

## **Mobile Sources Technical Review Subcommittee MOVES Work Group: Meeting Summary**

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January 28, 2013  
U.S. EPA Office of Transportation & Air Quality  
2000 Traverwood Drive  
Ann Arbor, MI 48105

### **Welcome and Introductions**

Megan Beardsley welcomed the participants. A full list of participants is provided as an attachment to this summary.

Ms. Beardsley presented the agenda and the focus of the meeting, which includes data sources and analysis methods and input on new user features for MOVES2013. Ms. Beardsley summarized and provided responses to comments received from the Truck and Engine Manufacturers Association (EMA), the Association of Equipment Manufacturers (AEM), and the California Air Resources Board (CARB). In response to a comment on nonroad equipment, Ms. Beardsley stated that AEM Agricultural Flash Reports is a source of sales data purchased from PPM. In response to a comment from CARB, Ms. Beardsley stated that the EPA supports the use of aerodynamic improvements for PM/NO<sub>x</sub> reductions, and the reductions can be reliably estimated. Ms. Beardsley also stated that several comments will be considered in the process of updating MOVES, including comments on activity, load factors, seasonal and regional activity for construction and agriculture, tractor populations, fuel consumption validation, growth trends, and including CO<sub>2</sub>. Regarding several comments, the EPA would welcome the submittal of data, including data on nonroad equipment sales and exports, implementation data of California rules requiring trailer improvements to long haul fleets, and national data sources of controls such as truck stop electrification and idle NO<sub>x</sub> certification.

### **Presentation: MOVES 2013– Planned Model Enhancements – Ed Glover, EPA/OTAQ**

Upgrades were made to MOVES processing algorithms that will be mostly invisible to the user but should result in significant improvements in model runtime. The EPA added new road types to MOVES2013, including nonroad, urban freeway ramp, and rural freeway ramp, as well as a new ramp calculation algorithm that separates ramps into 16 speed bins and will result in a slight increase in estimated emission rates. A new importer will be included in MOVES2013 to allow users to provide specific vehicle start data and distributions when available or use defaults; a new output in “grams/start” will also be available. A potential new feature planned for MOVES2013 is the fuel supply wizard, which will consolidate MOVES fuel inputs into one importer and will compute additional fuel parameters based on refinery modeling data. MOVES2013 will also include speciation of enhanced hydrocarbons and particulate matter; the speciation calculations currently performed in SMOKE-MOVES will be migrated to MOVES2013. The EPA has also

partially completed a new international tool to create and phase-in emission rates to account for different national emission standards and to input and report emission rates in metric units.

### *Discussion*

Susan Collet asked why ramps are being added to MOVES2013. It was explained, in response, that ramps have always been in MOVES but are not provided separately for urban/rural. The new ramp algorithms could result in higher emissions because precise speeds are used rather than the highway average.

One workgroup member asked whether the model will include nonroad equipment that is occasionally used on the road. Ms. Beardsley stated that this equipment will not be included.

Ms. Collet asked when the EPA would decide whether to include the fuel supply wizard. Ms. Beardsley responded that this decision would be made in the next couple of months, and the wizard could be ready by next May. The fuel supply wizard will only change the fuel supply equation and will not affect the emission calculations. The wizard will allow a user to change one or more of the fuel properties and will adjust the other fuel parameters to accommodate the user's changes. Ms. Beardsley further stated that fuel will be a topic of discussion in the March MOVES work group meeting.

Ms. Collet asked where the enhanced hydrocarbon speciation data comes from. It was explained that the data comes from various studies, including OAQPS data from the SPECIATE database.

One workgroup member asked if the speciation feature would also be available for nonroad. It was explained that speciation would initially only be available for onroad.

Mridul Gautam asked how the EPA planned to deal with organic carbon (OC) (as opposed to elemental carbon (EC)). It was explained that for MOVES2013, there will not be a change to the EC/OC splits but there will be a change to the definition of organic carbon.

Jeff Long inquired about how dynamic the fuel property calculations are and whether a change in one property such as ethanol content would affect the speciation profiles. It was explained that these changes would affect the speciation profiles regardless of whether the change came from the wizard or from user inputs.

Ms. Collet asked whether MOVES International was a low priority. It was explained that it is low priority and will only include basic changes.

### **Presentation: Evaporative Emissions Updates – Connie Hart, EPA/OTAQ**

Ms. Hart provided an introduction to the evaporative emissions presentations to follow. Ms. Hart reviewed what was covered in the November 27, 2012 meeting and outlined the real-world evaporative emission studies that were conducted. Evaporative emission sources include vapor breakthrough (carbon canister overflow), vapor leaks, permeation, refueling, and liquid leaks.

## **Presentation: DELTA Cold Soak Calculator – Jarrod Brown, EPA/OTAQ**

Cold soak is being updated because MOVES2010b only uses average three-day diurnal results to compute emissions, while cold soak emissions at 4+ days are significantly larger. Also, MOVES2010b does not separate the effect of properly functioning vehicles and leaking vehicles. DELTA is a model developed by the EPA to calculate tank vapor generation and predict tank vapor venting for various tank sizes, temperature changes and fuel properties for a single or fixed group of vehicles. DELTA is a response to the new cold soak testing from both E-77 and 14-day cold soak testing and is being built into the MOVES2013 code.

The DELTA methodology accounts for multiple day carbon canister loading (including 4+ days of cold soak) and canister capacity. Any vapor generated after the carbon canister has reached capacity is vented to the atmosphere. Vapor emissions to the atmosphere (i.e., breakthrough) first occur on day 2, reach maximum on day 3, and are at that maximum level on all subsequent days. Different models of vehicles have different canister capacities and some vehicles will leak; therefore, different vehicles have unique curves on a plot of tank vapor generated versus tank vapor vented. DELTA assumes average vapor generated versus vapor vented curves and average canister capacities. DELTA also assumes that canister adsorption is a linear process and that all trips lead to complete canister purging. A peer-reviewed report on the DELTA model will be released soon. The EPA highlighted the need to model cold soak on an individual vehicle level and plans to develop Super DELTA (after release of MOVES2013), which will be a new tool outside the MOVES model to allow for more complex calculations for cold soak, hot soak, permeation and running loss.

### *Discussion*

Ms. Collet inquired whether MOVES model runtime would be longer with DELTA. Mr. Brown stated that run time would not be longer when coupled with the improvements made elsewhere in MOVES2013.

Karen Landsburg asked if Super DELTA would need to be run separately. It was explained, in response, that the EPA would run Super DELTA and incorporate the results into MOVES.

Tom Darlington asked if the model assumes a weighted average percent for how full the tank is. It was explained that an average of 40% from a 1991 study is currently used.

It was explained, in response to a question, that MOVES has meteorological data that it uses for calculations, and changes in temperature and pressure based on this data can affect DELTA results; however, users are able to make changes to this data.

## **Presentation: Vapor Leak Frequency and Emissions – David Hawkins, EPA/OTAQ**

MOVES2013 will define a vapor leak as 0.3g/15min and will calculate vapor leaks and non-leaks separately. The vapor leak rates are binned based on severity, averaged, then multiplied by

the prevalence of leaks. The non-leak rate is multiplied by 1-prevalence and added to the leak rate to calculate an emission rate. The high evaporative field study in Chicago was conducted to provide an estimate of the frequency of leaks. The frequency of leaks was determined for each leak size and model year group. The study also evaluates the nominal age of the vehicles with the leak frequency and model year group. It was assumed that recent model year groups develop leaks more slowly than older model year groups. Leaks were found in all model year groups, including model year groups 2004 and later.

#### *Discussion*

Mr. Darlington asked how the EPA ensured that non-vapor leaks are not double counted as vapor leaks. It was explained, in response, that a leak check was done during the study to ensure that no leaks developed.

Ms. Collet asked why vehicles in model year group 1961-1970 have a 100% leak prevalence. It was explained that these vehicles did not have canisters so they are always considered leakers.

Mr. Long asked whether there was a leaking fraction of vehicles in MOVES2010b and how this compares with MOVES2013. It was explained that it is difficult to compare directly and the EPA does not have information on how they developed the previous methodology.

### **Presentation: Modeling Vapor Emissions during Hot Soak Operation from Leaking Vehicles – David Hawkins, EPA/OTAQ**

Hot soak operation is the time between turning off the engine and the engine reaching ambient temperature. Vapor leaks were not explicitly included in MOVES2010b hot soak rates. Hot soak high evaporative field studies were conducted in Colorado and Arizona. Higher elevations and fuels with higher vapor pressures will result in greater emissions from a vapor leak. Emission rates are converted to equivalent rates at sea level and 9 psi RVP gasoline. Leaks are combined into various severity bins and a weighted leak rate is calculated for each model year group and age. The hot soak rate is the leak rate (times the prevalence) plus the non-leak rate (times 1-prevalence). The same leak prevalences that are used for cold soak processes are also used for hot soak processes. Vapor leaks dominate hot soak emission rates and cause them to be higher than in MOVES2010b. Emissions from vehicles without vapor leaks are minimal.

#### *Discussion*

Mr. Long asked about the meaning of non-IM rates. It was explained that non-IM rates are used in MOVES for modeling non-IM areas.

### **Presentation: Proposed Temperature and RVP Adjustments for Evaporative Running Losses – David Brzezinsky, EPA/OTAQ**

Evaporative running losses are fuel vapor losses that occur while an engine is running. These losses are affected by vapor generation as a function of temperature and fuel volatility, vapor

storage capacity, canister purging strategy, and vapor leaks. During certain engine operating modes, vapors are purged from the canister and burned. However, vapor escapes to the atmosphere if the canister capacity is exceeded or the system has vapor leaks. Currently, MOVES running loss rates are based on an ambient temperature of 85°F and 9 psi RVP gasoline. The EPA proposes to adjust running loss rates in MOVES based on ambient temperature and fuel RVP based on MOBILE6 data. The MOBILE6 model was run at multiple temperatures and RVP levels and the results were used to develop adjustment factors that are applied to the vapor running loss rate at 85° F and 9 RVP. The overall effect of the change is likely to be small.

*Discussion*

Mr. Long asked if the EPA considered changing the fuel temperature profile based on ambient temperature. Mr. Brzezinsky responded that this will be done in Super DELTA, which will not be ready until after 2013.

Eulalie Lucas asked if EPA had considered updating the refueling and spillage losses. Ms. Beardsley responded that the EPA will not be considering this for MOVES2013.

**Presentation: Altitude Correction in MOVES: An Update – Jarrod Brown, EPA/OTAQ**

In MOVES 2010a, vapor generation is only calculated for two altitudes (low and high), which results in lower than expected vapor generation at the altitude of the user. The EPA proposes to interpolate/extrapolate between the low and high values using actual county altitude. This method assumes that vapor generation is linear.

*Discussion*

Ms. Landsburg asked about the difference in vapor generation between the low elevation level of 700 feet and sea level. It was explained that the model will extrapolate down to sea level, although there is no significant difference.

**Presentation: Evaporative Emissions Update Wrap-Up – Connie Hart, EPA**

The update to the multi-day diurnals emission estimate for cold soak includes canister breakthrough on soak day 4+ can lead to large emissions. The new algorithm captures canister loading and breakthrough. MOVES2013 will explicitly model leaking vehicles in calculations for cold and hot soak emissions. This will result in a large increase in cold and hot soak emissions. MOVES2013 will include temperature and RVP effects on running loss emissions. The EPA has applied a continuous approach to modeling altitude instead of the previous binary approach.

*Discussion*

Mr. Darlington asked why explicit modeling of vapor leaks caused an increase in emissions when they were already included in MOBILE and MOVES2010. Ms. Hart responded that the

model wrapped leaks into the base rate previously and was based on older studies that randomly recruited vehicles rather than an actual leak study. The new studies specifically looked for leak prevalence and leak rates and found greater leak frequencies than previously thought.

Mr. Darlington also asked if any changes had been made to modeling of liquid leaking vehicles. Ms. Hart responded that no significant changes were made.

Bob Maxwell observed that the leak data collected on vehicles is one step behind the current technology on vehicles, and asked how the EPA will project the effects of the Tier 3 standards, which will require more durable materials. Ms. Hart responded that the vehicle age where leaks first occur was moved to 5 years to account for newer technologies and more durables materials being used. Mr. Maxwell further inquired whether there was a 5 year extension before Tier 3 and if there will be an additional 5 year extension after Tier 3. Ms. Beardsley responded that it is more complicated than just a 5 year extension, and that there is more documentation on this issue that will be made public soon.

One workgroup member inquired whether it is assumed that the vapor generated every day is the same. It was explained, in response, that vapor generation is assumed to be the same each day.

## **WRAP-Up**

Ms. Beardsley noted that the EPA is expecting a fairly significant increase in evaporative emissions in MOVES2013. The next meeting is scheduled for March 26, 2013 and will focus on fuel effects. Additional meetings can be planned after March on an as-needed basis. Ms. Beardsley asked workgroup members to e-mail her about whether they feel additional meetings are needed and potential dates they would be available for these meetings. Ms. Beardsley discussed the need to draft recommendations for MSTRS, and stated that workgroup members could send MOVES recommendations to her or Bill Aikman. Recommendations could include things that the EPA is or is not doing right and how the EPA should be allocating resources. Bob Maxwell stated that it would be helpful if the EPA reviewed the current and future test programs at the next MOVES meeting in March. David Lax asked about the validation process for MOVES2013. Ms. Beardsley responded that the EPA has not begun this process but it will be considered in the future. Ms. Beardsley asked workgroup members to send comments to Lesley Stobert at EC/R Inc. and to send a copy of the comments to her and Bill Aikman two weeks prior to the next meeting.

**Attachment - Work Group Meeting Attendance List**

<b>Name</b>	<b>Organization</b>	<b>Attendance</b>
Matthew Barth	UC Riverside	X
Megan Beardsley	EPA/OTAQ	X
Marc Bennett	Massachusetts DEP	Webinar/teleconference
Susan Collet	Toyota	X
Denise Cormier		Webinar/teleconference
Mridul Gautam	West Virginia University	Webinar/teleconference
Syeda Haque	North Central Texas Council of Governments	Webinar/teleconference
Cecilia Ho		Webinar/teleconference
Kathy Jaw	CARB	Webinar/teleconference
Sandeep Kishan		Webinar/teleconference
John Koupal		Webinar/teleconference
Joeseph Kubsh	MECA	Webinar/teleconference
Estee Lafrenz		Webinar/teleconference
Karin Landsberg	Alaska DEC	Webinar/teleconference
Jeff Long	CARB	Webinar/teleconference
Eulalie Lucas	Metropolitan Washington Council of Governments	Webinar/teleconference
Roy Mann	CNH Global	Webinar/teleconference
Bob Maxwell	Global Automakers	Webinar/teleconference
Marcelo Norsworthy		Webinar/teleconference
George Scora		Webinar/teleconference
Tim Sexton		Webinar/teleconference
Mike Sheehan	NY	Webinar/teleconference
Jon Taylor		Webinar/teleconference
Christopher Voigt		Webinar/teleconference
Chengfeng Wang	California Air Resources Board (CARB)	Webinar/teleconference
<b>EPA Observers and Presenters</b>		
William Aikman	EPA/OTAQ	X
Jarrold Brown	EPA/OTAQ	X
David Brzezinski	EPA/OTAQ	X
Ed Glover	EPA/OTAQ	X
Connie Hart	EPA/OTAQ	X
Dave Hawkins	EPA/OTAQ	X
<b>EPA Contractor Support</b>		
Lesley Stobert	EC/R Incorporated	X
Alden West	EC/R Incorporated	Webinar/teleconference