

State of California  
AIR RESOURCES BOARD

**Final Statement of Reasons for Rulemaking,  
Including Summary of Comments and Agency Response**

PUBLIC HEARING TO CONSIDER PROPOSED REVISIONS TO ON-BOARD DIAGNOSTIC SYSTEM REQUIREMENTS, INCLUDING THE INTRODUCTION OF REAL EMISSIONS ASSESSMENT LOGGING (REAL), FOR HEAVY-DUTY ENGINES, PASSENGER CARS, LIGHT-DUTY TRUCKS, AND MEDIUM-DUTY VEHICLES AND ENGINES

Public Hearing Date: November 15, 2018  
Agenda Item No.: 18-9-4

**I. GENERAL**

In this rulemaking action, the California Air Resources Board (CARB or Board) adopted amendments that revised the on-board diagnostic (OBD) system requirements and associated enforcement provisions for heavy-duty engines, passenger cars, light-duty trucks, and medium-duty vehicles and engines to clarify regulation language, relax some requirements, and add new requirements that would assist and help improve the implementation of the OBD program and other CARB programs. The amendments to the heavy-duty OBD (HD OBD) regulation and the associated enforcement regulation are codified in sections 1971.1 and 1971.5, and the amendments to the on-board diagnostic II (OBD II) regulation are codified in section 1968.2 of title 13, California Code of Regulations (CCR).

The Staff Report: Initial Statement of Reasons for Rulemaking (staff report), entitled “Public Hearing to Consider Proposed Revisions to On-Board Diagnostic System Requirements, Including the Introduction of Real Emissions Assessment Logging (REAL), for Heavy-Duty Engines, Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines,” released September 25, 2018, is incorporated by reference herein. The staff report, which is incorporated by reference herein, contained a description of the rationale for the proposed amendments. On September 25, 2018, all references relied upon and identified in the staff report were made available to the public.

On November 15, 2018, the Board conducted a public hearing to consider staff’s proposed amendments. At the conclusion of the hearing, the Board approved Resolution 18-53 approving for adoption the proposed amendments to sections 1971.1, 1971.5, and 1968.2 that were initially proposed by staff and described in the Notice of Public Hearing (45-day notice) and staff report, along with modifications suggested by staff in Attachment D presented at the hearing. The modifications in Attachment D were made in response to comments received after the staff report was published on September 25, 2018, as part of the 45-day notice. The resolution directed the Executive Officer to make the modified regulatory language in Attachment D, and any additional conforming modifications, available for public comment, with any additional supporting documents and information, for a period of at least 15-days and consider written comments submitted during the public comment period, and to make any modifications as may be appropriate in light of the

comments received. The Executive Officer was directed to then either adopt the final regulatory amendments or to present the amendments to the Board for further consideration if warranted in light of the comments.

After the November 15, 2018, public hearing, staff proposed modifications to the originally proposed amendments to title 13, CCR sections 1971.1, 1971.5, and 1968.2. The text of the proposed modifications to the originally proposed amendments and additional supporting documents were made available for two supplemental 15-day comment periods through a “Notice of Public Availability of Modified Text and Availability of Additional Documents” (first 15-day notice) and “Second Notice of Public Availability of Modified Text and Availability of Additional Documents” (second 15-day notice). The 15-day notices and the attachments were distributed on June 4, 2019, and July 19, 2019, respectively, to all stakeholders, interested parties, and to other persons generally interested in CARB’s rulemaking requirements applicable to OBD systems. Both 15-day notices listed the CARB website where interested parties could obtain the complete text of the regulations that would be affected by the modifications, with all of the modifications clearly indicated and the additional supporting documents. These documents were also published on CARB’s webpage established for this rulemaking. The 15-day notices are incorporated by reference.

The resolution also directed the Executive Officer to finalize the Final Statement of Reasons (FSOR) for the regulatory amendments and to submit the final rulemaking package to the Office of Administrative Law for review. The FSOR updates the staff report by identifying and providing the rationale for the modifications made to the originally proposed regulatory text, including non-substantial modifications and clarifications made after the close of the 15-day comment periods. This FSOR also contains a summary of the comments received by CARB on the proposed amendments during the 45-day and 15-day comment periods and oral comments given at the Board hearing on November 15, 2018, and contains the modifications and CARB’s responses to those comments.

#### **A. MANDATES AND FISCAL IMPACTS TO LOCAL GOVERNMENTS AND SCHOOL DISTRICTS**

The proposed amendments will not have any fiscal impacts on local agencies on the current year and the 2020/2021 fiscal year because the earliest implementation date for the proposal is the 2022 model year. Beginning with the 2021/2022 fiscal year, however, local government agencies will pay a higher purchase price for new heavy-duty, medium-duty, and light-duty vehicles with engines covered by the proposed amendments, if manufacturers pass on costs. CARB’s EMFAC model indicates local government heavy-duty and medium-duty vehicles represent about 8.1 percent of the total State vehicle total. According to annual sales numbers provided by engine manufacturers to CARB, approximately 34,735 heavy- and medium-duty vehicles are sold annually in California. Assuming that local government fleets also purchase 8.1 percent of all new heavy-duty and medium-duty vehicles sold in California, a total of 2,814 of these vehicles are purchased annually (8.1% \* 34,735 annual California vehicles sales) by local government fleets. This indicates that approximately 16,884 vehicles (2,814 \* 6) would be impacted over the six-year life of

the proposal and the regulatory cost to local government fleets is estimated to be approximately \$99,800 per year (i.e., \$35.45 \* 2,814) on average in the 2021/2022 fiscal year and thereafter. In addition, local agencies purchased 5,681 light-duty vehicles on average for the past five years, according to interagency analysis of new vehicle registration records. Since the proposed amendments would increase the price of a new light-duty vehicle by \$0.34, local agencies will incur additional annual cost of roughly \$2,000 (i.e., \$0.34 \* 5,681). Therefore, the total annual costs to local agencies will amount to \$101,800 (i.e., \$99,800 + \$2,000) beginning with the 2021/2022 fiscal year and thereafter; and the total lifetime costs to local agencies will amount to \$610,800 (i.e., \$101,800 in annual costs x 6 years).

The Board finds that any cost to local government is not reimbursable by the State, pursuant to Part 7 (commencing with section 17500), Division 4, Title 2 of the Government Code because the additional costs associated with the proposed amendments apply generally to all entities that purchase affected engines and vehicles, private fleets and owners as well as State and local agencies. The proposed amendments do not mandate a new program or higher level of service on any local government.

## **B. CONSIDERATION OF ALTERNATIVES**

For the reasons set forth in the Staff Report, in staff's comments and responses at the hearing, and in this FSOR, the Board determined that no alternative considered by the agency would be more effective in carrying out the purpose for which the regulatory action was proposed, or would be as effective and less burdensome to affected private persons, or would be more cost-effective to affected private persons and equally effective in implementing the statutory policy or other provisions of law than the action taken by the Board.

## **II. MODIFICATIONS MADE TO THE ORIGINAL PROPOSAL**

### **A. MODIFICATIONS APPROVED AT THE BOARD HEARING AND PROVIDED FOR IN THE 15-DAY COMMENT PERIOD**

Various modifications to the original proposal were made in order to address comments received during the 45-day public comment period, and to clarify the regulatory language. These modifications include changes to delay the start dates for the more stringent amendments from the 2022 model year to the 2024 model year, revisions to the implementation of the REAL requirements, and the changes to the applicability dates and fine amounts for the deficiency provisions. Pursuant to the Board direction provided in Resolution 18-53, CARB released the first 15-day notice on June 4, 2019, which placed documents into the regulatory record and presented the additional modifications to the regulatory text.<sup>1</sup> Subsequently, staff made further modifications to indicate that several CFR documents were "incorporated by reference" in the regulations. CARB released the second 15-day notice on July 19, 2019, which placed additional documents into the regulatory record and presented these additional

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<sup>1</sup> California Air Resources Board. Notice of Public Availability of Modified Text and Availability of Additional Documents. Posted June 4, 2019. Available online at: <https://ww2.arb.ca.gov/rulemaking/2018/heavy-duty-board-diagnostic-system-requirements-2018>

modifications to the regulatory text.<sup>2</sup> Both 15-day notices described each substantive modification to the original proposal and the rationale for the modifications.

## **B. NON-SUBSTANTIAL MODIFICATIONS**

Subsequent to the 15-day public comment periods mentioned above, staff identified the following additional non-substantive changes to the regulation:

Section 1971.1(c) “MIL-on fault code”: Removed unnecessary underline text at end of definition. “[S]ections (d)(2), (e) (g), and (h)(4.4)” was already in the CCR.

Section 1971.1(d)(3.1.4)(C)(ii): Removed this subsection. CARB has decided not to proceed with this amendment.

Section 1971.1(e)(4.4.2): Added a missing closing parenthesis at the end of the phrase “(i.e., over and under boost.”

Section 1971.1(k)(3.2.1): Corrected the spelling of “carrover” to “carryover” in Table 1.

Section 1971.1(l)(1.3.1) and (1.3.2): Updated the title of the incorporated Society of Automotive Engineers International (SAE) document to accurately reflect the document that was added to the record during the second 15-day. The updated/correct title of the document is SAE J2534-1.

Sections 1971.5(a)(3) “OBD Emission Testing”: Underlined “d” in measuredd at end of definition to improve grammar.

Sections 1971.5(b)(6)(B)(iii): Added a space after 0.177 to improve grammar.

Sections 1971.5(d)(6)(B)(iv) and 1971.5(e)(6)(B): Changed the CARB division name “Emissions Compliance, Automotive Regulations and Science Division” to the newly revised name “Emissions Certification and Compliance Division.”

Section 1968.2(g)(4.2.2)(B)(iv): Corrected the phrase “medium-duty vehicles equipped with diesel vehicles” to “medium-duty vehicles equipped with diesel engines.”

Section 1968.2(d)(6.2.7): Changed “and” to “or” to clarify that an alternate plan may be submitted in lieu of the respective procedures stated in CFR title 40, part 86.004-28(i) “or” 1065.680.

Section 1968.2(f)(1.2.3)(B)(i): Removed strikethrough from a previously stricken closing parenthesis to improve grammar in the phrase “(or NMOG+NO<sub>x</sub>, if applicable)...”

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<sup>2</sup> California Air Resources Board. Second Notice of Public Availability of Modified Text and Availability of Additional Documents. Posted July 19, 2019. Available online at: <https://ww2.arb.ca.gov/rulemaking/2018/heavy-duty-board-diagnostic-system-requirements-2018>

Section 1968.2(g)(4.10.4)(B): Struck out two periods that had not been struck previously to improve grammar and clarity in formatting.

Section 1968.2(g)(6.12.4): Removed a repetitive sentence. The sentence “Manufacturers shall not include a humidity correction factor when calculating NOx mass” was erroneously in the text twice in a row.

Section 1968.2(g)(6.13) and (6.13.3): In order to clarify the parameters of (g)(6.13.1) and (6.13.2) the language from (g)(6.13.3) was incorporated into (g)(6.13). Thusly, (g)(6.13.3) has been deleted since the entirety of its language was moved (6.13).

Sections 1968.2(d)(6.2), 1968.2 (6.4), 1968.2 (i)(2.32), 1971.1(c), 1971.1(d)(6.2), 1971.1(i)(3.3.3), 1971.1(j)(2.6.2), and 1971.1(j)(2.26): Added commas after year for dates of sections of the Code of Federal Regulations incorporated by reference in order to make formatting consistent with other dates of previously incorporated documents.

Section 1968.2: Inserted the Authority and Reference note for the final text to the end of this section per title 1, CCR section 8(a)(1). No changes were made to the Authority and Reference of this section from the existing version in the CCR. The Authority and Reference listed here is also in accordance with what was noticed during the 45-day Notice.

The above described modifications constitute non-substantial changes to the regulatory text because they more accurately reflect the numbering of a section and correct spelling and grammatical errors, but do not materially alter the requirements or conditions of the proposed rulemaking action.

### **III. DOCUMENTS INCORPORATED BY REFERENCE**

The regulations adopted by the Executive Officer incorporate by reference the following documents:

1. EMFAC2014; section 1971.5(b)(3)(A)(iv)
2. 40 Code of Federal Regulations (CFR) 86.004-28(i), August 21, 2018; section 1971.1(d)(6)
3. 40 CFR 1065.680, August 21, 2018; section 1971.1(d)(6)
4. 40 CFR 86.004-28(i), as it existed on January 25, 2018; section 1968.2(d)(6.2)
5. 40 CFR 1065.680, as it existed on January 25, 2018; section 1968.2(d)(6.2)
6. 40 CFR 86.082-2, as it existed on January 25, 2018; section 1971.1(c)
7. 40 CFR 86.094-2, as it existed on January 25, 2018; section 1971.1(c)

8. 40 CFR 86.096-24, as it existed on January 25, 2018; section 1971.1(c)
9. 40 CFR 86, Appendix I, section (f)(1), as it existed on January 25, 2018; section 1971.1(c)
10. 40 CFR 86, Appendix I, section (f)(2), as it existed on January 25, 2018; section 1971.1(c)
11. 40 CFR 86.1370, as it existed on January 25, 2018; section 1971.1(c)
12. 40 CFR 86.1370(b)(7), as it existed on January 25, 2018; section 1971.1(c)
13. 40 CFR 86.007-11(a)(4)(iv), as it existed on January 25, 2018; section 1971.1(c)
14. 40 CFR 86.1360, as it existed on January 25, 2018; section 1971.1(c)
15. 40 CFR 86, Appendix I, section (d), as it existed on July 1, 2012; sections 1971.1(j)(2.6.2) and 1968.2(i)(2.32)
16. International Organization for Standardization (ISO) 2575 “Road vehicles – Symbols for controls, indicators and tell-tales,” July, 2010; section 1971.1(h)(1.12)
17. ISO 15765-4 “Road Vehicles-Diagnostic communication over Controller Area Network (DoCAN) - Part 4: Requirements for emission-related systems”, April, 2016; section 1971.1(h)(1.6)
18. SAE International (SAE) J1699-3 – “Vehicle OBD II Compliance Test Cases,” July, 2017; section 1971.1(h)(1.9)
19. SAE J1930 “Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms – Equivalent to ISO/TR 15031-2,” March, 2017; section 1971.1(h)(1.1)
20. SAE J1930-DA “Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms Web Tool Spreadsheet,” March, 2017; section 1971.1(h)(1.1.1)
21. SAE J1939 “Serial Control and Communications Heavy Duty Vehicle Network – Top Level Document,” August, 2013; section 1971.1(h)(1.7.1)
22. SAE J1939-DA “Digital Annex of Serial Control and Communication Heavy Duty Vehicle Network Data,” April, 2019; section 1971.1(h)(1.7.1)(A)
23. SAE J1939-1 “On-Highway Equipment Control and Communication Network,” November, 2012; section 1971.1(h)(1.7.2)
24. SAE J1939-11 “Physical Layer, 250 Kbps, Twisted Shielded Pair,” December, 2016; section 1971.1(h)(1.7.3)

25. SAE J1939-13 "Off-Board Diagnostic Connector," October, 2016; section 1971.1(h)(1.7.4)
26. SAE J1939-15 "Physical Layer, 250 Kbps, Un-Shielded Twisted Pair (UTP)," August, 2015; section 1971.1(h)(1.7.5)
27. SAE J1939-21 "Data Link Layer," March, 2016; section 1971.1(h)(1.7.6)
28. SAE J1939-31 "Network Layer," April, 2014; section 1971.1(h)(1.7.7)
29. SAE J1939-71 "Vehicle Application Layer," October, 2016; section 1971.1(h)(1.7.8)
30. SAE J1939-73 "Application Layer – Diagnostics," May, 2017; section 1971.1(h)(1.7.9)
31. SAE J1939-81 "Network Management," March, 2017; section 1971.1(h)(1.7.10)
32. SAE J1939-84 "OBD Communications Compliance Test Cases for Heavy Duty Components and Vehicles," October, 2017; section 1971.1(h)(1.7.11)
33. SAE J1962 "Diagnostic Connector," July, 2016; section 1971.1(h)(1.2)
34. SAE J1979 "E/E Diagnostic Test Modes," February, 2017; section 1971.1(h)(1.4)
35. SAE J1979-DA "Digital Annex of E/E Diagnostic Test Modes," May, 2019; section 1971.1(h)(1.4.1)
36. SAE J2012 "Diagnostic Trouble Code Definitions," December, 2016; section 1971.1(h)(1.5)
37. SAE J2012-DA "Digital Annex of Diagnostic Trouble Code Definitions and Failure Type Byte Definitions," December, 2016; section 1971.1(h)(1.5.1)
38. SAE J2403 "Medium/Heavy-Duty E/E Systems Diagnosis Nomenclature," February, 2014; section 1971.1(h)(1.8)
39. SAE J2534-1 – "Recommended Practice for Pass-Thru Vehicle Programming," December 2004; section 1968.2(g)(1.12)
40. SAE J3162 "Heavy Duty OBD IUMPR Data Collection Tool Process," September, 2018; section 1971.1(h)(1.11)
41. Data Record Reporting Procedures for Over-the-Air Reprogrammed Vehicles and Engines, August 16, 2018; sections 1971.1(h)(6) and 1968.2(g)(8)

These documents were incorporated by reference because it would be cumbersome, unduly expensive, and otherwise impractical to publish them in the California Code of Regulations. In addition, some of the documents are copyrighted, and cannot be

reprinted or distributed without violating the licensing agreements. The documents are lengthy and highly technical test methods and engineering documents that would add unnecessary additional volume to the regulation. Distribution to all recipients of the California Code of Regulations is not needed because the interested audience for these documents is limited to the technical staff at a portion of reporting facilities, most of whom are already familiar with these methods and documents. Also, the incorporated documents were made available by CARB upon request during the rulemaking action and will continue to be available in the future. The documents are also available from college and public libraries, or may be purchased directly from the publishers. The documents from SAE and ISO are copyrighted and are available only for purchase on the organizations' websites.<sup>3</sup>

#### IV. SUMMARY OF COMMENTS AND AGENCY RESPONSE

Written comments were received during the 45-day comment period in response to the November 15-16, 2018, public hearing notice, and written and oral comments were presented at the Board Hearing. Comments were also received during the first and second 15-day comment periods in response to the June 4, 2019, and July 19, 2019, public notices, respectively.

Listed below are the organizations and individuals that provided comments during the 45-day comment period:

<b>Commenter</b>	<b>Affiliation</b>
French, Timothy A. and Gault, Roger T. (November 5, 2018)	Truck & Engine Manufacturers Association (EMA)
Meschievitz, Will (November 12, 2018)	Toyota Motor North America, Inc. (Toyota)
Kodjak, Drew (November 13, 2018)	The International Council of Clean Transportation (ICCT)
Bui, Tin (November 13, 2018)	American Honda Motor Co., Inc. (Honda)
Wilson, Ann (November 13, 2018)	Motor & Equipment Manufacturers Association (MEMA)
Brezny, Rasto (November 13, 2018)	Manufacturers of Emission Controls Association (MECA)
Mandel, Jed (Oral, November 15, 2018)	Truck & Engine Manufacturers Association (EMA)
Blumberg, Kate (Oral, November 15, 2018)	The International Council of Clean Transportation (ICCT)
Geller, Michael D. (Oral, November 15, 2018)	Manufacturers of Emission Controls Association (MECA)
Magavern, Bill (Oral, November 15, 2018)	Coalition for Clean Air (CCA)

<sup>3</sup> Copies of SAE documents are available through the SAE at <http://www.sae.org> . Copies of ISO documents are available through ISO at <http://www.iso.org/iso/home.htm> .



Listed below are the organizations and individuals that provided comments during the first 15-day comment period:

<b>Commenter</b>	<b>Affiliation</b>
Corey, James (June 5, 2019)	Citizen (Corey)
Bui, Tin (June 19, 2019)	American Honda Motor Co., Inc. (Honda)
Wilson, Ann (June 19, 2019)	Motor & Equipment Manufacturers Association (MEMA)
Sutton, Tia (June 19, 2019)	Truck & Engine Manufacturers Association (EMA)

Listed below are the organizations and individuals that provided comments during the second 15-day comment period:

<b>Commenter</b>	<b>Affiliation</b>
Karlstad, Heather (July 30, 2019)	Shell Energy North America (US), L.P. (Shell Energy)

Below is a summary of each objection or recommendation made regarding the specific regulatory actions proposed, together with an explanation of how the proposed action was changed to accommodate each objection or recommendation, or the reasons for making no change. The comments have been grouped by topic wherever possible. Comments not involving objections or recommendations specifically towards the rulemaking or to the procedures followed by CARB in this rulemaking are not summarized below.

#### 45-DAY COMMENTS AND PUBLIC HEARING ORAL COMMENTS

##### COMMENTS IN SUPPORT

1. Comment: We support CARB’s proposal and urge the Board to approve this proposal without delay. (CCA)
2. Comment: MECA supports CARB’s proposal and REAL, which will result in a cost effective method to collect and report in-use operational data and enable quicker inspection and maintenance and repair. As CARB staff gain more experience after REAL is implemented, there may be an opportunity to reduce future certification and compliance burdens to industry. MECA agrees with CARB staff’s proposal that vehicle oxides of nitrogen (NOx) sensors meet the requirement of being within either 20 percent or 0.010 grams-per-brake horsepower-hour (g/bhp-hr) of the dynamometer instrument NOx measurements at the time of certification because today’s sensors can meet these goals. (MECA)
3. Comment: ICCT supports greater availability and transparency of real world emissions performance from heavy-duty trucks. ICCT supports REAL and CARB’s proposal in general. As sensor technology has improved and reduced in cost, we strongly support taking advantage of these systems to provide better data transparency and increased effectiveness of heavy-duty in-use monitoring

program in California and at the national level. The data currently available for real world emission testing for heavy-duty diesels in the U.S. show NOx emissions are consistently above certification levels for a large number of 2010 and newer model year vehicles under urban and suburban driving conditions, an area where Europe is actually doing better. This is the reason we need this information. Data show that emission behavior is extremely dependent on driving condition, which highlights the need for storing data under a binning methodology. The proposal will add transparency and make available key parameters that would provide a technical framework for inexpensive and early identification of high emitters and help in understanding and solving these high emissions. Portable emissions measurement system (PEMS) testing is very expensive. There is also a lack of publicly available real world fuel consumption data for heavy-duty vehicles, even though the Environmental Protection Agency (EPA) and CARB both have greenhouse gas (GHG)/efficiency standards. Having access to that data will help track the effectiveness of these programs and identify areas of improvement that will help researchers, governments, industry, and consumers. (ICCT)

Agency Response: We appreciate the comments.

#### GENERAL COMMENTS ABOUT REGULATIONS, COST, LEADTIME, AND STABILITY

4. Comment: CARB should work with EMA and other stakeholders to develop next-tier heavy-duty on-highway emission standards that would represent a paradigm shift from prescriptive-based to performance-based regulations. EMA's members have helped develop and implement standards for the past 40-plus years, with the basic structure of those standards and regulations being based on laboratory certification testing using prescriptive engine duty cycles and testing conditions and subject to detailed prescriptive on-board diagnostic requirements. Advancements in engine and vehicle technologies, including advanced emission sensors, real-time data processing and telematics capabilities, and geofencing strategies, afford a unique opportunity to move from a prescriptive-based approach to a robust and comprehensive performance-based approach for next-tier emission control regulations. Since CARB's current prescriptive-based emission control regulations have become increasingly expensive and complex with diminishing corresponding real world emissions benefits, EMA is actively working on a new paradigm that focuses on monitoring and assessing actual real world emissions performance of vehicles in real-time over a suitable duration of vehicle activity to ensure aggregate emissions for HD vehicles remain below a new, reduced in-use emission metric. This would involve regular reporting and sharing of in-use emissions data with regulatory agencies, which would allow for better correlation between reduced emission standard and reduced real world emissions and recognition, reporting, and correction of in-use compliance issues. The target date for this program implementation would be the 2027 model year since it will take time to develop and implement. The proposed HD OBD amendments impedes the development and implementation of the paradigm shift. The Board should defer adoption of the HD OBD amendments and instead direct CARB staff to report back on their recommendations for a future

performance-based regulation and on interim low-NOx emission reduction.  
(EMA)

Agency Response: The proposed amendments cover a range of changes. Some changes address issues with existing requirements that were identified through staff and/or manufacturer experience with certification and in-use activities such as manufacturer self-testing (MST); it is appropriate to adopt and implement such changes as soon as possible as some of these changes provide the manufacturers greater flexibility and even reduced burden while other changes address clarifications. It is important to adopt and implement the proposed changes for certification of future engines to existing emission standards rather than delaying the benefits of these changes to after future low NOx standards are adopted and implemented. The commenter is proposing its certification and compliance paradigm shift in many forums. CARB staff participates in those forums and acknowledge there are reasons to consider such a concept, which has many similarities to the REAL requirements that are part of these proposed OBD amendments. However, the commenter's proposed paradigm shift is largely conceptual at this point and its viability as a complete replacement to existing programs, including OBD, has not been established. Accordingly, staff believes it is appropriate to go forward with the proposed OBD amendments to provide the most capable OBD systems to ensure the vehicles introduced into the fleet in the near-term prior to any such paradigm shift are compliant and as clean as possible in use. Staff believes REAL will result in real world emission benefits by facilitating improved screening and compliance programs on engines certified to existing standards. These engines will continue to be a significant part of the inventory until future low NOx engines make up the majority of the California fleet. Additionally, data from engines equipped with REAL will also be used to inform inventory assessments and future heavy-duty program development. Staff believes this regulatory proposal will not impede development of future concepts such as the paradigm shift envisioned by the commenter but will rather serve as an important first step in that direction.

5. Comment: Significantly, CARB has never conducted a cumulative aggregate cost assessment of the HD OB program despite multiple requests from industry – CARB has only done incremental costs estimations. The Board should defer the proposed expansion of the HD OBD regulations and should instead direct CARB staff to conduct a thorough cumulative cost analysis and report back on all of the aggregate costs of the HD OBD program and how the program might be streamlined to comport with a new performance-based paradigm in the 2027 timeframe. (EMA)

Agency Response: As CARB staff indicated to industry when they made this request, CARB staff is not required to perform a total aggregate cost of the entire regulation for a rulemaking update where CARB staff is proposing amendments to current regulations. CARB staff is only required to determine the costs of the amendments being proposed (i.e., the incremental costs). Performing such a cost assessment during this HD OBD rulemaking update would unnecessarily delay the entire rulemaking update and adoption of the amendments. Also, CARB staff believes that its overall cost estimates detailed in the previous Staff Reports related to the HD OBD regulations are still applicable (with the exception of an

underestimation for the number of emission threshold monitors that would be required for MST when the MST requirements were first adopted in 2009; this underestimation has since been corrected in the current update as described in the Staff Report). Nevertheless, staff acknowledges the costs of the program are significant and has agreed to further consider OBD costs from a more comprehensive perspective in the future. Thus, as stated in Resolution 18-53, the Board directed CARB staff to report back in approximately 3 years (i.e., the 2021 calendar year) with a technical review of the HD OBD and OBD II regulations in light of any heavy-duty on-highway regulations adopted in the interim, and to include an updated economic analysis of the OBD program costs and benefits conducted consistent with the methodologies used by the agency for other programs. However, CARB does not agree that the currently proposed amendments to the HD OBD regulations should be deferred until then.

6. Comment: CARB should request an external, independent firm to do a completely new cost estimate of the HD OBD program. (EMA)

Agency Response: As mentioned in the Agency Response to Comment 5, CARB staff has agreed to conduct an updated cost analysis of the HD OBD program in the 2021 timeframe. CARB will consider stakeholder input on how such an analysis should be performed, but does not necessarily agree that the use of an external firm would constitute the best approach. Such decisions will ultimately be made in the context of the future OBD update requested by the Board.

7. Comment: CARB's HD OBD regulations are cost-prohibitive, unduly onerous, and costly. According to the *Engine Mfrs. Assoc. v. State Air Resources Board*, 231 Cal. App. 4<sup>th</sup> 1022, 1025 (2014), "the Legislature has granted CARB authority to adopt regulations designed to reduce air pollution caused by motor vehicle emissions... subject to cost-effectiveness and feasibility limitations." Therefore, if the OBD requirements "are 'unduly onerous and costly,'... the regulations may fall outside the scope of [CARB's] authority." Id. at 1041. Since CARB underestimated the costs of the HD OBD program, it raises the very real prospect that the HD OBD regulations exceed and violate CARB's authority under the Health and Safety Code and Clean Air Act (CAA) Sections 209(b) and 202(a)(3)(A), the latter provision relating to the impacts of excessive costs on feasibility. So the Board should not approve the proposed amendments and instead should direct CARB staff to conduct a comprehensive study of the cost-effectiveness of the entire HD OBD program and report back on how the program can be revised/streamlined to conform to the cost-effectiveness and feasibility limitations that bound CARB's authority and to accommodate a paradigm shift to performance-based regulations. (EMA)

Agency Response: CARB staff does not agree with the commenter's assertion that the HD OBD regulations are cost-prohibitive and unduly onerous. CARB does not believe that the HD OBD program results in excessive costs and, therefore, does not agree that the program violates CARB's authority under the Health and Safety Code. Regarding the comments about costs, please refer to the Agency Responses to the "Comments About Cost Estimates" below.

The commenter's assertion that CARB's alleged underestimation of costs could cause the rulemaking action to exceed CARB's authority under the Health and Safety Code and CAA sections 209(b) and 202(a)(3)(A) appears to conflate two distinct, yet interrelated concepts – CARB's authority to adopt emission standards and other emission-related requirements for new motor vehicles and new motor vehicle engines, and its ability to enforce those provisions after obtaining a waiver from the preemptive provisions of CAA section 209(a).

CAA section 209(a) generally prohibits states and their local governments from adopting or enforcing any “standard relating to the control of emissions from new motor vehicles or any new motor vehicle engines”, but CAA section 209(b) specifies that California is the only state that is authorized to adopt and enforce, in the first instance, its own new motor vehicle and new motor vehicle engine emission standards and other emission related requirements, provided that it obtains a waiver of preemption from section 209(a) from the Administrator of the EPA.<sup>4</sup>

Under section 209(b), the Administrator must grant a waiver to California if California has determined that its standards will be, in the aggregate, at least as protective of public health and welfare as applicable federal standards, unless the Administrator finds that (1) the state's protectiveness determination is arbitrary and capricious, (2) California does not need separate state standards to meet compelling and extraordinary conditions, or (3) the state's standards and accompanying enforcement procedures are not consistent with section 202(a) of the CAA.

With regards to the third criterion, EPA has historically interpreted consistency with CAA section 202(a) using a two-pronged test: (1) that there is sufficient lead time to permit the development of technology necessary to meet the standards and other requirements, giving appropriate consideration to the cost of compliance in the time frame provided, and (2) that the California and federal test procedures are sufficiently compatible to permit manufacturers to meet both the state and federal test requirements with one test vehicle or engine.<sup>5</sup> The reference to “cost of compliance” in CAA section 202(a) refers to the economic costs of emission standards and accompanying enforcement procedures and the timing of a particular emission control regulation rather than to its social implications.<sup>6</sup>

With regards to EPA's own authority to promulgate emission standards for new motor vehicles and new motor vehicle engines under CAA section 202(a), Congress

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<sup>4</sup> CAA section 209(b) provides for granting a waiver to “any State that has adopted standards (other than crankcase emission standards) for the control of emissions from new motor vehicles or new motor vehicle engines prior to March 30, 1966.” California is the only State that meets this eligibility criterion for granting waivers. *See, e.g.*, S. Rep. No. 90-403, at 632 (1967) and *Motor and Equipment Manufacturers Association v. EPA (MEMA I)* (D.C. Cir. 1979) 627 F.2d 1095, 1101 fn. 1.

<sup>5</sup> *See* 61 Fed. Reg. 53371, 53372 (October 11, 1996); Decision Document at p.2 (*OBD II Waiver Decision*). Even where there is incompatibility between the California and federal test procedures, EPA has granted a waiver under circumstances where EPA accepts a demonstration of federal compliance based on California test results, thus obviating the need for two separate tests. (43 Fed.Reg. 1829, 1830 (January 12, 1978); 40 Fed.Reg. 30311, 30314 (July 18, 1975).)

<sup>6</sup> *Id.*, referencing *See* S. Rep. No. 192, 89th Cong., 1st Sess. 5-8 (1965); H.R. Rep. No. 728, 90th Cong., 1st Sess. 23 (1967), U.S. Code Cong. & Admin. News 1967, p. 1938; *see also* 74 Fed.Reg. 3030 (January 16, 2009), Decision Document at p. 49.

wanted EPA to reduce motor vehicle emissions, but “also sought to avoid doubling or tripling the cost of motor vehicles.” *Motor & Equip. Mfrs. Ass’n, Inc. v. EPA*, MEMA I, 627 F.2d 1095 at 1118. (D.C. Cir. 1979). In past waiver decisions, EPA has stated that its consideration of costs under Section 209(b)(1)(C) is “fully consistent with *MEMA I*, which indicates that the cost of compliance must reach a very high level before the EPA can deny a waiver. Therefore, past decisions indicate that the costs must be excessive to find that California’s standards are inconsistent with section 202(a).” 74 Fed. Reg. at 32,774 (citing 47 Fed. Reg. 7306, 7309 (Feb. 18, 1982), 43 Fed. Reg. 25,735 (Jun. 14, 1978), and 46 Fed. Reg. 26,371, 26,373 (May 12, 1981)).

In light of this background, CARB disagrees with the commenter’s assertion that the provisions of the CAA section 202(a)(3)(C) apply to California under the waiver provision of CAA section 209(b). The text of section 202(a)(3)(C) itself dictates that the provision is not applicable to California:

“Any *standard promulgated or revised under this paragraph* and applicable to classes or categories of heavy-duty vehicles or engines shall apply for a period of no less than 3 model years beginning no earlier than the model year commencing 4 years after such revised standard is promulgated. [*Italics added for emphasis.*]”

The text states that “standards promulgated or revised under this paragraph,” that is, pursuant to the authority of CAA section 202(a), must provide the specified lead time and stability. *However, California promulgates its standards pursuant to the authority of state law*, and can enforce those standards once EPA grants California a waiver pursuant to the provisions of CAA section 209(b). Because section 202(a)(3)(C) is only applicable to standards promulgated under section 202(a), and because California does not promulgate its standards under 202(a), section 202(a)(3)(C) does not apply to California.

8. Comment: CARB cannot and should not enforce its enhanced HD OBD program and deficiency fine structure until it receives an updated preemption waiver from the United States EPA (U.S. EPA). (EMA)

Agency Response: In Resolution 18-53, the Board directed CARB’s Executive Officer to request a waiver or a confirmation that the regulations are within the scope of an existing waiver of federal preemption pursuant to section 209(b) of the CAA, as appropriate, and further found that to the extent the regulations fell within the scope of an existing waiver of federal preemption pursuant to section 209(b) of the CAA, that such amendments will not cause California requirements to be inconsistent with section 202(a) of the CAA or raise new issues that affect previous waiver determinations of the Administrator of the U.S. EPA under section 209(b) of the CAA.

EPA has determined, in appropriate cases, that California does not need a new waiver if California amends previously waived motor vehicle regulations. In such cases, California may request that EPA confirm that the amendments are within the scope of previously issued waivers or authorizations. A within-the-scope

determination for such amendments is permissible if: 1) the amendments do not undermine California's determination that its standards are, in the aggregate, as protective of public health and welfare as applicable Federal standards; 2) the amendments do not affect the consistency of California's requirements with section 202(a) of the CAA for waiver requests; and 3) the amendments raise no new issues affecting EPA's previous waiver or determination.<sup>7</sup>

9. Comment: The cost-prohibitive nature of CARB's HD OBD regulations disqualifies them from obtaining a legitimate preemption waiver under the federal CAA, since it can only be obtained if the standards and accompanying enforcement procedures are consistent with section 202(a) of the CAA, which requires emission standards to give "appropriate considerations to cost." For EPA's three previous preemption waivers for CARB's HD OBD regulations, EPA did not conduct any independent or rigorous nationwide cost analysis and simply relied in CARB's incorrect representations of California-only in-state costs in the waiver requests. EPA did note in its Decision Document (dated August 13, 2008) that the CAA "required the Administrator to decide whether the costs of developing and applying the [HD OBD] technology within the time [allocated] are feasible" and that it would "continue to closely monitor manufacturer progress in meeting the technical requirements of the OBD regulations, and CARB's efforts to address manufacturer-identified feasibility issues." EPA's 2016 preemption waiver decision reiterated that there can be instances where "the cost of compliance would be so excessive, such that California's [HD OBD] standards might be inconsistent with section 202(a)" (81 FR at 78154). (EMA)

Agency Response: No changes to the regulation were made in response to this comment. The Agency Response to Comment 7 is incorporated by reference herein. CARB disagrees with the commenter's suggestion that the subject amendments are cost prohibitive – please refer to the Agency Responses to the "Comments About Cost Estimates" below.

10. Comment: Section 202(a) of the federal CAA requires standards to apply for a period of no less than 3 model years and beginning no earlier than the model year commencing 4 years after the revised standards are promulgated, which CARB's proposed amendments violate since some amendments take effect in 2022 (3 full model years after the November 2018 board hearing and 2 full model years after any formal final rulemaking approval by the Office of Administrative Law) and even 2021. The 2022 start date is only 3 full model years after the November 2018 board hearing and 2 full model years after any formal final rulemaking approval by the Office of Administrative Law), and considering manufacturers have to submit their completed OBD applications 6-9 months before the start of engine production (and thus have to complete the necessary OBD design and testing before then), the leadtime is really only slightly more than 1 year. CARB's amendments are thus void and unenforceable under federal law since they violate sections 209(b)(1)(c) and 202(a)(3)(c) of the CAA. (EMA)

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<sup>7</sup> Decision Document accompanying within-the-scope determination in 69 Fed.Reg. 59920 (October 6, 2004), at pp. 2-3; *see also* Decision Document accompanying within-the-scope determination in 51 Fed.Reg. 12391 (April 10, 1986), at p. 2 and 46 Fed.Reg. 36742 (July 15, 1981); 82 Fed. Reg. 6500, 6502 (Jan. 19, 2017).

Agency Response: The commenter submitted the same comments regarding lead time and stability during the engine manufacturer diagnostic (EMD) rulemaking in 2004, the HD OBD rulemaking in 2005, the OBD II rulemaking updates in 2006 and 2015, and the HD OBD rulemaking updates in 2009 and 2012. In each of these rulemakings, CARB had provided a detailed response indicating why the federal lead time and stability provisions do not apply to the OBD regulations (see the Final Statement of Reasons for Rulemaking for the EMD, HD OBD, and OBD II regulations). Since the commenter has given the same comments again for this rulemaking, the following response is essentially the same as those given in the previous rulemakings.

Regarding the commenter's lead time and stability arguments, since 1970, U.S. EPA has typically applied a "two-pronged" test of whether California standards are consistent with CAA section 202(a) as required by section 209(b)(1)(C). The standards first must be technologically feasible in the lead-time provided considering the cost of compliance, and second must be compatible with the federal test procedures so that a single vehicle could be subjected to both tests. No more should be required.

This is in accord with the legislative history of section 209. When the California waiver provisions and the "consistent with section 202(a)" language were first placed in the CAA in 1965, section 202(a) consisted of just one sentence requiring adequate lead time in consideration of technological feasibility and economic costs. In the 1977 CAA amendments, Congress amended section 209 "to afford California the broadest possible discretion in selecting the best means to protect the health of its citizens and the public welfare." (H. R. Rep. No. 294, 95th Cong., 1st Sess. 301 (1977), reprinted in 4 Leg.Hist., at 2768.) At the same time, Congress expanded section 202(a) to add several directives to U.S. EPA regarding its adoption of emission standards, including the four-year lead time requirement for heavy-duty vehicles. (Emphasis added.) Given Congress's expressed intent to strengthen the waiver provisions, it is unlikely Congress intended to apply the specific four-year requirement to California, which would effectively narrow the deference provided to the state.

This is especially true in the case of OBD requirements. Congress clearly did not intend the OBD requirements to be subject to the lead-time and stability provisions of CAA section 202(a)(3)(C). First, as indicated above, those requirements were first enacted in 1977 and specifically applied to heavy-duty vehicle emission reductions, which at that time solely consisted of tailpipe and evaporative emission standards that Congress directed U.S. EPA to implement for new heavy-duty vehicles. (1977 CAA, section 202(3)(B).)

It was not until the 1990 CAA amendments that Congress enacted an entirely new provision, section 202(m), which directed the Administrator to adopt regulations to implement OBD requirements. Under the new provision, Congress directed the Administrator to promulgate regulations for new light-duty vehicles and light-duty trucks within 18 months of enactment. (CAA section 202(m)(1).) Additionally, at the Administrator's discretion, Congress provided



U.S. EPA with equivalent authority to adopt OBD requirements for new heavy-duty vehicles. (Id.) The federal CAA further provided that the effective date for those regulations initially adopted under section 202(m) shall be the model year 1994, unless the Administrator postpones application for certain classes and categories of vehicles until the 1996 model year. The Administrator could decide to delay implementation for reasons that the OBD requirements were infeasible or to be consistent with the policies adopted by ARB. (CAA section 202(m)(2).) Thus, theoretically, under the provisions of CAA section 202(m), the Administrator had effective authority to promulgate and implement OBD requirements for heavy-duty vehicles as early as the 1994 model year. Assuming that such requirements were adopted in June 1992 (18 months after the enactment of the CAA), Congress would have provided less than the requisite time allowed for implementation under CAA section 202(a)(3)(C). Accordingly, it would be appropriate to infer that Congress never intended that the OBD requirements be subject to the lead-time provisions of section 202(a)(3)(C).

This is confirmed by the administrative actions of U.S. EPA. Although the Administrator initially chose not to adopt OBD requirements for heavy-duty vehicles (58 Fed.Reg.9485 (February 19,1993)), OBD requirements were subsequently adopted and applied to medium-duty passenger vehicles (a subclass of heavy-duty vehicles). (64 Fed.Reg.23925 (May 4, 1999).). Adopted federal regulations provide, "Except as otherwise indicated, the provisions of this subpart apply to new 2001 and later model year Otto-cycle and diesel cycle light-duty vehicles, light-duty trucks, medium-duty passenger vehicles ["MDPVs"] . . ." (40 Code of Federal Regulations ("CFR"), subpart, S §86.1801-01. Emphasis added.) Under the Administrator's adopted definition, a heavy-duty vehicle is defined as "any motor vehicle rated at more than 8,500 pounds GVWR [gross vehicle weight rating] or that has a vehicle curb weight of more than 6,000 pounds or that has a basic vehicle frontal area in excess of 45 square feet. (40 CFR 1803-01.) MDPV is defined as "any heavy-duty vehicle . . . with a [GVWR] of less than 10,000 pounds that is designed primarily for the transportation of persons." (Id). The specific OBD requirements were set forth in section 86.1806-01 of the same regulation and provide that certain MDPVs, as well as light-duty vehicles and trucks, are required to meet the OBD standards set forth therein. An exception applied to diesel-fueled, chassis-certified MDPVs and engine-certified diesel engines used in MDPVs, but no exception exists for Otto-cycle MDPVs, which are subject to the requirements of section 1806-01. (40 CFR 1806-01(a)(2).) These vehicles were only subject to the requirements if the exhaust emission certification of the applicable test group is being carried across from a California configuration to which California OBD II requirements are applicable. The OBD provision does not provide for a separate and distinct implementation date for MDPVs to meet the OBD requirement. Accordingly, under the terms of section 1806-01, the 2001 and later model year implementation requirements would deem to be applicable to the OBD requirement. In such a case, the lead-time provided under the regulations would be less than two years from the May 4, 1999 initial promulgation date of the regulation.

Section 1806-05, which establishes OBD requirements for heavy-duty vehicles weighing 14,000 pounds GVWR or less, including diesel-powered MDPVs, provides a similarly abbreviated lead-time period. (68 Fed.Reg. 35800, June 17, 2003, 40 CFR section 1806.05.) The regulations were adopted in June 2003 and apply to 2005 and later model year vehicles. The lead-time again is well below the minimum four years of lead-time required under section 202(a)(3)(C). For the foregoing reasons, the only reasonable inference is that Congress did not intend that the provisions of CAA section 202(a)(3)(C) apply to OBD requirements and specifically not to California adopted OBD requirements.

While the argument above still holds for these amendments, as part of the first 15-day notice, staff proposed to delay the 2022 start dates to 2024 for all amendments except for amendments associated with REAL. The implementation of REAL is an important and necessary step to address issues with high-emitting in-use vehicles and ensuring the emissions reductions projected from the standards programs are realized in the real world. The data associated with REAL would also provide valuable information to assist CARB staff in improving and developing OBD and other CARB programs. However, staff understands the significant workload that will be involved with implementing the REAL requirements. Therefore, staff proposed the delay to the other amendments to ensure early and robust implementation of REAL and to address manufacturer's workload concerns. The proposed delays and the reasons for the delays are only applicable to this rulemaking update - CARB's assertions described in the previous paragraphs about not being subject to the leadtime and stability requirements of CAA are still valid.

Regarding the comment mentioning that some amendments take effect in 2021, these amendments relate to the procedures the manufacturer is required to use to calculate infrequent regeneration adjustment factors (IRAF) (section 1971.1(d)(6.2)) and the start date for the increased deficiency fines. For the IRAF determination, staff proposed to require diesel engine manufacturers to determine IRAFs in accordance with CFR title 40, part 86.004-28(i) for 2020 and earlier model year engines, and in accordance with CFR title 40, part 1065.680 for 2021 and subsequent model year engines. This proposal was intended to align with what is currently required in CFR section 86.004-28, with part 86.004-28(i) specifically stating the procedures listed applied to 2020 and older model year engines and part 86.004-28(j) specifically stating that 2021 and newer model year engines meet the procedures in CFR title 40, part 1065.680. For the deficiency fines, these fines are not "standards" and only relate to fines applied for not complying with OBD requirements. The implementation of deficiencies has not changed - staff will still grant deficiencies based on non-compliance with the OBD requirements just as they have done for years. Manufacturers will not have to do any "new" work to "meet" these increased deficiency fines – believing otherwise would indicate that manufacturers are currently not putting in good faith efforts to meet the OBD requirements to avoid a deficiency in the first place. Based on these reasons, staff proposed a start date earlier than 2022 as part of the 45-day notice. While this argument still holds, due to the reasons mentioned above, staff agreed to delay the start of the deficiency fine increases from the 2021 to the 2024 model year as part of the first 15-day notice.

## DEFINITIONS

11. Comment: The examples of an “active technology” that are included in the definition should be updated to eliminate possible confusion. There are concerns with the inclusion of “retractable gap fairings” as an example, since this is clearly a function where the engine will be unaware of the active control status. Engine manufacturers can only provide data on active technologies that they directly control and cannot be expected to canvass vehicle manufacturers 3 years in advance to plan for monitoring of active technology features provided by the vehicle manufacturer without using the engine control module. (EMA)

Agency Response: CARB staff does not believe a change in the proposed definition of “active technology” is needed. The proposed definition already explicitly states that it only includes technologies that are “either controlled by the engine or required to be monitored by the OBD system.” The definition does not require the monitoring of retractable gap fairings. Retractable gap fairings are included in the list of example technologies that improve the aerodynamic profile of a vehicle. If they are controlled by the engine or required to be monitored by the OBD system, then they would need to be tracked.

## GENERAL REQUIREMENTS

12. Comment: The provisions for non-analog malfunction indicator lights (MIL), which indicate that the delay in MIL illumination prior to the functional check cannot exceed 5 seconds, should be rephrased as follows: “...the display of the MIL’s functional check by any vehicle shall not be delayed by more than 5 seconds due to any limitation of the MIL’s display technology (e.g., the adverse impact of cold temperatures on liquid crystal displays must be managed to make the bulb check visible under expected operating temperatures).” (EMA)

Agency Response: CARB staff does not agree with the commenter’s proposed language and therefore did not make any changes to the regulation language. CARB staff is unsure what the commenter is requesting with their specific language. The intent of CARB’s proposed language was to indicate that any delay in MIL illumination for the functional check of non-analog MILs may not exceed 5 seconds, since some vehicles now use liquid crystal display (LCD) screens, which may result in some delay in the illumination of the MIL symbol during the functional check due to the “boot up” time. The commenter’s proposed language seems to be addressing other issues that may delay MIL illumination such as cold temperatures, but because CARB staff does not have any more details from commenter about the issue, CARB is not proposing any changes to the language.

13. Comment: CARB should allow for engines that store more than one freeze frame to opt out of the proposed changes to the freeze frame storage requirement, specifically the proposed requirement to replace currently stored freeze frame conditions in the event a new malfunction is detected, all available freeze frames are filled, and the currently stored freeze frame conditions are for a confirmed fault code that is currently not commanding the MIL on. The storing of multiple freeze frames already takes care of the issue that CARB’s proposal is supposed

to address, and requiring engines to change their freeze frame management methods where multiple faults are already stored has little real benefit and is unduly burdensome. (EMA)

Agency Response: Staff understands the commenter's concerns and proposed to delete this requirement as part of the first 15-day notice.

14. Comment: The proposed changes to the requirements related to erasing a confirmed/previously MIL-on fault code is not a relaxation of the regulation, since it will now take longer to erase a fault code. The current regulation does not include the criteria of the MIL not being on for other malfunctions, while the proposal requires consecutive cycles without MIL for any malfunction. It does not make sense to tie fault code-clearing for one monitor to all other fault codes. (EMA)

Agency Response: The commenter is misunderstanding the proposal. As described in the Staff Report, this amendment would allow OBD systems to erase individual confirmed/previously MIL-on fault codes or erase a subset of confirmed/previously MIL-on fault codes at the same time. The language indicates the earliest time the fault code can be erased (the end of the driving cycle in which the identified malfunction has not been again detected in at least 40 consecutive warm-up cycles and the MIL has not been illuminated for that malfunction for at least 40 consecutive warm-up cycles), and the latest time the fault code can be erased (the end of the driving cycle in which no malfunction has been detected in 41 consecutive warm-up cycles and the MIL has not been illuminated for any malfunction for 41 consecutive warm-up cycles). It seems the commenter believed the latter condition was the earliest time the fault code could be erased. However, CARB staff believes the use of the phrase "no sooner than" for the earliest time and "no later than" for the latest time clearly indicates otherwise, and therefore did not propose any further changes to the language.

15. Comment: The proposal prevents monitors whose in-use monitor performance ratio (IUMPR) data are not tracked and reported (as required under section 1971.1(d)(3.2.1)) from using the supplemental emission test (SET) cycle as a detection cycle. CARB is assuming that since the IUMPRs are not tracked and reported, the IUMPR in-use for the monitor will be poor if the monitor uses the SET cycle, which is not true. The proposal also conflicts with the demonstration testing protocol language in section 1971.1(i)(5.1.1) and (i)(4.2.2) that allows the MIL to be illuminated by the end of the emission test and allows the emissions test to be an SET cycle if it is the worst case cycle. CARB should allow manufacturers to use the SET cycle for a monitor if they can show good IUMPR performance (e.g., show evidence of on-road operation from development data), and the proposed language should be changed to ensure that monitors that meet CARB's other requirements that are demonstrated on the SET cycle as the worst case are not automatically required to have the IUMPR be tracked and reported. (EMA)

Agency Response: The commenter is incorrect - CARB did not assume that since the monitor does not track and report the IUMPR data, the monitor will by default

have poor IUMPR in the real world. As stated in the Staff Report, staff is concerned that monitors that run on the SET cycle instead of the Federal Test Procedure (FTP) cycle will not run frequently in-use since that cycle is around 40 minutes of mostly steady-state driving, and that these monitors may or may not have IUMPR tracked and reported. By limiting the monitors that can use the SET cycle to those that have the IUMPR tracked and reported, staff would be able to ensure that the monitor runs frequently in-use and identify those that do not. However, CARB staff understands EMA's concern about monitors that are not IUMPR tracked and reported under section 1971.1(d)(3.2.1). The current regulation language already requires manufacturers to provide data showing that a monitor meets the IUMPR requirements, so additional language related to this is not necessary. But to specifically address these monitors that are not IUMPR tracked and reported, staff proposed as part of the first 15-day notice that for these monitors, the manufacturer would be allowed to use the SET cycle only if they implement "enhanced tracking" of the IUMPR data for the monitor (i.e., the monitor meets the IUMPR requirements of 1971.1(d)(4) but the IUMPR data are reported through a manufacturer-specific tool (not through Mode 09 or DM20)) and collect rate-based data from in-use vehicles and report them to CARB at a later date.

Regarding the demonstration testing protocol language in sections 1971.1(i)(5.1.1) and (i)(4.2.2), staff does not believe there is a conflict with the language. The language in section 1971.1(i)(5.1.1), which requires malfunction detection/MIL illumination "before the end of the emission test specified in (d)(4.2.2)", does not require that the monitor actually runs and MIL illuminate during the emission test. There are multiple test cycles that occur in sequence during one demonstration test, so malfunction detection can occur during a test cycle before the emission test (e.g., the malfunction detection cycles under section 1971.1(i)(4.2.1)). The language in section 1971.1(i)(4.2.2) specifically is for emissions testing, not for malfunction detection (i.e., not for running the monitor), and is specifically tied to the test cycle and standard considered to be the most stringent under section 1971.1(d)(6.1). Similarly, the language in section 1971.1(d)(6.1) is specifically for setting the emission malfunction threshold based on the worst case emissions, but does not actually require the monitor to run on that specific cycle. Thus, a monitor can have an emission malfunction threshold based on the SET cycle, but the monitor may be designed such that it runs on the FTP cycle and not the SET cycle.

16. Comment: The provisions related to intrusive monitors should be revised to allow for monitors that are substantially included in regulated emission test cycles or that have no measurable emissions impact (similar to the requirement to monitor comprehensive components that "can affect emissions during any reasonable in-use driving condition"). The definitions and prohibitions related to intrusive monitors are too broad and will prevent the use of well-established and effective monitors, including monitors that "reduce the effectiveness of the emission control system" but where the on-road emissions are reasonably captured during emission testing (e.g., FTP). Examples include monitors that intrusively delay a fueled engine pull-down until a monitor completes on hybrid vehicles, take over fueling reactivation after deceleration fuel cuts, move turbo or exhaust gas recirculation (EGR) actuators to check for lack of response. The effectiveness of many comprehensive component rationality monitors could also be reduced or

eliminated since the prohibition of intrusive monitors will override the requirement to monitor “to the extent feasible” while the minimum required IUMPR is also increased. (EMA)

Agency Response: Staff does not agree with the commenter’s suggested changes. Staff does not intend to prohibit all intrusive monitors from the OBD program - only those monitors where the effectiveness of major emission control components are reduced for extended periods. The in-use emission benefits of the OBD program cannot be undermined by manufacturers’ continual execution of emissions-increasing intrusive diagnostics. The newly proposed section 1971.1(d)(3.1.4)(A) allows the use of intrusive monitors that “will not affect the effectiveness of the emission control system during any reasonable in-use driving conditions.” However, language calling out monitors that are “substantially included in regulated emission test cycles” is too vague and does not provide CARB staff with adequate criteria for review and evaluation. Nevertheless, staff did not intend to prevent manufacturers from using some current monitors such as gasoline catalyst monitors that require forced air-fuel ratio switching and monitors that intrusively take over fueling activations after deceleration fuel cuts. Therefore, staff proposed 15-day changes (during the first 15-day notice) that would allow for intrusive diagnostics where the manufacturer has employed the best available monitoring technology that, to the extent feasible, results in the smallest emissions impact.

17. Comment: CARB should clarify and provide further guidance on the intrusive diagnostics and IUMPR provisions. CARB should provide further definitions and guidelines for “real-world driving conditions” and “reasonable in-use driving conditions” to make clear when a standard procedure is not representative of real world driving conditions. CARB should also provide a definition of “alternative test procedure” to provide descriptions of alternate monitoring strategies and frequency to detect “real-world” failures of emission control systems, components, and alternate emissions strategies. CARB should also clarify that systems where intrusive strategies are more effective and accurate than non-intrusive strategies would be eligible for approval. Intrusive diagnostics are often needed in order to meet the IUMPR requirements. The proposed minimum IUMPR increase is tied closely to the potential need for intrusive diagnostics which may only be possible with a temporary increase in emissions. More frequent monitoring is not completely necessary to detect malfunctions and does not always add value to the emissions control system performance/function. Increased monitoring frequency can increase the need for emission-increasing auxiliary emission control devices (EI-AECD), which can have a negative overall emissions impact, or increase false fails. (MEMA)

Agency Response: Regarding the comment about “real-world driving conditions” and “reasonable in-use driving conditions,” the manufacturer’s plan should include data from engines running on certification cycles and real on-road driving. The on-road driving should include driving cycles of typical operation for the engine under consideration. Staff will compare data stream parameters for the engine under these conditions. If discrepancies exist in the data stream parameters collected (e.g., ammonia storage levels, dosing modes, dosing rates), this would be the basis for the use of alternate test procedures. Regarding the comment about the definition

of “alternative test procedure,” as an example of an alternative test procedure, staff may request the manufacturer to run an emission test without conducting a regeneration prior to the test, or, to define a preconditioning procedure with an SET cycle instead of an FTP cycle. The goal would be to find a preconditioning sequence that brings the engine into a condition that replicates in-use emissions performance. Staff believes the current language indicating that Executive Officer will approve alternate test procedures “based on the determination that the alternate test procedures would result in test cycle emissions representative of in-use driving conditions” and thus did not make changes to the proposed regulation. Therefore, staff is not proposing any additional changes to the proposed regulation language related to these comments (specifically section 1971.1(d)(4.1.3)(C)). Concerning the comment about the potential approval of intrusive strategies that are more effective and accurate than non-intrusive strategies, CARB staff did not propose any additional changes based on this comment. Reducing emissions from in-use engines and vehicles is of primary concern to CARB. It is unacceptable and counterproductive to the goals of the OBD program for staff to approve intrusive strategies that result in emission increases. As the OBD program has matured, manufacturers have gained experience in developing diagnostic strategies that do not have intrusive impacts on the emission control system or that have an insignificant impact. If an intrusive strategy does exist and is more effective than the corresponding passive strategy, the provision in section 1971.1(d)(4.1.3)(B)(i) (which was already proposed as part of the 45-day notice) will allow the manufacturer to use the more effective intrusive strategy for further pinpointing of the fault after the passive strategy has identified a malfunction and illuminated the MIL. However, as already mentioned above, staff proposed 15-day changes (during the first 15-day notice) that would allow for intrusive diagnostics where the manufacturer has employed the best available monitoring technology that, to the extent feasible, results in the smallest emissions impact.

18. Comment: The proposed minimum acceptable IUMPR of 0.300, which is a 300 percent increase in stringency, means the monitor should run 3 times out of every 10 driving cycles. CARB’s analysis that every manufacturer should be able to meet this ratio is fundamentally flawed since it does not assume that each monitor and its IUMPR have significant interaction with other monitors and the rest of the OBD system. Increasing the IUMPR of one monitor to meet 0.300 may significantly impair the ability of another monitor to meet 0.300. CARB staff’s comparison of HD diesel OBD systems and IUMPRs with light-duty gasoline OBD systems shows staff’s lack of understanding of the complexity of HD OBD diesel systems. Since the monitors that will require development are system-dependent, we recommend 2 free deficiencies be provided until 2024. (EMA)

Agency Response: As mentioned in the Staff Report, CARB staff believes that an IUMPR of 0.300 is technically feasible based on the IUMPR data manufacturers submitted to CARB. From reviewing the data, staff determined that most monitors are currently able to meet the proposed ratio of 0.300. For monitors that staff have observed having difficulties in meeting the proposed ratio (e.g., non-methane hydrocarbon (NMHC) catalyst monitors, staff proposed new denominator-incrementing criteria to enable manufacturers to meet the 0.300 ratio for the

monitors. Therefore, CARB staff does not believe there will be any significant issues with meeting the proposed 0.300 ratio. Regarding the commenter's assertion that increasing the IUMPR of one monitor can significantly lower the IUMPR of another monitor, CARB is unaware of any cases where such an interaction would occur, and the commenter did not give any example of such monitors. If the commenter is talking about monitors that require other monitors to run first before it can run, the commenter's claim that making one monitor run more frequently makes it harder for the next monitor to run more frequently misrepresents the interrelation between monitors. If one monitor affects the other, the sooner one runs, the sooner the next one has an opportunity to run and the greater the likelihood it will run. In addition, to support the 0.300 IUMPR ratio, CARB relies on IUMPR data from many manufacturers who are already meeting the proposed requirement today, therefore, demonstrating technical feasibility. These manufacturers would have little if any calibration changes to meet the 2022 model year implementation. Studying manufacturer data for instances where IUMPR was below 0.300, staff have found, typically, it was a single diagnostic that needed attention and re-calibration to meet the 0.300 ratio. Hence, pushing the implementation date out beyond the 2022 model year is not supported by the data since wide scale overhaul and calibration work is not anticipated. Nevertheless, as already mentioned above in the Agency Response to Comment 10, staff proposed to delay the start date for this requirement from 2022 to 2024 as part of the first 15-day notice.

19. Comment: Some manufacturers that do not run the diesel oxidation catalyst monitor during a regeneration event will lose the ability to use the 800-minute denominator due to CARB's proposal to require a regeneration-based denominator. (EMA)

Agency Response: Staff did not make any changes related to this comment and is keeping the proposed regeneration-based denominator for the diesel oxidation catalyst. The proposed change in the denominator incrementing criteria does not require the manufacturer to change their diagnostic strategy. For manufacturers that do not run the diesel oxidation catalyst monitor during a regeneration event, they can continue to utilize their existing diagnostic strategy and calibrate it to meet the required in-use monitoring frequency requirement. CARB's denominator incrementing criteria have never been proposed as cycles which manufacturers must exercise their diagnostics; rather, they were designed as vehicle activity metrics for use in calculating in-use monitoring frequencies. CARB has moved from the 800-minute denominator to the regeneration-based denominator to help eliminate intrusive diagnostic strategies triggered due to a denominator which increments every 800 minutes. To provide for efficiencies in the review process, CARB did not propose two different incrementing criteria for the denominator

20. Comment: The proposed requirement for manufacturers to submit a frequency factor derivation plan to CARB for approval (section 1971.1(d)(6.2.3)) adds significantly to the documentation work and should be eliminated. (EMA)

Agency Response: CARB disagrees that this requirement will add significantly to the documentation work required and, thus, will not eliminate this section. This section requires manufacturers to provide their proposed methodology for determining the



frequency factor when a malfunction is present. The presence of a malfunction can alter the system's ability to maintain compliance. Two performance characteristics affected due to a malfunction in the system are regeneration frequency and emissions during a regeneration event. Expected details in the plan will not be overly burdensome, and will provide valuable information including, but not limited to, how the particulate matter (PM) filter loading rate will be calculated (e.g., soot load model, micro soot sensor) and what and how many test cycles are required. In most cases, if the same methodology to determine the frequency is used for all OBD demonstration testing, the approved frequency factor derivation plan can be carried over, thereby reducing any additional workload. Further, staff believes that without this requirement, CARB cannot ensure that each malfunction accurately accounts for the impact on the frequency of regeneration, and as a result, cannot definitively determine if a malfunction is capable of detecting the fault prior to exceeding the specified emissions threshold. Staff must be assured that manufacturers' calculations of the frequency factors are based on sound engineering principles and this requirement will provide that assurance.

## MONITORING REQUIREMENTS

21. Comment: The proposal to require manufacturers to track and report the in-use performance of the diesel fuel system monitor (section 1971.1(e)(1.3.3)) will need additional lead time since this will require software changes. These monitors are already required to meet the minimum ratio requirements. (EMA)

Agency Response: The requirement to tracking and report the IUMPR data for this monitor is not new – this is already required in the current regulation since the 2013 model year. Additionally, looking over the IUMPR data on file, it seems all heavy-duty diesel manufacturers are already tracking and reporting these data. So CARB is confused about the comments. The proposed language in this section is intended only as clarifying language without adding any new requirement.

22. Comment: The new NOx activity monitoring requirement (section 1971.1(e)(9.2.2)(E)) requires significant development work and will need more lead time to develop and implement. (EMA)

Agency Response: As explained above in Agency Response to Comment 10, staff proposed to delay the 2022 start date to 2024 for all amendments except for those associated with REAL, since REAL is an important and necessary step to address issues with high-emitting in-use vehicles and ensuring the emissions reductions projected from the standards programs are realized in the real world. Considering that the NOx sensor is an important aspect of the REAL requirements, the NOx sensor activity monitor mentioned in the comment needs to be implemented to ensure that NOx data are tracked over as much vehicle activity as possible. Therefore, CARB did not change the start date of 2022 for this monitoring requirement. However, considering staff proposed to delay the implementation of all the other amendments, manufacturers should not have an issue with implementing this requirement in the required timeframe.

23. Comment: The requirement for manufacturers to “perform a failure modes and effects analysis for every reasonable hydraulic or mechanical failure” for the variable valve timing, lift, and/or control (VVT) monitor should be changed to “perform a comprehensive analysis of every reasonable hydraulic or mechanical failure.” (EMA)

Agency Response: The monitoring requirement for VVT systems is malfunction detection for any single fault (mechanical, electrical, or hydraulic, etc.) in the system which results in emissions above the appropriate OBD threshold. A comprehensive analysis and/or testing of every possible single fault failure mode of the system is required to verify compliance. Staff used the phrase “failure modes and effects analysis” to convey the level of detail and quality of the analysis required for compliance, but have not specified a particular standard to allow manufacturers sufficient flexibility to carry out this analysis according to their own internal company policies and procedures. However, to address the commenter’s concerns, staff proposed 15-day changes (during the first 15-day notice) that deletes the phrase “failure modes and effects analysis” and requires manufacturers to “submit data and/or an analysis identifying all possible failure modes of the VVT system (e.g., partial or complete blockage of hydraulic passages, broken return springs, a failure of a single cylinder-specific pin to move into the desired position on a lift mechanism) and the effect each has (e.g., failure modes and effects analysis) across the entire range of operating conditions.”

24. Comment: The proposed regulation language requires monitoring of engine cooling systems “modulated by a control unit”, which has ambiguity regarding what constitutes a “control unit.” If an electric pump just turns on/off based on the coolant temperature, this could be interpreted as not being modulated by a control unit. This requirement also needs additional leadtime. (EMA)

Agency Response: The revised language is intended to require submission of a monitoring plan for engine cooling systems that rely on electrical signals including on/off signals. Control units determine whether to turn on/off the electrical water pump based on coolant temperature, hence the use of modulation by the control unit. CARB staff disagrees the revised language is ambiguous. Regarding EMA’s request for additional leadtime, CARB staff believes every manufacturer with such systems/components is already currently monitoring them, since they regulate the engine coolant temperature. Nevertheless, as already mentioned above in the Agency Response to Comment 10, staff proposed to delay the start date for this requirement from 2022 to 2024 as part of the first 15-day notice.

25. Comment: The new crankcase ventilation (CV) monitoring requirements will require boosted spark-ignition engines to monitor the lines between the crankcase and fresh air intake, which can only be done under boosted conditions. The monitoring of these lines on these engines should be subject to similar denominator requirements as those required for the high-load purge monitor in the OBD II regulation (section 1968.2(d)(4.3.2)(M)). This should be applied to both the HD OBD regulation and the OBD II regulation. (EMA)

Agency Response: CARB staff agrees and proposed 15-day changes (during the first 15-day notice) to require this denominator for monitoring lines through which crankcase vapor flows under conditions where the intake manifold pressure is greater than ambient pressure on vehicles with forced induction engines in both the HD OBD and OBD II regulations.

26. Comment: In the comprehensive component monitoring section, the language should be clarified to specify that monitoring is required if “NOx, NMHC, carbon monoxide (CO), or PM” emissions are affected to avoid confusion between criteria and GHG emissions. (EMA)

Agency Response: CARB staff agrees and proposed to language referring to NOx, NMHC, CO and PM emissions in this section as part of the first 15-day notice.

27. Comment: CARB proposed language in the HD OBD regulation to allow manufacturers to be exempt from monitoring the wait-to-start lamp if (1) the lamp is located on the instrument cluster on an LCD screen and a malfunction that blacks out the lamp also blacks out the vehicle speed, engine speed, and fuel level displays, or (2) the engine cannot crank until the glow plugs have been activated for a specific amount of time needed to optimize cold start performance and emission control. CARB should include the same proposed language in the OBD II regulation. (EMA)

Agency Response: CARB agrees and proposed the same allowance in the OBD II regulation as part of the first 15-day notice.

28. Comment: CARB should align the HD OBD regulation with sections 1968.2(e)(17.7), (e)(17.8), (f)(17.8), and (f)(17.9) of the OBD II regulation, which allow manufacturers to be exempt from monitoring a component/system if a malfunction of the component/system affects emissions and/or other OBD monitors only when the ambient temperature is below 20 degrees Fahrenheit or vehicle speed is above 82 miles-per-hour. (EMA)

Agency Response: The HD OBD regulation already contains the same monitoring exemption allowance related to low ambient temperatures. Regarding the monitoring exemption allowance related to vehicle speed, CARB agrees and proposed to include the same allowance in the HD OBD regulation as part of the first 15-day notice.

## REAL TRACKING REQUIREMENTS

29. Comment: CARB should continue to explore the use of REAL data that could enhance future comprehensive inspection and maintenance (I/M) programs. We support the use of OBD and potentially telematics to screen vehicles with applicable OBD sensors. Future programs may use the REAL data and malfunction code information as part of a thorough I/M program to analyze vehicle operation and diagnostic current and potential issues. CARB should share their REAL data and experience with other states seeking to improve their

I/M programs, who may benefit from a simplified way to learn how vehicles are performing on the road. (MECA)

Agency Response: CARB staff currently engages other states on I/M programs to share CARB's experience gained through California's OBD and I/M programs. CARB staff expects REAL data will be an important source of information for future CARB programs. As those programs are developed, staff will assess how the REAL data may be used and incorporated.

30. Comment: MECA continues to recognize the benefit to real-world carbon dioxide (CO<sub>2</sub>) reductions via the off-cycle credit program as a policy to expand the available technologies that vehicle manufacturers can deploy to meet the goals of light-duty GHG regulations. A potential approach to certifying technologies for off-cycle credits could begin by assigning a conditional pre-approved credit value to a technology based on modeling using EPA's ALPHA model or initial demonstration of the technology on a limited number of vehicles. This can be further combined with fleet simulation data across broader vehicle categories and real world conditions under which the technology may offer CO<sub>2</sub> reductions. REAL CO<sub>2</sub> data may be reported as a way to demonstrate the real world off-cycle credit value by averaging over hundreds or thousands of vehicles in the field to obtain statistically significant analysis and verification. Following a review of the field results, the final credit allocation could be adjusted appropriately based on real world experience. (MECA)

Agency Response: CARB staff thanks the commenter for the support of tracking real world CO<sub>2</sub> emissions. As data from the heavy-duty GHG tracking requirements become available, staff plans to work with U.S. EPA to update the GHG reduction values given in the Phase 2 Greenhouse Gas Emissions Model (GEM) for heavy-duty vehicles that utilize certain GHG technologies. There is no current plan to change the way CARB certifies heavy-duty engines. However, that may change in the future, and CARB staff thanks the commenter for the suggestion.

31. Comment: The proposed NOx and fuel consumption tracking requirements should be deleted since they are non-germane to OBD. The purpose of the HD OBD regulation described in section 1971.1(a) of title 13, CCR does not include tracking, storage, and binning of second-by-second emissions or fuel consumption data. The OBD regulations do not require tailpipe emission levels to be monitored at all, but instead are directed at monitoring emission control systems upstream to detect malfunctions in the system's ability to control emissions. CARB stated in the Staff Report that the data would be used for other CARB programs such as improving the emissions/GHG inventory models to accurately project benefits from current and future regulations being considered (e.g., when planning for compliance with California's GHG goals) and stated in the OBD regulation that the data would not be used for compliance purposes. So even CARB concedes that this tracking and binning proposal is beyond the scope of legitimate OBD requirements and amounts to manufacturer-funded emissions inventory research compelled by regulations. They should be considered a major new rulemaking action, specifically in the context of the development of next-tier new-paradigm low-NOx regulations where those types

of requirements will be most germane, requiring full cost-benefit and feasibility analysis along with an independent review by EPA to determine whether the preemption waiver requirements can be met. (EMA)

Agency Response: CARB staff disagrees with the commenter the proposed NOx emissions and fuel consumption tracking requirements should not be included in the OBD regulations. As was re-iterated many times to the commenter during this regulatory update and past regulatory updates, for example, when adopting the emission-increasing auxiliary emission control device tracking requirements in 2009, the argument that tracking requirements are unrelated to the detection, diagnosis, or repair of malfunctions is irrelevant. CARB is not precluded from including this requirement within the OBD regulation so long as it is properly noticed and CARB demonstrates that the requirement is necessary, cost-effective, and technically feasible. As set forth in the staff report and below, CARB has met these requirements. For practical reasons, the OBD regulation is the only CARB regulation that specifies standardized communication between an engine/vehicle and an off-board tool (e.g., a scan tool) and specifies the entire content of what information must be available through that link. The requirement to track and report NOx and fuel consumption data is an example of one piece of information that must be reported over that very same data link. CARB can and has required other information to be made available through this data link that also are not solely related to the detection, diagnosis, or repair of malfunctions but are intended to facilitate vehicle inspection and/or CARB's job of determining compliance on in-use engines/vehicles. Having all vehicle communication requirements in one regulation provides for simplicity and better organization for both CARB and industry. Therefore, OBD regulation is the appropriate place for all required data link information to be specified.

32. Comment: CARB failed to do the following: (1) consider whether the proposed emissions-binning requirement would be feasible at the ultra-low NOx standards that CARB is considering adopting for HD on-highway engines in 2019, (2) assess in an adequate manner the feasibility and cost of the engine software and data storage systems improvements needed for the vast amount of second-by-second data and to resort the data in 100-hour and cumulative increments, (3) assess the feasibility and cost of improvements that would be needed to enhance the processing speed and data-handling capabilities of current NOx sensors, and (4) taking into account the NOx binning proposal could require the use of additional ammonia sensors to ensure accurate NOx readings (not NOx plus NH<sub>3</sub>). The emissions-binning proposal should not be considered a simple "biennial" add-on to the HD OBD regulations due to these significant technical concerns. CARB's incorrect cost estimates for the NOx binning proposal shows a lack of understanding about writing software of the scope and complexity of modern engine software. CARB's estimate to develop one software feature is too low by a factor of 14 for the first engine family, with the overall estimate too low by a factor of more than 4. (EMA)

Agency Response: Contrary to the commenter, CARB did not consider this proposal a "simple 'biennial' add-on to the HD OBD regulations. It seems the commenter is under the impression that "biennial" updates to the OBD regulations should only

involve small and unsubstantial changes to the regulations, which is not correct. “Biennial” updates can involve any level of changes, including the proposed NOx emission tracking requirements. For (1), CARB staff does not foresee conflict with lower NOx engines (e.g., low NOx engines should still satisfy the +/- 0.1 g/bhp-hr accuracy specification). CARB staff, however, will revisit this as engine technology evolves in the future. For (2), the key hardware consideration was the amount of available memory (NVRAM). The proposal would require about 1.5 kilobytes of data to be stored in memory (which could require between 5 and 12 kilobytes of memory depending on the memory handling strategy employed by the manufacturer). Staff gathered information on the scope of hardware changes needed to accommodate this additional amount of data in non-volatile memory. A leading microcontroller manufacturer has already indicated that this increase is easily accommodated by its products. Other microcontrollers may require additional memory. CARB staff believes it has provided enough lead time to industry to work out solutions that fit each engine manufacturers’ own circumstances. For (3), the performance of today’s NOx sensor technology is adequate to meet the proposed requirements. The processing speed and data-handling capabilities of mainstream NOx sensors already provide NOx concentration data every 50 milliseconds, which is a higher resolution than needed to satisfy the NOx tracking requirements. Also, staff provided test data in the Staff Report which supports the assertion that current NOx sensor technology already satisfies the proposed NOx mass parameter accuracy requirement of an error of no more than 20 percent or 0.10 g/bhp-hr . For (4), no additional NOx sensors or ammonia sensors would be required to meet this proposal with today’s engines. As already mentioned in the Staff Report, although NOx sensors have the shortcoming of being cross-sensitive to ammonia, most heavy-duty diesel engines have low ammonia emissions owing to conservative diesel exhaust fluid (DEF) dosing calibrations and the widespread use of ammonia slip catalysts. This is evidenced by the generally good correlation between NOx sensors and laboratory-grade analyzers that CARB staff has observed in various truck testing programs.

33. Comment: CARB should allow a fleet phase-in period for implementing REAL, specifically with a single engine in 2022, 25 percent of the fleet in 2023, 50 percent in 2024, 75 percent in 2025, and 100 percent in 2026. The proposed start date of 2022 model year is premature, since the on-board sensors’ computing capability needed may not be ready by then. The limited data that CARB based their start date on has led to a misassumption that REAL can be reliably achieved throughout the vehicle’s full useful life by the 2022 model year. We have questions related to the data in the Staff Report. The data in Figure 1 on page 102 indicates the majority are over the NOx emission limit, but it’s unclear why the West Virginia University data (Figure 3 on page 108) and CARB test data indicate most are under the NOx limit. It’s unclear if ammonia, which can lead to significant error in the NOx reading and which the Staff Report states the industry is working to resolve, was measured. The data may be statistically inconclusive since there was a limited number of test runs. And it is unclear if CARB verified the vehicle warranty and service history or if the vehicles had their original parts. (MEMA)

Agency Response: Staff does not agree with the commenter's proposed phase-in plan and is therefore keeping the 2022 start date. As mentioned in the Agency Response to Comment 10 above, the implementation of REAL is an important and necessary step to address issues with high-emitting in-use vehicles and ensuring the emissions reductions projected from the standards programs are realized in the real world. Staff understands that the workload involved with implementing the REAL requirements is significant, so staff proposed through the first 15-day notice the delay to the other amendments to ensure early and robust implementation of REAL and to address manufacturer's workload concerns. Further, though staff is keeping the 2022 start date for REAL, it also proposed revisions to the implementation of REAL. Specifically, staff proposed amendments as part of the first 15-day notice that would allow manufacturers to either implement "reduced" REAL requirements in the 2022 and 2023 model years (before implementing the full REAL requirements starting with the 2024 model year) or implement the full REAL requirements starting in 2022 with reduced durability demonstration testing for OBD monitoring strategies in this timeframe.

The commenter's remark that CARB has mistakenly assumed that REAL can be reliably achieved over a vehicle's full useful life appears to specifically point to the accuracy of the tracked NOx data over time, and not the durability of the other aspects of REAL such as the engine controller and the software algorithms that support this tracking. Staff points out that it proposed changes as part of the first 15-day notice indicating that NOx data would not be tracked if the OBD system detects a malfunction with a NOx sensor. This safeguard greatly reduces the likelihood of tracking inaccurate NOx emissions data regardless of the stage of a vehicle's life. As an engine's selective catalytic reduction (SCR) catalyst deteriorates over time, the risk of ammonia emissions and the associated noise in the NOx data may increase. However, staff points out that sources of inaccuracy such as this are expected, which is one of the reasons why tracked NOx data will be used as a screening tool and not directly for compliance determinations. Staff also comments that compliance with the NOx mass accuracy specification is determined at the time of certification, and not via testing aged in-use trucks with potentially deteriorated SCR catalysts.

Regarding the commenter's confusion over the performance of trucks relative to the NOx emissions limit (standard), staff points out that none of the data (except from one engine) come from testing according to the official certification test procedure, which requires testing with an engine dynamometer. The vast majority of the data are from whole vehicle testing, both on-road and with a chassis dynamometer, and the 0.2 g/bhp-hr NOx emissions standard is shown for reference only. All of the data shown in Figure 1 are from in-use trucks with at least 1 month of actual service, primarily low-load duty cycles. CARB does not use such data to determine compliance with the NOx emissions standards, but rather to shed light on the real-world effectiveness of the certification program and manufacturers' emission control strategies. Although the West Virginia University data are in fact relevant for in-use compliance, staff further clarifies that the data come from a single truck and only show performance over Not-to-Exceed (NTE) events which require operating conditions that are favorable for the NOx-reduction performance of catalyst systems. The dataset cannot be used

to draw broad conclusions about the emissions compliance status of heavy-duty trucks.

CARB staff agrees with the commenter that ammonia contributes to error in the NOx concentration output of a NOx sensor. Emissions of ammonia were separately measured with laboratory instrumentation in many of the test runs shown in the laboratory versus OBD NOx comparison data that is presented in the Staff Report. Staff specifically excluded the data from two engine families from the same manufacturer that had large ammonia slip problems because staff wanted to characterize the accuracy of OBD NOx data from engines with properly calibrated reductant injection systems. The manufacturer of the high-ammonia slip engines has already recognized the problem and has implemented a calibration fix. The commenter also raises a question about the statistical conclusiveness of the data presented in the Staff Report. Staff's aim in presenting these data is not to make a statistically strong case that every truck is already compliant with the NOx mass accuracy specification. Instead, the purpose of presenting the data from the 11 different engines was to demonstrate that the sensor and controller technology that is in widespread use today is already capable of satisfying the accuracy specification, even without specifically being designed to do so. As such, the specification does not force new technology development. Lastly, staff clarifies that an exhaustive warranty and service history was not performed as part of this work. Trucks were evaluated on an "as is" basis to get a more representative picture of the heavy-duty fleet. Older trucks without OBD systems and one with an obvious NOx sensor malfunction were excluded along with the two engine families with high ammonia slip emissions.

34. Comment: CARB should revise the NOx emission tracking requirements in section 1971.1(h)(5.3.4) to apply them only to tailpipe NOx emissions/mass parameters, since engine-out NOx mass emission rates is not usually measured by the test facility. For engine-out NOx mass, it is sufficient to just require the use of the most accurate NOx concentration and exhaust flow rate values that are calculated within the applicable electronic control unit. (MEMA)

35. Comment: CARB should eliminate the data elements for engine-out NOx. Engine-out NOx emission tracking is clearly not related to any aspect of real-world emissions performance. Moreover, the requirements to determine the engine-out NOx emissions accuracy would require modifications to the exhaust system to obtain a sample, along with a separate NOx emission analyzer system in 1065 compliant test cells. So the cost and complexities of all of the requirements related to measuring tracking and binning engine-out NOx would provide no environmental benefit. (EMA)

Agency Response to Comments 34-35: CARB staff disagrees with the commenters and believes engine-out NOx emission tracking serves a useful purpose and is indeed related to real-world emissions performance. Engine-out NOx data enable calculation of NOx conversion efficiency of the selective catalytic reduction (SCR) system, the key metric in SCR diagnostics. The data also give insight into engine operation and health (e.g., if there is high tailpipe NOx found in recent data, it would



be useful to know if this was caused by recent engine-out NOx levels being higher than normal (engine problem vs. catalyst problem). Further, engine-out NOx lets CARB staff understand real world operation where engine-out NOx emissions are higher than represented on certification test cycles and, consequently, where the OBD system may not be properly detecting high emissions and/or where defeat devices may exist. On-road engine manufacturers utilize different engine and emissions control system strategies to meet and maintain emissions compliance. A manufacturer may choose to engineer their emission control system to reduce the amount of engine-out NOx while accepting an increase in PM emissions. In electing to do so, the manufacturer may size their SCR catalyst to handle the levels of NOx they expect to generate from the engine (based on this low NOx/increased PM strategy). If a malfunction manifests itself in the emission control system (e.g., a valve mechanism breaks), then the amount of NOx generated by the engine can increase. If the manufacturer did not engineer the SCR catalyst and DEF dosing system to handle this increased amount in NOx, this would result in an increase in vehicle emissions and would strain the aftertreatment system's ability to maintain emissions compliance. So staff believes engine-out NOx data serve a useful purpose.

36. Comment: CARB should delete the current and cumulative 100 hour data requirements since they are unwarranted and requires significant resources in terms of programming and data storage. Deleting these data would save about 30 percent of the NVRAM resources estimated for the NOx binning requirements and about 40 percent for the fuel consumption tracking requirements. CARB should limit the collected information to the lifetime arrays only since there are only two logical scenarios for CARB to access the data: (1) when CARB develops a program requiring the data be reviewed as part of a compliance evaluation, or (2) if CARB wants to evaluate a given in-use vehicle over a specific test route. The lifetime data would provide all the relevant information by downloading the vehicle history or comparing the vehicle history before and after testing on the specified route. Short-term vehicle emission studies can be performed by recording the lifetime and engine activity array data before any data collection begins and subsequently subtracting the previously recorded data when data collection ends to assess the vehicle short-term emissions behavior. Regarding CARB's proposal to require data to be captured and reported to CARB when an over-the-air (OTA) reprogramming event occurs, the amount of data will be significantly greater if real-time and 100-hour data are included. CARB agreed that these data do not need to be included as part of the OTA reprogramming event update provisions, which confirms that these data are not necessary. The proposal also does not include provisions for CARB to access, store, or analyze the data. (EMA)

Agency Response: CARB disagrees with the commenter and did not delete the active 100-hour and stored 100-hour array requirements. Regarding the comment about how the lifetime data themselves would provide all the relevant information, there are issues with manually recording the parameter data in the Lifetime and Lifetime Engine Activity arrays at the start and at the end of an individual test cycle. It is possible for the operator to make an error when writing down the information or inputting the information into a spreadsheet on a computer. In addition, the

parameter data in the Active 100-hour array have finer resolution than that of the parameter data in the Lifetime and Lifetime Engine Activity arrays. As such, if NOx and fuel consumption tracking and binning data are to be collected on an individual test cycle that is much shorter than the overall accumulated operating conditions of the lifetime arrays, the finer resolution of parameter data will best be captured for analysis in the Active 100-hour array. For the fuel consumption data, staff requested the active and 100 hour arrays in order to better understand how a truck's recent activity has impacted fuel consumption. Although short-term performance studies could determine the fuel consumption over the study period by comparing the lifetime fuel consumption values at the start and end of the study, staff anticipates the active and 100 hour arrays will be collected outside the purview of structured studies. Staff anticipates that active, 100 hour, and lifetime values may be collected from hundreds, perhaps thousands, of vehicles. These data would be stored on each vehicle and periodically transferred through telematics to CARB staff to populate an in-use database. Calculating the short-term fuel consumption from lifetime parameters of each vehicle would be impractical. While staff understands that there are significant data storage requirements for the proposed fuel consumption tracking active and stored 100 hour arrays, staff believes they are necessary and feasible at reasonable costs.

Regarding the comment about CARB limiting the data reported to lifetime parameters when OTA programming updates occur, CARB staff disagrees with the commenter's assertion that this confirms that the active and stored 100-hour data are not necessary. The purpose of the requirement is to preserve snapshots of the fleet's lifetime data parameters when such parameters will be permanently erased by the occurrence of over-the-air programming updates. While it is true that the 100-hour parameters will also be erased, the active 100-hour parameters will regenerate completely after 100 hours of vehicle operation, and the stored 100-hour parameters will be fully regenerated after 200 hours of vehicle operation. As such, CARB staff believes the vast majority of in-use vehicles from which the data will be downloaded will have already regenerated the 100-hour parameters since the last reprogramming event, making it unnecessary for such data to be reported at the time of the last reprogramming event. The lifetime parameters will never fully regenerate in this manner, making the reporting requirement beneficial and necessary to fully make use of the data.

Regarding the last part of the comment, CARB does not need to include language into the OBD regulations to explain how CARB staff will access, store, or analyze the data that are submitted. As already described in the Staff Report, CARB staff would potentially use the data to identify populations of vehicles for additional testing, identify conditions in-use where vehicles are not performing as expected with regard to emission control, and generally better inform CARB's inventory, regulatory, certification, and enforcement programs.

37. Comment: For the NOx tracking requirements, using the Active 100-hour and Stored 100-hour array data to study 10 and 20-minute vehicle and engine dynamometer tests would require rescaling the data to accommodate 4 bytes to be able to display a change in NOx tons that would needed to be scaled in micrograms. This scaling adds about 30 percent to the NVRAM memory

requirements and it not believed to be feasible. Industry communication committee members proposed 2-byte scaling in February of 2018 for SAE J1939-DA and developed notional scaling based on dimensional analysis. The members believe that CARB staff concurs with that assessment based on recent CARB staff discussions with SAE motor vehicle counsel (MVC) and truck and bus counsel (T&BC) Communication committee members. (EMA)

Agency Response: CARB staff disagrees with the comment. The question of which scaling to use for the 100-hour arrays has now been worked through with both SAE J1979 and J1939 committees, and as indicated in the incorporated documents, in both cases a 4-byte scaling has been agreed upon to be able to support short term vehicle activity. Further, staff notes that changes were proposed as part of the first 15-day notice that removed the requirement to store the Active 100-hour array data in NVRAM, which helps to alleviate concerns over total NVRAM requirements.

38. Comment: The tests required to meet the NOx mass parameter accuracy requirements add to industry's test burden and increases utilization of scarce Part 1065-compliant emission test cells at a time when CARB is demanding increased utilization for MST and monitor demonstrations. Comparing the tolerance stack-up against the accuracy requirements, the available design margin after the stack-up is believed to be 2 percent or less than 0.01 g/bhp-hr based on industry discussions with SAE MVC and T&BC committee members and CARB staff. Such a slim design margin suggests that a manufacturer can, in good faith, calculate tailpipe NOx based on the formula and methods disclosed during the November 2018 workshop and subsequent staff presentations to the public, and still have CARB staff claim the manufacturer did not meet the accuracy requirement and result in a deficiency. (EMA)

Agency Response: The commenter is incorrect when it stated that "CARB is demanding increased 1065 compliant test cell utilization for MST and monitor demonstrations" – CARB has proposed no new demonstration tests and has in fact significantly decreased testing requirements for MST. These reductions more than offset the additional testing associated with this new requirement. Some manufacturers already include a special 2xFTP test (i.e., testing with 2 FTP cycles back to back) as part of their normal demonstration testing, but may not do so in a baseline configuration (i.e., with no malfunctions present). For those that do not, CARB staff agrees that demonstrating the NOx mass accuracy would indeed add to the testing burden. However, the additional testing amounts to 40 minutes of testing that can easily follow other baseline testing because no cold-start is required. The commenter's concerns over the potential difficulty of complying with the accuracy requirements because of an extremely slim design margin do not appear to be well founded. Data collected by staff under both on-road and test cell conditions as well as confidential data shared by several manufacturers consistently show compliance with the accuracy requirements even without any intention or effort on the part of the manufacturer to do so. The accuracy requirements were developed by staff as a reflection of what today's technology is already accomplishing in its present condition; this is not a technology forcing requirement. Further, industry has not supplied any data to show these specifications are not technically feasible.

39. Comment: The NVRAM requirements for the current HD OBD regulation is at least 2,296 bytes, and includes test results, fault codes (e.g., pending, MIL-on, previously MIL-on, permanent), IUMPR data, EI-AECD timers, freeze frame data, the vehicle identification number, and the engine serial number. The increased NVRAM requirement is 1856 bytes for the NOx binning and 336 for the fuel-consumption tracking (assuming 5 engine controller active technologies), resulting in 2,192 total bytes. The total for a single copy of the NOx binning and fuel consumption tracking element is 2,384 bytes of new information to be stored across ignition key cycles. Flash NVRAM technology requires an engine memory block to be erased before individual memory locations can be reused for new data values. Assuming 512 bytes for an NVRAM memory block, there must exist some overhead memory locations since all 512 bytes are erased. The 2,192 bytes of information fit into 5 512-byte NVRAM blocks for a length of 2,560 bytes. Multiple memory locations are required, and when 2,560 bytes are multiplied by 8 assumed memory locations (using the “ring of eight” effect, which is described in more detail below), a total of 20,480 bytes are needed. This represents a ten-fold increase over the current NVRAM allocation and more than half the 32K flash NVRAM block size planned for Near Term NXP chips. It is not certain if there are sufficient available ECU and data storage resources to support those requirements.

NVRAM technology does not provide infinite life in terms of the number of times a value can be written into an individual memory location, and instead exhibits an established wear-out phenomenon. For data that is stored frequently, there must be multiple memory locations to achieve the desired product-life goals. A “ring of eight” strategy can be used to allocate each data item 8 memory locations in NVRAM, where the data storage routine rotates the memory locations such that each of the 8 locations is used equally (i.e., utilized for one-eighth of the storage events). The life estimate for the NVRAM locations is summed across the 8 locations to provide the expected life for the ring of 8 storage method. Also, the demand for 4-byte parameters in the active and stored 100-hour arrays will increase the NVRAM size to 28,672, with the proposed 16 bins times 6 parameters for each bin driving this increase. This is more than half the 32K flash NVRAM block size planned for Near Term NXP chips. Publicly available information from NXP suggests that applications with a high NVRAM demand may challenge existing microcontrollers once used for engine controls. Even though an individual microcontroller may have 4 megabytes of flash data in the same ball-grid array package as the microprocessor, only a fraction of the data is configured to emulate electrically erasable and programmable read-only memory (EEPROM) that would be utilized for the NOx and fuel consumption tracking data. Manufacturers with a high utilization for that data today would be forced to migrate to a new microcontroller family to obtain additional memory.

Heavy-duty manufacturers do not use battery-backed RAM (or keep alive memory (KAM)) for such requirements since many heavy-duty vehicle owners disconnect the vehicle’s batteries, causing the data to be lost. Battery-backed RAM can also disturb the voltage drop that is experienced when starter motor is engaged on a diesel engine. A reset of an engine control module (ECM) during

engine start is a known phenomenon. So the existing requirements (e.g., test results, fault codes, freeze frame data) require NVRAM. (EMA)

Agency Response: CARB staff is confused about some of the numbers stated by the commenter. The commenter indicated that 2,384 bytes of increased NVRAM would be required to account for a single copy of the new NOx/fuel-consumption binning and tracking information. However, the detailed information provided by the commenter shows 2,192 bytes of NVRAM are required, which, after summing this with the existing NVRAM requirements, results in 4,488 bytes of NVRAM. If the commenter's assumption that an NVRAM memory block of 512 bytes is used, then 4,488 bytes of information are defined to fit in ten 512 byte blocks. Using the commenter's assumption that a "ring of eight" strategy is employed, this would result in a minimum of 40,960 bytes of NVRAM. Staff's understanding is that manufacturers typically specify 64 kilobytes of NVRAM in engine control modules. Furthermore, staff proposed language as part of the first 15-day notice that would allow parameter data from the Active 100-hour arrays to be stored in KAM, giving manufacturers the option of reducing the amount of NVRAM used by the system. Thus, sufficient memory storage is available to implement NOx and fuel consumption tracking and binning into manufacturers' systems. It also should be noted that the "ring of eight" strategy is not a requirement, so not all manufacturers will employ the "ring of eight" strategy and may utilize less memory space, as described in the Agency Response to Comment 40 below.

With regard to the finite number of times a memory location can be overwritten, staff's understanding is that the industry standard for the number of write cycles for a given memory location is 10,000. If, on average, data are written to NVRAM 4 times per day, then each memory storage location is overwritten once every 2 days. This calculates to an NVRAM useful life of over 54 years. Staff does not have any concerns with regard to the system exceeding the finite number of times a memory location can be overwritten within the useful life of the vehicle.

40. Comment: EMA disagrees with CARB's calculations that hardware costs per unit will increase by 10 dollars (\$10.00), which is not representative of actual costs. Each manufacturer will need to install additional memory into their own engine ECM(s), which then must be requalified for its functional, environmental and lifetime expectations. Those costs are borne by each manufacturer and amortized by the individual manufacturer's annual sales, not by an industry average annual volume. Few heavy-duty diesel engine manufacturers approach automotive-scale volumes in excess of 200,000 ECMs per year and can share hardware development costs with a light-duty diesel engine platform.

New microcontroller chips with additional memory cannot be assumed to be a direct substitution within an existing ECM's bill of material and be given a brief functional check. The new chips may create a domino effect that could require modifications to the ECM's printed circuit board. For example, if the footprint of the chip does not match the footprint of the existing microcontroller, then the printed circuit board must be modified to accommodate the new chip. As another example, if the new chip requires more power than the old chip, then the power supply circuit will be changed to

provide the additional current. Increases in power imply increases in heat rejection from the microcontroller package. Finite element analysis to determine the microcontroller manufacturer's maximum junction temperature must be performed again using the new inputs and validated in temperature chamber tests. In some cases, the existing housing may not be used due to the changes to the printed circuit board, so new die casting tooling for an aluminum clamshell would be needed to protect the circuit board and adapt it for mounting to the engine.

The new ECM part number must be approved through the Production Part Approval Process (PPAP), which requires that all key functional criteria are met. They may also be subjected to a vehicle trial that is judged using statistical analysis based on the Weibull curve. A vehicle trial was performed showing the test planning tool output and assuming Weibull analysis will be used on the collected data. Looking at the mileage accumulation required and test years anticipated for a given set of statistical goals, a reliability goal of 300,000 miles (compared to the industry service life goal of 1.2 million miles for vehicles with heavy-duty diesel engines) and low confidence of 75 percent would still require nearly 20 trucks with an annual test expectation of 4,000 hours per vehicle at 40 miles an hour to qualify a new ECM in under 18 months. The costs of the vehicles, drivers' wages, and the fuel are not in CARB staff's estimates for memory improvement.

Many tests must be performed when creating a new ECM or modifying an existing ECM. Commonly, tests included in PPAP data collection reflect what is shown in Table 4 of SAE J1455™ [March 2017] and are performed in addition to the functional tests associated with the device, which may include tests to confirm the current control waveforms and timing for fuel control systems. Other tests include environmental tests, temperature cycling protocols to the underhood temperature guide, electromagnetic compatibility tests, and many other tests related to HD vehicle electronics and listed in SAE J1455. This testing will exceed the calculated \$10,000 cost in the Staff Report. (EMA)

Agency Response: The commenter states that CARB staff's cost increase estimate of \$10 per controller is not representative of actual costs, and then proceeds to paint a theoretical picture of the worst-case scenario in which fundamental redesign of the engine controller may be necessary to support the non-volatile memory needs of the new tracking requirements. The comment does not, however, include any alternative cost data or any information on the likelihood of the potential design changes that are mentioned. As such, CARB staff acknowledges that some of the considerations indicated may be necessary depending on the highly-specific circumstances of a given manufacturer, but does not have any basis for accepting that fundamental controller redesign is universally necessary.

The scale of the changes required in the controller are a function of the estimated memory required to satisfy the tracking requirements relative to the amount of memory available on the controller. CARB staff disagrees with the commenter's

estimated 20 to 28 kilobyte (kB) memory required for tracking. First, this estimate assumes that 8 times the actual memory required must be allocated on the controller to ensure sufficient longevity (“ring of eight” strategy). This is one method of several which are employed by engine controllers. Staff had discussions with one manufacturer, for example, that utilizes an approach that requires only 3 times the actual memory required. Another issue with the commenter’s memory estimate is the doubling of memory needed before applying the factor of 8 to account for “intermediate values”. Staff does not believe that an entire doubling of memory is needed to account for fractional values of parameter data that are smaller than the resolution afforded by a given parameter. For example, if the resolution of the 4-byte lifetime engine output energy parameter is 1 kilowatt-hour per bit, a short trip that adds only 0.1 kilowatt-hours would not be enough to increment the parameter’s value. Using additional memory to capture small intermediate numbers until the primary parameter’s value can be incremented would provide enhanced resolution. For this example, 1 byte would support a resolution of 0.004 kilowatt-hours per bit which adequately covers very small amounts of engine output energy. To assume another full 4-bytes of memory is necessary is not appropriate. Staff adds 1-byte per parameter to account for intermediate values in the estimates shown below. Finally, staff points out that the changes were adopted as part of the first 15-day notice that modify the data storage requirements such that non-volatile memory is no longer needed for the 100-hour active array. Given all of these considerations, staff estimates a total non-volatile memory usage that will occupy 3 blocks of 512-byte memory for a total of 1,536 bytes. Applying a factor of 3 to 8 to represent a range of writing and erasing techniques, the resulting range of memory needed comes to about 5 to 12 kB, which is substantially less than the commenter’s estimates.

It is useful to put these memory estimates in the context of what level of non-volatile memory is commercially available today. Technical specifications of this nature are hard to come by, but a widely-used manufacturer of engine controllers has publicly-available product literature showing its engine controller is designed with 128 kB of non-volatile memory. Staff’s estimate of 5 to 12 kB described above is a relatively modest 4 to 10 percent of total non-volatile memory. This level of increase should be manageable and not necessitate a fundamental redesign of the controller.

41. Comment: The data in the Lifetime engine activity array (section 1971.1(h)(5.3.1)(E)) duplicate data in the run time tracking and fuel consumption tracking requirements (section 1971.1(h)(5.2.1)(A)). The values in sections 1971.1(h)(5.3.1)(D) and (F) (for “distance traveled” and “vehicle fuel consumption”) duplicate values in sections 1971.1(h)(5.4.5) and (5.4.10). Those duplications, which were noted in prior discussions with CARB staff, should be eliminated. These values should be calculated only once. (EMA)

Agency Response: CARB staff disagrees and did not delete any of these “duplications.” While the parameter in section 1971.1(h)(5.3.1)(E) (engine run time) does largely duplicate the parameter in section 1971.1(h)(5.2.1)(A) (total engine run time), the engine run time parameter for NOx tracking is based on a 1

Hertz (Hz) sampling rate and is synchronized with the other lifetime NOx tracking parameters. Therefore, important technical differences between the data stored for each requirement do exist. CARB staff believes leaving out the engine run time parameter data in the lifetime array would be inappropriate. With regard to the “distance traveled” and “vehicle fuel consumption” parameters, the proposed 45-day regulation language in section 1971.1(h)(5.7.2)(C) already addressed this issue, stating that these parameters are not required to meet section 1971.1(h)(5.7.2)(C) if the OBD system meets the requirements in section 1971.1(h)(5.3).

42. Comment: CARB should remove the positive kinetic energy (PKE) data, which does not directly improve air quality or improve OBD monitor performance. No industry precedence has been set for the use of PKE data for heavy-duty vehicles, with only a few scientific papers discussing its use. CARB’s inclusion of PKE amounts to industry-subsidized research into driving habits of heavy-duty drivers, who already have an economic incentive to maximize fuel economy. CARB’s own studies in support of the biennial review omitted PKE as a data collection objective when reported to the HD OBD symposium, which indicates that PKE data have low value added compared to the expense. PKE data for heavy-duty vehicles exhibit bimodal or multi-modal distribution because of the disparate power-to-weight ratios of the vehicles created under loaded and unloaded conditions, with the resulting values representing a weighted average of disparate modalities that would not reflect the more common operating conditions of the heavy-duty vehicles from which it was collected. Therefore, more studies should be done on PKE in heavy-duty vehicles before industry expends money on implementing this proposed requirement. (EMA)

Agency Response: CARB staff disagrees with the commenter's assertion that the inclusion of PKE as a data collection objective is of little value and should be discarded. PKE is a parameter used to quantify the aggressiveness of a drive cycle. The value for PKE only accumulates while a vehicle experiences positive acceleration over a drive cycle. It is calculated by subtracting the squared initial velocity from the squared final velocity and dividing the difference by distance. Mass is not used in the calculation, and thus, PKE will be the same for a given drive cycle regardless of the weight of a vehicle. Table 1 lists the PKE values for several heavy-duty driving cycles.<sup>8</sup> This table was included in CARB’s staff report for the rulemaking.

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<sup>8</sup> (CARB, 2016) Appendix A: Technical Supporting Information, Staff Report: Initial Statement of Reasons for Board Hearing to Consider the Proposed Regulation to Provide Certification Flexibility for Innovative Heavy-Duty Engines and California Certification and Installation Procedures for Medium-and Heavy-Duty Vehicle Hybrid Conversion Systems (Innovative Technology Regulation), California Air Resources Board, 2016.



<b>Table 1: Key Statistics for Typical Transient Truck and Bus Duty-Cycles</b>			
	<b>Average Driving Speed (mph)</b>	<b>PKE (feet/sec<sup>2</sup>)</b>	<b>Percent at Zero-Speed</b>
<b>Heavy-Duty Urban Dynamometer Driving Schedule</b>	28.2	0.90	33.3%
<b>Heavy-Duty Transient Test Cycle</b>	18.2	0.98	15.7%
<b>Hybrid Truck Users Forum (HTUF) Class 4 Parcel Delivery Cycle</b>	22.5	1.13	46.4%
<b>HTUF Class 6 Parcel Delivery Cycle</b>	21.9	1.15	54.2%
<b>Neighborhood Refuse Truck Cycle</b>	21.5	1.36	48.1%
<b>Orange County Bus Cycle</b>	15.7	1.43	21.3%

For vocational trucks, PKE will be a useful parameter when comparing the fuel consumption data from similar vehicles. By comparing the PKE results to the PKE values of the cycles listed, as well as other cycles, staff can begin to put into context how the vehicle was driven. By looking at other parameters collected simultaneously from the same vehicle, including engine output energy (EOE) and average vehicle speed, staff can better understand why differences in recorded fuel consumption exist between two similar vehicles.

For vehicles that operate at high speeds for long periods of time (e.g., combination tractors), PKE is less indicative of how a vehicle was driven because of far fewer accelerations and decelerations. However, as combination tractors transition from their first and second owners and switch from line-haul to short-haul (e.g. drayage) duties, PKE will be a useful parameter to help put into context any observed changes in fuel consumption. CARB had informed the commenter of its intent to adopt the PKE parameter since the start of the rulemaking update and mentioned the parameter during several subsequent meetings with the commenter, including the workshop in November 2017. CARB staff is unsure which HD OBD symposium the commenter is referring to, but at many of these symposiums in the last two years, CARB staff had indicated in their presentations that most of the GHG parameters already adopted in the OBD II regulation (which includes the PKE parameter) would be adopted in the HD OBD regulation. Furthermore, presentations at the HD OBD symposium are not designed to provide comprehensive and exhaustive updates on the program. The commenter's statement that the omission of specific mention of the PKE parameter in CARB's symposium presentations indicates the unimportance of the parameter is incorrect and misleading. Further, the sparsity of formal scientific papers discussing the use of PKE data for HD vehicles does not make the information any less useful as a metric to gauge what operating conditions a vehicle has been subjected to and determine if there is a correlation to the fuel consumption by the system. For the reasons discussed above, CARB staff did not remove the PKE parameter.

## OTHER STANDARDIZATION REQUIREMENTS

43. Comment: The SAE J1939-DA and SAE J1979-DA versions cited in the 45-day proposal do not provide the new content that is proposed in draft section 1971.1(h). The large number of requests (over 450 new individual data items, an increase of 400 percent) will create a much longer than commonplace request queue for committee work. This will be difficult for industry's standards-development volunteer work force to complete, and adds risk to the 2022 model year engine requirements. (EMA)

Agency Response: CARB staff is aware that the versions of SAE J1939-DA and J1979-DA that were included in the 45-day notice regulatory language do not contain the new data parameter content proposed by CARB staff. However, since release of the 45-day notice, CARB staff has been actively involved with manufacturers in helping to update these SAE documents. At this point, work to update the standards is complete, and the publication dates for the revised documents (April and May, 2019, respectively) were included in the first 15-day notice of proposed changes.

44. Comment: The proposed HD OBD regulation language for the diagnostic link connector (DLC) location on vehicles with no drivers' side doors in section 1971.1(h)(2.2.1)(A) is not fully consistent with the content in sections 1971.1(h)(2.2) and (2.3). Are vehicles that comply with the additional language in section 1971.1(h)(2.3) fully compliant, or do both sections 1971.1(h)(2.2.1)(A) and (2.3) apply to all vehicles without driver's side doors? The driver's side edge of a center console is where the accelerator pedal is located and, as result, is not a practical location because no cables should be in proximity of the accelerator pedal. Section 1971.1(h)(2.2.3) specifies that manufacturers are required to place the connector in a manner to ensure safe vehicle operation. For vehicles without a driver's side door, mounting the connector on the opposite side of the center line from the accelerator pedal provides a safe accessible location for connection of a scan tool. The insistence on the left side of the console or the vehicle centerline as the limit for vehicles with no driver's side door is an arbitrary choice, especially with respect to a technician who will be on the opposite side of the vehicle centerline from the accelerator pedal when he is looking for the diagnostic connector, and especially when his sightline may be obstructed by the center console. Locations to the right of the centerline are clearly closer to the crouched technician than those to the left of the centerline. Locations visible to the technicians viewing the vehicle interior may not meet the limits imposed in section 1971.1(h)(2.2.1)(A), but would still provide acceptable, if not preferred, alternatives to locations left of the steering wheel. Further, additional content that is not prefaced with an effective date, and the regulation of autonomous vehicles is a substantive change. Vehicle dash panels and center consoles are highly tooled. New location content means that vehicle manufacturers will be required to modify dash panel and/or center console tooling by engine manufacturers to comply with the regulation. (EMA)

Agency Response: The proposed 45-day regulation language in section 1971.1(h)(2.2.1)(A) requires the DLC on vehicles with no driver's side doors to be located in the driver's side foot-well region of the vehicle interior in the area bound by the driver's side of the vehicle and the driver's side edge of the center console (or

the vehicle centerline if the vehicle does not have a center console) and at a location no higher than the bottom of the steering wheel when in the lowest adjustable position. The commenter stated that the driver's side edge of the center console is not practical due to proximity of the accelerator pedal. It should be noted that the proposed language in section 1971.1(h)(2.2.1)(A) only defines the boundaries of connector location, not the precise location. Therefore, as has been done for previous model year vehicles, manufacturers should design connector locations which are safe and do not interfere with operation of the accelerator pedal. Further, the proposed 45-day regulation language section 1971.1(h)(2.3) requires the connector to be easily identified and accessed by a "crouched technician." The commenter indicated that the connector may not be easily identified and accessed by a crouched technician if the connector is located in the proposed area described in section 1971.1(h)(2.2.1), since the technician will be on the opposite side of the vehicle centerline and may have his or her sightline obstructed by the center console. To avoid confusion, CARB staff proposed 15-day changes (during the first 15-day notice) to delete the word "crouched" and to modify the language as follows: "For vehicles not equipped with a driver's side door, the connector shall be capable of being easily identified and accessed by a technician inside the vehicle and observing the foot-well region from an eyesight level located at the bottom of the steering wheel."

CARB staff is confused about the comments indicating that "regulation of autonomous vehicles is a substantive change." CARB's proposed regulation language requires manufacturers to come in with a proposed location for the DLC, since the current language does not cleanly fit autonomous vehicles (e.g., they may have no steering wheels or pedals). Manufacturers are not allowed to locate the DLC wherever they want without CARB's review and approval even if the regulations do not directly address autonomous vehicles. Furthermore, there are currently no autonomous vehicles certified today. So CARB disagrees with the commenter's assertion that the regulation language related to autonomous vehicles are "a substantive change." Regarding the comment that "Additional content that is not prefaced with an effective date... is a substantive change", if this is related to the new language regarding vehicles with no driver's side doors, then CARB staff considers this a clarification. For these vehicles, manufacturers should have been coming to CARB with their proposed location of the DLC.

45. Comment: CARB should harmonize the OBD regulation definition terms with SAE and ISO document definitions to promote better understanding and harmonization across product lines around the world and minimize confusion in industry and with consumers. (MEMA)(MECA)

46. Comment: Harmonization of definitions and accepted acronyms will aid future Vehicle Emissions Control Information (VECI) label requirements. (MEMA)

Agency Response to Comments 45-46: Staff agrees that harmonizing the terms used in the HD OBD regulation and the SAE and ISO documents would help prevent confusion in the industry and with customers. The HD OBD regulation, however, allows heavy-duty engines to use two different communication protocols, one of which uses SAE J1979 and the other SAE J1939. The terms used may be different

in each SAE standard for the same parameter, so staff would have to determine how to best reflect both terms in the regulation. Unfortunately, staff was unable to make any changes to the regulations to address this issue as part of the 15-day notices. Staff understands the commenter's concerns and will seek to harmonize the terms used in the HD OBD regulation with those used in the standards at a future HD OBD rulemaking update.

47. Comment: Regarding CARB's proposed addition of "(short term, long term, secondary)" to the "fuel trim" parameter, only two categories of fuel trim are defined in SAE J1939-DA and are believed to support all fuel trim communication needs today. It is expected that any party needing to define a third category will inform the SAE committee with the new need. (EMA)

Agency Response: SAE J1939-DA only describes long term and short term fuel trim, while SAE J1979-DA has all three categories. Gasoline engines, which utilize secondary fuel trim, are subject to the parameters listed under SAE J1979-DA since they use the ISO 15765-4 communication protocol. Further, the regulations require these parameters only on engines "so equipped." If the engine does not support secondary fuel trim, then it does not need to report the secondary fuel trim parameter. Therefore, CARB did not make any changes to this regulation language.

48. Comment: CARB should delete the proposed parameters "modeled actual ammonia storage level on SCR" and "target ammonia storage level on SCR" from the list of data stream parameters required to be reported by the engine. The requirement must be limited to available parameters. The ammonia storage level parameters present manufacturer proprietary information, which may be shared (if equipped) as part of the data collected during demonstration testing. These parameters are not believed to be necessary for diagnosis and repair of SCR-related components. DEF dosing rate is enough to identify the operating goals of the engine. (EMA)

Agency Response: CARB disagrees and did not delete these two parameters from the regulation. These parameters are critical to the performance of the SCR system just as EGR rate is to engine out emissions. When a fault is set for an SCR efficiency failure, providing the technician with data indicating whether adequate ammonia storage was present on the catalyst at the time of the fault is critical information to assist the technician in root cause analysis.

49. Comment: CARB should not require engines to report the odometer reading, since this is the vehicle manufacturer's responsibility and instead should report the total vehicle distance. The engine ECM typically provides a vehicle distance display that, even though it is highly correlated to the odometer, is not guaranteed to match the odometer display. This display is used by the engine manufacturer to assess warranty claims data where the value of the odometer (the commonplace data for administering warranty claims) is in dispute. Industry believes that existing displays of total vehicle distance by engine and vehicle components will provide suitable data for CARB's needs. The current methods between engine manufacturers and vehicle manufacturers are founded on prior negotiations regarding the level of responsibility that engine manufacturers are

willing to assume on behalf of the vehicle manufacturer. An example legal policy disclaiming responsibility for the odometer by an engine manufacturer has been previously provided as confidential business information. Reversal of such a settled matter between engine and vehicle manufacturers is not recommended. (EMA)

Agency Response: Staff understands the issues, and, after further discussions and agreement with industry, have proposed 15-day changes (during the first 15-day notice) that would require the OBD system to instead report to “chassis odometer reading,” which all vehicles should have, and “engine odometer reading” parameter if the engine is so equipped.

50. Comment: Regarding the requirements in section 1971.1(h)(4.4.2)(B), the manufacturer should have some say regarding the coordination of their service system and their products diagnosis and repair. “To the fullest extent possible” can be interpreted to mean that non-repairable components (e.g. resistors and capacitors in individual PWB circuits) need to be individually diagnosed, which may not be what CARB wanted. It shows that the language in the phrase is overly broad. The language in this section should reflect the content in the requirements for circuit faults in section 1971.1(g), which has specified the performance criteria distinctly for electrical circuit diagnostics, eliminating the need for the overly broad language. (EMA)

Agency Response: Although changes to section 1971.1(h)(4.4.2)(B) were adopted by the Board, the comment does not specially address a proposed 45-day amendment since the specific language for which the commenter expressed concern was in the regulation prior to the current rulemaking update. However, CARB staff will still respond to the comment. The first two sentences of the section (“Except as otherwise specified in sections (e) through (g), the stored fault code shall, to the fullest extent possible, pinpoint the likely cause of the malfunction. To the extent feasible, manufacturers shall use separate fault codes for every diagnostic where the diagnostic and repair procedure or likely cause of the failure is different.”) make clear that the fault codes should direct technicians to specific diagnostic and repair procedures for the faulty component or system rather than general fault information that requires a technician to go to greater lengths to run off-board tests or guess what needs to be repaired. The language in the context of the section cannot in CARB staff’s opinion be reasonably interpreted to require fault codes that point to unserviceable subcomponents as minor as resistors or capacitors on printed circuit boards. Since manufacturer emission control system designs and service procedures vary greatly, the regulation does in fact rely on the manufacturer to identify which specific fault code pinpoints the cause of the malfunction to the repairable/replaceable component or system. The manufacturer’s determinations are reviewed and approved through the certification process.

51. Comment: The requirement for manufacturers to submit calibration verification number (CVN) and calibration identification number (CAL ID) information to CARB should be deleted. At the 2018 U.S. SAE OBD Symposium, it was discovered that CARB was not using the CVN and CAL ID information submitted

by manufacturers. The California Bureau of Automotive Repair (BAR) reported that, for Smog Check, it currently gets this information directly from manufacturers and not from CARB. Generating the reports for CARB is a burden on manufacturers, so deleting this requirement will not have any impact to CARB and BAR's ability to do their work. (EMA)

Agency Response: The comment does not directly address a proposed 45-day amendment since the requirement the comment is addressing existed prior to this rulemaking. However, CARB staff will still respond to the comment. CARB staff disagrees and did not delete this requirement. CARB staff believes that its comments at the referenced symposium were misunderstood by the commenter. The point of CARB's comments was that it would be more efficient for BAR to get necessary CAL ID and CVN data directly from the manufacturers rather than by transfer of the data received by CARB to BAR. Although the CAL ID and CVN data received has been somewhat underutilized in the past, CARB staff is currently working with the data, and the elimination of the requirement for manufacturers to provide it would in fact impact CARB's ability to conduct program evaluations including those related to in-use tampering of OBD and other emission controls. Further, while it is true that some CAL ID and CVN data is available to BAR via manufacturers' service websites, it is not available for all manufacturers, and the access is only convenient when very limited data is needed for specific vehicles. CARB and BAR will continue to work with manufacturers to see if the transfer of information can be made more efficient and less burdensome for all parties.

52. Comment: Engine manufacturers believe the vehicle manufacturer is responsible for the display of the vehicle identification number (VIN) and engine serial number (ESN) on incomplete chassis and complete chassis sold by the vehicle manufacturer. Display of the VIN and ESN does not meet the criteria of a "diagnostic or emission critical control unit" control module in section 1971.1(c). Industry believes that SAE J1939-84 should better reflect the text in sections 1971.1(h)(4.8.1) and 1971.1(h)(4.8.2) to accept original equipment manufacturer-provided VIN and ESN. (EMA)

Agency Response: The comment does not directly address a proposed 45-day amendment since the requirement the comment is addressing existed prior to the rulemaking. However, CARB staff will still respond to the comment. There are no technical barriers to making the VIN and ESN data available through the diagnostic link. All manufacturers are currently complying with these requirements. Further, the requirements are completely independent of which on-board controllers meet the definition of a "diagnostic or emission critical control unit."

53. Comment: Regarding the regulatory language "emission-related diagnostic information' includes at least all the following" in section 1971.1(h)(4.10.1), it is better to delete the phrase "at least". The proposed addition of "at least" assumes that industry is responsible for omissions that are not listed and implies that the list may not be complete. CARB should provide a complete list for industry to use. (EMA)

Agency Response: The phrase “at least” was intended to clarify what information are required to be included. However, to avoid further confusion, staff proposed to delete the phrase “at least” as part of the first 15-day changes.

54. Comment: Regarding the engine runtime tracking requirements in the HD OBD regulation, the total engine runtime, total idle run time, and total run time with power take-off (PTO) active parameters are scaled with a range that extends to no less than 133 years at 1 second per bit, or not less than 400 years at 3 minutes per bit (0.05 hours/bit). Reuse of existing SAE J1939-DA suspect parameter numbers (SPN) saves industry implementation costs, and duplication of these values into SPNs that can be divided by 2 adds almost no value and is inherently unreasonable. The existing SAE J1939 engine-hour meter display is used to convey engine run time to the vehicle owner on the instrument cluster. The divide by 2 proposition makes the engine-hour meter for the total engine run time unusable for emissions warranty administration and distorts its value as an indication of the use of the vehicle with respect to its useful life. It also makes existing engine-hour meter calculations unsuitable for reuse in the NOx and fuel consumption tracking counters for engine run time. Storing a duplicate hour-meter to comply with the divide by two requirement is overly burdensome as it presents disparate requirements for the same hour meter. The other two counters for idle time and PTO time raise the same issue. (EMA)

Agency Response: The comment does not directly address a proposed 45-day amendment since the requirement the comment is addressing existed prior to the rulemaking. In fact, this requirement was required on all engines since the beginning of HD OBD implementation (i.e., the 2010 model year), so there should not be any additional implementation costs. It is also staff’s understanding that the scaling requirements in SAE J1979 and J1939 eliminate the need to divide the values by 2. Therefore, CARB staff did not make any changes to these requirements.

55. Comment: The proposal requiring engines to track and report the “distance since the last 3 PM filter regeneration events” is ambiguous and not reflective of staff’s discussion with industry at the 2017 OBD symposium. Industry thought this requirement refers to the total vehicle distance reading during the last 3 regeneration events, not a dynamic quantity that would be expected to change as the vehicle is driven. For heavy-duty vehicles, the SAE Committee recommends that the data reflect the engine’s own total vehicle distance display and not the vehicle manufacturer’s legal odometer. (EMA)

Agency Response: CARB agrees that changes are needed and proposed as part of the first 15-day notice to modify the regulatory language “distance since the last 3 PM filter regeneration events” to “Engine odometer reading (or chassis odometer reading if engine odometer is not available) at the beginning and end of the last 3 PM filter regeneration events.”

56. Comment: The proposal regarding data collection during an OTA reprogramming event requires manufacturers to create an information system infrastructure and

include computer software to calculate the required statistics. This goes beyond the “typical” cost structure of an HD OBD engine. (EMA)

Agency Response: While it is true that the costs to collect and submit data in conjunction with OTA reprogramming events are not direct vehicle costs, they have been analyzed and expressed in these terms by spreading the costs of compliance over the number of engines produced for sale. Further, manufacturers can avoid incurring the costs altogether by designing their OTA reprogramming technology such that the stored vehicle activity data referenced in the language is preserved during software updates. Several manufacturers have indicated to CARB staff that their systems will in fact be designed to preserve the data during an OTA software upgrade, making the proposed OTA requirements inapplicable.

57. Comment: The OTA reprogramming event requirements in section 1968.2(g)(8.1) and (8.2) should be removed, since they are redundant and requires more reporting but with no added emissions value. There already exists requirements in section 1968.2(j)(3) that require manufacturers’ sampling methods, number of samples, timeline, and reporting format to be approved by the Executive Officer. They are sufficient to handle the potential of minimal vehicle activity tracking data due to OTA, which has not been realized objectively and may not be equal for all manufacturers OTA implementation. This creates an unnecessary burden for manufacturers that do not have this potential near or long term issue. If there are issues with getting the required sampling number, manufacturers have other means to collect additional data. The OTA proposal increases the architecture development and data bandwidth costs, which limits the motivation of using OTA reprogramming technology. (Honda)

Agency Response: CARB disagrees and is not deleting this requirement. While IUMPR data is separately received by CARB via section 1968.2(j)(3), it is only submitted once for a given model. Collecting the data with respect to the various software versions that manufacturers may release over the course of a vehicle’s lifetime will help CARB staff to further evaluate the OBD performance of the in-use fleet. The IUMPR parameters are only a small subset of the total data record, and the inclusion of the fields should not add any significant compliance cost or effort.

The comment about minimal vehicle activity tracking is hard to understand, but it appears to say that it’s not fair to require this data reporting when the manufacturer hasn’t experientially shown that OTA practices are going to wipe out a lot of data in-use. Vehicle software updates are already commonplace within the industry even though the updates require a technician to have physical access to the vehicle. It only stands to reason that the frequency of software updating is likely to increase when manufacturers switch to OTA technology because the software will be installed without any burden to the vehicle owner, and without the time and expense required for a technician to perform the service. Waiting for the problem to be manifest in the field before it is addressed will only result in several model years for which the data will not be available.



Regarding the comments about costs, CARB staff has estimated that the cost impact of this requirement will be around 50 cents per engine for the heavy-duty engine manufacturers. Because of the higher volumes of vehicles produced by light-duty manufacturers, the cost impact is likely to be much less on a per vehicle basis. CARB staff does not believe that these minimal costs will in any way limit the motivation for manufacturers to use OTA technology. Further, manufacturers are exempt from this requirement if they design their OTA technology such that the vehicles retain the on-board data at issue when the vehicles are reprogrammed. Many manufacturers are expected to implement such designs, and would therefore not incur any additional expenses.

58. Comment: The start date for OTA reprogramming event requirements in section 1968.2(g)(8) should be changed from the 2022 model year to the 2024 model year, since Toyota is currently certifying 2020 model year vehicles and the 2021 model year hardware/software is close to final. Further, more time is needed for possible additional OTA infrastructure and hardware for data collection accumulation. (Toyota)

Agency Response: OTA infrastructure and hardware for data collection appear to relate to off-board equipment for the collection, storage, analysis, and reporting of the required data (as opposed to vehicle hardware/software changes). As such, they don't have to be fully implemented until the 2022 model year vehicles are in production (2021 calendar year at the earliest). Staff believes this provides adequate time (nearly 3 years) to implement the needed infrastructure. Nevertheless, as described above in the Agency Response to Comment 10, staff delayed the start date from the 2022 model year to the 2024 model year as part of the first 15-day notice.

59. Comment: The data reporting due date for the OTA reprogramming event requirement in section 1968.2(g)(8) should be changed from 60 calendar days to 75 calendar days after the release of the software update (or 30 calendar days after data aggregation), since steps (including correction if needed) are needed for regulatory submissions and considering holidays and weekends. (Toyota)

60. Comment: It is unlikely that data collected over 60 days will capture the majority of fleet vehicles. The resulting average statistics of the calibration's early adopters may be biased compared to the fleet as a whole. (EMA)

Agency Response: Concerning the data capture rate after 60 days of the OTA software update being available, CARB staff believe that most vehicle operators will accept OTA software updates within this time period. Otherwise, CARB staff believes the owners are likely not to accept the update at all. In any event, manufacturers are only required to collect and submit the data for those operators that do accept the software update. There is no requirement for the manufacturer to ensure that a certain percentage of the fleet has been captured. Although timely submittal of the information is important, CARB staff does not believe that an added 15 days of processing time will negatively impact use of the data. Therefore, CARB staff proposed to change the regulation to extend the

reporting deadline to 30 days after data aggregation (i.e., 75 calendar days after the release of the software update).

61. Comment: The inclusion of the IUMPR data in the OTA reprogramming event data submission should be limited to a period of 6 to 12 months after introduction into commerce of the test group of concern, since more time is needed to accumulate sufficient general denominator values and mileage. Unlike fuel consumption data, collecting IUMPR data too early results in data that are not usable for analysis. Manufacturers are already required to submit IUMPR data one year after sales begins, so reporting the data after one year seems also unnecessary. (Toyota)

Agency Response: CARB staff does not agree that IUMPR data should only be included in the OTA record between 6 and 12 months of introduction into commerce. While CARB staff agrees that IUMPR data reported in the OTA record may reflect only limited vehicle operation in cases where software updates are released shortly after vehicles are introduced into production, vehicles that are driven frequently can quickly accumulate enough data to be useful for program evaluation purposes. Further, while it is true that manufacturers have a separate and more formal data reporting requirement for IUMPR data when the vehicles have been on the road for a year, eliminating further submissions of the data unnecessarily limits CARB staff's ability to evaluate IUMPR performance as the fleet continues to age. Overall, one of CARB staff's objectives for receiving and analyzing the data is to study to what extent, if any, given software updates impact the performance of OBD systems on in-use vehicles. Limiting the submission of the IUMPR data to such a narrow window will greatly reduce staff's ability to do so.

CARB staff also believes that the commenter's suggestion will unnecessarily complicate the collection and analysis of the data records overall because it will result in the need to compile two different record formats into the same database (one with IUMPR data included, and one without its inclusion). Considering that the amount of data in question is comprised of relatively few fields, CARB staff does not see any practical benefit to manufacturers in omitting the data in some cases in light of the complications it creates with the creation, processing, reporting, and compilation of the data records.

## DEMONSTRATION REQUIREMENTS FOR CERTIFICATION COMMENTS

62. Comment: The demonstration test protocol is an engineering exercise that has the primary goal of demonstrating the ability of the OBD system to detect the best performing unacceptable (BPU) fault and provide an accurate assessment of the emissions performance of the BPU system. While the CARB proposal can serve as a baseline expectation to conduct monitoring system demonstration, it is too inflexible to cover all the technical issues that arise in designing robust diagnostics that meet the IUMPR requirements. As has been CARB's long standing practice, CARB should continue to use the provision in section 1971.1(i)(1.2) to approve deviations to the protocol outlined in section 1971.1(i)(4.1) as necessary to promote sound diagnostic design. These deviations include rearranging the order of the preconditioning and

demonstration tests, allowing additional preconditioning cycles, vehicle level demonstration drive cycles, etc. (EMA)

Agency Response: The language in section 1971.1(i)(1.2) is unchanged and still allows manufacturers the flexibility to request Executive Officer approval to deviate from the demonstration protocols in section 1971.1(i)(4) based on the same criteria that the timeliness of malfunction detection is within the constraints of the applicable monitoring requirements. Such an example would be to allow MIL detection on-road versus on the dyno. However, unless there is a good engineering reason for rearranging the order of the malfunction preconditioning and demonstration tests, this would not be accepted.

63. Comment: The proposed CO<sub>2</sub> emission data required to be provided with the demonstration data should be limited to raw measured CO<sub>2</sub> data (no carbon or fuel-corrected values). This requirement should not be held to the GHG Phase 2 standard of reporting. (EMA)

Agency Response: After discussions with industry, it is CARB's understanding that the concern was that corrected values would require lots of fuel samplings (which may involve manufacturers sending fuel samples to outside labs for analysis) several times during testing. Staff understands manufacturers' concerns about the additional workload, costs, and impacts on timing this may cause. Therefore, CARB proposed 15-day changes (during the first 15-day notice) that would allow manufacturer to request to submit raw measured CO<sub>2</sub> data provided the data are sufficient for CARB to assess the CO<sub>2</sub> impacts of each malfunction tested.

64. Comment: CARB's proposal that limits manual PM filter regeneration events during demonstration testing will unduly delay testing completion. The regulation needs to allow for manufacturer's discretion to execute regeneration to maintain the health of the aftertreatment throughout testing as needed. Manufacturers should be able to use standard stationary regeneration procedures to expedite testing. (EMA)

Agency Response: CARB staff disagrees and did not make any changes to the regulation language. As mentioned in the Staff Report, though manufacturers have used the manual regeneration as a way to condition their aftertreatment systems to provide the most optimal control and cleanest emissions, this is not representative of real world situations. Hence, it is critical that each manufacturer explain and provide the reason a manual regeneration is needed and request CARB's approval to use it. Manufacturers should make this request before conducting demonstration testing, specifically while presenting their demonstration testing plan to CARB staff for review and approval. CARB staff will approve this request for manual regenerations on specific malfunction demonstration tests if the manufacturer provides enough engineering evaluation and data that justify the need for the manual regenerations.

65. Comment: Clarification should be added regarding the preconditioning requirements in the HD OBD regulation and CFR Part 1065. Also, the Staff Report states that the malfunction preconditioning cycles are only allowed for "stabilization of the emission control system due to the introduction of the

malfunction, and are not intended for the purpose of learning or adapting of the diagnostic.” This statement ignores a whole class of diagnostics that monitor the control system adaptation and use it as an indication of a fault. In these systems, “stabilization of the emission control system” is identical to “learning or adapting of the diagnostic.” In addition, the example given (exponentially weighted moving average (EWMA)) is poor since CARB has allowed (and should continue to allow) the use of the precondition cycle as part of the fast initial response function as needed on a case by case basis. (EMA)

Agency Response: CARB staff agree that malfunction preconditioning cycles would be allowed for diagnostics that detect when the emission control systems have learned/adapted out to the points of their limits. Regarding the EWMA example, unless EWMA is used to correct/adapt the emission control system/function, malfunction preconditioning cycles will not be granted for diagnostics that use EWMA solely to filter the raw data for OBD detection purposes. As stated, the intent of the malfunction preconditioning cycles is to allow the emission control system to stabilize emissions after the malfunction has been implanted and not solely for the purposes of adding time for monitors to be able to detect malfunctions during demonstration testing. While staff tried to explain this in the Staff Report, staff proposed clarifying language in the first 15-day changes to make this clear. Further, staff believes the proposed regulatory language provides a clear distinction between "malfunction preconditioning cycles" (section 1971.1(i)(4.1)) and other types of preconditioning cycles (e.g., "exhaust emission preconditioning cycles" used in Part 1065). However, to make this distinction clearer, staff proposed 15-day changes (during the first 15-day notice) that would make sure the phrase “malfunction preconditioning cycle” is used consistently throughout the regulation and make clear that these cycles” are only used to stabilize the emissions (e.g., through control system adaptation or learning) due to the introduction of the malfunction and is not solely intended for the purpose of adding monitoring time to detect a malfunction.

66. Comment: Regarding the regulatory language in section 1971.1(i)(5.1.2)(A) related to testing the engine with a system/component adjusted to the “worst acceptable limit,” the term “worst acceptable limit” is too easily confused with the existing term “worst performing acceptable,” which means something different. The term should be replaced with the term “best performing unacceptable (BPU) minus.” There should also be a provision allowing for Executive Officer approval for alternate techniques to demonstrate that emissions do not exceed the applicable emission threshold at this BPU minus setting. A manufacturer was able to previously perform this testing by modifying the ECU calibration to disable the default fuel or emission control strategy that is used when the malfunction is detected. (EMA)

Agency Response: CARB staff disagrees that the term “worst acceptable limit” is confusing, considering that the regulation language is immediately followed by a definition of the term, specifically “the applicable monitor indicates the system or component’s performance is passing but at the closest possible value relative to the monitor threshold value at which a fault would be detected that would invoke the default strategy and illuminate the MIL.” Further, CARB staff believes the commenter’s suggested term “BPU minus” would be more confusing, since use of

“BPU” implies that the deteriorated component/system should be failing the monitor, which is not the intent of the requirement. Therefore, CARB did not modify the term in the regulation language. Regarding the allowance to use an alternative technique to disable the default strategy, CARB staff agrees with adding a provision to allow the alternative method of modifying the ECU to disable the default action and demonstrating emission compliance with the BPU part. CARB proposed 15-day changes (during the first 15-day notice) that would allow this alternative method if manufacturers can demonstrate the emissions results are equivalent to the production-level calibration.

## CERTIFICATION DOCUMENTATION COMMENTS

67. Comment: Regarding the proposed OBD certification documentation requirement to include a list of modifications made to the OBD system that were made as part of a running change or field fix applied to a previous model year, manufacturers already submit documentation for each running change. Adding this information in the next model year annual certification is redundant work. At a minimum, CARB should clarify the process to allow for the submission of copies of prior running change documents. (EMA)

Agency Response: CARB staff disagrees and did not delete this requirement. CARB staff believes this information is important to include in the certification application so that staff can know which running change applies to the engine they are certifying. The running change documents that are already submitted to CARB do not include information about which specific “future” engines (i.e., engines that CARB will be currently reviewing and certifying) these changes will apply to. Staff agree that this could seem like redundant work. However, the commenter’s proposal (to provide copies of prior running change documents) would require staff to review all the running change/field fix documents again, thereby delaying OBD certification of the engine family. CARB staff is willing to work with manufacturers to come up with a documentation reporting method that does not require CARB staff to review several running change/field fix documents in addition to the annual certification application.

68. Comment: Regarding the proposed OBD certification documentation requirement to include details of the cold start emission reduction strategy (CSERS), there needs to be a definition of CSERS so that any new strategies in the future can be evaluated. (EMA)

Agency Response: CARB staff did not propose any additional language related to this issue in the 15-day notices. While staff is not addressing this request in this proposal, the routine OBD certification process allows manufacturers to dialogue with CARB staff to ensure their documentation and proposed monitoring solutions meet the requirements of the regulation. Cold start emission reduction strategies are typically designed to reduce engine-out emissions before the aftertreatment has reached a high level of conversion efficiency and/or more quickly heat up the aftertreatment. Staff is not seeing big changes in these control strategies that would warrant modifications or amendments to the existing language. When manufacturers design and calibrate new strategies, they understand how these

strategies affect cold start emissions. However, if a manufacturer is unsure about a new control strategy in the context of the CSERS requirements, they can present to CARB staff all their auxiliary emission control devices and how they are used to control emissions during the test cycles and in the real world under conditions where the engine and/or emission control system (including the aftertreatment) are not at the temperature for optimal emission control upon starting the engine, so the strategies that affect cold start emissions can be fully identified and documented.

69. Comment: Regarding the proposed OBD certification documentation requirements for net brake torque, NOx sensor status, and instantaneous NOx mass emission rate data traces on test cycles, the regulation language needs to specifically state this is for baseline testing only. (EMA)

Agency Response: CARB staff agrees and proposed language clarifying that manufacturers should collect the required information during “baseline” testing (i.e., testing with an engine with no malfunctions on the engine, emissions controls, and aftertreatment) as part of the first 15-day notice.

70. Comment: Regarding the proposed OBD certification documentation requirements for active technologies, automatic engine shutdown technologies, start-stop technologies, and waste heat recovery technologies, the examples must be updated to exclude vehicle side tracking. (EMA)

Agency Response: Although staff understands the concern of the commenter, staff does not believe a change in the example is merited. The haptic-feedback accelerator pedal, which is the example used in the proposed regulatory language, is only an example of an active technology that may need to have a description for, and the example of the description is what staff is expecting. The proposed definition of active technologies specifically limit these technologies to those controlled by the engine or required to be monitored by the OBD system, and manufacturers will be required to provide a written description of only these technologies. The regulation language does not require the manufacturers to provide a written description of the haptic-feedback accelerator pedal unless that technology is controlled by the engine or required to be monitored by the OBD system. Therefore, CARB staff did not propose any additional amendments related to this comment.

71. Comment: Manufacturers should not be required to provide engine control unit software design specifications and source codes if requested by CARB staff to evaluate the OBD system pre-certification – CARB’s request for information should be limited to special circumstances that justify the request such as an enforcement case. With the current proposal, manufacturers are concerned CARB will request this for every OBD application and will ask numerous questions about the executable logic contained within the information due to the significant complexity of the emission control and OBD systems. Since CARB indicated that a special workspace and more restrictive staff-access provisions would be in place to ensure manufacturers’ highly proprietary information would not be revealed, this implies that the number of requests for the information would be substantially more limited than the current proposal indicates. So

limiting CARB's ability to request this information to special cases would align more with CARB's intent. (EMA)

Agency Response: CARB staff has no intention of asking for source code and associated hardware with every OBD application. However, limiting the ability to ask for these items to enforcement cases only limits the ability of the Board to get these information to conduct pre-certification activities, such as screening programs. As the commenter correctly states, there is significant complexity of emission control and OBD systems, which is exactly why CARB staff need to be able to access these tools to investigate suspected issues before they become "enforcement actions."

## HD OBD DEFICIENCY COMMENTS

72. Comment: The proposal would increase the deficiency fines structure by at least 300% (from \$500 to \$1500), which is excessively punitive considering CARB's stated goal of reducing real-world emissions. The proposal seems to force manufacturers reduce or eliminate the initial deficiencies that all manufacturers need to use to try to make the overall OBD program feasible. This proposal, along with the new REAL requirements that add 400-plus parameters and the undefined and subjective expectations of OBD certification staff, will require significant changes in the manufacturers' production approval process. CARB needs to keep the availability of deficiencies as a practical relief valve for the technical issues manufacturers will almost certainly encounter with the numerous proposed amendments. EPA specifically relied on deficiencies in its earlier preemption waiver for CARB's OBD requirements. CARB's proposed restrictions on the utility and availability of deficiencies inherently undermines the overall feasibility and validity of the HD OBD program. (EMA)

Agency Response: This proposal does not restrict the use or availability of deficiencies. The qualifications to receive a deficiency have not been modified. Only the fines for the deficiency have been changed. By stating that "the proposal seems to force manufacturers reduce or eliminate the initial deficiencies," the commenter seems to imply that manufacturers are using the current deficiency provision as a product planning tool instead of an emergency relief mechanism as it was designed to be. The use of deficiencies as a product planning tool is exactly what CARB staff is trying to discourage with the new deficiency proposal. CARB staff also disagrees with the commenter's assertion that the manufacturers "need" the "initial deficiencies" to try to make the overall OBD program feasible. CARB staff have always informed manufacturers to present their new monitoring strategies to CARB as early as possible before implementation of the monitor in-use so that any issues CARB staff finds with the monitoring strategy can be addressed and fixed by the manufacturer before the monitor is implemented in the field. This review process should limit or eliminate the need for granting deficiencies. If the manufacturer does not present the monitoring strategy to CARB staff beforehand, or presents the monitoring strategy at a later time such that it does not provide enough time for any fixes to the monitor before implementation in the field, then deficiencies are more likely to be necessary. Nevertheless, to address manufacturers' concerns, CARB staff made additional concessions to the deficiency provisions in the proposed 15-day changes (during the first 15-day notice). The changes included reducing the

maximum deficiency fine from \$1500 to \$1250 and allowing up to 2 emission threshold monitor (ET) deficiencies to be “free” during the first model year the deficiency is applied and one free ET deficiency the second model year the deficiency is applied.

73. Comment: The highly complex and onerous nature of the HD OBD requirements forces most, if not all, manufacturers to certify with deficiencies. So it is virtually certain that most, if not all, HD on-highway engines will have deficiency fines of \$750 to \$1500 per engine, which is 4 to 7 times the amount CARB ascribes to its entire HD OBD program (\$207.86 per engine). The proposed \$1500-per-engine cap for 2023 is too high and too soon, and would add a de facto \$150 surcharge nationwide on every HD on-highway engine sold in the United States (assuming California is 10 percent of the HD on-highway market). This \$150 exceeds CARB’s original (but erroneous) per-engine cost estimate of \$134.92 for the entire HD OBD program. (EMA)

Agency Response: While CARB staff agrees that the HD OBD requirements are complex and demand considerable resources to design compliant systems, CARB staff does not agree that the cost of deficiency fines should be ascribed to the HD OBD program. Costs should only be determined on compliant systems, not non-compliant systems. Some manufacturers have shown that they can design OBD systems that do not have deficiencies and are not subject to fines. Additionally, there has been an industry trend where the total deficiency fines are being reduced with each following model year. This seems to show that the learning curve for designing and building compliant HD OBD systems is flattening out.

As described above, CARB proposed 15-day changes (during the first 15-day notice) to the original deficiency fines proposal that lowered the maximum fine from \$1500 to \$1250 per engine. Nevertheless, CARB will address the original comment as stated. Based upon the analysis of available data, the commenter’s claim that the deficiency proposal effectively adds a “de facto” \$150 surcharge for all HD engines sold nationwide in the United States is a false claim. The claim that a defacto surcharge equal to 10% of the maximum fine amount would only be true if all manufacturers are reaching the deficiency fine cap on all engines. This is not a reasonable assumption even with today’s deficiency rates. CARB staff has done a rough estimation of how many 2017 model year engine families would be at or above the \$1500 deficiency cap. Using the proposed deficiency fines, CARB staff has estimated that only 12 of approximately 111 total HD engine families (or 11% of all HD on-highway engines) would be at above or above the \$1500 deficiency cap. Most engines would be well below the \$1500 cap. Additionally, the emission threshold requirements (which have the biggest deficiency fine increases) were not changed in this proposal – the final thresholds have been on the books for years now, with most stringent thresholds applied for the 2016 model year or earlier. So there has been sufficient stability in these requirements and enough time for manufacturers to meet these requirements. There are new CV monitoring requirements, but they are not emission threshold requirements and also do not start until 2025. As for the new requirements related to NOx/GHG tracking, the proposal includes 2 free deficiencies during the first 2 years of implementation (section 1971.1(k)(9)). Based on a review of the deficiency count from recent model years,



we have no expectation that manufacturers that make a good faith effort in meeting the requirements will be anywhere close to maxing out on the deficiency fines for all their engines.

74. Comment: Though CARB says the proposal to increase deficiency fines to deter manufacturers from misusing the deficiencies to relieve additional MST, the additional testing (even with CARB's proposed amendments to MST) would total about \$1 million based on manufacturers' actual MST experience and projections, not \$363,717 as CARB incorrectly estimated. So the maximum aggregate cost for any emission threshold deficiency over the potential three-year deficiency duration should be marginally in excess of \$1 million to deter deficiency misuse, but CARB is well above that. As an example, for a major manufacturer with around 2,000 engines in an HD OBD certification group in California (not 250-1000 as CARB asserted), if a group has one ET2 deficiency for three years, the aggregate cost would be \$1,275 (\$300 + \$300 + \$325 + \$350) per engine, totaling \$2,550,000, which is nearly three times the \$1 million benchmark. The per-engine deficiency cap to meet the benchmark is \$500, while CARB's proposed \$1500 cap is three times the benchmark. If CARB wants to deter manufacturers from misusing the deficiencies to relieve additional MST testing, CARB should make the deficiency fines just marginally higher (on a per engine and annualized cost basis) than the projected cost of MST testing up to 9 additional engines. Though CARB said they used the manufacturers' MST costs, the proposed deficiency fines are much higher than the actual additional MST costs. (EMA)

Agency Response: CARB disagrees that the proposed deficiency fines are excessively high and are three times the \$1 million MST benchmark provided by the commenter. The proposed deficiency fines were determined to deter the misuse of deficiencies with respect to the design and implementation of compliant monitors as well as MST costs. To determine the appropriate levels for the proposed deficiency fines, CARB staff used available data provided annually by the engine manufacturers to CARB for determining the number engines produced per year for an average engine family. Based on these data, it was determined that the average engine family volumes range from 250 to 1000 units per year, not 2000 units as the commenter claims. Using a volume of 750 units per year for an average engine family in the example provided by the commenter above results in a total cost of about \$960,000, which is slightly less than the \$1 million MST cost estimate provided by the commenter.

75. Comment: CARB is overlooking existing, more reasonable constraints that preclude any purely strategic use of deficiencies and incentive compliant systems. CARB does not issue deficiencies unless the manufacturer first demonstrates technological infeasibility after good faith effort toward compliance, and most deficiencies must be rectified within two model years. Also, CARB could withhold approvals of carry-over deficiencies or issue conditional certifications where appropriate. (EMA)

Agency Response: It is incorrect to say that deficiencies are given when manufacturers demonstrate technological infeasibility after good faith effort toward

compliance – if that were true, then no one would ever be able to correct deficiencies. The requirement can be technically feasible, but the manufacturer still falls short of meeting it for many reasons (e.g., errors in software, manufacturer’s misjudgment that the monitors they design meet the requirement). Concerning the commenter’s statement that the deficiency fine increases are not needed, it has been shown in many cases that the current requirements and practices are not effective in addressing the issues of manufacturers misusing deficiencies by them misrepresenting that good faith efforts have truly been made and the deficiencies are warranted. CARB staff would not be proposing these amendments if the current requirements were thoroughly effective in preventing this strategic use of deficiencies.

76. Comment: New OBD technology, which are often needed due to the “technology forcing” nature of the OBD regulations, can require years of verification testing and development to implement. Supplier selection and contract negotiation, production line modifications, training, and service support all require lead time. Increasing deficiency fines for early-year issues in implementing new technology could discourage manufacturers from embracing new technology due to increased financial risks. Current fines already create competitive disadvantages for non-compliant manufacturers. Therefore, CARB’s rationale for the increased deficiency fines is overstated. The increased deficiency fines are unreasonably punitive considering CARB’s new NOx emission regulations could drive new technology as it matures to fully comply with the HD OBD regulations, which is not consistent with CARB’s reasoning behind the deficiency fine increase. (EMA)

Agency Response: CARB staff disagrees with the commenter and does not believe that the increased deficiency fines will discourage manufacturers from using new technology. As already described in the Agency Response to Comment 73, the commenter’s assertion that the increased fines would add a de facto \$1500 per engine are unfounded, considering most engines would not reach anywhere near that level of deficiency fines based on currently available data. As described previously in the Agency Response to Comment 72, the proposal does not restrict the use or availability of deficiencies – if a manufacturer qualifies for a deficiency, CARB staff can still grant them, but it will come with higher consequences in the form of higher fines. Regarding the commenter’s concern on sufficient lead time, as mentioned above, CARB has modified the original 45-day proposal to provide additional lead time for most of the newly proposed requirements, including the new deficiency fine increases. The 15-day change (as noticed in the first 15-day notice) would extend the start date of the new deficiency fines from the 2021 model year to the 2024 model year.

CARB staff is unsure what the commenter meant when stating that CARB’s new NOx emission regulations could drive new technology as it matures to fully comply with the HD OBD regulation, and how that is inconsistent with CARB’s reasoning behind the deficiency increase. CARB staff is assuming that the commenter is stating that future lower NOx emission standards adopted by CARB would require manufacturers to utilize new technology to meet these lower standards, but the OBD systems on these engines would most likely be certified with deficiencies and thus greatly increase the cost per engine, which would seem to punish manufacturers

who use the new technologies. As already described in the Staff Report, the intent of the proposed deficiency fines structure is multi-faceted. The ET deficiencies fine structures are designed to discourage gaming of the MST requirements. The increase to the major and minor fines structures were done to discourage the use of deficiency fines as a product planning tool, where some manufacturers appeared to be abusing the deficiency provisions with maximum fines for virtually all of their products as compared to other manufacturers that spent more money upfront to product engines with significantly smaller deficiency amounts. The proposed deficiency fines proposal is not meant to punitively punish manufacturers who utilize new technology. In fact, the deficiency fines structure has always allowed some number of free deficiencies where deficiency fines are not assessed. Currently, the new lower NOx emission standards are optional, and the OBD NOx threshold required (i.e., 0.4 g/bhp-hr) is the same as the most stringent required emission standard, which should allow the same monitoring technologies to be used as current engines and not require new monitoring technology. Since the future NOx emission regulations and engines designed to meet these regulations have not been developed yet, it is premature to say that the monitoring of these future engines cannot be done without deficiencies. Even if deficiencies are required for these “new technologies”, the deficiency provisions allow for 2 “free” deficiencies that are not subject to any fines.

77. Comment: The 2021-2023 phase-in for the revised deficiency fines does not meet the 4-year leadtime and 3-year stability period requirements of sections 209 and 202(a) of the federal CAA. Additionally, since deficiency fines relate to enforcement of HD OBD requirements, which are standards related to the control of emissions, CAA’s preemption waiver provisions fully apply, but CARB does not meet these. (EMA)

Agency Response: Please refer to the Agency Responses to Comments 8 through 10.

78. Comment: The deficiency fines proposal should be changed as follows:

- 1) Delay the start date to 2024 with a 4-year phase-in (to accommodate all the work and challenges manufacturers will face implementing the new REAL requirements).
- 2) No fines for REAL-related requirements since they are non-germane to OBD.
- 3) No base fine multipliers for differing emission threshold (ET) deficiencies – instead use marginally higher carryover multipliers for higher ET deficiencies.
- 4) The increased cap should be as follows: \$600 in 2024, \$700 in 2025, \$800 in 2026, and \$1000 in 2027.
- 5) Any increased cap on deficiencies should apply to all deficiencies, not just non-ET deficiencies.
- 6) The two “free” deficiencies should include at least one ET deficiency (to provide flexibility for manufacturers trying in good faith to comply but may have something go awry during certification testing).
- 7) ET deficiencies should only be applied to those diagnostics that are subject to emissions measurement/requirements in demonstration testing.
- 8) If the fines are increased, manufacturers should receive some corresponding benefits from proactive mitigation actions. So CARB should give deficiency

“rebates” for running changes that are promptly implemented on in-use engines/vehicles. One approach would tie rebate percentage to percentage of full useful life that is remaining for an engine family at the time its OBD deficiency is remedied. The rebate could be limited to running changes/field fixes that are implemented in the first two years of a deficiency (since software changes typically cannot be implemented in the first year).

- 9) CARB will need to set up an objective OBD review board to which manufacturers can appeal a deficiency to ensure CARB staff implements the HD OBD requirements in a fair and uniform matter and pursuant to a well-defined process toward resolution, and to ensure a level regulatory playing field for all manufacturers. (EMA)

Agency Response: As described above, CARB staff has significantly modified the original 45-day deficiency fines proposal as part of the first 15-day changes so that most of the issues raised by the commenter in this comment are no longer applicable. The only issues that were not addressed with the new proposal are the last 2 issues regarding providing “rebates” for field fixes that addressed deficiencies on in-use vehicles and setting up an objective OBD review board to allow manufacturers to “appeal” deficiency determinations. Typically, CARB does not require payment of any deficiency fines that are addressed before the vehicles are sold to customers. This includes vehicles that are fixed after they have been produced but have not been sold to customers. CARB, however, does not refund deficiency fines that have already been paid unless the deficiency was an “erroneous” deficiency that was mistakenly granted by CARB staff due to incorrect or missing information and was later addressed when the correct or missing information was provided because this was not a “real” deficiency. Refunding deficiency fines for a field fix is too difficult to keep track of because not all vehicles will be captured and fixed by the manufacturer, so this option was rejected. Regarding setting up an objective OBD review board to hear appeals on deficiency determinations from manufacturers, CARB staff believes this is not necessary since deficiency determinations already have to go through an internal review process that CARB staff believes is objective and equitable to all manufacturers.

## PRODUCTION ENGINE/VEHICLE EVALUATION TESTING REQUIREMENTS COMMENTS

79. Comment: It is expected that the new freeze frame requirements of sections 1971.1(d)(2.2.1)(D)(vi) and (vii) will not be included in SAE J1699-3 or SAE J1939-84 test procedures. The number of faults that would need to be implanted to verify the required change exceeds the number of manipulations of a customer’s vehicle that can be explained to the customer as a manufacturing quality check and would diminish the vehicle’s commercial value after testing is done. (EMA)

Agency Response: As already discussed above in Agency Response to Comment 13, CARB staff proposed 15-day changes (during the first 15-day notice) that would delete these new freeze frame requirements. Therefore, the commenter’s concern is no longer applicable.

## RUNNING CHANGES AND FIELD FIXES COMMENTS

80. Comment: CARB proposed that “copies of all service manuals, technical service bulletins and instructions regarding the use, repair, adjustment, maintenance, or testing of such vehicles relevant to the emission control system, OBD system, as applicable,” in written or electronic form, in their running change/field fix documents. Most running changes/field fixes do not result in changes to most of these documents. Including such materials should only be required if they are substantially changed. (EMA)

Agency Response: CARB staff believes it is important that manufacturers properly report all relevant documents to CARB. During enforcement action, if there are changes to these documents, the reporting of these documents are heavily considered as disclosure. The risk is on the manufacturer if these documents are not properly reported to the agencies. However, with regards to service manuals, CARB only intended that manufacturers submit the portions of the manuals that included any changes that were made as a result of the running change/field fix. Therefore, staff proposed 15-day changes (during the first 15-day notice) that would make clear that the running change/field fix documents would only need to include portions of the service manual that were changed due to the running change/field fix, and that the changes would need to be highlighted.

81. Comment: Regarding the proposal that prohibits manufacturers from submitting a running change/field fix document for an engine family within 30 calendar days of the OBD approval date, CARB should allow early fixes to ensure production robustness. At a minimum, CARB should add the language “unless previously approved by the Executive Officer” to the end of this provision. (EMA)

Agency Response: The proposal already allows manufacturers to implement early fixes. The proposal states that manufacturers may implement running changes concurrently with and after notification to CARB of the change. This harmonizes with the current requirements in the CFR. The language the commenter is concerned about deals with “running change/field fix documents”. However, if a manufacturer wants to apply a fix earlier than the 30-day timeframe, CARB staff already added proposed regulation language (1971.1(h)(2.2)) to address this in the 45-day regulation language – this section would allow manufacturer to apply this running change/fix as long as they submit a “running change/field fix notification” concurrently with the implementation of the running change/field fix to document that a running change/field fix was released.

## OTHER OBD II REGULATION COMMENTS

82. Comment: The 2022 model year start date for considering engine stop-start systems as “active off-cycle credit technologies” should be changed to a 3-year 30/60/100 percent phase-in starting in 2022, which is similar to a 2016

amendment related to off-cycle technology tracking. Most of the 2020 model year vehicles are completed, and sufficient development time needed. (Honda)

Agency Response: As mentioned above in Agency Response to Comment 10, staff proposed to delay most of the amendments, including this one, from a start date of 2022 to the 2024 model year as part of the first 15-day notice.

## HD OBD ENFORCEMENT REQUIREMENTS

83. Comment: Regarding the proposed language in the enforcement testing procedures (section 1971.5(b)(4)(A)) requiring manufacturers, upon request of the Executive Officer, to provide information about the software design and source code of the engine control unit, there must be explicit protections regarding the confidential business information (CBI) nature of the information at issue. The regulations should state clearly that the highly proprietary CBI would only be requested if there was a specific need for the information (e.g., a potential enforcement action). (EMA)

Agency Response: As already stated in the Staff Report, CARB handles confidential information such as this as a matter of routine business, and staff are working with internal cyber-security experts to evaluate the internal procedures in place to protect sensitive manufacturer intellectual property and reduce the risk of exposure to the extent feasible. Further, the section referenced here is in the enforcement regulation, specifically enforcement testing. This testing is conducted to determine if there is any issue with the OBD systems in-use that may result potential enforcement action. Therefore, CARB believes this already addresses the commenter's statement about the information being requested "if there was a specific need for the information." See also the Agency Response to Comment 71.

84. Comment: CARB proposed that for MST, the manufacturer may request Executive Officer approval to procure an engine that has mileage below the required mileage if the manufacturer shows that the procured engine will produce equivalent results to an engine meeting the requirement mileage, which may involve "providing data showing operating hours-to-mileage equivalency." CARB needs to confirm the common understanding that this means that the manufacturer can age the engine on the dynamometer following accepted practices for aging an engine for certification demonstration testing. (EMA)

Agency Response: The commenter is incorrect. CARB did not intend the language to allow such dynamometer aging. Therefore, staff proposed 15-day changes (during the first 15-day notice) that clearly state that the manufacturer's plan may involve operating the "vehicle," not "engine," to accumulate more mileage, and that the manufacturer would not be allowed to operate the engine on a dynamometer to accumulate operating hours for the purposes of showing operating hours-to-mileage equivalency.

85. Comment: CARB's proposal deemed a deficient emission threshold monitor to be nonconforming if the emission levels for the test sample group

exceeded “20 percent of the emission standard above the emission level at which a malfunction was detected when the OBD system was approved by the Executive Officer.” This is not acceptable for PM emissions, since it would result in a very small number. 20 percent of the OBD PM threshold should be the margin. (EMA)

Agency Response: CARB staff agrees that the 20-percent criterion is not appropriate for PM emissions, since 20 percent of the PM emission standard would only be 0.0020 g/bhp-hr if the PM standard is 0.01 g/bhp-hr. Therefore, staff proposed 15-day changes (during the first 15-day notice) to increase the PM nonconformance criteria to “20 percent of the PM malfunction criterion above the emission level at which a malfunction was detected when the OBD system was approved by the Executive Officer.”

86. Comment: Regarding the mandatory recall criteria for IUMPR nonconformances in section 1971.5(d)(3)(A)(i), the criteria should be changed to 20.0 percent of the required minimum ratio for 2022 through 2025 model year engine and 33.0 percent of the required minimum ratio for 2026 and subsequent model year engines. (EMA)

Agency Response: As part of the 45-day notice, staff proposed changes to the mandatory recall criteria to account for monitors subject to the nonconformance criteria of sections 1971.5(b)(6)(B)(iii) and (iv) (i.e., monitors certified to an IUMPR of 0.300). In the Staff Report, staff indicated that for monitors covered under section 1971.5(b)(6)(B)(iii), staff is proposing that the mandatory recall would be applied if the average IUMPR or the IUMPR for at least 66 percent of the vehicles in the test sample group is less than or equal to 0.066, which is 33.0 percent of 0.200. This was intended to provide manufacturers some leeway in terms of mandatory recall for the first few years of the proposed 0.300 IUMPR requirement in order to allow manufacturers to gain more experience with their monitors and the new IUMPR in the field. However, in the proposed 45-day regulation language attached to the Staff Report, staff mistakenly amended the regulation language to indicate that for these monitors, mandatory recall would be applied if the average IUMPR or the IUMPR for at least 66 percent of the vehicles in the test sample group is less than or equal to 33.0 percent of the minimum acceptable ratio, which in this case would be 0.099 (33.0 percent of 0.300). Therefore, staff proposed corrections to the regulation language as part of the first 15-day notice to reflect the intention stated in the Staff Report, specifically that mandatory recall would apply if the IUMPR for these monitors is less than or equal to 0.066.

## COMMENTS ABOUT COST ESTIMATES

87. Comment: CARB’s HD OBD program is by far the most expensive certification-related program and substantially more onerous and costly than EPA’s HD OBD program, which do not require MST or deficiency fines. Thus, the cost-prohibitive and thereby infeasible nature of CARB’s HD OBD regulations continues to increase unabated. It should be noted that even EPA, when it adopted its own

HD OBD regulations in 2009, concluded that the type of MST testing that CARB requires is inherently cost-prohibitive and unreasonable. (EMA)

Agency Response: CARB acknowledges the cost of implementing the HD OBD program is not trivial. However, CARB's cost analysis indicates that while the costs are considerable, the requirements are still cost-effective when the costs are applied to the entire volume of vehicles that are sold nationwide. Regarding the comment that EPA's HD OBD regulation do not include deficiency fines, it should be noted that EPA's HD OBD regulation has more restrictions on what qualifies for a deficiency compared to CARB's HD OBD regulation. For example, CARB's HD OBD regulation would allow for a deficiency for minor mistakes in implementing a monitor, while EPA's HD OBD regulation does not. In this situation, manufacturers certifying their systems under EPA's HD OBD regulations would not qualify for a deficiency and therefore could not be certified, unlike CARB's HD OBD regulation, which would have allowed a deficiency in this situation and certification to be approved. Concerning the comment that EPA had mentioned the type of MST testing that CARB requires is inherently cost-prohibitive and unreasonable, CARB could not find such a direct statement in the Final Rule document that the commenter referenced. In fact, the EPA comment that the commenter indicated as proof that EPA concluded the MST requirement is costly and unreasonable were made in reference to the durability demonstration testing requirements, which are conducted prior to OBD certification. Further, the Final Rule document referenced was adopted by EPA before CARB proposed and adopted the MST requirements. Therefore, since EPA did not know of CARB's MST requirements (since they did not exist at the time) and thus did not know the background and reasoning behind the MST requirements, CARB staff believes it is not appropriate for the commenter to assume that EPA would not support the testing required by CARB's MST provisions.

88. Comment: HD engine manufacturers have each spent about \$10.6 million per year to comply with CARB's HD OBD regulations (\$2,344 per engine), an order magnitude higher than CARB's per-engine cost of \$207.86. They also each spend an additional \$1.5 million per year for MST (\$340 per engine), more than two orders of magnitude higher than CARB's per-engine cost of \$2.23. Thus, the regulations add nearly \$2,700 to the cost of a heavy heavy-duty (HHD) engine sold in California. These costs do not include the costs for the proposed HD OBD amendments. The estimated costs of the HD OBD amendments (minus MST) is \$4,265,901 per manufacturer (\$2,448 per engine), nearly two orders of magnitude higher than CARB's per-engine cost of \$42.26. Most of the costs is due to the new hardware/software costs for the REAL data tracking and the increased deficiency fines (up to \$1500 per engine). CARB's cost analysis unreasonably underestimates the time/cost to design, develop, test, and implement the amendments while assuming that each manufacturer's current OBD-related systems and change are similar. (EMA)

Agency Response: As previously mentioned, CARB staff acknowledges the cost of the OBD program is not trivial. In fact, CARB staff's cost estimates for previous HD OBD rulemaking updates when added up results in a non-inflation adjusted value of \$11.5 million for a "typical" OEM which is actually higher than the commenter's estimates. However, the per unit costs are considerably lower than the estimates



that the commenter indicates because CARB staff applies the costs for a manufacturer's average nationwide annual sales volume instead of California-only sales volumes as the commenter does in their analysis. CARB staff believes applying nationwide-sales numbers to the total costs is the correct approach to determining HD OBD system costs since manufacturers have historically only produced nationwide HD engines and continue to do so. Using the commenter's cost analysis approach would be clearly incorrect and is analogous to saying that the HD OBD costs should all apply only to California engines and that non-California engines would have zero costs even though these engines and their HD OBD systems are identical to California engines. Additionally, when estimating costs, CARB staff tried to utilize available information and assume the worst case scenarios whenever possible. While the analysis utilized assumptions to simplify the analysis, CARB staff's analysis did account for the different systems and situations of the various HD engine manufacturers. In the analysis, CARB staff estimated a percentage of the HD engine manufacturers that would need to undertake changes to their systems with hardware, software, calibration, and testing. Further, as mentioned in the Agency Response to Comment 73, CARB staff does not believe the costs of the proposed increased deficiency fines should be included in the HD OBD costs. The cost to comply with the HD OBD regulations should only consider engines with "compliant" HD OBD systems. Therefore, CARB staff believes its per-engine cost estimates were appropriately calculated.

89. Comment: EPA currently does not have a process or the requisite personnel to make its own independent determination of whether an engine meets the EPA's HD OBD requirements – EPA requires manufacturers to show compliance with CARB's HD OBD requirements before EPA will issue a federal Certification of Conformity. Therefore, CARB's HD OBD regulations are the de facto nationwide standard. The growing costs and complexity of CARB's HD OBD regulations, in addition to the other California-only heavy-duty on-highway regulations slated for adoption within the next 13 months, could drive HD engine manufacturers and EPA toward 49-state certifications under EPA's regulations, which would have significant adverse impacts on California's economy/business and air quality. This increasingly likelihood means CARB's statements that all manufacturers have chosen to design a single HD OBD system that meets both CARB and EPA's regulations and that any increase in costs will also be experienced by non-California businesses will no longer hold. It should be noted that EPA's HD OBD regulations do not include requirements for MST, deficiency fines, or any of the amendments at issue, which further undermines the continuing validity of CARB's statements. Consequently, CARB needs to recalculate all the projected costs using California-only volumes (34,735 vehicles), not nationwide sales volumes (500,000 units), or else this rulemaking is inherently unreasonable. The net cost-effectiveness calculation will similarly be unreasonable and violates CARB's delegated authority. EMA's cost estimates are based on the cost impacts of the five major manufacturers of HHDs, which comprise of 90 percent of the market for engines installed in large Class 7-8 commercial vehicles. Assuming 10 percent of the U.S. Class 7-8 vehicle market (approximately 250,000 sold annually) is the California market, the California numbers would be 25,000 vehicles, with 90 percent being 22,500 and, dividing by 5, 4,500 engines

per manufacturer. This is the per-manufacturer number CARB should be using to assess HD OBD costs. (EMA)

Agency Response: As mentioned previously, calculating costs based on California-only volumes would be incorrect since all HD engine manufacturers have been designing and producing a 50-state engine for many years. Should the majority of HD engine manufacturers choose to produce a California-only engine, then it would be appropriate to conduct the cost analysis with California-only volumes for the entire HD category. However, a revised analysis with California-only volumes would also have different dollar amounts because there would be shared costs certifying California and 49-state engines, and hence cost savings since EPA's HD OBD regulation would cover most of the costs. Additionally, the HD sector consists of classes 4 through 8. The commenter's suggested sales volume is erroneously only taking into account the sales volume for the 5 largest manufacturers in the class 7 through 8 categories, which would result in higher costs per engine, while CARB staff's analysis utilized the sales volumes for the entire HD category. CARB believes that utilizing the sales volumes for the entire HD engine weight class is the correct approach to take. Concerning the comment that EPA's HD OBD regulations do not contain requirements like MST and the deficiency fines and that this undermines CARB's statement that all HD engine manufacturers design a single OBD system to meet both CARB and EPA's HD OBD regulations, CARB staff disagrees with this assertion. CARB'S OBD regulations have always generally been more stringent than EPA's regulations, which is one of the reasons why EPA has historically accepted OBD systems certified to CARB's OBD regulations. In fact, MST testing has been required for a few years now, and deficiency fines have been applied since the 2013 model year, yet HD engine manufacturers still design one OBD system to meet both regulations, which contradicts the commenter's assertion.

90. Comment: While we support pragmatic strengthening of the OBD requirements (since it improves vehicle emissions compliance by identifying potential emissions technology problems and malfunctions sooner), CARB's proposed expansion of the HD OBD program could consume a large portion of engine and vehicle manufacturer's resources that would otherwise be directed towards emissions control technologies. (MEMA)

91. Comment: CARB's proposed expansion of the HD OBD program would consume a large portion of manufacturer's resources that could otherwise be directed towards developing a robust performance-based emissions control program for heavy-duty on-highway engines and vehicles focused on real-world real-time emissions performance. (EMA)

Agency Response to Comments 90-91: CARB staff made several changes to the original 45-day proposal in the first 15-day notice to address manufacturers' resource concerns. Most prominently, as stated above in the Agency Response to Comment 10, the 15-day change proposal delays the start date for most of the new requirements except for those related to REAL from the 2022 model year to the 2024 model year. Additionally, CARB staff proposed some relaxations associated to the original REAL proposal to address the workload issue for diesel engines. Specifically, staff proposed 15-day changes that allowed manufacturers of heavy-

duty and medium-duty diesel engines to implement one of two possible options that reduce the amount of testing or tracking requirements for the 2022 and 2023 model years. Therefore, CARB staff believes these changes will address some of the resources issues.

92. Comment: Even with the proposed relaxations for MST, the MST program would still cost each HD engine manufacturer about \$1 million per year to complete (\$222 per engine), not the \$363,717 per year stated in the Staff Report, and therefore is still cost-prohibitive. (EMA)

Agency Response: Please see the Agency Response to Comment 74.

93. Comment: Here are EMA's cost estimates for the proposed HD OBD amendments for an average engine manufacturer compared to CARB's cost estimates. (EMA)

HD OBD Proposal	CARB		EMA Ave.
	Total Cost	Total Annual Cost	Total Cost
IUM PR - Increase all monitors to 0.3 - 2022+M Y	\$401,567	\$66,928	\$ 255,360
IUM PR - Require new diesel monitors to track and report data - 2022+M Y	\$2,200	\$367	\$ 461,875
PHEVs - require 2 ignition cycle counters - 2022+M Y	\$4,200	\$700	\$ 23,733
Change freeze frame requirements - 2022+M Y	\$4,200	\$700	\$ 514,541
Monitoring Conditions - restrict SET cycle conditions to monitors that are IUM PR tracked and reported - 2022+M Y	\$1346,162	\$224,360	\$ 79,333
Limit emissions-increasing intrusive diagnostics to run only after MIL already on	\$15,000	\$2,500	\$ 333,333
Add NOx emission thresholds to PM filter filtering performance monitor and catalyzed PM filter conversion monitor - 2022+M Y	\$0	\$0	\$ 29,667
EGR/Boost continuous monitors - add similar conditions requirements - 2022+M Y	\$1,000	\$167	\$ 131,199
New NOx sensor monitor requirement - indicate fault when goes "inactive" when it should be "active" - 2022+M Y	\$186,216	\$31036	\$ 140,825
Add more stringent CV monitoring requirements - 2025-2027 M Y phase-in	\$75,409	\$12,568	\$ 295,799
DDE - Change engine durability aging requirements	\$694,756	\$694,756	\$ 303,750
PVE (1)(2) - Require testing of 10 monitors already tested during DDE testing	\$1,000	\$1,000	\$ 11,213
Readiness - add separate diesel exhaust gas sensor heater readiness bit for J1939 vehicles and add gasoline O2/exhaust gas sensor heater bit; for 2022+M Y, take PM filter frequent regen and active/intrusive injection out of readiness	\$1,000	\$167	\$ 450,000
New NOx performance control tracking parameters - 2022+M Y	\$19,900	\$1,990	\$ 485,217
New GHG-related parameters - 2022+M Y	\$13,400	\$1,340	\$ 384,122
New over the air reprogramming requirements - 2022+M Y	\$26,400.00	\$2,640	\$ 100,267
New certification doc requirements (e.g., torque PIDs correlation, Nox sensor status flag, 1Hz data showing the instantaneous NOx mass emission rate)	\$2,000	\$2,000	\$ 265,675
<b>Totals w/o MST</b>	<b>\$2,794,410</b>	<b>\$1,043,219</b>	<b>\$4,265,910</b>

Agency Response: As explained in the Staff Report, CARB staff conducted a comprehensive cost analysis of all the various elements of the HD OBD proposal. CARB staff utilized whatever data that were available to conduct the cost analysis. HD manufacturers were solicited to provide cost numbers but did not provide any numbers for non-MST costs. Since the table above does not

provide any details for how the commenter came up with their costs estimate, it is difficult to provide a response to why the costs are different. The commenter does go into detail in a separate section of their 45-day comments about the software development work required to meet the proposed revisions to the readiness status requirements, but CARB staff believes that the commenter's estimated costs associated with this requirement is overestimated. As already stated in the Staff Report, manufacturers are already meeting the amendments related to adding separate diesel exhaust gas sensor heater and gasoline oxygen sensor/exhaust gas sensor heater readiness bits since these bits were already required by the SAE J1979 and SAE J1939 standards, so these manufacturers would not need to make any changes. Further, the proposed deletion of the PM filter frequent regeneration and active/intrusive injection monitors from the PM filter readiness bit were specifically requested by the manufacturers. Thus, it is disingenuous for the commenter to imply that manufacturers would be unjustly subjected to high costs to meet amendments that were suggested by the manufacturer themselves. Therefore, CARB staff believes there may be other cases where the commenter inappropriately overestimated the cost for a specific proposed requirement. Nevertheless, CARB staff is willing to work with the commenter to understand what the fundamental differences are for the commenter's cost analysis and the CARB staff's cost analysis. As mentioned previously, CARB staff's cost estimates for the previous iterations of the HD OBD regulation when added up and without adjusting for inflation are actually higher than the costs estimated by the commenter. CARB staff is willing to modify any costs that were overlooked or overestimated as long as there is justification for a cost modification.

94. Comment: For the proposed amendments to the readiness status requirements (requiring new, separate readiness bits for diesel exhaust gas sensor heater and gasoline oxygen sensor/exhaust gas sensor heater) and taking out the PM filter frequent regeneration and active/intrusive injection monitors out of the PM filter readiness status), CARB's estimate of \$200 (or \$2,000 for a large manufacturer with 10 engine families) for algorithm development and reprogramming or less than half a day for a full-time employee (FTE) is completely unreasonable. It suggests a software development process where a single person has the entire software in her head, which has nothing in common with creating and maintaining modern engine software. Here is the actual breakdown from one member of EMA following a software development process based on the SPICE standard, with the total time being 43 FTE hours (people involved in the parentheticals):

- Updating requirements documents – discuss amendments, identify and update documents, hold meetings (regulatory analyst, software requirements writer testing teams, managers): 3 FTE hours
- Converting regulatory requirements into software requirements – identify and update proper software documents, hold meetings (regulation analyst, software writer, unit testing team, managers): 4 FTE hours (a 1-hour meeting with 3 engineers = 3 FTE hours)
- Writing the software: (programmers, possibly requirements writers); 3 FTE hours

- Management oversight – discuss during regular management review meetings (project managers, chief engineers, directors of regulatory compliance, engineering managers and supervisors: 2 FTE hours (assuming it takes 2 minutes in 2 meetings with 30 people)
- Unit testing software – create and run test cases (testers, requirements writers): 2 FTE hours (troubleshooting highly variable and time intensive)
- Vehicle final verification testing – create and run tests on vehicle, document tests (testers, requirements writers): 2 FTE hours (may take longer if diagnostic hard to run (e.g., requires overnight soak))
- Debugging (variable: project manager, chief and test engineers, director of regulatory compliance, requirements writers, regulatory analysts): 20 FTE or higher (multiple alignment meetings, each 30-minute meeting with 4 engineers = 2 FTEs)
- Documentation – document in certification application (documentation specialist and/or technical writer, regulatory specialist): 2 FTE hours (multiple subject matter experts need to be coordinated even though change small)
- Question and Answer with CARB – CARB asking specific detailed questions since these are new features (anybody depending on questions): 4 FTE hours (collecting information and translating to form that CARB can review is time intensive and requires highly skilled people)

Assuming an average in-house FTE-hour costs \$75 per hour, this work is \$3,225 as opposed to CARB's \$200 estimate. For a large manufacturer with 10 engine families, assuming minimal engineering effort for engine families 2 through 8 (4 FTE hours each) and assuming a special problem occurs that leads to significant effort on engine families 9 and 10 (20 FTE hours each), the total is 111 FTE-hours, or \$8,300, more than CARB's \$2,000 estimate.

Agency Response: The example that the commenter provides here (i.e., separate exhaust gas sensor heater/gasoline O2 heater readiness status amendments added to readiness) are actually relaxations since this is what HD engine manufacturers are all currently doing on their engines (because this is what is specified by the SAE J1939/J1979 standards). Therefore, CARB staff's analysis did not include any costs for these changes. Regarding the proposed removal of monitors from the PM filter readiness bit, this change was made specifically because HD engine manufacturers requested that CARB take those monitors out. Since this change would require software modifications, CARB staff added costs for this change only. Since the commenter's example is costing for changes to all 3 items, the cost estimates are over estimations by a factor of 3. Taking 43 hours and dividing that by 3 results in about 14 hours of FTE. This works out to be around \$1400 if an FTE is assumed to cost \$100 per hour, which is in the same magnitude of CARB staff's estimate of \$2000.

95. Comment: The HD OBD proposal has no additional emission-reduction benefits to the HD OBD program (which CARB projects eliminates 14 pounds (not tons) of PM over the HHD engine lifetime). Assuming that HHD engines have a 20-year lifetime, that would be an average of 0.7 pounds PM reduction per year, which is 15,750 pounds or 7.9 tons of PM per year for California HHD engines (22,500 engines). Considering the estimated aggregate annual cost of the HD OBD program in California for the five major HHD engine manufacturers

(\$52,750,000 (5x\$10,550,000) + \$7,640,000 (5x\$1,528,000) + \$21,329,550 (5x\$4,265,910) = \$81,719,550), the “cost-effectiveness” of the HD OBD regulations is \$10,344,247 per ton of PM reduced, which is well beyond the scale of any reasonable cost-effectiveness metric. If the PM cost were divided by half to reflect CARB’s unsupported assertion half of all OBD costs are for PM emission benefits, that is still more than \$5 million. For perspective, EPA’s cost-effectiveness projections for its last three significant HD on-highway engine PM standards were \$17,000 per ton (“EPA’s 2010 Standards”), \$46,000 per ton (“EPA’s Urban Bus Rule”), and \$37,000 per ton (“EPA’s 1998 standards), adjusted from 1999 to 2018 dollars using the U.S. Bureau of Labor Statistics Consumer Price Index. (EMA)

The proposed HD OBD amendments are costly and complex additions to a prescriptive-based program that have a negative benefit-to-cost ratio. For comparison, EPA projected the EPA 2010 HD on-highway engine emissions standards would result in a monetized net benefit of \$66.2 billion (a result of subtracting the projected costs of \$4.2 billion from the projected benefits of \$70.4 billion, with at least 89 percent of those benefits results from projected PM reductions and associated reduction of PM-related mortality and morbidity impacts. If the benefits are considered all PM-related, the benefit-to-cost ratio is 16.8-to-1 (\$70.4/\$4.2) for a cost-effectiveness of \$17,000 per ton. If EPA had projected the PM-related costs at \$285,600 per ton, that would be a “neutral” 1-to-1 benefit to cost ratio, so any PM cost-effectiveness projection greater than \$285,600 would be a net cost (not benefit) to the public. CARB’s HD OBD regulation cost effectiveness of \$10,344,247 per ton of PM reduced, which amounts to a benefit-to-cost ratio of 0.0276-to-1 (or cost-to-benefit ratio of 36.2-to-1) vastly exceeds any plausible amount of projected benefits. This confirms CARB’s HD OBD regulations are cost-prohibitive and so invalid. (EMA)

96. Comment: CARB should evaluate where the HD OBD regulation can be streamlined to reduce costs and for the highest benefit-to-cost ratio. CARB may have underestimated the costs to industry of the HD OBD proposal. Some of the revisions are costly and complex additions that do not necessarily help the OBD program benefit-to-cost ratio. (MEMA)

Agency Response to Comments 95-96: CARB staff does not understand how the commenter arrived at its cost-effectiveness numbers. As mentioned in the Staff Report, “the lifetime cumulative emission reductions on a per engine basis were calculated to be 165 pounds of ROG, 2000 pounds of NOx, and 14 pounds of PM.” Since the regulatory proposal only added an incremental cost of \$42.46 per engine for diesel engines, the results from the 2009 HD OBD biennial review still apply. As stated in 2009, the per-engine cost to implement OBD for the vehicle purchases was estimated at \$630 per engine. This cost includes the incremental cost of a new engine to comply with the HD OBD requirements during the 2009 timeframe (\$134) and the incremental cost of repairs due to OBD per engine over its life of \$496 per engine. Adjusting this cost for inflation results in an estimated cost of \$740 per engine in 2018 dollars. Adding the inflation-adjusted cost of the 2012 amendments (\$0.61 per engine) and the proposal’s incremental cost of \$42.46 per engine results in a total estimated cost of \$783 per engine. Splitting that in half, \$392 is attributed

to PM benefit for a cost-effectiveness of \$28 per pound of PM by dividing \$392 by 14 pounds of PM reduced over the lifetime of the engine. The other half of the cost was attributed to reactive organic gases (ROG)+NOx benefit for a cost-effectiveness of \$0.18 per pound of ROG+NOx by dividing \$392 by 2165 pounds of ROG+NOx reduced over the lifetime of the engine. If only NOx benefits were claimed, the cost-effectiveness for NOx is \$0.20 per pound. These values compare favorably with the cost-effectiveness of other, recently adopted regulations. CARB staff does not understand how the commenter calculated the cost effectiveness of \$10,344,247 per ton of PM reduced for CARB's HD OBD regulation. When converted to tons, the \$28 per pound of PM reduced for the HD OBD regulation is \$56,000 per ton of PM reduced, not \$10,344,247 per ton of PM reduced as the commenter states.

## COMMENTS ABOUT ENVIRONMENTAL IMPACTS

97. Comment: CARB failed to comply with the applicable California Environmental Quality Act (CEQA) and California Administrative Procedures Act (APA) requirements, since CARB did not prepare a Standardized Regulatory Impact Assessment (SRIA). See *Lawson Rock & Oil, Inc. v. State Air Resources Board*, Cal. Ct. App., 5<sup>th</sup> Dist. (Case No. F074003)(2018). The Economic Impacts Assessment (EIA) in the Staff Report does not analyze in an adequate manner the “potential adverse economic impacts on California business and individuals”, including the potential unavailability of California-certified for 2022 and subsequent model years, the “competitive disadvantages for businesses currently doing business within the state,” and the potential environmental adverse environmental consequences of the amendments. These are inconsistent with CARB's obligations under CEQA. There's no sufficient basis for CARB's unilateral assertion that the proposed amendments are exempt from CEQA because CARB determined there was no adverse effect on air quality. CARB failed to consider the reasonable possibility that new CARB-certified HD engines will be unavailable (since manufacturers will find it no longer feasible or economically viable to manufacture and sell CARB-certified products) and the significant price increase in price for the remaining new California-sold HD engines and vehicles. CARB's failure to consider the virtually certain deficiency-fine impacts of \$750-\$1,500 per engine in its EIA represents the lack of technical thoroughness, accuracy, and reasonableness of the EIA. (EMA)

Agency Response: CARB disagrees with this comment. A SRIA is not required for this rulemaking action. A major regulation is defined in the State Administrative Manual 6600 as: “any proposed rulemaking action adopting, amending or repealing a regulation subject to review by the Office of Administrative Law (OAL) that will have an economic impact on California business enterprises and individuals in an amount exceeding fifty million dollars (\$50,000,000) in any 12-month period between the date the major regulation is estimated to be filed with the Secretary of State through 12 months after the major regulation is estimated to be fully implemented (as estimated by the agency), computed without regard to any offsetting benefits or costs that might result directly or indirectly from that adoption, amendment or repeal.” The annual economic impacts of the subject amendments do not exceed \$50,000,000, and hence a SRIA is not required.



CARB also disagrees with the comment that it improperly determined the amendments are exempt from CEQA. First, the Environmental Analysis prepared for this item satisfies all requirements of CARB's Certified Regulatory Program (CRP). CARB's CRP provides that its staff reports "shall contain a description of the proposed action, an assessment of anticipated significant long or short term adverse or beneficial environmental impacts associated with the proposed action and a succinct analysis of those impacts. The analysis shall address feasible mitigation measures and feasible alternatives to the proposed action which would substantially reduce any significant adverse impact identified." (17 CCR § 60005(b).) The Environmental Analysis in this case satisfies this requirement. As no significant impacts are associated with this proposed action, the analysis does not need to, and cannot, assess any significant adverse impacts from the proposed action (as there are none). The analysis also does not need to address mitigation measures or alternatives, as under both CARB's CRP and long-established CEQA principles, those are only required where potentially significant impacts exist. (Id.; see also Pub. Resources Code §§ 21100(b)(3), 21150; and 14 CCR § 15126.4(a)(3).)

Second, it is also long-established that an agency's CRP exempts it from Chapters 3 and 4 of CEQA only. (Pub. Resources Code § 21080.5(c).) CEQA's exemption authority is not contained in Chapter 3 or 4; rather, it is located elsewhere in CEQA, mainly in Chapter 2.6. (See, e.g., Public Resources Code §§ 21080, 21083.) So, the commenter is incorrect that CARB lacks authority to properly determine that certain activities are exempt from CEQA.

Finally, CARB disagrees with the assertion that its EIA in the Staff Report did not adequately analyze the "potential adverse economic impacts on California business and individuals", because it did not address the potential unavailability of California-certified engines for 2022 and subsequent model years, the "competitive disadvantages for businesses currently doing business within the state," and the potential environmental adverse environmental consequences of the amendments. CARB does not believe that California-certified engines will be unavailable in the 2022 and subsequent model years due to excessive costs – rather, staff's cost estimates were lower than the commenter's costs by nearly half. (More details about the cost estimates can be found in discussions below in "Comments about Cost Estimates"). Further, CARB staff assumed that 2022 model year engines would be available because the proposal provides adequate lead time and reasonable cost increases for a 50-state engine/vehicle to be produced. Manufacturers have traditionally produced a 50-state engine/vehicle, so CARB staff has no reason to believe that this practice will not continue.

98. Comment: CARB's assertion that the HD OBD amendments will not have an adverse environmental impact is incorrect. Analyses of the impact of costs on new engine/vehicle purchasing decisions are well documented and evident for heavy-duty engines, and historically demonstrated by "pre-buy" marketplace activities when regulations have increased purchase costs or operation costs. A current analyses shows California significantly lags behind other states in purchasing and developing new heavy-duty engines. California-only regulations that increase the cost of CARB-certified engines will continue this trend, with fewer new engines being introduced and older engines remaining longer in the

California marketplace, resulting in slower fleet turnover (through pre-buy/no-buy behavior) and adverse air quality ramifications (i.e., increase in the amount of aggregate emissions). CARB's inventory modeling assumptions regarding engine replacement and resulting environmental benefits significantly distort the perceived environmental benefits of CARB's emission regulations. (EMA)

Agency Response: CARB staff disagrees with the commenter. Though the commenter claimed that the impact of costs on new engine/vehicle purchasing decisions are "well-documented and evident" for heavy-duty engines and that the California-only regulation would result in pre-buy/no-buy behavior and adverse air quality, the commenter did not provide any specific data or information supporting their claims. As mentioned in the Staff Report, CARB staff claimed that OBD helps maintain the emission benefits used for the emission standards and therefore did not claim any new emission benefits. As for the pre-buy activities, such activity tends to occur before major emission standard requirements are implemented since the new standards will most likely require new emission control technology. The HD OBD proposal, however, does not require new emission control technology that could impact on-going operating costs or reliability issues except for the initial incremental cost increase mentioned in the EIA, so no incentive to pre-buy engines has been created by this rulemaking. Therefore, CARB staff believes the HD OBD proposal will not have an adverse environmental impact.

## 15-DAY COMMENTS

99. Comment: A pickup truck in California is clearly lying on emissions, which should not be tolerated, and action needs to be taken against people like this. A link to the video of the truck is provided. (Corey)

Agency Response: This comment is outside the scope of the modifications made available in the first 15-Day Notice.

100. Comment: CARB should delete the requirements in section 1968.2(g)(8), which requires manufacturers to collect and report all lifetime data prior to erasure during an OTA reprogramming event. CARB indicated that the requirements of this section is not applicable if either OTA is not utilized or, if OTA is utilized, all data in sections (g)(5) and (g)(6) are retained during a reprogramming event. But this retaining of data is not an option since section 1968.2(g)(5.2.1)(B) requires that the IUMPR data be reset to zero (effectively erased) when an NVRAM reset occurs (e.g., reprogramming event). Manufacturers want to utilize OTA reprogramming to provide better service to customers, and OTA requires manufacturer commitment to the costs related to development and data bandwidth. Section 1968.2(g)(8) inherently and unnecessarily increases the development and bandwidth cost, which limits the motivation to use OTA reprogramming technology and, therefore, reduces service to customers. CARB should not force increased costs to manufacturers with OTA reprogramming. (Honda)

Agency Response: This comment extends beyond the scope of the modifications made available in the first 15-Day Notice because it does not raise any objections or

recommendations directed to those specified modifications. Further, the commenter submitted similar comments during the 45-day comment period, which CARB staff responded to above, including responses addressing the costs of the proposal (see Agency Response to Comment 57 above). Nevertheless, CARB provides the following response. The language in section 1968(g)(5.2.1)(B) is not intended to require an IUMPR data reset when a NVRAM reset occurs, but rather to state that the reset is permissible only when a non-volatile memory reset occurs. Manufacturers are permitted to design their controllers such that all information subject to the OTA data reporting requirement (including IUMPR values) are retained during a reprogramming event. If such a design is implemented, the manufacturer is exempt from the OTA reporting requirements for that vehicle model. Many manufacturers' designs are expected to comply with the regulation in this manner. For those designs that would erase any of the subject data during an OTA reprogramming event, the regulatory amendments would require manufacturers to collect the required information from the vehicle through the OTA connection prior to its erasure. After aggregating collected data, the manufacturer would be required to report it to CARB in the format specified by the regulation. CARB staff disagrees that the reporting requirement imposes costs on manufacturers that would in any way limit their motivation to use OTA reprogramming technology considering the cost to report and collect the data are estimated at 53 cents per engine for the heavy-duty manufacturers. Considering the commenter consists of primarily manufacturers of light- and medium-duty vehicles where production volumes are typically much higher, the per vehicle costs of the requirement would be substantially lower. Further, as described above, manufacturers have the option of avoiding the OTA reporting requirement (and the associated costs) entirely by designing their controllers to retain the subject information even when an NVRAM reset occurs. Therefore, no changes were made to the proposal based on this comment.

101. Comment: MEMA appreciates the 15-day changes related to providing longer leadtime to meet the requirements associated with REAL including the new tracking and reporting requirements and a few relaxations associated with the REAL proposal. MEMA also appreciates the changes related to the clarifications to the intrusive diagnostic requirements. (MEMA)

Agency Response: To clarify, the 15-day changes (during the first 15-day notice) provided longer leadtime to meet the requirements that are not associated with REAL, while no changes were made to the start dates for the REAL requirements. Notwithstanding, the added leadtime was in part intended to allow manufacturers to concentrate resources on compliance with the REAL requirements in the near term, and has the effect of spreading the workload associated with meeting the amended HD OBD requirements as a whole over a greater timeframe.

102. Comment: The NOx sensor activity monitor should be excluded from the readiness and test result reporting requirement in the HD OBD and OBD II regulations just like the NOx and PM sensor feedback monitors, which have a similar fault pattern and are subject to the same monitoring conditions. Further, a meaningful test result that could be reported for the NOx sensor activity monitor is not clear. (MEMA)

Agency Response: This comment extends beyond the scope of the modifications made available in the first 15-Day Notice because it does not raise any objections or recommendations directed to those specified modifications. Nevertheless, CARB provides the following response. Regarding the readiness requirements, the proposed regulation actually does not require the NOx sensor activity monitor to be included in the diesel exhaust gas sensor readiness status. Specifically, the language in sections 1971.1(h)(4.1.3)(I) and 1968.2(h)(4.1.3)(L), which list the monitors required to be included in the diesel exhaust gas sensor readiness status, do not include the NOx sensor activity monitor. Regarding test results, staff expects that as a matter of practical necessity, all diagnostic strategies will have thresholds that are used to determine whether a component is good or bad. If a diagnostic strategy does not have either an upper or lower threshold for this purpose, then the diagnostic is not capable of making pass/fail decisions and could not be approved as a monitoring strategy under the regulation. As such, the test results reporting requirements simply state that these upper and/or lower thresholds must be reported to a scan tool along with the monitoring metric used in the decision process. The purpose for the availability of the test results for these monitors is to aid service technicians in the diagnosis of such faults in the repair environment.

103. Comment: Though EMA appreciates the 15-day change that extends the 60-day deadline in sections 1971.1(h)(6.2) and 1968.2(g)(8.2) to “within 75 calendar days of the availability of the calibration/software update,” there are still timing concerns since manufacturers utilize a staggered release for software updates. CARB staff should either provide manufacturers with more than an additional 15 days or revise the language to begin calculation of the 75-day period from the “availability of the last-released calibration/software update.” (EMA)

Agency Response: As explained above in the Agency Response to Comments 59-60, CARB staff added 15 days to the original 60-day proposal since CARB staff believes this will not negatively impact use of the data, but also emphasized that timely submittal of the information was important. CARB staff believes that basing the start of the 75-day period from the availability of the “last-released” calibration/software update may lead to manufacturers unnecessarily delaying submittal of the information to CARB, since the date of the “last-released” calibration/software update is decided by the manufacturer and is not otherwise constrained in any way. If a manufacturer chooses to stagger the availability of a given software release, it can comply with the requirement by preparing a separate data submittal for each point of release.

104. Comment: The proposed 15-day changes to the DLC location requirement in the HD OBD regulation may not address the problem in all cases. Language should be added to section 1971.1(h)(2.3) to provide an opportunity for manufacturers to request Executive Officer approval for an alternative location on a case-by-case basis. (EMA)

Agency Response: This comment extends beyond the scope of the modifications made available in the first 15-Day Notice because it does not raise any objections or recommendations directed to those specified modifications that address how the

DLC location needs to be visible to a technician looking for the connector, but rather the commenter wants provisions for a different DLC location altogether. Nevertheless, CARB provides the following response. Staff believes the regulation with the proposed changes in the 45-day language and first 15-Day Notice allow significant flexibility in locating the connector while sufficiently standardizing the connector location such that it can be readily located by a technician or inspector. Staff does not believe that a provision to consider other locations is appropriate because any proposed locations that are outside of what is already provided for in the regulation would have the effect of undermining the purpose of the standard location requirement.

105. Comment: EMA had commented previously that it was unnecessarily onerous to submit corrected CO<sub>2</sub> emissions data for OBD certification demonstration because (i) the regulation currently does not have CO<sub>2</sub> OBD emissions limits, (ii) fuel correction typically accounts for a shift in reported CO<sub>2</sub> values of less than one percent, and accuracy to values of this level are not likely to be informative, (iii) EPA regulation currently require that fuel correction for reported CO<sub>2</sub> numbers be performed by three independent laboratories, and (iv) due to the many tests and lengthy nature of the HD OBD certification (as opposed to criteria pollutant and GHG certification), fuel samples would likely need to be analyzed multiple times over the course of the test as new fuel is delivered to the test facilities. While the 15-day change allows manufacturers to submit the raw measured CO<sub>2</sub> values, the language still requires manufacturers to request Executive Officer approval to do so. CARB should change the regulation to always allow raw measured CO<sub>2</sub> data to be submitted (i.e., take the Executive Officer request requirement out) considering the increased workload to correct the values and the limited potential of this correction to provide meaningful information. When the regulations are amended later to include CO<sub>2</sub> HD OBD emissions limits, the data requirement could be addressed at that time to support the appropriate level of accuracy, depending on the magnitude of the thresholds as compared to the potential impact from fuel correction. A data requirement absent set emissions limits is not appropriate or reasonable at this time. (EMA)

Agency Response: CARB disagrees and did not make any changes in response to this comment. The commenter mentioned that “fuel correction typically accounts for a shift in reported CO<sub>2</sub> values of less than one percent” – it is not clear under what conditions the shift would be more than one percent or how large it could be. It is also not clear if there are aspects related to OBD faults that would affect raw measured CO<sub>2</sub> data versus fuel corrected CO<sub>2</sub> data. As already mentioned in the Staff Report, the CO<sub>2</sub> data will be used to assist staff in determining and proposing appropriate emission malfunction thresholds based on CO<sub>2</sub> in future rulemaking actions. In allowing manufacturers to request approval to use the raw data, which may involve manufacturers providing information comparing the raw data to the corrected data, CARB will gain understanding on the impacts of the corrections, which may assist CARB staff in developing appropriate OBD CO<sub>2</sub> thresholds. Therefore, CARB staff believes requiring manufacturers to request Executive Officer approval to use only raw measured CO<sub>2</sub> data is appropriate. Further, contrary to the commenter, CARB staff believes that the CO<sub>2</sub> data requirement is appropriate and

reasonable, since the data would provide the basis for future proposed OBD CO<sub>2</sub> thresholds.

106. Comment: There is a typo in section 1968.2(g)(4.2.2)(B)(iv) – the phrase “medium-duty vehicles equipped with diesel vehicles” should be revised to “medium-duty vehicles equipped with diesel engines.” (EMA)

Agency Response: CARB staff agrees and made this non-substantive change, as explained in section II. B. above.

107. Comment: The 15-day change in the HD OBD enforcement regulation stating that, in making a finding regarding a remedial action, CARB’s determination will be based on the “degree to which a calibration error or other calibration feature adversely impacts the accuracy of the NO<sub>x</sub> mass values that are calculated by the OBD system” is extremely vague and does not adequately define or provide any specificity on the “degree” that would be acceptable. The language should be either changed to provide specific criteria or delayed until the 2024 model year to provide manufacturers adequate time to understand what this provision might entail in practice. (EMA)

Agency Response: CARB staff disagrees and did not make any changes in response to this comment. The proposed language does not apply to the finding of nonconformance by CARB. Rather, the proposed language applies after CARB has made a finding of nonconformance pursuant to section 1971.5 and is determining the remedial action to be required of the manufacturer. The existing regulation (section 1971.5(d)(4)) specifies that CARB can require remedial action up to and including recall after considering all relevant circumstances including but not limited to those specified in the regulation. To account for the proposed data parameters in sections 1971.1(h)(4.2) and (h)(5.3), CARB staff proposed 15-day language (during the first 15-day notice) in section 1971.5(d)(4)(B)(xiv) that merely added to the existing explicit relevant circumstances to be considered in section 1971.5(d)(4)(B). Staff does not believe manufacturers need to know how CARB will determine the necessary remedial actions of nonconforming systems in order for manufacturers to implement compliant systems. Accordingly, no changes were made in response to this comment.

108. Comment: The 45-day language in section 1971.1(e)(5.2.3)(D) is inconsistent with the 45-day language in section 1968.2(f)(1.2.3)(D)(i). Specifically, the language in section 1971.1(e)(5.2.3)(D) states that monitoring of the ammonia slip catalyst is not required if “there is no measurable emission impact on the criteria pollutants (i.e., NMHC, CO, NO<sub>x</sub>, and PM) during any reasonable driving condition in which the catalyst is most likely to affect criteria pollutants (e.g., during conditions most likely to result in ammonia generation or excessive reductant delivery)” while the language in section 1968.2(f)(1.2.3)(D)(i) states that monitoring of this catalyst is not required if “there is no measurable emission impact on the criteria pollutants (i.e., NMHC, CO, NO<sub>x</sub>, and PM) during any reasonable driving condition in which the catalyst is most likely to affect criteria pollutants (e.g., during conditions most likely to result in ammonia generation or excessive reductant delivery).” Please explain this inconsistency. (EMA)

Agency Response: This comment extends beyond the scope of the modifications made available in the first 15-Day Notice because it does not raise any objections or recommendations directed to those specified modifications. Nevertheless, CARB provides the following response. As mentioned in the Staff Report, staff intended the requirements in section 1968.2(f)(1.2.3)(D)(i), which apply to medium-duty vehicles certified to an engine dynamometer tailpipe emission standard, to align with the requirements for heavy-duty engines in section 1971.1(e)(5.2.3)(D). CARB staff believes any lack of alignment in the language may be an error. However, at this point in time, CARB staff is unable to make any further substantive changes to the regulation language. Nevertheless, CARB staff believes this will not create any issues in practice, but if needed, will address this at a future OBD rulemaking update. Manufacturers that meet the requirement as stated in section 1971.1(e)(5.2.3)(D) would also meet the requirement as stated in section 1968.2(f)(1.2.3)(D)(i) despite the wording differences. As such, the language differences would not require manufacturers to design two versions of the same engine to meet the respective requirements in sections 1971.1 and 1968.2.

109. Comment: The proposed language in section 1971.1(g)(3.3.1) is confusing and seems to prohibit emissions neutral diagnostics, which are not defined in the HD OBD regulations. While CARB staff previously discussed this issue with manufacturers and indicated it would add clarifying language in the 15-day notice, no such language was added. CARB should either modify the regulatory language in section 1971.1(g)(3.3.1) or add the definition of “emissions neutral diagnostic” that is used in the OBD II regulation into the HD OBD regulation.  
(EMA)

Agency Response: CARB staff believe the commenter is talking about the proposed 45-day changes in section 1971.1(g)(3.1.1) (not (g)(3.3.1) as the commenter stated) that included the language “If the control system detects deterioration or malfunction of the component/system and takes direct action to compensate or adjust for it, manufacturers may not use the criteria under section (g)(3) and are instead subject to the default action requirements of section (d)(2.2.1)(E) or (d)(2.2.2)(E), as applicable.” This language addresses alternate control strategies that are actuated in response to a malfunction, which would be considered default actions and thus subject to the requirements of section 1971.1(d)(2.2.1)(E) or (d)(2.2.2)(E). Those sections require MIL illumination and fault code storage if the default action affects emissions or the performance of the OBD system. Considering emissions neutral default actions activated by emissions neutral diagnostics (as defined in the OBD II regulation) do not affect emissions, CARB staff does not believe the proposed language in section 1971.1(g)(3.1.1) is prohibiting emissions neutral diagnostics. Thus, CARB staff believes that a heavy-duty engine manufacturer may be able to produce an engine that meets both the medium-duty requirements of the OBD II regulation (which allows for emissions neutral diagnostics) and the heavy-duty requirements of the HD OBD regulation (which does not have specific provisions for emissions neutral diagnostics but requires the OBD system to illuminate the MIL and store a pending fault code and confirmed fault code within 10 seconds to inform the vehicle operator whenever the engine enters a default or “limp home” mode of operation that can affect emissions or the performance of the OBD system).

110. Comment: CARB should make changes in sections 1971.1(h)(5.3.1)(A) and (h)(5.3.4) to allow for technologies in which the emission control systems do not utilize engine-out NOx sensors. Specifically, language should be added to allow manufacturers to request Executive Officer approval to track and report an alternative to the NOx mass – engine out data required in section 1971.1(h)(5.3.1)(A), with approval based on manufacturer-submitted information showing the alternative information is sufficient to satisfy the NOx emission tracking requirement. There are concepts in development that might not need this sensor to meet current tailpipe or diagnostic requirement for conversion efficiency. The requirement in section 1971.1(h)(5.3.4) might force new engine concepts to add an expensive engine-out NOx sensor that would only be used for meeting the tracking requirement. (EMA)

Agency Response: This comment extends beyond the scope of the modifications made available in the first 15-Day Notice because it does not raise any objections or recommendations directed to those specified modifications. Nevertheless, CARB provides the following response. In the early years of HD OBD implementation, some HD OBD systems monitored the SCR system using modeled engine-out NOx instead of an engine-out NOx sensor. The in-use performance and monitoring results were not acceptable and ultimately deemed non-compliant. Based on staff's experience with these systems, staff believes engine-out NOx sensors are necessary for robust monitoring of the SCR system. It is unlikely that staff would approve new HD OBD systems that do not utilize both an upstream and downstream NOx sensor for diagnosing SCR conversion efficiency malfunctions. Regarding the comment to use alternative information, it is important that data to be standardized across industry, so an alternative would be unacceptable and would compromise the usefulness of the data.

111. Comment: A definition should be added for the new term “worst acceptable limit” in section 1971.1(i)(5.1). CARB has a responsibility to add clear definitions for newly-created terms used in the regulations to provide clarity for regulated entities. Further, section 1971.1(i)(4.1)(C)(iii), which currently contains the allowance for manual regeneration events on the FTP cycle, should be modified to include the option to trigger the regeneration event on the SET cycle to allow for more efficient regeneration. (EMA)

Agency Response: This comment extends beyond the scope of the modifications made available in the first 15-Day Notice because it does not raise any objections or recommendations directed to those specified modifications. Nevertheless, CARB provides the following response. Regarding the comment about “worst acceptable limit,” the commenter is incorrect in stating that the term “worst acceptable limit” is “new.” The term is already contained in the current regulation in section 1971.1(i)(5.1.3)(A) and copied over to section 1971.1(i)(5.1.2)(A) as part of the 45-day changes, and therefore is not “new.” Further, the commenter had already submitted a 45-day comment related to the term “worst acceptable limit”, and as explained in the Agency Response to Comment 66 above, the term is immediately followed by a definition in the regulation language, specifically “the applicable monitor indicates the system or component’s performance is passing but at the



closest possible value relative to the monitor threshold value at which a fault would be detected that would invoke the default strategy and illuminate the MIL.” CARB staff, therefore, believes this term is already clearly defined. Concerning the commenter’s request to add the SET cycle, the purpose of the manual PM filter regeneration event is to lower the PM level on the filter and avoid a regeneration event during the OBD demonstration and subsequently invalidating the test. The FTP cycle has been demonstrated as a cycle in which a PM filter regeneration event could significantly reduce the soot level on the filter and, therefore, prevent the regeneration from occurring during the subsequent OBD demonstration test. With this understanding, staff does not have a technical basis for changing the language to add the SET cycle.

112. Comment: At CARB’s July 17, 2019, meeting regarding the FY 2019-20 Funding Plan for Clean Transportation Incentives, CARB proposed reduced funding for several key areas, including areas that helped fund low NOx engines. Shell Energy urges CARB to continue funding all forms of low NOx engines through the Hybrid Voucher Incentive Project. (Shell Energy)

Agency Response: This comment was erroneously submitted to this comment docket; the comment was in response to a July 17, 2019, work group meeting for Heavy Duty Projects in relation to the FY 2019-20 Funding Plan for Clean Transportation Incentives. Since this comment neither objects nor makes a recommendation regarding the scope of this rulemaking’s second 15-day changes, no response by CARB is required.

## **V. Peer Review**

Health and Safety Code Section 57004 sets forth requirements for peer review of identified portions of rulemakings proposed by entities within the California Environmental Protection Agency, including CARB. Specifically, the scientific basis or scientific portion of a proposed rule may be subject to this peer review process. Here, CARB determined that the rulemaking at issue does not contain a scientific basis or scientific portion subject to peer review, and thus no peer review as set forth in Section 57004 was or needed to be performed.