EPA National Nonroad Emissions Inventory Model (NONROAD)

Emission Inventory Workshop
March 20, 1997

Introduction

Who We Are?

- Assessment and Modeling Division
- Nonroad Emissions Modeling Team
  - » Rich Wilcox
  - » Greg Janssen
  - » Chris Lindhjem
  - » Craig Harvey

Introduction (cont'd)

- What Are We Doing?
  - National Nonroad Model for SIP Inventories
  - Software -- Contract Support
  - Specifications and Default Data -- EPA Team
  - Basic Schedule
    - » Fall 1997 -- Beta version completed
    - » Summer 1998 -- Final Release
    - » Ongoing -- Stakeholder Assistance/Review
    - » Later 1997 -- Peer Review

Introduction (cont'd)

- What We Want to Do Today
  - Begin Dialogue
  - Identify User Needs
  - Solicit Assistance
  - Share Experience/Expertise
- Written Comments Encouraged

Overview of Remaining Presentation

- Past and Present Inventory Tools
- Design Philosophy/Goals
- Overview of Structure/IO Features
- Default Inputs and Adjustments
- Open Discussion
- Wrap-Up

Past and Present Inventory Tools

- Past
  - AP-42
  - Nonroad Engine and Vehicle Emission Study (NEVES)
  - Procedures for Emission Inventory Preparation -- Volume 4
  - EPA Guidance on Adjusting/Enhancing NEVES
  - EPA Trends Report
  - CARB Offroad

Past and Present Inventory Tools (cont'd)

- Present (or anticipated)
  - EPA Nonroad SIP Model
  - Revised AP-42 (ongoing project)
  - EPA Large CI Engine Rule
  - EPA Small SI Engine Rule
  - EPA Trends
  - ARB MVOFF
  - Others (NESCAUM, FAA-FAEED&EDMS)

EPA National Nonroad Emissions Inventory Model (NONROAD) Overview

March 20, 1997

Design Philosophy/Goals

- **Make model flexible for user needs**
  - **Front-end interface**
  - **User can change inputs to reflect local parameters or use default data in model**
  - **User could model multiple scenarios in one run (batch mode)**
  - **Detailed user's guide**
  - **Programmer's guide**
- **Eventually inclusive of all nonroad sources**

Design Philosophy/Goals

- **Updated and improved data**
  - **In use emission factors are first priority**
- **Compatible with other models and reporting tools**
  - **California ARB Nonroad Model (MVOFF)**
    - **» Similar results if CA scenario run done on EPA NONROAD**
  - **Output compatible for input to EPS 2.0**
  - **Output equivalent to Trends Report**

Overview of Model Design
Interface

- **Not included in current work effort on beta version due to lack of funding**
- **Goal is to add it on to final version before it is released**
- **Programmed in Visual Basic to allow Windows-based control panel**
- **Basic interface would allow users to set scenario parameters**

Overview of Model Design Interface

- **User sets time period (calendar year, month), geographical region (state, county), equipment types to be modeled**
- **Advanced interface would allow users to view and change input data**
- **Without interface**
  - **Enter scenario parameters into ASCII control file with and change data input files with text editor**

Overview of Model Design
Core Model: Technical Specifications

- **Core Model does the calculations**
- **Programmed in FORTRAN**
  - **FORTRAN is common and familiar**
  - **Precedent of MOBILE**
  - **CARB MVOFF programmed in FORTRAN**
- **For optimal operation, will need 16 megabytes of RAM, but can operate at much slower speed with 8 megabytes**
- **Program will run from MS-DOS, Windows 3.1, or Windows 95**

Overview of Model Design
Core Model: Structure

- **Input files in ASCII text tables**
- **Model contains emission factor, population, and activity modules**
- **Control strategies reflected through either changing emission factors or activity data in input files.**
- **First version of model will most likely only be able to model one scenario at a time**

Overview of Model Design
Core Model: Equipment Categories

- **Based on 1991 NEVES report**
  - **Recreational**
  - **Logging**
  - **Agricultural**
  - **Construction**
  - **Industrial**
  - **Light Commercial**
  - **Lawn and Garden - Commercial/Residential Split**
  - **Airport Service**
  - **Recreational and Commercial Marine**

Overview of Model Design
Core Model: Equipment Categories

- **Aircraft and locomotives not included in current effort due to lack of funds**
- **Additional equipment (e.g., mining and oil field equipment) to be added in the future**
- **Engine types**
  - **4-stroke**
  - **2-stroke**
  - **Diesel**
  - **CNG**
  - **LPG**

Overview of Model Design Reporting Utility

- **Utility derived from Microsoft Access**
  - **Separate from core model**
  - **More flexible and easier to modify than programming output routines into FORTRAN, and uses less memory**
  - **Core Model creates unformatted data file which user imports into reporting utility**
- **Output formats: ASCII, Lotus Spreadsheet, EPS 2.0**

Overview of Model Design
Reporting Utility: Outputs

- **Pollutants reported**
  - **VOC, THC, NMHC, TOG, NMOG**
    - » **Exhaust, Refueling, Diurnal, Hot Soak, Running Loss, and Crankcase**
  - **CO, NOx, PM 10 and 2.5, and SO_2**
- **Emissions are in metric tons**
- **Emissions reported by:**
  - **Geographic areas:National, State, County**

Overview of Model Design
Reporting Utility: Outputs

- **Emissions reported by:**
  - **Time period: year, month, average week and weekend days in month or year, and average summer and winter days**
  - **Engine type**
  - **Source category code with name of equipment type or category**
  - **horsepower ranges**

Overview of Model
Status and Schedule

- **Status**
  - **OMS currently working with contractor to create default data inputs and algorithms**
  - **Contractor is working on programming**
- **Schedule of Model Development**
  - **Draft core model completed June 30th**
  - **Draft user's and programmer's guides completed in mid-July**

Overview of Model
Status and Schedule

- **Schedule of model development(continued)**
  - **Tested and debugged beta-version of model completed July 31st**
  - **User's and programmer's guide completed August 31st**
  - **Beta version model and guides sent out to interested parties for review**
  - **Final comments incorporated September 30th**

Overview of Model
Status and Schedule

- **Next Phase**
  - **Input data evaluation and upgrade**
  - **Adding Interface, Aircraft, and Locomotives**
  - **FACA Review**
  - **Peer Review - late Fall/early Winter 1997**
  - **Release of model - mid 1998**

National Average Inputs

- Base Emission Factors (Emission Factor File)
  - Exhaust
    - » Diesel, 4-stroke gasoline, 2-stroke gasoline, LPG, & CNG
    - » THC, NMHC, TOG, NMOG, NOx, PM, SO_2, CO, and Fuel Use
    - » Most new data will be from steady-state certification testing
    - » Adjusted for in-use activity and deterioration with respect to data availability
    - » 1991 NEVES values if no data is available
    - » New Final Standards

National Average Inputs

- Evaporative (Gasoline only)
  - » Refueling, diurnal, hot soak, minimal running loss, crankcase
    - Test data where available
    - Existing guidance
  - » Spillage (likely major portion of evaporative emissions)
    - Existing guidance
  - » Gas Cans?

Adjustments to Emission Factors

- Fuel Effects
  - Gasoline
    - » MOBILE RVP (adjustment to only refueling, diurnal, and hot soak)
    - » Gasoline Fuel Oxygen
      - Fuel\air adjustment affects HC, CO, and NOx
    - » Gasoline Sulfur (effect on SO_2 primarily, few catalyst equipped engines)
  - Diesel Fuel
    - » Sulfur (PM and SO_2); Highway and Nonroad Fuel Oil
    - » Cetane & Aromatics (Interested in information here)
  - CNG Fuel Quality (converting THC to NMHC)

Adjustments to Emission Factors

- Temperature Corrections
  - Exhaust (MOBILE Defaults)
    - » Gasoline (cold start but without catalysts; not much data)
    - » Diesel (effect on combustion temperature; not much data)
  - Evaporative (MOBILE Defaults)
- Altitude (MOBILE Defaults)
- Different Technologies
  - Possible but not planned other than fuel type
- Others?

Other Baseline Inputs

- Engine\Equipment Populations
  - National Default
    - » PSR Populations
  - State Defaults
    - » PSR allocation
    - » Other allocations to state level
      - Economic Indicators ($Income by sector)
      - Others (Farm acreage, population, other suggestions?)
  - County Level Default
    - » PSR allocation
    - » Economic or other indicators

Other Baseline Inputs

- Emission Rate Calculation Method
  - grams/engine = Emission Factor * Load * Hours
    - » Emission Factor is emissions per hp-hr (or kW-hr)
    - » Load is average power for a given engine
    - » Hours is use per day/month/year

Other Baseline Inputs

- Activity (hours/year)
  - NEVES
  - Encourage surveys
- Load Factor (% of available power)
  - NEVES
  - Encourage Surveys
- Individual Regional Adjustments
  - Equipment populations, load factor, and hours use must be surveyed concurrently for methodological consistency

Other Baseline Inputs

- Seasonal\Daily Adjustment (% by month, day of week, and hour)
  - NEVES, CARB, and other estimates if available
  - Obvious for special applications; snowmobiles & snowblowers
  - Other categories show marked useage by season, day of week, and hour of day
- Growth
  - BEA indicators, fuel consumption trends, and other methods
  - Will recommend a national strategy