Kevin Green
99 Haynes Hill Road
Brimfield, MA 01010

December 22, 1998

Penny Carey
U.S. EPA
Assessment and Modeling Division/SAG
2000 Traverwood Drive
Ann Arbor, MI 48105

Dear Penny:

I am writing to respond to Phil Lorang's November 2, 1998 letter regarding four reports written as part of EPA's MOBILE emissions model revision.

Although I am currently employed as a general engineer at the U.S. DOT Volpe National Transportation Systems Center, and Phil wrote to me at that address, I reviewed these reports on my own time. I am commenting on these reports as an individual, and not a representative of DOT or any other agency or organization.

As you are likely aware, I was employed for three years as an engineer at the U.S. EPA Office of Mobile Sources, where I was closely involved in conceptually similar yet considerably less complex emissions estimation methodologies for nonroad engines. I was subsequently employed as an engineer at the Northeast States for Coordinated Air Use Management (NESCAUM), where I was involved in a broader range of mobile source issues, examples of which include: nonroad engines, MOBILE-based emissions estimation, use of the complex model for RFG, and revisions to the FTP. Although I continue to monitor air quality and mobile source issues, this represents a secondary responsibility for me at the moment.

My major substantive comments pertain to Report Number M6.EXH.001, *Determination of Running Emissions as a Function of Mileage for 1981-1993 Model Year Light-Duty Cars and Trucks:*

First, although Section 4.0 references the consistency of running emissions models with both with test data and "engineering judgment," it includes no discussion of EPA's underlying hypotheses regarding causality. This section should specifically identify the physical processes relevant to emissions formation and control (e.g., misfire rate, catalysis, fuel characteristics, etc.), and explain how they lead to statistical model(s) for emissions deterioration.

Second, presenting its hypotheses, EPA should offer clearer justification for relating deterioration to accumulated mileage, rather than either time or both time and accumulated mileage. Uncertainties regarding in-field odometer readings (see M6.EXH.002) underscore this point.

Third, I question the extent to which the piecewise linear approach proposed by EPA in Section 4—with its two corners, multilayered logic, and 6-7 constants—truly represents a balance between simplicity and engineering judgment. For example, unless they are driven by intentionally odometer-driven systems, it isn't clear how the discontinuities presented by the corners arise. Also, notwithstanding the subsequent application of normal scrappage curves, the linear model presents the intuitive problem of *ad infinitum* deterioration. At least for the example given on page 9, a nonlinear form such as

$$a + b\left(1 - e^{-(x/l)^k}\right),$$

where *a, b, 1,* and k are constants, and x represents accumulated mileage (or, probably even better, time), appears able to do quite well. In addition, such a form is differentiable, has fewer constants and no need for complex logic, and does not increase indefinitely.

I have a few additional comments on Report Number M6.EXH.001: On page 3, it would be helpful to explicitly relate the cold and hot start trip weightings to data collected to support the SFTP rulemaking. More generally, Section 3.1 should clearly address the relationships between real-world driving, the FTP, and the SFTP. Section 4 should include simple graphical comparisons of different models against a scatter plot of the data. In Section 5, it would seem more appropriate to adjust the *data* to account for demonstrated sample bias and then fit a physical model, than to fit a *model* to suspect data and derive post-fit "correction factors."

Regarding Report Number M6.EXH.002, *Analysis of Emissions Deterioration Using Ohio and Wisconsin IM240 Data*, I have already noted that the apparent problems with odometer readings underscore the need to seriously consider a time-based model. I'd also like to point out that it seems quite a stretch to extrapolate, not just from Fast-Pass data to the full IM240 as is described in Section 3.2, but ultimately to a full FTP or LA4. Although this usage may, as indicated on page 8, be "indirect," it appears to have a profound impact in some cases. The report should more clearly address and justify this use of the data.

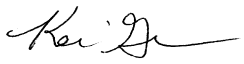
My main comment on Report Number M6.STE.002, *The Determination of Hot Running Emissions from FTP Bag Emissions*, is that it may not be appropriate to exclude vehicle #16 unless similar intermittent failures are known not to occur in the field. It would be helpful to include the HR505 data in Table 1. The three-bag form currently used in the report to predict

HR505 data should be compared to a model that excludes Bag l, and a model that excludes both Bag 1 and Bag 2. Finally, the introduction should address the relationship between the HR505 and real-world hot running conditions. For example, it should address idling emissions and the use of air conditioners.

Many of the above comments also apply to Report Number M6.STE.003, *Determination of Start Emissions as a Function of Mileage and Soak Time for 1981-1993 Model Year Light-Duty Vehicles.* Section 3 should address real-world driving and the SFTP. Section 4 should go to greater lengths to relate models to underlying physical phenomena.

If you'd like to discuss any of these comments directly, please contact me during normal business hours at (617)-494-2106. I appreciate being asked to review these draft reports, and hope that this helps with EPA's improvements to the MOBILE model.

Sincerely,



Kevin Green