State of California
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
AIR RESOURCES BOARD

STAFF REPORT:
INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

PROPOSED AMENDMENTS TO THE VERIFICATION PROCEDURE, WARRANTY AND IN-USE COMPLIANCE REQUIREMENTS FOR IN-USE STRATEGIES TO CONTROL EMISSIONS FROM DIESEL ENGINES

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TABLE OF CONTENTS

APPENDICES

TABLES

EXECUTIVE SUMMARY

In 2000, the Air Resources Board (ARB or Board) adopted the Diesel Risk Reduction Plan (DRRP) following its identification of particulate matter (PM) emissions from diesel engines as a toxic air contaminant. One of the key strategies in the DRRP for mitigating diesel PM emissions is retrofitting in-use diesel engines with diesel emission control systems (DECS). To ensure that DECS achieve real and durable reductions of PM and oxides of nitrogen (NOx) emissions, staff developed the *Verification Procedure, Warranty and In-Use Compliance Requirements for In-Use Strategies to Control Emissions from Diesel Engines* (the Procedure), which the Board adopted in May 2002. The Procedure is used by staff to evaluate DECS through emissions, durability, and field testing. In addition, it permits further evaluation after installation through warranty and in-use compliance requirements. The Procedure is therefore ARB's key tool for ensuring that DECS used by fleet owners are an effective means to achieving the emission reduction goals of the DRRP.

Staff is proposing amendments to the Procedure which will improve the verification process and better support ARB's in-use fleet rules. The amendments proposed by staff will:

- Allow conditional extensions for verified systems
- Require transient emissions testing for off-road verifications
- Specify requirements for systems that reduce NOx emissions
- Change requirements for fuel additives
- Clarify in-use compliance requirements
- Clarify verification transfer policy

The first three amendments listed above are the most significant changes staff is proposing. Allowing a conditional extension of an existing verification will enable an applicant to bring a proven technology to market as a verified system more quickly. The proposal to require transient emissions testing for off-road verifications that include variable-speed off-road vehicles and equipment is necessary as it will enable more accurate verifications of DECS performance. This is particularly true for the determination of the effect of a DECS on emissions of NOx and nitrogen dioxide (NO_2). The proposed amendments relating to NOx systems will create a classification system of levels based on performance that will allow verifications to cover a broader scope of engines. They will also specify important requirements for selective catalytic reduction (SCR) systems that are necessary to ensure the effectiveness of this key technology in practice.

Staff's proposed amendments do not have a direct, quantifiable emissions benefit, but will enable more accurate quantification of benefits from DECS as well as lower emissions of NO_2. In developing its proposal, staff held four public workshops in Los Angeles, El Monte, and Sacramento that were primarily

attended by DECS manufacturers and installers. Staff also held numerous meetings with the Manufacturers of Emission Controls Association (MECA) and individual companies to further discuss the proposal. Although staff did consider several alternatives to the proposal, staff concluded that the proposed amendments provide the best means of improving the Procedure's ability to support the in-use fleet rules and enable real reductions of PM and NOx emissions and the associated health risks.

The economic impacts of the proposed amendments on the State, affected businesses, and individual fleets are not expected to be significant, as participation in the verification process is voluntary. Applicants that participate choose to do so for financial gain because verification opens up many new markets for their products. The proposed amendments may require some test facilities to alter their infrastructure if they choose to offer testing compliant with verification requirements. For individual fleets subject to ARB's fleet rules, staff's proposal may accelerate the verification process, thereby resulting in additional products being available to meet the requirements of the rules in less time. Historically, increased product offerings and competition for market share among manufacturers has had the effect of lowering unit prices, resulting in a cost benefit to the regulated fleets.

I. INTRODUCTION

This report describes staff's proposed amendments to the *Verification Procedure, Warranty and In-Use Compliance Requirements for In-Use Strategies to Control Emissions from Diesel Engines* (Procedure), contained in the California Code of Regulations (CCR), title 13, sections 2700-2710. The main purpose of the Procedure is to support the Diesel Risk Reduction Plan (DRRP), which is the strategy adopted by the Air Resources Board (ARB or Board) in 2000 for dramatically reducing Californians' exposure to diesel particulate matter (PM).

The ARB has already adopted various regulations as part of the DRRP that require emissions reductions from in-use fleets of diesel vehicles and equipment. One of the primary paths to compliance with these "fleet rules", as they are commonly known, is for fleet owners to retrofit their engines with diesel emission control systems (DECS) that are verified by ARB under the Procedure. The Verification Program is therefore a critical element of the DRRP. It ensures that the benefits from a verified emission control system are both real and durable. To provide improved support for the fleet rules, staff has determined that the Procedure should be amended. This report describes staff's proposed amendments, the rationale behind them, and their potential impact.

A. DIESEL PM: RISK IDENTIFICATION AND MANAGEMENT

The basis for the development of the DRRP, the fleet rules, and the Procedure was ARB's identification of diesel PM as a toxic air contaminant (TAC)[1] in 1998. It was estimated that about 28,000 tons of diesel PM are emitted from diesel engines each year in California. The pollutant was found to constitute about 70 percent of the total ambient air toxics risk. The scientific assessment estimated diesel PM to be associated with over 500 potential cases of cancer per million people on a statewide average basis, and about 1,000 cases per million in the South Coast Air Basin (Air Resources Board, 2000). In 2001, diesel PM was reported to contribute to, on average, 2,900 premature deaths, 2,600 cases of chronic bronchitis, and 5,300 hospital admissions annually (Lloyd and Cackette, 2001). The significant health risk posed by exposure to diesel PM prompted ARB to make the scope of the DRRP equally significant.

The DRRP includes several far-reaching control measures to reduce diesel emissions from both new and in-use engines. The three main components are:

- Tighter certification emission limits for new diesel-fueled engines and vehicles;

[1] Toxic Air Contaminant – As defined in section 39655 of the Health and Safety Code, "an air pollutant which may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health.". Also see CCR, title 17, section 93000.

- Retrofitting in-use engines in on-road, off-road, and stationary applications with diesel emission control technologies; and

- Reducing the sulfur level in diesel fuel to no more than 15 parts per million to facilitate the use of advanced diesel emission control technologies.

The DRRP envisioned using these measures to achieve the goals it established of reducing emissions of diesel PM and the associated cancer risk by 75 percent in 2010 and by 85 percent in 2020 (Air Resources Board, 2000).

B. ESTABLISHMENT OF THE PROCEDURE AND ITS ROLE IN THE FLEET RULES

After the DRRP was adopted, staff developed and implemented the Procedure to ensure that DECS applied to in-use vehicles and equipment would achieve real and durable PM and NOx emissions reductions. The Procedure specifies testing procedures and requirements that must be followed in order for DECS to be verified in California. The Board approved the Procedure at its May 16, 2002, public meeting and amended it at subsequent public meetings in February, 2004, and March, 2006.

The Procedure plays a vital role in ARB's fleet rules, both adopted and under development, which provide a path towards meeting the goals of the DRRP. Each fleet rule gives fleet owners several compliance options. One compliance option that is used extensively and will continue to be used is retrofitting vehicles and equipment with DECS. For a given emission control system to qualify as a valid compliance option, the fleet rules require that it be verified by ARB under the Procedure. The Procedure is therefore one of the fundamental tools that staff uses to ensure the successful implementation of the fleet rules. Table 1 below summarizes the rules and related programs that currently rely on DECS verified under the Procedure:

Table 1: ARB Regulations and Programs Supported by the Procedure

Regulation/Program	Adoption Date
Fleet Rule for Transit Agencies	February 2000
Solid Waste Collection Vehicle Rule	September 2003
Transport Refrigeration Unit ATCM*	February 2004
ATCM for Stationary Compression Ignition Engines	February 2004
Portable Diesel-Fueled Engines ATCM	February 2004
Regulation for Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yards	December 2005
Fleet Rule for Public Agencies and Utilities	December 2005
In-Use Off-Road Diesel Vehicle Regulation	July 2007
On-Road Heavy-Duty Diesel Vehicles Regulation	under development
Intermodal Truck Rule (Port Trucks)	under development
Carl Moyer Memorial Air Quality Standards Attainment Program	n/a
Lower Emission School Bus Program	n/a

*ATCM = Airborne Toxic Control Measure

The Verification Program is an integral part of the ARB fleet rules. To support successful implementation of these rules, it is critical that the Procedure enable staff to efficiently and effectively evaluate DECS, and that the program be structured such that verified systems can enter the marketplace in an expeditious manner.

Over the course of implementation and enforcement of the fleet rules, several aspects of the Procedure have shown a need for improvement. Staff is proposing amendments to the Procedure to address these deficiencies, while proposing additional changes to ensure that verified systems remain available to support the fleet rules. The amendments proposed by staff include:

- Conditional extensions of existing verifications
- New test requirements for transient off-road applications
- Additional requirements for in-use compliance testing
- New classifications for NOx emissions reductions
- Additional requirements for fuel additives and NOx reduction systems

Staff's proposal also clarifies several requirements already implied (but not explicitly stated) within the Procedure. Staff believes that these amendments will improve the enforceability of the Procedure while enabling more systems to be verified in a way that ensures their effectiveness in reducing emissions.

C. PROGRAMS SUPPORTING THE VERIFICATION PROGRAM

Currently two demonstration projects are in development to promote DECS that will be candidates for verification for off-road vehicles and equipment. The Off-Road Diesel Construction Equipment Retrofit Demonstration Program (Showcase) is a multi-agency project between the Air Resources Board, the South Coast Air Quality Management District (SCAQMD), and the Mobile Source Air Pollution Reduction Review Committee (MSRC) designed to encourage manufacturers of qualifying DECS to participate with construction equipment fleet owners in retrofitting their engines to reduce diesel particulate matter (PM) or diesel PM plus oxides of nitrogen (NO_x). The goal of the Showcase is to demonstrate the viability of new DECS on various off-road applications and provide DECS that will ultimately be evaluated under the Procedure as compliance options for off-road fleet owners before the recently adopted in-use off-road diesel vehicle regulation takes effect. Sixteen manufacturers of 30 DECS, comprised of active and passive diesel particulate filters (DPF) systems, will participate. Eight of these DECS include selective catalytic reduction (SCR) systems, and seven are DPF systems utilizing fuel borne catalysts. The proposed systems will be demonstrated on 245 pieces of construction equipment operating within the South Coast Air Basin that belong to six public fleets and 14 private fleets. Nearly $4.9 million dollars in funding has been approved for allocation to fleet owners for the purchase of qualifying DECS. MSRC is in the process of initiating contractual agreements with the fleet owners. Installation and monitoring of the DECS is anticipated to begin in early 2008.

Currently, another off-road demonstration program is also being developed to demonstrate DECS that will be candidates for verification. It is anticipated that many DECS manufacturers that participate in the Showcase project will also participate in this demonstration. In conjunction with the United States Environmental Protection Agency (U.S. EPA), Supplement Environmental Projects (SEP) funds in the amount of $700,000 will be provided to support the demonstration. SEP is an environmentally beneficial project which a violator voluntarily agrees to perform as part of a settlement of an enforcement action. In return, U.S. EPA agrees to reduce the monetary penalty that would otherwise apply as a result of the violation(s). Through the SEP, funding to fleet owners can be provided to mitigate the cost of installing verified DECS. Funds may also be used to reduce the cost of testing for DECS manufacturers.

II. RECOMMENDATION

The proposed amendments to the Procedure, as described herein, will help ARB in its efforts to implement the Diesel Risk Reduction Plan and better protect public health. Verified control systems are one of the principal choices end users have to comply with ARB fleet rules. Therefore, the Verification Program strongly affects the success of many ARB regulations. The proposed amendments will strengthen the Procedure through more accurate and efficient assessment of PM and NOx control systems and their emission reduction effectiveness in the real world.

Staff recommends that the Board adopt the proposed amendments to sections 2700, 2701, 2702, 2703, 2704, 2705, 2706, 2708, 2709, and 2710, title 13, of the California Code of Regulations, as set forth in the proposed Regulation Order in Appendix A.

III. OVERVIEW OF THE VERIFICATION PROGRAM

This chapter describes ARB's Verification Program and other verification programs for systems to be used outside of California.

A. DESCRIPTION OF THE VERIFICATION PROCESS

The verification process, as defined by the Procedure, is the means employed by staff to ensure that DECS used to satisfy fleet rule requirements actually achieve the emissions reductions that are required. A manufacturer seeking to verify its product must satisfy emissions testing and warranty requirements up front, and subsequently complete in-use compliance testing with a number of production units retrieved from end users. A description of the types of DECS verified in California is provided in Appendix B.

To initiate the verification process, an applicant first submits preliminary information describing how its product works and the details of the verification test plan it proposes to follow. In this initial stage, staff is careful to evaluate the strengths and weaknesses of the technology, whether the proposed testing and test engine will enable a meaningful evaluation of the product's performance and durability, and the appropriateness of any alternative test methods or procedures that the applicant requests to use. Designing an appropriate test plan is a critical step in the verification process because the results are used to represent the performance of the product over a typically wide range of engine makes and models as well as applications. Shortcomings in test plan design can lead to exaggeration of emissions benefits, undetected secondary emissions with adverse health effects, and countless problems in the marketplace.

Once the preliminary information and test plan have been reviewed and approved, the applicant can begin testing. However, in practice, applicants often conduct unapproved testing and request that ARB consider the resulting data. Staff always reviews existing data and assesses to what extent they satisfy the requirements of the Procedure. That review, in particular when the data were generated using alternative test methods or procedures, slows the verification process, but it is part of the Procedure's flexibility and can potentially help the applicant to obtain verification in a more cost-effective manner.

Two key requirements in the verification process are emissions testing and a durability demonstration. The applicant must procure the services of a test facility (either a contract laboratory or in-house laboratory) that is capable of conducting the required emissions testing on both a new and aged unit. The aged unit is removed from the vehicle or piece of equipment following the durability demonstration. The required durability periods are shown in Table 2 below.

Table 2: Minimum Durability Demonstration Periods

Engine Type	Minimum Durability Demonstration Period
On-Road	50,000 miles or 1000 hours
Off-Road (including portable engines) and Stationary	1000 hours
Stationary Emergency Standby Engines	500 hours

If the aged unit performs as well as the new unit, staff has an indication that the product is well-made and compatible with the kinds of applications for which the applicant seeks verification.

Following completion of all testing, the applicant must submit a final application for staff's review. In addition to the test results, the final application must include:

- Discussion on principles of operation
- Discussion on compatibility with the various engines and applications to be included in the verification
- Explanation of potential safety issues
- Installation and maintenance requirements
- Fuel requirements
- Evaluative comments from a third party
- Raw data
- Quality assurance and control information
- Sample label
- Owner's manual with the warranty statement

The list above is indicative of the multitude of aspects that must be considered before a product can be verified. If staff is convinced that a product has met the requirements of verification, the applicant is issued an Executive Order which declares the product to be verified and specifies the terms and conditions of the verification. The product is then a candidate compliance option for the various fleet rules and programs that require verified systems.

Following verification, one of the on-going responsibilities of the applicant is to submit annual warranty reports to ARB. The warranty report informs staff of annual production and sales of systems in California and provides a summary of warranty claims. The summary includes a description of the nature of the claims and what actions were taken by the applicant to address them. The warranty reporting requirement provides a basic check as to the success of a verified product in California in terms of sales and performance.

After a system is verified and 50 units have been sold into the marketplace, the applicant is subject to in-use compliance testing requirements. ARB needs assurance that actual production units sold in California are performing in a manner consistent with the test units that were used to support the initial verification. To that end, the applicant must retrieve units from the end-users at two different stages of use and have them tested. Four units must be tested at each stage (more if there are failures). Failure of a system to perform consistent with its verification can lead to a lowering of the verified level of performance or revocation of the verification all together.

The verification process is a careful investigation into emission control systems that ARB relies on to protect the health of Californians. Because of the importance of this function and the many complex variables involved, there are many requirements for applicants to fulfill. Verification is by no means an easy task for either the applicant or ARB to perform, but it is necessary to ensure an effective reduction in the health risk posed by emissions from diesel engines. A list of devices currently verified in California is provided in Appendix C.

B. OTHER VERIFICATION PROGRAMS

Another well-known program that evaluates and verifies DECS is the United States Environmental Protection Agency's (U.S. EPA) Voluntary Retrofit Program (VDRP). It is a voluntary program designed to encourage owners of fleets of diesel powered vehicles and equipment to retrofit their engines with DECS. The VDRP evaluates diesel emission reduction technology through emissions and durability testing. Verified technologies are listed in the VDRP Verified Technology List which can be found at http://www.epa.gov/otaq/retrofit/verif-list.htm. After receiving verification, applicants are still responsible for meeting warranty and in-use compliance requirements.

In addition, there is a testing procedure used to evaluate diesel emissions reduction technology called Verminderung der Emissionen von Realmaschinen im Tunnelbau (VERT). It is a testing procedure required by the Swiss Agency for the Environment, Forests, and Landscape (SAEFL) and the Swiss occupational health agency (SUVA) to evaluate control technologies sold and used in underground workplaces, construction sites, and road vehicles in Switzerland. VERT requires at least 90 percent reduction in elemental carbon mass and at

least 95 percent reduction in particle count. Staff has received data used to support verification under both of these programs.

IV. PROPOSED CONDITIONAL EXTENSION AMENDMENT

This chapter presents staff's proposed conditional extension amendment and discusses how it would benefit the Verification Program.

A. CURRENT REQUIREMENTS FOR CONDITIONAL VERIFICATIONS

The Procedure requires staff to evaluate diesel emission control systems through emissions, durability, and field testing. Currently, the Procedure provides for conditional verifications for diesel emission control systems intended for off-road and stationary applications only. There are no provisions for on-road conditional verifications.

Conditional verification allows applicants to market their products as ARB verified prior to receiving full verification. This is accomplished by allowing applicants to complete one-third of the required minimum durability demonstration period. Since the durability demonstration period for off-road and stationary applications generally takes longer than for on-road applications, the conditional verification element of the Procedure allows applicants to sell their products in the off-road and stationary markets for a limited time while concurrently compiling all the data and information needed to attain a full verification. During this period, the conditionally verified diesel emission control systems are treated as fully verified systems for compliance with ARB's fleet rules, and applicants are responsible for meeting all warranty and in-use compliance requirements. Conditional verifications were developed and implemented to ensure that a sufficient number of diesel emission control systems would be available to end-users to comply with the requirements of the fleet rules.

B. DESCRIPTION OF THE PROPOSAL

Staff proposes amending the Procedure allowing for conditional extensions for new on-road applications. Applicants would be able to apply for new conditional on-road extensions for their systems already verified for on-road, off-road, and stationary applications. Applicants that qualify to receive conditional extensions would be able to sell their products as verified systems for one year and concurrently generate data and information needed to receive full verification. In granting a conditional extension, the Executive Officer would consider all relevant information including, but not limited to, the following: the design of the diesel emission control system, original test data, other relevant test data, the duty cycle of the prospective emission control group, and field experience. For the effective time period, the conditional extension would be considered equivalent to a full verification and would allow these systems to be viable solutions for compliance with the fleet rules.

Staff is not proposing that diesel emission control systems that have a conditional verification for off-road and stationary applications be eligible for a conditional extension. Staff believes that conditional extensions should only be based on systems that have been thoroughly tested. As such, diesel emission control systems need to receive full verification before receiving extensions or conditional extensions. This ensures that a conditionally extended technology is achieving real and durable emissions reductions before expanding the verification to include more applications.

V. PROPOSED AMENDMENTS TO TESTING REQUIREMENTS

This chapter describes staff's proposed amendments regarding testing requirements for fuel-based DECS, DECS intended for applications that do not operate on CCR compliant fuels, and DECS intended for off-road applications. It also addresses proposed amendments to NO_2 pre-conditioning requirements and proposed durability requirements for the monitoring and functionality systems of DECS. The need for such modifications to the Procedure is also discussed.

A. REQUIREMENTS FOR FUEL-BASED STRATEGIES

1. Background

The Procedure provides for the verification of fuel-based diesel emission reduction systems, which can typically be categorized as fuel additive-based and alternative diesel fuels. The Procedure defines an alternative diesel fuel as "any fuel used in diesel engines that is not commonly or commercially known, sold or represented as diesel fuel No. 1-D or No. 2-D, pursuant to the specifications in ASTM Standard Specification for Diesel Fuel Oils D975-81, and does not require engine or fuel system modifications for the engine to operate". They include, but are not limited to, biodiesel, Fischer Tropsch fuels, and emulsions of water in diesel fuel. Fuel additives are treated as alternative diesel fuels unless they are supplied to the vehicle or engine fuel by an on-board dosing mechanism, or if they are directly mixed into the base fuel inside the fuel tank of the vehicle or engine, or if they are not mixed with the base fuel until vehicle or engine fueling commences, and no more additive plus base fuel combination is mixed than required for a single fueling of a single engine or vehicle.

Under the Procedure, all fuel-based control systems must undergo a more comprehensive evaluation than other control systems that rely on emissions reductions through hardware alone (e.g., diesel particulate filters, diesel oxidation catalysts, etc). However, this testing is not consistent for alternative diesel fuels relative to fuel additive-based systems. Currently, applicants with fuel additive systems are required to meet requirements of sections 2700-2709. They must use the fuel-based control systems with level 3 diesel particulate filters unless they can be proven, to the satisfaction of the Executive Officer, to be safe for use alone. In addition, applicants must provide the exact chemical formulation, toxicological, epidemiological, and other health-related data regarding the fuel additive every two years. In addition to conducting emissions tests appropriate for the intended applications per section 2703, applicants with fuel additives must also conduct emissions tests using a high concentration of the fuel additives (known as "overdosing"). Also, any fuel additives must be in compliance with applicable federal, state, and local government requirements including registration with the U.S. EPA. Fuel additives must also be evaluated through the multimedia process as required in Health and Safety Code section 43830.8, which includes evaluations from all divisions within the California Environmental

Protection Agency. The Executive Officer may also request additional analyses if there is reason to believe the fuel additive based system will increase TACs, other harmful compounds, or change the nature or amount of emitted PM.

In contrast, applicants with alternative diesel fuels must also meet the requirements of section 2710. They must better characterize properties of the fuel, including aromatic content, American Petroleum Institute (API) gravity, and distillation temperature. Also, additional emissions testing relative to non-fuel based systems is required for alternative diesel fuels using the Federal Test Procedure (FTP) Heavy-Duty Transient Cycle, in accordance with the provisions in the Code of Federal Regulations, Title 40, Part 86, Subpart N. If applicants conduct cold and hot start tests, they must run at least 10 exhaust emissions tests following a specific test sequence. If they only conduct hot start exhaust emissions test, at least 40 tests must be conducted following a specific test sequence. To keep the emissions test cycles similar for all DECS intended for off-road and stationary applications, alternative diesel fuels intended for off-road and stationary applications should be tested under the appropriate test cycles specified in section 2703(e). The appropriate emissions test cycles will help ensure real and durable emissions reductions from applications subject to emissions requirements in the fleet rules.

2. A Description of the Proposal

Staff proposes to more uniformly evaluate all fuel-based control systems by requiring that all fuel-based control systems follow the verification procedures specified in section 2710. Fuel additive-based systems would still be required to perform the additional overdosing testing requirements specified in section 2706(c). In addition, staff proposes that the emissions testing for all fuel based systems follow the emissions test cycles prescribed in Section 2703. As such, systems intended for on-road applications would be tested with an engine dynamometer using the FTP Heavy-duty Transient Cycle compliant with the Code of Federal Regulations, Title 40, Part 86, Subpart N. Control technologies intended for off-road and stationary applications would be tested with engine dynamometers using the appropriate steady state and discrete mode test procedures outlined in the ARB off-road rule regulations given in sections 2703(e)(2) and 2703(e)(3).

B. ALLOWANCE FOR THE USE OF NON-COMPLYING FUELS

1. Background

The Procedure currently requires that all test fuels used for emissions and durability testing meet the specifications in title 13, CCR, sections 2280 through 2283, (typically known as the ARB Reformulated Diesel Fuel Regulations). However, as the scope of the Verification Program has expanded, several

stakeholders have commented that there are some applications that routinely use commercially available fuels that do not meet these specifications. One such example is marine vessels. The main engines of many ocean going vessels are designed to operate on either heavy fuel oil (HFO) or marine diesel oil (MDO). Neither HFO nor MDO meet the specifications currently required by the Procedure for emissions or durability test fuels. Emissions testing performed using a fuel not normally used during actual in-use operation may not be feasible and would likely yield results that are not representative of real-world activities. In addition, in the case of marine vessels, durability testing with fuels other than HFO or MDO would not provide staff with appropriate data to demonstrate that the diesel emission control system would achieve real and lasting emission reductions.

2. Description of Proposal

Staff proposes modifying the Procedure to allow the use of test fuels that do not meet the ARB Reformulated Diesel Fuel specifications of title 13, CCR, sections 2280 through 2283 for both emissions and durability testing in select applications. Approval of the Executive Officer would be required before the use of such fuels is permitted. The use of such fuels would only be allowed if it can be determined that the fuel is representative of commercially available fuel typically used for the intended application.

C. OFF-ROAD TESTING REQUIREMENTS

1. Background

The Procedure currently requires all applicants seeking verification of a DECS intended for use with off-road applications to follow the steady state test procedures outlined in title 13, CCR, section 2423 and the incorporated California Exhaust Emission Standards and Test Procedures for New 2000 and Later Off-Road Compression-Ignition Engines, Part I-B. Using an engine dynamometer, a test engine is operated to follow the International Organization for Standardization (ISO) 8178 C1 test cycle while the exhaust emissions are measured and quantified. The C1 test cycle is an 8-mode test, and includes operation of the engine at specified engine loads (torque) and specified engine speeds. Off-road applicants are required to perform three repetitions using this test cycle in three configurations: a baseline test with no DECS installed, a “pre-conditioned” test with a new DECS installed, and an “aged” test with a service accumulated DECS installed.

Unlike the on-road test cycles, the C1 test cycle does not represent engine operation under dynamic or changing conditions such as those seen in actual, in-use operation. The test engine is brought up to the required speed and torque and allowed to stabilize for a period of time. Once the test engine is stabilized,

the emissions are measured and quantified before moving to the next mode where the process is repeated. Once the emissions from all modes are quantified they are weighted according to a predetermined set of weighting factors. While the modes of the test cycle vary from one-hundred percent torque at rated speed to zero torque at low idle speed, this test cycle is not representative of actual in-use activity for the majority of the engines and equipment in the off-road category. Staff has determined that the majority of off-road engines and equipment have duty cycles that are significantly more transient in nature. Therefore, a test cycle that characterizes actual in-use operation is necessary to accurately determine the effectiveness of a DECS submitted for off-road verification.

The U.S. EPA recently addressed this issue in its determination that effective in-use control of emissions from off-road diesel engines requires a test cycle that more accurately characterizes the transient nature of this diverse category. Working with affected stakeholders such as the Engine Manufacturers Association (EMA) and Southwest Research Institute, U.S. EPA measured and recorded actual speed and load data from off-road equipment while in use. Each piece of equipment measured represented the top tier of off-road equipment as defined by their contribution to U.S. EPA's nonroad (off-road) diesel inventory. Data segments from the unique duty cycles of each off-road application were linked together to construct the Nonroad Compression-Ignition Composite Transient Cycle (NRTC). In May 2004, U.S. EPA released a final regulatory analysis to document the process and methodology used to develop the NRTC (U.S. EPA, 2004). This document provides an in-depth analysis of the technical feasibility of the NRTC and its applicability to equipment and engines in the off-road category. The U.S. EPA adopted the NRTC for variable speed engine certification as part of their new Tier 4 emission standards for nonroad diesel engines.

Similarly, in October 2005, ARB adopted the California Exhaust Emission Standards and Test Procedures for New 2008 and Later Tier 4 Off-Road Compression-Ignition Engines, Part I-C. This document incorporates the relevant sections of Code of Federal Regulations, Title 40, and requires manufacturers of new 2008 and later variable speed off-road diesel engines seeking certification for sale in California to perform emissions testing using the NRTC. In addition, the test procedures include several steady-state test cycles for engines manufactured specifically for off-road applications that do not have a duty cycle that is transient in nature. An example of this might include compression-ignition engines manufactured specifically for use in stationary applications, such as generator sets and agricultural pumps.

2. Description of Proposal

Since its adoption, staff has continually aligned the emissions testing requirements of the Procedure with those of ARB's engine certification programs

where practicable. This provides applicants and staff with access to current and future certification test cycles and procedures and ensures that emissions test facilities will be available to perform the necessary testing required by the Procedure. Since staff has determined that real-world activities for the majority of off-road equipment are not accurately characterized by steady-state test cycles, staff proposes modifying the Procedure to require applicants seeking verification of a DECS intended for use with variable speed off-road applications to perform emissions testing using the transient test procedures outlined in the title 13, CCR, section 2423 and the incorporated California Exhaust Emissions Standards and Test Procedures for New 2008 and Later Tier 4 Off-Road Compression-Ignition Engines, Part I-C (New 2008 Off-Road Test Procedures). All variable speed engines would be required to perform a minimum of three hot-start tests using the NRTC.

Though the New 2008 Off-Road Test Procedures requires both a cold-start and a hot-start test using the NRTC, staff is proposing to eliminate the cold-start portion of the test procedure. Stakeholders have commented that the cold-start test is overly burdensome, significantly lengthens their set-up time, and is weighted such that it contributes very little to the overall transient emissions results. Off-road engines and equipment are started and warmed to a point of stable, hot operation generally once per day. While these conditions could occur at other times, such as after a mid-day break, these types of engines and equipment experience cold-starts significantly less often than their on-road counterparts. In addition, the New 2008 Off-Road Test Procedures weights the cold-start portion of the transient emissions to only five-percent of the overall emissions test results. Therefore, staff agrees with stakeholders and is proposing that applicants be required to perform three test repetitions of the hot-start tests using the NRTC to satisfy the test requirements of the Procedure.

To assist applicants in the transition to the NRTC, staff is proposing a phase-in period which would allow applicants to continue to use the steady-state test procedures outlined in the current ARB off-road regulations (title 13, CCR, section 2423 and the incorporated California Exhaust Emission Standards and Test Procedures for New 2000 and Later Tier 1, Tier 2, And Tier 3 Off-Road Compression-Ignition Engines, Part I-B) until December 31, 2008, provided certain criteria are met.

In order to qualify to use the steady-state test procedures, an applicant must submit a completed preliminary verification application, including a testing proposal, to ARB by October 1, 2008. In addition, the applicant must receive a letter of notification from the Executive Officer dated no later than December 31, 2008, confirming that the preliminary verification application is complete. If approved, an applicant may perform their verification emissions testing using the steady-state test procedures provided that they complete their emissions testing and submit their final verification application no later than

July 1, 2010, and they adhere to the terms and conditions stated in the approved preliminary verification application. Failure to submit their final verification application by July 1, 2010, or to adhere to the terms and conditions stated in the approved preliminary verification application would require emissions testing using the NRTC and the New 2008 Off-Road Test Procedures.

In addition, applicants electing to use the steady-state procedures during the transition period resulting in the verification of their DECS after October 19, 2007, would be required to submit to the Executive Officer additional transient emission test data supporting the continued verification of the DECS by January 1, 2013, or have their verification revoked. The additional transient emissions test data must consist of a new baseline test, a pre-conditioned DECS test, and an aged DECS test using the New 2008 Off-Road Test Procedures. Verifications awarded prior to October 19, 2007 are not subject to this requirement. Table 3 below lists the proposed compliance dates.

Table 3: Proposed Requirements and Dates for Off-Road Verification

Applicants	Proposed Requirement	Compliance Date
Applicants using NRTC	Test emissions reductions using NRTC	NA
Applicants using ISO 8178 C1 test	Submit complete preliminary verification application	October 1, 2008
	Receive letter of notification from Executive Officer	December 31, 2008
	Submit complete final verification	July 1, 2010
	Submit test data using NRTC (for applicants verified after October 19, 2007)	January 1, 2013

Included in staff's recommendation is additional language that would provide the Executive Officer with the authority to allow applicants to use another test cycle if it is determined to be more representative of the engine's or equipment's actual in-use duty cycle. For example, DECS intended for use with auxiliary power units (APU) are currently being processed under the off-road engines and equipment section of the Procedure. However, the duty cycle of an APU is not accurately characterized by a transient test cycle. This language will allow staff to work with applicants to determine the most appropriate test cycle for the

application and ensure that the transient test cycle is only applied where appropriate.

D. NO_2 PRE-CONDITIONING REQUIREMENTS

1. Background

Many diesel emission control systems, in particular catalyzed DPFs, increase the amount of NO_2 in the exhaust to burn off soot that has collected in the filter. Because NO_2 has adverse health impacts arising from direct exposure as well as from its role in the formation of ozone and secondary particulate matter, the Procedure includes a limit on emissions of NO_2. These limits are shown in Table 4 below. To support these emissions limits, the Procedure is complemented by special test unit preconditioning requirements because the amount of NO_2 emitted by a system over an emissions test is sensitive to the state of system at the time of testing (ARB, 2006). These requirements apply to both the degreened and aged test units as well as units retrieved from the field for in-use compliance testing.

Table 4: Current NO_2 Emissions Limits for DECS

Date	NO_2 Emissions Limit (percent increase from baseline NOx emission level)
January 1, 2007	No more than 30 percent
January 1, 2009	No more than 20 percent

For the aged test unit, preconditioning is required only if the backpressure is greater than 30 percent higher than that of the degreened unit. Backpressure is used as a relative indicator for the amount of soot and ash in a system, both of which can suppress NO_2 emissions during testing. If the backpressure exceeds the 30 percent threshold, the aged system must be cleaned as necessary.

Subsequent to adoption of the preconditioning requirements in March 2006, staff found that the preconditioning criterion for the aged test unit, though simple and straightforward to implement, does not treat different systems on an equal basis. The Procedure is used to verify a wide range of diesel emission control systems that vary in their complexity and size. Systems ranging from a simple DPF with one component in the exhaust stream to a multi-component system with various catalysts, static mixers, and a DPF, are all subject to the same preconditioning

requirements. Under the same test conditions, a multi-component system will have a higher initial backpressure than a simpler system, and therefore the aged unit from the multi-component system would have a proportionally greater allowable increase in backpressure. For instance, a simple DPF that averages 8 inches of water (inH_2O) backpressure over the test cycle when degreened could not exceed 10.4 inH_2O when aged. A multi-component system that averages 10 inH_2O when degreened could not exceed 13 inH_2O when aged, which represents a 25 percent greater allowable increase relative to the former system. This can confer an advantage to the multi-component system because all of the backpressure increase is likely to occur in the DPF portion alone. The DPF can thus have more accumulated soot and/or ash than the DPF in the single-component system, and thereby resulting in suppressed NO_2 emissions.

2. Description of the Proposal

Staff proposes to add an alternative backpressure criterion to determine whether the aged test unit needs to be preconditioned. In addition to the current 30 percent maximum backpressure increase, staff proposes that an applicant have the option of complying with an absolute backpressure limit of 60 inH_2O. This alternative criterion is independent of diesel emission control system design and applies equally to all systems. Staff expects that this criterion will be used by smaller, simpler systems for which a backpressure increase of 30 percent can be quite small in absolute terms.

The proposed alternative backpressure criterion would be implemented differently depending on the nature of the verification test cycle. For transient cycles, the limit would be 60 inH_2O for 2 percent of the time. That is, no more than 2 percent of all the 1 Hertz (Hz) backpressure data may exceed 60 inH_2O. For steady-state cycles, the limit would simply be a cap of 60 inH_2O. Steady-state cycles are composed of modes, and so the backpressure recorded for each mode must be less than or equal to 60 inH_2O.

Staff selected 60 inH_20 for the absolute backpressure limit after reviewing DECS manufacturer backpressure warning thresholds and actual backpressure data for a variety of systems. The criterion of not exceeding 60 inH_2O for more than 2 percent of the time is below the first-stage backpressure warning thresholds used by the eight different DPF systems staff reviewed. The two systems with the lowest thresholds also use 60 inH_2O, but the criterion is for over 30 seconds continuously, which represents a significantly higher limit for transient test cycles. Actual backpressures recorded during emissions testing and in-use demonstrations of various systems show that some systems exceeded the proposed criterion and some did not. The proposed criterion therefore appears to be sufficient to prevent emissions testing of systems that are excessively loaded with soot or ash.

E. MONITORING AND NOTIFICATION SYSTEM FUNCTIONALITY REQUIREMENTS

1. Background

The Procedure currently requires applicants to verify their products as a complete system. For example, the Procedure requires all filter-based DECS be installed with a backpressure monitor and a means of notifying the operator when a high backpressure condition exists. Therefore, an applicant with a filter-based DECS would be required to develop a durability test plan that addresses not only the filter, but the backpressure monitoring system and driver notification system as well. However, as the scope of the Verification Program expands to include strategies such as SCR, applicants will likely develop products with increasingly more complex monitoring and notification systems. These systems may include items such as reductant level monitoring systems, operator inducement systems, and mechanisms to de-rate an engine's maximum power output. Staff is concerned that the language currently in the Procedure does not specifically address durability or functional testing of such systems.

2. Description of Proposal

Staff proposes adding clarifying language to the Procedure requiring applicants to demonstrate the durability of all monitoring and notification systems. Applicants would be required to demonstrate the durability and proper operation of such systems through functional testing following service accumulation. Applicants must develop and submit as part of their durability demonstration specific test procedures designed to validate the proper and continued operation of all monitoring and notification systems. Functional testing would be performed following the service accumulation period and the results reported with their final verification application. Successful operation of a complex DECS such as SCR is dependant upon the proper and continued operation of its monitoring and operator notification systems. Furthermore, certain driver inducements such as engine de-rate may not be triggered during the service accumulation period of a durability demonstration. Functional testing of such systems will validate that they perform as intended and ensure that the verified DECS provides continued emissions reductions. The additional language will provide clarity to applicants and allow them to develop and submit for review and approval test procedures designed to demonstrate the durability and functionality of their monitoring and notification systems.

VI. PROPOSED NOx CHANGES

Historically, the Procedure's primary purpose has been to evaluate diesel PM emissions reductions from DECS. However, given California's persistent ozone and secondary PM air quality challenges, staff also recognized that there was a need to be able to verify reductions of NOx emissions, should a system have that functionality. The Procedure, therefore, has provisions that provide for verification of NOx reductions. Because the regulatory need for NOx reductions from in-use vehicles and equipment has become increasingly important in recent times, staff revisited the Procedure to improve its ability to evaluate NOx systems, as well as broaden the scope of systems it can be used to evaluate.

A. REQUIREMENTS FOR NOx ONLY REDUCTION SYSTEMS

1. Current Provisions For Verifying NOx Reductions

The Procedure was created to support the DRRP by providing a means to ensure that diesel emission control systems used to satisfy in-use fleet rule requirements achieve real and durable reductions in emissions of diesel PM. As a result, one of the basic requirements for verification under the Procedure is that a system must reduce PM emissions. A system that only achieves NOx reductions (a "NOx-only" system) is not currently a candidate for verification.

Because diesel engines represent a significant source of NOx emissions in the state, there is now an urgent need to achieve additional reductions in emissions of NOx from in-use diesel engines. This is because NOx is a precursor to both fine particulate matter (PM 2.5) and ozone, and many areas of the state do not meet clean air standards for one or both of these pollutants. While the Procedure can currently help to meet this demand through the verification of systems that reduce emissions of both PM and NOx, it cannot be used to provide NOx-only controls for diesel engines.

2. Description of Proposal

Staff proposes to broaden the scope of the Procedure to allow for the verification of systems that reduce emissions of NOx, but not PM, for certain diesel engines. Specifically, such NOx-only systems could be used with on-road diesel engines certified to a PM emissions standard of 0.01 grams per brake horsepower-hour (g/bhp-hr) or less (typically 2007 and later model year engines), or off-road diesel engines certified to a PM emissions standard of 0.03 g/bhp-hr or less (typically Tier 4 engines over 25 horsepower). Many of these engines will come with DPFs as original equipment. Staff proposes to allow verification of NOx-only systems with additional engines provided that they are not regulated by ARB in-use fleet regulations or Airborne Toxic Control Measures that require PM emissions control, or provided that they would otherwise potentially not be retrofit with PM

emission control systems. The intention of this requirement is to avoid circumstances in which a diesel engine is retrofit with a NOx-only system that then preempts the subsequent use of a PM control system.

Without this provision, verifying NOx-only systems could create a potential for having an engine retrofitted with two different emission control systems: one for NOx control, the other for PM control. The in-use fleet rules, both adopted and under development, will prompt widespread retrofitting of diesel engines with emission control systems that can reduce emissions of PM and systems that can reduce emissions of both PM and NOx. It is conceivable, that without this provision, a given diesel engine could be retrofitted once with a PM control system and then later retrofitted again with a NOx-only system.

The primary issue with such a situation is the compatibility of the two systems. Both systems being verified for use with the same diesel engine is not equivalent to being verified for use with each other. For example, a selective catalytic reduction (SCR) system, which is a high level NOx reduction system, installed upstream of a pre-existing passively-regenerating diesel particulate filter would likely cause the filter to fail for lack of the NOx emissions that it needs to regenerate. To avoid such problems as well as a host of more subtle ones, the Procedure requires that a system composed of multiple components be tested and submitted for evaluation as one system.

Another key issue with having more than one system retrofitted onto a diesel engine is that the warranty claim resolution process would become more complicated. An end-user could be forced to potentially deal with two retrofit manufacturers and the engine manufacturer when trying to resolve a problem that arises with one of the systems. The likelihood of all manufacturers involved having a complete understanding of the other manufacturers' systems and the nature of interactions among all of the components is quite low. Consequently, it could be exceedingly difficult for an end-user to get a prompt and clear resolution to a warranty claim.

Staff also proposes adding general clarifying language that states that a verified diesel emission control system may not be installed on an engine with another diesel emission control system that is not included in the Executive Order. Currently, Executive Orders issued by ARB already have language to that effect, but staff believes it is necessary to reinforce this policy more explicitly in the Procedure.

B. NEW NOx REDUCTION CLASSIFICATIONS

1. Background

A fundamental aspect of the verification process is how the performance of an emission control system is characterized. For PM, three broad levels are used to establish PM reductions, which are defined by a lower bound in performance. Level 2, for example, is defined by PM reductions greater than or equal to 50 percent. This is in contrast to how the Procedure currently verifies NOx reductions, which are established in 5 percent increments. A system can, for example, be verified to a 45 or 50 or 55 percent NOx reduction.

One of the problems with simply using 5 percent increments for NOx verifications is the inherent performance variability of emission control systems under different conditions. An SCR system, for example, has the potential for reducing emissions of NOx anywhere from zero to 90 percent depending on the exhaust temperature. Defining a window of performance of only 5 percent with some degree of accuracy tends to require a narrowly-defined scope of the verification. Because of the large-scale need for NOx reductions, narrowly-defined verifications are not useful in an in-use regulatory strategy.

2. Description of Proposal

To enable more broadly-defined verifications, staff proposes to use a verification ranking for NOx reductions similar to that used for PM. As shown in Table 5, staff's proposal is to use five levels, called Marks, defined by lower bounds of NOx reduction performance. The lower bounds are equally spaced in 15 percent increments. Reductions less than 25 percent would not be verified. Currently, reductions less than 15 percent are not verifiable. In light of growing numbers of high-efficiency NOx systems, however, and the need for significant NOx reductions from in-use vehicles and equipment, there is little reason to spend valuable resources evaluating much lower efficiency systems. Staff therefore proposes the higher 25 percent threshold.

Table 5: Proposed NOx Reduction Classifications

Pollutant	Reduction	Classification
NOx	< 25%	Not verified
	≥ 25%	Mark 1
	≥ 40%	Mark 2
	≥ 55%	Mark 3
	≥ 70%	Mark 4
	≥ 85%	Mark 5

Staff defined the five Marks in large part based on the performance of existing technologies, some of which are already verified. Lean NO_x catalyst technology would be an example of a Mark 1 system. One such system is currently verified. Exhaust gas recirculation (EGR) systems that tend to achieve 40 to 50 percent NOx reductions would qualify as Mark 2 systems. Two such systems are currently verified at this level of performance. Mark 3 would likely include SCR systems that do not have sophisticated control schemes or which have lower operating temperature criteria. With NOx reductions greater than 70 percent, Mark 4 would encompass the higher-efficiency SCR systems, one of which has been verified for limited off-road use. Staff does not expect many systems to be verified at the Mark 5 level, which is at the upper limit of SCR system performance. More narrowly-defined verifications, in particular those involving engines with minimal transient operation, might lend themselves well to the Mark 5 classification.

Under the proposed system, emission control systems that achieve both PM and NO_x emission reductions would be characterized by two level designations. For example, a wall-flow DPF combined with a high-efficiency SCR system might qualify as a Level 3, Mark 4 system. Systems that achieve NO_x reductions alone are currently not candidates for verification under the Procedure, but as previously described, staff is proposing to change this on a limited basis.

C. REQUIREMENTS FOR SCR SYSTEMS

1. Background

Diesel emission control systems that use SCR technology are growing in number and maturity, but the Procedure does not explicitly address certain key issues

facing the technology. Though well-proven in its ability to reduce NOx emissions, an SCR system requires a continuous supply of a reductant (often a solution of urea and water) to function properly. Ensuring that end-users maintain a continuous supply of reductant, however, is not a trivial matter. If an SCR system were to run out of reductant while a truck is in use, for instance, there is no effect on the engine or any other natural consequence that could compel the end-user to refill the reductant tank. As a result, no NOx reductions would be realized. For SCR technology to be a viable option for controlling NOx emissions, there must be some reasonable level of assurance that the reductant supply will not be interrupted thereby ensuring the continued performance of the system.

2. Description of the Proposal

To ensure that systems using SCR technology achieve NOx reductions in practice, staff proposes new additional requirements. First, staff is proposing that SCR-based systems must include a system to both monitor the amount of reductant available and notify the operator when the level is low. Second, staff is also proposing that SCR systems include an effective means to induce the operator to maintain a constant supply of reductant. Staff is not proposing to prescribe a given method, but rather to have the applicant submit one for approval. One example of this is to prevent the engine from starting the next time the operator attempts to turn it on. Another example is to de-rate the engine such that its power output is noticeably lower. In both cases, operation would resume as usual once the reductant tank is refilled. The third requirement that staff proposes is for SCR systems to include a means to ensure that the reductant present in the tank has the right composition for proper system operation. If the operator simply pours water or any other incorrect liquid into the tank, the SCR system should be able to detect a problem. For urea-based systems, one direct method for fulfilling this requirement might be to employ a urea quality sensor, which is relatively new technology. An indirect method is to use NOx sensors in the exhaust system to determine whether the expected NOx reductions are actually occurring.

D. REQUIREMENTS FOR NOx EMISSION MEASUREMENTS DURING DURABILITY AND FIELD DEMONSTRATIONS

1. Background

One of the most important elements of the verification process is ensuring that a system can work in the real world, not just in a laboratory setting. Therefore, the Procedure requires that a system be installed and used on a representative vehicle or piece of equipment as part of a durability demonstration or field demonstration. Also, for all aftertreatment-based systems, the applicant must measure and record the exhaust temperature and backpressure during the

demonstration. These data provide a record of activity as well as insight into the functioning of a system while in actual use. Backpressure data from a DPF-equipped vehicle, for instance, can show whether the system regenerated properly over the course of the demonstration.

For NOx emission control systems, however, the in-use data required by the Procedure shed little light on in-use performance. The most common NOx control systems use open-channel catalysts together with a chemical reductant that is injected into the exhaust stream. Backpressure and exhaust temperature data give no indication as to whether the injection system is operational, whether the system delivers the right amount of reductant at the right time, or whether actual NOx reductions are achieved. At present, staff must rely exclusively on emissions testing in a laboratory following completion of the durability demonstration.

2. Description of the Proposal

To assist in the evaluation of in-use performance of aftertreatment-based NOx emission control systems, staff proposes that NOx emissions both upstream and downstream of the NOx device be measured and recorded during portions of the durability and field demonstrations. The proposal would apply to the first and last 100 hours of the durability demonstration and the entire field demonstration, if one is conducted. The applicant must propose a measurement method for approval by ARB.

Although requiring in-use NOx emission data would be a new element in the verification process, it is not impractical or overly burdensome because most NOx emission control manufacturers are already using technology that can generate such data. Of the nine manufacturers staff is aware of that currently offer or plan to offer NOx retrofits, seven have products that rely on in-use NOx measurements to function properly. These systems use one or two NOx sensors and a means to measure mass flow such as a mass air flow (MAF) sensor to estimate real-time NOx mass emissions. An example of published data generated by such a system can be found in a paper authored by staff of Johnson Matthey, Incorporated (Conway et al, 2005). In-use measurement systems that employ NOx sensors would meet staff's proposed requirements, and would in fact be the most likely option used by applicants.

E. RECISION OF ELEVATED NOx EMISSIONS TESTING

1. Background

In the 1990's, engine manufacturers utilized computer-based strategies in on-road engines that allowed the engines to comply with emission limits under certification testing conditions, but also allowed increased NOx emissions during

highway driving. U.S. EPA and ARB consider these strategies to be defeat devices (a.k.a. dual mapping and transient sensing algorithms) that result in significantly elevated off-cycle NOx emissions. To evaluate how a NOx emission control system would perform under such off-cycle conditions, the Procedure requires testing with an additional test cycle designed to trigger episodes of high NOx emissions.

One fundamental issue with this requirement is that there is no standard method or test cycle which is guaranteed to trigger off-cycle NOx emissions for all engine makes and models. The parameters and conditions that an engine's control system uses to activate defeat devices vary from engine to engine. Staff has had only limited success with emissions test conditions that reliably result in off-cycle emissions.

Besides being difficult to implement, the off-cycle NOx test requirement is much less relevant today than it was at the time it was adopted in 2002 as part of the original Procedure. Because of ARB's Low NOx Software Upgrade Program, trucks with defeat devices have been getting reprogrammed in recent years to emit less NOx. At present, staff estimates that about 70 percent of these trucks have already been upgraded with low NOx software. The population of trucks with off-cycle NOx emissions has greatly diminished, and along with it the need to evaluate NOx emission control systems under off-cycle conditions.

2. Description of the Proposal

Staff proposes to remove the requirement to test an on-road NOx emission control system under conditions that generate off-cycle emissions. This will reduce verification costs and simplify the overall process.

F. REQUIREMENT TO RECORD REDUCTANT USAGE

1. Background

Staff expects the Procedure to be used more frequently in the near future to verify a growing number of NOx emission control systems, in particular those that rely on a reductant such as urea. Although the Procedure currently requires measurement of all the primary pollutants, exhaust temperature, and backpressure during emissions testing, it does not require measurement of the amount of reductant consumed over a given test cycle. Knowing the amount of reductant consumed gives insight into the functioning of a system during testing and is also a useful consistency check when compared with the amount of NOx reduced over a given test run. For these reasons, U.S. EPA included reductant consumption as an ancillary measurement in its verification protocol for SCR systems (U.S. EPA, 2003).

2. Description of the Proposal

For systems that use a reductant to reduce emissions of NOx from on-road or off-road applications, staff proposes that the amount of reductant consumed during each test run must be measured and recorded.

VII. PROPOSED ADMINISTRATIVE AMENDMENTS AND OTHER CLARIFICATIONS

This chapter discusses staff's proposed amendments that clarify current requirements of the Procedure. The discussion also explains the need for such modifications and how they will improve the Verification Program.

A. CHANGES TO THE IN-USE COMPLIANCE REQUIREMENTS

1. Background

Manufacturers of verified control technologies must meet warranty and in-use compliance requirements for each verified product. In-use compliance ensures that control systems are still functioning at their verified performance levels in real applications. This ensures that the Verification Program is effectively supporting the fleet rules by providing verified systems with real and durable emissions reductions.

The in-use compliance requirements of the Procedure require applicants to obtain at least four test units[2] for testing for two distinct test periods, Phase 1 and Phase 2. Phase 1 testing ensures verified emissions reductions early on during the in-use period and is intended to reveal any problems that can be addressed prior to widespread distribution of the product. Phase 2 testing is intended to ensure verified emissions reductions throughout most of the warranty period of the product, thereby ensuring that the anticipated emissions reductions from ARB's fleet goals are being realized.

Phase 1 test units must be in use for at least one year or within three months of their first maintenance, whichever comes first. Phase 2 test units must be in use 60 - 80 percent of the minimum warranty period. To pass in-use testing, the in-use control systems must reduce emissions by at least 90 percent of the lower bound of their verified levels during each test phase. For example, a Level 2 verified DECS (reduces PM emissions by 50 percent or more) must reduce PM emissions by at least 45 percent during Phase 1 and Phase 2 in-use compliance testing. In addition they must not increase mass emissions of NO_2 by more than 33 or 22 percent of the baseline NOx emission level for systems verified under the 30 or 20 percent NO_2 limits, respectively.

Even though the onset of in-use compliance requirements begins when 50 units are sold, the Procedure does not currently specify a timeframe applicants have to complete the in-use compliance requirements. Currently, applicants are required to perform this testing after selling the fiftieth unit and they are expected to submit results in a timely manner. However, the lack of specific deadlines has delayed the in-use performance evaluation process for many verified control systems. ARB staff have concluded that explicit deadlines for in-use compliance

[2] The term "unit" refers to the diesel emission control system or technology.

information are necessary for the performance evaluation of verified control technologies. The addition of deadlines to the Procedure would provide a more structured in-use evaluation process for staff and device manufacturers, and it would also ensure that critical information is received in a timely manner and should expedite the in-use compliance process. The proposed deadlines are a clarification of what is already required.

Despite the current requirement for retrofit manufacturers to submit test plans and in-use compliance data, ARB staff has not received sufficient in-use compliance reports from many of the verified manufacturers. Retrofit manufacturers have provided a number of reasons as to why they have not submitted this data. Some applicants undergoing the in-use compliance process have experienced difficulty locating and obtaining in-use units primarily because they did not establish a mechanism to keep track of their sold systems. Staff believes it is necessary to explicitly require record keeping in the Procedure to have a successful in-use compliance program. The original intent was for applicants to keep necessary records that would allow them to meet in-use compliance requirements. The lack of specific requirements showing that intent has resulted in an in-use performance evaluation process that is not robust. If records are kept for each control system and contain updated end user contact information, a description of the vehicle or equipment on which the unit is installed, and a description of the engine on which the unit is installed, applicants will be able to identify appropriate candidate systems for in-use compliance testing. It will also help reduce the risk of companies being penalized because of non-compliance.

The Procedure also currently requires applicants to submit a testing proposal prior to in-use compliance testing. Applicants must receive approval from the Executive Officer before commencing in-use compliance testing. The Procedure does not clearly identify what information must be included in the testing proposal. It was expected that the testing proposal would contain enough information such that the Executive Officer can determine if the proposed units are a representative sample for in-use compliance testing. Manufacturers have indicated the current requirements are not sufficiently clear and that they require more explicit instructions. Based on this, and due to the insufficient testing proposals staff has received, staff believes a clarification of this required information is needed.

Currently, the Procedure specifies that if any test unit fails in-use compliance testing, the applicant must select two additional units for testing and provide a report detailing the causes of the failure. The Procedure is unclear as to the selection of the additional units. As a result, applicants may choose inappropriate test units since no staff review is required. Staff is proposing to correct this by including an approval process for the additional units.

2. Description of the Proposal

Staff proposes to include new requirements for when the testing proposals for each in-use test phase must be submitted. The Phase 1 testing proposal would be required to be submitted no later than 90 days after the fiftieth unit was sold. The Phase 2 testing proposal would have to be submitted no later than 3 years after the fiftieth unit was sold. Since the in-use compliance requirements are for units that have been in use, applicants that have sold but do not have 50 units installed on vehicles or equipment may request the Executive Officer to delay their submittal deadlines.

The proposed amendments would also specify what is to be included in each testing proposal. Under staff's proposal, the following information would be required:

(1) Applicant identification.

(2) Diesel emission control strategy family name.

(3) Parties to be involved in conducting in-use compliance tests.

(4) Test facility identification and description.

(5) Quality control and quality assurance procedures for the test equipment.

(6) List of candidate test units (at least 10 units per test phase) with the following information provided for each: vehicle/equipment information on which the unit is installed (make, model, model year), location, engine information (family name, make, series, model year, displacement), date of manufacture, date of installation, and cleaning/repair history.

(7) Cumulative sales of the emission control strategy family in each application.

(8) Predicted mileage or hours of use each diesel emission control system will have accrued by the time it is obtained.

(9) Description of test vehicles and engines (engine family name, make, model, model year, displacement)

(10) Testing plan for completing in-use compliance emissions testing.

Applicants with approved test plans will be notified in writing by the Executive Officer. Staff is proposing that applicants submit Phase 1 in-use compliance reports no later than 18 months after the fiftieth unit was sold. The Phase 2 report would have to be submitted no later than 4 years after the fiftieth unit was sold. Establishing a deadline based on the sale of the fiftieth unit will provide a clear timeframe for the applicant to complete in-use compliance requirements. The predictable evaluation timeline and standardized information should in turn

help staff better evaluate the effectiveness of verified control systems in reducing emissions from existing diesel engines.

Staff also proposes that during each phase of testing, if a test unit fails, the applicant be required to submit a testing proposal for two additional test units within 30 days of the failure. The testing proposal would include an investigative report detailing the causes of the failure. This proposed new 30 day deadline for the testing proposal of the new test units would require applicants to submit all the required information in a reasonable time. This should allow staff to address any problems and prevent the in-use compliance process from continuing indefinitely. Within 45 days of receipt, the Executive Officer would notify the applicant whether the testing proposal was sufficient. After receiving approval from the Executive Officer, the applicant would have to complete testing.

B. ADDITIONAL RECORD KEEPING REQUIREMENTS

1. Background

The Procedure requires applicants to provide warranty coverage for end users that purchase their control systems. As part of this warranty coverage, each applicant is required to provide annual warranty reports that document their annual and cumulative sales and leases in California, annual and cumulative production in California, and annual warranty claims in California. The warranty claims are to include a description of replacements and repairs, the engine families and vehicles on which the control systems were installed, and an explanation of denied warranty claims. The warranty and in-use compliance requirements are complimentary. That is that information obtained from annual warranty reports may aid in an appropriate in-use performance evaluation for a verified control system. Likewise, information received during an in-use compliance evaluation may support any information or issue discovered in the warranty process.

As was previously discussed, accurate record keeping is critical for both in-use and warranty reporting requirements. Proper records will show that the control systems are installed on fleets regulated by the fleet rules and allow for more refined evaluation of the systems' effectiveness in the field. However, to date, verified control systems manufacturers have not been equally diligent in fulfilling their warranty reporting obligations or their in-use compliance requirements. Therefore, staff proposes to clarify the reporting requirements for these elements of the Procedure as discussed below.

2. Description of Proposal

Staff is proposing to require applicants to keep updated records of the following information:

1. End User Contact Information
    - Name
    - Address
    - Phone Number

2. Description of Vehicle/Equipment On Which Unit Is Installed
    - Type of vehicle/equipment
    - Make
    - Model year
    - Vehicle Identification Number

3. Description of Engine On Which Unit Is Installed
    - Make
    - Model
    - Model Year
    - Engine Serial Number
    - Engine Family Name

Applicants would be required to keep these records until the in-use compliance requirements are met. Applicants would have to submit these records only upon request within 30 days. Applicants that received conditional verifications or conditional extensions would have to submit their records to the Executive Officer one year after receiving their conditional status in addition to submitting them upon request.

C. REQUIREMENT FOR CALIFORNIA SALES

1. Background

ARB's Verification Program is well known and highly regarded by manufacturers and government agencies throughout the country and even the world. Some programs outside of California favor ARB verified products when considering retrofit contracts. Therefore, manufacturers have incentive to be ARB verified even if they do not plan on participating in the California market. Staff wants to ensure that state resources used to verify diesel emission control systems are expended on applicants that will sell or pursue sales of their systems in the state in order to support California's fleet rules. ARB resources dedicated to verifications are limited. Utilizing resources on evaluating control systems only intended for sale or use exclusively out of state negatively impacts the Verification Program from producing verified technologies that will support fleet rules. Applicants who intend to market their devices exclusively outside of California may participate in U.S. EPA's Voluntary Retrofit Program.

2. Description of Proposal

Staff proposes that applicants who receive verifications, conditional verifications, or conditional extensions must demonstrate sales of their verified products in California. If they have not yet sold systems in California, the proposed amendment would require them to demonstrate that they have actively pursued sales and that their product is available to be sold to end users in California. If applicants can not provide such confirmation, the Executive Officer will evaluate whether the verification should be revoked.

D. CLARIFICATION FOR VERIFICATION TRANSFERS, ACCEPTANCE OF PRE-EXISTING DATA, SYSTEM LABELING, AND SALES AND INSTALLATION

1. Background

- Verification Transfers

Currently, the Procedure allows the transfer of an existing verification between consenting parties provided certain requirements are met. While this practice has been relatively uncommon thus far, staff wishes to clearly define the requirements of a verification transfer. Any applicant who wishes to market a product that was previously verified by another applicant may do so with the consent of the original verification holder provided they meet the requirements of verification. This includes the submission of an application and letters of consent from the original entity holding the verification. These letters must expressly state that the new applicant is permitted to market the product and use the data and information that supported the original verification. In addition, the new applicant must demonstrate a thorough understanding of how the product relies on sound principles of science and engineering to achieve the verified emissions reductions. If the new applicant elects to change the original verification in any way, including expanding the scope of the verification to include more applications than originally authorized, or expanding the conditions of the verification, then they must provide any additional information requested by the ARB to support the change.

- Acceptance of Pre-Existing Data

While the Procedure does not currently preclude the submission of pre-existing data in support of verification, staff is seeking to clarify its allowable use in light of recent questions by stakeholders. In some cases, applicants may have data generated from tests previously conducted for other emission reduction programs such as U.S. EPA's voluntary Retrofit Program or Verminderung der Emissionen von Realmaschinen im Tunnelbau (VERT). Pre-existing data may be used to support an ARB verification if it meets the requirements of the Procedure.

Allowing the use of pre-existing data significantly reduces the amount of testing needed for verification without compromising the integrity of the Procedure. Pre-existing data may be used to support verifications, conditional verifications, and extension applications.

- System Labeling

The Procedure currently requires applicants to ensure that a legible and durable label is affixed to both the diesel emission control system and the engine on which it is installed. It is important that the labels for any verified diesel emission control system not only be durable and resistant to tampering, but also easily visible. Preliminary information from regulated fleets indicates that device labels are often not visible after installation. In some cases, labels have been located under brackets or between the device and the vehicle chassis making viewing the labels nearly impossible. In addition, some engine labels have been installed that do not match the diesel emission control system label. Affixing visible and appropriate labels eases inspections of regulated fleets and provides a means of quickly determining if a control device is verified by ARB. There have also been cases of labels containing multiple diesel emission control strategy family names. It is important that each label identify only one DECS and that the label on each engine corresponds only to the DECS installed on that particular application. The original intent of the labeling requirement was to ensure that any diesel emission control system could be easily identified as a verified system for use in support the fleet rules.

- Sales and Installations

The Procedure was developed to ensure that diesel emission control systems produce real and durable emissions reductions. During the verification process, staff works closely with device manufacturers to identify emission control groups appropriate for each device. Once verified, an Executive Order is issued for the device which contains the relevant information pertaining to the selected emission control group. Parties that sell and install diesel emission control systems must ensure that they are installed only on applications that are within the appropriate emission control group as defined by the Executive Order. Information from regulated fleets indicates that verified systems have been installed on applications that are outside the terms of the governing Executive Order.

2. Description of the Proposal

- Verification Transfers

Staff proposes to clarify ARB policy regarding verification transfers. The clarifying language would explicitly state all the necessary requirements for verification transfers as discussed previously.

- Acceptance of Pre-Existing Data

Staff proposes to clarify ARB's policy regarding the acceptance of pre-existing data. The language would direct applicants that have participated in other diesel emissions control programs and/or generated useful data to submit an application including such data. ARB would evaluate the submitted data to determine if it satisfies requirements unique to the Procedure. Any data deemed sufficient per the Procedure would be accepted and the applicant would be notified of any additional data, testing, or information needs.

- System Labeling

Staff proposes to clarify the system labeling requirement by adding language that the system labels be identical and visible after installation. The proposal also clarifies that the labels must be durable and resistant to tampering or any degradation from the conditions of its environment.

- Sales and Installations

Staff proposes to amend the Procedure to include language specifying that no person or entity shall install any device, apparatus, or mechanism on vehicles or equipment as verified unless expressly allowed under the terms of the issued Executive Order. As such, control technologies installed on applications that are not within the terms of the Executive Order are not verified technologies and thus will not satisfy the requirements of the fleet rules. In addition, such installations may incur additional penalties if the installed systems do not have the appropriate vehicle code exemptions. The amendment would also require that applicants, distributors, and/or installers ensure their verified products are only installed on appropriate applications.

E. CLARIFICATIONS OF DEFINITIONS AND APPLICATION PROCESS

1. Background

The Procedure and the amendments to the Procedure include definitions of all terms that are not self-explanatory. These definitions were developed by staff with input from stakeholders and help to clarify the requirements of the regulations.

In addition, the application process described in section 2702 of the Procedure has several minor inconsistencies and does not currently address all of the

required information necessary for submission of a complete verification application. For instance, section 2702 of the Procedure describes the information required for submission of a verification application and identifies the appropriate format. This section could be clarified to help applicants better understand the process and ensure that all of the required information is clearly identified. Such clarifications could expedite the application process by providing detailed instructions and a clear understanding of all of the information necessary for submission of a complete verification application. This will generate more complete initial applications and require less correspondence with applicants to obtain missing information.

2. Description of the Proposal

Staff proposes to define “advertise”, “distributor”, “end user”, “installer”, “seller”, and “warrantable condition”. For a complete list of definitions please refer to Appendix A.

In addition, staff proposes modifying the application process description in section 2702. The modifications include renaming “proposed verification testing protocol” to “preliminary verification application”, changing the submittal address to Sacramento, California where the current branch chief is located, and expanding the list of information needed in the application format template found in section 2702(d). Currently, all required data and information is specified throughout the Procedure although it is not necessarily listed in the template found in section 2702(d).

F. REQUIREMENT TO PROVIDE THE INSTALLATION MANUAL AND PART’S LIST

1. Background

The Procedure does not currently require that an applicant submit a complete copy of their installation/owners manual or a complete part’s list for their diesel emission control system. Copies of these materials are essential for the effective evaluation of the diesel emission control system and provide staff with a better understanding of how these products will be introduced to end users. Since fleet owners will be installing verified control systems to comply with ARB fleet regulations, it is important that staff become familiar with every part of the control system while evaluating the technology. A more thorough evaluation will likely result in fewer problems for end users. These materials will also help staff respond to applicant’s requests regarding proposed changes their products. In addition, a part’s list is essential in identifying all parts of the system that are subject to the warranty requirements of the Procedure.

Staff also believes that additional information should be required to be included in an applicant's installation/owners manual. For instance, staff is aware of situations where fleet owners might want to remove control systems from vehicles on which they were originally installed and re-install them on other vehicles within their fleet. This may take place if a vehicle is damaged or during the cleaning and/or maintenance of the control system or the vehicle. Staff believes the applicant should clearly authorize the use and effectiveness of their product in this manner, and identify any conditions regarding this practice to the Executive Officer and end users. This information will ultimately help applicants and end users in matters regarding warranty claims.

2. Description of Proposal

Staff proposes that applicants provide a copy of the installation/owners manual that would be supplied to installers and/or end users. Applicants would include descriptions of appropriate end user installation practices. The proposal would require applicants to also include a part's list that includes all primary components of the control system including, but not limited to:

- substrates
- electronic control units
- sensors
- injectors
- pumps
- blowers
- storage tanks
- notification lights

Applicants would give a description and identification number to each part and specify which parts were excluded from the required warranty coverage, such as in the case of a consumable or disposable part. Under staff's proposal, the Executive Officer would approve of any parts excluded from the required warranty coverage.

Applicants would also need to specify if they authorize, after receiving approval from the Executive Officer, the removal of control systems by end users from their original installations and installing them on other vehicles or equipment. If so authorized, applicants would need to specify appropriate end user installation practices in the installation/owners manual. Applicants would also need to specify possible consequences should an end user elect to perform an unauthorized installation practice. As part of their submittal, applicants would need to include descriptions of circumstances that might result in denial of a warranty claim provided that it does not limit or modify the warranty requirements established in section 2707 of the Procedure. Staff's proposed changes would also specify that applicants that permit the end user installation practices

described above are still responsible for the warranty and in-use compliance requirements of those control systems.

G. OTHER MINOR CLARIFICATIONS

Staff has also determined that it is necessary to allow the Executive Officer to request records from applicants regarding their control systems at any time. In some cases this might be necessary to perform a complete evaluation of a technology for compliance purposes. Staff has also experienced trouble receiving required information such as warranty and in-use compliance reports from some applicants. In addition, staff is aware of applicants that are not following appropriate sales and installation practices. Since the Verification Program supports ARB fleet regulations, it is necessary to allow the Executive Officer to request records pertaining to certain control systems to ensure applicants are complying with all of the requirements of the Procedure. In addition, staff may also need additional information to ensure that certain products are still appropriate for verification. In all cases, based on this review and other relevant information, the Executive Officer would be able to take any appropriate actions, including lowering the verification level, revoking the verification status, or suspending review of all other applications sent by an applicant that has not provided required submittals or fraudulent submittals.

In addition, staff proposes that all DECS with aftertreatment devices, such as diesel particulate filters, be designed such that they can only be installed in one unique direction. To assist end users and installers in ensuring the device is properly installed, the device would also need to clearly show the proper direction for the exhaust flow. Currently, there is no such requirement. Thus devices can be installed backwards. If the exhaust enters the aftertreatment device flowing in the opposite direction from which it originally flowed, it could release PM that has accumulated inside the device and compromise emissions reductions. Also, reversing the direction of flow can compact soot within the device, impacting its ability to properly function or regenerate, resulting in device failure.

Staff is also proposing a number of other minor clarifying amendments which would:

- Specify discrete mode emissions testing for control systems intended for stationary applications in section 2703(e)(3)
- Allow the Executive Officer to require additional testing if it is needed for a complete evaluation of the control system
- Require the backpressure monitor notification system to be visible to the operator during normal operation of the vehicle or equipment

- Allow the Executive Officer to require applicants to submit records pertaining to their control systems
- Clarify the Executive Officer's right to seek remedial action against the applicant under provisions of Part 5, Division 26 of the Health and Safety Code

VIII. REGULATORY DEVELOPMENT

This chapter describes staff's interaction with the public and the effects of those meetings and discussions on the proposal.

A. PUBLIC OUTREACH

In developing the proposed amendments, staff held four public workshops in Los Angeles, El Monte, and Sacramento. Staff presented the proposed amendments and received questions and comments from stakeholders. Attendees were mostly comprised of representatives from diesel emission control system manufacturers and installers. Staff also held numerous meetings with the Manufacturers of Emission Controls Association (MECA) and individual companies to further discuss the proposal. All comments received by staff while developing the proposed amendments were considered.

B. ISSUES RAISED

During the regulatory development process, representatives from industry expressed concerns regarding the record keeping requirements. The two key issues raised were, 1) the ability to track a large number of applications on which the sold units are installed and, 2) the release of proprietary information. After considering these comments, staff is confident that applicants should be capable to track their sold control technologies until the in-use compliance requirements are completed. Once the in-use requirements are completed, applicants would no longer be responsible for keeping such information. In response to the second issue, as long as the information is so identified, staff adheres to both the confidentiality policy required by the Procedure, as well as the requirements of title 17, CCR, sections 91000-91022. For the most part, the applicants would be the only parties responsible for keeping the information and for submitting it, should the ARB so request.

Also, during the development of the proposed amendments, industry representatives requested a transition period to meet NRTC testing requirements for off-road applications. They also voiced concern over staff's initial proposal to require cold start testing under the NRTC. Staff addressed these issues by giving applicants more time to test using the ISO 8178 C1 test cycle and not requiring cold start tests under NRTC testing. Staff's proposal would allow applicants to continue testing their systems using the ISO 8178 C1 test if they submitted their preliminary verification applications before October 1, 2008, and receive a letter of notification from the Executive Officer dated no later than December 31, 2008, confirming that the preliminary verification application is complete. Also, as previously discussed, the cold start emissions reductions are only given a 5 percent weighting towards the final results, and as such, staff has proposed to not require cold starts as part of the NRTC testing.

IX. REGULATORY ALTERNATIVES

The ARB is required to do an analysis of reasonable foreseeable alternative means of compliance with the proposed amendments. While developing the proposal, staff considered several alternatives which are discussed below. ARB staff has concluded that the proposed amendments provide the best means of improving the Procedure to reduce public exposure to diesel particulate consistent with protection of public health.

A. Do Not Provide the Option for Applicants to Receive Conditional Extensions

Staff proposed providing conditional on-road extensions with the goal of introducing qualified control technologies into the market as quickly as feasible for products that have a high probability of achieving real and durable emissions reductions on new applications. However, staff considered not proposing this amendment. The effect of not proposing this change would mean that effective products that fleet owners could choose to meet fleet rules would not be expeditiously identified as verified products. Staff is confident in proposing this change because only products that have previously shown real and durable emissions reductions under the requirements of the Procedure would be considered for conditional extensions. Applicants receiving conditional extensions would have to provide all the necessary data and information within one year while being able to sell the product as ARB verified. This additional data and information would confirm that the product is appropriate for the new application. Since verified technologies have successfully gone through the verification process, staff already has a high level confidence in these products.

If it can be determined that the technology will perform just as effectively for new applications not included in the existing verification, staff believes the product should be treated as a verified product while confirmatory data and information is being developed. If applicants must provide all confirmatory data and information prior to receiving an extension, there will be a significant delay before receiving ARB recognition. This delay will not give end users as many choices to meet the requirements of the ARB fleet regulations. Therefore, staff does not support this alternative.

B. Do Not Verify NOx Only Reduction Systems

The Verification Program could maintain its current restriction on verification to systems that reduce PM by at least 25 percent. However, since the Verification Program supports other ARB regulations, the inclusion of NOx only control systems should provide much needed support of future regulations and programs that may either require or provide incentives for NOx reductions from diesel engines. Thus, staff does not support maintaining the current requirement in its present form.

C. Do Not Change Evaluation of All Fuel-Based Control Systems

Staff considered keeping the current requirements regarding alternative diesel fuels, which must follow the requirements of section 2710, and fuel additive-based systems, which must follow requirements in sections 2700 through 2709, separate in the Procedure. However, staff does not support this alternative because the information and data required for alternative diesel fuels are equally pertinent for fuel additive-based systems.

The main difference between the requirements of section 2710 and sections 2700 through 2709 is the emissions testing requirements, for which alternative diesel fuel systems must meet a more rigorous requirement. Section 2710 requires comparative emissions testing with a reference fuel and the alternative diesel fuel. Applicants that conduct cold and hot start tests must conduct at least 5 emissions tests for both the reference and alternative diesel fuels. Applicants that only conduct hot start tests must complete at least 20 tests for the reference and alternative diesel fuels.

In contrast, currently for fuel additives, sections 2700 through 2709 only require one set of baseline and control tests that consist of at least one cold start and three hot start replicates as required. Staff believes a more comprehensive evaluation of fuel additive-based technology is needed to ensure they are appropriate for fleets that must meet emissions requirements of the various ARB fleet rules, and to ensure the fuel additive does not cause adverse effects on the environment. The effects a fuel has on an engine and the emissions of an engine cannot be effectively gauged through one set of baseline and control testing, as is sufficient for hardware-based control systems. The repetitive testing required in section 2710 is designed to accurately evaluate emissions reductions and any changes to emissions caused by the fuel. The repetitive results show the relevance of errors that may occur during testing and allow staff to determine if the fuel causes real and durable emissions reductions. Since fuel additives and alternative diesel fuels are both fuels that reduce emissions, they should have similar testing requirements.

D. Do Not Add Clarifying Language for the In-Use Compliance Requirements

An alternative to the in-use compliance amendments is to not require applicants to submit their testing proposals and test reports within a specified period of time, as is currently the case. The lack of a deadline has resulted in delayed in-use compliance evaluations. Staff already has trouble receiving sufficient in-use compliance test proposals. It is important for staff to receive this information in a timely fashion to determine if the Verification Program is effectively supporting the various ARB fleet regulations. For this reason, staff does not recommend this alternative.

Another alternative is to not specify what would be required in the in-use compliance testing proposals for each phase. Staff seeks to make the Procedure as clear for applicants as possible. If the Procedure does not specify what staff needs in a complete testing proposal, most testing proposals will not be sufficient plans for successful in-use compliance testing and the numerous revisions of the testing proposal would delay the in-use compliance evaluation process. Therefore, staff does not recommend this alternative.

An alternative regarding in-use testing failures is to not have applicants submit a testing proposal for ARB approval for the two additional units that need to be tested. If applicants test additional units without staff's approval, the results may not be acceptable and additional testing may be needed, resulting in additional time and expense. In addition, a thorough description of the cause of failure will help staff properly advise applicants which in-use units would be appropriate for testing and it would also help staff determine if a more extensive evaluation is necessary. Consequently, staff does not recommend this alternative.

E. Do Not Require Sales in California

Staff could keep the Verification Program open to applicants that do not intend to sell their control systems in California. However, since the Verification Program was created to help ARB reach the goals of the DRRP and support other ARB regulations, spending state resources on products that would not support those goals does not best serve the citizens of California. If resources are spent to verify control systems that will not reduce emissions in California, control systems intended for sale in California will take longer to be verified. This will impact the Verification Program's ability to support California's fleet rules. Since another diesel emission reduction verification program is offered by the U.S. EPA in their Voluntary Retrofit Program, applicants who do not intend to sell their products in California can use this program for verification. This provides a mechanism for retrofit manufacturers to verify control systems to be used in the other 49 states.

F. Do Not Allow Non-CCR Compliant Test Fuels

If the current testing requirements are used to evaluate applications that do not typically operate on fuel that meets the specifications of the California Reformulated Diesel Fuel Regulation, the test fuel will not be representative of the real operation of those applications. Further, staff will not be able to verify that the emission reductions of control systems intended for these applications are real and durable. Therefore, staff does not support this alternative.

G. Do Not Change Off-Road Testing Requirements

If no changes are made to testing requirements for off-road verifications, staff will not be able to conduct a satisfactory evaluation of many different kinds of off-

road emission control systems. While steady state testing may be sufficient for the evaluation of certain diesel emission control systems in certain applications, such as non-catalyzed diesel particulate filters, it provides only a very limited picture of the performance of most catalyst-based technologies.

The primary issue with the current steady-state test cycle is its limited ability to show the actual effect of an emission control system on emissions of NO_x and NO_2. Systems to control NO_x emissions that inject a reductant into the exhaust stream, such as those using SCR technology, can have a wide range of performance. Whether a system is able to perform at the high end of its range is largely dependent on the exhaust temperature and its ability to deliver the right amount of reductant into the exhaust stream at the right time. A modal, steady-state test cycle only reveals a system's ability to perform the latter function under prescribed steady-state conditions. As such, performance under actual transient conditions, where NO_x concentrations and exhaust flows vary from one second to the next, remains unknown.

The limitation that the steady-state test cycle poses in the evaluation of a system's effect on NO_2 emissions is somewhat different. In staff's experience thus far, platinum is known to generate significant quantities of NO_2. It oxidizes some of the NO in the exhaust stream to form NO_2, which some diesel particulate filters require to burn out collected soot. The fraction of the NO converted is a strong function of exhaust temperature. Peak NO conversion typically occurs at intermediate temperatures of 300 to 350 degrees Celsius and drops off at both lower temperatures (due to kinetic limitations) and higher temperatures (due to thermodynamic limitations). The Board adopted limits on NO_2 emissions to prevent associated health impacts. However, the steady-state test cycle happens to emphasize very hot modes of operation and can thus suppress formation of NO_2 relative to somewhat cooler transient cycles like the NRTC, which is based on actual off-road operation. Verifications based on steady state test data could lead to non-NO_2 compliant systems being verified and thus result in associated increases in health impacts. For these reasons, staff proposes to change the current off-road verification testing requirements.

H. Allow NOx Only Systems for Any Engine

Staff considered proposing that NOx only DECS be candidates for verification for all applications, including those with installed DPFs not certified with the engine. If staff's proposal was expanded to include engines not equipped with DPFs as original equipment, the potential could exist for one vehicle to be retrofitted with two separate DECS. The primary issue with such a situation is the compatibility of the two systems. Both systems being verified for use with the same diesel engine is not equivalent to being verified for use with each other.

In addition, the Procedure requires applicants to warrant their verified products for up to 5 years or for a certain mileage, whichever comes first. If two applicants

are responsible for the warranty of two separate systems on the same vehicle, there will likely be complications for applicants and end users in the event of a warranty claim. Applicants will have difficulty assessing warranty claims because it might be unclear which control system caused a malfunction. This could result in applicants delaying their warranty responsibilities. Thus, end users may have trouble receiving prompt corrective service. This issue would negatively affect the Verification Program and the fleet rules. For these reasons, staff does not recommend this alternative.

I. No Changes

The current Procedure is a robust evaluation tool that has verified many DECS that provide real and durable emissions reductions from diesel engines. However, to continue to support the fleet rules in the most effective way, including those recently adopted and those to be adopted in the future, the Procedure needs certain modifications. Currently, the Procedure does not provide the following:

- Expeditious extensions of verified technology for new on-road applications
- Verification of DECS that only reduce NOx emissions
- Proper evaluation of all fuel-based DECS
- Flexibility to evaluate DECS intended for applications that cannot properly function on CCR compliant fuels
- Emissions testing that is representative of actual in-use operation of off-road applications
- Pre-conditioning requirements that are equivalent for all DECS
- Effective evaluation of monitoring and notification system functionality
- NOx reduction classifications aligned with NOx reduction technology performance
- Effective evaluation of all components of NOx reduction systems
- More detailed in-use compliance requirements
- Requirement of California sales
- Clarity of the application process and other requirements

Making these modifications would enable the Procedure to continue to be an effective mechanism that ensures real and durable emissions reductions from DECS that are to be installed on regulated diesel fleets. Therefore, staff does not support this alternative.

No alternative considered by the agency would be more effective in carrying out the purpose for which the regulation is proposed or would be as effective and less burdensome to affected private persons than the proposed regulation.

X. ENVIRONMENTAL IMPACTS

The proposal would allow control technologies to get into the on-road market faster, require more appropriate testing for off-road applications, and clarify policies and requirements. Staff does not believe any of these modifications will cause adverse environmental impacts. Staff's proposed amendments will result in unquantifiable environmental benefits by ensuring that there are no NO_2 emission increases from off-road applications relative to other applications, and will provide better quantification of in-use NOx benefits.

The ARB is committed to evaluating community impacts of proposed regulations, including environmental justice concerns. Because some communities experience higher exposures to toxic pollutants, it is a priority of the ARB to ensure that full protection is afforded to all Californians. The proposed amendments are not expected to cause significant negative impacts in any community. The proposed amendments are designed to continue the Verification Program's support of the DRRP and reduce emissions of diesel particulate throughout the state.

XI. ECONOMIC IMPACTS

This chapter discusses the economic impacts staff anticipates businesses will incur as a result of the proposed amendments.

A. Legal Requirement

Section 11346.3 of the Government Code requires State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination or creation, and the ability of California business to compete with business in other states.

State agencies are also required to estimate the cost or savings to any State or local agency and school district in accordance with instructions adopted by the Department of Finance. The estimate shall include any non-discretionary cost or savings to the local agencies and the cost or savings in federal funding to the State.

B. Estimated Costs and/or Benefits

The economic impacts of the proposed amendments on the State, affected businesses, and individual fleets are not expected to be significant. Participation in ARB's Verification Program is voluntary. Applicants electing to have their diesel emission control systems verified under the requirements of the Procedure choose to do so for financial gain. Verification for these participants translates into increased sales and therefore, increased revenues. For individual fleets subject to ARB's fleet rules, accelerating the verification process should result in additional products being available to meet the requirements of the rules. In some cases this should result in lower compliance costs, such as with early retrofit costs in the in-use off-road regulation. Historically, this increased competition for market share has had the effect of lowering unit prices and may result in a cost benefit to the regulated fleets.

Staff's analysis of the proposed amendments indicates that some may result in a minor cost increase, a cost savings, or have no economic impact. Since the proposed amendments do not universally apply to all applicants it is not possible to determine the aggregate economic impact of staff's proposal. For example, an applicant with a system intended to control PM emissions from on-road vehicles will not be affected by staff's proposed changes to the NOx emissions testing procedures. However, an applicant with a system designed to control NOx and PM emissions from off-road equipment may be required to perform additional emissions testing under staff's proposal. This could result in a cost increase when compared to the current requirements in the Procedure. Therefore, staff has analyzed each proposed amendment to determine the potential for adverse

economic impacts. The following sections discuss the estimated costs and benefits of staff's proposal. Where practicable, the proposed amendments contained in staff's proposal have been grouped together for brevity and clarity. Also, because no direct emissions benefits are associated with staff's proposal, no cost effectiveness analysis could be performed.

1. Conditional Extensions

Based on staff's analysis, the proposal for on-road conditional extensions should provide a cost benefit to regulated fleets. Allowing manufacturers of diesel emission control systems to conditionally verify their products should accelerate the verification process and result in additional devices available for compliance with the fleet rules sooner than would otherwise occur. This could lead to increased competition in the marketplace and possibly, lower unit prices. However, staff's analysis regarding the cost benefit associated with conditional extensions remains qualitative at this time.

2. NOx Only Reduction Systems

Staff's proposed amendment providing a means to verify NOx only emission reduction systems for certain diesel engines should have no adverse economic impact, but will in fact allow companies to verify products that cannot be verified today. Application for the verification of a system that reduces emissions of NOx only would still be voluntary.

3. Proposed Fuel-Based Strategies Amendment

Applicants with fuel additive-based DECS will likely incur additional costs to comply with the proposed fuel-based strategies amendment. Staff's proposal requires applicants with fuel additive-based systems to perform additional emissions testing to align the requirements with those of alternative diesel fuel based systems.

Staff estimates applicants with fuel additive-based strategies currently spend up to $50,000 for FTP emissions testing which includes 1 cold start and 3 hot start tests for both baseline and control configurations. However, applicants with alternative diesel fuel based systems are currently spending an estimated $100,000 to complete emissions testing comprised solely of hot start testing.

Based on this, the proposed additional emission testing for fuel additive-based systems is estimated to increase testing costs by approximately $50,000. In addition, applicants with alternative diesel

fuels are spending an additional $100,000 to satisfy toxics measurement requirements.

If toxics measurements are required for fuel additive-based systems, the costs could increase by an additional $100,000. This raises the verification costs to a level that is comparable to the costs associated with the verification of an alternative diesel fuel based system. However, the Procedure currently requires staff to request toxics measurements under certain conditions for fuel additive-based systems. Therefore, the additional expenses associated with requirements for toxics measurements may not represent an additional cost.

4. Proposed Acceptance of Non-CARB Diesel Test Fuels Amendment

Staff's proposal to modify the Procedure to allow the use of test fuels that do not meet the specifications of California Reformulated Diesel Fuel for durability and emissions testing should provide a cost benefit to applicants. Allowing the use of commercially available fuels where appropriate would relieve applicants of the burden of procuring and using test fuels that are not normally used during actual in-use operation. This should result in lowering the costs associated with emissions and durability testing and may relieve applicants of the burden of modifying fuel delivery systems.

5. Proposed Amendment to Off-Road Testing

The proposed NRTC testing requirement may increase costs for the verification of systems intended for some off-road applications. However, based on current applicant activity, staff estimates that most would not incur significant expenses to satisfy the proposed requirements. To date, staff has accepted data from 5 laboratories in support of the systems currently verified for off-road applications. Two of these laboratories are already capable of performing the NRTC. In addition, another laboratory that has submitted data to support on-road verifications can also run the NRTC. Applicants are familiar with these 3 laboratories. Several laboratory representatives indicated that the cost of running the NRTC and steady state cycles are similar. In certain instances, the NRTC would be less expensive that the steady-state alternative. Therefore, applicants can satisfy the proposed testing requirements with little, if any, cost increase.

Though it is difficult to determine cost estimates for future applicant activity based on past activity, staff estimates applicants using their own test facilities which can currently run transient testing (but not the NRTC) might spend an additional $35,000 to $500,000 to purchase the

software and hardware necessary to perform the NRTC. As an alternative, applicants may use their own staff to develop and install software and hardware. Cost estimates for this option are unknown.

Applicants whose labs can currently only run steady state testing might require an additional $250,000 to $3,000,000 to upgrade their facilities to accommodate the NRTC. Staff estimates that applicants or independent laboratories that wish to build a completely new test cell that can support NRTC testing could spend up to $5,125,000. Staff estimates that a new steady state test cell costs up to $1,200,000. Therefore, applicants could incur up to $4,000,000 in additional costs to build a new test cell that can run the NRTC relative to a steady state test cell. This estimate is an approximation, and is dependant upon several factors including the selection of vendors and equipment.

In spite of staff's proposal, testing facilities will still need to be upgraded to run the NRTC to accommodate testing requirements for Tier 4 off-road engine certification. Also, the adoption of the in-use off-road regulation will result in fleet owners buying thousands of DECS. For applicants testing at their own facilities, the cost increase of upgrading their facilities to run the NRTC could result in a small incremental increase to each DECS sold. For example, if an applicant spends $500,000 to upgrade their laboratory to run the NRTC and they sell 1,000 units for off-road applications, they would incur an incremental cost of $500 per DECS. However, this impact represents less than a 5 percent increase in the cost of the DECS.

6. Proposed Amendment to NO_2 Pre-Conditioning Requirements

The addition of an alternative backpressure criterion to determine whether a service accumulated system requires pre-conditioning should have no economic impact. Staff's proposed changes have the effect of treating all systems equally with respect to the NO_2 pre-conditioning requirements.

7. Proposed Amendment of Monitoring and Notification System Functionality

Staff's proposed amendment of monitoring and notification system functionality should have no economic impact. While not expressly stated in the current Procedure, applicants have always been required to address the functionality of any monitoring and/or notification system of a diesel emission control strategy submitted for verification. This amendment provides clarifying language to address this issue and should assist applicants in the verification process.

8. Proposed Amendment to NOx Reduction Classifications

The identification of NOx reduction classifications is designed to facilitate the verification of NOx only emission reduction systems and should have no economic impact.

9. Proposed Amendment for SCR Systems

Staff's proposal for additional requirements for SCR systems is consistent with the requirements of U.S. EPA and new engine certification regarding SCR systems. It is designed to ensure that a continuous supply of reductant remains available while these systems are in use and that the verified emissions reductions are realized in use. For SCR systems to be a viable option for controlling NOx emissions, there must be some reasonable level of assurance that the reductant supply will not be interrupted. Staff's proposed clarifying language is designed to assist applicants in the design and testing of their SCR systems with respect to this issue. As such, this amendment to the Procedure should have no economic impact.

10. Proposed Amendment of NOx Emission Measurements During Durability and Field Demonstrations

Applicants with NOx reduction aftertreatment systems may incur additional costs to comply with staff's proposed durability testing requirement. Applicants most likely will comply by installing two NOx sensors, one upstream and one downstream of the aftertreatment device. Staff estimates the additional costs to comply with the new durability testing requirement could be as much as $5,500 per verification. The cost of compliance for NOx reduction systems that currently employ one or more NOx sensors should be significantly less.

11. Proposed Removal of Elevated NOx Emissions Testing

The removal of the requirement to perform additional emissions testing using a test cycle designed to trigger episodes of high NOx emissions should result in a cost benefit for certain applicants. The removal of this requirement would reduce the amount of emissions testing required for verification. By eliminating this requirement, applicants may realize a significant cost savings with respect to emissions testing.

12. Proposed Requirement to Record Reductant Usage During Emissions Tests

The addition of the requirement that an applicant measure and record reductant usage during testing, when applicable, should have no

economic impact, as this type of information would likely be collected by the applicant anyway.

13. Proposed Administrative Amendments

Staff's proposed administrative amendments include changes to the in-use compliance requirements, a proposed record keeping amendment, and a requirement that applicants demonstrate sales of their verified products in the State. The record keeping proposal may result in a minor cost increase. Though it is difficult to estimate the cost increase, staff does not expect it to be significant. While additional requirements are included in staff's proposal, these requirements are designed to ensure that applicants have a clear understanding and the information necessary to adhere to the existing in-use compliance requirements and that state resources are appropriately used to benefit the residents of California. These requirements should result in no economic impacts.

14. Other Proposed Clarifications

Staff's remaining proposed amendments regarding verification transfers, acceptance of pre-existing data, system labeling, sales and installations, clarifications of definitions and the application process, proposed manual and part's list requirements, and other minor clarifications should have no economic impacts. These proposed amendments provide clarifying language to the existing Procedure and are designed to assist applicants and accelerate the verification process.

C. Potential Impact on Affected Businesses

Participation in California's Diesel Emission Control Verification Program is entirely voluntary. However, any business or individual that chooses to participate in the program will have to satisfy the requirements of the Procedure. Businesses that choose to participate and thus follow the Procedure include manufacturers and marketers of diesel emission control systems. In addition, some businesses may be indirectly affected, such as system installers, suppliers of raw materials or equipment, and testing laboratories.

The requirements for verification under the Procedure apply to any business that elects to participate in the program regardless of their location. Staff's proposal does nothing to alter the applicability of the program. Manufacturers that participate in the Verification Program need to provide detailed information and data on their products in accordance with the Procedure. The testing required by

the Procedure may require significant expenditures of capital on the part of an applicant.

The proposed amendments to the Procedure would either result in a modest cost savings, cause no change in costs, or increase costs due to the change in requirements for fuel-based systems, off-road testing, and NOx reduction systems. Nevertheless, staff's proposal will enable more verified products to be sold in California by accelerating the verification process thereby ensuring continued compliance with the fleet rules. Several California manufacturers and installers therefore stand to benefit and the increased sales could offset some of the cost increases. Off-road fleet owners may also incur increased costs for DECS because of the proposed changes to the off-road testing requirements. However, as previously discussed, these costs should not be significant.

Should a business choose not to participate in the Verification Program, there are other avenues by which its products may be sold in California. A business obtaining a Vehicle Code 27156 exemption can legally sell a product in California, but can claim no emissions reductions. However, this product would then not be a verified diesel emission control system and would therefore, not satisfy the requirements of the fleet rules.

E. Other Potential Impacts

The proposed amendments to the Procedure are not expected to cause a noticeable change in California employment and payroll. As previously noted, participation in the program is voluntary.

Also, the proposed amendments to the Procedure should not impact the status of California business. However, the amendments may have a slight positive effect on business expansion since companies will be able to introduce their products into the marketplace at an accelerated rate.

The proposed amendments to the Procedure should have no impact on the ability of California's businesses to compete with businesses in other states. Staff's proposals do not change the voluntary nature of the Procedure or its applicability to all businesses that manufacture or market diesel emission control systems regardless of their geographical location.

The proposed amendments to the Procedure should not create costs or savings, as defined in Government Code Section 11346.5 (a)(6), to any State agency or in federal funding to the State, costs or mandate to any local agency or school district whether or not reimbursable by the State pursuant to Part 7 (commencing with Section 17500, Division 4, Title 2 of the Government Code), or other non-discretionary savings to local agencies.

XII. REFERENCES

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