U.S. Environmental Protection Agency

Upgrading MOBILE to Include Particulate Emissions
Proposed Project Description

March 12, 2001

I. Introduction

OTAQ's Assessment and Modeling Center is undertaking a project to integrate the calculation of highway vehicle particulate air emissions into MOBILE6. These emissions are currently estimated with the separate PART5 model which is now outdated. We considered several other options for producing an updated mobile source particulate model, including updating PART5 separately, or creating a spreadsheet based on recent rulemaking models. Combining the PART and MOBILE models, however, is a prominent recommendation of *Modeling MOBILE SOURCE Emissions*, the National Academy of Science Research Council's review of MOBILE. This approach takes advantage of an integrated model development process in OTAQ, will benefit future releases of MOBILE as well as PART, and will eliminate significant duplication of technical material between the two models. It will also make things simpler for users who will be given a single, consistent interface for both functions. We've determined therefore to pursue the option of integrating PART5 and MOBILE6 and to call the product of this effort "MOBILE6.1."

Our objective is to quickly produce a MOBILE6.1 that takes into account data and rulemakings of the past 6 years, including the fuel sulfur level reductions that are now mandated. Based on stakeholder input, EPA has concluded that there is a great need for improved particulate modeling capability this year. Thus we have set a goal of releasing a model no later than September 30, 2001, and hopefully sooner. This means that MOBILE6.1 must be limited to correcting the major deficiencies and shortcomings of PART5.

We believe this can be accomplished most efficiently by incorporating work which is highly regarded and already complete. The most important component will be to incorporate mobile source particulate emission factors recently developed by the State of California for EMFAC2000. These are based on the most recent and relevant test data as described in Section 10.2 of the EMFAC2000 technical support document. EPA helped fund much of the data collection and the California model, which provides estimates of both PM2.5 and PM10, has undergone extensive review.

The project schedule does not allow for new test data to be collected or for new emission factor algorithms to be developed which would require extensive review, testing and coding. This type of work would push the project into a several year time frame.

Further improvements to the estimation of mobile source particulate emissions will be made in the course of the longer term effort to produce an entire New Generation of mobile source air pollution Models (NGM). The NGM will fully implement the National Academy of Science recommendations, will be based on an extensive database of emission measurements made during actual operation of in-use vehicles and will provide a framework for allocating emission estimates to much smaller geographic areas and time periods.

The following sections describe in more detail what will, and will not, be updated in MOBILE6.1 relative to PART5:

II. What Will be Changed in MOBILE6.1

A. Most of the basic emission factors used to calculate exhaust particulate emissions will be updated. The new factors will be based on those used in EMFAC2000, a model developed by the State of California Air Resources Board. As already mentioned, the advantage of using the calculations from EMFAC2000 is that they are based on the latest data available. Their use also represents a step towards harmonizing EPA's models with California's, which is another recommendation of the National Academy of Science. The form of these emission factors and calculation will require significant, but to some extent worthwhile, elaboration of the current PART model. The new factors, for example, include vehicle deterioration.

EMFAC2000 does not include emission factors to calculate the idle exhaust particulate emissions of heavy duty diesel trucks. This option of the current PART model will therefore be removed to avoid the inconsistency of MOBILE6.1 basing idle emissions on old data and very low speed emissions on the new data. This also means that MOBILE6.1 users will estimate idle particulate matter emissions the same way MOBILE6.0 users estimate idle emissions of HC, CO, and NOX, which is by calculating emissions at an average speed of 2.5 miles per hour.

The exhaust particulate emissions of Zero Emissions Vehicles (ZEVs) will be considered to be zero, since neither PART5 nor EMFAC2000 contain exhaust particulate emission estimates for them. Their tire and brake wear emissions will be assumed to be the same as gasoline-fueled vehicles.

The exhaust particulate emissions of Natural Gas Fueled Vehicles (NGVs) will be considered to be the same as gasoline fueled vehicles, operating on very low sulfur fuel. Neither PART5 nor EMFAC2000 contain exhaust particulate emission estimates for them but preliminary data supplied by the industry indicates their emissions are comparable to gasoline-fueled vehicles. Their tire and brake wear emissions will be assumed to be the same as gasoline-fueled vehicles.

Other mobile source emissions calculated by PART, such as tire wear, brake wear, and gaseous SO2 will not be updated by California emission factors, but some of these will be updated in other ways, as described in the items which follow.

B. The calculation of fugitive dust from paved and unpaved roads will be removed. The formulas used in PART5 to estimate these emissions are outdated. EPA's OAQPS has been the source for these calculation methods and has decided to produce a separate modeling tool that will produce estimates for road dust particulate as a function of vehicle miles of travel.

C. As discussed in the Introduction, we will combine the upgraded PART model with MOBILE6.

MOBILE6 input data will be used wherever it applies to PART, including vehicle registration, diesel fraction, and mileage accumulation information. MOBILE6 "command-style" inputs will be added to supply the few remaining inputs needed by PART.

A single, consolidated MOBILE6.1 User's Guide will be produced.

Database style reporting of particulate emissions will be fully integrated into the MOBILE6.0 database output reporting of HC, CO, and NOX. PART's descriptive output will remain separate from the output reports currently produced by MOBILE6 because a single, combined report would be too complicated for the user and too difficult to produce.

D. PART's calculation of sulphate particulate and gaseous SO2 exhaust emissions will be updated to account for the sulfur level of fuel (Both gasoline and diesel). This upgrade was planned, but not fully implemented in PART5. It is essential to model the effects of low sulfur fuels, given what we now know about sulfur effects.

E. We will remove the calculation of "indirect sulfate" (i.e. sulfate formed in the air from vehicle emissions such as SO2) from the model. EPA now requires that indirect sulfate emissions be handled with air quality modeling rather than as a mobile source emission.

F. We will remove the effect of I/M programs from the calculation of particulate emissions. The effect of I/M is very minor in PART5. Only lead particulate emissions are affected by I/M programs in PART5. The effect involved leaded gasoline, and the need for modeling leaded gasoline has declined. (Also it would be difficult and not worthwhile, to try to relate PART5's "Yes/No" input for I/M to MOBILE6's elaborate I/M inputs.)

G. MOBILE6.1 will include the effects of regulations on particulate emissions that have gone into effect since PART5. This includes the effects of the Tier2 regulation and the Heavy Duty 2007 rule. The effects of the 2004 rule are already incorporated in EMFAC2000's calculations.

H. MOBILE6.1 will add the ability to estimate exhaust emissions of ammonia. This may be based on the emission factors and calculation method described in EPA Report

Number EPA/AA/CTAB/PA/81-20, entitled “Determination of a Range of Concern for Mobile Source Emissions of Ammonia”. While this dates from 1981, we are not aware of a better basis for such calculations but we are examining more recent data.

I. MOBILE6.1 will improve PART’s “descriptive” output report to clearly organize the emission types and components. Users of PART5 often found the report confusing and found that emission component values did not always “add up” in the naturally expected fashion to the subtotals and totals shown.

J. PART5's option to model special driving cycles for buses (CBD and heavy urban) will be removed from MOBILE6.1. EMFAC2000 does not include this feature and the newer data do not include tests upon which such estimates could be based. MOBILE6 does not include this feature for HC, CO, or NOX, and this feature does not seem to be of importance to users.

K. We will improve the programming code of PART5 and MOBILE6 to some degree.

L. EPA will be developing policy guidance in the future for implementing MOBILE6.1

III. Some Aspects of PART5 that Will Not be Changed.

Section II above is intended to be complete. The intent of this section is to highlight some specific aspects of the model that will not be changed.

A. While total sulfur emissions (gaseous SO2 plus direct sulfate particulate emissions) will be calculated based on fuel sulfur content:

1. Assumptions in PART5 as to the fraction of sulfur which takes each form will not be updated.

2. Other than ammonia, no new exhaust emission components will be added to the model. While some have suggested that additional sulfur compounds should be modeled, neither PART5 nor EMFAC2000 provide a basis for doing so. PART5 actually has a more elaborate breakdown of exhaust particulate than EMFAC2000. PART5 considers exhaust particulate to consist of lead particulate, a soluble organic fraction of carbon-based particulates (SOF), a remaining portion of carbon-based particulates (RCP), and direct sulfate particulates (SO4). This structure will be retained.

B. The brake wear and tire wear calculation portions of PART5 will not be updated. (Though some consideration was given to updating tire wear, we have tentatively decided against it because PART5's estimates fall within the range of uncertainty of the newer studies.)

C. No effects of I/M or OBD programs on particulate emission levels will be modeled. This was discussed above, and is being restated here for clarity.

D. No effect of HC standards on particulate emissions will be modeled. This is implicit in the above discussion, but is being stated here for clarity.

E. EMFAC2000 does not appear to have updated factors for light duty diesel vehicles or for heavy - heavy duty (HHD) gasoline vehicles, so the basic emission rates for the exhaust particulate emissions of these types of vehicles will be retained from PART5. (These kinds of vehicles constitute a negligible portion of the vehicle fleet.)

F. Effects of ambient temperature on particulate emission levels will not be modeled. Neither PART5 nor EMFAC2000 attempt to model such effects.