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California Air Resources Board
P.O. Box 2815
Sacramento, CA 95812-2815

Dear Chairperson Nichols and Members of the Board:

Mike Campbell & Associates is actively exercising "green" technologies and practices, and is pleased with many of California's measures to reduce harmful emissions and air pollution from all facets of life. We are already employing alternative fuels (Biodiesel), new transport technologies (electric standby on Transportation Refrigerated Units), and innovative logistics programs (Turnpike GPS systems) to realize better fuel economy and more environmentally-sound practices. Overall, we support the ARB's regulations that should help clean the air quality throughout California.

Still, the ARB's Statewide In-Use Diesel Truck and Bus Rule may not yet be without fault. There are a couple of issues that seem to stand out when reading through the proposed regulation.

The first hitch in the ARB's rule seems to be with the BACT scheduling. After surveying the jumbled compliance dates, it does not seem sensible to require some of the newer model trucks to comply with Particulate Matter (PM) constraints (MY2005-2006) before older trucks (MY2000-2002). The ARB's BACT schedule is not chronological and does not seem to offer the best quality of emissions reductions in the time constraints that it is looking for. The DTCC has penned an alternative schedule which structurally follows the ARB's schedule, but is organized in a more chronological order and accounts for the present unavailability of some reduction technologies (for nitrogen oxides – NOx) thus far. This schedule is clearer, more concise, and still delivers the emissions reduction that the ARB seeks within the time frame that the ARB has dictated.

After spending considerable time attempting to apply the ARB's fleet average model, I have found that the numbers are inaccurate. Using the calculations provided – and attached to this letter – I recognized that trucks that use Tier 3 PM DPFs and proper NOx filters will never meet the highest level of emissions reduction, even though the regulation states that they will. The numbers fall short of the ARB's requirements and could affect entire fleets in the future. These numbers and calculations need to be revised (along with the ARB's online calculators) so that they help retrofitted trucks meet the ARB's standards.

Again, Mike Campbell & Associates is encouraged by the efforts of the ARB and will continue to work with the organization to promote clean air for California. However, we want to be certain that each aspect of this regulation is validated as true and keeps us moving in the right direction: toward a brighter, cleaner future.

Sincerely,

Andy Cox
Environmental Manager

Problems with the ARB's Statewide In-Use Diesel Truck and Bus Rule

⇒ **BACT Compliance Schedule**

- Summary
  - The ARB's Best Available Control Technology strategy seems flawed in its layout, as the ARB schedules many newer trucks to be compliant with "2010 MY NOx Emissions Equivalents" before many of their older counterparts. The schedule lacks chronology and is confusing.
- Solution
  - The DTCC's alternative schedule is a chronologically correct depiction of how a compliance schedule should read. This schedule cleans the oldest, dirtiest trucks first and leaves the newer trucks more time to run before retrofitting or replacing.
  - The majority of the ARB's compliance schedule will remain intact.
  - This solution allows owners more time to seek retrofit devices (especially for NOx) and still helps clean air quality at a progressive rate.
- Comparison (with changes in red)

Compliance Deadline (12/31)	Engine MY	BACT Requirements
2010	Pre-1994	PM BACT
2011	2003-2004	PM BACT
2012	2005-2006 1994-1999	PM BACT NOx & PM BACT
2013	2000-2002	NOx & PM BACT
2014	Pre-1994	NOx & PM BACT
2015	2003-2004	NOx & PM BACT
2016	2005-2006	NOx & PM BACT
2017	NA	NA
2018	NA	NA
2019	NA	NA
2020	2007	NOx & PM BACT
2021	2008	NOx & PM BACT
2022	2009	NOx & PM BACT

ARB Schedule[1]

Compliance Deadline (12/31)	Engine MY	BACT Requirements
2010	Pre-1994	PM BACT
2011	1994-1997	PM BACT
2012	1998-2003	PM BACT
2013	2004-2006	PM BACT
2014	Pre-1994	NOx & PM BACT
2015	1994-1997	NOx & PM BACT
2016	1998-2003	NOx & PM BACT
2017	2004-2006	NOx & PM BACT
2018	NA	NA
2019	NA	NA
2020	2007	NOx & PM BACT
2021	2008	NOx & PM BACT
2022	2009	NOx & PM BACT

DTCC Schedule[2]

[1] From the ARB's website (p. 12): http://www.arb.ca.gov/msprog/onrdiesel/documents/July_21_Truck_and_Bus_Proposed_Reg_with_2nd_Errata.pdf

[2] From the ARB's website (p. N-6): http://www.arb.ca.gov/regact/2008/truckbus08/appn.pdf

⇒ **Fleet Average Model**

- Summary
  - The ARB announced this compliance option to the BACT schedule so that large fleets may meet engine compliance in a manner that is more controlled by the fleet owner.
- Problem
  - The ARB's Emissions Factor numbers make it impossible for properly retrofitted vehicles to ever meet Fleet Targets.
    - PM Emissions:
      - All PM retrofits (85%) to Engine Model Years prior to MY2007 will only reach a minimum ***0.122*** PM Index (***.110*** is required)
      - All NOx retrofits (85%) to Engine Model Years prior to MY2007 will only reach a minimum ***1.8*** NOx Index (***1.6*** is required)
      - All NOx retrofits (70%) to Engine Model Years prior to MY2010 will only reach a minimum ***2.1*** NOx Index (***1.6*** is required)
    - Possible Solutions
      - Require further NOx reductions in vehicles to meet the ARB's Fleet Targets
        - May be tricky, as the 70% NOx reduction device has still yet to be invented, much less a 90% NOx reduction device.
        - ARB would risk any support by trucking industry by requiring more stringent emissions reductions than before.
      - Change the Fleet Targets to larger number, as they will be easier to reach with this formula
        - Environmentalists will panic and the ARB probably won't back down from these target numbers.
      - Modify the ARB Emission Factor numbers
        - By changing Engine Emission Factor numbers on the Truck and Bus Rule, Appendix A, Table A-2[3], the NOx Targets can be met.
      - Leave it as is and run into complications from the ARB's own rule, whose language and numbers contradict themselves.
        - And reap the wrath of the large fleets and the trucking industry

[3] See the ARB Truck & Bus Rule, Title 13, CCR, Section 2025, Appendix A: http://www.arb.ca.gov/msprog/onrdiesel/documents/July_17_Truck_and_Bus_Proposed_Reg.pdf

- Evidence of Fleet Average Model Problems

ARB Definitions[4]

(1) "2010 Model Year NOx Emissions Equivalent":
  (A) Emissions from an engine certified to the 2004 model year heavy-duty diesel engine emissions standard that is equipped with a verified diesel emission control strategy (VDECS) that reduces NOx exhaust emissions by more than 85 percent; or
  (B) Emissions from an engine certified to the 2007 model year heavy-duty diesel engine emissions standard that is equipped with a VDECS that reduces NOx exhaust emissions by more than 70 percent.

(2) "2007 Model Year NOx Emissions Equivalent":
  (A) Emissions from an engine certified to the 2003 or prior model year heavy-duty diesel engine emissions standard that is equipped with a VDECS that reduces NOx exhaust emissions by at least 70 percent; or
  (B) Emissions from an engine certified to the 2004 through 2006 model year heavy-duty diesel engine emissions standard that is equipped with a VDECS that reduces NOx exhaust emissions by at least 40 percent; or
  (C) Emissions from a 2004 model year NOx emissions equivalent heavy-duty diesel engine, as defined in section 2025(d)(3)(A), that is equipped with a VDECS that reduces NOx exhaust emissions by at least 70 percent.

(3) "2007 Model Year NOx Emissions Equivalent":
  (A) Emissions from an engine certified to the 2003 or prior model year heavy-duty diesel engine that was built to 2004 engine emission standards and was not used in any manufacturer's averaging, banking and trading program;
  (B) Emissions from a pre-2004 model year heavy-duty diesel engine that is equipped with a VDECS that reduces NOx exhaust emissions by at least 55 percent.

(34) "Highest Level VDECS" means the highest level VDECS verified by ARB under its Verification Procedure, Warranty and In-Use Compliance Requirements for In-Use Strategies to Control Emissions from Diesel Engines (Verification Procedure), title 13, CCR, sections 2700-2710, for a specific engine as of 10 months prior to the compliance date, which the diesel emission-control strategy manufacturer and authorized diesel emission-control strategy dealer agree can be used on a specific engine and vehicle combination without jeopardizing the original engine warranty in effect at the time of application.
  (A) The highest level VDECS is determined solely on verified diesel PM reductions.

(57) "PM BACT" means:
  (A) An engine equipped with the highest level VDECS for PM or an engine originally equipped with a particulate filter.

(71) "Verified Diesel Emissions Control Strategy" (VDECS) means an emissions control strategy, designed primarily for the reduction of diesel PM reductions, which has been verified pursuant to the Verification Procedures. VDECS can be verified to achieve level 1 diesel reductions (25%), level 2 diesel reductions (50%), or level 3 diesel PM reductions (85%). VDECS may also be verified to achieve NOx reductions. See also definition of Highest Level VDECS.

[4] See the ARB's proposed Title 13, CCR, Section 2025(d)

Definition of Fleet Averaging Option[5]

(2) NOx Fleet Average

(A) A fleet owner must demonstrate that on January 1 of each compliance year, starting in 2013 and ending on January 1, 2023, the calculated NOx Index of the applicable portion of the fleet was less than or equal to the calculated NOx Target Rate.

(B) NOx Index: The following equation is used to calculate the NOx Index.

$$\text{NOx Index} = \frac{\text{Sum of EF (HHD)} + \text{Sum of EF (MHD)}}{\text{Total number of vehicles subject to the NOx requirements}}$$

EF = NOx emission factor as specified in Appendix (B) for heavy-duty vehicles subject to the NOx requirements, or adjusted as applicable according to paragraphs (1) below.

(1) For engines that have been retrofit with VDECS, the NOx emission factor is reduced by the percentage NOx emissions reductions that are verified.

(C) NOx Target Rate: The following equation is used to calculate the NOx Target Rate.

$$\text{NOx Target Rate} = \frac{\text{Sum of Target (HHD)} + \text{Sum of Target (MHD)}}{\text{Total number of vehicles subject to the NOx requirements}}$$

Target = NOx target from Table 3 (Appendix A) for each HHD (Heavy heavy-duty) and MHD (Medium heavy-duty) vehicle subject to the NOx requirements.

(3) PM Fleet Average

(A) A fleet owner must demonstrate that on January 1 of each compliance year, starting in 2011 and ending on January 1, 2023, the calculated PM Index of the applicable portion of the fleet was less than or equal to the calculated PM Target Rate.

(B) PM Index: The following equation is used to calculate the PM Index.

$$\text{PM Index} = \frac{\text{Sum of PMEF (HHD)} + \text{Sum of PMEF (MHD)}}{\text{Total number of vehicles subject to the PM fleet averaging requirements}}$$

EF = NOx emission factor as specified in Appendix (B) for heavy-duty vehicles subject to the NOx requirements, or adjusted as applicable according to paragraphs (1) below.

(1) For engines that have been retrofit with VDECS, the NOx emission factor is reduced by the percentage NOx emissions reductions that are verified.

(C) PM Target Rate: The following equation is used to calculate the NOx Target Rate.

$$\text{PMTarget Rate} = \frac{\text{Sum of PMTarget (HHD)} + \text{Sum of PMTarget (MHD)}}{\text{Total number of vehicles subject to the PM fleet averaging requirements}}$$

PMTarget = PM target from Table 4 (Appendix A) for each HHD and MHD vehicle subject to the PM requirements.

[5] See the ARB's proposed Title 13, CCR, Section 2025(h)

- Testing Fleet Average Calculations Using the ARB's Formulas

When using the above definitions to meet the ARB's Fleet Average Option, one can see that the calculations eliminate the ability of any MY2006 or older engine to meet the ARB's standards. This is proved in the calculations below:

Vehicles to be Examined

Engine Model Year	PM Emissions Factors (g/mile)		NOx Emissions Factors (g/mile)	
	MHD vehicle	HHD vehicle	MHD vehicle	HHD vehicle
2006	0.43	0.81	6.7	12.0
2009	0.06	0.11	4.0	7.0

1) NOx Fleet Average for five (5) MY2009 HHD engines with 70% NOx reduction

$$\text{NOx Index} = \frac{(5 \text{ (vehicles)} \times 7.0 \ (EF_{HHD})) + (0 \text{ (vehicles)} \times 0 \ (EF_{MHD}))}{5 \text{ (number of vehicles)}} \times 30\% \text{ (after NOx reduction)}$$

$$\text{NOx Index} = \frac{35}{5} \times .30 = 7 \times .30 = \mathbf{2.1 \text{ g/mile NOx}}$$

When this is measured up to the Fleet NOx Targets (Appendix A), it only reaches compliance with 2022 standards, not the final 2023 standards (***1.6 g/mile***). However the above *2010 MY NOx Emissions Equivalent* defines "Emissions from an engine certified to the 2007 model year that is equipped with a VDECS that reduces NOx exhaust emissions by more than 70 percent" as the equivalent to a MY2010 engine, which is compliant through 2023.

The ARB's numbers and words do not reflect each other here, as the equation shows.

2) PM Fleet Average for five (5) MY2006 HHD engines with 85% PM reduction

$$\text{PM Index} = \frac{(5 \text{ (vehicles)} \times 0.81 \ (EF_{HHD})) + (0 \text{ (vehicles)} \times 0 \ (EF_{MHD}))}{5 \text{ (number of vehicles)}} \times 15\% \text{ (after PM reduction)}$$

$$\text{PM Index} = \frac{4.05}{5} \times .15 = 0.81 \times .15 = \mathbf{0.1215 \text{ g/mile PM}}$$

When this number is measured up to the Fleet PM Targets (Appendix A), it only reaches compliance with 2013 standards, not the final 2023 standards (***0.110 g/mile***). However the above *PM BACT* is defined as "an engine equipped with the highest level VDECS for PM," which, in fact, this test engine is employing and which should make the engine compliant through 2023.

Again, the ARB's numbers and words do not reflect each other here, as the equation shows.

Online Fleet Calculators

- Summary
  - The ARB has made some easy-to-use fleet input calculators that return solutions for meeting compliance to the BACT schedule, Fleet Averaging, and Fleet Percentages. While they seem to work well, the numbers tell completely different stories.
- Issues
  - The Engine Emission Factors for the Fleet Calculators[6] extend past the 2010MY Engine Emissions Equivalents that are stated in the Truck and Bus Rule
    - There should be no NOx Emissions Factors for any Model Year engine after MY2010
    - The NOx Emissions Factors for MY2010 should be at the minimum (1.6 g/mile), as defined by the ARB (Title 13, CCR, Section 2025[d][1])
  - The Fleet Calculators will sometimes show Fleet Percentage compliancy as 100%, even though the Fleet Average numbers do not meet the PM and NOx Emissions Factors defined by the ARB
    - The issues with the fleet average model, addressed above relate to this
    - The numbers, while not meeting the targets set forth by the ARB, are still shown as meeting the requirements on the calculator sheet
- Solutions
  - Fleet Calculator Emission Factor Numbers
    - Eliminate the Calculator Emission Factors for 2011, 2012
    - Change the emissions factor for 2010 to 1.6 g/mile
  - Percentage v. Averaging
    - Do not allow the Fleet Percentage to show 100% unless the total Fleet Average is reached 100%
    - Alter the Fleet Averaging equations (previous issue) to reflect the Fleet Targets

      - or -
    - Alter the Fleet Averaging equations, above, to reflect the Fleet Targets that the ARB is seeking to meet

[6] See worksheet "Data" from the "Updated Fleet Average Calculator (05/13/08)": http://www.arb.ca.gov/msprog/onrdiesel/calculators.htm

Appendix A

Table 3: Fleet NOx Targets (g/mile)

Compliance Deadline (January 1)	Fleet NOx Targets for each compliance deadline	
	MHD	HHD
2011	NA	NA
2012	NA	NA
2013	8.5	14.4
2014	5.8	9.8
2015	5.8	9.8
2016	4.6	7.8
2017	4.0	6.0
2018	4.0	6.0
2019	4.0	6.0
2020	3.2	4.4
2021	3.2	4.4
2022	1.6	3.0
2023	0.8	1.6

Table 4: Fleet PM Targets (g/mile)

Compliance Deadline (January 1)	Fleet PM Targets for each compliance deadline	
	MHD	HHD
2011	0.38	0.710
2012	0.29	0.530
2013	0.17	0.320
2014	0.06	0.110
2015	0.06	0.110
2016	0.06	0.110
2017	0.06	0.110
2018	0.06	0.110
2019	0.06	0.110
2020	0.06	0.110
2021	0.06	0.110
2022	0.06	0.110
2023	0.06	0.110

Appendix B

ARB's Emission Factor Numbers

(from ARB's proposed Title 13, CCR, Section 2025, Appendix A)

PM Emissions Factors (g/mile)*	
Engine Certification Standard Model Year	Heavy Heavy-Duty Vehicle
Pre-1991	3.36
1991-1993	1.25
1994-2006	.810
2007 & newer	.110 *

* Figure represents the maximum reduced PM Emissions Factor that must be met by all heavy-duty trucks

NOx Emission Factors (g/mile)*	
Engine Certification Standard Model Year	Heavy Heavy-Duty Vehicle
2003 & older	22.0
2004-2006	12.0
2007-2009	7.0
2010 & newer	1.6 **

** Figure represents the maximum reduced NOx Emissions Factor that must be met by all heavy-duty trucks