NMIM User Guide

NMIM User Guide

Assessment and Standards Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

United States
Environmental Protection
Agency

Table of Contents

Introduction

General Introduction

The National Mobile Inventory Model (NMIM) is a consolidated emissions modeling system for EPA's MOBILE6 and NONROAD models. It was developed to produce, in a consistent and automated way, national, county-level mobile source emissions inventories for the National Emissions Inventory (NEI) and for EPA rule making.

NMIM comprises a Java framework, graphical and command line user interfaces, the MOBILE6 and NONROAD models, the NMIM county database (NCD), and post-processing and aggregation capabilities.

NMIM's primary improvements over MOBILE6 and NONROAD are:

- The inclusion of all the required county data for the nation in a single database
- A Graphical User Interface (GUI)
- Shortcuts for generating national inventories
- Tools for the aggregation and post-processing, including NIF3 output
- Estimation of 33 hazardous air pollutants (HAPs) and 17 dioxin/furan congeners by ratio to various MOBILE6 and NONROAD output parameters
- Distributed processing capability to enhance performance

NMIM extends MOBILE6's capabilities by producing inventories rather than just emission factors. NMIM provides consistency across both models and all pollutants by using a single input database for MOBILE6 and NONROAD and for criteria pollutants and HAPs.

However, NMIM is not a complete GUI front end for MOBILE6 and NONROAD, nor can it replace these models for all applications, as it was designed primarily to generate national inventories. NMIM has features intended to speed its operation and minimize its output database size that also limit its capability. For example, it will not produce hourly or by-model-year output from MOBILE6. NMIM, like NONROAD, does not produce emissions inventories for aircraft, locomotives, and commercial marine vessels.

Based on the user's run specification (RunSpec) and information in the NMIM county database (NCD), NMIM writes one input file for MOBILE6 and one input file for NONROAD for every county and month selected. NMIM then runs these models, reads their output files, performs additional processing if necessary, and puts the the inventories into an output database. Additional processing includes multiplying MOBILE6 emission factors by VMT and estimating emissions of some other pollutants as ratios to pollutant inventories generated by MOBILE6 and NONROAD.

NMIM has post-processing capability that can be applied after the inventory is generated. This includes aggregation over months, roadway types, vehicle types, and equipment types. Output can go into a database table or into a tab-delimited ASCII file. The format can be normalized (a pollutant on each line) or wide (a pollutant in each column.) NMIM can also process the output database into annual or monthly inventories and convert them into NIF3

format, which is required for NEI submissions. The user's post-processing selections can be made from the GUI and saved as an ASCII "aggregation specification" or AgSpec, which can be reloaded into the GUI, edited from the GUI or in a text editor, and run from the GUI or from the command line

Because of the large amount of computing necessary to calculate a national inventory, NMIM was designed to utilize multiple computers over a computer network. In such a configuration, an NMIM Master computer runs the NMIM graphical user interface (GUI) and performs the high level calculations while one or more NMIM Worker computers run MOBILE6 and NONROAD and perform most of the calculations . Two or more instances of NMIM (i.e., two or more copies of the NMIM Master) may be run simultaneously on a given network. This allows multiple concurrent users of the model. NMIM may also be run on a single desktop computer running both the master and the worker program.

Model Components

The NMIM model consists of eight principal components:

- A Graphical User Interface (GUI) written in Java. It allows both the casual user and the expert user to easily access the model. With simple Windows-type screens and pull-down menus, the user can quickly set up, execute and aggregate the results of an NMIM run (though the run itself may require considerable time to execute).
- A Command Line Interface and an Application Program Interface (API). More advanced users can create or edit NMIM run specifications in an XML format and run NMIM directly from the DOS command line, or from a Java program. This facilitates the creation of a large number of runs and their execution in a more fully automatic and repeatable fashion.
- A core Java NMIM Master Program that generates MOBILE and NONROAD input files and performs final calculations.
- The Java NMIM Worker Program that controls execution of MOBILE and NONROAD and performs other calculations.
- The MOBILE6.2 emission factor model. This model is written in FORTRAN and performs emission factor calculations for on-road vehicles.
- The NONROAD emission inventory model (exclusive of its graphical user interface and reporting utility components). This model is written in FORTRAN and performs emission inventory calculations for all NONROAD sources except aircraft, commercial marine vessels, and locomotives.
- MySQL, an open-source relational database management system. All NMIM databases are in MySQL.
- The NMIM County Database (NCD), which holds extensive information for each county in the United States (and Puerto Rico and the Virgin Islands). This information includes temperatures, fuel parameters, onroad mobile source control programs, average speeds, and vehicle miles traveled.

During execution several pieces of NMIM may be running simultaneously on separate computers. These pieces are the main NMIM GUI and program, the NMIM Worker(s), the MYSQL Database Server, and the MOBILE6 / NONROAD models. During execution, the master computer controls the NMIM GUI and the main NMIM program. The main NMIM program in turn passes information to the individual NMIM Worker programs. The NMIM Worker(s) control the execution of the MOBILE6 and NONROAD models, and send results back to the Master computer. The MYSQL database runs in both the Master and Worker computers, and provides information from the county database to other program components upon request, as well as being used to produce the output database.

Several reporting methods are available in NMIM as post-processing tools that can be used to report the results in various formats and levels of detail. All of them are based on a results database which the NMIM program creates during execution. One specialized format is the NIF3 reporting format for the NEI.

Other Documentation

The NMIM model is an extension of the existing MOBILE6.2 and NONROAD models. As a result, this user guide assumes that the reader has access to the their user guides and technical documentation. See the EPA OTAQ website www.epa.gov/otaq/models.htm for information on these models.

Future Model Updates

The EPA vehicle emission modeling group is interested in receiving comments on NMIM and any suggestions for future model revisions and updates. E-mail your comments and suggestions to the team at mobile@epa.gov.

Graphical User Interface

The Graphical User Interface (GUI) provides the user with an easy method for specifying and running NMIM emissions simulations. In addition, the GUI provides the user with an easy means for accessing the reporting utility to further process the results of the modeling run. Simple Windows-type menus, menu button bars and pull-down screen, allow the user to quickly set up, execute, and view a modeling scenario without any computer programming experience or previous experience with EPA's MOBILE6 or NONROAD models.

This section discusses the following topics :

• launching the NMIM model from the Windows Desktop

• a description of model inputs (Run Specification) requested by the user interface

• creating and executing a Run Specification (RunSpec) file example

Launching the NMIM model

After proper installation, the NMIM program is launched in the standard way that all Windows programs are launched. To begin, use the left button on the mouse to double click on the NMIM desktop icon (Figure 3-1). Alternately, NMIM can be launched from the Windows Start button and Programs list button choice. When launched, the main menu screen of the interface appears (Figure 3-2). From this screen the user can access five menu bars and navigate the main screen containing the list button menu. These menu bars and the main list button menu comprise the entire GUI for NMIM.

The NMIM icon is a map of the United States with a mathematical integral symbol through it. The integral symbol represents the integration of MOBILE6, NONROAD, criteria pollutants, and HAPS within a single framework based on a single database.

**Figure 3-1: Graphical User Interface icon.**

Double Click on the NMIM Desktop Icon to Launch NMIM. The NMIM GUI application may also be launched by double clicking on the application file named NMIMGUI.exe located in the NMIM directory.

Description of the NMIM Model Inputs and Creation of a RunSpec

This section describes the principal portions of the NMIM GUI. These are all visible on Figure 3-2. They are the NMIM Pull-Down Menu at the top of the Figure, the blue scrollable NMIM Navigation List on the left hand side, and the Detail Panel on the right (the main section where the NMIM logo is initially shown). The Detail Panel is blank in Figure 3-2 because none of the input options on the Navigation List have been chosen. Once one of these is chosen, the Detail Panel changes to accept one of several sets of particular user input. This is fully explained in the Graphical User Input Section of this user guide.

These three portions of the NMIM GUI are used to create and/or execute an NMIM RunSpec. A RunSpec is an XML text file that contains all the user inputs needed to execute NMIM. The Graphical User Input Section of this user guide will illustrate in detail how to create and execute a working RunSpec through the use of a simple example.

Figure 3-2: Initial appearance of NMIM graphical user interface
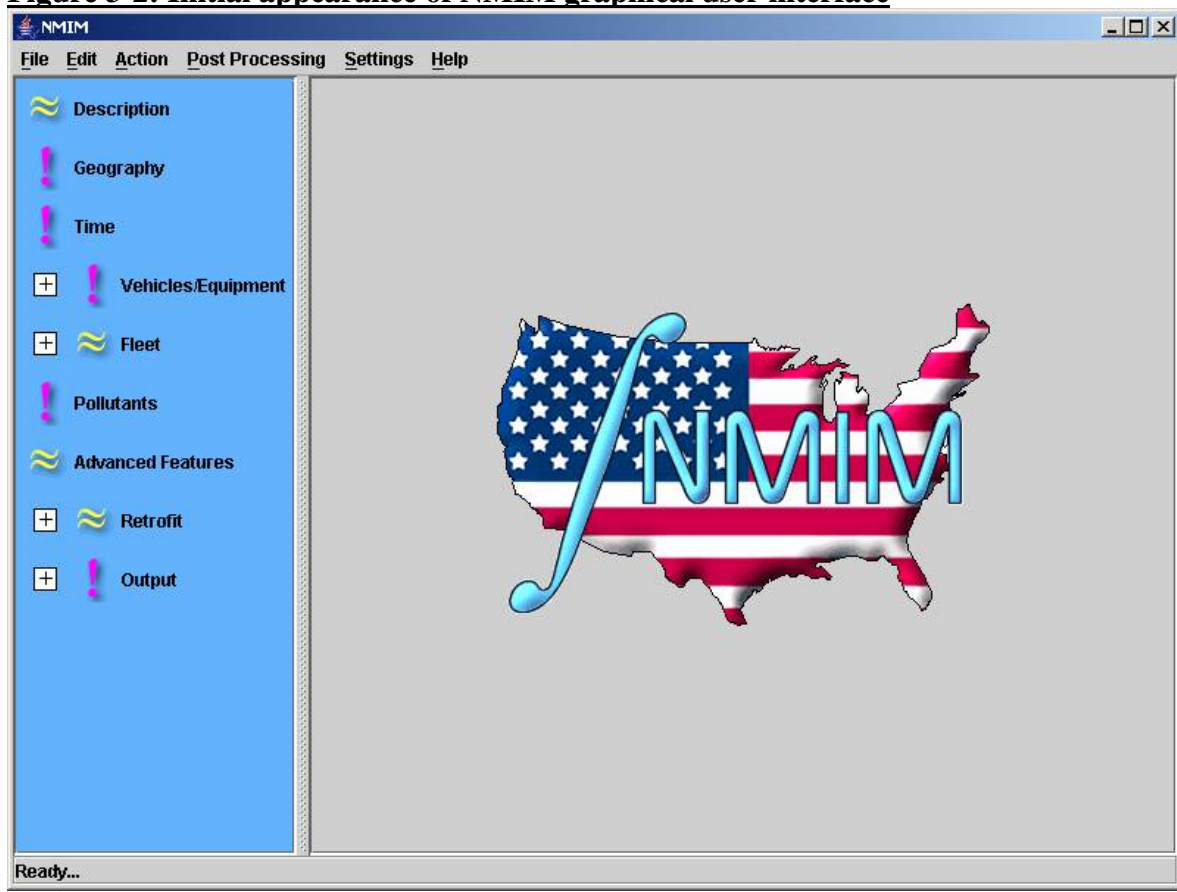
NMIM Navigation List

The NMIM Navigation List is shown with a light blue background on the left side of the Main NMIM window. It categorizes the input options available to the user. The list includes seven principal sections as shown in Figure 3-2 and listed below.

- Description
- Geography
- Time
- Vehicles/Equipment
- Fleet
- Pollutants
- Advanced Features
- Diesel Retrofit
- Output

"Vehicles/Equipment", "Fleet", Diesel Retrofit", and "Output" can be expanded into more detailed categories.

When the user selects a detailed category, or top-level category which has no subcategories, from the Navigation List, the appropriate Detail Panel opens on the right side of the Main NMIM GUI window. At this point, the user can enter the appropriate information in the Detail Panel, or navigate to a different item in the Navigation List. The user may also open a new Detail Panel, or if finished, save the information entered into the GUI and execute the NMIM program from the Main Menu. Note that the set of detail panels function together as a single set of input values; there is no "close" button on the individual panels, and panels can be visited and revisited in any order.

The information entered by the user into the set of Detail Panels can be saved, through the use of the File Menu item, as an NMIM "run specification" or RunSpec. This RunSpec can then be re-loaded into the NMIM GUI whenever desired and reused or modified.

The NMIM GUI has been designed such that the user is encouraged (but not required) to enter the RunSpec inputs in the order from top to bottom of the Navigation List starting with the Description input and ending with the Output section. The user should also note that four of the nine principal sections, "Vehicles/Equipment", "Fleet", Diesel Retrofit", and "Output, of the Navigation List contain sub-sections.

The Navigation List is a tree structure with some input categories that lead to additional input requirements depicted as sub-sections in the Navigation List. Sections that contain sub-sections are shown with an expand-or-collapse icon (square with a plus or minus sign). Selection of this icon allows the list of sub-sections to be expanded or collapsed.

Each section also displays readiness icons based on the state of completeness or readiness of the particular section input.

A **red exclamation mark** means "not ready:" sufficient information has not been entered for that section. For top-level categories, a red exclamation mark will prevent NMIM from executing. For subcategories, a red exclamation mark will not prevent NMIM from executing.

A **green check mark** means that sufficient information has been entered into the section and its sub-sections.

A **yellow double tilde** means that default information sufficient to run the program is present for the section. The user may still elect to change the default settings if desirable. This action would transform the yellow double tilde into a green check mark. Figure 3-4 illustrates the navigation list icons.

Figure 3-4 Navigation List Icons

Icon	Meaning
	Needs additional user supplied data.
	Filled in sufficiently to run.

 Default data present, but otherwise filled in sufficiently to run.

 Tree close/expand

Other general features of the NMIM GUI are drop-down menus, radio buttons, and check boxes, which work in a fairly standard way. Choices which are not allowed are disabled, as indicated by a light gray font (they are "grayed out").

Menu Bar Options

When the NMIM GUI is launched, the menu bar appears near the top of the window (Figure 3-2). From this menu bar, the user can access six menus. These menus are used to create, open, edit and/or save a RunSpec, execute the NMIM program (execute a RunSpec), access post processing options and obtain on-line help (the help function is self contained in the program and is not Web based).

The items on the menu bar are File, Edit, Action, Post Processing, Settings, and Help. In standard Windows fashion, these items can be selected by using the mouse to left-click on the menu choice or by typing the underlined letter in the menu choice while holding down the Alt key. To "deselect" any menu item, highlight another menu selection, or press **<ESC>**. To back up one level in the menu tree, press **<ESC>**. To back up from some menu sub-items may require clicking the "cancel" button.

File - This menu is used to create and modify RunSpecs, and its options are typical of those used when manipulating documents in Windows: **New, Open, Close, Save, Save As, and Print**. These allow the RunSpec to be created, loaded from computer's hard disk and saved to the computer's hard disk. The numbered entries at the bottom of the menu quickly reload recently used RunSpecs.

Edit - This is a standard Windows menu that is used for manipulating text. The individual sub-items are Cut, Copy, Paste and Clear. This menu can only be used on individual text items; it cannot be used to copy or manipulate data from entire sections such as the geography section.

Action - The Action menu gives the user five possible choices: Execute, Stop, Pause, Resume, and NMIM Run Error Log. Some of these choices will be unavailable, grayed out, depending on the current state of the program. Execute, Stop, Pause, and Resume control the execution of the currently loaded RunSpec. This menu also provides access to the NMIM error log, which contains error messages generated during a run.

Post Processing - This menu is used to activate additional programs that will process the NMIM output database after a run is complete. See the NMIM Output Section of this User Guide for more information regarding this menu.

Settings - This menu is used to access the Configure NMIM menu item. See the Settings and Configuration Section of this User Guide for more information regarding this menu item.

Help - The Help menu has two choices: **NMIM User's Guide** and **About**. The NMIM User's Guide is the document you are currently viewing. **About** displays the release date of the version of NMIM that is running.

Settings Menu / Configure NMIM

The Settings Menu is a pull-down menu from the menu bar at the top of the main window. If selected, an additional Configure NMIM tab becomes visible. If this tab is selected, the Configure NMIM window opens as shown in Figure 3-19. The Configure NMIM window is essentially a way to edit NMIMConfiguration.txt, which is located in the NMIM root directory and may also be edited with a text editor.

The top section of the configure NMIM window is the Default County Database selection box. The Default County Database is the NMIM County Database (NCD) that is used when NMIM is first started and provides the list of counties, vehicle types, etc. that populate the NMIM GUI. If the NCD is on the same computer as the NMIM Master (the usual case), locally on a PC, the server must be specified as "localhost". Individual RunSpecs may designate a different NCD, which overrides the default. The GUI is not functional without a default NCD.

The middle section allows the user to specify the MySQL server that hosts the NMIM output database. The usual choice is "localhost", which puts the output database on the same computer as the NMIM Master.

The bottom section is the Shared Distributed Folder Path box. This folder is where the NMIM Master and Workers share their common input, temporary, and output files. If a single PC is used to run NMIM, the Shared Distributed Folder Path is typically set to C:\NMIM\SharedWork, but could be set to any existing folder on the PC. However, if the multiple NMIM Workers are utilized over a network, a network drive and folder accessible to the Master and all the Workers should be specified.

Figure 3-19 Configure NMIM

Users should be aware that the settings menu does not display or allow them to set the mySQLFolderPath variable in NMIMConfiguration.txt. If necessary, users must set this variable using a text editor. This variable is important to enable NMIM to find the externalfiles folder of the NCD.

NMIM Inputs

Description Panel

The first item in the Navigation List is Description. When this item is selected, the Description Panel opens in the Detail Panel Section (The large gray panel on the right side in Figure 3-5). The Description Panel is a scrollable text window that allows the user to give the RunSpec a particular textual description. Up to 5000 characters of text may be entered to describe the RunSpec. The text entered in the Description Panel is for documentation purposes only. It has absolutely no effect on the results from the NMIM program. The default Description is blank and the NMIM model can be run without a Description.

Because RunSpecs are XML documents, do not use "&" or angle brackets in your description, since these characters have special meanings to XML.

Figure 3-5 Description Panel Figure
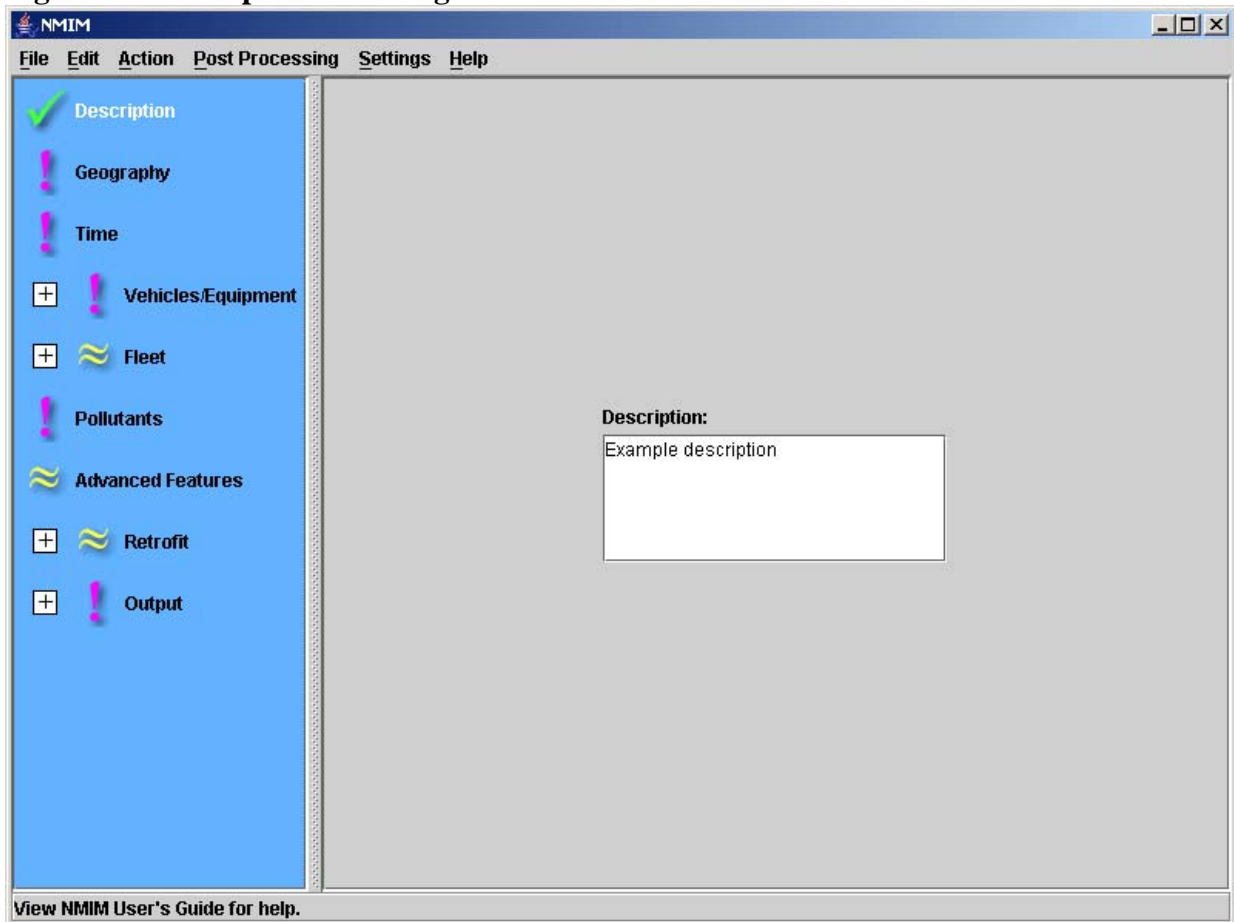
Geography Panel

The second item in the Navigation List is the Geography Section. When this item is selected, the Geography Panel opens in the Detail Panel Section. The initial Geography Panel as shown in Figure 3-6 contains a list of four buttons. These buttons are "All", "State," and "County," and "Fleet." The user must choose one of these buttons in order to get a successful NMIM RunSpec. If the "All" button is chosen, the NMIM model will run scenarios and compute emission inventory results for all counties/parishes in the United States and Territories. If the "All" button is selected, this completes the geography input requirement and the second Geography Panel Window will not open. The "All" button is generally chosen if the user wishes to create a national U.S. emission inventory. If such a choice is made, the user should be cautioned that this choice may take considerable computation time. The fleet button is grayed out unless the user is performing fleet modeling (see Retrofit and Fleet Modeling below).

Figure 3-6   Initial Geography Panel
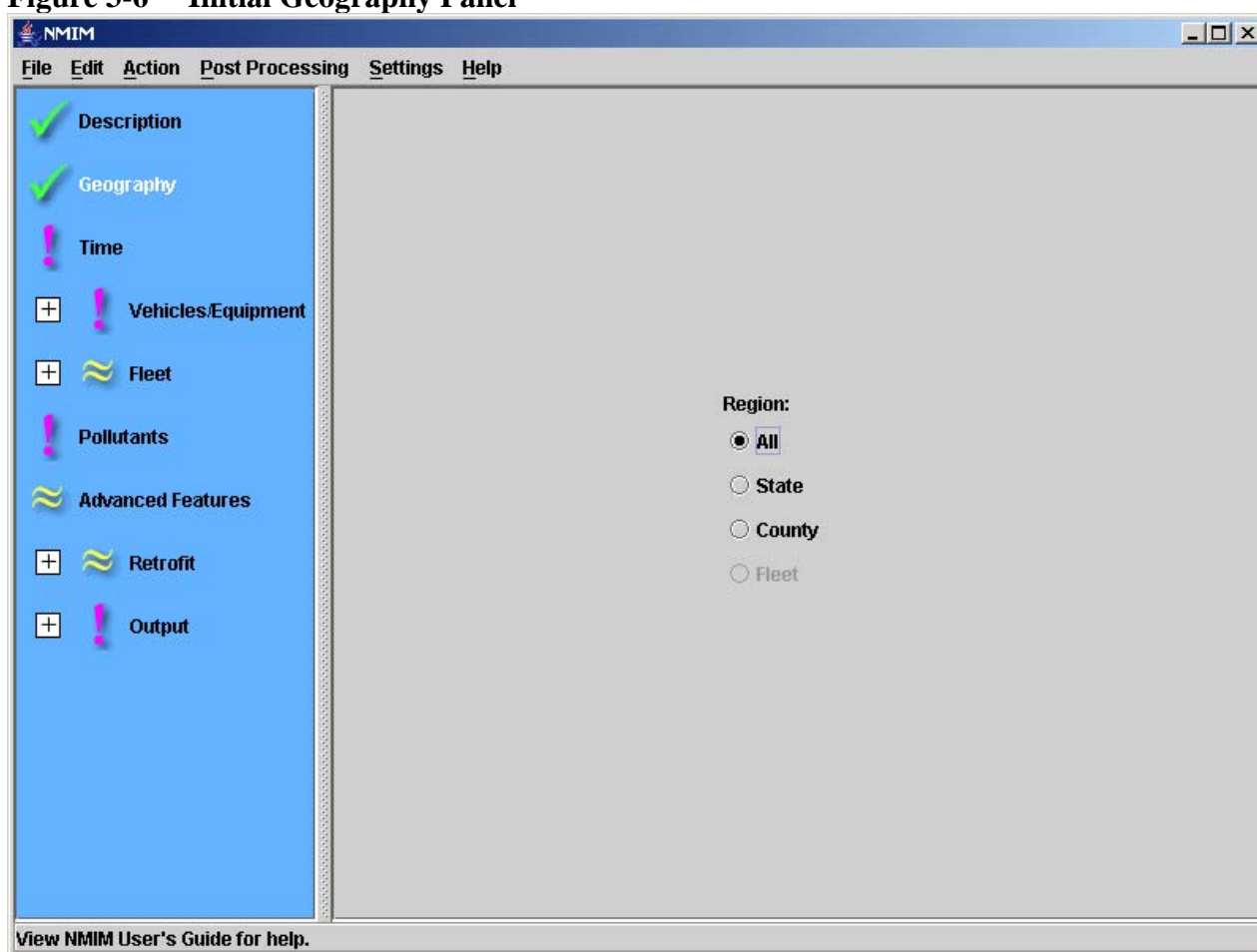
If the user selects "State" from the Initial Geography Panel (Figure 3-6), the Geography Panel for State Selection (Figure 3-7) will open in the Detail window.

Figure 3-7   Geography Panel for State Selection
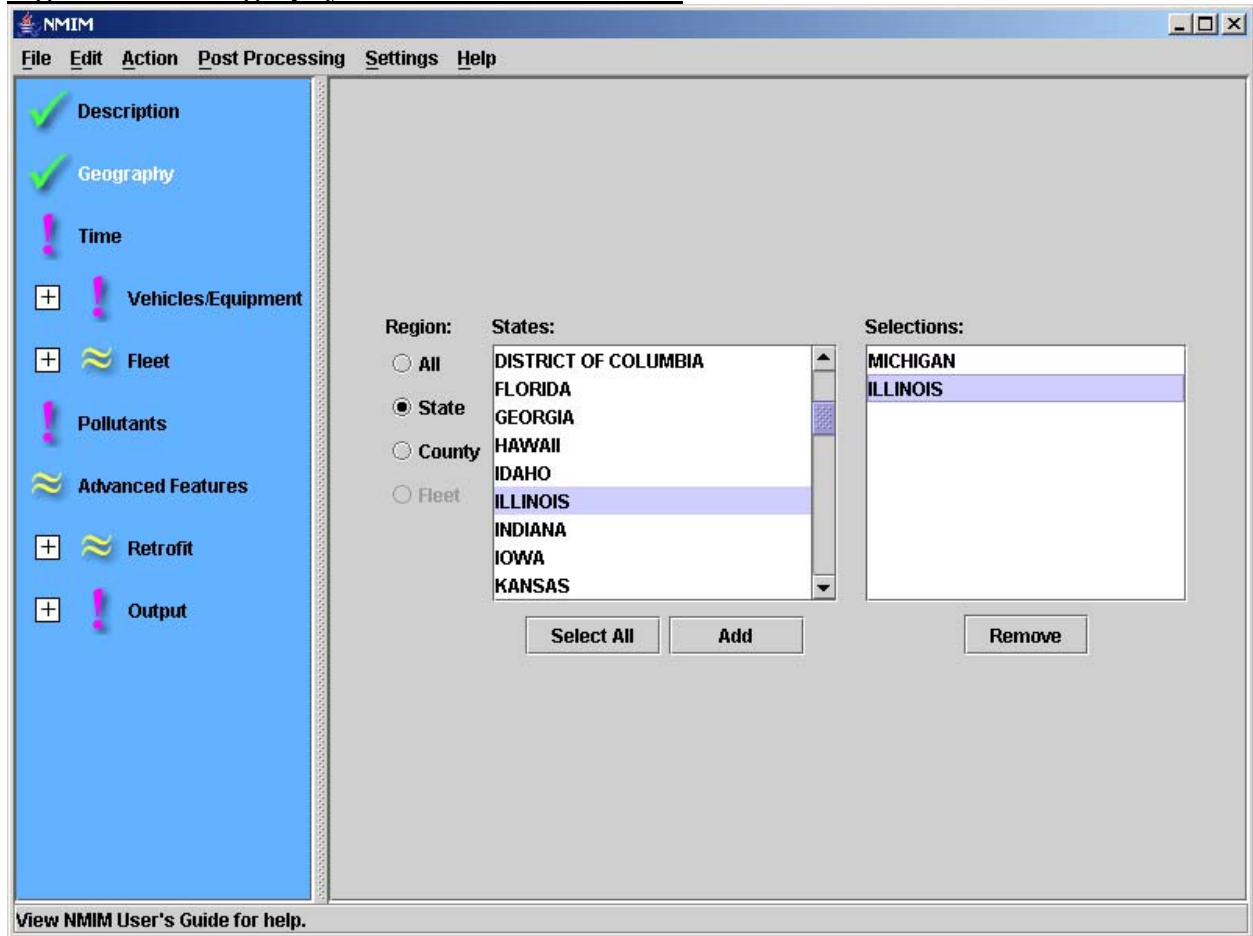
The Geography Panel shown in Figure 3-7 contains the Region box in which the "State" button is currently selected, the States box which contains a list of all the states and territories, and the Selections box. The States box contains a list of all of the US states and territories. The Selections box contains a list of the states which the user has chosen to model. A particular state is selected by scrolling the States box and selecting the particular state to be modeled. Once the state is selected the user clicks the Add button and the particular state moves to the Selections box. The All button allows the user to select all of the states and territories for modeling using one mouse action. The remove button allows the user to remove a selection. This is done by selecting the appropriate state with the mouse and clicking the remove button. The remove button is inactive if no states are in the Selection box.

If the user selects "County" from the Initial Geography Panel (Figure 3-6), the Geography Panel for County Selection (Figure 3-8) will open in the Detail window.
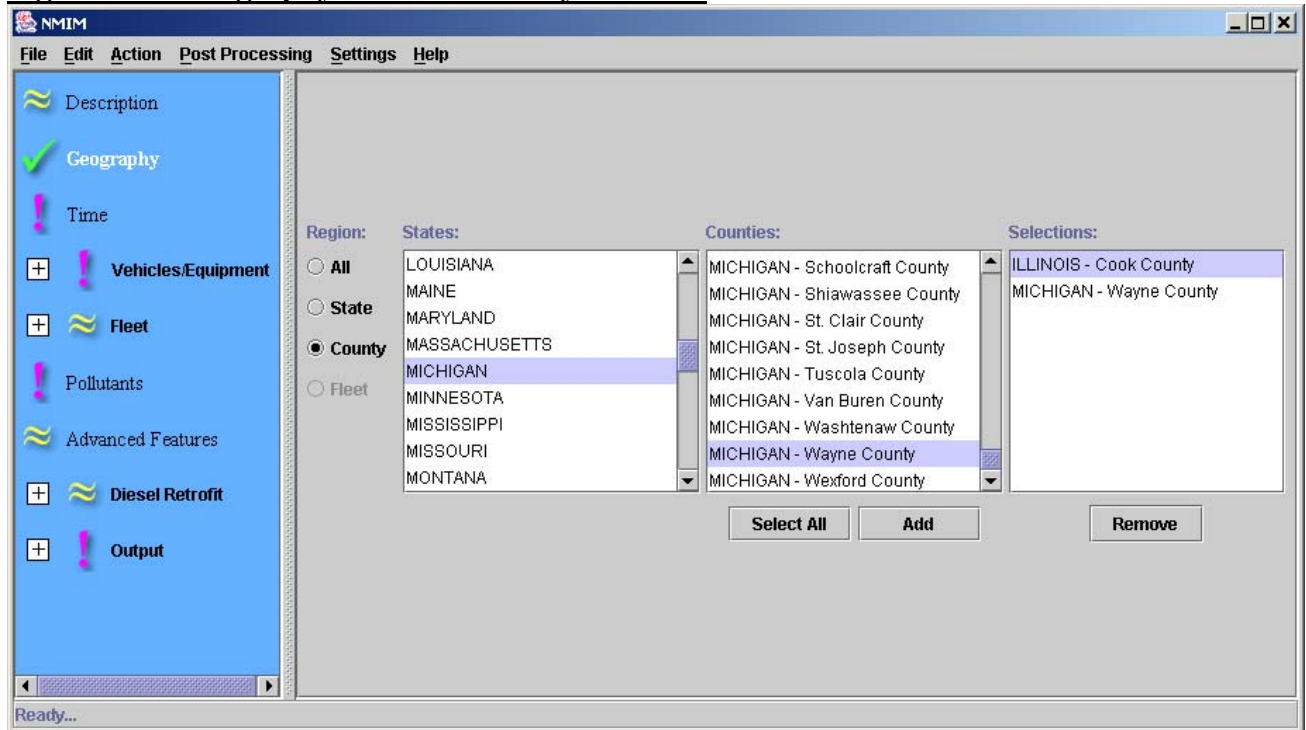
Figure 3-8   Geography Panel for County Selection

The Geography Panel shown in Figure 3-8 contains the Region box in which the "County" button is currently selected, the State box which contains a list of all the states and territories, the Counties box, and the Selections box. The States box contains a list of all of the US states and territories. The Selections box contains a list of the states which the user has chosen to model. The Counties box contains a list of counties in the selected state. A particular county is selected by scrolling the Counties box and selecting the particular county to be modeled. Once the county is selected, the user clicks the Add button and the particular state and county combination moves to the Selections box. The All button allows the user to select all of the counties in a particular state for modeling using one mouse action. The remove button allows the user to remove selection(s) which have been made by selecting the appropriate county with the mouse and clicking the remove button. The remove button is inactive if no state - county combinations are in the Selection box or if none are selected.

Time Panel

The third item in the Navigation List is the Time Section. When this item is selected, the Time Panel opens in the Detail Panel Section. The Time Panel contains two sub-panels. The leftmost sub-panel is the selection area for calendar year(s) to model. The calendar years are listed in the Year list box and can range from 1999 through 2050. Left-clicking the black triangle in the Year box with the mouse provides the list of calendar years. Click the Add button to move the selected year into the Year Selections box. A combination of individual years can be selected with the mouse. The right-most sub-panel is the selection area for months to model. The user can select one or more individual months to model by clicking the appropriate boxes. The user must check at least one month box. The same set of months

will be used for all years. Selecting the "Use Yearly Weather Data" check box causes NMIM to use historical data, if it is available, from the CountyYearMonthHour table for the year selected, If historical data is not present, NMIM will use 20-year average data from the CountyMonthHour table.

Figure 3-9 Time Panel
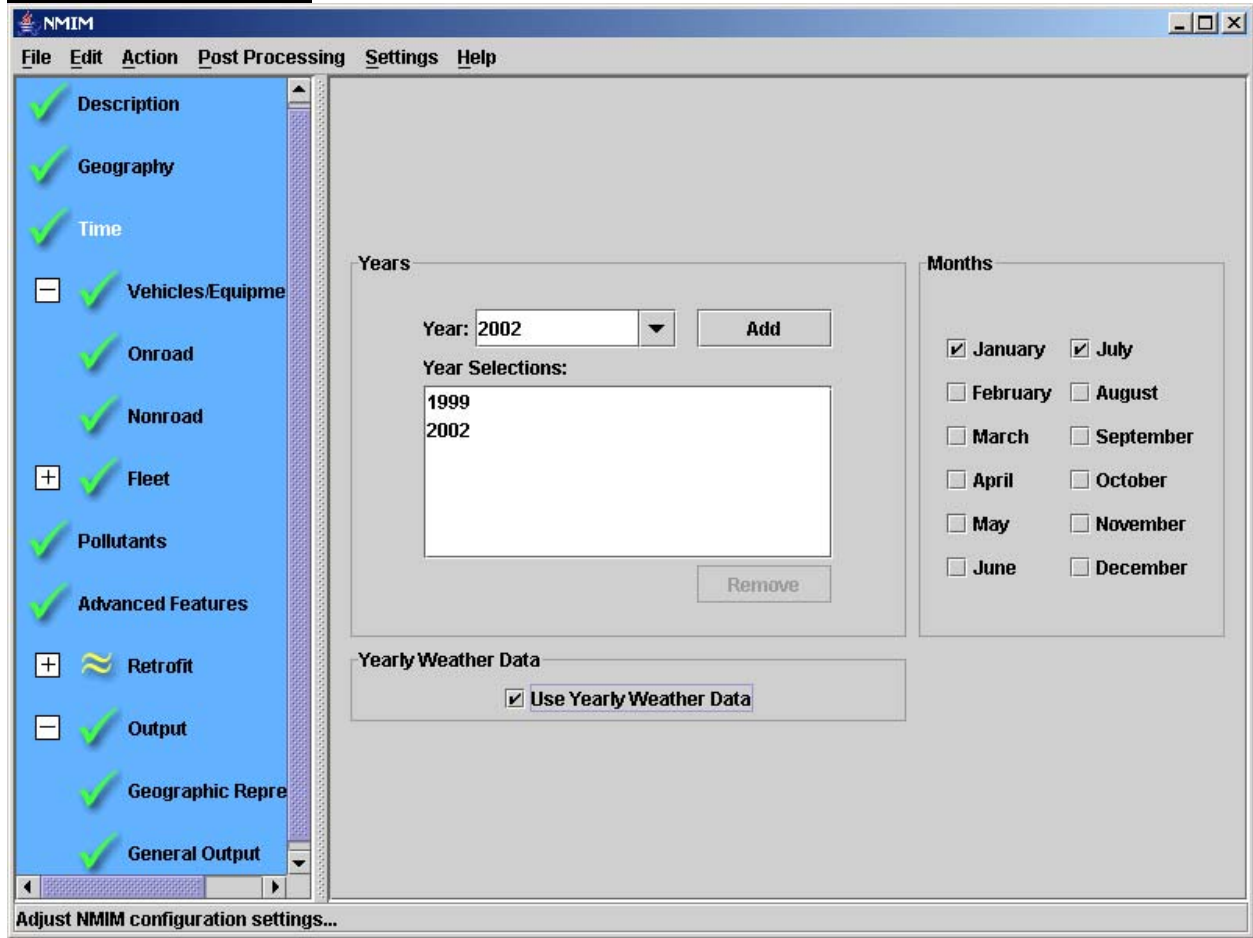
For NMIM to produce highway inventories for the years selected, VMT estimates for those years must be present in the BaseYearVMT table of the NCD or be bracketed by two years with VMT estimates, in which case NMIM will linearly interpolate between the two years. When running NMIM, users are advised to provide as much locally validated data as possible, including VMT estimates. The EPA does not endorse as appropriate for any particular purpose the VMT estimates contained in the NCD supplied with the NMIM download.

Nonroad equipment does not require VMT estimates and can be calculated for any of the calendar years listed.

NMIM creates a single RunSpec with a list of month-years. This list is the full combination (cross product) of the selected calendar years and the selected months. Thus, the same months apply for all years selected. For example, if the user decides to model calendar years

2010, 2015, and 2020, and selects January and August, modeling will be done for the January and August of all three years.

In the Time Panel, the user selects calendar years from the drop-down menu and then uses the "Add" button. Selecting a calendar year in the "Year Selections" list enables the "Remove" button but does not otherwise affect other controls. The "Add" button will give an error message if an attempt is made to add a year that was already selected.

There is no default selection for the Time Panel, and the NMIM model will not run without both a calendar year selection and a month selection on this panel.

Vehicles / Equipment Panel

The fourth item in the Navigation List is the Vehicles / Equipment Section. This section does not have its own panel. Instead, when selected on the Navigation List it reveals two sub-choices. These are the Onroad Section, and the Nonroad Section. If selected, both the Onroad and Nonroad sections open separate Detail panels. See the Onroad and Nonroad chapters of this user guide for further details.

There is no default selection for the Onroad or Nonroad Detail panel inputs. The NMIM model requires either a valid Onroad input or a valid Nonroad input (or both). If some vehicles or equipment are omitted, the NMIM will not execute those particular calculations and save program execution time.

Onroad Vehicle Panel

The Onroad section is a sub-section of the Vehicles / Equipment Section. When selected from the Navigation List, it opens the Onroad Detail Panel. This panel allows the user to select the on-road vehicle(s) types to be modeled. Figure 3-10 shows the Onroad Detail Panel.

Figure 3-10 Onroad Detail Panel
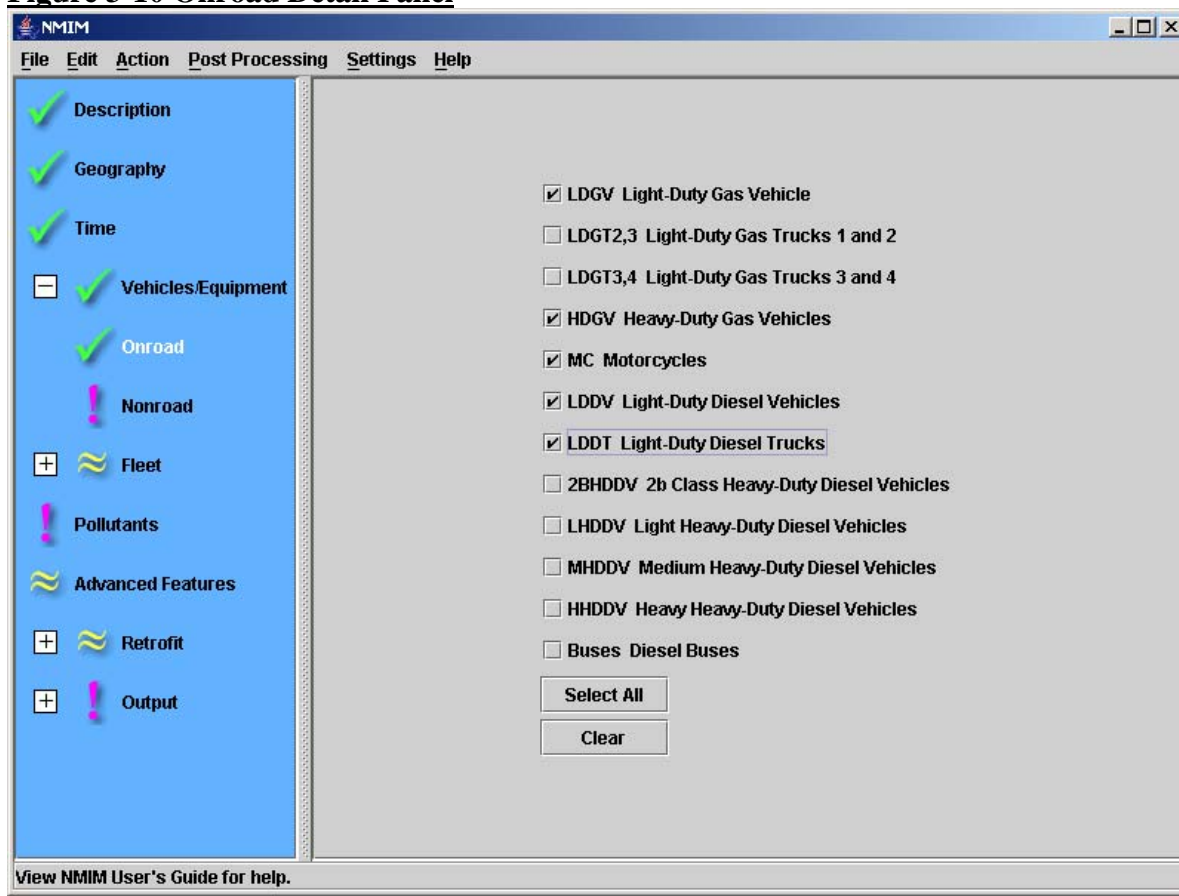
The Onroad Vehicle panel allows the user to select which on-road vehicles are to be modeled. The user may select between zero and all twelve vehicle types. Selection of a particular vehicle type is made by clicking its button on the panel with the mouse. In the example below, NMIM will compute emission inventories for light-duty gasoline vehicles, heavy-duty gasoline vehicles, motorcycles, light duty diesel vehicles, and light-duty diesel trucks. If no vehicle types are selected, the NMIM model will NOT run the underlying MOBILE6.2 emission factor model. If at least one vehicle type is selected, MOBILE6.2 will be run. However, even if MOBILE6.2 is run, there will be no NMIM output unless there is VMT in the BaseYearVMT table for the selected time period. NMIM will not warn you if you try to run an onroad inventory for a year with no VMT. Nor will it give you any error messages; there will simply be no output.

The twelve vehicle types and their weight definitions are as follows:

1. LDGV: Light-Duty Gasoline Vehicles (Passenger Cars)

2. LDGT1,2: Light-Duty Gasoline Trucks 1 and 2 (less than 6000 lbs GVW)

3. LDGT3,4: Light-Duty Gasoline Trucks 3 and 4 (6001 - 8500 lbs GVW)

4. HDGV: All Heavy-Duty Gasoline Vehicles (Trucks greater than 8500 lbs GVW)

5. MC: All Motorcycles

6. LDDV: Light-Duty Diesel Vehicles (Passenger Cars)

7. LDDT: Light-Duty Diesel Trucks (less than 8500 lbs GVW)

8. 2BHDDV: Class 2B Heavy-Duty Diesel Vehicles (8501 through 10,000 lbs GVW)

9. LHDDV: Light Heavy-Duty Diesel Vehicles (10,001 through 19,500 lbs GVW)

10. MHDDV: Medium Heavy-Duty Diesel Vehicles (19,501 through 33,000 lbs GVW)

11. HHDDV: Heavy Heavy-Duty Diesel Vehicles (33,001 + lbs GVW)

12. Buses: All Diesel Transit and School Buses

Nonroad Equipment Panel

The Nonroad section is a sub-section of the Vehicles / Equipment Section. When selected
from the Navigation List, it opens the Nonroad Detail Panel. This panel allows the user to
select the particular nonroad equipment types (called Segments) and fuel types to be
modeled. Each selection is a combination of equipment type (Segment) and fuel type. Figure
3-11 shows the Nonroad Detail Panel.

Figure 3-11   Nonroad Detail Panel
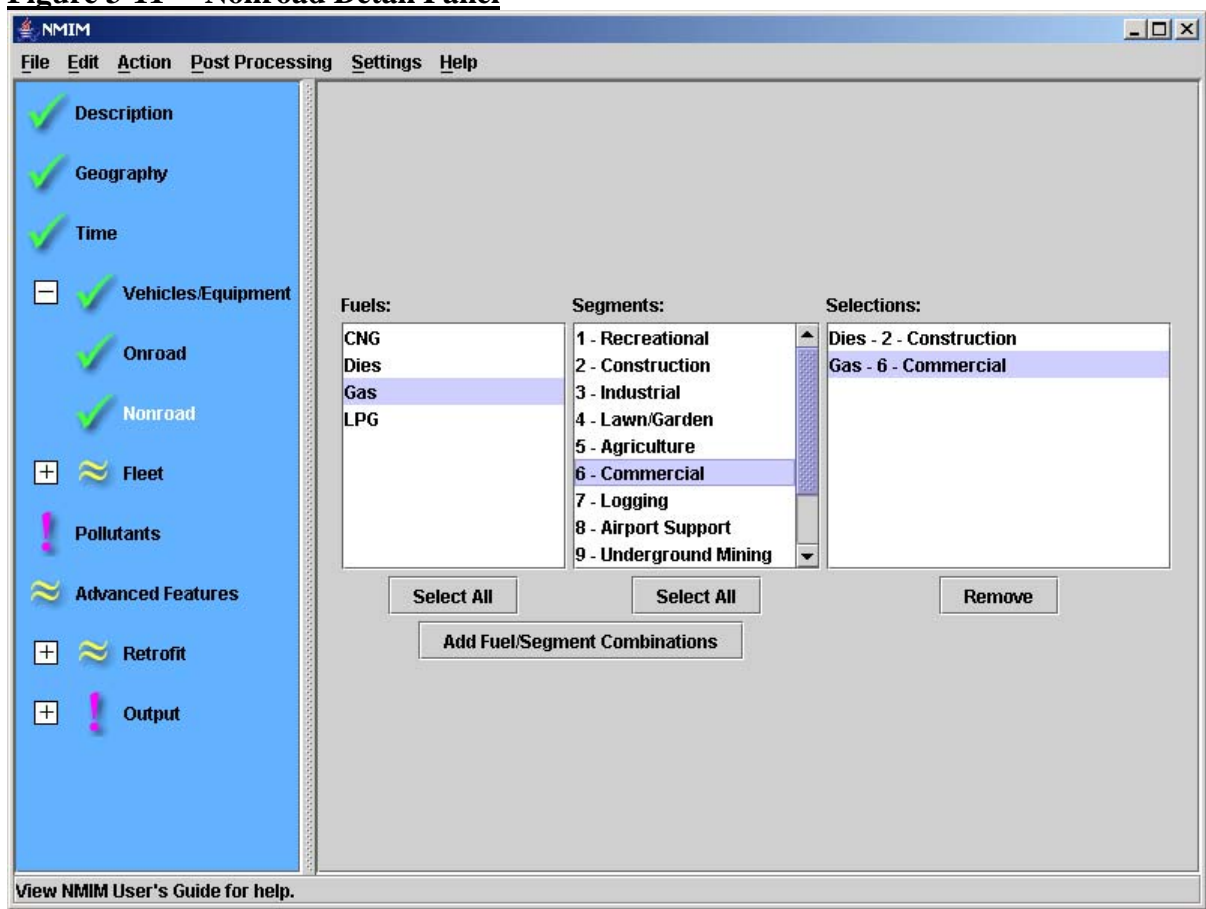
The NMIM model allows the user to choose one or more of the twelve vehicle / equipment types or Segments. These are:

- Recreational
- Construction
- Industrial
- Lawn and Garden
- Agriculture
- Commercial
- Logging
- Airport Support
- Underground Mining
- Oilfield
- Pleasure Craft (marine)
- Railroad

The NMIM model also allows the user to specify a particular fuel type for each of these vehicle / equipment choices. The fuel types are:

- CNG
- Diesel
- Gasoline
- LPG

In the Nonroad Sub-Panel the user may select between zero and the full combination of the twelve equipment types (Segments) and four fuel types. Selection of a particular equipment type (Segment) and fuel combination is made by clicking and highlighting the selection on either the Segments or Fuels boxes with the mouse. Once the selection of both a Segment item and the Fuel item is highlighted, a click of the "Add Fuel / Segment Combinations" button moves the selected choices to the Selections box. The Remove button clears the highlighted selections.

If zero equipment types (Segments) and fuel combinations are selected, the NMIM model will NOT run the NONROAD model. If at least one Segment / fuel combination is selected, NONROAD will be run. In the example below, NMIM will compute emission inventories for diesel construction equipment and commercial gasoline powered vehicles and equipment.

Pollutants Panel

The fifth item in the Navigation List is the Pollutants Section. When this item is selected, the Pollutant Panel opens in the Detail Panel Section. The Pollutants Panel contains three sub-panels. They are an Aerosols sub-panel, a Gases sub-panel and a Toxics sub-panel. Figure 3-12 shows an example Pollutants Panel.

Figure 3-12 Pollutants Panel
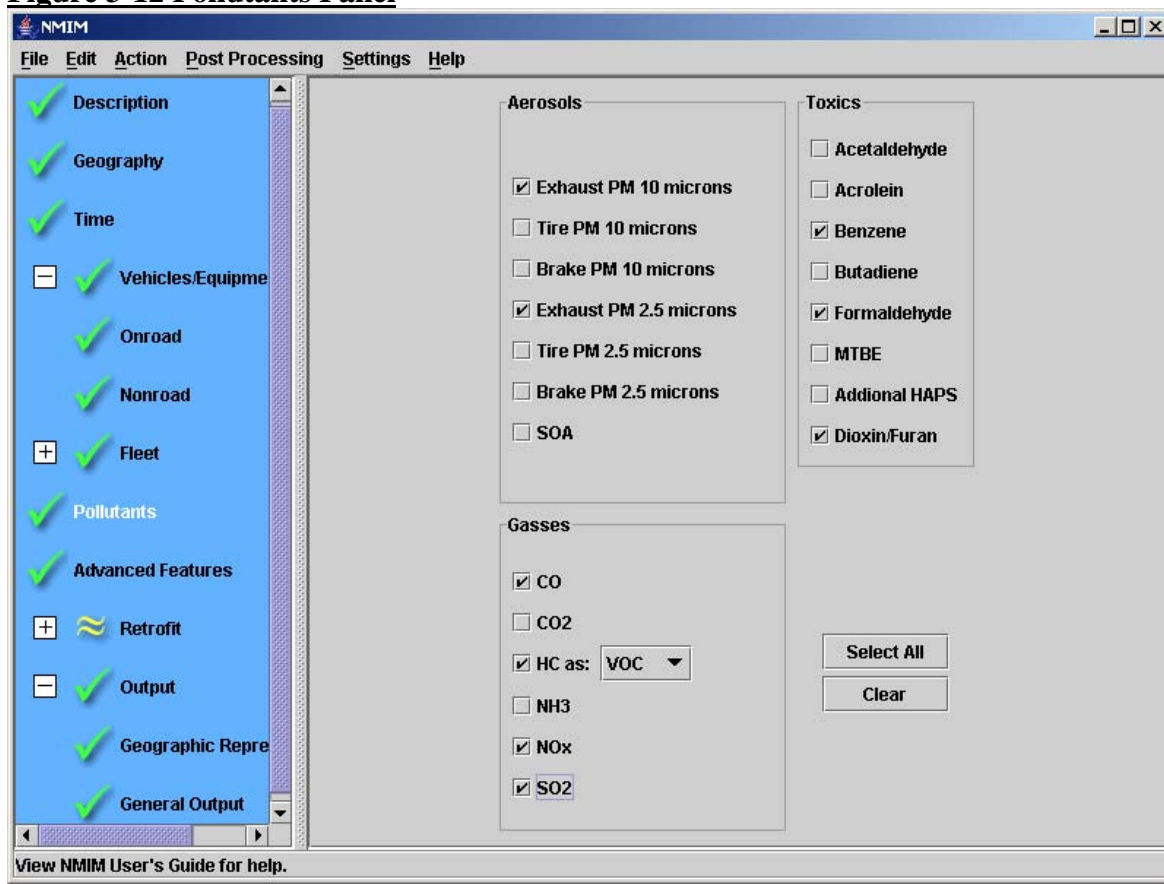
The Pollutants Panel allows the user to select pollutants to be modeled. This is done by selecting the appropriate pollutant check box on the Pollutant Panel. Selection of a pollutant automatically instructs the NMIM model to perform all calculations necessary for that pollutant. When an aerosol is selected, the user can select either 2.5 microns or 10 microns or both.

When HC is selected, a drop-down menu is enabled which allows the user to select the form in which to express the hydrocarbon inventory. Hydrocarbons may be expressed as NMHC, NMOG, VOC, THC, or TOG. The user may select only one of the hydrocarbon types from the list. Selecting HC as VOC will also allow the user to choose SOA results, if desired. Choosing Additional HAPS forces the choice of two pollutants, Exhaust PM10 and HC as VOC, because Additional HAPS are calculated by ratio to one of these two pollutants.

The pollutant abbreviations shown in the GUI have the following definitions.

Aerosols

- Exhaust PM - Sum of all exhaust (elemental carbon, organic carbon and sulfate) particulate matter emissions.
- Tire PM - Particulate matter emissions from tire wear.
- Brake PM - Particulate matter emissions from vehicle brake wear.
- SOA - Secondary organic aerosols.

Gases

- CO - Carbon monoxide
- CO2 - Carbon dioxide
- HC - Hydrocarbon
- NH3 - Gaseous ammonia
- NOX - NO + NO2
- SO2 - Sulfur dioxide

Toxics

- Acetaldehyde
- Acrolein
- Benzene
- Butadiene - 1,3-Butadiene
- Formaldehyde
- MTBE - Methyl Tertiary Butyl Ether
- Additional HAPS - 27 additional hazardous air pollutants
- Dioxin/Furan - 17 dioxin/furan congeners.

As a user convenience, the Pollutants Panel also contains a Select All and a Clear button. Clicking these buttons selects or removes all pollutants.

Advanced Features Panel

The seventh item in the Navigation List is the Advanced Features Section. This panel is shown in Figure 3-15.

Figure 3-15 Advanced Features Panel
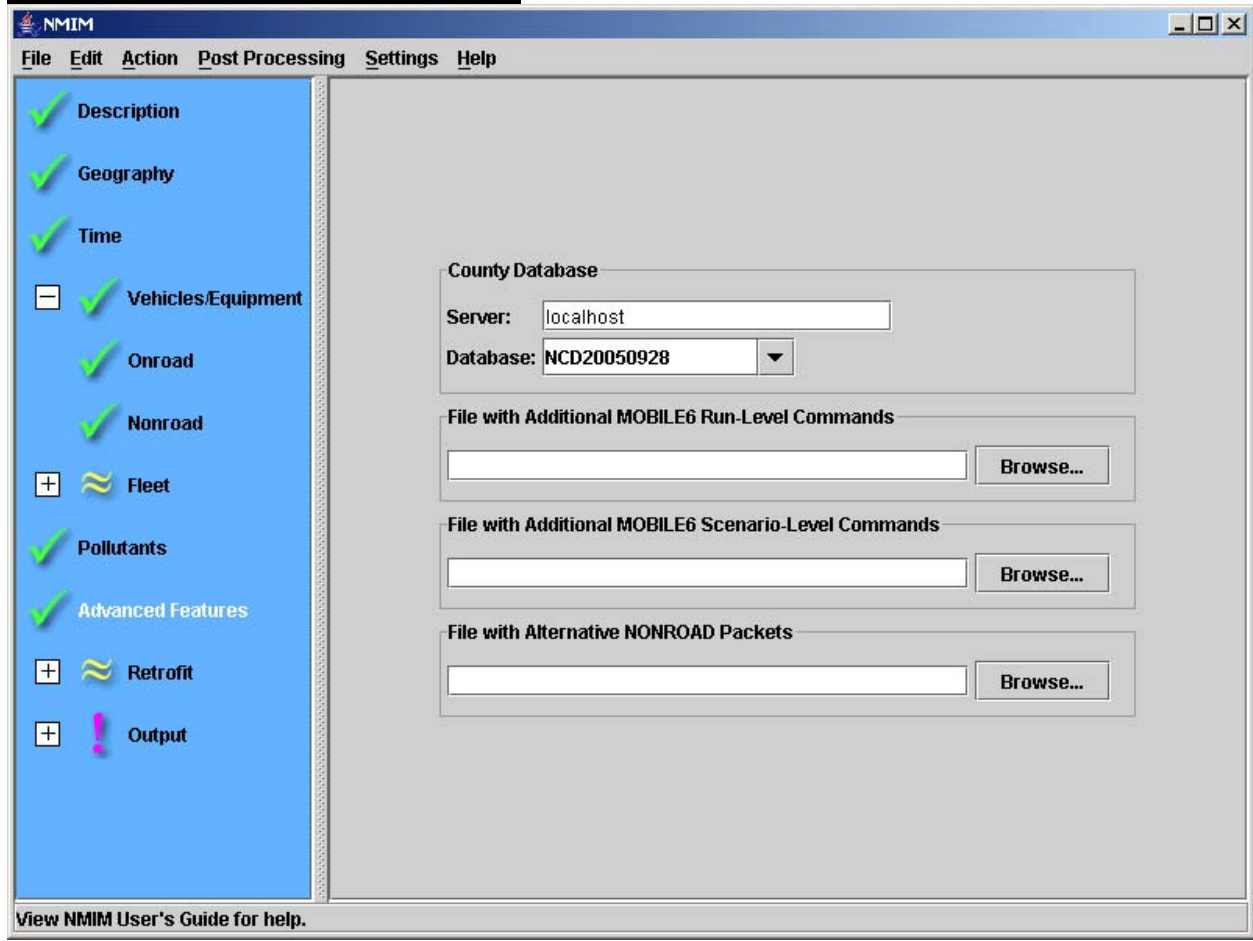
The Advanced Features detail panel can be used to specify a version of the NMIM County Database (NCD) to use during the model run. If nothing is entered, the default NCD specified in the NMIMConfiguration.txt file (in the NMIM root directory) will be used. To specify another NCD, enter the Server and Database names. If the database is physically located on the same machine as the NMIM master (the usual case), enter "localhost" in the Server box. If the database is on another machine, enter the appropriate server name. Enter the name of the NCD you wish to use in the Database box.

The Advanced Features detail panel also allows the user to provide additional text files containing MOBILE6 and NONROAD commands. Separate input files must be specified for the MOBILE6 Run Level and Scenario Level commands and NONROAD commands. We do not expect this capability to be frequently used, because of NMIM's newer capability to reference these files and commands at the county level in the NMIM County Database.

If an alternate file containing MOBILE6 or NONROAD commands is specified in this Advanced Features panel, NMIM will look for the file relative to the NMIMRoot directory. A file name without a path is expected to be in the NMIMRoot directory. NMIM will read the text file and write the contents to MOBILE6 or NONROAD input files, overriding other file or command specifications that would otherwise be written by NMIM.

Files specified in this panel must contain allowable MOBILE6 commands and/or NONROAD input file sections. The user is cautioned to use care when creating such files since NMIM model will perform only minimal testing of these files prior to attempting to execute them in a MOBILE6 or NONROAD model run. If errors are found during execution, the program will likely stop and the diagnostics will be minimal.

A text file containing MOBILE6 Run commands may contain the following MOBILE6 commands.

Allowable MOBILE6 - Run Level Commands

```
                        NO REFUELING
                        ABSOLUTE HUMIDITY
                        CLOUD COVER
                        PEAK SUN
                        SUNRISE/SUNSET
                        DIESEL FRACTIONS
                        MILE ACCUM RATE
                        NGV FRACTION
                        NGV EF
                        STARTS PER DAY
                        START DIST
                        WE DA TRI LEN DI
                        WE EN TRI LEN DI
                        STAGE II REFUELING
                        NO CLEAN AIR ACT
                        NO DEFEAT DEVICE
                        NO NOx PULL AHEAD
                        NO REBUILD
                        REBUILD EFFECTS
                        REG DIST
                        NO TIER2
                        NO 2007 HDDV RULE
```

A text file containing the MOBILE6 Scenario commands may contain the following MOBILE6 commands.

<u>Allowable MOBILE6 - Scenario Level Commands</u>

```
                         ABSOLUTE HUMIDITY
                         CLOUD COVER
                         PEAK SUN
                         SUNRISE/SUNSET
                         DIESEL FRACTIONS
                         WE DA TRI LEN DI
                         WE EN TRI LEN DI
                         WE VEH US
                         SOAK DISTRIBUTION
                         HOT SOAK ACTIVITY
                         DIURN SOAK ACTIVITY
```

Files specified in mobile commands must be located in the ExternalFiles subdirectory of the NCD and will not be shipped to the worker if they have any of the following names, which are the default MOBILE6 run files:

```
        asmdata.d       stperday.d
        cutpoint.d      t2cert.d
        dbase.d         t2evap.d
        dsact.d         t2exh.d
        hsact.d         tech12.d
        hsactday.d      wedatrip.d
        hsactend.d      weentrip.d
        imtest.d        pmddr1.csv
        miledat.d       pmddr2.csv
        ngvef2.d        pmdzml.csv
        ngvfr.d         pmgdr1.csv
        nlevne.d        pmgdr2.csv
        p94imp.d        pmgzml.csv
        pmnh3ber.d      airnasty.txt
        pmnh3sdr.d      fvmt.def
        regdata.d       hvmt.def
        sdist.d         mardata.def
        soakdst.d       svmt.def
```

If a NONROAD packet file is specified it must contain all of the following NONROAD input file sections:

/RUNFILES/, except for the first line (/RUNFILES/) and the MESSAGE and OUTPUT DATA lines. These three lines will be supplied by NMIM. Note that this packet begins in the middle. The remaining packets listed below must be supplied in their entirety.

```
/POP FILES/
/GROWTH FILES/
/ALLOCATION FILES/
/EMFAC FILES/
/DETERIORATE FILES/
/PM BASE SULFUR/
```

NMIM will check to see if the supplied file names are the standard ones. It checks the text both to the left and to the right of the colon. Below is what the file must look like in order for NMIM to conclude that all file names are standard. Case does not matter. The colon must occur in column 20. There may be, but does not have to be, a space after the colon.

```
ALLOC XREF          : data/allocate/allocate.xrf
ACTIVITY            : data/activity/activity.dat
EXH TECHNOLOGY      : data/tech/tech-exh.dat
EVP TECHNOLOGY      : data/tech/tech-evp.dat
SEASONALITY         : data/season/season.dat
REGIONS             : data/season/season.dat
EPS2 AMS            :
/END/

/Pop Files/
Population File     : data/pop/co.pop
/END/

/Growth Files/
National defaults   :data/growth/nation.grw
/END/

/ALLOC FILES/
Allocation File     :data/allocate/co_sbr.alo
Allocation File     :data/allocate/co_sbc.alo
Allocation File     :data/allocate/co_snowm.alo
Allocation File     :data/allocate/co_farms.alo
Allocation File     :data/allocate/co_const.alo
Allocation File     :data/allocate/co_wob.alo
Allocation File     :data/allocate/co_wib.alo
Allocation File     :data/allocate/co_golf.alo
Allocation File     :data/allocate/co_airtr.alo
Allocation File     :data/allocate/co_coal.alo
Allocation File     :data/allocate/co_holsl.alo
Allocation File     :data/allocate/co_loggn.alo
Allocation File     :data/allocate/co_lscap.alo
Allocation File     :data/allocate/co_mnfg.alo
Allocation File     :data/allocate/co_oil.alo
Allocation File     :data/allocate/co_rvprk.alo
Allocation File     :data/allocate/co_pop.alo
Allocation File     :data/allocate/co_house.alo
```

```
Allocation File    :data/allocate/co_rail.alo
/END/


/EMFAC FILES/
THC exhaust         : data/emsfac/exhthc.emf
CO exhaust          : data/emsfac/exhco.emf
NOX exhaust         : data/emsfac/exhnox.emf
PM exhaust          : data/emsfac/exhpm.emf
BSFC                : data/emsfac/bsfc.emf
Crankcase           : data/emsfac/crank.emf
Spillage            : data/emsfac/spillage.emf
Diurnal             : data/emsfac/diurnal.emf
TANK PERM           : data/emsfac/evtank.emf
NON-RM HOSE PERM     : data/emsfac/evhose.emf
RM FILL NECK PERM   : data/emsfac/evneck.emf
RM SUPPLY/RETURN    : data/emsfac/evsupret.emf
RM VENT PERM        : data/emsfac/evvent.emf
RM SUPPLY/RETURN    : data/emsfac/evsupret.emf
HOT SOAKS           : data/emsfac/evhotsk.emf
RUNINGLOSS          : data/emsfac/evrunls.emf
/END/


/Deteriorate Files/
THC exhaust         : data/detfac/exhthc.det
CO exhaust          : data/detfac/exhco.det
NOX exhaust         : data/detfac/exhnox.det
PM exhaust          : data/detfac/exhpm.det
Diurnal             : data/detfac/evdiu.det
TANK PERM           : data/detfac/evtank.det
NON-RM HOSE PERM     : data/detfac/evhose.det
RM FILL NECK PERM   : data/detfac/evneck.det
RM SUPPLY/RETURN    : data/detfac/evsupret.det
RM VENT PERM        : data/detfac/evvent.det
HOT SOAKS           : data/detfac/evhotsk.det
RUNINGLOSS          : data/detfac/evrunls.det
/END/


/PM Base Sulfur/
T2       0.2000     0.02247
T3       0.2000     0.02247
T3B      0.0500     0.02247
T4A      0.0500     0.02247
T4B      0.0015     0.02247
T4       0.0015     0.30
T4N      0.0015     0.30
T2M      0.0350     0.02247
T3M      1.0        0.02247
T4M      1.0        0.02247
/END/
```

If the commands or paths in any of these packets differ, NMIM will conclude that a nonstandard file is being specified. Please specify the packets and commands in the order shown. If you specify a nonstandard file, NMIM will look for it in the path specified, relative to the NMIMRoot directory. For example, if NMIMRoot is C:\NMIM, if you specify nation1.grw, it will look for that file in C:\NMIM. If you specify data\growth\nation1.grw, it will look in C:\NMIM\data\growth\nation1.grw. In either case, it

will ship the file to the worker, where it will be placed in the NONROAD root directory, without the added path. This behavior means that you can use the same filename without risk of overwriting the default file that NONROAD is using.

If any of these last three advanced features are used, the user-supplied information will be applied to all specified counties and all calendar years and will override similar commands and file references in the county database.

Before attempting to use this feature, the user should be quite familiar with the MOBILE6 User Guide and the NONROAD model User Guide.

Output Panel

The final item in the Navigation List is the Output Section. When selected, this section expands to reveal two additional sub-sections. These are the Geographic Representation and the General Output sub-sections. When either of these are chosen, the detail panel contains either the Geographic Representation panel (See Figure 3-16) or the General Output panel (See Figure 3-17). The first sub-panel allows the user to determine the basic processing of the NMIM program. The second sub-panel is where the server name and database name for the NMIM output are entered. The user may enter either a new name, and thereby create a new NMIM output database, or browse the server and specify an existing NMIM output database. If an existing database is specified, all new NMIM output records will be appended to the existing database, but with an new runid.

WARNING: Do not specify an NMIM County Database for the NMIM output. Doing so will cause the SCC and SCCToxics tables to be DELETED.

If you do find yourself in the position of having deleted the above tables you will need to reload the MySQL database

Geographic Representation Sub-panel

If the user selects the Geographic Representation button from the Navigation List, the Geographic Representation sub-panel opens in the detail panel. This detail panel is shown in Figure 3-16.

Figure 3-16
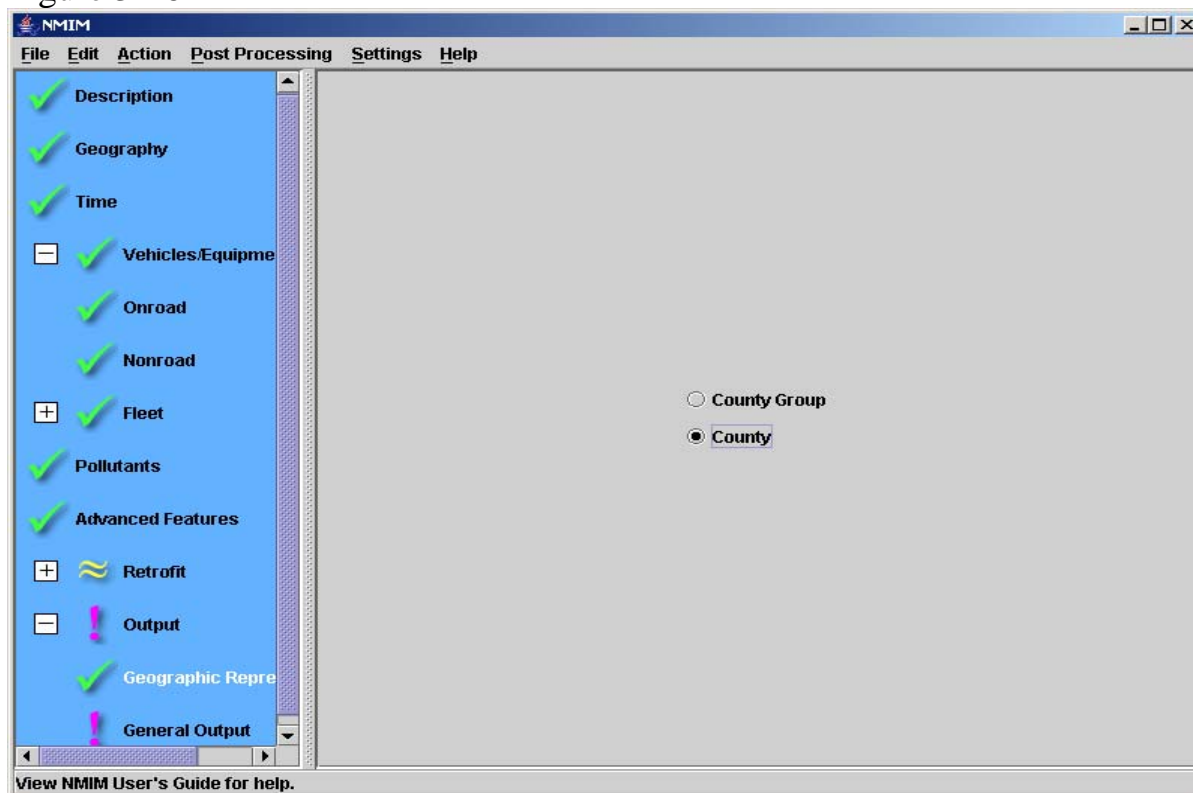
The Geographic Representation sub-panel offers the user two choices: (1) County and (2) County Group. If "County" is chosen, MOBILE6 and/or NONROAD is run once for each county and each time period selected. If "County Group" is chosen, NMIM does a single MOBILE6 or NONROAD run for the entire group, using the data (fuels, temperature, I/M, etc.) for one county in the group, called the "representing county." Since grouping results in fewer MOBILE6 and/or NONROAD runs, the total NMIM run is faster. County groups are defined in the CountyMap table of the NMIM County Database (NCD). Whether counties are grouped or not, the NMIM output contains inventories for all the individual counties in the selected geographic region. MOBILE6 emission factors are still multiplied by the county-specific VMT in the BaseYearVMT table. In the CountyMap table distributed with the NCD, all counties are mapped to themselves, meaning that there is no difference between selecting County and County Group. Users must develop county groups and specify the representing county for each one to take advantage of this feature. If time is available, running individual counties produces superior inventories, since it uses the most individualized data for each county.

General Output

This sub-panel is designed to be the final panel which is completed prior to running the NMIM model. The user must make appropriate selections on this panel since the NMIM model cannot run without this information. It is shown in Figure 3-17.

The user must specify the server and database into which the NMIM model results should be placed. The default server is "localhost". There is no default database. A warning to the user

is given if the database already contains rows within the output tables. However, the results from any new NMIM runs will be appended to any databases which already exist. The "Create Database" button is used for creating new MYSQL databases containing the required output tables.

The checkbox "Pre-aggregate non-road horsepower classes" causes NONROAD output to be aggregated over power class, which save significant space in the NMIMPollutantOutput table. This checkbox has no effect on onroad output.

Figure 3-17 General Output Panel
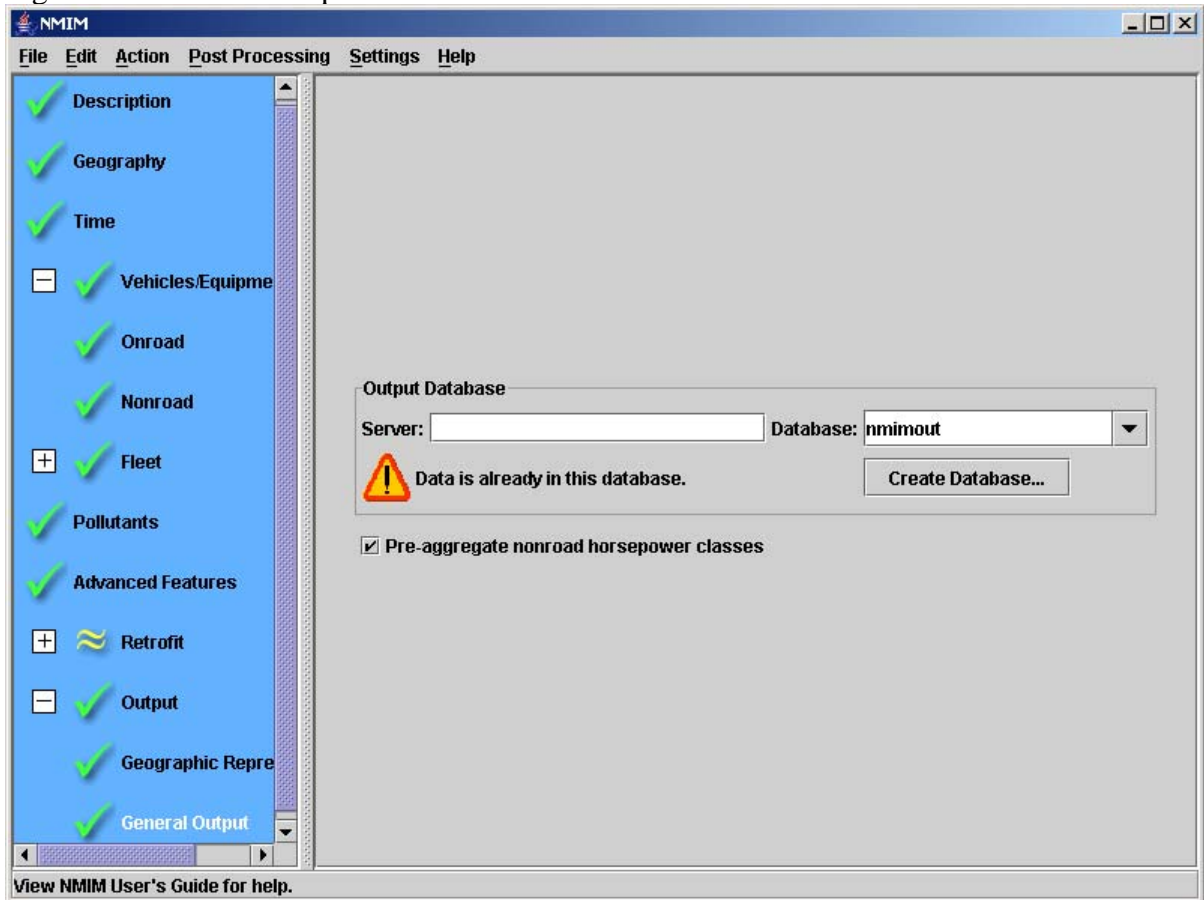
WARNING: Do not specify an NMIM County Database for the NMIM output. Doing so will cause the SCC and SCCToxics tables to be DELETED.

If you do find yourself in the position of having deleted the above tables you will need to reload the MySQL database

NMIM Output

Introduction

The NMIM model reports all of its output to the Output Database specified by the user in the NMIM GUI section Output / General Output. The NMIM Output Database is a MySQL database that can be accessed by running MySQL and issuing the appropriate SQL commands. Complete MySQL documentation can be found in the Docs subdirectory of the MySQL installation directory (C:\MySQL\Docs). Another good source of information is the MySQL website. Its address is: www.mysql.com

Output Database Description

The MySQL Output Database reports the NMIM results in a MySQL relational database that can be queried for report generation and/or exported to other formats for subsequent use. The MySQL Output Database contains four data tables. These tables are:

- NMIMPollutantOutput
- NMIMRun
- NMIMError
- NMIMVMTOutput

The NMIMPollutantOutput Table contains the emission results. The NMIMRun Table contains one row per run. The fields are RunID, RunSpecName, DateTime, and HCExpressAs. The NMIMError Table contains all error messages that were produced in a given run. The NMIMVMTOutput Table contains the vehicle miles traveled (VMT) for the onroad pollutant results.

NMIMPollutantOutput Table

This table contains the emission results for all selected pollutants in units of United States Short Tons (2000 pounds). The fields are:

RunID: A sequential run identifier. Adding runs to an existing database automatically increments this number.

State Identification Number (FIPSStateID): The Federal Information Processing System (FIPS) code for the state.

County Identification Number (FIPSCountyID): The Federal Information Processing System (FIPS) code for the county. The combination of FIPSStateID and FIPSCountyID uniquely identifies the county.

CalendarYear (Year): This can range from 1999 through 2050.

Month (Month): Each of the twelve months of the year.

EmissionType (EmissionTypeID): An integer identifying the emission type: 1=exhaust, 2=evaporative, 3=tire, 4=brake, 5=refueling. If emissiontype has been aggregated it will have a value of 124.

Source Classification Code ID (SCCID): SCCID is an integer associated with an SCC (Source Classification Code). The SCC associated with each SCCID may be found in the SCC table. For NONROAD equipment, SCCs represent particular equipment types (e.g., snowmobiles). For Onroad vehicles it represents one (out of 144) vehicle class and road type combinations.

Power Class (PowerClass): This is the top range of engine power in units of horsepower. It applies to NONROAD equipment. Onroad vehicles will show a value of zero. If powerclass has been pre-aggregated, it will have a value of 9999.

Pollutant Code ID (PollutantCodeID): This integer number specifies the particular pollutant represented in the record. There is a separate record for each pollutant requested by the run specification. PollutantCodeID is associated with PollutantCode in the PollutantCode table.

Pollutant: This field contains the emission results for the run specification in units of short tons.

NMIMRun Table

The NMIMRUN table contains information which is specific to the NMIM run. It includes:

RunId: Key field. It provides a unique sequential identifier for each NMIM run in the database

RunSpecName: The file name of the NMIM RunSpec that generated the results.

DateTime: The date and time associated with the NMIM Run.

HCExpressAs: The type of hydrocarbon emission reported in the NMIM Run.

NMIMError Table

The NMIMError table contains all error and other diagnostic information reported by the NMIM model. If the particular run contains no errors then there will not be a record for that run.

The fields are:

NMIMErrorID: Key field. It provides a unique identifier for each reported error message in a run.

RunId: This integer number specifies the particular NMIM run.

FIPSCountyId (see above for definition)

FIPSStateId (see above for definition)

Year (see above for definition)

Month (see above for definition)

ModelType: An integer code (1=MOBILE, 2=NONROAD) that identifies whether the error message was produced by the MOBILE6.2 model or the NONROAD model.

ErrorMessage: Text field containing the error message.

NMIMVMTOutput Table

The NMIMVMTOutput table contains the vehicle miles traveled for each onroad result. It includes:

County Identification Number (FIPSCountyID): (see above for definition)

State Identification Number (FIPSStateID): (see above for definition)

CalendarYear (Year): (see above for definition)

Month (Month): (see above for definition)

Source Classification Code ID (SCCID): (see above for definition)

Power Class (PowerClass): (see above for definition) This field is always zero, since onroad sources are not classified by power class.

Run Number (RunID): This integer number specifies the particular NMIM run.

Monthly VMT (MonthVMT): The monthly VMT (Vehicle Miles Traveled) is reported in units of millions of miles.

Post-Processing Options

The Post Processing/Aggregate and Export Menu is a user convenience feature that allows the user to aggregate the NMIM model results in various ways and produce alternative output formats. The alternative to using the Aggregate and Export function is to work with the NMIM output directly using MySQL. The Aggregate and Export function can operate on any NMIM output database. It may be used at any time after the completion of the NMIM run.

The Post Processing Menu is a pull-down menu at the top of the main window. If it is selected by the user with the mouse, an additional Aggregate And Export tab becomes visible. If this tab is selected, the Aggregate And Export window opens as shown in Figure 3-18. The Aggregate And Export window contains four principal sections. The top section specifies the server, the NMIM output database, and the NMIM run. There may be multiple NMIM runs in an output database, but only one at a time may be chosen for post-processing. The second section is "Output Format," where one of three output formats must be chosen: NMIM native normalized, Wide Tables, or NIF3). This section contains an additional data button to provide additional information needed for NIF3 output. The third section lists and describes the aggregation options, which are selected using check boxes. The final section is "Output," where file formats and locations are chosen. It may be necessary to use the scroll bar on the right side of the panel to access all of the options contained in this panel.

Figure 3-18 Aggregate And Export Window

NMIM User Guide   32

Top Section (Input Data for Post Processing)

Three inputs are required to identify the data to be processed. These are the "Source Output Server" selection, the "Database" selection and the "Run" selection. The Source Output Server selection is where the server information may be provided. If the NMIM output database is on the user's desktop computer, specify "localhost.". In the Database selection, the select the name of the NMIM output database that is to be post processed from the list of available NMIM output databases. Such a database is generated by first successfully running the NMIM model. An NMIM output database may contain several runs. The Run selection is used to specify a particular NMIM run that is to be post processed. Only one run may be post processed at a time.

The OK and Cancel buttons found in the top right corner execute or cancel a particular Post Processing panel selection. The OK button remains dark while the Aggregate and Export function is executing. It returns to gray when Aggregate and Export has completed.
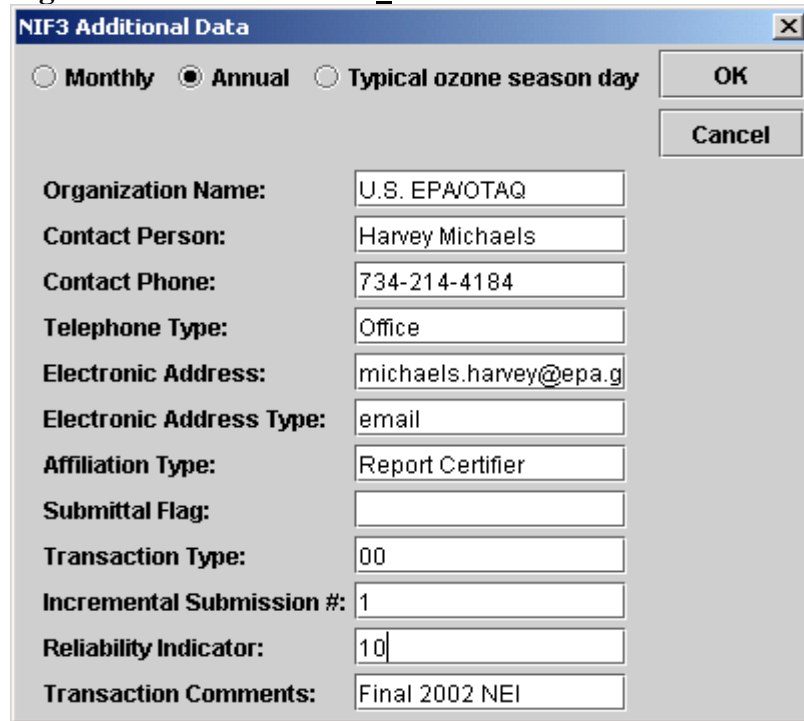
It is possible to save and load a Post Processing specification, called an "aggregation specification" or AgSpec, using the Save and Load buttons in this section. As with RunSpecs, AgSpecs are xml files that may be edited with a text editor and run from the command line.

Output Format

The user may select a particular output format by selecting the appropriate radio button. The available output parameters are:

- NMIM Native—a separate row for each pollutant.
- Wide Tables—a column for each pollutant.
- NIF3—NIF3 ASCII output generated for onroad and nonroad separately. The "Get Additional Data" button will invoke a form for inputting additional information needed for NIF3 output, shown in Figure 3-19 and listed below. This information is required to produce NIF3 output.

Figure 3-19 NIF3 Additional Data

NIF3 Additional Parameters

- Monthly, Annual radio buttons - one must be chosen (Typical ozone season day is not functional)
- Organization Name
- Contact Person
- Contact Phone
- Telephone Type
- Electronic Address
- Electronic Address Type
- Affiliation Type
- Submittal Flag - (Optional) Default is Blank
- Transaction Type - (Optional) Default is 00
- Incremental Submission Number - (Optional) Default is 1
- Reliability Indicator - (Optional)
- Transaction Comments - (Optional)

Aggregation Parameters

The user may select particular aggregation parameters by checking the appropriate boxes. The available aggregation options are:

- FIPSCounty – If this check box is chosen, the emissions for all counties within each state are summed.

- Month - If this check box is chosen, the emission results for all twelve months of the year are summed. This option also allows individual weighting factors for each month. The default weighting factor for any month is 1.0.
- Emission Type - If this check box is chosen, all emission types (exhaust, evaporative, refueling, brake, and tire) will be summed together.
- Power Class - If this check box is chosen, the model will combine all of the power classes within a given NONROAD SCC. This option produces results by SCC code for NONROAD equipment. Results for onroad vehicles are unaffected by this option.
- Nonroad - If this check box is chosen, the model will combine the emission results from NONROAD SCC codes into NONROAD segments (Recreation, Construction, Industrial, etc.) and fuel types (Diesel, Gasoline 2-stroke, Gasoline 4-stroke, LPG, CNG). The resulting sums will be re-labeled in terms of summary level pseudo-SCC codes that represent each segment-fuel type combination. This aggregation has no effect on onroad emissions.
- HPMS Roadway Type - If this check box is chosen, the model will combine onroad emissions so as to eliminate the twelve roadway types.
- All NONROAD- If this check box is chosen, the model will combine all of the NONROAD emission results into a total NONROAD emission sum.
- All Onroad - If this check box is chosen, the model will combine all of the onroad emissions into a total onroad emission sum.

All combinations of these parameters can be chosen. The user should exercise care when aggregating across more than one parameter at a time. Also, the user should understand that this utility is a post processing tool, and that it does NOT re-run the entire NMIM simulation to obtain additional information that might be missing for the desired aggregation. For example, if the user desires to aggregate by FIPSCounty (combine emissions from all counties within a state), and is missing emission information from one or more individual counties, the Post Processing tool will generate a state sum that does not include the missing county.

Output File Type Choices

MySQL Data Table

The bottom section of the Aggregate And Export window allows the user to choose between three output file types. If the MySQL Data Table button is selected, a MySQL table is produced in the NMIM output database. The user must supply a name for the output table in the Table Name box. This will create a new MySQL table in the NMIM output database that contains the aggregated emission results. MySQL must then be used to access the results.

Tab-Delimited ASCII Text File

If the Tab-Delimited ASCII Text File button is selected, the user must supply a file name for the text output table in the File Name box. The Browse button can be used to select the name and path of the output file. This option will create a tab-delimited text file of the emission results that can be read by a spreadsheet such as Excel.

If the NIF3 button is selected, the user must supply a directory pathname for the NIF3 text output files. The Browse button can be used to select the path of the output directory. This option will create standard ASCII NIF3 files in the specified directory. For the specification of the NIF3 format, see http://www.epa.gov/ttn/chief/nif/nif3.html#ver3.

The NIF3 files created for nonroad emissions are listed below. The file names are decoded as follows:

ss (characters 1-2): If the user selects "Each state in separate NIF3 output files," then the initial "ss" is the two-character postal code for the state (e.g., az for Arizona, vt for Vermont). If the user selects "All states grouped together in NIF3 output files," then the initial "ss" is replaced by "us".

character 3-4: nr=nonroad, or=onroad, rf=onroad refueling

characters 5-6: em=NIF3 "emissions" file, ep=NIF3 "emission process" file, pe=NIF3 "period" file, tr=NIF3 "transmittal" file

yy (characters 7-8): the two-digit year (e.g., 02 for 2002, 99 for 1999).

per (characters 9-11): period, ann=annual, mon=monthly. One of these periods is selected in the NIF3 Additional Data Panel (see Figure 3-19 above).

Four files are produced for nonroad NIF3: ssnremyyper.txt, ssnrepyyper.txt, ssnrpeyyper.txt, and ssnrtryyper.txt

Three files are produced for onroad NIF3: ssoremyyper.txt, ssorpeyyper.txt, ssortryyper.txt

Four files are produced for onroad refueling NIF3: ssrfemyyper.txt, ssrfepyyper.txt, ssrfpeyyper.txt, ssrftryyper.txt

How to Simulate Diesel Retrofit Modeling in NMIM

This section describes the diesel vehicle and equipment retrofit modeling module that is part of NMIM. It discusses the required NMIM inputs used to model retrofit emission effects for diesel onroad vehicles and nonroad equipment. For guidance on actual program input development, the user should consult the EPA document "Guidance for Quantifying and Using Emission Reductions from Mobile Source Retrofit Projects in State Implementation Plans and Transportation and General Conformity".   While the module will allow you to specify gasoline vehicles and equipment, the results will be incorrect because it does not handle evaporative and refueling emissions correctly.

In this chapter the following topics are discussed:

1.   Inputs to the Onroad and Nonroad Retrofit GUI Panels

These inputs include GUI inputs for a few panels depending on whether onroad, nonroad or both types are being modeled. Only a few special GUI inputs are required in each panel to model retrofits in NMIM. If retrofit is not being modeled then these inputs should remain inactive.

2.   Inputs Entered in Text Files

The comma delimited text files contain most of the retrofit model parameters. The files are created outside of the NMIM program in a text editor and read into the NMIM program. Once the files are read into the NMIM program, they will be checked for consistency and completeness by NMIM. Error messages will appear if problems are encountered.

3.   Inputs to other NMIM Panels when Performing a Retrofit Simulation

The retrofit model inside NMIM is not completely independent of other aspects of the NMIM code. To complete a successful retrofit model run, the user is required to enter proper choices for other NMIM inputs. Error messages will appear if inconsistencies are encountered between retrofit and other NMIM inputs. However, this section does not attempt to duplicate material covered in other sections of the NMIM User Guide. The reader should refer to these sections if additional detail is required.

R1. NMIM Navigation Window

Figure R-1 shows the overall NMIM Window, and the tabs to each of the individual NMIM input panels starting with the Description Panel and ending with the Output Panel. The NMIM input (RunSpec) is ready to be executed if all of the tabs are checked "green" or appear with yellow tildes. If a 'red' exclamation point appears, it means that one or more input requirements are not satisfied in that particular NMIM panel.

Most of the specific information required for a retrofit simulation is entered in two panels accessed from the Retrofit navigation tab. One panel is used to enter information for onroad retrofit simulations and the other panel is used to enter information for nonroad retrofit simulations. Figure R-1 shows the sub-navigation tabs for accessing these two panels.

Figure R-1   Overall NMIM Window
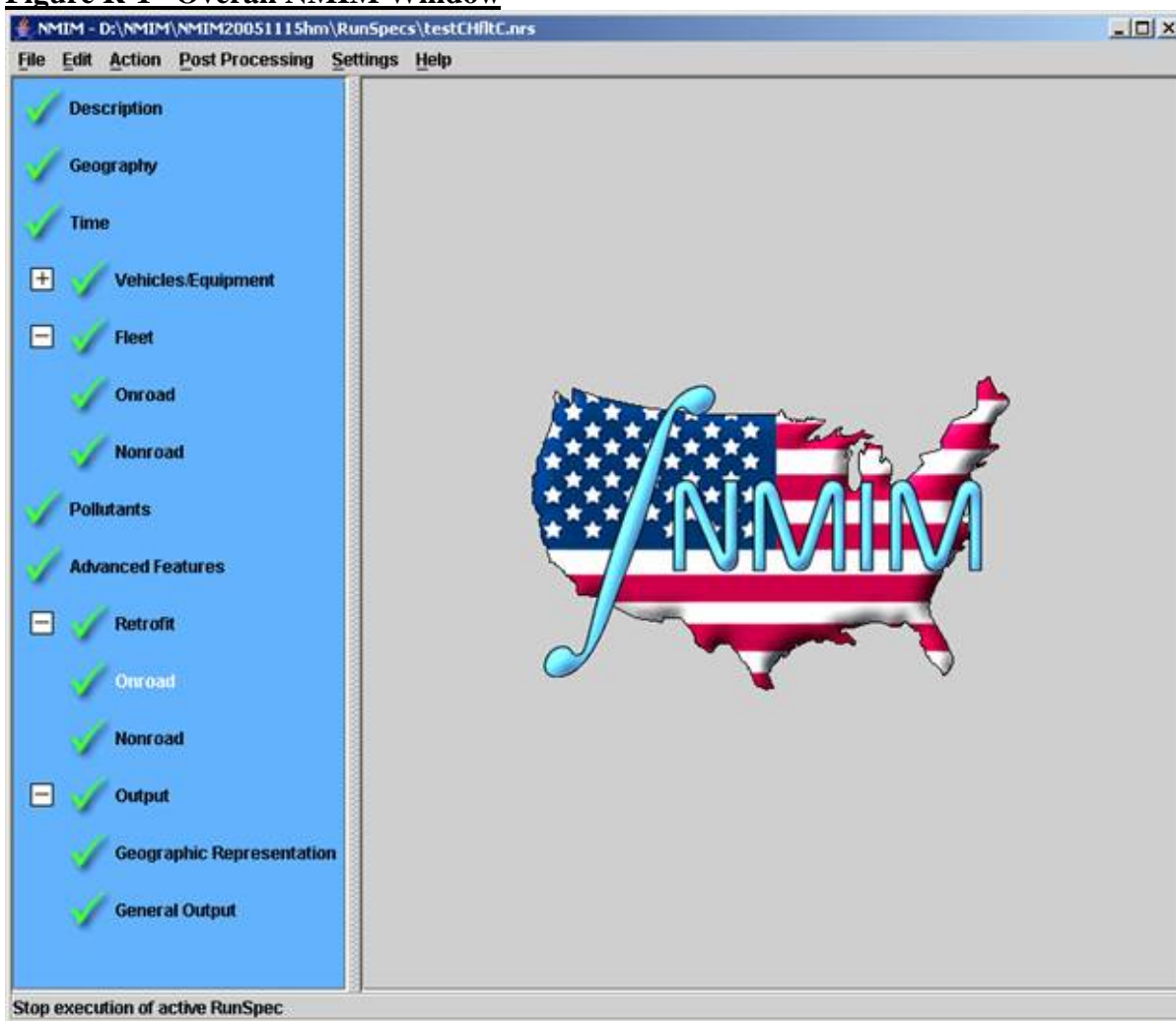
R2. Retrofit / Onroad Panel

The Retrofit / Onroad Panel is shown in Figure R-2. This panel contains the Perform Onroad Retrofit Modeling check box, the Retrofit Parameter File B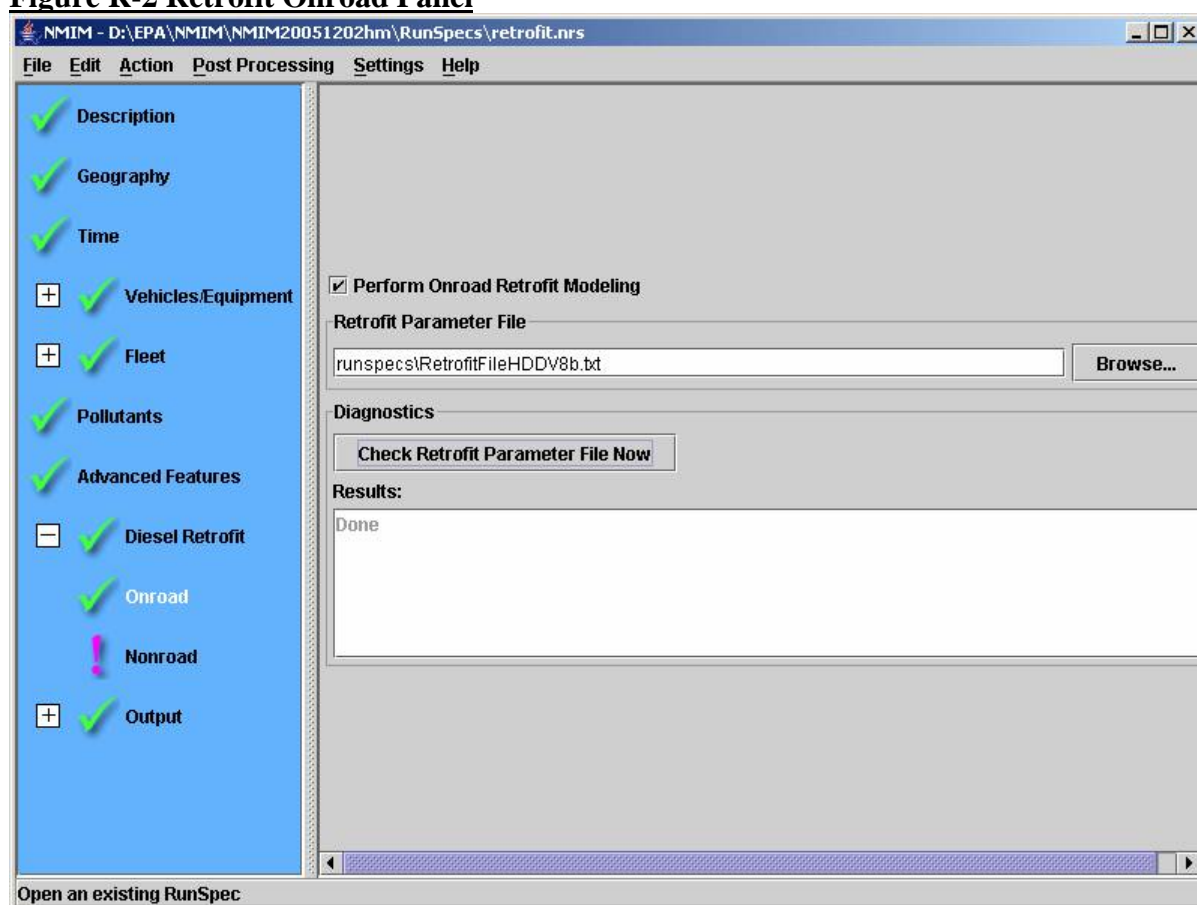ox and the retrofit parameter file Diagnostics Results Box. To perform an onroad retrofit simulation in NMIM, the user must first select the Perform Onroad Retrofit Modeling button (check mark the small box). This selection will activate the onroad retrofit portion of NMIM. Otherwise, the Retrofit / Onroad Panel inputs will be 'grayed out' and are inactive. The second required action is to select the path and file for the Retrofit Parameters File. This text file contains the required retrofit parameters (See the Retrofit Parameters File section for more details). A browse button is available that allows the user to browse through the system to find the required files.

Figure R-2 Retrofit Onroad Panel

The Diagnostics Results Box contains the Check Retrofit Parameter File Now button and the Results box. The Check Retrofit Parameter File Now button should be selected after all NMIM GUI inputs have been made and the Retrofit Parameters File has been completely developed and properly selected. Selection of this button tests the NMIM GUI inputs for consistency with the Retrofit Parameters File inputs. If the word "Done" appears in the Results box, then the retrofit inputs are consistent and the Retrofit / Onroad navigation icon should be a 'green check mark'. If errors, warnings or inconsistencies are present, messages will appear in the Results box. In most cases the message will indicate that an input change

needs to be made in the Retrofit Parameters File. An error message will prevent execution of the program. If retrofit modeling is being performed in conjunction with fleet modeling, the messages may also show inconsistencies between information in the Retrofit Parameters and Fleet Information files. Diagnostic messages in the Results box will often provide the exact line number(s) where invalid input can be found. Warning messages may also be displayed in the Results box. A "warning" condition will not block the execution of the simulation. They inform the user that NMIM has detected a possible inconsistency between the NMIM GUI inputs, the Retrofit Parameters File, and Fleet Information File. To prevent misleading or possibly erroneous emission results, the user should pay close attention to warning messages and review suspected inputs.

R3. Vehicles/Equipment / Onroad Panel

Figure R-3   Vehicles/Equipment / Onroad Panel
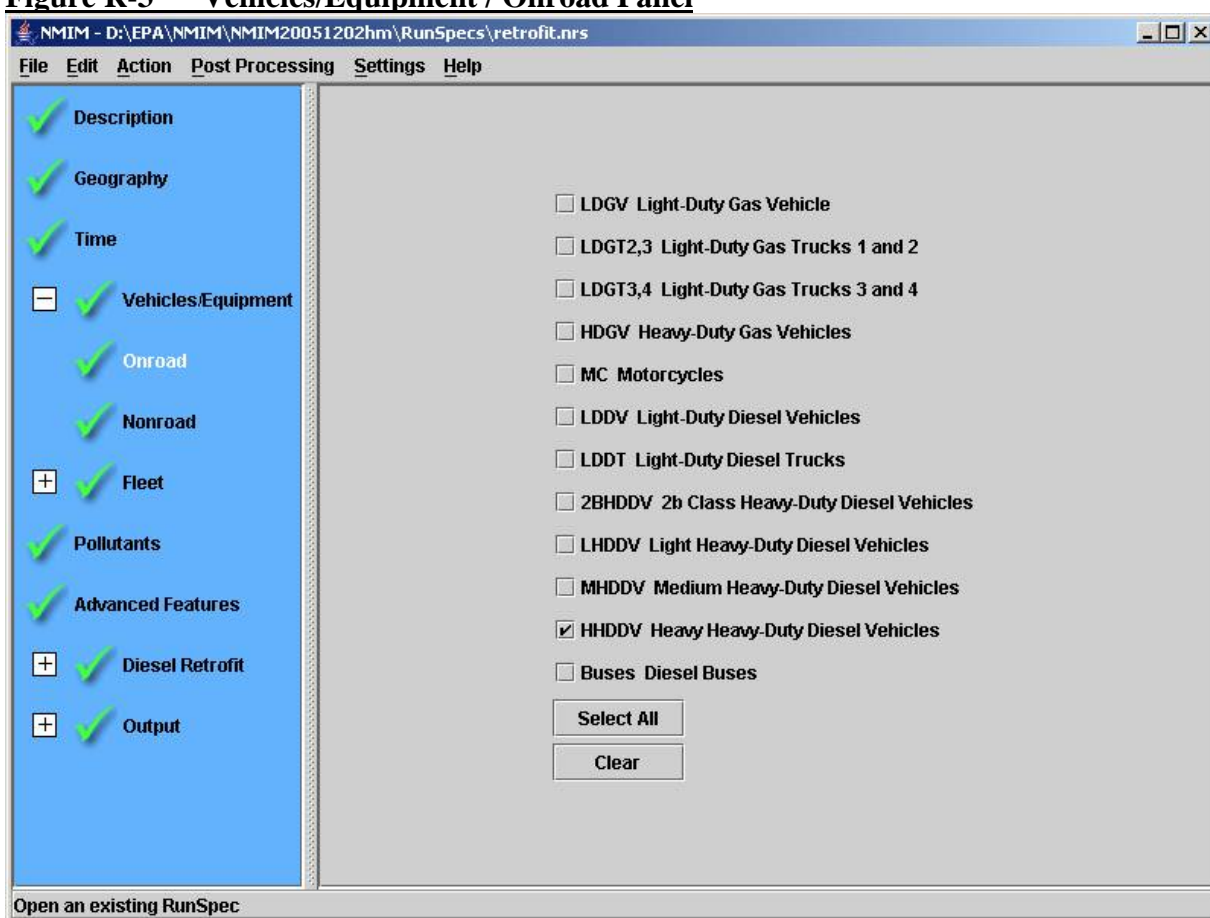
 In order to simulate vehicle retrofit, the user must select one or more vehicle classes in the Vehicles/Equipment Panel (for more information on this selection, see Section Vehicles / Equipment Panel in the NMIM User Guide). NMIM will check vehicle selections made in this panel against vehicle class parameters entered in the Retrofit Parameters File. For retrofit effects to be calculated, a vehicle class must be selected in Vehicles/Equipment Panel and included in the Retrofit Parameters File.

If Fleet modeling is also being performed, the vehicles from the Fleet Information File are used for the simulation and the inputs on the Onroad Vehicles/Equipment Panel are grayed out. The message "This panel is inactive because a fleet is being modeled" will be displayed at the top of the panel in this case. NMIM will check for consistency, and issue a warning message if the Retrofit Parameters File does not contain the same vehicle classes as the Fleet Information File. This consistency check is done because the Fleet calculations require fleet size and vehicle VMT information for each vehicle class.

R4. Pollutants Panel
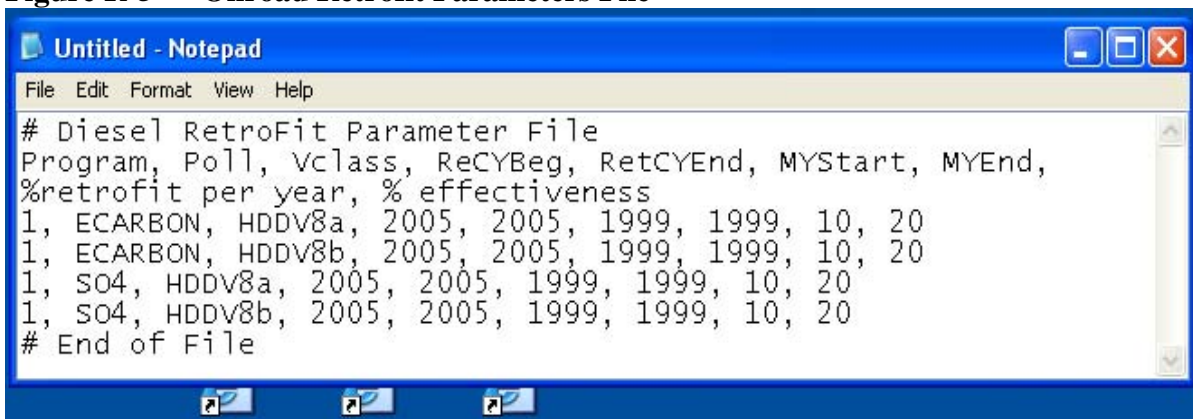
Figure R-4   Pollutants Panel
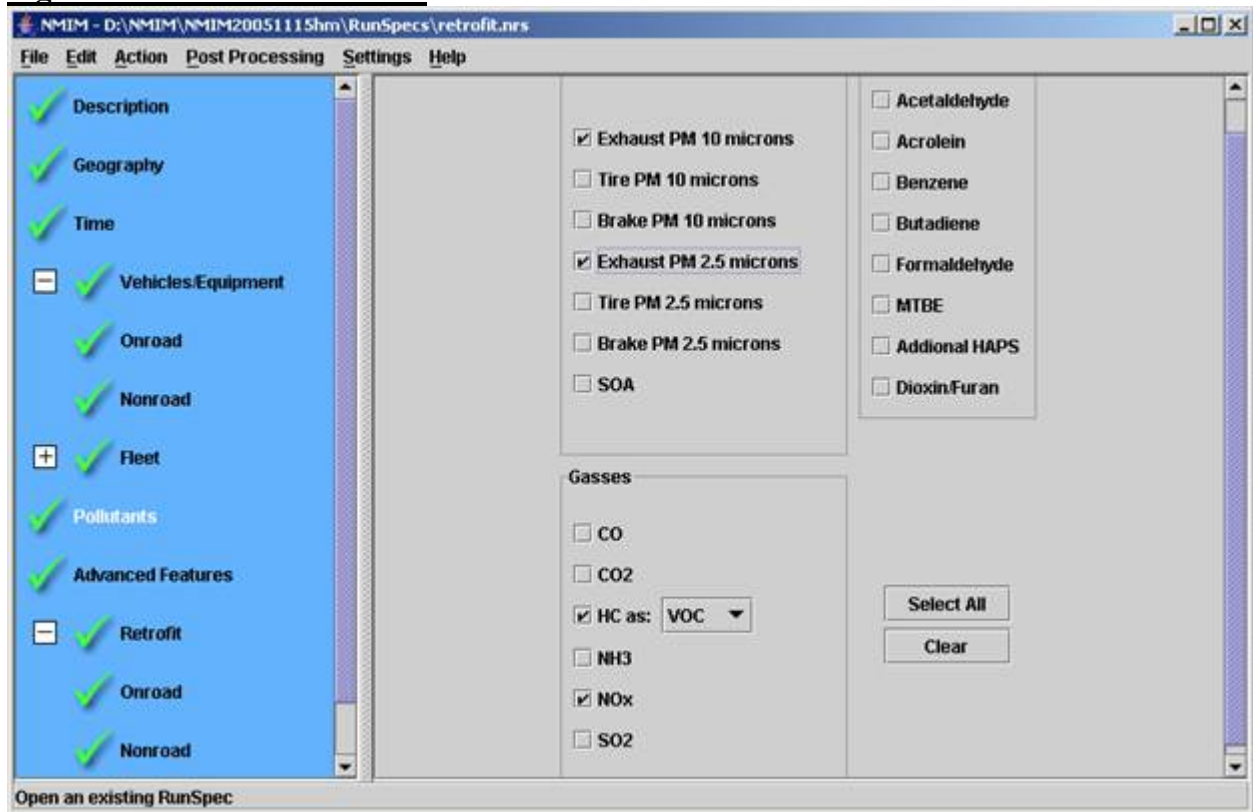
In order to simulate vehicle retrofit, the user must select in the Pollutants Panel the particular pollutants to be modeled. NMIM will check pollutant selections made in this panel (see the NMIM User Guide section Pollutants for an illustration and inputs of this panel) against pollutant parameters entered in the Retrofit Parameters File. For retrofit effects to be calculated for a given pollutant, that pollutant must be selected in both locations.

R5. Onroad Retrofit Parameters File

Figure R-5   Onroad Retrofit Parameters File

The Onroad Retrofit Parameters File is a required input to the NMIM model if the user wants to model vehicle retrofit effects. It is the comma delimited text file whose path and name are specified by the user in the Retrofit / Onroad detail panel in the Retrofit Parameters File input box (See the Retrofit / Onroad Section for complete details). It contains the bulk of the vehicle retrofit information. The user will need to create his or her own Retrofit Parameters File using a text editor such as Wordpad or Notepad or using a spreadsheet (i.e., Excel).   If a spreadsheet is used, the user should save the file as a comma separated variable (CSV) format.

The first row of the Retrofit Parameter File contains the retrofit input parameter names separated by commas (tab delimited input files do <u>not</u> work). The first row of the Retrofit Parameter File must be a 'header' row and not a data row. The remaining rows of the file contain the retrofit parameters. There must be no blank rows. Comment or descriptive rows are allowed if the first character in the row is the '#' character.   There can be no blank rows at the end of the file. (Note: the user should be aware that some spreadsheets tend to create extra blank records at the end of a delimited file. If not deleted, these may produce error messages.)   The Retrofit Parameter File contains the following required parameters with the corresponding definitions.

R5.1   **Retrofit Program Index** - An arbitrary numbering system used to keep track of the retrofit parameters.

R5.2 **Pollutant Abbreviation** - This column contains the name of the pollutant that is affected by retrofit. The proper spelling and case of the name of the pollutant must be strictly observed in the Retrofit Parameters File. Note that these are MOBILE6 pollutant names. The valid names are:

HC	SO2
CO	NH3
NOx	BENZ
CO2	MTBE
SO4	BUTA
OCARBON	FORM
ECARBON	ACET
GASPM	ACRO
Lead	

The HC input will affect all exhaust hydrocarbon emission sub-types. CAUTION: In NMIM2005, onroad evaporative hydrocarbons receive the same retrofit benefit specified for exhaust HC. Thus, it is recommended that retrofit modeling only be used for diesel vehicles, which are modeled as having no evaporative emissions. The PM inputs are SO4, OCARBON, ECARBON, GASPM, and Lead. These are the PM species which MOBILE6 models. NMIM output, however, is only total PM10 or PM2.5. Air toxic and Dioxin/Furan emissions will not be directly impacted by retrofit, but could be affected if the underlying HC or PM emission factor is changed as a result of retrofit. Only gasoline fueled vehicles will produce the pollutants GASPM and Lead. Only diesel fueled vehicles will produce OCARBON and ECARBON pollutants.

R5.3 **Vehicle Class Name** - The Vehicle Class column contains the names of the vehicle class types which can be retrofit. The list corresponds to the MOBILE6.2 vehicle classifications. To prevent errors, the user must enter a vehicle class name exactly as specified below (case sensitive). These names are:

LDGV	LDDT12
LDGT1	LDDT34
LDGT2	HDDV2b
LDGT3	HDDV3
LDGT4	HDDV4
HDGV2b	HDDV5
HDGV3	HDDV6
HDGV4	HDDV7
HDGV5	HDDV8a
HDGV6	HDDV8b
HDGV7	MC
HDGV8a	HDGB
HDGV8b	HDDBT
LDDV	HDDBS

Where LDGV means light-duty gas vehicle, LDGT means light-duty gas truck, HDGV means heavy-duty gas vehicle, LDDV means light-duty diesel vehicle, LDDT means light-

duty diesel truck, HDDV means heavy-duty diesel vehicle, MC means motorcycle, HDGB means heavy-duty gas bus, HDDBT means heavy-duty diesel transit bus, and HDDBS means heavy-duty diesel school bus.

 In general, these types are more detailed than the vehicle types which are present in the NMIM Vehicles/Equipment / Onroad panel. For example, the Vehicles/Equipment panel allows the user to specify HHDDV (heavy heavy-duty diesel vehicles), while the Retrofit Parameters File allows the user to separately specify retrofit parameters for both sub-types of HHDDV - the heavy-duty diesel 8a class, and the heavy-duty diesel 8b class. Similarly, the MHDDV group contains HDDV6 an HDDV7 as members, and the LHDDV group contains HDDV3, HDDV4 and HDDV5 as members.   Also, the LDGT2,3 category contains both LDGT1 and LDGT2, and the LDGT3,4 contains both LDGT3 and LDGT4. Finally, the NMIM Diesel Bus category includes both diesel transit buses (HDDBT) and diesel school buses (HDDBS).

Because NMIM output has broader vehicle class categories than retrofit inputs, the final inventory emission results cannot be specified for the individual retrofit vehicle classes. However, retrofit parameters can be entered for the specific classes. For example, emission inventory results cannot be generated for only the school bus class (HDDBS). The emission results will always contain both the school bus and the transit bus vehicles. However, the retrofit effects on 'school buses only' can be estimated by performing two separate NMIM runs – a baseline no retrofit run and a retrofit school bus / no retrofit transit bus – and take the difference.

R5.4	**Initial Calendar Year of Retrofit Implementation** - The Initial Calendar Year of the Retrofit Implementation is the first calendar year that a retrofit program is administered. A valid Initial Calendar Year input must be equal to or less than the Final Calendar Year of Retrofit Implementation. Initial Retrofit Calendar Year entries that are greater than the NMIM evaluation calendar year are ignored, but will generate a warning. All months within a calendar year are affected equally by the retrofit.

R5.5	**Final Calendar Year of Retrofit Implementation** - The Final Calendar Year of the Retrofit Implementation is the last calendar year that a retrofit program is administered. A valid Final Calendar Year input must be equal to or greater than Initial Calendar Year of Retrofit Implementation.

R5.6	**Initial Model Year that will be Retrofit** - The Initial Model Year that will be retrofit is the first model year of coverage for a particular vehicle class / pollutant combination. Valid entries for initial model year must meet the following mathematical requirement:

Initial Model Year >= Initial Calendar Year - 24

Also, the Initial Model Year cannot be greater than the Final Model Year that will be Retrofit.

R5.7 **<u>Final Model Year that will be Retrofit</u>** - The Final Model Year that will be retrofit is the last model year of coverage for a particular vehicle class / pollutant combination. The Final Model Year input cannot be less than the Initial Model Year that will be Retrofit. Retrofit entries with a Final Model Year input greater than the NMIM evaluation calendar year will generate a warning; any of the requested model years greater than the evaluation calendar year are ignored in NMIM's emission calculations.

R5.8 **<u>Percentage of the Fleet Retrofit per Year</u>** - The Percentage of the Fleet Retrofit per Year represents the percentage of VMT of a particular fleet of a particular vehicle class, retrofit calendar year group, model year group and pollutant combination that is to be retrofit or rebuilt in a given calendar year. For a successful retrofit simulation, a value greater than zero and less than or equal to 100.0% must be entered. The program also checks to insure that the product of the number of calendar years of retrofit coverage (Final Calendar Year of Retrofit Implementation minus Initial Calendar Year of Retrofit Implementation plus one) times the Percentage of the Fleet Retrofit per Year does not exceed 100%. For example, a retrofit simulation would be flagged as invalid if it had a retrofit program start in calendar year 2005, a program end in calendar year 2008, and a yearly Fleet Retrofit Percentage of 50 percent (4 times 50% > 100%).

R5.9 **<u>Percentage Effectiveness of the Retrofit</u>** - The Percentage Effectiveness of the Retrofit is the percent emission reduction achieved by a retrofit. It is computed from a non retrofit emission baseline. The file input structure allows the user to enter a retrofit effectiveness value for a particular vehicle class, retrofit calendar year group, model year group and pollutant combination. All values between 0% and 100% are valid.

In NMIM, a retrofit calculation is performed for each specified combination of:

Vehicle Class
Retrofit Calendar Year Group (i.e., the years that a retrofit program was implemented)
Model Year Group (defined by the beginning and ending model years)
Pollutant

$$\text{Retrofit Emis} = [\, (\%\text{Retrofit}*(1-\text{Retrofit Effectiveness})) + (1-\%\text{Retrofit}) \,] * \text{Base Emis}$$
Eqn 1a

Where
Retrofit Emis is the fleet emission inventory after the retrofit has applied
Base Emis is the fleet emission inventory before a retrofit
%Retrofit is the Percentage of the Fleet Retrofit per Year
Retrofit Effectiveness is the Percentage Effectiveness of the Retrofit

A more general form of the Retrofit Equation (shown as Eqn 1b) is used in the program if more than one retrofit program is specified for a given pollutant, vehicle class and model year group.

Retrofit Emis   = [(%Retrofit1*(1-Retrofit Effectiveness1)) +
             (%Retrofit2*(1-Retrofit Effectiveness2)) … + … (%Retrofit (i) *(1-Retrofit
         Effectiveness(i))) +   (1- %Retrofit1 -%Retrofit2 … - … %Retrofit (i))] * Base
         Emis   Eqn 1b

Where
    %Retrofit1 + %Retrofit2 … + %Retrofit(i) <= 100%
    i < 24 in %Retrofit(i)
    the term 'i' is the retrofit program number. Up to 24 retrofit programs may be
    simulated on the same vehicle class, model year range and pollutant combination.

R6. Retrofit / Nonroad Panel

The Retrofit / Nonroad Panel is shown in Figure R-2. This panel is virtually the same as the Retrofit / Onroad Panel. It contains the Perform Nonroad Retrofit Modeling check box button, the Retrofit Parameter File Box and the retrofit parameter file Diagnostics Results Box. To perform a nonroad retrofit simulation in NMIM, the user must first select the Perform Nonroad Retrofit Modeling button (check mark the small box). This selection will activate the nonroad retrofit portion of NMIM. Otherwise, the Retrofit / Nonroad Panel inputs will be 'grayed out' and inactive. The second required action is to select the path and file for the Retrofit Parameters File. This text file contains the required retrofit parameters (See the Retrofit Parameters File section for more details). A browse button is available that allows the user to browse through the system to find the required files.

Figure R-6   Retrofit Nonroad Panel
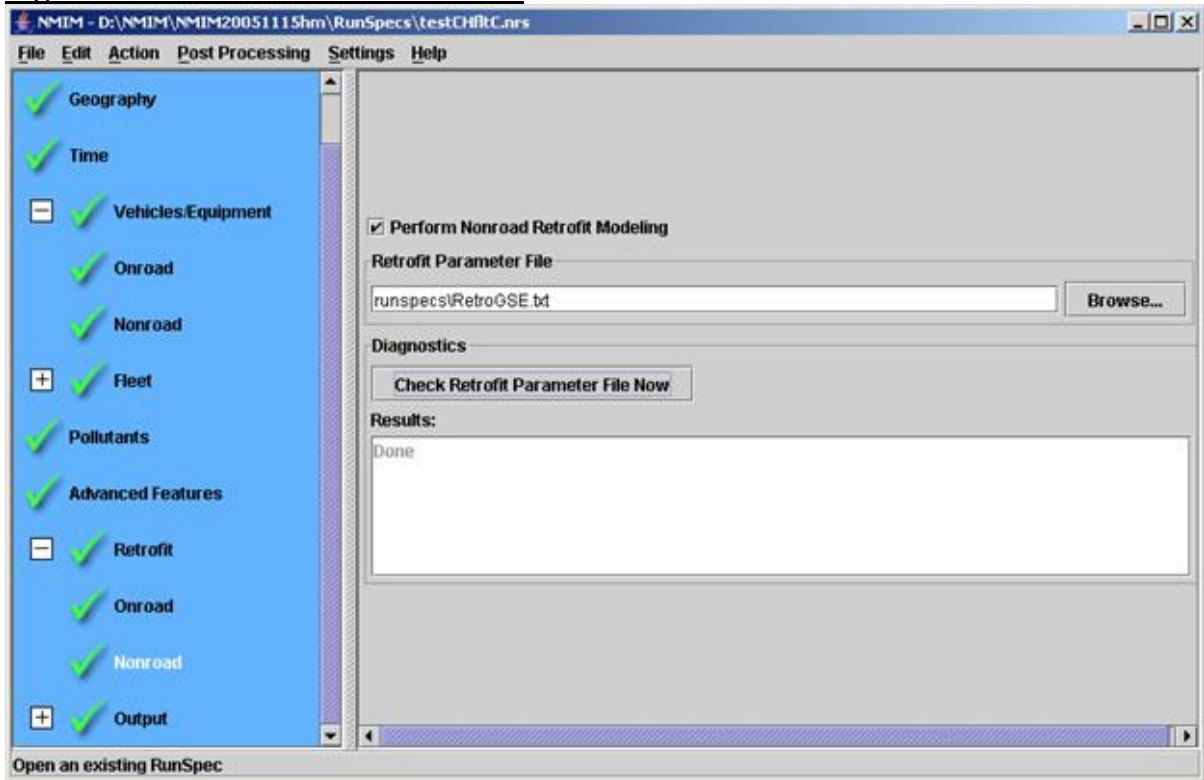
The Diagnostics Results Box contains the Check Retrofit Parameter File Now button and the Results box. The Check Retrofit Parameter File Now button should be selected after all NMIM GUI inputs have been made and the Retrofit Parameters File has been completely developed and properly selected. Selection of this button tests the NMIM GUI inputs for consistency with the Retrofit Parameters File inputs. If the word "Done" appears in the Results box, then the retrofit inputs are consistent and the Retrofit / Nonroad navigation icon should be a 'green check mark'. If errors or inconsistencies are present, error messages will appear in the Results box. In most cases the message will indicate that an input change needs to be made in the Retrofit Parameters File. If retrofit modeling is being performed in conjunction with fleet modeling, the messages may also show inconsistencies between information in the Retrofit Parameters and Fleet Information files. Diagnostic messages in the Results box will often provide the exact line number(s) where invalid input can be found. Warning messages may also be displayed in the Results box. A "warning" condition will not block the execution of the simulation. They inform the user that NMIM has detected a possible inconsistency between the NMIM GUI inputs and the Retrofit and Fleet Parameters Files. To prevent misleading or possibly erroneous emission results, the user should pay close attention to warning messages.

R7. Vehicles/Equipment / Nonroad Panel

Figure R-7   Vehicles/Equipment Nonroad Panel
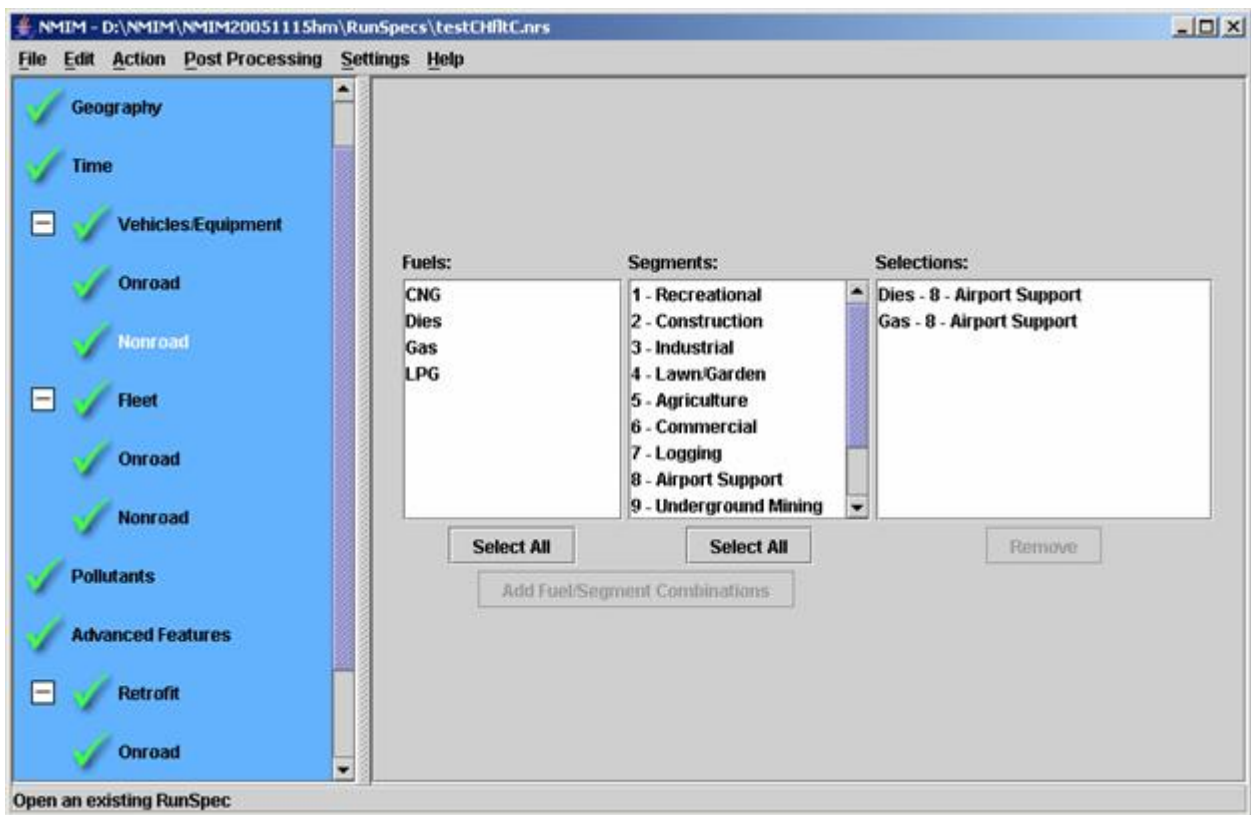
In order to simulate equipment retrofit, the user must select one or more equipment classes in the Vehicles/Equipment Panel (for more information on this selection, see Section Vehicles / Equipment Panel in the NMIM User Guide). NMIM will check equipment selections made in this panel against equipment parameters entered in the Retrofit Parameters File. For retrofit effects to be calculated, the equipment must be selected in Vehicles/Equipment Panel and included in the Retrofit Parameters File.

If Fleet modeling is also being performed, the equipment from the Fleet Information File is used for the simulation and the inputs on the Nonroad Equipment Panel are "grayed out". The message "This panel is inactive because a fleet is being modeled" will be displayed at the top of the panel in this case. NMIM will check for consistency, and issue a warning message if the Retrofit Parameters File contains equipment classes that are not in the Fleet Information File. Any such retrofit inputs are ignored, since there is no matching equipment in the specified fleet.

R8. Nonroad Retrofit Parameters File

Figure R-8   Nonroad Retrofit Parameters File
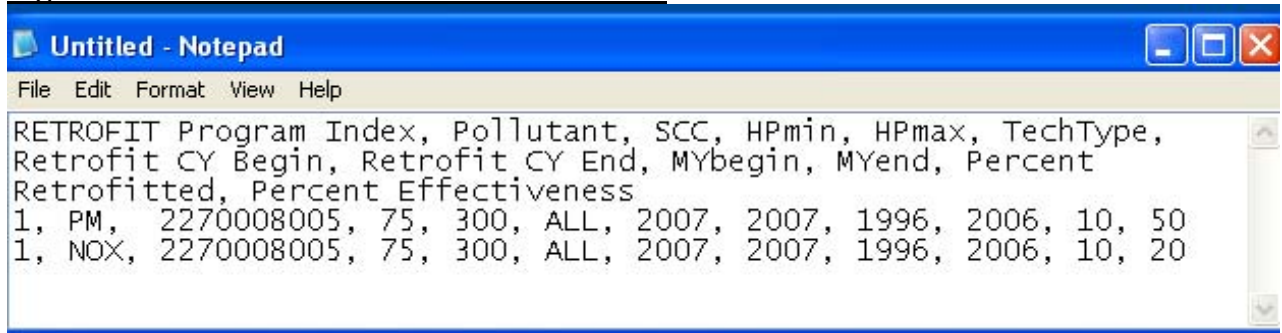
The Nonroad Retrofit Parameters File is a required input to the NMIM model if the user wants to model equipment retrofit effects. It is a comma delimited text file whose path and name are specified by the user in the Retrofit / Nonroad detail panel in the Retrofit Parameters File input box (See the Retrofit / Nonroad Section for complete details). It contains the bulk of the equipment retrofit information. The user will need to create his or her own Retrofit Parameters File using a text editor such as Wordpad or Notepad or using a spreadsheet (i.e., Excel).   If a spreadsheet is used, the user should save the file in a comma separated variable (CSV) format.

The **first row** of the Retrofit Parameter File contains the retrofit input parameter names separated by <u>commas</u> (tab or other delimited input files do <u>not</u> work). The first non-comment row of the Retrofit Parameter File must be a 'header' row and not a data row. The remaining rows of the file contain the retrofit parameters. These rows must be continuous and contain no blank rows or non data 'descriptive' information.   There can be no blank rows at the end of the file. (Note: the user should be aware that some spreadsheets tend to create extra blank records at the end of a delimited file. If not deleted, these may produce error messages.) The Retrofit Parameter File contains the following required parameters with the corresponding definitions.

R8.1   **Retrofit Program Index** - An arbitrary numbering system used to keep track of the retrofit parameters. The chosen value has no effect on the results, but may affect warnings about different inputs being used in the same retrofit program.

R8.2   **Pollutant Abbreviation** - This column contains the name of the pollutants that are affected by retrofit. The proper spelling of the name of the pollutant must be strictly observed in the Retrofit Parameters File. The valid names are:

HC
CO
NOx
PM

R8.3   **SCC** - This column contains the Nonroad SCCs of the equipment that are affected by retrofit. NMIM2005 is designed to estimate retrofit effects on diesel equipment only, so SCCs should be limited accordingly. NMIM2005 will allow non-diesel SCCs without warning, but evaporative and refueling

emissions may be incorrect. The SCC can be a full 10-digit SCC, or the more global 7 and 4 digit versions. For the definition of a specific SCC, the user should consult the NONROAD model user guide or other SCC information sources.

R8.4   **Beginning of HP Range** - This column contains the beginning number of the HP range for equipment that is affected by retrofit. It cannot be greater in value than the End of HP Range entry. This value must match a value that is defined in the NONROAD model. The list of possible values are:

0, 1, 3, 6, 11, 16, 25, 40, 50, 75, 100, 175,
300, 600, 750, 1000, 1200, 2000, 3000, 9999

In NONROAD, the HPs modeled will be HPbeg < x <= HPend. E.g., if the Beginning of HP Range is 100, and the End of HP Range is 600, then only equipment with rated horsepower greater than 100 and less than or equal to 600 will be modeled. Equipment rated at 100 hp will not be modeled.

R8.**5**   **End of HP Range** - This column contains the ending number of the HP range for equipment that is affected by retrofit. It must be greater than the Beginning of the HP Range entry, due to the way HP ranges are interpreted (as described above in R8.4). This value must match a value that is defined in the NONROAD model. The list of possible values is provided above in Section R8.4 (Beginning of HP Range).

R8.6   **Technology Type** - This column contains the Technology Type for the equipment that is affected by retrofit.   This entry, if used, must match one of the allowed Technology Types in the NONROAD model. The list of possible diesel entries includes the following:

Base (pre-1988 uncontrolled)
T0 (1988 and later uncontrolled, but with some benefits from truck controls)
T1 (Tier 1, applies only to engines <= 750 hp)
T2 (Tier 2, all hp land-based diesels and <= 50 hp recreational marine)
T3 (Tier 3, 100-750 hp only)
T3B (Tier 3, 75-100 hp only)
T4A (Transitional Tier 4 for engines <= 75 hp)
T4B (Final Tier 4 for engines <= 25 hp)
T4 (Final Tier 4 PM controls 25-750 hp; transitional Tier 4 PM for >750hp)
T4N (Full Tier 4 PM and NOx controls for engines > 75 hp)
BaseM (pre-1988 uncontrolled recreational marine)
T0M (1988 and later uncontrolled rec marine <= 50 hp)
T1M (Tier 1 recreational marine, applies only to engines <= 50 hp)
T2M (Tier 2 controls for recreational marine > 50 hp only)
T3M (Tier 3 controls for recreational marine, interim Tier 3 for 25-100 hp)
T4M (Tier 3 final controls for recreational marine 25-100 hp)

If "ALL" is used (or if this field is left blank), the retrofit applies to all Technology Types that exist in the chosen model year range.

R8.7 **Initial Calendar Year of Retrofit Implementation** - The Initial Calendar Year of the Retrofit Implementation is the first calendar year that a retrofit program is administered. A valid Initial Calendar Year input must be equal to or less than the Final Calendar Year of Retrofit Implementation. Retrofit entries with an Initial Retrofit Calendar Year greater than the NMIM evaluation calendar year will generate a warning, but are ignored in NMIM's emission calculations. All months within a calendar year are affected equally by the retrofit.

R8.8 **Final Calendar Year of Retrofit Implementation** - The Final Calendar Year of the Retrofit Implementation is the last calendar year that a retrofit program is administered. A valid Final Calendar Year input must be equal to or greater than Initial Calendar Year of Retrofit Implementation. If any requested Retrofit Calendar Years are greater than the evaluation calendar year a warning will be generated; those years are simply ignored in NMIM's calculation of retrofit effects.

R8.9 **Initial Model Year that will be Retrofit** - The Initial Model Year that will be retrofit is the first model year of coverage for a particular equipment class / pollutant combination. Valid entries vary widely across equipment types. Some equipment types have very short useful lives (e.g., chain saws) and correspondingly tight model year ranges. On the other hand, other equipment types (e.g., large infrequently used diesel equipment) may have very long lives (e.g., 50 years) and correspondingly large model year ranges. For additional details on this input the user is referred to the NONROAD Model User Guide. Any requested model years that are outside of the existing range for a given equipment type will generate a warning, but they are simply ignored in NMIM's calculation of retrofit effects.

The Initial Model Year of Retrofit cannot be greater than the Final Model Year of Retrofit.

R8.10 **Final Model Year that will be Retrofit** - The Final Model Year that will be retrofit is the last model year of coverage for a particular set of engines and affected pollutant. The Final Model Year input cannot be less than the Initial Model Year that will be Retrofit. Retrofit entries with a Final Model Year input greater than the NMIM evaluation calendar year will generate a warning; any of the requested model years greater than the evaluation calendar year are ignored in NMIM's emission calculations.

R8.11   **Percentage of the Fleet Retrofit per Year** - The Percentage of the Fleet Retrofit per Year represents the percentage of hours per year of a particular fleet of a particular equipment, retrofit calendar year group, model year group and pollutant combination that is to be retrofit or rebuilt in a given calendar year. For a successful retrofit simulation, a value greater than zero and less than or equal to 100% must be entered.   The program also checks each retrofit entry individually to ensure that the product of the number of calendar years of retrofit coverage (Final Calendar Year of Retrofit Implementation minus Initial Calendar Year of Retrofit Implementation plus 1) times the Percentage of the Fleet Retrofit per Year does not exceed 100%. For example, a retrofit simulation would be flagged as invalid if it had a retrofit program start in calendar year 2005, a program end in calendar year 2007, and a yearly Fleet Retrofit Percentage of 50 percent (3 times 50% > 100%).

R8.12   **Percentage Effectiveness of the Retrofit** - The Percentage Effectiveness of the Retrofit is the percent emission reduction achieved by a retrofit. The file input structure allows the user to enter a retrofit effectiveness value for a specific combination of equipment, retrofit calendar year group, model year group and pollutant. All values between 0% and 100% are valid.

A value of 0% (or removal of that entire retrofit entry) will compute a non retrofit baseline emission quantity.

Nonroad Retrofit Modeling uses the same formulas as Onroad Retrofit Modeling except that the calculations are performed for the SCC, Tech Type, and HP range instead of the Vehicle Class. See the Onroad Retrofit Parameters File section for information on the calculations being performed.

How to Simulate Fleet Modeling in NMIM

This section describes the vehicle and equipment fleet modeling module that is part of NMIM. It discusses the required NMIM inputs that allow the user to specify fleet populations and annual miles traveled or hours of operation. The general structure of this chapter is:

1. Inputs to the Onroad and Nonroad Fleet GUI Panels

These inputs include GUI inputs that depend on whether the Fleet modeling option is selected for onroad, nonroad or both types. Only a few special GUI inputs are required in each panel to perform Fleet modeling in NMIM. If the Fleet option is not selected these inputs should remain inactive.

2. Inputs Entered in Text Files

The comma delimited text files contain most of the required Fleet parameters. The files are created outside of the NMIM program in a text editor and read into the NMIM program. Once the files are read into the NMIM program, they will be checked for consistency and completeness by NMIM. Error or warning messages will appear if problems are encountered.

3. Inputs to other NMIM Panels when Performing a Fleet Simulation

The Fleet model inside NMIM is not completely independent of other aspects of the NMIM code. To complete a successful Fleet model run, proper choices for other inputs need to be entered by the user. Note that retrofits may be applied to fleets. Error or warning messages will appear if inconsistencies are encountered. However, this section does not attempt to duplicate material previously covered in the other NMIM User Guide sections. The reader should refer to these sections if additional detail is required.

F1. NMIM Navigation Window

Figure F-1 shows the overall NMIM Window, and the tabs to each of the individual NMIM input panels starting with the Description Panel and ending with the Output Panel. The NMIM input (RunSpec) is ready to be executed if all of the tabs are checked "green" or appear with yellow tildes. If 'red' exclamation points appear, it means that one or more input requirements are not satisfied in that particular NMIM panel.

Most of the information required specifically for a fleet simulation is entered in two panels accessed from the Fleet navigation tab. One panel is used to enter information for onroad fleet simulations and the other panel is used to enter information for nonroad fleet simulations. Figure F-1 shows the sub-navigation tabs for accessing these two panels.

Figure F-1   **Overall NMIM Window**
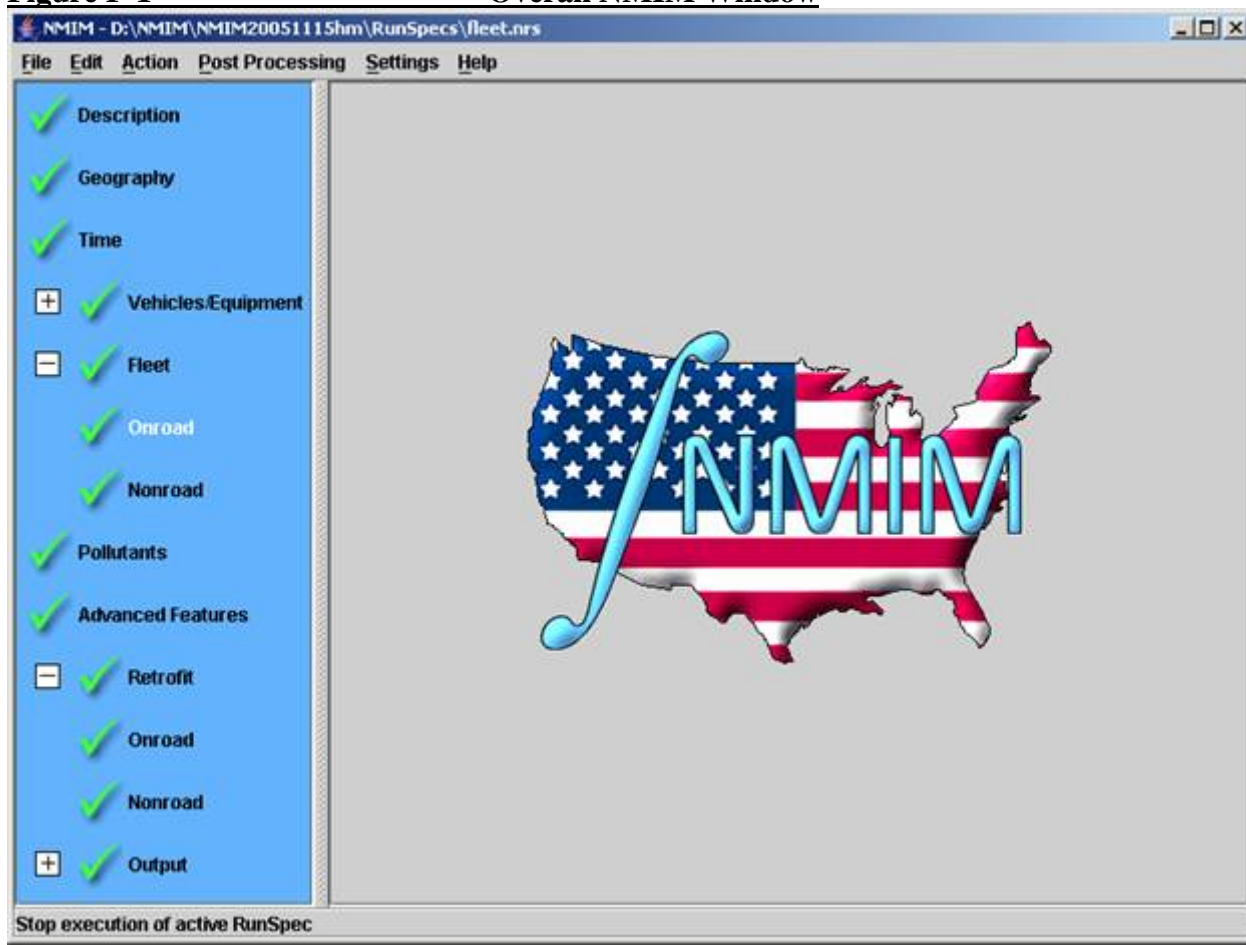
F2. Geography Panel

Figure F-2 shows the Geography Panel.   In this panel, the user can choose the geographical region or fleet level that they wish to simulate. The user may simulate an individual county or group of counties, a particular state or group of states or the entire USA nation.   See the 'Geography Panel" section of this user guide a complete description of the panel and its parameters.

Figure F-2   Geography Panel
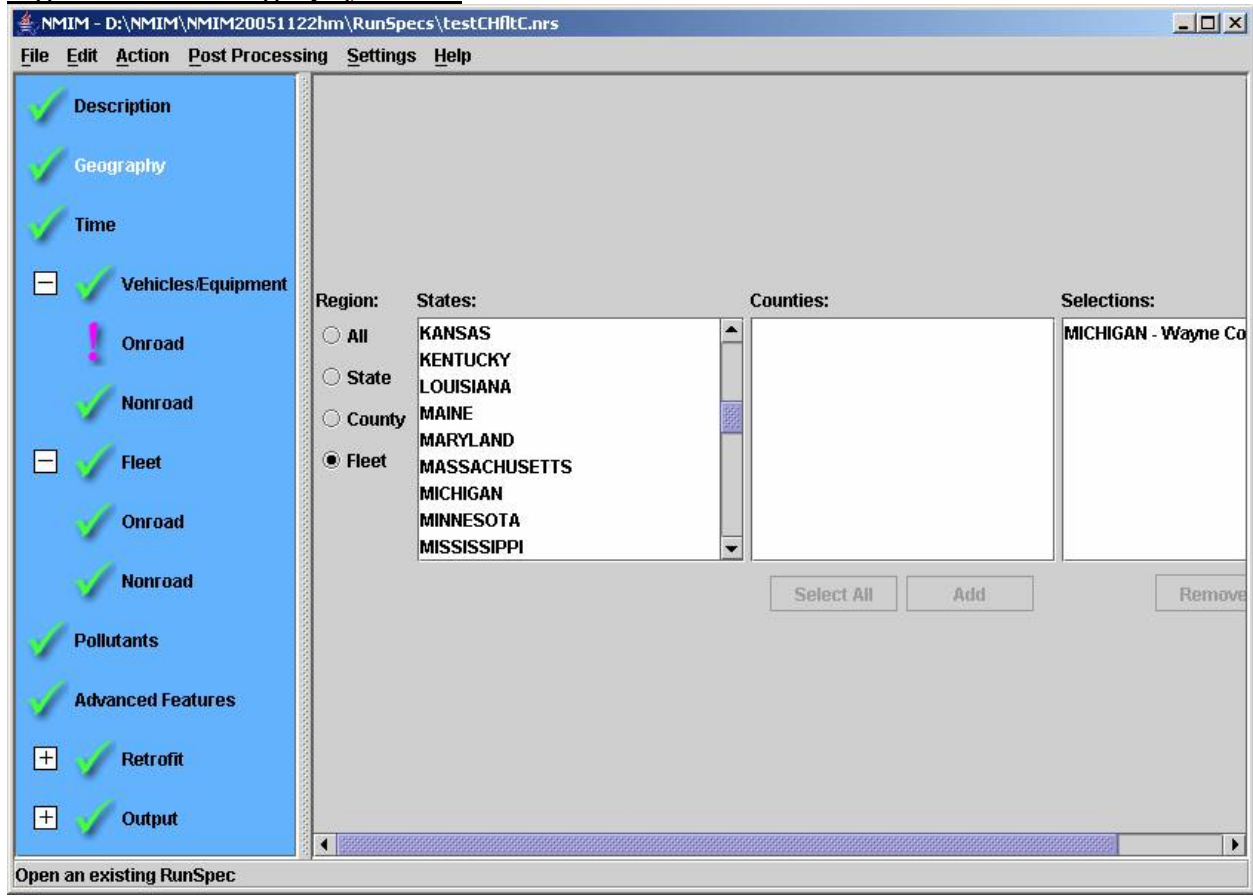
For fleet modeling, the user should select the "Fleet" button and then choose a single county. (Multiple counties or states can be modeled with the same fleet in each county by selecting the "State" or "County" button and then checking the "Perform Fleet Modeling" checkbox in the Fleet / Onroad panel or the Fleet / Nonroad panel.)

The Fleet option also requires that a valid Fleet Information File (Onroad or Nonroad) be selected and used in the simulation (see Section F-5 or F-8, Fleet Information Parameters File for more details). If the Fleet option is chosen, NMIM will simulate the specified fleet of vehicles and (if requested) apply various amounts of retrofit control to the fleet. The program is designed so that the user may simulate a fleet that contains one vehicle of one particular vehicle class, or simulate millions of vehicles of every type of vehicle class. Just as in a normal NMIM run, the chosen county will supply important modeling parameters to the simulation, such as fuel parameters, temperature and humidity, control programs, speed distributions, and monthly VMT distributions, etc. In essence, the user-defined fleet will be simulated to reside in the chosen county and behave similarly to other vehicles of the same type in that county.

F3. Fleet / Onroad Panel

The Fleet / Onroad Panel is shown in Figure F-3. This panel contains the Perform Onroad Fleet Modeling check box button, the Fleet Information File Box and the fleet information

file Diagnostics Results Box. To perform an onroad fleet simulation in NMIM, the user must first select the Perform Onroad Fleet Modeling button (check mark the small box). This selection will activate the onroad fleet portion of NMIM. Otherwise, the Fleet / Onroad Panel inputs will be 'grayed out' and all onroad NMIM fleet options will be inactive. The second required action is to select the path and file for the Fleet Information File. This text file contains the required fleet information (See the Fleet Information File section for more details). A browse button is available that allows the user to browse through their system to find the required files.

Figure F-3   Fleet Onroad Panel
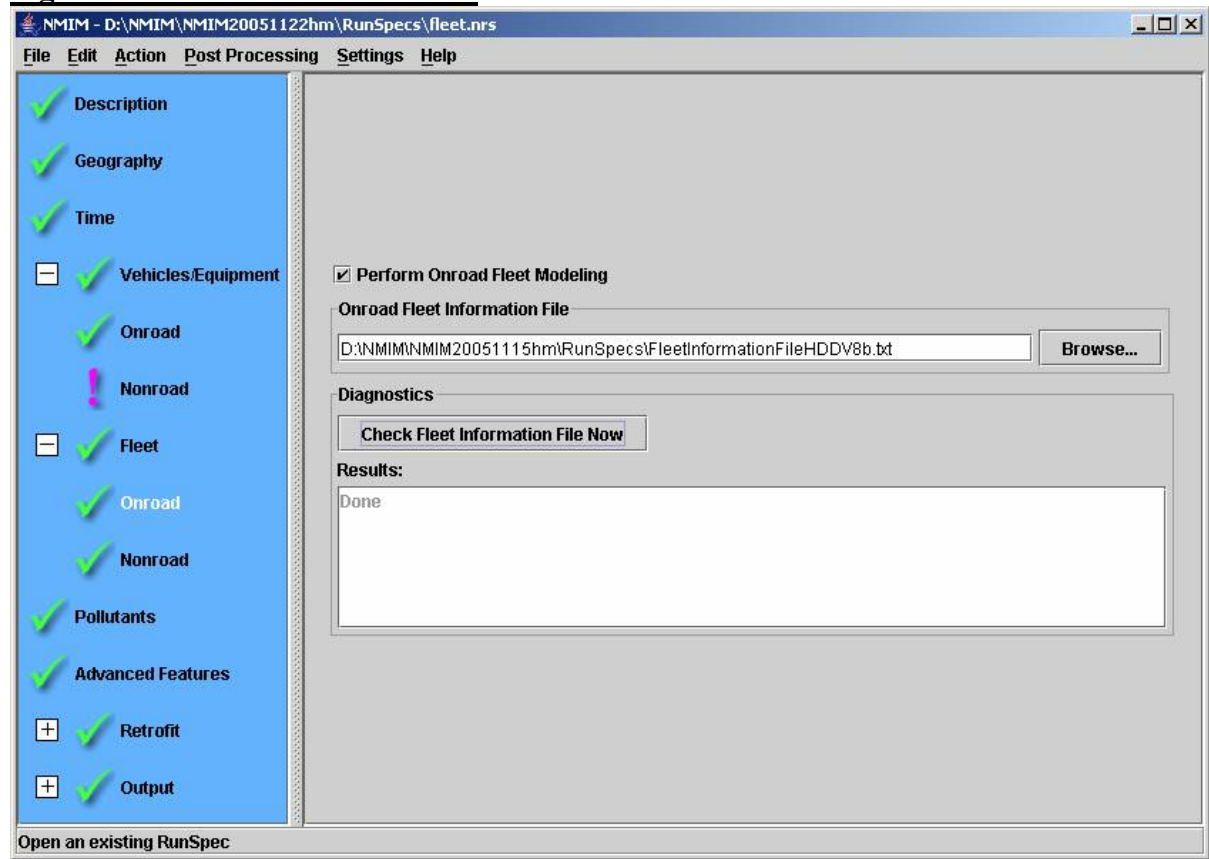
The Diagnostics Results Box contains the Check Fleet Information File Now button and the Results box. The Check Fleet Information File Now button should be selected after all NMIM GUI inputs have been made and the Fleet Information File has been completely developed and properly selected. Selection of this button tests the NMIM GUI inputs for consistency with the Fleet Information File inputs. If the word "Done" appears in the Results box, then the fleet inputs are consistent and the Fleet / Onroad navigation icon should be a 'green check mark'. If errors or inconsistencies are present, error or warning messages will appear in the Results box. In most cases the message will indicate that an input change needs to be made in the Fleet Information File. Diagnostic messages in the Results box will often provide the exact line number(s) where invalid input can be found. Warning messages may also be displayed in the Results box. A "warning" condition will not block the execution of the simulation. They inform the user that NMIM has detected a possible inconsistency between the NMIM GUI inputs and the Fleet Information File. To

prevent misleading or possibly erroneous emission results, the user should pay close attention to warning messages.

F4. Onroad Vehicles Panel

Figure F-4   Onroad Vehicles Panel
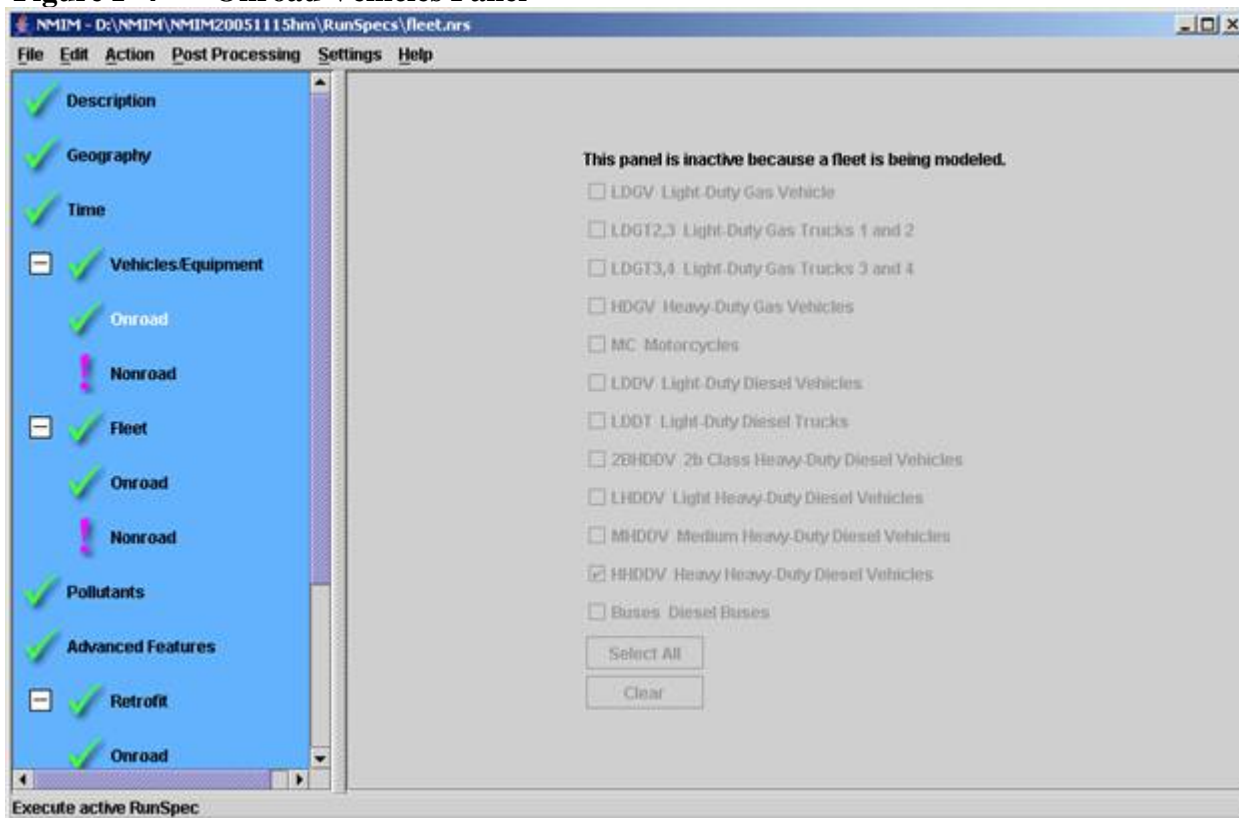
Figure F-4 shows the Onroad Vehicles/Equipment Panel when onroad fleet modeling is being performed. All the inputs on this panel are disabled and a message is displayed saying "This panel is inactive because a fleet is being modeled." When a fleet is being modeled, the vehicle classes are taken from the Fleet Information File instead of from this panel. The presence or absence of selections on this grayed out panel do not affect the results.

F5. Onroad Fleet Information Parameters File

 The Fleet Information Parameters File is a required input to the NMIM model if the user wants to model a specified fleet. It is a comma delimited text file whose path and name are specified by the user in the Fleet / Onroad detail panel in the Fleet Information Parameters File input box (See the Fleet / Onroad Section for complete details). It contains the vehicle fleet size information and the average vehicle miles traveled per year per vehicle. The user will need to create his or her own Fleet Information Parameters File using a text editor such as Wordpad or Notepad or using a spreadsheet (i.e., Excel). Figure F-5 shows an example in Notepad.   If a spreadsheet is used, the user should save the file as a comma separated variable (CSV) format.
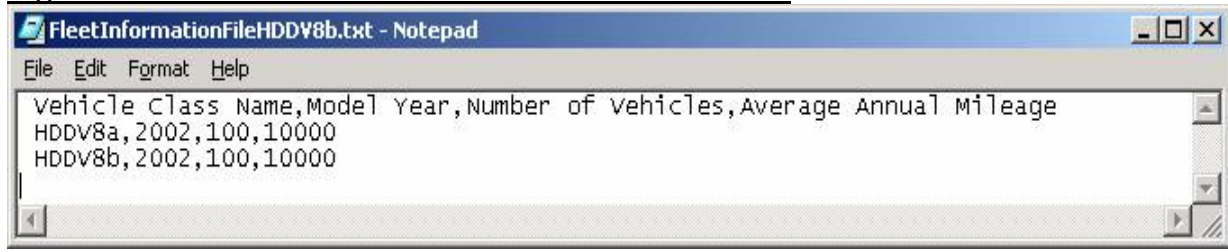
 The first row of the Fleet Information File contains the fleet information input field names separated by commas. The first row of the Fleet Information File must be a 'header' row and not a data row. The remaining rows of the file contain the fleet information input. These rows must be continuous and contain no blank rows. Descriptive or comment rows can be added to the file but they must include the '#' character in the first column. However, do not put # in from of the header row. A comment row cannot be the first row of the file. Also, there can be no blank rows at the end of the file. (Note: the user should be aware that some spreadsheets tend to create extra blank records at the end of a delimited file. If not deleted, these may produce error messages.)   The Fleet Information Parameter File contains the following required parameters with the corresponding definitions.

F5.1   **Vehicle Class Name** - The Vehicle Class column contains the names of the vehicle class types that can be included in a fleet. The list corresponds to the MOBILE6.2 vehicle classifications. To prevent errors, the user must enter a vehicle class name exactly as specified below (case sensitive). These names are:

LDGV	LDDT12
LDGT1	LDDT34
LDGT2	HDDV2b
LDGT3	HDDV3
LDGT4	HDDV4
HDGV2b	HDDV5
HDGV3	HDDV6
HDGV4	HDDV7
HDGV5	HDDV8a
HDGV6	HDDV8b
HDGV7	MC
HDGV8a	HDGB
HDGV8b	HDDBT
LDDV	HDDBS

F5.2   **Vehicle Model Year** - This is the model year of the particular vehicle class in the Fleet. Grouping of model years is not allowed in this input. All four digits of the model year must be entered. The range of allowable model years is from 1951 through 2050.

F5.3.   **Fleet Size by Vehicle Class and Model Year (Number of Vehicles) -** The Fleet Size input is the total number of vehicles of a particular vehicle class and model year in a simulated Fleet created by the user.   Any integer value

greater than zero may be entered as input. The Fleet Size parameter is multiplied by the per vehicle emission rate internally in the Fleet calculations. The final emission result is directly proportional to the number of vehicles specified in the Fleet Size parameter.

F5.4. **Annual Vehicle Miles Traveled (VMT) per Vehicle** **-** The Annual VMT per Vehicle input is the number of miles per vehicle that a particular vehicle class, and model year is expected to travel in the year specified in the Time panel. Any non negative value may be specified for a given Vehicle class and model year group. The product of Total Fleet Size and VMT per Vehicle will become the total VMT for the particular "Fleet".

F6. Nonroad Fleet Information Parameters File

Figure F-6   **Fleet Nonroad Panel**
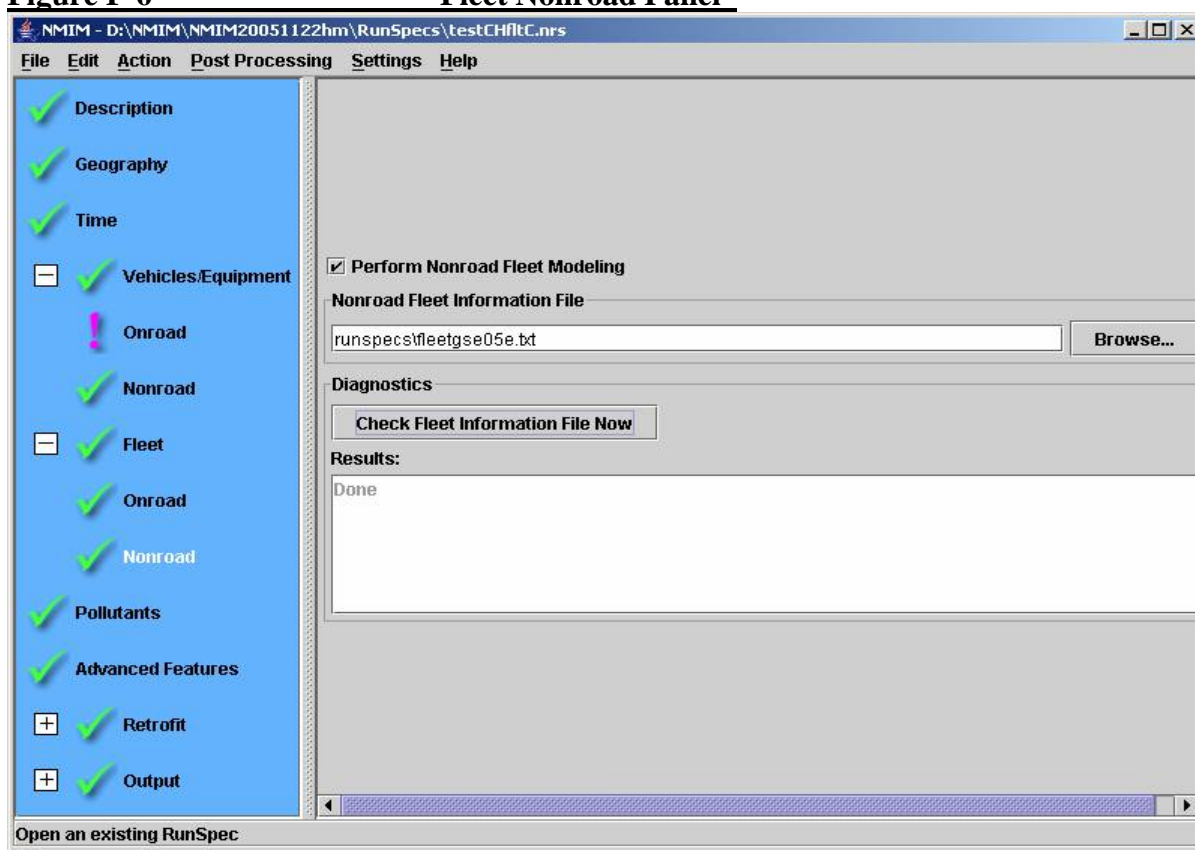
The Fleet / Nonroad Panel is shown in Figure F-6. This panel contains the Perform Nonroad Fleet Modeling check box button, the Fleet Information File Box and the fleet information file Diagnostics Results Box.

To perform a nonroad fleet simulation in NMIM, the user must first select the Perform Nonroad Fleet Modeling button (check mark the small box). This selection will activate the nonroad fleet portion of NMIM. Otherwise, the Fleet / Nonroad Panel inputs will be 'grayed out' and inactive.

The second required action is to select the path and file for the Fleet Information File. This text file contains the required fleet information (See the Fleet Information File section for more details). A browse button is available that allows the user to browse through their system to find the required files.

The Diagnostics Results Box contains the Check Fleet Information File Now button and the Results box. The Check Fleet Information File Now button should be selected after all NMIM GUI inputs have been made and the Fleet Information File has been completely developed and properly selected.

Selection of this button tests the NMIM GUI inputs for consistency with the Fleet Information File inputs. If the word "Done" appears in the Results box, then the fleet inputs are consistent and the Fleet / Nonroad navigation icon should be a 'green check mark'. If errors or inconsistencies are present, error or warning messages will appear in the Results box. In most cases the message will indicate that an input change needs to be made in the Fleet Information File.

Diagnostic messages in the Results box will often provide the exact line number(s) where invalid input can be found. Warning messages may also be displayed in the Results box. A "warning" condition will not block the execution of the simulation. They inform the user that NMIM has detected a possible inconsistency between the NMIM GUI inputs and the Fleet Information File. To prevent misleading or possibly erroneous emission results, the user should pay close attention to warning messages.

F7. Nonroad Equipment Panel

Figure F-7 shows the Nonroad Equipment Panel when nonroad fleet modeling is being performed. All the inputs on this panel are disabled and a message is displayed saying "This panel is inactive because a fleet is being modeled." When a fleet is being modeled, the equipment classes are taken from the Fleet Information File instead of from this panel.

Figure F-7   Nonroad Equipment Panel
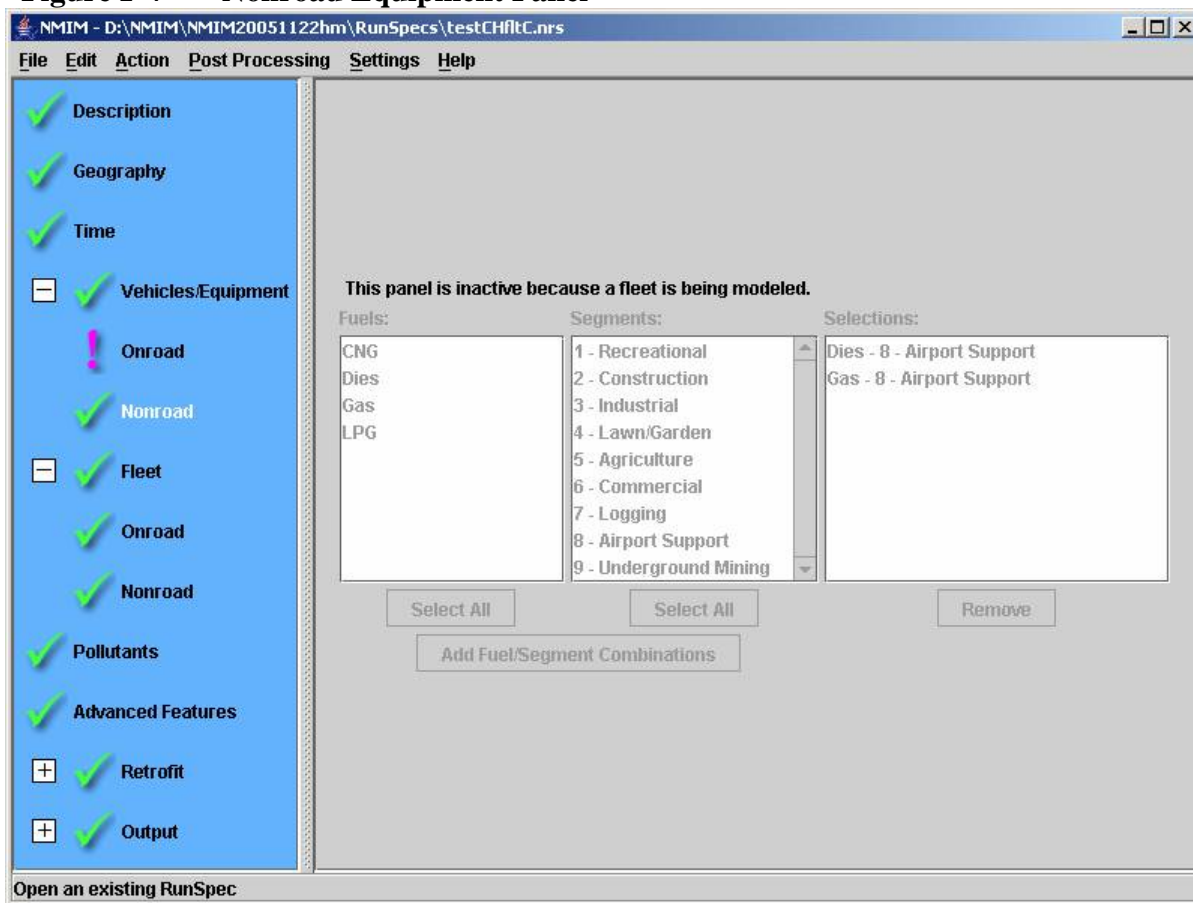
F8. Nonroad Fleet Information Parameters File

The Nonroad Fleet Information Parameters File is a required input to the NMIM model if the user wants to model "Fleet" equipment population and usage effects. It is a comma delimited text file whose path and name are specified by the user in the Fleet / Nonroad detail panel in the Fleet Information Parameters File input box (See the Fleet / Nonroad Section for complete details). It contains the equipment fleet size information and the average equipment hours operated per year per piece of equipment. The user will need to create his or her own Fleet Information Parameters File using a text editor such as Wordpad or Notepad or using a spreadsheet (e.g., Excel).   If a spreadsheet is used, the user should save the file as a comma separated variable (CSV) format.

Figure F-8   Nonroad Fleet Information Parameters File


```
SCC, HPmax, ModelYear, TechType, Population, Hours/Year
Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
2270008005, 175, 2005, All, 1, 1000
0.05, 0.05, 0.05, 0.10, 0.10, 0.05, 0.10, 0.10, 0.20, 0.10, 0.10
2265008005, 175, 2005, All, 1, DEFAULT
0.05, 0.05, 0.05, 0.10, 0.10, 0.05, 0.10, 0.10, 0.20, 0.10, 0.10
```
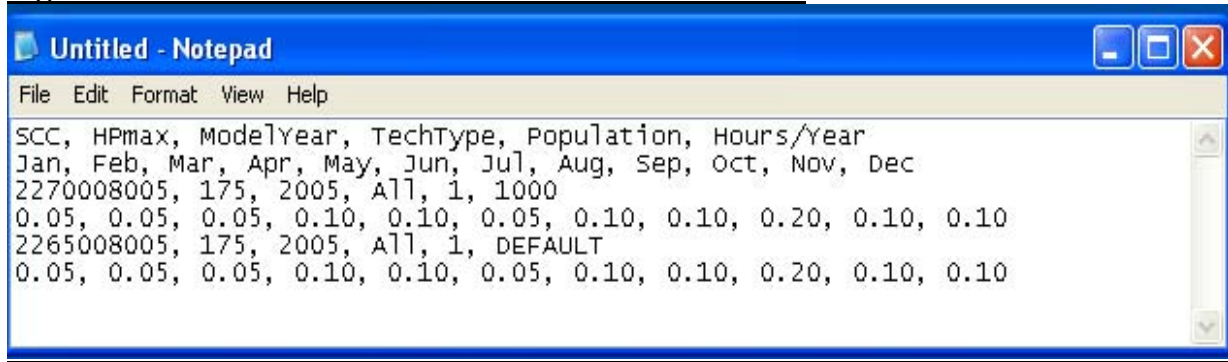
The first non-comment row of the Fleet Information File contains the fleet information input field names separated by commas.

The second row contains the field names for the monthly distributions of the hours/year. The remaining rows of the file contain the fleet information input.   These rows must be continuous and contain no blank rows or non data 'descriptive' information.

Descriptive or comment rows can be added to the file but they must include the '#' character in the first column.

There can be no blank rows at the end of the file. (Note: the user should be aware that some spreadsheets tend to create extra blank records at the end of a delimited file. If not deleted, these may produce error messages.)

The Fleet Information Parameter File contains the following required parameters with the corresponding definitions.

Each complete Fleet Information record takes **two lines** in the file. Fields are comma separated. White space (blanks or tabs) is permitted between fields and shall be ignored. The lines contain the following information:

Line 1 Field List

F8.1   **SCC** - This column contains the Nonroad SCCs of the equipment to be modeled. The SCC must be a full 10-digit SCC, NOT the more global 7 and 4 digit versions. The valid SCCs are any Nonroad SCC in the NMIM county database. The total number of valid SCCs is quite large and cannot be reproduced in this guide. For the definition of a specific SCC, the user should consult the NONROAD model user guide or other SCC information sources.

F8.2   **HPmax** – The upper end of a single specific NONROAD HPmax to which the equipment belongs, the list of valid values are:

 0, 1, 3, 6, 11, 16, 25, 40, 50, 75, 100, 175, 300, 600, 750, 1000, 1200, 2000, 3000, 9999

F8.3   **Model Year** – The model year of the equipment being modeled.

F8.4   **Technology Type** – This column contains the Technology Type for the equipment that is included in the fleet. This entry, if used, must match one of the allowed Technology Types in the NONROAD model. The list of possible diesel entries includes the following:

    Base (pre-1988 uncontrolled)

    T0 (1988 and later uncontrolled, but with some benefits from truck controls)

    T1 (Tier 1, applies only to engines <= 750 hp)

    T2 (Tier 2, all hp land-based diesels and <= 50 hp recreational marine)

    T3 (Tier 3, 100-750 hp only)

    T3B (Tier 3, 75-100 hp only)

    T4A (Transitional Tier 4 for engines <= 75 hp)

    T4B (Final Tier 4 for engines <= 25 hp)

    T4 (Final Tier 4 PM controls 25-75 hp; transitional Tier 4 PM for >750hp)

    T4N (Full Tier 4 PM and NOx controls for engines > 75 hp)

    BaseM (pre-1988 uncontrolled recreational marine)

    T0M (1988 and later uncontrolled rec marine <= 50 hp)

    T1M (Tier 1 recreational marine, applies only to engines <= 50 hp)

    T2M (Tier 2 controls for recreational marine > 50 hp only)

    T3M (Tier 3 controls for recreational marine, interim Tier 3 for 25-100 hp)

    T4M (Tier 3 final controls for recreational marine 25-100 hp)

If "ALL" is used (or if this field is left blank) the fleet emissions will be a weighted average of the Technology Types that exist for the chosen SCC and model year. This could be used if the model year is known, but the technology type is not known.

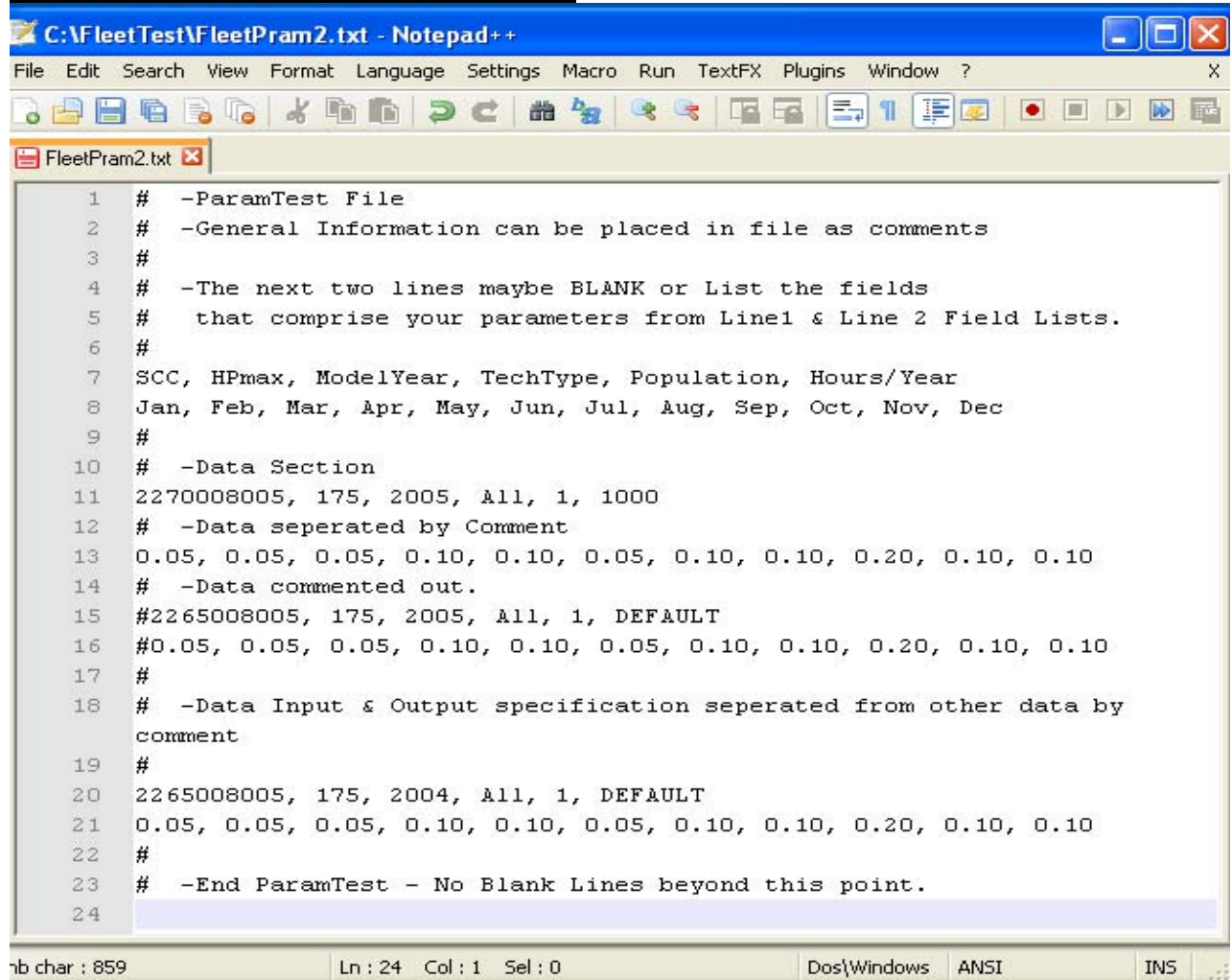F8.5   **Population** – The number of pieces of equipment / vehicles in the simulated fleet

F8.5   **Activity** – The hours per year this equipment is operated. If this is "DEFAULT" the simulation uses the default NONROAD hrs/year)

Line 2 Field List

F8.6   **Monthly Activity Allocation** – Either just the word "DEFAULT" (without quotes) or twelve monthly activity fractions, comma separated, which add up to 1.000 ± 0.001. If the

monthly activity allocation input for a given record is DEFAULT, then NMIM would use the monthly allocations for the closest matching SCC in the NONROAD seasonality file as specified in the OPT file generated by NMIM for the given model run (typically SEASON.DAT).

Same file as shown above with commenting

```
C:\FleetTest\FleetPram2.txt - Notepad++

File   Edit   Search   View   Format   Language   Settings   Macro   Run   TextFX   Plugins   Window   ?                    X

FleetPram2.txt

   1    #   -ParamTest File
   2    #   -General Information can be placed in file as comments
   3    #
   4    #   -The next two lines maybe BLANK or List the fields
   5    #    that comprise your parameters from Line1 & Line 2 Field Lists.
   6    #
   7    SCC, HPmax, ModelYear, TechType, Population, Hours/Year
   8    Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
   9    #
  10    #   -Data Section
  11    2270008005, 175, 2005, All, 1, 1000
  12    #   -Data seperated by Comment
  13    0.05, 0.05, 0.05, 0.10, 0.10, 0.05, 0.10, 0.10, 0.20, 0.10, 0.10
  14    #   -Data commented out.
  15    #2265008005, 175, 2005, All, 1, DEFAULT
  16    #0.05, 0.05, 0.05, 0.10, 0.10, 0.05, 0.10, 0.10, 0.20, 0.10, 0.10
  17    #
  18    #   -Data Input & Output specification seperated from other data by
        comment
  19    #
  20    2265008005, 175, 2004, All, 1, DEFAULT
  21    0.05, 0.05, 0.05, 0.10, 0.10, 0.05, 0.10, 0.10, 0.20, 0.10, 0.10
  22    #
  23    #   -End ParamTest - No Blank Lines beyond this point.
  24

nb char : 859              Ln : 24   Col : 1   Sel : 0              Dos\Windows   ANSI          INS
```

Command Line and API Usage

Introduction

This document describes the command line and API usage for the NMIM Java application. The NMIMCommandLine class is used to run NMIM without any GUI. Like the NMIMGUI class, NMIMCommandLine runs the master portion of NMIM and thus requires at least one NMIM worker application to run on the local file system. It should be noted that running the command line version of NMIM does not automatically start a worker; the user is still required to manually start a worker to provide results for NMIM.

Terminology

batch mode: NMIM is invoked with command line arguments by executing:
>java gov.epa.otaq.nmim.core.NMIMCommandLine
NMIMCommandLine will not display any GUI and NMIMEngine is invoked for the specified RunSpec file(s). This mode can run more than one RunSpec and automatically saves NMIMError and NMIMOutput rows for each RunSpec. Other intermediate files are saved as specified from the command line arguments.

GUI mode: NMIM is invoked by executing:
>java gov.epa.otaq.nmim.runspecgui.NMIMGUI
The main window is displayed and the user can edit and/or execute a single RunSpec file.

API

A new class, NMIMAPI, provides an API for NMIM in both batch and GUI modes. NMIM in batch mode can be entirely controlled by command line arguments, which are described in greater detail later in this document. Alternatively, an external Java program can invoke the various member functions of NMIMAPI to achieve the same purpose. As done within NMIMCommandLine, the basic method can be followed by programmatically invoking NMIMCommandLine with command line arguments or by following this high-level process:

1) Call NMIMAPI's openLogFileWriter()

2) Fill in the runSpecFileList

3) Fill in the desired file switches (e.g. m6in, etc...)

4) Set the desired output directory

5) Set the error level

6) Call runBatch()

7) Call closeLogFileWriter()

Command Line Arguments

To run NMIM in batch mode, specify one or more command line arguments to the NMIMCommandLine class's main function. The arguments are separated by whitespace and individual switches begin with a dash char, "-". Some arguments expect a parameter such as path and name of a file. These parameters are separated from their switches by a space and can be enclosed by double quotes if the specified names contain any spaces.

Argument	Parameters	Purpose or function
-m6in	None	Indicates whether to save mobilex.in files.
-m6svmt	None	Indicates whether to save SVMT files.
-m6tb1	None	Indicates whether to save aggregated mobilex.tb1 file from the worker.
-m6err	None	Indicates whether to save mobilex.err files.
-m6errtxt	None	Indicates whether to save M6error.txt files.
-m6process	None	Indicates whether to save ProcessOutput.txt files produced by MOBILE.
-nropt	None	Indicates whether to save NONROAD .opt files.
-nrmsg	None	Indicates whether to save NONROAD .msg files.
-nrout	None	Indicates whether to save NONROAD .out files.
-nrprocess	None	Indicates whether to save ProcessOutput.txt files produced by NONROAD.
-r	RunSpec file name and path	Specifies the location and name of a RunSpec file. If not using the "-rl" argument, then there should be at least one occurrence of "-r".
-o	Output folder name and path.	Specifies the location of the output files saved during batch mode. If not specified, then the current directory will be used. **NOTE: This is a name of a directory, not the name of a file.** **Also, if using double quotes to specify the directory path, you cannot use a trailing backslash.**
-e	1 - 5	Specifies the level of errors that should be logged into the log file. 1 = only RUN_ERROR types should be logged. 2 = ERROR and RUN_ERROR types should be logged. 3 = WARNING, ERROR, RUN_ERROR types should be logged. 4 = INFO, WARNING, ERROR, RUN_ERROR types should be logged. 5 = all error types should be logged.
-rl	RunSpec list file name and path	Specifies the location and name of a file that contains a list of RunSpec files to run. See "RunSpec List File Format" below.
-ol	Options list file name and path	Specifies the location and name of a file that contains a list of options. See "Options List File Format" below.

RunSpec List File Format

A RunSpec list file can have any valid name and extension but must specify the location and name of a single RunSpec per line. One example:

nrtest01.runspec
nrmobile1.xml
c:\temp\nrmobile2.xml

This list file specifies three files, the first two (having implicit relative paths) are expected to be in the current directory. The third file is identified by an absolute path.

Options List File Format

An options list file can also have any valid name and extension, each option is specified on a single line. The presence of an option indicates that the option is "selected"; likewise the absence of an option indicates a "non-selection". Only the first ten command line arguments as displayed in the above table can be used in an options list file (i.e. the "switch" arguments). One example:

               -m6in
               -m6svmt
               -m6tb1
               -m6err
               -m6errtxt
               -m6process
               -nropt
               -nrmsg
               -nrout
               -nrprocess

This file indicates that all ten types of optional intermediate files should be saved. Note that each option is also preceded by the dash char, "-".

Parsing Errors / Validation

To ensure that an NMIM batch can run to completion (barring any RunSpec-specific errors), all command line arguments validation is done at the beginning. If a RunSpec file, whether specified by the "-r" argument or in a list file, doesn't exist, NMIM will stop and complain about the invalid RunSpec file. The same applies to the RunSpec list file itself and the options list file. Also, if the error level is not between 1 and 5 (inclusive), then NMIM will complain and exit. Finally, if the specified output directory (from the "-o" switch" doesn't exist NMIM will exit.

If NMIM stops immediately due to parsing errors, the command line usage is written to the stdout stream (i.e. console window).

Examples:

This example specifies both an options list file and a RunSpec list file, along with an error level of "5" (report all error types) and an output directory "c:\temp\batchtest06":
C:\EPA\NMIM\NMIMSource>java gov.epa.otaq.nmim.core.NMIMCommandLine -ol optionslist.txt -rl runspeclist.txt -e 5 -o "c:\temp\batchtest06"

This example specifies that only mobilex.tb1 files should be saved to "c:\temp\batchtest07" and two RunSpecs (in the current directory) should be executed:
C:\EPA\NMIM\NMIMSource>java gov.epa.otaq.nmim.core.NMIMCommandLine -m6in -r mobile01.xml -r mobile02.xml -e 5 -o "c:\temp\batchtest07"

NOTE: if using double quotes to specify the directory path, you cannot use a trailing backslash. Also, the use of double quotes is not necessary, unless of course, the pathname contains space chars.

Output Directories and Files

NMIM in batch mode will not create the output directory from the "-o" switch; it will only ensure that this directory exists before starting the RunSpec batch runs. Likewise, NMIM will not delete any existing files in the output directory, but might overwrite any existing files should they happen to have the same filenames.

The proposed naming scheme supplied by EPA was implemented. Saved output files are named as follows:

MmmyyyyCssсccRbasefilename.extension,

where:

First char = "M" or "N" corresponding to MOBILE or NONROAD, respectively.

mm = The two-digit month of the output.

yyyy = The four-digit year of the output.

ss = The two-digit FIPSStateId of the output.

ccc = The three-digit FIPSCountyId of the output.

basefilename = The "base" name of the RunSpec file (without path or extension).

extension = The extension of the corresponding output file that was captured, such as ".in" or ".opt".

NMIMOutput, NMIMError, and the Log File

Every RunSpec executed during batch mode will produce a table dump from NMIMOutput and NMIMError in the output directory:

nmimerror23Rnrtest01.txt is an example of an NMIMError table dump for RunSpec "nrtest01" for RunID = 23.

nmimerror43Rnrmobile1.txt is an example of an NMIMOutput table dump for RunSpec "nrmobile1" for RunID = 43.

With the .txt extension, the table dump files can easily be imported in MS Excel.

Each invocation of NMIM in batch mode will create a corresponding log file that contains high-level NMIM output and any errors that are in the specified error level range. The log file, called "nmimbatch.log", is saved to the current directory. One example:

12/2/02 12:02 PM **** Started NMIM

12/2/02 12:02 PM Running C:\EPA\NMIM\NMIMSource\nrtest01.runspec

12/2/02 12:03 PM Running C:\EPA\NMIM\NMIMSource\nrmobile1.xml

12/2/02 12:05 PM Unable to copy the file:
    C:\TEMP\RetrieveProcessingTemp62930\mobilex.err

12/2/02 12:05 PM Unable to copy the file:
    C:\TEMP\RetrieveProcessingTemp62930\M6ERROR.TXT

12/2/02 12:05 PM Running C:\EPA\NMIM\NMIMSource\nrmobile2.xml

12/2/02 12:07 PM Unable to copy the file:
    C:\TEMP\RetrieveProcessingTemp62934\mobilex.err

12/2/02 12:07 PM Unable to copy the file:
    C:\TEMP\RetrieveProcessingTemp62934\M6ERROR.TXT

12/2/02 12:08 PM **** Ended NMIM

This example output shows the start and stop times of NMIM in batch mode along with a timestamp line for each RunSpec that it executed. The "unable to copy file" lines were

created since the "-m6err" and "-m6errtxt" switches were used, but MOBILE did not produce these files during either iteration, and as such, these files could not be saved to the output directory.

Output File List

Assuming a RunSpec with name "nrmobile1", for Autauga Alabama and Jan. 1999, MOBILE output files:

File Name	File Type
M011999C01001Rnrmobile1.txt	ProcessOutput.txt captured from MOBILE.
M011999C01001Rnrmobile1.0	SPEED VMT for scenario 0
M011999C01001Rnrmobile1.1	SPEED VMT for scenario 1
M011999C01001Rnrmobile1.2	SPEED VMT for scenario 2
M011999C01001Rnrmobile1.3	SPEED VMT for scenario 3
M011999C01001Rnrmobile1.4	SPEED VMT for scenario 4
M011999C01001Rnrmobile1.5	SPEED VMT for scenario 5
M011999C01001Rnrmobile1.6	SPEED VMT for scenario 6
M011999C01001Rnrmobile1.7	SPEED VMT for scenario 7
M011999C01001Rnrmobile1.8	SPEED VMT for scenario 8
M011999C01001Rnrmobile1.in	mobilex.in
M011999C01001Rnrmobile1.tb1	mobilex.tb1 (aggregated from the worker)
M011999C01001Rnrmobile1.m6error.txt	M6error.txt
M011999C01001Rnrmobile1.err	mobilex.err

Assuming a RunSpec with name "nrmobile1", for Autauga Alabama and Jan. 1999, NONROAD output files:

File Name	File Type
N011999C01001Rnrmobile1.txt	ProcessOutput.txt captured from NONROAD.
N011999C01001Rnrmobile1.msg	NONROAD .msg file
N011999C01001Rnrmobile1.opt	NONROAD .opt file
N011999C01001Rnrmobile1.out	NONROAD .out file

# Distributed Processing Algorithm Overview

Introduction

This document describes the concepts and algorithms involved with the NMIM distributed processing architecture.

Overall Architecture

The NMIM distributed computing architecture allows a dynamic set of worker computers to perform calculations for one or more master computers without requiring anything more than standard file-server services for communications. Other highlights include:

- All work files stored temporarily on the file server are compressed before being stored so as to minimize network bandwidth.
- Worker programs perform directory scans of the file server's shared directory approximately every 15 seconds when idle and not at all when busy processing a work file (which can last from 30 to 250 seconds)
- Worker computers may be disconnected and the system will automatically detect this and safely reroute data to the remaining workers, including data that was already being processed by a disconnected worker.
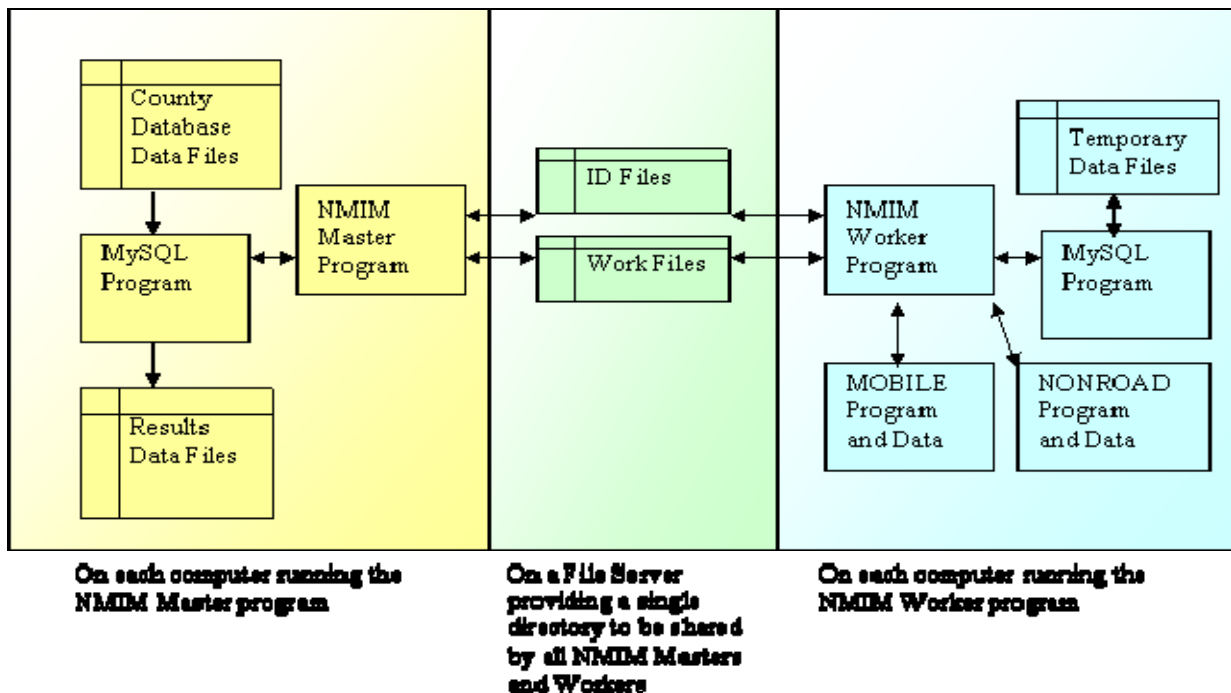
IDs

Each system has an ID. There are two classes of ID's: Masters and Workers. To own a specific ID, a system must create a temporary file in the shared folder. The file is typically empty and must be named as follows:

"MSTR" + ID + ".ID" (for Master ID's)
"WRKR" + ID + ".ID" (for Worker ID's)

Work Files

All work is broken up into digestible pieces and bundled into single Java JAR files called "work" files. The name of these files encodes pieces of information. The name has the following format:

MID_QID_TYPE_STATE

There are four elements of data delimited by three underscore characters. This fixed format allows simple wildcard file searches to find files with a specific field.

Glossary

MID – Master ID. This uniquely identifies a single master application instance.

QID – Queue ID. This uniquely identifies a specific queued job within a master application context.

WID – Worker ID. This uniquely identifies a specific worker application instance.

TYPE – Work File Type. Currently this is either "M6" for a MOBILE6 data queue file or "NR" for a NONROAD data queue file.

STATE – The state of the file in the distributed processing pipeline. This can be one of the following:

- o **"TEMP"**: Used when a system is building a file but the file isn't 100% ready for another system to process. Typically a file is built in this state and immediately renamed to another state.
- o **"TODO"**: A work file that is completely built and ready for a worker system to claim and process.
- o **"InProgress"** + **WID**: Used when a work file is claimed by a specific worker system and is being actively processed.
- o **"DONE"**: Used when a work file is completely processed and ready for the Master system to retrieve it.

Algorithm Outline

The following sections give the high-level steps involved in the distributed processing.

Master Computer Builds Input Files

1. Builds or copies work file into shared folder with a file name STATE of "TEMP".
2. Renames completed file with STATE of "TODO"
3.

Worker Computer Processes Files

3. Detect files with a STATE of "TODO": *_*_*_TODO
4. Set the state to InProgressWID where WID is the worker's ID.
5. Verify atomic rename success. On failure return to idle state.
6. Copy/unjar file to private folder
7. Process distributed work data. Build single result file in shared folder. STATE is "TEMP"

8. Check if the "InProgress" + WID file is still there. If it is, continue. If not, the master has likely aborted this worker. In this case, the worker should delete the "TEMP" JAR file.
9. Rename the "TEMP" file to a STATE of "DONE"
10. Delete file with STATE of "InProgress" + WID
11.

Master Computer Handles Results
11. Detect files belonging to this master that have a STATE of "DONE": MID_*_*_DONE
12. Copy/Unjar to private folder
13. Delete "DONE" file
14. Process
15. Delete Temp Folder