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EPA=s New Generation Mobile Source Emissions Model: Initial Proposal and Issues

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Table of Contents

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I. Executive Summary

The purpose of this paper is to present issues and options regarding the future direction of EPA=s mobile source emissions modeling program, and a proposed framework for the agency=s future modeling work. We are applying the term ANew Generation Model@ to this effort because we believe that fundamental changes are required in order to meet the expanding challenge of mobile source emission estimation in a way which is comprehensive, thorough and quality-based. The concepts presented in this report reflect initial thinking; no decisions have been made regarding model scope, structure, content, data, platform, etc. Rather, these concepts are meant to elicit comment from users of EPA=s mobile source emissions tools and stakeholders of the mobile source emissions estimation process.

Under the Clean Air Act, EPA is charged with developing emission factors for all emission sources. EPA=s Office of Transportation and Air Quality (OTAQ) has been the source for emission factor development for on-road sources such as light and heavy-duty vehicles and trucks, and off-road sources such as construction and agricultural equipment. This has led to the development of a number of emission factor estimation tools such as MOBILE (for on-road VOC, CO and NOx), PART (on-road particulate matter and SOx), MOBTOX (on-road toxics), and NONROAD (all off-road pollutants). These tools have been focused on the estimation of mobile source emissions based on average operating characteristics over broad geographical areas. In recent years, however, analysis needs have expanded in response to statutory requirements that demand the development of finer-scale modeling approaches to support more localized emission assessments. The growing needs of model users and external recommendations from a variety of sources have indicated the need for more emission research and improved modeling methodologies.

A comprehensive review of EPA=s mobile source modeling program was published by the National Research Council (NRC) in May 2000. It recommended that EPA develop a mobile source emission modeling system that is capable of supporting the expanding range of mobile source emissions analyses. EPA is in the process of releasing the updated on-road emission factor model MOBILE6, which represents a substantial improvement from MOBILE5, particularly for finer-scale modeling. We view the New Generation Model as a logical next step in the continual effort to improve mobile source emissions models to keep pace with new analysis needs, new modeling approaches, and new data.

The NRC recommendations also address the need for improved model science and improved model structure, two key objectives of the New Generation Model. An improved modeling structure will allow better responsiveness to new data and enable model validation, which in turn will facilitate improved science. Improved science is also a direct function of the quality of information feeding the model. We believe that the recent emergence of on-board emissions measurement devices will revolutionize how emissions data are collected for on-road and off-road mobile sources. We envision that this technology will become the focus of EPA=s emissions factor testing program, and will provide the opportunity for a significant shift in how emissions modeling is approached.

The primary drivers for mobile source emissions analyses are a) statutory requirements, b) support for studies on emission trends, air quality and cross-media impacts, and c) support for EPA regulatory efforts. Borrowing from a similar breakdown in the NRC report, we have identified four fundamental analyses which a mobile source modeling system will need to perform in response to these three drivers:

- Large Area (e.g. National) Emissions Inventory Generation
- Local Area Emissions Inventory Generation
- Transportation Scenario Evaluation
- Corridor/Intersection Emissions Analysis

In order to address this range of analytical needs, we are proposing that the New Generation Model allow for analysis at different scales, depending on the desired application. The system as proposed would estimate the emissions inventory from the national level to the corridor level, for off-road and on-road sources, for all pollutants. In order to address this range of analyses, the system would employ three analysis scales termed macroscale, mesoscale and microscale, defined as follows:

- **Macroscale** analyses are appropriate for developing large-scale (e.g. national) inventories, and will likely continue to be the default choice for generating local inventories for use in SIP and conformity planning. The basic spatial unit for this scale would be the county. As envisioned, the macroscale level would be consistent in concept with the current applications of MOBILE (with inventory generation capability) and NONROAD.

- **Mesoscale** analyses are geared towards generating local inventories at a finer level of spatial and temporal resolution. The basic spatial unit for this scale would be the roadway link and traffic analysis zone, consistent with output from standard travel demand models. Three options are being proposed for the mesoscale level: Abasic@, Amodal@, and Aadvanced@, which incorporate increasing levels of resolution in vehicle activity and spatial characteristics.

- **Microscale** analyses allow the estimation of emissions for specific corridors and/or intersections, which is appropriate for assessing the impact of transportation scenarios and performing project-level analyses. As proposed, this scale would rely on modal emission rates from the mesoscale level, in conjunction with localized activity information.

The proposed modeling system would combine these three basic levels of analysis in a way that provides for consistency in the emission component between scales. The user would choose which scale to implement depending on the desired application and the availability of necessary input data. Clear guidance will be critical for determining the appropriate analysis level and setting the standard for adequate input data at a given level.

Ultimately, our goal is to use on-board emissions data as the basis for the New Generation Model. The core of the proposed system would be an emission rate estimator, which processes instantaneous on-board emissions data into the modal and macroscale emissions rates used in the three analysis scales. We have identified three fundamental approaches for developing an emission rate estimator which serves this function: a) develop a microscale emissions model; b) process instantaneous emissions measurements produced in a laboratory or in the field; or c) create a direct link between a database of raw instantaneous emissions measurements and the New Generation Model.

Scope considerations are an important aspect of the planning process for the New Generation Model. A reduced scope option is presented which focuses on the development of emission rates and software support for the macroscale level, while providing only guidance for developing microscale and mesoscale models. Other scope considerations are whether to pursue an interim product which focuses on improving the software structure, and whether the on-road component of the New Generation Model should be pursued before the off-road component.

The next step for the New Generation Model is the development of a comprehensive plan, slated for the Fall 2001. The main purpose of the comprehensive plan would be to provide concrete steps for the development of the New Generation Model and allow for more detailed determination of resource needs, data needs, and timing. In general, we see three major issues which need to be addressed as we work towards this plan: 1) further definition of the modeling system, including the underlying model theory and the input/outputs of each modeling component; 2) establishing a methodology for estimating emission rates, including an assessment of how on-board emissions would be analyzed and a sampling plan for populating the model with on-board emissions data; and 3) developing a software design.