

Module 10

Modeling Nonroad Emissions



Module Overview

- Options for modeling nonroad emissions
- Overview of nonroad in MOVES2014a
- Hands-on demonstration of nonroad in MOVES
- Course wrap-up

Options for Modeling Nonroad Emissions

- NONROAD2008
 - Last revision of the NONROAD model
 - Can still be used for SIPs and other regulatory purposes
 - May not be fully compatible with latest operating systems
- NMIM2008
 - Last revision of NMIM, an inventory modeling “shell” for MOBILE6.2 and NONROAD2008
 - Includes some features that may make it easier to use than NONROAD2008
 - Nonroad portion only can still be used for SIPs and other regulatory purposes
 - Can model air toxics
 - May not be fully compatible with latest operating systems

Options for Modeling Nonroad Emissions

- MOVES2014
 - Incorporates existing NONROAD2008 into MOVES framework
 - No changes to basic model design or data
 - Same results as NONROAD2008 and NMIM2008
 - More limited output options than other two models
 - Compatible with latest operating systems
- MOVES2014a
 - Adds VOC, TOG, NMHC, NMOG, plus about 60 air toxics
 - Adds more output aggregation options to give flexibility similar to NONROAD and NMIM
 - Includes updated gasoline fuels
 - May be used for SIPs and other regulatory purposes

Nonroad Guidance

Which model should I use?

- Recommend using MOVES2014a for nonroad inventory development
 - NONROAD2008 and NMIM2008 no longer supported by EPA
 - MOVES2014a includes updated fuels, more pollutant options and more flexible output

What data should I use?

- It is acceptable to use default nonroad fleet and activity data for SIPs and other regulatory submissions
- You can use local fleet and activity data for any of these models
 - Contact us at mobile@epa.gov with questions about how to do this in MOVES2014a

Future of Nonroad Modeling

- Adding nonroad to MOVES2014 and MOVES2014a is the first step toward major revisions to the nonroad modeling process
- Those revisions may include:
 - New emissions, activity, and fleet data
 - New algorithms for calculating emissions
 - New design
 - New coding language
- Still in the early planning stages
 - Timetable is not yet determined
- Goal is for MOVES to be a comprehensive model that covers most types of mobile sources in a consistent way

Overview of Nonroad in MOVES

- Heavy reliance on national defaults applied at the county level
 - Local activity and fleet data can be hard to develop
 - MOVES uses surrogates (construction activity, acreage farmed, etc.) to allocate national data to the county level
- MOVES produces inventory output
 - Emission rates can be derived using post-processing scripts
- MOVES does not account for hourly activity patterns or aggregate emissions for more than 1 day
 - MOVES Nonroad inventory output is for a single day with no hourly detail

Overview of Nonroad in MOVES

- Nonroad equipment divided into 12 sectors with 91 equipment types
 - Not included are locomotives, commercial marine, and aircraft
- Pollutants and Processes detail more limited than for onroad
- Produces huge output files
 - A run for all nonroad source types and multiple pollutants can give several hundred thousand lines of output
 - Use post-processing scripts to trim

Hands-On Demonstration: Estimating Nonroad Emissions



Scale

- Nonroad sectors can be modeled by selecting “Nonroad” in the Scale panel
- “National” is only option for scale
 - Refers to national default database
 - Individual counties can be selected in Geographic Bounds panel
- “Inventory” is only option for Calculation Type
 - Several scripts are available in the Post Processing menu to calculate emission factors from inventory results

Scale

MOVES - ID 2214896263202995615

File Edit Pre Processing Action Post Processing Tools Settings Help

- Description
- Scale**
- Time Spans
- Geographic Bounds
- Vehicles/Equipment
- Road Type
- Pollutants And Processes
- Manage Input Data Sets
- Strategies
- Output
- Advanced Performance Features

Model

☐ Onroad

☒ Nonroad

Domain/Scale

☒ National

☐ County


☐ Project

Calculation Type

☒ Inventory Mass and/or Energy within a region and time span.

☐ Emission Rates Mass and/or Energy per unit of activity.

MOVESScenarioID:

 Caution: Changing these selections changes the contents of other input panels. These changes may include losing previous data contents.

Ready...

Time Spans

- Nonroad emissions in MOVES are calculated on a daily basis
- No options for specifying Time Aggregation Level or Hours
- Select:
 - 2015
 - July
 - Weekdays

Time Spans

MOVES - ID 2214896263202995615

File Edit Pre Processing Action Post Processing Tools Settings Help

Description

Scale

Time Spans

Geographic Bounds

Vehicles/Equipment

Road Type

Pollutants And Processes

Manage Input Data Sets

Strategies

Output

Advanced Performance Features

Time Aggregation Level

☐ Year ☐ Month ☐ Day ☒ Hour

Years

Select Year: 2015 Add

Years:

Remove

Months

☐ January ☒ July

☐ February ☐ August

☐ March ☐ September

☐ April ☐ October

☐ May ☐ November

☐ June ☐ December

Select All Clear All

Days

☐ Weekend

☒ Weekdays

Select All Clear All

Hours

Start Hour: End Hour:

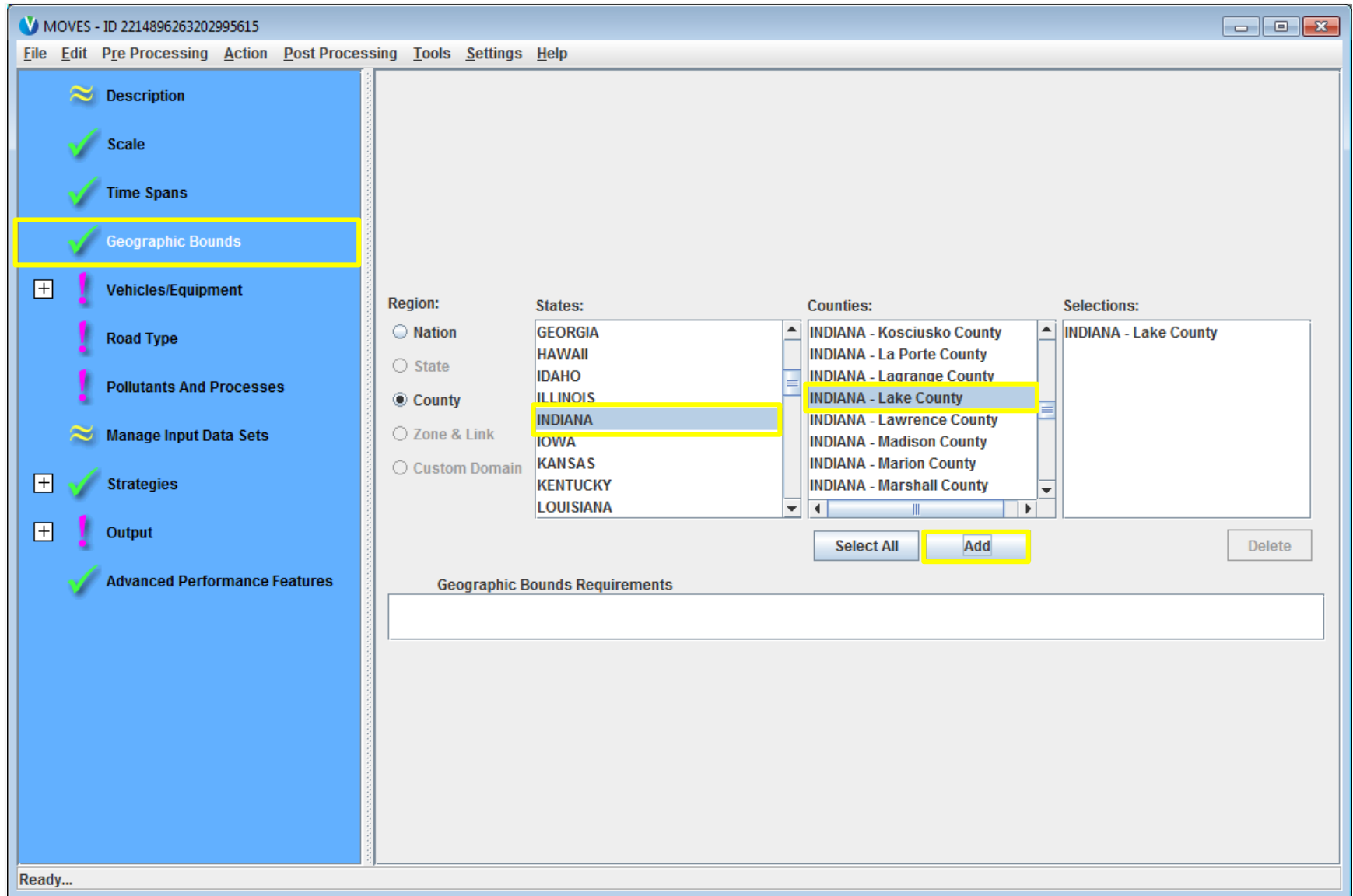
Select All Clear All

Ready...

Geographic Bounds

- Can select Nation or County
- Can run multiple counties in a single run
- Select:
 - Indiana
 - Lake County

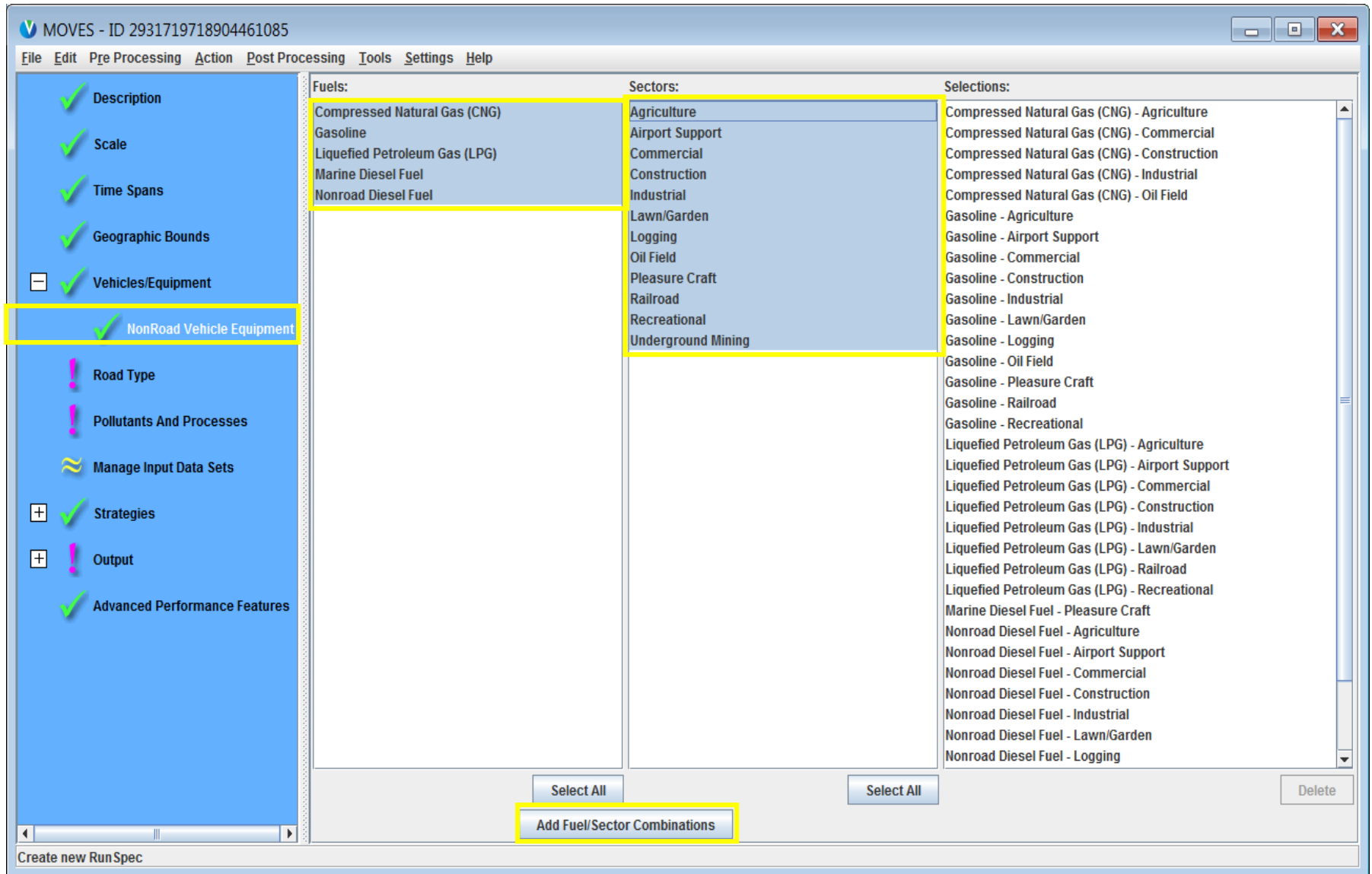
Geographic Bounds



Nonroad Vehicle Equipment

- Select these fuel types:
 - Compressed Natural Gas (CNG)
 - Diesel
 - Gasoline
 - Liquefied Petroleum Gas (LPG)
- Best to select all 12 sectors
 - MOVES allocates activity to each sector in a county based on various surrogates:
 - Farmed acreage for agriculture, construction starts for construction, etc.

Nonroad Vehicle Equipment



Road Type

- Doesn't apply to nonroad
- Click on Road Type in navigation panel to get green check

Pollutants and Processes

- All needed criteria pollutants are included
 - Less speciation detail than for onroad
 - Less differentiation by process than for onroad
- MOVES2014a adds about 60 toxics
- Select:
 - Total Gaseous HC
 - Oxides of Nitrogen
 - Primary Exhaust PM_{2.5}

Pollutants and Processes

MOVES - ID 2931719718904461085

File Edit Pre Processing Action Post Processing Tools Settings Help

✓ Description

✓ Scale

✓ Time Spans

✓ Geographic Bounds

[-] ✓ Vehicles/Equipment

✓ NonRoad Vehicle Equipment

✓ Road Type

✓ Pollutants And Processes

~ Manage Input Data Sets

[+] ✓ Strategies

[+] ! Output

✓ Advanced Performance Features

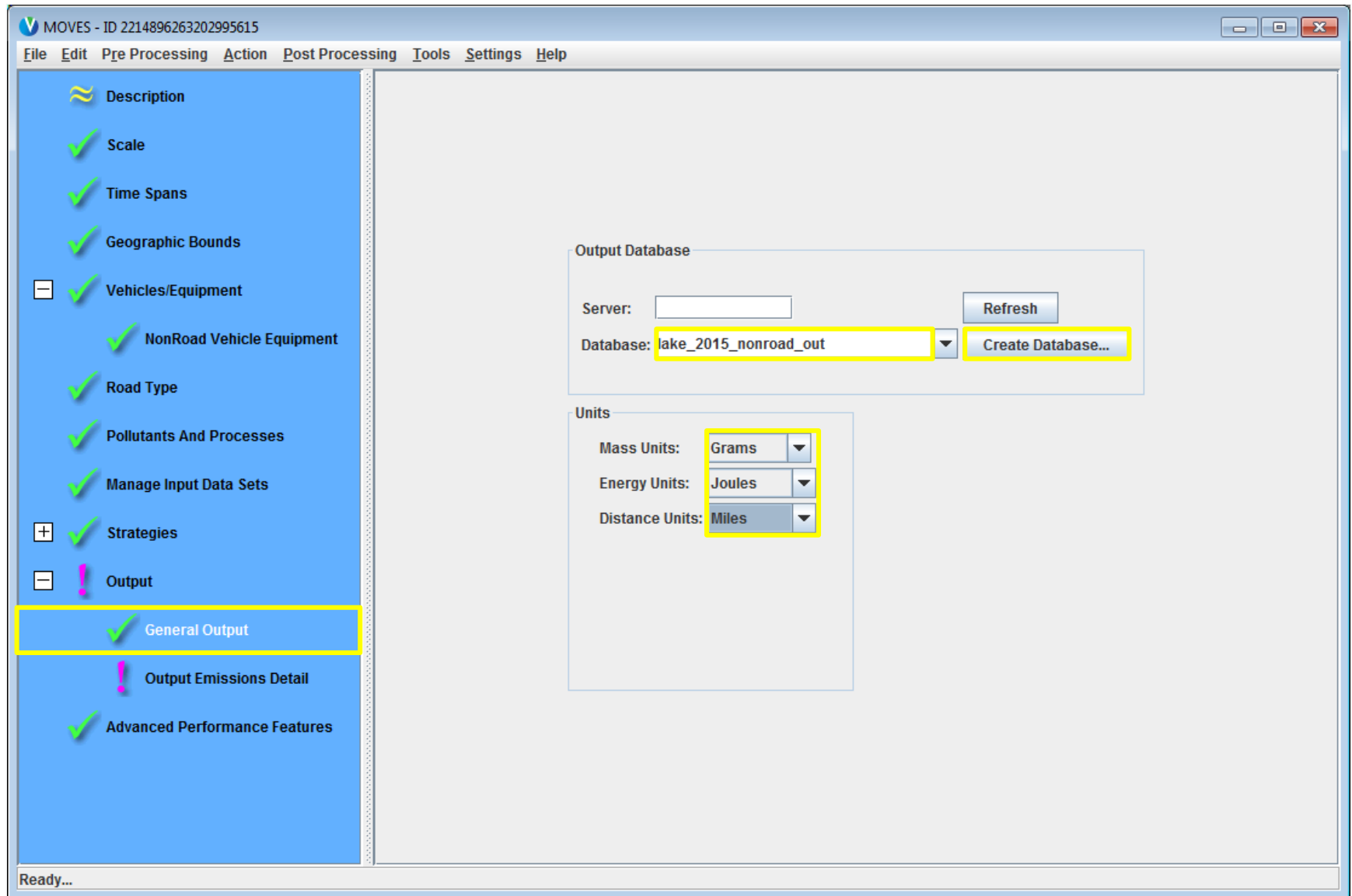
| | Running Exhaust | Crankcase Running Exhaust | Refueling Displacement Vapor Loss | Refuel |
|---|-------------------------------------|-------------------------------------|-------------------------------------|--------|
| <input checked="" type="checkbox"/> Total Gaseous Hydrocarbons | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | |
| <input type="checkbox"/> Non-Methane Hydrocarbons | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> Non-Methane Organic Gases | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> Total Organic Gases | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> Volatile Organic Compounds | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> Methane (CH4) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> Carbon Monoxide (CO) | <input type="checkbox"/> | | | |
| <input checked="" type="checkbox"/> Oxides of Nitrogen (NOx) | <input checked="" type="checkbox"/> | | | |
| <input type="checkbox"/> Ammonia (NH3) | <input type="checkbox"/> | | | |
| <input checked="" type="checkbox"/> Primary Exhaust PM2.5 - Total | <input checked="" type="checkbox"/> | | | |
| <input type="checkbox"/> Primary Exhaust PM10 - Total | <input type="checkbox"/> | | | |
| <input type="checkbox"/> Sulfur Dioxide (SO2) | <input type="checkbox"/> | | | |
| <input type="checkbox"/> Brake Specific Fuel Consumption (BSFC) | <input type="checkbox"/> | | | |
| <input type="checkbox"/> Atmospheric CO2 | <input type="checkbox"/> | | | |
| <input type="checkbox"/> Benzene | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> Ethanol | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> MTBE | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> 1,3-Butadiene | <input type="checkbox"/> | <input type="checkbox"/> | | |
| <input type="checkbox"/> Formaldehyde | <input type="checkbox"/> | <input type="checkbox"/> | | |
| <input type="checkbox"/> Acetaldehyde | <input type="checkbox"/> | <input type="checkbox"/> | | |
| <input type="checkbox"/> Acrolein | <input type="checkbox"/> | <input type="checkbox"/> | | |
| <input type="checkbox"/> [+] Additional Air Toxics | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> [+] Polycyclic Aromatic Hydrocarbons (PAH) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> [+] Metals | <input type="checkbox"/> | | | |
| <input type="checkbox"/> [+] Dioxins and Furans | <input type="checkbox"/> | | | |
| <input type="checkbox"/> NonHAPTOG | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |

Select Prerequisites

Clear All

Create new Run Spec

Output – General Output



Output – Output Emissions Detail

- All output will be for a 24-hour day
- Currently MOVES nonroad output can be broken down by:
 - Model year
 - Fuel Type
 - Emission process
 - Engine Technology
 - Horsepower class
- If you select all of these, output table is very large - 312,642 lines for this run
- Select Fuel Type, Sector, and SCC for basic information needed for a typical inventory

Output – Output Emissions Detail

MOVES - ID 2931719718904461085

File Edit Pre Processing Action Post Processing Tools Settings Help

- ✓ Description
- ✓ Scale
- ✓ Time Spans
- ✓ Geographic Bounds
- [-] ✓ Vehicles/Equipment
 - ✓ NonRoad Vehicle Equipment
 - ✓ Road Type
 - ✓ Pollutants And Processes
 - ✓ Manage Input Data Sets
- [+] ✓ Strategies
- [-] ✓ Output
 - ✓ General Output
 - ✓ **Output Emissions Detail**
 - ✓ Advanced Performance Features

Always

- ☒ Time 24-Hour Day
- ☒ Location COUNTY
- ☒ Pollutant

for All Vehicle/Equipment Categories

- ☐ Model Year
- ☒ Fuel Type ☐ Fuel Subtype
- ☐ Emission Process

☐ Estimate Uncertainty

On Road/Off Road

- ☒ On Road/Off Road

On and Off Road

- ☐ Road Type
- ☐ Source Use Type
- ☒ SCC
- ☐ Regulatory Class

Off Road

- ☒ Sector
- ☐ Engine Tech.
- ☐ HP Class

Number of iterations: 2

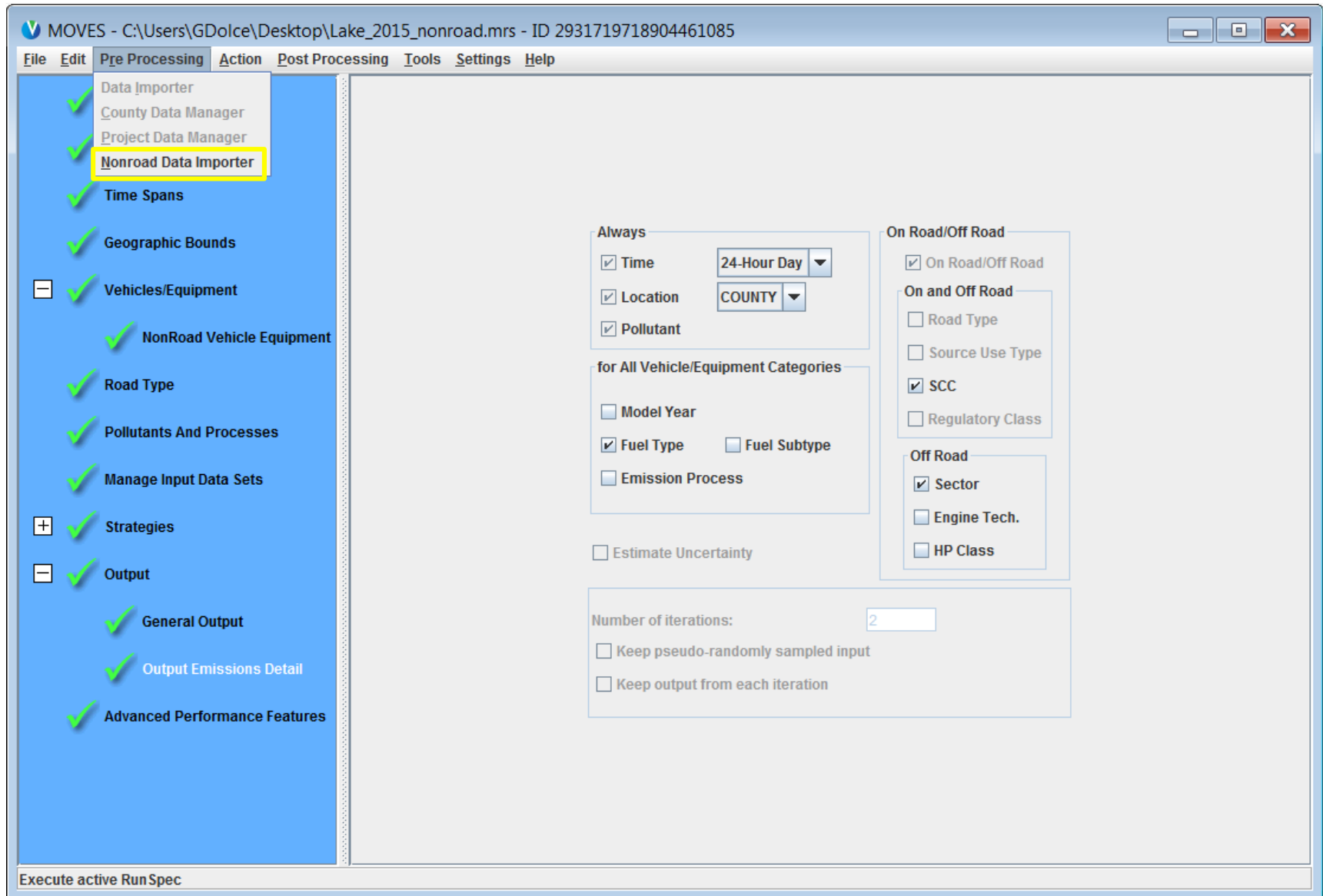
- ☐ Keep pseudo-randomly sampled input
- ☐ Keep output from each iteration

Create new RunSpec

Using the Nonroad Data Importer

- Access from Pre-Processing menu
 - Select “Nonroad Data Importer”
 - “Data Importer” is for onroad only
- Meteorology Data
 - Nonroad in MOVES uses the same met data table as onroad
 - ZoneMonthHour
 - Use same local temperature data for nonroad and onroad
- Fuels
 - Two tables
 - nrFuelSupply
 - FuelFormulation
- Generic
 - Provides access to nonroad tables
 - All begin with “nr” (e.g. nrfuelformulation)
 - Consult with EPA before changing nonroad tables

Using the Nonroad Data Importer



Nonroad Data Importer – Create Database

The screenshot shows the 'MOVES Data Importer' application window. The 'Database' tab is selected, and the 'Fuel' sub-tab is active, indicated by a green checkmark. The main area contains the instruction 'Select or create a database to hold the imported data.' Below this, there are input fields for 'Server:' (containing 'localhost') and 'Database:' (containing 'lake_2015_nonroad_in'). To the right of these fields are three buttons: 'Refresh', 'Create Database', and 'Clear All Imported Data'. A large empty text area is located below the input fields. At the bottom of the window, there is a green bar with the word 'Database' and a 'Done' button.

MOVES Data Importer

RunSpec Summary Database Fuel Meteorology Data Generic Tools

Select or create a database to hold the imported data.

Server: localhost Refresh

Database: lake_2015_nonroad_in Create Database

Log: Clear All Imported Data

Database

Done

Nonroad Data Importer – Meteorology

The screenshot shows the 'MOVES Data Importer' application window with the 'Meteorology Data' tab selected. The window has a standard Windows-style title bar and a tabbed interface. The 'Fuel' tab is also visible and marked with a green checkmark. The 'Meteorology Data' tab contains a 'Description of Imported Data' text area, a 'zoneMonthHour Data Source' section with a 'File: (please select a file)' label and a 'Browse...' button, and buttons for 'Clear Imported Data' and 'Create Template...'. Below these is an 'Import' button. A 'Messages' section with a large text area is at the bottom. At the very bottom, there are buttons for 'Export Default Data' and 'Export Imported Data', a green status bar with the text 'Meteorology Data', and a 'Done' button.

MOVES Data Importer

RunSpec Summary Database ☒ Fuel Meteorology Data Generic Tools

Description of Imported Data:

zoneMonthHour Data Source:

File: (please select a file)

Browse...

Clear Imported Data Create Template...

Import

Messages:

Export Default Data Export Imported Data

Meteorology Data

Done

Data Importer – Fuel

The screenshot shows the 'MOVES Data Importer' application window with the 'Fuel' tab selected. The interface includes a tab bar at the top with 'RunSpec Summary', 'Database', 'Fuel' (active), 'Meteorology Data', 'Generic', and 'Tools'. Below the tabs is a 'Description of Imported Data' section with a text area and a 'Fuels Wizard' button. The 'nrFuelSupply Data Source' section contains a 'File: (please select a file)' label, a 'Browse...' button, and 'Clear Imported Data' and 'Create Template...' buttons. The 'FuelFormulation Data Source' section has a similar layout with its own 'File: (please select a file)', 'Browse...' button, and 'Clear Imported Data' and 'Create Template...' buttons. An 'Import' button is located below these sections. A 'Messages' section with a large text area is positioned above the bottom buttons. At the bottom, there are 'Export Default Data' and 'Export Imported Data' buttons. A cyan bar at the very bottom displays 'Fuel' and a 'Done' button.

MOVES Data Importer

RunSpec Summary Database **Fuel** Meteorology Data Generic Tools

Description of Imported Data:

File: (please select a file) Browse... Clear Imported Data Create Template...

nrFuelSupply Data Source:

File: (please select a file) Browse... Clear Imported Data Create Template...

FuelFormulation Data Source:

File: (please select a file) Browse... Clear Imported Data Create Template...

Import

Messages:

Export Default Data Export Imported Data

Fuel Done

Data Importer – Generic Tab

The screenshot shows the 'MOVES Data Importer' application window with the 'Generic' tab selected. The interface includes a menu bar with 'RunSpec', 'Summary', 'Database', 'Fuel', 'Meteorology Data', 'Generic', and 'Tools'. Below the menu bar is a 'Description of Imported Data:' section. A table selection area on the left shows a list of tables, with 'nrretrofitfactors' selected and highlighted by a yellow box. To the right of the table list are buttons for 'Browse...', 'Clear Imported Data', 'Create Template...', and 'Remove previously imported data'. Below these buttons is an 'Import' button. At the bottom of the window are buttons for 'Export Default Data' and 'Export Imported Data'. A pink bar at the bottom right of the window contains the text 'Generic', and a 'Done' button is located at the bottom right corner.

MOVES Data Importer

RunSpec Summary Database Fuel Meteorology Data Generic Tools

Description of Imported Data:

Table: nrretrofitfactors

File: (p)

nrpahgasratio
nrpahparticleratio
nrprocessgroup
nrretrofitfactors
nrsc
nrscrappagecurve
nrsourceusetype
nrstatesurrogate

Browse...

Clear Imported Data Create Template...

Remove previously imported data

Import

Messages:

Export Default Data Export Imported Data

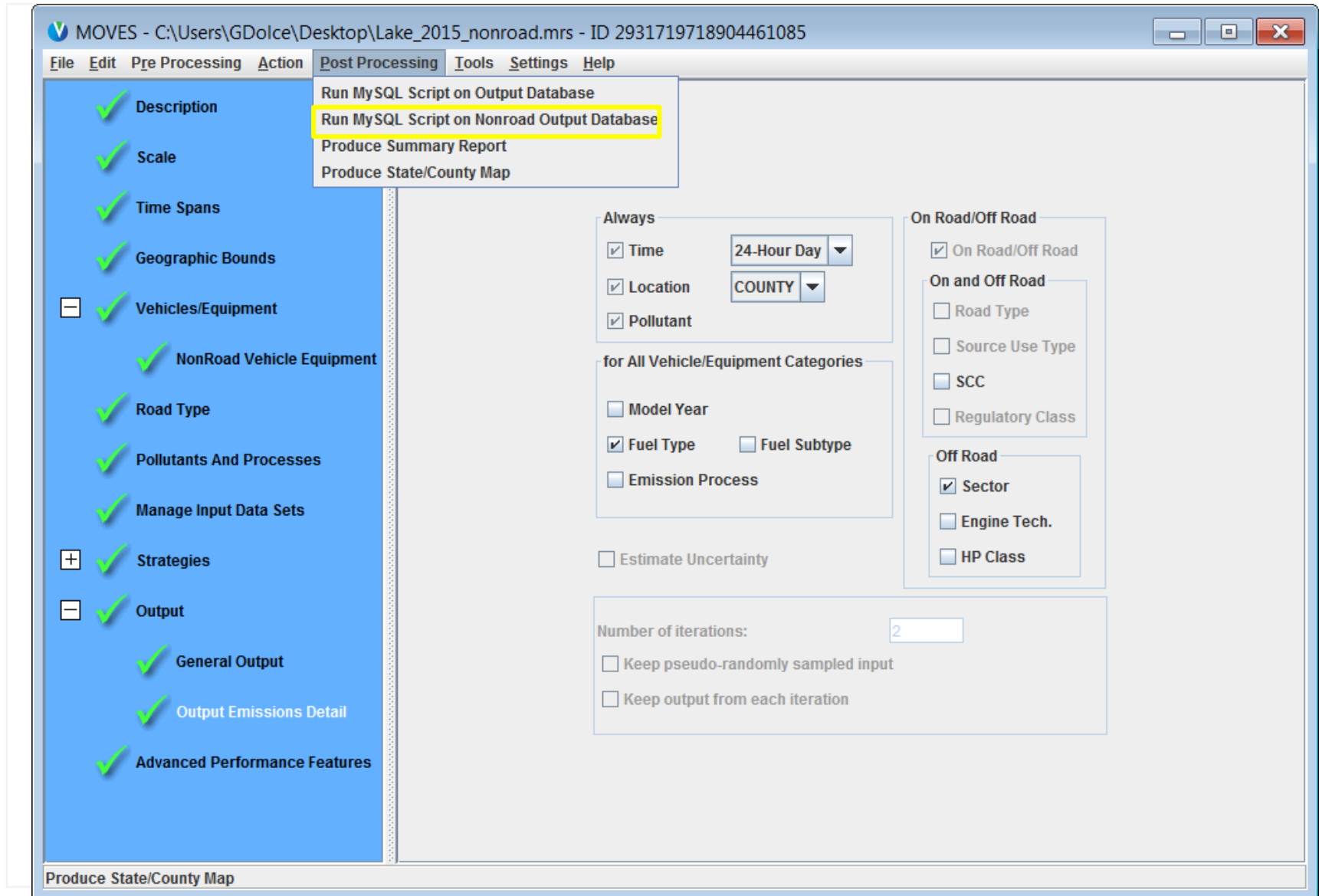
Generic

Done

Using Post Processing Scripts

- Post-processing menu contains scripts to process nonroad output into different forms
- 10 Emission factor scripts
 - Per horsepower/hour, per operating hour, per vehicle
 - Use these to produce emission factors that can be multiplied by locally derived hours of operation or equipment population
- 6 Inventory scripts
 - By county, by equipment type, by sector
 - Output Emissions Detail panel replaces most of these scripts used to consolidate inventory output
- 1 Population script
 - By sector and SCC

Using Post Processing Scripts



Using Post Processing Scripts

- Emission factor scripts can have very long run times depending on the size of the output database
- If you need emission factors:
 - Reduce the size of your output database by choosing just the amount of detail you need in the Output Emissions Detail panel
 - Only select sectors for which you have appropriate activity data
 - Delete source types for which you don't have activity information from the output file before running the script

Questions?



Course Wrap-up

EPA United States Environmental Protection Agency

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MOVES (Motor Vehicle Emission Simulator) Home

Previous MOVES versions Reports Presentations Training Tools Frequent Questions

Fuel Effects on Vehicle Emissions

MOBILE6.2 Model

NONROAD Model

NMIM (National Mobile Inventory Model)

Listserv Information

You are here: [EPA Home](#) » [Transportation and Air Quality](#) » [Modeling and Inventories](#) » [MOVES \(Motor Vehicle Emission Simulator\)](#)

MOVES (Motor Vehicle Emission Simulator)

EPA's MOtor Vehicle Emission Simulator (MOVES) is a state-of-the-science emission modeling system that estimates emissions for mobile sources at the national, county, and project level for criteria air pollutants, greenhouse gases, and air toxics.

MOVES2014a. MOVES2014a is the latest version of MOVES. It incorporates significant improvements in calculating on-road and non-road engine emissions. MOVES2014a does not significantly change the criteria pollutant emissions results of MOVES2014 and therefore is not considered a new model for SIP and transportation conformity purposes.

- [General Information about MOVES2014a](#)
- [MOVES2014a User Documents and Tools](#)
- [Downloading MOVES2014a](#)

Please find the latest guidance on Using MOVES for State Implementation Plans (SIP) and Transportation Conformity here:

- [Using MOVES2014a for SIP and conformity purposes](#)

For further information:

- [MOVES Technical Reports.](#) These technical reports document the data and analysis used to develop MOVES.
- [MOVES Training Sessions.](#)

If you need to use an earlier version of MOVES go to [MOVES2014 and Previous MOVES Versions and Documentation](#)

Visit: www.epa.gov/otaq/models/moves/

Course Wrap-up

- To join the MOVES listserv, send a blank email to join-EPA-MOBILENEWS@lists.epa.gov
- Questions? Contact us:
MOBILE@epa.gov
www.epa.gov/otaq/models/moves/
- Please turn in your course evaluations! We use them to improve the course.

Thank You

