KANSAS IMPLEMENTATION PLAN REVISION – KCMA OZONE MAINTENANCE PLAN, 2007

APPENDIX D

CALCULATION OF POINT, AREA, AND OFFROAD MOBILE SOURCE OZONE SEASON WEEKDAY EMISSIONS

The TEMPORAL module within the Sparse Matrix Operator Kernel Emissions (SMOKE) model v. 2.1 was used as a tool for calculating typical ozone season day emissions for point, area, and offroad mobile sources in the Kansas City ozone base year inventory. The calculations were also duplicated outside of the SMOKE modeling system using relational database software to double-check the results from SMOKE. The procedures summarized in this appendix are based on the April 29, 2002 memorandum from Gregory Stella, U.S. EPA, "Temporal Allocation of Annual Emissions using EMCH Temporal Profiles."

The first step is to allocate annual emissions to a particular month. A monthly profile is selected based on a facility/emission unit identifier or Source Classification Code (SCC). The annual emissions are multiplied by the monthly weight factor from the profile divided by the total weight factor as follows:

$$Emissions_{Month} = Emissions_{Annual} \text{ x } (Weight \text{ } Factor_{Month} / Weight \text{ } Factor_{Total})$$

Next, emissions for an average monthly day are estimated from the monthly total. Because the monthly profiles are not weighted for the specific number of days in each month, an average day per year is used in the calculation as shown below:

$$Emissions_{AvgDay} = Emissions_{Month} / (Days_{Year} / Months_{Year})$$

The average day's emissions value is then converted to a specific day of the week. A weekly profile is selected based on a facility/emission unit identifier or SCC. Using the day-of-week weighting factor from the profile, emissions for this day are calculated with the following equation:

$$Emissions_{Day} = Emissions_{AvgDay} \text{ x } [(Weight \text{ } Factor_{Day} / Weight \text{ } Factor_{Total}) / (Number_{AvgDay} / Number_{DaysWeek})]$$

For the Kansas City base year inventory, the calculations were done using a Monday in July as representative of a typical ozone season weekday. The results would have been the same if some other weekday in June or August had been assumed instead. This is because in the monthly profiles used in this effort, the monthly weight factors are the same for the high ozone season months (June, July, August). The weight factors also do not vary among weekdays in the weekly profiles used.

For the point source ozone season day calculations, monthly temporal profiles were generated at the emission unit level based on seasonal throughput percentages reported by facilities on their Emission Inventory Questionnaires (EIQs). The point source monthly weight factors were calculated by dividing the relevant seasonal throughput percentage by 3 months and multiplying by 10 as follows:

$$\text{Weight Factor}_{Month} = (\text{Seasonal Throughput Percentage} / 3) \times 10$$

For each monthly profile, a total weight factor was calculated by summing the individual monthly weight factors for that profile:

$$\text{Weight Factor}_{Total} = \text{Weight Factor}_{Jan} + \text{Weight Factor}_{Feb} + \ldots + \text{Weight Factor}_{Dec}$$

To the extent possible, weekly temporal profiles were assigned to emission units based on the reported number of days in operation per week from the EIQs. If 5, 6, or 7 days per week were reported, the EIQ information was used to assign weekly temporal profiles. However, if a value of less than 5 days per week was reported, EPA default weekly profiles were assigned based on SCC because it was not possible to determine which days of the week the unit was in operation. EPA's default temporal profiles and SCC-based cross reference files are available on the Clearinghouse for Inventories & Emissions Factors website: http://www.epa.gov/ttn/chief/emch/temporal/.

For area and offroad mobile sources, monthly temporal profiles developed by CENRAP were used for prescribed burning-related SCCs. See Sonoma Technology's prescribed burning report in Appendix N for more information on the monthly temporalization of these emissions. For all other area and offroad mobile categories, EPA default monthly and weekly temporal profiles were assigned based on SCC.

Example 1: Calculation of Point Source Monthly Profiles

For facility 5100053, Metropolitan St. Lewis Sewer District, emission unit 20007, the following seasonal throughput percentages are obtained from the EIQ:
Winter (January, February, December): 3%
Spring (March, April, May): 73%
Summer (June, July, August): 24%
Fall (September, October, November): 0%

Weight factors for each month are calculated by dividing the relevant seasonal throughput percentage by three and multiplying by 10. The results are rounded to the nearest integer. The total weight factor is calculated by summing the individual monthly weight factors.

$\text{Weight Factor}_{Jan} = (3 / 3) \times 10 = 10$
$\text{Weight Factor}_{Feb} = (3 / 3) \times 10 = 10$
$\text{Weight Factor}_{Mar} = (73 / 3) \times 10 = 243$
$\text{Weight Factor}_{Apr} = (73 / 3) \times 10 = 243$
$\text{Weight Factor}_{May} = (73 / 3) \times 10 = 243$
$\text{Weight Factor}_{June} = (24 / 3) \times 10 = 80$
$\text{Weight Factor}_{July} = (24 / 3) \times 10 = 80$
$\text{Weight Factor}_{Aug} = (24 / 3) \times 10 = 80$
$\text{Weight Factor}_{Sept} = (0 / 3) \times 10 = 0$
$\text{Weight Factor}_{Oct} = (0 / 3) \times 10 = 0$

Weight Factor$_{Nov}$ = (0 / 3) x 10 = 0
Weight Factor$_{Dec}$ = (3 / 3) x 10 = 10
Weight Factor$_{Total}$ = (3 x 10) + (3 x 243) + (3 x 80) + (3 x 0) = 999

This monthly profile is assigned a unique code number of 3242.

Example 2: Point Source Ozone Season Weekday Calculation

There are 16.3474 tons/year NOx emitted from facility 5100053, Metropolitan St. Louis Sewer District, emission unit 20007. From Example 1, this emission unit is assigned monthly profile 3242, which has a July weight factor of 80 and a total weight factor of 999.

To calculate July NOx emissions for this unit:

$$Emissions_{July} = 16.3474 \text{ tons/yr x } (80 / 999) = 1.309 \text{ tons NOx / month of July}$$

To calculate the average July day NOx emissions for this unit:

$$Emissions_{AvgDayJuly} = 1.309 / (365 / 12) = 0.043 \text{ tons NOx / average July day}$$

It is known from the facility's EIQ that this unit is in operation 7 days per week, which corresponds to weekly profile number 7 in Table E-5. Weekly profile 7 has a Monday weight factor of 143 and a total weight factor of 1000. To calculate Monday-specific emissions for this unit:

$$Emissions_{Mon} = 0.043 \text{ tons NOx x } [(143 / 1000) / (1 / 7)] = 0.043 \text{ tons NOx / weekday}$$

Example 3: Area Source Ozone Season Weekday Calculation

In the area source inventory, there are 20.21 tons/year VOC associated with SCC 2810015000, prescribed burning for forest management, in Franklin County. From Table C-2, SCC 2810015000 is assigned monthly temporal profile of number 1029 and weekly temporal profile 7. From Table E-4, monthly profile 1029 has a weight factor for July of 0.

To calculate the July VOC emissions for this SCC:

$$Emissions_{July} = 20.21 \text{ tons/yr x } (0 / 1000) = 0 \text{ tons VOC / month of July}$$

Daily calculations are not needed because there are no July emissions for this SCC in Franklin County.