Clerks' Office
California Air Resources Board
1001 I Street
Sacramento, California 95814

May 31, 2022

Re: Comments in Response to the Proposed Advanced Clean Cars II (ACC II) Regulations

Dear Sir or Madam,

Cummins Inc. appreciates the opportunity to provide comments regarding the California Air Resources Board's (CARB's) proposed Advanced Clean Cars II (ACC II) regulations. As a U.S.-headquartered company, over 100 years old, and a global power leader, Cummins is committed to helping our customers reach net-zero greenhouse gas emissions and to further reduce nitrogen oxides (NOx) to improve air quality. Our vision for a zero-emissions future includes electric vehicles, both battery-powered and fuel cell electric, as well as internal combustion engines running on net-zero carbon fuels.

Cummins understands the unique air quality issues California faces and shares CARB's goal to improve real-world NOx emissions from the medium-duty vehicles (MDV) which are part of the ACC II rulemaking. However, we have significant concerns with CARB's proposal to bring in-use testing requirements and standards that CARB developed for the Heavy-Duty (HD) Omnibus Low NOx rule for HD engine certification and compliance and apply them directly to chassis-certified MDV. Those concerns are outlined below.

CARB's proposed in-use NOx standards based on the HD Omnibus standard of 0.020 g/hp-hr are not feasible for diesel MDV

CARB's ACC II proposal includes amendments that apply to chassis-certified MDV as part of the new Low-Emission Vehicle (LEV) IV requirements. Those Class 2b and 3 vehicles (i.e., vehicles

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with 8,500-14,000 lbs Gross Vehicle Weight Rating (GVWR)), are manufactured as complete vans and pickup trucks. MDV pickup trucks can have significant towing capability and are often used in applications going beyond personal use such as construction and agriculture, and as such, do vital work in California. Towing capacity is defined by the vehicle's Gross Combined Weight Rating (GCWR), or the maximum allowable combined weight of the fully loaded vehicle and the maximum trailer weight that can be towed.

Similar to CARB's LEV III certification standards for light- and medium-duty vehicles, CARB's proposed more stringent LEV IV certification standards are based on chassis-dynamometer testing. However, for MDV with GCWR >14,000 lbs, CARB proposes to also add new Three-Bin Moving Average Window (3B-MAW) in-use testing requirements with emission limits based on the HD Omnibus engine-dynamometer certification standards for model year (MY) 2027 and later HD engines which include a 0.020 grams per brake horsepower-hour (g/hp-hr) NOx standard. Cummins did not support the 0.020 g/hp-hr NOx standard as feasible during the HD Omnibus rulemaking, did not support it when proposed recently by the U.S. Environmental Protection Agency (EPA) as part of their Option 1 standards for HD engines, and does not support its application here in the ACC II rule. The proposed mismatch of applying engine-certification based in-use limits to chassis-certified MDV is not workable for several reasons.

First, translating the proposed LEV IV distance-based, grams per mile (g/mi) NMOG + NOx certification bin standards to brake specific, g/hp-hr standards using reasonable assumptions for FTP 75 certification cycle work and vehicle test weight, and then comparing to the proposed engine-based in-use NOx limits in units of g/hp-hr, shows a significant misalignment in stringency. The HD engine-based in-use NOx limit of 0.020 g/hp-hr, even with an in-use conformity factor (CF) or multiplier applied, is much more stringent than even the lowest proposed bins available for MDV certification.

Additionally, even though CARB's HD engine-based in-use NOx limit adjusts proportionally for HD engines certifying at a Family Emission Limit different from the standard (i.e., credit-using or credit-generating engines), CARB has proposed only a single set of 3B-MAW in-use NOx standards for MDV regardless of the NMOG + NOx bin level to which they are certified, effectively eliminating any fleet averaging flexibility. CARB should address these mismatches through MDV in-use limits which are better aligned with the stringency of the proposed MDV certification standards and which adjust according to the certification bin level.

CARB has based justification of their proposed in-use NOx limits on data collected using Portable Emissions Measurement Systems (PEMS) on medium-duty vehicles driving several routes in Southern California and on their technology demonstration for the HD Omnibus rulemaking. However, none of the PEMS NOx results collected for medium-duty vehicles towing at 70%-80% GCWR (similar to the minimum loading required for inclusion in the new in-use testing procedure) on the Oxnard towing route meet the proposed MY 2027 limits for the low-load and medium/high load bins of the 3B-MAW test, not even the re-calibrated Cummins engine which showed emissions improvements on other drive cycles. (See Figures 31 and 32 of Appendix H, "ACC II LEV Technology Appendix", of CARB's rulemaking documents.) CARB suggests that hardware changes such as those included in the diesel technology package developed by Southwest Research Institute (SwRI) for CARB's HD Omnibus rulemaking will enable MDV to meet the engine-based 3B-MAW in-use NOx limits. Cummins does not agree the single system tested at SwRI demonstrated capability of the technology package for HD engines to robustly meet a 0.020 g/hp-hr NOx standard given the variability and useful life requirements a manufacturer must address to ensure compliance. In addition, that technology package was evaluated using very different certification requirements on a much larger displacement engine intended for a Class 8 vehicle application, all of which are inconsistent with MDV certification and applications.

The HD Omnibus technology package included dual selective catalytic reduction (SCR) systems and cylinder deactivation on a 15-liter diesel engine. The upstream SCR light-off catalyst was added to address cold start and light load NOx emissions. However, the weighting of HD FTP cold start emissions (1/7 or ~14% of the cold/hot composite) for HD engine certification is much lower than the 43% cold weighting of the FTP 75 used for MDV certification. MDV manufacturers will need to design for even faster SCR warm-up not considered as part of the HD Omnibus demonstration. The downstream SCR system in the Omnibus package was intended to address NOx emissions during higher load operation and would be located farther away from the engine. It was sized for the emission flow rates of a 15-liter engine, without consideration of the sizing and packaging constraints associated with a MDV pickup truck. The design tradeoffs and optimization of the overall aftertreatment system are much different for MDV, where manufacturers will need to balance meeting emissions requirements on the FTP 75 chassis-certification cycle and the >70% GCWR in-use towing conditions. Cummins does not agree that CARB has demonstrated feasibility of meeting the HD Omnibus 3B-MAW in-use standards for MDV.

The infeasibility of the 0.020 g/hp-hr in-use NOx standard for diesel MDV will impact California customers who depend on those new vehicles for critical work. Based on registration data, many of the largest fleet users of Class 2b and 3 diesel pickup trucks currently in operation in California are owned by city, county, or state governments, utilities, or other infrastructure-related entities. There are many more small businesses or individuals who own only one vehicle also doing important work. As noted above, Cummins urges CARB to reconsider the stringency of the MDV in-use standards and better align them with the stringency of the proposed MDV certification standards to ensure the requirements will be achievable with technologies that customers can readily adopt.

Use of a CO_2 FCL derived from FTP 75 or HD FTP cycles as a surrogate for work is a source of error for in-use emissions calculations

In the HD Omnibus regulation, the 3B-MAW approach uses the engine's HD FTP CO_2 Family Certification Level (FCL) with units of g/hp-hr as a surrogate for work in calculations to determine both placement of each window into one of the three bins and the brake specific emissions for a bin. However, using the HD FTP CO_2 FCL is not always representative of engine thermal efficiency on other duty cycles such as those encountered during in-use testing. Additionally, CO_2 does not always correlate well to power produced, such as when excess fuel is burned for thermal management. Using the FTP CO_2 FCL will result in higher emissions calculated for more efficient in-use duty cycles, which penalizes manufacturers with more efficient engines.

MDV do not have a CO_2 FCL since their CO_2 emissions are measured in g/mi on a chassis dynamometer for certification, so CARB proposes for manufacturers to determine one using CO_2 emissions and broadcast torque data during the chassis FTP 75 cycle. (CARB also proposes an option for manufacturers to determine the FCL using engine test procedures and the HD FTP cycle, which means running additional testing in an engine dynamometer test cell.) The penalty to manufacturers for using a CO_2 FCL derived from the FTP 75 is even greater than what is described above due to the higher cold start weighting of the FTP 75 compared to the HD FTP. During the cold cycles of the FTP 75, fuel must be burned for thermal management of the aftertreatment, which increases CO_2 emitted over the cycles. Multiplying this FCL by the pollutant emissions rates measured over in-use cycles (which are likely to have more efficient operation because of the high exhaust temperatures during towing) per CARB's proposed in-use test procedures over-estimates the brake specific in-use emissions.

CARB's proposal already makes use of broadcast torque by including it in the method for calculating the FTP 75 CO_2 FCL. To address the inaccuracies of using FCL, Cummins recommends using broadcast torque to determine work for bin placement and emissions calculations, instead of normalizing by CO_2 and scaling by FCL, and is willing to work with CARB to determine the appropriate validation of this method.

PEMS measurement accuracy has not been accounted for appropriately in the stringency of the in-use standards

The current in-use testing program for HD engines provides measurement allowances for all pollutants, including NOx, based on extensive test programs to quantify the accuracy of the measurement systems. CARB did not conduct any such studies for the new 3B-MAW in-use testing program in the HD Omnibus regulation and removed the existing additive measurement allowances in lieu of providing a conformity factor that is meant to cover not just measurement inaccuracies but also variability due to drivers, random duty cycles, ambient conditions, etc. That approach is carried over into CARB's proposed MDV in-use testing program. PEMS measurement accuracy is not yet quantified at NOx levels targeted by the HD Omnibus or LEV IV rules. However, there is a test program underway by EPA, industry, and other stakeholders at SwRI to assess PEMS measurement accuracy at low NOx levels. CARB should account for the outcomes of that test program by including separate PEMS measurement allowances in the final rule.

Flexibility will be needed to address difficulties in finding customer vehicles to fulfill the towing requirements

CARB's proposed MDV in-use testing procedure requires at least 50% of non-idle operation during the manufacturer's test to include towing with a combined vehicle weight at a minimum of 70% GCWR. The minimum towing requirement could limit the available customer vehicles from which a manufacturer can select vehicles to fulfill the testing requirement of 5-10 vehicles per test group. For example, depending on trailer weight needed to meet the 70% minimum GCWR, a fifth-wheel hitch would be required. It may be difficult to find customers who have such equipment already installed on their vehicle and who are willing to allow the manufacturer to use their vehicle. Subsection 4.6.5 of the in-use test procedures gives CARB the authority to make changes to the testing requirements if a manufacturer has made a good faith effort to comply. Such flexibility is

appreciated and likely needed.

Cummins is committed to working with CARB to address MDV in-use testing issues

Cummins is committed to continuing to work with CARB and other stakeholders on 15-day changes to ensure MDV in-use testing requirements are finalized in such a way to achieve the shared goal of real-world emission reductions. For questions, please contact me: jackie.m.yeager@cummins.com.

Sincerely,

Jackie M. Yeager

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