State of California
AIR RESOURCES BOARD

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

PUBLIC HEARING TO CONSIDER ONBOARD DIAGNOSTIC SYSTEM REQUIREMENTS FOR 2010 AND SUBSEQUENT MODEL YEAR HEAVY-DUTY ENGINES (HD OBD)

Public Hearing Date: July 21, 2005
Agenda Item No.: 05-7-4

I. GENERAL

The Staff Report: Initial Statement of Reasons for Rulemaking (ISOR or "Staff Report"), entitled *Malfunction and Diagnostic System Requirements for 2010 and Subsequent Model Year Heavy-Duty Engines (HD OBD)*, released June 3, 2005, is incorporated by reference herein.

Following a public hearing on July 21, 2005, the Air Resources Board (the Board or ARB) by Resolution 05-38 approved, with modifications, the adoption of section 1971.1, title 13, California Code of Regulations (CCR). Upon becoming operative, section 1971.1 would establish on-board diagnostic (OBD) system requirements for 2010 and subsequent model year on-road heavy-duty engines and vehicles produced for sale in California that have a gross vehicle weight rating greater than 14,000 pounds. Resolution 05-38 is incorporated by reference herein. At the hearing on July 21, 2005, in response to comments received, the staff presented the Board with modifications to the regulatory language originally proposed in the Staff Report. The changes included:

1. Modifications to the malfunction emission threshold levels for several diesel engine monitors (section 1971.1(e)).
2. Modification of the gasoline evaporative system monitoring requirement to detect a 0.150-inch leak instead of a 0.090-inch leak (section 1971.1(f)(7)).
3. Revisions to the number of engines required to be tested for certification demonstration (section 1971.1(i)(2)).
4. Clarification of the aging method for certification demonstration testing (section 1971.1(i)(2)).
5. Revisions to the production vehicle testing requirements of monitors to require testing of only vehicles, not engines (section 1971.1(l)(2)).
6. Clarifications on how groupings are to be defined for production vehicle verification of in-use monitor performance (section 1971.1(l)(3)).
7. Modifications to the interim in-use compliance standards (section 1971.1(m)).

Within the resolution, the Board directed the Executive Officer to adopt the proposed regulation after making available for public comment all changes specifically directed by the Board and any other necessary changes to the regulatory language as originally proposed in the Staff Report released on June 3, 2005. The changes directed by the Board, in addition to other changes initiated due to comments received during the hearing and the 45-day period prior to it, were made available for public comment in the ARB's Notice of Public Availability of Modified Text (Post-Hearing 45-Day Changes) on September 9, 2005. The Post-Hearing 45-Day Changes is incorporated by reference herein.

In the 45-Day Notice for this rulemaking, the ARB referenced that several Society of Automotive Engineers (SAE) and International Organization of Standards (ISO) documents would be incorporated by reference in title 13, CCR section 1971.1. The SAE and ISO documents that are incorporated by reference in the regulation are:

SAE J1930 "Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms – Equivalent to ISO/TR 15031-2:April 30, 2002", April 2002;
SAE J1939 March 2005-"Recommended Practice for a Serial Control and Communications Vehicle Network" and the associated subparts included in SAE HS-1939, "Truck and Bus Control and Communications Network Standards Manual", 2005 Edition;
SAE J1962 "Diagnostic Connector – Equivalent to ISO/DIS 15031-3: December 14, 2001", April 2002;
SAE J1978 "OBD II Scan Tool – Equivalent to ISO/DIS 15031-4:December 14, 2001", April 2002;
SAE J1979 "E/E Diagnostic Test Modes – Equivalent to ISO/DIS 15031-5: April 30, 2002", April 2002;
SAE J2012 "Diagnostic Trouble Code Definitions – Equivalent to ISO/DIS 15031-6: April 30, 2002", April 2002;
SAE J2403 "Medium/Heavy-Duty E/E Systems Diagnosis Nomenclature," August 2004;
ISO 15765-4:2001 "Road Vehicles-Diagnostics on Controller Area Network (CAN) - Part 4: Requirements for emission-related systems", December 2001.

Existing administrative practice of the ARB has been to have technical recommended practices, such as the above, incorporated by reference rather than printed in the CCR. These procedures are highly complex technical documents. Because the ARB has never printed these types of documents in the CCR, the affected public is accustomed to the incorporation format utilized in section 1971.1. Moreover, printing portions of the documents in the CCR when the bulk of the procedures are incorporated by reference would be unnecessarily confusing to the affected public. Additionally, the documents from SAE and ISO are copyrighted and are available only for purchase. The full documents are instead available for public inspection from the Clerk of the Board at 1001 "I" Street, 23rd floor, Sacramento, California 95814.

<u>Economic and Fiscal Impacts</u>. The businesses to which the regulation is principally addressed and for which compliance would be required are any business involved in

manufacturing, purchasing, or servicing heavy-duty engines and vehicles. There are 21 engine manufacturers, none of which are located in California. Of these businesses, two of the engine manufacturing companies are assumed to be "small businesses" (i.e., selling less than 150 engines per year based on California certification data). There are approximately 8 major vehicle manufacturers, but staff has been unable to obtain an estimation of the total number of vehicle manufacturers that manufacture and sell heavy-duty vehicles in California. Thus, staff is unable to determine how many of these companies are located in California and how many are considered "small businesses." However, the cost related to vehicle manufacturers is assumed to be negligible.

Staff determined that any business or individual purchasing a 2010 or subsequent model year heavy-duty vehicle equipped with an OBD system would incur additional costs as a result of the regulation. Specifically, retail costs for new heavy-duty vehicles equipped with an OBD system are expected to increase by $132 per vehicle (an increase of approximately 0.2 percent of the retail cost of the vehicle). Further, because the OBD systems are expected to detect emission system and component malfunctions that would not otherwise be detected, the regulation is expected to result in owners and operators having to make additional emission-related repairs. It is expected that these repairs will result in average costs of approximately $23 per vehicle per year after the expiration of the engine manufacturer's warranty (two-thirds of the vehicles are expected to incur one additional repair over the first 21 years of operation at an average repair cost of $741).

For engine manufacturers, the costs to comply with the regulatory action are expected to be less than the $132 retail price increase that was calculated for implementation of the requirements. Manufacturers would incur these costs in the form of additional hardware and software installed on the engine and the testing and development costs to implement the requirements. These costs are expected to be recouped through the anticipated $132 retail price increase on each engine they sell to heavy-duty vehicle manufacturers. During the warranty period the engine and vehicle manufacturers will absorb the additional costs for emission-related repairs. Given the anticipated durability of the emission-related parts, ARB does not anticipate the costs to be as high as the estimated $23 costs that owners and operators will incur in later years. The heavy-duty engine manufacturers are expected to pass all of their costs onto the heavy-duty vehicle manufacturers, and it is anticipated they will ultimately pass on their additional costs onto purchasers of assembled vehicles.

This regulatory action is expected to pose no adverse economic impact on private persons and businesses as consumers. The $132 cost increase represents less than a 0.2 percent increase in the retail price of a heavy-duty vehicle, and the $23 per engine per year in increased maintenance costs is negligible.

The Board has determined that this regulatory action will not result in a mandate to any local agency or school district the costs of which are reimbursable by the state pursuant to Part 7 (commencing with section 17500), Division 4, Title 2 of the Government Code.

Alternatives. For the reasons stated in the Staff Report and the agency's response to comments in this Final Statement of Reasons (FSOR), the Board has determined that no alternative considered by the agency would be more effective in carrying out the purpose for which the regulatory action was proposed or would be as effective and less burdensome to affected private persons than the action taken by the Board.

II. SUMMARY OF COMMENTS AND AGENCY RESPONSE

At the July 21, 2005 hearing, oral testimony was received in the following order from:

Mr. Jed R. Mandel, Engine Manufacturers Association (EMA)
Mr. Eric T. Swenson, Truck Manufacturers Association (TMA)
Mr. Bob Jorgensen, Cummins
Mr. Todd Campbell, Coalition for Clean Air (CCA)
Ms. Bonnie Holmes-Gen, American Lung Association (ALA)
Ms. Kathryn Phillips, Environmental Defense

Written comments in response to the 45-Day Notice were received during the 45-day comment period prior to the hearing from:

Mr. Martin F. Gerstl, International Organization for Standardization (ISO)
Mr. Michael J. Conlon, Heavy Vehicle Maintenance Group; Mr. Aaron Lowe, Automotive Aftermarket Industry Association/Automotive Warehouse Distributors Association; Mr. John Goodman, Automotive Engine Rebuilders Association; and Mr. William C. Gager, Automotive Parts Remanufacturers Association (Aftermarket Group)
Mr. Dirceu Lopez, Citizen
Mr. Jerry Henger, Citizen
Mr. Greg Buchler, Citizen
Mr. Robert Clarke, TMA
Mr. Jed R. Mandel and Ms. Lisa A. Stegink, EMA
Ms. Diane Bailey, Natural Resources Defense Council; Ms. Kathryn Phillips, Environmental Defense; Ms. Bonnie Holmes-Gen, American Lung Association of California; Mr. Don Anair, Union of Concerned Scientists; and Mr. Todd Campbell, Coalition for Clear Air (Environmental Group)

Written comments in response to the Post-Hearing 45-Day Changes were received during the Post-Hearing 45-day comment period from:

Mr. Jed R. Mandel and Ms. Lisa A. Stegink, EMA

Late written comments sent after the Post-Hearing 45-Day comment period were received from:

Mr. Dale Kardos, Recreational Vehicle Industry Association

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

45-DAY COMMENTS

COMMENTS IN SUPPORT

1. Comment: I support the adoption of the regulation. (Dirceu Lopez)(Jerry Henger)(Greg Buchler)(Environmental Group)

2. Comment: The staff has done their research and has done a good job on the proposal. They worked hard with the engine manufacturers, and the public process supports this rule. (CCA)

3. Comment: This rule is important because of the major public health benefits that are linked to reduction of diesel pollution. We know that you are all concerned about achieving the maximum possible reductions of diesel pollution. We are especially concerned about the role of diesel pollution in triggering asthma attacks, elevating cancer risks, increasing hospitalizations and emergency room visits, increasing premature deaths, and slowing lung function growth in children. (ALA)

4. Comment: The regulation helps ensure that the benefits we're trying to achieve with the 2007/2010 standards actually occur, particularly in the communities that are impacted by heavy-duty trucks more than others. (CCA)

5. Comment: We believe that the regulation provides extremely cost-effective emission reductions, and we're pleased that by 2020, we should get over 100 tons per day of nitrogen oxide emission reductions from this regulation. (ALA)

6. Comment: We believe that the Board needs to adopt technology-forcing standards such as these to keep the manufacturer on task to develop the new technologies that will assure that the engine standards are achieved through the life of the vehicle and to ensure that the public gets the expected health benefits from the smog and PM reductions from these emission control requirements. (ALA)

7. Comment: This regulation is also important because California has suffered from a defeat device that was installed by engine manufacturers. (CCA)

8. Comment: It is important to ensure these new applications, pre- and after-treatment, actually work in-use. A lot of people, particularly decision-makers for CEQA, rely on looking at engine emission factors and making sure they're in compliance and the rate of deterioration in the models are actually consistent. (CCA)

9. Comment: We support the implementation of an engine-focused rule because heavy-duty vehicles use engine-dynamometer-certified engines. Additionally, we support applying the regulation based on engine model year designations rather than vehicle model year designations. (TMA)

10. Comment: We support the allowance of either the ISO 15765-4/15031-4 or J1939 protocols to be used for communication. This allows investments in proven automotive technologies to be leveraged in lower volume, light-heavy duty engines, and also recognizes J1939's use in the larger Class 5-8 vehicles for transmission automation, traction control, and instrumentation. ISO 15765-2/15031-4 is preferred when class 3 products are extended up into higher weight categories, since this will prevent them from being redeveloped with a different diagnostic communication method. (TMA)

11. Comment: Emission diagnostic technology has proven successful in reducing harmful emissions from cars and trucks by quickly identifying emission control system failures and has lead to increasingly durable and reliable emission control systems. The heavy-duty OBD regulation will apply the same level of technology that has been required for cars and light trucks since 1996. OBD is necessary to ensure that the more sophisticated emission control technology that are going to be employed on heavy-duty trucks to meet the 2007-2010 standards are functioning as designed. Experience in the light-duty sector with OBD II has shown that OBD systems are essential to ensure that these standards continue to be met over the life of the vehicle. We prefer OBD to not be phased in as is currently required by the regulation, but we understand that it is important for the engine manufacturers to focus current resources on meeting the 2007-2010 standards. The final phase-in of 2013 will allow a full three years after the implementation of those standards for manufacturers to perform the necessary testing and development for this OBD rule. The much-needed emission reductions this regulation will achieve are well worth the minor costs. The emission malfunction thresholds required in the regulation are technically feasible and reasonably attainable given the timeframe, and much more lax than those for the light-duty vehicles. The testing requirements are important, since the OBD rule can only be successful if the diagnostics are shown to be working properly on different vehicle models and given that heavy-duty trucks are not subject to Smog Check and therefore less likely to discover and repair emission-related problems. We applaud staff for working with U.S. EPA over this rule and their diligent work with industry to address all concerns. (Environmental Group)

12. Comment: I hope to see an onboard diagnostic system regulation passed in states other than California. (Dirceu Lopez)(Jerry Henger)

13. Comment: This regulation would be great for the rest of the country, since the prevailing wind is to the east. (Jerry Henger)

14. Comment: Every little step towards clear air is a cleaner future. (Dirceu Lopez)

    Agency Response to Comments 1-14: We appreciate your comments.

15. Comment: Please avoid any temptation to weaken this rule, because we need to get this right at the outset. And we need a proposal that challenges the engine manufacturers enough to do the job well. (CCA)

16. Comment: Though ARB has the flexibility to change the regulation later, the industry should not take this as a signal that there will definitely be a change later and thus invest less time to developing the kinds of systems that will protect air quality and consumers and help ensure that consumers are going to be getting what they get. (Environmental Defense)

    Agency Response to Comments 15-16: The proposed regulation is technology forcing and does provide a significant challenge to engine manufacturers. As with other technology-forcing regulations, periodic review of industry's progress towards meeting the requirements (such as the biennial review directed by the Board for this rulemaking) is a prudent and necessary safeguard to ensure successful implementation of OBD systems and to address any unforeseen issues that may arise. The biennial review is not intended to be used to weaken or undermine the requirements at a later date and engine manufacturers generally are aware that such relief is not likely to be granted.

GENERAL COMMENTS ABOUT THE REGULATION

17. Comment: Had there been OBD systems present on heavy-duty vehicles, would the problem dealing with the chip reflash issue have been avoided? Is there a way to make the OBD regulation more stringent to ensure that there won't be an opportunity for a similar situation to occur? (Environmental Defense)

    Agency Response: The OBD system is designed to detect malfunctions of individual emission control components and it is primarily software designed and implemented by the engine manufacturers themselves. It is not intended, nor is it very practical, to detect alternate calibrations or commanded modes of operation such as the issue that resulted in the chip reflash regulation. It is unlikely that an engine manufacturer that purposely designed and implemented an alternate mode of operation with less effective emission control would also implement an OBD system that would then detect such operation and indicate a malfunction. However, the OBD system does include information about how often the engine is operated and how often certain diagnostics are run which could potentially show abnormalities if the emission controls were deliberately disabled for a significant amount of time. The system also contains information that makes it easier to connect external emission measurement equipment that will be used in the future to do additional compliance testing for items like the chip reflash issue.

18. Comment: On the issue of proprietary technology or software, this is a very technological world. Some gadgets like cell phones and Palm Pilots are able to store photos or take pictures now, with more advances in the near future. In the case of the OBD regulation, we're looking at eleven years, so I really don't think proprietary issues really apply. (CCA)

    Agency Response: Based on staff's experience with over 10 years of experience with OBD II (the OBD system requirements for light- and medium-duty vehicles), it is not anticipated that proprietary issues will prevent an engine manufacturer from developing systems that meet the requirements. In very rare cases, patent issues have surfaced and a manufacturer has had to alter its design to meet the regulation. However, since the regulation consists of performance requirements, there are generally many different ways in which a manufacturer may design a compliant system.

19. Comment: Engine manufacturers are investing in excess of a billion dollars to meet the federal and California 2007/2010 engine emission standards. These standards will result in diesel technology, long known for being the most durable and energy efficient, to also be rightfully called clean. The amount of financial capital and human resources to be used over the next five years are staggering, but worth the goal of clean diesels. During this time, the manufacturers also have to address the additional challenges of the manufacturer-run heavy-duty in-use test program and the Engine Manufacturer Diagnostic (EMD) requirements that become effective in 2007, and now the heavy-duty OBD requirements, which will require huge investment of resources (time, test cells, and engineering expertise) in developing modeling systems and software. This workload, the cost, and the invention of technology that will be required will be implemented on significantly more engine models and ratings and recouped in far, far fewer units of sale than ever has been required in any other OBD programs. (EMA)

20. Comment: The main goal is compliance with the 2007/2010 standards. The heavy-duty OBD rule must be implemented in such a way as to not interfere with engine manufacturers' ability to achieve the standards. (EMA)

    Agency Response to Comments 19-20: Staff has carefully considered input received by engine manufacturers (collectively and individually) and designed the phase-in schedule for 2010-2016 to account for the prior commitments on manufacturer's resources. A substantial number of discussions were held with the manufacturers on this specific topic to find a reasonable schedule that could be managed with their personnel and emission test cell resources. Staff's cost estimates included test cell and personnel resources and the phase-in was constructed to have as minimal impact as possible in the 2010 time frame with the bulk of calibration (personnel and emission test cell intensive work) in preparation for 2013 and 2016.

21. Comment: We understand that ARB imposes technology-forcing requirements in the new regulation. (EMA)(TMA)

22. Comment: Nevertheless, the Board must avoid crossing the line from technology-forcing to infeasible standards, or those imposing an unreasonable burdensome cost and workload, especially against all the work needed to meet the technology-forcing 2007/2010 standards. (EMA)

23. Comment: Manufacturers do not know how they will, as a matter of feasibility and as a practical matter, meet many of the requirements proposed today. (EMA)

24. Comment: This challenge to meet the OBD requirements is made more difficult by the fact that engine manufacturers do not know and have not yet invented the technology to meet the underlying emission standards. (EMA)

25. Comment: There are technological challenges (such as NOx sensors) associated with the regulation that could be problematic. (TMA)

    Agency Response to Comments 21-25: As required, the Staff Report outlines an approach that could be used to meet each of the diagnostic requirements imposed by the regulation. In some cases, such approaches are already being used in production vehicles (e.g., in light- or medium-duty applications with OBD II systems) and the technology is fairly mature. In other cases, similar approaches are being used on the same or similar emission controls and the approaches outlined by staff are able to be adapted. In still others, staff has relied on information from suppliers and/or past experience to identify feasible approaches that could be used by engine manufacturers to meet the requirements. There indeed are technical challenges to implementing many of the diagnostics across a manufacturer's product line but none that cannot be overcome with adequate development and resources between now and the start of implementation. Nonetheless, the Board, cognizant of the manufacturer concerns, directed the staff to continue to watch manufacturer's progress towards meeting the requirements and to report back to the Board in two years time to address any unforeseen issues that may arise.

26. Comment: OBD is technically complex and requires sophisticated new systems equipped on engines and vehicles. Regulating how manufacturers use OBD and monitor their engine emission controls adds more complexities and new challenges to produce engines that are compliant with 2010 and later standards. However, heavy-duty engine manufacturers have little experience with regulated OBD systems. (EMA)

27. Comment: OBD experience in light-duty is not really applicable to heavy-duty, because of the different technologies used in gasoline versus diesels. Also, only

a few manufacturers are involved in both the light-duty and heavy-duty arenas, and a few others have experience in the medium-duty and heavy-duty arenas, and thus have some experience with OBD. But most heavy-duty manufacturers have no experience with OBD. Those with no experience will have more challenges to overcome, from understanding basic OBD terminology to creating algorithms and writing the software code used for monitoring. (EMA)

Agency Response for Comments 26-27: The staff understands that a significant amount of learning is needed, which is why the staff proposed the full implementation date for heavy-duty OBD to be 2016. As mentioned in the response to comments 19-20, a significant amount of discussions were held with the manufacturers during the development of the regulation to address lead-time and find a workable phase-in schedule. Further, the lead-time provided has factored in that some manufacturers have had little or no prior experience in diagnostics required by ARB regulation. However, it must be noted that for many years all manufacturers have been developing and producing types of diagnostic systems for their own engines. While most of these diagnostics may not be as sophisticated as those required by the OBD regulation, the manufacturer experience in developing and implementing their diagnostic systems will carryover to the OBD requirements, and no manufacturer will be starting from scratch.

28. Comment: The heavy-duty industry is a non-vertically integrated industry, unlike light-duty. Engine manufacturers sell their engines to customers who put them in many different types of vehicles that vary in transmission types, customer specifications and performance requirements. Engine manufacturers cannot predict all possible variations in which their engines will be used and they do not have control over vehicles. Though ARB staff recognized this and made several changes to the OBD requirements to accommodate for this, further regulatory changes are needed to limit engine manufacturers' responsibility for vehicle matters outside of their control. (EMA)

Agency Response: As the commenter indicates, substantial changes were indeed made to the initial OBD proposal to limit the scope of the requirements as much as possible to the engine and not involve items outside of the engine. However, there are interactions between the engine and the vehicle in which it is installed that do have to be taken into account when designing and implementing a robust OBD system that actually works when the engine is being operated in a vehicle on the road. Like other emission and safety requirements, in some cases the engine manufacturer does have to impose limitations on how the vehicle builders integrate the engine into the vehicle to ensure the engine and its emission controls remain in a certified and legal configuration. OBD will likely add more limitations to the existing ones and will become part of the build specifications that engine manufacturers provide to vehicle manufacturers to ensure proper integration of the engine.

29. Comment: Heavy-duty engines are produced in relatively low volumes and are used in interstate commerce. Trucks licensed outside of California regularly operate in the state. So it is important to have a uniform nationwide heavy-duty OBD program. The Staff Report stated that the U.S. Environmental Protection Agency (U.S. EPA) staff had indicated a "strong interest" in developing harmonized regulations. ARB and U.S. EPA even signed a high-level memorandum of agreement to demonstrate their commitment to work collaboratively toward developing a nationwide heavy-duty OBD regulation. This is important to an industry that must be able to provide common engines to all fifty states if costs are to be controlled and the variety of engine choices are to remain available. Some negative consequences of disharmonized OBD requirements include disadvantages to California-based truckers and more difficulty for them to compete for nationwide shipping business. It should be noted that the California and federal processes for adopting a regulation are different: U.S. EPA cannot easily adopt requirements that can be periodically reviewed and revised, unlike ARB. So ARB should not adopt rules which can't be reasonably projected to be implemented with the false sense of security they can be reviewed and modified later, since this won't work for U.S. EPA. And frankly, this is not the most rational way to enforce investment in new technology. (EMA)

    Agency Response: U.S. EPA staff and ARB staff have been jointly involved in the development of this regulation from the start with the intent that the two agencies' regulations will be harmonized. There is no indication that the final rule adopted by U.S. EPA be anything will prevent one OBD system from satisfying both ARB and U.S. EPA regulations. While U.S. EPA has indicated that it does face a more difficult process in amending or altering adopted regulations, it can and has on several occasions expeditiously adopted light-duty OBD requirements that harmonize with the ARB OBD II requirements. Further, the proposed regulation has set forth technically feasible monitoring requirements, and it is not expected to make significant changes to the regulation in the future. While the biennial review is important to ensure that manufacturers are on track to comply with the OBD requirements and to address any previously unforeseen issues that may have arisen, the review has rarely been used in the context of light-duty OBD to make requirements less stringent and has never been used to drop a monitoring requirement to make the regulation, in manufacturers' eyes, "technically feasible."

30. Comment: Further changes to the regulation must be made to reduce or eliminate the risk of false malfunction indicator lights (MILs) – the risk that those annoying dashboard lights will come on when there really is no problem. The integrity of the OBD regulatory framework and the vehicle inspection and maintenance process can be compromised if MILs light up when there is no failure of an emission system or component. For drivers of commercial trucks and buses, those lights are more than just an annoyance. In practice, those lights may force the driver to stop and pull over immediately and wait for help,

causing safety concerns and stopping the movement of people, goods and services into, out of, and within California. (EMA)

Agency Response: An integral part of the OBD regulation is the requirement that engine manufacturers define monitoring conditions for each diagnostic that are "technically necessary to ensure robust detection of malfunctions (e.g., avoid false passes and false indications of malfunctions)." Staff agrees with the commenter that false MILs are beneficial to no one and can undermine drivers', inspectors', and repair technicians' confidence in the system. However, with over 10 years of experience in OBD systems, staff is confident that the regulatory requirements can be met without risk of false MILs just as light- and medium-duty manufacturers have been able to do. As with light-duty OBD, occasional mistakes by the engine manufacturer that result in increased risk of false MILs are bound to happen but they have generally been very infrequent and identified and eliminated during pre-production testing.

31. Comment: Engine manufacturers need stability and certainty – they need to know the requirements well in advance and know they are not changing – so that they can work productively and cost-effectively toward the goals that are set. Manufacturers should not be required to expend time and effort attempting to develop costly monitoring strategies that are not feasible. (EMA)

    Agency Response: The staff understands the engine manufacturers' needs to have the requirements defined well in advance and has made every effort to accommodate the manufacturers. This is also one of the reasons for the very slow phase-in of the regulatory requirements and the longer lead-time (four years) than required before the start of implementation in 2010. As mentioned in the response to comments 21-25 and 29, the requirements set forth are technically feasible and are not expected to change appreciably in subsequent biennial reviews of the regulation.

32. Comment: We wish to work with ARB staff on the following key issues during the future 15-day notice changes: particulate matter (PM) filtering thresholds and timing and liability for detecting failure modes, oxides of nitrogent (NOx) aftertreatment emission thresholds and timing, and the certification demonstration test burden and aging requirements. We also request that the 15-day period be changed to a 45-day period, given the complexities of the issues. (EMA)

33. Comment: We also need to work further with ARB on additional issues to ensure a reasonable heavy-duty OBD regulation that does not jeopardize engine manufacturers' ability to provide reliable, durable, cost-effective, and clean diesel engines, both in California and nationwide. (EMA)

    Agency Response to Comments 32-33: Staff agreed to change the 15-day period to a 45-day period. During this period, staff did revisit the issues and made several changes to the PM filter monitoring requirements and certification demonstration testing requirements and further details of the changes are detailed in the responses to subsequent comments.

34. Comment: We ask that ARB continue its practice of biennial reviews to reconcile regulations with actual achieved technological progress. (EMA)(TMA)

Agency Response: As the Board directed during the hearing and in Resolution 05-38, the staff will come back in two years during its biennial review to modify the heavy-duty OBD regulation where necessary.

COMMENTS ABOUT FEASIBILITY, COST-EFFECTIVENESS, AND LEADTIME

35. Comment: The HD OBD requirements constitute new emission standards that engine manufacturers are required to comply with prior to introducing their products for sale into commerce. Thus, the regulation is subject to clear mandates both by the U.S. Congress in the federal Clear Air Act (CAA) and by the California legislature in state law. Any mobile source emission standards adopted by the ARB for on-highway heavy-duty engines and vehicles require a waiver of federal preemption from U.S. EPA and must be technologically feasible, must be cost-effective, and may be implemented only if the requisite leadtime and period of stability are provided to manufacturers. If ARB is unable to demonstrate all these, California cannot obtain the necessary preemption waiver from U.S. EPA and cannot enforce its own emission standards, as required by section 209(b) of the CAA. (EMA)

36. Comment: The heavy-duty OBD regulation must be technologically feasible. However, the proposed requirements are not technologically feasible. Section 202(a) of the CAA requires that, among other things, "standards must reflect the greatest degree of emission reduction achievable through the application of technology…determine[d to] be available for the model year to which such standards apply, giving appropriate consideration to cost, energy, and safety factors associated with the application of such technology." California law also requires that emission standards be justified and technologically feasible. Although the Staff Report has tried to support the adoption of stringent requirements of various aspects of the regulation, staff has failed to justify the technological feasibility of many of the proposed requirements. (EMA)

Agency Response to Comments 35-36: In Resolution 05-38, the Board directed staff to request a waiver from U.S. EPA and made all the necessary findings necessary to obtain a waiver. Contrary to the unsupported assertions of the commenter, the Staff Report fully supports the findings of the Board that the requirements of this regulation are technologically feasible. Also, see responses to comments 21-29.

37. Comment: The HD OBD regulation must be cost-effective. Section 202(a) of the CAA requires the Board to consider cost and other related factors in setting new

heavy-duty engine and vehicle emission standards. The California Health and Safety Code establishes a similar mandate for ARB, requiring the Board to adopt emission standards which will result in the most cost-effective combination of control measures on motor vehicles and fuel. And California Government Code Sections 11346.3 and 11346.5 require the Board to assess the proposal's economic impact. The ARB staff has not met the burden of showing its proposal is cost-effective. Staff has both underestimated the costs to engine manufacturers and vehicle owners and has not fully analyzed the cost-effectiveness (the costs vs. the emission benefits). (EMA)

Agency Response: The staff disagrees. The staff had conducted a comprehensive cost analysis of the regulation and shown it to be cost-effective, and had detailed it in the Staff Report. The staff's calculations did include all costs to the engine manufacturers for development, calibration, testing, personnel, and hardware costs. Further, the staff included costs to vehicle owners in the form of emission-related repairs that would be incurred outside of the engine warranty period. Regarding the emission benefit calculations, the staff used ARB's EMFAC emission model to estimate the impact of the OBD system and vehicle owner's response to detected malfunctions to calculate the overall emission benefit. Not one detailed or specific comment was received criticizing any aspect of staff's methodology or identifying any flaws or errors in the staff's assumptions. The staff's calculations show that the OBD regulation is very cost-effective when compared to other previously adopted heavy-duty engine measures.

38. Comment: The HD OBD regulation must provide sufficient lead-time and stability. Engine manufacturers need sufficient time to develop OBD technology that is feasible and practical. We support a phase-in of the regulation which would narrow application of the full OBD implementation in the initial years to a limited number of engine ratings and would extend the time for meeting those requirements on all engines and extend the time for full in-use compliance. EMA and ARB staff have agreed in principle on the parameters of such a phase-in and we are continuing to work out the details. California law requires that the standards must be adopted within reasonable time frames (Health and Safety Code section 43013). Section 202(a) of the CAA requires that any new emission standards may go into effect only four or more full model years after the year in which they were promulgated, and those new standards must stay in effect for at least three full model years before ARB may establish another standard. (EMA)

Agency Response: Although ARB has provided manufactures with at least four years of lead-time before the OBD requirements are to be implmented, the ARB does not believe that conformance with the federal four-year lead-time requirement is required for California to qualify for a waiver of preemption. Since 1970, U.S. EPA has typically applied a "two-pronged" test of whether California standards are consistent with CAA section 202(a) as required by section 209(b)(1)(C). The standards first must be technologically feasible in the lead-time provided considering the cost of compliance, and second must be compatible with the federal test procedures so that a single vehicle could be subjected to both tests. No more should be required.

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

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

It was not until the 1990 CAA amendments, that Congress enacted an entirely new provision, section 202(m), which directed the Administrator to adopt regulations to implement OBD requirements. Under the new provision, Congress directed the Administrator to promulgate regulations for new light-duty vehicles and light duty trucks within 18 months of enactment. (CAA section 202(m)(1).) Additionally, at the Administrator's discretion, Congress provided U.S. EPA with equivalent authority to adopt OBD requirements for new heavy-duty vehicles. (*Id.*) The federal CAA further provided that the effective date for those regulations initially adopted under section 202(m) shall be the model year 1994, unless the Administrator postpones application for certain classes and categories of vehicles until the 1996 model year. The Administrator could decide to delay implementation for reasons that the OBD requirements were infeasible or to be consistent with the policies adopted by the ARB. (CAA section 202(m)(2).) Thus, theoretically, under the provisions of CAA section 202(m), the Administrator had effective authority to promulgate and implement OBD requirements for heavy-duty vehicles as early as the 1994 model year. Assuming that such requirements were adopted in June 1992 (18 months after the enactment of the CAA), Congress would have provided less than the requisite time allowed for implementation under CAA section 202(a)(3)(C). Accordingly, it would be appropriate to infer that Congress never intended that the OBD requirements be subject to the lead-time provisions of section 202(a)(3)(C).

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

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

Nonetheless, as stated, the commenter's point is moot in this case, because this regulation is on schedule to be promulgated prior to the end of the 2005 calendar year, a full four years ahead of 2010 when it is first in effect.

COMMENTS ABOUT SPECIFICS OF THE REGULATION

MONITORING REQUIREMENTS

39. Comment: We should support a 2010 threshold that does not exceed the standards by 2.5 times and a 2013 threshold at two times. We need a system in place that alerts the truck drivers and inspectors that a truck is out of compliance rather than have a compromised system or no system at all that allows for preventable excess emissions from trucks on our California roads. (CCA)

    Agency Response: The staff understands the commenter's desire to have the system alert drivers to the presence of an emission-related malfunction as early as possible after the vehicle exceeds the applicable standards. However, the staff developed the thresholds based on the limits of technical feasibility. Given the available (and projected to be available) technologies, the staff concluded tighter thresholds were not likely feasible in the 2010 and 2013 timeframes. Further, past experience with OBD has shown that having a higher interim threshold for the first few years provides for a more successful implementation as engineers designing and calibrating the system have a larger window to aim for and the risk of non-compliance is lower. This is especially important with technology-forcing regulations such as OBD.

40. Comment: Currently, the regulation (section (d)(6.1.3)) states that in cases where ARB believes the manufacturer has incorrectly determined the test cycle and standard that is most stringent when determining the emission malfunction threshold for diesel monitors, for 2010 through 2012, the Executive Officer shall require emission data from the applicable test cycles for more than one engine per year for each monitor. However, this is not consistent with what was stated in the Staff Report (page 9), specifically that engine manufacturers are allowed to use engineering judgment from 2010 through 2012 to determine the more stringent test cycle and calibrate accordingly in lieu of performing actual testing for every component on both cycles. Additionally, the language in the regulation allowing the Executive Officer to require submission of test data on up to one engine per year for each monitor is unreasonable and provides no relief to manufacturers. We support the language in the Staff Report which would not require manufacturers to submit test data in the early years, and the regulation should be changed accordingly to reflect this. But it has to go further. The gathering of these emission test data would require manufacturers to test each and every component on both tests. With all the other requirements manufacturers would have to meet, those testing requirements are unreasonable

and not doable, given manufacturers' limited resources and testing facilities. Manufacturers must be allowed to use engineering judgment through at least 2018 to determine which cycle is more stringent. (EMA)

Agency Response: As part of the post-Board Hearing 45-day changes, the staff removed the language of concern in section (d)(6.1.3). The language of concern was previously added at the request of one of the engine manufacturers. Nonetheless, even with the language removed, the staff still retains authority to challenge the manufacturer's decision and to request the engineering analysis and/or emission data the manufacturer used to make its decision. The staff believes such authority is sufficient to ensure manufacturers have selected the applicable test cycle.

41. Comment: We support ARB's newly revised thresholds of other monitors which are more reasonable than those outlined in the draft proposal. However, ARB should also limit the thresholds to the FTP test cycle only in order to reduce the significant burden the manufacturers are up against. At a minimum, manufacturers also need better clarity in the regulatory language and greater flexibility in the early years to decide which test cycle is more stringent. (EMA)

Agency Response: Heavy-duty engines are subject to emission standards on both the FTP and the SET steady-state test cycles. Engines are subject to both cycles partially to ensure a broad enough range of types of engine operation are covered during certification. Similarly, with OBD, manufacturer's emission control strategies can and do vary under the different test cycles and, accordingly, the impact of specific emission control malfunctions may be larger or smaller on the different cycles. To ensure that in-use malfunctions are detected at reasonable emission levels, regardless of the type of engine operation, manufacturers would be required to assess which of the two test cycles would be more sensitive to a particular emission control component malfunction and calibrate for that test cycle. For engineers involved in the design and calibration of the emission control system, this task will likely involve nothing more than reviewing the calibrations to determine which cycle will likely have the largest impact. In cases where such an assessment cannot be made, a single additional test would be necessary to determine which cycle has the largest impact and all further calibration work would be focused solely on that test cycle. One additional emission test early in development does not appreciably increase the testing burden for any monitor given the iterative emission test process that is used to develop the final calibrations.

42. Comment: Regarding diesel fuel system pressure control monitoring, the regulation should be revised to require an emission-threshold based monitor only on engines equipped with feedback control of the fuel pressure, which is similar to what the EMD regulation requires. Without this, ARB's proposal does not address the electronic unit injector fuel systems (EUI) that are not able to monitor fuel system pressure. (EMA)

Agency Response: Proper fuel injection is one of the most important emission controls on a diesel engine. In fact, prior to the recent addition of items like EGR and the future addition of PM and NOx aftertreatment, fuel control was the sole emission control on diesel engines. Precise control of fuel pressure is essential to proper fuel injection. Accordingly, the OBD regulation requires monitoring of the fuel pressure, regardless of whether the manufacturer has implemented mechanical or electronic control of the fuel pressure. In meeting with manufacturers and assessing the likely configurations of 2010 and subsequent model year engines, electronic feedback control of fuel pressure appears to be almost universally part of the configuration and additionally hardware would not be required. However, in a limited number of cases, manufacturers may be able to use non-feedback systems to otherwise meet the emission standards. In such rare cases, manufacturers would need to add hardware to meet the OBD requirements to verify proper fuel pressure was being achieved. The technical feasibility of these requirements are discussed in detail in the Staff Report.

43. Comment: Regarding diesel fuel injection timing and quantity monitoring, the emission thresholds should be eliminated and only functional or circuit continuity monitoring required to make this requirement more workable and reasonable. Specifically, the regulation should instead require circuit diagnostics to detect that multiple injections are electrically occurring (the determination must detect that the final current and voltage are proper on all activations) and allow functional monitoring of one pulse to ensure delivery of fuel to the cylinder "when expected" (a coarse determination of timing) and at the amount expected (which will exceed the minimum pilot quantity) under very constrained conditions.

Today there is limited capability to detect fuel quantity and timing errors. Our main issue is the requirement to detect any failure mode on any injection event. Some fuel systems may have five or more injection events per engine cycle, so relating failure mode on each of the injection events to an emission level increase is daunting. No feasible approach is known or has been demonstrated for an emission threshold monitor. Circuit monitors can confirm the voltage and current necessary for proper operation of all of the pulses for a given cylinder. No direct feedback method is available to determine absolute injection timing location short of applying combustion-sensing technology, which is not available now and would likely be very expensive. Existing diesel passenger car methods to detect small injected quantities are much more difficult for heavy-duty engines because they have higher rotational inertia, must deal with more accessory packages and driveline dynamics, and have an engine controller that may not know if the transmission is in gear or not. The proposal may require unique calibrations for each OEM transmission and vehicle application configuration, which engine manufacturers simply are not capable of knowing.

Our proposed changes to the fuel system monitor described above would cover the vast majority of fuel system failure modes. These include: most electrical issues internal and external to the controller, delivery of a small quantity at the expected angle and amount, sluggish hydro-mechanical fueling pressure actuator, fuel pressure sensor slow response time, overall system pressure high or low, and fuel restriction due to any number of fuel system issues including fuel filter issues, fuel tank supply issues, fuel line restriction, and fuel line leaks. The failure modes not caught by the electrical comprehensive component monitoring are very few. (EMA)

Agency Response: Staff held numerous meetings with engine manufacturers and suppliers to assess the feasibility of the proposed fuel injection quantity and timing regulations. The requirements were assembled using this information as well as strategies currently used on medium-duty diesel engine vehicles as well as those researched and published in technical papers. While the staff understands the commenter's position that the suggested changes would make it easier, it would also make the monitoring less comprehensive and risk some types of malfunctions going undetected. As mentioned in response to Comment 42, fuel injection is one of the most critical controls on a diesel engine and staff's proposed monitoring of fuel injection quantity and timing achieves comprehensive monitoring of these critical systems.

44. Comment: The diesel misfire monitoring requirements should be eliminated from the regulation. Since the diesel misfire monitoring requirements require monitoring for "misfire causing excess emissions," as opposed to the gasoline misfire monitoring requirements which require monitoring for "misfire causing catalyst damage" and "misfire causing excess emissions," this suggests that ARB understands that catalyst damage is not associated with diesel misfire. Misfire in diesel engines occurs in two ways. One is improper fuel injection (due to insufficient quantity of fuel injected, inadequate fuel atomization, or mistimed fuel injection), which is already covered by the diesel fuel system monitoring requirements. The second is the failure to auto-ignite when fuel is properly injected, which is due to inadequate cylinder compression to reach in-cylinder temperature conditions needed for auto-ignition. The root cause may be poor fuel quality (which is not an engine fault and thus shouldn't illuminate the MIL) or deterioration of the cylinder compression, which first manifests itself under cold engine conditions and low engine speed and light load. Misfire under non-idle conditions is rare and presents noticeable performance problems that would cause operators to seek corrective action. Additionally, the emission impact of misfire is small – failures can result in negligible emissions or increased hydrocarbons that are oxidized by the catalytic exhaust aftertreatment systems. As a practical matter, the tailpipe hydrocarbon emissions are only significantly increased during cold conditions before aftertreatment systems have reached their light-off temperatures. With all these considerations, the requirement to detect continuous misfire of one or more cylinders in 2010-2012 may be more stringent than the 2013+ requirement to monitor for 1.5 times the standards under positive torque conditions. Robust detection of misfire is difficult. The staff's suggestion to monitor crankshaft accelerations associated with combustion-induced torque pulses is hard, since under idle condition, torque pulses are weak. And since these crankshaft accelerations depend on the rotating inertia of the vehicle driveline and may be influenced by engagement and

disengagement of engine-driven devices like fans and air compressors, detection of misfire will likely require calibrations that are driveline-specific and even then may not be reliable. Significant cost and burden would be associated with developing all these calibrations. ARB's suggestion that emission threshold monitoring of misfire can be defined by the percentage of misfire that would result in 1.5 times the standard incorrectly presumes that there is a method that a manufacturer can use to induce a regular pattern of misfires during emission testing. Additionally, "similar conditions," though defined in terms of engine speed and "warm-up" status, does not specify the degree of "similarity" of these parameters, so the meaning of "similarity" is highly subjective. (EMA)

Agency Response: Medium-duty diesel engines have been satisfying the same misfire monitoring requirements since 1997 and many of these engines are also used in heavy-duty applications. In the Staff Report, staff outlined monitoring techniques that could be used to satisfy the requirements and is not aware of any reasons such monitoring cannot be successfully done on larger engine applications. Various techniques are available to meet the misfire monitoring requirements although some techniques are not as easily adaptable for vehicle to vehicle variations. For engines that are installed in a wide variety of applications, these non-adaptable techniques will likely need to be avoided to eliminate the need for individual vehicle calibrations. Further, many of these engines already incorporate "cylinder balancing" strategies intended to improve idle quality, reduce engine noise, or improve engine performance. Such strategies are used to compensate cylinders providing slightly higher or lower contribution and are typically much more sensitive than the required misfire monitor which would be looking for a cylinder that is not contributing at all. Regarding similar conditions, the regulation contains a definition for similar conditions in section (c) that provides precise numerical specifications for engine speed and load to be considered "similar" (e.g., +/- 375 rpm) and removes the need for any subjective judgment on the part of the manufacturer.

45. Comment: The monitoring requirements for the cooling system should be eliminated, since the emission impact is negligible. Engine accessory variations (including air compressors, fan drive, and fan type) as well as other configuration differences (including cooling system variations, transmission type, and vehicle model and application differences) all lead to excessive calibration burden. It is not feasible to test and calibrate the unique combinations for different vehicle applications. Many cooling system failures are vehicle-related while a fault will point to the engine's thermostat, even if replacing the thermostat is not the solution for many slow-to-warm-up cooling system failures. The only way to fully and accurately calibrate cooling system monitors is on a vehicle, but this is very time consuming, since cooling system performance varies widely based on vehicle configuration and the process requires the engine and vehicle systems to be cooled back to ambient conditions to ready the system for the next iteration of calibration development tests. Most, if not all, devices like cab heaters, transmission coolers, and cooling system capacity are added to the vehicle after it is out of the control and knowledge of engine manufacturers, so they cannot be

responsible for this kind of calibration. No clear alternative exists to de-sensitize algorithms to vehicle factors. The risk of false MILs is high, which industry is – and ARB should be – extremely concerned about since this is a big problem for end users and manufacturers and provides no benefits. Additionally, the calibration "extrapolation" concept that has been proposed to reduce calibration efforts from one engine family to other families is uncertain considering all of the vehicle installation variations that must be considered. (EMA)

Agency Response: The direct emission impact of a malfunctioning thermostat or cooling system is only a secondary reason for the requirement. The primary reason the cooling system is monitored for proper operation is because the engine manufacturer itself elects to use engine coolant temperature as a primary enabling criteria for monitoring of nearly every emission critical component. The requirement for cooling system monitoring is simply stated as a requirement to verify that the engine properly warms up to the highest temperature required by the engine manufacturer for monitoring of other components. The relative stringency of this monitor is a direct result of how high the manufacturer requires engine coolant temperature to get before monitoring other components and engine manufacturers can effectively desensitize algorithms to vehicle factors by enabling other monitors at lower temperatures. While staff understands engine manufacturers' concerns that actions by truck builders and users can impact their monitor design, the intent of OBD systems is to have monitoring of the emission components during real world operation of heavy-duty vehicles. Failure to achieve the necessary warmed-up temperatures required for monitoring would effectively mean monitoring is indefinitely disabled on real world vehicles, thus negating nearly the entire OBD system. Verifying the cooling system is operating properly is a crucial and necessary element to ensure OBD systems continue to operate on real world vehicles throughout their life.

As mentioned in the response to Comments 26-29, it is expected that the OBD requirements will result in the further limitations and specifications that the engine manufacturer will have to place on the vehicle builders to ensure the engine remains in a legally certified configuration. This cooling system monitoring requirement may result in additional calibration work or classification of the exact extent to which the vehicle builders can modify the cooling system to maintain a compliant system. Failure to do so could result in MIL illumination. However, while eliminating the cooling system monitoring requirements would avoid this potential MIL illumination, it would also re-open the possibility that such a system would be put into service and all of the OBD monitors would be disabled for the entire life of the vehicle.

46. Comment: The monitoring requirements for glow plugs and intake air heater systems should be eliminated for 2010. If monitoring requirements are warranted, the regulation should only require functional response and circuit continuity monitoring of these devices, not monitoring of low to moderate degradation. Reserve comprehensive component monitoring requirements only for the operating controls for power relays or independent controller feedback.

Additionally, the regulation should not require detection of a single glow plug failure unless it will cause an emission increase of 30 percent of the FTP standard (as determined over the federal transient test cycle). If a single glow plug failure causes an emission increase of less than 30 percent then the regulation should allow the manufacturer to determine the number of glow plug failures that would cause this 30% increase and only detect a fault when that number of glow plugs has failed.

Glow plugs and intake air heaters are high current devices (about 50 Amps or more) and subject to higher inrush currents as they warm. Typically, the engine control modules do not directly control them, but instead use a relay to switch the current from a high current connection to the vehicle's batteries, and some glow plugs on light-duty engines use separate controllers to modulate the current. So directly monitoring these devices will add hardware to today's systems, with monitoring hardware likely separate from the engine control system due to the high current. Additionally, typical construction and materials of these devices make them unlikely to experience gradual deterioration and instead fail to function altogether. Detecting low to moderate degradation levels using voltage and current measurements is impacted by variation in the vehicle electrical system (including the number and size of the batteries, the condition of the batteries at startup, the vehicle's power distribution architecture, the vehicle's other electrical loads and their use, and the operator's use of separate warming devices) which change the current achieved and the inrush current by changing the ability of the vehicle electrical system to deliver current. And because there are vehicle model and feature content differences, it is not feasible for engine manufacturers to test and calibrate for all unique combinations for different vehicle applications. Though intake air heaters can be monitored with manifold or intake air temperature sensors, they will not likely find low to moderate degradation levels and will not isolate specific failures that service-bay diagnostic procedures do today. For light-duty, glow plugs are only monitored for total failure, and because glow plus do not experience degradation, all failure modes are total failures detectable by gross continuity failures.

Additionally, an unintended consequence of requiring monitoring of cold start aids is the possibility that customers will add cold start aids in the aftermarket, which are customer-selected and not required for emissions compliance. Customers who voluntarily choose them on their new engines are highly motivated to seek repair if they fail. Manufacturers should not be responsible for monitoring aftermarket parts, which they have no control over. (EMA)

<u>Agency Response</u>: Glow plugs and intake air heaters do have an emission impact when malfunctioning and result in increased emissions. Accordingly, they are required to be monitored by the OBD system. This is consistent with the monitoring requirements that have been in place and met on medium-duty diesel vehicles since 1997. These systems can be monitored by measuring voltage, current, and/or resistance to verify that each individual glow plug or intake heater is functioning properly. And, the regulation already allows the manufacturer to

not detect failure of a single glow plug (but only if there is no measurable emission impact, not a “less than 30 percent impact on the FTP” as proposed by the commenter). The commenter’s suggested criteria are inappropriate if for no other reason that these devices are typically not even activated during an FTP test so no partial or complete failure of any element of the entire system would impact FTP emissions, thereby eliminating monitoring altogether of the system.

In regards to detection of completely failed components versus degraded components, the commenter is incorrect that light- and medium-duty applications do not currently monitor for this type of failure. While it was discovered that some of these manufacturers had implemented calibrations that were effectively only capable of detecting completely failed components, other manufacturers had correctly implemented the monitoring requirements. Further, those that did not were put on notice over the last two years that the monitoring strategy and/or calibration needed to be improved for future model year vehicles. Data have been submitted by some of these manufacturers showing that partially deteriorated glow plugs can indeed have a measurable emission impact before they have completely failed.

Aftermarket parts as those parts that are added after the vehicle has been purchased by the end user and introduced into commerce. Cold start aids that are added after purchase would not be subject to OBD monitoring (however they would be subject to ARB’s aftermarket parts regulations and restrictions). Cold start aids that are installed on a vehicle’s engine prior to purchase by the end user would indeed require monitoring by the engine manufacturer. This policy is used to ensure vehicle or engine manufacturers do not skirt their responsibilities simply by calling some emission controls or devices that reduce the effectiveness of emission controls “aftermarket parts”.

47. <u>Comment</u>: The monitoring requirements for diesel misfire, cooling system, and glow plug/intake air heater systems affect many businesses and users, especially vehicle manufacturers that have not been sufficiently included in the rulemaking process to ensure that they have voiced their opinions on new requirements affecting them. The requirements will force changes to the way vehicle manufacturers do business to ensure OBD systems work properly. During the 2010 through 2012 years, the regulation requires some engines to have OBD systems and others to have the EMD plus systems. The engines with the OBD system will need to monitor for the cooling system, for misfire, and for cold start aids, while the engines with the EMD plus systems are not required to. We’re concerned that these monitors will have an impact on vehicle design, resulting in some changes to the designs and thus raise the cost of OBD-equipped vehicles. Thus, those vehicles with OBD systems as opposed to EMD plus systems will be at a disadvantage (intra-company and inter-company), and may result in fewer purchases of OBD system-equipped engines. The goal of gaining experience with 2010 through 2012 OBD engines may be substantially defeated, which must be avoided. Thus, ARB should conduct a later rulemaking if ARB determines that these monitoring requirements are necessary after further analysis and with

input from all interested and affected parties, including vehicles manufacturers. (Cummins)(EMA)

48. Comment: At the very least, the applicability of these three monitors should be delayed for three years to 2013. In that timeframe, a better understanding about the industry norms and how trucks (and cooling systems) are designed and the powertrain attributes (for misfire monitoring) will be important. (Cummins)

Agency Response for Comments 47-48: Truck manufacturers, coach builders, and other powertrain component manufacturers have taken part in the rulemaking process and/or have been notified of the regulation. Staff has been in contact with several transmission manufacturers via phone, email, and in person, and supplier representatives have been present at ARB workshops and other related meetings. The ARB has made every effort to identify truck manufacturers and coach builders that would be potentially affected by this regulation. To the extent that they have been identified, the ARB has provided notice to such manufacturers and they have been involved in the regulatory process. Specific items about the misfire, cooling system, and glow plug monitors were previously addressed in the response to Comments 44-46 as well as the response to Comments 26-29 regarding increased restrictions that will likely be placed on truck builders as a result of the OBD requirements. The staff worked closely to find a phase-in plan for a comprehensive OBD system on a limited number of applications that was amenable to the manufacturers considering the workload and resource constraints. Accordingly, it would be inappropriate to remove some of the requirements and make the OBD system less comprehensive. Further, until more work is done towards implementing a comprehensive system, the scope of any unforeseen impacts for these three monitors that necessitate adjustment or modification to the requirements will remain unforeseen and the same concerns will exist for any future date that the requirements are adopted. The staff's experience from medium-duty diesel engines has already identified that there is a need for these three diagnostics and delaying adoption of the three provides no additional benefit to development of a comprehensive OBD system. Nonetheless, the Board has directed the staff to conduct a biennial review and report back with any necessary changes and the staff will continue to closely watch industry's progress in these three monitors to ensure successful implementation.

49. Comment: Emission threshold monitoring of non methane hydrocarbon (NMHC) converting diesel oxidation catalysts (DOC) should be eliminated since this is not feasible, and only functional monitoring should be required for DOCs located upstream of NOx and PM aftertreatment. Though the Staff Report suggests that emission threshold monitoring can be done by monitoring the oxygen storage capacity of the DOC using oxygen sensors, this cannot be done because DOCs have no ability to store oxygen and have no need to store oxygen since there is always excess oxygen in a diesel engine's exhaust. The only monitoring technology available to monitor DOCs is the use of temperature sensors to measure the exotherm of the catalyst, but this is not sufficient to differentiate

between a good DOC and one that is deteriorated to 2.0 times the standards, which ARB staff appears to acknowledge in the Staff Report and state that it can only be used for functional monitoring. There is a significant risk that manufacturers would be faced with having to meet this infeasible emission threshold requirement for DOCs on some engines: there is clearly a tradeoff between engine out NMHC and NOx emissions, which will result in higher NMHC levels in order to meet the more stringent NOx standard, and to account for this, higher-efficiency oxidation catalysts will be needed to meet the more stringent 0.14g NMHC standard. Staff has never presented any data or presented any credible argument demonstrating that the proposed threshold monitoring requirement can be met. (EMA)

Agency Response: The staff detailed two proposed methods for satisfying the catalyst monitoring requirements in the unlikely event that the catalyst itself has sufficient impact to require more than a functional check. The first method identified by the staff was the use of temperature sensors before and after the catalyst to monitor the exotherm during a rich excursion (e.g., during the start of an active regeneration of the PM filter). The staff did not indicate that this technique would not be capable of threshold monitoring as the commenter suggests. The staff indicated that, if such a threshold monitor was needed, it would likely take near complete failure of the catalyst to reach such emission levels and that the required monitor would not be that different than a functional monitor. Regarding the second method, the staff described a method similar to that used for gasoline catalyst monitoring wherein the oxygen storage of the catalyst is measured with exhaust gas sensors and correlated to conversion efficiency. The commenter indicates that diesel catalysts don't contain oxygen storage but that is a choice made by the manufacturer in specifying the catalyst formulation and washcoat. Regardless of whether or not diesel catalysts have traditionally had oxygen storage or whether oxygen storage is needed to meet the tailpipe emission standards, manufacturers could indeed add oxygen storage to the catalyst to meet these requirements. Further, as the staff indicated in the Staff Report, such a monitoring method would also require a rich excursion in the exhaust (e.g., during an active PM regeneration event) to remove the excess oxygen that the catalyst is normally exposed to.

50. Comment: Regarding diesel particulate filter (DPF) monitoring, the proposed thresholds are so low that manufacturers do not know how they will meet the requirements. The technology that staff has identified for monitoring is not workable. ARB must either eliminate the thresholds until such time as durable, reliable, and effective sensing technology has been developed, or, at a minimum, relax the emission thresholds in two steps and allow more time – at least until 2016 – to meet the second, more stringent threshold.

Manufacturers are currently engaged in overcoming the challenges associated with the implementation of practical and reliable DPF systems, and diverting these resources toward development of an impossible OBD monitor that will never be capable of meeting the proposed thresholds will jeopardize the success of the basic DPF systems. Further, from manufacturers' experience, cracks or leaks in DPF systems will be rare and when such failures do occur, many will be detected by the delta pressure monitoring technique (if the leak creates a sufficient reduction in pressure) or by the presence of visible exhaust smoke. Thus, even if the proposed monitors could be developed, the expected emission benefit would be small. (EMA)

51. Comment: There are substantial uncertainties associated with the various steps of the Staff Report's proposed method and reliably detecting exceedances of the proposed thresholds will not be possible. Several of these uncertaiinties include:

1) Uncertainties associated with soot accumulation model
  a) Uncertainty in engine-out soot level
    i. Variation of fuel (biodiesel, cetane, sulfur, additives)
    ii. Drift and engine-to-engine differences in fuel injection rates, injection timing and injection pressure
    iii. Variation in engine air flow (vehicle-to-vehicle differences in intake and exhaust restrictions, air cleaner loading, ambient conditions)
    iv. Vehicle-to-vehicle differences in charge cooling effectiveness
    v. drift and engine-to-engine differences in EGR rates
  b) Uncertainty in passive soot oxidation rate
    i. Variation/uncertainty in temperature of soot layer (ambient conditions, vehicle-to-vehicle differences in exhaust system design, imprecision of exhaust gas temperature measurement)
    ii. Variation in engine-out NOx
    iii. Variability in permeability and uniformity of soot layer
  c) Uncertainty in assessing completeness of active regenerations (which may be interrupted before going to completion)
  d) Inability to incorporate full range of steady-state and transient operating sequences that may occur in-use into the soot accumulation model

2) Uncertainties associated with deducing accumulated soot from DPF pressure drop measurements.
  a) Lack of correlation between pressure drop and filter soot loading due to variability in permeability and uniformity of soot layer
  b) Imprecision/uncertainty in assessing exhaust flow rage (influenced by vehicle design)
  c) Low sensitivity of pressure drop to soot load
  d) Imprecision of pressure drop measurement (influenced by vehicle exhaust system design)
  e) Confounding effects of ash loading
    i. Variation in oil consumption rate
    ii. Variation in oil ash content (quantity and quality of ash)
    iii. Uncertainties associated with effectiveness of periodic ash cleaning process
    iv. Variation in ash morphology, sintering, and nonuniform deposition

3) Uncertainties associated with correlation PM emissions with disparity between modeled soot loading and soot loading deduced from DPF pressure drop measurements.

a) Variability in FTP and ESC PM emission measurement, including both short term and long term and within lab and between lab PM measurement variability

b) Lack of correlation between filter pressure drop changes and PM emission increases for various types of DPF cracks/leaks

Several of the variabilities/uncertainties noted above are factors engine manufacturers can unilaterally control and will control to the best of their ability (for example, 1) a ii, 1) a v, 1) b ii, 2) e I, and 3) a). Despite this, absolutely precise control of these factors will not be technically possible with the result that these uncertainties will contribute to unreliability of the proposed method.

Other variabilities/uncertainties are controlled by vehicle OEMS (for example, 1) a iii, 1) a iv, 1) b I, 2) b, and 2) d) and can be diminished only by restricting vehicle designs or developing unique OBD threshold calibrations for each vehicle type. Engine manufacturers cannot predict all the unique calibrations and cannot control where the engines are ultimately used.

Still other variabilities/uncertainties are the result of limitations of scientific knowledge (for example, 1) b iii, 2) a, 2) e iii, 2) e iv, and 3) b). Although substantial effort and has been and will be put forth to develop this to allow these process to be more fully understood and used in the modeling, it I not clear to what extent will be made in these areas over the next few years.

Still other variabilities/uncertainties are related to in-use operating factors that are beyond the scope of what manufacturers can know and account for (for example, 1) a I, 1) c, 1) d, 1) b I, and 2) e iii). As a practical matter, it would be impossible to reduce these uncertainties without imposing impractical limitations on the usage of engine/vehicles.

Even under controlled laboratory conditions, there is significant uncertainty in the repeatability of loading and regeneration. Testing was done showing that repeatability of loading and regeneration in which the exact same loading and regeneration cycle were repeated five times on a single engine under controlled conditions on an engine dynamometer. PM filter loading was conducted during steady state conditions at 1500 PRM/230 Nm. Soot loading varied between 65 to 71 gms, the mass after regeneration varied between 47 to 52 gms, and the regenerated mass varied between 17 to 23 gms. This shows that even though all the other factors identified above that create uncertainty in modeling soot loading are controlled, there is significant variation in the loading/regeneration process that cannot be accounted for in the model.

We have presented the following data:

1) Data demonstrating the effect of DPF temperature on regeneration rate supporting uncertainty 1) b i above ("variation/uncertainty in temperature of soot layer (ambient conditions, vehicle-to-vehicle differences in exhaust system design, imprecision of exhaust gas temperature measurement"), showing a soot range of 5-20 gms for a 300 second regeneration and a 50-200 mile uncertainty in the expected regeneration trigger at 0.1 gm/mile loading.
2) Data demonstrating the pressure drop versus soot loading supporting uncertainty 2) c above ("low sensitivity of pressure drop to soot load").
3) Data demonstrating the effects of ash loading on DPF pressure supporting uncertainty 2) e above ("confounding effects of ash loading"), showing the pressure vs. flow relationship for a "green" DPF and ash-loaded DPFs with various leak sizes. Ash-loaded DPF has 1.5 times the pressure drop of a green DPF, and after regeneration, the 20% drilled (leaking) ash-loaded DPF gives the same pressure drop as a green DPF.
4) Data demonstrating the pressure drop of an intact DPF vs. a DPF with melted substrate supporting uncertainty 3) b above ("lack of correlation between filter pressure drop changes and PM emission increases for various types of DPF crack/leaks"), showing that depending on the distribution of porous material, holes and solid chunks (that result from melted substrate), the pressure drop would be indistinguishable from an intact DPF.

Concerning uncertainty 1) a i ("variation in fuel"), there are fuel effects on the modeled loss of PM filter efficiency; that is, the ability to model PM filter loading is impacted by system variabilities of the particulate output from the engine related to the type and quality of the fuel. This is especially relevant since California fuel rules already require on-highway diesel fuel formulations to have lower particulate emission characters than 49-state fuels. The widespread and rapidly growing interest by national, state, and local governments and supplier stakeholders in the use of biofuels and/or biofuel blends, spurred by national energy policiy and the recognized reduction benefits, are also relevant. The use of these fuels result in substantial reductions of particulate emissions, in the range of 12% for a B20 biodiesel fuel (EPA Draft Technical Report EPA 420-P-02-001). It is not expected that the availability or use of these fuels will be uniform or predictable across the states. So this may result in variability in particulate filter loading, which needs to be considered when establishing reasonable leakage thresholds that a filter loading model should be expected to detect. A filter loading/leaking model is sensitive to this variability.

Consider a hypothetical 2010 engine designed to an engine-out particulate level of 0.11 g/bhp-hr on federal/California certification fuel and with a 98% efficient particulate filter designed to require regeneration when the filter has accumulated 162 grams of PM. A perfect filter loading model would calculate the amount of work require from the engine to produce this amount of PM to be 1500 hp-hr (0.11 g/hp-hr * 0.98 * 1500 hp-hr = 162 grams), which would represent for example the amount of work generated over 10 hours at an average road load of

150 hp. If the truck operated on fuel with the same properties as the development fuel, the model would predict that the requisite amount of soot had accumulated after 10 hours of operation and would verify the filter loading using sensed parameters. If the sensed loading is less than the calculated loading after 10 hours, the model assumes the filter loading did not occur due to leakage. Since the model has no input for fuel quality, it must assume that lack of filter loading is related to loss of efficiency. If the engine has produced less PM than the model predicts, the model will comprehend that the amount of PM passed through (not collected) by filter is equal to the reduction of PM output from the engine caused by the fuel used. To the model, PM input reduction is equal PM filter leakage.

The consequence on modeled PM filter leakage from the use of a fuel ("fuel-X") that reduced PM emissions by 25% is estimated. With the original PM level being 0.11 g/hp-hr, the PM level with fuel-X is 0.082 g/hp-hr (a reduction of PM from the baseline of 0.028 g/hp-hr). The perfect model, when checking the sensed PM filter loading, will find that after the engine has generated 1500 hp-hr of work, the actual loading is only 122 grams, far short of the 162 grams expected. Commensurate with the lower loading it will believe that filter leakage has occurred and will falsely trigger a code that the leakage is above the 0.025 g/hp-hr threshold.

As another example, fuel-Y reduces PM emissions by 50%, so with the original PM level being 0.11 g/hp-hr, the PM level from the engine will be 0.055 g/hp-hr. The perfect model will find after 1500 hp-hr of work that the filter is only half loaded. Commensurate with half-loading of the filter will estimate that half of the expected soot has leaked through the filter and that the tailpipe emissions must have been 0.055 g/hp-hr, well above the 0.05 g/hp-hr 2010 threshold. So again, the system will falsely trigger a code. As demonstrated here, as the effectiveness of the fuel to reduce PM emissions increases, the likelihood of a false MIL for filter leakage increases. (EMA)

52. <u>Comment</u>: Engine manufacturers have proposed an objective, measurable way to detect failures and correlate them to an emission threshold, and we urge the Board to adopt this essential approach. The DPF monitoring requirements should be based on a leak introduced in a simulated manner with the leak size correlated to a tailpipe PM level of the PM FEL + 0.06 g/bhp-hr. At a minimum, the correlation should be to the level of the PM FEL + 0.04 g/bhp-hr or an absolute level of 0.05 g/bhp-hr, whichever is higher. Manufacturers would be responsible for detecting leaking DPF filters that result in reduction of the pressure drop determined by this method, but they cannot be responsible for detecting any malfunctions that result in an exceedance of emissions but still maintains a sufficient pressure drop. The following language should be used: The MIL shall be illuminated when any crack, hole, or melting of the DPF results in a change in pressure drop across the DPF equivalent to pressure drop determined by the engine manufacturer (using an artificially-created hold or holes

in the DPF backplate) that causes an increase in particulate matter in the tailpipe such that the OBD threshold for PM is exceeded. (EMA)

Agency Response to Comments 50-52: Industry presumes that because they currently do not have all the details of a PM monitoring strategy fully resolved, it is "infeasible" to establish a monitoring requirement that staff has clearly identified as promising but also technology-forcing. Staff concurs additional development will be needed to meet the adopted thresholds for PM monitoring, but the methods identified in the staff report are at least one way expected to successfully achieve the requirements. One of the comments suggested that the first level of PM monitoring stringency should first be verified before setting a second more stringent threshold. However, staff believes it is important to alert industry to the needed end goal in order to ensure adequate resources will be brought to bear over time in developing the needed monitoring thresholds. Even then, the proposed more stringent thresholds are well above actual vehicle emissions when the emission control system is functioning properly.

Industry also argues that it would be unwise to divert essential resources from developing successful PM filters to meet tailpipe requirements in 2010 for the purpose of developing a stringent PM filter monitor (or other monitors). However, engineers engaged in the development of diagnostic systems are not the same personnel with direct responsibility for overall emission system development. Staff's analysis budgeted for separate additional staff focused on developing diagnostic requirements that will be needed for the foreseeable future. These staff would perform a more specialized function than the base engine calibrators and emission system hardware developers, though they would be expected to work in concert with these other groups. In terms of facilities, staff also negotiated a phase-in plan with industry that would ensure current test cells would be adequate for conducting testing needed to successfully meet the tailpipe standards and would provide the needed leadtime to add a few additional test cells over time to cover increasing OBD calibration efforts.

Although industry speculates that certain types of failure modes of PM filters will be rare, staff has been unwilling to anticipate only the most likely modes of failure, especially with the introduction of newer technologies. Experience with the light duty OBD II regulations has shown that such predictions by industry are notoriously unreliable. Consequently, in developing this regulation, staff has identified performance requirements that are independent of likely modes of failure. In the course of meeting with heavy-duty engine manufacturers, they, however, successfully argued that detection of some combinations of internal filter failures could result in an unchanged pressure drop across it (e.g., a combination of a crack and areas of melting) and be virtually impossible to detect. Accordingly, the regulations provides that the Executive Officer may revise the monitoring requirements or exclude certain failure modes if the best available monitoring technique is unable to reliably detect such failures.

The remainder of the comments focus on enumerating all the potential issues involved with developing a rigorous monitoring strategy that would be robust in use. Actually, it is encouraging to see in response to the adopted requirement that industry is finally starting to sort through the issues that will impact their ability to achieve the needed monitoring capability. What is needed from this point on is to continue to sort through the issues and try to find which issues will be important and which ones will not be particularly relevant. Staff has noted similar activities already taking place with manufacturers of medium-duty diesel engines under the OBD II regulation. While staff agrees that development of a reliable strategy will be complex and require considerable testing and development effort, there has not been enough activity at this point to conclude that the modeling and pressure drop strategy would not be successful. One can point to all the issues involved in developing a monitoring strategy in order to prove that it won't work, or they can accept the challenge to solve the problems that come up along the way and strive to achieve the success that is needed.

With respect to many of the uncertainties listed in comment 51, they were grouped into four categories. The first category is acknowledged by the engine manufacturers as within their control but not to an ultimate precision. However, it is both normal for engine manufacturers to impose such specifications on their engine users (e.g., oil type/quality) and there is a responsibility on the user to adhere to them. Engines that seize or malfunction as a result of improper maintenance or service are not covered by the engine manufacturer under warranty. And, it is also quite normal to have parameters that cannot be determined with absolute certainty but that doesn't mean one of these uncertainties will prevent robust separation of good parts generating emissions below the standard and bad parts generating emissions at five times the standard.

The second category includes items within the control of the vehicle manufacturer. Again, however, it is the responsibility of the engine manufacturer to ensure its engine is being installed in a certified configuration and this requires the engine manufacturer to impose specifications on the vehicle manufacturer. Examples may include the minimum and maximum sizes on heat exchangers, air inlet pressure drops, and, with the addition of aftertreatment, vehicle exhaust configurations to ensure proper operation of the aftertreatment devices. Such build specifications are a routine part of the industry today and, while likely to grow given the addition of more emission controls, are something that the industry can handle.

The third category includes items that were indicated as beyond the limits of scientific knowledge. As the response indicated above, the monitoring requirements are technology-forcing and will require development and experimentation to get there. PM filter development is in its infancy and the devices won't even be introduced into the U.S. market on a reasonable number of vehicles until the 2007 model year. PM filter monitoring is even less developed at this point and has been studied for heavy-duty vehicles for less than two years. It is staff's expectation that substantial development will continue over the next four to ten years and the knowledge of PM filters and monitoring techniques will likely grow rapidly. Further, even today, monitoring techniques such as looking at the PM filter only after a regeneration event are being pursued which virtually eliminate concerns about rate of PM accumulation, variations during the loading process due to soot layers, etc.   Additional refinements in these techniques will likely occur and monitoring accuracy will improve. It is also likely that maintenance procedures will become refined and more automated, thus adding precision and repeatability to items such as periodic ash cleaning maintenance.

The fourth category includes items that are related to in-use operating factors and are said to be impossible to address without imposing impractical limitations on usage of engines/vehicles. Examples include type of fuel used and the different engine out PM and/or rate of PM loading in the filter as a result of the different fuel. Again, however, manufacturers can specify types of fuels that are allowed to be used and monitoring techniques are already being developed that look at PM filters only after regeneration, effectively eliminating any dependency on the type of fuel used. Other examples cite uncertainty in not being able to assess whether a sufficient regeneration was completed (or interrupted before completion). However, this is within the manufacturer's ability to assess. The manufacturer designs the regeneration strategy and the on-board computer clearly knows when the process has been interrupted because it makes the decision to stop the process (e.g., as a result of a driver action that makes regeneration infeasible). Regeneration strategies that wait for the next opportunity to pick up from where they left off are already being designed and could delay monitoring until the process had a chance to resume and complete.

In addition to the pressure drop/soot modeling monitoring strategy being pursued, staff has also received input that some manufacturers are pursuing in parallel an accelerated development program of a direct exhaust PM sensor that would be an alternative approach for meeting the adopted thresholds or ones even more stringent. This approach would also directly address many of the uncertainties involved in PM rate of accumulation or engine out PM due to fuel quantity. Another opportunity may include the use of fuel quality sensors to sense the relevant factors of the fuel being used that would impact PM emissions. Flex-fuel vehicles that run on gasoline and ethanol (or any blend of the two) initially were equipped with sensors to indicate the fuel blend so the fuel control system could appropriately adjust. Such a sensing technology could be pursued for diesel and biodiesel fuels or blends as well.

As noted above, the adopted thresholds are far less stringent than staff would normally accept in diagnostic systems adopted for light and medium duty vehicles. It is important to preserve in-use emissions near the tailpipe standards as vehicles age in order to achieve the maximum benefits of the more stringent emission standards. However, the PM filter monitor does reflect a technology-forcing requirement that will need further innovation to refine and accordingly, the higher malfunction thresholds were specified. Given the recognized complexity and difficulty for PM filter monitoring, staff also revised the regulation to only require implementation on a single engine family for 2010 with a higher interim PM threshold and implementation on all engines in 2013. Further, only the single engine family used in 2010 is subject to the more stringent PM thresholds in 2013 while all other engines can wait until 2016 before meeting the tighter thresholds. As such, meeting the more stringent threshold is almost 10 years away for the vast majority of engines industry will build. Given that staff has indicated they will, as directed by the Board, have technology reviews at an appropriate interval(s) to assess progress in meeting the adopted PM thresholds, there is opportunity to make mid-course corrections should they be needed.

53. <u>Comment</u>: While the regulation assumes that NOx sensor technology will meet the recently extended Heavy-Heavy useful life requirements, we do not believe they have been fully qualified to meet light-duty useful life requirements without replacement and therefore will not be capable of performing satisfactorily in heavy-heavy vehicles. (TMA)

54. <u>Comment</u>: Regarding NOx aftertreatment monitoring, the proposed thresholds are so low that manufacturers do not know how they will meet the requirements. They certainly cannot meet them without a NOx sensor that is accurate and durable enough to provide predictable results for monitoring throughout an engine's useful life, which manufacturers are not confident will be available when needed in 2010. ARB also must either eliminate the thresholds until such time as durable, reliable, and effective sensing technology has been developed, or, at a minimum, relax the emission thresholds in two steps and allow more time – at least until 2016 – to meet the second, more stringent threshold. Specifically, for 2010 through 2015, the threshold should be FEL + 0.40 g/hp-hr conditioned upon determination of availability of durable NOx sensors by July 2007, otherwise, only a functional check is required. For 2016 and later, the threshold should be the standard + 0.20 g/hp-hr conditioned upon determination of availability of an improved accuracy NOx sensor by July 2010, otherwise, FEL + 0.40 g/hp-hr. Even if a functional check is required, manufacturers have no information on how to perform this check. ARB must conduct further analysis of the technological feasibility of any NOx threshold requirements.

The Staff Report assumes the availability of reliable, durable, and sufficiently accurate NOx sensors, but does not contain any information or discussion supporting this assumption. ARB assumes that NOx sensors will be used by some or all engine manufacturers to control NOx engine and aftertreatment systems in 2010 and that a viable NOx sensor will be available for 2010 production engines, but these assumptions are wrong. Engine manufacturers will not use NOx sensors for NOx aftertreatment control if they can do so adequately without it. In this case, control might be based on an estimate of NOx produced by the engine. For example, for urea SCR systems, urea solution is metered in proportion to the NOx, which would be an estimate, flowing into the SCR catalyst. For lean NOx trap systems, the regeneration of the trap is done when storage of NOx in the catalyst, which would be calculated using the NOx estimate, nears a certain level relative to trap capacity (positive and negative errors in the NOx estimate would tend to cancel during the integration period of NOx storage). If compliance with the underlying emission standards does require a NOx sensor for aftertreatment system control, manufacturers will likely use a sensor of a different range and resolution/accuracy than that required for OBD monitoring and apply the sensor upstream of a NOx catalyst where NOx levels are higher than post-catalyst and where accuracy problems can be overcome. Current NOx sensors do not have the much narrower range, far greater accuracy, and durability required for OBD monitoring. Furthermore, an appropriate NOx sensor will have to be available no later than mid-2007 to meet the 2010 OBD requirements, but engine manufacturers have no assurance that a NOx sensor with these qualities will be available in time on 2010 production engines, and they are not responsible for developing these improved NOx sensors. Engine manufacturers currently know of one NOx sensor supplier with a target accuracy of 10 percent, but this target has not been proven. This is based on the supplier's experience with Euro 4 SCR engine with only limited experience on EGR-equipped engines. Engine manufacturers have not seen data on the effect of other aftertreatment technologies on NOx sensor technology, adding to more uncertainty, nor have long-term effects on soot contamination been evaluated. Engine manufacturers also believe the application and placement of NOx sensors will have an impact on accuracy. Data available show poor accuracy on a 1500 ppm-range sensor and are limited to use on a light-duty engine at 120,000 miles (the heavy-duty useful life requirement is 435,000 miles). Manufacturers' best data show an unproven target of 185,000 miles durability. Research done at Southwest Research Institute (limited to 6,000 hours of sensor use) show insufficient accuracy and decreases in sensor response rate at low hours. Additionally, sensors not in use (e.g., sitting on a shelf waiting to be installed) lose durability, leading sensor manufacturers to consider very limited time warranties on sensors. Real world problems also add to these problems, including temperature limitations for the sensor control module and packaging and wiring requirements that do not reflect actual operating conditions and potential electromechanical interference from the remainder of the engine system. Under engine manufacturers' knowledge, there is no NOx sensor under development that would suffice for HD OBD NOx monitoring purposes. (EMA)

<u>Agency Response to Comments 53-54</u>: The technical feasibility of meeting the OBD requirements for NOx aftertreatment are not predicated on the successful development of an NOx sensor. The staff proposed monitoring methods for NOx adsorbers that use wide-range air-fuel sensors, not NOx sensors, and these sensors are already being used on medium-duty diesel applications. Staff's proposed monitoring techniques would use these sensors to quantify the performance of the NOx adsorber and determine if it is above or below the proposed emission thresholds. This technique is very similar to a monitor of a NOx adsorber currently being used on a light-duty gasoline vehicle today and

staff is not aware of technical limitations that would prevent such a technique from also being successful on heavy-duty diesel applications.

Staff has acknowledged that other types of NOx aftertreatment would not likely be feasible as robust technologies to meet the emission standards without an NOx sensor. As an example, selective catalytic reduction (SCR) systems will likely need an NOx sensor to be able to accurately measure real-time NOx emission levels and determine the proper amount of reductant dosing. However, this is not an OBD issue—this is an underlying emission standard technical feasibility issue. For this type of aftertreatment to be successful, it must first be capable of meeting the emission standards robustly through the useful life. As such, a NOx sensor is likely necessary to properly correct and compensate for deterioration over the useful life period. Thus, for this aftertreatment to be a viable solution to meet the emission standards, staff agrees that a NOx sensor is necessary. Techniques that use SCR without a NOx sensor do not appear to be viable nor robust enough to reliably meet the stringent NOx emission standards for the useful life of 435,000 miles. Accordingly, if such a sensor becomes available to make the SCR technology viable, then such a sensor is also available to perform the necessary OBD monitoring.

Regarding sensor durability, it should be noted that the emission standards do not mandate that the sensor be able to last for the full useful life of 435,000 miles. The regulations allow engine manufacturers to have maintenance or service/replacement intervals and require periodic replacement of the sensor. If a NOx sensor cannot reliably last for 435,000 miles, a manufacturer could pursue this option and rely on periodic replacement of the sensor. This is not unlike conventional oxygen sensors in the early years of implementation of OBD II in light-duty gasoline vehicles. Early sensors had service intervals of just 30,000 miles and gradually, sensor performance and durability has improved to the point that today's sensors generally easily last more than 100,000 miles and have no required replacement intervals. NOx sensor technology will likely follow the same path, with durability and performance improving over time and providing longer and longer time between replacement intervals.

Lastly, regarding NOx sensor accuracy, the comment indicates that sensors may become durable and accurate enough for SCR control when located upstream of the SCR catalyst, they still will not be accurate enough for the lower concentration levels downstream of the catalyst necessary for OBD monitoring. However, staff believes this is unlikely as several techniques exist for addressing this problem. First, staff does not believe a manufacturer will be able to robustly and reliably meet the NOx emission standards for the full useful life with only an upstream NOx sensor and no ability to adapt, adjust, or compensate for degradation in the SCR catalyst during the useful life. Catalyst degradation could be substantial over a period of 435,000 miles and failure to compensate for it will likely result in over or under-dosing of reductant and, consequently, higher emissions. Second, a sensor that is accurate enough to measure upstream NOx levels during a variety of engine speeds and loads is also likely to have enough accuracy to measure downstream NOx levels during a portion of engine speeds or loads where engine out NOx emissions are higher. Monitoring during this subset of operation could be sufficient to properly detect malfunctioning SCR systems. Third, other monitoring techniques could be used including intrusive strategies that temporarily interrupt (or hold constant) reductant injection to assess the performance level while exposing the downstream sensor to higher concentrations. Partial SCR catalyst system monitoring, much like that which is used on the majority of light-duty gasoline vehicles today, could also address this problem. By placing the downstream sensor downstream of only a portion of the SCR catalyst rather than the entire SCR catalyst, the sensor would be exposed to higher concentrations where the sensor accuracy may be improved. By monitoring the front portion of the SCR catalyst (the most likely to be damaged first), the manufacturer could reliably infer the performance of the rear portion of the SCR catalyst and meet the monitoring requirements.

55. Comment: The regulation should not require heavy-duty gasoline engines to monitor the evaporative emission system (except the purge solenoid continuity), since the heavy-duty OBD regulation is an engine-only regulation and it would not be appropriate for engine manufacturers to monitor vehicle systems which they have no control over. Engine manufacturers are not in control of what happens to an engine when a vehicle manufacturer begins to modify the systems, particularly fuel lines and fuel tanks. (EMA)

    Agency Response: ARB staff disagrees and thus did not delete this requirement in the regulation. Evaporative emissions from gasoline heavy-duty vehicles are as critical as tailpipe emissions and a comprehensive OBD system must also monitor for evaporative system leaks. The engine manufacturers are responsible for the vast majority of the OBD system and it would not be feasible to require another party (such as vehicle manufacturers) to try and integrate a portion of the OBD system in with the rest of the engine manufacturer's OBD system. Further, the engine manufacturers already have experience in design and implementation of evaporative system monitors on medium-duty vehicles including incomplete medium-duty vehicles that have fuel system components such as tanks and lines added by a secondary vehicle manufacturer. Accordingly, they already have experience in both the monitoring requirements and the proper specification for the secondary vehicle manufacturers to ensure the end vehicle has a compliant evaporative system monitor. However, the staff did increase the size of the minimum leak that must be detected to accommodate the larger tank volumes that are more commonplace in heavy-duty applications.

56. Comment: The requirements to monitor comprehensive components based on if they can affect emissions under any reasonable in-use driving condition and a less than 15 percent increase of the FTP standard are unreasonable and unnecessarily burdensome. This would force manufacturers to design and run tests for all possible conditions that a driver may encounter and to attempt to create monitoring strategies to cover all possibilities. This requirement is far too stringent and would force monitoring of components with little or no effect on

emissions, leading to a greater risk of false MILs and undermining California's OBD program. ARB should require comprehensive component monitoring only when failure of a component causes an increase in emissions of 30 percent of the FTP standard as determined over the federal transient test cycle. (EMA)

Agency Response: The ARB staff disagrees and did not make any of these changes to the regulation. The OBD system is intended to be a comprehensive system that monitors each individual component that affects emissions during real world operation of the vehicle. The system does not comprehend or account for the cumulative or synergistic impacts of multiple component failures, nor are engine manufacturers liable for detecting all combinations of multiple component degradation and failures prior to a specific emission level being exceeded. Accordingly, the OBD system is designed to detect any single component failure that does cause a measurable increase in emissions.

However, it is important to note the magnitude of the emission increase does not change the monitoring requirements, the sensitivity of the monitor, nor the robustness of the monitor. Simply put, if a component causes a measurable increase, then it must be monitored for circuit faults and rationality faults. These diagnostics are not calibrated to a specific emission level and are solely required to be designed to robustly detect the failures (e.g., open circuit, shorted to ground). Rationality diagnostics are also calibrated similarly and are explicitly required to be calibrated to the extent feasible using available information. A component that causes a 75 percent increase in emissions is monitored no differently from a component that causes a 15 percent increase and is no more sensitive to false MILs.

Regarding the clause tying the measurable emission increase to any reasonable driving condition, the entire intent of the OBD system is to identify components in need of repair that are causing the vehicle to emit higher than normal emissions. Accordingly, it is appropriate to be concerned about any emission increase that occurs during reasonable driving conditions—not just some laboratory test cycle. The commenter has exaggerated the burden that this places on manufacturers. Any reasonable design or calibration engineer can look at a specific component, analyze its function and conditions for operation, and make a realistic assessment about what type of driving conditions would likely be most affected. If necessary, testing can then be done under that one type of driving condition to determine if there is a back-to-back measurable emission increase between a properly-operating component and a malfunctioning component.

57. Comment: While we support ARB's delaying the implementation of OBD systems on alternate-fueled engines until 2020, ARB must revise the rule to allow 2020 and later model year alternate-fueled engines that are derived from diesel engines the option to meet the diesel OBD monitoring requirements instead of the gasoline monitoring requirements. Alternate-fuel engines are already extremely low volume products for the engine manufacturers who make them, and the costs of adding OBD and imposing gasoline requirements on diesel-

derived engines will put them at a significant competitive disadvantage with their conventionally-fueled counterparts. (EMA)

Agency Response: It is ARB's position that alternate-fueled engines should be subjected to gasoline engine monitoring requirements because all alternate-fueled engines, whether derived from diesel or gasoline engines will use emission control systems and technology similar to gasoline-fueled engines and not at all like diesel-fueled engines. Accordingly, such engines should follow the gasoline-fueled monitoring requirements.

Attempting to apply the diesel engine monitoring requirements to alternate fuel engines would result, in most cases, in completely meaningless and irrelevant monitoring requirements as well as a large inequity in the level of OBD monitoring between alternate fuel engines derived from diesel engines versus gasoline engines. This inequity could lead to competitive advantages between gasoline and diesel engine manufacturers, a situation for which the commenter has had a long standing position against requirements that could cause such a disparity.

STANDARDIZATION REQUIREMENTS

58. Comment: We have concerns about the regulation limiting the allowable controller area network (CAN) baud rate to just the 500 kbps baud rate. Due to topology, cable length parameter and component tolerances of heavy-duty vehicles, there are technical reasons to limit the baud rate and this was confirmed by the CAN-physical/data link layer experts of TF6 – Controller Area Network during the WG1 meeting. Many truck OEMs use the 250 kBaud baud rate on their proprietary network architectures or use SAE J1939 for normal communication also specified for 250 kBaud. Engine controller modules are directly attached to the SAE J1939-11 CAN but implement ISO-diagnostics with 250 kBaud as allowed by Euro-OBD. A gateway would be required for baud rate conversion from 250 kBaud to 500 kBaud, even in cases where no gateway is necessary for normal communication, which mainly affects older vehicle architectures. There would be added costs to vehicles without any data throughput benefits. Additionally, Baud rate conversion will cause additional buffering and timing problems. The regulation should allow the use of both 250 and 500 kBaud for ISO diagnostics, since both baud rates (including initialization sequence) are specified in ISO 15765-4 and 29bit CAN-IDs for ISO 15765-4 are fully compatible with SAE J1939-21. (ISO)

Agency Response: As was made very clear from the start of the development of the heavy-duty OBD requirements, the goal was to require industry-wide standardization of a single communication protocol for all engines/vehicles. However, the industry was not capable of reaching a consensus within the regulatory timeframe for a single solution. As was argued by many manufacturers that produce vehicles/engines subject to the OBD II requirements of light- and medium-duty vehicles as well as vehicles/engines subject to the heavy-duty OBD requirements, there is a valid engineering reason for allowing manufacturers producing vehicles/engines in both classes to use a common protocol to satisfy both OBD requirements. Given that the only allowed protocol for light- and medium-duty applications is the 500k baud rate version of ISO 15765-4, the staff extended the allowance for the exact same protocol into the heavy-duty OBD regulation. The 250k baud rate has never been allowed for light- and medium-duty applications and an allowance for it in heavy-duty has no justification regarding maintaining commonality with the light- and medium-duty applications. Further, adding a third protocol (250k baud ISO 15765-4) gets another step away from a single solution and, as discussed in the staff report, adds unnecessary complexity and added risk for noncompliance in the field.

59. Comment: We have concerns about the diagnostic connector requirements. NAFTA trucks are partly manufactured with components chosen by the customer, including selection of the engine and transmission. One truck model-line of an OEM may have installed engines from different suppliers implementing either ISO diagnostics or SAE diagnostics. According to the regulation, the diagnostic connector used (either SAE J1962/ISO 15031-5 or SAE J1939-13) on the truck depends on what diagnostic protocol is used by the engine control module. However, both types of diagnostic connectors may be installed depending on other ECU's. This could cause confusion for service technicians in I/M or during roadside inspections. The scan tool would have to determine the diagnostic protocol and initialization sequence based on the installed connector – diagnostic connector detection needs to be implemented. The regulation should allow the use of either diagnostic connector regardless of the diagnostic protocol used. SAE diagnostics are on ISO 15031-3 connectors and ISO diagnostics are on SAE J1939-13 connectors. The initialization sequence could be extended to also cover SAE J1939-73 detection. And ISO 15031-4 already contains handling of SAE J1939-73 diagnostics. This way, the "plug and play" concept of the scan tool is retained as service technicians and roadside inspectors do not have to "decide" on the diagnostic connector to use. A generic scan tool can automatically detect the diagnostic protocol by slightly extending the initialization sequence. There would be one physical connector for all diagnostics, and the OEM can decide on the one connector for each model line. The vehicle specific diagnostic architecture would be transparent for the scan tool, and the existing RP1210 hardware can be reused for new architectures. (ISO)

    Agency Response: As noted in the response to comment 58, the intent of standardization in HD OBD is to achieve an industry-wide common solution rather than piece-meal solutions that add complexity. Industry, however, was unable to reach consensus on a single solution and indeed made a valid argument that manufacturers producing vehicles in both the medium- and heavy-duty segments should be able to use a common solution. Accordingly, the staff modified the regulation to allow the use of the same single protocol allowed for medium-duty. However, this does not justify allowing manufacturers to mix and match combinations of connectors and protocols in any manner they see fit.

That unnecessarily adds complexity to the system, adds difficulty to equipment and tool manufacturers, and increases the risk for mistakes that result in non-compliance in the field. The staff does not believe that allowing further permutations of the existing standards is a step in the right direction nor does the staff see a need to be able to retool all of the existing light- and medium-duty scan tools to comprehend ISO diagnostic messages over an SAE J1939 connector or vice-versa. The staff expects the manufacturers that will elect to use the ISO protocol will do so because they have market share in the medium-duty market and want to be able to use the existing tooling infrastructure to talk to the heavy-duty vehicles. Those that choose the SAE J1939 protocol will likely do so because they already are, in part or in whole, using SAE J1939 and want to utilize the tooling infrastructure they have. There is no reason to consider additional permutations that force redesign or changes to all existing tooling when the two distinct toolsets, to a large degree, already exist.

60. Comment: The requirement to report test results (section 1971.1(h)(4.5)) should be eliminated. The electronic control module's (ECM) test measurement data are not used in manufacturer's diagnostic methods today, and it is anticipated that they will not be used in manufacturers' provided service information or troubleshooting guides in the future. It is believed that troubleshooting guides will be organized by fault codes or performance symptoms, and the reporting of test results does not add significant value. (EMA)

    Agency Response: ARB staff disagrees and did not remove this requirement from the regulation. From over ten years of experience in light- and medium-duty OBD II systems, it has become evident that technicians need and use the test result information to make faster and more efficient repairs. The service information regulations already require the test result information to be available and past experience has shown that technicians will use it, regardless of whether the manufacturers' trouble-shooting procedures refer to it or not. Repair technicians can be extremely innovative and often find faster and more effective ways to diagnose and troubleshoot faults than the manufacturer originally envisioned. The test results give the technician insight as to exactly what the OBD system calculated as a diagnostic result the last time the particular diagnostic completed and can help technicians identify borderline or intermittent failed components.

61. Comment: The regulation should allow manufacturers to choose whether to disable all readiness flags or just the readiness flag(s) for the system(s) that have monitoring disabled due to power take-off (PTO) activity. This will provide more flexibility for implementation and could provide better information for maintenance. (EMA)

    Agency Response: The regulation explicitly requires all monitors to be reset to "not ready" while a PTO is active to provide a clear signal to inspectors and/or repair technicians that a PTO is active and disabling one or more monitors. If the manufacturers were allowed to only report "not ready" for the specific monitors that were currently disabled, an inspector or technician would be unable to determine if the monitors reported as “not ready” were disabled due to PTO activity or “not ready” because they had not been completed since the fault memory of the computer was erased. As readiness flags are intended primarily for use by inspectors to ensure the fault memory was not erased so recently such that many diagnostics had not yet had time to complete, it would be inappropriate to diminish the ability of the inspector to use the information for that very purpose.

62. Comment: The regulation should allow the practice of clearing fault codes on individual ECMs instead of all ECMs simultaneously. The heavy-duty industry requires the engine, transmission, and chassis to be treated as separate components under OBD because they are warranted by separate companies. Currently, SAE J1939 clear code commands are often directed at a specific ECM and do not clear fault codes on all ECMs. (EMA)

    Agency Response: The primary indicator to an inspector that the fault memory of the on-board computer has recently been erased is the readiness status. Without this information, vehicle operators could simply erase the memory immediately prior to an inspection and severely undermine the ability of the OBD system to identify vehicles in need of repair. Accordingly, any time fault information such as fault codes is cleared, the readiness status is also cleared. However, readiness status is only indicated for a few of the “major” monitors with the assumption that the majority of the other monitors would have run and completed prior to the major monitors completing. All of these major monitors are expected to be controlled by the engine ECM (as are the vast majority of all OBD monitors). However, if there are some additional OBD monitors in other ECMs, individual fault clearing would allow vehicle operators or technicians to erase fault codes in only those other ECMs, leaving readiness status untouched in the engine ECM. This would allow vehicles to pass through an inspection with what appears to be a thoroughly ready OBD system when, in actuality, the fault memory had been recently cleared and detected malfunctions had not yet been redetected. In the end, the commenter’s point is largely moot because the heavy-duty OBD requirements have been structured to impose diagnostic requirements on the engine manufacturer alone which means that all ECMs that would be subject to simultaneous clearing of faults would be ECMs designed and provided by the engine manufacturer.

63. Comment: The regulation should allow manufacturers the flexibility to log permanent fault codes in alternate strategies (e.g., FIFA, severity based). Manufacturers use their fault tracking database systems to capture faults for various purposes. Allowing for other strategies would allow for better integration of permanent fault logging with manufacturers software designs. (EMA)

    Agency Response: The staff has carefully thought through the permanent fault code specifications in the regulation and established rules that minimize the chance for tampering or cheating to avoid detection during an inspection.

Industry's proposals have also been considered and rejected because they are not as robust as the regulatory proposal. Further, the concept of permanent fault codes was created by the staff for the OBD regulation and it has never been used by manufacturers in the past. For the commenter to argue that their existing strategies are different is irrelevant because there are no existing strategies for permanent fault code storage. Additionally, the requirement for manufacturers to store permanent fault codes as specified in the regulation does not preclude them from using whatever format or priority they want for fault tracking databases. They do not need to use -- nor will they need to use -- common fault tracking databases or priorities with the required methods for permanent fault code storage.

64. Comment: The not-to-exceed (NTE) tracking requirements must be eliminated. It is not appropriate for ARB to require manufacturers to flag or track when an engine is operating in an NTE zone, in an NTE deficiency zone, and in an NTE limited testing zone. While the information needs to be available for those doing in-use tests, procedures for obtaining this information will be outlined in guidance documents associated with EPA's Heavy-Duty in-use test rule. NTE tracking is simply not a diagnostics issue but falls properly within the in-use testing regulations. Determining whether an engine is operating in one of these conditions can and likely will be done via post-processing of the data, which those working on the heavy-duty in-use testing program agree is a reasonable approach. Additionally, the real-time NTE status reporting that the heavy-duty OBD regulation requires is not something manufacturers are currently doing and not something that can be done easily by the ECM "on the fly," particularly in those cases where deficiency operation is conditioned on parameters that are not otherwise required to be monitored by the ECM. Requiring ECMs to be configured to routinely monitor NTE status when only a small fraction of production engines will be subjected to in-use NTE testing is an inappropriate burden that will necessitate an inefficient use of limited engineering resources. (EMA)

Agency Response: The commenter's argument that this requirement should not be included in the OBD regulation because it is not a diagnostic issue is completely irrelevant. The staff report, discussions at the workshop, meetings with manufacturers, meetings with the commenter, and discussions at the Board Hearing made it abundantly clear that the intent of the requirement was to simplify in-use testing. It was never argued by the staff that it was a diagnostic issue. It was, however, included in the OBD regulation because it is the only regulation that does provide detailed specification for communication of information from a vehicle to an off-board tool in a standardized manner. The specifications required to achieve the standardization in OBD encompass over 12 pages alone in the OBD regulation and reference an additional nine SAE and ISO documents. Placing this amount of information in another regulation just to require reporting of the NTE status would be unnecessarily duplicative and cause confusion by having multiple regulations that, in part, detail some of the required information. The OBD regulation is the appropriate place for all such information required to be made available in the same standardized manner for off-board equipment.

Notably, the commenter does not dispute ARB's authority to require NTE monitoring. It rather simply contends that this is not the appropriate place to regulate such requirement. The ability to post-process collected in-use data to determine NTE compliance or status does not preclude the authority of ARB to adopt this requirement nor does it obviate the need for it. While post-processing of the data can be done (and will need to be done on vehicles tested prior to implementation of the OBD system), most participants agree it will be a very detailed, complicated, and lengthy process that will heavily (if not solely) rely on the engine and vehicle manufacturer to provide access to engineering tools, special control units, and complex calculations. The regulatory requirement to output these data in a standardized manner greatly simplifies the data collection and processing, provides assurance to the manufacturer that the data were properly collected and processed, and greatly diminishes ARB and U.S. EPA's reliance on manufacturers to aid them in collection and processing of the data for enforcement.

Regarding the comment that it will be difficult to report these data on the fly, the regulatory proposal also already excludes the manufacturer from having to report changes in the NTE status that occur as a result of parameters not used or acted upon by the ECM. This leaves only those situations where the ECM is indeed already performing calculations and/or acting on sensed or calculated parameters and is taking a specific action as a result—simply reporting that it has made such a decision and is currently taking action is not a difficult task. Lastly, the comment that it is inappropriate to include this requirement on all engines because only a small fraction of production engines will be subjected to in-use testing is self-serving. One of the main reasons the in-use testing program is being developed is to greatly simplify the testing of production engines such that many more engines can be tested for in-use compliance. While manufacturers may not be happy with this intent given the increased risk for identification of noncompliant engines, it is the intent of ARB to use the procedures to test a greatly increased number of engines. Not requiring these data to be made available would severely hamper the ability of ARB to test engines independent of the vehicle/engine manufacturer and undermine the ability of ARB to enforce its own regulations.

TESTING REQUIREMENTS

65. <u>Comment</u>: Regarding the certification demonstration testing requirements, engine and aftertreatment components used for this testing should only have to be aged to 125 hours, not to full useful life. The cost and availability of engines and components that have been operated to a high mileage or end of useful life or ones declared durability test engines are not reasonable or feasible. (EMA)

Agency Response: The intent of OBD is to ensure that the system can robustly detect malfunctions throughout (and beyond) the useful life of the engine. Further, this demonstration testing is intended to verify, for the few monitors that are required to be calibrated to detect a fault at or prior to a specific emission level, that the system has been properly designed to detect faults at the correct emission level throughout the useful life. Accordingly, this demonstration is best carried out with the entire engine and emission controls deteriorated to the levels they would be at at the end of the engine's useful life. By successfully demonstrating that the OBD system monitors properly function at the required deteriorated levels would virtually guarantee that malfunctions would also be detected at the appropriate emission levels at any earlier point in the engine's useful life. A demonstration conducted after just 125 hours of operation would be less than five percent of the engines useful life and would provide minimal indication of the system's capability at later points in time.

Nonetheless, mindful of the lengthy useful life intervals of this class of engines and the limited engines run out to useful life prior to certification, the staff adopted a change to the regulation to allow a manufacturer to use an engine aged for 125 hours but requires that all aftertreatment components be aged to conditions that would be representative at the end of the engine's full useful life. As the aftertreatment is expected to deteriorate more severely than the engine, the staff believes this compromise will still provide some assurance that the monitors have been calibrated correctly while substantially reducing the resource burden on manufacturers to age the entire engine and emission control system.

66. Comment: The certification demonstration tests required by the regulation are lengthy and consume substantial manufacturer resources. Although ARB staff had reduced the number of engines being tested from its original proposal, the proposal still imposes substantial testing burdens that provide little or no benefit. Those tests are conducted after an OBD system is certified. Moreover, production vehicle evaluation testing already requires significant ongoing testing after engines are produced. With the number of OBD groups, parent ratings, and child ratings for each manufacturer, most manufacturers would have to test year after year and never reach a point of not having to test more engines, which is simply unreasonable. Each of these tests is very costly and requires the use of specialty test cells and costly equipment. Though ARB estimates the number of emission certification cycles to be 7-10, this is overly optimistic and probably will actually require the testing of a minimum of 14 to 20 cycles. Additionally, since many of the monitors are two-trip monitors, this would require two cycles to be run for each monitor to set the confirmed fault code, which adds to the workload burden. Even the testing required for certification of engine emissions systems is much lower, one certification cycle. Thus, this testing should not be required every year, but only in 2010 and 2013 and should be required only for the parent engine from each applicable OBD group. Specifically, in 2010 limit testing to one engine from the OBD parent rating, and in 2013, test the parent from each OBD group (as determined by the manufacturer). Additionally, there should be a cap on the number of engines tested by engine manufacturers who sell both

light-/medium-duty and heavy-duty products to avoid double-testing. If these changes are not made to the regulation, ARB should at the very least add language that the Executive Officer will reduce the number of certification demonstration tests required in 2016 and later based on experience and data obtained. (EMA)

Agency Response: The commenter's statement that the value of these tests is diminished (or unnecessary) because they are conducted after an OBD system is certified is surprising. The original draft regulation specified that these tests are required to be run prior to certification and the results submitted as part of the certification application. In response to manufacturers' concerns about certification timing in the initial years of OBD, the regulation was changed to give manufacturers flexibility in the 2010 through 2012 model years, and allow submittal up to six months after certification. To then argue that the relief requested by and granted to the commenter has suddenly rendered the data useless is disingenuous at best. Also, the commenter's statement that production vehicle evaluation testing requirements already require a significant amount of testing and that OBD certification testing is duplicative is incorrect. As the commenter should be aware, the goals and testing requirements of OBD production vehicle evaluation tests and the certification demonstration tests are completely different. The demonstration testing is the only emission testing required for the OBD system and is used to verify that the emission threshold monitors have indeed been calibrated to the appropriate emission levels. None of the other required testing includes emission measurement nor does any of it verify the function or calibration of the emission threshold monitors tested in the demonstration testing.

The staff also disagrees with the commenter's assessment that a minimum of 14-20 cycles would have to be run. As stated in the Staff Report, the staff's OBD experience indicates that 8-10 tests is a more realistic number. The statement that the testing load is then doubled because most monitors take two trips to complete is also misleading. The emission test procedure includes a preconditioning cycle prior to the actual emission cycle and this very preconditioning cycle is used for the first detection of the fault while the second detection occurs during the actual emission test. This is the normal emission test procedure currently used by manufacturers and was used by the staff in estimating the time, resources, and cost necessary to complete this testing.

Lastly, the comment that testing should be limited to only a single rating (the parent rating) of an engine family is unfounded. Unlike certification for emission testing where at least one engine must be tested for every single engine family certified, the OBD regulation gives manufacturers the benefit of the doubt and only requires "spot-check" testing of one to three engines per year, with even fewer in the first three years of implementation. While the regulation does not include an automatic provision to reduce the number of tested engines in the future, the regulation does include provisions to waive testing of one or more of the engines in future years if all of the engines have already been demonstrated.

Additionally, in regards to providing a cap on the number of test vehicles for manufacturers that produce products subject to both the light- and medium-duty OBD II regulation and the heavy-duty OBD regulation, the staff does not believe it is appropriate. The OBD regulations, while similar in many aspects, are indeed distinct regulations with specific requirements. Both regulations contain appropriate caps for the vehicles they apply to. Providing additional relief to those manufacturers that produce products subject to both regulations would create an inequity relative to those manufacturers that don't have the same breadth of products.

67. Comment: Even though this is an engine-based regulation, the production vehicle testing engine (PVE) requirements requires engine manufacturers to do vehicle testing after vehicles are assembled. ARB must limit PVE testing to engines only, not vehicles. Engine manufacturers are already responsible for ensuring that the diagnostic systems work properly for any defects or recall of those systems. Diagnostics are a critical part of service and warranty for the manufacturers. Virtually all engine diagnostic problems are found on the engine without the chassis and transmissions. Regarding standardization verification testing, if communications interaction problem makes it into vehicle production, it is more likely those problems would be associated with low-volume or unique variants (high-volume variants are more likely to be discovered/recognized). Because of the large number of vehicle variants, comprehensive on-engine testing is going to be more effective than the testing of a small number of vehicle variants. Regarding monitoring verification testing, this testing can be done on engines with essentially the same effectiveness as on vehicles. This testing process does not provide the same benefit as with light-duty, where the configurations are similar. With heavy-duty, the variations are so many and broad that in-vehicle testing does not add significant value. (EMA)

Agency Response: The commenter's quantification of the vast differences and breadth of vehicle variants is the exact reason that the regulation largely requires vehicle testing. Testing of a vehicle is guaranteed to catch everything that testing of a stand-alone engine would catch plus it can catch problems caused by integration of the engine into the vehicle. OBD is intended and required to work and properly detect malfunctions in the real world – engines are operated in vehicles in the real world, not on engine stands in a laboratory. As the commenter accurately points out, there is significant risk that unique vehicle variants are more likely to have problems, but the commenter suggests that it just be required to test engines, which does not address the problem. By requiring the testing of such vehicle variants, the problems could likely be addressed. Nonetheless, to afford manufacturers additional flexibility, the regulation provides that for production vehicle testing to verify monitoring requirements, they would be required to test just one complete vehicle and that other testing could be done on engines alone. While this clearly adds risk that non-compliant vehicles may go undetected, the staff made this generous compromise recognizing that engine manufacturers will be investing significant resources in implementing the regulation.

68. Comment: Adding together the three types of PVE testing the regulation requires, manufacturers could have to test more than 350 vehicles each year. ARB should place reasonable caps on the number of engines that engine manufacturers are required to test each year, as well as caps for manufacturers who must test both light-duty and heavy-duty vehicles. Specifically, limit testing to three engines per OBD group for verification of standardization in 2013 only, one engine per year for verification of monitoring requirements, and ten engines per OBD group for verification of in-use performance. (EMA)

Agency Response: The staff does not believe that the number of vehicles required to be tested by engine manufacturers is inappropriate, especially given the number of unique engine-chassis combinations that exist. A nominal manufacturer would be required to test approximately 50 vehicles for conformance to the communication protocol standards—a 20-30 minute test that can be conducted in a parking lot or a service bay. An additional two vehicles (one of which could be an engine instead of a vehicle) would have to be comprehensively tested for verification of monitoring requirements. Lastly, in-use performance data are required to be collected (not testing performed) on an additional approximately 90 vehicles—a process that takes less than a minute to download from the vehicle while the vehicle is in for service or maintenance and must be gathered within 12 months after vehicle production. As discussed in the response to comment 67, applying a cap that spans both the light-/medium-duty OBD regulation and the heavy-duty regulation is inappropriate and creates an inequity between manufacturers who span both product ranges and those who do not.

69. Comment: Manufacturers also need additional time in which to report testing results. Vehicle production dates may lag engine production by months. Additionally, for in-use monitoring performance data collection, vehicle applications may not accumulate enough data within six months of operation (e.g., snow-clearing vehicles might sit for months before being used). ARB must increase the data reporting deadline from 6 months to 18 months after the start of production, with the availability of a 6-month extension if needed. (EMA)

Agency Response: For in-use monitoring performance data collection, the staff agreed that the data collection deadline should be increased, but not to 18 months after the start of production. Instead, the staff increased the deadline from 6 months to 12 months with the availability of a 6-month extension if needed for a possible maximum of 18 months. Staff made this modification available in the Post-Hearing 45-Day Notice of Proposed Modifications to Text. Given the typical high mileage accumulation rates of heavy-duty vehicles, 12 months is expected to provide more than ample time for vehicles to accumulate sufficient data. Additionally, this timeframe begins when vehicles are introduced into commerce, not when engines are produced, so there is no impact as a result of a lag between engine production and vehicle production.

70. Comment: In-use monitoring performance verification testing should not be an annual requirement. It should be required only with the introduction of new OBD standards in 2010, 2013, and 2016. (EMA)

Agency Response: ARB staff disagrees. Past experience has shown that manufacturers are continually changing and revising emission controls and diagnostic strategies such that in-use monitoring frequency is significantly affected. Further, the staff expects that manufacturers will likely be making significant revisions to the monitoring strategies in the initial years of OBD implementation as well as emission standard implementation as designs are optimized to be the most cost-effective, competitive, and robust. Such changes can have dramatic impacts on in-use frequency and justify annual collection of data.

OTHER REQUIREMENTS

71. Comment: The 4-hour drive cycle requirement, which requires the drive cycle be reset every 4 hours of continuous driving, should be eliminated. There are significant complications that surface with the ECM software because the required resetting of diagnostic systems, their internal cumulatives, and diagnostic output values must occur while the engine is running. Thus, essentially every diagnostic algorithm that buffers and stores any data would require a mechanism to clear the stored data. The added hooks into software to perform this cause significant changes to both the architecture and validation. Additionally, the resetting of the diagnostic system normally occurs when the engine is not running (at power-up or at key-off). There is concern that this may briefly cause unexpected engine behavior due to both processing capability (loop time) and data that may be shared between the diagnostic algorithm and the control algorithm. The anti-idling laws being considered in California will make engines stop more frequently and diminish the need for this 4-hour drive cycle. (EMA)

Agency Response: The staff disagrees and did not make this change to the regulation. As the commenter often brought up in discussions with the staff, the variety of applications that heavy-duty engines are used in translates to an extremely broad range of usage patterns. Additionally, since most of the heavy-duty vehicles are used for business purposes, they are often operated as near to continuously as possible. This can include more than 8 hours of continuous operation per day and can include days or weeks of continuous operation without an engine shut-down. Accordingly, the staff believes it is appropriate to include this requirement to ensure that, regardless of vehicle usage patterns, monitors have sufficient opportunities to run and detect malfunctions in a timely manner. Regarding the resetting of internal software data buffers while the engine is running, these types of activities are already currently done within the engine control unit. As an example, most manufacturers already have some diagnostics in the engine control units for service purposes and most, if not all, of these diagnostics have the ability to detect and mature faults and subsequently erase the fault status within the same driving cycle. The requirement in the OBD regulation requires essentially the same capability to detect and mature faults within the same driving cycle and should not cause any additional difficulty from what they are already doing.

72. Comment: The definition of "engine start," which is currently defined as 150 rpm below low idle, should be changed to allow for engine start to be within a range of 50 to 150 rpm below low idle. Heavy-duty engine manufacturers have different "engine startup rpm" thresholds since, unlike the light-duty industry, the heavy-duty industry requires more flexibility to account for the wider range of applications (including off-road, marine, etc.). Not all current products use the 150 rpm definition. This would cause additional validation efforts by either making different applications use different startup criteria or by validating non-road applications to a new startup rpm which may not be optimal for those applications. Also, larger engines rotate more slowly due to their larger mass and lower idle set point used to minimize fuel consumption and emissions. Thus, rpm thresholds should naturally be lower for heavy-duty engines. In terms of OBD, manufacturers feel there is negligible effect in delaying the engine startup detection by 50 or 100 rpm. (EMA)

    Agency Response: The commenter seems to be confused. The definition in the regulation for engine start does not mean that the manufacturer has to change fueling, starting, or internal software routines to conform to this definition. This definition is solely for use in OBD monitoring and is usually a separate internal software flag created for and used exclusively by OBD for counting engine starts and, in some cases, for misfire monitoring. The commenter, however, is trying to suggest that the only way the requirement can be met is to use an existing internal software flag used for some other purpose and that subsequently, the "other purpose" must also then be modified as a result. While it may be more convenient to use an existing flag, the software resources to create an independent flag are negligible and are not a valid reason to compromise the purpose of this definition for OBD monitoring. Nonetheless, the staff did make a modification to the regulation as requested by the commenter where this definition is used to count ignition cycles. In that instance, the staff agrees that the differences in the definition are negligible. However, the staff did not modify the definition where it is used for determining the start of continuous misfire monitoring. While only gasoline engines are expected to be subjected to continuous misfire monitoring in the near future, advanced technology diesel engines in the future such as HCCI engines would also be subject to continuous misfire monitoring. In this instance, the staff believes it is necessary for all of industry to use a consistent definition to ensure the monitoring requirements are met and that equity is maintained throughout the industry.

73. Comment: The definition of "continuously" should be clarified with the phrase "within approved enablement conditions." Essentially all monitors have some sort of enablement criteria that must be met. ARB should further exempt

monitors that are termed “continuous,” including those that are “near-continuous,” from the requirements of rate-based monitoring under section (d)(4.1). (EMA)

Agency Response: ARB staff believes that there is some confusion over the usage of “continuous” when referring to monitors. For purposes of this regulation, continuous monitoring is generally used in reference to circuit monitoring of comprehensive components. Typically, these monitors do not include enable criteria and in fact, the regulation explicitly requires a manufacturer to get Executive Officer approval in special cases where it wants to disable continuous monitoring (e.g., in cases where a malfunctioning circuit cannot be distinguished from a properly operating circuit, which is usually quite rare). In a few other limited circumstances, continuous monitoring is applied to systems that have feedback or closed-loop controls. In those cases, the regulation requires monitoring for faults that cause the system to be unable to maintain adequate control of the system. Part of the confusion may arise because often manufacturers have specific criteria that must be satisfied before closed-loop control begins (and the regulation requires separate monitoring for faults that prevent or unnecessarily delay or interrupt that control). Thus, these closed-loop control systems are required to be continuously monitored while they are in feedback control (but not while feedback control is not active). Changing the definition as requested by the commenter is inappropriate because it is monitoring enable conditions that determine when the monitor is continuously operated—it is the base feedback control conditions (which already are manufacturer-defined) that define when feedback control is active (and thus, when monitoring must be active). Lastly, the regulation does not apply the rate-based requirements (minimum ratio or tracking/reporting) to monitors that are required to be continuous.

74. Comment: The regulation should allow alternate statistical methods in extinguishing the MIL and should allow some one-trip monitors to extinguish the MIL in the same drive cycle if the system determines a fault is no longer present. Some monitors (e.g., PM filter regeneration) could take several drive cycles to operate again, so running three successful (passing) tests could take many drive cycles. For false positives, this would cause the MIL to be on for a very long time. The regulation currently allows for alternate statistical methods for illuminating the MIL. It is our understanding this implies alternate methods for extinguishing the MIL. Additionally, fault conditions that can be confidently determined to no longer be present should have the option to extinguish the MIL immediately. (EMA)

Agency Response: Regarding the comment to allow some one-trip monitors to extinguish the MIL in the same drive cycle, the staff disagrees and did not make this change in the regulation. From the staff’s experience with OBD systems, one of the most important features for success of an OBD program is consistent and robust performance of the monitors across all manufacturers’ products. Acceptance and trust of the OBD system by repair technicians is paramount to its success and individual variances from manufacturer to manufacturer lead to unnecessary confusion which undermines the integrity of the program. The statistical methods for MIL illumination and extinguishing provide a solid basis for robust monitor performance and a consistent platform for repair technicians to understand the expected behavior. Allowing the MIL to prematurely illuminate (before a fault is confirmed) or prematurely extinguish (before it can truly be confirmed as no longer existing) leads technicians to believe the system is unreliable and cannot be trusted to provide an accurate evaluation of the monitored components. Further, manufacturers are required to design the monitors to be robust and avoid false positives (or false MILs) by proper design of the monitor---not by allowing the MIL to extinguish faster after it already made a false decision. It is inappropriate for a manufacturer to rely on quick MIL extinguishing to address improperly designed diagnostics.

75. Comment: We have a number of concerns regarding implementation of the regulation that do not affect emissions directly. Engine manufacturers have a high level of sophistication in current diagnostic systems, and they have troubleshooting methods that have been developed through many years of servicing engines. The regulation needs changes in its fault detection, storage, and reporting requirements so it complements manufacturers' current diagnostic procedures instead of ignoring them. For example, we anticipate that the requirement to latch the malfunction indicator light (MIL) on due to intermittent wiring faults will unnecessarily hinder a mechanic's ability to properly diagnose problems, thereby resulting in increased repair time and incorrect repairs. (EMA)

    Agency Response: Intermittent faults can be (and will remain) some of the most difficult for technicians to troubleshoot and find the root cause. However, the requirements in the regulation are based on over ten years of OBD experience on over 15 million vehicles operating in the United States. These requirements are a result of feedback from vehicle manufacturers as well as repair technicians to ensure that the system can provide a reasonable amount of information necessary for the technician to achieve a successful diagnosis. One area of continual feedback from the repair technicians is consistent system behavior from one vehicle to the next so that they may rely on specific information always being available and gain experience as to the levels of intermittent faults that are detected. Allowing manufacturers to deviate from this level of consistent behavior is a step in the wrong direction to achieving an industry-wide ability to effectively troubleshoot intermittent malfunctions. Lastly, as explained in the response to comment 74, the staff's experience is that the current MIL illumination and extinguishing protocol does provide a consistent message to repair technicians and is more effective than letting each manufacturer develop their own strategies and techniques.

76. Comment: We have concerns about the service information provisions (section 1971.1(h)(6)) in the regulation, and propose these provisions be eliminated from the heavy-duty OBD regulation. While we appreciate the efforts of the staff to ensure that the service information for heavy-duty OBD is readily available to the heavy-duty aftermarket industry, we have concerns about the limited nature of

the provisions, the need for these provisions with the separate service information regulation (section 1969, title 13, CCR), and the confusion and ambiguity that would be caused by these two different regulations. The aftermarket organizations have been actively involved in the rulemaking process that led to the adoption of section 1969, which extended coverage of the existing service information rule to all 2007 and subsequent model year heavy-duty vehicles equipped with OBD systems. One part of section 1969, which dealt with the availability of diagnostic and reprogramming tools and information, was not applied to heavy-duty vehicles in 2004. There had been ongoing discussions about amendments to address this issue, specifically our concerns about adopting limitations proposed by the heavy-duty manufacturers on the scope of diagnostic and reprogramming information which would have to be provided. While section 1971.1(h)(6) has service information provisions to detail the type of information that are required to be disclosed, sections (d)(1) and (d)(2) of section 1969 already require disclosure of all of this information for all heavy-duty vehicles starting in 2007 with the exception that they do not require the manufacturers to provide the information to aftermarket tool manufacturers necessary to incorporate enhanced repair procedures into their tools. But since we understand that further amendments to section 1969 will be proposed to the Board in January 2006 that will cover everything included in section 1971.1(h)(6), these provisions are not needed in the heavy-duty OBD regulation. Moreover, we are concerned about the more limited disclosure required under section 1971.1(h)(6) compared to section 1969, such as the lack of requiring making reprogramming information or tools available (even though this information is critical to the aftermarket and repair industry), the lack of training requirements for technicians to reinitialize the OBD computers when it is necessary for repair, and the limitation of providing information to the “repair industry” and not the broader group of “covered person” defined in section 1969 including fleets, government entities, tool manufacturers, and parts rebuilders/manufacturers. Since section 1971.1(h)(6) differs substantially from section 1969, we believe it will cause confusion about which rule applies and which information must be provided. Also, we are concerned that these requirements will imply that it specifies the maximum information which the manufacturers must provide, so we believe that the scope of the service information to be provided under section 1971.1(h)(6) is completely inadequate. (Aftermarket Group)

<u>Agency Response</u>: The staff disagrees and did not remove the service information requirements from the regulation. However, the service information requirements are intended to be a placeholder that ensures the minimum amount of service information necessary to make use of the OBD system is available to all repair technicians. It is not intended to address all service needs—only the minimum needed to use the OBD information that will exist as a result of the OBD requirements. As was done for light-duty, the heavy-duty OBD regulation defines this minimum subset of information and includes a clause that the requirements are automatically superseded if a separate service information regulation is adopted that requires, at a minimum, the same level of information to be made available. For light-duty, now that such a service information

regulation is in place and in effect, the staff is proposing that the requirements be removed from the OBD regulation. For heavy-duty OBD, the staff will do the same once service information regulations are in effect that supersede the requirements in the OBD regulation. However, given that the service information regulation is a separate regulation with its own regulatory schedule for adoption in the future, the staff has not yet removed these provisions from the heavy-duty OBD regulation. This provides the best plan to ensure no gap exists between the OBD regulation taking effect and service information being made available to access and use the OBD system information.

77. Comment: While we support the interim compliance standards set in the regulation, since this provides desperately needed compliance flexibility to this industry, we believe compliance flexibility is needed for at least three years beyond each change in the standard or requirement for a particular monitor or engine system. This is to account for the fact that heavy-duty manufacturers have little or no experience with OBD requirements. (EMA)

Agency Response: Staff has provided an abundant amount of time for the applicability of interim, higher in-use malfunction criteria. Specifically, for the six years from 2010 through 2015, the regulation provides an interim in-use level of double the OBD threshold before a manufacturer's OBD system would be considered non-compliant. For instance, a monitor that is required to detect a fault before emissions exceed 5.0 times the standard would not be considered noncompliant in-use until emissions exceed 10.0 times the standard without MIL illumination. Further, the regulation provides additional interim higher thresholds for 2016 through 2019 on PM filter monitors. Thus, by the time the higher in-use thresholds are phased out (2016 for most monitors, 2020 for other monitors), manufacturers will have six to ten years of OBD experience.

MISCELLANEOUS COMMENTS

78. Comment: ARB had stated that they intend to adopt an enforcement regulation that would accompany the heavy-duty OBD regulation in the future. But by not proposing this enforcement regulation now, ARB staff has deprived engine manufacturers – in fact, all interested parties – of due process by taking away the ability to comment meaningfully on all aspects of the proposed rule. The rule's enforcement provisions are an integral part of the entire rule. Engine manufacturer's comments on the regulatory provisions cannot be complete without the complete enforcement regulations to review and comment at the same time. Therefore, ARB should delay this rule until interested parties have had the chance to comment on the enforcement regulations which ARB intends to propose later. (EMA)

Agency Response: ARB staff disagrees. The enforcement regulation is an entirely separate regulation from the heavy-duty OBD regulation. The main intent of this enforcement regulation is to ensure that the requirements of the heavy-duty OBD regulation are being met and that heavy-duty engines and vehicles that do not meet the requirements of the heavy-duty OBD regulation are properly addressed and fixed. Thus, any requirements we detail in the enforcement regulation will not directly affect any of the requirements we detail in the heavy-duty ODB regulation. Therefore, adoption of the enforcement regulation at the same time as the heavy-duty OBD regulation is not necessary.

POST-HEARING 45-DAY COMMENTS

79. Comment: When ARB established the heavy-duty OBD phase-in schedule, in which one engine rating (the "parent") in a selected engine family is fully OBD-certified and tested and the remaining ratings in the family are required to have "extrapolated" OBD systems, ARB used the example of an engine family with five or six engine ratings. However, some engine manufacturers have 20 or more ratings within a single family. While meeting OBD on an additional four or five ratings is not impossible, extrapolating to 20 or more ratings is unreasonably burdensome and achieves little marginal benefit, especially when many of those ratings are sold in extremely small volumes. The extrapolation requirements will indirectly require manufacturers to run full OBD emissions tests on all engine ratings as part of the validation process, even when certification of those extrapolated engines is not required. The burden of meeting full OBD on a parent rating in 2010 will be an enormous challenge for engine manufacturers and will strain the limits of test capacity, but is a challenge they are willing to take. The additional burden of extrapolating thresholds to more than a handful of ratings in 2010 is far more than manufacturers can be expected to undertake. We propose the following:

In 2010, fully tested and certified OBD on the parent engine rating in a selected engine family, extrapolated OBD on an additional five ratings within the family – or on the ratings representing 60 percent of the manufacturer's expected sales volume – and enhanced EMD on the remaining ratings within the family.

In 2013, fully tested and certified OBD on the original parent rating and the five (or 60 percent previously-extrapolated child ratings, extrapolated OBD on the previous enhanced EMD engine ratings within that family, and enhanced EMD on the remaining ratings within that family. In each of the other OBD groups, fully tested and certified OBD on the parent engine rating in a selected engine family, extrapolated OBD on five child ratings – or a number representing 60 percent of the manufacturer's expected sales volume – within the family, and enhanced EMD on the remaining ratings within the OBD groups. (EMA)

Agency Response: Although ARB notes that the above comment does not specifically address modifications made available in the Post Hearing 45-Day Notice, and is effectively untimely, ARB provides the following response. The staff does not agree with the comment and thus did not modify the language as requested. It is within the discretion of the manufacturer to decide how many ratings to offer and how many ratings to group together into a single engine family for the purposes of certification. While staff estimated costs and resources for a nominal manufacturer in the heavy-duty sector, a manufacturer that is currently certifying more ratings in a single engine family could elect to split up that engine family in future years or devote the resources to meeting the requirements on all of the ratings—it is a business decision within the engine manufacturer's purview to make that choice. Further, a manufacturer that is offering a much larger number of ratings within a single engine family generally is only able to do so by producing many ratings that are very similar to each other—more so than a manufacturer that only certifies four to five more distinct ratings. As such, the ratings tend to be closer together and more likely to require little to no recalibration between many of the ratings to ensure adequate calibration. Accordingly, a manufacturer with many ratings may end up expending essentially the same calibration work to cover the many similar ratings as another manufacturer that is calibrating four or five distinct ratings. Lastly, the regulation only requires manufacturers to phase in OBD on a single engine family in the 2010 through 2012 model years. Typically, this will represent less than 15 percent of a manufacturer's total sales in that time period. To further water this down to a subset of only 60 percent of that one engine family would reduce the number of engines during the phase-in to practically render the phase-in non-existent and greatly minimize the opportunity for manufacturers to gather useful feedback with their first generation of OBD systems.

80. Comment: For diesel fuel system monitoring, there is no practical way to monitor injection pressure or quantity on unit injector-equipped engines without equipping each cylinder with a pressure-sensing device, which is infeasible, impractical, and would unreasonably increase the expense of OBD monitoring. ARB should provide an exception from the monitoring requirements when these types of systems are used. (EMA)

    Agency Response: As was partially discussed in the response to Comment 42, there are potential monitoring methods that would not require the use of individual cylinder pressure-sensing devices. As with many OBD monitors, a sensor or feedback signal that correlates to the required monitored element is used. In some cases, a manufacturer may be able to verify the fuel pressure by monitoring the hydraulic pressure used in the unit injectors. In other cases, this may not be sufficient to detect all required failure modes. Another approach being used in diesel engines utilizes an air-fuel ratio sensor in the exhaust to measure actual air-fuel ratio. Combining this information with fresh air intake measurements, a calculation of the actual injected fuel quantity can be made and compared to the commanded injected fuel quantity. Comparing calculated injected fuel quantity (a function of desired fuel pressure and injection on time) to actual fuel quantity (a function of actual fuel pressure and actual injection on time) could lead to identification of problems in either fuel pressure or quantity.

81. Comment: Regarding the charge air under-cooling monitoring requirements for diesel boost pressure control systems, it is impractical, if not impossible, for engine manufacturers to monitor charge air under-cooling considering the following factors. The placement of a charge air cooler often may be with other

coolers in vehicle profiles that are beyond the control of engine manufacturers. Additionally, owners/operators may make further vehicle adjustments (e.g., installing winter front covers) that significantly affect airflow to the charge cooler. (EMA)

Agency Response: Although ARB notes that the above comment does not specifically address modifications made available in the Post Hearing 45-Day Notice, and is effectively untimely, ARB provides the following response. The staff does not agree with the comment and thus did not modify the language as requested. Regardless of past practice, the charge air cooler is a part of the emission control system and modifications to its location or effectiveness can adversely alter the emission performance of the engine. While the main purpose of the OBD regulation is to detect failures of emission control systems, if current practices allow truck builders or operators to significantly alter the emission performance of an engine such that it exhibits similar behavior as a failed emission control component, it is appropriate that such practices be discontinued to ensure emission controls are working in-use as designed and certified. Many manufacturers have substantial control system strategies that are affected by charge air temperature and improper installation or modification of charge air cooler location or effectiveness can cause inappropriate activation of default strategies. As with all emission control devices, engine manufacturers should be designing the system and including specifications for proper installation of the system components to ensure the engine and its emission controls are operated as certified in-use.

82. Comment: For cooling system, cold start aid (e.g., glow plug and intake air heater systems), and misfire monitoring for diesels, changes to the regulation should be made. A single engine model/rating may be installed into many different vehicles for many different applications. There are many parts of the vehicle that affect the cooling system and cold start aids that are out of an engine manufacturer's control. The same problems with charge air under-cooling monitoring exist with cooling system and cold start aid monitoring. Further, as we testified at the hearing, ARB has not obtained sufficient input from vehicle makers in light of the significant vehicle impacts that these monitoring requirements will have on vehicles. Staff conceded at the hearing that more conversations with industry were necessary on those requirements and that staff should review them during the biennial review, and EMA agrees. However, now is not the right time to move ahead with finalizing these monitoring requirements. If finalized now, these requirements will suppress sales of 2010-certified OBD engine families. Engine manufacturers will be forced to make system changes that will force vehicle manufacturers to make vehicle changes, thereby raising the cost of OBD-equipped vehicles over that of EMD-plus-equipped vehicles. (EMA)

Agency Response: See responses to Comments 44 through 48 and 81. Regarding the comment that staff conceded at the hearing that more conversations with industry were necessary, the Board directed, as it typically does with OBD regulations, to monitor industry's progress towards meeting the requirements and report back to the Board at a biennial review. Staff is committed to doing so and, as it has done during this rulemaking, will continue to have discussions with all affected parties to review progress towards meeting the requirements and report back to the Board with any necessary revisions or changes.

83. Comment: The PM filter monitoring requirements are unworkable. The threshold level for PM is not achievable because of the poor correlation between filter health and differential pressure across the filter, and many failure modes of the PM trap do not cause a drop in pressure that is distinguishable from normal operating conditions. Engine manufacturers have proposed an objective and measurable way to detect failure and correlate those failures to an emission threshold. That test is essential to manufacturers' ability to meet the requirements, and we urge ARB to reconsider out proposed approach. (EMA)

    Agency Response: See responses to Comments 50 through 52.

84. Comment: NMHC monitoring of catalyst PM filters will require injecting fuel into the exhaust system and onto the filter, which will have a negative effect on increasing emissions unnecessarily when the diagnostic is running and also potentially causing the filter to experience excessive temperatures. Additionally, at the threshold levels in the rule, NMHC threshold monitoring will only be achievable using the latest temperature sensor technology under very limited entry conditions. This would require the addition of four sensors, thereby unreasonably increasing the costs for OBD. (EMA)

    Agency Response: Although ARB notes that the above comment does not specifically address modifications made available in the Post Hearing 45-Day Notice, and is effectively untimely, ARB provides the following response. The staff does not agree with the comment and thus did not modify the language as requested. First, staff is not aware of any NMHC catalyst monitoring approach being considered that would require the addition of four sensors and did not propose such a method in the staff report. Second, while not the preferred choice, monitors can be intrusive and interrupt normal emission control in order to make a robust decision regarding the health of a particular emission control component. In some cases, this intrusive action can cause a temporary increase in emissions. However, this occasional and temporary emission increase of a few seconds or more is usually far outweighed by the consequences of not monitoring a component and letting failed parts, with a large and continuous emission impact, go undetected.

85. Comment: For NOx aftertreatment, ARB must relax the proposed emission thresholds and allow more time – at least until 2016 – to meet the second, more stringent emission threshold. The proposed thresholds are set so low that manufacturers do not know how they will meet them and certainly cannot meet them without a NOx sensor that is accurate and durable enough to provide predictable results for OBD monitoring through an engine's life. Currently, there

is no such sensor, and manufacturers are not confident enough that such a sensor will be available when needed. In fact, the monitoring strategies for NOx aftertreatment are uncertain at best. (EMA)

Agency Response: See response to Comments 53-54.

86. Comment: Items 13 and 14 of Attachment II of the post-hearing 45-day notice indicate that changes were made to the air-fuel ratio and NOx sensor monitoring requirements (sections 1971.1(e)(9.2.1)(B)(i)(a) and (b) and (e)(9.2.2)(A)(i)) to align the PM thresholds with the PM filter malfunction thresholds. In those two sections, however, there are differences in the thresholds for 2010-2012 and 2013 and beyond. Thus, the statement is not true for engines that are not required to meet full OBD in 2013 under section 1971.1(d)(7.2.2), which engines maintain the same threshold from 2010-2015. ARB should review these sections to ensure it is consistent with description of the changes in Attachment II. (EMA)

Agency Response: The commenter has correctly pointed out a discrepancy between the regulatory language and the stated intent and rationale behind the regulatory language. Due to comments from the engine manufacturers during the initial 45-day Notice period, the phase-in for PM filter monitor thresholds was delayed from 2013 for all applications to 2016 for the majority of the applications. The PM thresholds for the exhaust gas sensors were inadvertently left unmodified in the post hearing 45-Day Notice of Modification of Text, which created a misalignment with the delayed PM filter monitor thresholds. However, in considering the issue further, staff is not convinced that the thresholds need to be aligned. Given the likely presence of the sensors downstream of the PM filter, it is unclear to staff what types of failures of these sensors would cause an increase in PM emissions to the point that the PM emission threshold is reached prior to a NOx or HC emission threshold. Nonetheless, staff is committed to revisiting the issue at a subsequent biennial review to determine whether such changes are actually needed. Given the likely schedule of periodic reviews in the next six years, staff believes more than ample opportunity exists to revisit the requirement and make any necessary corrections prior to 2013 (where the discrepancy first shows up).

87. Comment: The definition of “engine start,” which is currently defined as 150 rpm below low idle, should be changed to allow for engine start to be within a range of 50 to 150 rpm below warm engine low idle. The definition of “engine start,” as defined in the definitions section and as used throughout the regulatory text, is too narrowly focused on light-duty applications and does not appropriately account for heavy-duty engines and the varied applications in which these engines are used. (EMA)

Agency Response: See response to Comment 72.

88. Comment: The MIL illumination method should be changed to allow for quicker extinguishing of the MIL for malfunctions that that OBD system determines is no

longer present. Specifically, circuit continuity tests have results that are very high in confidence and if malfunctions are no longer detected, the MIL should be allowed to extinguish immediately. (EMA)

Agency Response: See response to Comment 74.

89. Comment: The requirement to log permanent fault codes (section 1971.1(h)(4.4.1)(F)) should be delayed until 2013. Permanent fault codes are useful only for I/M programs, and since full OBD standardization is delayed until 2013, OBD checks cannot be conducted under I/M programs until then. Further, since manufacturers use the same engine control module for both <14,000 and >14,000 lb. GVWR applications, a delay until 2013 would save time and resources for those manufactures who sell a small volume in the >14,000 market from having to make ECM changes for that small subset of engines. Permanent fault codes for those engines should be implemented in the same time frame that they will eventually be required in for light-duty/medium-duty OBD II (section 1968.2). We believe that the staff had agreed in discussions to resolve this matter, but the staff did not make a change or otherwise address the issue in the published post-hearing 45-day notice. (EMA)

    Agency Response: As currently written, the OBD regulation requires manufacturers to implement permanent fault codes on the one engine family that is phased-in for OBD in 2010 through 2012. And, as staff has explained, the delay for standardization requirements until 2013 does not eliminate the requirement to store fault codes (including permanent fault codes) but rather only eliminates the necessity of providing access to those codes via a standardized data link and message. Staff expects that, with the exception of providing access to certain information over a standardized link, the phase-in engines in 2010 through 2012 will contain the full complement of OBD required monitors and functions and will represent a crucial first set of engines for feedback and in-use experience. Permanent fault codes are one of the many set of features required with OBD and staff expects manufacturers to gain experience from implementing it in 2010 and to make any necessary corrections to ensure a smooth and successful implementation across the board in 2013. Further, in reference to the comment about consistency with medium-duty products certified to the OBD II regulation, the staff's workshop draft of the OBD II regulation includes a proposed implementation date of 2010 for permanent fault codes which would provide the alignment and consistency the commenter is requesting.

90. Comment: Regarding the Cal ID and CVN requirements (section 1971.1(h)(4.6) and (4.7)), although ARB modified the cost estimates for the rule, ARB failed to modify and properly account for the costs of compliance with these requirements. These requirements could potentially create a proliferation of identification numbers with high costs to initiate and maintain but with little or no benefit. Specifically, manufacturer workload would increase through having to create and track specific combinations of calibrations and software, as each would become an individual part number and have to be tracked. The investments made, and

efficiencies gained, to date by managing part combinations in assembly and service would be lost through having to break everything into individual part numbers. Engine-transmission control modules would require software changes as would the service tools used by dealers. It is possible that even hardware changes could be required for control modules. Yet, states do not even have the systems available to receive this standardized data, thus providing no real-world benefit but only adding cost. Previous identification practices established in the industry through SAE J1979 will no longer be allowed without real justification. (EMA)

Agency Response: Although ARB notes that the above comment does not specifically address modifications made available in the Post Hearing 45-Day Notice, and is effectively untimely, ARB provides the following response. First, ARB did not technically "modify" the costs estimates in the Post Hearing 45-Day Notice – ARB merely corrected a few mistakes in the cost tables that were present in the Staff Report (staff mistakenly included an older version of the cost tables in the Staff Report), so the overall cost analysis and the final cost numbers were unchanged. Second, the staff does not agree with the comment regarding the Cal ID and CVN requirements and thus did not modify the language as requested. Simply stated the CAL ID requirements mean the engine manufacturer must store a "software version number" in the engine control unit and transmit that number on request to a generic scan tool. This is not unlike what virtually all engine manufacturers currently do and should not represent any significant cost to implement. Secondly, CVN requires manufacturers to perform a calculation on the memory contents of an engine controller and transmit the results of that calculation to a generic scan tool upon request. Again, many manufacturers already do something similar (although it may use a very simplistic check sum algorithm instead of a more complex algorithm as required by the regulation) and this should not translate to any measurable increase in cost. Staff is not aware of how this could result in a significant change to part numbers—different software versions intended and certified for different engines already must use different part numbers to ensure proper in-use application and this does not alter that requirement.

91. Comment: As we have told ARB over and over again, it is not appropriate for ARB to require manufacturers to flag or track when an engine is operating in an NTE zone, and an NTE deficiency zone, and in an NTE limited testing zone (section 1971.1(h)(4.4.2)) in the OBD rule, so ARB should eliminate these requirements. While information needs to be available for those doing in-use tests, procedures for obtaining this information will be outlined in guidance documents associated with EPA's Heavy-Duty In-Use Test rule. NTE tracking is not a diagnostics issue but falls properly within the in-use testing requirements. Even the language used in the rule is inappropriate. It is not yet known whether an indication of "deficiency active area" or "limited testing region" (incorrectly referred to as "carve-out area") will even be needed or useful – it will only be known after the in-use test pilot period. Moreover, determinations of these areas are difficult and vary with manufacturers. Requiring the ECM to make this

determination for the sake of a few engines sampled for in-use testing creates an unnecessary burden on the ECM. There are other specific in-use issues that must be addressed in the in-use rule, not in this OBD rule. (EMA)

Agency Response: The term "carve-out area" is very clearly defined in the regulation as "regions within the NTE control area for [NOx or PM] where the manufacturer has limited NTE testing as allowed by 40 CFR 86.1370-2001(b)(7)," so while the term "carve-out area" may not be the most commonly used terminology, it is appropriately defined and used in the regulation (and apparently defined well enough that the commenter knew that it was exactly referring to the "limited testing region" terminology used by the commenter). Relative to the appropriateness of including this requirement in the OBD regulation, please refer to the response to Comment 64. And yes, the staff agrees with the commenter that determination of which of the NTE regions an engine is currently in is difficult and varies with each manufacturer. As a result, this requirement was included to ensure that the engine manufacturer, the party most capable to sort through the precise details of their own designs and control strategies, is responsible to do just that and provide a real time flag that can be reliably used to assess the current state of the engine. And lastly, while the common practice in the past may have been to only perform in-use testing on a "few engines" due to the costs and complexity of removing engines from trucks to perform laboratory testing, the entire concept of future in-use testing is to make it feasible for ARB, the U.S. EPA, and industry to conduct on-road testing on engines while still in vehicles, greatly reducing costs and complexity and opening the door for testing a great number of engines instead of just a "few".

92. Comment: As outlined in detail in our 45-day comments, ARB must obtain a waiver of federal preemption in order to proceed with implementation of the heavy-duty OBD standards. A preemption waiver is based on meeting the mandates of the federal Clean Air Act, including that the new OBD standards be feasible and cost-effective, and provide sufficient leadtime and stability. It is imperative that ARB not wait but submit its waiver application without unnecessary delay. That is the only way that ARB can support an effective and meaningful waiver process. Delay in applying for a waiver or in review of a waiver by EPA makes a mockery of the waiver process, and ARB should ensure that is does not contribute to any delay. (EMA)

    Agency Response: ARB has no intent or plan to unnecessarily delay the waiver process. ARB recognizes that the application for a waiver is a necessary element in the process and works to complete the application as soon as possible. Historically, ARB has submitted applications for waivers for OBD rulemakings in a very timely manner and has not contributed to delays in the waiver process and plans to do so for this OBD rulemaking as well.

93. Comment: ARB should place more effort on harmonizing with the world wide harmonization-OBD (WWH-OBD) regulations to produce a more common OBD system with fewer unique systems. Development of the WWH-OBD includes

experts from manufacturers and regulatory groups around the world, including the U.S. EPA working with ARB. ARB's harmonization with those efforts will reduce the overall cost to society for OBD regulatory development and OBD implementation. In order to achieve this harmonization, at a minimum ARB must consider how to incorporate key features of the WWH-OBD program under development, including options for: (1) discriminatory malfunction indicator (MI), which would allow for MI response based on emissions impact and (2) use of the WWH-OBD MI symbol(s), which would resolve manufacturers' issues and harmonize world-wide, thereby reducing cost and confusion. (EMA)

Agency Response: Although ARB notes that the above comment does not specifically address modifications made available in the Post Hearing 45-Day Notice, and is effectively untimely, ARB provides the following response. ARB staff have been and continue to be involved in the WWH-OBD development process. However, ARB staff are charged with developing regulations that get meaningful emission reductions in California and integrate with existing complementary programs. To that end, staff has attempted to harmonize where it is possible to do so without compromising the emission reductions that are achievable and needed from the OBD program. With respect to the commenter's specific two issues, staff has been involved in discussion on the two items but cannot achieve full harmonization without substantially compromising the benefits of the OBD program.

First, the proposal for a "discriminatory" MIL is simply not realistic. The proposal is based on the premise that the OBD system not only robustly detects faults but that it can, at all times, tell you the precise emission level at the tailpipe. This is simply not the case. OBD can be designed to robustly detect failures as they occur and, in some cases, before specific tailpipe levels are exceeded when all other components are known to be in reasonably good state. But, OBD does not include an actual tailpipe sensor nor can it comprehend all combinations and variations of multiple degraded or malfunctioning systems and thus, cannot accurately convey the instantaneous tailpipe emission level by different MIL illumination patterns. Further, this approach prematurely decides for a region/country/governing body that different perceived levels of emission faults must be reflected in different MIL illumination patterns, regardless of that region's/country's/governing body's air quality problems, emission reduction needs, or inspection plans/programs. It should also be noted that ARB staff did provide a counter proposal for WWH-OBD to allow such a discriminatory display "on demand" (e.g,, upon request by the driver, a tool, or an inspector) which would satisfy the need for those countries that falsely believe the OBD system is robust enough to accurately distinguish the current tailpipe emission level and want to impose different inspection actions or penalties as a result.

Second, the proposal within WWH-OBD is to allow the use of an alternate icon for the MIL symbol. As currently written, the OBD regulation requires the use of the ISO engine symbol alone, without any additional text such as "check" or "service soon". This symbol is currently used on the vast majority of over 120 million OBD II equipped vehicles in the U.S. and is commonly understood in the U.S. by repair technicians and inspectors as the MIL. The text was removed to make the proposal more amenable to non-English speaking countries that wanted to harmonize the MIL but without the English text attached. The WWH-OBD proposal, however, allows an icon for the MIL that represents a "cloud" of smoke being emitted from a tailpipe. Staff does not believe the icon is intuitive, easily recognizable, nor an accurate representation of the state of the engine and emission control system when an OBD fault is detected. Given the non-visibility of most pollutants and the advancements in emission control technology (especially PM filters), staff does not expect the majority of emission control faults to result in a visible cloud of emissions exiting the tailpipe as the picture represents. Further, with the high level of interaction and complexity in the engine and emission control systems, a fault that causes an emission increase (and thus, must turn on the MIL) often also causes other more noticeable effects such as poor drivability, reduced fuel economy, or reduced engine performance. Accordingly, staff believes an illuminated warning light with a picture of the engine is a more representative indication of the current state of the system -- a problem with the engine has been detected. And, with the OBD regulation structured nearly entirely around the engine and the engine emission controls (which are usually an integrated part of the engine and in all cases are included with the engine when purchased from the engine manufacturer and warranted/service by the engine manufacturer's authorized repair facilities), an icon indicating the engine needs attention is the most accurate direction that can be given to a vehicle operator.