barbara County Air Pollution Control District's "Area Source Methodologies". [3] Where there was only a qualitative description of a seep, flow rate estimations were made based on the qualitative and quantitative estimation of other seeps in the reports found in the reference section of this methodology, and engineering judgement. For example, the California Division of Oil & Gas report stated that "several trickles" total to 1 gallon/day. From this description, "trickles" were assigned a value of 1 gallon/day or 365 gallon/year. This method is not as accurate as actual field measurements, but there has not been any recent research on seeps.

There are no statewide control measures for oil and gas seeps. However, ARCO has placed a dome to control a large gas seep off the coast of Santa Barbara County. The gas is collected through the dome and the emissions that were generated from this seep are used as offset emissions by ARCO.

The emission factors for TOG in this methodology were based on the emission factor used in the "Draft EIR/EIS Proposed ARCO Coal Oil Point Project Volume 1, Appendix 4 - Air Quality". [4] Therefore, the emission factors used in this methodology apply to seeps statewide. In reality, emission factors for seeps would vary from one seep to another. The TOG emission factors for oil and gas are presented in Table I below.

Table I

EMISSION FACTORS FOR OIL & GAS SEEPS

TYPE OF SEEP	EMISSION FACTOR	UNITS
OIL	105	LB/BBL
GAS	48,648.65	LB/MMCUFT

TEMPORAL INFORMATION

Seeps ooze year round and ooze more in the warmer weather. The current monthly throughput profile does not reflect this seasonal change. The temporal profile and monthly throughput profile are assumed as follows:

Type of Seep	Hours	Days	Weeks
Petroleum Seeps - Oil	24	7	52
Petroleum Seeps - Gas	24	7	52

Type of Seep	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Seeps - Oil	83	83	83	83	83	83	83	83	83	83	83	83
Seeps - Gas	83	83	83	83	83	83	83	83	83	83	83	83

ASSUMPTIONS

The data from the listed references are assumed to contain all seeps. The emission factor is assumed to be applicable to all seeps. Seeps are assumed to flow at a steady state, 24 hours per day for the entire year.

RELIABILITY FACTOR

The reliability factor has not been determined.

CHANGES IN METHODOLOGY

This is a new methodology. The Santa Barbara APCD is the only district that has submitted emissions from seeps in previous years and ARB has included these emissions in the emission inventory.

DIFFERENCES BETWEEN 1989 AND 1991 EMISSION ESTIMATES

New methodology. There are no comparisons.

RECOMMENDATIONS

The seeps category needs several things to make the emissions more accurate. First, all seeps in California need to be resurveyed and activity rates measured or estimated. Second, emission factors need to be determined for the various seeps. For example, seeps containing oil emit more TOG than those containing tar or asphaltum. Gas concentration, flow rates and gas

constituents need to be determined for gas seeps. The temporal cycle needs to be adjusted for weather conditions. Warmer weather causes more seep activity.

SAMPLE CALCULATIONS

Fresno County oil seeps have been estimated to generate 340 bbls per year.
The emission estimate is as follows:

Process Rate: 340 bbls
Emission Factor: 105 lb/bbls

$$\frac{340 \text{ bbls/year} \times 105 \text{ lb/bbls}}{2000 \text{ lb/ton}} = 17.85 \text{ tons/year}$$

DEFINITION OF TERMS

Asphaltum: A brownish-black solid or semisolid mixture of bitumens with a density between 8.4 - 9.9 lb/gal.

Gas: In this methodology, gas is methane or other hydrocarbon gases and hydrogen sulfide occurring in nature.

Oil: Crude oil with a density between 7.08 - 7.3 lb/gal.

Seep: A spot where water and/or petroleum liquid trickles out of the ground and forms a pool, or a spot where gas escapes from the ground.

Tar: A dark, oily, viscid mixture, consisting mainly of hydrocarbons. Produced by the destructive distillation of organic substance such as wood, coal, or other organic substance with a density between 7.08 - 7.3 lb/gal.

ADDITIONAL CODES

SOURCE CATEGORY GROWTH AND CONTROL CODES

82206 Growth = 620, Control = 99.

82297 Growth = 620, Control = 99.

SOURCE CATEGORY CODE POLLUTANT SPECIATION PROFILES:

82206 VOC = 551, PM = 200.

82297 VOC = 550, PM = 331

SOURCE CATEGORY CODE REACTIVITY FACTORS:

Not Available

REFERENCES

1. California Department of Conservation, Division of Oil & Gas, Onshore Oil & Gas Seeps in California (1980, 1987).

2. California State Lands Commission, California Offshore Gas, Oil, and Tar Seeps, (1978).

3. Santa Barbara County Air Pollution Control District, Attainment Planning Section, Area Source Methodologies (April 1992).

4. California State Lands Commission, County of Santa Barbara & U.S. Army Corps of Engineer, L.A. District, Draft EIR/EIS Proposed ARCO Coal Oil Point Project Volume I, Appendix 4 - Air Quality (September 1986).

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Table II
1991 Area Source Emissions
Activity: Natural Sources
Process: Petroleum & Related
Entrainment: Crude Petroleum-Evap
Dimn: Petroleum Seeps
CES: 82206
Process Rate Unit: Barrels of Oil Seeping

AB	County	Process Rate	TOG Emis. (Tons / Year)	CO Emis. (Tons / Year)	NOX Emis. (Tons / Year)	SOX Emis. (Tons / Year)	PM Emis. (Tons / Year)
NC	HUMBOLDT	1	0.00	0.00	0.00	0.00	0.00
	MENDOCINO	1	0.00	0.00	0.00	0.00	0.00
	SONOMA	1	0.00	0.00	0.00	0.00	0.00
NCC	MONTEREY	16	0.80	0.00	0.00	0.00	0.00
	SANTA CRUZ	9	0.40	0.00	0.00	0.00	0.00
OCS	SANTA BARBARA	6207	325.87	0.00	0.00	0.00	0.00
SC	LOS ANGELES	19568	1027.30	0.00	0.00	0.00	0.00
	ORANGE	36	1.90	0.00	0.00	0.00	0.00
SCC	SAN LUIS OBISPO	98	5.10	0.00	0.00	0.00	0.00
	SANTA BARBARA	60361	3168.95	0.00	0.00	0.00	0.00
	VENTURA	26928	1413.70	0.00	0.00	0.00	0.00
SJV	KERN	966	50.70	0.00	0.00	0.00	0.00
	KINGS	85	4.40	0.00	0.00	0.00	0.00
SV	FRESNO	340	17.80	0.00	0.00	0.00	0.00
TOTAL		114617	6016.92	0.00	0.00	0.00	0.00

Fraction of Reactive Organic Gases (FROG): 1.0000
(Reactive Organic Gases (ROG) Emissions = TOG X FROG)
Fraction of PM10 (FRPM10): .9600
(PM10 Emissions = PM X FRPM10)

Table III
1991 Area Source Emissions
Activity: Natural Sources
Process: Petroleum & Related
Entrainment: Unspecified E&M
Dimn: Petroleum Seeps Natural Gas
CES: 82297
Process Rate Unit: Number of Average Size Gas Leaks

AB	County	Process Rate	TOG Emis. (Tons / Year)	CO Emis. (Tons / Year)	NOX Emis. (Tons / Year)	SOX Emis. (Tons / Year)	PM Emis. (Tons / Year)
LC	LAKE	2	44.50	0.00	0.00	0.00	0.00
NC	HUMBOLDT	4	93.60	0.00	0.00	0.00	0.00
	SONOMA	16	377.70	0.00	0.00	0.00	0.00
OCS	SANTA BARBARA	26	632.43	0.00	0.00	0.00	0.00
SC	LOS ANGELES	23	553.10	0.00	0.00	0.00	0.00
	ORANGE	10	230.80	0.00	0.00	0.00	0.00
SCC	SAN LUIS OBISPO	2	44.50	0.00	0.00	0.00	0.00
	SANTA BARBARA	724	17610.81	0.00	0.00	0.00	0.00
SF	CONTRA COSTA	1	26.70	0.00	0.00	0.00	0.00
	NAPA	1	9.00	0.00	0.00	0.00	0.00
SJV	KERN	5	117.20	0.00	0.00	0.00	0.00
SV	COLUSA	4	88.70	0.00	0.00	0.00	0.00
	SUTTER	1	8.80	0.00	0.00	0.00	0.00
TOTAL		819	19837.84	0.00	0.00	0.00	0.00

Fraction of Reactive Organic Gases (FROG): .2500
(Reactive Organic Gases (ROG) Emissions = TOG X FROG)
Fraction of PM10 (FRPM10): .6100
(PM10 Emissions = PM X FRPM10)