HD Truck Fuel Economy Task Group
Update on Release of Draft Phase 2 Rules & TG Consensus to Date
Discussion Notes
Wednesday, March 11, 2015
Bill Van Amburg, CALSTART
Alycia Gilde, CALSTART
Agenda

» Review: Goals of Task Group

» Status Update on Phase II Draft Rules
   » Highlight Connections to Consensus to Date

» Revisit Discussion on Key Issues
   » Test Cycles Closer to Real World Use
      » Idling?
   » Innovative Tech, Flexibility, Credits

» Additional Feedback to EPA & NHTSA Prior to Release

» Next Steps
HD Truck Fuel Economy Task Group

Goals:

» In advance of rule development, discuss key issues for industry and users.
» Provide platform for feedback through rule-making.
» Make sure beneficial fuel saving technology included in rule design.
» Seek areas of agreement; identify key areas of concern.
» Work collaboratively to develop recommendations.
» Provide feedback to agencies.
Overall - Current Status

» Still have some chances to impact draft rule – though slight, time short.

» Important to tee up and signal key concepts now to impact rule in later review stage.

» CALSTART wants to meet with companies on stringency levels.
Status on Phase 2 Draft Rules

» Slightly Behind on Release Date: 2.5 months? Estimate late May or possibly June 2015 Release.
  » Draft rule has not yet been submitted to OMD.

» No clear signal yet on stringency levels – and appears will still have an engine standard and a vehicle standard.

» Federal Focus: - NHTSA — Class 2B (Pick-ups/Vans) and EPA — Class 3 to 8

» Looking at possible 3 year Increments for Rule – 2021, 2024, 2027 (Exploring longer rule timeframes)
  » Possibly looking at a longer time horizon out to 2027, this has changed since previously discussed a few months back. (UCS – Dave Cooke)
### Status on Phase 2 Draft Rules

*Continued...*

#### 3 Vocational Bins – Weighting Drive Cycles

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» Some level of idling will be assumed in varying levels in all three cycles. Regional – low, Urban – high, and Multi-purpose – in the middle.

» See more on Volvo’s presentation to EPA – *slides # 22 -31*
Note: EPA in ballpark on vocational bins based on previous industry feedback:

- 3-4 Vocational segments based on CalHEAT findings are acceptable and outline way trucks generally used.

- Duty cycles are critical to successful Phase 2.

- Recommend fewest number of meaningful “cycles” that “bound” how a truck generally used (cannot specifically match how EVERY truck is specifically used) – 80% solution.
Current Testing Schemes Unintentionally Limit Tech Solutions

1. Drayage Long Hi Speed Transient
2. HHDDT Transient
3. CILCC
4. CSHRV
5. HTUF RD2
6. Drayage Short Hi Speed Transient
7. OCBC
8. WVU City
Status on Phase 2 Draft Rules

Continued...

» For Class 2B — NHTSA using HD version of Volpe Model to set standards.
  » Considering inclusion for Start – Stop Techs on Pick-ups and Vans (for both diesel and gasoline). There is some penetration assumed including hybrid technology.
  » Downsizing for Cargo Vans

» NHTSA still seeking feedback from industry.
Status on Phase 2 Draft Rules

Continued...

» **For Class 3 to 8 – EPA** working with DOE/NREL to look at appropriate duty cycle – possibly create new synthetic cycles.

» EPA is looking at innovative ways around OBD issues that will be more open to advancing new technologies.

» Plan to use powertrain test beyond engine test if need to address engine and transmission/powertrain.

» Considering SmartWay techs to go through own testing to demonstrate fuel economy benefits (advanced aerodynamics, low-resistance tires, etc.).

» Some Start-Stop will be allowed for both criteria and GHG emissions.
Status on Phase 2 Draft Rules

Continued...

» Concern with uncertainty of future for advanced vehicle technologies and price points.

» EPA conversations with some in line-haul industry suggest a need for 18 month payback period for new tech.

» EPA still wants to understand paths to market, especially in vocational; value of longer rule duration for investment.

» EPA most interested in collecting stakeholder feedback following release of draft rules but still open to feedback prior to release.
Group Discussion on Draft Rules (1)

Payback Period and Life Cycle Cost

» Concern raised on **Payback Period**, 18 month is the target for line-haul tractors but OEMs are somewhat split on this.

» Consider looking at longer payback periods for other vocational sectors.

» OEMs are concerned about life cycle costs vs. simple payback.
  
  » For ex. 2010 vehicle technologies originally estimated an additional $1900 but ended up being more around $40 K due to initial cost and cost of maintaining after-treatment techs.
Group Discussion on Draft Rules (2)
3 Proposed Vocational Duty Cycles

» Volvo heard that there were 3 proposed vocational duty cycles with 4 segments:
   » See slides # 22 - 31 on Volvo’s findings/recommendations to EPA on logged vocational duty cycle data.

» Volvo believes that there is higher idling for all vehicle classes and high speed time, even with refuse.
Group Discussion on Draft Rules (3)

Idle-Reduction Techs & Drive Cycles

» Need more feedback on idle-reduction and idle cycle.

» CALSTART’s understanding is the worksite idle would not be included unless brought in via innovative tech credit.

» Double counting issues with idle-reduction technologies?
Open Issues/Discussion Questions (1)

» Would additional flexibility in the engine certification/testing process help encourage additional high-efficiency technologies?
  » If so, what flexibility?

» What may get left off the table with the current rule design?
Volvo believes controlling high speeds that are currently occurring would have benefits and should be incentivized.

» Consider a cycle that shows high speed (higher than 65) and give OEMs extra credit for limiting speed.

Low volume testing may be too costly for OEMs, feedback from a Task Group member recommends a phased in approach for these technologies (innovative tech credits).

Volvo mentioned that trailers will come with certified SmartWay techs in 2018. In 2021, trailers will have to go through testing to establish aerodynamic performance.
Open Issues/Discussion Questions (2) continued...

» Part of the flexibility for new technology in Phase 1 was a “credit” structure that allowed engine and truck OEMs to earn credits with advanced technology. To date, it appears no one has used that. Is that still a good structure; are more credits needed; or is something else needed?
Group Discussion (2)

» Feedback on why OEMs are not taking advantage of credits from a company’s perspective.

1. The credits are too small at these low volumes for the OEM worry about.

2. In Odyne’s case – the technology goes on without the full awareness of the OEM (unusual nature of the distributed and serial manufacturing of bigger vocational trucks).
Key Takeaways and Next Steps (1)

» Release of *Draft Phase 2 Rules are slightly behind* schedule (May/June 2015)

» *Limited opportunity to provide feedback* to EPA *but important to tee up* and signal key concepts now to impact draft rule following release.

» Draft Rule proposing *3 Vocational Duty cycles* with some level of *idling assumed* in each cycle (Regional low idle, Multi-purpose medium idle, and Urban high idle).

» Looking at *3 year increments* for Rule (2021, 2024, 2027) ~ possibly looking at longer time horizon out to 2027.
Key Takeaways and Next Steps (2)  
Continued...

» Volvo finds that there is *higher idling for all vehicle classes* including high speed time (see slides # 22-31)
» Should *controlling high-speeds* be incentivized?
» Draft Rules looking at inclusion of *start-stop techs*.
» Need to take closer look at *life cycle cost vs. simple payback* for vehicle technologies.
» 18 mo typical for line haul but may need to look at *longer payback periods for other vocational vehicles*.
» Should we be looking at a *phased-in approach for advanced vehicle technologies* (innovative credits)?
Key Takeaways and Next Steps (3) Continued...

- *Are innovation credits worth pursuing* for advanced techs? Odyne’s experience says too small for low volumes and that the tech goes on without awareness of OEM.

- Need better understanding on *how 2nd and 3rd tier techs will be regulated by Phase 2*. 

- Stringency levels are still unknown, CALSTART would like to *meet one-on-one with companies to discuss recommended stringency levels* over the Phase 2 timeline.
Other Issues?

» Provide additional thoughts, comments and feedback to CALSTART:
   » Bill Van Amburg bvanamburg@calstart.org
   » Alycia Gilde agilde@calstart.org
Volvo Vocational Duty Cycle Analysis

Summary of conclusions and recommendations provided to EPA based on extensive Logged Vehicle Data.

Anthony Greszler
Volvo Group Truck Technology
March 9, 2015
## EPA Proposed GEM Vocational Weighting Factors

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<tr>
<td>Ave Speed Moving, mph</td>
<td>Distance-based Weighting Factors, sum to 100%</td>
<td>Time-based Weighting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase 1 Conventional</td>
<td>43.3</td>
<td>37%</td>
<td>21%</td>
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<tr>
<td>Phase 1 Hybrid</td>
<td>29.2</td>
<td>16%</td>
<td>9%</td>
<td>75%</td>
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<td>Phase 2 Regional</td>
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In order to simplify things, vocational vehicles were broken down into the following categories:

1. **Tractors:** Any vehicle determined to be vocational with a 5th wheel

2. **Rigid vocational Cab-over (MR/LE):** These vehicles are usually used for Refuse and other low speed applications

3. **Rigid Vocational (GU/VHD):** These vehicles are usually found in drill oil, municipal, and construction applications.
Process to Compare EPA road cycle vs Volvo proposal with Road Grades: Using Volvo’s internal simulation Tool

» Volvo’s internal complete vehicle/powertrain simulation tool (GST) was fed the GEM road duty cycles to compare EPA phase 2 proposal to Volvo proposal.

» Note that the 55 mph and 65 mph road duty cycles included grade but the ARB Transient did not have any grade (it was flat).

» Target was to match simulation results with Read World Customer Field Data

- LVD (logged Vehicle Data) graph values are based on Real World Customer Field Data.
- GST (Volvo vehicle simulation) graph values are based on simulation results using EPA duty cycle inputs.
- EPA graph values are based on the 3 proposed EPA cycles (Primarily High Speed, Primarily Low Speed, and Mixed Speed)
Volvo proposed Duty cycle Weighting Factors vs. EPA Proposal

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<tr>
<td>Volvo Motor Coach</td>
<td>50.6</td>
<td>65%</td>
<td>10%</td>
<td>25%</td>
<td>38%</td>
</tr>
<tr>
<td>Volvo Vocational Tractors</td>
<td>49.8</td>
<td>48.8%</td>
<td>27.8%</td>
<td>23.4%</td>
<td>35%</td>
</tr>
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<td>15%</td>
<td>82%</td>
<td>15%</td>
</tr>
<tr>
<td>Volvo Vocational Granite / VHD</td>
<td>34.1</td>
<td>20.5%</td>
<td>20.5%</td>
<td>59.0%</td>
<td>38%</td>
</tr>
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<tr>
<td>Volvo Vocational Cabover (primarily for refuse)</td>
<td>25.2</td>
<td>7.1%</td>
<td>10.2%</td>
<td>82.7%</td>
<td>36%</td>
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These weighting factors are proposed to provide a better match to the field data without modifying the three proposed cycles.
Vehicle Speed Conclusion

- Volvo’s Proposal is a closer match to real world customer data vs current EPA cycles. The EPA cycles need:
  - speeds higher than 65MPH
  - more 0-3MPH.
  - More idle time.
- The EPA ARB cycle spends too much time in the 6-11MPH range.
- There is not a perfect match of vehicle speed between 55 and 65MPH vs real customer data.
- It is impossible to weight the ARB Transient, 55MPH, and 65MPH cycles to match real customer data.
- Spending more time at 0-3MPH instead of 6-11MPH in the ARB Transient Cycle would be a significant improvement.
Engine Torque Conclusion

» Overall there is not a perfect match but utilizing Volvo proposal have a better match to Real world customer data.

» If the proposal was accepted to change the amount of time (or distance) from the 6-11MPH zone to 0-3MPH, the simulation tools would be a closer match in the 0-221 Ft-Lb bucket.
The graph below is the proposed EPA road cycle at 65MPH used in the simulation. The red line is altitude in Meters.

The graph below shows the current EPA road cycle at 65mph without grades. This cycle was not used.
EPA Proposed 55MPH Cycle with Grades

The graph below is the proposed EPA road cycle at 55MPH used in the simulation. The red line is altitude in meters.

The graph below shows the current EPA road cycle at 55mph without grades. This cycle was not used.
The graph below is the EPA ARB Transient road cycle. This cycle has no grade and is the current cycle used by the EPA.

The first 100 seconds of this cycle spends a lot of time in the 6-11mph range, and between 425 to 475 seconds. Real world customer field data from a large volume of trucks largely does not match the 6-11 mph zone. Overall the EPA cycles significantly does not match Real World customer’s field data in the 6-11 mph zone.

This cycle has a total of 5 stops not including the initial start and final stop of the simulation. The Vehicle speed in this road cycle is restricted by the set speeds in the cycle.