State of California
Air Resources Board

Public Hearing to Consider the Proposed Revisions to the On-Board Diagnostic System Requirements and Associated Enforcement Provisions for Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles and Engines, and Heavy-Duty Engines

Staff Report: Initial Statement of Reasons

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Background

On-board diagnostic (OBD) systems are mainly comprised of software designed into the vehicle's on-board computer system to detect emission control system malfunctions as they occur by monitoring virtually every component and system that can cause increases in emissions. When the OBD system detects an emission-related malfunction, it alerts the vehicle owner by illuminating a malfunction indicator light (MIL) located on the vehicle's instrument panel, and additionally stores information that helps to identify the faulty component or system and the nature of the fault, which enables technicians to quickly and properly repair such faults. OBD systems therefore benefit vehicle owners by ensuring detected malfunctions are promptly and correctly repaired, thereby reducing excess in-use emissions, and ensuring that in-use motor vehicle and motor vehicle engine emissions are reduced through manufacturers' improvements to emission system durability and performance to reduce the occurrence malfunctions during the warranty period and beyond.

The California Air Resources Board (CARB or Board) initially adopted second generation OBD regulations in 1990 that required all 1996 and subsequent model year passenger cars, light-duty trucks, and medium-duty vehicles and engines to be equipped with OBD systems (referred to as OBD II). CARB subsequently updated the OBD II regulations with the adoption of title 13, California Code of Regulations (CCR), sections 1968.2 and 1968.5, which established OBD II requirements and OBD II specific enforcement requirements for 2004 and subsequent model year passenger cars, light-duty trucks, and medium-duty vehicles and engines. In 2005, the Board adopted regulations (title 13, California Code of Regulations [CCR] section 1971.1) that required OBD systems in heavy-duty engines (HD OBD) beginning in the 2010 model year, and subsequently adopted an HD OBD-specific enforcement regulation, (title 13, CCR section 1971.5) in 2009.

Since the initial adoptions of the OBD II and HD OBD regulations, the Board has requested that staff biennially update it on vehicle and engine manufacturers' progress in meeting the OBD requirements and to propose such modifications as necessary to maximize the effectiveness of the regulation and to address any implementation issues. In accordance with the Board's direction, CARB staff has regularly met with manufacturers and the Board has adopted staff's proposed amendments several times over the years to the OBD II and HD OBD regulations.

Staff Proposal

Staff is proposing amendments to update the standardization requirements for OBD systems in order to address limitations in the number of fault codes that can be defined and to improve other aspects of the diagnostic information. When the OBD system detects an emission-related malfunction in the vehicle, the system stores information such as fault codes that help to identify the faulty component or system

and the nature of the malfunction. In recent years, vehicle and engine manufacturers have expressed concern to CARB staff about the limited number of remaining fault codes available under the current standardization protocols given the increase in usage of new emission control technologies to meet increasingly more stringent emission standards as well as the increased complexity of systems such as those on hybrid vehicles. Industry had indicated that the current fault codes available will soon run out. Therefore, industry had proposed that CARB require the implementation of Unified Diagnostic Services (UDS), which would significantly increase the number of available fault codes. Further, UDS has other features that would improve the usefulness of standardized OBD data to repair vehicles and provide needed information on in-use monitoring performance. Therefore, staff is proposing amendments that would require the implementation of UDS on vehicles and engines using the International Organization for Standardization (ISO) 15765-4 communication protocol. This would be required for all 2027 and subsequent model year vehicles and engines using ISO 15765-4, but manufacturers may implement the protocol as early as the 2023 model year.

Additionally, since the last comprehensive update to the OBD II regulation in 2015, staff has identified other proposed amendments to the OBD II regulation that it believes are warranted and necessary to address manufacturers' implementation concerns, enhance some existing requirements, and provide clarification on other requirements. A summary of staff's proposed amendments are provided below. A more detailed explanation of each change, as well as the rationale for making them, are provided in Chapter III of this report. The proposed amendments to the OBD II regulation include:

- Requiring the implementation of the UDS messages for OBD systems on all 2027 and subsequent model year light- and medium-duty vehicles, with optional implementation as early the 2023 model year
- Increasing the amount of information required to be contained within each supported fault code
- Increasing the number of freeze frames and readiness status indicators that must be supported
- Adding new data requirements to track and report in-use monitoring activity
- Updating the SAE International (SAE) documents that are incorporated by reference in the regulations to reflect the latest published versions
- Requiring the ability of vehicles to seal the evaporative system when commanded by a generic scan tool to aid service technicians in finding and fixing detected evaporative system leaks
- Requiring more stringent emission malfunction thresholds for the particulate matter (PM) filter monitor in conjunction with relaxing the in-use monitor performance ratio (IUMPR) requirements
- Revising the non-methane hydrocarbon (NMHC) catalyst and catalyzed PM filter monitoring requirements for feedgas generation performance to provide clarity and to make compliance easier to achieve

- Revising the cold start emission reduction strategy (CSERS) monitoring requirements to include more details on which features of the emission control system need to be monitored and under which conditions, and requiring new data to be tracked and reported related to CSERS activity
- Adding new monitoring requirements to detect engine stalls on gasoline vehicles/engines to ensure the idle speed system monitor covers stall malfunctions on virtually all engine starts
- Updating the supporting data requirements for the diesel oxides of nitrogen (NOx) sensor diagnostic to better ensure the robustness of monitoring strategies that rely on sensor readings
- Specifying the data manufacturers are required to submit to support the diesel catalyst/adsorber laboratory aging protocols and catalyst/adsorber monitor malfunction criteria and the associated acceptance criteria
- Revising the durability demonstration testing requirements to allow for alternate methods to conduct retesting
- Revising the production vehicle evaluation (PVE) testing requirements to decrease the number of tests required for verification of monitoring requirements and to collect more data from in-use vehicles

Staff is also proposing similar amendments to the HD OBD regulation, section 1971.1, to harmonize the light- and heavy-duty requirements with regard to the UDS-related amendments, the CSERS monitor and tracking data amendments, the engine stall monitor amendments, the NOx sensor monitoring amendments, and the diesel catalyst/adsorber monitor malfunction criteria determination amendments. Finally, staff is proposing amendments to correct regulatory language regarding diesel misfire monitoring.

Additionally, staff is proposing amendments to the OBD II enforcement regulation (section 1968.5) to align with the proposed changes to the OBD II regulation, specifically to account for the proposed UDS-related amendments and to add nonconformance criteria for the newly proposed IUMPRs applicable to the PM filter monitor. Further, staff is proposing amendments to correct errors in the regulation. Staff is also proposing amendments to the HD OBD enforcement regulation (section 1971.5) to account for the proposed UDS-related amendments in the HD OBD regulation.

Environmental and Cost Impacts

The proposed amendments are not expected to have an adverse impact on the environment. The proposed revisions to the OBD regulations primarily strengthen the requirements. Staff estimates the final cost impact to the California consumer of a new light- or medium-duty vehicle to be $0.67 (if purchasing from a large manufacturer) or $7.37 (if purchasing from a small manufacturer), and the final cost impact to the California consumer of a new heavy-duty vehicle to be $14.34 if purchasing from a large manufacturer) or $25.87 (if purchasing from a small manufacturer). Further details

of the environmental impact and costs are included in Chapter VI "Environmental Analysis" and Chapter VIII "Economic Impacts Assessment."

Staff Recommendations

Staff recommends that the Board adopt the amendments to the OBD II and HD OBD regulations and the associated OBD II and HD OBD enforcement regulations as proposed in this Initial Statement of Reasons.

I. Introduction and Background

OBD systems are mainly comprised of software designed into the vehicle's on-board computer system to detect emission control system malfunctions as they occur by monitoring virtually every component and system that can cause increases in emissions. CARB adopted title 13, CCR sections 1968.2 and 1968.5, which established OBD II requirements and OBD II specific enforcement requirements for 2004 and subsequent model year passenger cars, light-duty trucks, and medium-duty vehicles and engines. In 2005, the Board adopted regulations (title 13, CCR section 1971.1) that required OBD systems in heavy-duty engines (HD OBD) beginning in the 2010 model year, and subsequently adopted an HD OBD-specific enforcement regulation in 2009 (title 13, CCR section 1971.5). Since the initial adoptions of the OBD II and HD OBD regulations, the Board has requested that staff provide biennial updates on engine manufacturers' progress in meeting the OBD requirements and to propose such modifications as necessary to achieve maximum compliance with the regulation. Accordingly, CARB staff has regularly met with manufacturers and has proposed amendments several times over the years to the regulations which the Board adopted, with the most recent amendments adopted in 2018.

In this rulemaking, staff is proposing amendments to the OBD II and HD OBD regulations (title 13, CCR sections 1968.2 and 1971.1, respectively) and the associated OBD enforcement regulations (title 13, CCR sections 1968.5 and 1971.5, respectively). CARB staff is proposing these amendments to clarify regulatory language, relax some requirements, and add new requirements that would assist and help improve the implementation of the OBD program. Detailed explanations of the amendments, including the purpose and rationale for each amendment, are provided in Chapter III. All proposed amendments to sections 1968.2, 1968.5, 1971.1, and 1971.5 are included in Appendices A, B, C, and D, respectively, with proposed additions to the regulation denoted by underline and proposed deletions denoted by strikeout.

II. The Problem that the Proposal is Intended to Address

During the last comprehensive update to the OBD II regulations in 2015, manufacturers have expressed concern about the limited number of remaining fault codes that can be created in SAE J2012, which is the standard incorporated by reference in the regulation that defines all the standardized fault codes. The fault code structure is made up by only two bytes, and the number of available fault codes that can still be defined is quickly diminishing. However, the need to define additional fault codes is increasing as manufacturers implement new monitoring strategies for hybrid systems and other emerging technologies. Once available fault codes in the standard form are exhausted, manufacturers would have no choice but to use non-standardized fault codes or use standardized codes to apply to multiple

malfunctions, which would create confusion when repairing vehicles. They indicated that changing to the fault code structure specified in UDS services (currently specified under ISO 14229-1) would address the issue. UDS would also provide for other beneficial features for enhanced diagnostic information from vehicles, which would in turn better assist repair technicians and inspection and maintenance (I/M) programs.

Additionally, since the last comprehensive update to the OBD II regulations occurred in 2015 and to the HD OBD regulations in 2018, CARB staff has identified a number of proposed amendments to the OBD regulations that it believes are warranted. Manufacturers have expressed concerns over certain requirements that need to be addressed. There has also been confusion with some of the current regulatory language that warrant revisions to make the requirements clear.

The purpose of this rulemaking is to address these concerns and opportunities. CARB staff is proposing amendments to migrate OBD communications over to the UDS protocol, and to take advantage of certain UDS features and other improvements to expand and enhance the quality of the data that would be available to technicians. Amendments are also being proposed to address manufacturers' implementation concerns, to provide clarification on existing requirements, and to enhance other existing requirements. Chapter III provides a more detailed description of staff's proposed actions.

III. The Specific Purpose and Rationale of Each Adoption, Amendment, or Repeal

The information in this chapter provides a summary of the provisions, including the problem the proposed amendment is intended to address, and CARB staff's determination for why each provision proposed is: (1) reasonably necessary to carry out the purpose of the regulation; and (2) reasonably necessary to address the problem for which the amendments are proposed.

Staff is proposing amendments to the following sections in title 13, CCR: section 1968.2 "Malfunction and Diagnostic System Requirements – 2004 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines," section 1968.5 "Enforcement of Malfunction and Diagnostic System Requirements for 2004 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines," section 1971.1 "On-Board Diagnostic System Requirements – 2010 and Subsequent Model-Year Heavy-Duty Engines," and section 1971.5 "Enforcement of Malfunction and Diagnostic System Requirements for 2010 and Subsequent Model-Year Heavy-Duty Engines."

The purpose and rationale discussions of the proposed amendments are separated into six different subdivisions:
Chapter III.A. covers amendments related to the UDS services and apply to both title 13, CCR section 1968.2 (the OBD II regulation, which applies to light-duty and medium-duty vehicles and engines) and section 1971.1 (the HD OBD regulation, which applies to heavy-duty vehicles and engines).
Chapter III.B. covers non-UDS amendments that apply to both title 13, CCR section 1968.2 (the OBD II regulation, which applies to light-duty and medium-duty vehicles and engines) and section 1971.1 (the HD OBD regulation, which applies to heavy-duty vehicles and engines).
Chapter III.C. covers amendments that only apply to the OBD II regulation, title 13, CCR section 1968.2.
Chapter III.D. covers amendments that only apply to the HD OBD regulation, title 13, CCR section 1971.1.
Chapter III.E. covers amendments that apply to the OBD II enforcement regulation, title 13, CCR section 1968.5.
Chapter III.F. covers amendments that apply to the HD OBD enforcement regulation, title 13, CCR section 1971.5.

A. PROPOSED UDS AMENDMENTS TO OBD II REGULATION SECTION 1968.2 AND HD OBD REGULATION SECTION 1971.1

Sections 1968.2(c) and 1971.1(c): Definitions

"Calculated load value"

Purpose: The definition of "calculated load value" currently indicates the phrase is defined in SAE J1979. The proposed amendment to the definition would indicate that the phrase is also defined in SAE J1979-2 "E/E Diagnostic Test Modes - OBDonUDS".

Rationale: The proposed amendment to the definition is needed to account for vehicles/engines that newly meet the specifications of SAE J1979-2 (as proposed in subsections 1968.2(d)(9.2) and 1971.1(d)(7.7)) instead of SAE J1979.

Sections 1968.2(D) and 1971.1(D): General Requirements

Subsections 1968.2(d)(2.1.3) and 1971.1(d)(2.1.3)

Purpose: The proposed amendments to these subsections would indicate that the MIL may be used to indicate readiness status in a standardized format as described in "section (g)(4.1.1)(H) or (g)(4.1.2)(F)" instead of "section (g)(4.1.3)" in subsection 1968.2(d)(2.1.3) and in "section (h)(4.1.1)(G) or (h)(4.1.2)(E)" instead of "section (h)(4.1.6)" in subsection 1971.1(d)(2.1.3).

Rationale: The proposed changes are needed to account for the renumbering of subsections in 1968.2(g)(4.1) and 1971.1(h)(4.1) and to correct an error in section 1968.2. In the current regulation, subsection 1968.2(g)(4.1.7) contains the requirements for using the MIL to indicate readiness status, not subsections 1968.2(g)(4.1.3), which indicates the requirements to set the readiness status to "complete". Further, the proposed changes are needed to account for the newly proposed changes to subsections 1968.2(g)(4.1) and 1971.1(h)(4.1) that renumbered subsection 1968.2(g)(4.1.7) to 1968.2(g)(4.1.1)(H), renumbered subsection 1971.1(h)(4.1.6) to 1971.1(h)(4.1.1)(G), and added similar requirements for vehicles/engines using SAE J1979-2 in subsections 1968.2(g)(4.1.2)(F) and 1971.1(h)(4.1.2)(E).

Subsections 1968.2(d)(2.2.7) and 1971.1(d)(2.2.1)(D)

Purpose: The proposed amendments to these subsections would include new freeze frame condition storage and erasure requirements for vehicles/engines using SAE J1979-2. Specifically, subsection 1968.2(d)(2.2.7) would be newly titled "Storing and Erasing "Freeze Frame" Conditions," and subsections 1968.2(d)(2.2.7) and 1971.1(d)(2.2.1)(D) would be split into two subsections, with subsections 1968.2(d)(2.2.7)(A) and 1971.1(d)(2.2.1)(D)(i) containing the current freeze frame requirements that apply to vehicles/engines using SAE J1979, and with subsection 1968.2(d)(2.2.7)(B) and 1971.1(d)(2.2.1)(D)(ii) containing the new freeze frame requirements that apply to vehicles/engines using SAE J1979-2. The proposed amendment to subsection 1968.2(d)(2.2.7)(A) would also change the subsection reference of (e)(3.4.5) to (e)(3.4.4) in the list of subsections containing freeze frame requirements for the gasoline and diesel misfire and fuel system monitors.

The new requirements for vehicles/engines using SAE J1979-2 in subsections 1968.2(d)(2.2.7)(B) and 1971.1(d)(2.2.1)(D)(ii) would require two frames of freeze frame conditions (referred to as the "first frame" and "second frame") to be stored when a pending fault code is stored. Subsections 1968.2(d)(2.2.7)(B)(i) and 1971.1(d)(2.2.1)(D)(ii)b.1. would require the OBD system to erase the freeze frame conditions from both frames of data if the pending fault code is erased in the next driving cycle in which monitoring occurs and a malfunction is not detected. Subsections 1968.2(d)(2.2.7)(B)(ii) and 1971.1(d)(2.2.1)(D)(ii)b.2. would require that in the event the pending fault code matures to a confirmed fault code, the OBD system would be required to retain the freeze frame conditions stored in the first frame and replace the freeze frame conditions in the second frame of data with freeze frame conditions regarding the confirmed fault code. Subsections 1968.2(d)(2.2.7)(B)(iii) and 1971.1(d)(2.2.1)(D)(ii)b.3. would require that in the event the malfunction is redetected during a driving cycle after the driving cycle in which the confirmed fault code was first stored, the OBD system would be required to replace the freeze frame conditions in the second frame of data with freeze frame conditions regarding the redetected malfunction. Further, subsections 1968.2(d)(2.2.7)(B), 1968.2(d)(2.2.7)(B)(ii),

1968.2(d)(2.2.7)(B)(iii), 1971.1(d)(2.2.1)(D)(ii)b., 1971.1(d)(2.2.1)(D)(ii)b.2., and 1971.1(d)(2.2.1)(D)(ii)b.3. would allow the second frame to be updated more than once per driving cycle anytime the malfunction is redetected during that driving cycle. Subsections 1968.2(d)(2.2.7)(B)(iv) and 1971.1(d)(2.2.1)(D)(ii)b.4. would require the OBD system to erase both frames of data when the confirmed fault code is erased. Subsections 1968.2(d)(2.2.7)(B)(v) and 1971.1(d)(2.2.1)(D)(ii)d. would prohibit freeze frame conditions from being replaced in the event that a new fault code is stored but the maximum number of frames of freeze frame conditions are already stored. However, the subsections would allow 2023 through 2026 model year vehicles/engines to replace currently stored freeze frame conditions with those for a recently detected fuel system or misfire malfunction, which is currently required for vehicles/engines using SAE J1979.

Rationale: The proposed amendment to subsection 1968.2(d)(2.2.7)(A) that changes the subsection reference (e)(3.4.5) to (e)(3.4.4) is needed to correct an error. Specifically, subsection 1968.2(d)(2.2.7) contains freeze frame requirements and refers to other subsections that contain freeze frame requirements. However, subsection 1968.2(e)(3.4.5) contains the similar condition requirements for the gasoline misfire monitor, not the freeze frame requirements, which is contained in subsection 1968.2(e)(3.4.4).

The proposed amendments related to vehicles/engines using SAE J1979-2 in subsections 1968.2(d)(2.2.7)(B) and 1971.1(d)(2.2.1)(D)(ii) are needed to provide more information to the repair technician about the vehicle state when an emissions-related malfunction is detected. Requiring two data frames of freeze frame conditions to be stored for each fault code, as opposed to one data frame as currently required, would allow technicians to better reproduce the driving conditions that occurred when the fault was detected. Reproducing driving conditions aids in the diagnosing and repair process, which would result in more timely and effective repairs. The second frame of freeze frame conditions would be replaced whenever the malfunction is redetected in the same driving cycle and in subsequent driving cycles after storage of confirmed fault code so that the most recent fault data conditions are available to help the repair technician diagnose and repair the fault. In an effort to further aid technicians during repair, it is proposed that currently stored freeze frames for faults other than misfire or fuel system malfunction no longer be replaced by new freeze frames from either misfire or fuel system faults. This is intended to keep as much relevant freeze frame conditions available for the technician to use during diagnosis and repair. Additionally, CARB staff expect the increased number of freeze frames introduced with this proposal would reduce the need to over-write existing freeze frame conditions to make room for higher priority faults due to limited storage space in the on-board module.

Subsections 1968.2(d)(5.1) and 1971.1(d)(5.1)

Purpose: The proposed amendments to these subsections, which describe the tracking and reporting requirements for IUMPR, would indicate that the current requirements under subsections 1968.2(d)(5.1.1), 1968.2(d)(5.1.2), 1971.1(d)(5.1.1), and 1971.1(d)(5.1.2) apply to vehicles/engines "using SAE J1979." The new proposed subsections 1968.2(d)(5.1.3), 1968.2(d)(5.1.4), 1971.1(d)(5.1.3), and 1971.1(d)(5.1.4) would detail the reporting requirements for vehicles/engines using SAE J1979-2. Specifically, the subsections would require the OBD systems on vehicles/engines using SAE J1979-2 to report the in-use monitor performance numerator and denominator for each supported fault code associated with each monitor of the gasoline and diesel components detailed in subsections 1968.2(d)(5.1.3), 1968.2(d)(5.1.4), 1971.1(d)(5.1.3), and 1971.1(d)(5.1.4). The subsections would also require vehicles/engines using SAE J1979-2 to report a general denominator, an ignition cycle counter(s), and the newly proposed supplemental monitor activity data.

Rationale: The proposed amendments are needed to accommodate vehicles/engines using the newly proposed SAE J1979-2. Specifically, the proposed amendments would make clear that the current requirement to report one numerator and denominator for each component in subsections 1968.2(d)(5.1.1), 1968.2(d)(5.1.2), 1971.1(d)(5.1.1), and 1971.1(d)(5.1.2) would apply to vehicles/engines using SAE J1979. For vehicles/engines using SAE J1979-2, staff is proposing language in subsections 1968.2(d)(5.1.3), 1968.2(d)(5.1.4), 1971.1(d)(5.1.3), and 1971.1(d)(5.1.4) requiring OBD systems to report one numerator and denominator for each supported fault code associated with each monitor of the listed gasoline and diesel components (which are the same components as those listed for vehicles/engines using SAE J1979) as opposed to one numerator and denominator for each component as currently required. The proposed amendments for vehicles/engines using SAE J1979-2 are needed because some components have multiple monitors, and the current language requiring only one numerator/denominator for each component makes it difficult to determine which specific monitor the reported numerator and denominator refer to. The proposal would allow CARB and manufacturers to identify low performing monitors so that manufacturers could better address issues with low IUMPRs by targeting their remedial efforts on the specific monitor of concern.

Subsections 1968.2(d)(5.2) and 1971.1(d)(5.2)

Purpose: The proposed amendments to these subsections, which describe the standardized tracking and reporting requirements for the in-use monitor performance numerator, would renumber subsections 1968.2(d)(5.2.1) through (d)(5.2.3) to 1968.2(d)(5.2.1)(A) through (C), would renumber subsection 1971.1(d)(5.2.1) through (5.2.3) to 1971.1(d)(5.2.1)(A) through (C), and would indicate that these current requirements apply to vehicles/engines using SAE

J1979. The proposed amendments would also add numerator requirements in subsections 1968.2(d)(5.2.2) and 1971.1(d)(5.2.2) that would apply to vehicles/engines using SAE J1979-2. For these vehicles/engines, the newly proposed subsections 1968.2(d)(5.2.2)(A) and 1971.1(d)(5.2.2)(A) would require the OBD system to report a separate numerator for each supported fault code associated with each monitor of a component. Further, proposed subsections 1968.2(d)(5.2.2)(B) and 1971.1(d)(5.2.2)(B) would address supported fault codes with multiple monitors that are required to track and report the numerators/denominators. For these fault codes, the OBD system is required to track the numerators and denominators for each monitor and report the corresponding numerator and denominator for the monitor with the lowest numerical ratio or, in the case the ratios are the same, the numerator and denominator for the monitor with the highest denominator. Finally, proposed subsections 1968.2(d)(5.2.2)(C) and 1971.1(d)(5.2.2)(C) would require the numerator(s) to be reported in accordance with the specifications in subsection 1968.2(g)(5.2.1) and 1971.1(h)(5.1.2)(A), respectively.

Rationale: The proposed amendments are needed to accommodate vehicles/engines using the newly proposed SAE J1979-2. Specifically, the proposed amendments would make clear that the current requirements in newly renumbered subsections 1968.2(d)(5.2.1)(A) through (C) and 1971.1(d)(5.2.1)(A) through (C) would apply to vehicles/engines using SAE J1979. For vehicles/engines using SAE J1979-2, staff is proposing language in subsections 1968.2(d)(5.2.2)(A) and 1971.1(d)(5.2.2)(A) requiring OBD systems to report one numerator for each supported fault code of each monitor for the components listed in subsections 1968.2(d)(5.1) and 1971.1(d)(5.1) as opposed to one numerator for each component as currently required. The proposed amendments for vehicles/engines using SAE J1979-2 are needed since for components with multiple monitors, the current language requiring only one numerator for each component makes it difficult to determine which specific monitor the reported numerator belong to. The proposal would allow CARB and manufacturers to identify low performing monitors so that manufacturers could better address issues with low IUMPRs by targeting their remedial efforts on the specific monitor of concern. The proposed amendment in subsections 1968.2(d)(5.2.2)(B) and (C) and 1971.1(d)(5.2.2)(B) and (C) would carry over the same specifications requirements currently in the regulation (in previously numbered subsections 1968.2(d)(5.2.2) and (d)(5.2.3) and 1971.1(d)(5.2.2) and 1971.1(d)(5.2.3)).

Subsections 1968.2(d)(5.3) and 1971.1(d)(5.3)

Purpose: The proposed amendments to these subsections, which describe the standardized tracking and reporting requirements for the in-use monitor performance denominator, would renumber subsections 1968.2(d)(5.3.1) and (d)(5.3.2) to 1968.2(d)(5.3.1)(A) and (d)(5.3.1)(B), would renumber subsections 1971.1(d)(5.3.1) and (d)(5.3.2) to 1971.1(d)(5.3.1)(A) and (d)(5.3.1)(B), and would

indicate that these current requirements apply to vehicles/engines using SAE J1979. The proposed amendments would also add denominator requirements in subsections 1968.2(d)(5.3.2) and 1971.1(d)(5.3.2) that would apply to vehicles/engines using SAE J1979-2. For these vehicles/engines, the newly proposed subsection 1968.2(d)(5.3.2)(A) and 1971.1(d)(5.3.2)(A) would require the OBD system to report a separate denominator for each supported fault code associated with each monitor of a component, while the newly proposed subsections 1968.2(d)(5.3.2)(B) and 1971.1(d)(5.3.2)(B) would require the denominator(s) to be reported in accordance with the specifications in subsections 1968.2(g)(5.2.1) and 1971.1(h)(5.1.2)(A), respectively.

Rationale: The proposed amendments are needed to accommodate vehicles/engines using the newly proposed SAE J1979-2. Specifically, the proposed amendments would make clear that the current requirements in newly renumbered subsections 1968.2(d)(5.3.1)(A) and (B) and 1971.1(d)(5.3.1)(A) and (B) would apply to vehicles/engines using SAE J1979. For vehicles/engines using SAE J1979-2, staff is proposing language in subsections 1968.2(d)(5.3.2)(A) and 1971.1(d)(5.3.2)(A) requiring OBD systems to report one denominator for each supported fault code associated with each monitor of the components listed in subsections 1968.2(d)(5.1) and 1971.1(d)(5.1) as opposed to one denominator for each component as currently required. The proposed amendments for vehicles/engines using SAE J1979-2 are needed since for components with multiple monitors, the current language requiring only one denominator for each component makes it difficult to determine which specific monitor the reported denominator belong to. The proposal would allow CARB and manufacturers to identify low performing monitors so that manufacturers could better address issues with low IUMPRs by targeting their remedial efforts on the specific monitor of concern. The proposed amendment in subsections 1968.2(g)(5.3.2)(B) and 1971.1(g)(5.3.2)(B) would carry over the same specifications requirements currently in the regulation (in previously numbered subsections 1968.2(d)(5.3.2) and 1971.1(d)(5.3.2)).

Subsections 1968.2(d)(5.4.1) and 1971.1(d)(5.4)

Purpose: The proposed amendments to these subsections would indicate that the requirements for determining the corresponding numerator and denominator to report are now in subsections 1968.2(d)(5.2.1)(B) and (d)(5.2.2)(B), not subsection 1968.2(d)(5.2.2), and now in subsections 1971.1(d)(5.2.1)(B) and (d)(5.2.2)(B), not subsection 1971.1(d)(5.2.2). The proposed amendments would also change the phrase “the ratio shall be calculated” to “the ratio used for the determination shall be calculated.”

Rationale: The proposed amendments are needed to account for vehicles/engines using the newly proposed SAE J1979-2 and to make the requirement easier to understand. Specifically, the proposed changes of

1968.2(d)(5.2.2) to (d)(5.2.1)(B) and 1971.1(d)(5.2.2) to (d)(5.2.1)(B) are needed since the proposed changes in subsection 1968.2(d)(5.2) renumbered 1968.2(d)(5.2.2) to (d)(5.2.1)(B), with the same renumbering changes made to subsection 1971.1(d)(5.2). The proposed additions of reference to subsection 1968.2(d)(5.2.2)(B) and 1971.1(d)(5.2.2)(B) are needed to account for vehicles/engines using the newly proposed SAE J1979-2. The proposed change of "the ratio shall be calculated" to "the ratio used for the determination shall be calculated" is needed since the language can be misinterpreted as indicating that a ratio is required to be calculated and reported by the OBD system, which is not correct. The language is meant to indicate that the ratio specified in this subsection is related to the ratio used in determining which numerator and denominator to report for components/supported fault codes with multiple monitors, in accordance with subsections 1968.2(d)(5.2.1)(B), 1968.2(d)(5.2.2)(B), 1971.1(d)(5.2.1)(B), and 1971.1(d)(5.2.2)(B).

Subsections 1968.2(d)(5.7) and 1971.1(d)(5.7)

Purpose: These newly proposed subsections would detail new data the OBD system would be required to track and report for vehicles/engines using SAE J1979-2. Specifically, these subsections would require the OBD system to track and report the following three data parameters:

1. Mini-numerator: The mini-numerator is a counter that indicates the number of driving cycles over which a monitor ran and completed since the last time the mini-denominator (defined below) was reset to zero. Because the presence of a pending fault code pauses counting, the mini-numerator is effectively a counter of monitor pass decisions. The OBD system would be required to track and report a mini-numerator for each supported fault code that can illuminate the MIL.
2. Mini-denominator: The mini-denominator is a counter that indicates the number of driving cycles over which the general denominator incremented since the last time the mini-denominator was reset to zero. The OBD system would be required to track and report a mini-denominator for each diagnostic or emission-critical electronic powertrain control unit (DEC-ECU).
3. Monitor activity ratio (MAR): The MAR is the ratio of the mini-numerator to the mini-denominator when the mini-denominator reaches its maximum value of 255. The OBD system would be required to track and report the MAR for each supported fault code that can illuminate the MIL.

The mini-numerator and mini-denominator would be allowed to increment only over driving cycles in which there is no active pending fault code present in the DEC-ECU. When the mini-denominator reaches its maximum value of 255, the MAR is calculated and the new value replaces the previous one, and then the mini-denominator and mini-numerator are both reset to zero.

Rationale: The amendments in these newly proposed subsections are needed to address monitoring frequency issues with monitors that do not track and report IUMPR data. Currently, the OBD regulations specify the monitors for which IUMPR data are required to be tracked and reported to a scan tool. These monitors are generally major monitors (e.g., catalyst monitors, PM filter monitors) and do not include monitors such as those for comprehensive components. Since comprehensive components are often used in the strategies of many major monitors (e.g., as enable conditions or to determine the malfunction criteria), CARB believes it is important that the components are working properly, and therefore the monitors for these components should be running frequently in-use to detect any malfunction of the component. In CARB staff's original proposal presented at the February 2020 public workshop, staff proposed that vehicles/engines using SAE J1979-2 be required to track and report IUMPR data for all monitors. However, industry opposed this proposal, indicating that it would result in substantial costs (e.g., development of complex software) with limited benefits. This new proposal was agreed upon by many in industry because it provides CARB staff with an indication of monitoring frequency that can be used to identify monitors that have difficulty running in-use (or do not run at all) with much less cost and effort for industry as compared to staff's original proposal.

The new proposal incorporates the key cost-saving elements that were at the heart of industry's counter proposal to full IUMPR for all monitors. To begin with, IUMPR requires tracking the number of driving cycles over which all conditions are satisfied for a monitor to be able to detect a malfunction. The MAR proposal eliminates the complexity of tracking all such conditions and instead simply requires tracking the number of driving cycles over which each monitor reports an actual pass decision. The MAR proposal also eliminates the need to maintain special denominators for certain monitors by defining a single denominator for all monitors in the DEC-ECU (the mini-denominator). An even more substantial simplification is that the MAR proposal allows for the tracking of all monitors in a DEC-ECU to pause whenever there is an active emissions-related fault code present in that DEC-ECU (specifically, a pending fault code). With IUMPR, tracking would only pause for the specific monitors that are disabled by the given fault, which requires much more complex software according to industry. Finally, the MAR proposal dramatically reduces the memory requirements relative to full IUMPR, which allocates four bytes of memory for every tracked monitor: two for the numerator and two for the denominator. The MAR proposal retains industry's proposal of using 1-byte data parameters. Each monitor would only require two bytes of memory: one for the mini-numerator and one for the MAR. Each DEC-ECU would also have a 1-byte mini-denominator, which adds a trivial amount of memory.

Despite the aforementioned simplifications, staff's proposal would still provide the needed supplemental data on the real world activity of OBD monitors. Each monitor would have a count of the number of times it actually completed in-use

relative to the number of trips that were driven which incremented the general denominator. This is a solid indicator of monitor activity, which would readily give CARB staff a means of determining if any monitor does not appear to be running properly. Fitting these data into 1-byte parameters means that they have to get reset periodically, which is in contrast to full IUMPR that has 2-byte counters that are large enough (65,535 maximum value) to cover the life of most vehicles. While this may seem like a detraction of the MAR proposal, it actually provides valuable insight into the current behavior of a monitor. Full IUMPR is a continuous running average with ever-increasing numerators and denominators. When the denominator gets large, IUMPR cannot reveal the current behavior of a monitor. A monitor that suddenly starts performing poorly, for example, can show a good IUMPR for a long time. This is illustrated in Figure 1.

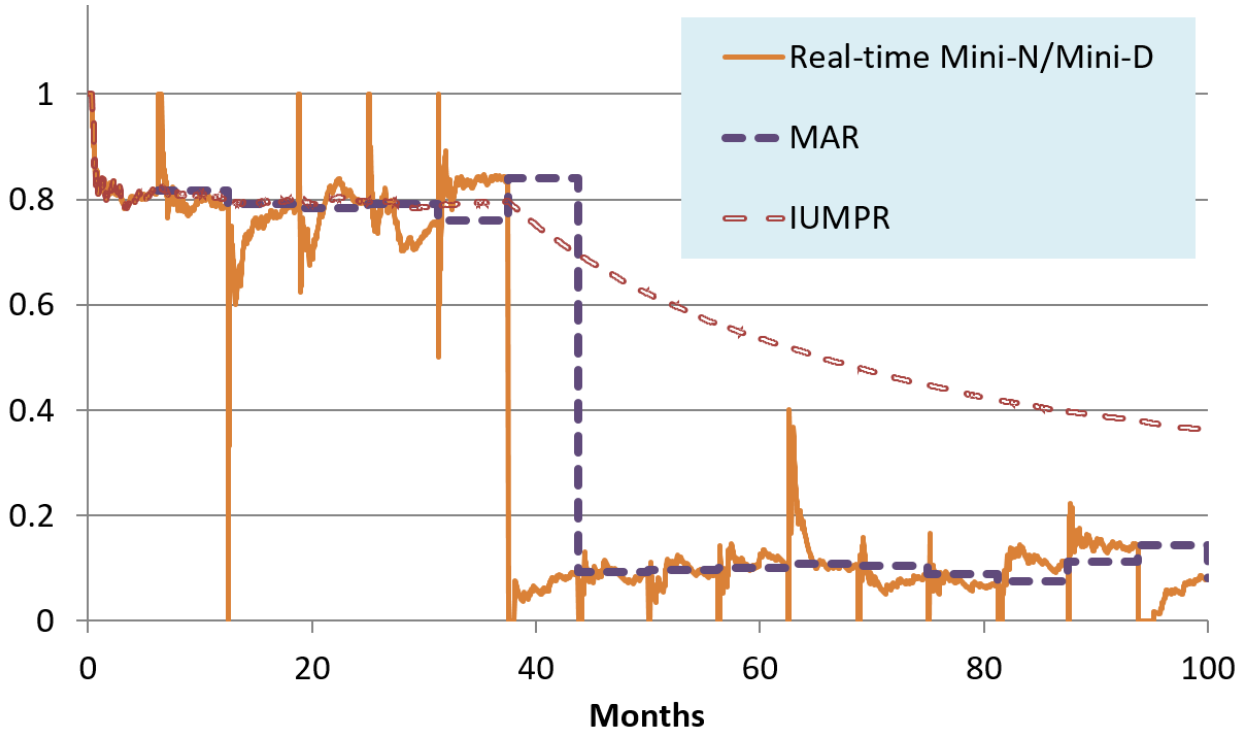


Figure 1. Illustration of Sudden Change in Monitor Performance

Figure 1 provides an illustration of a monitor that performs quite well for the first three years of operation but then gets partially disabled after that. The illustration assumes 40 trips per month that increment the general denominator. The illustration also assumes the monitor has an 80 percent probability of completing on these trips before the change in performance and 10 percent thereafter. The MAR is updated every 255 trips, or about 6 months, and quickly changes to reflect the new level of degraded performance. The IUMPR for this monitor, however, continues to exceed the minimum ratio of 0.336 that applies to many OBD II system major monitors for over 5 years. With its emphasis on

current behavior, the MAR nicely complements IUMPR data which provides overall average behavior.

Although the aforementioned example highlights the usefulness of MAR data in showing a monitor's current level of activity, MAR data actually cover an amount of vehicle operation that is on the same scale as the IUMPR data from manufacturers that CARB staff reviews each year as part of the post-certification process. The MAR data parameters are 1-byte in size, and can therefore cover as many as 255 to 509 trips at any given time. The MAR value itself always represents 255 trips worth of activity, and the current value of the mini-numerator and mini-denominator can range from zero to 254 trips. This total range of 255 to 509 trips is typical of the IUMPR data submitted every year by manufacturers as part of their PVE test data. Staff routinely use data with general denominators in this range to make determinations of a monitor's compliance with minimum performance requirements. This is also reflected in IUMPR enforcement testing for light-, medium-, and heavy-duty vehicles and engines (sections 1968.5(b)(3)(D)(ii) and 1971.5(b)(3)(D)(ii)), which requires most major monitors on a test vehicle to have denominators with a value of at least 300.

Subsections 1968.2(d)(9.2) and 1971.1(d)(7.7)

Purpose: These newly proposed subsections would detail the required schedule for implementing SAE J1979 and SAE J1979-2 on vehicles using the ISO 15765-4 protocol. Specifically, these subsections would require manufacturers to use SAE J1979 (which is currently required in the regulations for vehicles using ISO 15765-4) up through the 2026 model year unless manufacturers utilize the option to use SAE J1979-2 on 2023 through 2026 model year vehicles/engines. SAE J1979-2 would be required on all 2027 and subsequent model year vehicles/engines. Further, manufacturers would be prohibited from using SAE J1979-2 on 2022 and earlier model year vehicles/engines.

Rationale: The proposed amendment requiring vehicles/engines to use SAE J1979-2 for all 2027 and subsequent model vehicles/engines using the ISO 15765-4 protocol is needed so that the OBD systems can provide more information to assist repair technicians and technicians in the state I/M programs. In addition to providing more information, which CARB staff finds beneficial, many manufacturers have indicated that they are implementing UDS features in their vehicles, so changes would be needed in the regulations to accommodate these new features. The proposal would require OBD systems to add UDS features associated with SAE J1979-2, including fault code-based readiness status, extended data information for fault codes, and support for freeze frame storage for up to five fault codes. Staff believes the 2027 model year start date provides manufacturers with enough time to make the necessary software and possible hardware modifications to the vehicles to incorporate

these SAE J1979-2-related changes. Manufacturers have also requested that they be able to use SAE J1979-2 on vehicles/engines before the 2027 model year start date so that they can use the UDS features on their vehicles/engines sooner as it may better coincide with new vehicle/engine design production schedules. Therefore, staff proposed language that would allow manufacturers to use SAE J1979-2 on 2023 through 2026 model year vehicles/engines using the ISO 15765-4 protocol. Such vehicles/engines would be required to implement all the proposed requirements in the OBD regulation related to SAE J1979-2, not just a subset of the proposed requirements. Staff is also proposing to prohibit manufacturers from implementing SAE J1979-2 on vehicles/engines earlier than the 2023 model year, as aftermarket scan tools and state I/M program infrastructure may not be ready to communicate with SAE J1979-2 vehicles in time.

Sections 1968.2(e) and 1971.1(f): Monitoring Requirements for Gasoline/Spark-Ignited Engines

Subsections 1968.2(e)(1.3), (e)(4.3.2), (e)(5.3.2)(B), (e)(6.3.2), (e)(7.3.1)(A), (e)(7.3.2)(A), (e)(8.3.1), and (e)(13.3), and 1971.1(f)(1.3.2), (f)(3.3.1), (f)(5.3.1), (f)(6.3), (f)(7.3.2), (f)(8.3.1)(A), (f)(8.3.2)(A), and (f)(9.3)

Purpose: The proposed amendments to these subsections would separate out the IUMPR tracking and reporting requirements for each monitor section, indicating that the current requirements would apply to vehicles/engines using SAE J1979 and new requirements would apply to vehicles/engines using SAE J1979-2. The new requirements would require vehicles/engine using SAE J1979-2 to track and report the IUMPR data for the specific monitors listed in accordance with subsection 1968.2(d)(5.1.3) or (d)(5.2.2)(B) or subsection 1971.1(d)(5.1.4) or (d)(5.2.2)(B). Additionally, the proposed amendment would change "section (d)(5.2.2)" to "section (d)(5.2.1)(B)".

Rationale: The proposed amendments are needed to accommodate the changes to subsections 1968.2(d)(5.2) and 1971.1(d)(5.2), which includes the addition of new tracking and reporting requirements for gasoline/spark-ignited vehicles/engines using SAE J1979-2 in subsections 1968.2(d)(5.1.3) and 1971.1(d)(5.1.4). The proposed amendment changing "section (d)(5.2.2)" to "section (d)(5.2.1)(B)" is needed since the proposed amendments to subsection (d)(5.2) renumbered subsection (d)(5.2.2) to (d)(5.2.1)(B) in both sections 1968.2 and 1971.1.

Subsections 1968.2(e)(3.4.4) and 1971.1(f)(2.4.3)

Purpose: The proposed amendments to these subsections would add new freeze frame storage and erasure requirements for the gasoline misfire monitor on vehicles/engines using SAE J1979-2. Subsections 1968.2(e)(3.4.4)(A) and (B) (which contain the current requirements) would be renumbered to

1968.2(e)(3.4.4)(A)(i) and (ii), subsection 1971.1(f)(2.4.3)(A) and (B) would be renumbered to 1971.1(f)(2.4.3)(A)(i) and (ii), and subsections 1968.2(e)(3.4.4)(A) and 1971.1(f)(2.4.3)(A) would be modified to indicate that these current requirements would apply to vehicles/engines using SAE J1979. Subsections 1968.2(e)(3.4.4)(B) and 1971.1(f)(2.4.3)(B) would now apply to vehicles using SAE J1979-2, and would require manufacturers to store freeze frame conditions for the misfire monitor in accordance with the proposed requirements in subsections 1968.2(d)(2.2.7)(B) and 1971.1(d)(2.2.1)(D)(ii).

Rationale: For the gasoline misfire monitor, the current regulations require freeze frame conditions to be stored and erased in conjunction with storage and erasure of either the pending fault code or the confirmed fault code. Further, if there are freeze frame conditions currently stored for a fault other than a fuel system or misfire fault, the current regulations require that freeze frame conditions for a subsequently detected misfire fault replace the stored freeze frame conditions. The proposed amendments in subsection 1968.2(e)(3.4.4)(A) and 1971.1(f)(2.4.3)(A) would require vehicles/engine using SAE J1979 to continue following these current requirements. The proposed amendments for vehicles/engines using SAE J1979-2 would require the gasoline misfire monitor to follow the same freeze frame storage and erasure protocol as those proposed in subsections 1968.2(d)(2.2.7)(B) and 1971.1(d)(2.2.1)(D)(ii) for all other monitors. This would eliminate the freeze frame storage "priority" currently allowed for the gasoline misfire and fuel system monitors. This prioritization is no longer needed due to the proposal in subsections 1968.2(g)(4.3.2)(D) and 1971.1(g)(4.3.2)(C) that would increase the minimum number of fault codes that can be assigned freeze frames from one to five. With the availability of additional fault code freeze frame slots, storage priority becomes obsolete because there will be a sufficient number of freeze frame slots to cover the needs of most vehicles. Removing freeze frame storage priority would have the additional benefits of both simplifying the freeze frame software coding for manufacturers and reducing the need for staff review.

Subsections 1968.2(e)(6.4.4) and 1971.1(f)(1.4.4)

Purpose: The proposed amendments to these subsections would add new freeze frame storage and erasure requirements for the gasoline fuel system monitor on vehicles/engines using SAE J1979-2. Subsections 1968.2(e)(6.4.4)(A) and (B) (which contain the current requirements) would be renumbered to 1968.2(e)(6.4.4)(A)(i) and (ii), subsections 1971.1(f)(1.4.4)(A) and (B) would be renumbered to 1971.1(f)(1.4.4)(A)(i) and (ii), and subsections 1968.2(e)(6.4.4)(A) and 1971.1(f)(1.4.4)(A) would be modified to indicate that these current requirements would apply to vehicles/engines using SAE J1979. Subsections 1968.2(e)(6.4.4)(B) and 1971.1(f)(1.4.4)(B) would now apply to vehicles/engines using SAE J1979-2, and would require manufacturers to store freeze frame conditions for the fuel system monitor in accordance with the proposed requirements in subsections 1968.2(d)(2.2.7)(B) and 1971.1(d)(2.2.1)(D)(ii).

Rationale: For the gasoline fuel system monitor, the current regulations require freeze frame conditions to be stored and erased in conjunction with storage and erasure of either the pending fault code or the confirmed fault code. Further, if there are freeze frame conditions currently stored for a fault other than a fuel system or misfire fault, the current regulations require that freeze frame conditions for a subsequently detected fuel system fault replace the stored freeze frame conditions. The proposed amendments in subsections 1968.2(e)(3.4.4)(A) and 1971.1(f)(1.4.4)(A) would require vehicles/engines using SAE J1979 to continue following these current requirements. The proposed amendments for vehicles/engines using SAE J1979-2 would require the gasoline fuel system monitor to follow the same freeze frame storage and erasure protocol as those proposed in subsections 1968.2(d)(2.2.7)(B) and 1971.1(d)(2.2.1)(D)(ii) for all other monitors. This would eliminate the freeze frame storage "priority" currently allowed for the gasoline misfire and fuel system monitors. The prioritization is no longer needed due to the proposal in subsections 1968.2(g)(4.3.2)(D) and 1971.1(g)(4.3.2)(C) that would increase the minimum number of fault codes that can be assigned freeze frames from one to five. With the availability of additional fault code freeze frame slots, storage priority becomes obsolete because there will be a sufficient number of freeze frame slots to cover the needs of most vehicles. Removing freeze frame storage priority would have the additional benefits of both simplifying the freeze frame software coding for manufacturers and reducing the need for staff review.

Sections 1968.2(f) and 1971.1(e): Monitoring Requirements for Diesel/Compression-Ignition Engines

Subsections 1968.2(f)(1.3.1), (f)(2.3.1), (f)(4.3.3), (f)(5.3.1)(A), (f)(6.3.1)(A), (f)(6.3.1)(B), (f)(6.3.2), (f)(6.3.3), (f)(6.3.4), (f)(7.3.1), (f)(7.3.2), (f)(7.3.3), (f)(8.3.1), (f)(9.3.1), (f)(9.3.2), and (f)(13.3), and 1971.1(e)(1.3.3), (e)(3.3.1), (e)(3.3.2), (e)(3.3.3), (e)(4.3.1), (e)(4.3.2), (e)(4.3.3), (e)(5.3.1), (e)(6.3.1), (e)(7.3.1), (e)(8.3.1), (e)(8.3.2), (e)(9.3.1), and (e)(10.3)

Purpose: The proposed amendments to these subsections would separate out the IUMPR tracking requirements for each monitor section, indicating that the current requirements would apply to vehicles/engines using SAE J1979 and new requirements would apply to vehicles/engines using SAE J1979-2. The new requirements would require vehicles using SAE J1979-2 to track and report the IUMPR data for the specific monitors listed in accordance with subsections 1968.2(d)(5.1.4) or (d)(5.2.2)(B) or subsection 1971.1(d)(5.1.3) or (d)(5.2.2)(B). Additionally, the proposed amendment would change "section (d)(5.2.2)" to "section (d)(5.2.1)(B)."

Rationale: The proposed amendments are needed for consistency with the changes to subsections 1968.2(d)(5.2) and 1971.1(d)(5.2), which includes new tracking and reporting requirements for diesel vehicles/engines using SAE J1979-2 in subsections 1968.2(d)(5.1.4) and 1971.1(d)(5.1.3). The proposed

amendment changing "section (d)(5.2.2)" to "section (d)(5.2.1)(B)" is needed since the proposed amendments to subsection (d)(5.2) renumbered subsection (d)(5.2.2) to (d)(5.2.1)(B) in both sections 1968.2 and 1971.1.

Subsections 1968.2(f)(3.4.2)(B) and 1971.1(e)(2.4.2)(B)

Purpose: The proposed amendments to these subsections would add new freeze frame storage and erasure requirements for the diesel misfire monitor on vehicles/engines using SAE J1979-2. Subsections 1968.2(f)(3.4.2)(B)(i) and (ii) (which contain the current requirements) would be renumbered to (f)(3.4.2)(B)(i)a. and b., subsections 1971.1(e)(2.4.2)(B)(i) and (ii) would be renumbered to 1971.1(e)(2.4.2)(B)(i)a. and b., and subsections 1968.2(f)(3.4.2)(B)(i) and 1971.1(e)(2.4.2)(B)(i) would be modified to indicate that the current requirements would continue to apply to vehicles/engines using SAE J1979. Subsections 1968.2(f)(3.4.2)(B)(ii) and 1971.1(e)(2.4.2)(B)(ii) would now apply to vehicles/engines using SAE J1979-2, and would require manufacturers to store freeze frame conditions for the misfire monitor in accordance with the proposed requirements in subsections 1968.2(d)(2.2.7)(B) and 1971.1(d)(2.2.1)(D)(ii).

Rationale: For the diesel misfire monitor, the current regulations require freeze frame conditions to be stored and erased in conjunction with storage and erasure of either the pending fault code or the confirmed fault code. Further, if there are freeze frame conditions currently stored for a fault other than a fuel system or misfire fault, the current regulations require that freeze frame conditions for a subsequently detected misfire fault replace the stored freeze frame conditions. The proposed amendments in subsections 1968.2(f)(3.4.2)(B)(i) and 1971.1(e)(2.4.2)(B)(i) would require vehicles/engines using SAE J1979 to continue following these current requirements. The proposed amendments for vehicles/engines using SAE J1979-2 would require the diesel misfire monitor to follow the same freeze frame storage and erasure protocol as those proposed in subsections 1968.2(d)(2.2.7)(B) and 1971.1(d)(2.2.1)(D)(ii) for all other monitors. This would eliminate the freeze frame storage "priority" currently allowed for the diesel misfire and fuel system monitors. The prioritization is no longer needed due to the proposal in subsections 1968.2(g)(4.3.2)(D) and 1971.1(g)(4.3.2)(C) that would increase the minimum number of fault codes that can be assigned freeze frames from one to five. With the availability of additional fault code freeze frame slots, storage priority becomes obsolete because there will be a sufficient number of freeze frame slots to cover the needs of most vehicles. Removing freeze frame storage priority would have the additional benefits of both simplifying the freeze frame software coding for manufacturers and reducing the need for staff review.

Subsections 1968.2(f)(4.4.2)(D) and 1971.1(e)(1.4.2)(D)

Purpose: The proposed amendments to this subsection would add new freeze frame storage and erasure requirements for the diesel fuel system monitor on vehicles using SAE J1979-2. Subsections 1968.2(f)(4.4.2)(D)(i) and (ii) (which contain the current requirements) would be renumbered to 1968.2(f)(4.4.2)(D)(i)a. and b., subsections 1971.1(e)(1.4.2)(D)(i) and (ii) would be renumbered to 1971.1(e)(1.4.2)(D)(i)a. and b., and subsections 1968.2(f)(4.4.2)(D)(i) and 1971.1(e)(1.4.2)(D)(i) would be modified to indicate that these current requirements would apply to vehicles/engines using SAE J1979. Subsections 1968.2(f)(4.4.2)(D)(ii) and 1971.1(e)(1.4.2)(D)(ii) would now apply to vehicles/engines using SAE J1979-2, and would require manufacturers to store freeze frame conditions for the fuel system monitor in accordance with the proposed requirements in subsections 1968.2(d)(2.2.7)(B) and 1971.1(d)(2.2.1)(D)(ii).

Rationale: For the diesel fuel system monitor, the current regulations require freeze frame conditions to be stored and erased in conjunction with storage and erasure of either the pending fault code or the confirmed fault code. Further, if there are freeze frame conditions currently stored for a fault other than a fuel system or misfire fault, the current regulations require that freeze frame conditions for a subsequently detected fuel system fault replace the stored freeze frame conditions. The proposed amendments in subsections 1968.2(f)(4.4.2)(D)(i) and 1971.1(e)(1.4.2)(D)(i) would require vehicles/engines using SAE J1979 to continue following these current requirements. The proposed amendments for vehicles/engines using SAE J1979-2 would require the diesel fuel system monitor to follow the same freeze frame storage and erasure protocol as those proposed in subsections 1968.2(d)(2.2.7)(B) and 1971.1(d)(2.2.1)(D)(ii) for all other monitors. This would eliminate the freeze frame storage "priority" currently allowed for the diesel misfire and fuel system monitors. This prioritization is no longer needed due to the proposal in subsections 1968.2(g)(4.3.2)(D) and 1971.1(g)(4.3.2)(C) that would increase the minimum number of fault codes that can be assigned freeze frames from one to five. With the availability of additional fault code freeze frame slots, storage priority becomes obsolete because there will be a sufficient number of freeze frame slots to cover the needs of most vehicles. Removing freeze frame storage priority would have the additional benefits of both simplifying the freeze frame software coding for manufacturers and reducing the need for staff review.

Sections 1968.2(g) and 1971.1(h): Standardization Requirements

Subsections 1968.2(g)(1) and 1971.1(h)(1)

Purpose: The proposed amendments to this subsection would update the following document to the latest published version:
SAE J1979-DA "Digital Annex of E/E Diagnostic Test Modes," April 2021

Additionally, the proposed amendments would add the following new SAE standard:
SAE J1979-2 "E/E Diagnostic Test Modes: OBDonUDS," April 2021

Rationale: As is common practice with technical standards, industry periodically updates the standards to add specifications or clarity. Thus, staff is proposing these changes to reflect these updated standards. Additionally, the newly added SAE standard SAE J1979-2 is needed to support the proposed implementation of SAE J1979-2.

Subsections 1968.2(g)(3.4.1) and 1971.1(h)(3.1.2)

Purpose: These newly proposed subsections would indicate for vehicles/engines using SAE J1979-2, the OBD system would be required to respond to the functional request messages (i.e., request messages sent to all control modules (broadcast)) and physical request messages (i.e., request messages sent to individual control modules (point-to-point)) from a scan tool except the following request messages, which are optional: physical Service $14 (i.e., clear/reset emission-related diagnostic information) messages, and functional Service $19 subfunction $56 (i.e., "Request DTCs for a ReadinessGroup") and Service $19 subfunction $1A (i.e., "Request supported DTCExtendedRecord information") messages.

Rationale: The proposed amendments are needed to facilitate more efficient communication between the scan tool and vehicle control modules. With the new data and functionality provided with the new SAE J1979-2, the ability of a scan tool to communicate both physically and functionally is required to efficiently use these data. Although the proposal to communicate both physically and functionally would be beneficial for most SAE J1979-2 services, it may create issues for others. Industry had identified Service $14 and Service $19 subfunction $56 and $1A as potential Services that may not work well if the system is required to support both types of request messages. Some issues cited by industry include the inability to collect data due to insufficient memory in the scan tool (i.e., functional requesting Service $19 subfunction $56 or $1A) and unintentionally forcing manufacturers to follow the coordinated code clear requirement (i.e., physically requesting Service $14). Therefore, staff proposed that the OBD system may optionally respond to these specific Services.

Subsections 1968.2(g)(3.4.2) and 1971.1(h)(3.1.3)

Purpose: These newly proposed subsections would indicate for vehicles/engines using SAE J1979-2, the OBD system would be prohibited from responding to requests from the scan tool with a negative response code (NRC) except for the following instances: (A) the OBD system may respond with NRC $22, $31, $72, or $78 in response to Service $14 (i.e., clear/reset emission-related diagnostic information) request messages, (B) the OBD system may

respond with NRC $78 in response to request messages for tracking data specified in subsections 1968.2(g)(6.3) through (g)(6.5) and (6.12) and subsections 1971.1(h)(5.3) through (h)(5.6) from a scan tool, and (C) as provided in subsections 1968.2(g)(4.7.4)(B) and 1971.1(h)(4.7.4)(B) for calibration verification number (CVN) request messages.

Rationale: These proposed amendments would prevent delaying communication from the OBD system to the scan tool except for certain situations. For example, when the scan tool requests any of the tracking data in subsections 1968.2(g)(6.3) through (g)(6.5) and (6.12) and subsections 1971.1(h)(5.3) through (h)(5.6) (e.g., NOx emission tracking data), the vehicle control module may need additional time to gather the data for transmission. Staff realizes this may be an issue and proposed to allow the vehicle module to send the appropriate NRC $78 to the scan tool, which indicates the module needs additional time to respond. Additionally, this proposal would provide indication to the scan tool and technician when a Service $14 is requested but unable to be fulfilled by the vehicle module. Except for the NRC allowed for CVN message transmission (as specified in subsections 1968.2(g)(4.7.4)(B) and 1971.1(h)(4.7.4)(B)), no other NRCs would be allowed due to staff concerns that manufacturers would use NRCs to avoid the strict message timing requirements detailed in SAE J1979 and J1979-2.

Subsections 1968.2(g)(4) and 1971.1(h)(4)

Purpose: The proposed amendments to these subsections would indicate that the standardized functions described under subsections 1968.2(g)(4) and 1971.1(h)(4) would be required to be implemented in accordance with SAE J1979 or SAE J1979-2.

Rationale: The proposed amendment is needed to account for the new proposed requirements applicable to vehicles/engines using SAE J1979-2.

Subsections 1968.2(g)(4.1), 1968.2(g)(4.1.1), 1971.1(h)(4.1), and 1971.1(h)(4.1.1)

Purpose: The proposed amendments to these subsections would renumber subsection 1968.2(g)(4.1) to (g)(4.1.1) and subsection 1971.1(h)(4.1) to (h)(4.1.1). The amendments would also renumber all subsections and subsection references under these subsections accordingly, and would make clear that the current requirements under subsections 1968.2(g)(4.1.1) and 1971.1(h)(4.1.1) apply to vehicles/engines using SAE J1979. Additionally, the proposed amendment to subsection 1968.2(g)(4.1.1)(A) would change "2010 subsequent model year" to "2010 and subsequent model year." Further, the proposed amendment to subsection 1968.2(g)(4.1.1)(I), which lists the monitors not required to be used in determining the readiness status, would limit the application of this subsection to 2004 through 2018 model year vehicles.

Similarly, the proposed amendment to subsection 1971.1(h)(4.1.1)(H) would limit the application of this subsection to 2010 through 2015 model year engines.

Rationale: The proposed amendments to reorganize subsections 1968.2(g)(4.1) and 1971.1(h)(4.1) and to renumber the subsections are needed to account for the new proposed requirements for vehicles/engines using SAE J1979-2. The proposed amendment to change the phrase "2010 subsequent model year" to "2010 and subsequent model year" in subsection 1968.2(g)(4.1.1)(A) is needed to correct a grammatical error. The proposed amendment in subsection 1968.2(g)(4.1.1)(I) limiting the requirements to 2004 through 2018 model year vehicles is needed since the requirements under subsection 1968.2(g)(4.1.1)(I) are not needed for 2019 and subsequent model year vehicles. Specifically, subsection 1968.2(g)(4.1.1)(I) lists the monitors that are not required to be included in determining readiness, while subsection 1968.2(g)(4.1.1)(D) lists the monitors required to be included in determining readiness status for 2019 and subsequent model year vehicles. Since subsection 1968.2(g)(4.1.1)(D) does not include any of the monitors listed under 1968.2(g)(4.1.1)(I), the list of monitors under 1968.2(g)(4.1.1)(I) is redundant and therefore not needed for 2019 and subsequent model year vehicles. The rationale is similar for the proposed amendment to subsection 1971.1(h)(4.1.1)(H), since subsection 1971.1(h)(4.1.1)(D) lists the monitors required to be included in determining readiness for 2016 and subsequent model year engines and already excludes the monitors listed under subsection 1971.1(h)(4.1.1)(H), making subsection 1971.1(h)(4.1.1)(H) redundant for 2016 and subsequent model year engines.

Subsections 1968.2(g)(4.1.2) and 1971.1(h)(4.1.2)

Purpose: This newly proposed subsections 1968.2(g)(4.1.2) and 1971.1(h)(4.1.2) would describe the readiness status requirements for vehicles/engines using SAE J1979-2. Subsection 1968.2(g)(4.1.2)(A) would require these vehicles/engines to indicate readiness status for all components/systems identified in sections (e)(1) through (e)(16) and (f)(1) through (f)(16), while subsection 1971.1(h)(4.1.2)(A) would require these engines to indicate readiness status for all components/systems identified in sections (e)(1) through (g)(4). Subsections 1968.2(g)(4.1.2)(B) and 1971.1(h)(4.1.2)(B) would list the monitors for each component/system readiness bit that would be used to determine readiness status. Further, for all listed monitors other than the gasoline and diesel misfire monitors, subsections 1968.2(g)(4.1.2)(B) and 1971.1(h)(4.1.2)(B) would require each readiness status to indicate "complete" based on the same conditions as currently required for vehicles/engines using SAE J1979. Specifically, the readiness status would be required to indicate complete when either (1) all the supported monitors listed for each component/system have fully executed and determined that the component or system is not malfunctioning, or (2) at least one of the monitors listed for each component/system has determined that the component or system is

malfunctioning after the requisite number of decisions necessary for determining the MIL status have been fully executed, regardless of whether or not the other monitors listed have been fully executed. For the gasoline and diesel misfire monitors, the readiness status would be required to indicate complete if either condition (2) above is met or all the supported monitors have fully executed and determined there is no misfire malfunction and 4,000 fueled engine revolutions have occurred. Subsections 1968.2(g)(4.1.2)(C) through (F) would include the same requirements currently required for vehicles using SAE J1979 under subsections 1968.2(g)(4.1.1)(E) through (H), while subsections 1971.1(h)(4.1.2)(C) through (E) would include the same requirements currently required for engines using SAE J1979 under subsections 1971.1(h)(4.1.1)(E) through (G).

Rationale: The proposed amendments for vehicles/engines using SAE J1979-2 are needed to provide a more comprehensive indication that the vehicles/engines has completed its emissions systems self-checks compared to the current vehicles/engines using SAE J1979. The proposal for vehicles/engines using SAE J1979-2 would accomplish this by requiring readiness status reporting for more components/systems than currently required, with the additional components/systems being the positive crankcase ventilation/crankcase ventilation (CV) system, engine cooling system, cold start emission reduction strategy, air conditioning (A/C) system component, and other emission control or source system for gasoline and diesel vehicles/engines, and the heated catalyst and direct ozone reduction system for gasoline vehicles/engines. The proposal would also split up the currently combined gasoline and diesel exhaust gas recirculation (EGR)/variable valve timing (VVT) readiness bit into separate EGR system and VVT system readiness bits. Since the Smog Check program uses readiness status completion as a criterion to issue certification, these proposed amendments requiring expanded readiness indicators would help to improve the program's ability to identify malfunctioning vehicles that negatively impact air quality.

While the proposed readiness status completion criteria for vehicles/engines using SAE J1979-2 in subsections 1968.2(g)(4.1.2) and 1971.1(h)(4.1.2) are mostly the same as those currently required in the regulation for vehicles/engines using SAE J1979, the proposal would change the monitors required to be used to determine the readiness status. Specifically, unless a monitor does not run frequently in-use due to acceptable reasons (e.g., the monitor requires a regeneration event), the proposal would generally require all monitors that are required to meet the minimum in-use monitor performance requirements of subsections 1968.2(d)(3.2) and 1971.1(d)(3.2) to be included in the readiness status determination, with the exception of the "other emission control or source system" readiness bit for the OBD II regulation and the "other emission control" readiness bit for the HD OBD regulation. Since manufacturers are required to obtain Executive Officer approval of the monitoring plans for "other emission control or source systems" or "other

emission control systems," there are no specific monitoring conditions requirements prescribed in the regulations for these systems, and thus there is uncertainty about which monitors would be required to meet the in-use monitor performance requirements. Therefore, staff is proposing to require all monitors for these systems to be included in determining the readiness status determination to avoid confusion about whether or not to include certain monitors. The readiness proposal overall would ensure that virtually all monitors on the vehicle/engine run and complete to set the readiness status to complete, which further ensures that all emission-related malfunctions would be detected if they existed. This proposal makes available a comprehensive list of pertinent monitors to CARB staff and the Smog Check Program to indicate whether a vehicle has completed its emissions self-checks.

The proposal would also change how the gasoline/diesel comprehensive component and misfire readiness status would set to "complete." For these readiness groups, the current regulation requires the readiness status to always indicate "complete," regardless of whether or not all the associated monitors actually ran and completed. However, the proposal would require the comprehensive component and misfire readiness status for vehicles/engines using SAE J1979-2 to indicate "complete" only after the criteria specified in subsections 1968.2(g)(4.1.2)(B) and 1971.1(g)(4.1.2)(B) are met, or more specifically, after all the required monitors have run and completed. These readiness groups contain monitors of components/systems that can negatively impact vehicle emissions if these components/system are malfunctioning. CARB staff wanted the readiness groups to indicate when these particular monitors had run and completed in order to improve the Smog Check Program's ability to identify vehicles that have not completed emissions self-checks and may therefore have unrepaired malfunctions that are negatively impacting air quality. Further, for the gasoline and diesel misfire monitors, the additional criterion of 4,000 fueled engine revolutions in subsection (g)(4.1.3)(B) is needed to better ensure the misfire monitors have enough time to make a pass/fail determination.

The proposal would also rename the gasoline "oxygen sensor" readiness bit to the gasoline "exhaust gas sensor" readiness bit, delete the gasoline oxygen sensor heater readiness bit, and include the oxygen sensor heater monitor (1968.2(e)(7.2.3)(A) and 1971.1(f)(8.2.3)(A)) in the gasoline exhaust gas sensor readiness bit. These amendments would improve organization of the readiness bits by aligning the readiness groups to the current language in the regulation.

Subsections 1968.2(g)(4.2) and 1971.1(h)(4.2)

Purpose: The proposed amendment would indicate that the standard the signals listed under this subsection are required to meet includes the SAE J1979-2 specifications.

Rationale: The proposed amendment is needed to account for the new proposed requirements applicable to vehicles using SAE J1979-2.

Subsections 1968.2(g)(4.2.2)(A), 1968.2(g)(4.2.3)(C), 1971.1(h)(4.2.1)(C), and 1971.1(h)(4.2.2)(C)

Purpose: These subsections were modified to remove the requirement to report the data stream parameter "monitor status 'disabled for the rest of this driving cycle'" so that they will not be applied to gasoline and diesel vehicles using SAE J1979-2. Subsections 1968.2(g)(4.2.2)(A)(iii), 1968.2(g)(4.2.3)(C)(i), 1971.1(h)(4.2.1)(C)(i), and 1971.1(h)(4.2.2)(C)(i) were added to retain the requirement to report this data stream parameter for gasoline and diesel vehicles using SAE J1979.

Rationale: The staff proposal to not require vehicles/engines using SAE J1979-2 to report the data stream parameter "monitor status 'disabled for the rest of this driving cycle'" is needed because the parameter has not proven useful for technicians and is difficult to implement in the SAE J1979-2 data structure. Other regulatory proposals, such as the proposed status bits in subsections 1968.2(g)(4.12) and 1971.1(g)(4.12), provide more useful information to the technician about a monitor's completion status in the current driving cycle and eliminates the need for reporting the disablement status of a monitor. The technician is expected to refer to service literature to determine the enablement/disablement criteria for a particular monitor, which also reduces the value of the disablement status of a monitor.

Subsections 1968.2(g)(4.2.2)(F) and 1971.1(h)(4.2.4)

Purpose: The newly proposed subsections 1968.2(g)(4.2.2)(F) and 1971.1(h)(4.2.4) would require vehicles/engines using SAE J1979-2 to make available the following data stream signals: 1) fuel pressure from both the high-pressure and low-pressure fuel system, if so equipped, 2) cylinder-specific misfire counts, and 3) for vehicles /engines with evaporative systems that can be sealed when commanded by an enhanced scan tool, EVAP system sealing status.

Rationale: The proposed new data stream parameters in this subsection are needed to provide more information to the technician to assist in repairs of emission-related malfunctions. The proposed new fuel pressure signals are needed to provide additional information about the fuel system pressures that would aid the technician in diagnosing and repairing fuel system problems (i.e., high- and low-fuel pressure malfunctions). The proposed cylinder misfire counts signal is needed to provide additional real-time misfire counts of each cylinder (i.e., cylinder-specific misfire counts) that would aid the technician in determining the driving conditions under which misfire is occurring. The proposed EVAP system sealing status is needed to provide real-time sealing

status of the EVAP system in order to assist technicians repairing evaporative system leaks. The EVAP sealing function is a new requirement for SAE J1979-2 vehicles/engines and specified in sections 1968.2(g)(4.11) and 1971.1(h)(4.11).

Subsections 1968.2(g)(4.3) and 1971.1(h)(4.3)

Purpose: The proposed amendments to these subsections would include new freeze frame condition storage and erasure requirements for vehicles/engines using SAE J1979-2. Specifically, subsections 1968.2(g)(4.3) and 1971.1(h)(4.3) would be split into two subsections, with subsections 1968.2(g)(4.3.1) and 1971.1(h)(4.3.1) containing the current freeze frame requirements (with subsections renumbered) and applying to vehicles/engines using SAE J1979, and with subsections 1968.2(g)(4.3.2) and 1971.1(h)(4.3.2) containing the new freeze frame requirements and applying to vehicles/engines using SAE J1979-2. The proposed amendment to subsection 1968.2(g)(4.3.1)(B) would change "(g)(4.3.3)" to (g)(4.3.1)(C)". The proposed freeze frame requirements for vehicles/engines using SAE J1979-2 would contain the same requirements in subsections 1968.2(g)(4.3.2) and 1971.1(h)(4.3.2) as those currently required for vehicles/engines using SAE J1979, except for the following: Subsections 1968.2(g)(4.3.2)(B) and 1971.1(h)(4.3.2)(B) would require vehicles/engines using SAE J1979-2 to include the data stream signals under subsections (g)(4.2.2)(F)(i) and (ii) and 1971.1(h)(4.2.4)(A) and (B) (for the newly proposed fuel pressure and cylinder-specific misfire counts signals) in the freeze frame conditions, and subsections 1968.2(g)(4.3.2)(D) and 1971.1(h)(4.3.2)(C) would require vehicles/engines using SAE J1979-2 to store freeze frame conditions on two data frames (as described in subsections 1968.2(d)(2.2.7)(B) and 1971.1(d)(2.2.1)(D)(ii)) for each fault code for at least 5 fault codes per diagnostic or emission critical powertrain control unit.

Rationale: The proposed amendments are needed to provide the repair technician with more data indicating the relevant vehicle conditions that occurred when the fault was detected. The proposal would require freeze frame conditions to be stored for a minimum of five fault codes for each DEC-ECU as opposed to one fault code as currently required in the regulation. More data would be provided in two data frames per fault code, as opposed to a single data frame per fault code as currently required. As already described above for subsections 1968.2(d)(2.2.7)(B) and 1971.1(d)(2.2.1)(D)(ii), the first frame records freeze frame conditions when the fault was first detected while the second frame records the latest freeze frame conditions when the fault was last detected. These new data are expected to help the repair technician better diagnose the cause of the malfunction and verify repair, especially in the case where multiple malfunctions are present (and therefore, multiple fault codes are stored). The proposed amendment to include the newly proposed fuel pressure and cylinder misfire counts signals (as proposed in subsections 1968.2(g)(4.2.4)(i) and (ii) and 1971.1(h)(4.2.4)(A) and (B)) in the freeze frame conditions is needed to aid in the diagnosis of malfunctions. The fuel pressure

signals would help the technician immediately identify whether a fault was located in the low-pressure or high-pressure fuel system, while the misfire data would help the technician quantify the severity of the misfire when the fault was detected.

The proposed amendment to subsection 1968.2(g)(4.3.1)(B) changing "(g)(4.3.3)" to (g)(4.3.1)(C)" is needed to account for the renumbering under subsection 1968.2(g)(4.3).

Subsections 1968.2(g)(4.4.1) and 1971.1(h)(4.4.1)(A)

Purpose: The proposed amendment would indicate that the standard the OBD system is required to meet when making available fault codes through the diagnostic connector includes the SAE J1979-2 specifications. The proposed amendments would also indicate that manufacturers are required to use 2-byte fault codes on vehicles/engines using SAE J1979 (as currently required) and use 3-byte fault codes on vehicles/engines using SAE J1979-2.

Rationale: The proposed amendment is needed to account for the new proposed requirements applicable to vehicles/engines using SAE J1979-2. Currently, the regulations require vehicles/engines using the ISO 15765-4 protocol to make fault codes available in the standardized format described in SAE J1979, which currently requires 2-byte fault codes. The proposed amendment requiring vehicles/engines using SAE J1979-2 to use 3-byte fault codes is needed to increase the number of available fault codes. 3-byte fault codes would provide for a significantly increased number of available fault codes for vehicle and engine manufacturers to use. Currently, the number of available 2-byte fault codes are limited and nearing full capacity. Hybrid vehicles require the use of a substantially high number of new fault codes, which is consuming the remaining available 2-byte fault codes at a high rate. The first two bytes of the 3-byte fault codes would be carried over from the 2-byte fault code structure (SAE J1979) while a third failure-type byte would be appended to the end of the fault code. This third-byte would provide the technician with a standardized code (as detailed in SAE J2012-DA) to identify the specific failure of the fault. This would help the technician narrow down the cause of the failure as well as significantly increase the number of fault codes available to the vehicle and engine manufacturer.

Subsections 1968.2(g)(4.4.2) and 1971.1(h)(4.4.1)(B)

Purpose: The proposed amendment to these subsections would add new requirements for vehicles/engines using SAE J1979-2 in subsections 1968.2(g)(4.4.2)(A) and 1971.1(h)(4.4.1)(B)(i). These subsections would require that for monitors required to support test results under subsections 1968.2(g)(4.5) and 1971.1(h)(4.5), a unique fault code is required for each monitor. Notwithstanding, a manufacturer may request Executive Officer

approval to use a specific fault code for more than one monitor. The Executive Officer shall approve the request if there is no available unique SAE-defined fault code for each of the monitors of concern, or if the manufacturer can show that it is not technically feasible to support a unique fault code for each of the monitors of concern.

Rationale: The proposed amendment is needed to better determine which specific fault code the reported test result belongs to. CARB staff is proposing to require a unique fault code for each monitor that is required to support test results because these are major monitors of components/systems with greater impact on emissions compared to other monitors (e,g., comprehensive component monitors). However, staff is aware there may be situations where the manufacturer cannot report a single test result for a specific fault code due to issues such as the complexity in monitor design, for example. Therefore, in some cases, the manufacturer may report multiple test results per fault code with Executive Officer approval. Requiring a unique fault code for each of the other monitors (e.g., comprehensive component monitors) may prove too burdensome for manufacturers to implement and is therefore not required in this proposal.

Subsections 1968.2(g)(4.4.5) and 1971.1(h)(4.4.1)(E)(i)

Purpose: The proposed amendment would indicate that the standard the pending fault codes are required to meet includes the SAE J1979-2 (e.g., Service $19 subfunction $42) specifications.

Rationale: The proposed amendment is needed to account for the new proposed requirements applicable to vehicles/engines using SAE J1979-2.

Subsections 1968.2(g)(4.5.1) and 1971.1(h)(4.5.1)

Purpose: The proposed amendments would indicate that the standard the monitors are required to meet when storing and reporting test results includes the SAE J1979-2 (i.e., Service $19 subfunction $06) specifications.

Rationale: The proposed amendment is needed to account for the new proposed requirements applicable to vehicles/engines using SAE J1979-2.

Subsections 1968.2(g)(4.5.4)(A) and 1968.2(g)(4.5.4)(C)

Purpose: The proposed amendment would indicate that the standard the test results and limits are required to meet includes SAE J1979-2.

Rationale: The proposed amendments are needed to account for the new proposed requirements applicable to vehicles using SAE J1979-2.

Subsections 1968.2(g)(4.6.1) and 1971.1(h)(4.6.1)

Purpose: The proposed amendment would indicate that the standard the software calibration identification number (CAL ID) is required to be meet includes the SAE J1979-2 specifications.

Rationale: The proposed amendment is needed to account for the new proposed requirements applicable to vehicles/engines using SAE J1979-2.

Subsections 1968.2(g)(4.7.1) and 1971.1(h)(4.7.1)

Purpose: The proposed amendment would indicate that the standard the CVN is required to meet includes the SAE J1979-2 specifications. Further, the proposed amendment of footnote 2 of subsection 1968.2(g)(4.7.1) would change "supercede" to "supersede."

Rationale: The proposed amendment regarding language related to SAE J1979-2 is needed to account for the new proposed requirements applicable to vehicles/engines using SAE J1979-2. The proposed amendment to change "supercede" to "supersede" is needed to correct a misspelling.

Subsections 1968.2(g)(4.7.3) and 1971.1(h)(4.7.4)

Purpose: The proposed amendment would indicate that the standard that prohibits a generic scan tool from erasing the CVN value includes the SAE J1979-2 specifications.

Rationale: The proposed amendment is needed to account for the new proposed requirements applicable to vehicles/engines using SAE J1979-2.

Subsections 1968.2(g)(4.7.4)(B) and 1971.1(h)(4.7.5)(B)

Purpose: The proposed amendment would indicate that the standard the CVN request messages are required to meet includes the SAE J1979-2 specifications.

Rationale: The proposed amendment that added reference to SAE J1979-2 is needed to account for the new proposed requirements applicable to vehicles/engines using SAE J1979-2.

Subsections 1968.2(g)(4.8.1) and 1971.1(h)(4.8.1)

Purpose: The proposed amendment would indicate that the standardized format the vehicle identification number (VIN) would be required to meet would includes the SAE J1979-2 specifications.

Rationale: The proposed amendment is needed to account for the new proposed requirements applicable to vehicles/engines using SAE J1979-2.

Subsections 1968.2(g)(4.9) and 1971.1(h)(4.9)

Purpose: The proposed amendment would indicate that the standardized format the electronic control unit name (ECU Name) is required to meet includes SAE J1979-2 (i.e., ECUNAME in Service $22, InfoType $F80A).

Rationale: The proposed amendment is needed to account for the new proposed requirements applicable to vehicles using SAE J1979-2.

Subsections 1968.2(g)(4.10.2) and 1971.1(h)(4.10.2)

Purpose: These subsections describe the requirements for erasure of emission-related diagnostic information. Concerning the specifics of what control units to erase the information from, the proposed amendments would split that part of the subsection into two subsections, with subsections 1968.2(g)(4.10.2)(A) and 1971.1(h)(4.10.2)(A) containing the current requirements for vehicles/engines using SAE J1979 or SAE J1939 and subsections 1968.2(g)(4.10.2)(B) and 1971.1(h)(4.10.2)(B) describing the new requirements for vehicles/engines using SAE J1979-2. In response to a functional Service $14 scan tool request, subsections 1968.2(g)(4.10.2)(B)(i) and 1971.1(h)(4.10.2)(B)(i) would require vehicles/engines using SAE J1979-2 to erase all information from all control units. In response to a physical Service $14 request, subsections 1968.2(g)(4.10.2)(B)(ii) and 1971.1(h)(4.10.2)(B)(ii) would require vehicles/engines using SAE J1979-2 to erase all information from only that control module that received the physical Service $14 request. For both cases, the OBD system would be prohibited from erasing only a subset of the emission-related diagnostic information in response to a scan tool command.

Rationale: The proposed amendments are needed to account for the proposal described above related to the comprehensive component readiness bit in subsections 1968.2(g)(4.1) and 1971.1(h)(4.1), where the comprehensive component readiness bit would no longer be set to "complete" all the time on vehicles/engines using SAE J1979-2. As described above, staff is proposing to require the comprehensive component readiness bit set to complete when the monitors associated with the comprehensive component readiness group have met the requirements of subsections 1968.2(g)(4.1.2)(B) and 1971.1(h)(4.1.2)(B). Currently, the regulations require emission-related diagnostic information to be erased only from control units that report supported readiness for a readiness bit other than the comprehensive component bit. The proposed amendment would simplify the logic for clearing emissions-relevant data on OBD control units that receive a physical request by requiring only the control unit that received the physical Service $14 request to clear emissions-related diagnostic data. This would allow the OBD module to have its emissions-related diagnostic data to be cleared after a repair is performed without affecting the emissions-related diagnostic data of other modules on the vehicle. This amendment would reduce the burden on the technician to prepare the vehicle for an I/M

inspection after a repair is performed because emissions-relevant data is retained in other OBD control units unrelated to the repair. As described in the proposed amendments in subsections 1968.2(g)(3.4.1) and 1971.1(h)(3.1.2), the vehicle/engine would be required to support functional Service $14 with the option to support physical Service $14. A functional request is a message sent to all modules simultaneously, so all control units would be required to erase emission-related diagnostic information. A physical request is only sent to one control unit, so only that specific control unit would be required to erase emission-related diagnostic information.

Subsections 1968.2(g)(4.11) and 1971.1(h)(4.11)

Purpose: The new proposed subsections would require that for vehicles/engines using SAE J1979-2 and equipped with evaporative systems that can be sealed when commanded by an enhanced scan tool, these vehicles engines would need to be able to seal the evaporative system for at least 30 minutes when commanded by a generic scan tool.

Rationale: The proposed amendment is needed to assist repair technicians when fixing evaporative system malfunctions. Currently, technicians have to either use an enhanced scan tool to seal the evaporative system (assuming this function exists for a particular make and model vehicle) or seal the systems manually using things like hose clamps or plugs. This proposal would allow the technician to use a generic scan tool to seal the evaporative system instead of an enhanced scan tool, which is often expensive to purchase and may be difficult to obtain. However, if the manufacturer does not have this feature on its enhanced scan tools, it is not required to create this function for the generic scan tool.

Subsections 1968.2(g)(4.12) and 1971.1(h)(4.12)

Purpose: The new proposed subsections would require vehicles/engines using SAE J1979-2 to make available the following status bits for each fault code:
1) Bit 0: “TestFailed”
2) Bit 1: “TestFailedThisOperationCycle”
3) Bit 2: “pendingDTC”
4) Bit 3: “confirmedDTC”
5) Bit 4: “testNotCompletedSinceLastClear”
6) Bit 6: “testNotCompletedThisOperationCycle”

Rationale: The proposed amendments are needed to provide both the information currently provided using the original SAE J1979 standard for vehicles subject to that standard as well as new information required for vehicles meeting SAE J1979-2. The following provides additional details about each proposed bit required for vehicles supporting SAE J1979-2:

1) Bit 0: "TestFailed" – This bit would provide an indication that the monitor has completed and detected a malfunction during the current driving cycle. Unlike Bit 1 or Bit 2, this bit flag does not latch between driving cycles and therefore provides a continuous indication of monitor pass/fail status. This bit is useful for technicians diagnosing intermittent faults because it can be monitored with a scan tool in real time. For example, the technician can observe this bit while wiggling the wiring harness, driving over bumps, etc. to help narrow down the cause of the fault.
2) Bit 1: "TestFailedThisOperationCycle" – This bit would provide an indication that the monitor has detected a malfunction this driving cycle. It would also be used for the triggering of freeze frame information.
3) Bit 2: "pendingDTC" – This bit would provide an indication that the monitor has detected a pending fault.
4) Bit 3: "confirmedDTC" – This bit would provide an indication that the monitor has detected a confirmed fault.
5) Bit 4: "testNotCompletedSinceLastClear" – This bit would provide an indication that the monitor has not completed since emissions data was last cleared in the module. This bit would provide fault code-specific readiness, which is a new feature introduced with this proposal. This would allow technicians to determine which specific monitors within a readiness group are incomplete and causing the entire readiness group to be identified as incomplete.
6) Bit 6: "testNotCompletedThisOperationCycle" – This bit would provide an indication that the monitor has not completed this driving cycle.

Subsections 1968.2(g)(5.1) and 1971.1(h)(5.1.1)

Purpose: The proposed amendment would indicate that the standardized format the in-use performance numerator and denominator are required to meet would include the SAE J1979-2 (i.e., Service $19 subfunction $06) specifications.

Rationale: The proposed amendment is needed to account for the new proposed requirements applicable to vehicles/engines using SAE J1979-2.

Subsection 1968.2(g)(6)

Purpose: The proposed amendment would rename the title in this subsection from "Vehicle Operation Tracking Requirements" to "Vehicle Operation and Control Strategies Tracking Requirements."

Rationale: The proposed amendment is needed to more accurately reflect the tracking requirements in this subsection, which tracks not only vehicle operation conditions but also emission increasing auxiliary emission control device activity, active off-cycle credit technologies activity, NOx emission performance, and the newly-proposed CSERS activity.

Subsections 1968.2(g)(6.6.1), 1968.2(g)(6.6.2), 1971.1(h)(5.2.2), and 1971.1(h)(5.7.1)

Purpose: The proposed amendment would indicate the standardized format the counters specified in subsections 1968.2(g)(6.1) through (g)(6.5), 1968.2(g)(6.12), 1971.1(h)(5.2.1), and 1971.1(h)(5.4) through (h)(5.6) are required to meet would include the SAE J1979-2 specifications.

Rationale: The proposed amendment is needed to account for the new proposed requirements applicable to vehicles/engines using SAE J1979-2.

Subsection 1968.2(g)(7.1)

Purpose: This subsection currently allows manufacturers of medium-duty vehicles equipped with a diesel engine certified on an engine dynamometer to request to use an alternate diagnostic connector and emission-related message structure and format in lieu of the requirements in subsection 1968.2(g)(2) and (g)(4) that refer to SAE J1962, SAE J1978, and SAE J1979. The proposed amendments would add SAE J1979-2 to the list of SAE standards.

Rationale: The proposed amendment is needed to account for the new proposed requirements applicable to vehicles using SAE J1979-2.

Subsections 1968.2(g)(7.6) and 1971.1(h)(7.2.2)

Purpose: The proposed subsections would allow manufacturers of vehicles/engines using SAE J1979-2 to request Executive Officer approval to meet the standardization requirements of sections 1968.2(g) and 1971.1(h) using an alternate scan tool that does not meet SAE J1978. The Executive Officer shall approve the request upon determining that the SAE J1978 specifications do not adequately accommodate the SAE J1979-2 specifications, and that the manufacturer has submitted information that demonstrate the alternate scan tool is able to access all information required for SAE J1979-2 vehicles and is able to perform all the functions in title 13, CCR sections 1968.2 and 1971.1 required for SAE J1978 tools and applicable to vehicles/engines meeting SAE J1979-2.

Rationale: The proposed amendments are needed to account for cases where the SAE J1978 specifications are not updated to accommodate the newly proposed requirements related to SAE J1979-2. Many of the proposed amendments in the OBD regulations would require SAE J1979-2 vehicles/engines to make the new SAE J1979-2 features accessible and available to scan tools meeting the SAE J1978 standards. However, while subsections 1968.2(d)(9.2) and 1971.1(d)(7.7) allows manufacturers to use SAE J1979-2 on their vehicles/engines as early as the 2023 model year, there is concern that the SAE J1978 standards committee will not be able to update the

specifications in time to allow scan tools to be used with SAE J1979-2 vehicles/engines. The SAE committees have indicated that they intend to publish a new SAE standard (specifically, SAE J1978-2) that would meet the proposed requirements related to scan tools used with SAE J1979-2 vehicles/engines. While the publication date of the standard is unknown at this time, staff believes the standard will be available in time before the first vehicles/engines using SAE J1979-2 are produced. Therefore, staff is proposing the amendment to accommodate this. When the final standard is published in the near future, staff will propose amendments to the OBD regulations to incorporate by reference this standard at a future OBD rulemaking update.

Subsections 1968.2(g)(8) and 1971.1(h)(6)

Purpose: The proposed amendments to these subsections would renumber subsection 1968.2(g)(8.2) to 1968.2(g)(8.1.1) and renumber subsection 1971.1(h)(6.2) to 1971.1(h)(6.1.1). The proposed amendments to subsections 1968.2(g)(8.1.1) and 1971.1(h)(6.1.1) would indicate that the current reporting requirements specified in "Data Record Reporting Procedures for Over-the-Air Reprogrammed Vehicles and Engines" dated August 16, 2018, would apply to vehicles/engines using SAE J1979 and SAE J1939. The proposed amendments would also indicate that vehicles/engines using SAE J1979-2 would be required to meet the reporting requirements in "Data Record Reporting Procedures for Over-the-Air Reprogrammed Vehicles and Engines Using SAE J1979-2," dated June 1, 2021.

Rationale: The proposed amendments to renumber subsection 1968.2(g)(8.2) to 1968.2(g)(8.1.1) and subsection 1971.1(h)(6.2) to 1971.1(h)(6.1.1) are needed to address confusion about the language. Subsections 1968.2(g)(8.1) and 1971.1(h)(6.1) specifically indicate data collection requirements for 2024 and subsequent model year vehicles/engines if any of the data required to be stored and made available pursuant to sections 1968.2(g)(5) and (g)(6) or 1971.1(h)(5) would be erased by an over-the-air reprogramming of any control module, while currently numbered subsections 1968.2(g)(8.2) and 1971.1(h)(6.2) indicate specific reporting requirements for these vehicles/engines. However, the regulations did not include the statement that the reporting requirements under subsections 1968.2(g)(8.2) and 1971.1(h)(6.2) were specifically for the vehicles/engines mentioned in subsections 1968.2(g)(8.1) and 1971.1(h)(6.1), respectively. Therefore, manufacturers were not sure if vehicles/engines that did not meet the criteria in subsections 1968.2(g)(8.1) and 1971.1(h)(6.1) (i.e., vehicles/engines that did not erase the data by an over-the-air reprogramming) were required to meet the reporting requirements in subsections 1968.2(g)(8.2) and 1971.1(h)(6.2). Therefore, staff proposed to renumber the subsections to establish that the requirements of subsections 1968.2(g)(8.1.1) and 1971.1(h)(6.1.1) would apply only if the criteria described under subsections 1968.2(g)(8.1) and 1971.1(h)(6.1) were met, respectively.

Further, the proposed amendments to newly renumbered subsections 1968.2(g)(8.1.1) and 1971.1(h)(6.1.1) are needed since the current document "Data Record Reporting Procedures for Over-the-Air Reprogrammed Vehicles and Engines," dated August 16, 2018, does not address the newly proposed data for vehicles/engines using SAE J1979-2. Specifically, the proposed revisions to the IUMPR requirements in subsections 1968.2(d)(5) and 1971.1(d)(5) would require vehicles/engines using SAE J1979-2 to track and report IUMPR data for each supported fault code associated with each monitor required to track and report IUMPR data. The current requirements in the August 15, 2018 document reflect the current IUMPR requirements for vehicles/engine using SAE J1979 or J1939, which require vehicles/engines to report one set of IUMPR data for a specific component, not the individual monitors of each component. Therefore, staff developed the new document "Data Record Reporting Procedures for Over-the-Air Reprogrammed Vehicles and Engines Using SAE J1979-2," dated June 1, 2021," which includes specifications related to the proposed revisions to the IUMPR requirements. The manufacturer would be required to include in the data record the average value and standard deviation of each IUMPR for all supported fault codes of all monitors required to track and report IUMPR data. These data would be appended to the end of the record, since the number of supported fault codes that track and report IUMPR data (and thus, the number of additional data fields) vary among test groups/engine families.

Subsections 1971.1(h)(7.2) and (h)(7.2.1)

Purpose: The newly proposed subsection (h)(7.2) would contain exceptions to the standardization requirements for engines using SAE J1979-2. Subsection (h)(7.2.1) would indicate that for these engines, the manufacturer may use SAE-defined fault codes of SAE J1939 in lieu of SAE-defined fault codes of SAE J2012 as required in subsections 1971.1(h)(4.4.1)(A) and (C).

Rationale: The newly proposed subsection 1971.1(h)(7.2) is needed to provide exceptions to the standardization requirements as described in subsections 1971.1(h)(7.2.1) and (h)(7.2.2) (the rationale for subsection 1971.1(h)(7.2.2) is described above). Staff is proposing the amendment in subsection 1971.1(h)(7.2.1) at the request of manufacturers due to serviceability reasons. Manufacturers of heavy-duty engines using SAE J1939 have expressed interest in changing their engines to utilize SAE J1979-2, but have requested that they keep the SAE J1939 format for the fault codes due to the familiarity of those fault codes to the service industry for these engines. CARB staff agreed to allow this as an option.

Sections 1968.2(i) and 1971.1(j): Certification Documentation

Subsections 1968.2(i)(2.2.2)(F), 1968.2(i)(2.2.2)(G), 1971.1(j)(2.2.2)(F), and 1971.1(j)(2.2.2)(G)

Purpose: The proposed amendments would indicate that the standard that defines the engineering units used for all relative throttle position criteria and absolute throttle position criteria in the certification documentation includes SAE J1979-2.

Rationale: The proposed amendments are needed to account for the new proposed requirements applicable to vehicles/engines using SAE J1979-2.

Subsection 1968.2(i)(2.20.4)

Purpose: The proposed amendment to this subsection would indicate that for the emissions neutral diagnostics information in the certification documentation, the name of the control unit meeting automotive safety integrity C or D specifications would need to be the "SAE J1979 or SAE J1979-2 controller name and supplier name, if applicable."

Rationale: The proposed amendment is needed to account for the new proposed requirements applicable to vehicles using SAE J1979-2.

Sections 1968.2(j) and 1971.1(l): Production Vehicle Evaluation Testing

Subsections 1968.2(j)(1.3) and 1971.1(l)(1.3.1)

Purpose: The proposed amendments to these subsections would allow the manufacturers to use an off-board device for testing required under subsections 1968.2(j)(1) and 1971.1(l)(1) that does not use software meeting the requirements of SAE J1699-3. Specifically, subsections 1968.2(j)(1.3.1) and 1971.1(l)(1.3.1)(A) would indicate that if the software developed for SAE J1699-3 testing does not verify all the required functions in subsections 1968.2(j)(1.4) or 1971.1(l)(1.4) for the vehicle/engine being tested, the Executive Officer would approve the manufacturer's off-board device using software that does not meet SAE J1699-3 if the submitted data, specifications, and/or engineering analysis demonstrate the device is able to verify the vehicle will be able to perform all of the required functions in subsections 1968.2(j)(1.4) and 1971.1(l)(1.4).

Rationale: The proposed amendments are needed to account for cases where the SAE J1699-3 software is not updated to accommodate any newly proposed testing requirements under subsections 1968.2(j)(1.4) or 1971.1(l)(1.4). For this rulemaking, the case involves vehicles/engines using SAE J1979-2 but with the SAE J1699-3 standards not updated to accommodate testing of the newly proposed SAE J1979-2 features under subsections 1968.2(j)(1) and 1971.1(l)(1).

Specifically, while subsections 1968.2(d)(9.2) and 1971.1(d)(7.7) allow manufacturers to use SAE J1979-2 on their vehicles/engines as early as the 2023 model year, there is concern that the SAE J1699-3 committee (or any other SAE committee intended to address SAE J1979-2 vehicles/engines) will not be able to update the SAE specifications in time for the required testing of the newly required SAE J1979-2 features on such vehicles/engines. Since testing under subsections 1968.2(j)(1) and 1971.1(l)(1) is important to ensure that vehicles/engines are meeting the standardization requirements in-use, CARB staff did not want manufacturers to bypass this testing on such vehicles/engines. Therefore, staff is proposing that in such cases, the manufacturers would be required to get Executive Officer approval of the off-board device using alternate software. The Executive Officer would approve the device if the manufacturer can demonstrate that it will verify all the required functions in subsections 1968.2(j)(1.4) and 1971.1(l)(1.4) for the specific vehicle (e.g., verify all SAE J1979-2-related functions in subsection 1968.2(j)(1.4) or 1971.1(l)(1.4) meet the newly proposed requirements).

Subsections 1968.2(j)(1.4.2)(A) through (E) and 1971.1(l)(1.4.3) (A) through (E)

Purpose: The proposed amendments would indicate that the standard that the information being verified would have to meet includes SAE J1979-2.

Rationale: The proposed amendments are needed to account for the new proposed requirements applicable to vehicles/engines using SAE J1979-2.

Subsections 1968.2(j)(1.4.2)(B) and 1971.1(l)(1.4.3)(B)

Purpose: The proposed amendments to these subsections would change the subsection reference for the MIL functional check from "(g)(4.1.3)" to "(g)(4.1.1)(H) or (g)(4.1.2)(E)" in subsection 1968.2(j)(1.4.2)(B) and from "(h)(4.1.6)" to "(h)(4.1.1)(G) or (h)(4.1.2)(E)" in subsection 1971.1(l)(1.4.3)(B).

Rationale: The proposed amendments are needed to account for the renumbering of the subsections containing the requirements for the MIL functional check and the inclusion of the same requirements for vehicles/engines using SAE J1979-2, as described in the above discussions for subsections 1968.2(g)(4.1.1) and (g)(4.1.2) and 1971.1(h)(4.1.1) and (h)(4.1.2).

Subsections 1968.2(j)(3.2) and 1971.1(l)(3.4)

Purpose: The proposed amendments would split these subsections, with subsections 1968.2(j)(3.2.1) and 1971.1(l)(3.4.1) containing the current in-use monitor performance data collection requirements and applying to vehicles/engines using SAE J1979, and subsections 1968.2(j)(3.2.2) and 1971.1(l)(3.4.2) containing the new in-use monitor performance data collection

requirements for vehicles/engines using SAE J1979-2. Subsections 1968.2(j)(3.2.2) and 1971.1(l)(3.4.2) would require manufacturers to collect the same data and report the same information as currently required under subsections 1968.2(j)(3.2) and 1971.1(l)(3.4) with the following differences. First, data would need to be reported from vehicles that have general denominators with values equal to or greater than 300. Second, the data would include all the data specified in subsections 1968.2(d)(5.7), (g)(4.1) through (g)(4.9), and (g)(6) and 1971.1(d)(5.7), (h)(4.1) through (h)(4.9), and (h)(5).

Rationale: The proposed amendments are need to account for the new requirements for vehicles/engines using SAE J1979-2 and to address some issues. The proposed amendment requiring manufacturers to collect the required data from vehicles/engine using SAE J1979-2 only if the general denominators are equal to or greater than 300 is needed to ensure sufficient in-use monitoring performance data has been accumulated, with the minimum of 300 matching the requirements CARB enforcement testing is subject to (as set forth in subsections 1968.5(b)(3)(D)(ii)b. and 1971.5(b)(3)(D)(ii)b.). Allowing the data to mature would provide a better and more accurate assessment of the OBD system's monitoring performance over multiple months and after sufficient vehicle operation. Furthermore, as indicated by industry, an average consumer accumulates 40 general denominators per month, equating to roughly 7.5 months to achieve 300 general denominators. Since subsections 1968.2(j)(3.1) and 1971.1(l)(3.1) allots manufacturers up to 12 months after the test group has been introduced into commerce or the start of normal production to obtain data for such vehicles, identifying 15 vehicles (the required minimum) per test group/engine family with 300 general denominators should be easily attainable. Additionally, the proposed minimum of 300 general denominators is needed to accommodate the newly proposed supplemental monitor activity data requirements for vehicles/engines using SAE J1979-2 (subsections 1968.2(d)(5.7) and 1971.1(d)(5.7)). Specifically, the supplemental monitor activity MAR value would be updated only after 250 general denominators have accumulated. Based on an average consumer accumulating 40 general denominators per month, a minimum of 6 months would be needed to generate the first MAR value.

The proposed amendments require manufacturers with vehicles/engines using SAE J1979-2 to submit the data under subsections 1968.2(d)(5.7), (g)(4.1) through (g)(4.9), and (g)(6) and 1971.1(d)(5.7), (h)(4.1) through (h)(4.9), and (h)(5). These data, which include the standardized data, vehicle operation tracking data and the newly proposed supplemental in-use monitor performance data, are needed to assist staff in verifying compliance with CARB regulations. Specifically, the tracking data described in subsections 1968.2(g)(6) and 1971.1(h)(5) would assist CARB staff in other CARB programs to determine if the requirements of those programs are being met. The proposed collection of the other standardized data (e.g., readiness data, test results, data stream

parameters) would assist OBD staff in determining if the vehicles/engines are meeting the requirements of the OBD regulations in-use.

B. NON-UDS PROPOSED AMENDMENTS THAT APPLY TO THE OBD II REGULATION SECTION 1968.2 AND HD OBD REGULATION SECTION 1971.1

Sections 1968.2(c) and 1971.1(c): Definitions

"Cold start emission reduction strategy (CSERS) cold start criteria"

Purpose: The proposed amendments would define "cold start emission reduction strategy (CSERS) cold start criteria" as a set of criteria that meet all the following conditions in a single driving cycle:

(1) at least 6 hours of engine-off time before the initial combustion engine start for non-hybrid vehicles, or the continuous time the vehicle is not in a state of "propulsion system active" during the period immediately preceding the start of "propulsion system active" is at least 6 hours for hybrid vehicles,
(2) the ambient temperature is greater than or equal to 19.4 degrees Fahrenheit (or -7 degrees Celsius), and
(3) the engine coolant temperature is less than or equal to 27 degrees Fahrenheit (or 15 degrees Celsius) higher than the ambient temperature.

Rationale: The proposed definition is needed to accommodate the proposed amendments to the cold start emission reduction strategy monitoring requirements. The proposed definition would clearly indicate the conditions under which CSERS monitoring is required. Notwithstanding, staff expects cold start strategies to be active in broader conditions than the criteria defined for the monitoring to occur. More details about the rationale can be found in subsections 1968.2(e)(11), 1971.1(f)(4), 1968.2(f)(12), and 1971.1(e)(11) below.

Sections 1968.2(d) and 1971.1(d): General Requirements

Subsections 1968.2(d)(3.2.1)(D) and 1971.1(d)(3.2.2)(B)(i)

Purpose: The proposed subsections would require a minimum acceptable IUMPR of 0.100 for the diesel cold start emission reduction strategy catalyst warm-up strategy (CWS) monitor (newly proposed in subsections 1968.2(f)(12.2.2) and 1971.1(e)(11.2.2)).

Rationale: The proposed amendments are needed to accommodate the proposed amendments to the cold start emission reduction strategy monitoring requirements. Specifically, manufacturers have expressed concerns about meeting the newly proposed diesel CWS monitoring requirements in subsections 1968.2(f)(12.2.2) and 1971.1(e)(11.2.2), indicating that there are technical feasibility issues with developing a robust monitor. In previous OBD rulemaking updates, CARB's typical practice was to set a lower minimum

acceptable IUMPR for the newly proposed monitors due to the lack of experience and in-use data for the monitor. CARB staff and manufacturers recognize that it takes significant time to collect the data necessary to develop a robust monitor. Therefore, staff is proposing a minimum acceptable IUMPR of 0.100 for this monitor. This amendment, in conjunction with the new proposed denominator for this monitor in subsections 1968.2(d)(4.3.2)(N) and 1971.1(d)(4.3.2)(M), should alleviate manufacturers' concerns about satisfying the minimum monitoring frequency requirements. After the diesel CWS monitor has been implemented in the field and manufacturers gain more experience with the monitor, CARB staff may revisit this requirement in the future and possibly increase the required IUMPR to a more appropriate ratio based on in-use data. More details about the rationale for this proposed amendment and other cold start emission reduction strategy monitor-related amendments can be found in subsections 1968.2(e)(11), 1971.1(f)(4), 1968.2(f)(12), and 1971.1(e)(11) below.

Subsections 1968.2(d)(4.3.2)(N) and 1971.1(d)(4.3.2)(M)

Purpose: The proposed subsections would require the denominator for the newly proposed diesel cold start emission reduction strategy CWS monitor (subsections 1968.2(f)(12.2.2) and 1971.1(e)(11.2.2)) to increment when the requirements of subsection 1968.2(d)(4.3.2)(B) or 1971.1(d)(4.3.2)(B) and the CSERS cold start criteria have been met.

Rationale: These amendments are needed to accommodate the proposed amendments to the cold start emission reduction strategy monitoring requirements. Specifically, manufacturers have expressed concerns about meeting the newly proposed diesel CWS monitoring requirements in subsections 1968.2(f)(12.2.2) and 1971.1(e)(11.2.2), indicating that there are technical feasibility issues with developing a robust monitor. To address these concerns, as described above in subsections 1968.2(d)(3.2.1)(D) and 1971.1(d)(3.2.2)(B)(i), staff is proposing that this monitor meet a lower minimum required IUMPR of 0.100. In conjunction with this IUMPR, staff is also proposing that the denominator for this monitor increment only when the criteria in subsections 1968.2(d)(4.3.2)(B) or 1971.1(d)(4.3.2)(B)) and the CSERS cold start criteria have been met. More details can be found in subsections 1968.2(f)(12) and 1971.1(e)(11).

Sections 1968.2(e), 1971.1(f), and 1971.1(g): Monitoring Requirements for Gasoline/Spark-Ignited Engines

Subsections 1968.2(e)(11) and 1971.1(f)(4)

Purpose: The proposed amendments would add end dates to the current gasoline CSERS monitoring requirements and add new gasoline CSERS monitoring requirements in these subsections. The current monitoring

requirements in subsections 1968.2(e)(11.2.2) and 1971.1(f)(4.2.2) were modified to sunset with the 2025 model year. New CSERS monitoring requirements are proposed in subsections 1968.2(e)(11.2.3) through (11.2.5) and 1971.1(f)(4.2.3) through (4.2.5), with implementation starting with the 2026 model year. Subsections 1968.2(e)(11.2.5) and 1971.1(f)(4.2.5) would allow manufacturers to use the proposed requirements in lieu of the current requirements in subsections 1968.2(e)(11.2.2) and 1971.1(f)(4.2.2) for the 2023 through 2025 model year.

The proposed amendments in subsections 1968.2(e)(11.2.3) and 1971.1(f)(4.2.3) would require manufacturers to implement a new cold start emission reduction strategy system monitor, the Cold Start Catalyst Heating Monitor. The purpose of this proposed monitor would be to detect significant reduction in the extra exhaust heat energy directed to a cold catalyst subsequent to an engine start. The new monitor would be required to detect a fault if the system is unable to deliver the commanded or targeted extra cold start exhaust heat energy before emissions exceed specific emission thresholds (i.e., the "Monitor Thresholds" in Table 1 in the beginning of section 1968.2(e) for Low Emission Vehicle (LEV) III applications, and 1.5 times the emission standards for heavy-duty engines and 2023 through 2025 model year non-LEV III applications). In addition, the new monitor would be required to detect a fault when the system fails to deliver most of the intended accelerated catalyst heating, specifically when the system is unable to achieve at least 20 percent of the additional element commanded by the cold start strategy. The additional element shall be determined by comparing the commanded value of the element in a properly functioning vehicle during an FTP test cold start with the commanded value in a fully warmed-up vehicle/engine. The proposal would define a "fully warmed-up vehicle/engine" by driving the vehicle/engine until the engine coolant and/or block temperature achieves the targeted regulated temperature for at least 2 minutes prior to shutting the engine off and then restarting the engine within 60 seconds of shut off. Manufacturers would need to meet this new requirement by monitoring one of three parameters: (1) increased airflow into the engine, (2) final commanded torque reserve/spark retard, or (3) catalyst temperature. This monitor would be required to run at idle conditions after engine starts meeting the proposed CSERS cold start criteria as defined in section (c), and would continue no longer than 30 seconds after engine start. Monitoring would not be required if the idle operation during the first 30 seconds after engine start is shorter than 10 seconds. Manufacturers are exempted from these new system monitoring requirements if disabling the CSERS would not cause the vehicle/engine to exceed the full useful life emission standards or the vehicle/engine does not use increased air, increased fuel flow, and/or combustion efficiency degradation to accelerate aftertreatment heating to reduce cold start emissions (e.g., catalyst is only electrically heated).

The proposed amendments in subsections 1968.2(e)(11.2.4) and 1971.1(f)(4.2.4) would require manufacturers to detect a malfunction of any of the following components and features if they do not properly respond to the commanded action while the CSERS cold start criteria are met: fuel pressure, idle speed control, variable valve timing/lift, split/multiple injections, charge motion control, intake runner, swirl control valves, and electronic wastegate position. If the setpoint of a component/feature is different between cold start conditions and non-cold start conditions, these subsections would define "properly respond" to mean the component/feature responds by a robustly detectable amount, in the direction of the desired command, and above and beyond what the component/feature would achieve on start-up without the cold start strategy active. For features/components where feedback from a sensor is not available to monitor for proper response, the monitor would be allowed to verify the final commanded action in lieu of verifying actual delivered action.

Rationale: The proposed amendments are needed to address issues concerning the current CSERS monitoring requirements. In order to meet the increasingly more stringent emission standards, manufacturers design emission control systems and control strategies to minimize emissions during and after a cold engine start. CARB adopted CSERS monitoring requirements to ensure a malfunction would be detected when these strategies failed to execute properly on in-use vehicles. Although the regulations currently require a detailed disclosure of each manufacturer's cold start strategies, it also requires an in-depth understanding by both CARB staff and manufacturers of how malfunctions, drivers' actions, and vehicle operating conditions (e.g., fuel quality) can affect the proper execution of the CSERS. Historically, staff and manufacturers have frequently disagreed about what is a CSERS strategy and what is not a CSERS strategy. Some manufacturers believe CARB's interpretation of the requirements for CSERS monitoring has been inconsistent. Therefore, manufacturers requested that CARB review the CSERS monitoring requirements and propose changes to ensure consistent interpretation and implementation and to provide a clear metric and additional specificity to determine what is subject to CSERS monitoring. In order to address manufacturers' concerns, CARB staff has investigated several key issues of CSERS monitoring requirements. These issues include determining what strategies and/or elements/components need to be monitored under the CSERS monitoring requirements, performance criteria for the CSERS monitoring requirements, and possible alternatives to monitoring requirements that still ensure CSERSs are executing appropriately in-use. CARB worked with manufacturers to discuss these issues, and is proposing the amendments described below as a result of those discussions. The proposed implementation date of 2026 would provide adequate lead time for manufacturers to implement these new requirements.

Manufacturers typically calibrate engines to accelerate catalyst heating at cold start. The newly proposed cold start catalyst heating monitor for gasoline

vehicles/engines would provide clarity for a system level diagnostic and ensure that catalyst heating is monitored, which has always been a focus of the CSERS monitoring requirements. Staff developed these proposed requirements with stakeholders after extensive discussions. In order to remove ambiguity regarding the identification of heating strategies and the corresponding malfunction thresholds, staff and manufacturers agreed to limit the monitoring of catalyst heating to idle conditions following a start meeting the new criteria to enable CSERS monitors. The proposal would require manufacturers to design this monitor using one of three methods: (1) increased airflow into the engine, (2) final commanded torque reserve/spark retard and (3) catalyst temperature. Industry has represented the first two methods as appropriate metrics for detecting malfunction in gasoline cold start emission reduction strategies for catalyst heating, while the third method is a more direct monitoring method comparing measured or modelled catalyst heating to expected catalyst heating. OBD systems would be required to detect a malfunction before exceeding the specified emission threshold, or when the system fails to deliver at least 20 percent of the intended extra element (airflow or torque reserve) or the intended extra heat. Staff expects manufacturers to select option (3) and directly monitor the modelled or measured heating of the catalyst if monitoring airflow or torque reserve is not capable of detecting a malfunction prior to exceeding the specified emission limits or the loss of more than 80 percent of the intended extra heating as applicable.

Some engines may not utilize alteration of engine operation control to significantly accelerate the heating of the catalyst. For example, an engine may be equipped with an electrically heated catalyst and may fully rely on the electric heating instead of altering engine operation. In addition, some vehicles/engines may not utilize changes in operation that are significant enough to detect reliably which would result in non-robust fault detection. For vehicles/engines in these categories, the proposed regulation allows a demonstration to be exempt from the cold start catalyst heating monitor requirements. Vehicles and engines will qualify for the exemption if they do not exceed the applicable emission standard with the CSERS fully disabled (i.e., with the system configured to the fully warmed-up values as if the vehicle was shut off after the engine coolant and/or block temperature achieve the targeted regulated temperature for at least 2 minutes and immediately restarted within 60 seconds). Vehicles and engines that utilize both electrically heated catalysts and accelerated catalyst heating based on engine operating conditions would be expected to monitor the electrically heated catalyst per the existing monitoring requirements for electrically heated catalysts and would not be expected to disable the electrical heating for the exemption demonstration.

Staff and manufacturers have sometimes found difficulty agreeing on which components and features in a vehicle/engine system require CSERS monitoring. To make clear which components/features require monitoring, staff is proposing to list the CSERS-related components (one list for gasoline

vehicles/engines, a separate list for diesel vehicles/engines) that would be subject to CSERS monitoring. Staff developed the lists based on discussions between manufacturers and CARB staff and after careful consideration of component malfunctions that could affect emissions during cold start. Manufacturers would be required to monitor these components/features while the "CSERS cold start criteria" proposed in sections 1968.2(c) and 1971.1(c) are met regardless of any difference in operation, setpoint, or control between starts that meet the "CSERS cold start criteria" and starts that do not (e.g., warm or hot starts). If the set point of the component/feature is different between cold start conditions (refers specifically to CSERS cold start criteria defined in section (c)) and non-cold start conditions (if applicable), these subsections would define "properly respond" as when the component/feature responds by a robustly detectable amount, in the direction of the desired command, and above and beyond what the component/feature would achieve on start-up without the cold start strategy active. The proposal to require each CSERS component/feature to use 2 different fault codes (one to be stored for CSERS-related malfunctions and another to be stored for non-CSERS-related malfunctions) is not a new requirement, but would be newly applied to these specific monitors. This would separate the potentially different causes of malfunction and could be useful for fault identification and repair.

While the proposal for the new CSERS monitoring requirements would start with the 2026 model year, manufacturers have expressed concern about implementing robust monitors that would be able to meet the proposed malfunction criteria. Therefore, staff is proposing to allow manufacturers to implement the new proposed CSERS monitoring requirements in lieu of the current CSERS monitoring for the 2023 through 2025 model year. This proposal, in conjunction with the proposed allowance of "free" deficiencies for these monitors during the 2023 through 2025 model years, would provide manufacturers flexibility with reduced with in implementing these monitors early and would allow manufacturers to gain experience with the monitors for a few years to ensure that the monitors are robust and sufficiently meeting the new proposed monitoring requirements by the 2026 model year when the additional free deficiencies would no longer be available. More details about the rationale for the incentive can be found in subsections 1968.2(k)(7.4) and 1971.1(k)(10).

Subsections 1968.2(e)(15.2.2)(B), 1968.2(e)(15.3.2)(C), 1968.2(e)(15.4.5), 1971.1(g)(3.2.2)(B)(i)c., 1971.1(g)(3.3.2)(C), and 1971.1(g)(3.4.5)

Purpose: The proposed amendments would add new monitoring requirements in subsections 1968.2(e)(15.2.2)(B)(iii) and 1971.1(g)(3.2.2)(B)(i)c. and the corresponding monitoring conditions requirements in subsections 1968.2(e)(15.3.2)(C) and 1971.1(g)(3.3.2)(C) and MIL illumination and fault code storage requirements in subsections 1968.2(e)(15.4.5) and 1971.1(g)(3.4.5). The

proposal would require manufacturers to implement a stall monitor that detects a fault when the engine stalls within 20 seconds of engine start at the beginning of a driving cycle for vehicles when the fuel tank level is higher than 15 percent. For this monitor, manufacturers would be required to implement these new requirements on 20 percent of 2026 model year, 50 percent of 2027 model year, and 100 percent of 2028 and subsequent model year vehicles/engines without manual transmissions (i.e., any transmission that relies on the vehicle operator to independently control clutch engagement/disengagement and gear selection). The monitor would not be required on vehicles/engines with manual transmissions. Manufacturers would be allowed to use an alternate phase-in schedule in lieu of the required phase-in schedule, with the exception that 100 percent of 2028 and subsequent model year vehicles/engines would be required to comply with the requirements.

The proposed amendments to subsections 1968.2(e)(15.3.2)(C) and 1971.1(g)(3.3.2)(C) would move the current monitoring conditions requirements for the current idle system monitors into subsections 1968.2(e)(15.3.2)(C)(i) and 1971.1(g)(3.3.2)(C)(i), and would require the new stall monitor to run after every engine start at the beginning of every driving cycle in subsections 1968.2(e)(15.3.2)(C)(ii) and 1971.1(g)(3.3.2)(C)(ii). For subsection 1968.2(e)(15.4.5), there would be two options to illuminating the MIL and storing fault codes: (1) the OBD II system would illuminate the MIL and store both a pending and confirmed fault code when the engine stalls on 3 consecutive driving cycles, or (2) the OBD II system would store a pending fault code after the engine stalls on two consecutive driving cycles, then store a confirmed fault code if the engine stalls on the third driving cycle. For subsection 1971.1(g)(3.4.5), there would be two options to illuminating the MIL and storing fault codes. For heavy-duty vehicles using the ISO 15765-4 protocol, the options are as follows: (1) the OBD system would illuminate the MIL and store both a pending and confirmed fault code when the monitor runs and detects engine stalls on 3 consecutive driving cycles, or (2) the OBD system would store a pending fault code after monitor runs and detects an engine stalls on the first driving cycle, then store a confirmed fault code after the third driving cycle if the monitor runs and detects engine stalls on the second and third sequential driving cycle after the pending fault code is stored. For heavy-duty vehicles using the SAE J1939 protocol, the options are as follows: (1) the OBD system would illuminate the MIL and store a MIL-on fault code when monitor runs and detects engine stalls on 3 consecutive driving cycles, or (2) the OBD system would store a pending fault code after the monitor runs and detects an engine stall on the first driving cycles, then erase the pending fault code and store a MIL-on fault code after the third driving cycle if monitor runs and detects engine stalls on the second and third driving cycles.

Rationale: Staff have proposed amendments to address issues concerning the current idle speed control system monitoring requirements. Frequent engine stall indicates a system failure and may have an impact on emissions due to

frequent restarts. While a stall is arguably a failure of the idle control system and zero rpm is certainly below the currently required fault threshold of more than 100 rpm below the target idle speed, staff has historically accepted idle speed monitor enable conditions of engine rpm greater than zero (i.e., where the engine has to be running) which prevents detection of a stall as an idle control fault. The proposed changes remove any ambiguity in the monitoring requirements relative to engine stalls. The proposal requires manufacturers to detect a fault for any stall that occurs within 20 seconds after the first engine start at the beginning of every driving cycle.

The new monitor would aid I/M inspections in identifying vehicles with increased emissions. In addition, staff expects manufacturers may alter the design of other existing monitors to provide better pinpointing to repair technicians for stalling vehicles. For example, some vehicles in the existing fleet with a stalling malfunction have been repaired by cleaning the throttle plate and throttle body to remove deposits that limit airflow into the engine. Frequently, the OBD system on current vehicles are blind to engine stall malfunctions in the field with no malfunction detected and no fault codes stored, despite the obvious stalling. With the adoption of this proposed requirement, manufacturers may elect to improve pinpointing of the fault in these cases by storing a more relevant fault code (e.g., a fault code for a throttle or airflow malfunction) prior to engine stall.

The proposed monitor would be required to be phased in during the 2026 through 2028 model years. This should provide adequate lead time for manufacturers to implement this new requirement with scheduled vehicle/engine design changes. In order to distinguish engine stalls caused by the lack of fuel or fuel issues, staff is proposing the monitor be enabled when the fuel tank level is greater than 15 percent. This fuel tank level proposal would provide enough margin for both vehicle operation and monitoring performance frequency. Similarly, in order to avoid storing the fault code due to occasional engine stall (not due to a system failure), staff is proposing 3 consecutive driving cycles of engine stalling for pending and confirmed/MIL-on fault code storage, which is different from the typical OBD 1 or 2 trips fault code storage convention required by the regulations. In order to separate stalls that occur during cold start conditions (specifically when the CSERS cold start criteria defined in sections 1968.2(c) and 1971.1(c) are met) from stalls that occur during non-cold start conditions, staff is proposing that the OBD system store separate fault codes for stalls detected during cold start conditions and stalls detected during non-cold start conditions. This approach would help technicians troubleshoot malfunctions during vehicle repairs and ensure vehicles that only stall in cold start conditions are capable of detecting the malfunction.

Vehicles with manual transmission are exempt from this engine stall monitoring due to the potential for significant driver influence on stalling. If the driver engages the clutch improperly, this will cause the engine to stall and this kind of

engine stall is not a system failure. The proposed language that indicates that manual transmission refers to any transmission that relies on the vehicle operator to independently control clutch engagement/disengagement and gear selection is needed to ensure that vehicles with automated-manual transmission meet these stall monitoring requirements.

Sections 1968.2(f) and 1971.1(e): Monitoring Requirements for Diesel/Compression-Ignition Engines

Subsections 1968.2(f)(1.2.4), 1968.2(f)(2.2.4), 1968.2(f)(8.2.4), 1968.2(f)(8.2.5), 1971.1(e)(5.2.4), 1971.1(e)(6.2.3), and 1971.1(e)(7.2.6)

Purpose: The proposed amendments to these subsections would modify the system aging and monitoring requirements for the diesel NMHC converting catalyst, the NOx converting catalyst, and the NOx adsorber. Specifically, the amendments would delete the current language in subsections 1968.2(f)(1.2.4)(A), 1968.2(f)(2.2.4)(A), 1971.1(e)(5.2.4)(A), 1971.1(e)(6.2.3)(A), and 1971.1(e)(7.2.6)(A), which contain the requirements for individually monitored catalysts/adsorbers. As a result, subsections 1968.2(e)(5.2.4)(B), 1968.2(f)(2.2.4)(B), 1971.1(e)(5.2.4)(B), 1971.1(e)(6.2.3)(B), and 1971.1(e)(7.2.6)(B) were renumbered to 1968.2(f)(1.2.4)(A), 1968.2(f)(2.2.4)(A), 1971.1(e)(5.2.4)(A), 1971.1(e)(6.2.3)(A), and 1971.1(e)(7.2.6)(A), respectively. The amendments would delete the phrase "for catalysts monitored in combination with others" from subsections 1968.2(f)(1.2.4)(A), 1968.2(f)(2.2.4)(A), 1971.1(e)(5.2.4)(A), and 1971.1(e)(6.2.3)(A), and would delete the phrase "For NOx adsorber systems that consist of more than one NOx adsorber (e.g., two or more adsorbers in series" from subsection 1971.1(e)(7.2.6)(A).

The proposed amendments would include new requirements for 2025 and subsequent model year vehicles/engines in subsections 1968.2(f)(1.2.4)(B), 1968.2(f)(2.2.4)(B), 1968.2(f)(8.2.5), 1971.1(e)(5.2.4)(B), 1971.1(e)(6.2.3)(B), and 1971.1(e)(7.2.6)(B). The new requirements would apply to vehicles/engines from test groups/engine families selected for durability demonstration vehicle/engine testing. For these vehicles/engines, the information and data to support methods by the manufacturer to represent real world catalyst/adsorber deterioration under normal and malfunctioning operating conditions would need to include, at a minimum, an analysis of the potential failure modes and effects, highlighting the most likely cause of failure, and comparison of laboratory aged versus real world aged catalysts/adsorbers. Manufacturers would also be required to submit the following information and data to the Executive Officer from a laboratory-aged catalyst/adsorber and a minimum of three field-returned catalysts/adsorbers:

- For all catalysts/adsorbers:
    - For light- and medium-duty vehicles:

        - Emissions data and all data required by sections 1968.2(g)(4.1) through (g)(4.9), (g)(5), and (g)(6) from the Federal Test Procedure (FTP), Highway Fuel Economy Test (HWFET), and US06 cycles,
        - Modal data during the FTP, HWFET, and US06 cycles,
        - All data required by sections 1968.2(g)(4.1) through (g)(4.9), (g)(5), and (g)(6) collected from a wide range of monitoring conditions,
    - For heavy-duty engines:
        - Emissions data and all data required by sections 1971.1(h)(4.1) through (h)(4.9), and (h)(5) from the FTP and Supplemental Emission Test (SET) cycles,
        - Modal data during the FTP and SET cycles,
        - All data required by sections 1971.1(h)(4.1) through (h)(4.9), and (h)(5) from a wide range of monitoring conditions,
- Additionally, for NMHC converting catalysts:
    - Catalyst conversion efficiency as a function of catalyst temperature and exhaust gas flow rate,
    - Catalyst feedgas generation as a function of catalyst temperature,
- Additionally, for NOx converting catalysts:
    - Catalyst NOx conversion efficiency as a function of catalyst temperature and exhaust gas flow rate,
    - Catalyst NOx conversion efficiency as a function of catalyst temperature and nitrogen dioxide (NO_2) to nitric oxide (NO) ratio,
    - Catalyst NOx conversion efficiency as a function of ammonia storage (relative to the maximum ammonia storage capacity of a new catalyst),
- Additionally, for NOx adsorbers: NOx adsorber desorption performance as a function of NOx adsorber temperature and NOx adsorber system active/intrusive injection quantity and flow rate.

The proposal would require the manufacturer to include in the catalyst/adsorber aging and monitoring plan the timeline for submitting the newly proposed data and information, where the timeline may include several dates for data submission for new emission control system designs where the manufacturer has not achieved sufficient in-use aging to demonstrate real world deterioration prior to certification of the OBD system.

The proposal would establish the following "pass" criteria that the Executive Officer would use to approve the catalyst/adsorber aging method:

1) Pass criterion 1: High mileage or field-returned parts with FTP emission results that are less than the OBD emission threshold (i.e., parts degraded by less than 2 sigma below the catalyst/adsorber monitor malfunction threshold) are passing the catalyst conversion efficiency or adsorber capability monitor without MIL illumination. If the vehicle/engine is certified with a catalyst/adsorber monitor deficiency for not detecting a malfunction before emissions exceed the malfunction criteria, the emission levels at which the malfunction was detected when the OBD system was approved by

the Executive Officer would be used in place of the OBD thresholds specified in the regulation.

2) Pass criterion 2: Field-returned parts that have a conversion efficiency/adsorber capability averaged over the FTP test that is representative of the manufacturer's durability demonstration part (i.e., parts degraded within 2 sigma of the catalyst/adsorber monitor malfunction threshold) meet the following: 1) the catalyst conversion efficiency or adsorber capability monitor illuminates the MIL with emissions below the emission threshold during the applicable cycle (i.e., the cycle the monitor is designed to run on), and 2) the data and analysis show robust detection of catalyst conversion efficiency or adsorber capability malfunctions during conditions meeting the applicable cycle and all other monitoring conditions. This testing can be done on road or on a dynamometer. If the vehicle/engine is certified with a catalyst/adsorber monitor deficiency for not detecting a malfunction before emissions exceed the malfunction criteria, the emission levels at which the malfunction was detected when the OBD system was approved by the Executive Officer would be used in place of the OBD thresholds specified in the regulation.
3) Pass criterion 3: Field-returned parts that have a conversion efficiency/adsorber capability averaged over the FTP test that is worse than best performing unacceptable conversion efficiency (i.e., degraded by more than 2 sigma from the manufacturer's durability demonstration part for durability demonstration testing or are catastrophically failed meet the following: 1) the catalyst conversion efficiency or adsorber capability monitor illuminates the MIL during the applicable cycle, and 2) the data and analysis show robust detection of catalyst conversion efficiency or adsorber capability malfunctions during conditions meeting the applicable cycle and all other monitoring conditions (this testing can be done on road or on a dynamometer). If the vehicle/engine is certified with a catalyst/adsorber monitor deficiency for not detecting a malfunction before emissions exceed the malfunction criteria, the test cycle conversion efficiency of the manufacturer's deficient durability demonstration part for durability demonstration testing would be used for this assessment.

If the manufacturer is not able to locate at least one catalyst/adsorber to be evaluated under pass criteria 1 through 3 below, the manufacturer may propose to include an additional catalyst/adsorber described in another pass criterion as representative of the missing catalyst/adsorber. For example, if a catalyst/adsorber described in pass criterion 2 cannot be located, the manufacturer may use an additional catalyst/adsorber described in either pass criterion 1 or 3 instead.

The Executive Officer may waive the requirements for the submittal of the aging and monitoring plan and data for a test group/engine if the plan and data have been submitted for a previous model year and the calibrations and hardware of the catalyst/adsorber monitor, the engine, and the emission control

system for the current model year have not changed from the previous model year.

Rationale: The proposed amendments are needed to address issues with the current system aging and monitoring requirements for the NMHC catalyst, NOx catalyst, and NOx adsorber monitors. These subsections require manufacturers to design catalyst/adsorber aging protocols that are representative of real world deterioration. Manufacturers use laboratory aging methods for selective catalytic reduction (SCR) catalysts, NMHC catalysts, and NOx adsorbers and then use those aged parts for demonstration of compliance with the OBD emission thresholds (i.e., use those aged parts to show that the catalyst/adsorber monitor is able to detect a malfunction before emissions exceed the OBD emission thresholds). Even though the subsections applicable to individually monitored catalysts/adsorbers did not explicitly state that manufacturers were required to submit a plan or supporting data, staff requested submission of this information in support of the manufacturers aging protocols. Accordingly, manufacturers had to supply these data for staff review whether they had individually monitored catalysts/adsorbers or combined catalysts/adsorbers. Staff previously used the provisions in subsections 1968.2(i)(2.34) and 1971.1(j)(2.35) in the certification documentation sections in which the regulations allow staff to ask for any supporting data to verify compliance with the OBD requirements. The proposed amendments that combine the requirements for individually monitored catalysts/adsorbers and catalysts/adsorbers monitored in combination with others under one subsection would now make it clear that manufacturers must submit these data for all catalyst/adsorber configurations and all aging protocols for OBD demonstration vehicles/engines.

During review of OBD system applications, staff usually ask manufacturers to provide supporting data to show compliance with this requirement (i.e., that catalyst aging protocols are representative of real world deterioration). For catalysts/adsorbers monitored in combination with others, the OBD regulations currently require manufacturers to provide data to support their catalyst/adsorber aging methods and to show that the aged parts are representative of parts that experience real world aging and deterioration. However, the regulations do not have clear direction on exactly what data were required to be submitted for staff review or the acceptance criteria for such data. Further, the regulation was not clear regarding the number of catalysts to be evaluated or the submission timing for the data.

Accordingly, to clarify the data submission requirements, staff has proposed specific language to provide details on the data submission requirements, with the new data required starting with the 2025 model year. The proposed data that manufacturers would be required to submit are necessary for CARB staff to adequately ensure the malfunction criteria for these catalysts/adsorbers have been appropriately determined and that real world failures of these

catalysts/adsorbers will be detected in-use. The analysis of potential catalyst failure modes would be reviewed by staff to ensure the manufacturer's diagnostic strategy is comprehensive and sufficiently capable of detecting real world failures. The emissions data provided by the manufacturer are necessary to support the manufacturer's compliance with the OBD emission thresholds. The following paragraph details the purpose and uses for each of the data submission types.

The OBD regulations require manufacturers to detect failures of certain emission controls (e.g., catalyst) before specific emission levels are exceeded, specifically levels based on the FTP standards (or the SET standards for heavy-duty engines). If the OBD system is unable to detect the fault and illuminate the MIL before the required emission levels are exceeded on the FTP or SET cycles, this may indicate an issue with the OBD monitor calibration, which would require the manufacturer to update and improve the monitoring strategy. The additional emissions data for the remaining certification cycles (e.g., HWFET and US06 for light- and medium-duty vehicles) would be used for comparative purposes to allow staff to better understand how the real world catalysts/adsorbers are aging compared to the laboratory-aged catalysts for other operating conditions. The modal emissions data over the certification cycles would allow staff to more closely evaluate the precise conditions where the real world catalysts/adsorbers may deviate from the laboratory-aged catalysts/adsorbers. These data may reveal specific temperature and/or load conditions where the real world aged catalyst/adsorber may not perform as well as the laboratory-aged catalyst/adsorber. Catalyst conversion efficiency or adsorber capability data would similarly allow staff to critically analyze the performance of each catalyst/adsorber under controlled test conditions. Such tests would reveal any deviations in catalyst/adsorber performance as efficiency/capability is observed with incremental changes in temperature and exhaust flow rate. The standardized data would provide the monitoring results, monitor performance, tracking and other OBD data to allow staff to assess that the diagnostic strategy is robust and not vulnerable to false-passing a bad catalyst/adsorber or false-failing a good catalyst/adsorber. The remaining proposed data are specific to each catalyst/adsorber (e.g., feedgas data for NMHC converting catalysts, NOx conversion efficiency as a function of catalyst temperature and nitrogen dioxide/nitric oxide ratio for NOx converting catalysts, NOx adsorber desorption performance as a function of NOx adsorber temperature for NOx adsorbers) and are needed to provide more information so that CARB staff can determine if manufacturers are designing OBD monitors correctly. For example, the catalyst feedgas data are specific to diesel oxidation catalysts (i.e., NMHC converting catalysts). The feature is used by manufacturers to provide better conversion capability for the downstream SCR. Staff has observed that the feedgas capability of the diesel oxidation catalyst may deteriorate faster than the catalysts ability to generate an exotherm. Therefore, staff has requested that these data be submitted for comparative purposes with

the laboratory-aged catalyst. By analyzing these data, staff would then be able to observe how the feedgas generation capability for real world catalysts is operating as a function of temperature and comparisons with the laboratory-aged catalysts can be made to improve the manufacturer aging protocols. All these comparisons are important to ensure that real world emissions and monitoring performance are consistent with what is submitted at the time of certification. Where there are discrepancies, staff would then work with the manufacturer toward improving the laboratory aging procedure to make it more representative of real world aging.

Staff has also proposed the manufacturer submit a timeline for the data submittal since all of the data may not be available at the time of OBD certification. Staff has also limited this submission to vehicles/engines from test groups/engine families selected for durability demonstration vehicle or engine (DDV/DDE) testing, and allowed manufacturers to waive the data submission requirements if data were previously submitted for the vehicle/engine and no changes have been made to the vehicle/engine that would impact the validity of the data. These provisions will limit the amount of data the manufacturer would be required to submit each year.

To address the pass/fail ambiguity, staff has proposed three pass criteria for emissions analysis and comparison to the laboratory aged part with the primary objective being verification of proper MIL illumination for in-use aged catalysts/adsorbers with high emissions. Each passing criterion is defined by a level of catalyst deterioration and requires the manufacturer to show proper OBD system performance relative to the level of deterioration and emissions performance of the catalyst when comparing field-returned catalysts to the catalyst used for OBD system demonstration at the time of certification. Pass criterion 1 would show the OBD system is robustly making passing decisions for field-returned catalysts/adsorbers that are not exceeding the OBD emission threshold and have better conversion efficiency than the catalyst/adsorber used for OBD system durability demonstration testing at the time of certification. Pass criterion 2 would show the OBD system is robustly making failing decisions for field-returned catalysts/adsorbers that have representative conversion efficiency compared the catalyst/adsorber used for OBD system durability demonstration at the time of certification but are not yet exceeding the OBD emission threshold. Pass criterion 3 would show the OBD system is robustly making failing decisions for field-returned catalysts/adsorbers that have worse conversion efficiency than the catalyst/adsorber used for OBD system durability demonstration at the time of certification and are exceeding the OBD emission threshold. The manufacturer would be required to submit data for all field-returned catalysts/adsorbers that are collected for this aging correlation analysis to ensure the OBD system and emissions performance is consistent across all catalysts/adsorbers and the manufacturer is not selectively submitting data only from the catalysts/adsorbers that will satisfy the pass criteria.

Subsections 1968.2(f)(5.2.2)(D) and 1971.1(e)(9.2.2)(D)

Purpose: The proposed amendments to these subsections describe changes to the NOx sensor and PM sensor monitoring capability monitor malfunction criteria, and provide more details regarding the supporting data required to be submitted by the manufacturer. First, the proposed amendments would require that the dependent monitor (e.g., catalyst, EGR, SCR, or NOx adsorber monitoring) makes a robust diagnostic decision (e.g., avoid false passes of a best performing unacceptable catalyst and false fails of a nominal catalyst) with a deteriorated but passing exhaust gas sensor. Second, for the NOx sensor on 2025 and subsequent model year diesel vehicles/engines, manufacturers would be required to test each applicable failure mode of the sensor (e.g., sensor offset high failure mode) with the component/system for the dependent monitor set at the best performing unacceptable level (e.g., best performing unacceptable catalyst). For each sensor failure mode, the manufacturer would be required to collect a minimum of 7 total data points with a 2 sigma (calculated from the NOx sensor monitor result distribution for the malfunction threshold sensor for the sensor failure mode under consideration) separation between each point (i.e., 3 data points with the sensor performance set below the sensor malfunction threshold, 1 data point with the sensor performance set at the sensor malfunction threshold, and 3 data points with the sensor performance set above the malfunction threshold). The manufacturer would also be required to submit data and/or engineering analysis (which may include data previously collected during development of the monitor) showing the NOx sensor monitor is robust against false pass and false fail decisions for a wide range of monitor enable conditions. The manufacturer would perform the minimum 7 tests for a specific failure mode without a scan tool code clear command between any of the 7 tests, and would send a scan tool code clear command between testing of each failure mode. The NOx sensor monitor would be considered compliant by CARB if all of the following are met:

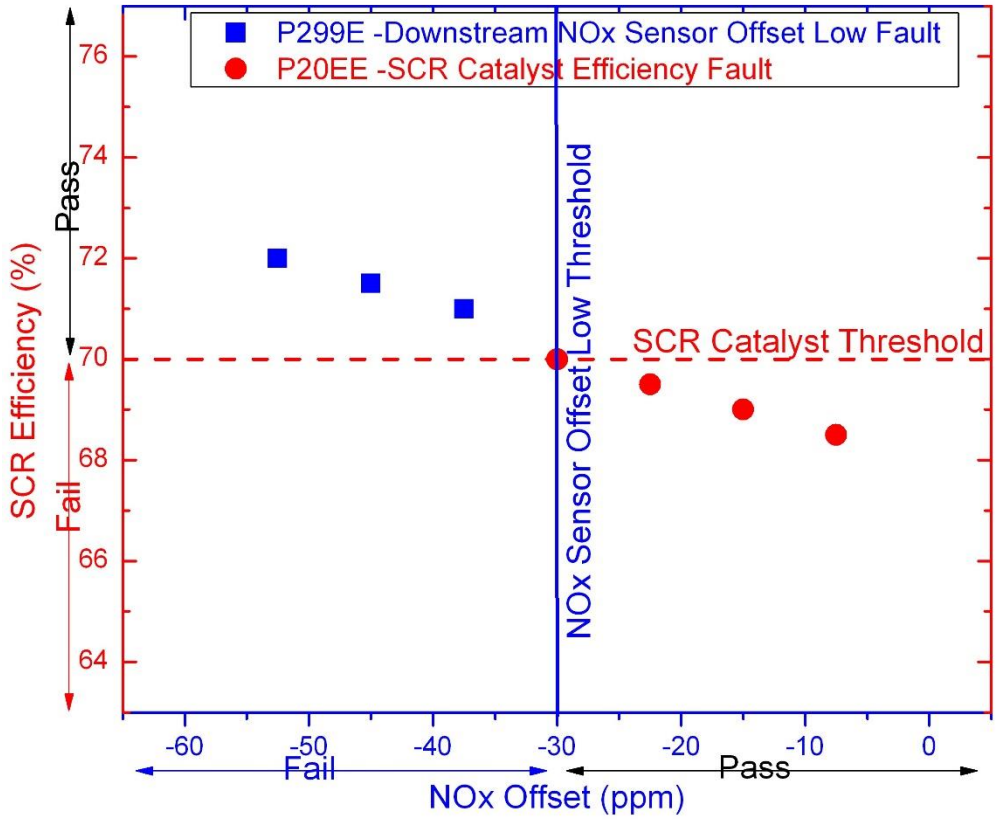
1. The NOx sensor monitor makes a fail decision during testing for each data point (except the data point at the sensor monitor malfunction threshold) that is in the failing region of the sensor monitor,
2. The NOx sensor monitor makes a pass decision during testing for each data point (except the data point at the sensor monitor malfunction threshold) that is in the passing region of the sensor monitor,
3. The dependent monitor (e.g., catalyst monitor) makes a fail decision during testing for each data point in the passing region of the sensor monitor,
4. The MIL illuminates and is commanded on for a malfunction of the NOx sensor at least once during testing of each applicable NOx sensor failure mode, and
5. The MIL illuminates and is commanded on for a malfunction of the dependent component (e.g., catalyst) at least once during testing of each applicable NOx sensor failure mode.

If the data do not satisfy any of the 5 criteria listed above due to a result being in the 2 percent tail of the normal distribution, the manufacturer may submit additional data points at the same sensor performance level to support the demonstration of compliance. For example, for a data point at a 2 sigma distance from the malfunction threshold, there is a 2 percent probability the data point will result in a false-pass or a false-fail. When this occurs, by allowing manufacturers to submit additional data points, the probability that these additional data points also yield fault-pass or false-fail results is extremely unlikely for a properly calibrated OBD system. Therefore, the additional data would show compliance with the criteria listed above. Further, the manufacturer would not be required to submit the data described above for the current model year if data have already been submitted for a previous model year and the calibrations of the NOx sensor monitor and the dependent monitor for the current model year have not been changed from the previous model years. Lastly, the manufacturers would be allowed to meet the proposed new requirements for the NOx sensor on 2023 and 2024 model year vehicles/engines.

Rationale: The amendments to these subsections are needed to address manufacturers' concerns regarding the data required and the criteria used to determine compliance with the diesel exhaust gas sensor monitoring capability requirement; specifically for NOx sensors. Manufacturers have indicated that the language was unclear and lacking a definition for the phrase "no longer sufficient."

Accordingly, staff have proposed additional language indicating the data required to be submitted by the manufacturer and the criteria by which the monitor would be approved by CARB staff. Instead of adding ambiguous definitions to the requirement, staff is requesting that manufacturers submit at least 3 data points on both sides of the NOx sensor malfunction threshold and 1 data point at the threshold used for the given monitor. In order for CARB staff to more accurately determine if the NOx sensor monitor meets the proposed criteria for compliance, the data for each sensor failure mode would also need to show the order in which the 7 (or more) tests were performed, the fault code(s) stored for each of the tests, and the MIL status as well as the fault code commanding the MIL on for each test. Figure 2 below shows an example of how manufacturers can provide part of the required data. For this example, the manufacturer would need to supplement the data with information about the order of the testing and the MIL status and associated fault code for each. In staff's experience, this is the minimum data set needed to properly determine if a given calibration is vulnerable to false-passes and/or false-failures.

Figure 2. NOx Sensor Monitor Data Example



Manufacturers have indicated concerns with submitting sensor data at 2 sigma from the sensor malfunction threshold as it may lead to false passing results from the sensor diagnostic. Manufacturers and CARB staff agree that the probability of a false passing result at a distance of 2 sigma from the sensor malfunction threshold is 2 percent (or 2 out of 100). Staff believes this probability is too low to be of concern. Moreover, staff believes that data at 2 sigma separation (instead of 3 or 4 sigma as proposed by industry) are needed to more clearly see if a monitoring gap exists near or at the sensor monitor malfunction threshold. To address manufacturers' concerns, the CARB proposal would allow the manufacturer to submit additional data points to support compliance with the requirement and show that the initial test result landed in the 2 percent tail of the normal distribution and, therefore, produced the false passing result. The proposal addresses the manufacturer concern as it would allow the manufacturer to more clearly describe the distribution of test results and provide additional data to demonstrate correct monitoring behavior for the majority of the entire set of sensor data points (i.e., show the additional data points all reach the correct monitor decision and therefore make the case that the false passing result was an extremely rare occurrence).

Subsections 1968.2(f)(12) and 1971.1(e)(11)

Purpose: The proposed amendments would add end dates to the current diesel CSERS monitoring requirements and add new diesel CSERS monitoring requirements in these subsections. Subsections 1968.2(f)(12.2) and 1971.1(e)(11.2) were restructured so that the current requirements are now under subsections 1968.2(f)(12.2.1) and 1971.1(e)(11.2.1), respectively, with all subsections underneath renumbered accordingly. The current monitoring requirements in newly renumbered subsections 1968.2(f)(12.2.1) and 1971.1(e)(11.2.1) were modified to end the requirements in the 2025 model year. New CSERS monitoring requirements are proposed in subsections 1968.2(f)(12.2.2) through (12.2.5) and 1971.1(e)(11.2.2) through (11.2.5).

The proposed amendments in subsections 1968.2(f)(12.2.2) and 1971.1(e)(11.2.2) would require manufacturers to implement a CWS system monitor. This monitor would detect a fault when the CWS is no longer functioning as intended. The CWS monitor measures the inlet temperature and/or energy to the first NOx reducing element (e.g., SCR) and compares it to the modeled inlet temperature and/or energy to the first NOx reducing element (e.g., SCR). The CWS monitor would not be required if no malfunction of the CWS can cause emissions to exceed the following: the "Monitor Thresholds" in Table 2 in the beginning of section (f) for passenger cars, light-duty trucks, and medium-duty passenger vehicles (MDPV) certified to a chassis dynamometer standard; 1.5 times the applicable NMHC and carbon monoxide (CO) standards, 0.3 grams per brakehorsepower-hour (g/bhp-hr) NOx, or 0.015 g/bhp-hr PM for medium-duty vehicles certified to an engine dynamometer standard; and 1.5 times the applicable NMHC and CO standards, 0.3 g/bhp-hr NOx, or 0.030 g/bhp-hr PM for heavy-duty engines. This monitor would be required to run while the CSERS cold start criteria (proposed in section (c)) are met. Manufacturers would be required to implement this CWS monitor on 20 percent of 2026 model year, 50 percent of 2027 model year, and 100 percent of 2028 and subsequent model year vehicles/engines.

The proposed amendments in subsections 1968.2(f)(12.2.3) and 1971.1(e)(11.2.3) would require manufacturers to detect a malfunction of any of the following components and features if they do not properly respond to the commanded action while the CSERS cold start criteria are met: EGR valve position, EGR cooler bypass control, variable geometry turbocharger position, swirl valve position, fuel rail pressure, commanded injection quantity/timing, exhaust throttle, intake throttle, and VVT components position. If the setpoint of the component/feature is different between cold start conditions (refers specifically to CSERS cold start criteria defined in section (c)) and non-cold start conditions, these subsections would define "properly respond" as when the component/feature responds by a robustly detectable amount, in the direction of the desired command, and above and beyond what the component/feature would achieve on start-up without the cold start strategy active. For

features/components where feedback from a sensor is not available to monitor for proper response, the monitor would be allowed to verify the final commanded action in lieu of verifying actual delivered action. Manufacturers would be required to implement these new monitors in subsections 1968.2(f)(12.2.3) and 1971.1(e)(11.2.3) on all 2026 and subsequent model year vehicles/engines.

Proposed subsections 1968.2(f)(12.2.4) and 1971.1(e)(11.2.4) would allow manufacturers to use an alternate phase-in schedule for implementing the diesel CWS monitor with the exception that 100 percent of 2028 and subsequent model year vehicles/engines would be required to implement the CWS monitor. In addition, proposed subsections 1968.2(f)(12.2.5) and 1971.1(e)(11.2.5) would allow the early implementation of the diesel CWS and component/feature monitors for the 2023 through 2025 model years.

Rationale: The proposed amendments are needed to address manufacturers' concerns regarding the current CSERS monitoring requirements. Specifically, manufacturers requested more clarity regarding what components need to be monitored to satisfy the CSERS monitoring requirements. The proposed diesel CWS monitor in subsections 1968.2(f)(12.2.2) and 1971.1(e)(11.2.2) would require system level diagnostics and ensure that catalyst heating is monitored, which has always been a primary objective of the CSERS monitoring requirements. The proposed individual component/feature monitors in subsections 1968.2(f)(12.2.3) and 1971.1(e)(11.2.3) would make clear which components/features are required to be monitored. These proposed requirements were developed after extensive discussions between manufacturers and CARB staff. More details of the rationale for these changes are provided in subsections 1968.2(e)(11) and 1971.1(f)(4) above.

Concerning the proposed phase-in schedule for the diesel CWS monitor, while alternate phase-in schedules would be allowed in lieu of the required phase-in schedule, the manufacturer would be required to implement the monitor on 100 percent of 2028 and subsequent model year vehicles/engines. CARB staff is also proposing to allow free deficiencies for this monitor for the first few years of implementation. Additionally, while the proposal for the new CSERS monitoring requirements would start with the 2026 model year, manufacturers have expressed concern about implementing robust monitors that would be able to meet the proposed malfunction criteria. CARB staff believes it is important to have manufacturers implement these robust monitors in-use. Therefore, staff is proposing to allow manufacturers to implement the new proposed CSERS monitoring requirements in lieu of the current CSERS monitoring for the 2023 through 2025 model year. This proposal, in conjunction with the proposed allowance of "free" deficiencies for these monitors during the first few years of implementation, would provide manufacturers flexibility with reduced risk in implementing these monitors early and allow them to gain experience with the monitors for a few years to ensure that the monitors are

robust and sufficiently meeting the new requirements by the 2026 model year when the additional free deficiencies would no longer be available. Further rationale for the proposed free deficienies is provided in subsections 1968.2(k)(7.4) and 1971.1(k)(10) below.

Sections 1968.2(g) and 1971.1(h): Standardization Requirements

Subsections 1968.2(g)(6.12.4) and 1971.1(h)(5.3.4)

Purpose: The proposed amendment to these subsections would specify how to handle the negative concentrations that are sometimes reported by a NOx sensor when calculating NOx mass as required under the regulation's standardization requirements. Specifically, the amendment would indicate that for the NOx mass parameter requirements, any negative concentrations reported by a NOx sensor must be set to zero when used in a NOx mass calculation, and any tracking and reporting of negative NOx mass data must be done separately from the parameters covered by the regulation.

Rationale: The proposed amendment is needed to address questions raised by industry regarding how the OBD system should calculate NOx mass as required by the regulation. Specifically, it settles the question over how the OBD system should interpret any negative NOx concentrations that are reported by a NOx sensor. The proposed amendment would require manufacturers to set all negative NOx concentrations to zero in their mass calculations and specify that any tracking and reporting of negative NOx mass data must be done separately from the parameters covered by the regulation.

In discussions on this topic, several manufacturers have advocated that negative NOx concentration values should be included in NOx mass calculations because they are part of the dynamic response of the sensors which also includes corresponding positive deviations from the actual concentration. They indicate that these positive and negative deviations should balance out on the whole thereby yielding the most accurate NOx mass estimate. They also indicate that not including the negative values would positively bias the resulting NOx mass calculations. Industry points out that this is particularly significant for future model year diesel engines that will meet the 0.02 g/bhp-hr NOx emission standard.

Staff agrees that setting all negative readings to zero could introduce a small positive bias in the NOx mass calculations, but prefers this method because of the lack of a strategy for managing negative NOx sensor readings that are not associated with symmetric positive deviations. Staff has observed that there are still poorly understood NOx sensor behaviors such as sustained periods of negative values which are neither associated with balanced positive deviations nor are they consistent offsets of the signal. An example of this phenomenon is observed with the Stage 3 test engine which is part of the Low-NOx

Demonstration Program being conducted at the Southwest Research Institute (SwRI) in San Antonio, Texas. Figure 3 below compares the real-time NOx mass emission rate of this engine derived from the NOx sensor with that measured by the laboratory over a 20-minute test run (hot-start FTP cycle). The arrow in the figure points to one of the more prominent regions of the test in which sustained negative values persist even during a period where the laboratory measured relatively substantial NOx mass emissions. The overall NOx emission rate for the cycle determined by the laboratory was 0.0152 g/bhp-hr. If all negative concentration values are set to zero, the NOx sensor-derived NOx emission rate is 0.0109 g/bhp-hr. Preserving all negatives yields a less accurate value of 0.0003 g/bhp-hr.

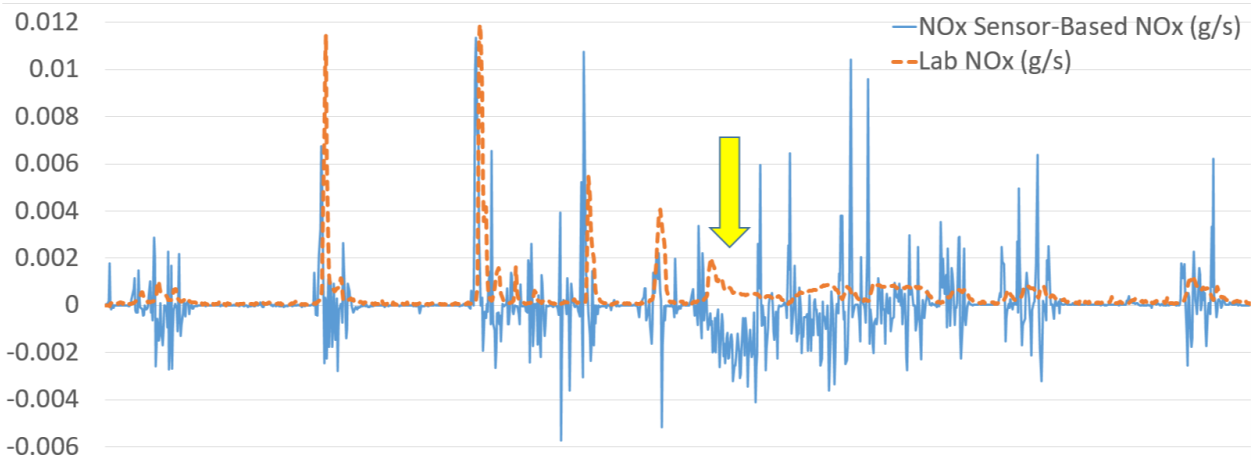


Figure 3. Emissions Comparison Over Hot FTP Cycle

In addition to the SwRI low-NOx engine, staff has observed unbalanced negative behavior in another exceptionally clean engine that was part of the CARB's Truck and Bus Surveillance Program (TBSP). While the SwRI engine's NOx sensor had no apparent offset in the NOx signal, the TBSP engine's sensor did have a small negative offset (about -2 to -3 parts-per-million). As a result, when tested over the heavy-duty Urban Dynamometer Driving Schedule, the overall NOx emission rate was found to be negative when negative concentrations were taken as-is (-0.018 g/bhp-hr versus the lab-measured value of 0.014 g/bhp-hr). Recording negative NOx masses in the NOx tracking parameters required by the regulation could be misleading to some individuals by suggesting either that the engine is cleaning the air or that there must be some data stream or scan tool malfunction present. Setting all negative concentrations to zero prevents these issues but can introduce a positive bias as observed with the TBSP engine (0.012 g/bhp-hr above the laboratory-measured value).

Until staff has a better understanding of how to manage the NOx sensor behavior described here, staff prefers to err on the side of creating a small positive bias instead of underestimating NOx or causing issues with interpretation of negative masses in the field. Such a bias would not in and of itself be large enough to make a clean engine appear to be a high emitter and is therefore of little concern. Also, putting negative values in a separate bin that is outside the scope of this regulation is always an option available to manufacturers that are interested in tracking the full possible range of emission levels measured by the NOx sensor.

Subsections 1968.2(g)(6.6.3), 1968.2(g)(6.14), and 1971.1(h)(5.9)

Purpose: The proposed new subsections would require CSERS-related parameters to be tracked and reported on 20 percent of 2026 model year, 50 percent of 2027 model year, and 100 percent of 2028 and subsequent model year diesel vehicles/engines.

The proposal would include the following definitions:

1) "Catalyst light-off temperature" would be defined as the SCR catalyst inlet temperature at which the SCR catalyst NOx conversion efficiency reaches 50 percent.
2) "FTP catalyst light-off time" would be defined as the time from engine start until the SCR catalyst inlet temperature reaches the light-off temperature on an FTP cycle (for section 1968.2) or FTP test (for section 1971.1).
3) "Engine output energy", in units of Joules (J) or W*s, would be defined by integrating brake engine power output over time, with:
   "Brake engine power output" = 2π x (brake engine torque) x (engine RPM)/60 in units of Watts (W), and
   "Brake engine torque" = (engine reference torque) x [(indicated torque) – (friction torque)].
4) "Specified FTP engine output energy" would be defined as the accumulated engine output energy measured from engine start until the SCR catalyst inlet temperature reaches the light-off temperature on an FTP cycle (for section 1968.2) or FTP test (for section 1971.1).
5) "Post-diesel oxidation catalyst (DOC) heat energy" would be defined as the heat energy flow through the DOC over time, with:
   "Heat energy flow through the DOC" = (heat capacity of exhaust gas (Cp)] x (exhaust mass flow (mexhaust)) x (temperature difference between DOC outlet and ambient) /1000

The proposal would require the following 10 trackers. All trackers would start incrementing from engine start when the CSERS cold start criteria are met and stop incrementing when specific conditions are met as described below:

1) Heat energy release tracker #1: This tracker would accumulate post-diesel oxidation catalyst (DOC) heat energy (in units of kiloJoules (kJ)) until the "FTP catalyst light-off time" is achieved. For heavy-duty engines with multiple power ratings under one engine family, manufacturers may request

Executive Officer approval to use a representative FTP catalyst light-off time for the engine family. The Executive Officer shall approve the request upon determining that, based on manufacturer-submitted data and/or information, the representative light-off time represents the FTP catalyst light-off time on the majority of the power ratings in the field.

2) Heat energy release tracker #2: This tracker would accumulate post-DOC heat energy (in kJ) until the "specified FTP engine output energy" is achieved. For heavy-duty engines with multiple power ratings under one engine family, manufacturers may request Executive Officer approval to use a representative specified FTP engine output energy for the engine family. The Executive Officer shall approve the request upon determining that, based on manufacturer-submitted data and/or information, the representative energy represents the specified FTP engine output energy on the majority of the power ratings in the field.
3) Heat energy release tracker #3: This tracker would accumulate post-DOC heat energy (in kJ) until the on-road catalyst light-off temperature is achieved.
4) Engine output energy tracker #1: This tracker would accumulate engine output energy (in kJ) until the FTP catalyst light-off time is achieved.
5) Engine output energy tracker #2: This tracker would accumulate engine output energy (in kJ) until the on-road catalyst light-off temperature is achieved.
6) EGR mass flow tracker #1: This tracker would accumulate EGR mass flow (in units of kilograms (kg)) until the FTP catalyst light-off time is achieved.
7) EGR mass flow tracker #2: This tracker would accumulate EGR mass flow (in kg) until the specified FTP engine output energy is achieved.
8) EGR mass flow tracker #3: This tracker would accumulate EGR mass flow (in kg) until the on-road catalyst light-off temperature is achieved.
9) Engine output energy timer: This tracker would accumulate time (in seconds) until the specified FTP engine output energy is achieved.
10) Catalyst light-off timer: This tracker would accumulate time (in seconds) until the catalyst light-off temperature is achieved.

The trackers would include data for the current driving cycle and historical data (i.e., an exponentially weighted moving average (EWMA) value) for all driving cycles. The EWMA value (EWMA(t)) would be defined by the following formula, using a lambda (λ) of 0.2:

$EWMA(t) = (1-\lambda)*EWMA(t-1) + \lambda*Y(t)$ (for $t = 1, 2, ..., n$), where

EWMA(t) is the weighted mean of historical data (the current weighted moving average),

EWMA(t-1) is the weighted mean of historical data calculated one event prior to time t,

Y(t) is the observation at time t (i.e., the current driving cycle data),

n is the number of measurements, and

λ is a constant that determines the degree of weighting/filtering for the EWMA calculation.

If any of the trackers has not reached the condition required to stop incrementing in a driving cycle (e.g., FTP catalyst light-off time), the OBD system would be required to set the current driving cycle data for all trackers to zero, and may not use these zero values in the historical data calculations. Further, pausing conditions were added, which would require these proposed trackers to stop accumulating within 10 seconds if a malfunction of an input to any of the trackers or a CSERS malfunction (i.e., a malfunction described in subsections 1968.2(f)(12.2.2), 1968.2(f)(12.2.3), 1971.1(e)(11.2.2), or 1971.1(e)(11.2.3)) has been detected and the MIL is commanded on for that malfunction. Tracking would start again within 10 seconds when the malfunction is no longer detected and the MIL no longer commanded on.

The proposal would also set numerical value specifications for these trackers. Specifically, the trackers for historical data would be required to reset to zero only when a non-volatile random access memory (NVRAM) reset occurs, and would be prohibited from resetting to zero under any other circumstances. Trackers for the current driving cycle data would be required to reset to zero if a scan tool command to clear fault codes is received, an NVRAM reset occurs, or, if stored in keep alive memory (KAM), when keep alive memory is lost. Trackers for the current driving cycle would be stored within 10 seconds after all the trackers have stopped incrementing in the driving cycle, while trackers for the historical data would be stored within 600 seconds after the end of the driving cycle.

Manufacturers would be allowed to use an alternate phase-in schedule in lieu of the required phase-in schedule described above, with the exception that 100 percent of 2028 and subsequent model year diesel vehicles/engines would be required to comply with the requirements. Manufacturers would also be allowed to implement the diesel CSERS tracking parameters for diesel vehicles/engines early in the 2023 through 2025 model years.

Rationale: As already described above in subsections 1968.2(e)(11) and 1971.1(f)(4), the proposed amendments are needed to address manufacturer concerns regarding the current CSERS monitoring requirements. These CSERS trackers would cover several categories of information: engine output energy (i.e., brake work), output energy for the DOC, EGR flow, and timers for catalyst achieving light-off temperature and engine output energy achieving a specified value. In addition, these trackers would provide the engine brake work, heat, and catalyst light-off information under the standard federal test cycle and on-road conditions. These trackers are essential tools that would provide real-time information for understanding how diesel cold start strategies operate during in-use driving conditions to ensure consistent behavior between the standard federal test cycle and on-road conditions.

Tracking the energy downstream of the DOC in concert with brake work form the engine over the same interval would provide real-time information under federal test cycle and in-use cycle operating conditions. These trackers would provide valuable information on CSERS system calibrations and/or malfunctions if abnormal output energy is observed relative to the reference conditions of the certification cycle when the active CSERS is employed. Tracking the EGR flow rate is another key parameter to determine how the manufacturer controls engine-out emissions during in-use driving conditions. The proposed timers for catalyst achieving light-off temperature and an engine output energy achieving a specified value would provide direct information regarding the catalyst heating and engine operation under various in-use conditions. Similar to the energy trackers, any abnormal catalyst light-off timer data and engine output energy timer data may indicate CSERS system calibration issues or undetected malfunctions. These trackers would capture the nature and characteristics of CSERS operation during in-use driving conditions and provide useful information for possible future changes to the CSERS monitoring requirements, including the newly proposed diesel CWS system monitor in subsections 1968.2(f)(12.2.2) and 1971.1(e)(11.2.2). These trackers would provide more field data and better technical and engineering understanding of diesel CWS system and assist manufacturers in designing more robust diesel CWS system monitors.

The CSERS trackers would include data for the current driving cycle and a EWMA value for all driving cycles, which would provide the current and historical data and are similar to the types of data currently required for other OBD tracking parameters in subsections 1968.2(g)(6) and 1971.1(h)(5). For the calculation of the EWMA value, a lambda of 0.2 would be used in order to reflect a sufficient amount of influence of previous observations on the reported EWMA. The proposed pausing conditions are needed in the event of a CSERS-related malfunction or a malfunction of an input to the trackers, since the resulting tracker data would be not be valid or useful. The proposal regarding the numerical value specifications, which would require storage of historical data in NVRAM but would allow storage of current driving cycle data in KAM, are similar to those currently required for other tracking data in subsections 1968.2(g)(6) and 1971.1(h)(5). The proposed NVRAM storage requirement for historical data would prevent data from being erased during routine service events and help to ensure that a useful amount of data are available at the time of request. Requiring NVRAM storage for current driving cycle data is not necessary since the data would only be valid for a specific driving cycle, and thus would save memory space.

The proposal to set all CSERS tracker values to zero in the event one tracker has not finished incrementing is needed to avoid issues with the validity of the data. In the real world, the vehicle/engine may shut down before one or more CSERS tracking parameter reaches the specific conditions required to stop incrementing (e.g., the FTP catalyst light-off time, the specified FTP engine output energy). For these cases, if all the tracking parameters are not set to

zero, the data would provide incorrect and potentially misleading information. For example, any data recorded before the tracking parameter reaches the specified condition to stop incrementing would have lower values than it normally would have accumulated. These lower values may incorrectly indicate CSERS system calibration issues or undetected malfunctions. Further, it would not provide any useful information if some trackers are set to zero while other trackers are not set to zero in the same driving cycle. Having valid non-zero data for all 10 parameters would provide a complete picture of how diesel cold start strategies operate during in-use driving. Therefore, staff is proposing the OBD system to set the current driving cycle data for all 10 parameters to zero if one or more of the parameters has not reached the conditions required to stop incrementing before the end of the driving cycle. In addition, the OBD system would not be allowed to use these zero values data in the historical data calculations since the data would not provide useful information.

Further rationale for these amendments (e.g., phase-in requirements and early adoption) are provided in subsections 1968.2(e)(11) and 1971.1(f)(4) above.

Sections 1968.2(k) and 1971.1(k): Deficiencies

Subsections 1968.2(k)(4.4) and 1971.1(k)(4.3)

Purpose: The proposed subsections would allow deficiencies associated with the current cold start emission reduction strategy monitoring requirements in subsections 1968.2(e)(11.2.2), 1968.2(f)(12.2.1), 1971.1(e)(11.2.1), and 1971.1(f)(4.2.2), and carried over from the 2022 or earlier model year, to be carried over up to and including the 2025 model year. This would only be allowed if the OBD system has the same or more comprehensive monitors as compared to the 2022 model year.

Rationale: The proposed new subsection is needed to address the deficiencies associated with the current CSERS monitoring requirements for gasoline and diesel vehicles. Since the newly proposed CSERS requirements would start from the 2026 model year, manufacturers would still need to meet the current requirements up through the 2025 model year. Manufacturers that currently have deficiencies for their CSERS monitors have expressed concerns about having to modify their monitors to address the deficiency before the maximum allowed 3-year carryover of the deficiency is exceeded, but then needing to implement new monitors to meet the newly proposed monitoring requirements only a few years later. This proposed deficiency provision would provide a realistic and amenable path for manufacturers' implementation of the current CSERS monitors and development of the newly proposed CSERS monitors during this 2023 through 2025 model year transition period. The proposed condition that would only allow the carry over of the deficiency if the OBD system has the same or more comprehensive monitors as compared to the 2022 model year is needed to prevent manufacturers from using less capable

monitors than those for which the original deficiency was applied to. With this proposed "anti-backsliding" provision, manufacturers would not be allowed to degrade the CSERS monitors and would maintain the same or more comprehensive CSERS monitors during the 2023 through 2025 model years.

Subsections 1968.2(k)(7.4) and 1971.1(k)(10)

Purpose: The proposed subsection would allow certain deficiencies to be exempt from the specified fines of subsections 1968.2(k)(3) and 1971.1(k)(3) and excluded from the count of deficiencies used in subsection (k)(2) to determine the number of deficiencies subject to fines. The "free" deficiencies for the 2023 through 2025 model years would apply to: (1) a deficiency covered under section 1968.2(k)(4.4) or 1971.1(k)(4.3), (2) a deficiency for a monitor required to meet subsection 1968.2(e)(11.2.3), 1968.2(e)(11.2.4), 1971.1(f)(4.2.3), or 1971.1(f)(4.2.4) for gasoline vehicles/engines, and (3) a deficiency for a monitor required to meet subsection 1968.2(f)(12.2.3) or 1971.1(e)(11.2.3) for diesel engines. In addition, for deficiencies related to the diesel CWS monitor (subsections 1968.2(f)(12.2.2) and 1971.1(e)(11.2.2)) and associated IUMPR requirements (subsections 1968.2(d)(3.2.1)(D) and 1971.1(d)(3.2.2)(B)(i)) and the cold start emission reduction strategy tracking requirements (subsections 1968.2(g)(6.14) and 1971.1(h)(5.9)), the "free" deficiency would be applied to the first 3 model years of implementation for vehicles/engines that first implement the CWS monitor or tracking parameters in the 2023 through 2026 model years diesel vehicles/engines. For example, a CWS monitor or a tracking parameter deficiency is not subject to fines for the 2025, 2026, and 2027 model years for diesel vehicles/engines first certified with the CWS monitor or tracking parameter in the 2025 model year. Further, for vehicles/engines that first implement the CWS monitor or tracking parameter in the 2027 model year, the "free" deficiency would apply to the 2027 and 2028 model years. Finally, a CWS monitor or tracking parameter deficiency is not subject to fines for only 2028 model year for diesel vehicles/engines first certified with the CWS monitor or tracker parameter in the 2028 model year.

Rationale: As described above in subsections 1968.2(e)(11) and 1971.1(f)(4), CARB is proposing amendments to the CSERS monitoring requirements to address manufacturer concerns with implementation of the requirements. Manufacturers that currently have deficiencies for their CSERS monitors have expressed concerns about having to modify their monitors to address the deficiency before the maximum allowed 3-year carryover of the deficiency is exceeded, but then needing to implement new monitors to meet the new proposed monitoring requirement only a few years later. This proposed deficiency provision would provide a realistic and amenable path for manufacturers' ongoing implementation of the current CSERS monitors and development of the newly proposed CSERS monitors during this 2023 through 2025 model year transition period. As already mentioned above in subsections 1968.2(k)(4.4) and 1971.1(k)(4.3), the OBD system in the 2023 through 2025

model year vehicles/engines must have the same or more comprehensive monitors as compared to the 2022 model year. For gasoline vehicles/engines, staff believe that the "free" deficiency provision for 2023 through 2025 model year vehicles/engines that implement the new CSERS monitoring requirements would provide a good incentive to encourage manufacturers to implement the new proposed CSERS monitors earlier. The same rationale applies to 2023 through 2025 model year diesel vehicles/engines that implement the new components/features monitors in subsections 1968.2(f)(12.2.3) and 1971.1(e)(11.2.3).

Regarding the diesel CWS monitor and tracking parameters, when discussing the proposal with CARB staff, manufacturers have expressed concerns about developing a robust CWS monitor in time to meet the requirement and requested that the monitoring requirement be delayed to a later start date. Specifically, they proposed that the CSERS tracking parameter requirements in subsections 1968.2(g)(6.14) and 1971.1(h)(5.9) be implemented first for a few years, and the data reviewed by CARB staff to determine the appropriate monitoring requirements for the CWS. While staff does not agree to delaying the diesel CWS monitoring requirement and believes a robust monitor could be developed in the required time, staff understands manufacturers' concerns. Therefore, staff is proposing any deficiency granted for this CWS monitoring requirement and CSERS tracking parameters in the 2023 through 2028 model years be exempt from fines for the first few years of implementation and not beyond the 2028 model year. This would give manufacturers time to observe how the monitor works during in-use driving conditions and to gather enough data to improve the CWS monitor and address any issues during the initial years of implementation without any monetary penalties. More details about the rationale for CSERS-related amendments can be found in subsections 1968.2(e)(11), 1971.1(f)(4), 1968.2(f)(12), and 1971.1(e)(11).

C. OTHER PROPOSED AMENDMENTS TO OBD II REGULATION SECTION 1968.2

Section 1968.2(c): Definitions

"FTP cycle"

Purpose: The proposed amendment to this definition would indicate that the driving schedule described in Code of Federal Regulations (CFR) 40, Appendix 1, Part 86, section (a) entitled, "EPA Urban Dynamometer Driving Schedule for Light-Duty Vehicles and Light-Duty Trucks," is also referred to as the FTP-72 cycle or LA-4 cycle.

Rationale: The proposed change is needed to make clear that this driving schedule is known by alternate names that may be more well known by

manufacturers than the "EPA Urban Dynamometer Driving Schedule for Light-Duty Vehicles and Light-Duty Trucks."

"Low Emission Vehicle III application"

Purpose: The proposed amendment to the definition of "Low Emission Vehicle III application" would change a comma to a period at the end of the first sentence.

Rationale: The proposed change is needed to correct a punctuation error.

Section 1968.2(d): General Requirements

Subsection 1968.2(d)(1.4)

Purpose: The proposed amendment to this subsection would add a comma to the end of "e.g." so that it reads "e.g.,".

Rationale: The proposed amendment is needed to correct a punctuation error, since "e.g.," is correct, not "e.g."

Subsection 1968.2(d)(3.2.1)

Purpose: The proposed amendments would renumber subsection (d)(3.2.1)(C) to (d)(3.2.1)(E) and renumber subsection (d)(3.2.1)(D) to (d)(3.2.1)(F). As a result, the proposed amendments to subsection (d)(3.2.1) would change the reference "section (d)(3.2.1)(D)" to "section (d)(3.2.1)(F)," and the proposed amendments would change the reference in subsection (d)(3.2.1)(F)(iv) from "section (d)(3.2.1)(C)" to "section (d)(3.2.1)(E)." Further, the proposed amendment to subsection (d)(3.2.1)(F)(i) would change the reference "section (d)(3.2.1)(A) through (C)" to "section (d)(3.2.1)(A) through (C) and (E)."

Rationale: The renumbering of the subsections are needed to account for the new proposed IUMPR requirements in subsections (d)(3.2.1)(C) and (D) for the diesel PM filter filtering performance and missing substrate monitors and the diesel cold start emission reduction strategy CWS monitor, which caused current subsections (d)(3.2.1)(C) and (d)(3.2.1)(D) to be renumbered.

Subsections 1968.2(d)(3.2.1)(C) and (d)(3.2.1)(F)(vi)

Purpose: The proposed amendments to these subsections would modify the interim and final minimum acceptable IUMPRs for the diesel PM filter filtering performance monitor (subsection (f)(9.2.1)) and missing substrate monitor (subsection (f)(9.2.5)). The proposed amendments to subsection (d)(3.2.1)(C) would modify the final minimum acceptable IUMPR for these monitors from 0.336 to 0.200 for passenger cars, light-duty trucks, MDPVs certified to a chassis dynamometer tailpipe emission standard, and medium-duty vehicles

certified to an engine dynamometer tailpipe emission standard, while the current final ratio of 0.336 would apply only to medium-duty vehicles (except MDPVs) certified to a chassis dynamometer tailpipe emission standard. Additionally, the proposed amendments to subsection (d)(3.2.1)(F)(vi) would extend the model years allowed to use an interim minimum acceptable IUMPR and modify the interim IUMPRs as follows:

Table A: Proposed Minimum Acceptable IUMPR for PM Filter Filtering Performance and Missing Substrate Monitors

	Vehicles meeting Option 1 for PM threshold (in Table 2 of section (f) or subsection (f)(9.2.1)(A)(ii)e.1.)	**Vehicles meeting Option 2 for PM threshold (in Table 2 of section (f) or subsection (f)(9.2.1)(A)(ii)e.1.)**
Applicable Vehicles	**Model Years: Minimum IUMPR**	**Model Years: Minimum IUMPR**
Passenger cars, light-duty trucks, and MDPVs certified to a chassis dynamometer tailpipe emission standard	2019-2021: 0.100 2022-2025: 0.150 2026-2028: 0.336	2019-2021: 0.100 2022-2028: 0.150
Medium-duty vehicles (except MDPVs) certified to a chassis dynamometer tailpipe emission standard	**(Note: no Option 1 or 2 applicable to these vehicles)** 2019-2021: 0.100 2022-2025: 0.150	N/A
Medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard	2016-2018: 0.100 2019-2025: 0.300 2026-2028: 0.336	2016-2018: 0.100 2019-2025: 0.300 2026-2028: 0.150

Note: The table above includes the current interim IUMPR requirements (those with IUMPRs of 0.100) for completeness.

Rationale: The proposed amendments are needed to address manufacturers' concerns regarding meeting the currently required minimum IUMPRs for the PM filter monitors. For the PM filter filtering performance and missing substrate monitors, the OBD II regulation currently requires manufacturers to meet an

interim minimum required ratio of 0.100 until the 2019 model year for medium-duty vehicles certified to an engine dynamometer tailpipe emission standard and 2022 model year for passenger cars, light-duty trucks, and medium-duty vehicles certified to a chassis dynamometer tailpipe emission standard, when a final ratio of 0.336 will be required. Manufacturers have indicated that they will be unable to meet the final ratio by these dates based on the current capability of the sensing technologies required for these monitors, and have submitted data from in-use vehicles supporting their assertions. They have also indicated more time is needed to develop an alternative sensing technology that will be able to meet the final ratio requirements. Therefore, they proposed that the ratio of 0.100 be extended up through the 2025 model year, with the start date for the 0.336 ratio delayed until the 2026 model year. While CARB staff agrees that a delay for the 0.336 ratio requirement is necessary, staff does not believe that extending the 0.100 ratio is warranted. Based on in-use IUMPR data obtained from the California Smog Check program and spanning several model years, staff has determined that these PM filter monitors have IUMPRs well above the 0.100 ratio on a vast majority of the vehicles. Therefore, CARB believes that interim ratios higher than 0.100 would be technically feasible to meet. However, CARB staff is concerned that extending the use of interim ratios would slow progress toward achieving the final monitoring requirements and its associated emission benefits. Therefore, CARB staff is proposing that in addition to increasing and extending the use of interim ratios, there would be two phase-in options that would lower the emission thresholds at which the PM filter monitors would be required to detect malfunctions for most of these vehicles. PM filter filtering performance monitors that would be certified to these lower emission thresholds would be allowed to meet lower ratios than the currently required final ratio of 0.336. Further, CARB staff is proposing to decrease the final minimum acceptable IUMPR for medium-duty vehicles certified to an engine dynamometer tailpipe emission standard, passenger cars, light-duty trucks, and MDPVs certified to a chassis dynamometer tailpipe emission standard for these monitors from 0.336 to 0.200 to accommodate the lower emission threshold and manage the balance between monitoring frequency and malfunction thresholds. The current final ratio of 0.336 would still apply to medium-duty vehicles (except MDPVs) certified to a chassis dynamometer tailpipe emission standard because the medium-duty vehicles are already meeting a threshold of 1.75 times the standard and improvements in sensor technology would allow more frequent monitoring while continuing to meet this threshold. More details about the proposed amendments to the PM filter monitor emission thresholds and the rationale can be found in section (f): Table 3 and subsection (f)(9.2.1)(A) below.

Subsection 1968.2(d)(3.2.2)

Purpose: The proposed amendments to this subsection would renumber the list of monitors from a. through k. to (A) through (K).

Rationale: The proposed amendments are needed to correct the numbering of the subsections (d)(3.2.2)a. through k. to (d)(3.2.2)(A) through (K) to be consistent with the numbering of the rest of section 1968.2.

Subsection 1968.2(d)(4.3.2)(H)(vi)

Purpose: The proposed amendment to this subsection would change the word "capablity" to "capability."

Rationale: The proposed amendment is needed to correct a mispelling.

Subsection 1968.2(d)(4.3.2)(L)

Purpose: The proposed amendments to this subsection, which describes the denominator incrementing criteria for monitors such as the evaporative system monitors on plug-in hybrid electric vehicles, would delete the phrase "and (f)(11)" and would change "choose the increment the denominator" to "choose to increment the denominator."

Rationale: The proposed amendments are needed to correct errors. Subsection (d)(4.3.2)(L) lists the corresponding subsections for the engine cooling system input component rationality monitors subject to the denominator incrementing requirements of this subsection. Since subsections (f)(11.2.2)(C) and (D) are currently listed, the reference to subsection (f)(11) is not needed. Additionally, the proposed change of the word "the" to "to" is needed to make the sentence read correctly.

Subsection 1968.2(d)(4.5.5)

Purpose: The proposed amendments to this subsection, which describes denominators that are required to disable incrementing if certain criteria are met, would include the denominator described in subsection (d)(4.3.2)(M).

Rationale: The proposed amendment is needed to correct an error. When the OBD II regulation was amended in 2015, subsection (d)(4.3.2)(M) was newly added to describe the denominator incrementing criteria for the evaporative system high-load purge monitor, and subsection (d)(4.5.5) was newly added to correct an oversight, specifically requiring OBD II systems to disable incrementing of numerators and denominators for a specific monitor if a fault of any component used to determine any denominator incrementing criteria for that specific monitor is detected. However, CARB staff mistakenly did not include the denominator in subsection (d)(4.3.2)(M) in the list of denominators subject to the disabling criteria in subsection (d)(4.5.5). Therefore, staff is proposing to amend subsection (d)(4.5.5) to add this denominator.

Section 1968.2(e): Monitoring Requirements for Gasoline/Spark-Ignited Engines

Subsection 1968.2(e)(3.4.1)(A)(ii)

Purpose: The proposed amendment to this subsection would change "drive cycle" to "driving cycle."

Rationale: The proposed amendment is needed to correct an error, since the phrase "driving cycle" is the correct phrase to use. Specifically, "driving cycle" is defined in subsection (c) and used throughout section 1968.2.

Subsection 1968.2(e)(6.3.2)

Purpose: The proposed amendment to this subsection would move the sentence "Manufacturers that use other existing monitors (e.g., misfire monitor under section (e)(3), fuel system monitor under section (e)(6.2.1)(A)) to detect malfunctions identified in section (e)(6.2.1)(C) are subject to the tracking and reporting requirements of the other monitors." from newly proposed subsection (e)(6.3.2)(A) to (e)(6.3.2).

Rationale: The proposed amendment is needed to accommodate the proposed reorganization of subsection (e)(6.3.2) described above. Specifically, subsection (e)(6.3.2) would apply to both vehicles using SAE J1979 and vehicles using SAE J1979-2, subsection (e)(6.3.2)(A) would apply to vehicles using SAE J1979, and subsection (e)(6.3.2)(B) would apply to vehicles using SAE J1979-2. The sentence of concern applies to both vehicles using SAE J1979 and vehicles using SAE J1979-2, so its placement in subsection (e)(6.3.2)(A), which describes requirements for only vehicles using SAE J1979, would not be appropriate.

Subsection 1968.2(e)(6.3.3)

Purpose: The proposed amendment to this subsection, which detail the monitoring conditions for certain gasoline fuel system monitors, would change "(e)(6.4.2)(C)" to "(e)(6.2.4)(C)."

Rationale: The proposed amendment is needed to correct an error, since subsection (e)(6.3.3) is meant to define monitoring conditions for gasoline fuel system monitors of specific malfunctions under subsection (e)(6.2.4) except for the malfunction specified in subsection (e)(6.2.4)(C). Further, subsection (e)(6.4.2)(C) does not exist.

Subsection 1968.2(e)(12.2.1)(C)

Purpose: The proposed amendment to this subsection, which detail the malfunction criteria for the gasoline A/C system component monitors, would require the OBD II system to detect an A/C malfunction if the "the malfunction

effectively disables the monitors of any other monitored system or component," not if "the malfunction effectively disables any other monitored system or component."

Rationale: The proposed amendment is needed to correct a mistake. Specifically, the intent of subsection (e)(12.2.1)(C) is to require the OBD II system to detect an A/C system malfunction if the malfunction disables another "monitor", not if the malfunction disables another "monitored system or component."

Subsection 1968.2(e)(15.2.3)(A)(v)

Purpose: The proposed amendment to this subsection, which details the fault code requirements for the hybrid energy storage system, would change the subsection reference "(e)(15.2.3)(iii)" to "(e)(15.2.3)(A)(iii)."

Rationale: The proposed amendment is needed to correct the subsection reference, since the "(A)" was mistakenly left out.

Subsection 1968.2(e)(17.3)

Purpose: The proposed amendment to this subsection would allow manufacturers to request Executive Officer approval to disable monitors at altitudes below 8000 feet above sea level, with approval based on the manufacturer demonstrating with data and/or engineering evaluation that misdiagnosis would occur at the altitudes of concern because of its effect on the component itself.

Rationale: The proposed amendment is needed to address manufacturers' concerns about monitoring at altitudes below 8000 feet above sea level. The regulation currently allows manufacturers to disable monitors when the elevation is above 8000 feet above sea level. Manufacturers have asked that they be allowed to disable certain monitors at lower elevations if robust monitoring is not possible at such elevations due to certain effects on the components involved (e.g., turbocharger that cannot build sufficient overboost). Staff therefore is proposing amendments that would allow manufacturers to request such disablements, with Executive Officer approval based on manufacturer-submitted data or information demonstrating that the disablement is necessary to avoid false detections by the monitor.

Section 1968.2(f): Monitoring Requirements for Diesel/Compression-Ignition Engines

Section 1968.2(f): Table 2

Purpose: The proposed amendments to Table 2 are needed to change the section reference in footnote 2 from "(f)(9.2.4)(A)" to "(f)(9.2.4)."

Rationale: The proposed amendments are needed to include reference to the newly proposed monitor in subsection (f)(9.2.4)(B), which would be required to detect a feedgas generation performance malfunction before emissions exceed the non-methane organic gases (NMOG)+NOx threshold in Table 2 for LEV III applications.

Section 1968.2(f): Table 3

Purpose: The proposed amendments to Table 3 would modify the PM thresholds for the PM filter filtering performance monitor for passenger cars, light-duty trucks, and chassis certified medium-duty vehicles. Specifically, for passenger cars, light-duty trucks, and chassis certified MDPVs, proposed Option 1 would lower the PM threshold from 17.50 milligrams-per-mile (mg/mi) to 10.00 mg/mi for 2029 and subsequent model year vehicles, while proposed Option 2 would lower the PM threshold from 17.50 mg/mi to 10.00 mg/mi for 2026 and subsequent model year vehicles. The row for chassis certified medium-duty vehicles (except MDPVs) was split into 2 rows based on the gross vehicle weight rating (GVWR). For medium-duty chassis certified vehicles (except MDPVs) with a GVWR between 8,500-10,000 pounds (lbs.), the proposed amendments would lower the PM threshold from 17.50 mg/mi to 14.00 mg/mi for 2029 and subsequent model year vehicles. Medium-duty chassis certified vehicles (except MDPVs) with a GVWR between 10,001-14,000 lbs. would still use the current PM threshold of 17.50 mg/mi. Additionally, footnote 5 was added to indicate how to use the Options. Specifically, all vehicles within a test group shall meet the same Option (either Option 1 or 2). Further, if the test group is carried over to subsequent model years, the test group may use one Option while the carried over test group may use the other Option (i.e., different Options may be used for different years for a test group and its carried over test groups). The footnote also indicates that in order to use the provisions of subsections (h)(2.1.1) (which would allow relaxations for durability demonstration testing) and (k)(7.3) (which would allow relaxations for deficiencies) for a test group, the PM filter filtering performance monitor must meet the requirements of Option 2 (i.e., must be able to detect a malfunction before the emission malfunction threshold described under Option 2) and must meet the minimum acceptable ratio in section (d)(3.2.1)(F)(vi). Specifically, a test group that is granted a deficiency because the PM filter monitor is not able to detect a malfunction before emissions exceeded the threshold in Option 2 or not able to meet the minimum ratio in section (d)(3.2.1)(F)(vi) would not be able to use the provisions of subsections (h)(2.1.1) and (k)(7.3).

Rationale: The proposed amendments are needed to address manufacturers' concerns regarding the PM filter filtering performance monitors. Specifically, manufacturers have indicated issues with meeting the current final stringent IUMPRs, and have requested an extension of the lower interim IUMPR. CARB staff, however, is concerned that extending the use of the lower interim IUMPR would slow progress toward achieving the final monitoring requirements and its

associated emission benefits. While CARB in-use data indicate that near-term relief is needed for some vehicles, the level of relief needed is less than what industry requested. As such, staff is proposing an extension of the interim IUMPR but at a level higher than requested by industry and proposed an increase in the stringency of the final emission threshold to achieve more long-term emission benefits. For passenger cars, light-duty trucks, and chassis-certified MDPVs, the proposed PM threshold of 10.00 mg/mi was set based on the capability of improved PM sensor technology, where data have shown that malfunction detection at emission levels as low as 4 mg/mi is feasible. For chassis-certified medium-duty vehicles with a GVWR between 8,500-10,000 lbs., the proposed PM threshold of 14.00 mg/mi is equivalent to 1.75 times the PM standard. The proposed footnote 5 is needed to explain how the manufacturers can apply the Options and the relaxations allowed under subsection (h)(2.1.1) for durability demonstration testing and subsection (k)(7.3) for deficiencies. More details about the proposed amendments to the PM filter monitor emission thresholds and other related amendments can be found in subsections (d)(3.2.1)(C) and (d)(3.2.1)(F)(vi) above and subsection (f)(9.2.1)(A) below.

Subsections 1968.2(f)(1.2.3)(B) and 1968.2(f)(9.2.4)(B)

Purpose: The proposed amendments to this subsection would renumber subsection (f)(1.2.3)(B) to (f)(1.2.3)(B)(i) and subsection (f)(9.2.4)(B) to (f)(9.2.4)(B)(i), as well as the subsections under each subsection accordingly. For the current feedgas generation monitoring requirements (now under subsections (f)(1.2.3)(B)(i) and (f)(9.2.4)(B)(i)), the proposal would end the current requirements with the 2024 model year. Newly proposed subsections (f)(1.2.3)(B)(ii) and (f)(9.2.4)(B)(ii) would require manufacturers of 2025 and subsequent model year vehicles to detect a malfunction when the catalyst/catalyzed PM filter is unable to generate the necessary feedgas constituents to the point where emissions exceed the following:

1) For LEV III applications, any of the applicable NMOG+NOx emission thresholds set forth in Table 2 in the beginning of section (f).
2) For medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard, the applicable NOx standard by more than 0.2 g/bhp-hr.

Newly proposed subsections (f)(1.2.3)(B)(iii) and (f)(9.2.4)(B)(iii) would allow manufacturers to be exempt from developing a separate feedgas generation performance monitor to meet the current and newly proposed feedgas generation monitoring requirements. Specifically, if the vehicle has an NMHC catalyst conversion efficiency monitor that meets subsection (f)(1.2.2), the manufacturer is not required to develop a separate NMHC catalyst feedgas generation monitor. Similarly, if the vehicle has a catalyzed PM filter NMHC conversion monitor that meets subsection (f)(9.2.4)(A), the manufacturer is not required to develop a separate catalyzed PM filter feedgas generation monitor.

Also, for subsection (f)(1.2.3)(B), regarding the language allowing the NMHC catalyst to be monitored either by itself or in combination with the catalyzed PM filter, the proposed amendments would change the subsection reference from "(f)(1.2.3)(B)" to "(f)(9.2.4)(B)." For subsection (f)(9.2.4)(B), regarding the language allowing the catalyzed PM filter to be monitored either by itself or in combination with the NMHC catalyst, the proposed amendments would change the subsection reference from "(f)(9.2.4)(B)" to "(f)(1.2.3)(B)."

Rationale: The proposed amendments are needed to address manufacturers' concerns about the feedgas generation performance monitoring requirements. Presently, implementing a diagnostic that detects a malfunction when the catalyst is unable to generate the necessary feedgas constituents for proper SCR operation poses a challenge for industry. Complete deterioration of the feedgas generation functionality in the catalyst occurs sooner than the level of deterioration in the catalyst when the OBD II system detects a hydrocarbon conversion performance malfunction. Industry has explained that the OBD II system could set a fault code for a feedgas generation performance malfunction for a catalyst that would not be deemed as a malfunctioned part. Industry has also explained that even when a catalyst ceases to generate feedgas constituents, the catalyst is still able to deliver feedgas constituents from the engine-out exhaust gas to the SCR system for proper SCR operation. Furthermore, NMHC conversion efficiency monitoring requirements for NMHC converting catalysts and catalyzed PM filters include NOx (or NMOG+NOx, if applicable) emission thresholds. Thus, staff is proposing that OBD II systems with a diagnostic that fulfills the NMHC conversion efficiency monitoring requirement may use that diagnostic as a surrogate for detecting when the catalyst/catalyzed PM filter experiences a malfunction in feedgas generation performance.

In the event industry chooses to develop and implement a separate feedgas generation performance monitor, instead of defining the malfunction criteria by the inability of the catalyst/catalyzed PM filter to generate the necessary feedgas constituents for proper SCR operation, staff is proposing that the malfunction criteria be defined by an emission threshold for 2025 and subsequent model year vehicles. That is, the feedgas generation performance monitor would be required to detect a malfunction before a specific emission threshold is exceeded. As the main function of feedgas generation is to assist the SCR system's ability to convert NOx, OBD staff deemed it acceptable to limit the emission threshold criteria to NOx (or NMOG+NOx, if applicable) criteria pollutants. For LEV III applications, the OBD II system would be required to detect a malfunction when the catalyst is unable to generate the necessary feedgas constituents to the point where emissions exceed the applicable NMOG+NOx emission thresholds set forth in Table 2 of section (f). For medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard, the OBD II system would be required to detect a malfunction when the catalyst is unable to generate the necessary feedgas

constituents to the point where emissions exceed the applicable NOx standard by more than 0.2 g/bhp-hr. When the feedgas monitoring requirement was originally adopted, the regulation identified feedgas performance as a potential important design feature performance of the NMHC converting catalyst and the rest of the aftertreatment system. At that time, monitoring for complete loss of feedgas generation was considered sufficient and did not require calibrating the monitor to an emission threshold. It has been difficult for manufacturers to implement monitors to discern degradation of the feedgas performance from other reactions in the catalyst; consequently, the regulations allowed a manufacturer to "test out" and be exempt from monitoring if emissions impacts were below specified levels. Despite the provisions to test out, functional monitoring continues to be challenging, and the proposed changes would help to address these challenges because emission threshold monitoring would provide sufficient separation in the monitoring data between properly functioning and malfunctioning catalysts.

Finally, the proposed amendment to change the subsection reference "(f)(1.2.3)(B)" to "(f)(9.2.4)(B)" is needed to correct an error, since the NMHC catalyst monitoring requirements are located in subsection (f)(1.2.3)(B), not (f)(9.2.4)(B), and the catalyzed PM filter monitoring requirements are located in subsection (f)(9.2.4)(B), not (f)(1.2.3)(B).

Subsections 1968.2(f)(1.2.3)(B)(i)a. and 1968.2(f)(9.2.4)(B)(i)a.

Purpose: The proposed amendments to these subsections would set the exemption criteria to test out of monitoring for NMHC catalyst and catalyzed PM filter feedgas generation performance at 30 percent of the applicable NOx standard as measured from an applicable emission test cycle for all vehicles. Specifically, for all vehicles, NMHC catalysts and catalyzed PM filters would be exempt from monitoring if (1) no malfunction of the catalyst's/catalyzed PM filter's feedgas generation ability can cause emissions to increase 30 percent or more of the applicable NOx (or NMOG+NOx, if applicable) standard as measured from an applicable emission test cycle; and (2) no malfunction of the catalyst's/catalyzed PM filter's feedgas generation ability can cause emissions to exceed the applicable NOx (or NMOG+NOx, if applicable) standard as measured from an applicable emission test cycle.

Rationale: For NMHC catalysts and catalyzed PM filters used to generate a feedgas constituency to assist SCR systems (e.g., to increase NO_2 concentration upstream of an SCR system), the OBD II regulation currently requires OBD II systems to detect a malfunction when the catalyst or catalyzed PM filter is unable to generate the necessary feedgas constituents for proper SCR system operation. The performance of the NMHC catalyst/catalyzed PM filter from a feedgas perspective is based on the feedgas constituency that the catalyst/catalyzed PM filter is able to achieve at its outlet, which is the net result of both production and any consumption of NO_2 within the catalyst/catalyzed

PM filter. NMHC catalysts are currently exempt from this monitoring if both of the following criteria are satisfied: (1) no malfunction of the catalyst's feedgas generation ability can cause emissions to increase by 25 percent or more for SULEV30 and SULEV20 vehicles, 20 percent or more for ULEV70 and ULEV50 vehicles, 30 percent or more for medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard, and 15 percent or more for all other vehicles, where the percentage is based on the applicable full useful life NOx (or NMOG+NOx, if applicable) standard as measured from an applicable emission test cycle; and (2) no malfunction of the catalyst's feedgas generation ability can cause emissions to exceed the applicable NOx (or NMOG+NOx, if applicable) standard as measured from an applicable emission test cycle. Similarly, catalyzed PM filters are exempt from feedgas generation monitoring if (1) no malfunction of the catalyzed PM filter's feedgas generation ability can cause emissions to increase by 30 percent or more for medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard, and 15 percent or more for all other vehicles, where the percentage is based on the applicable full useful life NOx (or NMOG+NOx, if applicable) standard as measured from an applicable emission test cycle; and (2) no malfunction of the catalyzed PM filter's feedgas generation ability can cause emissions to exceed the applicable full useful life NOx (or NMOG+NOx, if applicable) standard as measured from an applicable emission test cycle.

Presently manufacturers are having difficulty developing a diagnostic which can detect a malfunction when the catalyst is unable to generate the necessary feedgas constituents for proper SCR operation. Attempts have been made at correlating a loss of feedgas generation capability to a loss in hydrocarbon conversion efficiency. However, manufacturers have been unable to robustly detect a malfunction in hydrocarbon conversion performance before feedgas generation in the catalyst becomes completely deteriorated. Furthermore, manufacturers' SCR systems rely on feedgas generation performance to such an extent that they experience difficulty in testing out of the feedgas generation diagnostic requirement. In 2018, CARB staff amended the HD OBD regulation to revise the NOx test out criteria from no more than 15 percent to no more than 30 percent of the applicable NOx standard as measured from an applicable emission test cycle. Staff is now proposing the same change to the OBD II regulation.

Subsections 1968.2(f)(6.2.3)(A) and (f)(6.2.3)(B)

Purpose: The proposed amendments to these subsections, which describe the EGR slow response malfunction criteria, would move the sentence "The OBD II system shall monitor the EGR system response under both increasing and decreasing EGR flow rates" from subsection (f)(6.2.3)(B) to subsection (f)(6.2.3)(A). Further, the proposed amendments would add a period to the end of the last sentence in subsection (f)(6.2.3)(B).

Rationale: The proposed amendment to relocate the sentence is needed to correct an error. Specifically, subsection (f)(6.2.3)(A) currently indicates that the OBD II system is required to detect an EGR system response malfunction "(e.g., capability to achieve the specified flow rate within a manufacturer-specified time)" prior to emissions exceed the required emission thresholds. The sentence indicating that the OBD II system is required to monitor EGR system response under both increasing and decreasing EGR flow rates is intended to further describe the types of EGR system response malfunctions required to be detected in subsection (f)(6.2.3)(A). The proposed amendment to add a period to the end of subsection (f)(6.2.3)(B) is needed to correct the punctuation error.

Subsection 1968.2(f)(9.2.1)(A)

Purpose: The proposed amendment to this subsection would modify the emission thresholds at which the PM filter must be detected as malfunctioning for medium-duty vehicles certified to an engine dynamometer tailpipe emission standard. Specifically, the proposed amendments to subsection (f)(9.2.1)(A)(ii)d. would end the use of the current thresholds with the 2025 model year. Newly proposed subsection (f)(9.2.1)(A)(ii)e. would require 2026 and subsequent model year vehicles to continue meeting the current NOx threshold of 0.2 g/bhp-hr above the applicable NOx standard. For the PM threshold, this subsection would require vehicles to meet one of two options: Option 1 would require a PM threshold of 0.03 g/bhp-hr PM for 2026 through 2028 model year vehicles and 0.02 g/bhp-hr PM for 2029 and subsequent model year vehicles, while Option 2 would require a PM threshold of 0.02 g/bhp-hr for 2026 and subsequent model year vehicles.

Rationale: The proposed amendments are needed to address manufacturers' concerns about the PM filter performance monitors. Specifically, as already described above in subsections (d)(3.2.1)(C) and (d)(3.2.1)(F)(vi), manufacturers have indicated issues with meeting the current final stringent IUMPRs, and have requested an extension of the lower interim IUMPR. CARB staff, however, is concerned that extending the use of the lower interim IUMPR would slow progress toward achieving the final monitoring requirements and realizing the associated emission benefits. While CARB in-use data indicate that near-term relief is needed for some vehicles, the level of relief needed is less than industry requested. As such, staff proposed an extension of the interim IUMPR but at a level higher than that requested by industry and has increased the stringency of the final emission threshold to achieve more long-term emission benefits. CARB staff ultimately worked together with industry to develop the following proposal. As described in section (f): Table 3 above, staff proposed to lower the PM emission thresholds for light-duty vehicles and chassis-certified medium-duty vehicles with GVWR between 8,500-10,000 lbs. Staff is also proposing similar modifications to the PM emission thresholds for medium-duty vehicles certified to an engine dynamometer tailpipe emission standard. The proposed Option 1 would require the PM filter performance monitors to detect

malfunctions at lower emission thresholds of 0.02 g/bhp-hr PM starting with the 2029 model year. The proposed Option 2 would require the monitor to meet the 0.02 g/bhp-hr PM threshold earlier, starting with the 2026 model year. Vehicles with PM filter monitors certified to the 0.02 g/bhp-hr PM threshold would be allowed to meet lower IUMPRs than the monitors meeting the 0.03 g/bhp-hr PM threshold. Industry has indicated that the current state of PM filter performance monitoring capability requires a trade-off between monitoring to lower PM thresholds and increasing the monitoring frequency or IUMPR. Taking this monitoring trade-off into consideration, the proposal would require PM filter malfunctions to be detected at lower PM thresholds but at a lower monitoring frequency or IUMPR. Staff believes this trade-off would provide the most emission benefit since the monitoring threshold determines the level where malfunctions must be detected and therefore, more directly impacts in-use emissions than a slightly lower monitoring frequency requirement that may decrease PM filter malfunction detection by less than a week for most drivers. Further, for light-duty and medium-duty vehicles, manufacturers that choose to meet Option 2 (i.e., that detect PM filter malfunctions at lower emission thresholds earlier) would be given certain benefits. These benefits are being proposed to offset any risks or additional costs manufacturers may incur to meet the more stringent option earlier. Specifically, vehicles meeting Option 2 and that do not have deficiencies for not meeting the thresholds of Option 2 or not meeting the minimum IUMPR requirements in subsection (d)(4.3.1)(F)(vi) would be allowed to choose one of the following options (as described in the proposed amendments to subsections (h)(2.2.1) and (k)(7.3.2)): Option A would allow manufacturers to decrease the number of vehicles tested under the DDV testing requirements in subsection (h) for one of the following two model years, while Option B would allow manufacturers to certify the vehicle with additional "free" deficiencies. Further descriptions of these options can be found in subsections (h)(2.2.1) and (k)(7.3.2) below.

A summary of the entire PM filter monitor IUMPR and PM emission threshold proposal is shown here in Tables B through D:

Table B: Passenger cars, light-duty trucks, and MDPVs certified to a chassis dynamometer tailpipe emission standard

Option	Model Years	Minimum IUMPR	PM Emission Threshold
Option 1	2019-2021	0.100	17.50 mg/mi
	2022-2025	0.150	17.50 mg/mi
	2026-2028	0.336	17.50 mg/mi
	2029+	0.200	10.00 mg/mi
Option 2	2019-2021	0.100	17.50 mg/mi
	2022-2025	0.150	17.50 mg/mi
	2026-2028	0.150	10.00 mg/mi
	2029+	0.200	10.00 mg/mi

Table C: Medium-duty vehicles (except MDPVs) certified to a chassis dynamometer tailpipe emission standard

Model Year	Minimum IUMPR	PM Emission Threshold
2019-2021	0.100	1.50x PM standard or 17.50 mg/mi[1]
2022-2025	0.150	17.50 mg/mi
2026-2028	0.336	17.50 mg/mi
2029+	0.336	GVWR 8,500-10,000 lbs.: 14.00 mg/mi GVWR 10,001-14,000 lbs.: 17.5 mg/mi

Footnote 1: See Table 3 at beginning of section 1968.2(f) for applicable threshold.

Table D: Medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard

Option	Model Years	Minimum IUMPR	PM Emission Threshold
Option 1	2016-2018	0.100	0.03 g/bhp-hr
	2019-2025	0.300	0.03 g/bhp-hr
	2026-2028	0.336	0.03 g/bhp-hr
	2029+	0.200	0.02 g/bhp-hr
Option 2	2016-2018	0.100	0.03 g/bhp-hr
	2019-2025	0.300	0.03 g/bhp-hr
	2026-2028	0.150	0.02 g/bhp-hr
	2029+	0.200	0.02 g/bhp-hr

Subsection 1968.2(f)(10.2.2)(F)

Purpose: The proposed amendment to this subsection, which describes the CV malfunction criteria for medium-duty vehicles with engines certified on an engine dynamometer equipped with an open CV system, would change the subsection references for "(f)(10.2.1) through (f)(10.2.4)" to "(f)(10.2.2)."

Rationale: The proposed amendment is needed to correct some errors. The current language in subsection (f)(10.2.2)(F) states that Executive Officer approval of a manufacturer's proposed monitoring strategy for an open CV system will be based on the effectiveness of the strategy to monitor the CV system performance "with respect to the malfunction criteria in sections (f)(10.2.1) through (f)(10.2.4)." When the OBD II regulation was last updated in 2015, subsections (f)(10.2.2) through (10.2.4) were renumbered to (f)(10.2.2)(A) through (C). However, the language "with respect to the malfunction criteria in sections (f)(10.2.1) through (f)(10.2.4)" in subsection (f)(10.2.2)(F) was mistakenly not updated with the revised subsection numbers. Additionally, subsection (f)(10.2.1) does not contain malfunction criteria – it contains definitions for CV system terminologies. So the reference to (f)(10.2.1) in subsection (f)(10.2.2)(F) should not have been included.

Subsection 1968.2(f)(15.2.3)(A)(v)

Purpose: The proposed amendment to this subsection, which details the fault code requirements for the hybrid energy storage system, would change the subsection reference "(f)(15.2.3)(iii)" to "(f)(15.2.3)(A)(iii)."

Rationale: The proposed amendment is needed to correct the subsection reference, since the "(A)" was mistakenly left out.

Subsection 1968.2(f)(17.3)

Purpose: The proposed amendment to this subsection would allow manufacturers to request Executive Officer approval to disable monitors at altitudes below 8000 feet above sea level, with approval based on the manufacturer demonstrating with data and/or engineering evaluation that misdiagnosis would occur at the altitudes of concern because of its effect on the component itself.

Rationale: The proposed amendment is needed to address manufacturers' concerns about monitoring at altitudes below 8000 feet above sea level. The regulation currently allows manufacturers to disable monitors when the elevation is above 8000 feet above sea level. Manufacturers have asked that they be allowed to disable certain monitors at lower elevations if robust monitoring is not possible at such elevations due to certain effects on the components involved (e.g., turbocharger that cannot build sufficient boost).

Staff therefore is proposing amendments that would allow manufacturers to request such disablements, with Executive Office approval based on manufacturer-submitted data or information demonstrating that the disablement is necessary to avoid false detections by the monitor.

Section 1968.2(g): Standardization Requirements

Subsection 1968.2(g)(4.7.4)(B)

Purpose: The proposed amendments to this subsection would extend the maximum time for the CVN to be made available after a reprogramming event, non-volatile memory clear, volatile memory clear, or battery disconnect from 120 seconds to 600 seconds.

Rationale: The proposed amendment increasing the maximum CVN availability time to 600 seconds is needed to address manufacturers' concerns. The OBD II regulation requires the CVN to be made available at all times to a general scan tool except for extreme circumstances where the stored CVN value has been erased and not yet had an opportunity to be calculated and re-stored. The regulation currently requires the CVN to be made available within 120 seconds after a reprogramming event, non-volatile memory clear, volatile memory clear, or battery disconnect. Manufacturers have stated that vehicles are becoming more complex and control modules have been increasing the amount of information stored and memory capacity, which have resulted in longer times to calculate the CVN value. Therefore, they have indicated the current 120-second requirement is insufficient to recalculate a new CVN and have it available, and proposed to extend the timeframe to 600 seconds. Therefore, to address this concern and given the very limited and rare scenarios in which the timeframes apply, staff is proposing to extend the timeframe to within 600 seconds after a reprogramming event, non-volatile memory clear, volatile memory clear, or battery disconnect.

Subsection 1968.2(g)(6.1.7)

Purpose: The proposed amendments to this subsection would renumber the subsection (i) and (ii) to (A) and (B), respectively.

Rationale: The proposed amendments are needed to correct the subsection number in order to match the numbering system used in section 1968.2. Specifically, subsections directly under (g)(6.1.7) should have been numbered with (A) and (B), not (i) and (ii).

Subsection 1968.2(g)(6.7.5)

Purpose: The proposed amendment to this subsection would change "drive cycle" to "driving cycle."

Rationale: The proposed amendment is needed to correct an error, since the phrase "driving cycle" is the correct phrase to use. Specifically, "driving cycle" is defined in subsection (c) and used throughout section 1968.2.

Subsection 1968.2(g)(6.12.3)(F)

Purpose: The proposed amendment to this subsection would require that for medium-duty vehicles certified to a chassis dynamometer tailpipe emission standard, Bin 15 for the NOx emission tracking data is required to be set to zero at all times.

Rationale: The proposed amendment is needed to address an oversight regarding this NOx emission tracking bin. The regulation currently requires medium-duty vehicles equipped with diesel engines to track and report NOx emission tracking data under subsection (g)(6.12) – this includes vehicles certified to chassis dynamometer tailpipe emission standards and engine dynamometer tailpipe emission standards. Further, the regulation currently requires data to be stored in Bin 15 only when the engine is operating within the NOx not-to-exceed (NTE) control area and no exclusions apply. However, medium-duty vehicles certified to chassis dynamometer tailpipe emission standards are currently not subject to the NTE standards – these standards only apply to vehicles/engines certified to the engine dynamometer tailpipe emission standards. Further, only medium-duty vehicles with a diesel engine certified on an engine dynamometer are required to report NTE-related data stream parameters under section (g)(4.2.3)(E). Therefore, manufacturers have inquired about what to do with Bin 15 for medium-duty diesel vehicles certified to chassis dynamometer tailpipe emission standards, specifically whether to exclude this bin or to keep the bin and report a specific value. Industry and CARB staff agreed that Bin 15 should remain to preserve the overall standardization of the structure of the data, and that the value reported by this bin should always be 0 for these vehicles. Therefore, staff is proposing to amend this subsection to make this clear.

Section 1968.2(h): Monitoring System Demonstration Requirements For Certification

Subsection 1968.2(h)(2.2.1)

Purpose: The proposed new subsection would indicate that for vehicles with PM filter monitors meeting Option 2 in Table 3 at the beginning of section (f) or in subsection (f)(9.2.1)(A)(ii)e.2. that do not have deficiencies for not meeting Option 2 or the minimum acceptable ratio in section (d)(3.2.1)(F)(vi), the manufacturer would be allowed to use one of the following options (but not both):
Option A: For each test group that meets Option 2 on 2026 through 2028 model year vehicles, the manufacturer may exclude one test group from the

total number of test groups being certified for one of the following two model years – this is specifically for determining the number of vehicles to perform durability demonstration vehicle testing on, as described in subsection (h)(2.2). For example, a manufacturer certifying a test group that meets Option 2 in the 2027 model year may exclude one test group from the total count of test groups being certified in either the 2028 model year or the 2029 model year. One test group would be excluded from the total number for each test group with a PM filter filtering performance monitor certified to Option 2 for the current model year. Option A, however, would require that at least one vehicle is tested for the model year the option is applied.
Option B: Manufacturers may use the provision under section (k)(7.3.2), which would allow manufacturers an additional "free" deficiency if the manufacturer is certifying a test group with deficiencies for that model year. This would be applicable for the 2026 through 2028 model years. For example, a test group meeting Option 2 in the 2027 model year may be granted a deficiency that is exempt from the specific fines and excluded from the count of deficiencies for the 2027 model year.

Rationale: The proposed amendments are needed to address manufacturers' concerns about the PM filter monitors. Refer to the rationale for subsection (f)(9.2.1)(A) above.

Subsection 1968.2(h)(3.9)

Purpose: The proposed amendment to this subsection would modify the language to include subsection (e)(11.2.3)(A)(ii) as a cold start emission reduction strategy monitor required to be tested under subsection (h)(3).

Rationale: The proposed amendments are needed to account for the new emission threshold monitoring requirements being proposed for the gasoline cold strategy emission reduction strategy monitors in subsection (e)(11.2.3)(A)(ii). Since testing under section (h) is required for all emission threshold monitors, this newly proposed monitor would need to be included.

Subsection 1968.2(h)(4.1)

Purpose: The proposed amendment to this subsection would require manufacturers to perform DDV testing of the NMHC catalyst feedgas generation performance monitor described in subsection (f)(1.2.3)(B)(ii). The manufacturer would be required to perform the test with the catalyst(s) deteriorated to the applicable malfunction limit(s) established by the manufacturer and calibrated to the emission threshold malfunction criteria in subsection (f)(1.2.3)(B)(ii).

Rationale: The proposed amendment is needed to account for the newly proposed emission threshold monitor for the NMHC catalyst feedgas

generation performance in subsection (f)(1.2.3)(B)(ii). As described above in subsection (f)(1.2.3)(B), for 2025 and subsequent model year vehicles, staff is proposing amendments to require the OBD II system to detect NMHC converting catalyst feedgas generation performance malfunctions before specific emission thresholds are exceeded. For monitors tied to an emission thresholds, the manufacturer is required to demonstrate that the OBD II system is capable of detecting the malfunction before emissions exceed the applicable thresholds in accordance with the DDV testing requirements of section (h).

Subsection 1968.2(h)(4.9)

Purpose: The proposed amendment to this subsection would require manufacturers to perform DDV testing of the catalyzed PM filter feedgas performance monitor described in subsection (f)(9.2.4)(B)(ii). The manufacturer would be required to perform the test with the catalyzed PM filter deteriorated to the applicable malfunction limit calibrated to the emission threshold malfunction criteria in subsection (f)(9.2.4)(B)(ii).

Rationale: The proposed amendment is needed to account for the newly proposed emission threshold monitor for the catalyzed PM filter feedgas generation performance in subsection (f)(9.2.4)(B)(ii). As described above in subsection (f)(9.2.4)(B), for 2025 and subsequent model year vehicles, staff is proposing amendments to require the OBD II system to detect catalyzed PM filter feedgas generation performance malfunctions before specific emission thresholds are exceeded. For monitors tied to an emission threshold, the manufacturer is required to demonstrate that the OBD II system is capable of detecting the malfunction before emissions exceed the applicable thresholds in accordance with the DDV testing requirements of section (h).

Subsection 1968.2(h)(4.10)

Purpose: The proposed amendment to this subsection would change "(f)(12.2.2)" to "(f)(12.2.1)(B)".

Rationale: The proposed amendments are needed to account for the proposed renumbering in subsection (f)(12).

Subsection 1968.2(h)(5.2.3)

Purpose: The proposed amendment to this subsection would modify the language to indicate that the manufacturer may request Executive Officer approval to operate the vehicle on an additional test cycle or other driving conditions prior to running the exhaust emission test, not prior to implantation of the fault.

Rationale: The proposed amendment is needed to correct an error. Subsection (g)(5.2.3) describes the exhaust emission test requirements for durability

demonstration engine testing. This subsection indicates that "Except with Executive Officer approval, the "applicable exhaust emission test" may not include any other test cycle (e.g., any test cycle used to precondition the vehicle specifically for demonstrating compliance with the tailpipe emission standards) prior to running the exhaust emission test cycle." The "except with Executive Officer approval" aspect is supposed to be explained in the following sentence. However, the following sentence erroneously indicated that the manufacturer may request Executive Officer approval to run the additional test cycle/other driving conditions before "implantation of the fault", not before running the exhaust emission test. Therefore, staff is proposing amendments to correct this.

Subsection 1968.2(h)(6.3)

Purpose: The proposed amendment to this subsection would modify the language to indicate that the provisions under this subsection applying to misfire monitors using the misfire malfunction criteria of "one percent as allowed in sections (e)(3.2.2)(A) and (f)(3.2.2)(B)" would include misfire monitors using the misfire malfunction criteria of "five percent."

Rationale: The proposed amendment is needed to correct an error. Specifically, the current language indicated that the requirement in this subsection applied to misfire monitors that use the minimum misfire malfunction criteria of "one percent as allowed in sections (e)(3.2.2)(A) and (f)(3.2.2)(B)." However, while the malfunction criterion specified in subsection (e)(3.2.2)(A) is one percent, the malfunction criterion specified in subsection (f)(3.2.2)(B) is five percent. Therefore, staff is proposing amendments to correct this oversight.

Subsection 1968.2(h)(6.4.1)

Purpose: The proposed amendments to this subsection would set forth that in the case where the MIL first illuminates after emissions exceed the applicable emission threshold malfunction criteria during durability demonstration vehicle testing, for the retest provisions for cases where the monitor activates a default fuel or emission control strategy when a malfunction is detected, the default strategy would need to be an AECD that is disclosed in the application for emissions certification (as required in Part I, section H.4. of the "California 2015 and Subsequent Model Criteria Pollutant Exhaust Emission Standards and Test Procedures and 2017 and Subsequent Model Greenhouse Gas Exhaust Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" as incorporated by reference in section 1961.2, title 13, CCR). Further, the proposed amendments to this subsection would allow manufacturers to use computer modifications to prevent the default fuel or emission control strategy from activating when retesting of a monitored system/component is required (i.e., when the MIL does not illuminate when the system/component is set at its limits during the initial durability demonstration vehicle test). This would be allowed if the manufacturer can demonstrate that

the computer modifications used produce emission results equivalent to the production-level calibration (i.e., emissions data from back-to-back tests of a vehicle with no malfunctions installed are equivalent, with one test not using the computer modifications and the other test(s) using the computer modifications). Lastly, the proposed amendments would establish that for catalyst monitors (monitored under subsections (e)(1.2), (f)(1.2.2), (f)(2.2.2), and (f)(8.2.1)) and PM filter system monitors (i.e., subsections (f)(9.2.1) and (f)(9.2.4)(A)), the provisions described under subsection (h)(6.4.1) only apply if the on-board computer invokes a default fuel or emission control strategy when a catalyst or PM filter fault is detected.

Rationale: The proposed amendments are needed to address CARB staff's concerns with the increasing amount of durability demonstration tests that require retesting due to the diagnostic utilizing a default fuel or emission control strategy upon malfunction detection. Specifically, CARB staff is concerned that manufacturers in some cases have conveniently, but inappropriately, calibrated the monitors to activate the default action at the performance level aligned with the OBD malfunction criteria set forth in sections (e) or (f) even though the detected level of malfunction would not damage the engine or component of concern. When the United States Environmental Protection Agency (U.S. EPA) and CARB review AECDs for compliance, the approval criteria generally used include the determination that the AECD activation is limited to only the conditions necessary and the modulation of the emission control system is limited to the minimum necessary to achieve the stated purpose. Additionally, CARB staff has discovered that many manufacturers have not readily disclosed or justified the default actions as an AECD within the application for emissions certification. As a result, CARB staff is proposing to amend the language of this subsection to ensure that retesting to show compliance with the requirements is limited to default strategies that are AECDs listed in the application for emissions certification. The proposed regulation language references specific sections of the test procedure "California 2015 and Subsequent Model Criteria Pollutant Exhaust Emission Standards and Test Procedures and 2017 and Subsequent Model Greenhouse Gas Exhaust Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" (and associated title 13 CCR section 1961.2), since that section requires manufacturers to meet 40 Code of Federal Regulations 86.1844-01(d)(11), which in turn requires the manufacturer to include the AECD information in their applications for emissions certification.

Additionally, this subsection states that for any durability demonstration vehicle test in which a default fuel or emission control strategy is used when a malfunction is detected and the MIL does not illuminate prior to emissions exceeding the applicable emission threshold malfunction criteria, manufacturers are required to retest and collect emission data with a worst acceptable limit component or system. The purpose was to address default fuel or emission

control strategies that negatively affect the emission control system (which may result in emission levels above the OBD emission threshold) and to ensure that emissions do not exceed the OBD emission threshold when the component/system is performing better than a best performing unacceptable part, when such a default strategy is not triggered and the MIL is not illuminated. Manufacturers have requested that they be allowed to use computer modifications to prevent the default fuel or emission control strategy from activating during the retest, similar to what is allowed in the HD OBD regulation. CARB staff agrees that similar provisions should be allowed in the OBD II regulation, but believes the language in the HD OBD regulation needs further changes to address confusion about what is required from the manufacturer to be able to use the allowance. Staff's proposal would require manufacturers to perform the following tests:

1) An emission test with no malfunction (i.e., with a healthy, full useful life system) using the production software and with no computer modifications (i.e., without the computer modifications designed to deactivate the default strategy).
2) An emission test with no malfunction (i.e., healthy, full useful life system) using the prototype software with computer modifications designed to deactivate the default strategy.
3) An emission test with a malfunctioning threshold part using the prototype software with computer modifications designed to deactivate the default strategy – this test should have the default strategy(ies) deactivated.

The emission results from Test 1) and Test 2) would be compared to each other, with similar emission results ensuring that the prototype software with the computer modifications (i.e., that the software changes made to deactivate the default action(s)) do not change anything else in the emission control system. Test 3) would be used to determine if the monitor is able to detect a fault before emissions exceed the emission threshold.

The proposed amendments specific to the catalyst and PM filter monitors are needed to address confusion about the language. This subsection describes the procedure that must be taken when the MIL does not illuminate when the malfunction is set at the limits during demonstrating testing for all monitors. This includes procedures for monitors of systems/components where a default fuel or emission control strategy is used when a malfunction is detected. Manufacturers, however, mistakenly believed the requirements of this subsection (including the retest procedures related to the default strategy) only applied to the catalyst and PM filter monitors. The proposed changes are needed to make clear that the requirements of subsection (h)(6.4.1) applied to all monitors, except that for the catalyst and PM filter monitors, the requirements of the subsection apply only if a default strategy is invoked after detection of a catalyst or PM filter malfunction.

Subsections 1968.2(h)(6.4.1) and (h)(6.4.3)

Purpose: The proposed amendment to subsection (h)(6.4.1) would not require manufacturers to meet subsection (h)(6.4.1) if they meet subsection (h)(6.4.3). The proposed subsection (h)(6.4.3) would indicate that for monitors of VVT systems with discrete operating states (e.g., two step valve train systems) that are not required to detect a malfunction prior to exceeding the threshold but are required to detect all failures that exceed the threshold, if the MIL does not illuminate when the VVT system is tested using the worst case failure mode, the OBD system is not acceptable.

Rationale: Subsection (h)(6.4.1) currently requires additional testing if the monitor is unable to detect a fault and illuminate the MIL before emissions exceed the required thresholds. These criteria do not fit the case of VVT systems with discrete operating states, which are not required to detect faults and illuminate the MIL before emissions exceed the threshold. Thus, staff is proposing changes to address these systems.

Section 1968.2(i): Certification Documentation

Subsection 1968.2(i)(2.32)

Purpose: The proposed amendments to this subsection would split up the subsection, with subsection (i)(2.32.1) applying to engine dynamometer-based testing and subsection (i)(2.32.2) applying to chassis dynamometer-based testing. Subsection (i)(2.23.1) would set forth that the FTP cycle applicable to medium-duty engines certified on an engine dynamometer must be used for engine dynamometer-based testing. For chassis dynamometer-based testing, subsection (i)(2.23.2) would allow manufacturers the option to use the FTP cycle applicable to medium-duty vehicles certified on a chassis dynamometer (i.e., the FTP-72 cycle or LA-4 cycle).

Rationale: The proposed amendments are needed to make the language easier to read and to add a chassis test cycle option that was requested by manufacturers. Subsection (i)(2.32) describes the instantaneous NOx mass emission rate data that manufacturers are required to submit as part of the certification documentation for 2022 and subsequent model year medium-duty vehicles equipped with diesel engines. The requirement applies to all medium-duty diesel vehicles: those that are certified to an engine dynamometer standard as well as those that are certified to a chassis dynamometer standard. While the current language provides test cycle options for both engine and chassis dynamometer-based testing, it needs to be improved to avoid confusion about which testing path each type of vehicle must follow. Manufacturers have also requested that the more familiar FTP-72/LA-4 chassis cycle be added as an acceptable test cycle due to lack of experience with the heavy-duty Urban Dynamometer Driving Schedule chassis cycle, which is currently allowed as an

option in subsection (i)(2.32). Staff has determined that testing with the FTP-72/LA-4 cycle is an acceptable alternative given its widespread use as an official certification test cycle and proposes that it be added to the language accordingly.

Subsections 1968.2(i)(2.34) and (i)(2.35)

Purpose: The proposed amendments would renumber subsection (i)(2.34) to (i)(2.35) and add new certification documentation requirements to subsection (i)(2.34). Specifically, subsection (i)(2.34) would require manufacturers to include in the certification documentation the data required under subsection (f)(5.2.2)(D)(i) for the NOx sensor monitoring capability diagnostic.

Rationale: The proposed amendments are needed to accommodate the newly proposed test data requirement for the NOx sensor monitor in subsection (f)(5.2.2)(D).

Section 1968.2(j): Production Vehicle Evaluation Testing

Subsection 1968.2(j)(2.1)

Purpose: The proposed amendment to this subsection would extend the deadline for manufacturers to conduct the required testing under subsection (j)(2) and submit the results to the Executive Officer. Specifically, the deadline would be extended from 6 months to 9 months after the start of production.

Rationale: The proposed amendment is needed to address manufacturers' concerns about the PVE testing required under subsection (j)(2). Currently, manufacturers are required to perform this testing and submit the testing results on 2 to 6 vehicles per model year within 6 months after the start of production. Manufacturers have expressed difficulty in meeting the current 6-month deadline for completing the required testing considering the significant increase of monitors in their OBD II systems over the years. Further, they indicated that the recent inclusion of required testing of emissions neutral diagnostics and a subset of permanent fault codes added to the testing burden. Therefore, manufacturers have requested relaxations to the test requirements to ease the amount of work required to meet this subsection, including extending the deadline for completion of the testing from 6 months to 9 months after the start of production. While staff believes that this testing is important for ensuring that OBD II systems are working properly in-use (i.e., are able to detect emissions-related malfunctions, store faults codes, and illuminate the MIL in-use), staff also understands the manufacturers' concerns about the amount of work and testing required. Therefore, staff is proposing to modify this subsection to extend the deadline for completing the tests and reporting the results from 6 months to 9 months after the start of production, as manufacturers requested. Staff is also proposing relaxations to the testing

requirements themselves, which will be covered below in subsection 1968.2(j)(2.3.1).

Subsection 1968.2(j)(2.3.1)

Purpose: The proposed amendments to this subsection would decrease the amount of testing required. For testing of emissions neutral diagnostics on all test vehicles, the proposed amendments to subsection (j)(2.3.1)(A) would require manufacturers to test only diagnostics for components/systems that provide inputs to or receives commands from major monitors. For vehicles from test groups that are not selected for DDV testing in section (h), in lieu of the current requirements under subsection (j)(2.3.1) requiring testing of each individual diagnostic, the proposed amendments in subsection (j)(2.3.1)(B) would require manufacturers to test a specific subset of monitors. Specifically, the manufacturer would be required to test all monitors covered by sections (e)(1) through (e)(8), (e)(11) through (e)(14), (e)(16), (f)(1) through (f)(9), (f)(12) through (f)(14), and (f)(16) (i.e., "major monitors") and 400 other monitors that are not major monitors. The 400 monitors would be chosen at random by the manufacturer and would not include any monitor that was determined by the Executive Officer to be exempt from testing under subsection (j)(2.3.6).

Rationale: The proposed amendments are needed to address manufacturers' concerns about the PVE testing required under subsection (j)(2). As already described above in subsection (j)(2.1), manufacturers have expressed concern about the amount of testing required under subsection (j)(2) and requested relaxations to the required testing. Manufacturers requested that CARB decrease the number of vehicles to be tested per model year, cap the number of monitors to be tested per year at 400 for each vehicle, require testing of all major monitors and half of the comprehensive component monitors, and require testing of only emission neutral diagnostics that provide inputs to or receives commands from (i.e., are outputs of) major monitor. Though staff agreed that relaxations are needed, staff does not agree with the degree of testing reductions proposed by industry. Considering the testing under subsection (j)(2) was first adopted to address several issues found in-use regarding noncompliant OBD systems, staff believes this testing is very important and should provide enough coverage of the OBD system such that there is less chance for noncompliant OBD systems on in-use vehicles. Therefore, while staff is proposing amendments that would relax the testing requirements, most of these test relaxations would only apply to the test vehicles that are selected for PVE testing under subsection (j)(2) but not selected for DDV testing under section (h). Test vehicles from test groups that were also selected for DDV testing under section (h) would still be required to meet the current testing requirements under subsection (j)(2). Staff believes these relaxations, in addition to the proposed deadline extension in subsection (j)(2.1), would provide enough time for manufacturers to complete the testing

as well as significantly reduce the amount of testing manufacturers would be required to perform each year.

Subsection 1968.2(j)(2.3.5)

Purpose: The proposed amendments to this subsection, which requires manufacturers to submit a test plan for Executive Officer approval, would require manufacturers to include a description of the method used to determine the 400 diagnostics to test under subsection (j)(2.3.1)(B)(ii). The Executive Officer would approve the method if it results in a random selection of diagnostics and does not purposely exclude specific diagnostics other than those mentioned under section (j)(2.3.1)(B)(i).

Rationale: The proposed amendment is needed to account for the proposed amendments to subsection (j)(2.3.1), which would require manufacturers to test the "major monitors" described in subsection (j)(2.3.1)(B)(i) as well as 400 other monitors under subsection (j)(2.3.1)(B)(ii). While the proposed requirement in subsection (j)(2.3.1)(B)(ii) would require the 400 diagnostics to be selected at random by the manufacturer, CARB staff wanted to ensure that the diagnostics were indeed selected at random and did not purposely exclude specific diagnostics due to various reasons (e.g., exclude diagnostics that were harder to run and complete, diagnostics that were already tested in the previous model year). Therefore, staff proposed the amendments to subsection (j)(2.3.5) to ensure that the method used by the manufacturer to select the 400 diagnostics is documented and able to be reviewed by CARB staff to ensure the selection process is indeed random.

Subsection 1968.2(j)(3.2.3)

Purpose: This newly proposed subsection would allow manufacturers to submit an alternate vehicle identifier other than the VIN as part of the required data submission, provided the manufacturer can demonstrate that the alternate identifier is unique for each vehicle, and a specific VIN always has the same alternate vehicle identifier. The manufacturer would also be required to provide the VIN for a specific alternate vehicle identifier upon request from the Executive Officer.

Rationale: The proposed amendments to this subsection are needed to address manufacturers' concerns about the proprietary nature of the VIN. Subsection (j)(3) currently requires manufacturers to submit in-use monitor performance data from in-use vehicles, which are required to include the VIN of each vehicle the data is collected from. Specifically, manufacturers have indicated that since the VIN is considered by some manufacturers as personally identifiable information, collecting VIN information from customers would require significant additional consumer consent. Therefore, manufacturers have requested that they be able to report an alternate identifier of a vehicle in lieu

of the VIN in their data submission. Since the purpose of the VIN was to ensure that data are collected from different vehicles (and thus not repeated in the data submission), staff agreed to allow an alternate identifier. The proposed amendment requiring manufacturers to provide the actual VIN for a specific vehicle identifier upon request is needed in case CARB staff needs to identify the specific vehicle for various reasons (e.g., need to retrieve the vehicle for possible future enforcement cases).

Section 1968.2(k): Deficiencies

Subsections 1968.2(k)(4.1) and (k)(4.2)

Purpose: The proposed amendment to subsection (k)(4.1), which currently indicates that the deficiency carry over provisions described in the subsection would apply for all deficiencies "except for deficiencies associated with PM filter monitoring section (f)(9.2.1)(A)," would indicate that the provisions for deficiencies associated with this PM filter monitoring section are located in subsection (k)(4.2). The proposed amendment to subsection (k)(4.2), which describe the carry over provisions for deficiencies associated with the PM filtering monitoring requirements in subsection (f)(9.2.1)(A), would indicate the provisions apply to deficiencies first granted before the 2010 model year. Additionally the proposed amendment to subsection (k)(4.2) would change the term "Executive" to "Executive Officer."

Rationale: The proposed amendments are needed to address confusion and correct errors. The language in subsection (k)(4.1) did not clearly indicate where the provisions for deficiencies related to PM filter monitors (subsection (f)(9.2.1)(A)) were located. Therefore, staff indicated the provisions were located in subsection (k)(4.2). Concerning subsection (k)(4.2), the provisions in this subsection were originally added into the regulation in 2010 to address issues with manufacturers unable to meet the final stringent malfunction threshold required for the PM filter filtering performance monitor in 2013. Specifically, this provision was included to allow such manufacturers to certify their 2013 model year OBD II systems with a PM filter monitor deficiency in cases where the manufacturer had already exceeded the 3-year deficiency carry-over limit for the deficiency as described in subsection (k)(4.1) (i.e., for manufacturers with a PM filter monitor deficiency that was original granted in the 2009 model year or earlier). Further, subsection (k)(4.3), which indicates that a deficiency for a monitor that does not meet the required emission threshold in a specific model year will be considered a new and different deficiency in another model year when the required emission threshold is different (and thus "reset" the deficiency carry-over clock), was not adopted at that time. However, while subsection (k)(4.2) indicated a manufacturer may carry over a PM filter monitor deficiency "up to and including the 2013 model year," it was not clear this provision only applied to deficiencies that were originally granted prior to the 2010 model year. Therefore, the language was misinterpreted to prohibit any

carry over of PM filter monitor deficiencies past the 2013 model year, which was not the intent. Therefore, staff is proposing amendments that would make clear that the provisions of subsection (k)(4.2) apply to PM filter filtering performance monitor deficiencies that were originally granted prior to the 2010 model year. The proposed amendment to subsection (k)(4.2) regarding the term "Executive" is needed to correct an error, since the appropriate term is "Executive Officer."

Subsection 1968.2(k)(6.1)

Purpose: The proposed amendment to this subsection would extend the deadline for manufacturers to request retroactive deficiencies for issues found during PVE testing required under subsection (j)(2), with the deadline extended from 6 months to 9 months after the start of normal production.

Rationale: The proposed amendments are needed to align with the proposed amendments to subsection (j)(2.1), which would extend the deadline for the PVE testing and submittal of testing results from 6 months to 9 months after the start of normal production to address manufacturers' concerns about meeting the current deadline.

Subsection 1968.2(k)(7.3)

Purpose: The proposed subsection would indicate that for the PM filter filtering performance monitor, vehicles using Option 2 in Table 3 at the beginning of section (f) or in section (f)(9.2.1)(A)(ii)e.2. for the PM emission threshold and that do not have deficiencies for not meeting Option 2 or the minimum acceptable ratio in section (d)(3.2.1)(F)(vi) would be allowed to use one of the following options (but not both):

Option A: The manufacturer may use the provisions of subsection (h)(2.2.1)(A), which indicates that for each test group that meets Option 2 on 2026 through 2028 model year vehicles, the manufacturer may exclude one test group from the total number of test groups being certified for one of the following two model years – this is specifically for determining the number of vehicles to perform durability demonstration vehicle testing on, as described in subsection (h)(2.2). Option A, however, would require that at least one vehicle is tested for the model year that the Option A provision is applied.

Option B: Manufacturers would be allowed an additional "free" deficiency if the manufacturer is certifying a test group with deficiencies for that model year. This would be applicable for the 2026 through 2028 model years. For example, a test group meeting Option 2 in the 2027 model year may be granted a deficiency that is exempt from the specific fines and excluded from the count of deficiencies for the 2027 model year.

Rationale: The proposed amendments are provided to incentivize manufacturers to meet the more stringent PM filter monitor thresholds earlier than required. Refer to the rationale for subsection (f)(9.2.1)(A) above.

D. OTHER PROPOSED AMENDMENTS TO HD OBD REGULATION SECTION 1971.1

Section 1971.1(d): General Requirements

Subsection 1971.1(d)(3.2.2)(B)

Purpose: The proposed amendments would split this subsection into two subsections, (d)(3.2.2)(B)(i) and (ii), with subsection (d)(3.2.2)(i) containing a newly proposed minimum acceptable IUMPR of 0.100 for diesel CWS monitors and subsection (d)(3.2.2)(ii) containing the current IUMPR requirement. The proposed amendment to the current requirement in subsection (d)(3.2.2)(B)(ii) would change "monitors" to "other monitors."

Rationale: The proposed amendments are needed to accommodate the proposed amendments to the cold start emission reduction strategy monitoring requirements, which would require a minimum acceptable IUMPR of 0.100 for the diesel CWS monitor. The proposed amendment to add "other" in subsection (d)(3.2.2)(B)(ii) is needed to set forth that the current ratio in this subsection applies to monitors "other" than the diesel CWS monitor.

Subsections 1971.1(d)(4.3.2)(N)

Purpose: The proposed amendments would renumber previous subsection (d)(4.3.2)(M) to (d)(4.3.2)(N).

Rationale: The proposed amendment is needed to accommodate the newly proposed requirement in subsection (d)(4.3.2)(M) for the diesel cold start emission reduction strategy CWS monitor.

Section 1971.1(e): Monitoring Requirements for Diesel/Compression-Ignition Engines

Subsections 1971.1(e)(2.2.2) and (e)(2.3.3)

Purpose: The proposed amendments to these subsections would change the wording of the last year for the phase-in schedules. The proposed amendment to subsection (e)(2.2.2), which requires diesel engines to detect a malfunction when the percentage of misfire is 5 percent or above, would state that 100 percent of 2018 and subsequent model year diesel engines (not 100 percent of 2018 model year diesel engines) would be required to meet this subsection. The proposed amendment to subsection (e)(2.3.3), which requires monitoring of misfire over almost all positive torque engine speed conditions, would state

that 100 percent of 2021 and subsequent model year diesel engines (not 100 percent of 2021 model year diesel engines) would be required to meet this subsection.

Rationale: The proposed amendments are needed to correct errors in the regulation language. Specifically, during the 2012 OBD rulemaking update, staff mistakenly wrote language indicating that the requirements of subsection (e)(2.2.2) applied to 100 percent of "2018 model year diesel engines," and that the requirements of subsection (e)(2.3.3) applied to 100 percent of "2021 model year diesel engines." While the intent was to ensure all later vehicles also met the requirements, which was understood by industry based on the numerous discussion between CARB staff and industry, staff mistakenly left out the phrase "and subsequent" to these subsections. Therefore, staff is proposing amendments to correct this error.

Section 1971.1(i): Monitoring System Demonstration Requirements for Certification

Subsection 1971.1(i)(3.1.11)

Purpose: The proposed amendment to this subsection would change "(e)(11.2.2)" to "(e)(11.2.1)(B)".

Rationale: The proposed amendments are needed to account for the proposed renumbering in subsection (e)(11).

Subsection 1971.1(i)(3.2.4)

Purpose: The proposed amendment to this subsection would modify the language to include subsection (f)(4.2.3)(A)(ii) as a cold start emission reduction strategy monitor required to be tested under subsection (i)(3).

Rationale: The proposed amendments are needed to account for the proposed renumbering in subsection (f)(4) and account for the new emission threshold monitoring requirements being proposed for the gasoline cold strategy emission reduction strategy monitors in subsection (f)(4.2.3)(A)(ii). Since testing under section (i) is required for all emission threshold monitors, this newly proposed monitor would need to be included.

Subsections 1971.1(i)(5.1.2)(A)

Purpose: For durability demonstration engine testing of monitors where the MIL illuminates prior to emissions exceeding the applicable emission threshold malfunction criteria, the proposed amendments would modify the retest provisions for cases where the monitor activates a default fuel or emission control strategy when a malfunction is detected. The proposed amendment to this subsection would set forth that in the case where the MIL first illuminates

prior to emissions exceeding the applicable emission threshold malfunction criteria during durability demonstration vehicle testing and a default fuel or emission control strategy is used when a malfunction is detected, for the retest provisions, the default strategy would need to be an AECD that is disclosed in the application for emissions certification (as required in as required in Part 86, Subpart I, section 21 of the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines And Vehicles" and Part I section 21 of the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Otto-Cycle Engines and Vehicles," as incorporated by reference in section 1956.8(d), title 13, CCR). The proposed amendment to this subsection would also delete the current regulation language that indicates that the manufacturer may request Executive Officer approval to use computer modifications to disable the default fuel or emission control strategy when retesting the engine if the manufacturer presented data meeting certain criteria. The proposed subsection (i)(5.1.2)(A)(i) would set forth new retest provisions, which would allow manufacturers to use computer modifications to prevent the default fuel or emission control strategy from activating when retesting of a monitored system/component is required. This would be allowed if the manufacturer can demonstrate that the computer modifications used produce emission results equivalent to the production-level calibration (i.e., emissions data from back-to-back tests of an engine with no malfunctions installed are equivalent, with one test not using the computer modifications and the other test(s) using the computer modifications).

Rationale: The proposed amendments are needed to address CARB staff's concerns with the increasing amount of durability demonstration tests that require retesting due to the diagnostic utilizing a default fuel or emission control strategy upon malfunction detection. Specifically, CARB staff is concerned that manufacturers in some cases have conveniently, but inappropriately, calibrated the monitors to activate the default action at the performance level aligned with the OBD malfunction criteria set forth in sections (e) through (g) even though the detected level of malfunction would not damage the engine or component of concern. When U.S. EPA and CARB review AECDs for compliance, the approval criteria generally used include the determination that the AECD activation is limited to only the conditions necessary and the modulation of the emission control system is limited to the minimum necessary to achieve the stated purpose. Additionally, CARB staff has discovered that many manufacturers have not readily disclosed or justified the default actions as an AECD within the application for emissions certification. As a result, CARB staff is proposing to amend the language of this subsection to ensure that retesting to show compliance with the requirements is limited to default strategies that are AECDs that are listed in the application for emissions certification. The proposed regulation language references specific sections of the test procedures "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines And

Vehicles" and "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Otto-Cycle Engines and Vehicles" (and associated title 13 CCR section 1956.8), since that section requires manufacturers to meet 40 Code of Federal Regulations 86.004-21 and 86.007-21, which in turn requires the manufacturer to include the AECD information in their applications for emissions certification.

Additionally, subsection (i)(5.1.2)(A) currently states that retesting using computer modifications to deactivate the default fuel or emission control strategy is allowed if the manufacturer submits data demonstrating that (1) emissions do not exceed the applicable malfunction criteria with the system or component adjusted to the best performing unacceptable level of performance, and (2) the computer modifications used to disable the default fuel or emission control strategy produce emissions results equivalent to the production-level calibration. CARB staff determined that condition (1) should not have been required since these emissions data are not relevant to whether or not the computer modifications are acceptable. Further, the purpose of the retest is to determine if emissions are above or below the malfunction criteria with the default strategy deactivated, so including condition (1) does not make sense. Additionally, CARB staff believes the language in condition (2) needs further changes to address confusion about what is required from the manufacturer. Therefore, the allowance to use computer modifications was moved to proposed subsection (i)(5.1.2)(A)(i), which would require manufacturers to perform the following tests:

1) An emission test with no malfunction (i.e., a healthy, full useful life system) using the production software and with no computer modifications (with the computer modifications designed to deactivate the default strategy).
2) An emission test with no malfunction (i.e., healthy, full useful life system) using the prototype software with computer modifications designed to deactivate the default strategy.
3) An emission test with a malfunctioning threshold part using the prototype software with computer modifications designed to deactivate the default strategy – this test should have the default strategy(ies) deactivated.

The emission results from Test 1) and Test 2) would be compared to each other, with similar emission results ensuring that the prototype software with the computer modifications (i.e., that the software changes made to deactivate the default action(s)) do not change anything else to the emission control system. Test 3) would be used to determine if the monitor is able to detect a fault before emissions exceed the emission threshold.

Subsection 1971.1(i)(5.1.3)(A)

Purpose: The proposed amendment to this subsection would set forth that in the case where the MIL first illuminates after emissions exceed the applicable emission threshold malfunction criteria during durability demonstration vehicle testing, for the retest provisions for cases where the monitor activates a default

fuel or emission control strategy when a malfunction is detected, the default strategy would need to be an AECD that is disclosed in the application for emissions certification (as required in Part 86, Subpart I, section 21 of the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines And Vehicles" and Part I section 21 of the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Otto-Cycle Engines and Vehicles," as incorporated by reference in section 1956.8(d), title 13, CCR). The proposed amendment to this subsection would also delete the current regulation language that indicates that the manufacturer may request Executive Officer approval to use computer modifications to disable the default fuel or emission control strategy when retesting the engine if the manufacturer presented data meeting certain criteria. Further, proposed subsection (i)(5.1.3)(A)(i) would allow manufacturers to use computer modifications to prevent the default fuel or emission control strategy from activating when retesting of a monitored system/component is required (i.e., when the MIL does not illuminate when the system/component is set at its limits during the initial durability demonstration vehicle test). This would be allowed if the manufacturer can demonstrate that the computer modifications used produce emission results equivalent to the production-level calibration (i.e., emissions data from back-to-back tests of an engine with no malfunctions installed are equivalent, with one test not using the computer modifications and the other test(s) using the computer modifications).

Rationale: The proposed amendments are needed to address CARB staff's concerns with durability demonstration tests that require retesting due to the diagnostic utilizing a default fuel or emission control strategy upon malfunction detection. The rationale has been provided in subsection (i)(5.1.2)(A) above.

Section 1971.1(j): Certification Documentation

Subsections 1971.1(j)(2.35) and (j)(2.36)

Purpose: The proposed amendments would renumber subsection (j)(2.35) to (j)(2.36) and subsections (j)(2.35.1) through (j)(2.35.4) to (j)(2.36.1) through (j)(2.36.4), and add new certification documentation requirements to subsection (j)(2.35). Specifically, subsection (j)(2.35) would require manufacturers to include in the certification documentation the data required under subsection (e)(9.2.2)(D)(i) for the NOx sensor monitoring capability diagnostic.

Rationale: The proposed amendments are needed to accommodate the newly proposed test data requirement for the NOx sensor monitor in subsection (e)(9.2.2)(D).

Section 1971.1(k): Deficiencies

Subsection 1971.1(k)(4.4)

Purpose: The proposed amendment would renumber previous subsection (k)(4.3) to (k)(4.4).

Rationale: The proposed amendments are needed to account for the new deficiency allowances for cold start emission reduction strategy monitors proposed in subsection (k)(4.3).

Subsection 1971.1(k)(11)

Purpose: The proposed amendment would renumber previous subsection (k)(10) to (k)(11).

Rationale: The proposed amendments are needed to account for the new deficiency allowances for cold start emission reduction monitors and tracking parameters proposed in subsection (k)(10).

E. PROPOSED AMENDMENTS TO OBD II ENFORCEMENT REGULATION SECTION 1968.5

Section 1968.5(b): Testing Procedures

Subsection 1968.5(b)(1)(D)(iii)d.

Purpose: The proposed amendment to this subsection, which details the vehicle selection criteria for CARB-conducted enforcement testing, would not require the Executive Officer to meet the criterion under this subsection (i.e., not require the Executive Officer to select a vehicle that has a mileage/age equal to or less than the certified full useful life mileage) in cases where the Executive Officer is testing to determine if the OBD II system is designed to deactivate based on age and/or mileage.

Rationale: The proposed change is needed to correct an oversight and to be consistent with section 1968.5(b)(3)(A)(iv), which does not prohibit the Executive Officer from conducting testing on a motor vehicle class whose vehicles, on average, exceed the defined full useful life in cases where the Executive Officer is trying to determine if an OBD II system is designed to deactivate based on age and/or mileage.

Subsection 1968.5(b)(6)(B)(i)

Purpose: The proposed amendment to subsection 1968.5(b)(6)(B)(i)a. would change "1968.2(d)(3.2.1)(D)" to "1968.2(d)(3.2.1)(F)." The proposed amendment to subsection 1968.5(b)(6)(B)(i)b. would change "1968.2(d)(3.2.1)(A) through (C)" to "1968.2(d)(3.2.1)(A), (B) and (E)".

Rationale: The proposed amendments are needed to account for the proposed renumberings in subsection 1968.2(d)(3.2.1).

Subsection 1968.5(b)(6)(B)(ii)

Purpose: The proposed amendment to this subsection would change "1968.2(d)(3.2.1)(A) through (C)" to "1968.2(d)(3.2.1)(A) through (F)". The proposed amendment would renumber subsection 1968.5(b)(6)(B)(ii)c. to 1968.5(b)(6)(B)(ii)e. New subsection 1968.5(b)(6)(B)(ii)c. would describe the nonconformance IUMPRs for the PM filter filtering performance and missing substrate monitors and would be as follows:

1. 0.265 for monitors certified to a ratio of 0.300,
2. 0.177 for monitors certified to a ratio of 0.200,
2. 0.133 for monitors certified to a ratio of 0.150, and
3. 0.297 for monitors certified to a ratio of 0.336.

New subsection 1968.5(b)(6)(B)(ii)d. would set a nonconformance IUMPR for the newly proposed diesel CWS monitor (subsection 1968.2(f)(12.2.2)).

Rationale: The proposed amendments related to the renumbering of the subsection references are needed to account for the proposed renumberings in subsection 1968.2(d)(3.2.1). The other proposed amendments are needed to account for the new minimum acceptable IUMPRs proposed for the PM filter filtering performance and missing substrate monitors and the diesel CWS monitor. The proposed nonconformance ratios for the PM filter monitors in subsection 1968.5(b)(6)(B)(ii)c. are needed since the current nonconformance ratio of 0.296 (in previously numbered subsection 1968.5(b)(6)(B)(ii)c.) only applies to monitors certified to the 0.336 ratio, while ratios other than 0.336 (e.g., 0.150, 0.300) are being proposed for the PM filter monitors in subsection 1968.2(d)(3.2.1)(F)(vi). The proposed nonconformance ratio for the diesel CWS monitor in subsection 1968.5(b)(6)(B)(ii)d. is needed since subsection 1968.2(d)(3.2.1)(D) would set a final ratio of 0.100 for this monitor, but the current nonconformance ratios listed under 1968.5(b)(6)(B)(ii)d. do not account for a final ratio of 0.100.

Subsection 1968.5(b)(6)(C)(ii)

Purpose: The proposed amendment to this subsection, which describes the finding of nonconformance criteria for standardized data, would change "Society of Automotive Engineers" to "SAE International" in subsection

1968.5(b)(6)(C)(ii)a. Regarding the testing to confirm if valid and correct data for the parameters/data listed under the subsection can be obtained, the proposed amendments would indicate that the parameters/data would need to meet either SAE J1979 or SAE J1979-2 specifications and would include details (e.g., Service, PID, InfoType) related to SAE J1979-2.

Rationale: The proposed amendment to change "Society of Automotive Engineers" to "SAE International" is needed since the name was changed since the time this subsection was adopted. The proposed amendment related to the renumbering in subsection 1968.5(b)(6)(C)(ii)b. is needed to account for the proposed renumberings in subsection 1968.2(g)(4.1) and the new requirements proposed for vehicles using SAE J1979-2 in subsection 1968.2(g)(4.1.2). The proposed amendments related to SAE J1979-2 are needed to account for the new proposed requirements applicable to vehicles using SAE J1979-2.

Subsection 1968.5(b)(6)(C)(iii)

Purpose: The proposed amendment to this subsection, which describes the finding of nonconformance criteria for IUMPR data specifications, would change the applicable requirements from "title 13, CCR section 1968.2(d)(4) or (5)" to "title 13, CCR section 1968.2(d)(4) or (5.1) through (5.6)."

Rationale: This subsection indicates the requirements for a finding of nonconformance related to the in-use monitor performance ratio requirements in sections 1968.2(d)(4) and (5). Specifically, this subsection indicates that any noncompliance of the in-use monitor performance ratio data would be presumed to result in an OBD II ratio enforcement test result that would be subject to an ordered recall. The proposed amendment is needed to exclude newly proposed section 1968.2(d)(5.7), which describes the new supplemental monitor activity data that vehicles using SAE J1979-2 are required to implement. Staff determined that the newly proposed data would not affect the OBD II ratio data subject to the mandatory recall criteria, and therefore should not be included in this subsection.

Section 1968.5(c): Remedial Action

Subsection 1968.5(c)(3)(A)(i)

Purpose: The proposed subsection would change "sections 1968.2(d)(3.2.1)(A) through (C)" to "sections 1968.2(d)(3.2.1)(A) through (E)."

Rationale: The proposed amendment is needed to account for the proposed changes and renumberings in subsection 1968.2(d)(3.2.1).

Subsection 1968.5(c)(3)(A)(viii)

Purpose: The proposed subsection would modify the ordered remedial action (i.e., mandatory recall) criteria for monitors of VVT systems with discrete operating states (e.g., two step valve train systems) that are not required to detect a malfunction prior to exceeding the threshold but are required to detect all failures that exceed the threshold. Specifically, when the vehicle is operated so as to reasonably encounter all monitoring conditions disclosed in the manufacturer's certification application, if the monitor for these VVT systems cannot detect and illuminate the MIL for a malfunction, then the vehicle would be subject to mandatory recall.

Rationale: The proposed amendments are needed to address VVT systems that are not required to detect a malfunction before emissions exceed the required emission thresholds. Specifically, subsections (e)(13) and (f)(13) of section 1968.2 indicate that VVT systems with discrete operating states (e.g., two step valve train systems) are not required to detect a malfunction prior to exceeding the required emission thresholds, but instead are required to detect all failures that exceed the thresholds. The OBD II enforcement regulation currently requires that emission threshold monitors are subject to mandatory recall if they do not detect a fault and illuminate the MIL before emissions exceed specific emission levels, which does not account for these VVT system monitors. Therefore, staff is proposing specific mandatory recall criteria that would apply to these VVT system monitors.

Subsections 1968.5(c)(6)(B)(iv) and (d)(6)(A)

Purpose: The proposed amendments to these subsections would change the division name and mailing address that the manufacturer would be required to submit the remedial action plan and the remedial action progress report to. Specifically, the new address is to the "Chief, Emissions Certification and Compliance Division, CA Air Resources Board, P.O. Box 55009, Riverside, California 92517."

Rationale: The proposed amendments are needed to correct the division name and to indicate the new mailing address.

F. PROPOSED AMENDMENTS TO HD OBD ENFORCEMENT REGULATION SECTION 1971.5

Section 1971.5(b): Testing Procedures for ARB-Conducted Testing

Subsections 1971.5(b)(6)(C)(ii)a. through f.

Purpose: Subsection 1971.5(b)(6)(C)(ii) indicates that engines shall be considered nonconforming if specific data are not valid and correct in accordance to specific standards. The proposed amendments to these

subsections would include SAE J1979-2 as part of these standards. The proposed amendment to subsection 1971.5(b)(6)(C)(ii) b. would change "1971.1(h)(4.1.6)" to "1971.1(h)(4.1.1)(G) or (h)(4.1.2)(E)."

Rationale: The proposed amendments related to the inclusion of SAE J1979-2 are needed to account for the new proposed requirements in section 1971.1 applicable to engines using SAE J1979-2. The proposed amendment in subsection 1971.5(b)(6)(C)(ii)b. is needed to account for the proposed renumbering of subsection 1971.1(h)(4.1.6) to 1971.1(h)(4.1.1)(G) and the proposed new requirements in subsection 1971.1(h)(4.1.2)(E) for engines using SAE J1979-2.

Subsection 1971.5(b)(6)(C)(iii)

Purpose: The proposed amendment to this subsection, which describes the finding of nonconformance criteria for IUMPR data specifications, would change the applicable requirements from "section 1971.1(d)(4) or (5)" to "section 1968.2(d)(4) or (d)(5.1) through (5.6)."

Rationale: This subsection indicates the requirements for a finding of nonconformance related to the in-use monitor performance ratio requirements in sections 1971.1(d)(4) and (5). Specifically, this subsection indicates that any noncompliance of the in-use monitor performance ratio data would be presumed to result in an OBD ratio enforcement test result that would be subject to an ordered recall. The proposed amendment is needed to exclude newly proposed section 1971.1(d)(5.7), which describes the new supplemental monitor activity data that engines using SAE J1979-2 are required to implement. Staff determined that the newly proposed data would not affect the OBD ratio data subject to the mandatory recall criteria, and therefore should not be included in this subsection.

Subsections 1971.5(d)(6)(B)(iv) and (e)(6)(B)

Purpose: The proposed amendments to these subsections would change the mailing address that the manufacturer would be required to submit the remedial action plan and the remedial action progress report to. Specifically, the new address is "CA Air Resources Board, P.O. Box 55009, Riverside, California 92517."

Rationale: The proposed amendments are needed to update the mailing address to the new address.

IV. Benefits Anticipated from the Regulatory Action, Including the Benefits or Goals Provided in the Authorizing Statute

The OBD regulatory proposal will help improve the realization of the emission benefits projected for the light-, medium-, and heavy-duty vehicle programs. The proposal to require OBD systems to provide more information related to emissions-related malfunctions on in-use vehicles would greatly assist technicians in repairing such malfunctions. The clarification of the regulation and modifications to the CSERS monitoring requirements helps streamline the review process for CARB since it is easier to determine compliance with the requirements. Should the OBD proposal not be adopted, the review of OBD system designs would likely result in more time-consuming determination of compliance for CARB and higher costs to manufacturers due to unclear requirements that manufacturers may not be able to meet, with the manufacturer ending up with non-compliance fines or even the inability to certify engines or vehicles for sale in California.

This proposal will greatly improve the reliability of the emission benefits expected from the light-, medium-, and heavy-duty vehicle programs. For example, the LEV III program emission benefits are based upon effective OBD II, emission warranty, and Smog Check programs. While the LEV III program sets stringent tailpipe and evaporative system requirements that require a vehicle's tailpipe emission levels to be durable for up to 150,000 miles, there is no assurance these emission levels will be maintained in-use for the required mileage and beyond until the vehicle is retired. As previously mentioned in this Staff Report, the OBD II and HD OBD regulations require all emission controls on an engine/vehicle to be monitored for proper performance. For emission control components that can affect emissions by large amounts when they fail, the OBD system must detect a malfunction before emissions exceed a certain emission threshold. While the OBD system can alert the vehicle operator to a problem by requiring illumination of the MIL on the vehicle's instrument panel, it does not force the vehicle operator to repair the malfunction. I/M programs such as the Smog Check program for light- and medium-duty vehicles, however, do require the vehicle operator to repair the malfunction detected by the OBD system. If there was no OBD program, both Smog Check and programs such as the LEV III program would not be as effective at keeping vehicle emissions low throughout its entire life.

Since the proposal consists mainly of changes to clarify the OBD requirements, add some streamlining and flexibility features, and require more collection of data from the vehicles/engines, the proposal is not expected to significantly change the emission benefits that were calculated during the 2009 HD OBD

regulatory process[1]. Specifically, HD OBD was calculated to generate a statewide benefit of 1.5 tons/day (tpd) of ROG, 109 tpd of NOx, and 0.6 tpd of PM in calendar year 2020. The lifetime cumulative emission reductions for HD OBD, on a per engine basis, were calculated to be 165 pounds of ROG, 2000 pounds of NOx, and 14 pounds of PM. Similarly, regarding the proposed amendments to the OBD II regulation, the proposal is also not expected to change the emission benefits that were calculated in the 2012 LEV III Staff Report[2].

The OBD proposal is also expected to provide consumer benefits that are difficult to quantify. Since the OBD system is constantly monitoring the emission control components on engines/vehicles, consumers are expected to benefit from more durable engines/vehicles because manufacturers would specify more durable emission control components in their engine/vehicle designs to avoid customer dissatisfaction from frequent MIL illuminations resulting from premature emission control component failures. The proposal to require the OBD systems to provide more information related to emissions-related malfunctions is expected to greatly benefit consumers. Specifically, consumers benefit from how the OBD system can provide engine/vehicle repair technicians with information pinpointing the likely component causing a MIL to be illuminated. This quick identification of the malfunctioning component results in quicker diagnosis and repair of engines/vehicles, which should also result in lower repair costs. The improved standardized OBD information also provides for more rigorous Smog Check inspections and improves repair technicians' and vehicle operators' ability to get a vehicle ready for re-inspection post repair. Malfunctions found by the OBD system when the emissions warranty or new vehicle/engine warranty is effective will also benefit consumers by effectively documenting the failure with a corresponding MIL and other information for easier reporting of malfunctions and subsequent reimbursement for repairs. The benefits of the regulations become increasingly important as certification levels become more and more stringent and as a single malfunction has an increasingly greater impact on air quality relative to certification levels.

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[1] Staff Report: Initial Statement of Reasons for Proposed Rulemaking: Technical Status and Revisions to Malfunction and Diagnostic System Requirements for Heavy-Duty Engines (HD OBD) and Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines (OBD II), April 10, 2009. https://ww3.arb.ca.gov/regact/2009/hdobd09/obdisor.pdf

[2] Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Public Hearing to Consider the "LEV III" Amendments to the California Greenhouse Gas and Criteria Pollutant Exhaust and Evaporative Emission Standards and Test Procedures and to the On-Board Diagnostic System Requirements for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles, and to the Evaporative Emission Requirements for Heavy-Duty Vehicles, December 7, 2011. https://www.arb.ca.gov/regact/2012/leviiighg2012/levisor.pdf

V. Air Quality

The proposed amendments to the OBD regulations are not expected to provide significant direct emissions reduction benefits. Specifically, the proposed amendments are not expected to significantly reduce emissions beyond what is required of the current OBD programs. As stated above, the proposal would help improve the realization of the emission benefits expected from existing light-, medium-, and heavy-duty programs.

VI. Environmental Analysis

A. Introduction

This chapter provides the basis for CARB's determination that the proposed amendments are exempt from the requirements of CEQA. A brief explanation of this determination is provided in section B below. CARB's regulatory program, which involves the adoption, approval, amendment, or repeal of standards, rules, regulations, or plans for the protection and enhancement of the State's ambient air quality, has been certified by the California Secretary for Natural Resources under Public Resources Code section 21080.5 of the California Environmental Quality Act (CEQA) (14 CCR 15251(d)). Public agencies with certified regulatory programs are exempt from certain CEQA requirements, including but not limited to, preparing environmental impact reports, negative declarations, and initial studies. CARB, as a lead agency, prepares a substitute environmental document (referred to as an "Environmental Analysis" or "EA") as part of the Staff Report prepared for a proposed action to comply with CEQA (17 CCR 60000-60008). If the amendments are finalized, a Notice of Exemption will be filed with the Office of the Secretary for the Natural Resources Agency for public inspection.

B. Analysis

CARB staff has determined that the proposed amendments are categorically exempt from CEQA under the "Class 8" exemption (14 CCR 15308) because it is an action taken by a regulatory agency for the protection of the environment. A few of the proposed amendments merely provide clarifying language to the existing requirements manufacturers are currently required to meet on their vehicles.

Some of the proposed amendments would relax a few requirements in the OBD II regulation. First, the proposed amendments would modify the criteria used to determine if manufacturers are required to monitor the feedgas generation performance of NMHC catalysts and catalyzed PM filters. Currently, manufacturers are required to have a specific monitor to detect these feedgas generation performance malfunctions and specifically identify them as feedgas-related malfunctions. However, there have been technical feasibility issues with

designing such monitors, and current NMHC catalyst and catalyzed PM filter monitors are able to detect such malfunctions, though the monitors would indicate these malfunctions as NMHC catalyst and catalyzed PM filter NMHC conversion efficiency malfunctions instead of feedgas generation malfunctions. Therefore, staff proposed to allow manufacturers to be exempt from designing specific feedgas generation monitors if they already implement the catalyst/catalyzed PM filter monitors. For virtually all manufacturers, this would require no changes to the OBD systems since they would already be meeting this new amendment. Second, the proposal would reduce the amount of monitors required to be tested on production vehicles as well as extend the deadline for completing the testing (from 6 months to 9 months after the start of production). This reduction of testing, however, is not expected to negatively impact emissions, given that the required testing would still cover all the important monitors for emission-related components that have the most impact on emissions and a great percentage of the remaining monitors. None of these changes adversely affects emissions benefits in the interim.

The vast majority of the proposed amendments would establish more stringent requirements that OBD systems on vehicles would be required to meet. For both the OBD II and HD OBD regulations, the proposed amendments would require the vehicle's on-board computer to store and report more information related to emissions-related faults and OBD system performance, which would assist technicians in diagnosing and repairing emission-related malfunctions and assist CARB staff in determining if OBD systems are working properly in-use. Manufacturers would be expected to incorporate software changes and possibly hardware changes to add more memory to the vehicles' on-board computers to meet these new requirements. Additionally, CARB staff is proposing amendments to the PM filter monitoring requirements in the OBD II regulation which will ultimately be more stringent overall than the current requirements, even though there is a relaxation in the interim years. Specifically, PM filters are currently required to run in-use at a minimum frequency stated in the regulation, with the final stringent minimum frequency required to be met in the 2019 model year for medium-duty vehicles certified to an engine dynamometer standard and the 2022 model year for light-duty and medium-duty vehicles certified to a chassis dynamometer standard. While these requirements are considered technically feasible, there were delays in the development of the technology which prevented manufacturers from implementing the requirements within the required deadlines. The proposed amendments would delay the final stringent requirement until a later model year (2026 or 2029, depending on the vehicle) as well as relax the final minimum frequency. However, to ensure that PM emissions impact will not be negatively impacted, the proposal would also require manufacturers to detect a PM filter malfunction at a lower emission threshold than what is currently required in the regulation in conjunction with this relaxation of the minimum required monitoring frequencies. By requiring PM filter malfunctions to be detected at

lower emission thresholds, the proposal would enable OBD systems to detect deteriorated PM filters earlier than the current requirements, thereby helping keep PM emissions low in-use. Additionally, in both the HD OBD and OBD II regulations, the proposal would modify the CSERS monitoring requirements to more clearly indicate what exactly needs to be detected as malfunctions. Further, for diesel vehicles, the proposal would require these vehicles to implement new data that would track CSERS-related activities in-use. For these new proposed PM filter and CSERS monitoring requirements, manufacturers would need to modify their monitoring strategies (either by modifying the existing monitors or implementing new monitors) and modify the software to implement the new trackers.

These amendments will encourage manufacturers to design and build more durable, cleaner vehicles to comply with the requirements. The proposed OBD amendments will help ensure that previously forecasted emission reduction benefits from adopted light-, medium-, and heavy-duty vehicles and engine emission standards programs are achieved. The proposed amendments are expected to accomplish this goal by achieving these emission benefits in two distinct ways: first, to avoid customer dissatisfaction caused by frequent illumination of the MIL due to emission-related malfunctions, it is anticipated that the manufacturers will produce increasingly durable, more robust emission-related components; and second, by alerting vehicle operators of emission-related malfunctions and providing precise information to the service industry for identifying and repairing detected malfunctions, thereby help ensuring that emission systems will be quickly repaired. The benefits of the regulations become increasingly important as certification emission levels become more and more stringent, and a single malfunction has an increasingly greater air quality impact relative to the vehicle's certification level.

CARB staff has also determined that the proposed amendments are categorically exempt from CEQA under the "Class 6" exemption (14 CCR 15306) because it is an action taken for purposes of data collection which does not result in serious or major disturbances to an environmental resource. The OBD regulations currently require manufacturers to submit specific data related to the OBD system performance from in-use vehicles. As mentioned above, the proposal would require vehicles to store additional data related to the OBD system performance of heavy-duty engines. These additional data would be part of the data submitted by manufacturers to CARB staff, which would help CARB staff determine if the OBD systems are working properly on in-use vehicles.

Based on the above, CARB staff has determined that the proposed action involves collection of data and is designed to protect the environment and would ensure the emission benefits of the light-, medium-, and heavy-duty programs are realized. CARB has determined there is no substantial evidence indicating the proposal could adversely affect air quality or any other

environmental resource area, or that any of the exceptions to the exemption applies (14 CCR 15300.2); therefore, this activity is exempt from CEQA.

VII. Environmental Justice

State law defines environmental justice as the fair treatment and meaningful involvement of people of all races, cultures, incomes, and national origins, with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies (Gov. Code, § 65040.12, subd. (e)(1)). Environmental justice includes, but is not limited to, all of the following: (A) The availability of a healthy environment for all people. (B) The deterrence, reduction, and elimination of pollution burdens for populations and communities experiencing the adverse effects of that pollution, so that the effects of the pollution are not disproportionately borne by those populations and communities. (C) Governmental entities engaging and providing technical assistance to populations and communities most impacted by pollution to promote their meaningful participation in all phases of the environmental and land use decision making process. (D) At a minimum, the meaningful consideration of recommendations from populations and communities most impacted by pollution into environmental and land use decisions (Gov. Code, § 65040.12, subd. (e)(2)). The Board approved its Environmental Justice Policies and Actions (Policies) on December 13, 2001, to establish a framework for incorporating environmental justice into CARB's programs consistent with the directives of State law (CARB 2001). These policies apply to all communities in California, but are intended to address the disproportionate environmental exposure burden borne by low-income communities and communities of color. Environmental justice is one of CARB's core values and fundamental to achieving its mission.

Over the past twenty years, CARB, local air districts, and federal air pollution control programs have made substantial progress towards improving the air quality in California. However, some communities continue to experience higher exposures than others as a result of the cumulative impacts of air pollution from multiple mobile and stationary sources and thus may suffer a disproportionate level of adverse health effects.

Adoption and implementation of the proposed OBD II and HD OBD regulations amendments will not result in any adverse environmental impacts on environmental justice communities. In fact, the proposed amendments would help ensure that emission benefits are achieved both statewide and in environmental justice communities. By providing more information about emissions-related malfunctions, the proposed UDS-related amendments would help technicians accurately and quickly repair these malfunctions. Considering vehicles, especially heavy-duty vehicles, are known to have great pollution impacts on low-income and minority communities, the proposed amendments are expected to benefit environmental justice communities.

VIII. Economic Impacts Assessment

A. Introduction

The proposed revisions to the OBD II and HD OBD regulations include various updates to the existing requirements. These updates include provisions to implement the UDS features (i.e., SAE J1979-2 protocol), address manufacturers' implementation concerns, and enhance and clarify existing requirements to ensure the integrity of the OBD II and HD OBD systems. In order to determine the economic impact of the proposal, staff assessed the cost impact of each proposed revision.

Some of the proposed revisions are not expected to impact costs because the changes involve the updating and clarifications of existing requirements or only involve software changes which are not expected to impact costs given adequate lead time such that manufacturers can bundle the required software changes when major software work is otherwise required. However, most other proposed changes effectively increase the stringency of the regulations and are projected to increase costs. Several of the proposed changes expected to increase costs are associated with the implementation of the SAE J1979-2 protocol, which include the implementation of 3-byte fault codes, addition of status bits, addition of fault code specific readiness bytes, requirements for fault code specific IUMPR data, requirements for fault code specific test results, expansion of freeze frame data, and addition of supplemental monitor activity data parameters. Other proposed changes expected to increase costs include the addition of data stream parameters for various systems (i.e., fuel pressure, misfire count, EVAP sealing status), the addition of a scan tool commanded EVAP system sealing function, the addition of gasoline stall monitoring, changes to the IUMPR and monitoring requirements for PM filter monitors, modifications to the CSERS monitoring requirements, the addition of diesel CSERS tracking and reporting parameters, modifications to the diesel NOx sensor monitor data submission, and modifications to the diesel catalyst/adsorber malfunction criteria determination requirements.

A few of the proposed changes reduce the stringency of monitoring requirements (e.g., diesel feedgas generation monitoring, PVE testing relaxations), which could result in cost savings to the OBD system manufacturers. Staff included the estimated cost savings for these proposed requirements in this analysis.

Estimating the cost impacts for the proposed modifications to the PM filter IUMPR and monitoring requirements is complex because some parts of the proposed requirements could result in cost increases while the other parts potentially could result in cost reductions. Staff determined that cost reductions are not easily quantifiable because they are associated with IUMPR relaxations which would make compliance easier for manufacturers (e.g., reduced

deficiencies and fines, avoided costs associated with implementing software changes to meet the current, more stringent requirements). On the other hand, staff determined that cost increases can be quantified where they are associated with hardware changes, software development, and testing, so the costs were estimated accordingly.

Tables located in Appendix F provide the cost assessment for many of the specific elements of the proposed modifications to the OBD II and HD OBD regulations. Both cost impacts and cost savings are included. In general, cost savings are minor compared to cost impacts, but nevertheless staff considered both when they could be quantified in this analysis.

B. Cost Analysis

Methodology and Assumptions

Since the internal corporate costs of implementing the modifications to the OBD II and HD OBD regulations are closely guarded by individual manufacturers and can vary significantly within the industry, CARB staff made several assumptions throughout this analysis that are summarized in this section. As vehicle manufacturers typically conduct a major redesign of a vehicle model every 6 years to maintain competitiveness with other manufacturers, staff assumed an OBD system lifetime of 6 years when calculating annual and per-vehicle costs throughout this analysis. It was assumed that while manufacturers incur most of the costs before the OBD certification process and the rest of the costs throughout the production, eventually all the costs are passed on to vehicle purchasers during the OBD system lifetime of 6 years. Even though the proposed amendments have different implementation schedules, staff opted to present the per-vehicle costs based on model years 2029-2034 when all the proposed OBD amendments will be fully implemented and manufacturers are assumed to pass incremental costs on to vehicle purchasers.

OBD II Cost Analysis Assumptions

For the proposed OBD II regulatory modifications, staff used the following steps for per-vehicle cost estimation.

The first step was to estimate the numbers of vehicles that would be impacted by the proposed amendments. As zero emission vehicles are not impacted by the OBD II program, they are excluded from the analysis. Staff started with calculating the 2019 calendar year nationwide sales number to be 16,863,000, by subtracting the zero emissions vehicle sales number of 245,000[3] from the

[3] Wagner I., Estimated battery electric vehicle sales in the U.S. by brand 2019, March 4, 2020, Statista USA. https://www.statista.com/statistics/698414/sales-of-all-electric-vehicles-in-the-us-by-brand/

total light-duty (LD) and medium-duty (MD) vehicle sales number of 17,108,156[4]. Using this number as the baseline, staff then estimated the projected sales numbers for the calendar years 2029-2034 based on EMFAC2021's[5] projected sales trend for this period. From these projected sales numbers of this period, staff calculated the cumulative number of the new LD and MD vehicles impacted by the proposed OBD II amendments to be 101,717,810 units (or an annual average of 16,952,968 units). Although the proposed regulatory modifications apply only to California-certified vehicles, the estimated costs of the proposal were applied to the manufacturers' entire, nationwide fleet of new vehicles because virtually all manufacturers have chosen to design a single OBD II system that meets both CARB and U.S. EPA regulations and have equipped all vehicles nationwide with the same systems. Therefore, any costs incurred by the manufacturers are expected to apply to all vehicles nationwide.

The next step was to estimate the cost impacts on a typical manufacturer. Staff surveyed the production offerings of all LD and MD vehicle manufacturers that produce new vehicles for the California market to determine the characteristics of their product line (e.g., number of vehicle models, sales volumes, engine types) for the 2019 model year. The cost estimates for LD and MD vehicles with OBD II systems were categorized into two separate distinct groups: 15 large vehicle manufacturers with an annual California sales number greater than 5,000 units, and 6 small vehicle manufacturers with an annual California sales number less than 5,000 units. The rationale for this separation was that while the per-vehicle hardware related costs are expected to be about the same, the per-vehicle software related costs were expected to differ substantially between a typical large manufacturer and a typical small manufacturer due to the difference in sales volume and software development process. Staff assumed that due to the potential higher per-vehicle cost when developing the OBD II system software in-house, the small manufacturers will typically purchase OBD II system software packages from suppliers or large manufacturers. This per-vehicle cost estimate method was aimed to give more representative per-vehicle cost estimates than a one-size-fits-all model, while balancing content management requirements and comprehensibility with accuracy (e.g., compared to other methods that are more complicated with higher resolution, or less complicated with lower resolution).

In order to estimate the typical vehicle product lineup for the cost analysis for large and small manufacturers, based on the California market production survey described above, staff assumed that a typical large manufacturer has 53

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[4] Philips D., Market slips 5.2% in Dec.; SAAR dips below 17M, January 3, 2020, Automotive News USA. https://www.autonews.com/sales/market-slips-52-dec-saar-dips-below-17m
[5] Vehicle Data from EMFAC2021 v1.0.0, January 2021

gasoline vehicles and 3 diesel vehicles to calibrate and validate, while a typical small manufacturer has 4 gasoline vehicles and no diesel vehicles to calibrate and validate.

The last step was to calculate the per-vehicle incremental costs based on the costs for a typical impacted manufacturer, the number of impacted manufacturers, and the cumulative number of impacted vehicles, for large and small manufacturers, respectively.

Additionally, some of the OBD II regulatory modifications apply only to diesel vehicles (e.g., CSERS diesel reporting and tracking parameters). As none of the small manufacturers offer diesel vehicles in California, staff did not consider costs associated with diesel OBD II requirements for small manufacturers. When estimating hardware costs associated with the diesel requirements for large manufacturers, staff adjusted the per-vehicle costs according to the sales volume ratio of diesel vehicles to all vehicles subject to the regulations. However, the same adjustment cannot be applied to the support costs (e.g., software algorithm development, calibration, validation testing, reporting) associated with the diesel requirements for large manufacturers because of the nature of the development process. For example, even though diesel vehicle sales only account for a small percentage of its total sales, a typical large manufacturer that offers diesel vehicle still need to spend the same amount of engineering hours to develop the basic software algorithm for a diesel monitor as for a similar gasoline monitor, thus using a sales volume based adjustment would underestimate the costs. That is why staff applied a 40 percent factor to the support costs associated with diesel requirements for a typical large manufacturer according to the assumption that only 6 out of 15 large manufacturers offer diesel vehicles in California. While staff understood that in reality a manufacturer incurs either 100 percent of the costs when it offers diesel vehicles or 0 percent of the costs when it does not offer any diesel vehicles, staff chose the 40 percent assumption for the ability to present the industry-wide per-manufacturer costs (see Appendix F).

HD OBD Cost Analysis Assumptions

Similar methodology and assumptions were applied to the cost analysis for the proposed HD OBD regulatory modifications. The same 6-year OBD system lifetime (and using model years 2029-2034) assumption was applied to the HD OBD analysis when calculating the annual costs and per-vehicle costs as applied in the OBD II analysis. When estimating the per-vehicle costs, staff started with the 2019 calendar year nationwide sales number of 527,000 HD engine units[6], and adjusted this number to be 423,325 units to avoid double counting based

[6] Mazareanu E., Class 3-8 Truck Sales in the United States from 2001 to 2019, Sep 1, 2020, Statista. https://www.statista.com/statistics/261416/class-3-8-truck-sales-in-the-united-states

on the assumption discussed in the "Other Assumptions" subsection below. Staff then went through a similar process as discussed previously to calculate the cumulative number of new HD engines subject to the HD OBD regulation in the calendar years 2029-2034 period to be 2,490,736 units (or an annual average of 415,123 units). The assumption that all HD engine manufacturers will design one single HD OBD system that meets both CARB and U.S. EPA regulations will not apply to the 2024 and subsequent model years, since CARB recently proposed low NOx emission standards for HD engines that will differ from the corresponding U.S. EPA NOx emission standards. As all HD OBD amendments will be impacted by this misalignment, staff adjusted the annual average number of impacted HD vehicles for all the proposed HD OBD amendments. The adjustments were based on the assumption that some engine manufacturers will design different HD OBD systems for California from the rest of the nation. Therefore, only California sales numbers were considered for this subset of manufacturers. Staff assumed that some manufacturers (accounting for 78 percent of the nationwide vehicle sales) will design a different HD OBD system for California from the rest of the nation, while the other manufacturers (accounting for 22 percent of the nationwide vehicle sales) will use one HD OBD system for the entire nation throughout the 6-year window. For manufacturers that choose to design two systems, the California sales number of 41,512 (i.e., 415,123 * 10%) was used, where 10 percent is the percentage of sales in California compared to nationwide sales based on 2019 model year data and this is assumed to remain the same for future model years. The annual average number of impacted HD vehicles was adjusted to be 123,706 units (i.e., 41,512 *78% + 415,123 * 22%).

The cost estimates for HD vehicles with HD OBD systems were separated into two groups to characterize the on-road HD engine industry: 7 large manufacturers with an annual California sales volume greater than 1,000 units, and 8 small manufacturers with an annual California sales volume less than 1,000 units. The rationale for this separation was based on staff's survey of the HD engine manufacturers' engine production line for the 2019 model year in California and assumed to be true for future model years.

When estimating hardware costs associated with the SAE J1979-2 implementation for HD OBD systems, staff adjusted the per-vehicle costs according to the sales volume ratio of the HD vehicles implementing SAE J1979-2 to all vehicles with HD OBD systems.

Similar to the OBD II cost analysis, staff assumed that due to the potential higher per-engine cost for developing the HD OBD system software in-house, small engine manufacturers will typically purchase OBD system software packages from suppliers or large manufacturers. Because the proposed HD OBD modifications regarding implementing SAE J1979-2 would be required only for a subsection of HD engines (i.e., engines using the ISO 15765-4 protocol, not engines using the SAE J1939 protocol), staff assumed that only 3

out of the 7 large engine manufacturers would elect to implement SAE J1979-2; therefore, the costs associated with SAE J1979-2 implementation were adjusted accordingly. All small engine manufacturers were assumed to implement SAE J1979-2 because they purchase the OBD system software packages from large manufacturers and/or suppliers who will implement SAE J1979-2. Based on the California market production survey described previously, staff assumed that a typical large manufacturer has 34 diesel engines and no gasoline engines to calibrate and validate, while a typical small manufacturer has 3 gasoline engines and 1 diesel engine to calibrate and validate. Thus, staff assumed that none of the costs associated with the gasoline engine monitoring requirements apply to large engine manufacturers.

Other Assumptions

It is important to note that there are a few manufacturers that produce vehicles/engines that are subject to both the OBD II and HD OBD regulations at the same time; therefore, to simplify and obtain more accurate cost estimates, staff considered the corporate focus for each manufacturer as explained below.

- If the majority of the vehicles are subject to the OBD II regulation, staff assumed that the software for the OBD II systems will be applied to their HD OBD systems as well, and the costs due to the HD OBD regulatory modifications are combined into the OBD II cost analysis instead of being presented in the HD OBD cost analysis separately.
- If the majority of the vehicles are subject to the HD OBD regulation, staff assumed that the software for the HD OBD systems will be applied to their OBD II systems as well, and the costs due to the OBD II regulatory modifications are combined into the HD OBD cost analysis instead of being presented in the OBD II cost analysis.

Lastly, the goal of this cost analysis is to estimate the "learned-out" costs of the program to vehicle purchasers for a typical vehicle. The analysis includes estimates of the incremental costs of implementing the proposed modifications to the OBD II and HD OBD regulations for a typical large LD and MD vehicle manufacturer, a typical small LD and MD vehicle manufacturer, a typical large HD engine manufacturer, and a typical small HD engine manufacturer, respectively. The various types of costs that are addressed in this analysis are the direct costs to the regulated businesses (e.g., vehicle and engine manufacturers) including variable costs and support costs, and the indirect costs (including manufacturer and dealership mark-ups). Results of the analysis of the learned-out initial costs per vehicle to incorporate the proposed OBD II and HD OBD regulatory modifications can be found in the next section (C. Total Incremental Cost of the Proposed Requirements). Details of the cost analysis methodology used to estimate the costs are discussed in the following sections.

Variable Costs

Variable costs addressed in this section are the costs of additional hardware added to engines or vehicles. Staff concluded that the proposed regulatory modifications would not increase costs for assembly operations, the cost of shipping parts, or any warranty implications.

Staff considered each of the proposed regulatory modifications to determine if additional hardware would be required to comply with the proposal. Based on discussions with manufacturers, staff determined that several proposed changes are expected to have ECU memory cost impacts on both the OBD II and HD OBD systems, such as the implementation of SAE J1979-2, addition of various data stream parameters, addition of a scan tool commanded EVAP sealing function, addition of gasoline stall monitoring, modified CSERS monitoring requirements, and the addition of diesel CSERS trackers.

The modified PM filter monitor IUMPR and monitoring requirements are expected to affect the OBD II systems with increased ECU memory and increased costs associated with the use of a new generation of PM sensors. The current generation of PM sensors, which are estimated to cost around $100 a piece, might not be sufficient to comply with the proposed final 10.00 mg/mi PM filter threshold. At this moment, staff is projecting that there are two types of PM sensors that could meet the proposed requirements: advanced resistive PM sensors and electrostatic PM sensors. The advanced resistive PM sensors are based on current technology and are expected to cost about the same as the current generation sensors when they are in mass production. Thus, the manufacturers that choose advanced resistive sensors were expected to incur no cost associated with PM sensors. The electrostatic PM sensors, on the other hand, use a very different technology, and the manufacturers that choose this path were expected to incur additional costs. The current retail price for electrostatic PM sensors is approximately $200. However, considering that the price manufacturers receive from the suppliers is usually much lower than the retail price and the price could go down further as production ramps up, staff estimated the costs as $125 per sensor, which represents an incremental cost of $25 per vehicle for manufacturers that choose this technology. Staff assumed that only 25 percent of diesel vehicles equipped with the OBD II systems will use electrostatic PM sensors. As previously explained, the per-vehicle hardware costs associated with the diesel requirement were adjusted according to the sales volume ratio of diesel vehicles to all vehicles, so the per-vehicle costs associated with PM sensors are much smaller than $6.25 (i.e., $25 * 25%).

Table E lists the technologies that staff projected to be needed for LD and MD vehicles to comply with the proposed OBD II requirements and the associated costs to a typical large LD and MD vehicle manufacturer and a typical small LD and MD manufacturer. Table F lists the technologies that staff projected to be needed for HD engines to comply with the proposed HD OBD requirements

and the associated costs to a typical large HD engine manufacturer and a typical small HD engine manufacturer.

Table E: Cost of Additional Hardware for OBD II Requirements

Emission Control Technology	Incremental cost estimate per vehicle (2020 $)
Increased ECU memory capability for implementing SAE J1979-2 for Large LD and MD Manufacturers	0.1116
Increased ECU memory capability for other proposed regulatory modifications for Large LD and MD Manufacturers	0.0316
New generation PM sensors for the modified PM filter monitoring requirements for Large LD and MD Manufacturers	0.1241
Total incremental component cost for Large LD and MD Manufacturers	0.2673
Increased ECU memory capability for implementing SAE J1979-2 for Small LD and MD Manufacturers	0.1116
Increased ECU memory capability for other proposed regulatory modifications for Small LD and MD Manufacturers	0.0297
Total incremental component cost for Small LD and MD Manufacturers	0.1413

Table F: Cost of Additional Hardware for HD OBD Requirements

Emission Control Technology	Incremental cost estimate per vehicle (2020 $)
Increased ECU memory capability for implementing SAE J1979-2 for Large HD Manufacturer	0.0247
Increased ECU memory capability for other proposed regulatory modifications for Large HD Manufacturer	0.0170
Total incremental component cost for Large HD Manufacturer	0.0417
Increased ECU memory capability for implementing SAE J1979-2 for Small HD Manufacturer	0.0247
Increased ECU memory capability for other proposed regulatory modifications for Small HD Manufacturer	0.0193
Total incremental component cost for Small HD Manufacturer	0.0440

Support Costs

Support costs affecting the retail price of vehicles/engines that are subject to the OBD II and HD OBD regulatory modifications are addressed in this section and include software development costs, testing costs, and reporting/miscellaneous documentation costs. It has to be emphasized that the only cost savings from the proposed modifications are associated with diesel feedgas generation monitoring and PVE testing relaxations as discussed in the testing costs subsection.

Software Development Costs

Software Development costs include the engineering and other labor costs needed to develop and calibrate the base OBD II and HD OBD system algorithms. However, it does not include the vehicle or engine testing costs required when developing software for OBD II and HD OBD systems (i.e., validation testing). Instead, validation testing costs for software development are included in the testing cost category described in the next subsection.

To determine the cost impact of the proposed changes on software development costs, staff assessed each of the changes to determine their potential impact, if any, on the OBD II and HD OBD system algorithms and calibrations. From this initial screening, staff determined that several proposed

changes apply to both OBD II and HD OBD systems, such as the implementation of SAE J1979-2, addition of various data stream parameters, addition of a scan tool commanded EVAP sealing function, addition of gasoline stall monitoring, modified CSERS monitoring requirements, and the addition of diesel CSERS trackers. The modified PM filter monitor IUMPR and monitoring requirements apply only to OBD II systems. Based on the assumption about the two potential PM sensor technologies discussed in the previous subsection, staff assumed a higher incremental software algorithm costs for the manufacturers that choose the electrostatic PM sensors compared to the manufacturers that choose the advanced resistive PM sensors, while the incremental calibration costs were assumed to be the same no matter which technology the manufacturer chooses.

Staff assumed that a manufacturer will develop a single base algorithm that can be applied across all different vehicle/engine variants within the manufacturer's product lineup without modifications to the algorithm. Staff also assumed that manufacturers will develop the algorithm on a pre-production vehicle or engine that is close to production intent because developing the algorithm on a vehicle/engine that is not near its production state will be inefficient and would unnecessarily require significant redevelopment work when applied to the production vehicle/engine.

To adjust the base algorithm to work on other engines/vehicles, each algorithm will need to be individually calibrated based on the tuning and validation guide developed during the algorithm development process. The costs to calibrate other engines/vehicles were discounted with factors that take into account the similarity of engine/vehicle designs relative to the base engine/vehicle used to develop the software algorithm, since the amount of engineering and testing work should be less on similar engines/vehicles.

The life of the software algorithm design and calibration for OBD monitors were estimated at 6 years without any major modifications. However, staff did account for minor algorithm and calibration modifications after 3 years. The cost of the 3-year midpoint algorithm and calibration modifications was discounted by 80 percent (i.e., the costs of the midpoint modifications were estimated to be 20 percent of the initial software algorithm development and calibration costs).

As discussed previously, the validation testing costs for software development are included in the testing cost category. Software development costs were determined through discussions with industry combined with engineering judgement. Since software development costs primarily consist of labor costs, labor rates of $77 and $45 per hour were assumed for software developers and

calibrators, respectively, including both salaries/wages and benefits[7]. From the industry discussions, an estimation of the amount of software algorithm and calibration changes and the associated labor hours needed to conduct the changes were determined. The annual and per-vehicle software development costs are summarized in Tables G and H for a typical large LD and MD vehicle manufacturer, a typical small LD and MD vehicle manufacturer, a typical large HD engine manufacturer, and a typical small HD engine manufacturer.

Table G: Software Development Costs for OBD II Requirements

Type of Costs	Software Algorithm Costs (2020 $)	Calibration Costs (2020 $)	Total Software Dev. Costs (2020 $)
Total Annual Incremental Costs for Large LD and MD Manufacturers	3,851,457	434,420	4,285,878
Incremental Costs per Vehicle for Large LD and MD Manufacturers	0.23	0.03	0.25
Total Annual Incremental Costs for Small LD and MD Manufacturers	56,848	12,514	69,362
Incremental Costs per Vehicle for Small LD and MD Manufacturers	3.30	0.73	4.03

[7] U.S. Bureau of Labor Statistics, Employer Costs for Employee Compensation Historical Listing - National Compensation Survey, March 2004 - December 2020, https://www.bls.gov/web/ecec/ececqrtn.pdf

Table H: Software Development Costs for HD OBD Requirements

Type of Costs	Software Algorithm Costs (2020 $)	Calibration Costs (2020 $)	Total Software Dev. Costs (2020 $)
Total Annual Incremental Costs for Large HD Manufacturer	979,067	229,069	1,208,136
Incremental Costs per Engine for Large HD Manufacturers	8.34	1.95	10.29
Total Annual Incremental Costs for Small HD Manufacturer	91,100	10,187	101,287
Incremental Costs per Engine for Small HD Manufacturers	13.97	1.56	15.53

Testing Costs

Testing costs were determined to include the costs from the validation testing associated with the software development discussed in the previous section and the costs for other testing that are required by the proposed modifications. To determine the impact of the proposed changes on testing costs, staff considered each of the proposed regulatory modifications to determine their potential impact, if any, on the current OBD II and HD OBD system testing. From this initial screening, staff determined that several proposed changes are expected to have cost increases for both the OBD II and HD OBD systems, such as the implementation of SAE J1979-2, addition of a scan tool commanded EVAP sealing function, addition of gasoline stall monitoring, modified CSERS monitoring requirements, the addition of diesel CSERS trackers, modified diesel NOx sensor monitor data submission, and modified diesel catalyst/adsorber malfunction criteria determination requirements. While modified PM filter monitor IUMPR and monitoring requirements are expected to have cost increases for the OBD II systems, diesel feedgas generation monitoring and PVE testing relaxations are expected to have cost savings.

The cost impacts and cost savings were also estimated through discussions with manufacturers and engineering analysis. The testing costs include the equipment and labor costs to conduct the tests and data analyses. Staff assumed labor rates of $41 per hour for testing technicians[4].

For validation testing associated with the software development discussed in the previous section, staff applied the following discount factors in the cost analysis:

- Staff assumed that the initial validation testing was conducted on each vehicle/engine in the manufacturer's product lineup after the software algorithm development and calibration implementation addressing the proposed regulatory modifications were applied to these vehicles. For the subsequent model year vehicles, the validation testing costs were assumed to be minimal, because software algorithms and calibrations mostly carry over. However, staff did account for midpoint validation testing costs after 3 years to account for the minor midpoint software and calibration changes that were described in the previous section. Similar to the analysis in the software development costs subsection, the costs of the 3-year midpoint validation testing were discounted by 80 percent from the initial validation testing costs.
- Staff applied discounts to the costs of conducting the validation testing (e.g., equipment costs, dynamometer time, labor costs to conduct tests) for each proposed regulatory modification, due to the fact that the validation testing required by the proposal would be conducted together as much as possible to save dynamometer and on-road testing time. However, data analyses were not discounted because manufacturers still need to verify each proposed regulatory modification.

Moreover, five proposed requirements were estimated to impact other testing that are not associated with validation testing: modified diesel NOx sensor monitor data submission requirements, modified diesel catalyst/adsorber malfunction criteria determination requirements, and modified PM filter monitor IUMPR and monitoring requirements were estimated to have cost increases for the manufacturers, while diesel feedgas generation monitoring and PVE testing relaxations were estimated to have cost savings. Examples of other testing include additional testing to meet the more detailed requirements during the OBD certification process beyond what an average manufacturer is doing today, additional testing associated with creating a threshold PM filter, reduced testing associated with the test-out procedure for diesel feedgas generation monitoring, and reduced PVE testing for the monitors that are above the proposed cap of 400 fault codes.

Tables I and J summarize the total annual testing costs for manufacturers and the incremental costs per unit for meeting the proposed OBD II and HD OBD requirements. Note that the cost estimates presented in these tables included cost savings as well. Details of the testing cost analysis are provided in Appendix F.

Table I: Testing Costs for OBD II Requirements

Type of Costs	Testing Costs (2020 $)
Total Annual Incremental Costs for Large LD and MD Manufacturers	879,771
Incremental Costs per Vehicle for Large LD and MD Manufacturers	0.05
Total Annual Incremental Costs for Small LD and MD Manufacturers	24,892
Incremental Costs per Vehicle for Small LD and MD Manufacturers	1.45

Table J: Testing Costs for HD OBD Requirements

Type of Costs	Testing Costs (2020 $)
Total Annual Incremental Costs for Large HD Manufacturer	186,808
Incremental Costs per Engine for Large HD Manufacturers	1.59
Total Annual Incremental Costs for Small HD Manufacturer	28,995
Incremental Costs per Engine for Small HD Manufacturers	4.45

Reporting and Miscellaneous Documentation Costs

Reporting and miscellaneous documentation costs were determined by evaluating the amendments for changes that apply additional administrative and reporting requirements. Reporting costs primarily consist of extra labor costs to prepare and report the proposed fault code specific IUMPR data, supplemental monitor activity data, modified NOx sensor monitor data submission requirements, and the modified diesel catalyst/adsorber malfunction criteria determination requirements. Staff assumed labor rates of $41 per hour for in-house engineers[4] who compile data and report to CARB. For fault code specific IUMPR and supplemental monitor activity data, staff considered that the majority of the reporting costs would be the initial setup to develop an automated data compiling tool that in return would save labor costs in the long term. For NOx sensor monitor data submission requirements and diesel catalyst/adsorber malfunction criteria determination, staff considered the additional labor costs beyond what manufacturers currently incur. In addition, staff considered the estimated workload of administering the data collection, aggregating the data, conducting quality control checks on the data summary, submitting the data report to CARB, and maintaining the raw data records.

Staff estimated reporting and miscellaneous documentation costs for a typical manufacturer on an annual basis as well as on a per-vehicle/engine basis, for meeting the proposed OBD II and HD OBD requirements. Details of the reporting and miscellaneous documentation costs are summarized in Tables K and L.

Table K: Reporting and Miscellaneous Costs for OBD II Requirements

Type of Costs	Reporting and Miscellaneous Costs (2020 $)
Total Annual Incremental Costs for Large LD and MD Manufacturers	33,293
Incremental Costs per Vehicle for Large LD and MD Manufacturers	0.0020
Total Annual Incremental Costs for Small LD and MD Manufacturers	12,222
Incremental Costs per Vehicle for Small LD and MD Manufacturers	0.7095

Table L: Reporting and Miscellaneous Costs for HD OBD Requirements

Type of Costs	Reporting and Miscellaneous Costs (2020 $)
Total Annual Incremental Costs for Large HD Manufacturers	9,305
Incremental Costs per Engine for Large HD Manufacturers	0.0792
Total Annual Incremental Costs for Small HD Manufacturer	10,634
Incremental Costs per Engine for Small HD Manufacturers	1.6305

C. Total Incremental Cost of the Proposed Requirements

The total incremental cost of the proposed requirements were obtained by summing up the incremental cost of the four primary cost categories (the costs of hardware, software development, testing, and reporting and miscellaneous) for large LD and MD vehicle manufacturers for meeting OBD II requirements, small LD and MD vehicle manufacturers for meeting the OBD II requirements, large HD engine manufacturers for meeting the HD OBD requirements, and small HD engine manufacturers for meeting the HD OBD requirements. Details of the total incremental cost estimates are shown in Tables M through P.

For the OBD II requirements, the incremental cost was then assumed to receive a mark-up at each step of the distribution chain[8] including a manufacturer mark-up of 9 percent to cover profit, overhead, and indirect costs that are not addressed in the above analysis, a dealership holding cost of 1.5 percent assuming an average vehicle sits on the dealer lot for 3 months, and a dealership mark-up of 6 percent. Staff chose this conservative approach to avoid underestimation of the final costs. These mark-ups are included in Tables M and N. The final impact to the California consumer per new LD or MD vehicle is anticipated to be $0.67 or $7.37, for purchasing from large and small manufacturers, respectively.

Similarly, for the HD OBD requirements, the incremental cost was assumed to incur a markup at each step of the distribution chain consisting of an engine manufacturer mark-up of 6 percent, a vehicle manufacturer mark-up of 6 percent, a dealership holding cost of 1.5 percent, and a dealership mark-up of 6 percent (see Tables O and P). The final impact to the California consumer per new HD vehicle is anticipated to be $ 14.34 or $ 25.87, for purchasing from large and small manufacturers, respectively.

Table M: Incremental Consumer Cost of LD and MD Vehicle OBD II Systems for Purchasing from Large Manufacturers

Category	Subcategory	Cost (2020 $)
Variable Costs	Component	0.27
Support Costs	Software Development	0.25
	Testing	0.05
	Reporting/Miscellaneous Documentation	0.00 (e)
Manufacturer Mark-up (a)		0.05
Dealership Holding Cost (b)		0.01
Dealership Mark-up (c)		0.03
Total Initial Incremental Cost to Consumers (d)		0.67

(a) Cost of manufacturer mark-up was estimated at 9 percent.
(b) Cost of dealership holding cost was estimated at 1.5 percent.
(c) Cost of dealership mark-up was estimated at 6 percent.
(d) Rounding of numbers to 2 significant figures may result in the total cost not matching the summation of the individual cost items shown in the table.
(e) Showing zero due to rounding

[8] Martins, J. O., Scarpetta, S., Pilat, D., 1996, Mark-Up Ratios in Manufacturing Industries - Estimates for 14 OECD Countries, http://www.oecd.org/regreform/reform/1863340.pdf

Table N: Incremental Consumer Cost of LD and MD Vehicle OBD II Systems for Purchasing from Small Manufacturers

Category	Subcategory	Cost (2020 $)
Variable Costs	Component	0.14
Support Costs	Software Development	4.03
	Testing	1.45
	Reporting/Miscellaneous Documentation	0.71
Manufacturer Mark-up [(a)]		0.57
Dealership Holding Cost [(b)]		0.09
Dealership Mark-up [(c)]		0.38
Total Initial Incremental Cost to Consumers [(d)]		7.37

(a) Cost of manufacturer mark-up was estimated at 9 percent.
(b) Cost of dealership holding cost was estimated at 1.5 percent.
(c) Cost of dealership mark-up was estimated at 6 percent.
(d) Rounding of numbers to 2 significant figures may result in the total cost not matching the summation of the individual cost items shown in the table.

Table O: Incremental Consumer Cost of HD OBD Systems for Purchasing from Large Manufacturers

Category	Subcategory	Cost (2020 $)
Variable Costs	Component	0.04
Support Costs	Software Development	10.29
	Testing	1.59
	Reporting/Miscellaneous Documentation	0.08
Engine Manufacturer Mark-up [(a)]		0.72
Truck Manufacturer Mark-up [(a)]		0.72
Dealership Holding Cost [(b)]		0.18
Dealership Mark-up [(c)]		0.72
Total Initial Incremental Cost to Consumers [(d)]		14.34

(a) Cost of engine/truck manufacturer mark-up was estimated at 6 percent.
(b) Cost of dealership holding cost was estimated at 1.5 percent.
(c) Cost of dealership mark-up was estimated at 6 percent.
(d) Rounding of numbers to 2 significant figures may result in the total cost not matching the summation of the individual cost items shown in the table.

Table P: Incremental Consumer Cost of HD OBD Systems for Purchasing from Small Manufacturers

Category	Subcategory	Cost (2020 $)
Variable Costs	Component	0.04
Support Costs	Software Development	15.53
	Testing	4.45
	Reporting/Miscellaneous Documentation	1.63
Engine Manufacturer Mark-up [(a)]		1.30
Truck Manufacturer Mark-up [(a)]		1.30
Dealership Holding Cost [(b)]		0.32
Dealership Mark-up [(c)]		1.30
Total Initial Incremental Cost to Consumers [(d)]		25.87

(a) Cost of engine/truck manufacturer mark-up was estimated at 6 percent.
(b) Cost of dealership holding cost was estimated at 1.5 percent.
(c) Cost of dealership mark-up was estimated at 6 percent.
(d) Rounding of numbers to 2 significant figures may result in the total cost not matching the summation of the individual cost items shown in the table.

As explained in the "Methodology and Assumptions Section", staff applied a conservative approach for HD OBD cost analysis to account for the potential misalignment between CARB and U.S. EPA NOx emission standards for 2024 and subsequent model years. However, as discussed in the Staff Report for the Heavy-Duty Omnibus regulation[9], U.S. EPA is planning to develop its own low NOx emission standards. Therefore, staff believes that U.S. EPA will likely align its NOx emission standards with CARB's recently proposed low NOx emission standards for the 2027 and subsequent model years. For this scenario, starting with the 2027 model year, HD engine manufacturers are assumed to use the California version of the OBD system for the entire nation to comply with both California and federal HD OBD requirements. This is historically how HD engine manufacturers have complied with HD OBD requirements. Based on this

[9] Staff Report: Initial Statement of Reasons for Rulemaking: Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments: Proposed Amendments to the Exhaust Emissions Standards and Test Procedures for 2024 and Subsequent Model Year Heavy-Duty Engines and Vehicles, Heavy-Duty On-Board Diagnostic System Requirements, Heavy-Duty In-Use Testing Program, Emissions Warranty Period and Useful Life Requirements, Emissions Warranty Information and Reporting Requirements, and Corrective Action Procedures, In-Use Emissions Data Reporting Requirements, and Phase 2 Heavy-Duty Greenhouse Gas Regulations, and Powertrain Test Procedures, June 23, 2020. https://ww3.arb.ca.gov/regact/2020/hdomnibuslownox/isor.pdf

assumption, staff has conducted an alternative cost analysis to illustrate the per-vehicle costs in the following paragraphs.

In this alternative scenario, staff assumed that the misalignment between CARB and U.S. EPA regulations would be limited to the 2024-2026 model years. Therefore, staff adjusted the annual average number for each proposed amendment that has its implementation schedule falling within this window: gasoline stall monitoring, gasoline cold start catalyst heating monitoring, modified gasoline CSERS component monitoring, diesel CWS monitoring, modified diesel CSERS component monitoring, diesel CSERS tracking and reporting parameters, modified diesel NOx sensor monitor data submission, and modified diesel catalyst/adsorber malfunction criteria determination requirements. The adjustments were based on the assumption that some engine manufacturers design different HD OBD systems for California from the rest of the nation. Therefore, only California sales numbers were considered in each instance where an amendment impacts 2024-2026 model year engines. For example, the modified diesel CSERS component monitoring is required for the HD OBD systems starting with the 2026 model year. Thus, staff assumed that some manufacturers (accounting for 78 percent of the nationwide vehicle sales) will design a different HD OBD system for California only in 2026 and use the California version for the entire nation in 2027 through 2031, while the other manufacturers (accounting for 22 percent of the nationwide vehicle sales) will use one HD OBD system for the entire nation throughout the 6-year window. For manufacturers that choose to design two systems in 2026, the California sales number of 41,512 (i.e., 415,123 * 10%) was used for 2026, while the nationwide sales number of 415,123 was used for 2027 through 2031, where 10 percent is the percentage of California over nationwide sales based on 2019 model year data and assumed to remain the same for the future. The annual average number was adjusted to be 366,554 units (i.e., (41,512 * 1 + 415,123 * 5) /6 *78% + 415,123 * 22%). Other aforementioned requirements are adjusted in a similar method based on their implementation schedules. To be consistent with the 6-year OBD system lifetime assumption, these adjusted numbers of impacted vehicles were used to calculate the per-vehicle costs for each impacted requirement for the 2029-2034 model years to illustrate what would happen if each requirement was implemented in the 2029-2034 timeframe.

In this more likely scenario, the final impact to the California consumers per new HD vehicle is anticipated to be $4.40 or $8.03, for purchasing from large and small HD manufacturers, respectively.

D. Benefits of the Proposal

The proposed OBD II and HD OBD revisions are not expected to reduce emissions beyond what is required of the current OBD II and HD OBD programs. However, they will more effectively improve the realization of the

OBD II and HD OBD programs' emission reductions. As there have been different methodologies determining emission benefits for the OBD II and the HD OBD regulations, they are addressed separately in this section.

Since the adoption of the LEV III program, emission benefits have not been claimed for the OBD II regulation and, following this same approach, will not be claimed for this proposal either. While the OBD II regulation does result in emission benefits, these benefits were previously applied to other mobile source programs related to emission standards and inspection and maintenance programs such as, the LEV program and Smog Check program. However, the OBD II proposed amendments will improve the reliability of the emission benefits expected from the LEV III program. The LEV III program emission benefits are based upon an effective OBD II and Smog Check program. While the LEV III program sets stringent tailpipe and evaporative system requirements that necessitate a vehicle's tailpipe emission levels to be durable for up to 150,000 miles, there is no assurance these emission levels will be maintained in use for the required mileage and beyond until the vehicle is retired. As previously mentioned in this Staff Report, the OBD II regulation requires all emission controls on a vehicle to be monitored for proper performance. For emission control components that can affect emissions by large amounts when they fail, the OBD II system must detect a malfunction before emissions exceed a certain emission threshold. While the OBD II system can alert the vehicle operator to a problem by requiring illumination of the MIL on the vehicle's instrument panel, it does not force the vehicle operator to repair the malfunction. The Smog Check program, however, does require the vehicle operator to repair the malfunction detected by the OBD II system. If there was no OBD II program, both Smog Check and the LEV III program would not be as effective at keeping vehicle emissions low throughout a vehicle's entire life.

While the proposed amendments are expected to result in emission benefits, these benefits will not be quantified or claimed independently by the OBD II program. Instead, the OBD II program has been credited with making the emission benefits of related mobile source control programs more reliable (e.g., the LEV and Smog Check programs). As such, the proposal will not change the emission benefits that were previously calculated in the 2012 LEV III Staff Report[10].

[10] Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Public Hearing to Consider the "LEV III" Amendments to the California Greenhouse Gas and Criteria Pollutant Exhaust and Evaporative Emission Standards and Test Procedures and to the On-Board Diagnostic System Requirements for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles, and to the Evaporative Emission Requirements for Heavy-Duty Vehicles, December 7, 2011. https://www.arb.ca.gov/regact/2012/leviiighg2012/levisor.pdf

Conversely, for the HD OBD program, emission benefits have historically been claimed. The benefits of the HD OBD programs historically have assumed a fully functioning OBD system when determining the benefits of the program. In order to ensure the previously assumed benefits of the HD OBD programs are realized, the HD OBD regulations must be updated as proposed here.

In conducting the cost-effectiveness analysis for these proposed requirements, the staff revisited the cost estimates of the most recent HD OBD program update that was reported in the 2018 HD OBD Staff Report and updated that analysis to include the additional costs of the current proposed amendments to the HD OBD regulations. The emission benefits, however, were not recalculated since the proposal does not claim any additional emission benefits from the emission benefits claimed when HD OBD was first adopted in 2006. Based on the updated benefit analysis from the 2009 biennial review[11], the HD OBD program was calculated to generate a statewide benefit of 1.5 tons/day (tpd) of reactive organic gases (ROG), 109 tpd of NOx, and 0.6 tpd of PM in calendar year 2020. 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. For the cost estimation, it was assumed that half of the cost was for PM emission benefit and the other half was for ROG+NOx benefit. While the emission benefit numbers from the 2009 biennial review still apply, since the regulatory proposal added an incremental cost of $14.34- 25.87per engine for heavy-duty engines, the cost effectiveness of the HD OBD program is updated as described below. As stated in the 2018 HD OBD Staff Report[12], the per-engine cost to implement OBD for the vehicle purchasers was estimated at $783 per engine. Adjusting this cost for inflation results in an estimated cost of $812 per engine in 2020 dollars[13]. Adding the proposal's incremental cost of $14.34- 25.87 per engine results in a total estimated cost of $826.34- 837.87 per engine. Splitting that in half, $413.17- 418.94 is attributed to PM benefit for a cost-effectiveness of $29.51- 29.92 per pound of PM. The other half of the cost was attributed to ROG+NOx benefit for a cost-effectiveness of $0.19 per pound of ROG+NOx. If only NOx benefits were claimed, the cost-effectiveness for NOx is $0.21 per pound. These values compare favorably with the cost-

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[11] Staff Report: Initial Statement of Reasons for Proposed Rulemaking: Technical Status and Revisions to Malfunction and Diagnostic System Requirements for Heavy-Duty Engines (HD OBD) and Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines (OBD II), April 10, 2009. https://ww3.arb.ca.gov/regact/2009/hdobd09/obdisor.pdf

[12] Staff Report: Initial Statement of Reasons: 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, September 25, 2018. https://ww3.arb.ca.gov/regact/2018/hdobd18/isor.pdf

[13] U.S. Bureau of Labor Statistics CPI Inflation Calculator, https://www.bls.gov/data/inflation_calculator.htm

effectiveness of other, recently adopted regulations. For example, the heavy duty engine and vehicle omnibus regulation[6] reported a cost-effectiveness of $5.45 per pound of NOx reduced. CARB's public fleets rule[14] resulted in a cost-effectiveness of $11.47 per pound of NOx and $159 per pound of PM, and CARB's Drayage Truck Regulation[15] resulted in a cost-effectiveness of $6 to $8 per pound of NOx and $57 to $77 per pound of PM. Therefore, the estimated cost-effectiveness of the HD OBD program is within the range of the cost-effectiveness of CARB's previously adopted measures.

E. Impact Analysis on Businesses, Vehicle Operators, Employment, Local Government, and State Government

Affected Businesses and Potential Impacts

Any business involved in manufacturing, purchasing, or servicing light-, medium-, heavy-duty engines and vehicles could be affected by the proposed amendments. Also affected are businesses that supply parts for these vehicles, scan tool manufacturers, and state government (e.g., Bureau of Automotive Repair (BAR)). While there will be California businesses affected by the proposal, CARB does not expect a significant statewide adverse economic impact directly affecting these businesses.

Potential Impacts on Vehicle Operators

The proposed amendments are anticipated to have a negligible impact on new light- and medium-duty vehicle prices, since the calculated increase in retail price of a vehicle is estimated to be $0.67-7.37 per vehicle. Similarly, the calculated increase in retail price of a heavy-duty vehicle is estimated to be $ 14.34- 25.87 per vehicle. For light-, medium-, and heavy-duty engines and vehicles, the proposed amendments would provide additional OBD II and HD OBD information and encourage manufacturers to build more durable engines/vehicles, which would result in the need for fewer repairs and savings for vehicle owners. The proposed amendments would also provide clearer OBD II and HD OBD regulatory requirements and streamline the OBD II and HD OBD certification process. Additionally, OBD II and HD OBD systems detect malfunctions that may otherwise go undetected (and thus, unrepaired) by the vehicle owner. These additional repairs that are detected and repaired due to the presence of OBD II and HD OBD systems will potentially result in emission benefits and cost savings by catching problems early before they

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[14] Staff Report: Initial Statement of Reasons for Rulemaking: Proposed Diesel Particulate Matter Control Measure for On-Road Heavy-Duty Diesel-Fueled Vehicles Owned or Operated by Public Agencies and Utilities, October 21, 2005. https://ww3.arb.ca.gov/regact/dpmcm05/isor.pdf

[15] Staff Report: Initial Statement of Reasons for Rulemaking: Public Hearing to Consider Regulation to Reduce Emissions from Heavy-Duty On-Road Drayage Trucks in California Port and Intermodal Rail Service, October 2007. https://ww3.arb.ca.gov/regact/2007/drayage07/drayisor.pdf

adversely affect other components and systems in the engine and/or aftertreatment system.

Potential Impacts on Business Competiveness

The proposed amendments are not expected to adversely impact the ability of California businesses to compete with businesses in other states. Generally, virtually all LD and MD vehicle manufacturers have chosen to design a single OBD II system and equipped all vehicles nationwide with the same system. Therefore, any increase in costs will also be experienced by non-California businesses that purchase LD and MD vehicles due to the federal requirements. Thus, any price increases of LD and MD vehicles are not expected to dampen the demand for these vehicles in California relative to other states, since price increases would be the same nationwide. However, the assumption that all HD engine manufacturers will design one single HD OBD system that meets both CARB and U.S. EPA regulations will not apply to 2024 and subsequent model years when the recently proposed CARB emission standards and U.S. EPA emission standards for HD engines will not align with each other. Therefore, staff applied the conservative assumption that some manufacturers (accounting for 78 percent of the total HD vehicle sales volume) would choose to design different HD OBD systems for California from the rest of the nation and only California sales volume was considered in estimating the per-vehicle costs, while the other manufacturers (accounting for 22 percent) would continue to design one single OBD system nationwide. Because the proposed amendments are anticipated to have only a negligible impact on retail prices of new HD vehicles ($14.34-25.87 per vehicle), staff projects this price increase will not adversely impact California business' competitiveness.

The Creation or Elimination of Jobs Within the State of California.

The proposed amendments are not expected to create or eliminate jobs within the State of California because California accounts for only a small share of motor vehicle, engine, and parts manufacturing employment nationwide, and the minimal additional work allocated to the California employees of the engine and vehicle manufacturers can be done with existing staff. For example, some engineering jobs may be reassigned to design and calibrate OBD II and HD OBD systems.

The Creation of New Business or the Elimination of Existing Businesses Within the State of California

The proposed amendments are not expected to affect business creation or elimination within California.

The Expansion of Businesses Currently Doing Business Within the State of California

The proposed amendments are not expected to affect the expansion of existing businesses currently doing business within the State of California.

Significant Statewide Adverse Economic Impact Directly Affecting Business, Including Ability to Compete

The proposed amendments are not expected to have significant statewide adverse economic impact directly affecting business. As described above, the incremental price increase for light-, medium-, and heavy-duty vehicles in California is considered negligible. Additionally, the proposed amendments are not expected to impact California businesses' ability to compete with businesses in other states.

The Benefits of the Regulation to the Health and Welfare of California Residents, Worker Safety, and the State's Environment

The proposed amendments are not expected to result in direct emission benefits, but rather increase the certainty that emission benefits projected for the light-, medium-, and heavy-duty vehicle programs are realized in practice. As a result, Californians will benefit from more durable vehicles and more efficient diagnosis and repair of malfunctioning vehicles. No quantifiable benefit to worker safety is expected.

Fiscal Effect on Local Government

The proposed amendments are estimated to have no fiscal impact on local agencies on the current 2021/2022 fiscal year and the two subsequent fiscal years. Even though manufacturers are allowed to voluntarily implement SAE J1979-2 as early as the 2023 model year and, as a result, local government agencies may pay a higher purchase price for new LD, MD, and HD vehicles, if manufacturers pass on costs, it is difficult to know the actual timeline for SAE J1979-2 early implementation. Further, there are other proposed requirements that do not allow early implementation. In addition, local agencies have freedom to choose whether to purchase a vehicle that has a higher price due to the proposed amendments before all requirements are fully implemented. Therefore, staff determined not to consider the fiscal impact before all the proposed amendments are fully implemented. Consequently, staff estimated the fiscal impact for fiscal year 2028/2029 and subsequent 5 fiscal years when all the proposed requirements are fully implemented and manufacturers are assumed to pass incremental costs to vehicle purchasers, based on the assumptions described in Chapter VIII.B.

Staff's estimate considers the local government HD vehicle population to be about 10.8 percent of total HD vehicles in the state using CARB's EMFAC data. According to 2019 annual sales numbers provided by HD engine manufacturers to CARB, approximately 42,645 HD vehicles were sold annually in California. Assuming that local government fleets also purchased 10.8 percent of all new complying HD vehicles sold in California, a total of 4,606 of these vehicles were purchased in 2019 (10.8 percent * 42,645 annual California vehicles sales) by local government fleets. In addition, staff estimated that in 2019, local agencies purchased 21,243 LD and MD vehicles, using the estimated number of vehicles purchased by the State government (refer to the

next subsection "Fiscal Effect on State Government") and the assumption that local government owned 4.84 times more vehicles than State government[16]. Using the 2019 numbers as the baseline, staff then projected the new vehicles of model years 2029-2034 purchased by local government agencies based on EMFAC2021's projected sales trend for this period, for HD and LD and MD fleets respectively. Based on the projected new vehicle purchases by local government and the per-vehicle costs from Chapter VIII.B, staff estimated the fiscal effect on local government throughout the lifetime of the proposed amendments, which is summarized in Table Q.

Staff also estimated the sales tax revenue that would accrue to local governments as a result of the incremental cost of the proposal based on a statewide average rate of 8.5 percent, of which 3.95 percent is allocated to state government and the remainder is allocated to local governments.[17]

Table Q. Fiscal Effect on Local Government

Fiscal Year	Net Costs (2020 $)	Sales Tax Revenue (2020 $)	Total Fiscal Impact (2020 $)*
2028/2029	90,756	91,633	878
2029/2030	82,887	88,280	5,392
2030/2031	83,338	88,634	5,296
2031/2032	79,436	87,145	7,709
2032/2033	78,268	86,800	8,532
2033/2034	76,970	86,392	9,422
Total	***491,655***	***528,885***	***37,229***

*Total Fiscal Impact is calculated as the change in revenue minus costs.

Any cost to local government is not reimbursable by the State, pursuant to Government Code, title 2, division 4, part 7 (commencing with section 17500) 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

[16] Standardized Regulatory Impact Assessment (SRIA), Equivalent Document for Proposed Amendments to The Low-Emission Vehicle III Greenhouse Gas Emission Regulation, June 7, 2018. https://www.dof.ca.gov/Forecasting/Economics/Major_Regulations/Major_Regulations_Table/documents/LEV%20III%20GHG%20Regulation%20Amendments.pdf

[17] The sales tax varies across the state from a minimum of 7.25% up to 10.25% in some municipalities; a value of 8.5% was used for staff's analysis based on a statewide population weighted average.

amendments do not mandate a new program or higher level of service on any local government.

Fiscal Effect on State Government

The proposed amendments are estimated to have no fiscal impact on State agencies on the current 2021/2022 fiscal year and two subsequent fiscal years. For the same reasons described in the previous subsection "Fiscal Effect on Local Government", staff determined to estimate the fiscal impact for 2028/2029 and subsequent 5 fiscal years when all the proposed requirements are fully implemented and manufacturers are assumed to pass incremental costs to vehicles purchasers.

Staff's estimate considers the State government HD vehicle population to be about 3.3 percent of total HD vehicles in the state using CARB's EMFAC data. Based on the 2019 annual sales number of 42,645 HD engines in California and the assumption that State government fleets also purchased 3.3 percent of all new complying HD vehicles sold in California, a total of 1,407 of these vehicles were purchased in 2019 (3.3 percent * 42,645) by State government fleets. In addition, staff estimated that in the last three years, the State agencies purchased 4,380 LD and MD vehicles annually according to California state fleet 2015-2019 database[18]. Using the 2019 numbers as the baseline, staff then projected the new vehicles of model years 2029-2034 purchased by State government agencies based on EMFAC2021's projected sales trend for this period, for HD and LD and MD fleets respectively. Based on the projected new vehicle purchases by State government and the per-vehicle costs from Chapter VIII.B, staff estimated the fiscal effect on State government throughout the lifetime of the proposed amendments starting the fiscal year 2028/2029, which is summarized in Table R. Staff assumed the State government will receive 3.95 percent of the costs as sales tax revenue.

The proposed amendments may indirectly impact the BAR due to the upgrades to its software and database for the I/M program to utilize the UDS features that will improve the I/M program. Based on the discussions with BAR, staff estimated 500 hours of software development and a potential indirect cost impact of $38,440 over two years before the SAE J1979-2 requirements are fully implemented. The fiscal impacts are estimated to affect fiscal years 2025/2026 and 2026/2027.

The proposed amendments may require a small amount of additional time for CARB staff to review new OBD II and HD OBD requirements in manufacturer applications. However, clarifications in the proposed amendments would streamline other parts of the review process for CARB staff, since it will be

[18] California state fleet 2015-2019, https://data.ca.gov/dataset/california-state-fleet/resource/5c42e9f6-e172-4db4-9a51-ca1256b03a26

easier to determine compliance with the requirements. Any additional staff time required as part of the proposed amendments are anticipated to be offset by a reduction in staff time from the proposed clarifications.

Table R. Fiscal Effect on State Government

Fiscal Year	Net Costs for Vehicle Purchases (2020 $)	Net Costs for I/M Program (2020 $)	Total Costs (2020 $)	Sales Tax Revenue (2020 $)	Total Fiscal Impact (2020 $)*
2025/2026	0	19,220	19,220	0	(19,220)
2026/2027	0	19,220	19,220	0	(19,220)
2028/2029	26,303	0	26,303	79,375	53,072
2029/2030	23,899	0	23,899	76,470	52,571
2030/2031	24,033	0	24,033	76,778	52,745
2031/2032	22,836	0	22,836	75,487	52,651
2032/2033	22,475	0	22,475	75,189	52,713
2033/2034	22,075	0	22,075	74,835	52,760
Total	141,622	38,440	180,062	458,135	278,072

*Total Fiscal Impact is calculated as the change in revenue minus costs.

IX. Evaluation of Regulatory Alternatives

Government Code section 11346.2, subdivision (b)(4) requires CARB to consider and evaluate reasonable alternatives to the proposed regulatory action and provide reasons for rejecting those alternatives. This section discusses alternatives evaluated and provides reasons why these alternatives were not included in the proposal. As explained below, no alternative proposal was found to be less burdensome and equally effective in achieving the purposes of the regulation in a manner than ensures full compliance with the authorizing law. The Board has not identified any reasonable alternatives that would lessen any adverse impact on small business.

Staff considered the following two alternatives to the proposed amendments: (1) adopting no amendments; and (2) adopting more stringent amendments.

Adopting No Amendments Alternative

Compared to the baseline, this alternative would result in no costs to manufacturers or increase in vehicle purchase price for California businesses and individuals who purchase new light-, medium-, and heavy-duty vehicles. Compared to the proposed amendments, this alternative would result in a cost savings to businesses and individuals who purchase new light-, medium-, and heavy-duty vehicles in California of $11.60 million over six years, or $0.67-7.37 per light- or medium-duty vehicle and $14.34- 25.87 per heavy-duty vehicle if manufacturers were able to pass on all costs and markup.

However, this alternative could prevent California from realizing all of the emission benefits projected for the light-, medium-, and heavy-duty vehicle programs. This could result in higher than anticipated emissions from malfunctioning vehicles which would lead to adverse health impacts for individuals in California and make it more difficult for the State of California to meet federal ambient air quality standards. Taking no action would also make it more difficult for manufacturers to comply with the existing OBD II and HD OBD requirements and more difficult and time consuming for CARB to review and approve the OBD II and HD OBD system design on vehicles. This could require more staff resources resulting in an additional fiscal impact. Staff rejected the no-action alternative because of the potential for adverse emissions impacts and lack of flexibility and clarity.

Adopting More Stringent Amendments Alternative

Staff also rejected the second alternative of more stringent amendments. Originally, CARB proposed adopting more stringent requirements for the OBD II and HD OBD amendments. For the IUMPR requirements, CARB had proposed to report fault code specific IUMPR data for all OBD monitors. Manufacturers indicated that CARB's original proposal would require them to modify the IUMPR software for all fault codes, which requires excessive work load and cost for software design and implementation such as algorithm design, software engineering, component level software testing, calibration and validation testing.

To estimate the costs of this alternative, the same methodology and assumptions used to quantify costs for the proposed amendments were also applied here. This alternative would be more costly than the proposed amendments primarily due to the wider scope of the IUMPR requirements. For example, staff assumed 800 fault codes[19] would be affected instead of 65 fault codes in the proposed amendments. In addition, the alternative doesn't include the supplemental monitor activity data for all fault codes as in the proposed

[19] The 800 fault codes were considered based on staff's survey of current OBD system applications to account for the number of fault codes from plug-in hybrid electric vehicles, which have the largest number of fault codes among a typical manufacturer's product line.

amendments, which represents a significantly less costly approach to fulfill a similar goal. When considering these changes, the costs result in an incremental cost to consumers of $0.73-8.30 per light- or medium-duty vehicle and of $17.00-30.38 per heavy-duty vehicle with all markups applied, and a total of $13.04 million over the 6-year lifetime. By comparison, the proposal's incremental cost to consumers is $0.67-7.37 per light- or medium-duty vehicle or $14.34- 25.87per heavy-duty vehicle, and the total incremental cost is $11.60 million. This represents a total lifetime savings of $1.44 million over the 6-year lifetime for the proposed amendments. In addition, this alternative does not have any additional emissions benefits compared to the proposed amendments, especially considering that the supplemental monitor activity data provides similar information to the traditional IUMPR. Therefore, considering its higher cost and no additional benefits, staff rejected this more stringent alternative.

Small Business Alternative

Staff has not identified any reasonable alternatives that would lessen any adverse impact on small business.

Performance Standards in Place of Prescriptive Standards

With respect to Government Code section 11346.2(b)(4)(A) and 11346.2(b)(1), the proposed amendments do not mandate use of specific technologies or equipment, nor do they prescribe specific actions or procedures on regulated entities.

Health and Safety Code section 57005 Major Regulation Alternatives

The proposed regulation will not result in a total economic impact on state businesses of more than $10 million in one or more years of implementation. Therefore, this proposal is not a major regulation as defined by Health and Safety Code section 57005.

X. Justification for Adoption of Regulations Different from Federal Regulations Contained in the Code of Federal Regulations

In February 1993, the U.S. EPA promulgated OBD requirements for federally certified light-duty vehicles and trucks. (40 CFR Part 86, §§ 86.094-2, 86.094-17, 86.094-18(a), 86.094-21(h), 86.094-25(d), 86.094-30(f), 86.094-35(l), 86.095-30(f), 86.095-35(l); see 58 Fed.Reg. 9468-9488 (February 19, 1993).) These requirements were later amended to require OBD systems on medium-duty vehicles by the 2008 model year. The final rule with the latest modifications of the requirements was published on February 24, 2009. A central part of the federal regulation is that, for federal certification of vehicles, U.S. EPA will deem California-certified OBD II systems to comply with the federal regulations.

In Health and Safety Code sections 43013, 43018, and 43101, the Legislature directed CARB to adopt emission standards for new motor vehicles that are necessary and technologically feasible and to endeavor to achieve the maximum emission reduction possible from vehicular and other mobile sources to accomplish the attainment of the State standards at the earliest practicable date. CARB initially adopted the OBD II regulations to meet those legislative directives. The OBD II regulation was first adopted in 1989. On October 11, 1996, the U.S. EPA granted California's request for a waiver regarding the OBD II regulation, as last amended in December 1994,[20] recognizing that the OBD II regulation is at least as stringent in protecting public health and welfare as the federal regulation, and that unique circumstances exist in California necessitating the need for the State's own motor vehicle regulations program.

In 2014, the U.S. EPA adopted Tier 3 regulations that include provisions (40 CFR 86.1806-17) that generally align federal OBD requirements for 2017 and subsequent model year light duty vehicles, light-duty trucks, medium-duty passenger vehicles, and complete heavy-duty vehicles between 8,501 and 14,000 lbs. GVWR with CARB's California OBD II regulation, as last amended in 2013. The federal requirements differ from the corresponding California OBD requirements in several aspects. For example, the malfunction thresholds for the emission threshold monitors may differ based on the emission standard the vehicle is certified to, especially in cases involving vehicles certified to Tier 3 standards that have no corresponding LEV standard. Additionally, the federal OBD requirements do not incorporate the anti-tampering provisions of the OBD II regulation (that prevent unauthorized modifications of the computer-coded engine operating parameters of the on-board computer). Further, while the federal regulation does not incorporate the specific deficiency provisions of the California OBD II regulation, it contains its own deficiency provisions that contain differences from than the deficiency provisions in the OBD II regulation.

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[20] *California State Motor Vehicle Pollution Control Standards; Waiver of Federal Preemption; Decision,* 61 Fed. Reg. 53371 (October 11, 1996).

Specifically, the federal requirements do not assign fines for deficiencies while California's OBD II regulation would require manufacturers to pay fines if their OBD system is certified with 3 or more deficiencies. Additionally, the California OBD II regulation allows for deficiencies that are applied after certification of the OBD system (i.e., retroactive deficiencies), while the federal OBD regulation does not contain such provisions. Further, the federal requirements specifically do not allow deficiencies for complete lack of major monitors. Further, considering California updated the OBD II regulation with more stringent requirements after 2013, including the requirement for the vehicle to track and report certain data parameters to characterize the vehicle's NOx control performance as well as the greenhouse gas emissions in the real world, California's OBD II regulation establishes more comprehensive and stringent requirements than the federal regulation.

CARB initially adopted the HD OBD regulation in 2005. A waiver for the regulation was granted by U.S. EPA in 2008.[21] CARB amended the regulation in 2010, and was granted another waiver action by U.S. EPA in 2012.[22] On November 7, 2016, the U.S. EPA formally granted California's request for a waiver regarding the HD OBD regulation, as last amended on June 26, 2013,[23] recognizing that the HD OBD regulation is at least as stringent in protecting public health and welfare as the federal regulation, and that unique circumstances exist in California necessitating the need for the State's own motor vehicle regulations program. The U.S. EPA has also adopted OBD requirements for vehicles and engines above 14,000 pounds, which is the weight range for California's "heavy-duty" class. The federal regulation (40 CFR 86.010-18) was published on February 24, 2009, and subsequently amended on September 15, 2011 and June 17, 2013.

The federal regulation is consistent with CARB's California regulation in the most important aspects. However, the California HD OBD regulation in general still establishes more comprehensive and stringent requirements than the federal OBD regulation. For example, the HD OBD regulation generally requires California OBD systems on diesel engines to detect malfunctions before emissions exceed more stringent thresholds than those required by the federal HD OBD regulation. Further, the federal regulation does not require the

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[21] *California State Motor Vehicle Pollution Control Standards; Notice of Waiver of Clean Air Act Preemption; California's 2010 Model Year Heavy-Duty Vehicle and Engine On-Board Diagnostic Standards,* 73 Fed. Reg. 52042 (September 8, 2008).
[22] *California State Motor Vehicle Pollution Control Standards; Notice of Waiver of Clean Air Act Preemption; California's 2010 Model Year Heavy-Duty Vehicle and Engine On-Board Diagnostic Standards,* 77 Fed. Reg. 73459 (December 10, 2012).
[23] *California State Motor Vehicle Pollution Control Standards; Malfunction and Diagnostic System Requirements for 2010 and Subsequent Model Year Heavy-Duty Engines; Notice of Decision,* 81 Fed. Reg. 78149 (November 7, 2016).

OBD system to detect diesel oxidation catalyst malfunctions before a specific emission threshold is exceeded like the California OBD regulations—it is only required to detect a failure if the catalyst completely lacks NMHC conversion capability. As another example, under the federal HD OBD regulation, the malfunction thresholds for the emission threshold monitors are not required to be adjusted to account for emissions due to infrequent regeneration events.

The proposed 2021 amendments would continue California's efforts to require more comprehensive and robust monitoring of emission related systems and components than required by federal OBD regulations. Historically, virtually every light- and medium-duty vehicle sold in the U.S. is designed and certified to California's OBD II requirements in lieu of the federal OBD requirements, while virtually all heavy-duty engine manufacturers have certified to California's HD OBD regulation, since U.S. EPA's regulation directly allows acceptance of systems that have been certified to California's regulation. While this process is expected to continue, this may not be the case for some future heavy-duty engines that will be certified to the lower emission standards recently proposed as part of CARB's Heavy-Duty Omnibus rulemaking update[24]. This rulemaking, which will result in California regulations having different emission standards than the federal regulation, may result in heavy-duty engine manufacturers producing federal-only engines that do not meet California's regulations. Therefore, it is expected that heavy-duty engine manufacturers will need to design different OBD systems, one meeting the California OBD regulation and the other meeting the federal OBD regulation, for a portion of their future product lines. However, if U.S. EPA adopts emission standards in the future that align with CARB's lower emission standards, it is expected that heavy-duty manufacturers will continue to design one OBD system to meet both the California and federal OBD requirements.

XI. Public Process for Development of the Proposed Action (Pre-Regulatory Information)

Consistent with Government Code sections 11346, subdivision (b), and 11346.45, subdivision (a), and with the Board's long-standing practice, CARB staff held public workshops and had other meetings with interested persons

[24] Staff Report: Initial Statement of Reasons for Rulemaking: Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments: Proposed Amendments to the Exhaust Emissions Standards and Test Procedures for 2024 and Subsequent Model Year Heavy-Duty Engines and Vehicles, Heavy-Duty On-Board Diagnostic System Requirements, Heavy-Duty In-Use Testing Program, Emissions Warranty Period and Useful Life Requirements, Emissions Warranty Information and Reporting Requirements, and Corrective Action Procedures, In-Use Emissions Data Reporting Requirements, and Phase 2 Heavy-Duty Greenhouse Gas Regulations, and Powertrain Test Procedures, June 23, 2020. (https://ww3.arb.ca.gov/regact/2020/hdomnibuslownox/isor.pdf)

during the development of the proposed regulation. These informal pre-rulemaking discussions provided staff with useful information that was considered during development of the regulation that is now being proposed for formal public comment.

CARB began the OBD regulatory update process at the end of 2016, when CARB staff had meetings with industry to discuss UDS-related amendments to the OBD regulation. CARB staff then began meetings with SAE committee members in 2017 to help develop the specifications related to the proposed UDS-related requirements in the SAE standards. CARB held a public workshop in El Monte on February 27, 2020 to discuss the proposal and to seek comments. Interested stakeholders participated in the workshop in person or via webinar. The workshop notice and workshop presentation were posted on the CARB OBD Program website prior to the workshop. CARB staff also presented and sought comments regarding elements of the upcoming proposed amendments to the OBD regulations during several SAE OBD symposiums. These symposiums were attended by vehicle and engine manufacturers, scan tool manufacturers, and individuals involved in various other aspects of the automotive industry.

Additionally, throughout the rulemaking process, CARB staff held numerous teleconferences with the Alliance for Automotive Innovation and the Truck and Engine Manufacturers Association, which represent the main stakeholders affected by the proposed rulemaking, as well as numerous meetings and correspondences (comprising of teleconferences, in-person meetings, and e-mail correspondences) with individual manufacturers. The proposal was developed in close collaboration with these stakeholders. As a result of the comments received throughout the regulatory process, staff made significant changes to the proposed amendments to the OBD II and HD OBD regulations, which are reflected in the final proposal.

XII. References

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XIII. Appendices

Appendix A: Proposed Regulation Order, OBD II Regulation
Title 13, California Code of Regulations, Section 1968.2, Malfunction and Diagnostic System Requirements--2004 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines

Appendix B: Proposed Regulation Order, OBD II Enforcement Regulation
Title 13, California Code of Regulations, Section 1968.5, Enforcement of Malfunction and Diagnostic System Requirements for 2004 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines

Appendix C: Proposed Regulation Order, HD OBD Regulation
Title 13, California Code of Regulations, Section 1971.1, On-Board Diagnostic System Requirements--2010 and Subsequent Model-Year Heavy-Duty Engines

Appendix D: Proposed Regulation Order, HD OBD Enforcement Regulation Title 13, California Code of Regulations, Section 1971.5, Enforcement of Malfunction and Diagnostic System Requirements for 2010 and Subsequent Model-Year Heavy-Duty Engines

Appendix E: Data Record Reporting for Over-the-Air Reprogrammed Vehicles and Engines Using SAE J1979-2, June 1, 2021

Appendix F: Economic Analysis Support