APPENDIX B

FLOW CHARTS OF DATA SET USED IN THE DEVELOPMENT OF CORRELATION EQUATIONS AND EMISSION FACTORS
APPENDIX B

FLOW CHARTS OF DATA SET USED IN THE DEVELOPMENT OF CORRELATION EQUATIONS AND EMISSION FACTORS

In order to apply and use the new emission factors and correlation equations correctly, it is important to understand how they were derived. The following three flow charts are presented below:

Flow chart 1: Development of 1995 EPA Correlation Equations and Factors for the Petroleum Industry summarizes the sequence by which default zero factors, correlation equations, pegged at 10,000 ppmv and pegged at 100,000 ppmv factors, screening value ranges, and average emission factors for the petroleum industry were derived in the 1995 EPA Protocol.

Flow chart 2: Development of Revised 1995 EPA Correlation Equations and Factors for the Petroleum Industry is similar to flow chart 1 except the refineries and marketing terminals bagged data, collected using the blowthrough bagging technique, were adjusted to account for the hydrocarbon leak flowrate.

Flow chart 3: Development of the Oil and Gas Production Correlation Equations and Factors summarizes the sequence by which default zero factors, correlation equations, pegged at 10,000 ppmv factors, screening value ranges, and average emission factors for oil and gas production facilities were derived.

Flow Chart 1 - Development of 1995 EPA Correlation Equations and Factors for the Petroleum Industry:

As shown in flow chart 1, collected 1993 bagged data from refineries, marketing terminals, and oil and gas production facilities were combined to develop default zero factors, correlation equations and pegged factors for the petroleum industry referenced as the Correlation Equation Method. Note that default zero data were not collected from oil and gas production facilities; the default zero factors were based on the refineries and marketing terminals data only.

The Correlation Equation Method was applied to additional screening data from marketing terminals (time period unknown) and from oil and gas production facilities (1993) to develop screening value range emission factors for marketing terminals and production facilities respectively. Note that no additional screening data were collected for refineries during the 1993 Refinery Study. Thus, the refinery screening value range emission factors presented in the 1995 EPA Protocol are based on 1980 and 1982 refining fugitive emission studies. The refinery, marketing terminal, and oil and gas production screening value range emission factors are referenced as the Screening Value Range Method or the Leak/No leak Method.
Additionally, fugitive emissions were combined and averages were determined by service types and component types for marketing terminal and production separately. Again, because no additional screening data from refineries were collected, the refinery average emission factors presented in the 1995 EPA Protocol are based on 1980 and 1982 refining fugitive emission studies. The refinery, marketing terminal, and oil and gas production average emission factors are referenced as the Average Emission Factor Method.

**Flow chart 2 - Development of Revised 1995 EPA Correlation Equations and Factors for the Petroleum Industry:**

Flow chart 2 is similar to flow chart 1 except the refineries and marketing terminals bagged data, collected using the blowthrough bagging technique, were revised to account for several technical corrections and adjustments. These technical corrections and adjustments include the following: adjustments to account for hydrocarbon leaks in bags collected with the blowthrough method; removal of one set of data from components that were double counted; removal of data from components that exceeded the 1995 EPA Protocol's 5% O$_2$ concentrations criterion; inclusion of data that had been inadvertently omitted; and, inclusion of data from liquid leaks in additional pegged source calculations. The revisions resulted in changes to average emission factors, screening value range factors, default zero factors, correlation equations, and pegged factors, ranging on the order of a few percent to about 50 percent. At this time, CAPCOA recommends that the default zero factors, correlation equations, and pegged factors be revised to account for the documented technical corrections and adjustments.

Screening value range and average emission factors for oil and gas production were revised based on the separate set of oil and gas production default zero factors, correlation equations, and pegged at 10,000 ppmv factors (see flow chart 3). However, revision to screening value range and average emission factors for marketing terminals were not revised because the revision would require additional subjective review of the marketing terminals data set which is not feasible at this time.

**Flow chart 3 - Development of the Oil and Gas Production Correlation Equations and Factors:**

Not enough data are available at this time to develop a complete separate set of default zero factors, correlation equations, and pegged factors for oil and gas production operations. As shown in flow chart 3, data were only sufficient to develop pegged factors. The correlation equations were developed using the combined facility types data set (refineries, marketing terminals, oil and gas production). It should also be noted that default zero data were not collected from oil and gas production facilities. Therefore, the correlation equations were used to develop default zero factors using a screening value of 9.9 ppm.
FLOW CHART 1
DEVELOPMENT OF EPA 1995 CORRELATION EQUATIONS AND FACTORS FOR THE PETROLEUM INDUSTRY
(SOURCE: SCAQMD, 1997)

COMPONENTS BY INSTRUMENT SCREENING RANGE, CORRECTED FOR BACKGROUND

BAGS COLLECTED AND USED IN 1995 PROTOCOL

FACTORS AND CORR. EQNS. DEVELOPED (ALL FACILITIES AND ALL STREAMS COMBINED)

SCREENING VALUE RANGES AND AVE. FACTORS DEVELOPED

ADDITIONAL FACTORS

SCREENING VALUE RANGE

AVERAGE FACTOR

OILGAS PRODUCTION

ABOVE 2,088
IN RANGE 2,708*
BELOW 179,239

*10-100,000 PPM

306
368
0

PEGGED FACTOR

P.F. X 2,088 = PEGGED EMISSIONS
C.E. X 2,708 = CORR. EQ. EMISSIONS
D.Z. X 179,239 = D. ZERO EMISSIONS

= OR > 10,000

< 10,000

ALL COMPONENTS

MARKETING TERMINALS

ABOVE 36
IN RANGE 1,243**
BELOW 4,882

**1-100,000 PPM

16
137
28

CORR. EQN.

P.F. X 63 = PEGGED EMISSIONS
C.E. X 24,815 = CORR. EQ. EMISSIONS
D.Z. X 51,509 = D. ZERO EMISSIONS

= OR > 10,000

< 10,000

ALL COMPONENTS

DEFAULT ZERO FACTOR

REFINERIES

ABOVE 0
IN RANGE 0
BELOW 0

123
270
102

These values from April 26, 1994 letter (R. Striefer, API to D. Markwordt, EPA re:
Submittal of gasoline distribution facility fugitive equipment screening data. There was no
EPA-reviewed QAPP for the collection of this data.

From EPA Report
450/3-82-010; based on 6000 components

From EPA Report
600/2-80-075c; based on 5000 components

Production and Marketing Terminal data collected in accordance with EPA-reviewed Quality Assurance Program Plans, and the data collection was audited. There was no refinery screening data.

ARBS/SO, 1997
FLOW CHART 2
DEVELOPMENT OF CORRECTED EPA 1995 CORRELATION EQUATIONS AND FACTORS FOR THE PETROLEUM INDUSTRY
(SOURCE: SBCAPCD, 1997)

<table>
<thead>
<tr>
<th>COMPONENTS BY INSTRUMENT SCREENING RANGE, CORRECTED FOR BACKGROUND</th>
<th>BAGS* COLLECTED AND USED IN 1995 PROTOCOL</th>
<th>&quot;CORRECTED&quot; FACTORS AND CORR. EQNS. DEVELOPED (ALL FACILITIES AND ALL STREAMS COMBINED)</th>
<th>ADDITIONAL FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OILGAS PRODUCTION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABOVE</td>
<td>2,088</td>
<td>308</td>
<td></td>
</tr>
<tr>
<td>IN RANGE</td>
<td>2,708**</td>
<td>368</td>
<td></td>
</tr>
<tr>
<td>BELOW</td>
<td>179,239</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>**10-100,000 PPM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MARKETING TERMINALS</td>
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<td></td>
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</tr>
<tr>
<td>ABOVE</td>
<td>36</td>
<td>16</td>
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</tr>
<tr>
<td>IN RANGE</td>
<td>1,243***</td>
<td>137</td>
<td></td>
</tr>
<tr>
<td>BELOW</td>
<td>4,882</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>***1-100,000 PPM</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>REFINERIES</td>
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</tr>
<tr>
<td>ABOVE</td>
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<td>123</td>
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</tr>
<tr>
<td>IN RANGE</td>
<td>0</td>
<td>270</td>
<td></td>
</tr>
<tr>
<td>BELOW</td>
<td>0</td>
<td>102</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: SCREENING VALUE RANGES AND AVERAGE FACTORS FOR OILGAS PRODUCTION IS DIAGRAMMED IN FLOW CHART 3 - DEVELOPMENT OF THE OIL AND GAS PRODUCTION CORRELATIONS AND FACTORS.


Production and Marketing Terminal data collected in accordance with EPA-reviewed Quality Assurance Program Plans, and the data collection was audited. There was no refinery screening data.

*Bagged data for MT and R corrected for blow-through method.

ARB/SSO, 1997

From EPA Report 450/3-82-010; based on 6000 components
From EPA Report 600/2-80-075c; based on 6000 components.
FLOW CHART 3
DEVELOPMENT OF THE OIL AND GAS PRODUCTION CORRELATION EQUATIONS AND FACTORS
(SOURCE: SBCCAPCD, 1997)

COMPARATOR BY INSTRUMENT SCREENING RANGE, CORRECTED FOR BACKGROUND

OIL/GAS PRODUCTION
- ABOVE 2,088
- IN RANGE 2,708
- BELOW 179,239

**10-100,000 PPM

BAGS* COLLECTED AND USED IN 1995 PROTOCOL

FACTORS AND CORR. EQNS. DEVELOPED (ALL STREAMS COMBINED)

- P.F. X 2,088 =
- C.E. X 2,708 =
- D.Z. X 179,239 =

SCREENING VALUE RANGES AND AVE. FACTORS DEVELOPED

- PEGGED EMISSIONS
- CORR. EQ. EMISIONS
- D. ZERO EMISSIONS

ADDITIONAL FACTORS

- SCREENING VALUE RANGE
- AVERAGE FACTOR

- OR > 10,000
- < 10,000

ALL COMPONENTS

MARKETING TERMINALS
- ABOVE 36
- IN RANGE 1,243
- BELOW 4,882

***1-100,000 PPM

- CORR. EQN.

REFINERIES
- ABOVE 0
- IN RANGE 0
- BELOW 0

123
270
102

(Note: The corrected correlation equations were used to develop default zero factors using a screening value of 9.9 ppm.)

Production and Marketing Terminal data collected in accordance with EPA-reviewed Quality Assurance Program Plans, and the data collection was audited. There was no refinery screening data.

*Bagged data for MT and R corrected for blowthrough method.

SBCCAPCD, 1997