To: Ford, Hayley[ford.hayley@epa.gov]; Abboud, Michael[abboud.michael@epa.gov]; Baptist, Erik[Baptist.Erik@epa.gov]; Beck, Nancy[Beck.Nancy@epa.gov]; Bennett, Tate[Bennett.Tate@epa.gov]; Block, Molly[block.molly@epa.gov]; Bodine, Susan[bodine.susan@epa.gov]; Bolen, Brittany[bolen.brittany@epa.gov]; Bolen, Derrick[bolen.derrick@epa.gov]; Bowman, Liz[Bowman.Liz@epa.gov]; Brown, Byron[brown.byron@epa.gov]; Burke, Marcella[burke.marcella@epa.gov]; Cory, Preston (Katherine)[Cory.Preston@epa.gov]; Daniell, Kelsi[daniell.kelsi@epa.gov]; Darwin, Henry[darwin.henry@epa.gov]; Darwin, Veronica[darwin.veronica@epa.gov]; Dominguez, Alexander[dominguez.alexander@epa.gov]; Dourson, Michael[dourson.michael@epa.gov]; Dravis, Samantha[dravis.samantha@epa.gov]; Falvo, Nicholas[falvo.nicholas@epa.gov]; Feeley, Drew (Robert)[Feeley.Drew@epa.gov]; Ferguson, Lincoln[ferguson.lincoln@epa.gov]; Forsgren, Lee[Forsgren.Lee@epa.gov]; Fotouhi, David[Fotouhi.David@epa.gov]; Frye, Tony (Robert)[frye.robert@epa.gov]; Gordon, Stephen[gordon.stephen@epa.gov]; Greaves, Holly[greaves.holly@epa.gov]; Greenwalt, Sarah[greenwalt.sarah@epa.gov]; Gunasekara, Mandy[Gunasekara.Mandy@epa.gov]; Hanson, Paige (Catherine)[hanson.catherine@epa.gov]; Harlow, David[harlow.david@epa.gov]; Hewitt, James[hewitt.james@epa.gov]; Hupp, Millan[hupp.millan@epa.gov]; Jackson, Ryan[jackson.ryan@epa.gov]; Kelly, Albert[kelly.albert@epa.gov]; Konkus, John[konkus.john@epa.gov]; Kundinger, Kelly[kundinger.kelly@epa.gov]; Leopold, Matt[Leopold.Matt@epa.gov]; Letendre, Daisy[letendre.daisy@epa.gov]; Lovell, Will (William)[lovell.william@epa.gov]; Lyons, Troy[lyons.troy@epa.gov]; McMurray, Forrest[mcmurray.forrest@epa.gov]; Munoz, Charles[munoz.charles@epa.gov]; Palich, Christian[palich.christian@epa.gov]; Ringel, Aaron[ringel.aaron@epa.gov]; Rodrick, Christian[rodrick.christian@epa.gov]; Ross, David P[ross.davidp@epa.gov]; Sands, Jeffrey[sands.jeffrey@epa.gov]; Schwab, Justin[Schwab.Justin@epa.gov]; Traylor, Patrick[traylor.patrick@epa.gov]; Wagner, Kenneth[wagner.kenneth@epa.gov]; Wehrum, Bill[Wehrum.Bill@epa.gov]; White, Elizabeth[white.elizabeth@epa.gov]; Wilcox, Jahan[wilcox.jahan@epa.gov]; Woods, Clint[woods.clint@epa.gov]; Yamada, Richard (Yujiro)[yamada.richard@epa.gov]
From: Shimmin, Kaitlyn
Sent: Fri 1/12/2018 11:06:12 PM
Subject: 115th Congress Look Ahead and Weekly Report
OCIR Weekly Report DRAFT 1.12.18 KS.docx

Hey everyone, see the OCIR weekly report below. As always, let us know if you have any questions and enjoy your long weekend! -KS

Office of Congressional & Intergovernmental Relations

Not Responsive

Not Responsive

Weekly Review

Not Responsive

Administrator Pruitt spoke with Senator Corker via telephone regarding the regulation of glider kits.

Not Responsive

Not Responsive

Kaitlyn Shimmin

Special Assistant Congressional and Intergovernmental Affairs

Office of the Administrator

U.S. Environmental Protection Agency

1200 Pennsylvania Ave., N.W.

Washington, D.C. 20460

O: (202) 564-4108

C: Ex. 6 - Personal Privacy

Shimmin.Kaitlyn@epa.gov

To: Bowman, Liz[Bowman.Liz@epa.gov]; Gunasekara, Mandy[Gunasekara.Mandy@epa.gov]; Treimel, Ellen[Treimel.Ellen@epa.gov]; Millett, John[Millett.John@epa.gov]; Grantham, Nancy[Grantham.Nancy@epa.gov]; Jackson, Ryan[jackson.ryan@epa.gov]
Cc: Dominguez, Alexander[dominguez.alexander@epa.gov]; Haman, Patricia[Haman.Patricia@epa.gov]; Lewis, Josh[Lewis.Josh@epa.gov]; Harlow, David[harlow.david@epa.gov]; Cyran, Carissa[Cyran.Carissa@epa.gov]; DeLuca, Isabel[DeLuca.Isabel@epa.gov]; Bolen, Brittany[bolen.brittany@epa.gov]; Dravis, Samantha[dravis.samantha@epa.gov]; Hewitt, James[hewitt.james@epa.gov]; Abboud, Michael[abboud.michael@epa.gov]
From: Sutton, Tia
Sent: Thur 11/9/2017 2:49:45 PM
Subject: RE: Proposed glider repeal release and web posting

Thanks – the web link is: https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-greenhouse-gas-emissions-commercial-trucks.

From: Bowman, Liz
Sent: Thursday, November 09, 2017 9:46 AM
To: Gunasekara, Mandy <Gunasekara.Mandy@epa.gov>; Treimel, Ellen <Treimel.Ellen@epa.gov>; Millett, John <Millett.John@epa.gov>; Grantham, Nancy <Grantham.Nancy@epa.gov>; Jackson, Ryan <jackson.ryan@epa.gov>
Cc: Dominguez, Alexander <dominguez.alexander@epa.gov>; Sutton, Tia <sutton.tia@epa.gov>; Haman, Patricia <Haman.Patricia@epa.gov>; Lewis, Josh <Lewis.Josh@epa.gov>; Harlow, David <harlow.david@epa.gov>; Cyran, Carissa <Cyran.Carissa@epa.gov>; DeLuca, Isabel <DeLuca.Isabel@epa.gov>; Bolen, Brittany <bolen.brittany@epa.gov>; Dravis, Samantha <dravis.samantha@epa.gov>; Hewitt, James <hewitt.james@epa.gov>; Abboud, Michael <abboud.michael@epa.gov>
Subject: RE: Proposed glider repeal release and web posting

We can mock up the press release and send it out, once we get the final go-ahead…is there a web link that we need to include in the release?

From: Gunasekara, Mandy
Sent: Thursday, November 9, 2017 9:44 AM
To: Treimel, Ellen <Treimel.Ellen@epa.gov>; Millett, John <Millett.John@epa.gov>; Bowman, Liz <Bowman.Liz@epa.gov>; Grantham, Nancy <Grantham.Nancy@epa.gov>; Jackson, Ryan <jackson.ryan@epa.gov>
Cc: Dominguez, Alexander <dominguez.alexander@epa.gov>; Sutton, Tia <sutton.tia@epa.gov>; Haman, Patricia <Haman.Patricia@epa.gov>; Lewis, Josh <Lewis.Josh@epa.gov>; Harlow, David <harlow.david@epa.gov>; Cyran, Carissa <Cyran.Carissa@epa.gov>; DeLuca, Isabel <DeLuca.Isabel@epa.gov>; Bolen, Brittany

<bolen.brittany@epa.gov>; Dravis, Samantha <dravis.samantha@epa.gov>
Subject: RE: Proposed glider repeal release and web posting

Adding in Ryan, Brittany and Samantha.

OP (Brittany and Nicole Owens) confirmed it was sent to OEX this morning. Beth (White) is out in South Carolina so we need to confirm who at OEX received it – can someone find that out?

Ryan - can you authorize this for auto-pen so Ellen has the necessary record?

From: Treimel, Ellen
Sent: Thursday, November 9, 2017 9:40 AM
To: Millett, John <Millett.John@epa.gov>; Bowman, Liz <Bowman.Liz@epa.gov>; Grantham, Nancy <Grantham.Nancy@epa.gov>
Cc: Gunasekara, Mandy <Gunasekara.Mandy@epa.gov>; Dominguez, Alexander <dominguez.alexander@epa.gov>; Sutton, Tia <sutton.tia@epa.gov>; Haman, Patricia <Haman.Patricia@epa.gov>; Lewis, Josh <Lewis.Josh@epa.gov>; Harlow, David <harlow.david@epa.gov>; Cyran, Carissa <Cyran.Carissa@epa.gov>; DeLuca, Isabel <DeLuca.Isabel@epa.gov>
Subject: RE: Proposed glider repeal release and web posting

Hi everyone,

I have not seen a package from OEX of this proposal to be signed. I went by and checked Ryan's desk and our log of folders that have been dropped off, and it is not listed. If that is integral to your press plan, then we need the document as soon as possible, along with an auto pen approval from someone with that authority, as it does not appear that Ryan is in the office today.

Thanks,

Ellen Treimel, Special Assistant

Office of the Administrator

U.S. Environmental Protection Agency

WJC-N 3310

202-564-0557 (w)

Ex. 6 - Personal Privacy (c)

From: Millett, John
Sent: Thursday, November 09, 2017 9:30 AM
To: Bowman, Liz <Bowman.Liz@epa.gov>; Grantham, Nancy <Grantham.Nancy@epa.gov>
Cc: Gunasekara, Mandy <Gunasekara.Mandy@epa.gov>; Dominguez, Alexander <dominguez.alexander@epa.gov>; Sutton, Tia <sutton.tia@epa.gov>; Haman, Patricia <Haman.Patricia@epa.gov>; Lewis, Josh <Lewis.Josh@epa.gov>; Treimel, Ellen <Treimel.Ellen@epa.gov>; Harlow, David <harlow.david@epa.gov>; Cyran, Carissa <Cyran.Carissa@epa.gov>; DeLuca, Isabel <DeLuca.Isabel@epa.gov>
Subject: Proposed glider repeal release and web posting

Hi Liz and Nancy – Attached is the final press release on the gliders proposal. We're shooting for an 11 am announcement and web posting, but we'll want to confirm that the proposal has been signed before anything leaves the building.

Thanks –

John

From: Gunasekara, Mandy
Sent: Thursday, November 09, 2017 9:02 AM
To: Millett, John <Millett.John@epa.gov>
Cc: Sutton, Tia <sutton.tia@epa.gov>; Harlow, David <harlow.david@epa.gov>; Bolen, Brittany <bolen.brittany@epa.gov>; Dravis, Samantha <dravis.samantha@epa.gov>; Dunham, Sarah <Dunham.Sarah@epa.gov>; Grundler, Christopher <grundler.christopher@epa.gov>; Charmley, William <charmley.william@epa.gov>; Hengst, Benjamin <Hengst.Benjamin@epa.gov>; Lewis, Josh <Lewis.Josh@epa.gov>
Subject: RE: OMB has cleared the glider repeal NPRM

Attached is the updated press release – redline and clean version – and the roll out plan with updated Q &A section.

From: Millett, John
Sent: Wednesday, November 8, 2017 5:42 PM
To: Gunasekara, Mandy <Gunasekara.Mandy@epa.gov>
Cc: Sutton, Tia <sutton.tia@epa.gov>; Harlow, David <harlow.david@epa.gov>; Bolen, Brittany <bolen.brittany@epa.gov>; Dravis, Samantha <dravis.samantha@epa.gov>; Dunham, Sarah <Dunham.Sarah@epa.gov>; Grundler, Christopher <grundler.christopher@epa.gov>; Charmley, William <charmley.william@epa.gov>; Hengst, Benjamin <Hengst.Benjamin@epa.gov>; Lewis, Josh <Lewis.Josh@epa.gov>
Subject: Re: OMB has cleared the glider repeal NPRM

I've shared draft materials as a heads up with the public affairs/press folks, letting them know that this is on the way. We'll want to get the final press release to Liz tonight or tomorrow morning and confirm the announcement time with them.

Sent from my iPhone

On Nov 8, 2017, at 5:25 PM, Gunasekara, Mandy <Gunasekara.Mandy@epa.gov> wrote:

> Great and thank you for the update. Let's plan to get this signed first thing tomorrow with a press roll-out/pre-pub posting on our website at 11 am. Let me know if anyone has problems with that timing.
>
> Best,
>
> Mandy
>
> **From:** Sutton, Tia
> **Sent:** Wednesday, November 8, 2017 5:22 PM
> **To:** Harlow, David <harlow.david@epa.gov>; Gunasekara, Mandy <Gunasekara.Mandy@epa.gov>; Bolen, Brittany <bolen.brittany@epa.gov>; Dravis, Samantha <dravis.samantha@epa.gov>; Dunham, Sarah <Dunham.Sarah@epa.gov>; Grundler, Christopher <grundler.christopher@epa.gov>; Charmley, William <charmley.william@epa.gov>
> **Cc:** Hengst, Benjamin <Hengst.Benjamin@epa.gov>; Lewis, Josh <Lewis.Josh@epa.gov>; Millett, John <Millett.John@epa.gov>

Subject: OMB has cleared the glider repeal NPRM

Hi everyone,

We just received word from OMB that they have cleared the Glider NPRM (with the change from "economically significant" to "significant").

Thank you,

Tia

From: Harlow, David
Sent: Wednesday, November 08, 2017 1:48 PM
To: Hengst, Benjamin <Hengst.Benjamin@epa.gov>; Gunasekara, Mandy <Gunasekara.Mandy@epa.gov>
Cc: Bolen, Brittany <bolen.brittany@epa.gov>; Dravis, Samantha <dravis.samantha@epa.gov>; Dunham, Sarah <Dunham.Sarah@epa.gov>; Grundler, Christopher <grundler.christopher@epa.gov>; Charmley, William <charmley.william@epa.gov>; McGartland, Al <McGartland.Al@epa.gov>; Wolverton, Ann <Wolverton.Ann@epa.gov>; Sutton, Tia <sutton.tia@epa.gov>
Subject: RE: Why the draft glider repeal NPRM is Economically Significant

Ben,

Thanks for this.

Ex. 5 - Deliberative Process

David S. Harlow
Senior Counsel

Immediate Office of the Acting Assistant Administrator
Office of Air and Radiation, USEPA
WJC-N Room 5409K

1200 Pennsylvania Avenue NW
Washington, DC 20460
202-564-1233

Harlow.David@epa.gov

From: Hengst, Benjamin
Sent: Wednesday, November 8, 2017 1:39 PM
To: Gunasekara, Mandy <Gunasekara.Mandy@epa.gov>; Harlow, David <harlow.david@epa.gov>
Cc: Bolen, Brittany <bolen.brittany@epa.gov>; Dravis, Samantha <dravis.samantha@epa.gov>; Dunham, Sarah <Dunham.Sarah@epa.gov>; Grundler, Christopher <grundler.christopher@epa.gov>; Charmley, William <charmley.william@epa.gov>; McGartland, Al <McGartland.Al@epa.gov>; Wolverton, Ann <Wolverton.Ann@epa.gov>
Subject: FW: Why the draft glider repeal NPRM is Economically Significant

David, Mandy:

Ex. 5 - Deliberative Process

Thanks,

Ben

From: Hengst, Benjamin
Sent: Friday, October 20, 2017 12:45 PM
To: Nickerson, William <Nickerson.William@epa.gov>; Wolverton, Ann <Wolverton.Ann@epa.gov>
Cc: Sutton, Tia <sutton.tia@epa.gov>
Subject: FW: Why the draft glider repeal NPRM is Economically Significant

Bill, Ann: hope this helps. Ben

From: Charmley, William
Sent: Friday, October 20, 2017 11:26 AM

Subject: Why the draft glider repeal NPRM is Economically Significant

Ben,

Ex. 5 - Deliberative Process

Attachment—Additional Questions for the Record

The Honorable John Shimkus

1. **OECA** This committee was instrumental in developing the Electronic Hazardous Waste Manifest Act of 2012, which requires EPA to replace the outdated paper documents with a new electronic system for tracking all hazardous waste shipments.

    a. What are some of the other ways the hazardous waste program could be improved, particularly in terms of the elimination of duplicative and unnecessary regulations?

    b. Is EPA pursuing any of these efforts?

2. **OAR** The previous Administration attempted to regulate farms and agricultural processors by saying that its 2009 Endangerment Finding regulated "biogenic" CO2 from agricultural crops. I understand The Endangerment Finding, however, never mentions the word "biogenic."

    a. Do you intend to look at this interpretation of the Endangerment Finding?

    b. If so, would you view it in terms of whether EPA overreached to regulate natural CO2 from U.S. farms?

3. **OAR** On October 17, 2017, EPA's Air Enforcement Division sent a letter to the Ozone Transport Commission stating that the agency "agrees that the 1986 policy on aftermarket catalytic converter emissions is outdated."

    a. What steps are being taken to update this policy?

    b. Does the Agency have a timeline for this process?

4. There has been concern that EPA's regional offices enforce their authority differently from each other and Headquarters guidance. Do you intend to bring alignment among EPA Headquarters and the Regions?

    DRAFT RESPONSE: Ex. 5 - Deliberative Process

    Ex. 5 - Deliberative Process

5. **OLEM** The Administration's budget request zeroed out the funding to the Department of Justice for superfund-related enforcement activities and for cost recovery efforts for the superfund program. If the goal is to get more sites cleaned up and to speed up cleanups, that seems like an odd budget request since DOJ brings money back into the federal coffers from superfund polluters – can you explain to us why the president's budget request would zero out those funds?

6. **OLEM** On December 1, 2017 EPA issued a decision not to do a final rule regarding financial assurance requirements for the hard rock mining sector. Can you tell us what the status is of the 108(b) rule making for the other industry sectors that are next in line [chemical manufacturing, petroleum and coal products manufacturing, and the electric power generation, transmission, and distribution]?

7. **OLEM** EPA announced that it could be a year before it can start cleanup of the San Jacinto River Waste Pits, which sprung a leak during Hurricane Harvey flooding. Is that because EPA officials are in the process of negotiating with responsible parties to pay for the $115 million project?

    a. Does EPA have a plan to address the leaking cap in the meantime?

    b. It was also announced that once the cleanup process starts, it is expected to take about 27 months. What safeguards will EPA put in place to ensure that more damage to the cap does not occur before the removal can be completed?

8. **OGC** Administrator Pruitt, in October you announced a new policy of the Agency regarding the use of settlements to circumvent the regulatory process and indicated that EPA "will no longer go behind closed doors and use consent decrees and settlement agreements to resolve lawsuits filed against the Agency." The issue of "sue and settle" and the ability of special interest groups to use deadline lawsuits to force EPA to issue regulations that advance their priorities on a specified timeframe has long been a concern of this Subcommittee.

    a. As you noted in your statement about the new policy, "'sue and settle' cases establish Agency obligations without participation by states and/or the regulated community; foreclose meaningful public participation in rulemaking; effectively force the Agency to reach certain regulatory outcomes; and, cost the American taxpayer millions of dollars." Has the Agency started implementing the changes?

    b. There has been some pushback on your sue and settle proposal. How do you respond to the people, many of whom are former EPA attorneys, who say that the policy "discourages settlements when they would have been appropriate and increases agency costs?"

    c. How do you differentiate between the negative aspects of sue and settle [lack of transparency etc…] and the positive? For example, regulated entities and EPA often reach agreement on a cleanup or enforcement issue, enter a settlement, and then file a lawsuit seeking court approval and enforcement of the settlement. Is your new "sue and settle" policy agency-wide? And is it a mandate to not use sue and settle in ways that shorten the administrative time it takes to get a cleanup or resolution of an enforcement action?

9. **OLEM** When was the last time EPA listed a Federal facility on the National Priorities List (NPL)?

    a. If a site scores high enough to rank on the Hazard Ranking System (HRS), will EPA list the Federal facility on the NPL?

    b. How does OMB factor into the decision about whether to list a Federal facility on the NPL?

    c. What if a Federal facility ranks on the HRS and the State in which it is located requests that the Federal facility be added to the NPL, will EPA list the Federal facility?

10. **OLEM/OGC** How do you reconcile Executive Order 12580 when it gives the polluter who is also the person paying for the cleanup, the right to make all of the decisions with respect to the remedy with no oversight from EPA?

11. **OLOEM** How will EPA build consistency into how the Regions manage CERCLA cleanups?

12. **OLOEM** What is the timing for the issuance of the Record of Decision for the Westlake Landfill in Bridgeton, Missouri?

13. **OLOEM** The Superfund Task Force conducted a 30-day review of the program and released 42 recommendations in July. The Task Force reemphasized long accepted concepts that are necessary to ensure remedies are consistent nationwide, data-driven, and efficient – such as adaptive management, early actions, technical oversight, and strengthening partnerships with stakeholders. You also revised the delegation of authority procedures to require that remedies potentially totaling more than $50 million must receive approval from the Administrator, which will help promote regional accountability.

    a. How have you been implementing the recommendations of the Task Force at sites with existing Records of Decision and how will you implement the recommendations with new cleanups?

    b. How will EPA ensure that Regional offices closely follow the principles set forth by the Agency's 2005 Sediment Guidance and the National Contingency Plan?

    b. Since many of the Task Force's recommendations require further action, what is your timeline and plan for next steps?

The Honorable David McKinley

1. **OLEM** Mr. Administrator - when EPA finalized the "coal ash" regulations, they adopted in the self-implementing rule a "one-size-fits-all" approach that does not allow for the consideration of site specific, risk-based factors.

   I appreciate that EPA has committed to reconsider elements of the rule.
   The timing of these revisions is critical to ensure that the power sector has regulatory certainty.

   a. Can you provide an update on how this process is going?

2. **OAR** As you know, a federal district court ordered EPA in January this year to begin to implement section 321 of the clean air act. This provision from the late 1970s provides that the administrator "shall conduct continuing evaluation of potential loss or shifts in employment…"

   a. What are your plans for implementing this provision? What can you tell us about your timeline?

   b. Will you work with me to identify whether statutory changes will help make for a more useful and transparent section 321 program?

3. **OAR** Small refineries have an inherent hardship in complying with the renewable fuel standards. These refineries do not have the ability to pass the rin cost on to their customers. It would put them at a competitive disadvantage to do so.

   Congress has clearly stated its intent regarding this.

   a. What is the agency doing to address streamlining and improving the hardship petition process?

4. **OLEM** Mr. Administrator – we understand that one of your objectives at EPA is a revised federalism, including providing the states with a greater partnership role with EPA in administering and implementing environmental laws in the respective states. Congress' recent enactment of the wiin act – which allows the states to implement the federal coal combustion residual – or "coal ash" – rules in lieu of the federal rule – is a perfect example of this philosophy and provides your administration with the opportunity to put this goal into action.

   Unfortunately, however, we have heard from some of the states that EPA has been slow in reviewing and approving state program applications to operate the ccr rule in lieu of EPA. Indeed, we understand that not a *single* state application has been deemed complete by EPA, which is necessary to allow for the formal review process to begin.

   a. Can we get some assurances from you that the agency will accelerate this process?

5. **OAR** The EPA's Air Enforcement Division sent an October 17 letter to the Ozone Transport

Commission stating it "agrees that the 1986 [aftermarket catalytic converter emissions] policy is outdated." We encourage you to look into this issue. U.S. manufacturing jobs are threatened and U.S. consumers are already being harmed by this outdated policy.

Are you aware of how U.S. manufacturers of aftermarket catalytic converters are being severely impacted by an outdated EPA policy guidance that guides the industry?"

The Honorable Marsha Blackburn

1. **OAR** An Obama-EPA rule from 2016 would have required glider kit vehicles – which are made with *old* engines, and are not new vehicles – to comply with Phase 2 EPA greenhouse gas emission standards that were targeted solely for *new* vehicles and engines. This rule would have had a devastating impact on the state of Tennessee, resulting in a loss of $512 million-dollars in economic output and a loss of 947 jobs. The rule would have been particularly harmful for small businesses that create and sell refurbished trucks using glider kits, providing an alternative in the medium and heavy-duty truck market that is 25% less expensive than buying a new truck. Mr. Pruitt, I want to thank you on behalf of the hundreds of Tennesseans who still have their jobs because of your common-sense action to reverse the previous administration's meritless and radical position.

    a. Following up on that, do you agree that the needs of small business job creators should be taken into account when setting regulations that impact industries dominated by small businesses?

    b. What can we do as a legislative body to ensure future abuses such as these do not take place again?

    c. Can you discuss some of your efforts to reconsider regulations that pose an undue burden on small businesses?

2. **OP/OGC** In accordance with the President's Executive Order 13777, your Agency began a process of reviewing EPA regulations in need of reform because they eliminate or inhibit job creation, are outdated, ineffective, or unnecessary, impose costs that exceed benefits, or create legal inconsistencies.

    a. What is the status of this review?

    b. What are your planned next steps?

    c. What timeline do you envision for implementing the recommendations?

3. **OAR** On November 30, 2017, EPA finalized volume requirements under the Renewable Fuel Standard (RFS) program for 2018 for cellulosic biofuel, biomass-based diesel, advanced biofuel, and total renewable fuel, and biomass-based diesel for 2019. The 2007 law shaping the RFS required EPA to study and report to Congress on whether the RFS will adversely impact air quality. To date, EPA has never completed that study. EPA was also

required to report to Congress on the RFS' impacts to the environment and resource conservation every three years. To date, EPA has issued only one report – in December 2011. Administrator Pruitt, when can Congress expect the EPA to comply with the law and provide the necessary studies?

The Honorable Gregg Harper

1. **OLEM** Mississippi is home to a significant forest products industry. The EPA, under the Obama Administration, drafted and imposed a wood products procurement regulation that allows only for Forest Stewardship Council – or FSC – certified products to be purchased by the government, which bars the purchase of products certified by other credible forest certification standards, such as the American Tree Farm System (ATFS) or Sustainable Forestry Initiative. This regulation, which is now under review, excludes a significant number of family forest owners in the United States with homegrown products certified by other reputable standards. 1) Could you please provide a status update on the current review process? 2) What potential changes can be made to improve this policy that currently puts American forest owners at a disadvantage?

2. **OW** In the 113th Congress, EPA was provided discretion over the allocation of approximately $12.7 million in annually appropriated EPA technical assistance funding. The EPA used the discretion to eliminate the two full-time circuit rider technical assistance positions in Mississippi and other states. In response to concern raised by my rural and small community water constituents, I introduced legislation to reauthorize and direct the technical assistance funding to where it is most helpful. Senator Wicker's companion bill was signed into law in 2015. I appreciate EPA's July 25, 2017, response to a June 9, 2017, Senate letter in which EPA committed to following the intent of the Grassroots Rural and Small Community Water Systems Assistance Act (PL 114-98). 1) Could you please provide an update on implementation of the law and the possibility of the two-full time circuit rider technical assistance positions being re-established in Mississippi?

The Honorable Bill Johnson

1. **OAR** As is true in a lot of areas around the country, job creators in my district are having a difficult time obtaining New Source Review air permits in order to build or upgrade manufacturing facilities or power plants, which is hurting our local economy and employment opportunities. And, as the recent DOE report on electricity markets and grid reliability further emphasizes, "NSR creates an unnecessary burden that discourages… investments in efficiency because of the additional expenditures and delays associated with the permitting process".

    a. Do you agree that issuing New Source Review permits takes too long and is

unnecessarily complex?

b. What is EPA doing to assess the impact of current NSR review requirements on decisions to modernize facilities and power plants?

c. What reforms may EPA make administratively to improve the New Source Review permitting program so that we can continue to improve air quality and achieve economic growth?

The Honorable Kevin Cramer

1. **OAR** After 2022, EPA is required to set volumes for total renewable fuel, advanced biofuel, cellulosic biofuel, and biomass based diesel. The assumption is the total renewable fuel volume would contain some amount of conventional biofuel. The statute, however, does not set a minimum amount for conventional biofuel because it does not specify a minimum volume for the total renewable fuel. Thus, EPA could set the total renewable fuel volume as the same as the advanced biofuel volume.

    a. Does the current statute have a specific requirements for corn-based ethanol until 2022?

    b. Does the statute require a minimum volume of total renewable fuel for each year following 2022?

    c. Is it your belief that after 2022, the RFS gives significant preference to advanced biofuels over conventional corn-based ethanol?

2. **OAR** The implied mandate for corn-based ethanol is set at 15 billion gallons until 2022. As the statute is written today, do you view this 15 billion gallons as a ceiling or a floor?

    a. If floor: What in the statute leads you to believe the RFS will require more than 15 billion gallons of corn-based ethanol?

3. **OAR** The prior Administration proposed the Renewable Enhancement and Growth Support (REGS) Rule in 2016 and took comment on the potential for capturing RINS from renewable electricity used to charge electric vehicles.

    a. Where does this proposal currently stand?

    b. Is the EPA planning to continue to finalize the REGS Rule?

4. **OAR** A number of ethanol producers in my state have talked to me at length about the benefits of high-octane fuels which are said to provide substantial engine efficiency benefits.

They indicated a wealth of information has been provided to the EPA in support of such a fuel with 30 percent ethanol.

a. Can automakers now certify their engines on these fuels?

b. If not, why not? If so, what is the process?

The Honorable Tim Walberg

1. **OLEM** Administrator Pruitt, one of the priorities of this Subcommittee has long been to, where appropriate, give more authority to the states and it has been suggested that there are aspects of the Superfund program that would be better handled by the states.

   a. What are your thoughts on delegating portions of the CERCLA cleanup authority to states that can demonstrate the ability to conduct certain superfund cleanups?

2. **OCSPP** At present, there are no standard EPA methods for analyzing PFAS in environmental media, but EPA officials have stated the agency will have draft methods for water and solids by fall 2017. For the purpose of Michigan's continued engagement on this critical issue, as well as the betterment of EPA's developing approach to addressing PFAS nationwide, when do you expect these methodologies will be complete?

3. **OW** The EPA issued a drinking water health advisory for PFAS in May 2016, however, the advisory is non-enforceable and non-regulatory. Do you foresee changes to EPA's role in regulating PFAS contamination at the national level?

4. **OAR** In the Motor Fuels Act of 1988 Congress established a variety of alternate fuel incentives to be used by NHTSA in the administration of the CAFE fuel economy regulations. EPA originally used the same statutory incentives as NHTSA therefore vehicle emissions and fuel economy incentives were harmonized. But in 2012, under the previous administration, EPA diverged from this harmonization by favoring electric vehicles over other alternative fuel vehicles thereby nullifying Congressional intent. Do you think it would be good policy for EPA to return to its previous approach and harmonizing its emissions incentives with NHTSA's fuel economy incentives?

The Honorable Buddy Carter

1. **OAR** The EPA issued a review of the Phase 2 Greenhouse Gas Rule for Medium and Heavy-Duty Trucks and in November the EPA issued a statement on the review of glider kits. However, we haven't seen any announcements about progress with truck trailers. Are you currently reviewing trailers as part of the rule and if so, what is the status? Please provide an update on the rulemaking process and any progress that has been made.

2. **OLEM** Which recommendations from the Super Fund Task Force have been implemented?

3. **OLEM** The EPA recently announced the full or partial removal of Superfund sites from the National Priorities List. How many cleanups will the EPA pursue in 2018 and what will those be?

4. **OLEM** In June, the EPA announced an interim remedy for the Superfund site located at Terry Creek in my district. What is the status of that effort?

5. **OLEM** This committee has been looking to make sensible reforms to the program. Are there any legislative actions that this committee would need to take to aid in reforming the program?

The Honorable Michael Burgess

1. **OGC/OECA** In my State of Texas, we have become too familiar with the EPA making examples of a few people to scare everyone else into compliance. Could you explain why you are intentionally moving away from heavy handed regulatory treatment and moving more toward building partnerships with States and industry to improve the environment?

2. **OP** Some of your critics view the EPA as if it's a factory; where success is measured by the quantity of rules issued, grants passed out, or enforcement cases brought. Rarely do people size up EPA by compliance achieved or improvements in the environment. What goals, budgetary or otherwise, are you setting for individual programs and what metrics are being used to measure progress or success of an office or program?

3. **OLEM/OECA/OGC** I'd also like to touch on the spill at the Gold King Mine. Shortly after the spill occurred there, I visited the mine to observe the impact myself and was shocked by the severe the damage was at that time. Could you please provide me an update on the situation there and the status of the claims brought by the victims?

4. **OP** EPA's authority to use the Title 42 hiring authority derives from an appropriations rider and not legislation originating from either the House Energy & Commerce or Senate Environment & Public Works Committees. Does the EPA intend to continue to use Title 42 to hire and pay new and existing employees under this authority?

    a. Does EPA intend to formally ask the authorizing committees for special hiring authority or will it continue to base its authority on the appropriations rider?

    b. Has EPA ever formally or informally requested such authority from the authorizing committees? If so, when?

    c. Has the EPA ever proposed language similar to the Title 42 hiring authority be included in any of its authorizing legislation?

    d. Does EPA intend to continue to request that the Appropriations Committee include this rider in future appropriations legislation?

e. Does EPA intend to ask the Appropriations Committee for any increase to the currently allowed number of employees it may pay under Title 42?

The Honorable Frank Pallone

Superfund:

OLEM During the hearing, you suggested that you proposed cutting the budget for Superfund cleanups because more money is not needed. You also said that there are very few orphan sites, meaning sites that will require public cleanup funds. However, in 2015, the Government Accountability Office found that as federal funding for cleanups has declined, the number of construction completions and remedial action completion declined while the number of National Priority List sites remained constant. In other words, less money buys fewer needed cleanups.

1. How many sites, exactly, on the National Priority List require public cleanup funds?

Environmental Justice:

OP/OLEM Since the issuance of Executive Order 12898 in 1994, EPA has been required to incorporate the goal of environmental justice into its mission. As part of that executive order, and in keeping with Title VI of the Civil Rights Act of 1964, EPA is required to ensure all of its activities that affect human health and the environment do not directly or indirectly discriminate on the basis of race, color, or national origin.

2. What are you doing to ensure that EPA's response and recovery efforts in Puerto Rico and the U.S. Virgin Islands comply with the Executive Order on environmental justice and the Civil Rights Act?

OP/OLEM Environmental justice is also a serious concern in the Agency's response to Hurricane Harvey because of disparities between communities affected by that storm.

3. What have you been doing to ensure that EPA's response and recovery efforts in Texas comply with the Executive Order on environmental justice and the Civil Rights Act?

4. What direction, if any, have you given to your Regional Administrators and other regional staff with regard to ensuring environmental justice in EPA's hurricane response? Please provide any memoranda or email correspondence you or your staff have sent to regional staff on the subject of environmental justice and hurricane response.

5. Who on your staff is tasked with coordinating response efforts across the regions to ensure equal treatment for the people of Puerto Rico and the U.S. Virgin Islands?

OP/OGC Since assuming your position as Administrator, you have delayed or abandoned numerous rules and regulations that would have protected vulnerable communities.

6. Do you believe that your decision to abandon EPA's proposed ban of the dangerous pesticide chlorpyrifos complies with the Executive Order on environmental justice and the Civil Rights Act?

7. Do you believe that your decision to delay the important amendments to the Risk Management Planning program complies with the Executive Order on environmental justice and the Civil Rights Act?

8. Do you believe that your actions delaying notifying communities that are out of attainment with the 2015 ozone National Ambient Air Quality Standard complies with the Executive Order on environmental justice and the Civil Rights Act?

9. Do you believe that your decision to repeal the Clean Power Plan complies with the Executive Order on environmental justice and the Civil Rights Act?

10. Do you believe that your decision to delay revisions to the Lead and Copper Rule complies with the Executive Order on environmental justice and the Civil Rights Act?

Management of Toxic Pesticides:

11. **OCSPP** Documents reveal that Monsanto employees may have ghostwritten scientific papers on glyphosate, including papers published in the journal Regulatory Toxicology and Pharmacology, which has an editorial board populated by industry scientists, lawyers and consultants with clear financial ties to the chemical industry. Has EPA relied on those studies in its evaluation of glyphosate?

12. **OCSPP** Did EPA rely on studies from that journal in its decision to deny the petition to ban chlorpyrifos?

13. **OCSPP** In 2015, the Food and Drug Administration (FDA) agreed with recommendations from GAO[1] that glyphosate monitoring should be done, but subsequently suspended its efforts to conduct that monitoring.[2] Documents suggest that this decision may have been made under pressure from an EPA employee working with Monsanto. Please provide any email or other correspondence between EPA employees and FDA employees regarding glyphosate monitoring.

14. **OCSPP** EPA's March 30 decision on chlorpyrifos will allow continued use of this dangerous pesticide on golf courses. Did trade associations representing the Trump Organization golf courses, or lobbyists who represent the Trump Organization, communicate with EPA, the White House, or the Trump transition team regarding the March

[1] U.S. Government Accountability Office, "Food Safety: FDA and USDA Should Strengthen Pesticide Residue Monitoring Programs and Further Disclose Monitoring Limitations" (Nov. 6, 2014).

[2] Gillam, C. *FDA Suspends Testing for Glyphosate Residues in Food* (Nov. 11, 2016) (http://www.huffingtonpost.com/carey-gillam/fda-suspends-glyphosate-r_b_12913458.html)

30 decision or chlorpyrifos in general?

Transparency:

OP/OGC Nearly thirty-five years ago, in his landmark "Fishbowl Memo," Administrator Ruckelshaus announced that he would release his appointment calendar on a weekly basis, and he directed the Deputy Administrator and all Assistant Administrators, Associate Administrators, Regional Administrators, and Staff Office Directors to do the same. Administrator Ruckelshaus emphasized that "EPA will not accord privileged status to any special interest group" and that the public should be "fully aware of [top officials'] contacts with interested persons." In the intervening decades, Administrators serving under both Democratic and Republican Administrations have upheld this practice. But your senior management team has yet to release its calendars, undermining agency transparency and raising questions about who may be accessing and influencing top EPA officials.
EPA has recently provided the public with a "summary" of your calendar, and provided some heavily redacted records of your calendar through March 31. But the agency still has not released the actual records of your daily calendars since March, despite numerous FOIA requests for them.

15. Will you commit to making your schedule public on a regular basis, so that Congress, the press, and ordinary Americans can see who you are meeting with?

16. Will you commit to directing your senior officials to release their calendars on a regular basis?

OGC We are also concerned about delays in EPA's response to FOIA requests under your administration. EPA's failure to meet the deadlines specified in the Freedom of Information Act results in legal violations, which then subject EPA to repeated lawsuits.

17. Given the legal expenses and waste of resources caused by EPA's failure to comply with FOIA deadlines, do you agree that EPA should streamline the review process for release of documents to eliminate any unnecessary steps, such as multiple levels of document review?

18. Do you this it is appropriate for political appointees and advisors to hold up the release of document for further review, even when documents have already been determined to be public documents not subject to FOIA exemptions by FOIA officers and FOIA attorney advisors?

19. Why would it be necessary for the documents to undergo a political review if they are public documents under the law?

20. It appears that EPA has now adopted a policy of responding to FOIA requests based only or primarily on the date of the request, regardless of the type of information requested, the simplicity of the request, or the relevance of the information to the public. Is that correct?

21. If not, please describe in detail the criteria that EPA is now using to prioritize processing FOIA requests?

22. Given EPA's large backlog, under your current approach, how long will it be before you respond to a substantial number of requests regarding your tenure and release documents generated during your tenure (besides those documents that EPA releases when a lawsuit is filed)? Please provide an estimate in weeks, months, or years.

23. Will you establish a policy of responding to new FOIA requests on an ongoing basis, rather than relegating them to the back of the line and without waiting to be sued on each request?

OGC It has been reported that you and other political appointees have directed staff to avoid creating public records that could be subject to FOIA requests, such as directing staff to provide internal policy decisions orally instead of by electronic mail or directing staff not to take notes in meetings.

24. Do you agree that EPA is required to create and maintain records that document the formulation of the agency's decisions, and the people and matters dealt with by the agency, so that proper scrutiny by Congress and other agencies is possible?

25. Have you or other political employees provided any direction to staff that could discourage them from creating such records?

Contract with Definers Public Affairs:

OPA/OGC On the day you testified before Energy and Commerce, EPA entered into a no-bid contract with Definers Public Affairs to provide "news analysis and brief service focusing on EPA work and other topics of interest to EPA."[3] The awarding of this contract without full and open competition to a company with no apparent experience in providing these services to a Federal agency is concerning, as are the political lobbying activities of the firm. Though Definers recently terminated the contract with EPA, we have outstanding questions regarding EPA's selection of Definers and whether the Contract was an appropriate use of taxpayer dollars.

26. What was your role in selecting Definers for this award? In addition to yourself, which EPA political appointees were involved in selecting Definers? Please provide all communications between yourself and all other EPA political appointees and any Definers representative between February 17, 2017 and December 7, 2017.

27. Were you or other EPA political appointees aware of the FOIA requests filed by Definers employees against individual agency employees before the contract was awarded? Were those FOIA requests considered in the identification of Definers as a potential candidate for the Contract, or a factor in ultimately awarding the Contract?

28. Was Definers, AmericaRising, or any of their agents involved in creating or funding the website ConfirmPruitt.com?

29. Were you, any of your agents, or any current EPA employees involved in generating or reviewing the content of the website ConfirmPruitt.com, or providing or raising funds for

[3] EPA Award Number EP18H000025 to Definers Corps. (Dec. 7, 2017)

the site? Did any representative of Definers, America Rising, or America Rising Squared generate or review content for the website?

30. What work did Definers perform for EPA pursuant to the contract? Please provide a list of all services performed by Definers for EPA during the duration of the contract, including the date, the service provided, time required, the itemized cost, and the name of the Definers employee who performed the work. What was the total amount of taxpayer funds EPA paid Definers during the duration of the contract? Please provide copies of all communications between EPA and any representative of Definers, America Rising, America Rising Squared, and the Need to Know Network during calendar year 2017.

31. On December 10, the New York Times published an article identifying an alarming decrease in enforcement actions brought by the EPA during your administration.[4] EPA issued an unusual press release in response, which has since been removed from the agency website but continues to be cited by conservative media sources. What role did Definers play in the agency's response to the December 10th article? Provide any correspondence between EPA and any representative of Definers, America Rising, America Rising Squared, and the Need to Know Network regarding the December 10th article.

32. What firewalls were in place in the contract with Definers Corp to ensure that Definers firewalled the media monitoring services provided under the Contract from its services that would violate the Publicity or Propoganda Prohibition and Anti-Lobbying provisions?

33. Please provide a copy of the contract between EPA and Definers Corp. including any statement of work.

Enforcement:

OECA As noted above, on December 10, the New York Times published an article identifying an alarming decrease in enforcement actions during your administration. Specifically, their analysis shows your EPA has brought one quarter fewer cases than President George W. Bush's EPA and one-third fewer cases than President Barack Obama's EPA over comparable periods. The analysis also shows that you have sought significantly smaller amounts in civil penalties.

34. Can you explain why EPA has pursued fewer enforcement cases under your leadership?

35. Please describe any complaints you have received from communities/others who have been seeking, but apparently failing to receive relief from EPA from polluters?

36. Have you been asked by anyone in industry to change EPA's enforcement policies?

37. If so, please describe those conversations.

[4] Eric Lipton and Danielle Ivory, *Under Trump, EPA has Slowed Actions Against Polluters, and Put Limits on Enforcement Officers*, New York Times, (Dec. 10, 2017), https://www.nytimes.com/2017/12/10/us/politics/pollution-epa-regulations.html

38. Can you explain any changes you have made to testing procedures and policies (e.g. requests for information) permitted by your regional offices, enforcement officers or other EPA staff, why those changes were made and what effect they have had on enforcement?

Co-Benefits of Air Rules:

OAR You have questioned EPA's prior evaluations of public health protections that have included "co-benefits" of deadly particulate matter.

39. Do you agree there is judicial precedent upholding EPA's approach to consider co-benefit pollution reductions?
40. Why or why not?

41. Are you planning to seek legal review of this matter?

42. Are you planning to try to change the way co-benefits, like PM2.5, are counted or considered in EPA rulemakings?

43. If so, why and what evidence do you have to support such a change?

Ozone:

OAR For the 2015 Ozone rule, the Clean Air Act required all states and Tribes to submit attainment designation recommendations by October 1, 2016, and EPA was required to finalize area designations a year after. On November 6, the agency issued attainment designations for those areas that meet the 2015 standard, however EPA failed to release any nonattainment designations. In response to questions about EPA missing deadlines associated with the 2015 Ozone rule, you said the delay was due to "information that has not been provided by the states."

44. Please provide a list of all states or Tribes who have not submitted designation recommendations to EPA for the 2015 Ozone standard. What information is still outstanding from these states or Tribes?

45. To date, has EPA notified any states or Tribes that it intends to modify any of their recommended designations? Please provide the Committee with a list of these states or Tribes, and copies of the notice provided by EPA.

46. Have you been in contact with any industry representatives or states about delaying the implementation of the 2015 Ozone standard as it relates to finalizing the remaining designations? If so, please describe the nature of your meetings and communications.

47. The Unified Regulatory Agenda included a reference to using "additional time afforded by the designations extension to finalize necessary guidance" related to the 2015 Ozone standards. However, after legal challenges from states and others, you walked back your effort to delay implementation of these standards.

    a. Can you clarify what "extension" this refers to in the Unified Agenda?

b. Why would EPA need an extension to issue remaining designations?

48. When can we expect EPA to issue the remaining designations?

49. Who is on the Ozone Compliance Task Force, and what is its roll in implementing the 2015 Ozone standard? Please provide the Committee with a list of participants, schedule, meetings, materials, and communications.

Climate Change:

50. **OAR** Federal courts have held that the quantity of emission reductions to be achieved is an important consideration in determining the "best system of emission reduction" for sources under section 111 of the Clean Air Act. What weight will you give to achieving significant emission reductions in considering a replacement for the Clean Power Plan?

OAR At the hearing you questioned the integrity of the rulemaking that led up to EPA's December 2009 science-based finding that greenhouse gas pollution endangers public health and welfare. As you know, EPA received over 380,000 comments on the Endangerment Finding, responded to 10 petitions for reconsideration, and explained its determination in almost one thousand pages of documentation in the Federal Register and supporting technical documents. A three-judge panel of the D.C. Circuit unanimously upheld that finding in 2012 against a barrage of legal challenges, finding that it was supported by ample evidence and that EPA had appropriately relied on authoritative analyses by the Intergovernmental Panel on Climate Change, the U.S. government and other sources.

51. Please explain why you continue to question the process that led to the Endangerment Finding in light of this history and the D.C. Circuit's decision?

OAR You recently stated that you intend to move forward imminently with a so-called "red team" exercise in which you will convene rival panels of scientists to debate climate science, just weeks after the Administration's Global Change Research Program released a "Climate Science Special Report" confirming that human activities are "the dominant cause" of observed climate change, and that climate change is already having adverse impacts around the country. This report was authored by scientists from multiple Federal agencies, national laboratories, universities, and the private sector, and went through six stages of external review including review by the National Academies of Sciences, Engineering, and Medicine and an open public comment period.

52. Please explain why the "red team" exercise a good use of scarce Agency resources in light of the extraordinary research and review that the Administration invested in the CSSR?

Budget:

OCFO It was recently reported that officials at the Center for Disease Control and Prevention are being directed to not use seven words or phrases in official documents for the FY 2019 Budget. The forbidden words are "vulnerable," "entitlement," "diversity," "transgender," "fetus," "evidence-based" and "science-based."

53. Is EPA also barred from using "vulnerable," "entitlement," "diversity," "transgender," "fetus," "evidence-based" or "science-based," in official budget documents?

54. Does EPA have a list of forbidden words or phrases for official budget documents? If so, please provide the Committee with such list.

OCFO/OARM EPA has been experiencing a workforce reduction, including through the use of buy-outs.

55. Please detail the status of workforce reductions conducted to-date, during this administration, including overall net personnel reductions?
56. In what offices and programs have net reductions occurred?

57. Please detail the categories in which workforce reductions have occurred in 2017, such as buy-outs, other voluntary separations, reductions-in-force, etc.

58. In 2018, what additional workforce reductions are planned, assuming funding is available to accomplish them?

59. In which programs and offices are reductions planned?

60. What closures or other changes to the current EPA regional offices or labs are planned for 2018 or beyond?

The Honorable Paul Tonko

1. **Travel to Morocco**

OP On December 12, EPA issued a press release, "Administrator Pruitt Promotes Environmental Cooperation with U.S. Partners in Morocco." While no members of the press accompanied you on this trip, it was reported that the purpose of the trip was to promote U.S. natural gas exports.

a. Please provide an itinerary of your trip along with total estimated costs to U.S. taxpayers for you and any accompanying staff, including security details.

b. How does promoting U.S. LNG exports fit into your "Back to Basics" agenda?

c. What authority does EPA have related to the exportation, sale, or promotion of U.S. LNG?

d. Please provide a list of companies, trade associations, or natural gas industry representatives that you or your staff have been in contact with regarding U.S. LNG exports. Please provide all records, communications, emails, meeting attendance or materials for any of these interactions.

e. This trip was not publicly announced until EPA issued a press release once you had already arrived in Morocco. Moving forward, will you commit to publicly announcing all foreign and domestic trips prior to traveling?

2. **Science at EPA**

ORD/OAR In the draft FY 2018-2022 EPA Strategic Plan, you have promised to "prioritize robust science." Under Objective 3.3 of the draft plan, you say that "EPA will identify, assess, conduct, and apply the best available science to address current and future environmental hazards, develop new approaches, and improve the scientific foundation for environmental protection decisions."

a. Do you commit to ensuring that the EPA's actions and policies are guided by the latest climate science, as reflected in Volume 1 of the Fourth National Climate Assessment (also known as the Climate Science Special Report or CSSR), and as described in statements and reports from the National Academy of Sciences?

b. Do you agree with the CSSR's conclusion that "it is *extremely likely* that human influence has been the dominant cause of the observed warming since the mid-20th century… For the warming over the last century, there is no convincing alternative explanation supported by the extent of the observational evidence"?

c. Do you commit to making information about climate change prominently available on the EPA's website, alongside information about other critical issues related to human health and the environment?

d. Regarding the October 31 Science Advisory Board directive, can you please provide specific examples of when an EPA grant recipient on an advisory committee provided conflicted advice?

e. On October 22, the New York Times reported, "E.P.A. Cancels Talk on Climate Change by Agency Scientists." Why were EPA scientists prohibited from speaking at a Rhode Island conference on climate change?

f. Moving forward, will EPA scientists have the opportunity to communicate publicly about their research?

3. **Advisors to the Administrator**

OP/OGC On December 13, it was reported that Dr. Michael Dourson withdrew his name to serve as Assistant Administrator for the Office of Chemical Safety and Pollution Prevention.

a. In October, it was reported that Dr. Dourson was already working at the agency as an Adviser to the Administrator. Can you confirm whether Dr. Dourson has left the agency?

b. If not, what are the roles and responsibilities of Dr. Dourson?

c. What ethics or conflict of interest agreements apply or applied to Dr. Dourson in his role as Advisor to the Administrator?

d. You testified that the October 31 Science Advisory Board directive was driven by a concern that "a perception or an appearance of a lack of independence in advising the Agency." Did any EPA leadership have a conversation or express concerns about the perception of conflict of interest from Dr. Nancy Beck's involvement in revising the TSCA framework rules after leaving a position with the American Chemistry Council?

4. **Enforcement Actions and Monitoring**

OCFO On December 10, the New York Times reported that EPA regional staff must seek authorization from HQ before asking companies to track their emissions. Monitoring is critical to ensure that the environmental and health gains that have been made in recent decades are not undone. Power generating facilities in the Midwest emit sulfur dioxide and nitrogen oxides, which are the major precursors of acid rain which has caused the acidification of many Adirondack lakes and ponds.

a. The Adirondack Lake Survey Corporation receives EPA funding for long-term monitoring of water quality recovery from acid rain. Do you support continuation of this long-term monitoring funding?

5. **Hudson River Superfund Site**

OLEM The State of New York has stated that the Hudson River PCB cleanup has not met the goals of the program, and that additional action is needed. Federal Natural Resource Trustees have also expressed concerns. The EPA Region II office does not appear to acknowledge the scientific basis of the state's and Trustee's analysis.

a. Will EPA reconsider the recommendations of the Second Five-Year Review Report in light of the analysis done by the State and Trustee agencies?

6. **OIG**

OGC The Office of Inspector General (OIG) Semiannual Report: April 1, 2017 - September 30, 2017 raised a number of issues about interference with the OIG's independence. From that report:
"A second budget impediment occurred when the OIG submitted an FY 2019 request for $62 million to the agency for inclusion in the President's budget. Without seeking input from the OIG, the agency provided us with a request of $42 million. The agency informed the OIG that the Office of Management and Budget mandated budget requests Semiannual Report to Congress April 1, 2017—September 30, 2017 13 could not be more than a certain percentage above the President's FY 2018 budget. The EPA also informed the OIG that the $42 million request would not change. The OIG submitted a memorandum to the Office of Management and Budget stating the OIG's original budget request, and explaining that the EPA's submitted

budget did not reflect the OIG's desired funding levels and would have significant negative impacts on OIG operations."

a. Do you believe a fully funded, independent Inspector General is necessary for EPA to run as an efficient and accountable agency?

7. **IRIS**

a. **ORD** How do you view the role of IRIS relative to ensuring full implementation of the TSCA program?

b. **ORD** Will you commit to fully supporting the IRIS program?

The Honorable Diana DeGette

1. **OAR** Methane is up to 34 times more potent a greenhouse gas than carbon dioxide and makes up approximately ten percent of annual greenhouse gas emissions in the United States. Despite the harm methane can cause, the EPA has proposed delaying rules that would have curbed methane emissions from oil and gas industry sources. The proposed delay of the 2016 methane rule published in the Federal Register on June 16, 2017, states "the EPA believes that the environmental health or safety risk addressed by this action may have a disproportionate effect on children."

   a. Do you agree that children would be disproportionately affected by delaying methane emissions restrictions on the oil and gas industry?
   b. What are the estimated costs of the health impact on children?

2. **OCSPP** During your testimony we discussed the decision on a final rule concerning methylene chloride use in paint stripper. You promised to review the status of the rule and provide an update soon after the hearing. Rules concerning N-methylpyrrolidone (NMP) and trichloroethylene (TCE) were proposed at the same time. Prohibitions against certain uses of NMP and methylene chloride were removed from the Fall 2017 Unified Agenda of Regulatory and Deregulatory Actions.

   a. The Fall Unified Agenda was released on December 14, one week after your testimony before the committee. At what point was the decision made to remove the NMP and methylene chloride rules from the Unified Agenda?

   b. When will EPA finalize the rules for TCE, NMP, and methylene chloride under TSCA?

   c. What role did Michael Dourson have as an EPA adviser in determining the timeline for these rules?

3. **OLEM** In response to the explosion at the West Fertilizer Plant in Texas in 2013, EPA developed updates (the "Chemical Disaster Rule") to Risk Management Plans (RMP) requirements. This update would have included common sense reforms, including improved accident prevention provisions and enhancements to emergency response preparation. In June 2017, the implementation of this rule was delayed. The rule had been in development for three years and was subject to more than 40,000 public comments.

    a. During Hurricane Harvey, the Arkema Chemical plant in Crosby, Texas, experience fires due to a failure of emergency generators and backup cooling systems. First responders have filed suit against Arkema alleging that Arkema misrepresented the threat posed by chemicals at the site. A situation like this, where first responders cannot adequately prepare to respond to emergencies at chemical production facilities, is the sort of circumstances that the Chemical Disaster Rule was designed to avoid. Have the events at the Arkema plant, where first responders were put at risk, caused you to reconsider the delay of the Chemical Disaster Rule?

    b. The proposed EPA budget for fiscal year 2018 reduced funding for inspection of sites under the RMP by 35 percent, straining a program that only has 30 inspectors for 12,500 sites. In light of the number of facilities that need to be inspected, the low frequency of inspection, and the specter of climate change related extreme weather events like Hurricane Harvey, do you still feel the cuts to the inspection program are prudent?

4. **OW/OCSPP** The Climax Molybdenum Mining company in Colorado has asked the state of Colorado to relax limits on molybdenum allowed in runoff from the Climax mine in Summit County Colorado. Molybdenum is on the Contaminant Candidate List 4 (CCL-4). It was also on the CCL-3. Currently, states have minimal guidance from the EPA on the potential hazards of molybdenum in drinking water.
    a. Is EPA currently collecting data on the health or environmental impacts of molybdenum in drinking water?

    b. Will molybdenum be part of the Regulatory Determination 4 process going forward?

5. **OLEM** For more than two years, I have been focused on addressing the environmental damage caused by the August 2015 release of toxic mine water from Gold King mine in San Juan County, Colorado.

    a. I was glad to see the Bonita Peak Mining District (which includes Gold King mine) was included on the list EPA released on December 8, 2017, of sites targeted for "immediate, intense action." Can you elaborate on the action EPA plans to take in the Bonita Peak Mining District and the expected timeline?

    b. On December 17, 2017, the *Denver Post* reported on the success of cleanup efforts related to toxic Argentine Mine complex near Rico, Colorado. The article noted that the part of the success is that the private company legally responsible for cleaning up

the site has invested "tens of millions of dollars" in the cleanup compared to less than $5 million the EPA has invested in the cleanup of Gold King. What additional funding will EPA invest in the Gold King cleanup?

c. On October 19, 2017, the *Denver Post* reported that there is uncertainty regarding the ongoing costs association with the water treatment plant EPA is operating to clean up water from Gold King Mine. The annual cost of operating the plant is $1.2 million and it produces toxic sludge while purifying the runoff. What is the EPA's long-term plan for the plant costs?

d. What is the status of finding a permanent solution for the waste sludge from the plant?

The Honorable Jerry McNerney

1. **OAR** At the December 7th hearing, I stated that less than half of the U.S. population was included in the ozone designations laid out by the EPA. Though this statement was not made in the form of a question, Administrator Pruitt interjected, proclaiming that the lack of inclusion was due to missing information that needs to be submitted by states. However, on the EPA's website, there is a full list of state recommendations from 2015. Will the Administrator please explain his statement and what information is missing from which states?

To: Ringel, Aaron[ringel.aaron@epa.gov]
Cc: Gunasekara, Mandy[Gunasekara.Mandy@epa.gov]
From: Harlow, David
Sent: Fri 1/26/2018 5:43:25 PM
Subject: Gliders NPRM
Gliders NPRM Nov9.pdf
53 Fed. REg. 53442 (Nov. 16, 2017).pdf

Aaron,

Sorry to take so long to get this to you. It took a while for me to locate the original (double-spaced text) version of the NPRM. That is the first of the two documents attached here. The second is the as-published *Federal Register* version of the same.

Ex. 5 - Deliberative Process

Of course, if there should be anything that I might be able to help you with regarding Rep. Griffith, either now or going forward, please don't hesitate to ask.

David S. Harlow
Senior Counsel

Immediate Office of the Assistant Administrator
Office of Air and Radiation, USEPA
WJC-N Room 5409K

1200 Pennsylvania Avenue NW
Washington, DC 20460
202-564-1233

Harlow.David@epa.gov

To: Gunasekara, Mandy[Gunasekara.Mandy@epa.gov]
From: Baptist, Erik
Sent: Thur 8/24/2017 1:30:49 AM
Subject: FW: Meeting request

Mandy,

Please see the email below. Can we have Alex set up a meeting with these folks? Ex. 6 - Personal Privacy

Ex. 6 - Personal Privacy

Happy to discuss,

Erik Baptist

Senior Deputy General Counsel

Office of General Counsel

U.S. Environmental Protection Agency

1200 Pennsyvlania Ave., NW

Washington, DC 20460

(202) 564-1689

baptist.erik@epa.gov

From: Jeff Speaks [mailto:jeff@jbsgov.com]
Sent: Wednesday, August 23, 2017 9:14 AM
To: Baptist, Erik <baptist.erik@epa.gov>
Subject: FW: Meeting request

Erik:

I hope you're doing well and having a good week. Per the emails below, Justin suggested I reach out to you and see if I could schedule a few mins with you at some point convenient for you the week of September 5 (I return to DC that week). I and reps from Volvo would like to discuss the Phase 2 GHG rule's glider provisions and the work we've done on this issue, background, etc. I can meet whenever convenient for you that week and thanks in advance for your time and the opportunity to discuss this issue with you.

Jeff Speaks

Worldwide Equipment, Inc.

Jeff Speaks

JBS Communications

149 Cherokee Park

Lexington, Kentucky 40503

(859) 494-2681

jeff@jbsgov.com

From: Schwab, Justin [mailto:schwab.justin@epa.gov]
Sent: Saturday, August 19, 2017 12:26 PM
To: Jeff Speaks <jeff@jbsgov.com>
Subject: Re: Meeting request

Jeff,

Thank you for reaching out.

Due to the subject matter I will refer you to my colleague Erik Baptist, another of the deputy general counsels. He specializes in CAA Title II issues.

His email is baptist.erik@epa.gov.

But I am happy to participate in discussions to the extent you and he would find my participation useful.

Best,

Justin

Sent from my iPhone

On Aug 18, 2017, at 10:12 AM, Jeff Speaks <jeff@jbsgov.com> wrote:

Justin:

Hope you're doing well and having a good week. You and I have emailed and talked on the oyster/Chesapeake Bay issue and very much appreciate all of your help and assistance on that but I wanted to see if I could get 15 min from you at some point in the next week or two to discuss another issue I'm working on. I am working with Volvo, Cummins and others through one of my clients, Worldwide Equipment, on issues related to the glider kit provisions contained in the recent Phase 2 GHG rule and have been doing so for the last couple of years. As one of Volvo's biggest dealers, Worldwide has experienced some pretty significant competition issues related to gliders and I wanted to spend just a few mins with you on this topic due to the agency's decision yesterday to revisit the glider provisions in the rule. I know that Volvo and others have reached out to the Administrator's Office and there's a meeting being set up for some dealers and manufacturers to meet with Administrator Pruitt on September 19 or September 20 but I was hoping to spend a few mins with you prior to this as I believe there's some important background info on this issue you should know.

Thank you in advance for your consideration of this request and, again, I'm certain I can accommodate whatever works for you over the next couple of weeks. Again, thank you and hope to visit with you soon.

Jeff Speaks

Jeff Speaks

JBS Communications

149 Cherokee Park

Lexington, Kentucky 40503

(859) 494-2681

jeff@jbsgov.com

To: Baptist, Erik[baptist.erik@epa.gov]
Cc: Gunasekara, Mandy[Gunasekara.Mandy@epa.gov]
From: Harlow, David
Sent: Sat 10/7/2017 2:08:05 AM
Subject: RE: authority for regulating gliders

Mercifully, after a few fits and starts, I (somehow) managed to achieve remote access here at home. I'm glad one of the IT folks happened to have passed along instructions earlier this week.

So thanks for all the material you sent, Erik, both here and in your prior email. I'll start digesting all of this over the next couple of days, starting with this memorandum.

Have a good (long) weekend, and I'll see you on Tuesday.

David S. Harlow
Senior Counsel

Immediate Office of the Acting Assistant Administrator
Office of Air and Radiation, USEPA
WJC-N Room 5409K

1200 Pennsylvania Avenue NW
Washington, DC 20460
202-564-1233

Harlow.David@epa.gov

From: Baptist, Erik
Sent: Friday, October 6, 2017 6:55 PM
To: Harlow, David <harlow.david@epa.gov>
Cc: Gunasekara, Mandy <Gunasekara.Mandy@epa.gov>
Subject: FW: authority for regulating gliders

Please see attached and below. You might want to start with the memorandum and the attachments to this email.

Erik Baptist

Senior Deputy General Counsel

Office of General Counsel

U.S. Environmental Protection Agency

1200 Pennsyvlania Ave., NW

Washington, DC 20460

(202) 564-1689

baptist.erik@epa.gov

From: Kataoka, Mark
Sent: Tuesday, September 26, 2017 6:22 PM
To: Baptist, Erik <baptist.erik@epa.gov>
Cc: Srinivasan, Gautam <Srinivasan.Gautam@epa.gov>; Orlin, David <Orlin.David@epa.gov>; Schmidt, Lorie <Schmidt.Lorie@epa.gov>
Subject: RE: authority for regulating gliders

Erik,

Ex. 5 - Attorney Client; Deliberative Process

Ex. 5 - Attorney Client; Deliberative Process

Ex. 5 - Attorney Client; Deliberative Process

Not Responsive; Ex. 5 - Attorney Client; Deliberative Process

Not Responsive; Ex. 5 - Attorney Client; Deliberative Process

Ex. 5 - Attorney Client; Deliberative Process

Also scheduled for ARLO retreat on Thurs but I guess we'll see.

Mark M. Kataoka

Attorney

EPA OGC ARLO (2344A)

202-564-5584

To: Harlow, David[harlow.david@epa.gov]
Cc: Gunasekara, Mandy[Gunasekara.Mandy@epa.gov]
From: Baptist, Erik
Sent: Fri 10/6/2017 10:54:32 PM
Subject: FW: authority for regulating gliders
Glider Rule Legal Authority.docx
Phase 2 NPRM.pdf
NODA.pdf
Legal Memorandum Feb 2016.pdf
Phase 2 Final Rule.pdf
Phase 2 RTC.pdf

Please see attached and below. You might want to start with the memorandum and the attachments to this email.

Erik Baptist

Senior Deputy General Counsel

Office of General Counsel

U.S. Environmental Protection Agency

1200 Pennsyvlania Ave., NW

Washington, DC 20460

(202) 564-1689

baptist.erik@epa.gov

From: Kataoka, Mark
Sent: Tuesday, September 26, 2017 6:22 PM
To: Baptist, Erik <baptist.erik@epa.gov>
Cc: Srinivasan, Gautam <Srinivasan.Gautam@epa.gov>; Orlin, David <Orlin.David@epa.gov>; Schmidt, Lorie <Schmidt.Lorie@epa.gov>
Subject: RE: authority for regulating gliders

Erik,

Ex. 5 - Attorney Client; Deliberative Process

Ex. 5 - Attorney Client; Deliberative Process

Not Responsive; Ex. 5 - Attorney Client; Deliberative Process

Not Responsive; Ex. 5 - Attorney Client; Deliberative Process

Ex. 5 - Attorney Client; Deliberative Process

Also scheduled for ARLO retreat on Thurs but I guess we'll see.

Mark M. Kataoka

Attorney

EPA OGC ARLO (2344A)

202-564-5584

To: Sarah Dunham (Dunham.Sarah@epa.gov)[Dunham.Sarah@epa.gov]; Lewis, Josh[Lewis.Josh@epa.gov]
From: Gunasekara, Mandy
Sent: Wed 7/26/2017 6:21:30 PM
Subject: Trailers/Gliders for HDV

We have an issue kind of blowing up regarding the gliders. Can we get the team together this week to touch base on the petitions for reconsideration that is in line with the email Erik sent last week?

Mandy M. Gunasekara

Senior Policy Advisor for Office of Air and Radiation

Office of the Administrator

US Environmental Protection Agency

To: Orlin, David[Orlin.David@epa.gov]
From: Srinivasan, Gautam
Sent: Wed 1/31/2018 12:50:19 PM
Subject: Re: meeting with Matt L. on Thursday

I think there may be a bit of a breaking in period with Matt, so to speak.

++++++++++++
202-564-5647 (o)
202-695-6287 (c)

On Jan 31, 2018, at 7:48 AM, Srinivasan, Gautam <Srinivasan.Gautam@epa.gov> wrote:

He seemed reluctant when I asked if you could join. I didn't push it.

++++++++++++
202-564-5647 (o)
202-695-6287 (c)

On Jan 31, 2018, at 7:43 AM, Orlin, David <Orlin.David@epa.gov> wrote:

Any reason not to forward to Mark?

On Jan 30, 2018, at 8:51 PM, Srinivasan, Gautam <Srinivasan.Gautam@epa.gov> wrote:

Hi Carla- Matt mentioned that he has a meeting with outside parties on Thursday morning on a rule addressing "gliders" (that is probably the easiest way to find it). Matt would like ARLO attendance at the meeting. Can you please add David and me to the invite? Please let me know if you need more information. Thanks.

++++++++++++

202-564-5647 (o)

202-695-6287 (c)

To: Duncan, Allen[duncan.allen@epa.gov]
Cc: Healy, Stephen[healy.stephen@epa.gov]
From: Bunker, Byron
Sent: Tue 1/9/2018 4:48:36 PM
Subject: FW: Current Gliders' Compliance with CAA Rebuild Requirements

Hi Allen,

Ex. 5 - Deliberative Process

Thanks,

Byron

****

Byron Bunker

Director Compliance Division

Office of Transportation and Air Quality

Environmental Protection Agency

2000 Traverwood Drive

Ann Arbor, MI 48105

Bunker.Byron@epa.gov

Phone: (734) 214-4155

Mobile: (734) 353-9623

****

From: Grundler, Christopher
Sent: Tuesday, January 09, 2018 11:20 AM
To: Bunker, Byron <bunker.byron@epa.gov>; Haugen, David <haugen.david@epa.gov>; Charmley, William <charmley.william@epa.gov>
Cc: Cook, Leila <cook.leila@epa.gov>
Subject: Current Gliders' Compliance with CAA Rebuild Requirements

Colleagues:

Ex. 5 - Deliberative Process

Pls decide who among you has the lead on this question and convene the four of us to discuss once you feel you have solid information.

Thanks,

Chris

Christopher Grundler, Director

Office of Transportation and Air Quality

U.S. Environmental Protection Agency

202.564.1682 (Washington, DC)

734.214.4207 (Ann Arbor, MI)

To: Hengst, Benjamin[Hengst.Benjamin@epa.gov]
From: Bunker, Byron
Sent: Thur 8/3/2017 12:15:00 PM
Subject: RE: 3pm OTAQ general with Sarah

Hi Ben,

I am going to plan to join in case Sarah asks about the **Not Responsive** Let me know if you a confident Sarah won't ask about those. I would then skip.

Thanks,

Byron

****
Byron Bunker
Director Compliance Division
Office of Transportation and Air Quality
Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, MI 48105
Bunker.Byron@epa.gov
Phone: (734) 214-4155
Mobile: (734) 353-9623
****

-----Original Message-----
From: Hengst, Benjamin
Sent: Thursday, August 03, 2017 8:06 AM
To: Bunker, Byron <bunker.byron@epa.gov>; Simon, Karl <Simon.Karl@epa.gov>; Cook, Leila <cook.leila@epa.gov>
Cc: Sargeant, Kathryn <sargeant.kathryn@epa.gov>; Grundler, Christopher <grundler.christopher@epa.gov>
Subject: 3pm OTAQ general with Sarah

Hi folks:

We have our weekly with Sarah today. As far as agenda items go, here's what I have on my list, all of which are quick check-in type items:

Not Responsive

- confirming follow up items on gliders/trailers **Ex. 5 - Deliberative Process**

Ex. 5 - Deliberative Process

Not Responsive; Deliberative

Any others? Byron--up to you on whether you want to attend this one or not.

To: Peralta, Maria (Peralta.Maria@epa.gov)[Peralta.Maria@epa.gov]
From: Haugen, David
Sent: Fri 12/8/2017 8:11:57 PM
Subject: Talking Points for Bill Wehrum Lab Tour

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

-----Original Appointment-----
From: Haugen, David
Sent: Friday, December 08, 2017 2:33 PM
Cc: OAR-OTAQ-TATD Managers
Subject: Bill Wehrum Lab Tour - Reminder
When: Monday, December 11, 2017 10:45 AM-12:45 PM (UTC-05:00) Eastern Time (US & Canada).
Where:

Times	TOPIC	Key Message	LOCATION	REQ PERS
10:45 – 11:15 (30 min)	MTE & Technology Assessments	Ex. 5 - Deliberative Process	Small Soak NCAT Area	TATD – Andy Kevin ASD – M
11:15-11:20 (5-10 min)	ISO 17025, Metrology, Int to 3x3 Compliance Strateg		Metrology Lab	Davi
OPTIONAL:	Dyno Driving Experience		Vehicle Dynos-	CD – L Joel Bal

(10-15 min)	Driving a Cycle on a Dyno	Ex. 5 - Deliberative Process	CTF	Dalto
11:25-11:40 (15 min)	Lab Expansions, Tier 3, VW Compliance		Hot & Cold Test Cells	TATI Peralta, Jim Br Mc
11:40-11:50 (10 min)	Small Gasoline Engines		Small Non-Road Engine Cell	TATD In CD – C
11:50-12:00 (10-15 min)	Fuels – Chemistry & Fuel Industry Surveillance		Chemistry Lab	TATI Ko
12:05-12:15 (10-15 min)	Diesel (HD) Engine Cert		Mid-Range Diesel Engine Cell	CD - A TATD –
12:15-12:30 (15 min)	Real World Testing (PEMS & Signature Device)		530 HD Prep Area	TATI Peral Sc
12:30-12:45 (15 min)	HD Truck & Bus Emissions		HD Chassis Dyno	ASD – E TATD – Scott

•□□ Gliders, etc

To: Sutton, Tia[sutton.tia@epa.gov]
From: Harlow, David
Sent: Wed 11/8/2017 6:06:27 PM
Subject: Re: Last-minute significance change request from OMB

Thanks, Tia. I'm looking to have Mandy or Brittany weigh in and decide this ASAP, if possible.

Sent from my iPhone

On Nov 8, 2017, at 1:02 PM, Sutton, Tia <sutton.tia@epa.gov> wrote:

Thanks, David. **Ex. 5 - Deliberative Process**

Ex. 5 - Deliberative Process

From: Harlow, David
Sent: Wednesday, November 08, 2017 12:59 PM
To: Sutton, Tia <sutton.tia@epa.gov>; Hengst, Benjamin <Hengst.Benjamin@epa.gov>
Cc: Charmley, William <charmley.william@epa.gov>; Orlin, David <Orlin.David@epa.gov>; Sargeant, Kathryn <sargeant.kathryn@epa.gov>; Moulis, Charles <moulis.charles@epa.gov>
Subject: RE: Last-minute significance change request from OMB

Tia,

I've forwarded this email string to Mandy and Brittany, while cc'ing Erik

Ex. 5 - Attorney Client; Deliberative Process

Ex. 5 - Attorney Client; Deliberative Process

David S. Harlow
Senior Counsel

Immediate Office of the Acting Assistant Administrator
Office of Air and Radiation, USEPA
WJC-N Room 5409K

1200 Pennsylvania Avenue NW
Washington, DC 20460
202-564-1233

Harlow.David@epa.gov

From: Sutton, Tia
Sent: Wednesday, November 8, 2017 12:46 PM
To: Hengst, Benjamin <Hengst.Benjamin@epa.gov>
Cc: Harlow, David <harlow.david@epa.gov>; Charmley, William <charmley.william@epa.gov>; Orlin, David <Orlin.David@epa.gov>; Sargeant, Kathryn <sargeant.kathryn@epa.gov>; Moulis, Charles <moulis.charles@epa.gov>
Subject: RE: Last-minute significance change request from OMB

Ex. 5 - Attorney Client; Deliberative Process

From: Hengst, Benjamin
Sent: Wednesday, November 08, 2017 12:43 PM

To: Sutton, Tia <sutton.tia@epa.gov>
Cc: Harlow, David <harlow.david@epa.gov>; Charmley, William <charmley.william@epa.gov>; Orlin, David <Orlin.David@epa.gov>; Sargeant, Kathryn <sargeant.kathryn@epa.gov>; Moulis, Charles <moulis.charles@epa.gov>
Subject: Re: Last-minute significance change request from OMB

Ex. 5 - Attorney Client; Deliberative Process

On Nov 8, 2017, at 12:32 PM, Sutton, Tia <sutton.tia@epa.gov> wrote:

Hi all,

Ex. 5 - Attorney Client; Deliberative Process

Please let me know ASAP how you would like to proceed here.

Thanks!

-Tia

To: Brian C Mormino[brian.c.mormino@cummins.com]; Jon A Dickson[jon.a.dickson@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Charmley, William[charmley.william@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gary C Salemme[gary.c.salemme@cummins.com]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; Manik Narula[manik.narula@cummins.com]; erin.luke@paccar.com[erin.luke@paccar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; david.gardner@navistar.com[david.gardner@navistar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]; Ricart-Ugaz, Laura M[Laura.Ricart@Navistar.com]; Marley Jeffrey[jeff.marley@volvo.com]; Mark Malowicki[Mark.Malowicki@PACCAR.com]; Costi Nedelcu[Costi.Nedelcu@PACCAR.com]; Miller Marc[marc.miller@volvo.com]; donald.keski-hynnila@daimler.com[donald.keski-hynnila@daimler.com]; aaron.neuman@daimler.com[aaron.neuman@daimler.com]; gerald.freitag@daimler.com[gerald.freitag@daimler.com]; steve.berry@volvo.com[steve.berry@volvo.com]; tblubaugh@emamail.org[tblubaugh@emamail.org]; david.kayes@daimler.com[david.kayes@daimler.com]; Mark.Siddall@HMMUSA.COM[Mark.Siddall@HMMUSA.COM]; LIN_GEORGE@cat.com[LIN_GEORGE@cat.com]; inderpal.singh@daimler.com[inderpal.singh@daimler.com]; Kaslavage Charles[charles.kaslavage@volvo.com]; scott.mundy@allisontransmission.com[scott.mundy@allisontransmission.com]; Thomas Manley[Thomas.Manley@HMMUSA.COM]
From: Jackie M Yeager
Sent: Wed 4/27/2016 6:19:48 PM
Subject: Phase 2 Collaboration meeting agenda
Joining Skype for Business Meetings (External).pdf

Reminder of Thursday's call at 3:00 pm Eastern. (This call has been rescheduled from last week.)

Proposed agenda:

1. ISB and N13 testing at SwRI – Houshun
2. ISX test results – Jackie
3. Road grade evaluation – TBD
4. Other topics?
5. Plan next call – All

Call-in and Skype information:

New non-Cummins attendees will need to install the Skype for Business web app plug-in. See the attached instructions.

For non-Cummins participants:

→ Join Skype Meeting

This is an online meeting for Skype for Business, the professional meetings and communications app formerly known as Lync.

For Cummins participants:

→ Join Skype Meeting

This is an online meeting for Skype for Business, the professional meetings and communications app formerly known as Lync.

Join by phone

Ex. 6 - Personal Privacy

Forgot your dial-in PIN? | Help

Audio for this Skype for Business meeting is available using a computer or the phone dial-in bridge. Cummins Skype Advanced users should select "Use Skype for Business (full audio and

video experience)" when using their PCs to connect to the meeting audio. Cummins Skype Standard users should select "Don't Join Audio" and dial into the phone bridge.

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

To: Brian C Mormino[brian.c.mormino@cummins.com]; Jon A Dickson[jon.a.dickson@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Charmley, William[charmley.william@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gary C Salemme[gary.c.salemme@cummins.com]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; Manik Narula[manik.narula@cummins.com]; erin.luke@paccar.com[erin.luke@paccar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; david.gardner@navistar.com[david.gardner@navistar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]; Ricart-Ugaz, Laura M[Laura.Ricart@Navistar.com]; Marley Jeffrey[jeff.marley@volvo.com]; Mark Malowicki[Mark.Malowicki@PACCAR.com]; Costi Nedelcu[Costi.Nedelcu@PACCAR.com]; Miller Marc[marc.miller@volvo.com]; donald.keski-hynnila@daimler.com[donald.keski-hynnila@daimler.com]; aaron.neuman@daimler.com[aaron.neuman@daimler.com]; gerald.freitag@daimler.com[gerald.freitag@daimler.com]; steve.berry@volvo.com[steve.berry@volvo.com]; tblubaugh@emamail.org[tblubaugh@emamail.org]; david.kayes@daimler.com[david.kayes@daimler.com]; Mark.Siddall@HMMUSA.COM[Mark.Siddall@HMMUSA.COM]; LIN_GEORGE@cat.com[LIN_GEORGE@cat.com]; inderpal.singh@daimler.com[inderpal.singh@daimler.com]; Kaslavage Charles[charles.kaslavage@volvo.com]; scott.mundy@allisontransmission.com[scott.mundy@allisontransmission.com]; Thomas Manley[Thomas.Manley@HMMUSA.COM]
From: Jackie M Yeager
Sent: Thur 4/7/2016 1:46:52 PM
Subject: RE: Phase 2 Collaboration meeting agenda
Cummins ISL and N-V update 4-07-16.pdf

All – attached are slides that Cummins would like to review on today's call.

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

From: Jackie M Yeager

Sent: Wednesday, April 6, 2016 2:50 PM
To: Brian C Mormino <brian.c.mormino@cummins.com>; Jon A Dickson <jon.a.dickson@cummins.com>; 'spears.matthew@epa.gov' <spears.matthew@epa.gov>; 'charmley.william@epa.gov' <charmley.william@epa.gov>; 'Sanchez.james@Epa.gov' <Sanchez.james@Epa.gov>; Gary C Salemme <gary.c.salemme@cummins.com>; 'tom.sloane@paccar.com' <tom.sloane@paccar.com>; 'Cortney.Guzlas@Navistar.com' <Cortney.Guzlas@Navistar.com>; 'Zhang.Houshun@epa.gov' <Zhang.Houshun@epa.gov>; 'Matthew.Hunkler@Navistar.com' <Matthew.Hunkler@Navistar.com>; Manik Narula <manik.narula@cummins.com>; 'erin.luke@paccar.com' <erin.luke@paccar.com>; 'debbie.gordon@allisontransmission.com' <debbie.gordon@allisontransmission.com>; 'MihaiDorobantu@eaton.com' <MihaiDorobantu@eaton.com>; 'Jeffrey.shultz@allisontransmission.com' <Jeffrey.shultz@allisontransmission.com>; 'david.gardner@navistar.com' <david.gardner@navistar.com>; 'David.Majors@Navistar.com' <David.Majors@Navistar.com>; 'MatthewRBusdiecker@eaton.com' <MatthewRBusdiecker@eaton.com>; 'ErikDykes@eaton.com' <ErikDykes@eaton.com>; 'dan.kieffer@paccar.com' <dan.kieffer@paccar.com>; Anthony Greszler (anthony.greszler@volvo.com) <anthony.greszler@volvo.com>; 'He Yuesheng' <yuesheng.he@volvo.com>; 'Ricart-Ugaz, Laura M' <Laura.Ricart@Navistar.com>; 'Marley Jeffrey' <jeff.marley@volvo.com>; 'Mark Malowicki' <Mark.Malowicki@PACCAR.com>; 'Costi Nedelcu' <Costi.Nedelcu@PACCAR.com>; 'Miller Marc' <marc.miller@volvo.com>; 'donald.keski-hynnila@daimler.com' <donald.keski-hynnila@daimler.com>; 'aaron.neuman@daimler.com' <aaron.neuman@daimler.com>; 'gerald.freitag@daimler.com' <gerald.freitag@daimler.com>; 'steve.berry@volvo.com' <steve.berry@volvo.com>; 'tblubaugh@emamail.org' <tblubaugh@emamail.org>; 'david.kayes@daimler.com' <david.kayes@daimler.com>; 'Mark.Siddall@HMMUSA.COM' <Mark.Siddall@HMMUSA.COM>; 'LIN_GEORGE@cat.com' <LIN_GEORGE@cat.com>; 'inderpal.singh@daimler.com' <inderpal.singh@daimler.com>; 'Kaslavage Charles' <charles.kaslavage@volvo.com>; 'scott.mundy@allisontransmission.com' <scott.mundy@allisontransmission.com>; 'Thomas Manley' <Thomas.Manley@HMMUSA.COM>
Subject: Phase 2 Collaboration meeting agenda

Reminder of tomorrow's call at 3:00 pm Eastern. Let me know if anyone has additional agenda topics or updates to share. In case there are any issues with the new version of Skype, you may want to email your slides to the group before the call.

Proposed agenda:

1. ISL engine test results – Manik

2. Road grade evaluation – TBD

3. Other topics?

4. Plan next call – All

Call-in and Skype information:

New non-Cummins attendees will need to install the Skype for Business web app plug-in. See the attached instructions.

For non-Cummins participants:

.....

→ Join Skype Meeting

This is an online meeting for Skype for Business, the professional meetings and communications app formerly known as Lync.

For Cummins participants:

.....

→ Join Skype Meeting

This is an online meeting for Skype for Business, the professional meetings and communications app formerly known as Lync.

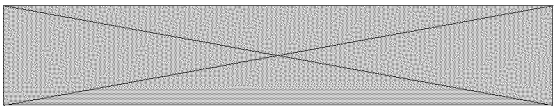
Join by phone

Ex. 6 - Personal Privacy

Find a local number

Ex. 6 - Personal Privacy

Forgot your dial-in PIN? | Help



Audio for this Skype for Business meeting is available using a computer or the phone dial-in bridge. Cummins Skype Advanced users should select "Use Skype for Business (full audio and video experience)" when using their PCs to connect to the meeting audio. Cummins Skype Standard users should select "Don't Join Audio" and dial into the phone bridge.

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

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To: Spears, Matthew[spears.matthew@epa.gov]; Charmley, William[charmley.william@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gary C Salemme[gary.c.salemme@cummins.com]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; Manik Narula[manik.narula@cummins.com]; erin.luke@paccar.com[erin.luke@paccar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; david.gardner@navistar.com[david.gardner@navistar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]; Ricart-Ugaz, Laura M[Laura.Ricart@Navistar.com]; Marley Jeffrey[jeff.marley@volvo.com]; Mark Malowicki[Mark.Malowicki@PACCAR.com]; Costi Nedelcu[Costi.Nedelcu@PACCAR.com]; Miller Marc[marc.miller@volvo.com]; donald.keski-hynnila@daimler.com[donald.keski-hynnila@daimler.com]; aaron.neuman@daimler.com[aaron.neuman@daimler.com]; gerald.freitag@daimler.com[gerald.freitag@daimler.com]; anirban.sett@daimler.com[anirban.sett@daimler.com]; Brian C Mormino[brian.c.mormino@cummins.com]; steve.berry@volvo.com[steve.berry@volvo.com]; tblubaugh@emamail.org[tblubaugh@emamail.org]; david.kayes@daimler.com[david.kayes@daimler.com]; Mark.Siddall@HMMUSA.COM[Mark.Siddall@HMMUSA.COM]; LIN_GEORGE@cat.com[LIN_GEORGE@cat.com]
From: Jackie M Yeager
Sent: Thur 1/14/2016 3:25:14 PM
Subject: 1/7 Collaboration Call Notes
Work Planning 1-07-16 updated.pptx

Participants:

- Allison – Mike Howenstein
- Cummins – Jackie Yeager
- Daimler – Anirban Sett, Gerald Freitag
- Eaton – Erik Dykes
- EMA – Tim Blubaugh
- EPA – Houshun Zhang, James Sanchez
- Navistar – Cortney Guzlas, Dave Gardner
- PACCAR – Dan Kieffer, Erin Luke, Mark Malowicki, Tom Sloane, Costi Nedelcu

•□□□□□□□□ Volvo – Marc Miller, Steve Berry, Yuesheng He, Tony Greszler

Discussion and follow-up items (with owner's name in **bold**):

•□□□□□□□□ SwRI testing update – Houshun

o Only testing not completed is the N13 child rating.

o Asked SwRI to further investigate 55/65 mph results on ISB child rating.

•□□□□□□□□ Open questions/work planning - All

o Reviewed 2015 progress and began 2016 planning (see attached Powerpoint). Continue planning discussion next week – **All**

o New road grade profile ("Profile D")

▪· Volvo noted new road grade profile operates the engine at full load and no load ~3x more often than their logged vehicle data. Also saw 20% increase in fuel consumption. Consider sharing analysis in future call – **Tony**

▪· EPA testing at ORNL did not show as much difference in fuel consumption. Summarize on a future call – **James**

•□□□□□□□□ Other topics

o Use box.com to transmit debug version of GEM. Give access to box.com to newest members of the group – **Erik**

o Post past material on box.com – **Jackie**

o Let Jackie know ASAP if any concerns with posting old material – **All**

Topics for future calls:

•□□□□□□□□ (Tentative) Volvo analysis of new road grade profile – Tony

•□□□□□□□□ (TBD) – Summarize road grade results at ORNL – James

•□□□□□□□□ (1/14) – Open questions/work planning – All

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

To: Brian C Mormino[brian.c.mormino@cummins.com]; Jon A Dickson[jon.a.dickson@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Charmley, William[charmley.william@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gary C Salemme[gary.c.salemme@cummins.com]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; Manik Narula[manik.narula@cummins.com]; erin.luke@paccar.com[erin.luke@paccar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; david.gardner@navistar.com[david.gardner@navistar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]; Ricart-Ugaz, Laura M[Laura.Ricart@Navistar.com]; Marley Jeffrey[jeff.marley@volvo.com]; Mark Malowicki[Mark.Malowicki@PACCAR.com]; Costi Nedelcu[Costi.Nedelcu@PACCAR.com]; Miller Marc[marc.miller@volvo.com]; donald.keski-hynnila@daimler.com[donald.keski-hynnila@daimler.com]; aaron.neuman@daimler.com[aaron.neuman@daimler.com]; gerald.freitag@daimler.com[gerald.freitag@daimler.com]; steve.berry@volvo.com[steve.berry@volvo.com]; tblubaugh@emamail.org[tblubaugh@emamail.org]; david.kayes@daimler.com[david.kayes@daimler.com]; Mark.Siddall@HMMUSA.COM[Mark.Siddall@HMMUSA.COM]; LIN_GEORGE@cat.com[LIN_GEORGE@cat.com]; inderpal.singh@daimler.com[inderpal.singh@daimler.com]; Kaslavage Charles[charles.kaslavage@volvo.com]; scott.mundy@allisontransmission.com[scott.mundy@allisontransmission.com]; Thomas Manley[Thomas.Manley@HMMUSA.COM]
From: Jackie M Yeager
Sent: Thur 5/19/2016 5:37:20 PM
Subject: RE: Phase 2 Collaboration meeting agenda - Cummins slides
GEMShiftLogicSensitivity05192016.pdf

Here are slides that Cummins would like to review on today's call.

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

From: Jackie M Yeager

Sent: Wednesday, May 18, 2016 8:51 AM
To: Brian C Mormino <brian.c.mormino@cummins.com>; Jon A Dickson <jon.a.dickson@cummins.com>; 'spears.matthew@epa.gov' <spears.matthew@epa.gov>; 'charmley.william@epa.gov' <charmley.william@epa.gov>; 'Sanchez.james@Epa.gov' <Sanchez.james@Epa.gov>; Gary C Salemme <gary.c.salemme@cummins.com>; 'tom.sloane@paccar.com' <tom.sloane@paccar.com>; 'Cortney.Guzlas@Navistar.com' <Cortney.Guzlas@Navistar.com>; 'Zhang.Houshun@epa.gov' <Zhang.Houshun@epa.gov>; 'Matthew.Hunkler@Navistar.com' <Matthew.Hunkler@Navistar.com>; Manik Narula <manik.narula@cummins.com>; 'erin.luke@paccar.com' <erin.luke@paccar.com>; 'debbie.gordon@allisontransmission.com' <debbie.gordon@allisontransmission.com>; 'MihaiDorobantu@eaton.com' <MihaiDorobantu@eaton.com>; 'Jeffrey.shultz@allisontransmission.com' <Jeffrey.shultz@allisontransmission.com>; 'david.gardner@navistar.com' <david.gardner@navistar.com>; 'David.Majors@Navistar.com' <David.Majors@Navistar.com>; 'MatthewRBusdiecker@eaton.com' <MatthewRBusdiecker@eaton.com>; 'ErikDykes@eaton.com' <ErikDykes@eaton.com>; 'dan.kieffer@paccar.com' <dan.kieffer@paccar.com>; Anthony Greszler (anthony.greszler@volvo.com) <anthony.greszler@volvo.com>; 'He Yuesheng' <yuesheng.he@volvo.com>; 'Ricart-Ugaz, Laura M' <Laura.Ricart@Navistar.com>; 'Marley Jeffrey' <jeff.marley@volvo.com>; 'Mark Malowicki' <Mark.Malowicki@PACCAR.com>; 'Costi Nedelcu' <Costi.Nedelcu@PACCAR.com>; 'Miller Marc' <marc.miller@volvo.com>; 'donald.keski-hynnila@daimler.com' <donald.keski-hynnila@daimler.com>; 'aaron.neuman@daimler.com' <aaron.neuman@daimler.com>; 'gerald.freitag@daimler.com' <gerald.freitag@daimler.com>; 'steve.berry@volvo.com' <steve.berry@volvo.com>; 'tblubaugh@emamail.org' <tblubaugh@emamail.org>; 'david.kayes@daimler.com' <david.kayes@daimler.com>; 'Mark.Siddall@HMMUSA.COM' <Mark.Siddall@HMMUSA.COM>; 'LIN_GEORGE@cat.com' <LIN_GEORGE@cat.com>; 'inderpal.singh@daimler.com' <inderpal.singh@daimler.com>; 'Kaslavage Charles' <charles.kaslavage@volvo.com>; 'scott.mundy@allisontransmission.com' <scott.mundy@allisontransmission.com>; 'Thomas Manley' <Thomas.Manley@HMMUSA.COM>
Subject: Phase 2 Collaboration meeting agenda

Reminder of tomorrow's call at 3:00 pm Eastern.

Proposed agenda:

1. Shifting sensitivity to generic steady state map – Manik, Matt H.

2. 55/65 cycle average map speed/load coverage – Matt H.

3. Other topics?

4. Plan next call – All

Call-in and Skype information:

New non-Cummins attendees will need to install the Skype for Business web app plug-in. See the attached instructions.

For non-Cummins participants:

→ Join Skype Meeting

This is an online meeting for Skype for Business, the professional meetings and communications app formerly known as Lync.

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Ex. 6 - Personal Privacy

Find a local number

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Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

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To: Spears, Matthew[spears.matthew@epa.gov]; Charmley, William[charmley.william@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gary C Salemme[gary.c.salemme@cummins.com]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; Manik Narula[manik.narula@cummins.com]; erin.luke@paccar.com[erin.luke@paccar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; Brian C Mormino[brian.c.mormino@cummins.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; david.gardner@navistar.com[david.gardner@navistar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]; Ricart-Ugaz, Laura M[Laura.Ricart@Navistar.com]; Marley Jeffrey[jeff.marley@volvo.com]; Mark Malowicki[Mark.Malowicki@PACCAR.com]; Costi Nedelcu[Costi.Nedelcu@PACCAR.com]; Miller Marc[marc.miller@volvo.com]; donald.keski-hynnila@daimler.com[donald.keski-hynnila@daimler.com]; aaron.neuman@daimler.com[aaron.neuman@daimler.com]; gerald.freitag@daimler.com[gerald.freitag@daimler.com]; anirban.sett@daimler.com[anirban.sett@daimler.com]; steve.berry@volvo.com[steve.berry@volvo.com]; tblubaugh@emamail.org[tblubaugh@emamail.org]; david.kayes@daimler.com[david.kayes@daimler.com]; Mark.Siddall@HMMUSA.COM[Mark.Siddall@HMMUSA.COM]; LIN_GEORGE@cat.com[LIN_GEORGE@cat.com]; inderpal.singh@daimler.com[inderpal.singh@daimler.com]; Jon A Dickson[jon.a.dickson@cummins.com]; Kaslavage Charles[charles.kaslavage@volvo.com]; Scott.Mundy@allisontransmission.com[Scott.Mundy@allisontransmission.com]
From: Jackie M Yeager
Sent: Mon 4/4/2016 8:19:01 PM
Subject: Collaboration meeting invitations

Hi all,

I have been migrated to a new version of Skype, so I need to set up a new Skype meeting link for our Thursday bi-weekly Phase 2 Collaboration Group calls. I will send a new repeating invitation and cancel the old one. I apologize for any inconvenience.

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
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From: Andjelka Vujovic
Sent: Tue 2/9/2016 5:03:05 PM
Subject: EMA - EMTC, CARB, EPA & Others - January 19-20, 2016, EMTC Meeting Minutes and Attachments
ITR_Presentation to EMTC_1-19-16.ppt
Marshik VOC ICAC EPA Roundtable FINAL.pptx
RoundRobinEngine-TestSchedule-20160107.xlsx
Test Plan Discussion for Revised Fuel Mapping Variability-20160120.pdf
Attendance List - 2016-01-19 EMTC Meeting.pdf
2016-01-19 and 20 EMTC_meeting minutes - 2016-02-08.DOCX

TO: Engine Emissions Measurement & Testing Committee

(EMA Members, CARB, EPA & Others)
CC: Timothy A. French
FROM: Shirish Shimpi
DATE: February 9, 2016
RE: **January 19-20, 2016, EMTC Meeting Minutes and Attachments**

Attached are the January 19-20, 2016, EMTC meeting minutes and attachments. The next EMTC meeting will be held on March 29-30, 2016, at the Cummins, Inc.'s Technical Center in Columbus, Indiana. The meeting details will be sent in the near future.

If you have any questions, please do not hesitate to contact me.

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Engine Emissions Measurement & Testing Committee Meeting
(EMA Members, CARB, EPA & Others)

January 19-20, 2016
UC-Riverside, CE-CERT

Day 1: Scheduled Start Time:	9:00 AM	Scheduled End Time: 5:00 PM
Day 2: Scheduled Start Time:	9:00 AM	Scheduled End Time: 2:00 PM

DRAFT MINUTES

The following are the draft minutes of the EMTC meeting held at University of California in Riverside, CA January 19-20 2016. There are a number of attachments that go with the minutes listed at the end of the minutes. The scribe of the meeting minutes was Joshua Israel, WVU.

If you have any additions, corrections, or questions concerning the draft minutes, please feel free to contact me.

Shirish

Shirish A. Shimpi, Ph. D.

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Meeting Minutes

Meeting agenda and attendance list are part of the attachments to these minutes.

Shirish Shimpi opened the meeting at 9 am. Introductions were made (list of participants is part of the attachments to these minutes) and logistics for the meeting were discussed. Joshua Israel was the meeting scribe and Costi Nedelcu was the time keeper.

The November 2015 EMTC meeting minutes were approved and the agenda was discussed and finalized. The March EMTC meeting has been tentatively schedules for March 29-30 2016 at the Cummins Technical Center in Columbus, IN. EMA staff will send out the meeting notice.

The welcome presentation was given by UC-Riverside CE-CERT's staff – Director Matt Barth and Kent Johnson. Matt Barth provided a brief overview of testing programs and partnerships: Clean Air, Sustainable Transportation, Renewable Fuels, Renewable Electricity and Smart Grids. He also spoke about CARB's relocation of El Monte Testing Facility in Riverside. Kent Johnson spoke about the upcoming 6th annual PEMS conference that will be held at CE-CERT in March 2016. Shirish thanked CE-CERT for hosting the EMTC meeting. He also announced that the regular meeting would be finished on that day at 4 pm, an hour earlier so that EMTC members can visit the CE-CERT's test labs.

Discussion on Items in Part 1065 and in other Standard Setting Parts

EPA's Chris Laroo had forwarded updates on Part 1065 and the Standard Setting Parts before the meeting. These items were circulated to EMTC members ahead of the meeting. They are also stored on the EMA member website under EMTC resources.

Note that the discussions below took place over the two meeting dates but they have been compiled in order and included in one area.

Part 1065 Discussion

- **1065.210: Work input and output sensors**. Additions were made in response to transmission and axle manufacturers' project. EPA's James Sanchez – comments received about sampling frequencies. Intention is to make it reflect current practices and to make 1605 more complete. Feedback from EMA members that the language needs to be more defined about checking frequency content. Suggestion that the language could be simplified to say "sample fast enough to avoid aliasing". Concerns voiced over the demonstration process that the requirement has been met. General consensus reached to include language about anti-alias sample rates in 1065.202 and strike out what had been proposed in 1065.210. Question posed by Horiba asking if this section will be relevant to PEMS measurement of ECM data – EPA responded that PEMS will likely not be affected.

- **1065.220:** Minor changes made to break out paragraphs.
- **1065.266:** Additions made in response to high ethane content in fuel causing engines to fail NMHC standard. The change is to allow natural gas fueled engines to certify on a non-methane, non-ethane standard. Questions on whether this applies to non-road, locomotive, and on-highway – EPA responded that it will apply to all.
    - MKS proposed further review of the results of their study regarding FTIR and FID for NMHC determination. Barb Marshik provided the MKS presentation entitled, "Comparison of Results Using the Proposed Quad J Difference Methods in CNG-Based Engine Emissions".
    - Horiba asked if manufacturer can lower catalyst temp to capture methane and ethane with a FID – EPA responded that it is possible but additional language would have to be added to subpart C in Part 1065 to verify correct use.
    - Question about linearity verification and interference test requirements– EPA responded that they would be necessary, but there may be concessions made for linearity and schedule requirements similar to N2O measurements.
- **1065.341:** Added language to provide additional clarity about the location of the C_3H_8 port location for CVS verification, allowing the port to be moved upstream of dilution mixing into the exhaust tube. 1065.340 Flow calibration was intended to be modified to more align with language from part 1066. EPA commented that the proposed changes were performed without a technical review, and the comments from the meeting were valuable and accomplished this purpose. Added text to clarify the intent that the CVS shall be calibrated with any upstream screens or restrictions that would be present during testing. Additionally, text was changed for CFV range of use based on the pressure ratio "r" to correct a historical error that was brought about by previously redefining the pressure ratio.
- **1065.360(d)(7):** Modified text that had originally specified that CH4 span gas be introduced at the <u>sample port</u> of the FID analyzer, to be less prescriptive and be just introduced to the FID analyzer.
- **1065.590:** Change made after discussions at previous meeting. Section (j) changed as a result of feedback relative to automated weighing. EPA's interpretation is that for manual weighing use good engineering judgement to develop own procedure. Change of language in (j) from "media" to "medium" to specifically reference single filter. Change made to (f) (2) to be inclusive of automatic weighing. General consensus that changes to this section are appropriate. Some additional discussion about substitution weighing. Typo found in (j) (4): "calibration" should be changed to "substitution" for consistency with (j) (3).
- **1065.640:** Flow meter calibration calculations
    - SwRI brought up that Table 1 of 1065-640 had non-representative PDP example calibration data. Chris Sharp will provide EPA with more realistic values.
    - 640(d)(3) had some language that was being changed from "Re#" to "flow rates".

EPA agreed to make changes to make sure that the intent of keeping Cd as a function of Re# is kept intact.

- **1065.642**: Changed the order of PDP, SSV, and CFV to stay consistent with the order in the sections referring to these devices. Additionally, variable definitions were added in reference to equations 1065.642-1, 2, and 3.
- **1065.655** – Changes were made relative to the introduction of urea into the exhaust stream.
    - Section (a) - "…rate of additional injected fluid must be known": EPA was not definite that this will be required. Even If it is, manufacturers will have sufficient lead time (likely for the 2021 product).
    - Section (c) - initial changes made to account for DEF as part of fuel property coefficients, no changes made to calculations themselves
    - Section (d) - introductory paragraph changed …
    - Section (e) – new paragraph to specifically reference DEF fluid and fuel composition. New instructions for determining alpha, beta, and gamma compositions. "…total mass of 100 +/- 0.5%" will apply to all gaseous fuels.
        - Paragraph (2), use default values for coefficients and good engineering judgement for gaseous fuels.
        - Paragraph (3) use default values for coefficients and good engineering judgement for DEF fluid.
        - Paragraph (4) "…account for varying concentrations" Some discussion on whether this accounting should be done on a continuous basis or a test interval basis. Initial conclusion is that either approach is acceptable, but that the language needs to be clearer. Suggestion made for additions include: "show by engineering analysis which is more accurate". Long discussion here on use of batch measurements for fuel and DEF and coefficients as constants. Shirish suggested that Mike Akard at Horiba put the problem into a reviewable proposal for further study. Consensus to move forward with the section as is, under the assumption that this section is likely to be reviewed and changed at a later time. Changes made to equations 655-20 through 655-23 to break out summations into numerator and denominator
        - Paragraph (5) existing equations – changes made in definition of variables to include "fuel or any injected fluid".
        - Table 1 of 1065.655 header changed to include "injected fluid" and row added to provide values for DEF
    - Section (f)
        - Paragraph (3) - Fuel mass flow rate calculation
          Changes made to Eq. 1065.655-25 to correct summation notation. The summation would only go around the fuel rate (j summation). This change would apply to Eq. 1065.655-20 through -23 as well. For clarity, urea will also be an *fluid. Bill Martin notes that there may be other equations that*

need a similar correction, but he has not identified them at this time.

- Section (h)
  - Paragraph (2) -Some discussion on what would be the effects of changing Eq. 1065.655-28. Bill Martin suggested that it may need to be adjusted.

- **1065.667:** Paragraph (c) – changed reference from 1065.655 (f) to 1065.655(g)

- **1065.680(b)(3)(i):** Language was added for IRAF which allows the use of a separate "F" for GHG adjustment - "Determine the frequency of regeneration, *F*, in a way that incorporates the impact of cold-start operation in proportion to the cold-start weighting factor specified in the standard-setting part. You may use good engineering judgment to determine the effect of cold-start operation analytically."
- Chris Sharp commented that there may be confusion on whether GHG requires cold-start or not. PACCAR and others commented that their interpretation is that cold-start is currently not required for GHG.
- **1065.655** – Changes were made relative to the introduction of urea into exhaust stream. See minutes of the EMTC for details.
- **1065.1001** – Definition of DEF changed for consistency with standard setting part
- EPA was asked why the prescribed soak time of 20 +/- 1 minute was removed from Part 86. After some investigation, EPA said this was done by mistake and will be fixed.

<u>Standard Setting Discussion</u>

Chris Laroo – There are 7 pages of information. We will focus on fuel mapping procedure.

James Sanchez went over the subsequent items:

- **1036.535** Determining engine fuel maps and fuel consumption at idle.
  Opening paragraph: Addition to reference powertrain approach "This testing is to be performed if the optional powertrain approach in 40 CFR 1037.550 is not used for certifying Phase 2 vehicles."
  - Section (a) Paragraph (1) – additions made to reference 1065.510
    Question as to what is the intent of this section as related to control of speed and torque. No solid answer from EPA, except that their intent is to create a repeatable procedure. Long discussion on application-specific application of this language. Bill Martin proposes validating both speed and torque over the sample window.
  - Section (a) Paragraph (2) – recent addition as a result of Nov 19 2015 EMTC discussion. Provides guidance on measuring NOx during GHG demonstration. Chris Sharp calls into question the definition of NTE reporting provisions relevant to this section. Chris Laroo will review. James proposes to review internally at the EPA and simplify.
  - In general, for sections (a) and (b): Ryan Parcel and Chris Sharp propose aligning

it with the RMC and using linear ramps. General agreement from EMA members and EPA. Bill Martin proposes validation by the standard regression criteria. General consensus is to move on and revisit stabilization and validation criteria.

- Section (b) Paragraph (3) and (4) "warm up" replaced with "pre-conditioning"
- Section (b) Paragraph (5) (i) and (ii) Bill Martin suggests to look at 1065 and use consistent language here.

- Some discussion of background readings as it pertains to these sections... Reference to procedures for background sampling continuously and with bags. §1065.140 does not allow for background measurement before and after sample interval, only provides some flexibility for measurement method. Before and after would require a special clause. After discussing multiple options, general feedback from EPA is that there should be a "good engineering judgement" clause as regards background determination to include in 1036
- Eq. 1036.535-1 updated to include DEF in SCR equipped engines. "w_{Cmeas} = carbon mass fraction of the mixture of fuel(s) being combusted as determined by 40 CFR 1065.655(d), except that you may not use the default properties" and "$x_{Ccombdry}$ = the mean concentration of carbon from fuel and diesel exhaust fluid (SCR equipped engines) in the exhaust per mole of dry exhaust as determined by 40 CFR 1065.655(c)."
- Section (b) (8) – continued discussion of calculation problem, Equation 1066.535-1 modified.
- Section (b) (9) – section updated to include diesel exhaust fluid "…determined directly from the engine control module or from independent measurement of the diesel exhaust fluid mass flow rate, consistent with good engineering judgment." Example also added
- Section (b) (10) – references added to 1036.530 as relates to carbon-specific net energy calculation. Question posed as to natural gas fuels – EPA responds that it is not clear how they will handle that as this time, expect that there will be further discussions. Suggestion from Bill Martin about weighted values for multiple fuels, EPA will consider. Also questions posed about reference values for fuels –
- Paragraph (c) and paragraph (d) – no new changes since previous meeting

- **Section 1036.540**

  - Introductory Paragraph – changes since last review are marked in red in the copy distributed to EMA members. Paragraphs (1) and (2) broken into sections for clarity.
  - Section (b) – small changes:
    Reference to 1065.535 added
  - Expansion of variable explanation for Eq. 1066.540-2 to include "…from Table 4

of this section (for powertrain testing use actual top gear ratio)."

- (b) (2) (B) (iii) – addition of language for heavy-haul tractors. Same clarity provided for general purpose and heavy-haul applications. Some clarification provided by EPA for variables in Table 3 and Table 4.
  - Section (b) Paragraph (5) – additions based on feedback from last meeting "Warm up the engine as described in 40 CFR 1037.510(a)(2)(i) using the Test 1 vehicle configuration and test the different configurations in numerical order. Measure emissions as described in 40 CFR part 1065 and perform cycle validation at 10 Hz according to 40 CFR part 1065 subpart F. You may send signals to the engine controller during the test that make the engine's operation more representative of in vehicle operation over the cycle (e.g. vehicle speed and transmission current gear). "
  - Section (b) Paragraph (6) – changes made to provide clarity on pre-conditioning after regen event.
  - Section (b) Paragraph (7) – romanettes (i) and (ii) added to provide clarity on methods to determine fuel mass. EPA asks for feedback on elimination of fuel measurement option. General comments from EMA that data needs to be reviewed to examine accuracy of both methods.
  - Section (b) Paragraph (8) (ii) (A) – additions made to variable definitions for clarity and to be inclusive of DEF

- **Section 1037.550**
  - Section (a) - (1) and (2) added
  - Section (h) (i) added language for clarity on regen events
  - Section (n) - additions made to be inclusive of DEF
  - No additional comments at this time from EMA members

- **Section 1036.530**
  - Section (b) (3) - question from EPA about why this language has been added to 1036. Chris Laroo questions EMA about whether anyone is using this provision. EPA would like to remove. Bill Martin proposes addition of language to specifically reference t-test as means to quantify batch-to-batch variability of fuel. EPA will revise language and present for further review.

Presentation by CARB's Joseph Calavita on CARB's Proposed Innovative Technology Rulemaking

CARB is developing an Innovative Technology Regulation – rooted in challenges meeting climate and environmental goals. This is Joseph Calavita's second appearance in front

of the EMTC. His presentation is part of the attachments to the meeting minutes.

- Primary objective is to provide flexibility in certification/OBD and aftermarket part approval to facilitate technology, while maintaining ability to ensure air quality
- ARB is proposing multiple test demonstration options (A to B), which include: Chassis dynamometer test, powertrain test, PEMS test.
- PEMS work is expected to follow the direction (to some degree) given in 40 CFR Part 1065 Subpart J, and the Smartway protocol for vehicle selection. CARB is asking for some feedback about potential problems with that idea, especially as relates to
    - Instrument verification
    - Reporting of mile-specific results
    - How will duty cycle validation take place? How to apply key metrics to validate test runs?
    - Defining of pass-fail criteria
    - Identifying an appropriate emissions "test allowance"

ISO TC70/SC8 Update

- Shirish reminded EMA members that comments on the ISO 8178 Parts 1 and 4 are due to ISO by Jan 31 2016. He has received some comments but is waiting for comments from others. Any update after the deadline will not go into the changes until the next rotation, which could be up to four years down the road. Ryan Parcel asked for an opportunity to see draft. Shirish said that ISO will provide a draft of FDIS, but most changes after that will only be editorial.
- Shirish requested EMA members to provide him input by next week to meet the deadline.

EMTC's Very Low NOx (0.02 g/bhp-hr) project at SwRI

- Chris Sharp reported that the Very Low NOx report is going into review at SwRI. Members should have it on or before end of January.
- Additional bench study reporting along with package of other items will likely be distributed to EMA members by first week of February.

Round Robin Test Update – SwRI Presentation

- There is no new data from engine testing since the last meeting since no testing has taken place.
- The engine had been at Volvo since testing at EPA. At Volvo they experienced driveline issues and realized that they would not be able to test the engine and keep the Round

Robin engine schedule. The engine was then moved to Isuzu where test cell scheduling issues pushed testing beyond January 2016. It was then decided that the engine will not be tested at Isuzu but will be sent to Ricardo. The plan is to test the engine at Ricardo in the mid-February 2016 timeframe.

- Mike May of Ricardo provided a brief description of Ricardo's test cell: Horiba 460 kW Dc dyno, Horiba CVS, Horiba analytical bench w/ software. Ricardo asked a question about preferred analyzer ranges for the testing. Chris Sharp answered that that information has not been specified, but the data that has been distributed may be helpful.
- Isuzu will likely be re-scheduled for end of 2016 – beginning of 2017. The engine will then go to EPA where testing is planned for April/May 2016. The testing at EPA is to run additional tests to make an A/B comparison with a new aftertreatment. The testing will likely be a subset, not the full round robin test plan.
- Test facilities requesting to be added to the Round Robin engine testing are WVU, CE-CERT, PACCAR. EPA will also likely be put back on the schedule in 2017 for another round of repeat testing.

SwRI's Test Plan Discussion for Revised Fuel Mapping Variability Program

Chris Sharp provided an update on SwRI's plans to respond to EMA's request to address GHG Phase 2 Fuel Mapping variability study. Chris Sharp's presentation material is part of the attachments to these minutes. Discussion intended to settle on scope. Some initial discussion with Tim French about how the work will be tied together between different EMA groups.

- Proposed changes in scope based on: EMA desire to focus on long-term viability, hybrid approach to mapping exercises, EPA plan to contribute funding
- Summarization of points on steady-state fuel map approach 1036.535:
    - "Hybrid" approach may shorten process down to 90 pts as opposed to 143. If information from this process comes quickly, they can finalize the approach.
    - Separate process for idle.
    - NOx will be measured and reported.
- Cycle average approach – 1036.540:
    - Use GEM to generate set of engine transient cycles. Question is how to handle grouping: should we explore two sets of gear ratios to account for Class 8 vs Class 2b-7? SwRI will have options in the final proposal based on how the scope of testing is changed by this decision. Bill Martin also proposes scaling the vehicle mass to the power level of the engine.
    - Run cycles and measure fuel flow
    - Table is interpolated by GEM for vehicle cert results
- Test Engines: Previous plan was 1 HHD and 1 MHD, this can still be done if desired. Someone will need to supply an engine, unless an older engine is preferred. Chris Sharp asks for support from EMA on this point. Chris Sharp said that thermal management can have a large effect on fuel consumed and will be a large source of variation of results. For that reason, a more modern test article may be important.

- Biggest timing question: when can SwRI get a test article?
- Long-term variability terms:
    - Installation.
        - Tim French asks for clarity about where the test article will be used and if it will be moved. Chris Sharp explained that there are no plans to move it, and that the three installations are at three separate test cells at SwRI.
    - Carbon balance differences?
    - Linearity tolerances
    - NIST traceable tolerances
    - Fuel properties
- Cycle Test Order – some discussion about running test cycles in order and how pre-conditioning should be handles. Chris Sharpe: default pre-conditioning would lead to long test cycle. EPA responds that the language in 1065.540 has been updated and is the preferred method.
- Carbon balance errors and QA/QC. Chris Sharpe: should this be incorporated into the model and if so, how? Proposes idea that process be formalized.
- Next steps:
    - Chris Sharp will continue to revise proposal for review based on feedback from this meeting.
    - Shirish will coordinate with Tim French to get EMA members together to discuss test engine question.

Next Meetings - Locations finalized, dates TBD:

- March 29-30, 2016 – Cummins Technical Center, Columbus, IN
- May 2016 – Navistar, Chicago, IL
- July 2016 – EPA Offices, Ann Arbor, MI
- September 2016 – West Virginia University, Morgantown, WV
- December 2016 – Southwest Research Institute, San Antonio, TX

List of Attachments

- Meeting Agenda
- Attendance List
- Comparison of Results Using the Proposed Quad J Difference Methods in CNG-Based Engine Emissions (Marshik VOC ICAC EPA Roundtable FINAL)
- Presentation by CARB's Joseph Calavita on CARB's Proposed Innovative Technology Rulemaking
- SwRI's Test Plan Discussion for Revised Fuel Mapping Variability Program

History List of Meeting Scribes to help in Scribe selection:

Date	Name of Scribe	Affiliation
January 2016	Joshua Israel	WVU
November 2015	David Horstman	Intertek
August 2015	Ryan Parcell	Caterpillar
June 2015	Palak Patel & Sam Cao	Cummins Inc.
April 2015	Andreas Burger	MTU
January 2015	Michael Traver	ARAMCO
November 2014	Joe Sweeny	ACS
September 2014	Frank Berghof	AVL
July 2014	Zachary Murter	Volvo
May 2014	Brian Mace	Horiba
March 2014	John Briggs	ProCat Testing
January 2014	Bob Bair	John Deere
November 2013	Carol Smith	Isuzu
September 2013	David Hortsman	Intertek
July 2013	Barbara Marshik	MKS
May 2013	Ryan Parcell	Caterpillar
March 2013	Chris Sharp	SwRI
January 2013	Henry Ng	Univ. of Houston
October 2012	Todd Carpenter	AVL
August 2012	Dave Munday	Horiba
June 2012	Dan Sales	CAI
April 2012	Keith Scales	DTNA
February 2012	Brian Mace	Volvo
November 2011	Carol Smith	Isuzu
September 2011	Dean Buchholz	Caterpillar
July 2011	Chris Wright	PACCAR
March 2011	Bob Bair	Deere
February 2011	Dean Buchholz	Caterpillar

- Entities not yet represented in scribing assignment:
  - Hino Motors
  - Ricardo
  - General Motors
  - IAV
  - A&D Technology
  - Others?

From: EMA
Location: U.S. EPA; 2000 Traverwood Drive; Ann Arbor, Michigan
Importance: Normal
Subject: EMA - EMTC, CARB, EPA & Others - July 27-28, 2016, EMTC Meeting Notice
Categories: Purple Category
Start Date/Time: Wed 7/27/2016 1:00:00 PM
End Date/Time: Thur 7/28/2016 6:00:00 PM

;;;;;
;;;;;

TO: Engine Emissions Measurement & Testing Committee
(EMA Members, CARB, EPA & Others)

CC: Timothy A. French
FROM: Shirish Shimpi
DATE: June 20, 2016
RE: **July 27-28, 2016, EMTC Meeting Notice**

EMA will convene a two-day meeting of the Engine Emissions Measurement and Testing Committee on Wednesday and Thursday, July 27 and 28, 2016, at EPA's Offices in Ann Arbor, Michigan. An agenda will be circulated prior to the meeting.

Following are the meeting details:

DATE: Wednesday, July 27, 2016
TIME: 9:00 a.m. – 5:00 p.m.
Thursday, July 28, 2016
9:00 a.m. – 2:00 p.m.

LOCATION: EPA Office
2000 Traverwood Drive
Ann Arbor, Michigan

Conference call access and webcast information is being provided for those who are not able to attend in person.

Following are the call-in details:

DATE: Wednesday, July 27, 2016
TIME: 8:00 a.m. – 4:00 p.m. (Chicago time)
Thursday, July 28, 2016
8:00 a.m. – 1:00 p.m. (Chicago time)

Ex. 6 - Personal Privacy

To join the web conference, please click on the following link:
https://epawebconferencing.acms.com/emtcmeeting/

If you have any questions, please do not hesitate to contact me.

Shirish A. Shimpi, Ph. D.
Director
Emissions Development
Cummins Inc.
Mail Code 50180
1900 McKinley Ave

Columbus, Indiana 47201
Office: (812) 377-7532
Cell: (812) 447-3767
Andjelka Vujovic
Truck & Engine Manufacturers Association
333 West Wacker Drive ▪ Suite 810
Chicago, Illinois ▪ 60606
(312) 929-1973 direct ▪ (312) 929-1975 fax
avujovic@emamail.org

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From: Jackie M Yeager
Location: 2000 Traverwood Drive, Ann Arbor, MI
Importance: Normal
Subject: Cummins/EPA meeting
Categories: Purple Category
Start Date/Time: Fri 1/29/2016 2:00:00 PM
End Date/Time: Fri 1/29/2016 5:00:00 PM

;
Discuss Phase 2 GHG

From: Brian C Mormino
Location: Brian's Office Conf. Call 877.810.9439 Code: 6351781
Importance: Normal
Subject: Economic Assessment Discussion
Categories: Purple Category
Start Date/Time: Wed 4/15/2015 1:00:00 PM
End Date/Time: Wed 4/15/2015 2:30:00 PM

;;
Hello ,

Jackie Yeager has invited you to join a meeting on the Web, using WebEx

Topic: Cummins/NERA/EPA Call
Date: Wednesday, April 15, 2015
Time: 9:00 am, Eastern Daylight Time (New York, GMT-04:00)
Meeting number: Ex. 6 - Personal Privacy
Meeting passwor

Please click the link below to see more information, or to join the meeting.
NEW USER? Prepare your computer in advance of the meeting by clicking New User on the navigation bar.

https://cummins.webex.com/cummins/j.php?MTID=me07c7940c7d6ddd11b196f9c0e3ce059

Teleconference: None

To contact Jackie Yeager, call 1-812-377-8774 or
send a message to this address: jackie.m.yeager@cummins.com

To add this meeting to your calendar program (for example, Microsoft Outlook or Lotus Notes), do the following:

* For all calendar programs (except Lotus Notes), click the following link, or copy the link and paste it into your Web browser:
https://cummins.webex.com/cummins/j.php?MTID=mbee84eb17f9d766af002d5ca1b54126b

NOTE: Release 6 will be available with PowerSweep II
*For Lotus Notes (Release 6), follow these steps:
1. Right-click the attached iCalendar format (*.ics) file, and then choose View.

https://cummins.webex.com/cummins/j.php?MTID=mbee84eb17f9d766af002d5ca1b54126b

2. Click Import All. A new broadcast email message is added to your Inbox.
3. Open the new message.
4. Click Respond button. A menu appears.
5. Click Accept.

http://www.webex.com

This email has been scanned for Malware.

From: Brian C Mormino
Location: US toll-free Ex. 6 - Personal Privacy
Importance: Normal
Subject: FW: EPA & CMI Call
Categories: Purple Category
Start Date/Time: Wed 2/11/2015 7:00:00 PM
End Date/Time: Wed 2/11/2015 8:00:00 PM

-----Original Appointment-----
From: Brian C Mormino [mailto:brian.c.mormino@cummins.com]
Sent: Tuesday, February 10, 2015 8:32 AM
To: Brian C Mormino; Jackie M Yeager; Spears, Matthew; Zhang, Houshun; Charmley, William; Gary C Salemme
Subject: EPA & CMI Call
When: Wednesday, February 11, 2015 2:00 PM-3:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: US toll-free Ex. 6 - Personal Privacy

From: Grundler, Christopher
Location: RM. 6524 DC/RM. C-174 DOD AA
Importance: Normal
Subject: Phase 2 Program and General Update with Cummins Inc.
Categories: Purple Category, Red Category
Start Date/Time: Fri 1/23/2015 7:00:00 PM
End Date/Time: Fri 1/23/2015 8:00:00 PM

AGENDA AND PARTICIPANTS:

Good morning Gwen,

Please see below for the agenda and list of Cummins participants. Please let me know if you have any questions.

Agenda

1) Phase 2 update from EPA
2) Phase 2 update from Cummins
3) Other regulatory or certification emission topics

Cummins Participants

1. John Wall, Chief Technical Officer
2. Brian Mormino, Executive Director, Worldwide Environmental Strategy and Compliance
3. Jackie Yeager, Global Energy Policy Director

Have a great day, Gwen!

All the best,
Emily

Emily Diedrich Foster

Director, Government Relations
Cummins Inc.
601 Pennsylvania Avenue, NW | Suite 1100 North
Washington, DC 20004
Phone: (202) 393-7074 | Mobile: (202) 253-0843 | Fax: (202) 393-8111

Gwen, happy new year! John Wall and I will be in Washington, DC on Friday, January 23rd, and Dr. Wall was hoping to meet with Chris Grundler during his trip. The topics would be the Phase 2 program and general update on other emissions issues. Does he have any time between 9:30 am and 3:30 pm?

Brian C. Mormino
Executive Director -- Worldwide Environmental Strategy & Compliance
Cummins Inc.
MC 60203, 500 Jackson Street
Columbus, IN 47201
812-377-0512 (p)
202-669-3597 (c)
brian.c.mormino@cummins.com

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John Wall and Brian Mormino, Cummins Inc. will be attending the meeting.

To: Spears, Matthew[spears.matthew@epa.gov]; Charmley, William[charmley.william@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gary C Salemme[gary.c.salemme@cummins.com]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; Manik Narula[manik.narula@cummins.com]; erin.luke@paccar.com[erin.luke@paccar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; david.gardner@navistar.com[david.gardner@navistar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]; Ricart-Ugaz, Laura M[Laura.Ricart@Navistar.com]; Marley Jeffrey[jeff.marley@volvo.com]; Mark Malowicki[Mark.Malowicki@PACCAR.com]; Costi Nedelcu[Costi.Nedelcu@PACCAR.com]; Miller Marc[marc.miller@volvo.com]; donald.keski-hynnila@daimler.com[donald.keski-hynnila@daimler.com]; aaron.neuman@daimler.com[aaron.neuman@daimler.com]; gerald.freitag@daimler.com[gerald.freitag@daimler.com]; anirban.sett@daimler.com[anirban.sett@daimler.com]; Brian C Mormino[brian.c.mormino@cummins.com]; steve.berry@volvo.com[steve.berry@volvo.com]; tblubaugh@emamail.org[tblubaugh@emamail.org]; david.kayes@daimler.com[david.kayes@daimler.com]
From: Jackie M Yeager
Sent: Thur 1/7/2016 2:30:23 PM
Subject: RE: Phase 2 Collaboration meeting agenda
EPA Testing overview - 7-23-2015 v2.pdf
Work Planning 1-07-16.pdf

Here are a couple background documents for today's call. The first is a test plan overview that EPA shared previously. The second is a quick review of last year's work. Together these can hopefully set the stage for our work planning discussion.

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

From: Jackie M Yeager
Sent: Wednesday, January 6, 2016 3:38 PM

To: 'spears.matthew@epa.gov' <spears.matthew@epa.gov>; 'charmley.william@epa.gov' <charmley.william@epa.gov>; 'Sanchez.james@Epa.gov' <Sanchez.james@Epa.gov>; Gary C Salemme <gary.c.salemme@cummins.com>; 'tom.sloane@paccar.com' <tom.sloane@paccar.com>; 'Cortney.Guzlas@Navistar.com' <Cortney.Guzlas@Navistar.com>; 'Zhang.Houshun@epa.gov' <Zhang.Houshun@epa.gov>; 'Matthew.Hunkler@Navistar.com' <Matthew.Hunkler@Navistar.com>; Manik Narula <manik.narula@cummins.com>; 'erin.luke@paccar.com' <erin.luke@paccar.com>; 'debbie.gordon@allisontransmission.com' <debbie.gordon@allisontransmission.com>; 'MihaiDorobantu@eaton.com' <MihaiDorobantu@eaton.com>; 'michael.j.howenstein@allisontransmission.com' <michael.j.howenstein@allisontransmission.com>; 'Jeffrey.shultz@allisontransmission.com' <Jeffrey.shultz@allisontransmission.com>; 'david.gardner@navistar.com' <david.gardner@navistar.com>; 'David.Majors@Navistar.com' <David.Majors@Navistar.com>; 'MatthewRBusdiecker@eaton.com' <MatthewRBusdiecker@eaton.com>; 'ErikDykes@eaton.com' <ErikDykes@eaton.com>; 'dan.kieffer@paccar.com' <dan.kieffer@paccar.com>; Anthony Greszler (anthony.greszler@volvo.com) <anthony.greszler@volvo.com>; He Yuesheng <yuesheng.he@volvo.com>; Ricart-Ugaz, Laura M <Laura.Ricart@Navistar.com>; 'Marley Jeffrey' <jeff.marley@volvo.com>; 'Mark Malowicki' <Mark.Malowicki@PACCAR.com>; Costi Nedelcu <Costi.Nedelcu@PACCAR.com>; Miller Marc <marc.miller@volvo.com>; 'donald.keski-hynnila@daimler.com' <donald.keski-hynnila@daimler.com>; 'aaron.neuman@daimler.com' <aaron.neuman@daimler.com>; gerald.freitag@daimler.com; anirban.sett@daimler.com; Brian C Mormino <brian.c.mormino@cummins.com>; 'steve.berry@volvo.com' <steve.berry@volvo.com>; 'tblubaugh@emamail.org' <tblubaugh@emamail.org>; 'david.kayes@daimler.com' <david.kayes@daimler.com>
Subject: Phase 2 Collaboration meeting agenda

Reminder of tomorrow's call at 3:00 pm Eastern.

Proposed agenda:

1. SwRI testing update (if needed) – Houshun
2. Open questions/work planning – All
3. Other topics?
4. Plan next call – All

Call-in information:

Ex. 6 - Personal Privacy

Skype information:

Link for non-Cummins attendees (see additional instructions in the attachment):

→ Join Skype Meeting (web guest)

Link for Cummins attendees:

→ Join Skype Meeting

This is an online meeting for Skype for Business, the professional meetings and communications app formerly known as Lync.

Help

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

To: Greszler Anthony[anthony.greszler@volvo.com]; Spears, Matthew[spears.matthew@epa.gov]; Charmley, William[charmley.william@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gary C Salemme[gary.c.salemme@cummins.com]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; Manik Narula[manik.narula@cummins.com]; erin.luke@paccar.com[erin.luke@paccar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; Brian C Mormino[brian.c.mormino@cummins.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; david.gardner@navistar.com[david.gardner@navistar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; Morgan Andreae[morgan.andreae@cummins.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; He Yuesheng[yuesheng.he@volvo.com]; Ricart-Ugaz, Laura M[Laura.Ricart@Navistar.com]; Marley Jeffrey[jeff.marley@volvo.com]
From: Jackie M Yeager
Sent: Tue 11/10/2015 9:09:49 PM
Subject: RE: Phase 2 Collaboration meeting agenda

Tony, we can certainly add those to the agenda:

Proposed agenda:

1. ISB child rating results – Houshun
2. Volvo questions – Tony
3. Other topics?
4. Plan next call – All

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

From: Greszler Anthony [mailto:anthony.greszler@volvo.com]
Sent: Tuesday, November 10, 2015 3:57 PM
To: Jackie M Yeager <jackie.m.yeager@cummins.com>; spears.matthew@epa.gov; charmley.william@epa.gov; Sanchez.james@Epa.gov; Gary C Salemme <gary.c.salemme@cummins.com>; tom.sloane@paccar.com; Cortney.Guzlas@Navistar.com; Zhang.Houshun@epa.gov; Matthew.Hunkler@Navistar.com; Manik Narula <manik.narula@cummins.com>; erin.luke@paccar.com; debbie.gordon@allisontransmission.com; Brian C Mormino <brian.c.mormino@cummins.com>; MihaiDorobantu@eaton.com; michael.j.howenstein@allisontransmission.com; Jeffrey.shultz@allisontransmission.com; david.gardner@navistar.com; David.Majors@Navistar.com; Morgan Andreae <morgan.andreae@cummins.com>; MatthewRBusdiecker@eaton.com; ErikDykes@eaton.com; dan.kieffer@paccar.com; He Yuesheng <yuesheng.he@volvo.com>; Ricart-Ugaz, Laura M <Laura.Ricart@Navistar.com>; Marley Jeffrey <jeff.marley@volvo.com>
Subject: RE: Phase 2 Collaboration meeting agenda

Here are some added topics that Volvo would like:

•□□□□□□□ Should we be focusing our evaluation on ARB transient?

•□□□□□□□ How can we access GEM revisions that impact engine test cycle? -revised shifting, torque lag, ???

•□□□□□□□ Will GEM include cycle average interpolation scheme? If so, when can we access GEM with this feature?

•□□□□□□□ Can we get a copy of proposed cycle average test procedure, so we are clear what we should be evaluating?

Tony

From: Jackie M Yeager [mailto:jackie.m.yeager@cummins.com]
Sent: Tuesday, November 10, 2015 3:35 PM
To: spears.matthew@epa.gov; charmley.william@epa.gov; Sanchez.james@Epa.gov; Gary C Salemme; tom.sloane@paccar.com; Cortney.Guzlas@Navistar.com; Zhang.Houshun@epa.gov; Matthew.Hunkler@Navistar.com; Manik Narula; erin.luke@paccar.com; debbie.gordon@allisontransmission.com; Brian C Mormino; MihaiDorobantu@eaton.com; michael.j.howenstein@allisontransmission.com; Jeffrey.shultz@allisontransmission.com; david.gardner@navistar.com; David.Majors@Navistar.com; Morgan Andreae; MatthewRBusdiecker@eaton.com; ErikDykes@eaton.com; dan.kieffer@paccar.com; Greszler Anthony; He Yuesheng; Ricart-Ugaz, Laura M; Marley Jeffrey
Subject: Phase 2 Collaboration meeting agenda

Reminder of Thursday's call at 3:00 pm Eastern. Let me know if anyone has agenda topics to add.

I'll try again this week to use Skype for Business (not the same as the regular Skype) for presenting any data. Our IT group tells me that in order to access the meeting through the guest link below, you may need to first install a web app plug-in according to the instructions in the attached PDF. Sorry for the inconvenience.

Proposed agenda:

1. ISB child rating results – Houshun (Houshun, you may want to email your slides to the group in advance if possible, in case we have Skype issues again.)

2. Other topics?

3. Plan next call – All

Call-in information:

Ex. 6 - Personal Privacy

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Link for non-Cummins attendees (see additional instructions in the attachment):

Join Skype Meeting (web guest)

Link for Cummins attendees:

→ Join Skype Meeting

This is an online meeting for Skype for Business, the professional meetings and communications app formerly known as Lync.

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

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Cc: shirish.a.shimpi@cummins.com[shirish.a.shimpi@cummins.com]
From: Andjelka Vujovic
Sent: Thur 9/24/2015 8:43:44 PM
Subject: EMA - EMTC, CARB, EPA & Others - Rescheduled - November 2015 EMTC Meeting

TO: Engine Emissions Measurement & Testing Committee

(EMA Members, CARB, EPA & Others)
CC: Timothy A. French
FROM: Shirish Shimpi
DATE: September 24, 2015
RE: **Rescheduled - November 2015 EMTC Meeting**

Please note that the November 11-12, 2015, EMTC meeting has been rescheduled due to November 11th being a government holiday. The new meeting dates are November 17-18, 2015, and will be held at EPA Offices in Ann Arbor, MI. The meeting will start at 9:00 a.m. on both days and end at 5:00 p.m. on the first day (November 17th) and end at 2:00 p.m. on the second day (November 18th). A meeting notice will be sent out in the near future.

If you have any questions, please do not hesitate to contact me.

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Cc: shirish.a.shimpi@cummins.com[shirish.a.shimpi@cummins.com]
From: Andjelka Vujovic
Sent: Mon 11/9/2015 4:04:54 PM
Subject: EMA - EMTC, CARB, EPA & Others - 1065 Working Document
40 CFR Part 1065 Engine Test Procedures Working Document 11-6-15 Staff Draft.pdf
Duty Cycle Generation Issue - FEV.pdf

TO: Engine Emissions Measurement & Testing Committee

(EMA Members, CARB, EPA & Others)
CC: Timothy A. French
FROM: Shirish Shimpi
DATE: November 9, 2015
RE: **1065 Working Document**

Please see the following email and attachments from EPA's Chris Laroo.

If you have any questions, please do not hesitate to contact me.

From: Laroo, Chris [mailto:laroo.chris@epa.gov]
Sent: Friday, November 06, 2015 1:43 PM
Subject: 1065 Working Document for Circulation to EMTC

Please note that there are extensive editorial changes to 1065.340, CVS calibration. When drafting the CVS calibration section in 40 CFR 1066, 1065.340 was used as the template. The resulting 1066 procedure contained many editorial changes. It was felt that these changes would also benefit 1065, so we are moving forward with making the changes in 1065 as well.

Also attached is an issue that came in from FEV regarding duty-cycle generation that I would like to discuss at the meeting.

Regards,

Chris Laroo

Environmental Protection Specialist

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Office of Transportation and Air Quality

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Cc: shirish.a.shimpi@cummins.com[shirish.a.shimpi@cummins.com]
From: Andjelka Vujovic
Sent: Thur 11/5/2015 9:37:09 PM
Subject: EMA - EMTC, CARB, EPA & Others - November 17-18, 2015, EMTC Meeting Agenda
2015-11-17 to 18 EMTC Meeting - Agenda.docx

TO: Engine Emissions Measurement & Testing Committee

(EMA Members, CARB, EPA & Others)
CC: Timothy A. French
FROM: Shirish Shimpi
DATE: November 5, 2015
RE: **November 17-18, 2015, EMTC Meeting Agenda**

Attached is the agenda for the upcoming EMTC meeting that will take place on November 17-18, in Ann Arbor.

If you have any questions, please do not hesitate to contact me.

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To: Charmley, William[charmley.william@epa.gov]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Lemieux, Stephan@ARB[stephan.lemieux@arb.ca.gov]
Cc: Brian C Mormino[brian.c.mormino@cummins.com]
From: Jackie M Yeager
Sent: Thur 11/5/2015 3:33:17 PM
Subject: RE: Cummins slides from 10/29/15 - Confidential Business Information

Ex. 4 - CBI

Ex. 4 - CBI

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Message encryption by Microsoft Office 365

From: Jackie M Yeager
Location: US toll-free Ex. 6 - Personal Privacy
Importance: Normal
Subject: Phase 2 Collaboration Meeting
Start Date/Time: Fri 8/7/2015 7:00:00 PM
End Date/Time: Fri 8/7/2015 8:00:00 PM

....
;;;;
Rescheduling this week due to conflict with Phase 2 public hearing on 8/6.
Background:
Joint sessions to exchange information on the development and validation of engine/powertrain test cycles and information going into the vehicle simulation for Phase 2.
Teleconference call-in number:

Ex. 6 - Personal Privacy

Webex information:
Topic: Phase 2 Collaboration Mtg
Date: Every Thursday, from Thursday, December 18, 2014, to no end date
Time: 3:00 pm, Eastern Standard Time (New York, GMT-05:00)
Meeting number Ex. 6 - Personal Privacy
Meeting passwo
Please click the link below to see more information about the meeting, including its agenda, or to join the meeting.
https://cummins.webex.com/cummins/j.php?MTID=m2c63d17e27cf5ffc33c45243d3d6bf70
To contact Jackie Yeager, call 1-812-377-8774 or
send a message to this address: jackie.m.yeager@cummins.com>
To update this meeting to your calendar program (for example, Microsoft Outlook or Lotus Notes), do the following:

- For all calendar programs (except Lotus Notes), click the following link, or copy the link and paste it into your Web browser:
  https://cummins.webex.com/cummins/j.php?MTID=mc9c01348d9c3328b70f08715b47954ba

NOTE: Release 6 will be available with PowerSweep II
*For Lotus Notes (Release 6), follow these steps:
1. Right-click the attached iCalendar format (*.ics) file, and then choose View.
2. Click Import All. A new broadcast email message is added to your Inbox.
3. Open the new message.
4. Click Update Calendar.
The playback of UCF (Universal Communications Format) rich media files requires appropriate players. To view this type of rich media files in the meeting, please check whether you have the players installed on your computer by going to https://cummins.webex.com/cummins/systemdiagnosis.php.
http://www.webex.com

To: Brian C Mormino[brian.c.mormino@cummins.com]; Charmley, William[charmley.william@epa.gov]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; Gary C Salemme[gary.c.salemme@cummins.com]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Morgan Andreae[morgan.andreae@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; david.gardner@navistar.com[david.gardner@navistar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; erin.luke@paccar.com[erin.luke@paccar.com]; Manik Narula[manik.narula@cummins.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Sanchez, James[sanchez.james@epa.gov]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]
From: Jackie M Yeager
Sent: Sun 8/2/2015 8:17:16 PM
Subject: Move August 6 Collaboration call?

Hello,

Our next Phase 2 Collaboration call is scheduled for Thursday, August 6. However, that is the same day of the first Phase 2 public hearing in Chicago which several people from this group will be attending in person. It seems we should reschedule our call. Please let me know if any of these alternatives work for your company:

Friday, August 7 at 3:00 pm Eastern

Monday, August 10 at 4:00 pm Eastern

Tuesday, August 11 at 4:00 pm Eastern

Thanks,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

To: Charmley, William[charmley.william@epa.gov]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Lemieux, Stephan@ARB[stephan.lemieux@arb.ca.gov]
Cc: Brian C Mormino[brian.c.mormino@cummins.com]
From: Jackie M Yeager
Sent: Wed 11/4/2015 1:52:07 PM
Subject: Cummins slides from 10/29/15 - Confidential Business Information

Ex. 4 - CBI

Ex. 4 - CBI

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From: Jackie M Yeager
Sent: Wed 7/22/2015 1:49:49 AM
Subject: Phase 2 Collaboration meeting agenda

Reminder of Thursday's call at 3:00 pm Eastern. You should have a new repeating invitation from me extending the calls for every other week until year-end.

Proposed agenda:

1. Summary of completed and planned testing – Houshun
2. Generating engine cycles from GEM – James
3. "Hybrid" concept of alt map + ss map – All
4. Other topics?
5. Plan next call – All

Call-in and Webex information:
Teleconference:

Ex. 6 - Personal Privacy

Topic: Phase 2 Collaboration Mtg
Date: Every Thursday, from Thursday, December 18, 2014, to no end date
Time: 3:00 pm, Eastern Standard Time (New York, GMT-05:00)
Meeting number: Ex. 6 - Personal Privacy
Meeting passwor

Please click the link below to see more information about the meeting, including its agenda, or to join the meeting.

https://cummins.webex.com/cummins/j.php?MTID=m2c63d17e27cf5ffc33c45243d3d6bf70

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

From: Jackie M Yeager
Location: EPA Ann Arbor office
Importance: Normal
Subject: Cummins/EPA meeting
Start Date/Time: Tue 7/28/2015 1:00:00 PM
End Date/Time: Tue 7/28/2015 8:00:00 PM

;
Discuss Phase 2 GHG NPRM.

To: Brian C Mormino[brian.c.mormino@cummins.com]; Charmley, William[charmley.william@epa.gov]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; Gary C Salemme[gary.c.salemme@cummins.com]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Morgan Andreae[morgan.andreae@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; david.gardner@navistar.com[david.gardner@navistar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; erin.luke@paccar.com[erin.luke@paccar.com]; Manik Narula[manik.narula@cummins.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Sanchez, James[sanchez.james@epa.gov]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]
From: Jackie M Yeager
Sent: Thur 7/16/2015 3:03:46 AM
Subject: GEM source code available

All,

EPA asked me pass along that the GEM source code, executable(s), and support information from the EPA HD Phase 2 NPRM Public Docket are available in the Box.com location we have been using to share files on the alternative mapping project. Go to this link and look for the GEM power user zip file in the Phase II GHG Collaboration folder:

Ex. 6 - Personal Privacy

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

To: Brian C Mormino[brian.c.mormino@cummins.com]; Charmley, William[charmley.william@epa.gov]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; Gary C Salemme[gary.c.salemme@cummins.com]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Morgan Andreae[morgan.andreae@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; david.gardner@navistar.com[david.gardner@navistar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; erin.luke@paccar.com[erin.luke@paccar.com]; Manik Narula[manik.narula@cummins.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Sanchez, James[sanchez.james@epa.gov]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]
From: Jackie M Yeager
Sent: Tue 7/14/2015 5:14:39 PM
Subject: 7/9 Phase 2 Collaboration Call Notes

Participants:

- Cummins – Gary Salemme, Jackie Yeager
- Eaton – (Erik on vacation)
- EPA – Matt Spears, Houshun Zhang, James Sanchez
- Navistar – David Gardner, Cortney Guzlas
- PACCAR – Erin Luke, Dan Kieffer
- Allison – Mike Howenstein, Debbie Gordon

Discussion and follow-up items (with owner's name in **bold**):

- NPRM update
  - Federal Register notice on July 13 (http://www.gpo.gov/fdsys/pkg/FR-2015-07-13/pdf/2015-15500.pdf); comments due September 11
  - Public hearing dates will be finalized soon; tentatively during weeks of August 3 and 17
- Next steps
  - Areas for additional work
    - Continued engine and powertrain testing at ORNL, SwRI, EPA

- Refine generic vehicle definition, interpolation/extrapolation routines

- Ideas for reducing test burden

o Check with SwRI on whether ISB engine and/or Allison transmission should be updated – **Houshun**

o Consider "hybrid" concept of using alternative mapping for ARB transient cycle and smaller steady state map on 55, 65 mph cruise cycles as way of reducing test time, for discussion on next call – **All**

o Summarize completed and planned testing for next call – **Houshun**

o Summarize how to generate engine cycles from GEM for next call – **James**

• Plan next call, frequency

o Extend invitation for additional calls every other week starting 7/23 – **Jackie**

• Other

o SAE paper drafts are receiving good ratings from reviewers

o Presenter needed for industry paper at SAE COMVEC (Oct. 6-8)

o Still working to setup EMA discussion on alternate mapping

Topics for future calls:

• (7/23) "Hybrid" concept of alt map + ss map – All

• (7/23) Summary of completed and planned testing – Houshun

• (7/23) Generating engine cycles from GEM – James

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance

Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

To: Andjelka Vujovic[avujovic@emamail.org]; Schrodt, Thomas[schrodt.thomas@epa.gov]; Aiko Matsunaga[amatsuna@arb.ca.gov]; Alberto Ayala (aayala@arb.ca.gov)[aayala@arb.ca.gov]; Atul Shah (ashah@sensors-inc.com)[ashah@sensors-inc.com]; Barbara Marshik Ph. D. (Barbara_Marshik@MKSinst.com)[Barbara_Marshik@MKSinst.com]; Benjamin C. Shade (bshade@tenneco.com)[bshade@tenneco.com]; Bertrand Lanher (blanher@sensors-inc.com)[blanher@sensors-inc.com]; Bill Baker (bbaker@aanddtech.com)[bbaker@aanddtech.com]; Bill Martin (w.t.martin7019@outlook.com)[w.t.martin7019@outlook.com]; Bill Silvis (bill.silvis@avl.com)[bill.silvis@avl.com]; Bishnu, Dipak (dbishnu@arb.ca.gov)[dbishnu@arb.ca.gov]; Giannelli, Bob[Giannelli.Bob@epa.gov]; bradley.bane@ge.com[bradley.bane@ge.com]; Brendan Sherry (brendan.sherry@iav-usa.com)[brendan.sherry@iav-usa.com]; Brian Dueber (bdueber@mtlcorp.com)[bdueber@mtlcorp.com]; Brian Mace (brian.mace@horiba.com)[brian.mace@horiba.com]; Olson, Brian[olson.brian@epa.gov]; Carl D. Ensfield (censfield@sensors-inc.com)[censfield@sensors-inc.com]; Ryan, Carl[ryan.carl@epa.gov]; Charmley, William[charmley.william@epa.gov]; Chris Sharp (chris.sharp@swri.org)[chris.sharp@swri.org]; Dan Carder (daniel.carder@mail.wvu.edu)[daniel.carder@mail.wvu.edu]; Dan Meyerkord [daniel.j.meyerkord@emdiesels.com]; Dan Sales (dsales@gasanalyzers.com)[dsales@gasanalyzers.com]; David Dikken (ddikken@mtlcorp.com)[ddikken@mtlcorp.com]; david.horstman@intertek.com[david.horstman@intertek.com]; dmacdonald@acscm.com[dmacdonald@acscm.com]; Don Chernich[dchernic@arb.ca.gov]; Doug Sobotka (dougexcel@iowatelecom.net)[dougexcel@iowatelecom.net]; Hamady, Fakhri[hamady.fakhri@epa.gov]; Dustin Osborne (dustin.osborne@swri.org)[dustin.osborne@swri.org]; Dylan Mann[dmann@peaker.com]; Frank Berghof (Frank.Berghof@avlna.com)[Frank.Berghof@avlna.com]; Gil LaDuke (ghladuke@gw.dec.state.ny.us)[ghladuke@gw.dec.state.ny.us]; 'Glenn, Doug (GE Infra, Transportation)'[doug.glenn@ge.com]; Glinsky, Gerard (Aurora)[Gerard.Glinsky@sgs.com]; Granville Hayworth [GHayworth@Tenneco.com][GHayworth@Tenneco.com]; Gurdas Singh Sandhu (gssandhu@ncsu.edu)[gssandhu@ncsu.edu]; Harlan Quan[hquan@arb.ca.gov]; htle@arb.ca.gov[htle@arb.ca.gov]; lKhalek@swri.edu[lKhalek@swri.edu]; jlourenc@arb.ca.gov[jlourenc@arb.ca.gov]; Jackson, Cleophas[jackson.cleophas@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gumbs, Jason[Gumbs.Jason@epa.gov]; Jeff R. Wasil (jeff.wasil@brp.com)[jeff.wasil@brp.com]; jlowry@arb.ca.gov[jlowry@arb.ca.gov]; Joe Sweeney (jsweeney@acscm.com)[jsweeney@acscm.com]; John Harrod (jdharrod@netzero.com)[jdharrod@netzero.com]; John R Briggs (John.Briggs@procat-testing.com)[John.Briggs@procat-testing.com]; McDonald, Joseph[McDonald.Joseph@epa.gov]; Joseph McManus[joe.mcmanus@ricardo.com]; Joshua Israel[joshua.israel@mail.wvu.edu]; Keith Vertin (Keith.vertin@sgs.com)[Keith.vertin@sgs.com]; 'Kelly, Brian E (GE Infra, Transportation)'[Brian.Kelly1@ge.com]; Kent Johnson (kjohnson@cert.ucr.edu)[kjohnson@cert.ucr.edu]; Laroo, Chris[laroo.chris@epa.gov]; Loren Mathews (lmathews@gasanalyzers.com)[lmathews@gasanalyzers.com]; Maldonado, Hector (hmaldona@arb.ca.gov)[hmaldona@arb.ca.gov]; Mang Zhang (mzhang@arb.ca.gov)[mzhang@arb.ca.gov]; Peralta, Maria[Peralta.Maria@epa.gov]; Mark Fuentes (mfuentes@arb.ca.gov)[mfuentes@arb.ca.gov]; Spears, Matthew[spears.matthew@epa.gov]; Matt Swanson - CAI, Inc. (mswanson@gasanalyzers.com)[mswanson@gasanalyzers.com]; Matt Thiel (mthiel@acscm.com)[mthiel@acscm.com]; Mayotte, Steve[mayotte.steve@epa.gov]; mcarter@arb.ca.gov[mcarter@arb.ca.gov]; Michael L. Traver (michael.traver@aramcoservices.com)[michael.traver@aramcoservices.com]; Mike Akard (mike.akard@horiba.com)[mike.akard@horiba.com]; Mike May[mike.may@ricardo.com]; mjsmith@swri.edu[mjsmith@swri.edu]; Mohan Krishnamurthy (mkrishna@arb.ca.gov)[mkrishna@arb.ca.gov]; Mridul Gautam (mgautam@wvu.edu)[mgautam@wvu.edu]; Munday, Dave (dave.munday@horiba.com)[dave.munday@horiba.com]; Nelson, Brian[nelson.brian@epa.gov]; Ng, Henry K[hkng@Central.UH.EDU]; Oliver Chang (ochang@arb.ca.gov)[ochang@arb.ca.gov]; Paolo Di Martino (paolo.di.martino@iav-usa.com)[paolo.di.martino@iav-usa.com]; Paul Rieger (prieger@arb.ca.gov)[prieger@arb.ca.gov]; rick.rooney@horiba.com[rick.rooney@horiba.com]; Rob Wilson[rwilson@sensors-inc.com]; Robert C. Anderson

(robert.anderson@tsi.com)[robert.anderson@tsi.com]; Ron Tandy - Horiba[Ron.tandy@horiba.com]; russell.graze@yahoo.com[russell.graze@yahoo.com]; sfritz@swri.org[sfritz@swri.org]; Sonny Moore (smoore@mtlcorp.com)[smoore@mtlcorp.com]; sshakenis@wabtec.com[sshakenis@wabtec.com]; Steve Mitchell (steven.j.mitchell@emdiesels.com)[steven.j.mitchell@emdiesels.com]; Sun, Ruonan[sun.ruonan@epa.gov]; Thomas Lanni (thomaslanni@gmail.com)[thomaslanni@gmail.com]; Tim Johnson (tim.johnson@tsi.com)[tim.johnson@tsi.com]; Todd Carpenter[Todd.Carpenter@avl.com]; Valerie Bossoutrot Ph. D. (valerie.bossoutrot@airliquide.com)[valerie.bossoutrot@airliquide.com]; Virendra Kumar (vkumar@eswgroup.com)[vkumar@eswgroup.com]; Wayne Sobieralski[wsobiera@arb.ca.gov]; William Carnegie[william.carnegie@ge.com]; William Robertson (wroberts@arb.ca.gov)[wroberts@arb.ca.gov]; Williamson, James AVLNA[James.Williamson@avl.com]; Yannick Cizeron (y.cizeron@ja-gastechnology.com)[y.cizeron@ja-gastechnology.com]
Cc: Shirish A Shimpi[shirish.a.shimpi@cummins.com]
From: Andjelka Vujovic
Sent: Mon 7/13/2015 8:31:22 PM
Subject: RE: EMA - EMTC, CARB, EPA & Others - June 10-11, 2015, EMTC Meeting Minutes and Attachments
2015-06-10 and 11 EMTC_meeting minutes - draft final.docx

PLEASE NOTE:

Attached are the meeting minutes that were inadvertently omitted in the previous email.

From: Andjelka Vujovic
Sent: Monday, July 13, 2015 11:48 AM
Subject: EMA - EMTC, CARB, EPA & Others - June 10-11, 2015, EMTC Meeting Minutes and Attachments

TO: Engine Emissions Measurement & Testing Committee

(EMA Members, CARB, EPA & Others)
CC: Timothy A. French
FROM: Shirish Shimpi
DATE: July 13, 2015
RE: **June 10-11, EMTC Meeting Minutes and Attachments**

Attached are the June 10-11, EMTC meeting minutes and attachments.

If you have any questions, please do not hesitate to contact me.

Shirish A. Shimpi, Ph. D.
Director
Emissions Development
Cummins Inc.
Mail Code 50180
1900 McKinley Ave
Columbus, Indiana 47201
Office: (812) 377-7532

Cell: (812) 447-3767

Andjelka Vujovic

Truck & Engine Manufacturers Association

333 West Wacker Drive ▪ Suite 810
Chicago, Illinois ▪ 60606
(312) 929-1973 direct ▪ (312) 929-1975 fax

avujovic@emamail.org

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-

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To: Spears, Matthew[spears.matthew@epa.gov]; Charmley, William[charmley.william@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gary C Salemme[gary.c.salemme@cummins.com]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; Manik Narula[manik.narula@cummins.com]; erin.luke@paccar.com[erin.luke@paccar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; david.gardner@navistar.com[david.gardner@navistar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]; Ricart-Ugaz, Laura M[Laura.Ricart@Navistar.com]; Marley Jeffrey[jeff.marley@volvo.com]; Mark Malowicki[Mark.Malowicki@PACCAR.com]; Costi Nedelcu[Costi.Nedelcu@PACCAR.com]; Miller Marc[marc.miller@volvo.com]; donald.keski-hynnila@daimler.com[donald.keski-hynnila@daimler.com]; aaron.neuman@daimler.com[aaron.neuman@daimler.com]; gerald.freitag@daimler.com[gerald.freitag@daimler.com]; anirban.sett@daimler.com[anirban.sett@daimler.com]; Brian C Mormino[brian.c.mormino@cummins.com]; steve.berry@volvo.com[steve.berry@volvo.com]; tblubaugh@emamail.org[tblubaugh@emamail.org]; david.kayes@daimler.com[david.kayes@daimler.com]
From: Jackie M Yeager
Sent: Wed 1/6/2016 8:37:41 PM
Subject: Phase 2 Collaboration meeting agenda
Joining Skype for Business Meetings (External).pdf

Reminder of tomorrow's call at 3:00 pm Eastern.

Proposed agenda:

1. SwRI testing update (if needed) – Houshun

2. Open questions/work planning – All

3. Other topics?

4. Plan next call – All

Call-in information:
US toll-free Ex. 6 - Personal Privacy
Access code

Skype information:

Link for non-Cummins attendees (see additional instructions in the attachment):

→ Join Skype Meeting (web guest)

Link for Cummins attendees:

.....

→ Join Skype Meeting

This is an online meeting for Skype for Business, the professional meetings and communications app formerly known as Lync.

Help

.....

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

To: Spears, Matthew[spears.matthew@epa.gov]; Charmley, William[charmley.william@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gary C Salemme[gary.c.salemme@cummins.com]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; Manik Narula[manik.narula@cummins.com]; erin.luke@paccar.com[erin.luke@paccar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; david.gardner@navistar.com[david.gardner@navistar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]; Ricart-Ugaz, Laura M[Laura.Ricart@Navistar.com]; Marley Jeffrey[jeff.marley@volvo.com]; Mark Malowicki[Mark.Malowicki@PACCAR.com]; Costi Nedelcu[Costi.Nedelcu@PACCAR.com]; Miller Marc[marc.miller@volvo.com]; donald.keski-hynnila@daimler.com[donald.keski-hynnila@daimler.com]; aaron.neuman@daimler.com[aaron.neuman@daimler.com]; gerald.freitag@daimler.com[gerald.freitag@daimler.com]; anirban.sett@daimler.com[anirban.sett@daimler.com]; Brian C Mormino[brian.c.mormino@cummins.com]; steve.berry@volvo.com[steve.berry@volvo.com]; tblubaugh@emamail.org[tblubaugh@emamail.org]; david.kayes@daimler.com[david.kayes@daimler.com]
From: Jackie M Yeager
Sent: Tue 1/5/2016 3:41:16 PM
Subject: 12/17 Collaboration Call Notes

Participants:

- Cummins – Jackie Yeager, Manik Narula
- Eaton – Erik Dykes
- EPA – Houshun Zhang, James Sanchez
- Navistar – Cortney Guzlas, Dave Gardner, Matt Hunkler
- PACCAR – Dan Kieffer, Erin Luke, Mark Malowicki
- Allison –
- Volvo – Marc Miller, Steve Berry, Yuesheng He
- Daimler – Don Keski, David Kayes, Gerald Freitag

Discussion and follow-up items (with owner's name in **bold**):

- SwRI testing update – Houshun

o Regression model analysis – SwRI looking into why Model 2 (bsfc) and Model 8 (fuel mass) do not look as good for child ratings on 55 and 65 mph cycles

o Testing – Only N13 child rating testing has not been completed

•□□□□□□□□ EMTC update – James

o James reported on November EMTC discussions pertaining to cycle average map

o Pre-conditioning was a big focus; drafting language to prescribe test order to reduce variability

o Discussion on fuel calculations from emissions measurements

o Discussion on measurement techniques and variability for potential SwRI study

•□□□□□□□□ Other topics

o January version of GEM will incorporate elements to handle cycle average map, including regression Model 8 (fuel mass)

o Number of required data points in SS map not finalized yet

o How will NOx measurements during cycle average map be used?

o Can we identify various work tasks that still need to be done, and by when? For next call, everyone be prepared to discuss open questions that still need work – **All**

▪· For example, after bug fixes and other changes are implemented in GEM, does any validation testing, regression model analysis, etc. need to be re-visited?

Topics for future calls:

•□□□□□□□□ (1/7) SwRI update – Houshun

•□□□□□□□□ (1/7) Open questions/work remaining – All

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

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To: Brian C Mormino[brian.c.mormino@cummins.com]; Jon A Dickson[jon.a.dickson@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Charmley, William[charmley.william@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gary C Salemme[gary.c.salemme@cummins.com]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; Manik Narula[manik.narula@cummins.com]; erin.luke@paccar.com[erin.luke@paccar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; david.gardner@navistar.com[david.gardner@navistar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]; Ricart-Ugaz, Laura M[Laura.Ricart@Navistar.com]; Marley Jeffrey[jeff.marley@volvo.com]; Mark Malowicki[Mark.Malowicki@PACCAR.com]; Costi Nedelcu[Costi.Nedelcu@PACCAR.com]; Miller Marc[marc.miller@volvo.com]; donald.keski-hynnila@daimler.com[donald.keski-hynnila@daimler.com]; aaron.neuman@daimler.com[aaron.neuman@daimler.com]; gerald.freitag@daimler.com[gerald.freitag@daimler.com]; steve.berry@volvo.com[steve.berry@volvo.com]; tblubaugh@emamail.org[tblubaugh@emamail.org]; david.kayes@daimler.com[david.kayes@daimler.com]; Mark.Siddall@HMMUSA.COM[Mark.Siddall@HMMUSA.COM]; LIN_GEORGE@cat.com[LIN_GEORGE@cat.com]; inderpal.singh@daimler.com[inderpal.singh@daimler.com]; Kaslavage Charles[charles.kaslavage@volvo.com]; scott.mundy@allisontransmission.com[scott.mundy@allisontransmission.com]; Thomas Manley[Thomas.Manley@HMMUSA.COM]
From: Jackie M Yeager
Sent: Tue 5/17/2016 9:09:06 PM
Subject: 5/5 Collaboration Call Notes

Participants:

- Allison – Scott Mundy
- Caterpillar –
- Cummins – Manik Narula, Jackie Yeager
- Daimler – Gerald Freitag, Inderpal Singh
- Eaton – Erik Dykes
- EMA – Tim Blubaugh
- EPA – Houshun Zhang, Matt Spears, James Sanchez
- Hino – Mark Siddall

- Navistar – Cortney Guzlas, Matt Hunkler, Laura Ricart-Ugaz
- PACCAR – Mark Malowicki, Dan Kieffer, Erin Luke
- Volvo – Marc Miller, Tim Connors, Tony Greszler

Discussion and follow-up items (with owner's name in **bold**):

- Generic vehicle definition – All
  - Discussion about impact of assuming automatic transmission on N/V coverage
- Cycle average map option – All
  - Discussion about GEM shift algorithm and using an EPA default (generic) steady state fuel map for shifting if manufacturer chooses to use a cycle average map for all 3 GEM cycles
    - Shape (not absolute values) of default map matters for shifting, also engine torque curve
    - Actual engine torque curve still used
  - Discussion about confirmatory testing scenarios

Topics for future calls:

- (TBD) SwRI results (gasoline engine) – Houshun

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

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To: Spears, Matthew[spears.matthew@epa.gov]; Charmley, William[charmley.william@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gary C Salemme[gary.c.salemme@cummins.com]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; Manik Narula[manik.narula@cummins.com]; erin.luke@paccar.com[erin.luke@paccar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; david.gardner@navistar.com[david.gardner@navistar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]; Ricart-Ugaz, Laura M[Laura.Ricart@Navistar.com]; Marley Jeffrey[jeff.marley@volvo.com]; Mark Malowicki[Mark.Malowicki@PACCAR.com]; Costi Nedelcu[Costi.Nedelcu@PACCAR.com]; Miller Marc[marc.miller@volvo.com]; donald.keski-hynnila@daimler.com[donald.keski-hynnila@daimler.com]; aaron.neuman@daimler.com[aaron.neuman@daimler.com]; gerald.freitag@daimler.com[gerald.freitag@daimler.com]; anirban.sett@daimler.com[anirban.sett@daimler.com]; Brian C Mormino[brian.c.mormino@cummins.com]; steve.berry@volvo.com[steve.berry@volvo.com]; tblubaugh@emamail.org[tblubaugh@emamail.org]; david.kayes@daimler.com[david.kayes@daimler.com]
From: Jackie M Yeager
Sent: Tue 1/5/2016 3:39:13 PM
Subject: 12/3 Collaboration Call Notes

Participants:

- Cummins – Jackie Yeager, Manik Narula
- Eaton – Erik Dykes
- EPA – Houshun Zhang, James Sanchez
- Navistar – Cortney Guzlas, Dave Gardner
- PACCAR – Dan Kieffer, Erin Luke, Mark Malowicki
- Allison –
- Volvo – Tony Greszler, Marc Miller
- Daimler – Anirban Sett, David Kayes, Gerald Freitag

Discussion and follow-up items (with owner's name in **bold**):

- SwRI testing update – Houshun

- See slides sent previously by Houshun

- Analyzing 12 regression models each for bsfc and fuel flow, using various combinations of N/V, work, T, N for ISB and N13 engines on parent and child ratings

- Models using N and T terms so far have better correlations than N/V and cycle work, and fuel flow might be better than bsfc

- Most promising regression model will be built into 'debug version' of GEM

• Half-hill cycle results – Erik

- See slides previously sent by Erik

- Evaluated latest road grade profiles from NREL on ISX engine + 10 speed Eaton FAS transmission running in test cell

- New steeper % grades are more realistic, but not the hill shapes – similar conclusion from Volvo simulations comparing to logged vehicle data

Topics for future calls:

• (12/17) SwRI update – Houshun

• (12/17) EMTC update – James

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

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To: Grundler, Christopher[grundler.christopher@epa.gov]
Cc: Manik Narula[manik.narula@cummins.com]; Gary C Salemme[gary.c.salemme@cummins.com]; Jackie M Yeager[jackie.m.yeager@cummins.com]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Charmley, William[charmley.william@epa.gov]; Matthew Psota[matthew.psota@cummins.com]
From: Brian C Mormino
Sent: Mon 12/21/2015 8:53:30 PM
Subject: Re: Request for ISB data

I am following up on this note as both Volvo and Navistar just approved sharing the data from their engines. We also approve Shari g the data from our engine.

Houshun, I will forward you their emails. It is very important that we move quickly. All the companies seem unified in generating and sharing data. Thanks for your help.

Sent from my iPhone

On Dec 18, 2015, at 6:31 PM, Brian C Mormino <brian.c.mormino@cummins.com> wrote:

Chris, it was very good to see you today. Thanks for making the time, and we look forward to continuing to work together on Phase 2. Please see below on our email requests tied to data surrounding the cycle average map as we discussed with you and Janet today. We want to be able to perform some analyses over the next few weeks as we prepare for the next meeting with EPA in January on this topic as well as the questions around engine platforms. Thanks in advance for your consideration,

Brian

From: Jackie M Yeager
Sent: Friday, December 18, 2015 6:19 PM
To: Zhang, Houshun <Zhang.Houshun@epa.gov>
Cc: Manik Narula <manik.narula@cummins.com>; Gary C Salemme <gary.c.salemme@cummins.com>; Brian C Mormino <brian.c.mormino@cummins.com>
Subject: FW: Request for ISB data

Hello Houshun,

I wanted to follow up with you to check whether EPA will be able to share the ISB data we requested? We would also like to request the same data for the other engines EPA has tested (ISX, Navistar, and Volvo). Our interest is in doing additional analysis to understand issues you are seeing with the cycle average map on the 55 and 65 mph cycles. Please let me know if EPA can share the data.

Thanks,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

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jackie.m.yeager@cummins.com

From: Jackie M Yeager
Sent: Friday, December 4, 2015 3:59 PM
To: 'Zhang.Houshun@epa.gov' <Zhang.Houshun@epa.gov>
Cc: Manik Narula <manik.narula@cummins.com>
Subject: Request for ISB data

Hi Houshun,

As follow up to our discussion earlier this week, attached is a description of the ISB data from SwRI testing that we would like to request. We are ok if you need to share the data with the whole collaboration group that has been working on the cycle average mapping approach. Please let us know if EPA can accommodate the request, or if you have any questions.

Thanks,

Jackie Yeager

GHG/Fuel Efficiency Policy Director

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To: Spears, Matthew[spears.matthew@epa.gov]; Charmley, William[charmley.william@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gary C Salemme[gary.c.salemme@cummins.com]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; Manik Narula[manik.narula@cummins.com]; erin.luke@paccar.com[erin.luke@paccar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; Brian C Mormino[brian.c.mormino@cummins.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; david.gardner@navistar.com[david.gardner@navistar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]; Ricart-Ugaz, Laura M[Laura.Ricart@Navistar.com]; Marley Jeffrey[jeff.marley@volvo.com]; Mark Malowicki[Mark.Malowicki@PACCAR.com]; Costi Nedelcu[Costi.Nedelcu@PACCAR.com]; Miller Marc[marc.miller@volvo.com]; donald.keski-hynnila@daimler.com[donald.keski-hynnila@daimler.com]; aaron.neuman@daimler.com[aaron.neuman@daimler.com]; gerald.freitag@daimler.com[gerald.freitag@daimler.com]; anirban.sett@daimler.com[anirban.sett@daimler.com]; steve.berry@volvo.com[steve.berry@volvo.com]; tblubaugh@emamail.org[tblubaugh@emamail.org]; david.kayes@daimler.com[david.kayes@daimler.com]
From: Jackie M Yeager
Sent: Thur 12/17/2015 11:38:23 AM
Subject: Phase 2 Collaboration meeting agenda
Joining Skype for Business Meetings (External).pdf

Reminder of today's call at 3:00 pm Eastern. Sorry I haven't issued meeting notes yet for the last call. These are the agenda topics we agreed on last time – any others?

Proposed agenda:

1. SwRI testing update – Houshun

2. EMTC update – James

3. Other topics?

4. Plan next call – All

Call-in information:
US toll-free
Access code

Ex. 6 - Personal Privacy

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→ Join Skype Meeting (web guest)

Link for Cummins attendees:

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→ Join Skype Meeting

This is an online meeting for Skype for Business, the professional meetings and communications app formerly known as Lync.

Help

.....

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
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From: jeannie.carpenter@cummins.com
Location: Ex. 6 - Personal Privacy & Conf. Room L207/CTC
Importance: Normal
Subject: Prep Mtg for EPA-CMI Ann Arbor Disc on Oct 29
Start Date/Time: Mon 9/21/2015 12:30:00 PM
End Date/Time: Mon 9/21/2015 1:00:00 PM

;

To: Jackie M Yeager[jackie.m.yeager@cummins.com]; Brian C Mormino[brian.c.mormino@cummins.com]; Charmley, William[charmley.william@epa.gov]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; Gary C Salemme[gary.c.salemme@cummins.com]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Morgan Andreae[morgan.andreae@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; david.gardner@navistar.com[david.gardner@navistar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; erin.luke@paccar.com[erin.luke@paccar.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Sanchez, James[sanchez.james@epa.gov]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]
From: Manik Narula
Sent: Thur 9/17/2015 1:10:58 PM
Subject: RE: Phase 2 Collaboration meeting agenda
Parent_Child_AltMethod_analysis_v3.pdf

All,

Regarding agenda # 2 (child rating analysis), I plan to go through the attached presentation.

Thanks

Manik Narula
Technical Advisor,

Advanced Engineering Systems Integration

Cummins Inc.

Cummins Technical Center, MC 50030

1900 Mckinley Ave
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U.S.A.

Phone 1-812-341-1460
Fax 1-812-377-7226
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manik.narula@cummins.com

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From: Jackie M Yeager
Sent: Thursday, September 17, 2015 7:34 AM
To: Brian C Mormino <brian.c.mormino@cummins.com>; charmley.william@epa.gov; Cortney.Guzlas@Navistar.com; dan.kieffer@paccar.com; David.Majors@Navistar.com; Gary C Salemme <gary.c.salemme@cummins.com>; Matthew.Hunkler@Navistar.com; MihaiDorobantu@eaton.com; Morgan Andreae <morgan.andreae@cummins.com>; spears.matthew@epa.gov; Zhang.Houshun@epa.gov; david.gardner@navistar.com; debbie.gordon@allisontransmission.com; ErikDykes@eaton.com; erin.luke@paccar.com; Manik Narula <manik.narula@cummins.com>; MatthewRBusdiecker@eaton.com; michael.j.howenstein@allisontransmission.com; Sanchez.james@Epa.gov; tom.sloane@paccar.com; Jeffrey.shultz@allisontransmission.com; Anthony Greszler (anthony.greszler@volvo.com) <anthony.greszler@volvo.com>; He Yuesheng <yuesheng.he@volvo.com>
Subject: Phase 2 Collaboration meeting agenda

Reminder of today's call at 3:00 pm Eastern.

Proposed agenda:

1. Volvo summary of observations on cycle average approach – Yuesheng
2. Child ratings analysis – Manik
3. Other topics?
4. Plan next call – All

Call-in and Webex information:
Teleconference:
US toll-free
Access code

Ex. 6 - Personal Privacy

Topic: Phase 2 Collaboration Mtg

Date: Every Thursday, from Thursday, December 18, 2014, to no end date
Time: 3:00 pm, Eastern Standard Time (New York, GMT-05:00)
Meeting number: Ex. 6 - Personal Privacy
Meeting passwor

Please click the link below to see more information about the meeting, including its agenda, or to join the meeting.

https://cummins.webex.com/cummins/j.php?MTID=m2c63d17e27cf5ffc33c45243d3d6bf70

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

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To: Brian C Mormino[brian.c.mormino@cummins.com]; Charmley, William[charmley.william@epa.gov]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; Gary C Salemme[gary.c.salemme@cummins.com]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Morgan Andreae[morgan.andreae@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; david.gardner@navistar.com[david.gardner@navistar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; erin.luke@paccar.com[erin.luke@paccar.com]; Manik Narula[manik.narula@cummins.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Sanchez, James[sanchez.james@epa.gov]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]
From: Jackie M Yeager
Sent: Thur 9/17/2015 11:34:06 AM
Subject: Phase 2 Collaboration meeting agenda

Reminder of today's call at 3:00 pm Eastern.

Proposed agenda:

1. Volvo summary of observations on cycle average approach – Yuesheng

2. Child ratings analysis – Manik

3. Other topics?

4. Plan next call – All

Call-in and Webex information:
Teleconference:
US toll-free Ex. 6 - Personal Privacy
Access code

Topic: Phase 2 Collaboration Mtg
Date: Every Thursday, from Thursday, December 18, 2014, to no end date
Time: 3:00 pm, Eastern Standard Time (New York, GMT-05:00)
Meeting number: Ex. 6 - Personal Privacy
Meeting passwor

Please click the link below to see more information about the meeting, including its agenda, or to

join the meeting.

https://cummins.webex.com/cummins/j.php?MTID=m2c63d17e27cf5ffc33c45243d3d6bf70

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

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Phone 812-377-8774
jackie.m.yeager@cummins.com

To: Brian C Mormino[brian.c.mormino@cummins.com]; Charmley, William[charmley.william@epa.gov]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; Gary C Salemme[gary.c.salemme@cummins.com]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Morgan Andreae[morgan.andreae@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; david.gardner@navistar.com[david.gardner@navistar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; erin.luke@paccar.com[erin.luke@paccar.com]; Manik Narula[manik.narula@cummins.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Sanchez, James[sanchez.james@epa.gov]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]
From: Jackie M Yeager
Sent: Wed 9/16/2015 3:08:36 PM
Subject: 9/3 Phase 2 Collaboration Call Notes

Participants:

- Cummins – Jackie Yeager, Manik Narula
- Eaton – Erik Dykes
- EPA – Houshun Zhang, James Sanchez
- Navistar –Cortney Guzlas, Matt Hunkler, Brad Carlson, Laura Richart
- PACCAR – Dan Kieffer, Erin Luke
- Allison – Mike Howenstein, Jeff Shultz
- Volvo – Tony Greszler, Yuesheng He

Discussion and follow-up items (with owner's name in **bold**):

- Update on Volvo testing – Yuesheng/Tony

o Volvo shared in-progress results from engine dyno testing on GEM-generated cycles – observations:

- Did not get expected spread of N/V on 55 mph cycle
- Vehicle struggling to hit vehicle speed target on ARB transient cycle

- Houshun – could be issue with auto shift in GEM, which will be re-calibrated once more data available from SwRI and ORNL tests

- Saw high cycle work on the config with low axle ratio

o Houshun requested comparison of interpolation scheme from Excel file vs. surface fit from SAE paper – **Yuesheng**

• Other topics

o Question about transfer case efficiency losses in GEM missing from vehicle sub-categories other than Class 8 tractor

o New grade profiles

- Some vehicles can't follow trace – will +/- constraint on vehicle speed target be retained? Yes, but could be improved, need some metric to constrain how driver model is tuned for powertrain test

- Test won't be invalidated for not meeting speed target if at max effort/full pedal

- Some technologies intentionally don't follow the trace (for example, predictive technologies) – how to account for in powertrain testing and in GEM?

- Will powertrain protocol allow grade inputs to ECM or transmission? Could consider it

o Houshun requested comparison of interpolation scheme vs. surface fit – **Manik**

Topics for future calls:

• (9/17) – Update on engine testing – Yuesheng

• (9/17) – Child ratings analysis – Manik

• (9/17?) – Comparison of interpolation vs. surface fit – Manik

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance

Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

To: Charmley, William[charmley.william@epa.gov]
Cc: Spears, Matthew[spears.matthew@epa.gov]; Jackie M Yeager[jackie.m.yeager@cummins.com]; Jeannie Carpenter[jeannie.carpenter@cummins.com]
From: Brian C Mormino
Sent: Wed 9/16/2015 1:26:26 PM
Subject: RE: Oct 29

Correct! We're good.

From: Charmley, William [mailto:charmley.william@epa.gov]
Sent: Wednesday, September 16, 2015 9:26 AM
To: Brian C Mormino <brian.c.mormino@cummins.com>
Cc: Spears, Matthew <spears.matthew@epa.gov>; Jackie M Yeager <jackie.m.yeager@cummins.com>; Jeannie Carpenter <jeannie.carpenter@cummins.com>
Subject: Re: Oct 29

Oops

I just realized you were talking probably about a pre-meeting call next week on Monday at 8:30am. That sounds good

Bill Charmley

Assessment and Standards Division

Office of Transportation and Air Quality

National Vehicle & Fuel Emissions Laboratory

US Environmental Protection Agency

Ann Arbor, Michigan

Desk phone 734-214-4466

Mobile phone 734-545-0333

Email charmley.william@epa.gov

On Sep 16, 2015, at 9:24 AM, Charmley, William <charmley.william@epa.gov> wrote:

Brian

Oct 29 is a Thursday

Just want to make sure we are talking about he same date

Thanks

Bill

Bill Charmley

Assessment and Standards Division

Office of Transportation and Air Quality

National Vehicle & Fuel Emissions Laboratory

US Environmental Protection Agency

Ann Arbor, Michigan

Desk phone 734-214-4466

Mobile phone 734-545-0333

Email charmley.william@epa.gov

On Sep 16, 2015, at 9:08 AM, Brian C Mormino <brian.c.mormino@cummins.com> wrote:

Let's go with Monday. I will send invite.

From: Charmley, William [mailto:charmley.william@epa.gov]
Sent: Wednesday, September 16, 2015 6:21 AM
To: Brian C Mormino <brian.c.mormino@cummins.com>
Cc: Spears, Matthew <spears.matthew@epa.gov>; Jackie M Yeager <jackie.m.yeager@cummins.com>
Subject: RE: Oct 29

Dear Brian,

Thank you for being willing to come to Ann Arbor on October 29. I realize my voice my was wandering around a little, but I think you got the main point – we are going to be very busy in October and November, so I really appreciate Cummins coming to EPA for this.

Matt and I caught up on this yesterday, and we are all set – we will plan on meeting with you, Jackie and others on October 29 in Ann Arbor.

Regarding a pre-meeting call, I could do a call any day next week if the start time is 8:30am eastern – just let me know which day.

Best regards,

Bill

Bill Charmley

Director

Assessment and Standards Division

Office of Transportation and Air Quality

U.S. Environmental Protection Agency

National Vehicle and Fuel Emissions Laboratory

2000 Traverwood Drive

Ann Arbor, MI 48105

desk ph. 734-214-4466

cell ph. 734-545-0333

e-mail: charmley.william@epa.gov

From: Brian C Mormino [mailto:brian.c.mormino@cummins.com]
Sent: Friday, September 11, 2015 12:06 PM
To: Charmley, William
Cc: Spears, Matthew; Jackie M Yeager
Subject: Oct 29

Bill, I got your voicemail. We will come to Ann Arbor on October 29. It would be very helpful if you could lay out what you want to hear from us. Maybe have a call to discuss in the next week or so?

To: Spears, Matthew[spears.matthew@epa.gov]; Charmley, William[charmley.william@epa.gov]
Cc: Jackie M Yeager[jackie.m.yeager@cummins.com]
From: Brian C Mormino
Sent: Tue 9/8/2015 10:12:36 PM
Subject: RE: New Date - Oct 29?

Bill, will October 29 work for a visit to Columbus?

From: Brian C Mormino
Sent: Thursday, September 03, 2015 6:54 PM
To: 'Spears, Matthew' <spears.matthew@epa.gov>; Charmley, William <charmley.william@epa.gov>
Cc: Jackie M Yeager <jackie.m.yeager@cummins.com>
Subject: RE: New Date - Oct 29?

I will also be at Integer so thought this date could work. Bill, what about you and Chris?

From: Spears, Matthew [mailto:spears.matthew@epa.gov]
Sent: Thursday, September 03, 2015 10:20 AM
To: Brian C Mormino <brian.c.mormino@cummins.com>; Charmley, William <charmley.william@epa.gov>
Cc: Jackie M Yeager <jackie.m.yeager@cummins.com>
Subject: RE: New Date - Oct 29?

Hi Brian,

That could potentially work for me. I would be traveling directly from the DEF Integer conference in Chicago the day before.

From: Brian C Mormino [mailto:brian.c.mormino@cummins.com]

Sent: Thursday, September 03, 2015 7:46 AM
To: Charmley, William; Spears, Matthew
Cc: Jackie M Yeager
Subject: New Date - Oct 29?

Bill and Matt – Given the extension on the comments deadline, we are looking for a date in October for you to come to Columbus. We can make October 29th work. Could that work for you?

From: Charmley, William [mailto:charmley.william@epa.gov]
Sent: Tuesday, August 25, 2015 12:08 PM
To: Brian C Mormino <brian.c.mormino@cummins.com>
Cc: Spears, Matthew <spears.matthew@epa.gov>; Jackie M Yeager <jackie.m.yeager@cummins.com>
Subject: RE: Sept 30?

Brian and Jackie

I have not had a chance to catch up with Matt on this request, and it's already Tuesday.

I do know that both Chris and I have an all-day meeting with a light-duty OEM on that day, but I don't think we both have to attend it. It is possible that I could go to Columbus, and Chris could cover the other meeting. However, it's also very important that I check with Matt and a few others on the staff to understand if they can attend, as they are more important than me for a meeting like this.

For now, please put a place holder on September 30, but it may be another week before you hear back from Matt or I on this (unless Matt has already given you some feedback).

Thanks

Bill

Bill Charmley

Director

Assessment and Standards Division

Office of Transportation and Air Quality

U.S. Environmental Protection Agency

National Vehicle and Fuel Emissions Laboratory

2000 Traverwood Drive

Ann Arbor, MI 48105

desk ph. 734-214-4466

cell ph. 734-545-0333

e-mail: charmley.william@epa.gov

From: Brian C Mormino [mailto:brian.c.mormino@cummins.com]
Sent: Friday, August 21, 2015 9:56 PM
To: Charmley, William
Cc: Spears, Matthew; Jackie M Yeager
Subject: Sept 30?

Bill, I am following up on our discussion on Phase 2 and the need for a deep dive on technologies and technical issues. I have checked and my schedule lines up with both John and Jen on September 30th. We could get into the whole suite of issues that we discussed as well as show you directly the latest on Waste Heat Recovery. Could that work for you and the team to come down to Columbus for the day? How about Chris?

Brian C. Mormino
Executive Director -- Worldwide Environmental Strategy & Compliance
Cummins Inc.

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Columbus, IN 47201
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202-669-3597 (c)
brian.c.mormino@cummins.com

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To: Charmley, William[charmley.william@epa.gov]; Jackie M Yeager[jackie.m.yeager@cummins.com]; Olechiw, Michael[olechiw.michael@epa.gov]; McDonald, Joseph[McDonald.Joseph@epa.gov]
Cc: Brian C Mormino[brian.c.mormino@cummins.com]
From: Michael J Ruth
Sent: Tue 9/8/2015 1:27:54 PM
Subject: RE: Follow-up with Cummins on Light-duty vehicle diesel engine technologies

We would be willing to bring the vehicle as a show and tell. If you would like to test our vehicle at your facility, we would need to do some level of negotiation of what we would allow as some of the technology is still pending IP concerns.

Michael J Ruth

Director – Advanced Systems Integration

Chassis Certified Products

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USA

317 727 2530

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michael.j.ruth@cummins.com

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From: Charmley, William [mailto:charmley.william@epa.gov]
Sent: Tuesday, September 08, 2015 8:19 AM
To: Michael J Ruth <michael.j.ruth@cummins.com>; Jackie M Yeager <jackie.m.yeager@cummins.com>; Olechiw, Michael <olechiw.michael@epa.gov>; McDonald, Joseph <McDonald.Joseph@epa.gov>
Cc: Brian C Mormino <brian.c.mormino@cummins.com>
Subject: RE: Follow-up with Cummins on Light-duty vehicle diesel engine technologies

Mike –

Thanks for the response. Yes, this would be lucky for me, two interactions in one month, but unfortunately I'm going to have to hand this one off to Mike Olechiw and Joe McDonald on my team.

Mike and Joe will be tied up this week with me at a series of meetings with some of the light-duty OEMs, but I know that Joe is very interested in learning more about the ATLAS project. I believe Joe went to the DOE merit reviews this past June and was probably on a review panel for the project, but I believe he has a number of more detailed questions.

Joe – can you follow up with Mike Ruth directly?

Thanks

Bill

From: Michael J Ruth [mailto:michael.j.ruth@cummins.com]
Sent: Friday, August 28, 2015 7:53 AM
To: Jackie M Yeager; Charmley, William; Olechiw, Michael
Cc: Brian C Mormino
Subject: RE: Follow-up with Cummins on Light-duty vehicle diesel engine technologies

Bill, Lucky you. Another opportunity for you to interact with me.

Michael J Ruth

Director – Advanced Systems Integration

Chassis Certified Products

Cummins Technical Center

M/C 50030

1900 McKinley Ave

Columbus, IN 47201-3005

USA

317 727 2530

cummins.com

michael.j.ruth@cummins.com

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From: Jackie M Yeager
Sent: Friday, August 28, 2015 6:26 AM
To: Charmley, William <charmley.william@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>
Cc: Brian C Mormino <brian.c.mormino@cummins.com>; Michael J Ruth <michael.j.ruth@cummins.com>
Subject: RE: Follow-up with Cummins on Light-duty vehicle diesel engine technologies

Bill,

Cummins would be happy to discuss the 2.8L engine which was part of the ATLAS project with DOE. Mike Ruth, whom I have cc'ed here, was the Principal Investigator for the project. We look forward to hearing from Mike O. and Joe.

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

From: Charmley, William [mailto:charmley.william@epa.gov]
Sent: Wednesday, August 26, 2015 9:03 AM
To: Jackie M Yeager <jackie.m.yeager@cummins.com>; Olechiw, Michael <olechiw.michael@epa.gov>
Cc: Brian C Mormino <brian.c.mormino@cummins.com>
Subject: Follow-up with Cummins on Light-duty vehicle diesel engine technologies

Dear Jackie,

Thanks for your response, I had thought maybe you would be sticking around today for the rest of the EMA meeting, but given the focus on tractor aerodynamics for today I can understand why you choose not to.

I had wanted to introduce you to Matt's light-duty counterpart in my Division, Mike Olechiw.

Mike is leading up the technical analysis for the EPA light-duty vehicle GHG Mid-term Evaluation team. This is the regulatory commitment EPA made in the final rule for the 2017-2025 light-duty vehicle GHG/Fuel Economy rule with NHTSA, where we committed to a

process to re-assess the appropriateness of the 2022-2025 standards.

I am sure that Cummins will be interested in participating at some level in this multi-year review, and I wanted to take the opportunity to introduce you to Mike. I will still do that, but it will now be via email.

One near-term request that Mike and his staff have for Cummins is regarding the Cummins light-duty 2.8 L project. Mike's subject matter expert on his staff for this project for engine technologies is Joe McDonald, who many of your colleagues at Cummins probably know. Joe attended this past spring/summer the DOE merit reviews (which he has done for many, many years), and I believe he heard the update from the Cummins folks.

Mike and Joe would like to follow up with you and Brian very soon regarding our interest in this engine.

At this point I will leave it to Mike and Joe to follow up with you on this topic.

Thanks

Bill

From: Jackie M Yeager [mailto:jackie.m.yeager@cummins.com]
Sent: Wednesday, August 26, 2015 8:47 AM
To: Charmley, William
Cc: Iffland, JoNell
Subject: RE: Jackie - if you get to the EPA office's before 9am, can you ask the guards to call me, I wanted to talk with you regarding a Light-duty Diesel topic. Thanks, Bill Charmley

Hi Bill – I am actually back in Columbus today. I did not stay in town for the aero discussion. Would you like to call me on the LD topic?

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

From: Charmley, William [mailto:charmley.william@epa.gov]
Sent: Wednesday, August 26, 2015 8:45 AM
To: Jackie M Yeager <jackie.m.yeager@cummins.com>
Cc: Iffland, JoNell <Iffland.JoNell@epa.gov>
Subject: Jackie - if you get to the EPA office's before 9am, can you ask the guards to call me, I wanted to talk with you regarding a Light-duty Diesel topic. Thanks, Bill Charmley

To: Brian C Mormino[brian.c.mormino@cummins.com]; Charmley, William[charmley.william@epa.gov]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; Gary C Salemme[gary.c.salemme@cummins.com]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Morgan Andreae[morgan.andreae@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; david.gardner@navistar.com[david.gardner@navistar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; erin.luke@paccar.com[erin.luke@paccar.com]; Manik Narula[manik.narula@cummins.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Sanchez, James[sanchez.james@epa.gov]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]
From: Jackie M Yeager
Sent: Wed 9/2/2015 3:26:02 PM
Subject: Phase 2 Collaboration meeting agenda

Reminder of tomorrow's call at 3:00 pm Eastern. Let me know of any changes or additions to the agenda.

Proposed agenda:

1. Update on Volvo testing – Yuesheng

2. Other topics?

3. Plan next call – All

Call-in and Webex information:
Teleconference:
US toll-free Ex. 6 - Personal Privacy
Access code

Topic: Phase 2 Collaboration Mtg
Date: Every Thursday, from Thursday, December 18, 2014, to no end date
Time: 3:00 pm, Eastern Standard Time (New York, GMT-05:00)
Meeting number: Ex. 6 - Personal Privacy
Meeting passwor

Please click the link below to see more information about the meeting, including its agenda, or to join the meeting.

https://cummins.webex.com/cummins/j.php?MTID=m2c63d17e27cf5ffc33c45243d3d6bf70

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

To: Brian C Mormino[brian.c.mormino@cummins.com]; Charmley, William[charmley.william@epa.gov]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; Gary C Salemme[gary.c.salemme@cummins.com]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Morgan Andreae[morgan.andreae@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; david.gardner@navistar.com[david.gardner@navistar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; erin.luke@paccar.com[erin.luke@paccar.com]; Manik Narula[manik.narula@cummins.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Sanchez, James[sanchez.james@epa.gov]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]
From: Jackie M Yeager
Sent: Wed 9/2/2015 3:13:06 PM
Subject: 8/20 Phase 2 Collaboration Call Notes

Participants:

- Cummins – Jackie Yeager, Manik Narula
- Eaton –
- EPA – Houshun Zhang, James Sanchez
- Navistar – David Gardner, Cortney Guzlas, Matt Hunkler
- PACCAR – Dan Kieffer, Erin Luke
- Allison – Mike Howenstein
- Volvo – Tony Greszler, Yuesheng He, Jeff Marley

Discussion and follow-up items (with owner's name in **bold**):

- Vehicle configs with similar cycle work and N/V – Manik

o Reviewed the slides prepared by Manik (emailed to the group after the call)

o Re-send the EPA spreadsheet with details of the vehicle configurations used in the simulations – **James** (DONE, emailed to the group after the call)

o Next step is to see if testing confirms the spread in CO2 for similar N/V and cycle work values is acceptable

•□□□□□□□□ Engine testing issues – Tony/Yuesheng

o Discussed issues trying to run engine speeds and torques generated by GEM: test cell can't follow drastic torque changes on ARB cycle; lower cycle work in test cell; engine speed going below idle because GEM only moves 1 gear at a time (no skip shifting)

o GEM engine transient response not representative of real engine and needs improvement

o Use Part 1065 regression criteria for now

o Volvo may be ready with some test results to share on next call

•□□□□□□□□ Questions on entering powertrain map into GEM – Hunkler

o Question on why GEM does not use the specific powertrain you are testing (to determine N/V and cycle work for entering the powertrain map??) – Needed a general approach that would cover transmissions GEM can't simulate, such as CVT, so using a generic powertrain

Topics for future calls:

•□□□□□□□□ (9/3?) – Update on engine testing – Yuesheng

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

To: Charmley, William[charmley.william@epa.gov]
From: Berry Steve
Sent: Tue 9/1/2015 4:25:18 PM
Subject: Your voicemail

Hi Bill

I got your vmail. I think it's a great idea and I'll inform Denny and Niklas of the interest and do what I can on my end to make it happen.

Steve

Steve Berry

Volvo Group Trucks Product Planning

2900 K St NW

South Building, Suite 401

Washington, DC 20007

Office 202-536-1557

Cell: 301-660-0037

steve.berry@volvo.com

To: Charmley, William[charmley.william@epa.gov]
Cc: Spears, Matthew[spears.matthew@epa.gov]; Jackie M Yeager[jackie.m.yeager@cummins.com]
From: Brian C Mormino
Sent: Tue 8/25/2015 6:57:06 PM
Subject: RE: Sept 30?

Have not heard back from Matt yet. Yes, I think it would be good for you and Matt and the team to be present and I think it is ok if Chris is not able to attend. Please let us know as soon as you can about Sept 30.

From: Charmley, William [mailto:charmley.william@epa.gov]
Sent: Tuesday, August 25, 2015 12:08 PM
To: Brian C Mormino <brian.c.mormino@cummins.com>
Cc: Spears, Matthew <spears.matthew@epa.gov>; Jackie M Yeager <jackie.m.yeager@cummins.com>
Subject: RE: Sept 30?

Brian and Jackie

I have not had a chance to catch up with Matt on this request, and it's already Tuesday.

I do know that both Chris and I have an all-day meeting with a light-duty OEM on that day, but I don't think we both have to attend it. It is possible that I could go to Columbus, and Chris could cover the other meeting. However, it's also very important that I check with Matt and a few others on the staff to understand if they can attend, as they are more important than me for a meeting like this.

For now, please put a place holder on September 30, but it may be another week before you hear back from Matt or I on this (unless Matt has already given you some feedback).

Thanks

Bill

Bill Charmley

Director

Assessment and Standards Division

Office of Transportation and Air Quality

U.S. Environmental Protection Agency

National Vehicle and Fuel Emissions Laboratory

2000 Traverwood Drive

Ann Arbor, MI 48105

desk ph. 734-214-4466

cell ph. 734-545-0333

e-mail: charmley.william@epa.gov

From: Brian C Mormino [mailto:brian.c.mormino@cummins.com]
Sent: Friday, August 21, 2015 9:56 PM
To: Charmley, William
Cc: Spears, Matthew; Jackie M Yeager
Subject: Sept 30?

Bill, I am following up on our discussion on Phase 2 and the need for a deep dive on technologies and technical issues. I have checked and my schedule lines up with both John and Jen on September 30th. We could get into the whole suite of issues that we discussed as well as show you directly the latest on Waste Heat Recovery. Could that work for you and the team to come down to Columbus for the day? How about Chris?

Brian C. Mormino
Executive Director -- Worldwide Environmental Strategy & Compliance
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To: Jackie M Yeager[jackie.m.yeager@cummins.com]; Brian C Mormino[brian.c.mormino@cummins.com]; Charmley, William[charmley.william@epa.gov]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; Gary C Salemme[gary.c.salemme@cummins.com]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Morgan Andreae[morgan.andreae@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; david.gardner@navistar.com[david.gardner@navistar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; erin.luke@paccar.com[erin.luke@paccar.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Sanchez, James[sanchez.james@epa.gov]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]
From: Manik Narula
Sent: Fri 8/21/2015 1:31:26 PM
Subject: RE: Phase 2 Collaboration meeting agenda
EMA_VehicleConfigQuestion_analysis_v5.pdf

All,

The presentation related to agenda #1 which I went through yesterday is enclosed for your reference.

Thanks

Manik Narula
Technical Advisor,

Advanced Engineering Systems Integration

Cummins Inc.

Cummins Technical Center, MC 50030

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From: Jackie M Yeager
Sent: Thursday, August 20, 2015 8:45 AM
To: Brian C Mormino <brian.c.mormino@cummins.com>; charmley.william@epa.gov; Cortney.Guzlas@Navistar.com; dan.kieffer@paccar.com; David.Majors@Navistar.com; Gary C Salemme <gary.c.salemme@cummins.com>; Matthew.Hunkler@Navistar.com; MihaiDorobantu@eaton.com; Morgan Andreae <morgan.andreae@cummins.com>; spears.matthew@epa.gov; Zhang.Houshun@epa.gov; david.gardner@navistar.com; debbie.gordon@allisontransmission.com; ErikDykes@eaton.com; erin.luke@paccar.com; Manik Narula <manik.narula@cummins.com>; MatthewRBusdiecker@eaton.com; michael.j.howenstein@allisontransmission.com; Sanchez.james@Epa.gov; tom.sloane@paccar.com; Jeffrey.shultz@allisontransmission.com; Anthony Greszler (anthony.greszler@volvo.com) <anthony.greszler@volvo.com>; He Yuesheng <yuesheng.he@volvo.com>
Subject: Phase 2 Collaboration meeting agenda

Reminder of today's call at 3:00 pm Eastern. Welcome to Volvo (Tony and Yuesheng) who will be joining the calls going forward and are cc:ed here. Please use the dist list from this email if you need to share info with the whole group. Note, Daimler was invited but declined to participate.

Proposed agenda:

1. Vehicle configs with similar cycle work and N/V – Manik
2. Engine testing issues – Tony
3. Questions on entering powertrain map into GEM – Hunkler
4. Other topics?
5. Plan next call – All

Call-in and Webex information:

Teleconference:
US toll-free: Ex. 6 - Personal Privacy
Access code:

Topic: Phase 2 Collaboration Mtg
Date: Every Thursday, from Thursday, December 18, 2014, to no end date
Time: 3:00 pm, Eastern Standard Time (New York, GMT-05:00)
Meeting number: Ex. 6 - Personal Privacy
Meeting password:

Please click the link below to see more information about the meeting, including its agenda, or to join the meeting.

https://cummins.webex.com/cummins/j.php?MTID=m2c63d17e27cf5ffc33c45243d3d6bf70

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

To: Timothy A. Blubaugh[tblubaugh@emamail.org]
Cc: Cullen, Angela[cullen.angela@epa.gov]; Moulis, Charles[moulis.charles@epa.gov]; Gururaja, Prashanth[Gururaja.Prashanth@epa.gov]; Mitcham, Arvon[mitcham.arvon@epa.gov]; Charmley, William[charmley.william@epa.gov]
From: Spears, Matthew
Sent: Thur 8/20/2015 4:01:18 PM
Subject: Aug 25 & 26 EMA - EPA/NHTSA/ARB meetings: EPA call-in and AdobeConnect Information

HI Tim,

Thanks for the quick reply, and I'll keep an eye out for your email with updated EMA agenda items.

Here is the EPA call-in and AdobeConnect information to pass along to your members. The dial-in information is the same for both days, but please note that the AdobeConnect links are unique for each day:

Meeting Name: EMA-EPA/NHTSA/ARB HD Phase 2 General Items
Summary:
Invited By: Matthew Spears (spears.matthew@epa.gov)
When: 08/25/2015 9:00 AM - 4:00 PM
Time Zone: (GMT-05:00) Eastern Time (US and Canada)

Conference Number(s): Ex. 6 - Personal Privacy
Participant Code: Ex. 6 - Personal Privacy

To join the meeting:
https://epa.connectsolutions.com/r2vib9zykj5/

Meeting Name: EMA-EPA/NHTSA/ARB HD Phase 2 Aero Topics
Summary:
Invited By: Matthew Spears (spears.matthew@epa.gov)
When: 08/26/2015 9:00 AM - 1:00 PM
Time Zone: (GMT-05:00) Eastern Time (US and Canada)

Conference Number(s): Ex. 6 - Personal Privacy
Participant Code: Ex. 6 - Personal Privacy

To join the meeting:
https://epa.connectsolutions.com/r4no1j24eth/

If you have never attended an Adobe Connect meeting before:

Test your connection:
https://epa.connectsolutions.com/common/help/en/support/meeting_test.htm

Get a quick overview: http://www.adobe.com/products/adobeconnect.html

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To: Brian C Mormino[brian.c.mormino@cummins.com]; Charmley, William[charmley.william@epa.gov]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; Gary C Salemme[gary.c.salemme@cummins.com]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Morgan Andreae[morgan.andreae@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; david.gardner@navistar.com[david.gardner@navistar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; erin.luke@paccar.com[erin.luke@paccar.com]; Manik Narula[manik.narula@cummins.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Sanchez, James[sanchez.james@epa.gov]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]
From: Jackie M Yeager
Sent: Thur 8/20/2015 12:37:10 PM
Subject: 8/7 Phase 2 Collaboration Call Notes

Participants:

- Cummins – Jackie Yeager, Manik Narula

- Eaton – Erik Dykes

- EPA – Houshun Zhang

- Navistar – David Gardner, Cortney Guzlas

- PACCAR – Dan Kieffer

- Allison – Jeff Shultz, Laverne Spears

Discussion and follow-up items (with owner's name in **bold**):

- "Hybrid" concept of alt map + ss map

o EPA's objective with combining the two mapping approaches is to decrease test burden.

o Discussed whether vocational would need more steady state points than tractor. Testing of ISB+Allison TX, gasoline engine may answer.

o Discussed whether number of cycle average points could be reduced. Risk of reducing interpolation accuracy. Also being looked at by SwRI.

- Industry group comments

- Might depend on where EMA ends up
- Invite Volvo and Daimler to join these calls – **Jackie**

- EMA questions on cycle average map

- How to define generic vehicle configurations – any need to normalize cycle work as has been done in engine speed space?
- Can two different vehicle configs give same cycle work and N/V but different CO2?
  - Look in existing simulations from James – **Manik**
  - Any insight from testing (past or planned)?

- Other

- Next GEM release will be around August 18
- Road grade changes – intent is to keep cycle time the same

Topics for future calls:

- (8/20) – Data mining for different vehicle configs with similar cycle work and N/V – Manik

- (8/20) – How to enter powertrain map in GEM? – Hunkler

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
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To: Grundler, Christopher[grundler.christopher@epa.gov]; Charmley, William[charmley.william@epa.gov]
From: Berry Steve
Sent: Tue 4/26/2016 7:55:55 PM
Subject: Additional meetings with Volvo Group CEO

Hello Chris and Bill,

I wanted to inform you that Volvo Group CEO Martin Lundstedt will also have meetings with DoT (Sec Foxx and Blair Anderson), the White House (Dan Utech and Jason Miller), and very briefly with DoE (Sec Moniz and David Danielsson) on Thursday. The messages around the items of interest to EPA (ignoring safety, for example) will be basically the same as those we outlined for Matt concerning the meeting with Janet McCabe.

With DoT, our points around Phase 2 are limited to our general support for the rule, the importance not to increase engine stringency, and Alt 4 is unworkable. We'll also express our support for EPA's efforts on Gliders and ask the status of NHTSA's enforcement actions.

Same for White House, but also asking about available flexibility in the Ph 2 rulemaking timeline.

With DoE (just 20 minutes!), it's mainly about SuperTruck.

Let me know if you have any questions.

Steve

Steve Berry

Volvo Group Trucks Product Planning

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To: Charmley, William[charmley.william@epa.gov]; White, Erik@ARB[erik.white@arb.ca.gov]
Cc: Iffland, JoNell[Iffland.JoNell@epa.gov]; Lange, Bryan@ARB[bryan.lange@arb.ca.gov]
From: Jackie M Yeager
Sent: Wed 3/18/2015 12:30:18 AM
Subject: Logistics for EPA and ARB visit to Cummins on March 23

Hello Bill and Erik,

We are looking forward to hosting you at Cummins in Columbus, Indiana next Monday, March 23. Here is a summary of logistical details.

- Time:

2:00 – 5:30 pm Eastern

(Bill arrives at 2:00 pm, Erik arrives at 4:00 pm)

- Location:

Columbus Technical Center (CTC)

Customer Visit Room A

1900 McKinley Avenue

Columbus, IN 47201

- Arrival/parking:

We will have a parking spot reserved for each of you in the main aisle leading to the guard shack – look for orange cones. (You may need to drop in the guard shack before you park to alert a guard to move the cones out of your way.) Have the guard call me on my cell phone to come escort you into the building.

- Jackie Yeager's cell phone:

Ex. 6 - Personal Privacy

Feel free to call me if you need anything.

- Dress:

I suggest business casual. We are pretty informal.

Please let me know if you need any other details. I will send a finalized agenda later this week.

Regards,

Jackie Yeager
Global Energy Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

To: Jackie M Yeager[jackie.m.yeager@cummins.com]
Cc: Brian C Mormino[brian.c.mormino@cummins.com]; Charmley, William[charmley.william@epa.gov]; Spears, Matthew[spears.matthew@epa.gov]; John C Wall[john.c.wall@cummins.com]
From: Grundler, Christopher
Sent: Tue 3/17/2015 11:45:17 PM
Subject: Re: Motoring onward: part two of emissions regimes

Great stuff! I shared with Janet and Gina's press office

Christopher Grundler, Director
Office of Transportation and Air Quality
U.S. EPA
202-564-1682 (DC)
734-214-4207 (Ann Arbor)

On Mar 17, 2015, at 10:16 AM, Jackie M Yeager <jackie.m.yeager@cummins.com> wrote:

Chris, Bill, and Matt - here is an editorial today from the same author.

Link: http://www.truckinginfo.com/article/story/2015/03/commentary-good-news-coming.aspx?utm_campaign=Headline-News-20150317&utm_source=Email&utm_medium=Enewsletter&btm_ea=Y2Fyb2wubGF2ZW5nb29kQGN1bW1

Commentary: Good News Coming?

March 2015, TruckingInfo.com - Editorial

By Rolf Lockwood

You should hear some important news this month, and it might eventually save you a buck.

A year ago, President Obama decreed that a new set of rules regarding greenhouse-gas emissions and fuel economy should be proposed, as of this month, covering medium- and heavy-duty trucks built in 2020 and beyond. Not sure I'd hold my breath about the timing, but he charged the U.S. Environmental Protection Agency and the National Highway Traffic Safety Administration with figuring out how to go even further than we've already gone. And that's quite a way.

The 2020 rules represent Phase 2 of an effort that began with another presidential decree back in 2010 demanding serious GHG and fuel consumption cuts for the 2014-2019 period. That was Phase 1 of the long-term plan, and it seemed complex and arbitrary. But if you've bought trucks in the last year, I'll bet you didn't even notice a change unless you examined what should be lower fuel bills.

And that's a far cry from all the wrangling and arguing — not to mention the paying — that accompanied previous emissions regimes.

The GHG targets are mainly carbon dioxide, but also methane and nitrous oxide. The thing is, when you cut CO2, you also increase fuel economy. Official projections tell us that Phase 1 will save 530 million barrels of oil, 270 million metric tons of GHGs, and $50 billion in fuel costs. Government projections being what they are, who knows how accurate those estimates might actually be, but for the first time in recorded history, the EPA and NHTSA are sort of your friends.

Yes, as in the past, the cost of engines will rise, but this time there will be fuel savings to bring a fairly quick payback.

Things really have gone pretty quiet on the diesel front, and it hasn't been this way since the EPA started tinkering with things back in the 1990s.

In fact, they were at it as early as 1974, though the broad and heavy crunch came later. It really began in 1997 when the EPA set the standard for model years 2004-2006. But after all the trouble and woe brought on then and later with the 2007 emissions regime — which linger on for many of you — the 2010-spec heavy-duty diesel has proven to be a big improvement in terms of both reliability and fuel economy.

Are we back to where we were a dozen-plus years ago? No, but compared to EPA 2007, we're way ahead.

The present 2014-2019 rules say that tractors must achieve as much as a 20% reduction in CO2 emissions and fuel consumption by 2017, a little more by 2019. Mixers, refuse haulers, and other vocational machines have to get to a 10% reduction in fuel consumption by 2017.

None of this caused a stir last year, and targets were met with ordinary improvements of existing hardware and software. Things will get tougher as 2017 approaches, but radically new hardware such as waste-heat recovery won't be required.

Phase 2 will clearly demand even tougher CO2 and fuel-consumption reductions, and we know that the final regulation will appear some time in 2016. Our firm knowledge stops there.

I'm almost sitting on the edge of my seat, anxious to see the draft rules soon. And for the first time ever, I have the feeling that a major government intervention might actually bring good news.

Holy moly, did I just write that?

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From: Grundler, Christopher [mailto:grundler.christopher@epa.gov]
Sent: Wednesday, March 04, 2015 11:02 PM
To: Brian C Mormino
Cc: Charmley, William; Spears, Matthew; Jackie M Yeager; John C Wall
Subject: Re: Motoring onward: part two of emissions regimes

Thanks for sharing this Brian!

Christopher Grundler, Director

Office of Transportation and Air Quality

U.S. EPA

202-564-1682 (DC)

734-214-4207 (Ann Arbor)

On Mar 4, 2015, at 7:23 PM, Brian C Mormino <brian.c.mormino@cummins.com> wrote:

Chris, Bill and Matt – Thought you would be interested in seeing this recent article from Today's Trucking on Phase 2.

http://www.todaystrucking.com/motoring-onward-part-two-of-emissions-regimes?page=1

TODAY'S TRUCKING

Motoring onward: part two of emissions regimes

By Rolf Lockwood, Posted: Mar 3, 2015 4:35 PM | Last Updated: Mar 3, 2015 4:35 PM

TORONTO-- Apples and oranges. That's how Brian Mormino describes the difference between the emissions regimes of the previous decade and the one that was launched last year and will enter its second phase in 2020. Executive director, worldwide environmental strategy and compliance at Cummins, he says all the hard work and heartache of dealing with engine emissions from 2002 on to 2010 has left us well equipped for the next steps.

We've already taken the first of those steps, starting a year ago, with Phase 1 of the fuel economy and greenhouse gas regulations as decreed by President Obama. Back in 2010, with so-called 'criteria' pollutants like nitrogen oxide (NOx) under control, he ordered the Environmental Protection Agency (EPA) and the National Highway Traffic Administration to move on. He told them to cut carbon dioxide (CO2) emissions, along with other gases in lesser amounts, while improving fuel economy in medium- and heavy-duty trucks.

The challenge was anything but small, the timeline short, but the 2014 targets were met, largely because so much had already been achieved. And the next target in 2017 will be met as well.

"I'd like to help people understand that the industry is in a great place from the standpoint of technology and the future," Mormino told me in a lengthy recent interview. "What I mean by that is that we now have diesel particulate filters, we have SCR systems, we're taking care of emissions in the exhaust. And we have learned and improved on those systems.

"And so when we look at meeting the first GHG and fuel-consumption standard in 2013, a year early, how did Cummins do that? We did it by improving the engine architecture that we already had in place. And what are we going to do for 2017? We're going to improve on the engine architecture that we already have in place. And I would even venture to say that when we look at 2021, we're going to improve on the engine architecture that we already have in place."

The New Regime

Phase 1 of the GHG and fuel-economy regime does not involve just engines as in the past, but trucks as well, with tires and aerodynamic devices tested and taken into account. The present 2014-19 rules say that heavy-duty tractors must achieve as much as a 20-percent reduction in CO2 emissions and fuel consumption by 2017, a little more by 2019. Engines, tested separately, had to improve three percent by 2014, and six percent by 2017. Mixers, refuse haulers, and other vocational machines must get to a 10-percent reduction in fuel consumption by 2017.

None of this change caused a stir last year, and initial targets were met with ordinary improvements of existing hardware and software. Things will get tougher on engines in 2017 but radically new hardware -- like waste-heat recovery -- won't be required.

When these rules were announced it seemed to many observers that, with so many variations in commercial vehicles, it would be near impossible to find a standard that applies to all. But not so, apparently, and for reasons similar to those cited by Mormino.

"It's complicated but we've been able to manage all the configurations in Phase 1," said Sean Waters, director of compliance and regulatory affairs at Daimler Trucks North America. "Mostly we're able to manage all the differences because we spent a lot of money developing fuel-efficient technologies years ago. All those decisions that have paid off for our business and paid off for our customers, have also paid off in the regulatory world and enabled us to deal with all the different configurations out there."

Phase 2 Tougher

Phase 2 of the fuel-efficiency/greenhouse gas regulations will soon be unveiled. A draft rulemaking proposal was due to be released this month by the EPA and NHTSA, but I'm hearing there's a delay. Regardless, the final rule is due some time in 2016, affecting trucks built in 2020 and beyond.

We don't know much about it, and even the people I've talked to lately who keep track of what's going on in Washington can only guess. All we really know is that Phase 2 will demand even tougher, more stringent CO2 and fuel-consumption reductions. Much tougher, it seems. But our firm knowledge stops there.

Will trailers be added to the mix? It's almost certain, it seems, and there are suggestions that it will happen in 2018. At least for dry vans and reefers.

One test or two?

Engines and vehicles are tested separately in Phase 1, but there are those who urge that just one test, with engines rolled into the whole truck like any other component, is the better approach for Phase 2. Both sides are pretty vehement.

As things stand now engines are tested on a dynamometer as they have been all along, and Cummins thinks it should stay that way. Among other reasons, Mormino says that this would preserve spec'ing flexibility for truck buyers and ensure repeatability in the testing process.

Trucks, on the other hand, are tested by way of computer modelling in Phase 1, with some inputs coming from on-track trials using standard SAE protocols and that data then fed into the modelling software. Daimler and Volvo (including Mack), the only fully integrated OEMs, are arguing that a single all-inclusive test would be simpler and more cost-effective.

Mormino says the implementation of Phase 1 was pretty much seamless, and he attributes that success largely to the continued use of familiar regulatory tools and testing methods that had been in place for decades.

For 30 years engine makers have tested NOx and particulates on the dyno, and it was easy to include CO2 as well.

"We just added CO2," Mormino says, "which means that we allowed all that diversity to continue in the marketplace because the engine is certified to operate in a wide range of vehicles and applications. So customers and end-users still have all the choice that is really, really important... in terms of all of

their preferences and the types of work they have to do. The regulation didn't... limit their choices."

Perhaps a more compelling argument is the one he makes about the huge number of fuel-economy variables when a truck is put to use. Like driver skills, terrain, trailer type, highway or city, load, and countless others.

"That is a challenge for any type of regulation that tries to drive technology on vehicle aspects that are highly variable," Mormino says. "And the way that the regulation attempted to deal with that is that it separated out the most certain aspect, the engine, and provided a much brighter focus on something you can repeatably and accurately measure and do so in a way where it can be enforced."

On the other side of this argument sits DTNA's Sean Waters, as well as the Volvo Group's Tony Greszler.

"Our goal has always been to provide our customers with the lowest total operating costs to increase their revenues, and the most effective way to do that has been to provide better fuel efficiency," says Waters. "Regulations have interfered with this goal in the past where criteria-pollutant emissions control technology had a great negative impact on fuel economy.

"It's critical that regulations to reduce fuel consumption do not in actuality result in negative impacts on real-world fuel efficiency gains, and this is where the current separate engine standard program has failed. Engine test cycles are based on historical operating data and cannot reflect changes in engine size, powertrains, or vehicle power demand and do not accurately represent the fuel used in the real-world, nor were they ever designed to do so," Waters suggests.

"DTNA believes the best way to ensure that the Phase 2 regulation provides a total-cost-of-operation benefit to customers is to give manufacturers the ability to focus on improving the entire vehicle as it operates on the road and in the application for which its customers want to use the vehicle. Any regulation that doesn't give manufacturers the flexibility to meet it in the manner that works best for our customers, results in vehicles that customers can't afford, or doesn't provide sufficient real-world payback and risks creating a pre-buy prior to the regulation becoming effective."

Waters goes further, saying that the tests for criteria pollutants -- NOx and PM -- are based on a test designed in 1990 or 1991 "when trucks had higher horsepower, more torque. It was just a different way of operating an engine. The test was never designed for CO2." Nor was it designed to measure fuel economy, he adds.

He figures the test was used for convenience in Phase 1 to get a rule done

quickly.

At Volvo Group North America, Tony Greszler is vice president of government and industry relations, and he's the point man on Phase 2 rules.

"The bottom line here is that the engine test doesn't test the engine the way it runs in the truck," he says. "It's impossible for any engine test to do that. And it also doesn't account for the impact of the engine on the rest of the truck.

Waste-heat Recovery

"The technology of most concern is what we call waste-heat recovery," Greszler goes on.

It's a tool that Cummins expects to deploy in 2020 or so, though Brian Mormino says some customers may get field-test units in 2017 or 2018. In fact all engine makers are developing it, and a variation is even used in today's Formula One race cars where they add it to the standard V6 and call the package a hybrid. It recovers exhaust heat and turns it back into energy.

"It's essentially a second engine," says Greszler. "And it requires that you run the exhaust heat through a fluid, via a heat exchanger in the exhaust, and run it through an expansion machine to make power, and then condense that fluid again. Which means that you've got a lot more cooling demand. You've now got to cool most of the heat from the exhaust, because the process isn't very efficient, so most of that heat ends up in your condenser.

"And we end up having to add substantial weight, space, and cooling capacity into our trucks," he continues, "which means that we lose aerodynamic performance and we lose freight capacity because of weight. So we add efficiency to the engine but we take it away from the truck. That doesn't make sense.

"Why would you force us to do something like that? Give us the flexibility to look at the truck as a complete entity and make the best, most cost-effective decisions about how to improve the fuel efficiency in a way that meets the target," Greszler urges.

"I think it's also obvious that a system like that adds a lot of components, a lot of sensors, a lot of complexity, and potentially a lot of unreliability. Which customers don't want or need. And if you're not getting the full benefit from it anyway, you're really kidding yourself when you measure the efficiency of the engine in a test cell where weight, space, and cooling demand are not accounted for at all."

Waste heat recovery is just an example, of course, and there might be any number of similar examples that could come up in the future.

"A particular customer could well benefit from efficiency improvements that have nothing to do with the engine and hit the overall targets that EPA will establish," Greszler continues. "Are we going to force him into engine efficiency solutions that don't necessarily match his operational requirements because EPA structured a rule that said X amount had to come from the engine? It just doesn't make sense to us."

Depending on the stringency of the coming rules, and whether or not we have a separate engine test, waste-heat recovery may or may not be needed.

"If we have a fairly stringent engine efficiency requirement measured in a test cell, then WHR may be the only available technology to meet that target," Greszler says. "If it's not applied to the engine but to the truck, we may find quite a few other options.

"We're all developing waste-heat recovery," he adds, "don't get me wrong. I'm not saying it's a technology that shouldn't be explored and exploited when and where it makes sense, but it ought not be forced into production on a time schedule that doesn't allow adequate reliability development and it shouldn't be forced into applications where it doesn't really deliver."

So, much remains to be seen on this topic, and given how much information couldn't be packed into this space, a Part Three seems to be in order. Stay tuned.

This email has been scanned for Malware.

To: Brian C Mormino[brian.c.mormino@cummins.com]; Jon A Dickson[jon.a.dickson@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Charmley, William[charmley.william@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gary C Salemme[gary.c.salemme@cummins.com]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; Manik Narula[manik.narula@cummins.com]; erin.luke@paccar.com[erin.luke@paccar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; david.gardner@navistar.com[david.gardner@navistar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]; Ricart-Ugaz, Laura M[Laura.Ricart@Navistar.com]; Marley Jeffrey[jeff.marley@volvo.com]; Mark Malowicki[Mark.Malowicki@PACCAR.com]; Costi Nedelcu[Costi.Nedelcu@PACCAR.com]; Miller Marc[marc.miller@volvo.com]; donald.keski-hynnila@daimler.com[donald.keski-hynnila@daimler.com]; aaron.neuman@daimler.com[aaron.neuman@daimler.com]; gerald.freitag@daimler.com[gerald.freitag@daimler.com]; steve.berry@volvo.com[steve.berry@volvo.com]; tblubaugh@emamail.org[tblubaugh@emamail.org]; david.kayes@daimler.com[david.kayes@daimler.com]; Mark.Siddall@HMMUSA.COM[Mark.Siddall@HMMUSA.COM]; LIN_GEORGE@cat.com[LIN_GEORGE@cat.com]; inderpal.singh@daimler.com[inderpal.singh@daimler.com]; Kaslavage Charles[charles.kaslavage@volvo.com]; scott.mundy@allisontransmission.com[scott.mundy@allisontransmission.com]; Thomas Manley[Thomas.Manley@HMMUSA.COM]
From: Jackie M Yeager
Sent: Tue 4/19/2016 5:34:23 PM
Subject: 4/7 Collaboration Call Notes

Participants:

- Allison – Scott Mundy
- Caterpillar –
- Cummins – Manik Narula, Jackie Yeager
- Daimler – Gerald Freitag, Don Keski, Inderpal Singh
- Eaton –
- EMA – Tim Blubaugh
- EPA – Houshun Zhang, James Sanchez, Matt Spears
- Hino – Tom Manley

•□□□□□□□□ Navistar – Dave Gardner

•□□□□□□□□ PACCAR – Mark Malowicki, Erin Luke, Dan Kieffer, Costi Nedelcu

•□□□□□□□□ Volvo – Marc Miller, Tim Connors, Tony Greszler, Chuck Kaslavage, Steve Berry

Discussion and follow-up items (with owner's name in **bold**):

•□□□□□□□□ ISL engine test results – Manik

o Cummins presented cycle average map test results for ISL 450 and 300 hp ratings – see slides emailed previously

o Cycle average map performance matches that of steady state map on cruise cycles

•□□□□□□□□ Addressing N/V overlap – Manik

o Cummins presented example of how to revise generic vehicle definition to prevent N/V overlap – see slides emailed previously

o EPA asked companies to consider options of 1) adding generic vehicle configurations, or 2) selecting custom vehicle configurations instead of generic

o Discussion about how to certify vehicles not designed to reach 65 or 55 mph

•□□□□□□□□ Road grade profiles – EPA

o Discussion about a couple options for further modifying the cycles to better match time at peak torque in-use:

▪· Add miles at zero grade, or

▪· Reduce grade by a fixed percentage (same effect as reducing vehicle mass)

Topics for future calls:

•□□□□□□□□ (TBD) SwRI results (N13 365, gasoline engine) – Houshun

•□□□□□□□□ (4/21) Road grade evaluation – TBD

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

To: Brian C Mormino[brian.c.mormino@cummins.com]; Charmley, William[charmley.william@epa.gov]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; Gary C Salemme[gary.c.salemme@cummins.com]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Morgan Andreae[morgan.andreae@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; david.gardner@navistar.com[david.gardner@navistar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; erin.luke@paccar.com[erin.luke@paccar.com]; Manik Narula[manik.narula@cummins.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Sanchez, James[sanchez.james@epa.gov]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]
From: Jackie M Yeager
Sent: Mon 4/20/2015 6:59:52 PM
Subject: 4/16 Phase 2 Collaboration Call Notes

Reminder, please review the SAE paper draft that Gary Salemme shared and provide feedback to him by Tuesday, April 21.

Participants:

- Cummins – Jackie Yeager, Manik Narula
- Eaton –
- EPA – James Sanchez, Houshun Zhang
- Navistar – Matt Hunkler
- PACCAR – Dan Kieffer
- Allison –

Discussion and follow-up items (with owner's name in **bold**):

- Group was small and meeting was short due to multiple conflicts with other meetings
- EPA draft SAE paper – Houshun
  - Undergoing internal EPA review

- Industry draft SAE paper – Cummins

o Gary circulated draft earlier in the week. Please provide feedback by April 21 so he can start incorporating changes in order to submit the first draft to SAE by 4/28 – **All**

o Check on possibility to include 1-2 paragraphs summarizing the Navistar generic vehicle analysis reviewed on 3/19 – **Matt H.**

Topics for future calls:

- (4/23) EPA draft SAE paper – Houshun
- (4/23) Industry draft SAE paper – Cummins
- (TBD) Update on Cummins fntest data – Jackie
- (TBD) Engine cert ideas – Cummins
- (TBD) Update on powertrain family concept – Matt S.
- (TBD) Update on transient correction factor in primary approach – Matt S.

Regards,

Jackie Yeager
Global Energy Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
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To: Brian C Mormino[brian.c.mormino@cummins.com]; Jon A Dickson[jon.a.dickson@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Charmley, William[charmley.william@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gary C Salemme[gary.c.salemme@cummins.com]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; Zhang, Houshun[Zhang.Houshun@epa.gov]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; Manik Narula[manik.narula@cummins.com]; erin.luke@paccar.com[erin.luke@paccar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; david.gardner@navistar.com[david.gardner@navistar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; Anthony Greszler (anthony.greszler@volvo.com)[anthony.greszler@volvo.com]; He Yuesheng[yuesheng.he@volvo.com]; Ricart-Ugaz, Laura M[Laura.Ricart@Navistar.com]; Marley Jeffrey[jeff.marley@volvo.com]; Mark Malowicki[Mark.Malowicki@PACCAR.com]; Costi Nedelcu[Costi.Nedelcu@PACCAR.com]; Miller Marc[marc.miller@volvo.com]; donald.keski-hynnila@daimler.com[donald.keski-hynnila@daimler.com]; aaron.neuman@daimler.com[aaron.neuman@daimler.com]; gerald.freitag@daimler.com[gerald.freitag@daimler.com]; steve.berry@volvo.com[steve.berry@volvo.com]; tblubaugh@emamail.org[tblubaugh@emamail.org]; david.kayes@daimler.com[david.kayes@daimler.com]; Mark.Siddall@HMMUSA.COM[Mark.Siddall@HMMUSA.COM]; LIN_GEORGE@cat.com[LIN_GEORGE@cat.com]; inderpal.singh@daimler.com[inderpal.singh@daimler.com]; Kaslavage Charles[charles.kaslavage@volvo.com]; scott.mundy@allisontransmission.com[scott.mundy@allisontransmission.com]; Thomas Manley[Thomas.Manley@HMMUSA.COM]
From: Jackie M Yeager
Sent: Tue 4/19/2016 5:32:42 PM
Subject: Phase 2 Collaboration meeting agenda
Joining Skype for Business Meetings (External).pdf

Reminder of Thursday's call at 3:00 pm Eastern. I only heard from a couple people who had conflicts due to the EMA workshop, so let's stick with our regular day and time.

Proposed agenda:

1. ISB and N13 testing at SwRI – Houshun

2. Road grade evaluation – TBD

3. Other topics?

4. Plan next call – All

Call-in and Skype information:

New non-Cummins attendees will need to install the Skype for Business web app plug-in. See the attached instructions.

For non-Cummins participants:

→ Join Skype Meeting

This is an online meeting for Skype for Business, the professional meetings and communications app formerly known as Lync.

For Cummins participants:

→ Join Skype Meeting

This is an online meeting for Skype for Business, the professional meetings and communications app formerly known as Lync.

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Audio for this Skype for Business meeting is available using a computer or the phone dial-in bridge. Cummins Skype Advanced users should select "Use Skype for Business (full audio and video experience)" when using their PCs to connect to the meeting audio. Cummins Skype Standard users should select "Don't Join Audio" and dial into the phone bridge.

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

To: Brian C Mormino[brian.c.mormino@cummins.com]; Charmley, William[charmley.william@epa.gov]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; Gary C Salemme[gary.c.salemme@cummins.com]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Morgan Andreae[morgan.andreae@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; david.gardner@navistar.com[david.gardner@navistar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; erin.luke@paccar.com[erin.luke@paccar.com]; Manik Narula[manik.narula@cummins.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Sanchez, James[sanchez.james@epa.gov]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]
From: Jackie M Yeager
Sent: Thur 4/16/2015 1:29:46 AM
Subject: 3/19 Phase 2 Collaboration Call Notes

(Just catching up on some meeting notes that I missed awhile back)

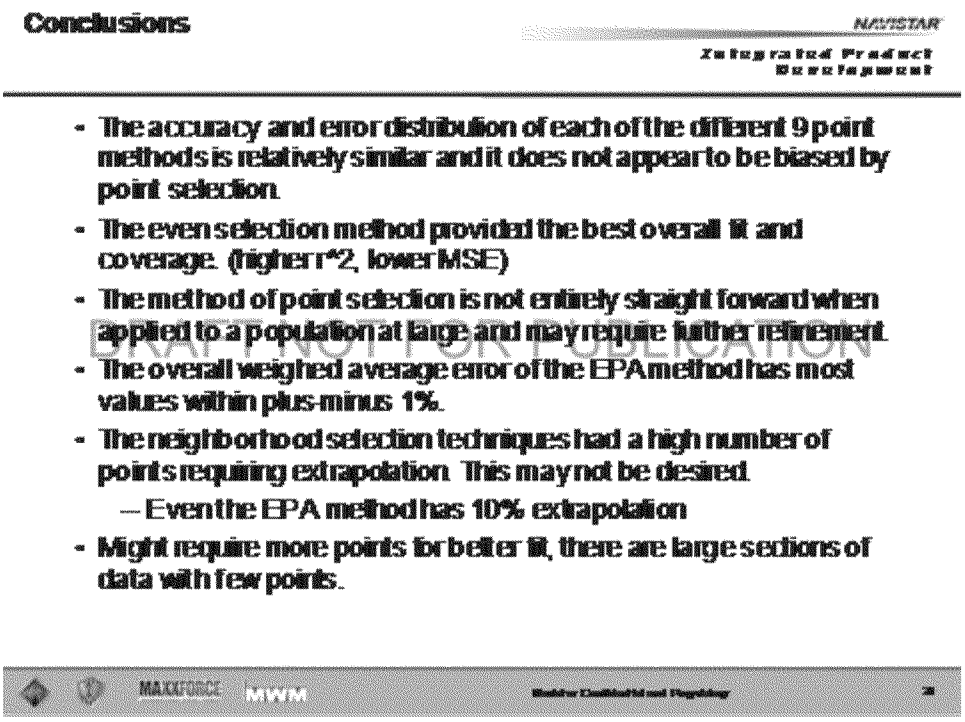
Participants:

- Cummins – Jackie Yeager, Manik Narula
- Eaton –
- EPA – James Sanchez, Houshun Zhang
- Navistar – Cortney Guzlas, Matt Hunkler, Dave Gardner
- PACCAR – Dan Kieffer, Tom Sloane
- Allison – Jeff Shultz, Mike Howenstein

Discussion and follow-up items (with owner's name in **bold**):

- Navistar vehicle analysis – Matt H.

o Matt reviewed his analysis of different methods of selecting the 9 generic vehicle configurations – conclusions below:



DRAFT NOT FOR PUBLICATION

•□□□□□□□□ Error for generic vehicle selection using cycle composite – James

o James compared errors using weighted cycle composites to errors of individual cycles (see Powerpoint emailed by James) – not significantly different

Topics for future calls:

•□□□□□□□□ (TBD) Comparison of 1 Hz and 10 Hz – Manik

•□□□□□□□□ (TBD) Update on Cummins fntest data – Jackie

•□□□□□□□□ (TBD) Engine cert ideas – Cummins

•□□□□□□□□ (TBD) Update on powertrain family concept – Matt S.

•□□□□□□□□ (TBD) Update on transient correction factor in primary approach – Matt S.

Regards,

Jackie Yeager

Global Energy Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
jackie.m.yeager@cummins.com

To: Brian C Mormino[brian.c.mormino@cummins.com]; Charmley, William[charmley.william@epa.gov]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; Gary C Salemme[gary.c.salemme@cummins.com]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Morgan Andreae[morgan.andreae@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; david.gardner@navistar.com[david.gardner@navistar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; erin.luke@paccar.com[erin.luke@paccar.com]; Manik Narula[manik.narula@cummins.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Sanchez, James[sanchez.james@epa.gov]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]
From: Jackie M Yeager
Sent: Thur 4/16/2015 1:28:32 AM
Subject: 4/9 Phase 2 Collaboration Call Notes

Participants:

- Cummins – Jackie Yeager, Manik Narula

- Eaton – Erik Dykes

- EPA – James Sanchez, Houshun Zhang, Matt Spears

- Navistar – Cortney Guzlas, Dave Gardner

- PACCAR – Erin Luke, Dan Kieffer

- Allison – Jeff Shultz

Discussion and follow-up items (with owner's name in **bold**):

- Analysis of 1 Hz, 5 Hz, 10 Hz – Erik

o Erik presented a comparison of data analyzed at 10, 5, and 1 Hz, where the 5 Hz and 1 Hz data was an average of 2 and 10 points, respectively, to represent logging the data at lower frequency

o Results support logging data at lower than 10 Hz – for example, command speed/torque at 10 or 5 Hz and log at 1 Hz – which would not drive a change to Part 1065

- Update on EPA SAE paper – Houshun

o Discussed status of EPA and industry drafts

- Will request a 2 week extension for turning in the first drafts (extension to April 28)
- Share drafts with group by early next week to start reviewing – **Houshun, Gary**
- Share latest draft of Eaton technical report – **Erik**

Topics for future calls:

- (4/16) EPA draft SAE paper – Houshun
- (4/16) Industry draft SAE paper – Gary/Cummins
- (TBD) Update on Cummins fntest data – Jackie
- (TBD) Engine cert ideas – Cummins
- (TBD) Update on powertrain family concept – Matt S.
- (TBD) Update on transient correction factor in primary approach – Matt S.

Regards,

Jackie Yeager
Global Energy Policy Director

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Phone 812-377-8774
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To: Brian C Mormino[brian.c.mormino@cummins.com]; Charmley, William[charmley.william@epa.gov]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; Gary C Salemme[gary.c.salemme@cummins.com]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Morgan Andreae[morgan.andreae@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; david.gardner@navistar.com[david.gardner@navistar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; erin.luke@paccar.com[erin.luke@paccar.com]; Manik Narula[manik.narula@cummins.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Sanchez, James[sanchez.james@epa.gov]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]
From: Jackie M Yeager
Sent: Thur 4/16/2015 1:27:50 AM
Subject: Phase 2 Collaboration meeting agenda

Reminder of tomorrow's call at 3:00-4:00 pm Eastern.

Proposed agenda:

1. EPA draft SAE paper – Houshun

2. Industry draft SAE paper – Jackie

3. Other topics?

4. Plan next week's call

Call-in and Webex information:
Teleconference:
US toll-free Ex. 6 - Personal Privacy
Access code

Topic: Phase 2 Collaboration Mtg
Date: Every Thursday, from Thursday, December 18, 2014, to no end date
Time: 3:00 pm, Eastern Standard Time (New York, GMT-05:00)
Meeting number Ex. 6 - Personal Privacy
Meeting passwo

Please click the link below to see more information about the meeting, including its agenda, or to join the meeting.

https://cummins.webex.com/cummins/j.php?MTID=m2c63d17e27cf5ffc33c45243d3d6bf70

Regards,

Jackie Yeager
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To: Brian C Mormino[brian.c.mormino@cummins.com]; Charmley, William[charmley.william@epa.gov]; Cortney.Guzlas@Navistar.com[Cortney.Guzlas@Navistar.com]; dan.kieffer@paccar.com[dan.kieffer@paccar.com]; David.Majors@Navistar.com[David.Majors@Navistar.com]; Matthew.Hunkler@Navistar.com[Matthew.Hunkler@Navistar.com]; MihaiDorobantu@eaton.com[MihaiDorobantu@eaton.com]; Morgan Andreae[morgan.andreae@cummins.com]; Spears, Matthew[spears.matthew@epa.gov]; Zhang, Houshun[Zhang.Houshun@epa.gov]; david.gardner@navistar.com[david.gardner@navistar.com]; debbie.gordon@allisontransmission.com[debbie.gordon@allisontransmission.com]; ErikDykes@eaton.com[ErikDykes@eaton.com]; erin.luke@paccar.com[erin.luke@paccar.com]; Manik Narula[manik.narula@cummins.com]; MatthewRBusdiecker@eaton.com[MatthewRBusdiecker@eaton.com]; michael.j.howenstein@allisontransmission.com[michael.j.howenstein@allisontransmission.com]; Sanchez, James[sanchez.james@epa.gov]; tom.sloane@paccar.com[tom.sloane@paccar.com]; Jeffrey.shultz@allisontransmission.com[Jeffrey.shultz@allisontransmission.com]; Jackie M Yeager[jackie.m.yeager@cummins.com]
From: Gary C Salemme
Sent: Wed 4/15/2015 11:19:05 PM
Subject: New Draft SAE Paper
Alternative Approach SAE Paper Draft r12.docx

All,

Here's a new draft in closer to final form. Seems light on discussion of choosing vehicle configurations. I look forward to feedback.

Regards,

Gary

Gary C. Salemme, P.E.

Director, Advanced Engineering Systems Integration

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U.S.A.

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From: Gary C Salemme
Sent: Wednesday, April 15, 2015 8:36 AM
To: Brian C Mormino; 'charmley.william@epa.gov'; 'Cortney.Guzlas@Navistar.com'; 'dan.kieffer@paccar.com'; 'David.Majors@Navistar.com'; Gary C Salemme; 'Matthew.Hunkler@Navistar.com'; 'MihaiDorobantu@eaton.com'; Morgan Andreae; 'spears.matthew@epa.gov'; 'Zhang.Houshun@epa.gov'; 'david.gardner@navistar.com'; 'debbie.gordon@allisontransmission.com'; 'ErikDykes@eaton.com'; 'erin.luke@paccar.com'; Manik Narula; 'MatthewRBusdiecker@eaton.com'; 'michael.j.howenstein@allisontransmission.com'; 'Sanchez.james@Epa.gov'; 'tom.sloane@paccar.com'; 'Jeffrey.shultz@allisontransmission.com'; Jackie M Yeager
Subject: Draft SAE Paper

All,

Here's a draft. Some work remains on citations and references, clean up of figures, conversion of figures to SI units, and conversion to the two column format desired by SAE. But I think the content is in place that I want to include. I think I followed the original outline reasonably well, but I probably did add some content that I think helps tell the "whole story" about the evolution of the cycle average map. I did leave some details out as well, like discussion of looking at many fits to the map. The paper is kind of long. They recommend 9-12 pages. I think it will come down some in the 2 column format, but it's currently at 19 pages (with a lot of figures though).

I still need to circulate for review within Cummins as well. Please be sure to comment on anything that you do or don't like. I'm certainly aware that the different companies may have different views on some items so let me know if I overstepped any bounds.

I'm sending the word document in "track changes" mode so you can make comments and edits as you like. Then send back and I will try to consolidate. I've asked for a 2 week extension, which puts submission at April 28. So I'd like comments back by like Tues the 21st or as soon as possible.

Unfortunately, it looks like I will not make the call tomorrow (yet again, I apologize). Jackie and Manik can take the lead on the paper discussion.

Also, I know we decided to use 1 author per company, but I'd like to change that. I think for sure Manik did a lot of the analysis and needs to be on there. So let me know if you feel strongly about adding other names.

Regards,

Gary

Gary C. Salemme, P.E.

Director, Advanced Engineering Systems Integration

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gary.c.salemme@cummins.com

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To: Schrodt, Thomas[schrodt.thomas@epa.gov]; Aiko Matsunaga[amatsuna@arb.ca.gov]; Alberto Ayala (aayala@arb.ca.gov)[aayala@arb.ca.gov]; Atul Shah (ashah@sensors-inc.com)[ashah@sensors-inc.com]; Barbara Marshik Ph. D. (Barbara_Marshik@MKSinst.com)[Barbara_Marshik@MKSinst.com]; Benjamin C. Shade (bshade@tenneco.com)[bshade@tenneco.com]; Bertrand Lanher (blanher@sensors-inc.com)[blanher@sensors-inc.com]; Bill Baker (bbaker@aanddtech.com)[bbaker@aanddtech.com]; Bill Martin (w.t.martin7019@outlook.com)[w.t.martin7019@outlook.com]; Bill Silvis (bill.silvis@avl.com)[bill.silvis@avl.com]; Bishnu, Dipak (dbishnu@arb.ca.gov)[dbishnu@arb.ca.gov]; Giannelli, Bob[Giannelli.Bob@epa.gov]; bradley.bane@ge.com[bradley.bane@ge.com]; Brendan Sherry (brendan.sherry@iav-usa.com)[brendan.sherry@iav-usa.com]; Brian Dueber (bdueber@mtlcorp.com)[bdueber@mtlcorp.com]; Brian Mace (brian.mace@horiba.com)[brian.mace@horiba.com]; Olson, Brian[olson.brian@epa.gov]; Carl D. Ensfield (censfield@sensors-inc.com)[censfield@sensors-inc.com]; Ryan, Carl[ryan.carl@epa.gov]; Charmley, William[charmley.william@epa.gov]; Chris Sharp (chris.sharp@swri.org)[chris.sharp@swri.org]; Dan Carder (daniel.carder@mail.wvu.edu)[daniel.carder@mail.wvu.edu]; Dan Meyerkord [daniel.j.meyerkord@emdiesels.com]; Dan Sales (dsales@gasanalyzers.com)[dsales@gasanalyzers.com]; David Dikken (ddikken@mtlcorp.com)[ddikken@mtlcorp.com]; david.horstman@intertek.com[david.horstman@intertek.com]; dmacdonald@acscm.com[dmacdonald@acscm.com]; Don Chernich[dchernic@arb.ca.gov]; Doug Sobotka (dougexcel@iowatelecom.net)[dougexcel@iowatelecom.net]; Hamady, Fakhri[hamady.fakhri@epa.gov]; Dustin Osborne (dustin.osborne@swri.org)[dustin.osborne@swri.org]; Dylan Mann[dmann@peaker.com]; Frank Berghof (Frank.Berghof@avlna.com)[Frank.Berghof@avlna.com]; Gil LaDuke (ghladuke@gw.dec.state.ny.us)[ghladuke@gw.dec.state.ny.us]; 'Glenn, Doug (GE Infra, Transportation)'[doug.glenn@ge.com]; Glinsky, Gerard (Aurora)[Gerard.Glinsky@sgs.com]; Granville Hayworth [GHayworth@Tenneco.com][GHayworth@Tenneco.com]; Gurdas Singh Sandhu (gssandhu@ncsu.edu)[gssandhu@ncsu.edu]; Harlan Quan[hquan@arb.ca.gov]; htle@arb.ca.gov[htle@arb.ca.gov]; lKhalek@swri.edu[lKhalek@swri.edu]; jlourenc@arb.ca.gov[jlourenc@arb.ca.gov]; Jackson, Cleophas[jackson.cleophas@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gumbs, Jason[Gumbs.Jason@epa.gov]; Jeff R. Wasil (jeff.wasil@brp.com)[jeff.wasil@brp.com]; jlowry@arb.ca.gov[jlowry@arb.ca.gov]; Joe Sweeney (jsweeney@acscm.com)[jsweeney@acscm.com]; John Harrod (jdharrod@netzero.com)[jdharrod@netzero.com]; John R Briggs (John.Briggs@procat-testing.com)[John.Briggs@procat-testing.com]; McDonald, Joseph[McDonald.Joseph@epa.gov]; Joseph McManus[joe.mcmanus@ricardo.com]; Joshua Israel[joshua.israel@mail.wvu.edu]; Keith Vertin (Keith.vertin@sgs.com)[Keith.vertin@sgs.com]; 'Kelly, Brian E (GE Infra, Transportation)'[Brian.Kelly1@ge.com]; Kent Johnson (kjohnson@cert.ucr.edu)[kjohnson@cert.ucr.edu]; Laroo, Chris[laroo.chris@epa.gov]; Loren Mathews (lmathews@gasanalyzers.com)[lmathews@gasanalyzers.com]; Maldonado, Hector (hmaldona@arb.ca.gov)[hmaldona@arb.ca.gov]; Mang Zhang (mzhang@arb.ca.gov)[mzhang@arb.ca.gov]; Peralta, Maria[Peralta.Maria@epa.gov]; Mark Fuentes (mfuentes@arb.ca.gov)[mfuentes@arb.ca.gov]; Spears, Matthew[spears.matthew@epa.gov]; Matt Swanson - CAI, Inc. (mswanson@gasanalyzers.com)[mswanson@gasanalyzers.com]; Matt Thiel (mthiel@acscm.com)[mthiel@acscm.com]; Mayotte, Steve[mayotte.steve@epa.gov]; mcarter@arb.ca.gov[mcarter@arb.ca.gov]; Michael L. Traver (michael.traver@aramcoservices.com)[michael.traver@aramcoservices.com]; Mike Akard (mike.akard@horiba.com)[mike.akard@horiba.com]; Mike May[mike.may@ricardo.com]; mjsmith@swri.edu[mjsmith@swri.edu]; Mohan Krishnamurthy (mkrishna@arb.ca.gov)[mkrishna@arb.ca.gov]; Mridul Gautam (mgautam@wvu.edu)[mgautam@wvu.edu]; Munday, Dave (dave.munday@horiba.com)[dave.munday@horiba.com]; Nelson, Brian[nelson.brian@epa.gov]; Ng, Henry K[hkng@Central.UH.EDU]; Oliver Chang (ochang@arb.ca.gov)[ochang@arb.ca.gov]; Paolo Di Martino (paolo.di.martino@iav-usa.com)[paolo.di.martino@iav-usa.com]; Paul Rieger (prieger@arb.ca.gov)[prieger@arb.ca.gov]; rick.rooney@horiba.com[rick.rooney@horiba.com]; Rob Wilson[rwilson@sensors-inc.com]; Robert C. Anderson (robert.anderson@tsi.com)[robert.anderson@tsi.com]; Ron Tandy - Horiba[Ron.tandy@horiba.com];

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Cc: Shirish A Shimpi[shirish.a.shimpi@cummins.com]
From: Andjelka Vujovic
Sent: Mon 7/13/2015 4:49:12 PM
Subject: EMA - EMTC, CARB, EPA & Others - June 10-11, 2015, EMTC Meeting Minutes and Attachments
ITR_Presentation to EMTC_6-10-15.pdf
June 10-11 EMTC Meeting Attendance List.pdf
RoundRobinEngine-TestSchedule-20150608.xlsx
RRSummary-Combined-20150608.xlsx
SAE TEVEM Update (2015_06_11).pdf
Torque-Curve_Compare-RREngine-20150608.xlsx
2015-06-10 to 11 EMTC - Agenda.pdf
EMA Round Robin Testing Results_Caterpillar.pdf
RR_Results_Navistar_06_11_15.pdf
EMTC-2014-VeryLowNOxProgram-20150609.pdf

TO: Engine Emissions Measurement & Testing Committee

(EMA Members, CARB, EPA & Others)
CC: Timothy A. French
FROM: Shirish Shimpi
DATE: July 13, 2015
RE: **June 10-11, EMTC Meeting Minutes and Attachments**

Attached are the June 10-11, EMTC meeting minutes and attachments.

If you have any questions, please do not hesitate to contact me.

Shirish A. Shimpi, Ph. D.
Director
Emissions Development
Cummins Inc.
Mail Code 50180

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Andjelka Vujovic

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Laroo, Chris

From: Sanchez, James
Sent: Thursday, November 05, 2015 11:51 AM
To: Laroo, Chris
Subject: RE: Duty Cycle Generation - Maximum Test Speed Calculation

Ex. 5 - Deliberative Process

James

From: Laroo, Chris
Sent: Thursday, November 05, 2015 10:37 AM
To: Sanchez, James <sanchez.james@epa.gov>
Subject: FW: Duty Cycle Generation - Maximum Test Speed Calculation

Any thoughts?

Regards,

Chris Laroo
Environmental Protection Specialist
US Environmental Protection Agency
Office of Transportation and Air Quality
Assessment and Standards Division
2000 Traverwood Dr.
Ann Arbor, MI 48105
(734) 214-4937
(734) 214-4055 (fax)
Email: laroo.chris@epa.gov

From: Baddam, Praveen [mailto:Baddam@FEV.COM]
Sent: Wednesday, November 04, 2015 4:34 PM
To: Laroo, Chris <laroo.chris@epa.gov>
Subject: Duty Cycle Generation - Maximum Test Speed Calculation

Dear Mr. Laroo,

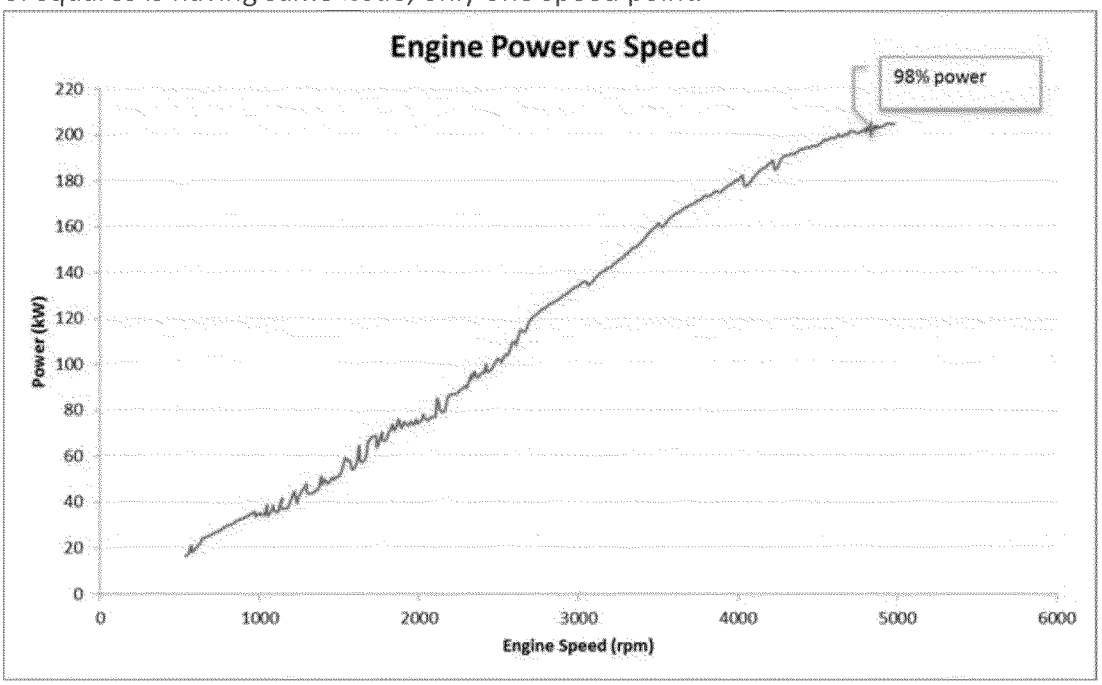
We are running Otto cycle engine(on-road) with high speed governor, which shuts off the fuel once the engine speed limit is reached. We ran engine mapping according to CFR 1065.510(b)(5)(iii).

The check point speed of the map is the highest speed above maximum power at which 50% of maximum power occurs. If this speed is unsafe or unachievable (e.g., for ungoverned engines or engines that do not operate at that point), use good engineering judgment to map up to the maximum safe speed or maximum achievable speed.

According to CFR 1065.610(a)(1)(ii)

Determine the lowest and highest engine speeds corresponding to 98% of P_{max}, using linear interpolation as appropriate.

For the full load, the last point is maximum power point and we are getting only one speed point where 98% of maximum power occurs. So the highest and lowest speed would be same in this situation. And 98% of sum of squares is having same issue, only one speed point.



Can you please let us know how to proceed in this situation. We can't use CFR 1065.610(a)(2), as the normalized speed are not greater than 100%.

Thank you

Praveen Baddam
Regulations & Gov't Relations Engineer
FEV, Inc.
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Auburn Hills, MI 48326 USA
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Cycle average map – child rating analysis

9/17/2015

EMA call question – Child rating

Question: How would child rating perform when cycle average map is created using parent engine?

- Will parent and child rating have different N/V and cycle work?
- What could be the difference between CO2 from cycle average map and from steady state fuel map?

Data source: GEM simulations of 8 generic vehicle configurations for Class2b-7 with AT transmission. A 360hp-800lb-ft engine is used as a parent and 280hp-660lb-ft, 200hp-520lb-ft as children.

Observation: For a given vehicle configuration and parent engine fuel map, changing torque curve from 360HP-800 lb-ft to 280 HP 660 lb-ft & 200 HP 520 lb-ft did not significantly impact avgN/avgV & cycle work. In addition, CO2 prediction based on a cycle average map created from a parent engine is within 0.5-1% when compared to SS map based GEM simulation of a child rating.

Next step: Analyze results from testing at SWRI and ORNL

Generic vehicles for GEM simulation

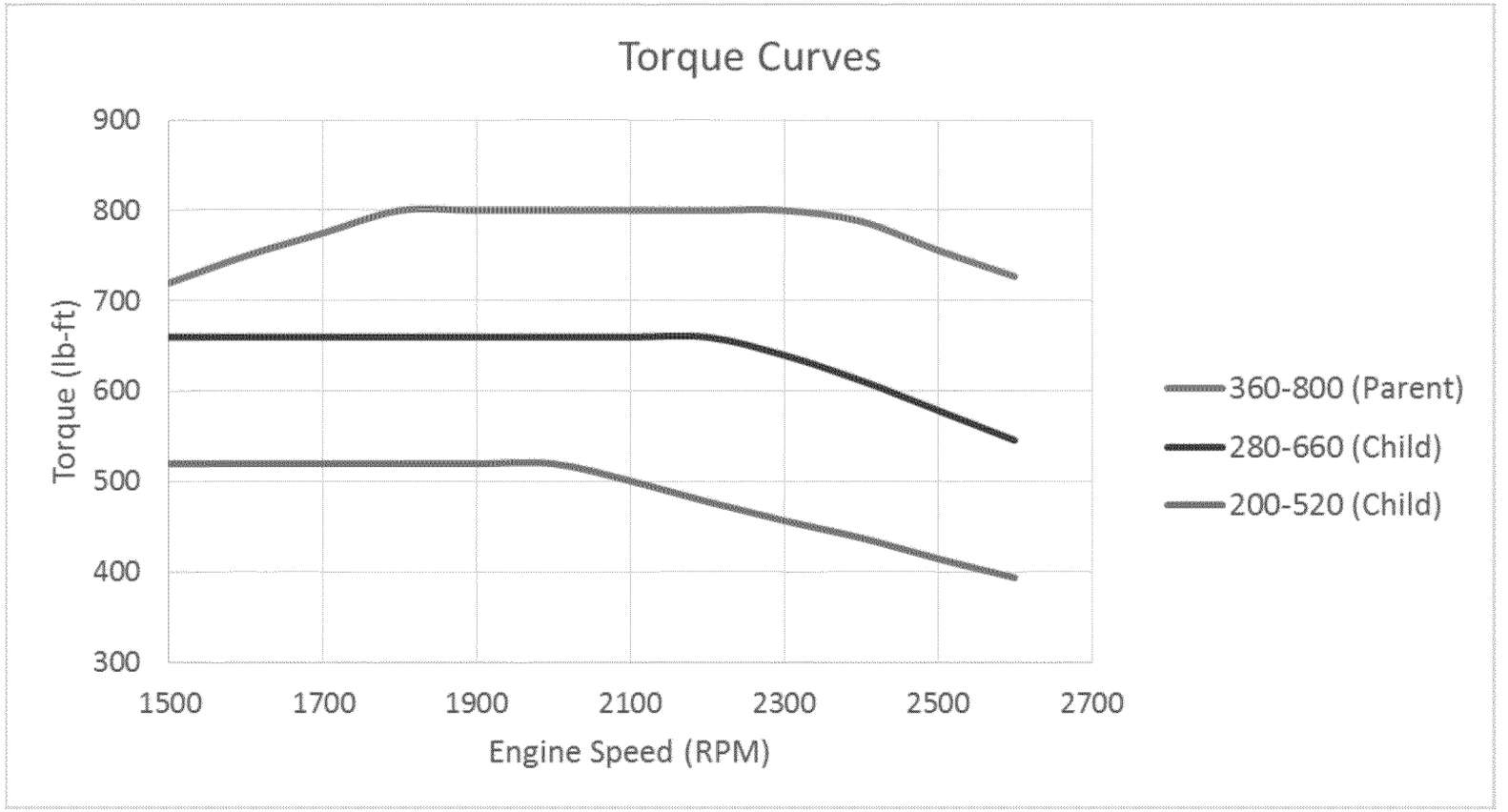
Table 3-30 Proposed Generic Vehicle Definitions for Class 2b-7 Vehicles

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	TEST 6	TEST 7	TEST 8
Mass (kg)	7,257	11,408	7,257	11,408	7,257	11,408	7,257	11,408
C_dA	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Tire C_{rr} (kg/ton)	6.7	6.9	6.7	6.9	6.7	6.9	6.7	6.9
Tire Radius (m)	0.426	0.426	0.426	0.426	0.426	0.426	0.426	0.426
Rotating Inertia (kg)	454	454	454	454	454	454	454	454
Axle Gear Efficiency (%)	95.5	95.5	95.5	95.5	95.5	95.5	95.5	95.5
Accessory Power (W)	1300	1300	1300	1300	1300	1300	1300	1300
Axle ratio at engine speed	A	A	B	B	C	C	Maximum engine speed	Maximum engine speed

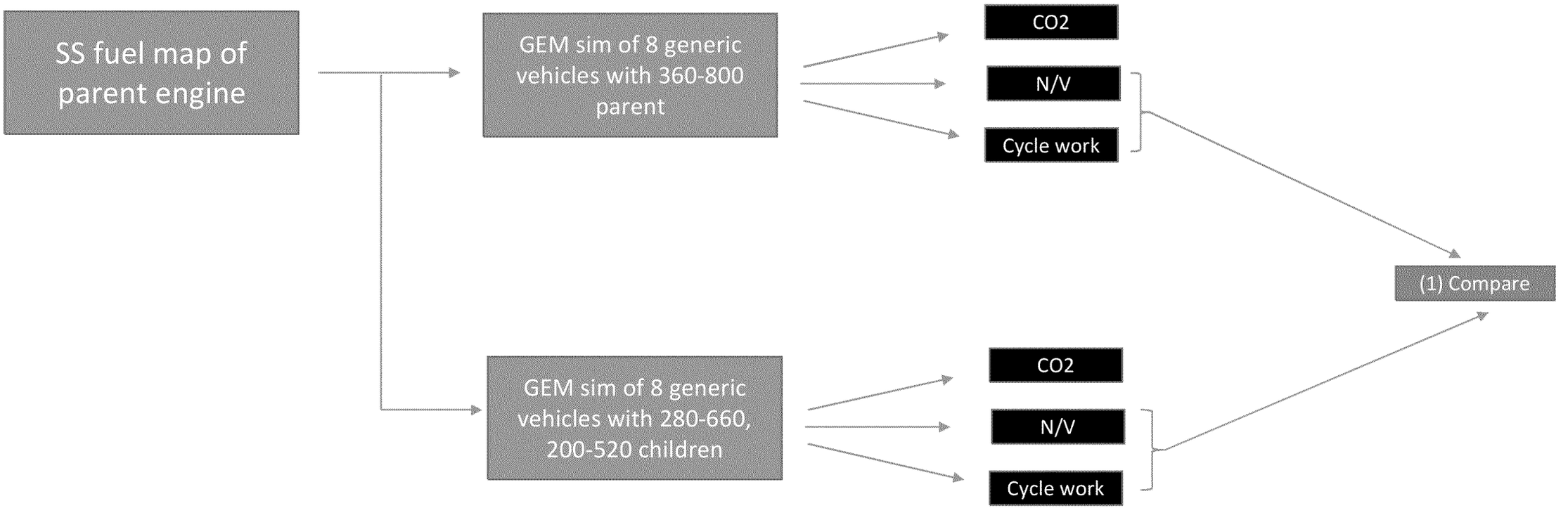
Table 3-34 Default Transmissions

GEAR NUMBER	TRANSMISSION TYPE AND GEAR RATIOS		
	10 speed AMT	6 speed HH AT	6 speed MH AT
1	12.8	4.6957	3.102
2	9.25	2.213	1.8107
3	6.76	1.5291	1.4063
4	4.9	1	1
5	3.58	0.7643	0.7117
6	2.61	0.6716	0.61
7	1.89	N/A	
8	1.38		
9	1		
10	0.73		

Parent/Child Torque curves

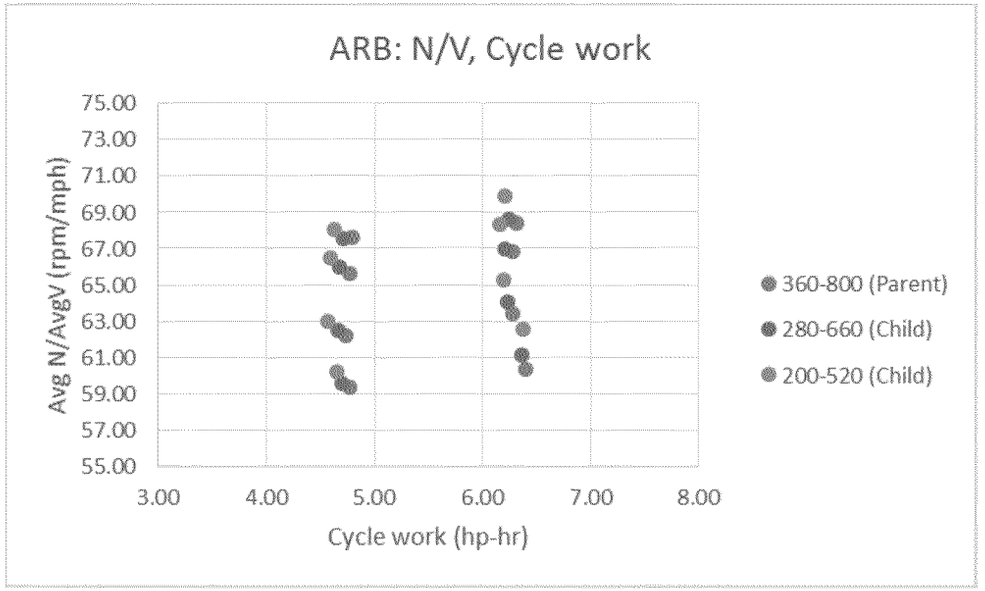


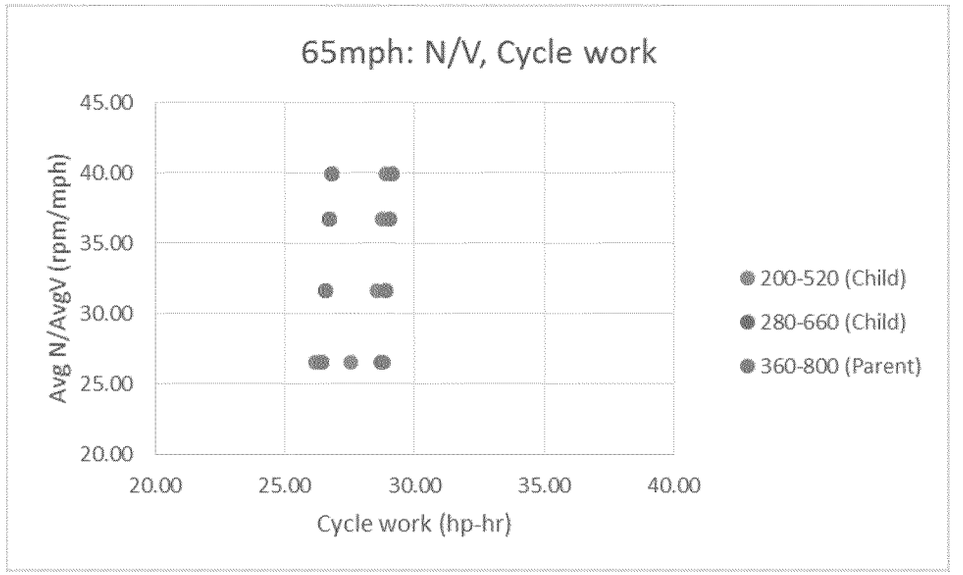
Steady State Fuel map approach

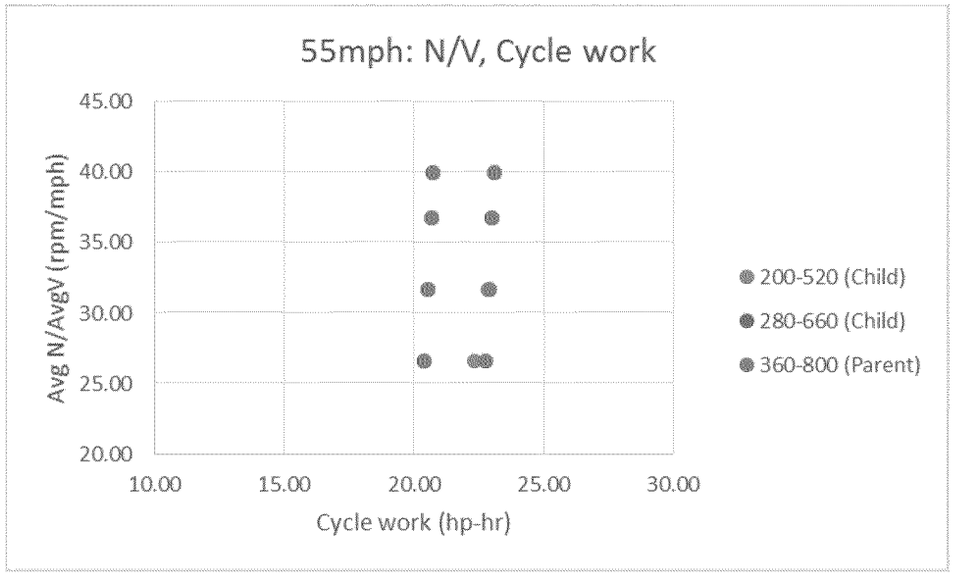


(1) What is the difference in N/V and cycle work due to change in torque curve for a given SS fuel map?

(1) What is the difference in N/V and cycle work due to change in torque curve for a given SS fuel map?

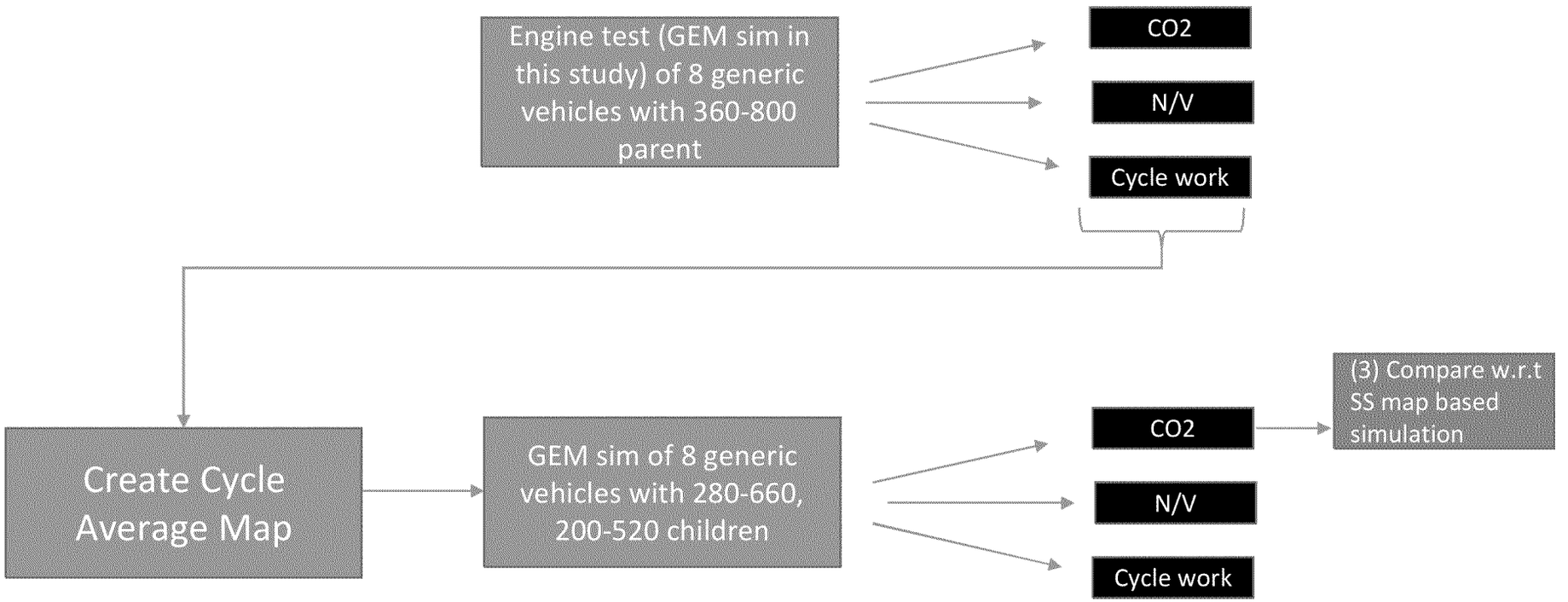






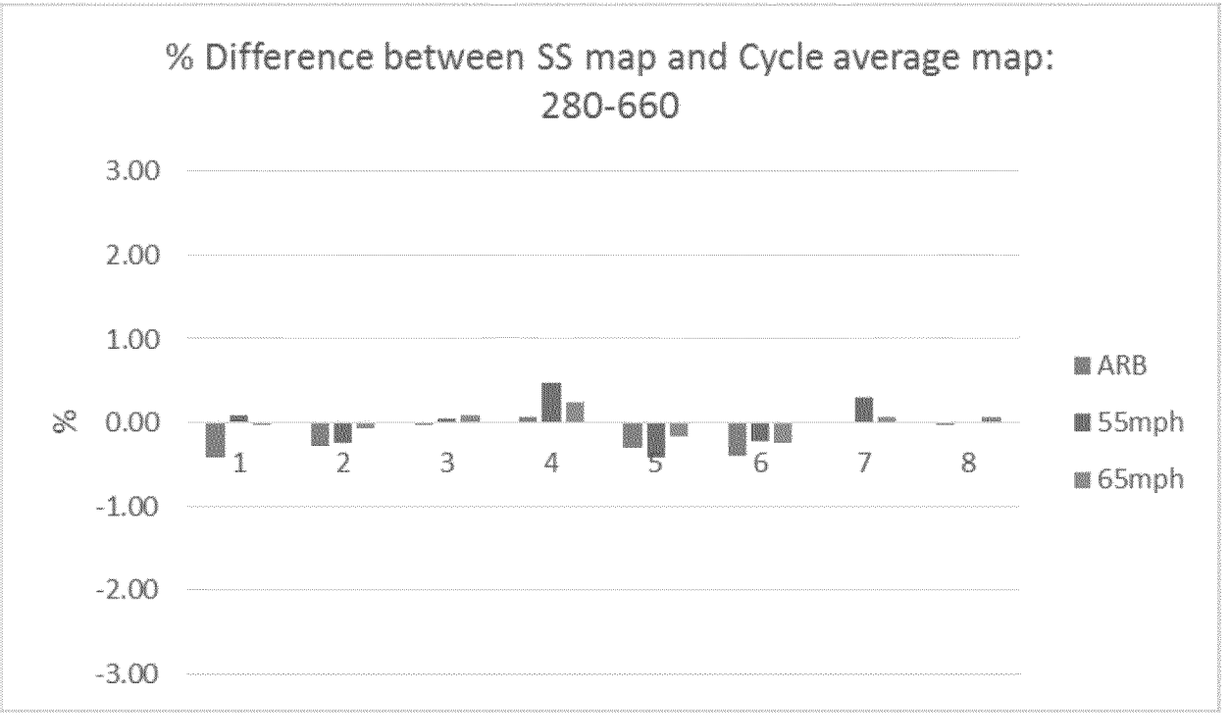
Torque curve change from Parent to Child did not significantly impact change in avgN/avgV and Cycle work

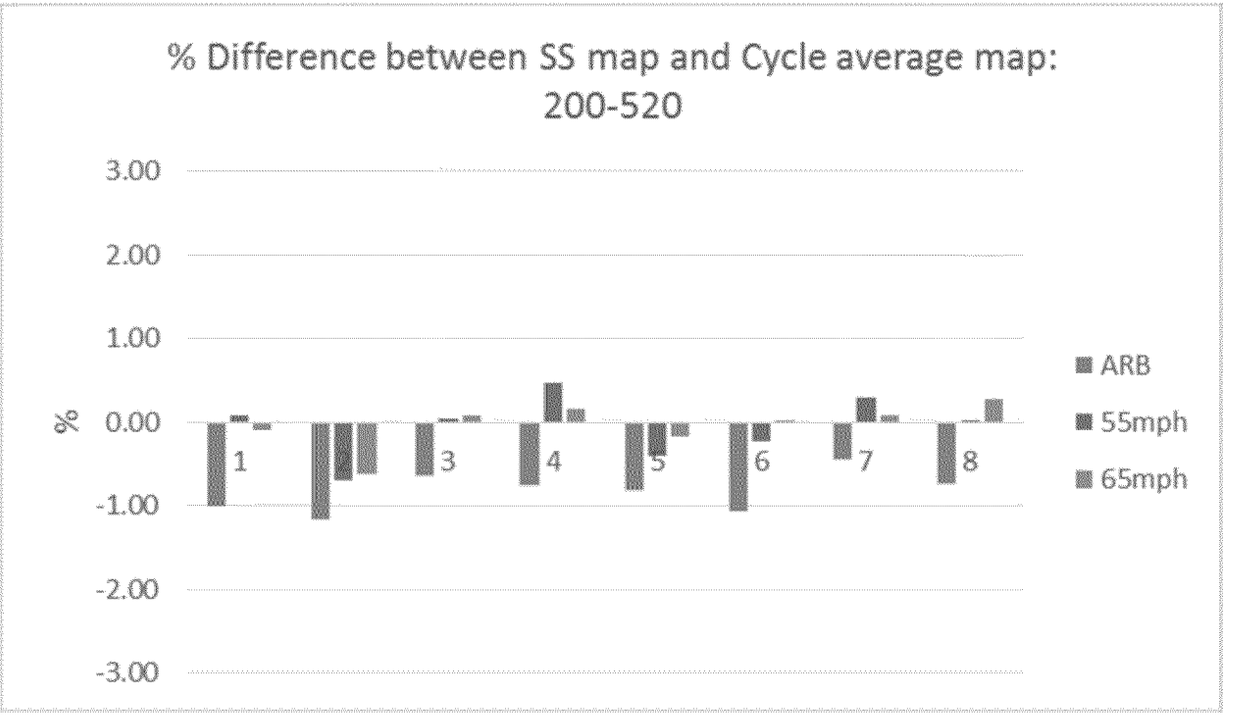
Cycle Average map approach



(2) What is the difference in CO2 as predicted by cycle average map based vs. SS map based GEM sim?

(2) What is the difference in CO2 as predicted by cycle average map vs. SS map based GEM sim?





Cycle Average map based prediction is within 1% of SS map based GEM sim

Summary

Observation: For a given vehicle configuration and a parent engine fuel map, changing torque curve from 360HP-800 lb-ft to 280 HP 660 lb-ft & 200 HP 520 lb-ft did not significantly impact avgN/avgV & cycle work. In addition, CO_2 prediction based on a cycle average map created from a parent engine is within 0.5-1% when compared to SS map based GEM simulation of a child rating.

Next step: Analyze results from testing at SWRI and ORNL

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From: Jackie M Yeager
Sent: Wed 7/8/2015 4:59:15 PM
Subject: Phase 2 Collaboration meeting agenda

Reminder of tomorrow's call at 3:00 pm Eastern. The repeating invitations have run out so I will issue a new one after tomorrow's call. Let's discuss frequency on the call.

Proposed agenda:

1. NPRM update – Matt Spears

2. Next steps – All

3. Plan next call, frequency – All

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Teleconference:
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Access code

Topic: Phase 2 Collaboration Mtg
Date: Every Thursday, from Thursday, December 18, 2014, to no end date
Time: 3:00 pm, Eastern Standard Time (New York, GMT-05:00)
Meeting number Ex. 6 - Personal Privacy
Meeting passwor

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Regards,

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GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
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Cc: 'shirish.a.shimpi@cummins.com'[shirish.a.shimpi@cummins.com]
From: Andjelka Vujovic
Sent: Tue 6/9/2015 5:59:50 PM
Subject: EMA - EMTC, CARB, EPA & Others - CARB Presentation
ITR_Presentation to EMTC_6-10-15.pdf

TO: Engine Emissions Measurement & Testing Committee

(EMA Members, CARB, EPA & Others)
CC: Timothy A. French
FROM: Shirish A. Shimpi
DATE: June 9, 2015
RE: **CARB Presentation**

I received a file from Mr. Joseph Calavita of CARB who will be making a presentation to EMTC members on June 10, 2015, after lunch on an item in CARB's Innovative Technology Regulation. Mr. Calavita in his note to me wrote the following:

"California Air Resources Board is developing a new regulation that include a PEMS testing element. The Innovative Technology Regulation is intended to encourage early deployment of hybrid trucks and buses by providing near-term certification (especially OBD) flexibility for eligible technologies. One of the key elements of this voluntary regulation would be PEMS (or chassis dyno) testing to ensure no NOx increase in-use from the hybrid relative to a non-hybrid. The testing would likely not be relative to an emission standard but rather A to B in-use (hybrid versus conventional) testing over the vehicle's typical drive cycle to determine if NOx emissions from the hybrid are significantly higher."

More information on the rulemaking is available from the link below:

http://www.arb.ca.gov/msprog/itr/itr.htm

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Cc: shirish.a.shimpi@cummins.com[shirish.a.shimpi@cummins.com]
From: Andjelka Vujovic
Sent: Mon 3/28/2016 5:47:10 PM
Subject: EMA - EMTC, CARB, EPA & Others - Final Report for Very Low NOx Measurement Program
Truck_and_Engine_Manufacturers_Association_2016_03_03-20433_FinalReport_V2.pdf

TO: Engine Emissions Measurement & Testing Committee

(EMA Members, CARB, EPA & Others)
CC: Timothy A. French
FROM: Shirish Shimpi
DATE: March 28, 2016
RE: **Final Report for Very Low NOx Measurement Program**

Please see the attached final report for the EMTC Very Low NOx Measurement Program from Chris Sharp.

If you have any questions, please do not hesitate to contact me.

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From: Jackie M Yeager
Sent: Thur 2/5/2015 7:42:15 PM
Subject: RE: Phase 2 Collaboration meeting agenda - abstracts
Zhang_abstract_2015-v6.docx
Industry paper abstract v2.docx

All,

Attached are two draft technical paper abstracts for discussion on today's call.

Regards,
Jackie

From: Jackie M Yeager
Sent: Wednesday, February 04, 2015 10:22 PM
To: 'Brian C Mormino'; 'charmley.william@epa.gov'; 'Cortney.Guzlas@Navistar.com'; 'dan.kieffer@paccar.com'; 'David.Majors@Navistar.com'; 'Gary C Salemme'; 'Matthew.Hunkler@Navistar.com'; 'MihaiDorobantu@eaton.com'; 'Morgan Andreae'; 'spears.matthew@epa.gov'; 'Zhang.Houshun@epa.gov'; 'david.gardner@navistar.com'; 'debbie.gordon@allisontransmission.com'; 'ErikDykes@eaton.com'; 'erin.luke@paccar.com'; 'Manik Narula'; 'MatthewRBusdiecker@eaton.com'; 'michael.j.howenstein@allisontransmission.com'; 'Sanchez.james@Epa.gov'; 'tom.sloane@paccar.com'; 'Jeffrey.shultz@allisontransmission.com'
Subject: Phase 2 Collaboration meeting agenda

Reminder of Thursday's call at 3:00-4:00 pm Eastern.

Proposed agenda:

1. Analysis of interpolation/extrapolation scheme – James

2. Regression criteria for engine tests – James

3. Technical paper abstracts – Houshun, Jackie

4. Other topics?

5. Plan next week's call

Call-in and Webex information:
Teleconference:
US toll-free Ex. 6 - Personal Privacy
Access code

Topic: Phase 2 Collaboration Mtg
Date: Every Thursday, from Thursday, December 18, 2014, to no end date
Time: 3:00 pm, Eastern Standard Time (New York, GMT-05:00)
Meeting number: Ex. 6 - Personal Privacy
Meeting passwor

Please click the link below to see more information about the meeting, including its agenda, or to join the meeting.

https://cummins.webex.com/cummins/j.php?MTID=m2c63d17e27cf5ffc33c45243d3d6bf70

Regards,

Jackie Yeager
Global Energy Policy Director

Environmental Strategy and Compliance
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Phone 812-377-8774
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To: Charmley, William[charmley.william@epa.gov]
From: John C Wall
Sent: Tue 10/27/2015 11:37:28 PM
Subject: Re: Draft agenda for Cummins visit Oct. 29

I had a quarter in Aero Engineering before I transferred into ME in 1970. And I've stayed in a Holiday Inn Express. Annnnnddddd ... WHR has a turbine expander!! I can fake it! (:D)

Seriously -- what the heck is going on with aviation emissions? Chris mentioned it, too.

Sent from my iPhone

On Oct 27, 2015, at 6:00 PM, Charmley, William <charmley.william@epa.gov> wrote:

> How much do you know about jet engines and advanced aircraft designs?

Bill Charmley
Assessment and Standards Division
Office of Transportation and Air Quality
National Vehicle & Fuel Emissions Laboratory
US Environmental Protection Agency
Ann Arbor, Michigan
Desk phone 734-214-4466
Mobile phone 734-545-0333
Email charmley.william@epa.gov

On Oct 27, 2015, at 5:58 PM, John C Wall <john.c.wall@cummins.com> wrote:

> Can I join you? (:D)
>
> Sent from my iPhone
>
> On Oct 27, 2015, at 3:49 PM, Charmley, William <charmley.william@epa.gov> wrote:
>
> > The conflict with the Assistant Administrator is mine. I will need to step out for 30 minutes from 12-12:30.

Thanks

Bill

From: Spears, Matthew
Sent: Tuesday, October 27, 2015 3:45 PM
To: Jackie M Yeager
Cc: Charmley, William; Brian C Mormino; John C Wall
Subject: Re: Draft agenda for Cummins visit Oct. 29

Hi Jackie,

That all sounds good. I think the AA meeting schedule changed so I don't think we have a conflict anymore. We've invited NHTSA staff, but I still have to send a formal email invite to CARB staff. I'll do that from my computer this evening, when I can also make the Webex reservation.

Regards,

Matthew Spears

Center Director, Heavy-Duty Diesel Standards

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m. 734-276-7079

On Oct 27, 2015, at 15:33, Jackie M Yeager <jackie.m.yeager@cummins.com> wrote:

Matt,

Thanks for the confirmation. We do need to adjust the start and end times slightly due to travel logistics. Our start time will need to move out to ~8:45 am. We would still target to wrap up by 3:00 pm but might have flexibility to stay a bit longer if needed. Even with the later start time, we might still need to move some topics around due to a conflict that's come up for one of our key presenters (Gary) - - still working through that one.

We seem to remember you or Bill mentioning a call you have with the Assistant Administrator at 2:00 pm. Should we plan to work around that as well? Also, do you know if NHTSA and/or ARB will participate?

Thanks,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

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From: Spears, Matthew [mailto:spears.matthew@epa.gov]
Sent: Tuesday, October 27, 2015 1:26 PM
To: Jackie M Yeager <jackie.m.yeager@cummins.com>
Cc: Charmley, William <charmley.william@epa.gov>; Brian C Mormino <brian.c.mormino@cummins.com>
Subject: Re: Draft agenda for Cummins visit Oct. 29

Hi Jackie,

The agenda looks great. Are there any updates to your travel timing?

Bill can confirm, but I don't think Bill will be available until 9am-except maybe by phone, so maybe we could pull ahead the cycle-average mapping EPA update so that Bill would be available for the remaining items. Would that work for Cummins? Thanks.

Matthew Spears

Center Director, Heavy-Duty Diesel Standards

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On Oct 20, 2015, at 16:51, Jackie M Yeager <jackie.m.yeager@cummins.com> wrote:

Matt and Bill,

Here is a proposed agenda for our meeting in Ann Arbor on Oct. 29. Please let me know if you have any suggested changes or questions – I think it is pretty similar to what we discussed in our call on Sept. 21. If you have any questions about our written comments that you would like to share ahead of time, please pass them long and we can try to address them when we're there. Also, do you know if NHTSA and/or ARB plan to participate?

Draft Agenda

8:00 Opening – Cummins, EPA

8:15 Technologies other than WHR – Cummins

(Including mode by mode reductions)

9:15 WHR – Cummins

(Customer demo update, cost)

10:15 Engine platforms – Cummins

(Current capability vs. new, OEM lead times)

11:15 Implied stringency– Cummins

(Analysis of fuel maps used to set vehicle standards)

12:00 Break to begin working lunch in room

12:30 Cycle average fuel map – Cummins, EPA

(How to summarize latest work, remaining work needed)

1:30 Other topics from comments – Cummins

2:30 Next steps

2:45 Cummins departs

(Note, we are still finalizing our travel plans, so we might still need to adjust the start/end times a bit.)

Thanks,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

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From: Andjelka Vujovic
Sent: Fri 3/18/2016 3:29:03 PM
Subject: EMA - EMTC, CARB, EPA & Others - Part 1065 and Standard Setting Part Documents
40 CFR Part 1065 Engine Test Procedures Working Document 3-14-16 Staff Draft.pdf
Standard Setting Part Sections Draft 3-14-16.pdf

TO: Engine Emissions Measurement & Testing Committee

(EMA Members, CARB, EPA & Others)
CC: Timothy A. French
FROM: Shirish Shimpi
DATE: March 18, 2016
RE: **Part 1065 and Standard Setting Part Documents**

Please see the attached documents from EPA's Chris Laroo. If you have any questions, please do not hesitate to contact me.

Shirish A. Shimpi, Ph. D.
Director
Emissions Development
Cummins Inc.
Mail Code 50180
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Office: (812) 377-7532

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To: Charmley, William[charmley.william@epa.gov]; Spears, Matthew[spears.matthew@epa.gov]; Grundler, Christopher[grundler.christopher@epa.gov]
Cc: John C Wall[john.c.wall@cummins.com]; Jackie M Yeager[jackie.m.yeager@cummins.com]
From: Brian C Mormino
Sent: Mon 10/19/2015 9:46:53 PM
Subject: CMI Ann Arbor Visit on 10/29

Ex. 6 - Personal Privacy

I will be involved in the preparation and will connect with them after. We look forward to continuing to work with you on Phase 2,

Brian

Brian C. Mormino
Executive Director -- Worldwide Environmental Strategy & Compliance
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From: Jackie M Yeager
Sent: Wed 6/3/2015 9:03:11 PM
Subject: Phase 2 Collaboration meeting agenda

Reminder of tomorrow's call at 3:00 pm Eastern. I think we can keep it brief – I would just like to follow up on discussion from the last call about updating other companies on the alternate mapping approach. Of course, if anyone has other topics we should discuss, just let me know, and I'll be happy to add to the agenda.

Proposed agenda:

1. Plan for updating other companies – All

2. Other topics?

3. Plan next call

Call-in and Webex information:
Teleconference:
US toll-free Ex. 6 - Personal Privacy
Access code

Topic: Phase 2 Collaboration Mtg
Date: Every Thursday, from Thursday, December 18, 2014, to no end date
Time: 3:00 pm, Eastern Standard Time (New York, GMT-05:00)
Meeting number: Ex. 6 - Personal Privacy
Meeting password

Please click the link below to see more information about the meeting, including its agenda, or to join the meeting.

https://cummins.webex.com/cummins/j.php?MTID=m2c63d17e27cf5ffc33c45243d3d6bf70

Regards,

Jackie Yeager
Global Energy Policy Director

Environmental Strategy and Compliance
Cummins Inc.
Phone 812-377-8774
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To: Charmley, William[charmley.william@epa.gov]; Spears, Matthew[spears.matthew@epa.gov]
Cc: Jackie M Yeager[jackie.m.yeager@cummins.com]
From: Brian C Mormino
Sent: Wed 6/3/2015 7:47:35 PM
Subject: HDLG Press Release
HDLGProposalRelease6.3.15.pdf

Bill and Matt – Attached is the press release from the Heavy-Duty Leadership Group on the Phase 2 proposal. We wanted to get it out there given some reporters are writing stories now.

Brian C. Mormino
Executive Director -- Worldwide Environmental Strategy & Compliance
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From: Gary C Salemme
Sent: Wed 4/15/2015 12:36:24 PM
Subject: Draft SAE Paper
Alternative Approach SAE Paper Draft r9.docx

All,

Here's a draft. Some work remains on citations and references, clean up of figures, conversion of figures to SI units, and conversion to the two column format desired by SAE. But I think the content is in place that I want to include. I think I followed the original outline reasonably well, but I probably did add some content that I think helps tell the "whole story" about the evolution of the cycle average map. I did leave some details out as well, like discussion of looking at many fits to the map. The paper is kind of long. They recommend 9-12 pages. I think it will come down some in the 2 column format, but it's currently at 19 pages (with a lot of figures though).

I still need to circulate for review within Cummins as well. Please be sure to comment on anything that you do or don't like. I'm certainly aware that the different companies may have different views on some items so let me know if I overstepped any bounds.

I'm sending the word document in "track changes" mode so you can make comments and edits as you like. Then send back and I will try to consolidate. I've asked for a 2 week extension, which puts submission at April 28. So I'd like comments back by like Tues the 21st or as soon as possible.

Unfortunately, it looks like I will not make the call tomorrow (yet again, I apologize). Jackie and Manik can take the lead on the paper discussion.

Also, I know we decided to use 1 author per company, but I'd like to change that. I think for sure Manik did a lot of the analysis and needs to be on there. So let me know if you feel strongly about adding other names.

Regards,

Gary

Gary C. Salemme, P.E.

Director, Advanced Engineering Systems Integration

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From: jeannie.carpenter@cummins.com
Location: Brian's Office Conf. Call 877.810.9439 Code: 6351781
Importance: Normal
Subject: Economic Assessment Discussion
Start Date/Time: Wed 4/15/2015 1:00:00 PM
End Date/Time: Wed 4/15/2015 2:30:00 PM

;;
Hello ,

Jackie Yeager has invited you to join a meeting on the Web, using WebEx

Topic: Cummins/NERA/EPA Call
Date: Wednesday, April 15, 2015
Time: 9:00 am, Eastern Daylight Time (New York, GMT-04:00)
Meeting number
Meeting passwor Ex. 6 - Personal Privacy

Please click the link below to see more information, or to join the meeting.
NEW USER? Prepare your computer in advance of the meeting by clicking New User on the navigation bar.

https://cummins.webex.com/cummins/j.php?MTID=me07c7940c7d6ddd11b196f9c0e3ce059

Teleconference: None

To contact Jackie Yeager, call 1-812-377-8774 or
send a message to this address: jackie.m.yeager@cummins.com

To add this meeting to your calendar program (for example, Microsoft Outlook or Lotus Notes), do the following:

* For all calendar programs (except Lotus Notes), click the following link, or copy the link and paste it into your Web browser:
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NOTE: Release 6 will be available with PowerSweep II
*For Lotus Notes (Release 6), follow these steps:
1. Right-click the attached iCalendar format (*.ics) file, and then choose View.

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2. Click Import All. A new broadcast email message is added to your Inbox.
3. Open the new message.
4. Click Respond button. A menu appears.
5. Click Accept.

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To: Schrodt, Thomas[schrodt.thomas@epa.gov]; Aiko Matsunaga[amatsuna@arb.ca.gov]; Alberto Ayala (aayala@arb.ca.gov)[aayala@arb.ca.gov]; ANTHONY.BECK@sgs.com[ANTHONY.BECK@sgs.com]; Atul Shah (ashah@sensors-inc.com)[ashah@sensors-inc.com]; Barbara Marshik Ph. D. (Barbara_Marshik@MKSinst.com)[Barbara_Marshik@MKSinst.com]; Benjamin C. Shade (bshade@tenneco.com)[bshade@tenneco.com]; Berghof, Frank AVL/AT [Frank.Berghof@avl.com][Frank.Berghof@avl.com]; Bertrand Lanher (blanher@sensors-inc.com)[blanher@sensors-inc.com]; Bill Silvis (bill.silvis@avl.com)[bill.silvis@avl.com]; Bishnu, Dipak (dbishnu@arb.ca.gov)[dbishnu@arb.ca.gov]; Giannelli, Bob[Giannelli.Bob@epa.gov]; bradley.bane@ge.com[bradley.bane@ge.com]; Brendan Sherry (brendan.sherry@iav-usa.com)[brendan.sherry@iav-usa.com]; Brian Dueber (bdueber@mtlcorp.com)[bdueber@mtlcorp.com]; Brian Mace (brian.mace@horiba.com)[brian.mace@horiba.com]; Olson, Brian[olson.brian@epa.gov]; Carl D. Ensfield (censfield@sensors-inc.com)[censfield@sensors-inc.com]; Ryan, Carl[ryan.carl@epa.gov]; Charmley, William[charmley.william@epa.gov]; Chris Sharp (chris.sharp@swri.org)[chris.sharp@swri.org]; Dan Carder (daniel.carder@mail.wvu.edu)[daniel.carder@mail.wvu.edu]; Dan Sales (dsales@gasanalyzers.com)[dsales@gasanalyzers.com]; David Dikken (ddikken@mtlcorp.com)[ddikken@mtlcorp.com]; david.horstman@intertek.com[david.horstman@intertek.com]; dmacdonald@acscm.com[dmacdonald@acscm.com]; Don Chernich[dchernic@arb.ca.gov]; Doug Sobotka (dougexcel@iowatelecom.net)[dougexcel@iowatelecom.net]; Hamady, Fakhri[hamady.fakhri@epa.gov]; Dustin Osborne (dustin.osborne@swri.org)[dustin.osborne@swri.org]; Dylan Mann[dmann@peaker.com]; Frank Berghof (Frank.Berghof@avlna.com)[Frank.Berghof@avlna.com]; Gil LaDuke (ghladuke@gw.dec.state.ny.us)[ghladuke@gw.dec.state.ny.us]; 'Glenn, Doug (GE Infra, Transportation)'[doug.glenn@ge.com]; Glinsky, Gerard (Aurora)[Gerard.Glinsky@sgs.com]; Granville Hayworth [GHayworth@Tenneco.com][GHayworth@Tenneco.com]; Gurdas Singh Sandhu (gssandhu@ncsu.edu)[gssandhu@ncsu.edu]; Harlan Quan[hquan@arb.ca.gov]; htle@arb.ca.gov[htle@arb.ca.gov]; lKhalek@swri.edu[lKhalek@swri.edu]; jlourenc@arb.ca.gov[jlourenc@arb.ca.gov]; Jackson, Cleophas[jackson.cleophas@epa.gov]; Sanchez, James[sanchez.james@epa.gov]; Gumbs, Jason[Gumbs.Jason@epa.gov]; Jeff R. Wasil (jeff.wasil@brp.com)[jeff.wasil@brp.com]; jlowry@arb.ca.gov[jlowry@arb.ca.gov]; Joe Sweeney (jsweeney@acscm.com)[jsweeney@acscm.com]; John Harrod (jdharrod@netzero.com)[jdharrod@netzero.com]; John R Briggs (John.Briggs@procat-testing.com)[John.Briggs@procat-testing.com]; McDonald, Joseph[McDonald.Joseph@epa.gov]; Joseph McManus[joe.mcmanus@ricardo.com]; Joshua Israel[joshua.israel@mail.wvu.edu]; Keith Vertin (Keith.vertin@sgs.com)[Keith.vertin@sgs.com]; 'Kelly, Brian E (GE Infra, Transportation)'[Brian.Kelly1@ge.com]; Kent Johnson (kjohnson@cert.ucr.edu)[kjohnson@cert.ucr.edu]; KUMAR, Anuj [anuj.kumar@airliquide.com][anuj.kumar@airliquide.com]; Laroo, Chris[laroo.chris@epa.gov]; Loren Mathews (lmathews@gasanalyzers.com)[lmathews@gasanalyzers.com]; Maldonado, Hector (hmaldona@arb.ca.gov)[hmaldona@arb.ca.gov]; Mang Zhang (mzhang@arb.ca.gov)[mzhang@arb.ca.gov]; Peralta, Maria[Peralta.Maria@epa.gov]; Mark Fuentes (mfuentes@arb.ca.gov)[mfuentes@arb.ca.gov]; Spears, Matthew[spears.matthew@epa.gov]; Matt Swanson - CAI, Inc. (mswanson@gasanalyzers.com)[mswanson@gasanalyzers.com]; Matt Thiel (mthiel@acscm.com)[mthiel@acscm.com]; Mayotte, Steve[mayotte.steve@epa.gov]; mcarter@arb.ca.gov[mcarter@arb.ca.gov]; Michael L. Traver (michael.traver@aramcoservices.com)[michael.traver@aramcoservices.com]; Mike Akard (mike.akard@horiba.com)[mike.akard@horiba.com]; Mike May[mike.may@ricardo.com]; mjsmith@swri.edu[mjsmith@swri.edu]; Mohan Krishnamurthy (mkrishna@arb.ca.gov)[mkrishna@arb.ca.gov]; Mridul Gautam (mgautam@wvu.edu)[mgautam@wvu.edu]; Munday, Dave (dave.munday@horiba.com)[dave.munday@horiba.com]; Nelson, Brian[nelson.brian@epa.gov]; Ng, Henry K[hkng@Central.UH.EDU]; NICHOLAS.BELLOVARY@sgs.com[NICHOLAS.BELLOVARY@sgs.com]; Oliver Chang (ochang@arb.ca.gov)[ochang@arb.ca.gov]; Paolo Di Martino (paolo.di.martino@iav-

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From: Andjelka Vujovic
Sent: Fri 12/4/2015 8:22:24 PM
Subject: EMA - EMTC, CARB, EPA & Others - November 17-18, 2015, EMTC Meeting Minutes and Attachments
2015-1117-1118 EMTC_meeting minutes - 112015 (003).pdf
2016 Nov EMTC Attendance List.pdf
CO2Mapping-Telecon_MEasurement error sources-20151028.pdf
EMTC Round Robin Update-Nov2015.pdf
EMTC-2014-VeryLowNOxProgram-20151118.pdf
MKS_Precisive_DDH_for EPA_Nov2015.pdf
Quad J Proposed Changes Update.pdf
RoundRobinEngine-TestSchedule-20151116.xlsx
RRSummary-Combined-20151116.xlsx

TO: Engine Emissions Measurement & Testing Committee

(EMA Members, CARB, EPA & Others)
CC: Timothy A. French
FROM: Shirish Shimpi
DATE: December 4, 2015
RE: **November 17-18, 2015, EMTC Meeting Minutes and Attachments**

Attached are the November 17-18, EMTC meeting minutes and attachments. The next meeting will take place in January 2016 at University of California, CE-CERT. A meeting notice will be sent out as we get closer to the date.

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From: Andjelka Vujovic
Sent: Fri 6/10/2016 2:29:27 PM
Subject: EMA - EMTC, CARB, EPA & Others - May 17-18, 2016, EMTC Meeting Minutes and Attachments
Test Plan Discussion for Revised Fuel Mapping Variability-May2016.pdf
EMTC Round Robin Update-May2016.pdf
EMTC Attendance List - May 17&18 2016.pdf
2016-05-17 to 18 EMTC Meeting - Agenda.pdf
2016-03-29 and 30 EMTC_ meeting minutes_revised.pdf
RoundRobinEngine-TestSchedule-20160518.xlsx
2016-05-17 and 18 EMTC_draft meeting minutes-1.pdf
Particles-EMTC-MAY182016-Imad Khalek.pdf

TO: Engine Emissions Measurement & Testing Committee

(EMA Members, CARB, EPA & Others)
CC: Timothy A. French
FROM: Shirish Shimpi
DATE: June 10, 2016
RE: **May 17-18, 2016, EMTC Meeting Minutes and Attachments**

Attached are the May 17-18, 2016, EMTC meeting minutes and attachments.

If you have any questions, please do not hesitate to contact me.

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From: Jackie M Yeager
Sent: Wed 10/14/2015 5:38:42 PM
Subject: Phase 2 Collaboration meeting agenda
Joining Skype for Business Meetings (External).pdf

Reminder of tomorrow's call at 3:00 pm Eastern. Let me know if anyone has agenda topics to add.

Cummins has replaced WebEx with Skype, so I'll try again this week to get it working. I updated the repeating invitation with new Skype links, including one for non-Cummins attendees. In order to access the meeting through the link, you may need to first install a web app plug-in according to the instructions in the attached PDF. Sorry for the inconvenience.

Proposed agenda:

1. Update on SwRI testing – Houshun

2. Other topics?

3. Plan next call – All

Call-in information:
Teleconference:
US toll-free Ex. 6 - Personal Privacy
Access code

Skype information:

Link for non-Cummins attendees (see additional instructions in the attachment):

Join Skype Meeting (web guest)

Link for Cummins attendees:

.....

→ Join Skype Meeting

This is an online meeting for Skype for Business, the professional meetings and communications app formerly known as Lync.

Help

.....

Regards,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
Cummins Inc.
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To: Charmley, William[charmley.william@epa.gov]; Spears, Matthew[spears.matthew@epa.gov]; Blubaugh, Jim[Blubaugh.Jim@epa.gov]
Cc: Brian C Mormino[brian.c.mormino@cummins.com]
From: Jackie M Yeager
Sent: Fri 6/24/2016 8:12:23 PM
Subject: CATARC request to visit EPA Ann Arbor

Hello Bill, Matt, Jim –

Several people from the Chinese testing agency CATARC, including their Deputy Director, plan to visit the US in late August. We will host them at our Tech Center in Columbus. If possible, they would also like to visit your chassis dyno lab in Ann Arbor and discuss HD GHG. The proposed date is August 25 or 26. Can you please let me know to whom at EPA we should direct this request?

Thanks,

Jackie Yeager
GHG/Fuel Efficiency Policy Director

Environmental Strategy and Compliance
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Phone 812-377-8774
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To: Spears, Matthew[spears.matthew@epa.gov]; Charmley, William[charmley.william@epa.gov]
Cc: Scott Perry (sperry@ryder.com)[sperry@ryder.com]; Iffland, JoNell[Iffland.JoNell@epa.gov]
From: Brian C Mormino
Sent: Fri 5/29/2015 7:53:02 PM
Subject: Ryder-CMI Visit on June 10

Bill and Matt – JoNell and I have been working to finalize a schedule for when Scott Perry and I visit Ann Arbor on Wednesday, June 10th. This is our current plan:

1-2:00 Meeting with Chris Grundler and Bill Charmley

2-4:00 Meeting with Bill Charmley, Matt Spears and Team

For the 1:00 meeting, I would think this would be an open ended discussion covering an education of Ryder, its business and fleet, Phase 2 issues, etc.

For the 2 to 4:00 discussion, we have previously discussed having Scott explain to the EPA staff his business. If I remember correctly, there was interest in having Scott explain the range of vehicles and duty cycles, how he specs out vehicles for the fleet, technologies that have been and are being adopted for greater efficiency, etc. You both indicated that you could put together a list of other questions and issues and send them to us in advance so that we could prepare. I expect this would involve Scott ultimately putting together and showing a presentation during the meeting.

Can you get us a list of issues/questions?

Thanks and looking forward to it,

Brian

Brian C. Mormino
Executive Director -- Worldwide Environmental Strategy & Compliance

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From: Jackie M Yeager
Sent: Tue 8/23/2016 11:35:46 AM
Subject: Collaboration call this week

Hello,

Let's plan to have a call this week. I would like to hear the group's thoughts on whether to continue having these calls now that the final rule has been published. If you have other agenda topics as well, please let me know.

Thanks,

Jackie Yeager
Director – Emissions and Fuel Efficiency Policy

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To: White, Erik@ARB[erik.white@arb.ca.gov]; Charmley, William[charmley.william@epa.gov]
From: Jackie M Yeager
Sent: Thur 3/12/2015 6:23:03 PM
Subject: RE: March 23-25 ACT Seminar

Bill and Erik,

I wanted to start fleshing out the agenda for your visit to Cummins in Columbus on March 23. See below for possible topics. Do you have other requests for topics to discuss, either when Bill first arrives, or in the joint portion after Erik arrives? We expect to have our technology experts available. Please let me know.

2:00 – Bill arrives – possible topics:

- Phase 2 NPRM status (Bill) – Bill, would you mind giving us an update?

- Phase 2 stringency (Cummins) – We shared this material with Matt Spears/Houshun and Erik recently, but if you have not seen it we can take you through it.

- Low NOx capability (Cummins) – We shared some material with ARB recently but not yet EPA.

- Other topics?

4:00 – Erik arrives – possible topics:

- Low NOx (Erik) – Erik, would you mind sharing more thoughts on target areas for in-use NOx reductions (besides lowering the FTP/SET limits)? This goes back to our discussion about a 0.02 g NOx standard getting used as "shorthand" for the 90% in-use reduction, where there may be additional paths to consider.

- Moving the low NOx market forward (Erik) – Erik, this is the topic you requested to solicit our input on California's funding program. We will have a participant from Cummins Westport/natural gas business in attendance.

- Other topics?

5:30 – End

Thanks,

Jackie

Jackie Yeager
Global Energy Policy Director

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From: Brian C Mormino
Sent: Saturday, February 28, 2015 5:57 PM
To: White, Erik@ARB; Charmley, William
Cc: Jackie M Yeager; Rich S Wagner; Mike Cooper; Jeannie Carpenter
Subject: RE: March 23-25 ACT Seminar

Thanks Bill and Erik. We look forward to meeting with you on Monday, March 23rd for as much time as you can spare.

We will hold 2 to 5:30 with Bill arriving first and then Erik around 4:00. We will send out an invite to get the time held on calendars. We could have people join by phone if that is helpful.

Jackie will be in touch to work on topics and an agenda as I will be out until that time traveling to Brazil and other places. Of course, we can connect by email or by phone along the way if helpful.

From: White, Erik@ARB [mailto:erik.white@arb.ca.gov]
Sent: Monday, February 23, 2015 1:37 PM
To: Charmley, William; Brian C Mormino
Cc: Jackie M Yeager; Rich S Wagner; Mike Cooper; Jeannie Carpenter
Subject: RE: March 23-25 ACT Seminar

The earliest I can arrive from CA into Indianapolis is at 2:45 pm on Monday (23rd). I THINK I could get to Columbus by 4:00, and could join a meeting then. I too am attending a dinner/lecture at 6:30, so will need to be able to conclude (5:30 ish) in time to make that.

If that works, I'll chat with Bill about potential topics of discussion for our meeting.

Erik White, Chief

Mobile Source Control Division

(916) 322-1017

From: Charmley, William [mailto:charmley.william@epa.gov]
Sent: Monday, February 23, 2015 9:13 AM
To: Brian C Mormino; White, Erik@ARB
Cc: Jackie M Yeager; Rich S Wagner; Mike Cooper; Jeannie Carpenter
Subject: RE: March 23-25 ACT Seminar

Dear Brian,

I am planning on going to the ACT Seminar in March. It has been over ten years since I saw Ken or Kenny Vieth, and I am looking forward to participating in their seminar.

I will be flying to Indianapolis on Monday, the 24th, and by the time I get a rental car and drive to Columbus it will probably be 1:30 or 2pm. I also plan on going to one of the Monday seminar dinners/lectures, which start at 6:30 or so.

That means I should be available for a meeting with Cummins between say 2pm and 5pm on Monday. I will give some thought to a few topics that I would like to cover - and of course I can adjust that based on feedback/ideas from Brian and Erik.

Best regards,

Bill

Bill Charmley

Director

Assessment and Standards Division

Office of Transportation and Air Quality

U.S. Environmental Protection Agency

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From: Brian C Mormino [mailto:brian.c.mormino@cummins.com]
Sent: Monday, February 16, 2015 2:39 PM
To: White, Erik@ARB; Charmley, William
Cc: Jackie M Yeager; Rich S Wagner; Mike Cooper; Jeannie Carpenter
Subject: March 23-25 ACT Seminar

Bill and Erik – I see that all of us are on the agenda at some point for the ACT seminar located here in Columbus, Indiana in March. During your visit, we would love the opportunity to host you at our Technical Center to see and discuss technologies and regulatory issues surrounding future greenhouse gas and NOx requirements.

Please let me know schedule and we can put together an agenda.

-Brian

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ANALYTICAL AND BENCH EVALUATION OF VERY LOW NO_X MEASUREMENT ISSUES

FINAL REPORT

SwRI® Project No. 03.20433

Prepared for:

Truck and Engine Manufacturer's Association
333 West Wacker Drive, Suite 810
Chicago, IL 60606

Prepared by:

Christopher A. Sharp
Staff Engineer

March 2016

SwRI Benefiting government, industry and the public through innovative science and technology

ANALYTICAL AND BENCH EVALUATION OF VERY LOW NO_X MEASUREMENT ISSUES

FINAL REPORT

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Prepared for:

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March 2016

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Results and discussion given in this report relate only to the test items described in this report.

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EXECUTIVE SUMMARY

This report documents the results of a program executed by Southwest Research Institute (SwRI) on behalf of the Truck and Engine Manufacturer's Association (EMA). The objective of the program was to examine a number of potential NO_x measurement issues that are relevant at levels around 0.02 g/hp-hr, and to determine whether these potential issues would be problematic enough to warrant concern, and possibly further study.

A list of these potential issues was established through several discussions and teleconferences with EMTC members. Preliminary analytical and bench evaluations were conducted in order to determine the magnitude of these potential issues with respect to the current measurement equipment and procedures outlined in CFR 40 Part 1065. The program efforts ranged from data gathering and mining, to selected bench experiments. The brief list of measurement issues examined during this program is given below:

- Analyzer Drift and Stability
- Dilution Air Background Issues
- Calibration Methodology
- NO_2 Lag / Hang-up
- Low Level Analyzer Performance

The concern over Analyzer Drift and Stability could be summarized in the question of whether the current analytical equipment could reliably pass the 4% drift tolerance in Part 1065 at a level of 0.02 g/hp-hr. This question was examined via a data gathering and analytical approach, wherein a large body of zero-span data was collected from SwRI and various EMTC member companies. The data was then processed through an analytical model which applied the drift check algorithm in Part 1065 to a sample transient test profile that was developed to represent an engine emitting 0.02 g/hp-hr NO_X. The data set contained some 1500 data points, representing both Dilute and Raw measurement. For Dilute measurement, more than 98% of the data passed, while for Raw measurement only 55% of the data passed. This indicated that current Dilute NO_X measurement system would likely have no issue with the requirement, while there might be an issue with Raw NO_X measurement systems. More study would be needed to examine the reason for the issues observed with the Raw NO_X measurement systems.

Dilute air background concerns primarily involved the accurate sampling and quantification of dilution air NO_x background over transient cycles. Given the possibility of varying background over time, there was concern over whether the current practice of constant flow rate background bag sampling was still adequate for proper background correction. SwRI collected several 8-hour background sample sets, both internally and from EMTC members. These sample sets were used to produce 1000 s of 20-minute background profiles, some of which showed considerable variation during the test interval. These profiles were analyzed using a model which generated background emission mass using the sample test profiles discussed above. The profiles indicated that in cases where background levels were both high and varying significantly over the test, background correction could result in errors as large as +/- 2.5%, with errors over 1% occurring in roughly 1 out of 20 tests. The final effect on transient results could

be larger, given that at high background levels, the correction could be larger than the net mass from the exhaust . The primary countermeasure to address this error would be to switch to sampling the background bag at a rate proportional with the dilution air flow rate. In addition to this, it was also found that the currently permitted practice of using the chemical balance in 1065.655 to calculate dilute fraction without intake air flow measurement resulted in a positive bias in calculated background mass of 7% for the modeled test engine at a minimum dilution ratio of 3 to 1.

NO_x analyzer calibration methodology was examined, with a focus on the concern of what could be done to minimize residual errors in the generation of the analyzer calibration curve. This is relevant for continuous analyzers which are required to operate at a high turn down ratio between peak concentrations, and near zero cycle average levels. A bench experiment was conducted to generate a large set of calibration data over 3 decades of analyzer range from 100 ppm to zero. This data set was used to examine various procedural and analytical approaches to minimizing residual errors near zero. It was found that drift correction could be a valuable tool in minimizing day-to-day errors, and that weighting calibration points inverse to concentration in order to emphasize the lower level calibration points could also help with these errors. The long term stability of such countermeasures would have to be examined via further study, as would their application to other equipment.

Previous studies at SwRI had indicated the possibility of hang-up or lag of NO_2 in the bench sampling systems. Given that NO_2 can be a large component of total NO_x with some aftertreatment systems; this could be a measurement concern. A test fixture was developed to evaluate NO_2 sampling hang-up using a complete bench sampling system, and experiments were executed on both Dilute and Raw benches. The results indicated that there was visible lag above the t50 response point for both kinds of benches, however no loss of NO_2 was observed. Lag was observed on both step tests and short spike tests. This would indicate that NO_2 lag may not be a significant problem for Dilute measurement, but could be a larger problem for Raw measurement because it could disturb the time alignment between gas concentration and exhaust flow in an unpredictable manner. More study would be required in order to estimate the potential magnitude of this error on Raw emissions.

Another issue was surfaced during the NO_2 lag experiments, and this was a tendency for the NO_x analyzers to take a long time to settle back to zero after a brief spike at the sample probe inlet. This resulted in the tendency to recover more than 100% of the input spike, which would be a positive measurement bias. In the case of an emissions profile having the shape or an early input spike followed by a long period of near zero emissions, this could be a significant problem. This behavior was seen on both NO and NO_2. However, the experiments were not explicitly designed to examine such an issue in detail. More study, in terms of a focused experiment to specifically determine the nature and magnitude of this issue is recommended.

Finally, experiments were conducted to look at the measurement resolution and capability of a current generation NO_x analyzer to determine whether the instrument had sufficient accuracy and repeatability at levels near 0.02 g/hp-hr. Repeat measurements were conducted by injecting a low level test gas into a humidified CO_2 stream representative of dilute exhaust at the sample probe inlet. This test concentration was representative of roughly half the average over a

hot-FTP transient test at a 0.02 g/hp -hr composite level. It was found that the analyzer had a repeatability (as defined in 1065 terms) of 9 ppb at this level, which represents slightly less than 3% of the average dilute concentration at a standard of 0.02 g/hp -hr. The accuracy of the analyzer was within 2% of the concentration at the standard. This should be sufficient for measurements at a level of 0.02 g/hp -hr, but it does indicate that the analyzer is operating near the limits of its capability during hot-start measurements.

Overall, there were several areas of measurement concern which warranted further study in order to assess their magnitude more rigorously, or to examine poten tial countermeasures. In addition, it is anticipated that a Low NOx test article will be available in the ARB funded program in the summer of 2016. This will allow for the conduct of complete emission tests to assess measurement variation on a representa tive test article, should EMA desire to fund such an effort.

1.0 INTRODUCTION

This report documents a test program executed at Southwest Research Institute (SwRI) on behalf of the Truck and Engine Manufacturer's Association (EMA). The program involved the examination of several potential issues related to measurement of NO_x emissions at very low levels.

This effort was motivated by the plan announced by ARB to pursue a next phase of on-highway emission standards, which would potentially include a NO_x standard as low as 0.02 g/hp-hr. In addition, ARB has contracted with SwRI to demonstrate heavy-duty emission control technologies, with a development target of 0.02 g/hp-hr. These very low NO_x levels present a considerable measurement challenge, and EMA indicated a desire to fund efforts to examine these issues.

It is understood that the ARB demonstration program in progress at SwRI will likely produce a test article in 2016 that would allow on-engine efforts looking at very low NO_x levels. However, there were a number of potential measurement issues that could be examined prior to the availability of that test article. A list of these potential issues was established through several discussions and telecons with EMTC members. The objective of this program was to perform several preliminary analytical and bench evaluations in order to determine the magnitude of these potential issues with respect to the current measurement equipment and procedures outlined in CFR 40 Part 1065. The program efforts ranged from data gathering and mining, to selected bench experiments. The objective of these experiments was to identify the magnitude of potential measurement issues, and if necessary, recommend areas for further investigation or solutions.

The brief list of measurement issues examined during this program is given below:

- Analyzer Drift and Stability
- Dilution Air Background Issues
- Calibration Methodology
- NO_2 Lag / Hang-up
- Low Level Analyzer Performance

It is important to note that the evaluations performed in this program were intended as a first look at each issue, with the intent of determining if each issue was in fact a problem of sufficient magnitude to warrant concern. In the event of such a determination, recommendations were developed with respect countermeasures to mitigate the issue, or future experiments in order to define the issue in more detail to allow for the development of countermeasures.

The program was guided by the input of members of the Emission Measurement and Testing Committee, and results were regularly reported and discussed at the EMTC meetings. In addition, several of the tasks required data to be supplied by EMA members companies who participate in the EMTC, and SwRI would like to thank those companies who participated in this program for their efforts.

2.0 BACKGROUND AND DESCRIPTION OF PROGRAM TASKS

In order to consider the challenges associated with NO_x measurement at a 0.02 g/hp-hr standard, it is helpful to scale this level in terms of the measured NO_x concentrations that would be observed from an engine running at a 0.02 g/hp-hr level. Table 1 provides a summary of predicted concentrations that are likely to be observed from such an engine.

Table 1. Anticipated Measured NO_X Concentrations at 0.02 G/HP-HR

Method	Cycle Average NO_x, ppm		Peak NO_x, ppm	
	Cold-FTP	Hot-FTP	Cold-FTP	Hot-FTP
Dilute	0.8	0.2	25-30	~ 10
Raw	7.3	1.3	~ 200-300	~ 50
Calculation assumes NO_x background = 0.07 ppm and 10:1 average CVS dilution ratio				

These concentrations will, of course, vary somewhat from engine to engine, but they are useful for considering potential measurement issues at 0.02 g/hp-hr. In comparing these concentrations to the levels typically observed for current on-highway diesel test articles (2010 and later model year), it is apparent that the measured average concentrations will be an order of magnitude lower, but the peak concentrations will not be that much lower than the levels observed currently. For continuous analyzers, this creates the need to support a very high turndown ratio, while still maintaining high accuracy at near-zero measured levels. It should also be noted average dilute concentrations are at or near levels equivalent to background NO_x.

A final element of scaling to be considered relates to the 1065 drift check, which is a required QA measure detailed in 40 CFR Part 1065. This check requires that drift corrected and un-corrected brake-specific emission levels may not deviate from each other by more than 4% of the standard. At a level of 0.02 g/hp-hr, this means that the permissible deviation due to drift is 0.0008 g/hp-hr. This is equivalent to a correction of roughly 13 ppb on the average dilute concentrations given above.

A final note related to a number of the concerns addressed in this program is that many of them are either related to or magnified by the use of continuous analyzers, which is the general practice for most heavy-duty on-highway laboratories at the present time. Moving to dilute bag sampling would help to address a number of concerns, but this is a major change for most facilities, and therefore it is important to assess the capability to continue to operate with continuous gaseous analyzers, whether raw or dilute

2.1 Task 1 – Analyzer Drift and Stability

The issue addressed with this task is the concern about whether the current gaseous analyzer equipment that is being used by most laboratories is capable of passing the 4% 1065 Drift Validation Check at a level of 0.02 g/hp-hr. The drift check details are outlined in 40 CFR 1065.550. Essentially both a set of drift corrected brake-specific emission values are calculated and compared with the un-corrected brake-specific results. As noted earlier, this requires a drift of no more than 0.0008 g/hp-hr at a standard of 0.02 g/hp-hr.

In order to examine this concern, SwRI proposed a data gathering and analysis exercise. Utilizing both internally available databases and data gathered from participating EMA member companies, a large set of pre-test and post-test zero-span data was collected. This data set was then utilized, along with an analytical model in order to examine that population of zero-span data on an emission profile representative of 0.02 g/hp-hr. The resulting drift corrected and uncorrected values were compared to determine the amount of drift relative to the 0.02 g/hp-hr standard.

Separate assessments were made for Dilute Continuous, Raw Continuous, and Dilute Bag measurement methods.

2.2 Task 2 - Dilution Air Background Issues

As noted above, the measured emission levels at 0.02 g/hp-hr, especially during hot-FTP test phases, is at or near dilution air background levels. This makes accurate background correction an important issue. The current methodology for background correction involves filling a bag at a constant flow rate (essentially a time-weighted average concentration) and then performing the correction given in 40 CFR Part 1065. If background levels vary during testing, there is the potential for error from this correction. This error can be mitigated via proportional (flow weighted) background bag sampling, which is more accurate, but this takes considerable effort to implement.

The approach to this issue involved first gathering continuous profiles of background emissions over 8-hour periods. Then these profiles were used to analytically compare the effect of time-weighted background sampling versus flow-weighted sampling, in order to determine the potential error associated with the current process.

2.3 Task 3 - Calibration Methodology

This issue looked at whether the current calibration methodology generally used on 40 CFR Part 1065 was adequate for the high potential turndown for continuous NO_x from engines at 0.02 g/hp-hr. The question examined was whether the current process could be improved to achieve better control of the residual errors of the calibration curve near zero.

The experiment involved using a carefully matched and named set of bottles to generate a calibration data set spanning 3 logarithmic decades on a 100 ppm full scale range (i.e., 100, 10, and 1 ppm). This data set was repeated multiple times to also examine day-to-day variation. The data set was then examined analytically and processed in a variety of ways to look at procedures that could be implemented to reduce residuals near zero in the final calibration curve, which is normally generated using fewer points.

2.4 Task 4 - NO_2 Sampling Lag/Hang-up

Previous experiments conducted at SwRI, as well as by others involved with instrumentation, have indicated that NO_2 measurement can experience sampling delays due to hang-up and transport issues. In the worst cases, there is the potential for NO_2 loss in the sampling system. This has the potential for large measurement errors if a significant portion of the tailpipe NO_x is in the form of NO_2. Note that this behavior is distinct from NO_x converter issues, which are well controlled by the QA checks in 40 CFR Part 1065.

In order to examine this issue more closely, SwRI developed up a bench-top test system that allowed the rapid switching of NO_2 concentration (up and down), blended into a gas stream of humidified CO_2. This gas was sampled at the probe of an emission bench incorporating the full sampling system. The response to NO and NO_2 concentration changes was compared to examine the relative response of NO_2. Both raw and dilute benches were examined.

2.5 Task 5 - Low Level Analyzer Performance

This task was designed to examine the basic capability of current generation dilution continuous analyzers to make repeatable measurements of very low levels of NO_x. To make this assessment, a bottle gas named at 1 ppm was divided 10:1 into a humidified CO_2 stream, resulting in a 0.1 ppm concentration. Repeat steps between zero and 0.1 ppm were made in order to generate enough observations to perform a statistical analysis. The experiment was similar in concept to the accuracy, noise, repeatability checks in 40 CFR Part 1065, but conducted in a more realistic measurement setting. The data were then analyzed to determine if the analyzer had the basic accuracy characteristics required to accurately measure very low NOx levels. A second experiment was also conducted as part of this task to quantify low concentration stability over a 20-minute test interval. In this experiment the same 0.1 ppm test gas in humidified CO_2 was used, but was continuously metered to the bench at the sample probe for the entire test interval.

3.0 TASK-BY-TASK RESULTS AND ANALYSIS

This section of the report details the methodology, results, and analysis for each task. In cases where a large amount of data was collected, the data is presented only in graphical or summary form. However, the data files remain available to any EMTC member, and these files can be supplied upon email request.

3.1 Task 1 – Analyzer Drift and Stability

As discussed earlier, the basic approach to this task was to collect a large body of zero-span data from a variety of sources, and then to analyze that data and provide an assessment of whether the 4% drift correction could be met reliably at 0.02 g/hp-hr utilizing current analytical equipment.

The task efforts began with the data collection effort. SwRI developed a template for data submission, and this was distributed to the EMTC members to enable data submission. An example of the data template is given below in Table 2, to illustrate the information that was collected. In addition, SwRI also mined data in internal databases to locate suitable data for inclusion in the sample set. The principal target was data for Dilute Continuous and Raw Continuous measurements, although some Dilute Bag data was also provided. Given existing light-duty Dilute Bag measurement experience, from SwRI and others, it was felt that these systems would not have difficulty with the 4% requirement. However, a small amount of data was collected to verify this as well.

Table 2. Example of Zero-Span Data Collection Format

	Drift Info				Pre-Test		Post-Test		Analyzer Info				
Data Point	Drift g/hp-hr	% 2010 Standard %	% of 0.02 %	Test Cycle	Zero ppm	Span ppm	Zero ppm	Span ppm	Full Scale ppm	Span Value ppm	Analyzer Model	Dry / Wet	Sampling Method
1	-0.000254	-0.13%	-1.3%	RMC-SET	0.00000	88.68200	0.028	89.03	100	88.67	Horiba MEXA 7200D CLA	Dry	Dilute

General guidelines for the data were provided along with the template. Target data was intended to be for post-2010 on-highway and Tier 4 Final nonroad, ideally from engines that were compliant with the standards (rather than those meeting a higher FEL). Cold-start, hot-start, and steady-state data were all useable. Data was collected between July 2014 and October 2014. Ultimately, data was received from a total of four laboratories, in addition to the data used from SwRI.

The data was compiled and screened to make sure that a set of data representative of appropriate ranges for 0.02 g/hp-hr was used. Any data that did not pass the 4% drift check was removed. In addition, analyzer information was used to determine whether the analyzer in question was operating at the highest available resolution (i.e., maximum digital gain), if multiple gains were available. Lower resolution data was removed, because such analyzer settings would not be appropriate for the concentrations observed at 0.02 g/hp-hr.

The final screened data set contained roughly 1800 data points. Of these data points, about 1500 (84% of the data) were for Dilute Continuous sampling, while another 300 data points (16% of the data) were for Raw Continuous sampling. There were also roughl y 50 data points for Dilute Bag sampling. The range of tailpipe emission levels represented in the data set was roughly from 0.05 g/hp -hr to 0.5 g/hp -hr (including cold -start data points). The data included on -highway FTP cycles, NRTC cycles, and RMC cyc les for both on -highway and nonroad.

An initial look at the data, examining the drift amount in comparison to the requirement at 0.02 g/hp -hr is shown in Figure 1. For this compiled data set, cold -start and hot -start data were weighted appropriately, so that the overall impact of drift on the final composite value was assessed.

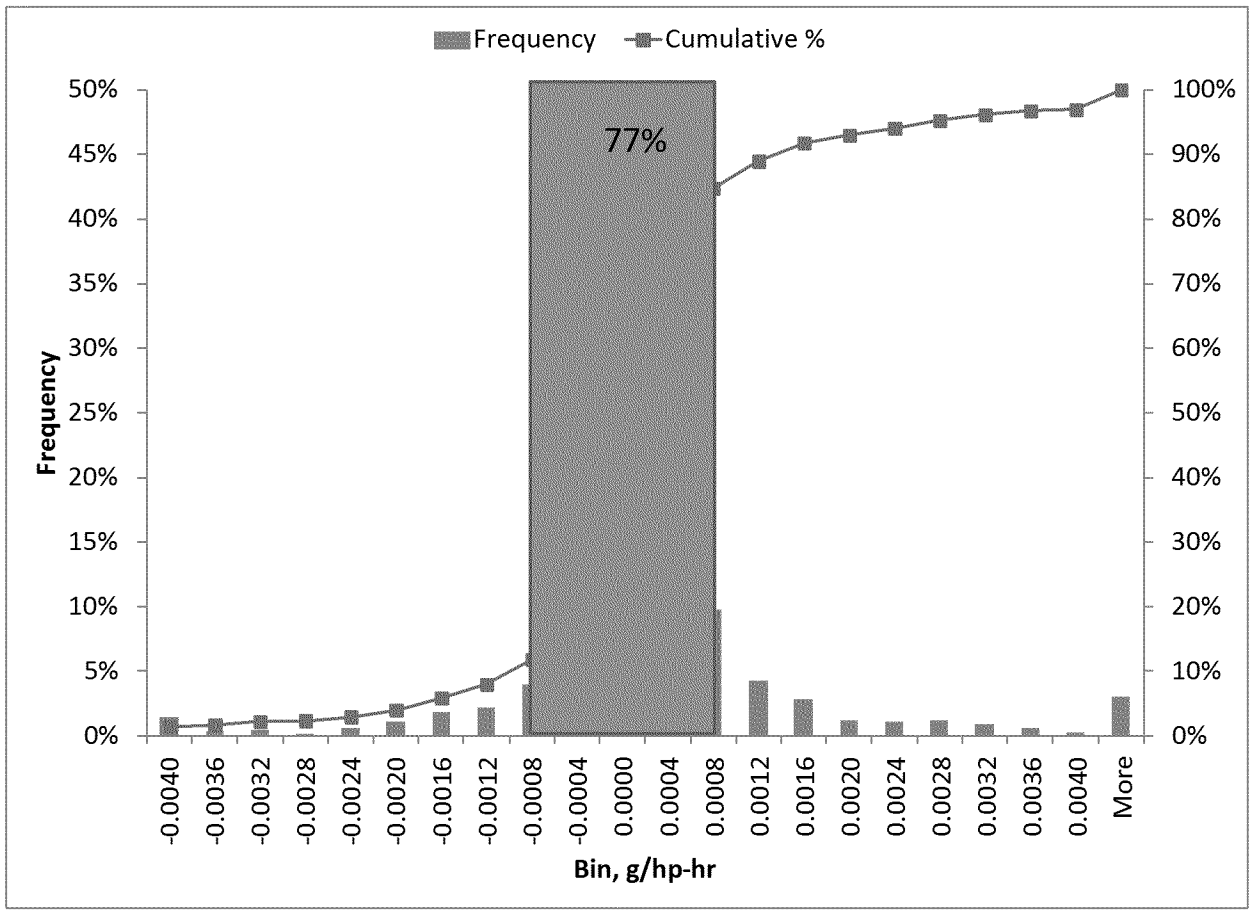

Figure 1. Initial Distribution of Drift Check Data

The data shows that roughly 77% of the observations were within +/ - 0.0008 g/hp -hr, which is the 4% tolerance at 0.02 g/hp -hr. This broke down as 82% of Dilute Continuous data, 54% of Raw Continuous data, and all of the Dilute Bag data.

However, this simple analysis is not appropriate to answer the question of drift at 0.02 g/hp-hr. This is because drift data, measured in brake -specific units, scales with the absolute emission level. Furthermore, the effect of the drift correction in 40 CFR 1065.672 on a given test depends very much on the pattern of the continuous data signal. Therefore, a more sophisticated analysis was required to make a proper determination. The drift correction equation is included below for reference;

$$x_{\text{idriftcorrected}} = x_{\text{refzero}} + \left(x_{\text{refspan}} - x_{\text{refzero}}\right) \cdot \frac{2x_i - \left(x_{\text{prezero}} + x_{\text{postzero}}\right)}{\left(x_{\text{prespan}} + x_{\text{postspan}}\right) - \left(x_{\text{prezero}} + x_{\text{postzero}}\right)}$$

Eq. 1065.672-1

$x_{\text{idriftcorrected}}$ = concentration corrected for drift.
x_{refzero} = reference concentration of the zero gas, which is usually zero unless known to be otherwise.
x_{refspan} = reference concentration of the span gas.
x_{prespan} = pre-test interval gas analyzer response to the span gas concentration.
x_{postspan} = post-test interval gas analyzer response to the span gas concentration.
x_i or $\bar{x}$ = concentration recorded during test, before drift correction.
x_{prezero} = pre-test interval gas analyzer response to the zero gas concentration.
x_{postzero} = post-test interval gas analyzer response to the zero gas concentration.

As noted in Table 2, the data collection also included the actual pre -test and post -test zero-span data for each run. Therefore, each line of data was an observation of analyzer drift over the course of a typical test duration. Given that the analyzer ranges for the screened data are still representative of what would be used for an engine at 0.02 g/hp -hr, these data could be used to conduct a proper assessment of drift at very low NO_X levels.

Based on information from the ARB Low NO_X Demonstration program, a representative NO_X emission profile was generated for both cold -start and hot-start FTP cycles. These profiles were based in part on projections of what would be required to reach the 0.02 g/hp -hr level, as well as exhaust flow data taken from the test program, as well as some early aftertreatment data. The final exhaust NO_X concentration profiles that were used for analysis are given in Figure 2 and Figure 3, for cold-start and hot-start FTP respectively. The Dilute Continuous profile for the baseline engine is also show in the figures for comparison.

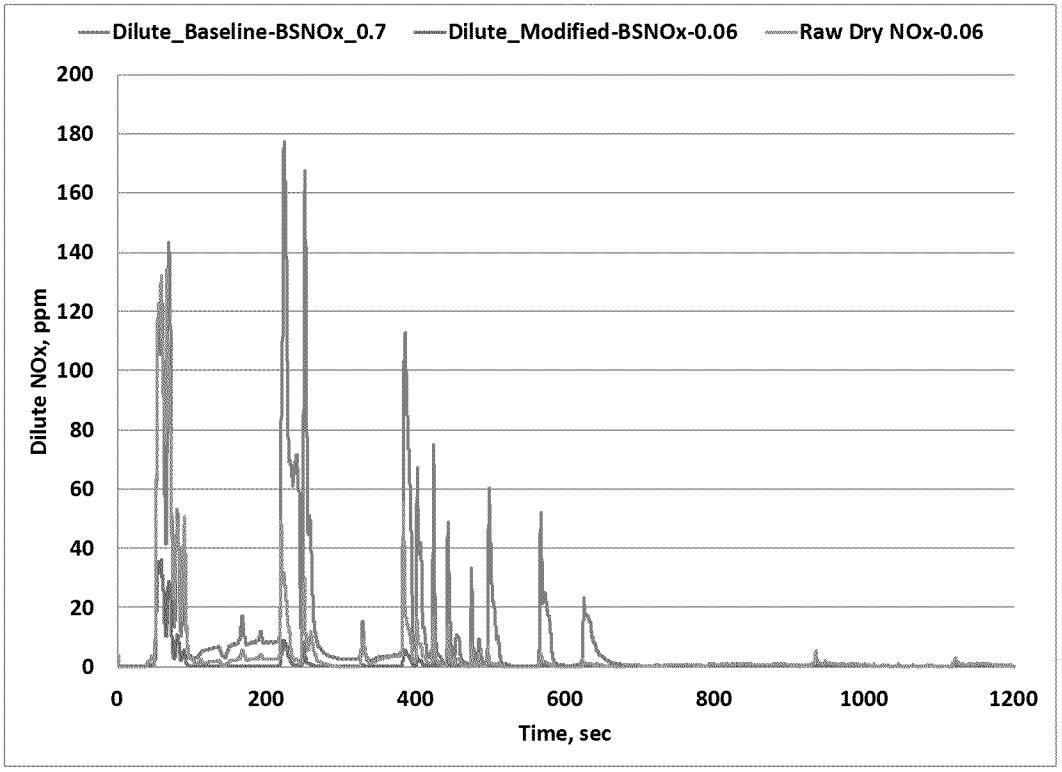

Figure 2. Cold-Start NO_X Concentration Profile for Drift-Check Analysis

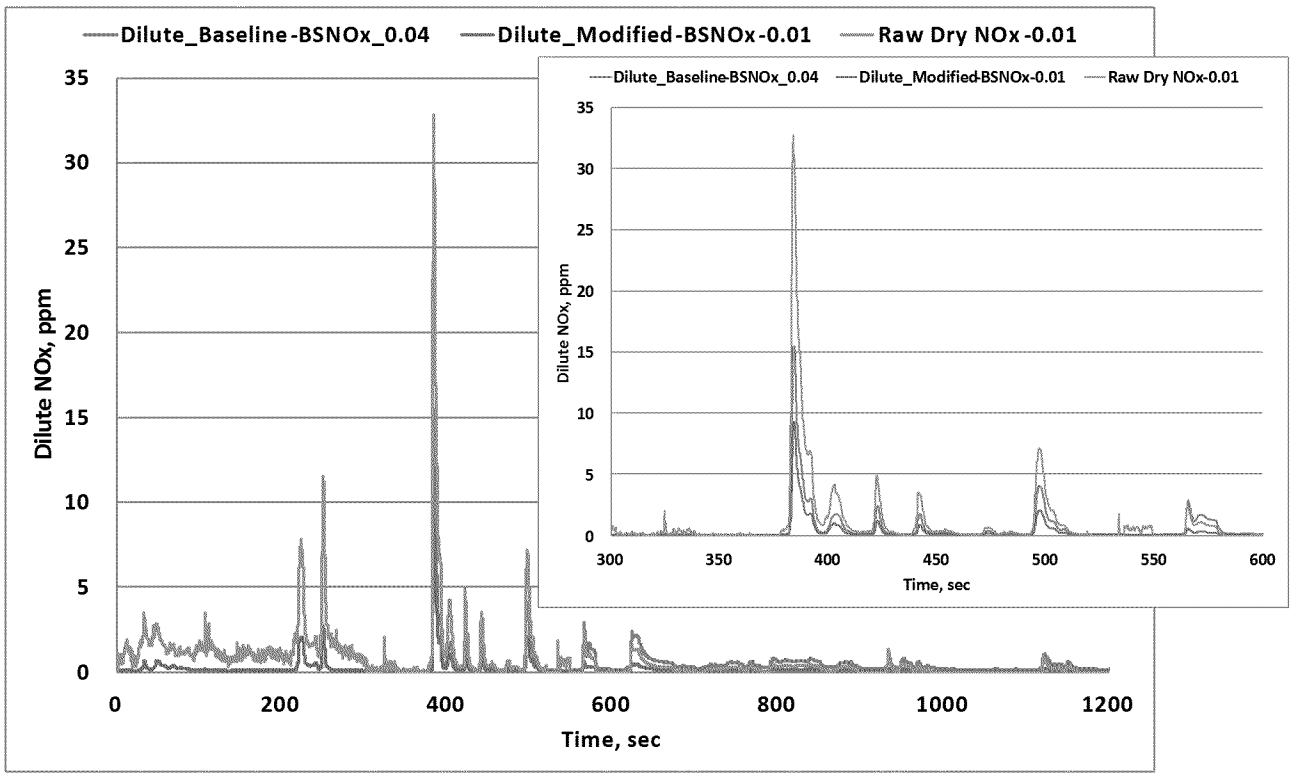

Figure 3. Hot-Start NO_X Concentration Profile for Drift-Check Analysis

As can be seen the cold-start involves an early period of high NO_x emissions prior to the light-off of the aftertreatment system, followed by a long period of near -zero. For the hot -start, the aftertreatment begins warm enough for good NO_x control, and therefore only a few small breakthrough events are observed in the m iddle portions of the cycle. The profiles also included exhaust flow and all other data channels required to perform the 1065 calculations. The brake -specific NO_x level for the cold-start FTP was roughly 0.06 g/hp-hr, while for the hot-start FTP it was 0.01 g/hp-hr.

Based on these profiles, an analytical model was set up that would use each set of zero -span data from the drift check data set, and which would calculate both drift -corrected results for each data set. Each drift corrected emission value was then compared to the uncorrected value, which would of course be the same for all sets of zero -span data. This resulted in a predicted of a drift value at a representative 0.02 g/hp -hr emission level. Analysis was completed for both dilute and raw data sets, and for cold -start and hot -start FTP values. The results were then compiled and analyzed further.

The result of the final analysis for Dilute Continuous hot -start values is shown in Figure 4. It was observed that 98% of the zero -span observations resulted in drift values that were within +/- 0.0008 g/hp-hr, with most of the data between +/ - 0.0004 g/hp-hr. Similar data were generated for the cold-start, and when weighted appropriately, all of the cold -start observations were within +/- 0.0002 g/hp-hr in terms of their effect on the final composite value. In addition, all of the cold-start drift values were also within +/ - 3% of the cold-start test value of 0.06 g/hp-hr, which would also be considered valid for drift check purposes. It was noted that assessing the drift check on a composite basis (which incorporates the weighting factors), rather than on a test interval basis which is more typical, provides more margin for the drift check.

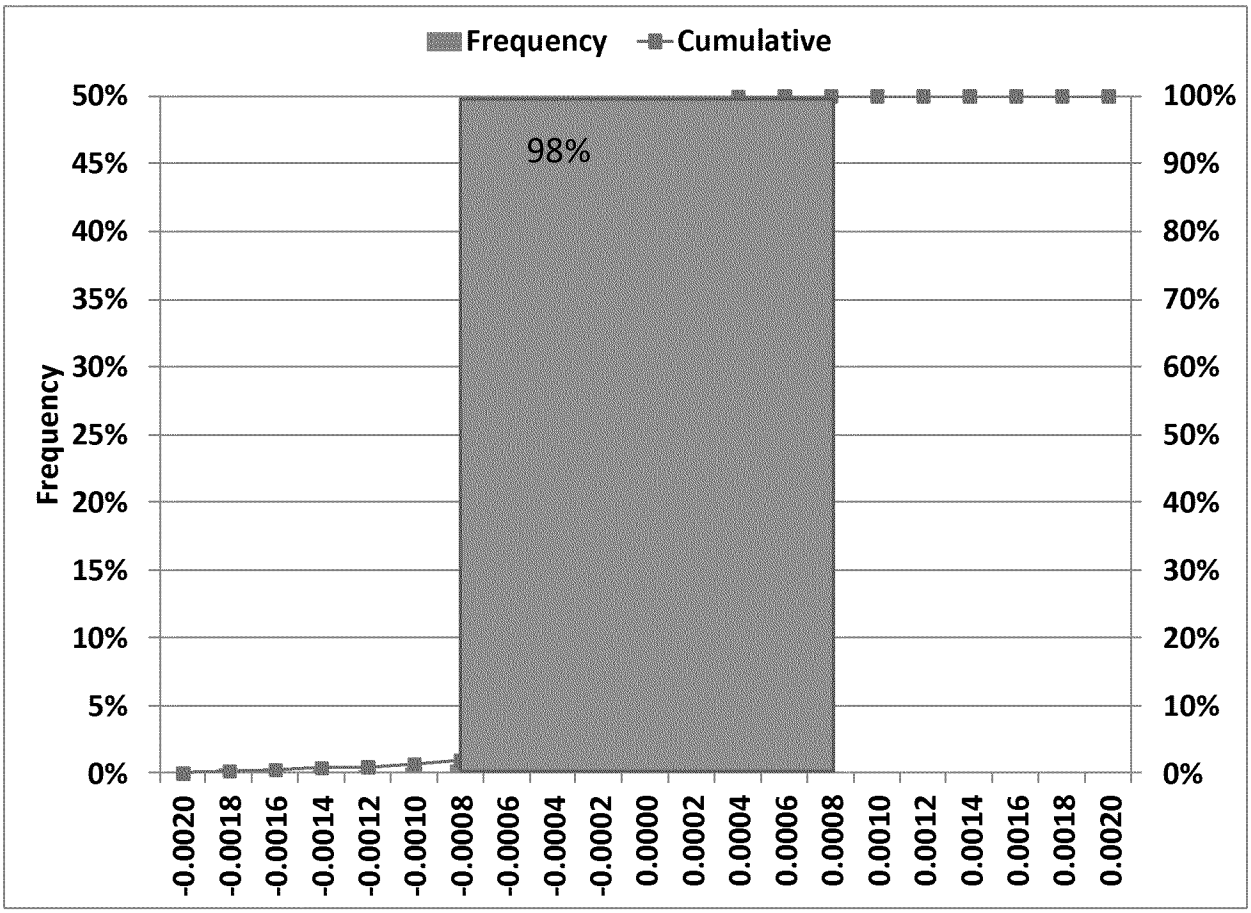

Figure 4. Final Drift Analysis Result for Dilute Continuous Hot-Start Data

In the case of the Dilute Bag results, all of the observations were well within +/ - 0.0008 g/hp-hr. This was the case even before the zero -span results were applied to the lower concentrations to evaluate them at the correct level. It was quickly apparent that Dilute Bag would have no difficulty with drift check at 0.02 g/hp-hr, which was anticipated.

The result of the final analysis for Raw Continuous hot -start values is shown in Figure 5. Only about 55% of the Raw Drift data was within +/- 0.0008 g/hp-hr. Most of the data that was out of limit was on the high side, although there were some data points that were low as well. This bias may have been the result of the relatively small sample size (roughly 300 data points). A significant portion of the drift results more than twice the tolerance. There were only a small number of cold-start observations for the Raw data set it was not possible to do a robust analysis, although it is worth noting that roughly have of those failed the specification as well.

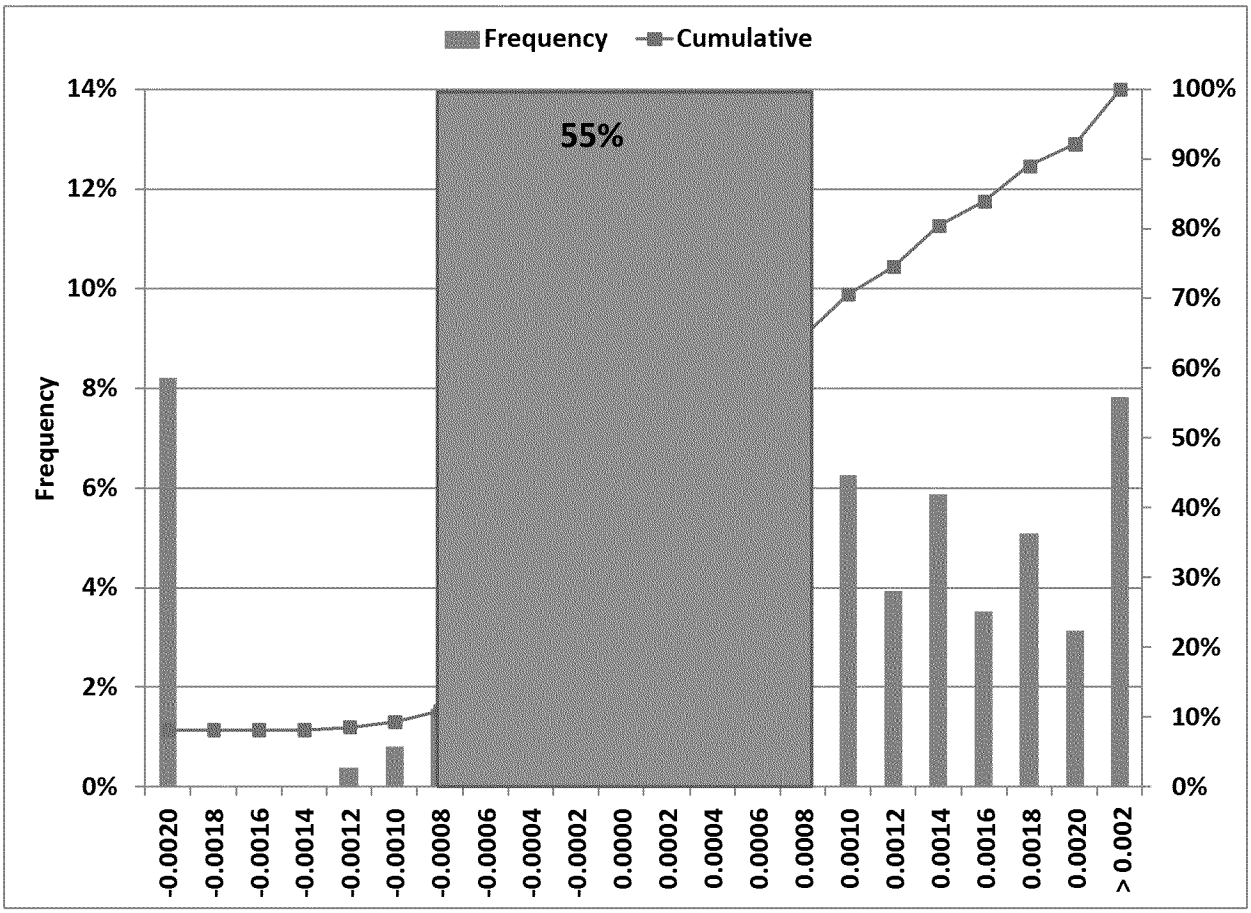

Figure 5. Final Drift Analysis Result for Raw Continuous Hot-Start Data

These results do give preliminary indication that there may be difficulties for Raw Continuous measurement with regard to the drift check at 0.02 g/hp-hr. It is not yet known what was driving these issues; more analysis would be needed to isolate the root cause of the problem. It would also be preferable to collect additional data if possible to refine the prediction.

Taken as a whole, the drift analysis indicated that there should be no difficulties with current equipment for either the Dilute Continuous or Dilute Bag measurements methods, but there may be some concern for the Raw Continuous method. More effort is recommended to examine the reasons for the issues observed with the raw data, and to potentially recommend countermeasures to deal with those issues.

3.2 Task 2 – Dilution Air Background Issues

As noted earlier, measured NO_x concentrations at 0.02 g/hp-hr are anticipated to be at or near the levels observed in dilution air background, especially during hot-start FTP and RMC-

SET testing. This means the any variations or errors related to correction for background could have a significant impact on the final emissions values. The issue of variation in the background determination from the bag reading was dealt with in Task 5. The issue examined in Task 2 was to assess variation that resulted from the background sampling approach.

In order to examine this issue, it was first necessary to look at how much dilution air NO_x varies and over what kind of timescales. Higher background values result in a larger correction, but as long as this correction is done accurately, the end result is still valid. If, on the other hand background varies a great deal over the timescale of a test (i.e., 20-40 minutes), then there is potential for error in the correction.

In order to develop representative profiles, SwRI performed experiments in its own laboratory wherein a dilute emission bench was used to continuously monitor background for an 8-hour shift. A number of these measurements were performed at different test cell locations and on different days over the course of a three-month period. Each measurement was a profile of dilution air background over a single shift. A procedure was developed with respect to data recording, zero-span, and drift correction in order to facilitate accurate background quantification.

SwRI also provided the details of the procedure to EMTC members, in order to allow others to duplicate the experiment and provide additional background profiles. Several profiles were received from one EMTC laboratory to augment the SwRI generated data set. Some of these data sets were "well-behaved" with background remaining stable over most of the shift at levels around 50 to 70 ppb. Other profiles were problematic, showing considerable variation. Examples of some of these problematic profiles are shown in Figure 6 and Figure 7. As can been seen in these profiles, background variations are not predictable and events can be separated by long periods of stability.

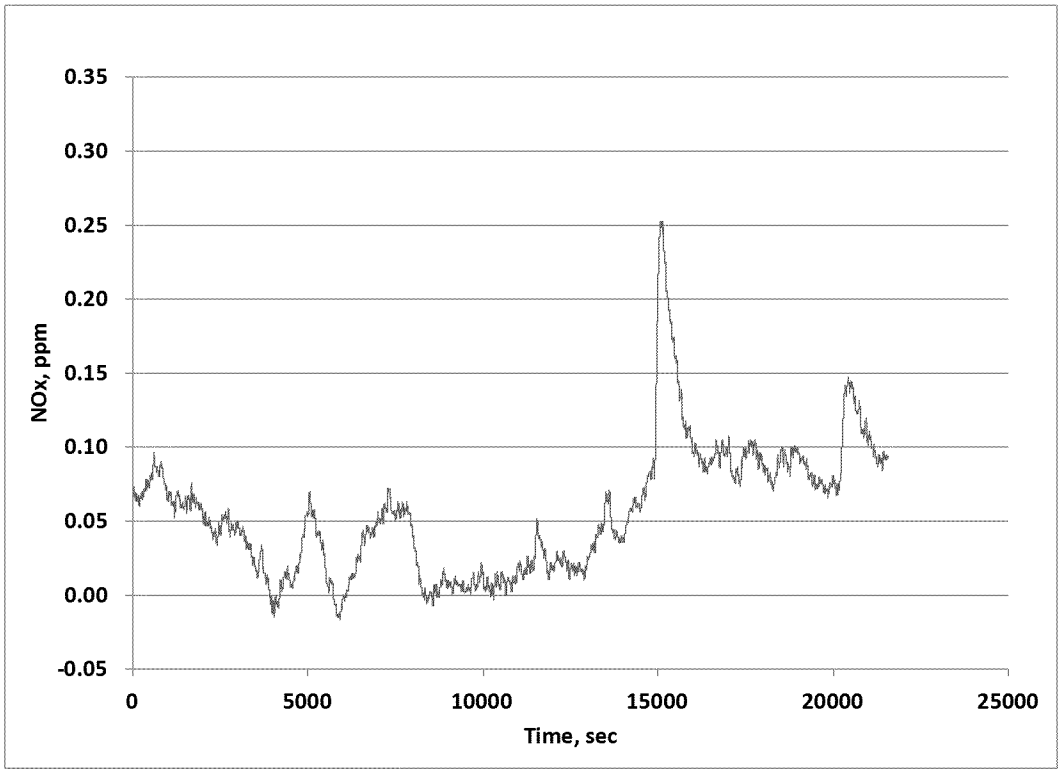

Figure 6. Eight-Hour NO_X Background - Profile 1

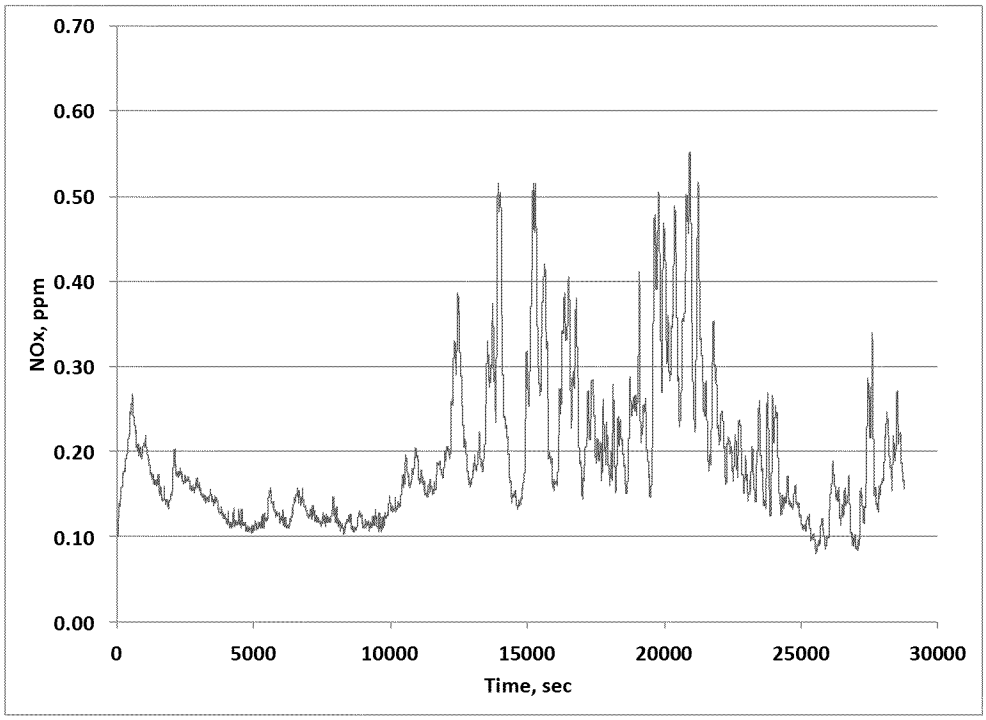

Figure 7. Eight-Hour NO_X Background - Profile 2

Figure 8 and Figure 9 show examples of the same data examined over a 20 -minute test interval window. These examples illustrate that considerable variation can be seen over even a single test.

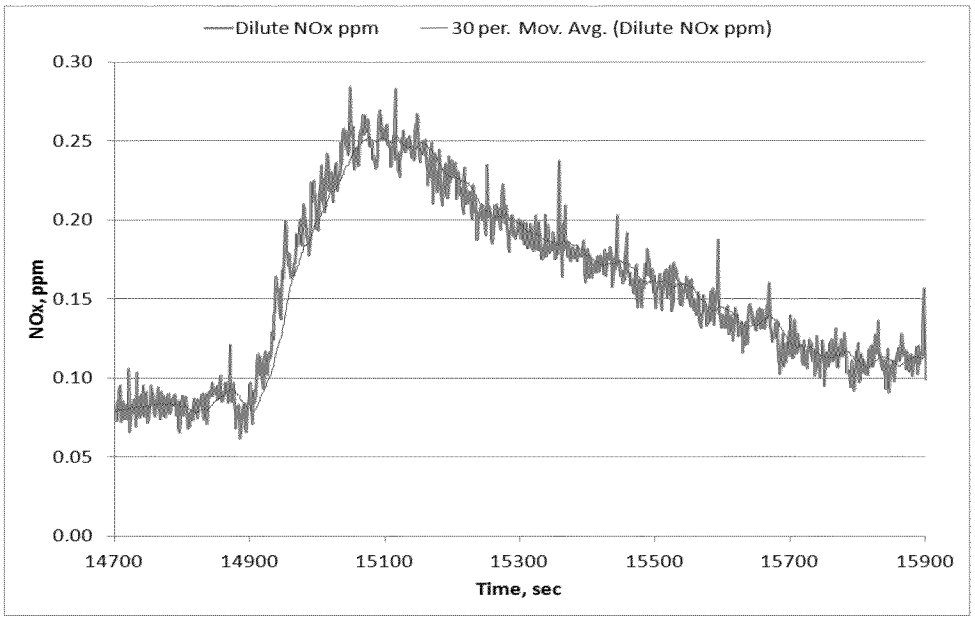

Figure 8. Example 1 of 20-Minute NO_X Background Variation

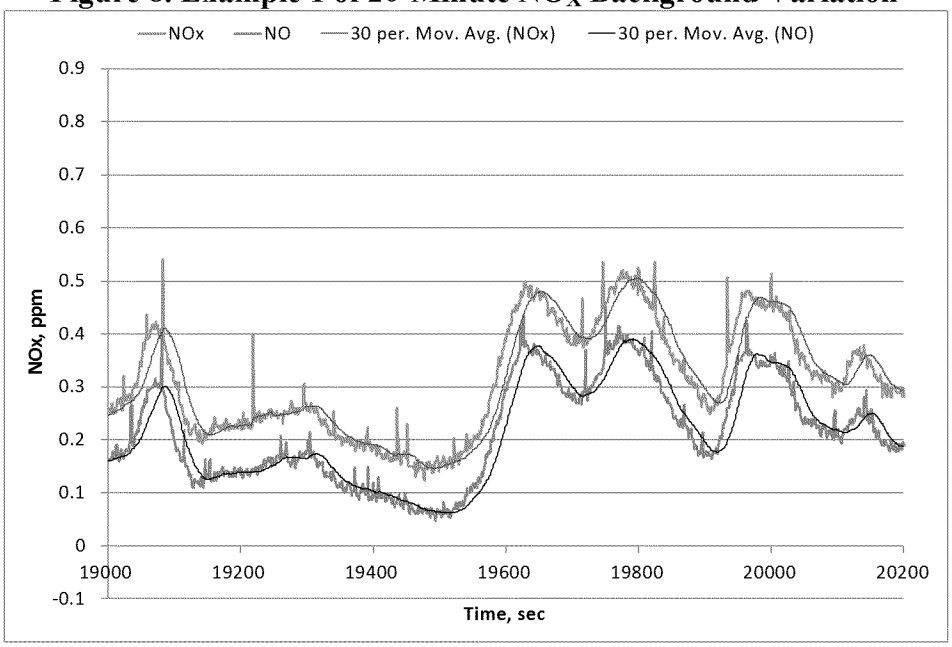

Figure 9. Example 2 of 20-Minute NO_X Background Variation

In the event of these kinds of variations, the interaction between varying background levels and var ying dilution ratios results in an error using the current practice which involves sampling dilution air background at a constant ra te. A more accurate approach would be to use proportional background ba g sampling (flow weighted) to insure that the final background

correction is more accurate. The question is how much error is associated with the current approach as opposed to proportional sampling.

To examine this question, a model was built that used the background profiles, along with the representative transient test data set that were generated for Task 1. This test data set contained data on measured dilution ratio (based on CVS flow measurements, and exhaust flow measured from intake airflow and the 1065 chemical balance). This allowed the use of a mathematical exercise to predict the value of a proportionally sampled bag, versus a straight time average of background concent ration over a 20 -minute period. A moving 20 -mintue window was used to sample many different background profiles over the course of an 8 -hour data file (the window was moved in 10-second increments). This resulted in thousands of evaluations in a short pe riod of time. For each evaluation, the value of the time -weighted and flow weighted background values were compared to develop an error value. The analysis was conducted on several of the background profiles that showed significant variations over the day.

The analysis also examined the effect of using the dilution fraction (x_{dil}) calculated from the chemical balance on 40 CFR 1065.655, as compared to using the measured dilution ratio from the comparison of CVS flow and measured exhaust flow (based on intake air flow and the 1065 chemical balance. The later approach is a more accurate representation of the true x_{dil}, given that the chemical balance alone cannot differentiate engine excess air from dilution air.

Figure 10 shows the transient test profile that was used for the analysis. It illustrates raw and dilute exhaust flow, as well as dilution airflow (by difference of those two) over the 2 0-mintue period. The average dilution ratio for this test profile was 17:1, while the minimum dilution ratio was 3:1.

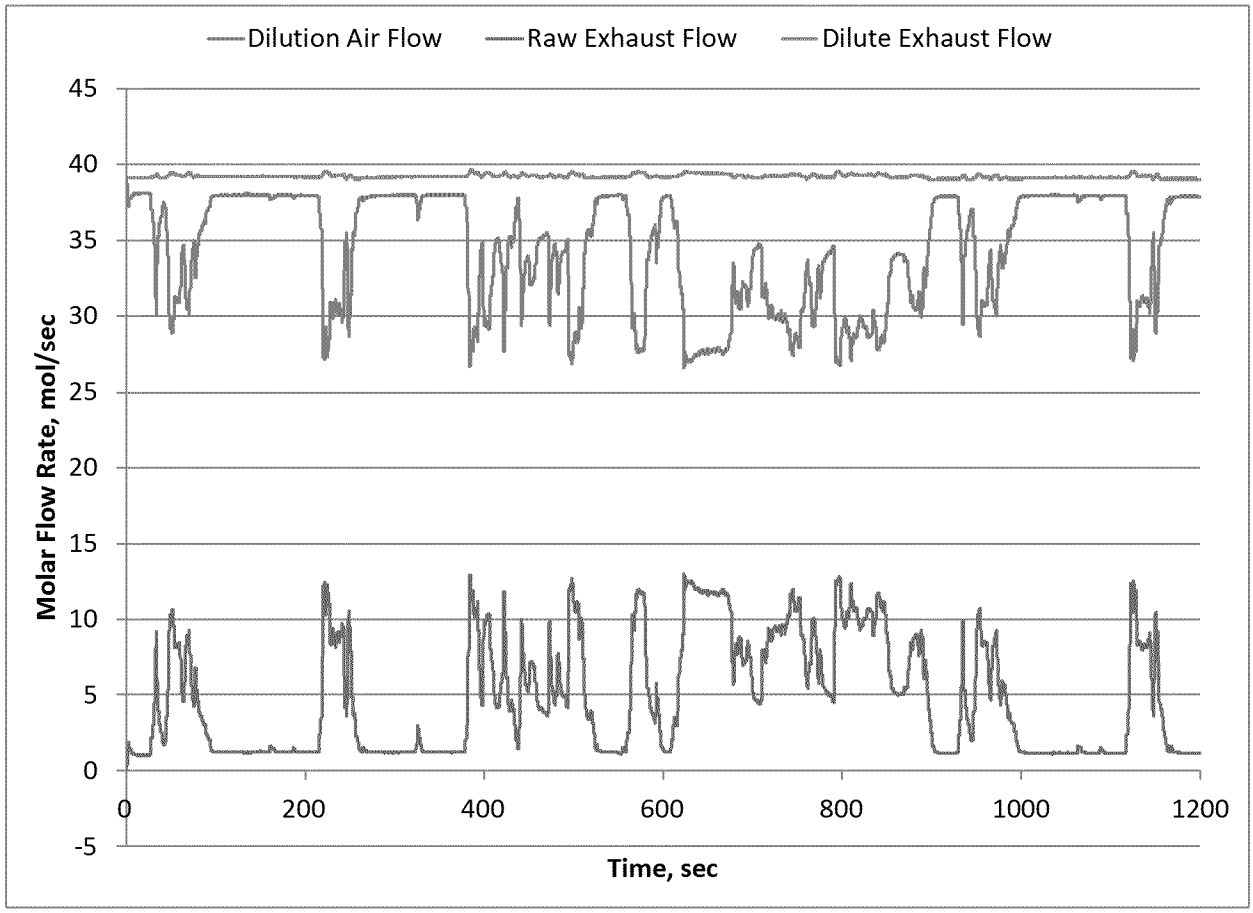

Figure 10. FTP Transient Test Profile for Background Analysis

The data from the model simulations was compiled and analyzed with respect to background behavior, in order to determine how much potential error was observed, and also what was driving that error. In addition, the data was examined to determine the frequency of larger error events.

The result of this analysis is shown in Figure 11 and Figure 12, for 8-hour background profiles 1 and 2, respectively. Each sample represents a 20 -minute background profile, which has been analyzed using the transient test data in the model. Between the two background data sets, nearly 4800 separate samples were analyzed. For each sample, the graphs show both the average background concentration and the amount of variation in that background concentration over the 20 -minute period, as measured by the standard deviation of the background concentration. The analytical result sho ws the change in NOx emissions as a percentage of 0.02 g/hp-hr, between time weighted and flow weighted sampling. The calculation was performed as:

[Time Weighted Bkgrd – Flow Weighted Bkgrd] / Flow Weighted Bkgrd

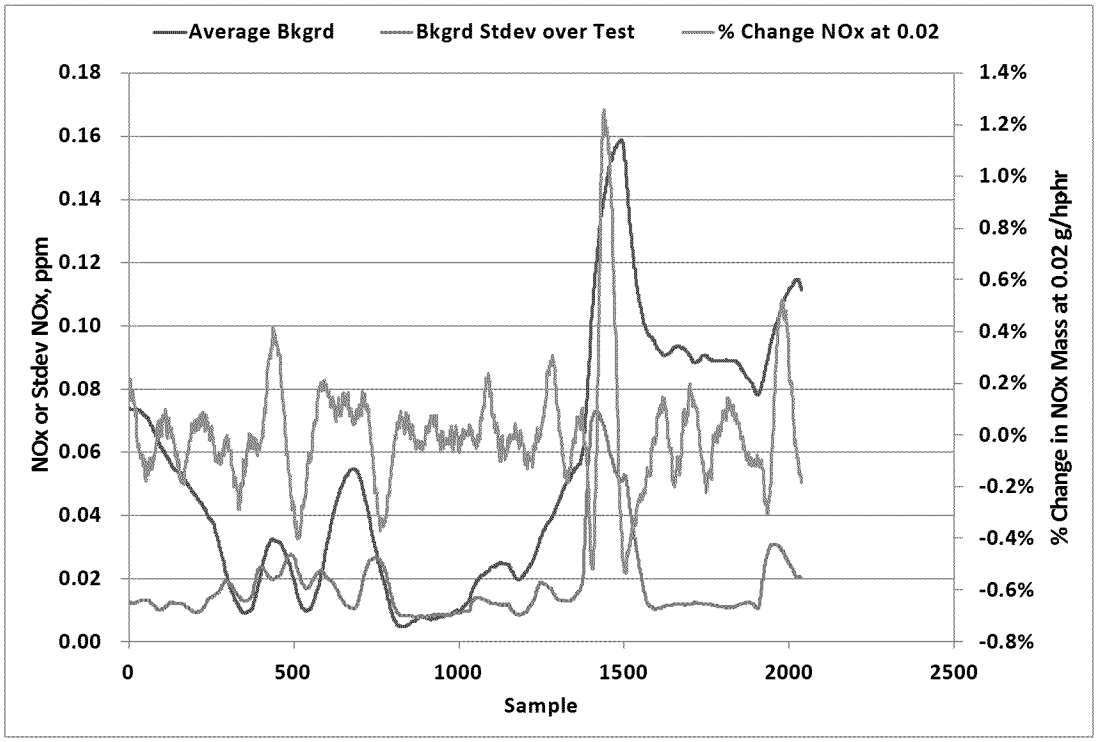

Figure 11. Background Analysis Result for Profile 1

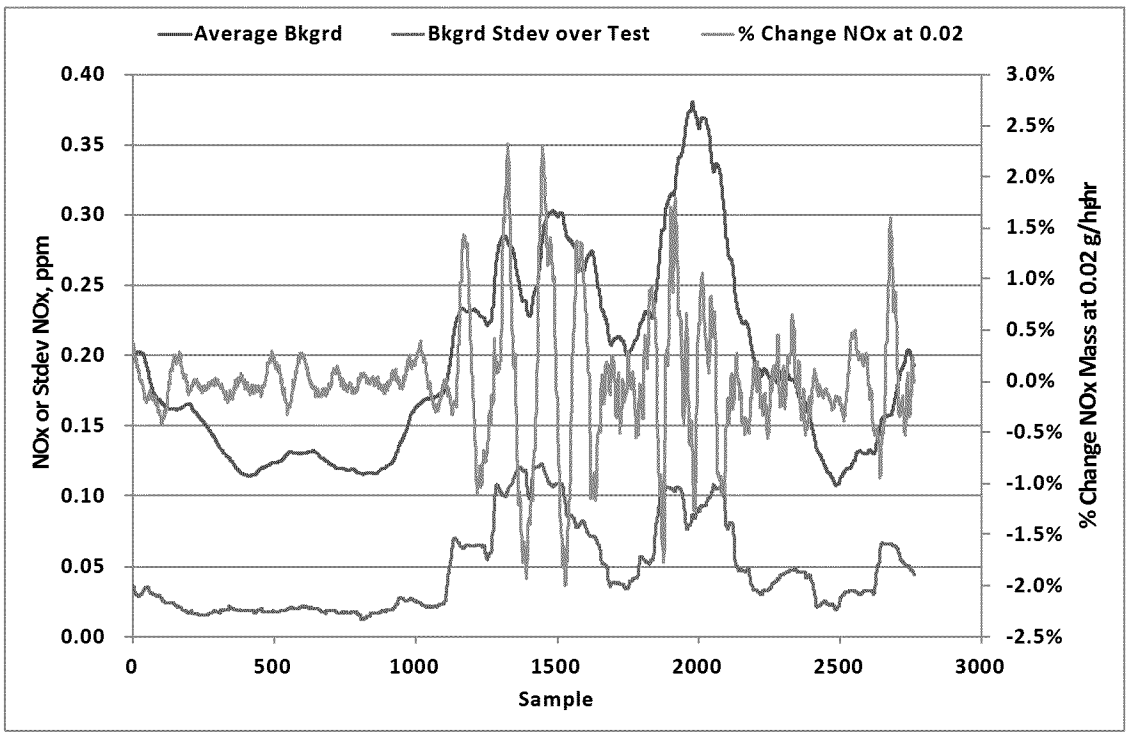

Figure 12. Background Analysis Result for Profile 2

As seen in the figures, the background error is largest when background is both high and

varying. When background is well behaved , the errors are relatively small even when the background levels are higher. Likewise, when background levels are low, variability does not cause a significant problem. Errors were equally distributed between positive and negative errors. The largest errors observed were on the order of +/- 2 to 2.5% of 0.02 g/hp-hr, or nearly a 5% swing in the final value. It should be noted that within the data set examine, the error was larger than 0.5% for roughly 10% of the samples, and over 1% for roughly 5% of the samples.

Figure 13 shows the result of the comparison of methods for determining fraction, x_{dil}. Note that using the more accurate approach of measured dilution fraction always results in a lower background ma ss because the chemical balance overestimates the amount of dilution air. The result for this data set is a 7% shift down in background mass. The effect of this shift on the final net mass will vary with background level, but in this data set, which is f or background profile 2, the effect is in the range of a 3% to 10% offset on the final net mass, which is a significant shift.

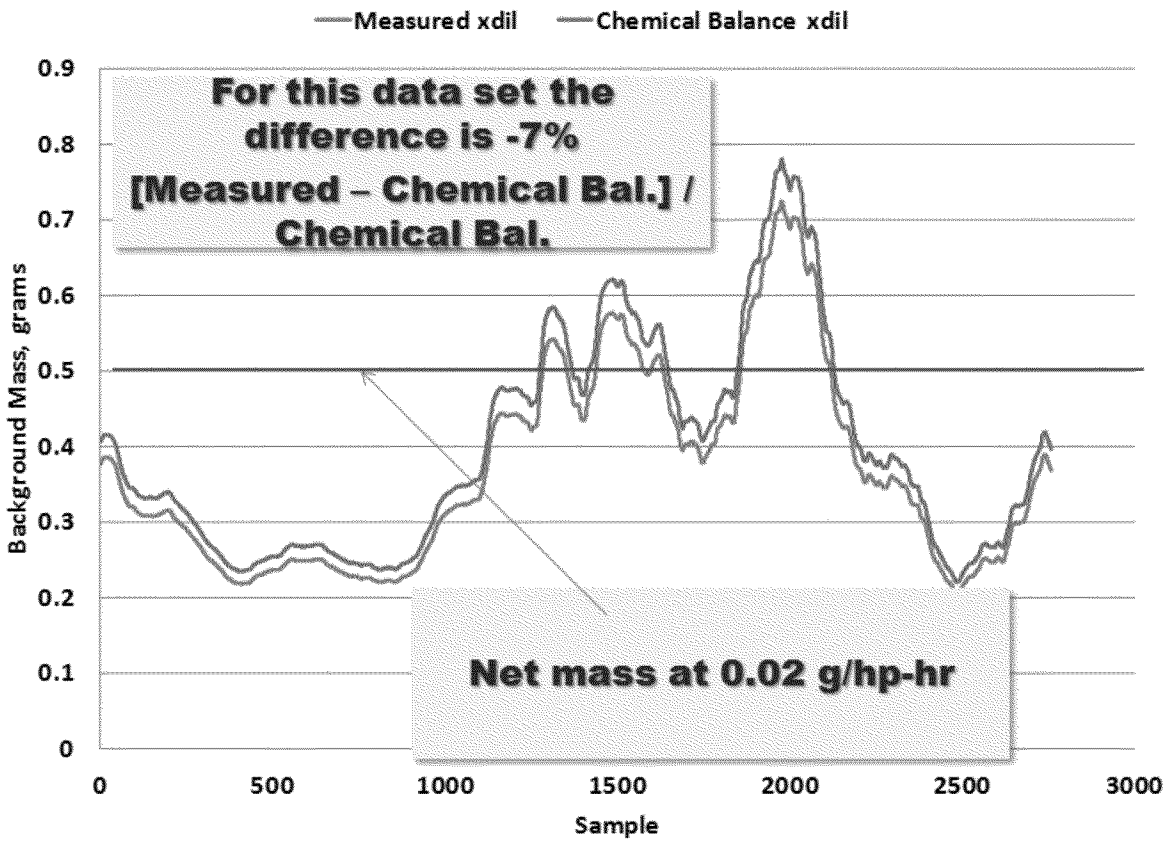

Figure 13. Comparison of Background Mass Based on Measured and Chemical Balance x_{dil} for Various Background Profiles

3.3 Task 3 – Calibration Methodology

This objective for this task was to examine the analyzer calibration process, with a focus on examining the residual errors near zero NO_X levels. This was performed by using a matched set of bottles to generate a set of calibration data that covered three different decades of analyzer response. A dilute analyzer was used for this task, given that the final result would be more sensitive to any offsets near zero. The analyzer utilized for this study was a Horiba CLA 725M atmospheric NO_x instrument, which was installed in a MEXA 7200D dilute emissions bench. For the purpose of generating the curve data, a GDC -703 gas divider was utilized. This experiment was conducted using a nominal 100 ppm full scale range.

The bottles and calibration cut points were selected such that no data was utilized with a cut point below 3% of a given bottle, in order to insure maximum accuracy of the calibration inputs with the GDC -703 hardware. The bottles were named at SwRI in succession, starting with a NIST standard for the high bottle and moving through the other bottles on the same range, so the set was matched. Figure 14, Figure 15, and Figure 16 showed the comparison of named values for the bottles.

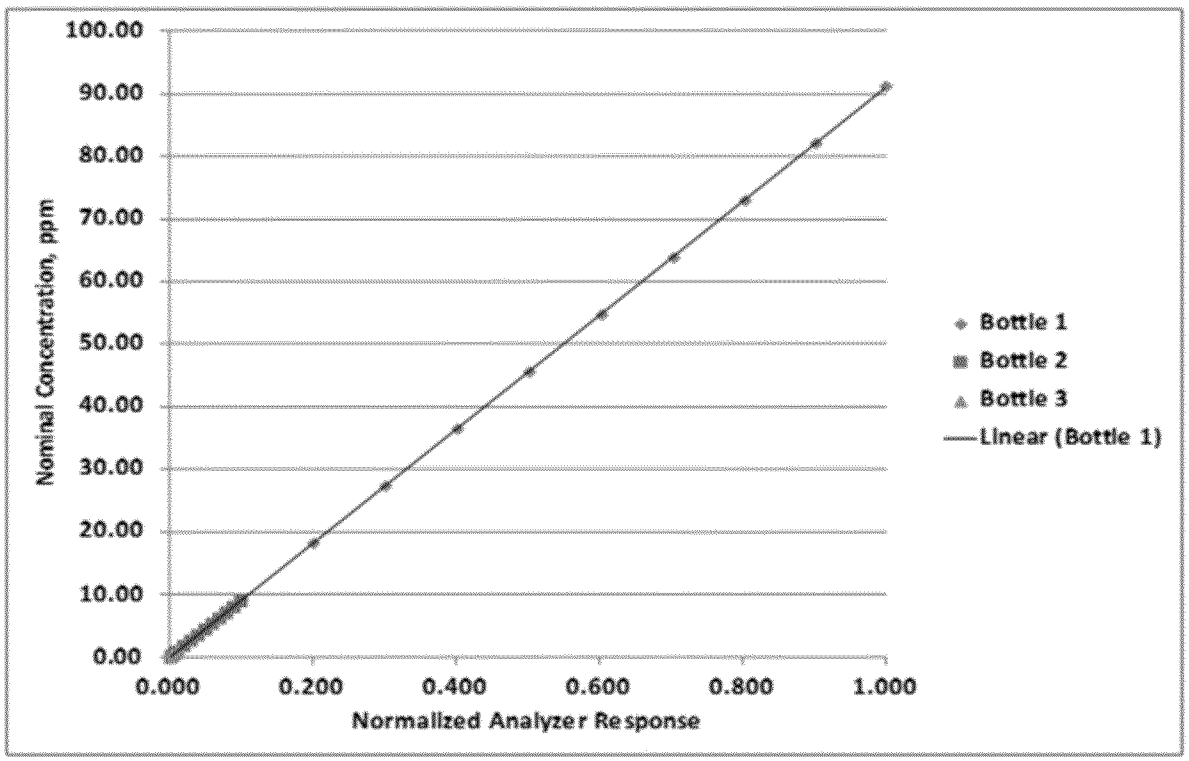

Figure 14. Matched Bottle Data Set

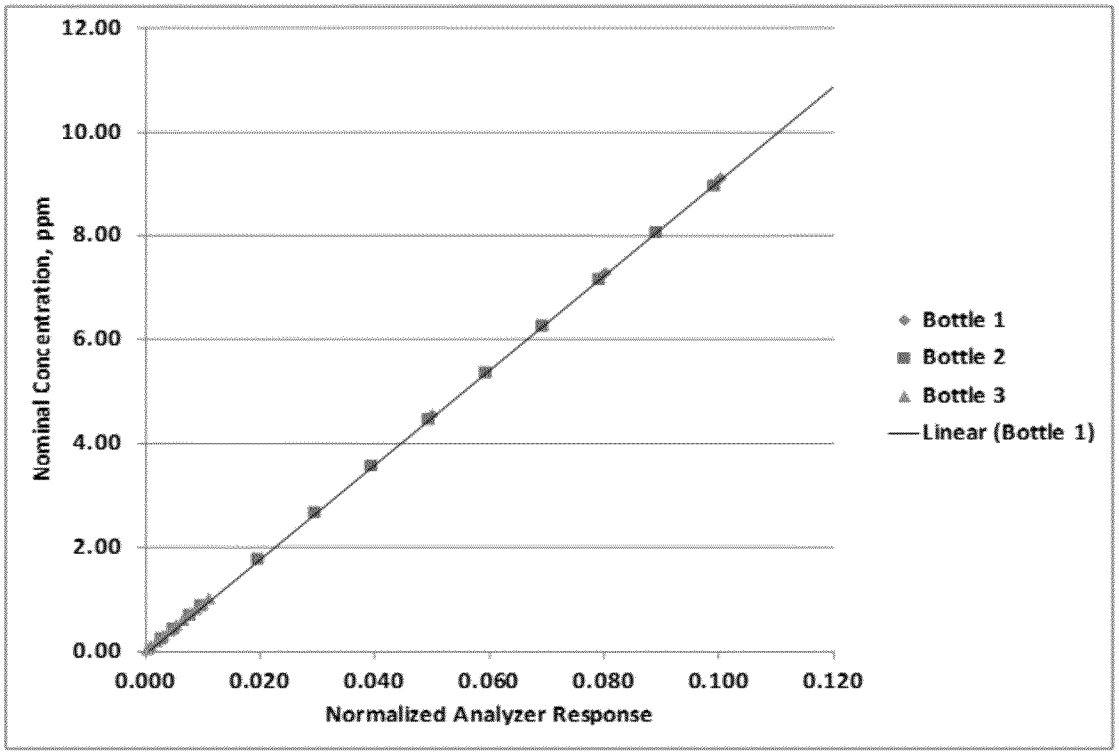

Figure 15. Matched Bottle Data Set Showing High to Mid Bottle Transition

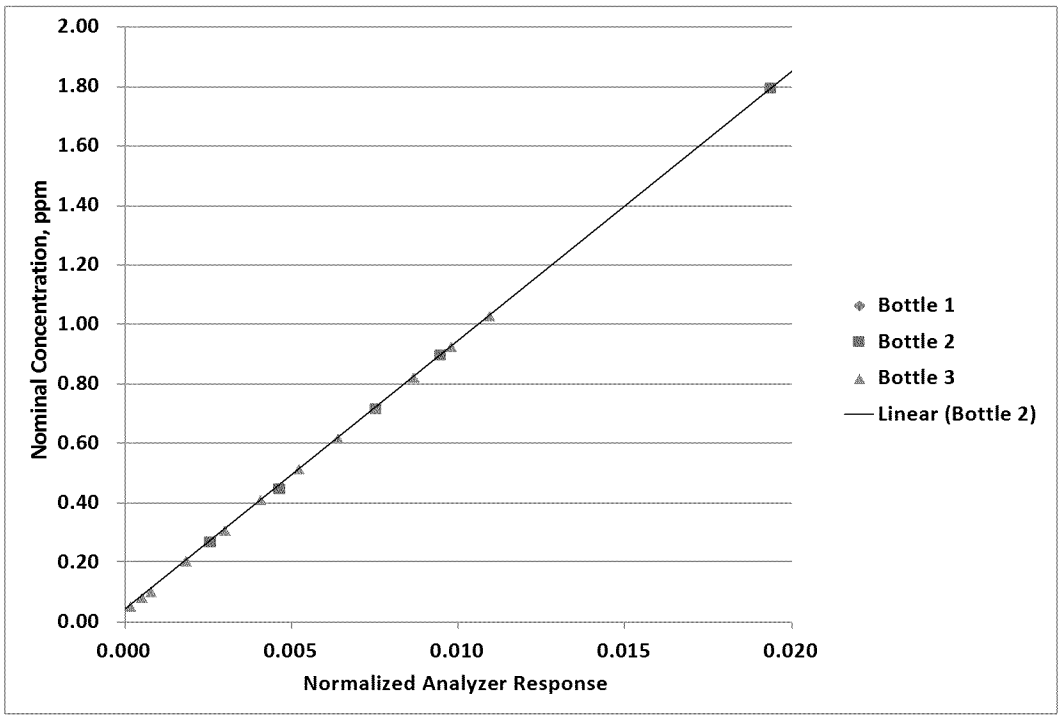

Figure 16. Matched Bottle Data Set Showing Mid to Low Bottle Transition

In order to collect the actual curve data, The GDC -703 was set up to operate in an automated fashion, with the sequence of calibration points given below in Table 3, along with the actual calibration data results. The span gas bottle was switched at appropriate points in order to move from one group of calibration points to the next lower group. Care was taken to insure that the bottle pressures were closely matched to avoid rapid pressure changes, and the switch was performed during intermediate zero points so that there was not a disruption in flow across the mass flow controllers in the GDC -703. A total of 41 calibration data points were collected for each calibration run (including zeros), and three calibrations were performed on each of three separate days, in order to assess day-to-day repeatability of the process.

Table 3. Full Task 3 Calibration Data Set

Cutpoint	Nominal Concentration	Normalized Analyzer Response						
		1st run	2nd run	3rd run	Average	Stdev	COV	Stdev/FS
High Bottle								
100.00%	91.25	***0.9992769***	1.0001172	1.0006059	**1.00000**	*0.00067*	0.07%	0.067%
90.00%	82.13	0.9018368	0.902401	0.9028031	**0.90235**	0.00049	0.05%	0.049%
80.00%	73.00	0.8031113	0.8035741	0.8037501	**0.80348**	0.00033	0.04%	0.033%
70.00%	63.88	0.7035084	0.7038578	0.7039352	**0.70377**	0.00023	0.03%	0.023%
60.00%	54.75	0.6030706	0.6034844	0.603769	**0.60344**	0.00035	0.06%	0.035%
50.00%	45.63	***0.5010421***	0.5027964	0.503124	**0.50232**	*0.00112*	*0.22%*	0.112%
40.00%	36.50	0.4017847	0.4019308	0.4021951	**0.40197**	0.00021	0.05%	0.021%
30.00%	27.38	0.3013028	0.3012793	0.3015575	**0.30138**	0.00015	0.05%	0.015%
20.00%	18.25	0.2007357	0.2005137	***0.2015208***	**0.20092**	*0.00053*	0.26%	0.053%
10.00%	9.13	0.1001516	0.1000999	0.1004359	**0.10023**	0.00018	0.18%	0.018%
8.00%	7.30	0.0800171	0.0797508	0.0805746	**0.08011**	0.00042	0.52%	0.042%
5.00%	4.56	0.0499124	0.0496284	0.0502105	**0.04992**	0.00029	0.58%	0.029%
0.00%	0.00	-0.0001592	-0.0004021	0.0003195	**-0.00008**	0.00037		0.037%
Mid Bottle								
9.84%	8.98	0.0989272	0.0988035	0.0992607	**0.09900**	0.00024	0.24%	0.024%
8.86%	8.08	0.0888451	0.0886406	0.0891861	**0.08889**	0.00028	0.31%	0.028%
7.87%	7.18	0.0789121	0.078741	0.0791707	**0.07894**	0.00022	0.27%	0.022%
6.89%	6.29	0.0689715	0.0687397	0.0693378	**0.06902**	0.00030	0.44%	0.030%
5.90%	5.39	0.0590999	0.058829	0.0594766	**0.05914**	0.00033	0.55%	0.033%
4.92%	4.49	0.0490905	0.0488312	0.0495631	**0.04916**	0.00037	0.75%	0.037%
3.94%	3.59	0.0392326	0.0389241	0.0393969	**0.03918**	0.00024	0.61%	0.024%
2.95%	2.69	0.0293295	0.0289539	0.0296273	**0.02930**	0.00034	1.15%	0.034%
1.97%	1.80	0.0194199	0.0189415	0.0196878	**0.01935**	0.00038	1.95%	0.038%
0.98%	0.90	0.0093967	0.0090712	0.0098188	**0.00943**	0.00037	3.98%	0.037%
0.79%	0.72	0.0076424	0.0071219	0.0077235	**0.00750**	0.00033	4.36%	0.033%
0.49%	0.45	0.0046628	0.0042464	0.0048887	**0.00460**	0.00033	7.08%	0.033%
0.30%	0.27	0.0024325	0.0022	0.0029518	**0.00253**	0.00038	15.23%	0.038%
0.00%	0.00	-0.0003884	-0.0008078	-6.785E-05	**-0.00042**	0.00037		0.037%

continued

Table 3. Full Task 3 Calibration Data Set (continued)

Cutpoint	Nominal Concentration	Normalized Analyzer Response						
		1st run	2nd run	3rd run	Average	Stdev	COV	Stdev/FS
Low Bottle								
1.13%	1.03	0.0109163	0.0105544	0.0112527	**0.01091**	0.00035	3.20%	0.035%
1.02%	0.93	0.0097593	0.0094848	0.0100341	**0.00976**	0.00027	2.81%	0.027%
0.90%	0.82	0.0086237	0.0082777	0.0089967	**0.00863**	0.00036	4.17%	0.036%
0.79%	0.72	0.0074989	0.0071276	0.0078491	**0.00749**	0.00036	4.82%	0.036%
0.68%	0.62	0.0064313	0.0059723	0.0066854	**0.00636**	0.00036	5.68%	0.036%
0.56%	0.52	0.0052711	0.0047638	0.0055302	**0.00519**	0.00039	7.51%	0.039%
0.45%	0.41	0.0040286	0.0036966	0.0044109	**0.00405**	0.00036	8.84%	0.036%
0.34%	0.31	0.0029539	0.0026074	0.0033359	**0.00297**	0.00036	12.29%	0.036%
0.23%	0.21	0.00193	0.0013179	0.0021683	**0.00181**	0.00044	24.30%	0.044%
0.11%	0.10	0.0007047	0.0004182	0.0011383	**0.00075**	0.00036	48.10%	0.036%
0.09%	0.08	0.000449	6.54E-05	0.0009006	**0.00047**	0.00042	88.63%	0.042%
0.06%	0.05	0.0002198	-0.0003315	0.0004956	**0.00013**	0.00042	329.10%	0.042%
0.03%	0.03	-2.699E-05	-0.0004021	0.0002139	**-0.00007**	0.00031	-432.69%	0.031%
0.00%	0.00	-0.0005295	-0.0009225	-0.0001999	**-0.00055**	0.00036		0.036%

After the naming process, all three bottles were measured in succession on the same analyzer to document the match between the bottles. The data in the figures indicate that the bottles were well matched, and that there were no significant step changes in response moving from one bottle to the next, which was very important for the experiment.

Given that this report will be distributed to the full EMTC, the raw analyzer response has been translated into a normalized format, in order to avoid giving away too much information regarding the details of the particular analyzer. This normalized response was calculated as the raw response for a given point, divided by the average response at the 100% cutpoint.

The data set is summarized in

Table **3**, showing normalized analyzer response to the nominal concentrations on all three runs. This data set provides a robust characterization of the analyzer response. However, this process would be far too long and time consuming to conduct on a regular basis for a large number of analyzers. Therefore, subsets of this data set were analyzed to generate curves using different approaches that were more realistic for laboratory use. These approaches were evaluated by using the resulting curve coefficients with the average analyzer response from the full data set, in order to generate concentration data for comparison with the nominal bottle values.

Several observations can be made looking at the full calibration data set. First, it appeared that the calibration process itself was generally repeatable from day-to-day within a level of 0.04% of full scale. It should be noted that there were occasional cutpoints that deviated from that normal variation, where a single observation on a given day would be an outlier from this level. These points are noted in Table 3 in bold and italics. A second observation is that

there was some drift in the zero value from the start to the end of the process, and that drift behavior was not necessarily the same from d ay to day. A summary of the zero -drift data from all three calibration runs is given in Table 4. The data indicated roughly 0.04% to 0.05% of drift, as percent of full scale, generally in the negative direction, from the start to the end of the process. In addition, the offset in the zero was between 0 and 0.1% of full-scale.

Table 4. Zero-Response Behavior during Calibration Tests

Normalized Analyzer Response at Zero			
Observation	Day 1	Day 2	Day 3
1	-0.016%	-0.040%	0.032%
2	-0.039%	-0.081%	-0.007%
3	-0.053%	-0.092%	-0.020%

Given that bracketing zero observations are available for each bottle data set (if the zero prior to the start of the experiment is included), it is possible to use the bracketing zero data to do drift correction on the calibration data, which could be an effective measure for improving calibration results at the low end of the scale.

The initial comparison point for analysis was a standard 10 -point linearity check, which would comprise 11 actual data points if the zero observation is included in the data set. Figure 17 shows a plot of residuals at concentrations below 10 ppm with varying numbers of observations. Recall the additional obser vations are additional data points closer to zero. The 12-point curve adds on 2 extra points at 8 percent and 5 percent of full scale, still using the high bottle only. The 20-point curve includes the entire data set from the middle bottle. As expected, these additional observations closer to the zero help reduce the residuals. The full 41-point data set has residual values very near zero. However, adding these data points increases the calibration time, and in the case of the second bottle and third b ottles would make the calibration exercise more difficult. All of the regressions were produced using Minitab 16.

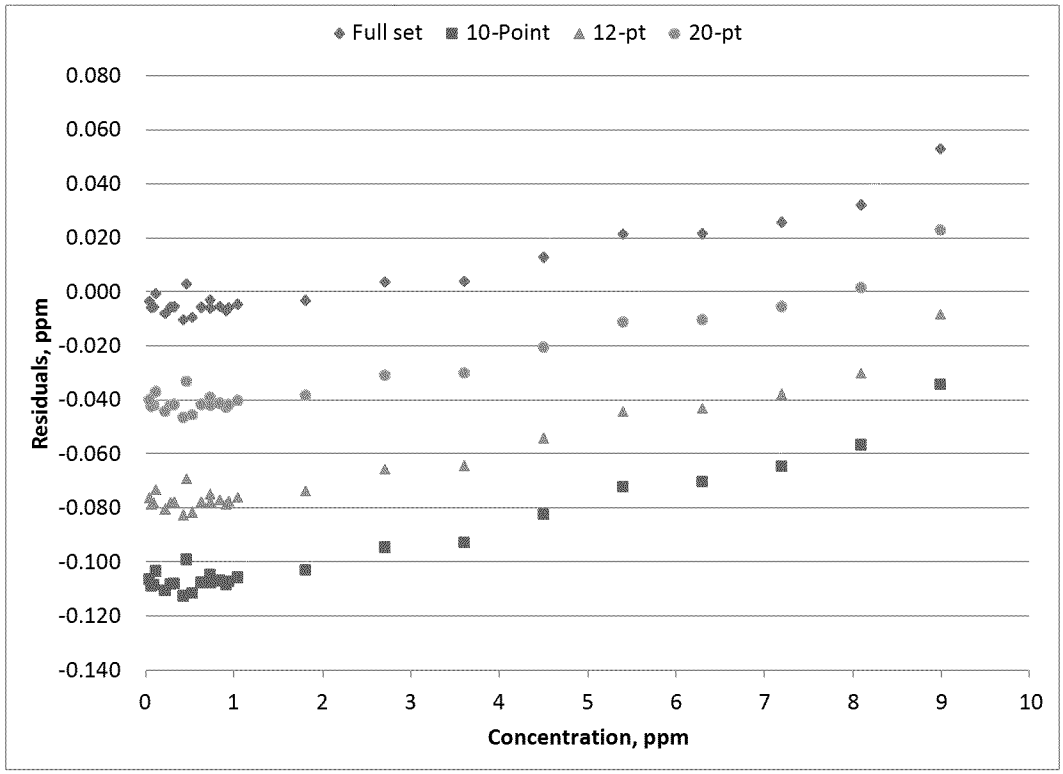

Figure 17. Effect of Large Number of Low-Value Observations on Residuals near Zero (Linear Fit)

Two other countermeasures were also investigated in the form of drift correction, and the use of point weighting for the calibrations with fewer data points. The weighting approach is one typically applied for non-linear analyzers and involves a weight factor for each point of 100 / (X+1), where X is the calibration cutpoint expressed as a percent of full scale. This places more weight on the lower points in the scale, and prevents a zero in the denominator to allow the zero-point to be used. Both of these counter measures would be equally applicable to a non -linear analyzer. In the case of a linear analyzer (such as this one), application of the weighting produces a result very similar to forcing the intercept through zero. However, the weighting is more generic and can also produce better results if a larger number of observations near zero are used (such as for an initial calibration exercise).

The effect of these measures on residuals near zero is shown in Figure 18, using an 11-point data set (with zero data point). Both the weighting and the drift correction help to reduce the residuals, while the application of both measures produces a result that is ver y similar to the fit generated with the full 41 -point data set. The residual behavior with these approaches was also better than the results obtained by moving to second and third order curve, which generated unpredictable results near zero, and were gene rally not representative of the behavior of this linear analyzer in any case.

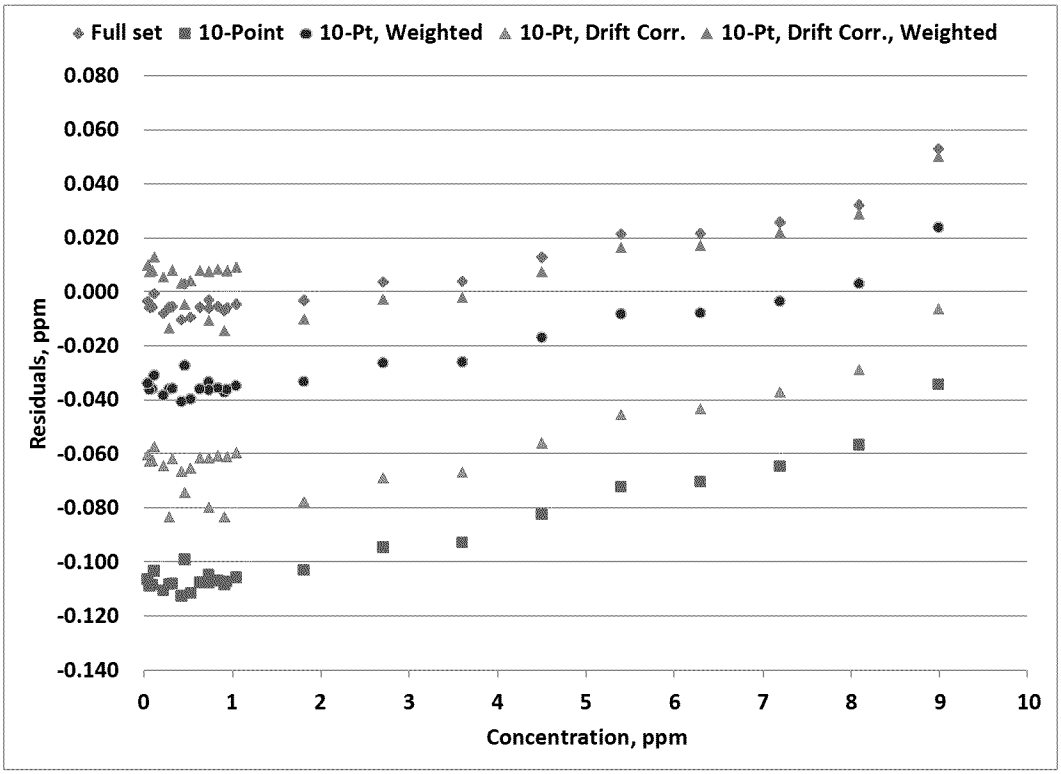

Figure 18. Effect of Various Measures on Residuals using an 11-Point Calibration Data Set (Linear Fit)

3.4 Task 4 – NO_2 Lag/Hang-up

The methodology used to identify possible NO_2 lag or hang-up in the sampling system involved the introduction of step changes in either NO or NO_2 at the sample probe connection of a typical bench sampling system. These step changes were introduced in a base gas of humidified CO_2 in order to generate a representative sampling environment. Because there is no substantial lag for NO in the sampling system, any NO_2 lag can be assessed by comparing the relative response of NO_2 to NO.

The experiments were conducted for both dilute and raw sampling systems. For the dilute experiment a Horiba MEXA 7200D emission bench was used, which featured a CLA 725M atmospheric NO_x analyzer. The base gas consisted of 1% CO_2 and 2% water. NO and NO_2 levels of 2.7 ppm and 27 ppm were examined for the dilute experiments. For the raw experiments, a Horiba MEXA 7100DEGR emission bench was used, which contained a CLA 755M vacuum NO_x analyzer. The base raw gas was 10% CO_2 and 8% water. NO and NO_2 levels of 27 ppm and 120ppm were tested for the raw experiments.

A schematic of the test system is given below in Figure 19. The test rig was designed to switch between the spike gas (either NO_2 or NO) and the zero gas with minimal disruption in system flow or pressure, and to maintain a consistent dilution rate.

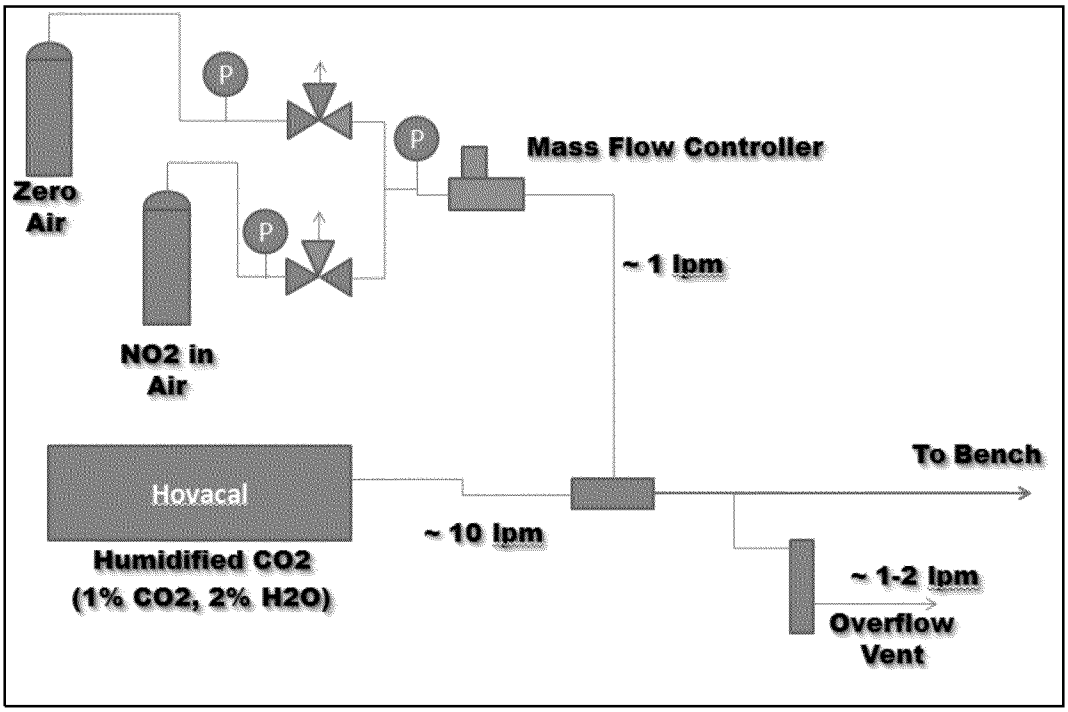

Figure 19. Schematic of NO_2 Hang-Up Test Rig

The total flow rate of the rig was set to allow a small amount of overflow at the probe inlet, allowing the bench to sample normally from atmospheric pressure conditions. The monitoring of CO_2 via the emission bench allowed a n independent measurement of the dilution ratio, and therefore enabled an accurate calculation of the inlet concentration of NO and NO_2. This also allowed the test rig to be set up in a very repeatable fashion, and enabled verification that the system maintained flow and dilution during switching events. The test rig was controlled directly from the test cell host system interfaced to the emission bench being tested, so that the timing of the switching solenoid and events could be logged on the same system at a 10 Hz rate. As shown in Figure 19, the gas that is not currently flowing to the MFC is ve nted to atmosphere, and pressures are controlled upstream of both valves to ensure a constant pressure at the mass flow controller inlet, so that the dilution rate is maintained and there is no pressure spike at the switching event.

The test rig is shown in Figure 20. The response delay and transport time of the rig from the switch point were quantified at 2.8 seconds using the switching of both CO_2 and NO, both of which have negligible lag or hang-up on the sample system. The nominal setpoint for the test rig was approximately a 10:1 dilution ratio from the base bottle concentration of the test gas.

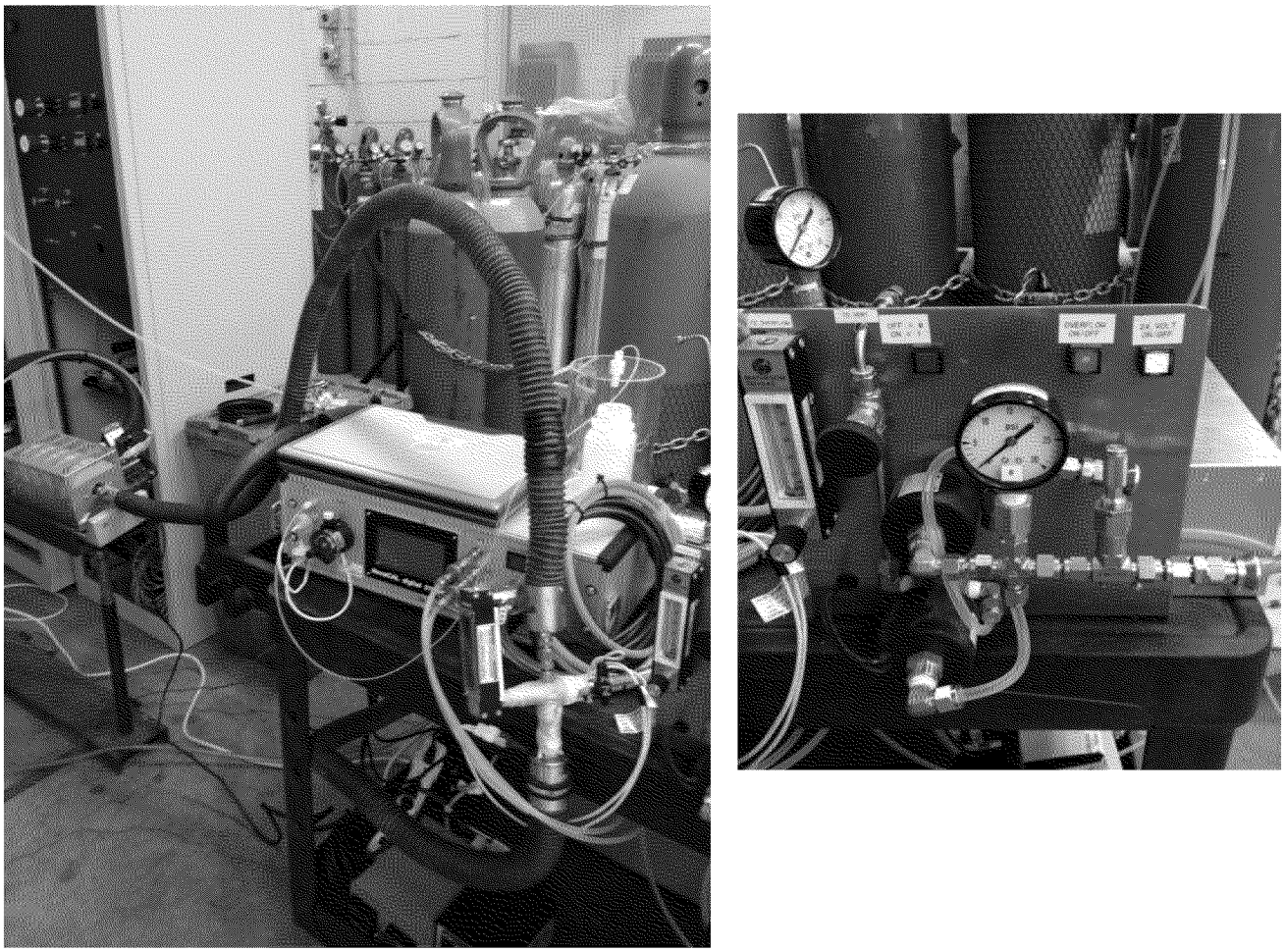

Figure 20. NO_2 Lag Experiment Test Rig

Two types of experiments were conducted to identify lag, and to examine its effects. The first type of experiment was a step -response test, where the test gas concentration (either NO or NO_2) was switched from low to high, or vice versa, and then fixed at steady-state until the bench measurement was observed to have stabilized. Each experiment, both increasing and decreasing was repeated in triplicate, and experiments were conducted on both NO and NO_2. As noted earlier, the intent was to use the relative response between NO_2 and NO to look for any lag or hang-up in the system. The comparison of the final response to the expected input allowed for an assessment of any losses. For each experiment, the measured CO_2 value was used to calculate the dilution ratio for that particular test run.

Figure 21 and Figure 22 show an example of the step test experiment on the dilute analyzer for both NO and NO_2. This experiment in the example was conducted at a nominal expected concentration of 27 ppm for the step. Note that in the case of NO_2 this value was corrected for the measured NO_2-NO converter performance of 98% to produce an expected target concentration. As can be seen from the shape of the curves on the graphs, which are

shown in green, there does appear to be some lag in the NO_2 response, though it primarily appears to manifest above the 50% response point, and it becomes pronounced above the 90% response level. A similar comparison of step response steps is shown in Figure 23 and Figure 24 for a much smaller 2.7 ppm nominal concentration.

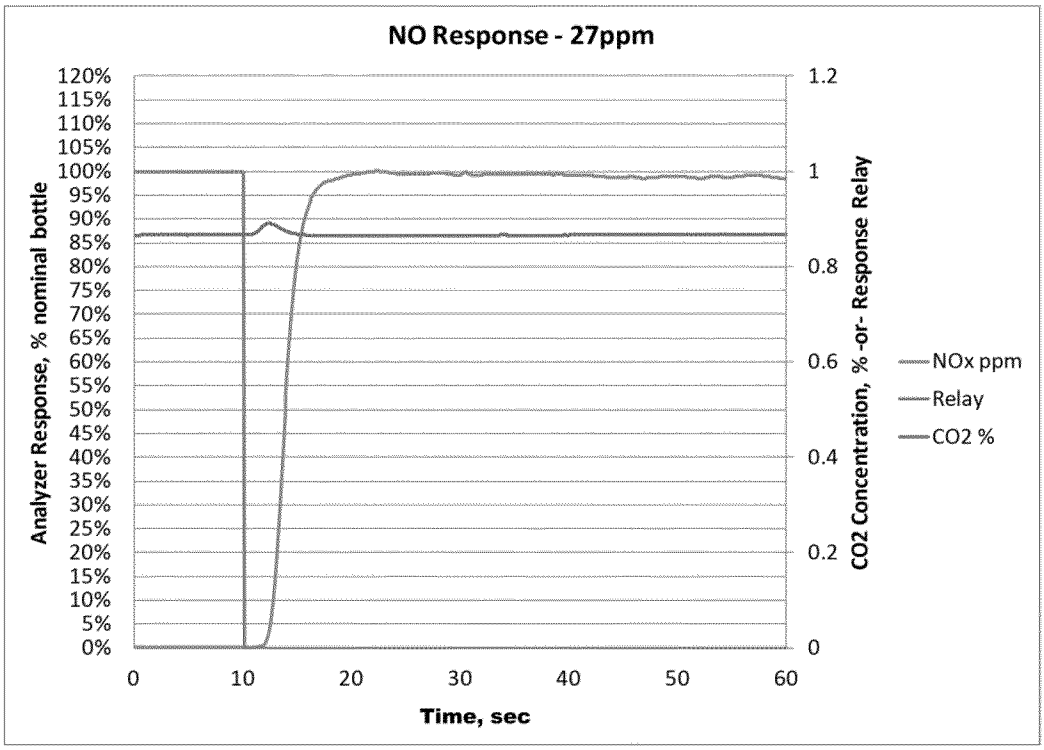

Figure 21. Dilute NO Step-Test, Nominal 27PPM

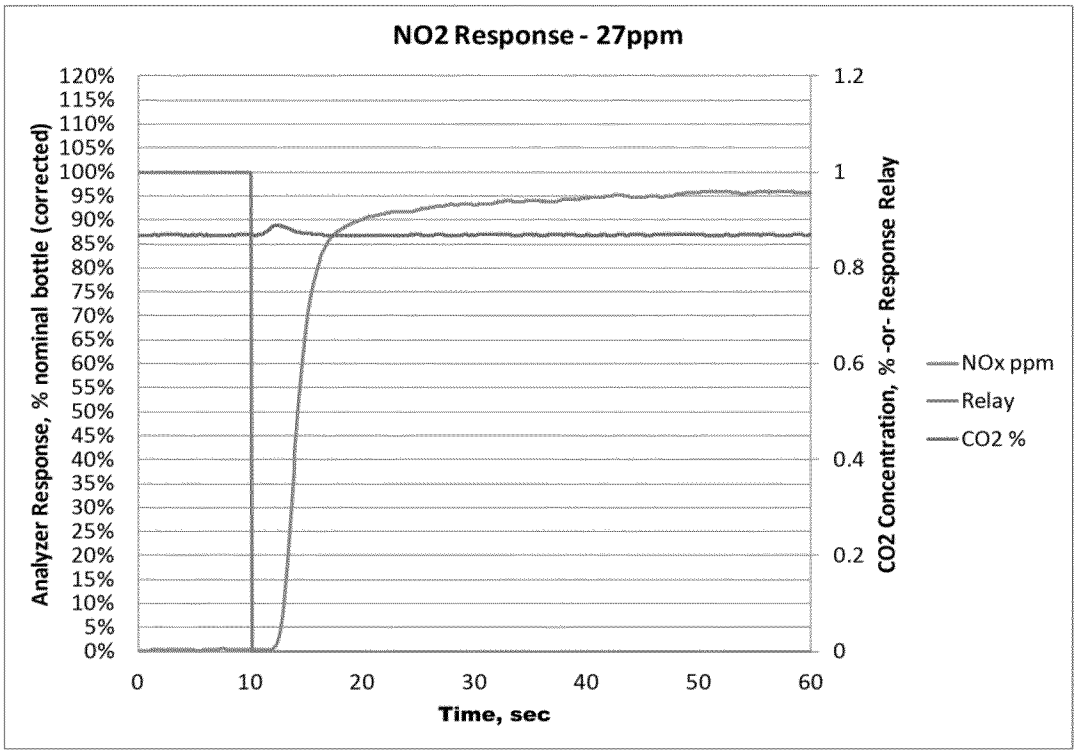

Figure 22. Dilute NO_2 Step-Test, Nominal 27PPM

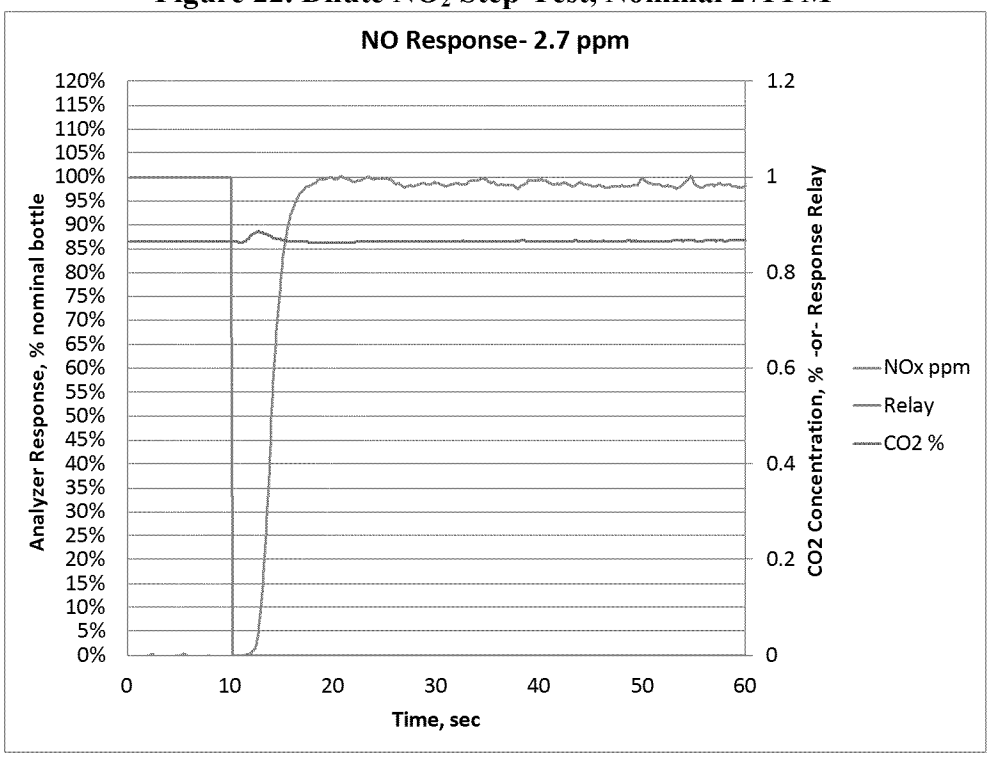

Figure 23. Dilute NO Step-Test, Nominal 2.7PPM

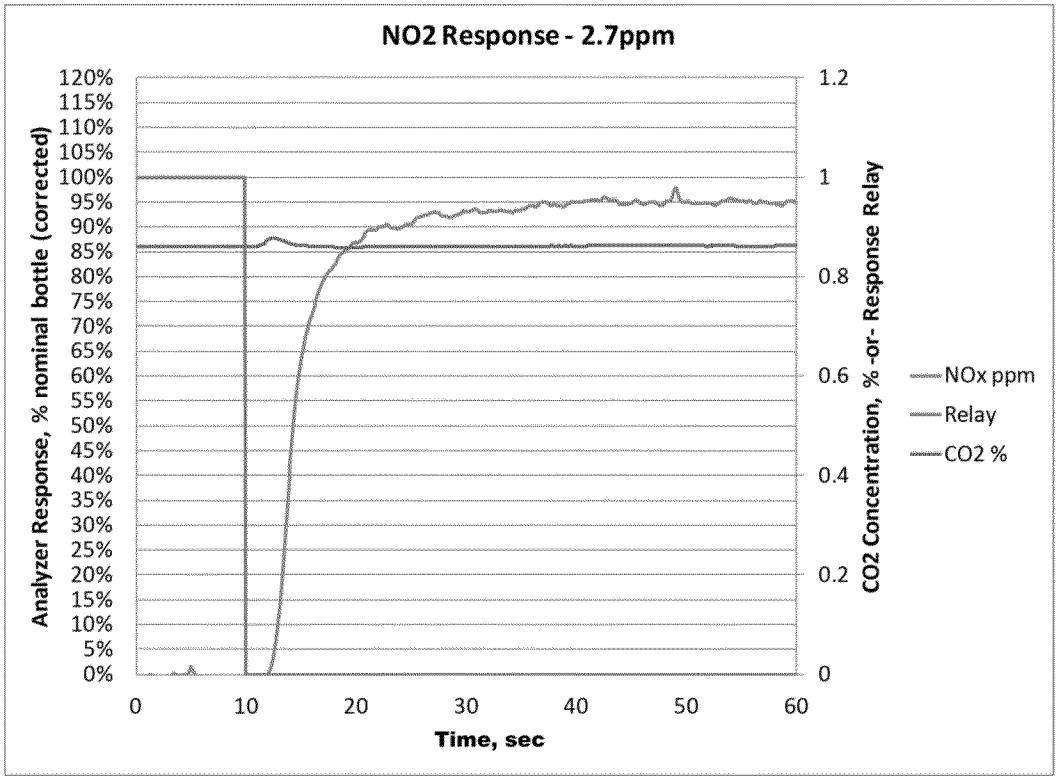

Figure 24. Dilute NO_2 Step-Test, Nominal 2.7PPM

The results for both of these dilute step tests are summarized below in Table 5. The results show the relative response to the step input at various key response levels. These findings confirm that there is significant lag in NO_2 response past the t90 point. The results are relatively consistent regardless of level. In addition, the test results were relatively consistent over the three replicate step tests for each gas. This indicates that there is little evidence of a longer term equilibration process. Finally, the full response on NO_2 was near 100%, indicating that there is little evidence of NO_2 loss or reaction in the sample train.

Table 5. Summary of Dilute Step-Test Result, Relative Response of NO_2 versus NO

Response Point	2.7 ppm	27 ppm
t10	0.1	0.2
t50	0.3	0.3
t90	5.5	3.4
t95	29.8	18.5
Full Response (vs. corrected bottle)	96%	99%

A similar experiment was conducted for the Raw sampling system. Example results at a roughly 120 ppm concentration setpoint are given in Figure 25 and Figure 26, for NO and NO_2, respectively. Similar to the dilute observations, the re does appear to be some lag in the NO_2 response. However, it was also observed at the 120 ppm steps that the lag appeared to decrease somewhat with each successive step test in the sequence of three. A summary of the raw step results is given in Table 6. Although the NO_2 response lag decreased from run to run, it did not go away entirely. It should be noted that the run -to-run behavior of the NO st eps was very consistent. The decrease would appear to indicate some sort of storage equilibrium in the sample system; however the decreasing steps did not indicate any subsequent release events. A similar movement was observed with the 30 ppm raw steps, which is interesting given that this behavior was not observed on the dilute steps at a similar concentration. It is possible that this behavior was related to the higher water content for the raw steps, but this is not yet known.

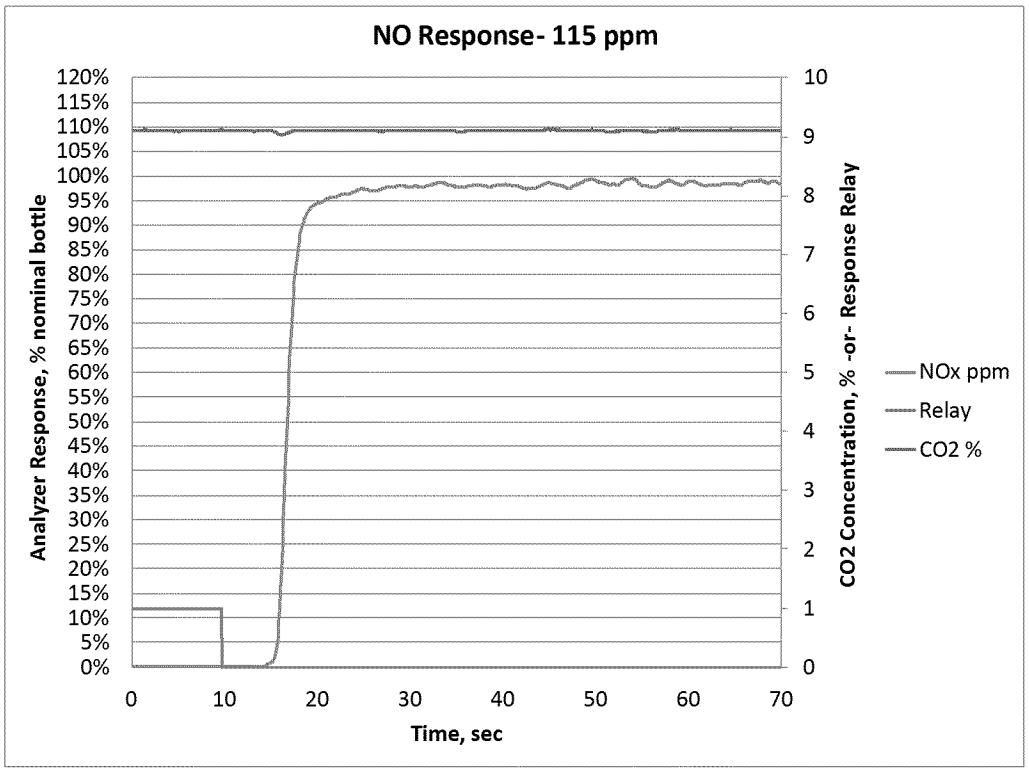

Figure 25. Raw NO Step-Test, Nominal 115 PPM

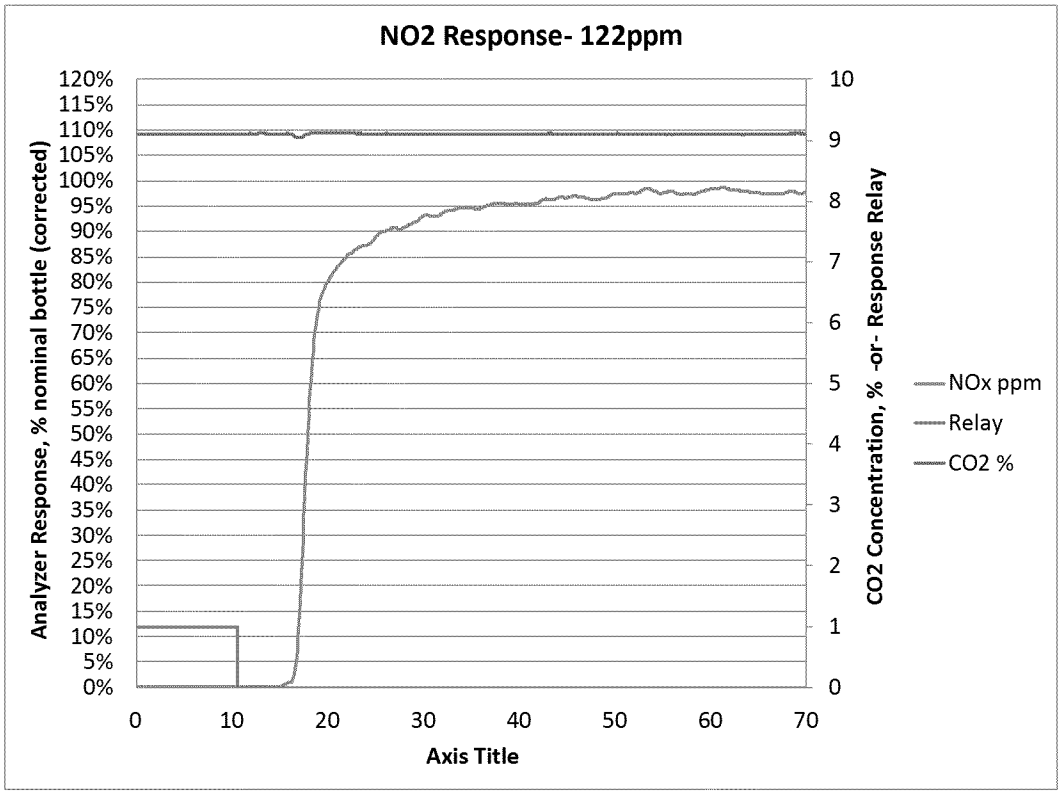

Figure 26. Raw NO2 Step-Test, Nominal 122 PPM

Table 6. Summary of Raw Step-Test Results, Relative Response of NO_2 versus NO

Response Point	120 ppm Raw
t10	0.2
t50	0.4
t90	5.7 / 2.9 / 1.6
t95	15.7 / 8.4 / 5.2
Full Response (vs. corrected bottle)	99%

Taken as a group, these results indicated that there a lag in NO_2 response to a step input, and that the lag is present for both dilute and raw measurements, and for both atmospheric and vacuum analyzers. Given that these systems both used a fairly similar sampling system, it is likely that the lag is a function of the sample system, rather than the analyzer. However, it is worth noting that the lag observed for the raw vacuum analyzer was smaller than was noted for the dilute atmospheric analyzer. Finally in the raw analyzer, the NO_2 lag appeared to decrease with repeated step experiments, while the dilute analyzer appeared consistent from run-to-run.

The second type of experiment was a transient spike test, wherein the rig was started on zero-air, and then was switched to the test gas for a fixed period of time, then switched back to zero-air. These experiments were conducted for 10, 5, 2, and 1 second nominal durations. Actual event durations were slightly different given manual switching, typically 0.1 to 0.3 seconds longer than the nominal duration. As with the step tests, experiments were conducted using both NO and NO_2, and each test condition was repeated 3 times.

Given that these spike tests were intermittent in nature, it was not possible to evaluate the results in the same manner as the step tests with relative response times. Therefore, a metric was developed based on integration of signals over time. This integration was done for both the input spike, which was a step change of a known duration (essentially a square wave), as well as for the actual analyzer response. The intent was to determine the time required for the integrated analyzer response to reach the same level as the integrated square wave input. This time could then be compared between NO_2 and NO in order to look for any lag in the response. In addition, if the analyzer response did not reach 100% of the input signal, this would indicate a loss of NO_2. Given that overall flow rates are not known, the integration area is presented as the product of concentration and time, in ppm*sec, and would be analogous to something like peak area counts on a GC.

An example of the spike test and analysis is given in Figure 27 for a dilute spike test of a nominal 1-second duration at a concentration of 28 ppm. The nominal spike input is shown in red, and the resulting integrated area is shown in blue. The actual analyzer signal is shown in green, while the integrated area of the analyzer peak is given in orange. As expected the measured analyzer signal is a somewhat attenuated version of the square wave concentration input, and it is also delayed somewhat in time, in part due to the response time of the test rig itself. Figure 28 shows the same test, but with the output response time aligned to match the 50% integration point between the input and output.

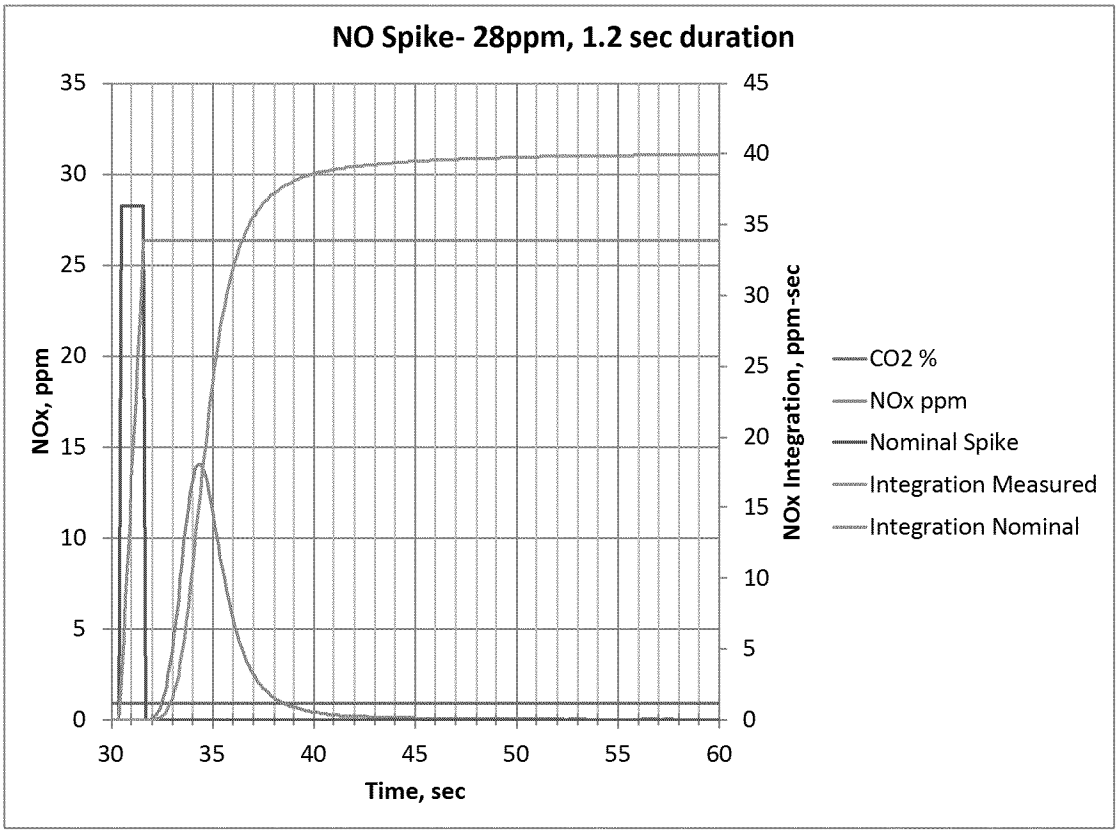

Figure 27. Example NO Spike Test Input and Analyzer Response Output

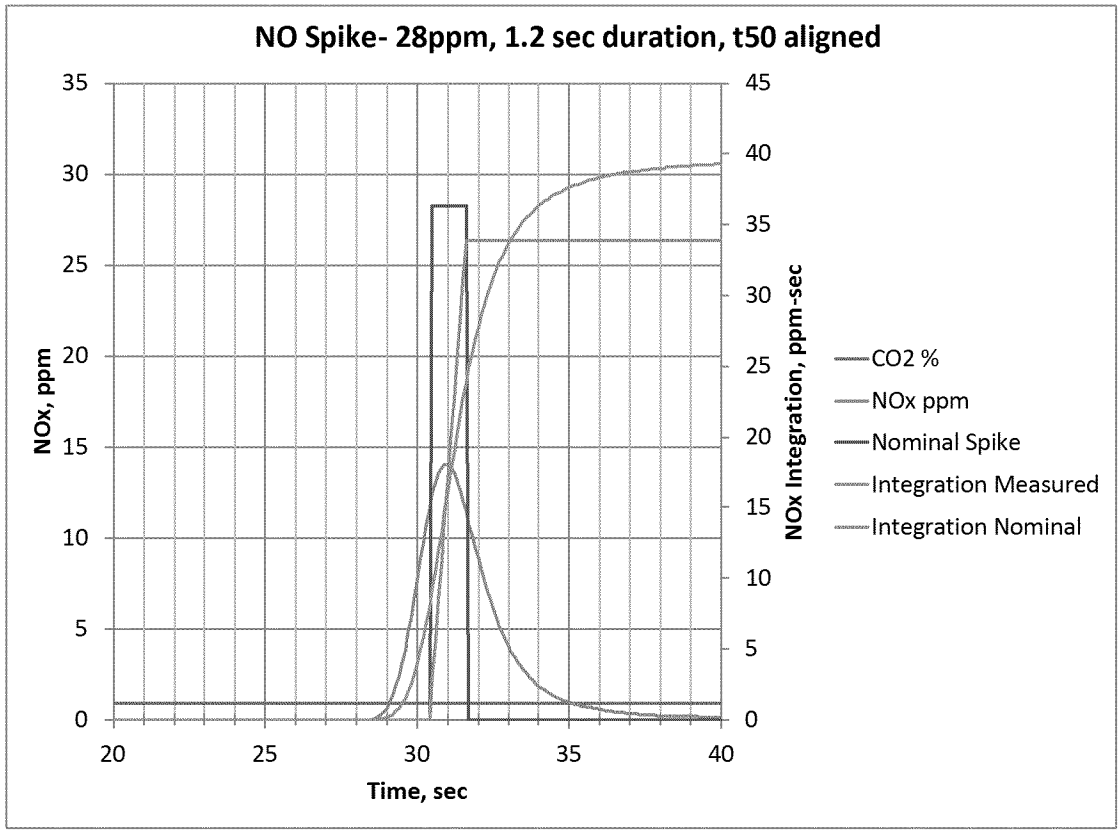

Figure 28. NO Spike Test Input and t50 Aligned Analyzer Response Output

It is interesting to note the shape of the analyzer response curve, in that it appears to be somewhat asymmetrical. While the upward response appears fairly rapid, the analyzer response appears to tail off slowly on the downward side of the spike, taking a long time to settle back to a zero signal. As a result of this long settling behavior, the final integrated analyzer response is actually larger the predicted square wave input. This behavior was unexpected and at first led to a significant diagnostic effort to verify the timing and on-off behavior of the fast-acting solenoids in the system. These efforts verified the square wave nature of the input to the measurement system, and that once switched back to zero gas there was no cross leakage of the tes t gas. Recall that all the gases in the system are always flowing, either into the test system or venting, so there is no start -stop behavior associated with the bottle regulators. Therefore, the behavior appeared to be real and will be discussed as a potential issue later.

A comparison set of spike test data for NO_2 on the dilute system is given in Figure 29, which shows the aligned response for a n ominal 1-second spike at 29 ppm NO_2. Note that the recovered peak is somewhat lower, but it still exhibits the same tailing off behavior as observed for NO. In addition, the NO_2 spike takes a significantly longer time to reach 100% recovery of the input spike, although time to 50% recovery is similar for NO and NO_2.

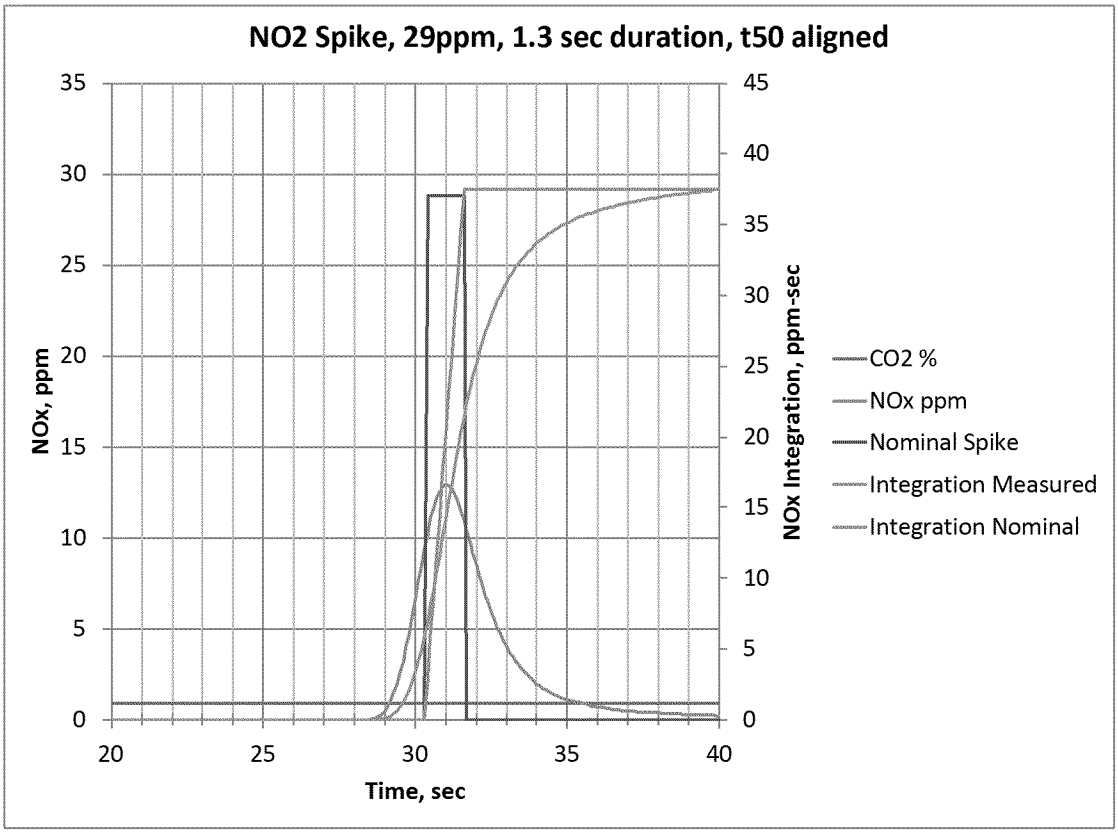

Figure 29. NO_2 Spike Test Input and t50 Aligned Analyzer Response Output

Table 7 shows a comparison of integration times to various points of spike recovery for both NO and NO_2. As can be seen, the time to full recovery of the input spike begins to diverge at about the 50% point, and it takes significantly longer to reach 90% recovery and above with NO_2. This behavior is consistent at longer spikes of 2, 5, and 10 seconds, although the time varied somewhat.

Table 7. Comparison of Dilute Integration Times for a 1-Second Nominal Input Spike

Integration Point	NO	NO_2	Relative
t10	2.8	2.9	0.1
t50	3.6	3.8	0.2
t90	4.2	7.6	3.4
t100	5.0	11.8	6.8
Full integrated area	118%	105%	n/a

A similar comparison for raw spikes is shown in Figure 30 and Figure 31, showing a 5-second spike at a nominal 100 ppm concentration for NO and NO_2, respectively. The 1-second response data for the Raw was problematic and proved to be very inconsistent, but the 2-second and 10-second data showed trends consistent with what is seen in Table 8, with a definite response lag appearing somewhere after the t50 point.

Table 8. Comparison of Raw Integration Times for a 5-Second Nominal Input Spike

Integration Point	NO	NO_2	Relative
t10	2.6	2.6	0.0
t50	4.4	4.7	0.3
t90	5.1	6.8	1.7
t100	5.4	7.7	2.3
Full integrated area	118%	105%	n/a

As with the step tests, these spike test results for both raw and dilute indicate that there is some lag on the response of NO_2 as compared to NO. Furthermore, that lag appears to be focused towards the end of that response, appearing significant at the t90 point and beyond. This is significant because it indicates that the t50 time alignment generally prescribed in 40 CFR Part 1065 will not account for this lag. The dilute system appears to have a more pronounced NO_2 lag, and it is possible that this is due to the fact that the dilute analyzer is an atmospheric one, while the raw analyzer is a vacuum instrument. However, more testing would be required to verify whether this is in fact the case.

The spike tests help to confirm that NO_2 response lag is in fact present. In the case of a dilute analyzer, this is not likely to be a problem given that the dilute exhaust flow rate is essentially constant. As a result, the mass result is not particularly sensitive to timing, as long as the complete response to an input can be recovered before the end of the test event. On the other hand, a delayed response to an input spike for a Raw analyzer could be very problematic, especially if that delay cannot be resolved using a t50 time alignment. Given that time alignment of the analyzer response to exhaust flow is critical for accurate raw transient mass calculations, the NO_2 lag has the potential to cause significant errors.

The work in Task 4 has identified a potential problem associated with NO_2 lag. However, more analysis is needed in order to determine the potential magnitude of this issue. This could potentially be assessed by an additional analytical modeling effort, however such an effort is beyond the scope of the current program. Such an effort could form a task of a follow on program.

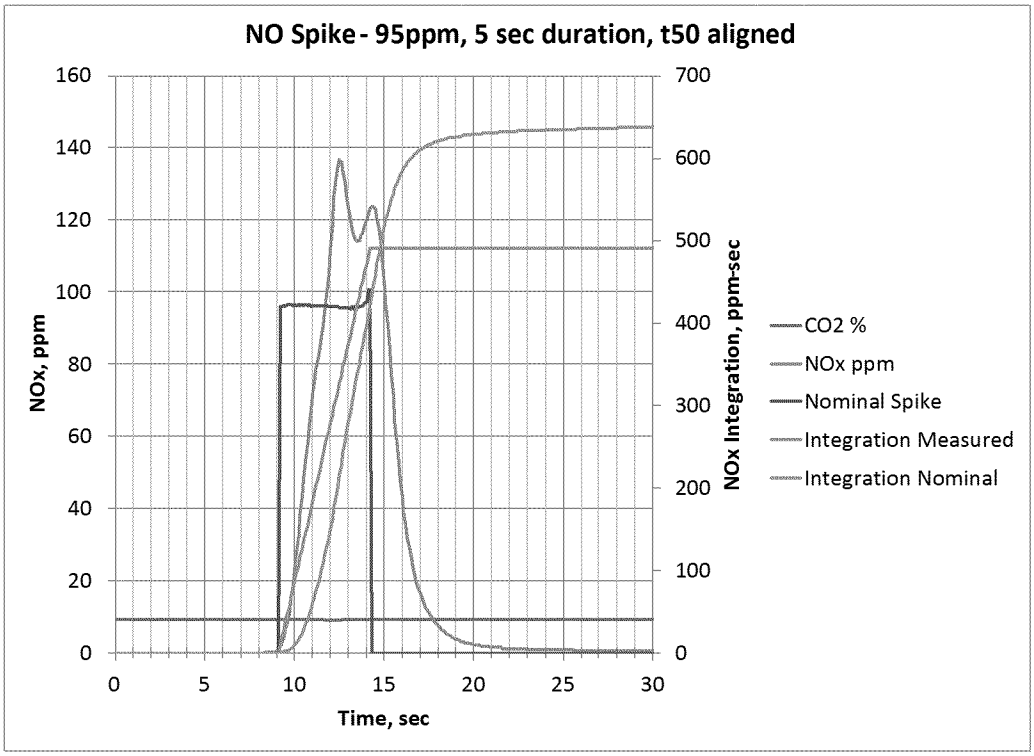

Figure 30. Raw NO Spike Test Input and t50 Aligned Analyzer Response Output

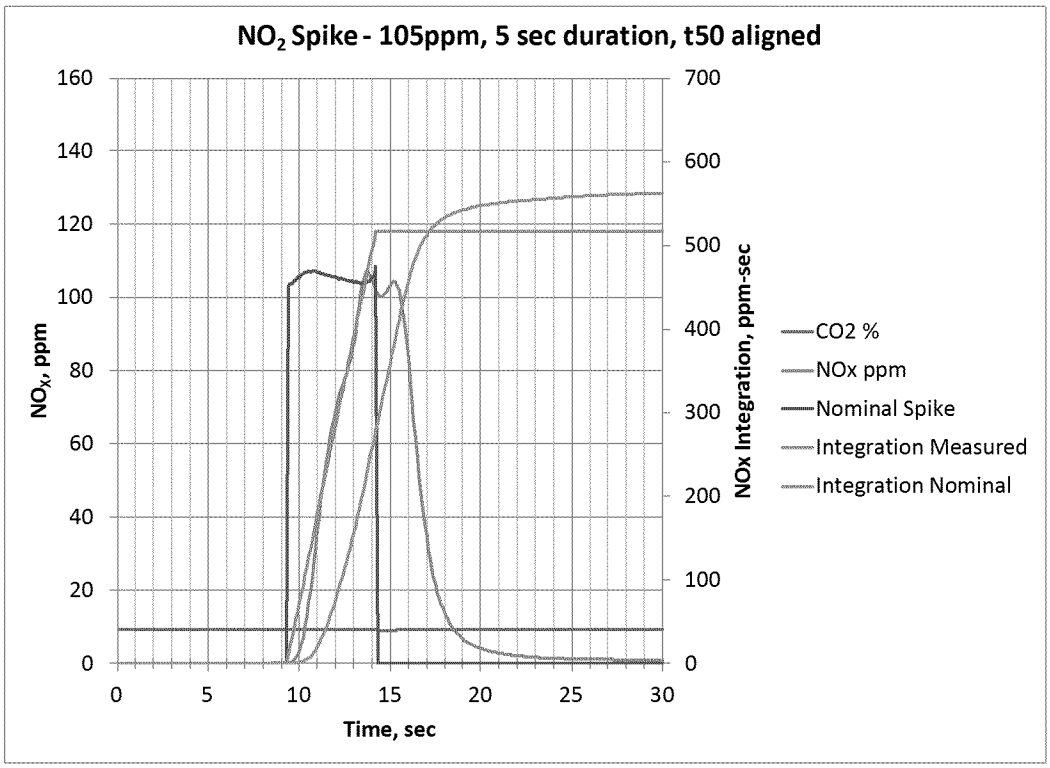

Figure 31. Raw NO_2 Spike Test Input and t50 Aligned Analyzer Response Output

Another trend which was consistently observed on both the raw and dilute analyzers was the fact the integrated instrument response was large than the prediction from the input spike. As discussed earlier, this was due to the asymmetrical response of the analyzer to the input spike with a very long tail on the downward response as a result of the an alyzer taking a long time to settle back to zero response. This behavior could be problematic in a case where NO_x emission signature takes the form of a large initial breakthrough spike, followed by a long period of near -zero emissions from catalyst that has reached light off. That is concerning because this pattern is in fact what the signature of an engine running at 0.02 g/hp -hr is likely to look like. The projected emission signatures used for the Task 1 and Task 2 efforts , shown in Figure 2 and Figure 3, indicate this kind of pa ttern, and some of the initial tests of advanced aftertreatment systems in the ARB Low NO_x Demonstration program have confirmed these projections.

It should be noted that both analyzers showed a smaller tendency to recover more than 100% of the input spike when the gas was NO_2, as compared to NO. This is likely due to the lag in NO_2 response. Nevertheless, some amount of excess integrated response was observed to some degree at all concentration levels on both gases, and at different spike times. This raises a concern of a potential bias.

However, it should be noted that these experiments were not designed to examine such a phenomenon in detail. Therefore, it is premature to conclude that there is a real bias at this point, as well as to attempt to d etermine the magnitude of any potential offset. More experimentation is recommended in a follow an effort in order to examine this effect. This would include a more purpose designed experiment using more gases than just NO and NO_2. Such an effort could form a significant task for a follow on program to this one.

3.5 Task 5 – Low Level Analyzer Performance

The objective of Task 5 was to make an assessment of analyzer accuracy at low levels associated with the concentrations that would be observed at NO_X levels near 0.02 g/hp-hr. The assessment was focused on dilute analyzers, given that the analyzer accuracy was considered of less concern at the raw average level of 2 ppm expected at that standard. However, given projected dilute levels at 0.2 ppm or less, it was deemed that an assessment of current analyzer technology to perform at that level was needed.

The experimental setup for this involved use of the same test rig developed for the NO_2 lag experiments, but only NO would be used as a spike gas. The experimental plan was similar in nature to the accuracy, repeatability, and noise experiments specified in 40 CFR 1065.305. However, instead of using dry gases, these experiments would be co nducted using a simulated dilute exhaust gas, containing both CO_2 and H_2O. In addition, the gases would be sampled through the entire sample train, in a manner similar to actual measurement.

The test gas was set up at 1% CO_2 and 2% H_2O. A bottle of NO at a nominal concentration of 1 ppm was utilized at a nominal dilution ratio of 10 to 1, which was verified by CO_2 measurement in a manner similar to what was done for the NO_2 lag experiments. This

resulted in a nominal input gas concentration of 0.1 ppm, or 100 ppb. This level is about half the expected average dilute concentration for a hot-start FTP, prior to background correction.

Prior to the initiation of testing, the test bottle was named on a 10 ppm full-scale range in order to verify the actual concentration of the input gas. Triplicate runs were conducted and zero-span drift correction was applied to these naming runs. The measured concentration based on the drift -corrected average was within 1% of the named bottle concentration, therefore the originally named concentration was used at 1.013 ppm. Based on the measured CO_2 values with and without the spike gas stream operating, it was found that the actual dilution ratio for the tests was approximately 8.5 to 1, resulting in a nominal step input of 0.120 ppm, or 120 ppb. A nominal 25 ppm full scale range was used for this experiment, consistent with expectations for a hot-start FTP transient test at this emission level.

Once the test rig was set up and verified, a test sequence was executed wherein the spike gas was cycled between zero air and the 0.12 ppm test gas at the inlet to the probe. This cycling was repeated 10 times to gather sufficient data for statistics. Each step had a 30-second duration. The alternating zero values also allowed for an assessment of zero drift, and for zero drift correction, which was critical at this low level for establishing accuracy. The analyzer was zero calibrated at the start of the test, then the experimental flows were set, and the 10 repeat steps were conducted. At the start of the experiment, the 30 -second average zero measured approximately 7 ppb, and by the end of the experiment, the 30 -second average zero measured approximately -90 ppb. These numbers are significant compared to the test value. However, because each 30 -second reading was bracketed by a pre -test and post -test zero reading, it was possible to perform drift correction, which allowed the recovery of the accurate analyzer reading.

Table 9 shows the experimental results for this test. The statistics for the results are also given in the table. The overall average of the readings after drift correction was within 6 ppb of the nominal expected value. Repeatability for the measurement, as calculated according to 1065 procedures, was on the order of 9 ppb, while noise on both the sample and the zero readings was on the order of 18 ppb. A 9 ppb repeatability represents about 8% of the nominal input value, or about 3% of the average concentration at a standard of 0.02 g/hp-hr.

Table 9. Low Level Accuracy Experimental Result for the Ten Data Points

Test Point		1	2	3	4	5	6	7	8	9	10
Uncorrected	ppm	0.089	0.057	0.062	0.053	0.045	0.028	0.02	0.03	0.03	0.022
Corrected	ppm	0.111	0.119	*0.104*	0.112	0.114	0.112	0.110	0.119	0.117	0.114
Nominal	ppm	0.115	0.118	0.117	0.119	0.120	0.120	0.120	0.120	0.120	0.120
Zero Shift	ppm	-0.021	-0.060	-0.041	-0.058	-0.068	-0.082	-0.088	-0.088	-0.086	-0.091
30-sec SD	ppm	0.011	0.007	0.008	0.008	0.007	0.01	0.009	0.011	0.007	0.01
Error	ppm	-0.003	0.001	-0.014	-0.008	-0.005	-0.007	-0.010	-0.001	-0.003	-0.005
Mean Value	**ppm**	**0.113**									
Mean Error	**ppm**	**-0.006**	**-5%**								
Repeatability	**0.009**	**ppm**	Nominal Bottle		1.013	ppm					
Noise on Sample	**0.018**	**ppm**	Dilution Ratio		8.5						
Noise on Zero	**0.017**	**ppm**	Reference Value		**0.120**	ppm					

Based on these results, it can be concluded that the analyzer in question, which was a CLA-725M atmospheric NO_x analyzer, installed in a Horiba MEXA 7200D dilute bench, has sufficient accuracy to make acceptable readings near the concentrations expected at 0.02 g/hp-hr. However, it does appear that this Dilute continuous analyzer is operating near the edge of its capability from a repeatability standpoint. Given that this analyzer is representative of the capability of analyzers installed in the majority of diesel emissions cells operated by EMTC members, it can be stated that currently installed analyzers should have sufficient capability to make accurate measurements at dilute concentrations representative of 0.02 g/hp-hr, but that these analyzers will be operating near the limits of their capability in this regard.

However, it is noted that zero drift correction at these levels is crucial to making accurate measurements. As seen in Table 9, errors of between 50 and 100 ppb from a nominal value of 120 ppb were observed prior to drift correction. After drift correction, the errors were in the range of +/-10 ppb, which is consistent with the repeatability statistic. There was one measurement in the data set, Point 3, where a larger negative error was observed that was not as well handled by the zero correction. The repeatability itself was about half the value of the raw analyzer noise, therefore analyzer noise is probably a key driver of the remaining errors, at least for a 30-second window. It is possible that a longer stabilization time prior to integration might produce a further improvement in repeatability, but such a countermeasure is only available for a bag measurement.

A second experiment was run to evaluate the stability of the measured value over a typical 20-minute test window. For this experiment, the same test rig was used, but no step changes were made. As before, a stable mixture of nominally 1% CO_2 and 2% H_2O was used as the base gas. A zero-span calibration was conducted on the analyzer, and then the analyzer was switched to measure an already flowing stream that had been set up again for a nominal 0.101 ppm target level, roughly 10:1 dilution of the test bottle. Recorded CO_2 levels during the same experiment indicated that the measured dilution ratio of 10.3:1 varied by less than 0.1 to 1 over the course of the experiment, resulting in a stable nominal input level of 0.098 ppm.

Two examples of the measured data for this experiment are shown in Figure 32 and Figure 33, respectively. These two examples show very different behavior of the 20-minute period. The test shown in Figure 32 indicates significant movement over the course of the test interval, as compared to the very stable input value. On the other hand, the test shown in Figure 33 appears relatively stable during the 20-mintue test period. Both show a general noise band on the NO_x reading of roughly +/-15 ppb, consistent with the measured noise level for the analyzer. A summary of these results is given below in Table 10. The pre-test and post-test zero span behavior does appear to generally reflect the observations during the test, in terms of the trend from start to end of the test, and therefore, the drift correction does appear to remain effective at these levels as a countermeasure to compensate for analyzer signal fluctuation during the test. However, this is only the case for the final cycle average number, as the continuous data does not necessarily reflect the input on a second-by-second basis.

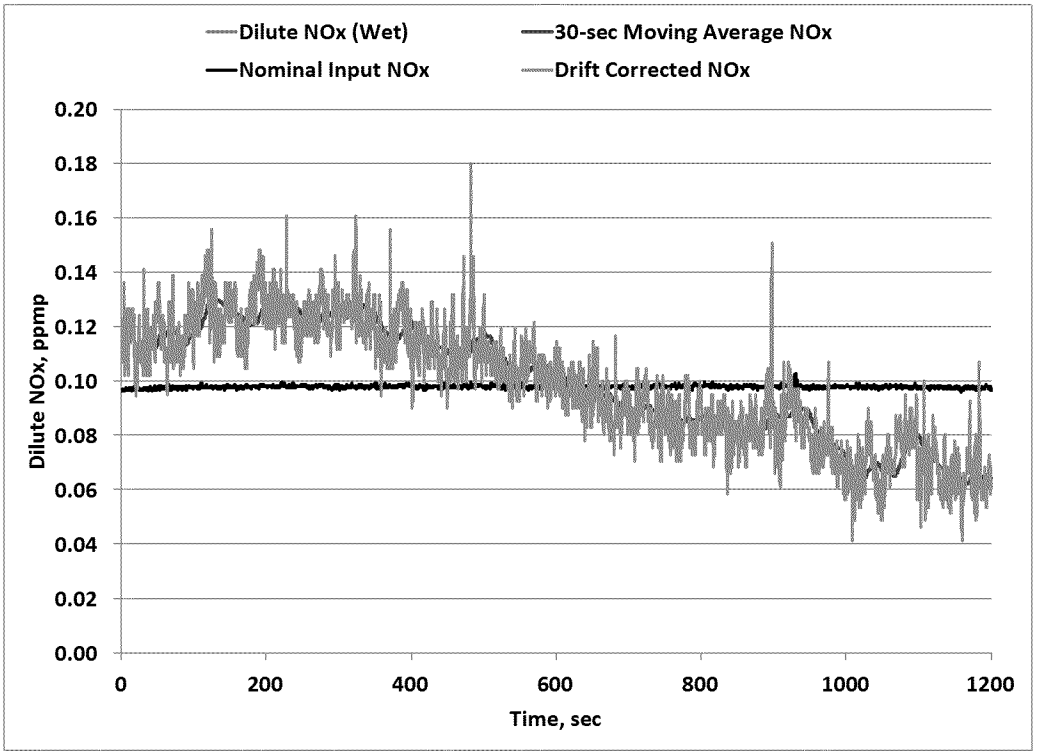

Figure 32. Test Results for 20-Minute Low Level Analyzer Check - Example 1

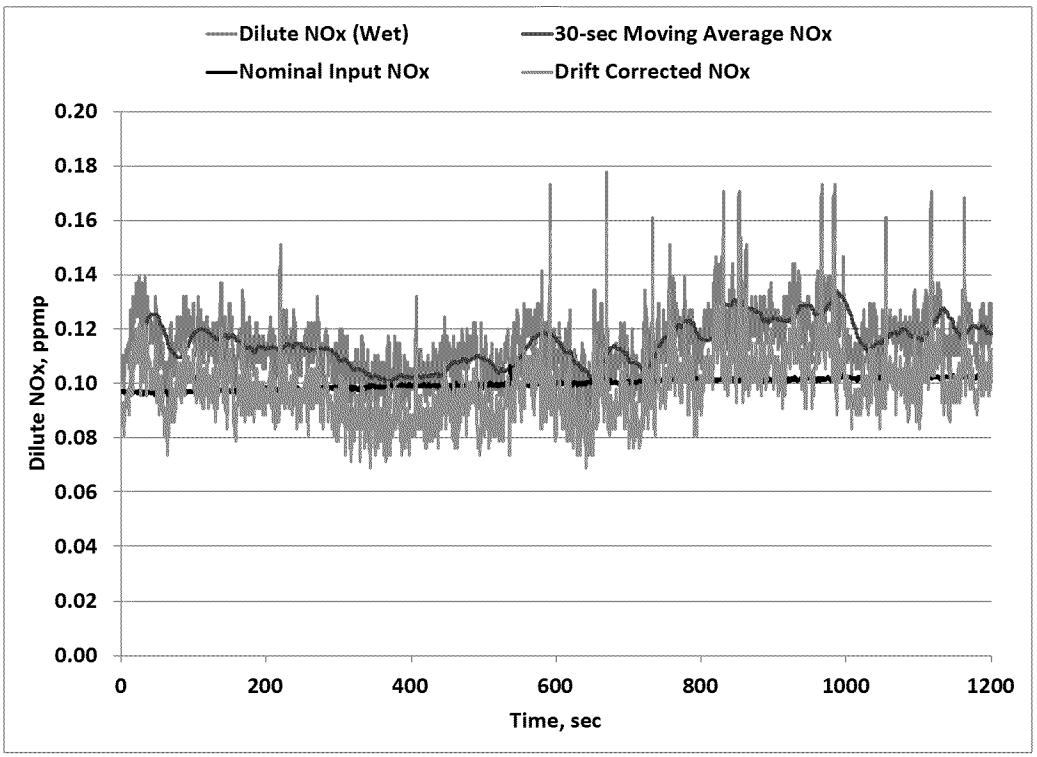

Figure 33. Test Results for 20-Minute Low Level Analyzer Check - Example 2

Table 10. Summary Data for Example 20-Minute Drift Tests

	NOx, ppm	
	Example 1	Example 2
Nominal Input	0.098	0.100
Measured Average	0.101	0.115
DC Average	0.099	0.098
Pre-Zero	0.026	0.013
Pre-Span	22.484	22.476
Post-Zero	-0.027	0.021
Post-Span	22.633	22.492
Ref-Span	22.470	22.470

It should be noted Example 1 shows in Figure 32 the first measurement during a given test shift. These measurements generally showed more analyzer movement than subsequent runs on the same shift. This may indicate that at shift -start a longer period of time with the analyzer in measure ment mode, perhaps sampling ambient air could help to stabilize the analyzer performance. This would likely be especially helpful in the case of an analyzer that has been idle for a period of time prior to the start of the current shift.

4.0 SUMMARY AND CONCLUSIONS

SwRI completed an initial round of experiments and analys es on each of the areas of concern represented by the individual program tasks. The experiments identified whether a significant issue was present, and in some cases could provide an assessment of the magnitude of the issue. In some cases, countermeasures were examined to the degree possible, but that was limited by the program scope and budget. A number of areas were found where further stu dy could be useful in evaluating the root cause responsible for various issues, or to assess their magnitude in better detail. A summary of conclusions and recommendations is given below on a task-by-task basis.

The concern over Analyzer Drift and Stabil ity could be summarized in the question of whether the current analytical equipment could reliably pass the 4% drift tolerance in Part 1065 at a level of 0.02 g/hp -hr. For Dilute measurement, it was apparent that the current analytical equipment would have little difficulty passing the 4% tolerance, given that more than 98% of the zero-span data that was collected would meet the requirement. On the other hand, for Raw measurement only 55% of the data collected would meet the requirement. However, it should be noted that the Raw data set was considerably smaller, representing only about 25% of the total data collected. Based on EMTC discussions, a follow on study would be required in order to examine the reason for the observed issue with the Raw data, which would be done initially with the already gathered data. It would also be beneficial to expand the Raw study to collect a wider range of zero-span data in order to insure that the conclusion is consistent with a larger data set that represents more laboratories.

Dilute air background profiles indicated that while the majority of background data appears relatively stable, a significant amount of variation can be observed depending on local laboratory conditions in representative labs . These variations can be significant, even over the relatively short time period of a 20-minute test. The result of the analytical study of thousands of different background profiles indicated that in cases where background levels were both high and varying significantly over the test, background correction could result in errors as large as +/ - 2.5%, with errors over 1% occurring in roughly 1 out of 20 tests. The final effect on transient results could be lar ger, given that at high background levels, the correction could be larger than the net mass from the exhaust. The primary countermeasure to address this error would be to switch to sampling the background bag at a rate proportional with the dilution air f low rate. In addition to this, it was also found that the currently permitted practice of using the chemical balance in 1065.655 to calculate dilute fraction without intake air flow measurement resulted in a positive bias in calculated background mass of 7% for the modeled test engine a t a minimum dilution ratio of 3: 1. After discussion of the results, EMTC indicate d an interest in analysing these results at different minimum dilution ratios within the range that is practically observed within the limits permitted by 1065 (i.e. from 1.5: 1 to about 5: 1). In addition, the models could also be used to examine the effect of varying intake and dilution air humidity on the NO_x Correction equations in 1065.670. This would require collection of representative h umidity profiles, as well as additional model runs. Both of these efforts could be the subject of a follow on study.

The NO_x analyzer calibration data set indicated a repeatability in calibration point

generation of roughly 0.04% of full scale, with a 1 00 ppm range on maximum analyzer gain, which is a significant amount near zero at the high turn down required for a 0.02 g/hp -hr engine. This level could be reduced by the incorporation of drift correction into the calibration process. The data set was u sed to examine various procedural and analytical approaches to minimizing residual errors near zero. It was found that drift correction could be a valuable tool in minimizing day -to-day errors, and that weighting calibration points in proportion to level in order to emphasize the lower level calibration points could also help with these errors. A follow on study could examine the long term stability of such countermeasures, by repeating the data set over longer periods of time (i.e., month-to-month). Characterization of other analyzer equipment could also be done as an additional effort.

NO_2 lag experiments indicated that there was visible lag above the t50 response point for both kinds of benches, however no loss of NO_2 was observed. Lag was observed on both step tests and short spike tests. This would indicate that NO_2 lag may not be a significant problem for Dilute measurement, but could be a larger problem for Raw measurement because it could disturb the time alignm ent between gas concentration and exhaust flow in an unpredictable manner. More analytical studies are required in order to estimate the potential magnitude of this error on Raw emissions.

More concerning on the NO_2 lag experiments was that a tendency w as seen for the NO_x analyzers to take a long time to settle back to zero after a brief spike at the sample probe inlet. This resulted in the tendency to recover more than 100% of the input spike, which would be a positive measurement bias. In the case of an emissions profile having the shape or an early input spike followed by a long period of near zero emissions (as is expected for a cold start FTP test) , this could be a significant problem. This behavior was seen on both NO and NO_2. However, the experiments were not really designed to examine such an issue in detail. More study, in terms of a focused experiment to specifically determine the nature and magnitude of this issue would be needed. There was considerable EMTC concern about this unexpected f inding, and this would likely be a significant topic of study in any follow-on effort.

Regarding low-level analyzer capability, the accuracy and repeatability experiments were conducted at a concentration that was representative of roughly half the average over a hot-FTP transient test at a 0.02 g/hp-hr composite level. It was found that the analyzer had a repeatability (as define in 1065 terms) of 9 ppb at this level, which represents a little under 3% of the average dilute concentration at a standard o f 0.02 g/hp-hr. The accuracy of the analyzer was within 2% of the concentration at the standard. This should be sufficient for measurements at a level of 0.02 g/hp-hr, but it does indicate that the analyzer is operating near the limits of its detection capability during hot -start measurements. The 20-minute drift experiments indicated that drift appeared to be effectively dealt with on a cycle -average basis by the current drift correction algorithms, although the second-by-second data was not always accu rate, given the nature of the drift correction calculations. Drift behavior appeared to be worse at the start of a measurement shift, following a period of idle time. Some amount of pre-test sampling, preferably on ambient air, appeared to be helpful in minimizing drift during the test interval.

5.0 SUMMARY OF AREAS FOR FURTHER STUDY

The following is a short summary of areas recommended for further study, based on the conclusions provided earlier and following EMTC discussions at various meetings of the past year regarding these results.

- Raw drift check analysis to determine cause of observed difficulties in meeting the 4% for the Raw measurements at 0.02 g/hp-hr.
- Gathering and analysis of more Raw data to examine the above question.
- Evaluation of background variation effects using the program models at different minimum dilution ratios
- Use of the models to examine the effect of varying Intake and Dilution Air humidity levels on the NO_x Humidity corrections in 1065.670.
- Examination of calibration stability and countermeasures of longer period of time (i.e. repeat experiments over a 6-12 month period).
- Analyses to determine the potential error on Raw measurement associated with the observed sampling system lag in NO_2 response.
- A new task effort to examine the issue of over -integration of concentration spikes as a result of the observed issues in study with analyzer response taking a long time to settle fully back to zero after a spike input. This would involve gases such as NO, NO_2, and CO_2.

SwRI can provide a proposal for these efforts if desired by EMA.

Innovative Technology Regulation

Presentation to
Emissions Measurement and Testing Committee
June 10, 2015

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
Air Resources Board

Innovative Technology Rulemaking

Regulatory Need

- *Certification:* Existing certification/OBD requirements geared towards traditional technologies
  - Critical for ensuring emission benefits achieved and maintained
  - OBD, in particular, may pose challenge for emerging new truck and bus technologies
- *Aftermarket Parts:* Formal ARB approval procedures do not exist specifically for hybrid medium- and heavy-duty aftermarket conversions
  - Case-by-case consideration based upon 1990 regulation

Innovative Technology Rulemaking

Objective

√ Provide certification/OBD and aftermarket part approval flexibility to facilitate market launch of needed truck and bus technologies, while maintaining ability to ensure anticipated air quality benefits

Innovative Technology Regulation

Conceptual Framework

- Defines ARB approval pathway for HD hybrids and optional low NOx engines
  - Approval pathway must ensure no emission increase due to hybridization
- Cert. requirements increase within volumetric tiers
  - Tier 1 (~100 engines): Basic cert./OBD requirements

  Hybrids must complete chassis dyno or PEMS testing to demonstrate no NOx increase prior to proceeding to Tier 2
  - Tier 2 (~1,000 engines): OBD requirements ramp up
  - Each manufacturer reverts to full certification requirements after California sale of Tier 2 volumes

Innovative Technology Regulation

PEMS Testing Considerations

- Public Work Group stablished to inform PEMS protocols
  - EMTC members encouraged to participate
- PEMS testing to determine if hybrid emits significantly more criteria pollutants than base vehicle
  - Regulation likely to require hybrid versus base vehicle (A to B) in-use emissions comparison
  - Testing not intended to relate back to an emission standard

Next Steps

Ongoing

ARB Meetings with Stakeholders

Summer 2015

Public Workgroup Meetings: Informal, detailed group discussion on specific topics

Next Meetings (by teleconference)

1. June 23, 2015 *(tentative)*: Aftermarket Parts Work Group
2. Early July 2015 *(date tbd)*: PEMS Work Group

→ To participate, e-mail jcalavit@arb.ca.gov

Next Steps (cont.)

Fall 2015

- Second Public Workshop

Late 2015/Early 2016 *(tentative)*

- Proposed Regulation released for 45-Day Public Comment Period

Early 2016 *(tentative)*

- Board Consideration of Proposed Regulation
- If adopted, ARB to request early effective date

Key Contacts

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Title

An Alternative Engine and Powertrain Mapping Approach for Simulation of Vehicle CO_2 Emissions

Abstract

Simulations used to estimate carbon dioxide (CO_2) emissions and fuel consumption of medium- and heavy-duty vehicles over prescribed drive cycles often employ engine fuel maps consisting of engine measurements at numerous steady-state operating conditions. However, simulating the engine in this way has limitations as engine controls become more complex, particularly when attempting to use steady-state measurements to represent transient operation. This paper explores an alternative approach to vehicle simulation that uses a "cycle average" engine map rather than a steady state engine fuel map. The map contains engine CO_2 values measured on an engine dynamometer on cycles derived from vehicle drive cycles for a range of generic vehicles. A similar cycle average mapping approach is developed for a powertrain (engine and transmission) tested together in order to show the specific CO_2 improvements due to powertrain integration and optimization that would not otherwise be recognized in simulation, engine testing, or full vehicle evaluation. While a related paper entitled "Alternative Vehicle Certification Procedure" focuses primarily on simulation results, this paper summarizes the associated experimental results and the development of the cycle average map concept. Test results for an engine and a powertrain demonstrate the cycle average map is a smooth, continuous surface in each case. The paper also compares accuracy of using the steady-state engine map versus the cycle average engine map, with the cycle average map performing similarly or better, depending on drive cycle. Advantages of using the cycle average map for vehicle simulation in the context of CO_2 regulations are also discussed with the conclusion that the cycle average map is a good alternative to the steady state map approach for representing engine fuel consumption and CO_2 emissions performance in a vehicle certification program.

Introduction

An engine map is used to represent tested engine performance (fuel consumption, emissions, etc.) in a vehicle simulation in order to estimate drive cycle performance of the engine and vehicle. The map is defined by triplets of engine speed, engine torque, and an engine performance parameter, for example brake specific fuel consumption. Figure 1 shows a schematic of the typical process to create such a map. An engine is run at steady speed and load conditions for some amount of time (usually minutes) for stabilization and data acquisition. After data collection at one point, the speed and load are ramped to another steady condition and the process repeated. The number of points varies depending on the intended use of the map, but can be over 100. Figure 2 shows an example map. Figure 3 shows how the map is used as part of a vehicle simulation, with each simulation time step using the map to predict instantaneous fuel consumption based on the current speed and load.

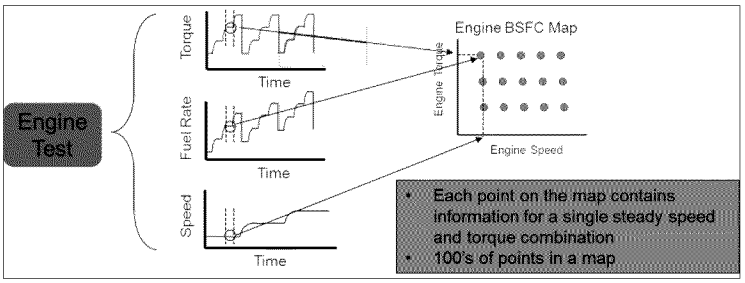

Figure 1. Typical Steady State Map Generation Process

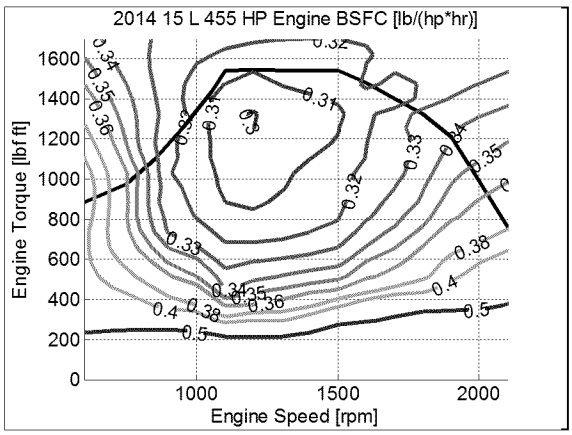

Figure 2. Steady State BSFC Map for the 2014 15 L 455 HP Engine Used in GEM

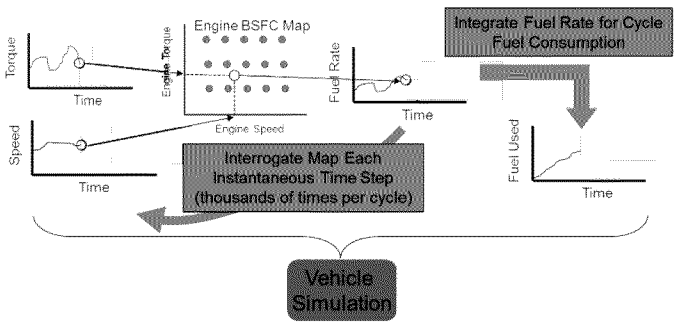

Figure 3. Process for Using a Steady State BSFC Map in a Vehicle Simulation

This map can be used in a vehicle simulation for general vehicle performance understanding as well as powertrain matching of the engine, transmission, and axle ratio to the vehicle. Historically, the engine map approach has also been a reasonable method to predict vehicle drive cycle fuel consumption.

However, there are some inherent assumptions in using an engine map in this manner:

1. The test cell engine installation mimics the vehicle installation. This assumption includes

considerations such as radiator performance, charge air cooler cooling performance as well as flow restriction, combustion air inlet restriction, exhaust system restriction, and ambient cooling of the engine.

2. The engine performance is closely correlated to engine speed and engine torque. These parameters are the map axes for defining the engine performance.
3. The engine performance at a speed and torque in transient operation is very close to the performance at a steady state operating point of the same speed and torque.
4. The engine performance is "well behaved" in the speed and torque space so interpolation or surface fitting of the map can be used to represent non-tested operating points.

Traditionally, these assumptions have held well enough to use an engine map for relative comparisons of engine performance. For example, engine maps for two different model year engines have been used to reasonably accurately predict the change in drive cycle fuel consumption. (Reference something that shows that hopefully)

However for modern diesel engines with aftertreatment and complex controls systems, the assumptions above are starting to be challenged. Engine performance is closely tied to aftertreatment performance, with closed loop feedback from the aftertreatment system to the engine. The aftertreatment performance is dependent on temperature, so ambient cooling differences between the test cell and the vehicle are becoming more important. Aftertreatment systems also have longer time responses than the base engine. It can take minutes for the aftertreatment to respond to engine changes (Reference SAE Fuels and Lubes Material). So treating a speed and torque in a transient cycle the same as a steady state point becomes difficult.

In the past heavy duty engines set controls references based on tables that had axes of engine speed and fueling (or torque), but modern engines have much more complex control algorithms that depend on ambient conditions, temperature of the aftertreatment, or storage state of the aftertreatment (ammonia or soot for example). These control systems do not necessarily repeat performance at the same engine speed and torque in two different drive cycles. With these changes in the engine system, steady state maps can be expected to have trouble predicting the fuel consumption of a vehicle drive cycle (Figure XX). So a new approach to model an engine in a vehicle simulation is needed.

Vehicle CO_2 Regulation Considerations

The EPA GHG Regulations instituted in 2011 (?) ("Phase 1") (Reference) use vehicle simulation to regulate CO_2 emissions from heavy duty vehicles. This simulation (GEM) uses engine steady state maps to represent the engine performance in the vehicle. But note that the simulation is really just used to evaluate vehicle characteristics like aerodynamics, tire rolling resistance, and weight. There is a generic map that represents engine performance at the engine standard level which is used for all vehicle technologies. This approach essentially builds the engine map into the standard and all vehicles in a class are evaluated on the same engine.

For the next round of GHG Regulations ("Phase 2"), there is a desire to use the specific engine performance in the vehicle certification. In this way the vehicle will get credit for an engine performing under the standard or take the penalty for an engine performing above the standard. This approach will require some method of representing the actual engine performance in GEM. A steady state map representation of the engine is expected to be proposed. This approach has been suggested by others (Vecto Reference) but with some clear qualifiers that the steady state engine map does not alone suffice to represent the engine.

For a regulation there are some different considerations for the engine information used in a vehicle simulation than for a product development effort. Some key considerations are:

- The CO_2 evaluation of the engine for use in the vehicle program should be consistent with the criteria emissions regulation protocol. If the protocol for "giving credit" for a good CO_2 engine in the vehicle program is not consistent with the protocol for engine regulation for NOx, HC, and PM, then manufacturers will have a large incentive to create systems that perform well on CO_2 at the expense of NOx which may end up with solutions that do not drive both NOx and CO_2 control to the real world.
- The engine information should be accurate, auditable, and relatively easy to collect. These requirements are not always consistent with each other, so trade-offs between them are likely to be needed. Accuracy includes accurate representation of the engine performance as well as an accurate accounting of the benefit of vehicle technologies when used with this engine. A regulation requires compliance procedures. It seems unlikely that the GHG regulation will audit a full vehicle on the road, so auditing the inputs to the simulation becomes the compliance pathway. Consideration should be given to using common engine performance test results in the engine regulation and the vehicle regulation so that there is minimal extra test and auditing burden for the engine data used for the vehicle program.
- The engine should be evaluated in a manner consistent with how it will be used in the vehicle regulation. Simply put, the engine model should be created with the expectation that it will be used in a transient vehicle simulation across a range of vehicle configurations and drive cycles.
- Because engine manufacturers are not always the vehicle manufactures, consideration needs to be given to keeping proprietary engine performance and controls information confidential.
- With future emphasis on engine and transmission integration, some form of powertrain (engine and transmission) representation is desired for the vehicle regulation. A consistent approach for modeling the engine and powertrain for the vehicle regulation is desirable.

Options for Engine Model

With the above requirements in mind, it is useful to step back and consider what options exist to provide appropriate engine information to the vehicle regulatory program. Some traditional options are listed in Table 1.

(if we use this, maybe move to an appendix? Won't fit in 3.5 in wide columns of final paper format)

Table 1. Comparison of Typical Options to Represent Engine Performance in a Vehicle Simulation

Requirement	**Form of Engine Information in the Vehicle Program**			
	None	**Single Value from Engine Certification Program (SET or FTP)**	**Steady State Engine Map**	**1D Thermodynamic Model**
Criteria Emissions Link	Good (built into Generic Map)	Good	Weak. Steady state map links to SET somewhat.	Hard to do
Accuracy	Generic Engine Map (Phase 1 GHG Approach)	Better than Generic Map	Better than Generic Map, but no transients	Depends on effort on calibration of the model
Auditability	N/A	Built into the engine certification program	Auditing each map point is a burden	Still need to audit engine?
Amount of Work	None for engine manufacturer (some for EPA)	None extra if using engine cert program value	Extra engine testing needed beyond the engine cert program	Very large to manage a detailed model
Consistency with Vehicle Operation	Reasonable	Possible if cycle represents vehicle operation well, but as powertrain configurations change maybe not	Speed and load matching but no transient content	Speed and load matching and could have transient content if controls are included
Confidentiality	N/A	No Issues	Map is confidential	Detailed model and controls logic are highly confidential

Powertrain Evaluation Capability	Generic Powertrain	Can move the transmission into the engine test	Hard to make a steady state map with the transmission included	Requires transmission controller model like the engine controller model

Each of the options in Table 1 has some positive and negative attributes. A generic map puts no burden on the engine manufacturer but also gives no credit to the vehicle for a well performing engine. A single cycle value is simple, connected to the criteria emissions program, and auditable but depends on a single cycle operation matching the engine's operation in the vehicle. A steady state map doesn't capture engine transient behavior. A more detailed engine model adds a lot of complexity and confidentiality concerns.

In choosing a method, a process that relies on engine system testing is preferable. This approach avoids any of the issues with model calibration or confidentiality and leads to an auditable process. A map is needed that is based on testing, includes transient content, and is flexible to adjust the engine's performance when the vehicle configuration or drive cycle changes.

To consider such a map, it's worth noting that the cumulative vehicle CO_2 on any drive cycle can be considered in parts as shown in Figure 4. The Engine CO_2 is just the cycle cumulative brake specific emissions of the engine that is typically measured and regulated. This value is a measure of the engine efficiency. The vehicle power demand is the cycle cumulative engine work normalized by the payload and distance travelled. Another way to consider this value is the average horsepower required to move a unit of payload at a given speed. It is a measure of the efficiency of the vehicle to move payload. Mathematically, these values can be calculated from any drive cycle simulation and combined to provide the overall drive cycle vehicle CO_2 emissions.

Engine CO_2		Vehicle Power Demand		Vehicle CO_2
$\frac{g}{hp*hr}$	x	$\frac{hp}{ton*mph}$	=	$\frac{g}{ton*mile}$

Figure 4. Relationship of Engine Brake Specific CO_2, Vehicle Power Demand, and Vehicle Emissions

The engine CO_2 part of Figure 4 can be represented by a cycle average BSFC map. The engine is tested on a cycle that matches vehicle operation well and the cycle cumulative fuel consumption is measured. The cycle can then be changed to represent slightly different vehicle

operation for a new value of fuel consumption. In this way a set of cycles can be tested to "map" the engine's cumulative cycle fuel consumption response. A schematic of this approach is shown in Figure 5. An example cycle average map is shown in Figure XX. The process for using it in a vehicle simulation is shown in Figure 6. The entire cycle is simulated and then the cumulative cycle work, average engine speed, and average vehicle speed are used to interrogate the map for a cycle brake specific fuel consumption value. Then the relationship of Figure 4 is used to calculate the vehicle cycle fuel consumption or CO_2.

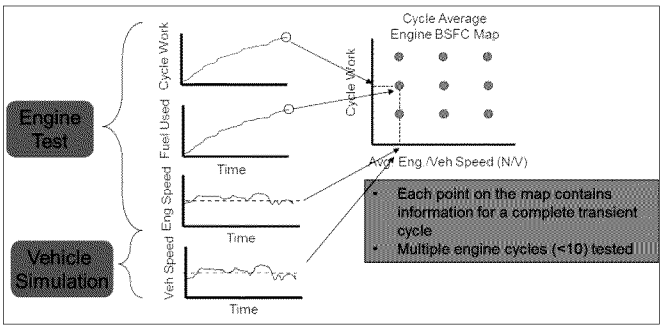

Figure 5. Cycle Average Map Generation Process

(Need cycle average map example, like figure 2)

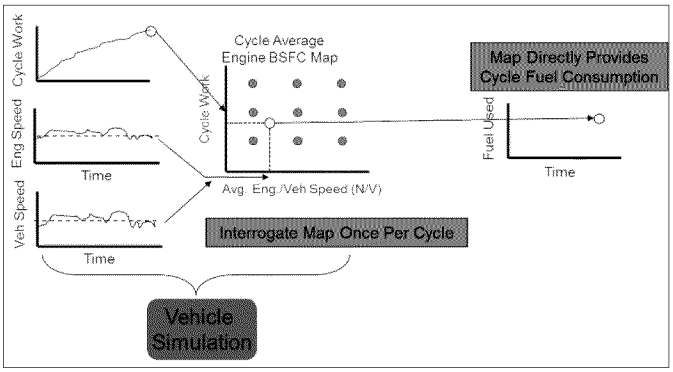

Figure 6. Process for Using a Cycle Average BSFC Map in a Vehicle Simulation

Average engine speed divided by average vehicle speed (denoted as N/V) has been used as a map axis to represent the nature of the engine speed operation on the cycle. Cycle work has been used as a second map axis to represent the engine loading on the cycle. These parameters are analogous to using engine speed and load as the axes for a steady state map. Table 2 summarizes some more similarities and some differences between the two mapping approaches.

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Table 2. Comparison of the Steady State and Cycle Average Maps

	Steady State Map Approach	Cycle Average Map Approach
Similarities	Actual engine with production controls in a CFR1065 capable test cell	
	Requires an extra test beyond what is used for the engine CO_2 certification	
	Points on map can be audited	
	Provides cycle fuel consumption based on the speeds and loads the engine sees in the vehicle	
	Uses speed and torque as axes to define the map	Uses a Cycle Average Speed metric and Cycle Average Torque (Cycle Work) as axes to define the map
Differences	No transient performance evaluated or captured	Realistic transient performance built into each point on the map
	Not possible to consider for criteria emissions use	Possible to consider as a criteria emissions protocol for the future
	Fuel use at each point in the cycle is calculated	Fuel use is only calculated as a total cycle value
	Audit steady state points	Audit transient cycles
	Differences in the testing burden need to be investigated	

Based on the comparisons above, the cycle average map approach is a good alternative to investigate for modeling the engine performance in the vehicle CO_2 regulation protocol.

Validation of Cycle Average Map

Some of the key questions to consider for the cycle average map are:

1. Is the map surface well behaved so that interpolation can represent points not tested?
2. How does the accuracy compare to a steady state map approach?

A first check of the surface shape was performed via simulation in GEM and is described in a separate paper (Reference). After reasonable results from a simulation study, two test programs were implemented to investigate the questions above. The first test program included only the engine in the map and the second program included the powertrain (engine and transmission).

Engine Only Approach

The engine-only test cell as shown in Figure 7 was sized to accommodate a heavy-duty (HD) engine. A Cummins 15 liter ISX engine rated to 336kW (450 hp) with peak torque of 2375 Nm (1750 ft-lb) was used for the evaluation. A HD aftertreatment system was installed to meet the

EPA and CARB emissions standards. The aftertreatment system utilized both a Diesel Particulate Filter (DPF) and a Selective Catalytic Reduction (SCR) system. To maintain a baseline condition for the DPF during testing, a DPF regeneration was forced prior to each set of tests to clean the DPF of stored particulates. The SCR system was operated during testing as would be witnessed in-vehicle operation to reduce NOx. The exhaust emissions were collected continuously using a Horiba Mexa7100D emission bench. The fuel was measured continuous during each test cycle using a ReSol RS438A-200 Fuel Flow Measurement System. The testing is completed using ultra low sulfur diesel fuel with a maximum sulfur concentration of 15 PPM. The engine intake air is temperature, humidity and pressure controlled to 25°C, 53% and 99kPa, respectively. All temperatures, pressures, fuel flow and emissions measurements were logged at a rate of 10 Hz.

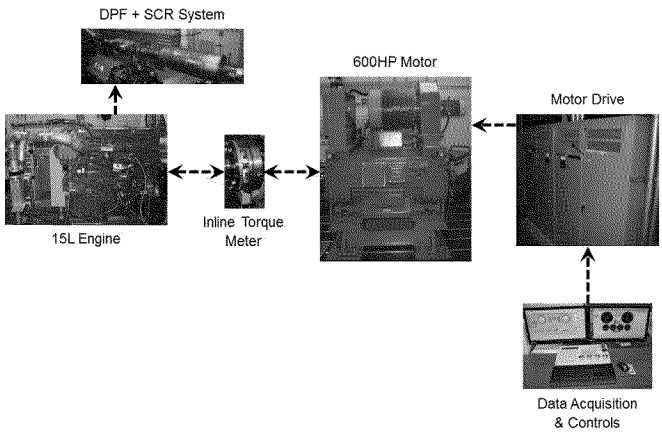

Figure 7. Engine Only Testing Setup

The test cycles utilized for the engine-only mapping approach were generated using GEM. Three separate vehicle configurations were input into the GEM model to generate speed and load points for each of the regulatory cycles (ARB, 65MPH, and 55 MPH). A total of nine traces were generated for each cycle. Each individual cycle was repeated two times consecutively and emission data sampled during the second cycle. A total of 27 engine tests were run (3 vehicle configurations x 3 test cycles x 3 axle ratios). The cycles run are shown in Figure 8. These are the GHG Phase 1 GEM cycles (Reference) with the change that the highway cycles have been modified to include grade profiles. The grade profiles were provided by the EPA.

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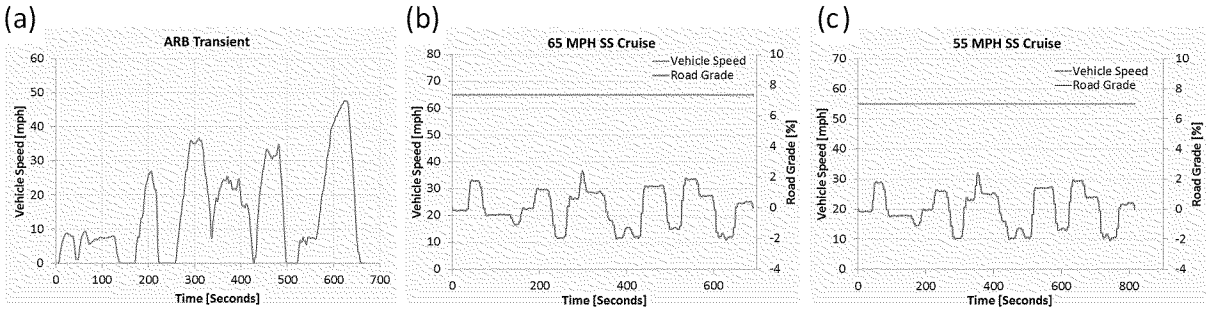


Figure 8. Vehicle Cycles: a) California Air Resources Board (ARB) transient cycle, b) 65 MPH [105 kph] GEM cycle with road grade, c) 55 mph [88 kph] GEM cycle with road grade.

Test Results

Example engine map results are shown in Figure 9. These show a generally well-behaved surface for either surface fitting or interpolation.

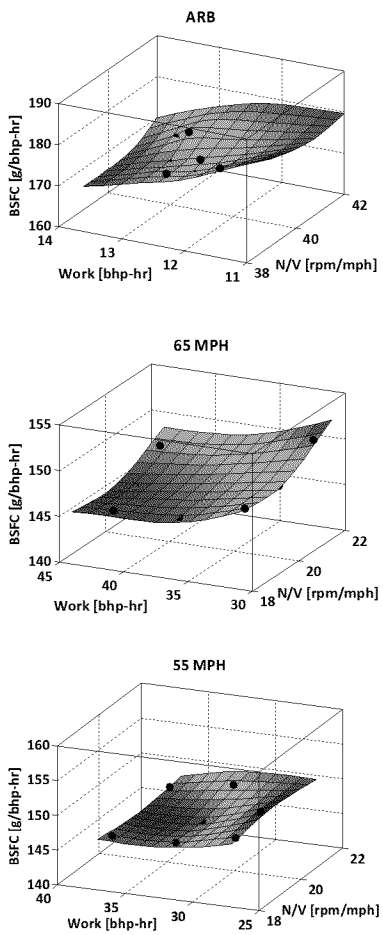


Figure 9. Engine Only Cycle Average BSFC Map Surface Plots: a) ARB Transient, b) 65 mph, c) 55 mph

To check the predictability of the map, half the data set was used to fit BSFC to a linear model in N/V and cycle work. Testing this model on the other half of the data set shows the model performance as seen in Figure 10, indicating good behavior of the model to represent truck configurations different than those tested to create the map. Additionally, some extra truck configurations were tested at a later date as independent check points for the map. Those points are also shown in Figure 10, with similar good agreement between the model and test results.

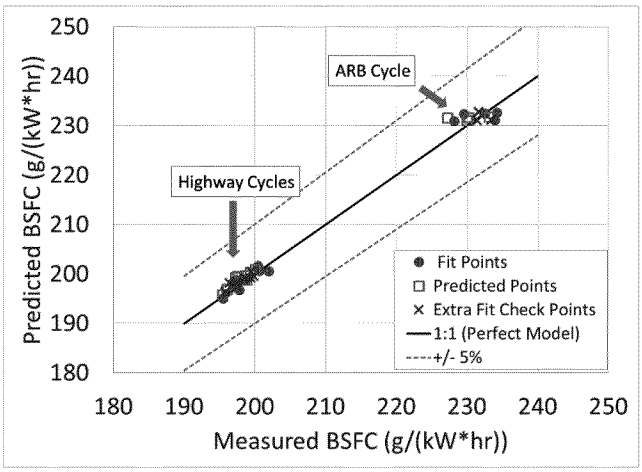


Figure 10. Cycle average map prediction capability with a linear fit in cycle work and N/V

A comparison of the cycle average map to the steady state map approach was completed and is shown in Figure 11. The steady state map results were taken directly from GEM using a steady state map for the same engine model as tested for the cycle average map, but it was not the identical engine. So engine to engine and test cell to test cell variability on the order of 2% need to be considered in comparing results. In the region of the 55 MPH and 65 MPH cycles (labelled Highway Cycles), differences between the cycle average map and the steady state map can be attributed to that measurement variability. For these relatively steady cycles the two map approaches are expected to produce similar results and they do agree within the variability of testing.

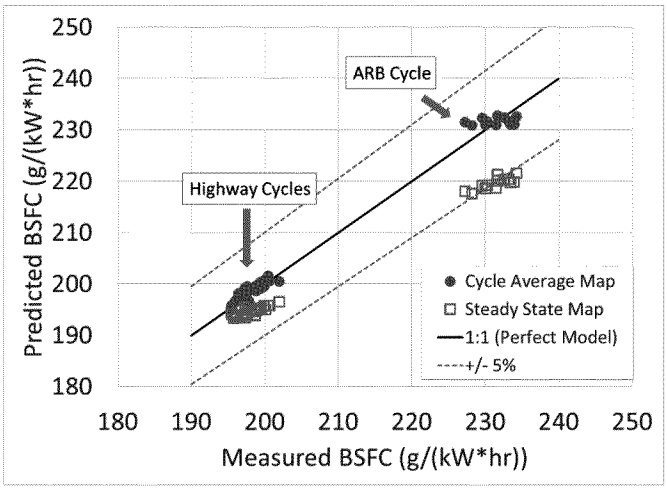


Figure 11. Comparison of cycle average map linear fit in cycle work and N/V to a steady state map interpolation

For the ARB cycle with more transient content the cycle average map does show a better match to the measured data than the steady state map approach. This result is expected from the more transient nature of the ARB cycle and the ability of the cycle average map approach to capture transient performance content.

Note that for this initial investigation of the cycle average map approach, the goal was not to precisely and completely prove capability, but rather to check for concept feasibility. For a regulation approach, it's likely that a surface fit to the cycle data would not be used. If a certification configuration matches a mapped configuration, the exact tested result is a desired output of the model. So an interpolation method will likely be proposed for any regulation.

Powertrain Approach

The powertrain test cell as shown in Figure 12 was sized to accommodate a powertrain from a relatively heavy-duty vehicle. The vehicle test weight was 30,391 kg [67,000 lbs.]. The powertrain tested included a Cummins 15-liter ISX engine with an Eaton 10-speed automated manual transmission. The engine maximum rated performance was 336kW (450 hp) at 1800 rpm with peak torque of 2375 Nm (1750 ft-lb) at 1000 rpm and was operated using two separate calibrations; one base calibration for testing with the 10-speed UltraShift PLUS LAS transmission and an additional calibration with SmartTorque2 (ST2) technology for testing in conjunction with the 10-speed Fuller Advantage™ (FASA) transmission. Both engine calibrations tested were emission certified for 2013 CARB and EPA. The dynamometer was sized to accommodate the engine's peak torque multiplied by the transmission's maximum gear reduction. All data collection and test procedures described for the engine only test were repeated for the powertrain testing. For the powertrain testing, the test cell ran as an HIL system with a vehicle model controlling the dynamometer and throttle controls so that the engine ran as if in a vehicle.

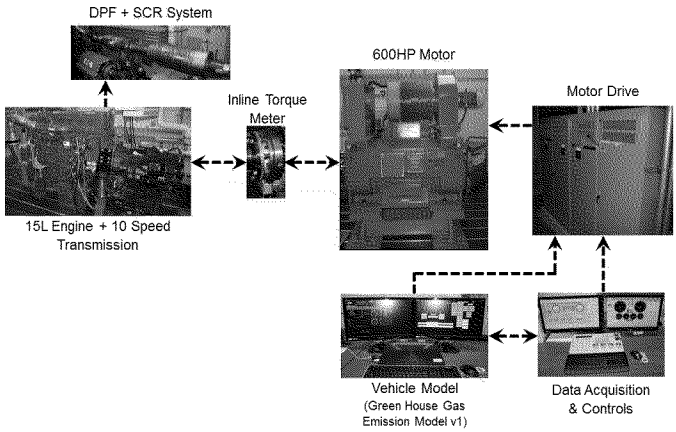
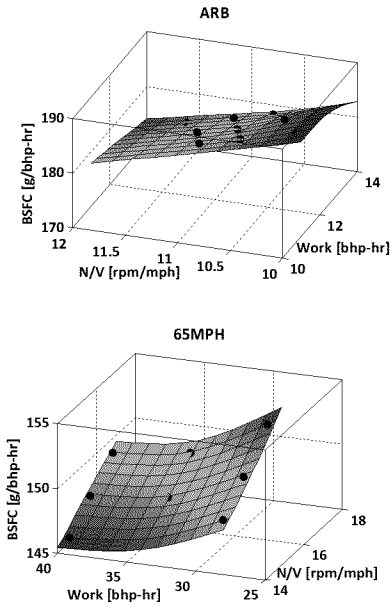


Figure 12. Powertrain Test Setup

The same three cycles from Figure 8 were used for the powertrain testing. Each individual cycle was repeated two times consecutively and emission data sampled during the second cycle.

An example powertrain cycle average map is shown in Figure 13. As with the engine only results, the surfaces look to have a reasonable shape that can be used for interpolation use in a vehicle simulation for regulation purposes.



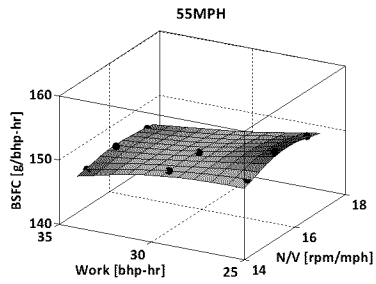


Figure 13 Powertrain Cycle Average BSFC Map Surface Plots: a) ARB Transient, b) 65 mph, c) 55 mph

Using the cycle average map in the CO_2 Regulation

With some level of validation complete, a potential procedure for utilizing a cycle average map in the vehicle CO_2 regulation can be outlined:

1. Generate engine torque and speed cycles from the vehicle certification cycles using GEM and generic vehicle configurations (Figure 14)
    a. The generic vehicles are defined based on the characteristics of the parent engine torque curve based on a pre-defined approach stipulated in the regulation protocol. This approach can be considered analogous to the de-normalization process of a normalized FTP cycle into the absolute speed and torque target cycle. This process will ensure that vehicles are chosen to match up with the engine and not force the mapping process to run the engine in a manner in which it will not be used in the field.
    b. The generic vehicles are simulated within GEM with the use of a default engine map and the torque curve and motoring curves of the parent target engine. The speed and torque profiles for the engine are recorded and then used as reference targets for the engine testing.
2. Run engine tests and tabulate cycle average CO_2 , N/V and cycle work for use in certification (Figure 14)
    a. The engine must match the target cycles with a regression requirement similar to that used for criteria emissions certification.
    b. Alternately, a hardware-in-the-loop (HIL) approach can also be used with GEM running at the test cell and creating the speed and torque targets in real time. This approach is preferred for powertrain testing or any controls features that will have a close integration with vehicle speed, road grade, or other vehicle level information.
3. Generate certification data for the specific vehicle using GEM simulation (Figure 15)
    a. The certified vehicle configuration is run in GEM with the torque and motoring curves for the specific engine rating, but with a default engine fuel consumption map.
    b. GEM calculates the engine (or powertrain) cycle work and average N/V then interpolates within the cycle average map to obtain a cycle average fuel

consumption value. GEM also calculates the vehicle power demand and then multiplies the cycle average fuel consumption by the cycle cumulative power demand to arrive at the vehicle drive cycle fuel consumption as shown in Figure 4. In this manner, the cycle average map use is a simple post processing step in GEM and does not interact with the detailed GEM vehicle modeling calculations. Note that the only difference between use of an engine or a powertrain map is the location of the cycle work calculation. For an engine map, the cycle work is the engine cycle work. For a powertrain map, the cycle work is calculated at the transmission output.

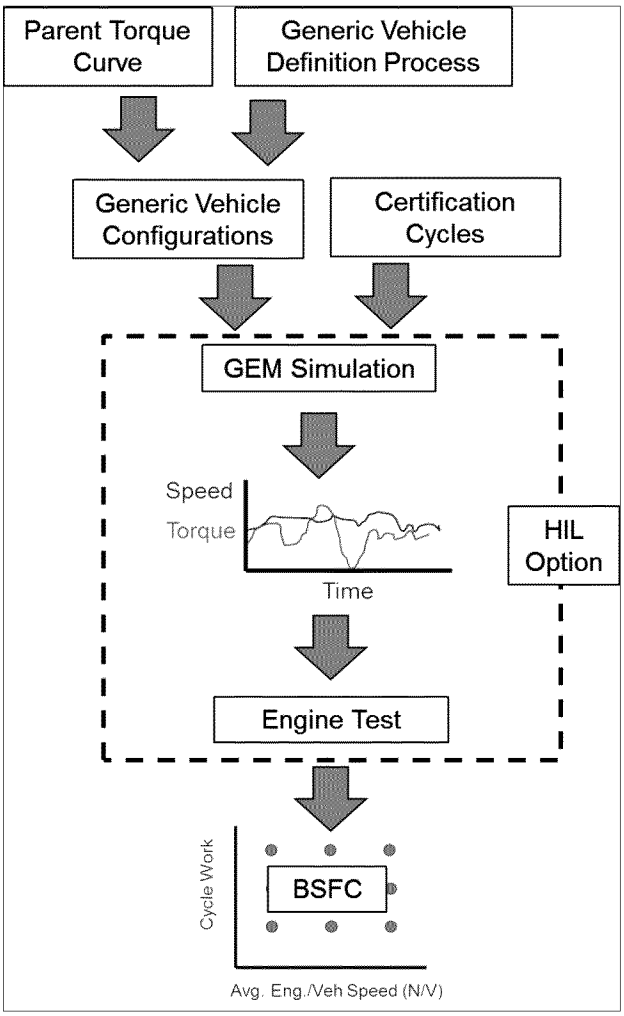


Figure 14. Process for generating the cycle average map for use in vehicle CO_2 regulation

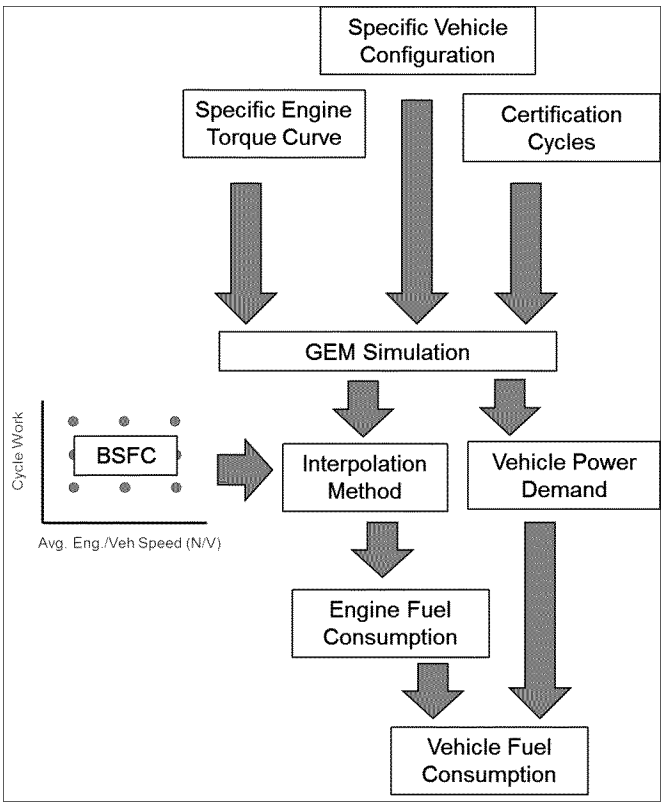


Figure 15. Process for using the cycle average map in vehicle CO_2 regulation

In work to date, nine vehicle configurations have been used and run on each of the three certification cycles, providing 27 data points. This number of cycles is a significant amount of engine testing time. A comparison of the testing time required for this approach and a steady state map approach is shown in Table 3. Future work will focus on reducing the number of test cycles or streamlining the testing protocol. As shown in the table, a change in the pre-conditioning cycle strategy can reduce the test time significantly.

Table 3. Comparison of Testing Times for Different Approaches

Cycle	Steady State Map [Hours]	Cycle Average Map [Hours]	Cycle Average Map New Pre-Conditioning Strategy [Hours]
Engine Warm-Up	0.3	0.3	0.3
DPF Regeneration	1.0	1.0	1.0
Emission Purge & Calibration	2.4	5.9	1.1
Pre-conditioning	3.3	5.6	1.9

Time at Test	1.2	5.6	5.6
Total Time	8.3	18.4	9.9

Future Regulatory Considerations

In the current work, the cycle average map has been utilized to represent engine fuel consumption performance for use in the vehicle CO_2 regulation. But in the future, this concept could be used for other purposes.

The engine cycles tested for the cycle average map are inherently linked to the vehicle configurations expected to be using the engine. So these cycles are good realistic cycles that could be considered for criteria emissions certification for the engine. By using the same cycles, the criteria emissions program and the GHG program would be linked so that one cannot be compromised in favor of the other. This approach can also simplify the engine certification program. Figure 16 shows the expected GHG phase 2 engine regulatory structure with 3 pathways of regulation on the engine. Figure 17 shows that a future structure based on a cycle average map could simplify this picture.

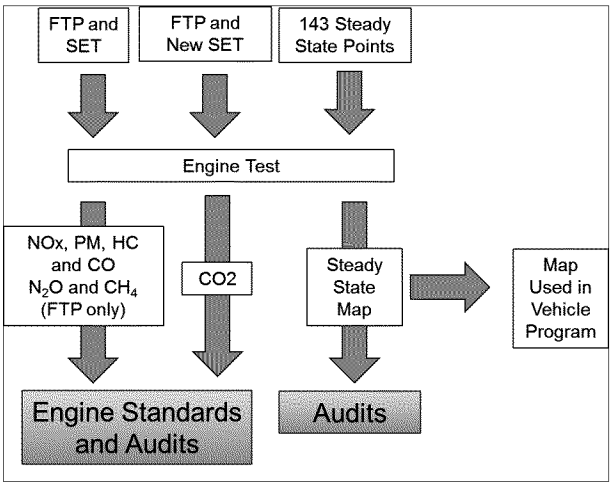


Figure 16. Expected GHG Phase 2 Engine Regulatory Structure

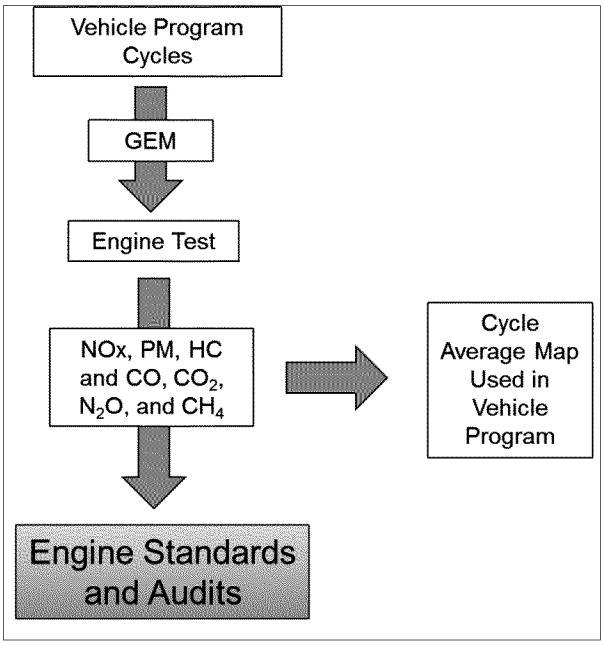


Figure 17. Potential Simplified Engine Regulatory Structure Using the Cycle Average Map Approach

The consistent treatment of the powertrain and engine with a cycle average map approach allow it to be considered for regulating criteria emissions at the powertrain level. The powertrain test results for criteria emissions could be directly regulated, allowing the benefits of the transmission and engine integration to be recognized for optimizing fuel consumption and emissions.

Also, if there is ever a desire to give credit to a lower power demand vehicle in reducing criteria emissions, the cycle average map approach could be used. Because transient cycles are tested to create the map, it is possible criteria emissions could be treated in the same manner as fuel consumption.

Summary

The cycle average map is a viable approach to utilizing engine fuel consumption performance in a vehicle regulation. First indications are that the accuracy is comparable or better than a steady state map. It also allows a consistent treatment of the engine and the powertrain in the same approach and has potential to simplify and link the criteria emissions and CO_2 programs in the future.

Recommendation

Future work should investigate the cycle average map for use in the GHG Phase 2 program. Specifically some work should look at the behavior of the cycle average map on other engines. More work can certainly be done to choose the right number of map points and to consider interpolation and fit methods, especially with a goal to reduce the number of mapping points and testing burden.

Nomenclature

N/V – Average engine speed on a cycle divided by average vehicle speed on the cycle

Contact Information

Gary Salemme
e-mail: gary.c.salemme@cummins.com

References (still need cleaned up)

Certification Test Approach for the Phase II Greenhouse Gas Regulations, Dykes and Dorobantu, Eaton

Heavy Duty Engine System Optimization to Meet Future GHG Emissions Regulations, Salemme, SAE Fuels, Lubricants, and Aftertreatment Symposium, Nov. 2013

Vehicle Testing of Cummins Turbocompound Diesel Engine, Brands, Werner, Hoehne, DOE/NASA Report NASA CR-159840, June 1980

The Development of a Simulation Tool for Monitoring Heavy-Duty Vehicle CO_2 Emissions and Fuel Consumption in Europe, Fontaras, Rexeis, Dilara, Hausberger, Anagnostopoulos, SAE 2013-24-0150, Sep. 2013

GHG Phase 1 Reference (CFR citation?)

Use of Vehicle Modeling in Engine Development at Cummins, Eckerle, Salemme, NAS Committee Meeting, June 2013

Houshun's presentation at NAS meeting where SS map accuracy was shown.

Original VMS SAE Paper

Some reference for how we got we grade profiles for the new cycles

I have some others I need to put in here.

Acknowledgements

The authors would like to acknowledge the many conversations with others in the participating companies and around the industry to help develop the concept presented here. Houshun Zhang, James Sanchez, and Matt Spears at the EPA deserve mention for many collaborative and insightful discussions.

FOR IMMEDIATE RELEASE

Contacts: Christina Heartquist, 415.453.0430

Trucking Industry Leaders Engaged on New Heavy Duty Fuel Efficiency Standards

Big fleets and manufacturers weigh in on proposed new standards to increase efficiency for heavy-duty vehicles

WASHINGTON – An alliance of the country's largest names in trucking said today that they look forward to working with Federal regulators on the Obama Administration's Notice of Proposed Rule Making (NPRM) for the second phase of national fuel efficiency and greenhouse gas emission standards for heavy-duty vehicles. Noting the success of Phase I standards finalized in 2011, the group said it is supportive of a process to achieve substantial environmental and economic benefits by reducing GHG emissions, improving fuel efficiency and delivering fuel cost savings for fleets.

"Cummins supports the proposed Phase II rule and believes it will help our industry grow in a more sustainable way, which is a win for our customers and win for the environment," said Tom Linebarger, Chairman and CEO, Cummins Inc. "The rule, which was developed through a collaborative effort with agencies and industry partners, builds on the emissions reductions and fuel efficiency gains that the Phase I standards helped make possible. We look forward to the process of finalizing these new standards. Cummins is committed to continuing to use our technological leadership to develop products that our customers rely on, while also reducing our environmental footprint."

The Leadership Group formed in 2010 to provide industry input into the historic first-ever national greenhouse gas and fuel efficiency standards for heavy-duty engines and vehicles. Its member companies supported Phase I of the Environmental Protection Agency (EPA) and National Highway Traffic Safety Administration (NHTSA) Heavy Duty Rule, and give the first phase of the rule credit for accelerating the industry's adoption of advanced technologies while minimizing market disruption.

You can read the Heavy Duty Fuel Efficiency Leadership Group's 2015 Statement of Principles here.

"As a power management company committed to increased fuel efficiency and reduced greenhouse gases, Eaton strongly supports the next phase of standards for medium and heavy duty commercial vehicles," said Alexander M. Cutler, Eaton Chairman and CEO. "These standards provide important incentives to help deploy the next generation of fuel efficient technologies. Eaton stands ready to provide cost-effective advanced drivetrain technologies that make vehicles more efficient while achieving significant operational savings for our customers' commercial vehicle fleets."

The Phase I standards, finalized in 2011, set out to improve fuel economy and reduce emissions from medium and heavy-duty trucks. The standard was applied to vehicles ranging from pickup trucks to big-rig tractors, including 18-wheelers, sanitation trucks,

buses and other commercial vehicles, manufactured in model years 2014 through 2018. These vehicles collectively represent only 7 percent of vehicles on the road, but account for over 25 percent of the fuel used to travel those roads. The Phase I rule is estimated to save $50 billion in fuel costs and a projected 530 million barrels of oil.

"Fuel-efficient vehicles make good business sense and are good for the communities where we live and work," said Indra K. Nooyi, Chairman and CEO of PepsiCo. "Using our scale and resources responsibly, we take a comprehensive approach to global fleet efficiency in how we deliver our foods and beverages. Whether it's enhanced driver training or operating one the country's largest all-electric vehicle delivery fleets, PepsiCo thrives in today's economy by deploying new technology and capabilities."

"We look forward to continue working with EPA, NHTSA and the Administration on this national Phase II program," added Michael L. Ducker, President and CEO of FedEx Freight. "We need to ensure national harmonization of standards and compliance requirements in order to maximize environmental benefits and fuel cost savings for fleets so as to decrease U.S. dependency on oil. This would serve as an effective complementary approach with equipment improvements like the use of 33 ft. twin trailers, which can reduce fuel use by millions of gallons per year through up to an 18 percent improvement in operational efficiency. The use of 33 ft. trailers has the added benefit of enhancing safety and reducing emissions due to fewer truck trips needed to transport the same amount of freight."

"As the largest semi-trailer manufacturer in North America, we will continue to work with the EPA and NHTSA as they finalize a trailer program intended to improve fuel economy in our industry," added Richard Giromini, President and CEO of Wabash National. "As a leader in advanced trailer aerodynamic technologies, we want to ensure that the new rule offers multiple options, in an effort to simplify compliance, while maximizing environmental benefits and overall cost savings for the fleets."

"Our hope with the Phase II rule is that we can continue our investment in a natural gas collection fleet that has proven to be good for our customers and communities, good for the environment and good for business," added David Steiner, Waste Management CEO. "We have eliminated the use of 8,000 gallons of diesel fuel per year with each of our more than 4,000 natural gas trucks. Each truck eliminates nearly all particulate emissions, significantly reduces smog-forming NOx emissions and cuts GHG emissions by over 20 percent."

"With or without standards, we strive to be one of the most fuel efficient fleets in the country. Clearly, the Phase II rule is intended to further improve the efficiency of how we move goods across the United States," said Doug Stotlar, President and CEO of Con-way Inc., America's 3rd largest freight transportation company. "The devil is in the details, but we will continue to work with our partners to ensure the final rule is strong but still implementable for our industry."

Stakeholders expect the Phase II rule to be finalized in March 2016. The Leadership Group companies had extensive opportunities for technical input and collaboration with EPA and NHTSA as the draft rule was being developed.

* * *

The **Heavy Duty Fuel Efficiency Leadership Group** is an informal alliance of leading companies involved in trucking, whose goal is to inform and support the development of national fuel efficiency and greenhouse gas emission regulations for heavy duty vehicles.

Its members include:

- **Con-way Inc.** – America's third-largest freight company.
- **Cummins Inc.** – the world's largest independent manufacturer of diesel engines.
- **Eaton** – focused on power management solutions, is a leading supplier of advanced transmissions, engine and powertrain components.
- **FedEx Corporation** – the world's largest express transportation company, operating one of the world's largest truck fleets.
- **PepsiCo** – North America's largest food and beverage business by net revenue.
- **Wabash National Corporation** – North America's largest manufacturer of semi-trailers.
- **Waste Management, Inc.** – operates North America's largest refuse fleet.

To: Charmley, William[charmley.william@epa.gov]; Moulis, Charles[moulis.charles@epa.gov]; Spears, Matthew[spears.matthew@epa.gov]
From: Silverman, Steven
Sent: Tue 7/12/2016 4:08:07 PM
Subject: FW: litigation on gliders

From: Silverman, Steven
Sent: Saturday, July 09, 2016 2:29 PM
To: Spears, Matthew <spears.matthew@epa.gov>; Moulis, Charles <moulis.charles@epa.gov>; Yanca, Catherine <yanca.catherine@epa.gov>
Cc: Orlin, David <Orlin.David@epa.gov>; Charmley, William <charmley.william@epa.gov>
Subject: litigation on gliders

Ex. 5 - Attorney Client; Attorney Work Product; Deliberative Process

Ex. 5 - Attorney Client; Attorney Work Product; Deliberative Process

To: Owens, Nicole[Owens.Nicole@epa.gov]; Corrales, Mark[Corrales.Mark@epa.gov]; Curry, Bridgid[Curry.Bridgid@epa.gov]
From: Nickerson, William
Sent: Tue 11/7/2017 4:21:03 PM
Subject: FW: Update on glider kit NPRM

Latest on this from an interagency call this morning

From: VanLare, Paula
Sent: Tuesday, November 07, 2017 11:18 AM
To: Nickerson, William <Nickerson.William@epa.gov>
Subject: Update on glider kit NPRM

Short version:

Ex. 5 - Attorney Client; Deliberative Process

Ex. 5 - Deliberative Process

Ex. 5 - Attorney Client; Attorney Work Product; Deliberative Process

Ex. 5 - Deliberative Process

I hope this is useful. Let me know if you have any questions.

Paula Van Lare

US EPA Office of Policy

(202) 566-2951

To: Orlin, David[Orlin.David@epa.gov]
From: Sutton, Tia
Sent: Wed 4/27/2016 4:58:01 PM
Subject: RE: legal argument in P01

Ex. 5 - Attorney Client; Deliberative Process

From: Orlin, David
Sent: Wednesday, April 27, 2016 10:20 AM
To: Sutton, Tia <sutton.tia@epa.gov>
Subject: RE: legal argument in P01

thanks

David Orlin

U.S. EPA, Office of General Counsel

(202) 564-1222

From: Sutton, Tia
Sent: Wednesday, April 27, 2016 10:19 AM
To: Orlin, David <Orlin.David@epa.gov>
Subject: RE: legal argument in P01

Ex. 5 - Attorney Client; Deliberative Process

Ex. 5 - Attorney Client; Deliberative Process I'll let you know what I hear back!

From: Orlin, David
Sent: Wednesday, April 27, 2016 10:15 AM
To: Sutton, Tia <sutton.tia@epa.gov>
Subject: FW: legal argument in P01

Tia,

Ex. 5 - Attorney Client; Deliberative Process

David Orlin

U.S. EPA, Office of General Counsel

(202) 564-1222

From: Moulis, Charles
Sent: Wednesday, April 27, 2016 7:08 AM
To: Silverman, Steven <silverman.steven@epa.gov>; Spears, Matthew <spears.matthew@epa.gov>; Yanca, Catherine <yanca.catherine@epa.gov>
Cc: Orlin, David <Orlin.David@epa.gov>
Subject: RE: legal argument in P01

Ex. 5 - Attorney Client; Deliberative Process

From: Silverman, Steven
Sent: Tuesday, April 26, 2016 9:11 PM
To: Moulis, Charles <moulis.charles@epa.gov>; Spears, Matthew <spears.matthew@epa.gov>; Yanca, Catherine <yanca.catherine@epa.gov>

Cc: Orlin, David <Orlin.David@epa.gov>
Subject: legal argument in P01

Ex. 5 - Attorney Client; Deliberative Process

To: Parsons, Christy[Parsons.Christy@epa.gov]
From: Sutton, Tia
Sent: Thur 1/4/2018 4:42:41 PM
Subject: RE: Wehrum Briefing Question

Yep- just send the form to Gwen, you can cc me & Ben if you'd like, but she'll send to us for review anyway before she sends down to OAR for scheduling. (Side note that Gwen's out this week, so you'll get an out-of-office message directing you to Susan White – so you can also cc Susan when you send the form if you'd like. It's of course not necessary to do so, just giving you a heads up.)

Gwen won't know offhand which Wehrum meetings need a Chris prebrief or not, so if you would like one, you'll need to put in a request for that as well. You can send them in the same email if you'd like, but you will need to fill out the 2 separate requests. And a reminder to put everyone you'd like in the briefing(s) on the form (i.e., Bill C, Grundler…don't assume that we/OAR will add folks that should've been included).

Hope that helps!

From: Parsons, Christy
Sent: Thursday, January 04, 2018 11:30 AM
To: Sutton, Tia <sutton.tia@epa.gov>
Subject: RE: Wehrum Briefing Question

Thanks so much for the guidance Tia!

Just to confirm the process, I send the form to Gwen and she handles coordinating with any necessary pre-briefs (Bill C. didn't specify any pre-briefs, so it would only be what's part of the 'normal' process)?

Christy

From: Sutton, Tia
Sent: Thursday, January 04, 2018 9:17 AM
To: Parsons, Christy <Parsons.Christy@epa.gov>
Subject: Re: Wehrum Briefing Question

Hi Christy,

We have not received new forms for BW (or the Administrator, for that matter), so just use the old forms but edit to reflect Bill instead of Sarah. And same process as before, at least for now.

Ironically, I'm always the one around here reminding folks that we have to actually tell people that there's no news to tell, we can't expect them to know...so I think I should take a bit of my own advice. I'll get a note out to all the schedulers and such just to let them know that we don't have new forms (and I'll ask the web folks to edit the description a bit so there's no confusion).

Thanks!

-Tia

Sent from my iPhone

On Jan 4, 2018, at 8:36 AM, Parsons, Christy <Parsons.Christy@epa.gov> wrote:

Hi Tia,

I'm reaching out to see if you can point me in the right direction for requesting briefings with Bill Wehrum? Bill requested that we submit a request for 2 briefings to discuss the glider rule with Bill Wehrum in the coming weeks (briefing outlines are included below for reference). When I looked on the OTAQ@work site the forms are still for Sarah Dunham, so I want to check in with you before filling out the request.

Thanks very much for your help and insight!
Christy

Bill Wehrum Briefings re. Glider Rule:

•□□□□□□□ The first briefing would be to cover for Bill Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

schedule that briefing for as early as next week.

•□□□□□□□ The second briefing will cover Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process We will schedule this briefing for the week of January 15.

Christy Parsons

Physical Scientist

Assessment and Standards Division

Office of Transportation and Air Quality

U.S. Environmental Protection Agency

Ann Arbor, MI

Tel: 734.214.4243

E-mail: parsons.christy@epa.gov

Notice (If This Communication Regards a Contract): Nothing in this message shall be construed as a change to the price, schedule, or terms and conditions of the contract. If the receiver does construe it otherwise, please notify me immediately so that proper contract action can be initiated.