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2007 AQMP APPENDIX IV-B

DISTRICT STAFF'S RECOMMENDED STATE AND FEDERAL STATIONARY AND MOBILE SOURCE CONTROL MEASURES

OCTOBER 2006

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SECTION 1

DISTRICT STAFF'S RECOMMENDED STATE AND FEDERAL CONTROL MEASURES

INTRODUCTION

Since the California Air Resources Board (CARB) does not plan to release its State and federal strategy for the California SIP until January 2007, this Appendix describes the South Coast Air Quality Management District (District) staff's suggestions for state and federal mobile source control measures to be included in the 2007 AQMP. Control measures presented in this appendix for $PM_{2.5}$ demonstration are based upon a variety of control technologies that are commercially available and technologically feasible in the next several years. The focus of these measures includes acceleration of vehicle turnover and the use of cleaner fuels (either alternative or new formulations of gasoline and diesel fuels). This appendix also includes one control measure for consumer products that the state has the authority to implement.

SUGGESTED CONTROL MEASURES

The District staff is proposing consideration of 25 control measures for mobile sources and one consumer products measure. The mobile source control measures cover all categories of mobile sources including primarily federal sources such as planes, trains, and ships in order to achieve the necessary emission reduction targets to demonstrate attainment of the fine particulate air quality standards by 2015 and the 8-hour ozone air quality standard by 2021. A summary of the 26 control measures is provided in Table 1.

TABLE 1
List of District's Suggest State and Federal Control Measures Categorized by Control Strategy

On-Road Mobile Source Control Measures	
Number	**Title**
ONRD-01	Smog Check Improvements [VOC, NOx]
ONRD-02	Expanded BAR Vehicle Retirement and Mandatory Part Replacement [All Pollutants]
ONRD-03	California Phase 3 Reformulation Gasoline Modifications [VOC, NOX]
ONRD-04	More Stringent Motorcycle Standards [VOC, NOx]
ONRD-05	PM Testing for Light- and Medium-Duty Vehicles [PM]
ONRD-06	Accelerated Penetration of Partial Zero-Emission and Zero Emission Vehicles [VOC, NOx, PM]
ONRD-07	Greater Use of Diesel Fuel Alternatives and Diesel Fuel Reformulation [NOx, PM]
ONRD-08	Accelerated Retrofits of Heavy-Duty Vehicles [NOx, PM]
ONRD-09	In-Use Emission Reductions from On-Road Heavy-Duty Vehicles [NOx, PM]
ONRD-10	Further Emission Reductions from Out-of-State/International Registered Heavy-Duty Vehicles [NOx, PM]
ONRD-11	Enhanced Inspection and In-Use Emissions Tracking of Heavy-Duty Vehicles [NOx, PM]
ONRD-12	Further Emissions Reductions from Heavy-Duty Trucks Providing Freight Drayage Services [NOx, PM]

TABLE 1
Concluded

Off-Road Mobile Source Control Measures	
Number	**Title**
OFFRD-01	Construction/Industrial Equipment Fleet Modernization [VOC, NOx, PM]
OFFRD-02	Accelerated Turnover and Catalyst Based Standards for Pleasure Craft [VOC, NOx]
OFFRD-03	More Stringent Exhaust Standards for Off-Road Recreational Vehicles [VOC, NOx]
OFFRD-04	Evaporative Standards for Recreational Vehicles and Pleasure Craft [VOC]
OFFRD-05	Further Emission Reductions from Locomotives [NOx, PM]
OFFRD-06	Clean Marine Fuel Requirements for Ocean-Going Marine Vessels [NOx, SOx, PM]
OFFRD-07	Further Emission Reductions from Ocean-Going Marine Vessels and Harbor Craft While at Berth [All Pollutants]
OFFRD-08	Further Emission Reductions from Cargo Handling Equipment [NOx, PM]
OFFRD-09	Vessel Speed Reduction [NOx]
OFFRD-10	Further Emission Reductions from Ocean-Going Marine Vessels [NOx, PM]
OFFRD-11	Emission Reductions from Aircraft [VOC, NOx, PM]
OFFRD-12	Lower Exhaust and Evaporation Standards and Fleet Modernization for Lawn and Garden Equipment [VOC]
OFFRD-13	Emission Reductions from Airport Ground Support Equipment [VOC, NOx, PM]
Consumer Products	
CONS-01	Further Emission Reductions from Consumer Products [VOC]

On-Road Mobile Source Control Measures

The District is proposing 12 on-road mobile source control measures. The first six measures focus on on-road light- and medium-duty vehicles operating in the South Coast Air Basin. By 2014, it is estimated that about 12 million vehicles will be operating in the Basin. The first measure would implement enhancements to the current Smog Check program with a focus on reducing evaporative emissions, inclusion of more stringent cut-points, and inclusion of a smoke test. The second control measure calls for an expanded vehicle retirement program and mandatory parts replacement. The third measure addresses the offsetting of emissions due to the introduction of ethanol blended gasoline. Depending on the gasoline reformulation, this measure could result in additional NOx emission reductions. The fourth measure would tighten emission standards for motorcycles. The fifth measure would expand the Smog Check program to include vehicle testing of particulate emissions. The sixth measure would implement programs to accelerate turnover of older light- and medium-duty vehicles to new

vehicles certified to the partial zero emissions vehicle (PZEV) exhaust emissions standard. This measure emphasizes an accelerated penetration of hybrid and plug-in hybrid vehicle technologies.

The remaining six measures focus on heavy-duty vehicles and the use of cleaner diesel fuel or diesel fuel alternatives. Current diesel fuel specifications could be specified in a manner that would result in further emission reductions of NOx and particulate matter. In addition, diesel fuel alternatives such as gas-to-liquids or Fisher-Tropsch fuels, dimethyl ether (DME), and emulsified diesel fuels can provide immediate emissions benefits. The seventh control measure calls for greater use of diesel alternative fuels and reformulation of the current diesel fuels. This measure would apply to all mobile and stationary sources that use diesel fuel. The eighth control measure seeks additional emission reductions from pre-2010 model year on-road heavy-duty vehicles through an accelerated retrofit program that would achieve 30 percent reduction in NOx and depending on the age of the vehicle, 30 to 85 percent reduction in particulate matter. The ninth control measure calls for an accelerated on-road heavy-duty vehicle replacement program of pre-2007 vehicles with vehicles meeting the 2010 on-road heavy-duty exhaust emissions standards. It is estimated that 25 percent of the heavy-duty vehicle miles traveled are associated with out-of-state vehicles. The state is limited in authority to regulate these vehicles. As such, the tenth control measure seeks to reduce emissions from out-of-state/international heavy-duty vehicles through a federal incentives program. The eleventh control measure would require the implementation of an inspection and maintenance program for California registered heavy-duty vehicles. It is estimated that 38 percent of all of the on-road heavy-duty vehicle activities are associated with goods movement. Due to the unique nature of the types of trucks performing freight drayage services, a separate control measure is proposed for this category of sources. The twelfth control measure calls for on-road trucks that provide freight drayage services to implement the eighth or ninth control measure.

Off-Road Mobile Source Control Measure

The District is proposing 13 control measures that seek further emission reductions from off-road mobile sources and industrial equipment. Transportation sources such as aircraft, locomotives, and marine vessels are associated with anticipated economic growth not only in the Basin, but also nationwide. These sources are principally regulated by the federal and state agencies. However, certain local actions can result in emission reductions beyond the emissions standard setting authority of the state and U.S. EPA. The first measure calls for an accelerated turnover of construction and other mobile industrial equipment to cleaner engines. The second and third measures focus on recreational vehicles and pleasure craft. The fourth measure calls for the implementation of evaporative standards for recreational vehicles. The fifth measure calls for new locomotive emissions standards and the retrofit of existing locomotives to further reduce NOx and particulate emissions. The sixth control measure calls for the use of 0.2 percent sulfur content marine fuels by 2014. The seventh control measure seeks

emissions reductions for marine vessels and harbor craft while at berth through the use of shore-side power or equivalent alternative control technologies. The eighth measure calls for additional emission reductions from cargo handling equipment. The ninth control measure would limit the speed of ocean-going vessels as they enter and leave the two major commercial marine ports. The tenth control measure calls for ocean-going vessels to install retrofit devices to reduce NOx and/or particulate emissions. The eleventh control measure calls for reduction in NOx exhaust emissions from aircraft. The twelfth control measure seeks further emission reductions from lawn and garden equipment through accelerated replacement programs. The thirteenth control measure would require additional emission reductions from aircraft ground support equipment.

Consumer Products

The District is also proposing additional emission reductions from consumer products. This measure examines further reductions of VOC from consumer products through 2020.

FORMAT OF CONTROL MEASURES

Included in each control measure description is a title, summary table, description of source category (including background and regulatory history), proposed method of control, estimated emission reductions, rule compliance, test methods, cost effectiveness, and references. The type of information that can be found under each of these subheadings is described below.

Control Measure Number

Each control measure is identified by a control measure number such as "CM #2007MCS-04" located at the upper right hand corner of every page. "CM #" is the abbreviation for the "control measure number" and is immediately followed by the year of the AQMP revision.

The next four- or five-letter designation, "ONRD" represents the abbreviation for a source category or specific programs. For example "ONRD" is an abbreviation for "On-Road Mobile Sources." The following provides a description of the abbreviations for each of the measures.

- ONRD On-Road Mobile Sources
- OFFRD Off-Road Mobile Sources
- CONS Consumer Products

Title

The title contains the control measure name and the major pollutant(s) controlled by the measure. Titles that state "Control of Emissions from..." indicate that the measure is regulating a new source category, not presently regulated by an existing source- specific District rule. Titles that state "Further Emission Reductions of" imply that the measure would result in an amendment to an existing District rule.

Summary Table

Each measure contains a table that summarizes the measure that is designed to identify the key components of the control measure. The table contains a brief explanation of the source category, control method, emission reductions, control costs, and implementing agency.

Description of Source Category

This section provides an overall description of the source category and the intent of the control measure. The source category is presented in two sections, background and regulatory history. The background has basic information about the control measure such as the number of sources in the Basin, description of emission sources, and pollutants.

The regulatory history contains information regarding existing regulatory control of the source category such as applicable state or federal rules or regulations and if the source category was identified in the 2003 or prior AQMPs.

Proposed Method of Control

The purpose of this section is to identify potential control options an emission source can use to achieve emission reductions. If an expected performance for a control option is provided, it is intended for informational purposes only and should not be interpreted as the targeted overall control efficiency for the proposed control measure. To the extent feasible, the overall control efficiency for a control measure should take into account achievable controls in the field by various subcategories within the control measure. A more detailed type of this analysis is typically conducted during rulemaking, not in the planning stage. It has been the District's long standing policy not to exclude any control technology and have intentionally identified as many control options as possible to spur further technology development. Therefore, potential control options described in this section do not ensure their viability when subject to further technology assessment conducted during the rulemaking process.

Emissions Reduction

The emission reductions are estimates based on the baseline inventories prepared for the 2007 AQMP and are provided in the Control Measure Summary Table. The emissions

data are based on the annual average inventory for all five criteria pollutants. The planning inventory adjusts the emissions by taking into consideration a source category's seasonal variations. The emissions affecting ozone concentration (i.e., VOC and NO_x) are presented under the Summer Planning Inventory. The emissions section of the summary table includes the 2002, 2014, and 2020 inventory. The 2014 and 2020 emission projections reflect implementation of adopted rules. Based on the expected reductions associated with implementing the control measure, emission data are calculated for 2014 and 2020 assuming the implementation of the control measure in the absence of other competing control measures.

The emission reductions listed in the summary table represent the current best estimates, which are subject to change during rule development. As demonstrated in previous rulemaking, the District is always seeking maximum emission reductions when proven technically feasible and cost-effective. For emission accounting purposes, a weighted average control efficiency is calculated based on the targeted controls. The concept of weighted average acknowledges the fact that a control measure or rule consists of several subcategories, the emission reduction potential for each subcategory is a function of proposed emission limitation and the associated emission inventory. Therefore, the use of control efficiency to estimate emission reductions does not represent a commitment by the District to require emission reductions uniformly across source categories. In addition, due to the current structure of emission inventory reporting system, a control measure may partially affect an inventory source category (e.g., certain size of equipment or certain level material usage). In this case, an impact factor is incorporated into the calculation of a control efficiency to account for the fraction of inventory affected. During the rule development, the most current inventory will be used. However, for tracking rate-of-progress on the SIP emission reduction commitment, the approved AQMP inventory will be used. More specifically, emission reductions due to mandatory or voluntary, but enforceable, actions will be credited under SIP obligations.

Rule Compliance

This section was designed to satisfy requirements in the 1990 Clean Air Act in which EPA has indicated that it is necessary to have a discussion of rule compliance with each control measure. This section discusses the recordkeeping and monitoring requirements envisioned for the control measure. As discussed under this section of the control measure, the District would continue to verify rule compliance through site inspections and submittal of compliance plans.

Test Methods

In addition to requiring recordkeeping and monitoring requirements, EPA has stated that "An enforceable regulation must also contain test procedures in order to determine

whether sources are in compliance." This section of the measure identifies appropriate approved District, ARB, and EPA source test methods.

Cost Effectiveness

The Discounted Cash Flow (DCF) method is used to calculate the cost-effectiveness of each control measure. As control measures undergo the rule making process, more detailed control costs will be developed, and therefore, may differ from the data presented here.

The cost effectiveness may overestimate actual levels because the number of affected facilities may also include those that presently are not regulated by the District. As additional information on costs and more accurate numbers of affected facilities becomes available, the cost effectiveness will be revised and analyzed in the socioeconomic assessment report of the 2007 AQMP.

Implementing Agency

This section identifies the agency(ies) responsibility for implementing the control measure. Also included in this section is a description of any jurisdictional issues that may affect the control measure's implementation.

References

This section identifies directly cited references, or those references used to provide general background information.

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GROUP 1

ON-ROAD MOBILE SOURCES

SMOG CHECK IMPROVEMENTS [ALL POLLUTANTS]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY: GASOLINE- AND DIESEL-POWERED ON-ROAD VEHICLES

CONTROL METHODS: SMOG CHECK IMPROVEMENTS INCLUDING: LOW PRESSURE EVAPORATIVE TEST; COMPREHENSIVE EVAPORATIVE EMISSIONS TESTING; MORE STRINGENT CUT-POINTS FOR AFTER-REPAIR TESTS; ASM TESTING FOR ALL WHEEL AND FOUR WHEEL DRIVE VEHICLES; ENHANCED ON-BOARD DIAGNOSTICS; REMOTE SENSING TO IDENTIFY HIGH EMITTING VEHICLES W/ REPAIR & RETIREMENT COMPONENT; IDLE TESTING PLUS ASM TEST; INSPECTION OF DIESEL-POWERED LIGHT- AND MEDIUM- DUTY DIESELS; INSPECTION OF MOTORCYCLES

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	**2002**	**2014**	**2020**
VOC INVENTORY	422.9	177.7	132.1
VOC REDUCTION		18.7	15.9
VOC REMAINING		159.0	116.2
NOX INVENTORY	381.1	143.3	94.7
NOX REDUCTION		13.3	13.3
NOX REMAINING		129.9	81.4
CO INVENTORY	3839.7	1431.5	953.5
CO REDUCTION		103.5	102.5
CO REMAINING		1328.0	851.0
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
VOC INVENTORY	424.9	185.1	139.0
VOC REDUCTION		19.6	16.5
VOC REMAINING		165.5	122.5
NOX INVENTORY	363.3	136.8	90.5
NOX REDUCTION		12.7	12.7
NOX REMAINING		124.0	77.8
CO INVENTORY	3791.2	1411.1	938.5
CO REDUCTION		102.2	101.3
CO REMAINING		1308.9	837.2

CONTROL COST: NOT DETERMINED

IMPLEMENTING AGENCY: CALIFORNIA AIR RESOURCES BOARD AND BUREAU OF AUTOMOTIVE REPAIR (MAY REQUIRE STATE LEGISLATION)

DESCRIPTION OF SOURCE CATEGORY

The purpose of this control measure is to implement control strategies that will augment the current Smog Check program applicable to gasoline- and diesel-powered vehicles up to 10,000 lbs. gross vehicle weight rating (GVWR). These vehicles include passenger cars, vans, pick-up trucks and medium-duty vehicles.

Background

Motor vehicle emissions progressively increase as vehicles age and accumulate mileage. The causes of these emissions increases are numerous, but can be broadly categorized in terms of normal deterioration of properly functioning on-board emission control system components, emission control system malfunctions due to design flaws and/or lack of proper maintenance, and tampering. In recognition that potential substantial emission reductions could be generated by regularly emission testing in-use vehicles and repairing those vehicles with high in-use emissions, Smog Check programs have been established to ensure that in-use vehicles stay clean as they age.

Regulatory History

The 1977 amendments to the Federal Clean Air Act required areas that did not attain ambient air quality standards to implement inspection and maintenance programs by 1982, for the purpose of reducing emissions from in-use cars and light-duty trucks. As a result, the California Legislature approved a Smog Check program for those portions of California with the most serious air quality problems. The legislation specified that the Smog Check program would be based on inspections at privately owned inspection stations, and that the overall program design would meet U.S. EPA targets for hydrocarbon and carbon monoxide reductions. The California Bureau of Automotive Repair (BAR) was charted with implementing the Smog Check program, which began in 1984.

Significant modifications have been made to the Smog Check program since its initial rollout. For instance, the Smog Check program was strengthened as a result of the 1990 amendments to the Clean Air Act to require enhancements such as dynamometer-based emission testing in those ozone nonattainment areas classified as serious, severe, or extreme. This legislation resulted in the implementation of Accelerated Simulation Monitoring-dynamometer emission testing in the South Coast Air Basin due to its classification as an extreme ozone nonattainment area. More recently, BAR has implemented Smog Check improvements between 2000 and 2003 requiring, for example, more stringent NOx cutpoints, expanded ASM-dynamometer testing of vehicles up to 9,999 lbs GVW, and checks for liquid fuel leaks.

PROPOSED METHODS OF CONTROL

The following program enhancements are proposed for inclusion in the current Smog Check program beginning in 2010 and no later than 2012.

<u>Low-Pressure Evaporative Test</u> - The low-pressure evaporative test is designed to identify vehicles with evaporative emission control problems. The test would basically involve slightly pressurizing the vehicle's evaporative emissions control system. If leaks were present, hydrocarbon emissions would escape and be detected by emissions measurement

instrumentation. This test would augment the current Smog Check emission testing protocol which currently only measures exhaust emissions. The low pressure evaporative test would be applicable to a subset of the Smog Check inspection fleet, including 1976 to 1995 model year vehicles that are not equipped with an on-board diagnostics system (OBD II), and only for those vehicles where the evaporative canister is accessible by a repair technician.

Comprehensive Evaporative Emissions Testing – Gasoline used in motor vehicles readily evaporates in the atmosphere, and the resultant hydrocarbon emissions contribute to poor air quality including elevated ambient ozone levels. To address this situation, vehicle manufacturers have been required to control evaporative emissions since 1971 by installing systems on gasoline-powered vehicles that collect evaporative emissions and subsequently route these emissions back to the engine for combustion. This control method proposes that all gasoline vehicles be subjected to a comprehensive evaporative emission test (shed testing) at least once in their lifetime when vehicles reach an age of seven years or greater. Such testing can be performed at Smog Check Referee Stations to avoid having all smog check stations incur the cost for additional equipment. The emission reductions generated by this proposed control method would partially overlap with emission reductions associated with vehicles equipped with OBD II systems (1996 model year and newer), since OBD II systems have the capability of detecting some evaporative emission control malfunctions.

More Stringent Cut-Points for After-Repair Tests – The use of random roadside tests, conducted by the BAR with the assistance of the California Highway Patrol, is one of the primary methods used to evaluate the effectiveness of the current Smog Check program. Although the inspection is not mandatory, the majority of motorists pulled over participate in the program. Analyses of roadside data from vehicles tested between January 2000 and October 2002 indicate that the emissions from vehicles initially passing the Smog Check inspection were approximately 25 to 30 percent lower emitting than vehicles that had failed their initial Smog Check inspection and were subsequently repaired, based on the after-repair emission test of these vehicles. These emission results suggest that many of the failing vehicles were improperly repaired or that the repairs were only sufficiently durable for the vehicle to minimally pass the Smog Check emission test. One approach for addressing this weakness in the current Smog Check program would be to establish a more stringent after-repair emission test levels or cut-points that would be applicable for initially failed vehicles that have been repaired, applicable to all model-year vehicles. This lower cut-point would promote more complete and durable repairs that would potentially last for the entire two-year period between Smog Check tests.

Accelerated Simulation Monitoring (ASM) Testing for All Wheel and Four Wheel Drive Vehicles – Most vehicles registered in the District normally undergo ASM emission testing. This emission test basically consists of operating the vehicle on a dynamometer and measuring tailpipe emission levels at two different speed-load points. The loads vary as a function of the specific vehicle model being emission tested; however, the speeds are specified at 15 and 25 miles per hour. One segment of the on-road vehicle population that cannot be tested on the dynamometers at Smog Check stations are all wheel drive and four wheel drive vehicles, where the engines on these vehicles deliver power to all four wheels at all times. This situation is incompatible with the dynamometers utilized in the current Smog Check program. These dynamometers only incorporate one roller, limiting compatibility with vehicles that can be operated with front wheel drive or rear wheel drive. This control method proposes that a limited

number of Smog Check stations, such as referee stations, be equipped with dynamometers incorporating a two roller system, where the front and rear wheels of the vehicle would be positioned on a set of two rollers to accommodate the spinning of all four wheels during vehicle operation. In addition, this control method proposes that beginning with the 2010 model year, all four wheel drive and all wheel drive vehicles must have the optional capability to switch to two wheel drive operation, gradually eliminating the need for two-roller system dynamometer deployment in the Smog Check program.

Enhanced On-Board Diagnostics – On-board diagnostic (OBD) systems consist of on-board vehicle sensors coupled with electronic hardware implementing an electronics communication protocol for the purpose of identifying, communicating, and storing emission control system malfunctions or faults. When a fault occurs during vehicle operation, a malfunction indicator light (MIL) is activated on the vehicle's dashboard (usually called a check-engine light) and a fault code is simultaneously stored in the OBD system electronic hardware. Vehicles in California became equipped with OBD systems beginning with the 1987 model-year. OBD II is the second generation version of this emission control technology, incorporating the sensing of more emission control related components as well as utilizing a defined performance standard, one and one-half times the applicable emission standard, to use as the basis for determining when a fault code should be registered (and MIL activation) in response to an emission control component malfunction. Vehicles sold in California beginning with the 1996 model year were required to be equipped with OBD II systems. As part of the Smog Check program, OBD systems promote the repair of malfunctioning emission control system components by allowing vehicle service technicians to download any fault codes during the biennial Smog Check test. Notwithstanding this advantage, one of the obvious weaknesses with OBD is that if a fault occurs in between Smog Check tests, the illumination of the MIL or check engine light will not provide sufficient impetus for the vehicle owner to seek emission control system repair if the vehicle is otherwise operating correctly. This situation would be especially evident if the vehicle was outside of warranty coverage. This control method proposes that existing vehicles with OBD II systems and all new vehicles be retrofitted or installed with on-board electronic transponders that would generate a signal when the OBD II system registers a fault, detectable by network of roadside detectors or satellites that would subsequently notify the Bureau of Automotive Repair (BAR). Owners of vehicles operating with malfunctioning emission control equipment as determined by their OBD system would be required to submit their vehicle for a Smog Check inspection within a specified period of time subsequent to BAR notification.

Remote Sensing To Identify High Emitting Vehicles and Require Off-Cycle Repairs or Vehicle Retirement – Currently, California vehicles less than 10,000 GVW are required to undergo Smog Check testing every two years or upon change of vehicle ownership. Recent studies have indicated that repairs done in conjunction with the Smog Check Program do not last the entire biennial cycle and result in high emitting vehicles being driven on California roadways. The implementation of a remote sensing component to California's Smog Check Program will also capture those vehicles who bypass California's Smog Check program through various techniques such as clean piping (using the clean tailpipe exhaust of one vehicle for another). The use of remote sensing programs identifying high emitting vehicles will allow for off-cycle repairs and encourage vehicle retirement of identified high emitting vehicles. The current Consumer Assistance Program (CAP) operated by BAR encourages vehicle retirement for on-cycle (those vehicles within three months of its smog check test due date) vehicles that cannot

pass the Smog Check Test. Vehicles identified as high emitters that are off-cycle to the smog check test are not eligible to the CAP program implemented by BAR. This control measure would apply to those vehicles identified as high emitters that are off-cycle to the smog check program. The benefits to the program would be the off-cycle repair or vehicle retirement occurring prior to the next smog check emission test.

Idle Emission Testing Plus ASM Test – As mentioned previously, most vehicles registered in the District normally undergo ASM emission testing. This emission testing basically stipulates that the vehicle be operated on a dynamometer and emission tested at two different speed-load points. As an additional augmentation to the ASM emission testing, this control method proposes that vehicles be additionally emission tested at two different idle speeds while the vehicle is parked with no load applied to the engine. The idle speed emission information will help identify additional vehicles with malfunctioning emission control system components that would otherwise be missed if the ASM emissions testing were solely utilized. Staff believes that in congested urbanized regions two-speed idle testing is a cost-effective test to identify high emitters. It should be noted that this proposed control method could potentially overlap with the proposed enhanced OBD and more stringent cut-point control method proposals, since all of these control methods promote additional Smog Check emission testing and emission system repairs.

Inspections of Diesel-Powered Light- and Medium-Duty Vehicles – There are roughly 100,000 diesel-fueled passenger cars, light-duty trucks or medium-duty-vehicles operating in the District. Diesel-powered vehicles have inherently low hydrocarbon emissions; however, these vehicles emit higher levels of NOx than similar sized gasoline powered vehicles, and these emission levels could become elevated due to the failure of an emissions-related component. This proposed control method would require inclusion of diesel-powered light- and medium-duty vehicles into the current Smog Check program for the purpose of checking, identifying and repairing malfunctioning emission control system components that result in high NOx emission levels. With the anticipated growth in diesel-fueled passenger vehicles, this enhancement to the Smog Check program may be a critical component in reducing diesel emission from the light- and medium-duty vehicle sector.

Inspection of Motorcycles – Approximately 150,000 motorcycles are registered in the District, and they emit the same types of pollutants as cars and trucks currently being tested in the Smog Check program. In addition, evaporative emissions are a major problem with motorcycles as the sun typically shines directly on the fuel tank, heating the fuel in the tank and causing increased fuel vaporization and release into the atmosphere. Motorcycles are also subject to high rates of tampering especially with regard to the deliberate removal of catalytic converters. This control method proposes the inspection and emission testing of motorcycles as part of the current Smog Check program. The emission testing would consist of two components. The first component would implement the emission testing of tailpipe exhaust emissions, most likely employing a dynamometer-based emission testing procedure similar to the ASM test protocol currently utilized on cars and trucks. The second component would implement evaporative emission testing utilizing an enclosed space where hydrocarbon vapors escaping from the motorcycle's fuel tank and fuel system could be reliably measured to determine the presence of evaporative-system related malfunctions.

EMISSIONS REDUCTIONS

Full implementation of the proposed improvements to the current Smog Check program would result in 15.9 tons/days of VOC and 13.3 tons/day of NOx reductions by 2014.

RULE COMPLIANCE AND TEST METHODS

Low-Pressure Evaporative Test - The equipment used to implement this test would be a stand-alone device that operates independently of the ASM test equipment. It is expected that the evaporative emissions test equipment would be sufficiently sophisticated to compensate for fuel tank fill level, fuel volatility, and liquid fuel temperature, allowing for improved test repeatability. Test results would be electronically reported to BAR.

More Stringent Cut-Points for After-Repair Tests – Lower emission cut-points would be incorporated into existing Smog Check emission test equipment, applicable for vehicles that have been repaired subsequent to initially failing the Smog Check test. Test results would be electronically reported to BAR.

ASM Testing for All Wheel and Four Wheel Drive Vehicles – Additional two-roller dynamometer systems would need to be deployed at a limited number of Smog-Check Stations, such as referee stations, to provide sufficient emission testing capability to accommodate the estimated 80,000 vehicles per year that would undergo this emission testing in the District. This testing capability would eventually be phased-out as a result of the proposed requirement that all wheel drive and four wheel drive vehicles be installed with systems that would allow the vehicle to be optionally operated with engine power delivered to only two wheels.

Enhanced On-Board Diagnostics – This proposed control method would require the installation of an OBD II connected transponder to vehicles that are 1996 model year and newer that would transmit an electronic signal to a roadside or satellite network, for the purposes of notifying BAR. Upon receiving this notification, BAR would alert the vehicle owner that their vehicle Smog Check test is required for that vehicle.

Comprehensive Evaporative Emissions Testing – This proposed control method would require the installation of enclosures and associated hydrocarbon concentration monitoring instrumentation at a limited number of Smog Check stations. The details of the testing protocol would have to be developed, but most likely would involve subjecting the vehicle to ASM emission testing, and then transferring the warmed-up vehicle into a sealed enclosure and measuring hydrocarbon emission concentrations within that enclosure over a specified time period.

Remote Sensing To Identify High Emitting Vehicles – Adding a remote sensing component to the existing smog check program would require either the purchase or lease of remote sensing equipment or the contracting of services to collect remote sensing data. Details of the remote sensing protocol would have to be developed and could be very similar to the remote sensing protocol currently being developed for the Carl Moyer Program. The off-cycle repair and vehicle retirement components can be developed similar to BAR's CAP program.

Idle Testing Plus ASM Test – Additional or augmented emission testing equipment would need to be utilized to perform idle emission testing in addition to the ASM emission test equipment already present at Smog Check test facilities. The emissions test equipment is commercially available, and implementation of the idle test would add at least several minutes to the current Smog Check test.

Inspections of Diesel-Powered Light- and Medium-Duty Vehicles – New emissions measuring test equipment would need to be purchased by Smog Check station operators in order to detect NOx emissions from diesel-powered vehicles.

Inspection of Motorcycles –New test equipment would most likely be needed by Smog Check stations. It is envisioned that the test procedure would be very similar to the procedure currently being implemented for gasoline cars and trucks with the addition of equipment that would be used to measure motorcycle evaporative emissions. This equipment would most likely consist of a sealed enclosure, incorporating instrumentation that could measure hydrocarbon emission concentrations.

COST EFFECTIVENESS

Overall cost-effectiveness values for the control method concepts included in this control measure would require additional study. As a guide, the cost-effectiveness of the current Smog Check program is estimated to be approximately $5,300 per ton of hydrocarbons, NOx and CO, and it would be expected that the cost-effectiveness values for the methods of control included in this control measure would result in similar cost-effectiveness values.

IMPLEMENTING AGENCY

The implementing agencies would be the Bureau of Automotive Repair and the California Air Resources Board. Some of the methods of control may require new state legislation

REFERENCES

CARB, Staff Report, Environmental Impacts of Implementing a Low-Pressure Evaporative Test in the California Smog Check Program, November 29, 2005.

Department of Consumer Affairs/Bureau of Automotive Repair, Report to the Legislature – April 2004 Evaluation of the California Enhanced Vehicle Inspection and Maintenance (Smog Check) Program, September, 2005.

Department of Consumer Affairs/Bureau of Automotive Repair, Technical Support Document for Evaluation of the California Enhanced Vehicle Inspection and Maintenance (Smog Check) Program, June 2004

CARB, Proposed 2003 State and Federal Strategy for California SIP - Section II Mobile Sources, August 25, 2003

EXPANDED BAR VEHICLE RETIREMENT AND MANDATORY PART REPLACEMENT [ALL POLLUTANTS]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY: GASOLINE – POWERED ON-ROAD VEHICLES

CONTROL METHODS: VOLUNTARY RETIREMENT OF HIGH-EMITTING VEHICLES; IMPLEMENTATION OF AN EMISSION CONTROL SYSTEM PARTS REPLACEMENT PROGRAM

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	**2002**	**2014**	**2020**
VOC INVENTORY	411.3	166.8	121.6
VOC REDUCTION		0.7	0.4
VOC REMAINING		166.1	121.2
NOX INVENTORY	373.7	135.8	88.5
NOX REDUCTION		1.0	0.5
NOX REMAINING		134.8	87.9
CO INVENTORY	3752.8	1347.7	878.2
CO REDUCTION		2.7	1.8
CO REMAINING		1345.0	876.4
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
VOC INVENTORY	413.2	173.7	127.9
VOC REDUCTION		0.7	0.4
VOC REMAINING		173.0	127.5
NOX INVENTORY	356.0	129.4	84.4
NOX REDUCTION		0.9	0.5
NOX REMAINING		128.5	83.9
CO INVENTORY	3704.3	1327.3	863.1
CO REDUCTION		2.7	1.7
CO REMAINING		1324.6	861.4

CONTROL COST: NOT DETERMINED

IMPLEMENTING AGENCY: BUREAU OF AUTOMOTIVE REPAIR AND CALIFORNIA AIR RESOURCES BOARD

DESCRIPTION OF SOURCE CATEGORY

This source category includes all on-road gasoline-powered cars, trucks, vans, and miscellaneous work vehicles up to 10,000 lbs gross vehicle weight rating (GVWR). On-road gasoline-powered vehicles significantly contribute to ozone precursor emissions in the South Coast Air Basin. Reducing volatile organic compounds (VOC) and oxides of nitrogen (NOx)

emissions from these vehicles is a high priority since these vehicles are a significant source of air pollution. Approximately 40 percent of all ozone precursor emissions come from this emission source.

Background

Vehicles with deteriorated emission control components/systems cause disproportionate air pollution impacts. Various strategies addressing this problem primarily depend on the overall vehicle condition of the vehicle. If the vehicle's high emissions are caused by the generally deteriorated state of the emission control system and emissions related components, permanent vehicle retirement may make the most sense in this situation. On the other hand, if the vehicle's high emissions are caused by the deteriorated state of specific emission control system component(s), a parts replacement program may be preferred over permanent vehicle retirement.

Regulatory History

To address the problem of high-emitting vehicles causing disproportionate air pollution impacts, the Bureau of Automotive Repair (BAR) currently implements a Consumer Assistance Program that offers motorists financial assistance to retire vehicles that fail its b biennially Smog Check test. Between July 1, 2000 and December 31, 2001, BAR retired 34,003 vehicles of which 23,648 or 69 percent failed Smog Check at "gross polluter" levels. Participating vehicle owners received a financial incentive of approximately $1,000 to promote the voluntary retirement of these vehicles. This program was suspended in January 2002 due to state budget constraints, but has recently been restarted.

PROPOSED METHODS OF CONTROL

This control measure proposes to reduce the air pollution impact of high-emitting vehicles by promoting the permanent retirement of eligible vehicles through financial incentives currently offered through the California Smog Check Program. In addition, this control measure proposes the implementation of a program for remaining high-emitting vehicles through the mandatory replacement of critical emission control system components. The current BAR vehicle retirement program would be expanded from the current 18,000 vehicles per year rate statewide to 50,000 vehicles per year beginning in 2010. The District's proportion corresponds to about 50 percent of this value or about 25,000 vehicles per year. The current Smog Check Program's emissions cutpoints or future emission's cutpoints in combination with an assessment of the vehicle's overall condition could be used as the basis for selecting eligible vehicles for the retirement program or parts replacement program. For example, Smog Check emission levels within approximately 20 percent of the applicable cut-point could be one of eligibility criteria used to qualify vehicles for program participation.

EMISSIONS REDUCTIONS

This control measure complements Control Measure ONRD-01. As such, the additional reductions associated with this measure are conservatively estimated at this time. Additional analysis will be conducted prior to implementation of this measure.

RULE COMPLIANCE AND TEST METHODS

This control measure would be administered by the State of California's Bureau of Automotive Repair BAR. Existing Smog Check testing protocol and an assessment of overall vehicle condition would be used to potentially qualify vehicle for the voluntary retirement program or parts replacement.

COST EFFECTIVENESS

Overall cost-effectiveness values for this control measure would require additional study, including further specifying program design. As a guide, the cost-effectiveness of BAR's vehicle retirement program is estimated to be $8,500 per ton of VOC plus NOx.

IMPLEMENTING AGENCY

The implementing agencies would be the Department of Consumers Affairs, Bureau of Automotive Repair.

REFERENCES

Department of Consumer Affairs/Bureau of Automotive Repair, Report to the Legislature – April 2004 Evaluation of the California Enhanced Vehicle Inspection and Maintenance (Smog Check) Program, September 2005.

CARB, Proposed 2003 State and Federal Strategy for California SIP - Section II Mobile Sources, August 25, 2003

CALIFORNIA PHASE 3 REFORMULATED GASOLINE MODIFICATIONS [VOC, NOx]

CONTROL MEASURE SUMMARY			
SOURCE CATEGORY:	VEHICLES AND EQUIPMENT POWERED BY GASOLINE		
CONTROL METHODS:	GASOLINE FUEL REFORMULATION		
EMISSIONS (TONS/DAY):			
ANNUAL AVERAGE	**2002**	**2014**	**2020**
VOC INVENTORY	582.0	286.2	232.9
VOC REDUCTION		11.6	9.9
VOC REMAINING		274.7	222.9
NOX INVENTORY	435.7	175.3	122.4
NOX REDUCTION		16.1	11.3
NOX REMAINING		159.2	111.1
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
VOC INVENTORY	620.3	327.6	271.9
VOC REDUCTION		13.9	12.0
VOC REMAINING		313.7	259.8
NOX INVENTORY	422.9	173.1	122.3
NOX REDUCTION		15.9	11.3
NOX REMAINING		157.1	111.0
CONTROL COST:	NOT DETERMINED		
IMPLEMENTING AGENCY:	CALIFORNIA AIR RESOURCES BOARD		

DESCRIPTION OF SOURCE CATEGORY

Background

In August 2003, the District proposed gasoline formulation requirements for consideration by the ARB. Since that time, substantial information has been made available on the impacts of ethanol in gasoline on permeation emissions. Research Studies from the Coordinating Research Council and CARB's technical consultants indicate that the only gasoline formulations with zero incremental permeation emissions are formulations which contain 0% ethanol. Accordingly, the formulation originally proposed by the District – 0% oxygen – provides the only certain gasoline formulation which would inherently mitigate the effects of the phase of MTBE as required by SB 989. The specifications proposed in this control measure therefore are consistent with recent studies which have reinforced the validity of the original proposal in terms of emission impacts.

Automotive exhaust and evaporative emissions are very sensitive to the quality of fuel being combusted, as well as the sophistication of emission control hardware. CARB has adopted Phase 3 reformulated gasoline (RFG3) specifications for gasoline which set limits on fuel sulfur,

vapor pressure, benzene, aromatics, distillation temperature, and other parameters [1]. The Alliance of Auto Manufacturers has proposed a Global Fuel Charter which recommends that tighter gasoline specifications be adopted. Based in part on this Charter, this control measure would establish tighter specifications compared to current Phase 3 Gasoline requirements.

Regulatory History

CARB has recently updated its RFG3 requirements to accommodate the blending of ethanol into gasoline and to delay the final deadline for the phase-out of MTBE. Major amendments including a prohibition of the use of MTBE in gasoline starting December 31, 2002 (§ 2262.6), establishment of the Phase 3 RFG standards (§ 2262), and establishment of a Phase 3 CaRFG Predictive Model (§ 2265(a)) were adopted June 16, 2000. Other amendments made numerous changes, including establishing specifications for denatured ethanol intended for blending into gasoline, establishing a CARBOB model and downstream CARBOB cap limits, making other changes regarding blending ethanol into gasoline, and establishing a mechanism for a small refiner to offset excess emissions from small refiner producing Phase 3 RFG.

At the April 24, 2002 CARB workshop on RFG3, the Alliance of Auto Manufacturers presented information on the potential for enhancements to current gasoline specifications [2]. They noted that the European Union is moving aggressively to adopt stricter sulfur standards, and that an opportunity exists to leverage international efforts to enhance gasoline fuel quality beyond those reflected in RFG3. The Alliance proposed that stricter standards be pursued on an expedited basis. CARB has recently issued a draft updated version of the Predictive Model used to qualify California gasoline formulations, and expects to finalize this model by the end of the year.

PROPOSED METHOD OF CONTROL

This measure calls on CARB to adopt by mid-2007, enhanced gasoline specifications as shown below:

	CARB RFG3 (flat limits)	Cleaner Alternative Formulation
Reid Vapor Pressure *(psi)*	7.0	6.5
Sulfur *(ppm)*	20	5
Benzene *(vol. %)*	0.8	0.1
Aromatics *(vol. %)*	25	20
Olefins *(vol. %)*	6	5
T-50 *(° F)*	213	200
T-90 *(° F)*	305	300
Oxygen Content *(wt. %)*	1.8 – 2.2	0
Distillation Index	None	1,200
Octane	None	90

These alternative specifications reflect that there are overlapping impacts of certain gasoline specifications. For example, unless aromatics are constrained, the need for octane may lead refiners to increase the volume percent of aromatics such as benzene, toluene or xylene to offset the octane and volumetric loss due to phase-out of MTBE. Similarly, benzene content of

gasoline is directly associated with the relative toxicity of gasoline, and prudent toxic control strongly suggests that it should controlled to the maximum extent. Sulfur levels in gasoline have also been consistently shown to have a significant adverse effect on in-use emissions, although this effect diminishes at lower sulfur levels. Data compiled by the Alliance demonstrates that further emission reductions are possible with cleaner gasoline specifications. In 1999, the Alliance proposed specifications which were tighter than RFG3 flat limits for sulfur, olefins, T-50, T-90, and recommended that the specification be amended to include a new Distillation Index criterion to address drivability issues.

Slightly lower maximum octane levels not exceeding 90 are expected to reduce refinery energy use and enhance system efficiency while having no effect on drivability or cold start capability.

EMISSIONS REDUCTION

CARB's Complex Model has been used to confirm the net emission reduction impact of this formulation compared to average RFG3 specifications expected during summer months. CARB and SCAQMD project that the baseline inventory for gasoline vehicle emissions from light and medium duty vehicles will be 286 tons per day (tpd) of VOC and 175 tpd of NO_x in the year 2014. The Alliance of Auto Manufacturers has stated that tighter specifications should be adopted for "markets with additional advanced requirements for emission controls, to enable sophisticated NO_x after-treatment technologies." [3] The Alliance's proposed fuel charter calls for sulfur levels to be "at or below detection limits", which in practical terms is approximately 5 ppm.

An analysis performed by Air Improvement Resources Inc. based on fuel specifications recommended by the Alliance indicates that stricter limits on olefins down to 5%, distillation temperatures of 200 ºF for T-50 and 300 ºF for T-90, respectively, and a Distillation Index of 1,200 would significantly reduce emissions. [4] While the Alliance does not recommend stricter limits on benzene, it would also be prudent to minimize benzene levels to the maximum extent economically feasible, due to its carcinogenic and toxic properties. Oxygenates would be banned from cleaner gasoline, as they are associated with higher NO_x and VOC emissions. Based on a comparison of projected in-use RFG3 parameters to those proposed here, the emission reductions from the proposed fuel formulation can be estimated based on the draft ARB Predictive Model [1]. Although this model is still under development, it provides a reasonable first order estimate of the potential emission reductions from in-use gasoline vehicles. Because ARB has not completed its estimate of the off-road permeation impacts from the use of ethanol, the basis for this first order estimate does not include off-road gasoline vehicle impacts. Accordingly the reductions identified in Table 1 are therefore likely to be underestimates.

[1] September 14, 2006, Draft Predictive Model, http://www.arb.ca.gov/fuels/gasoline/premodel/091406%20draftPM.xls

Table 1 - 2010 Impacts From AQMD Proposed Gasoline Formulation

	TPD Inventory	Percent Reduction	TPD Reduction
HC Exhaust	68.47	0.0064	**0.44**
HC Evap	126.98		**16.05**
Total HC	195.45	0.084	**16.48**
NOx	111.69	0.0916	**10.230804**
HC + NOx			**26.71**

Based on this assessment, the upper range of emission reduction potential for the proposed fuel specifications are 11.6 tons/day of VOC and 16.1 tons/day of NO_x in 2014.

COST EFFECTIVENESS

The cost of refinery upgrades to accommodate the proposed cleaner gasoline specifications is estimated to be comparable to control costs imposed when RFG 2 was introduced in 1996. Cost estimates before RFG2 modifications were made ranged from 6 to 11¢ per gallon, while actual costs were found to be much lower, approximately 4¢ per gallon. Refinery modifications for the proposed cleaner gasoline would include added hydrogen capacity / hydrotreating, hydrocracking, and alkylation, while reduced octane requirements would tend to improve refinery efficiency slightly. On balance, a first order estimate of the cost of cleaner gasoline is shown below:

Per Gallon Cost	4-6 ¢
Refinery Amortization Period	3 years
Capital Cost ($B)	1.8 – 2.6
VOC + NO_x Reduction (tpd)	18.5
RFG4 Life (years of benefit)	15
Cost Effectiveness ($ / ton of VOC + NO_x)	
low	17,300
high	26,000

The cost burden for reformulating gasoline will fall disproportionately on lower income gasoline purchasers, and those with higher fuel consumption rates, such as SUV owners. The magnitude of these cost increases are not projected to be > 5% of operating costs for the vehicle. Furthermore, the full cost impacts of these proposed cleaner gasoline specifications are expected to diminish significantly once the capital costs of refinery modification are recovered after the first four years.

There will be some degree of stranded capital investment designed to accommodate the unique blending and transport requirements of ethanol. However, these costs are a relatively small portion of the total costs of compliance. There are also concerns about additional market isolation for California gasoline. However, the fungibility of this proposed gasoline will be easier than with ethanol blended gasoline. There are also potential socio-economic effects on

out-of-state ethanol producers who invested in increased production. However, these out-of-state losses will be offset by the net reduction in federal subsidies needed to secure such production. These specifications will also better insulate California from the possibility of drought-induced shortages of ethanol. There may be some vehicle for which performance is slightly impaired due to lost octane. However, it is unlikely that such losses would affect actual operating costs.

IMPLEMENTING AGENCY

CARB has the authority to establish stricter gasoline specifications.

REFERENCES

Literature:

1. California Reformulated Gasoline Regulations, Title 13, California Code of Regulations, Sections 2250-2273.5 As of May 1, 2003, http://www.arb.ca.gov/fuels/gasoline/050103rfg3regheader.doc
2. Alliance of Auto Manufacturers, "CARFG3 – Unfinished Business", CARB Workshop, April 24, 2002, http://www.arb.ca.gov/fuels/gasoline/meeting/2002/042402AAMPrstn.pdf
3. Alliance of Auto Manufacturers, World Wide Fuel Charter, issued jointly with European Auto Manufacturers Association, Engine Manufacturers Association, and the Japan Auto Manufacturers Association, December, 2002. http://www.autoalliance.org/fuel_charter.htm
4. Air Improvement Resource, Inc., "Benefits of the Alliance Proposal for RFG in California Using Latest Inventory and Predictive Models", presented to the South Coast Air Quality Management District, July 22, 2003.
5. September 14, 2006, Draft Predictive Model, http://www.arb.ca.gov/fuels/gasoline/premodel/091406%20draftPM.xls
6. CRC Project No. E-67: Effects of Ethanol and Volatility Parameters on Exhaust Emissions (2006).

Expert Opinion:

1. Loren Beard, DaimlerChrysler (see: http://www.arb.ca.gov/fuels/gasoline/meeting/2001/AlliancePrestn.pdf
2. Harold Askew, Consultant, "Evaporative Emission Effects Created by Ethanol in Gasoline", July 12, 2001,
3. (see: http://www.arb.ca.gov/fuels/gasoline/meeting/2001/071201HHArprt.pdf)
4. Cal Hodge, President, A 2nd Opinion, Inc., personal communication, (see: http://www.arb.ca.gov/fuels/gasoline/meeting/2002/A2OPrstn030502.pdf)
5. WSPA, "CARBOB Commingling Challenges" slide, in presentation at CARB RFG3 Workshop, July 25, 2000
6. (see: http://www.arb.ca.gov/fuels/gasoline/meeting/2000/0725wspa1.PDF

MORE STRINGENT MOTORCYCLE STANDARDS [ALL POLLUTANTS]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY: GASOLINE – POWERED ON-ROAD MOTORCYCLES

CONTROL METHODS: ESTABLISH MORE STRINGENT CERTIFICATION EMISSION STANDARDS FOR EXHAUST AND EVAPORATIVE EMISSIONS

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	**2002**	**2014**	**2020**
VOC INVENTORY	6.9	8.3	8.0
VOC REDUCTION		1.0	2.9
VOC REMAINING		7.3	5.1
NOX INVENTORY	2.0	3.1	3.2
NOX REDUCTION		0.4	1.2
NOX REMAINING		2.7	2.0
CO INVENTORY	84.8	82.5	74.3
CO REDUCTION		9.0	26.3
CO REMAINING		73.5	48.0
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
VOC INVENTORY	6.3	7.8	7.6
VOC REDUCTION		1.0	2.8
VOC REMAINING		8.8	4.8
NOX INVENTORY	1.9	2.9	3.0
NOX REDUCTION		0.4	1.1
NOX REMAINING		2.5	1.9
CO INVENTORY	84.7	82.6	74.3
CO REDUCTION		9.0	26.3
CO REMAINING		73.6	48.0

CONTROL COST: NOT DETERMINED

IMPLEMENTING AGENCY: CALIFORNIA AIR RESOURCES BOARD

DESCRIPTION OF SOURCE CATEGORY

This control measure proposes to reduce the air pollution impact of on-road motorcycles with engine displacements of 50 cubic centimeters (cc) and greater. For the purposes of this control measure, motorcycles are defined as two-wheeled, self-powered vehicles, although a limited number of three-wheeled and four wheeled designs exist. Currently there are approximately 300,000 on-road motorcycles operating in the South Coast AQMD jurisdictional boundaries. The motorcycle population is expected to increase to 350,000 by 2020.

Background

Motorcycles are powered by internal combustion engines and use emission control technologies that are not as developed compared to on-road vehicles. From a regulatory standpoint, on-road motorcycles are organized according to three engine displacement-based classes, with Class I, Class II and Class II incorporating engine displacements of 50 to 169 cc, 170 to 279 cc, and 280 cc and greater, respectively. The motorcycle emission regulations contain specific sets of emission standards for each motorcycle class, with emission standard stringency gradually increasing from Class I through Class III.

Regulatory History

The first emission control regulations for on-road motorcycles were adopted by CARB in 1975, applicable for the 1978 model-year and later. These emission standards were applied to hydrocarbons and carbon monoxide. In 1984, CARB amended these regulations to basically provide motorcycle manufacturers the flexibility of complying with emissions standards on a "corporate average" basis. In 1998, CARB amended the on-road motorcycle regulations by adopting more stringent emission standards, applicable to hydrocarbons, carbon monoxide and NOx, in recognition that technological advances in emission control technology for the 1975 to 1998 timeframe justified these more stringent standards. Two tiers of emission standards were adopted for Class II motorcycles, with Tier I applicable to 2004 to 2007 model-year motorcycles, and Tier II applicable to 2008 model-year and later motorcycles.

PROPOSED METHODS OF CONTROL

The proposed method of control is to establish a 50 percent reduction target applicable to the exhaust emission standards over all three classes of motorcycles beginning with the 2010 model-year. Given the development of emission control technology since the last amendment of the on-road motorcycle regulations in 1998, and that the tightest passenger car emission standards are approximately 40 times more stringent than the current applicable emission standards, a significant reduction in current on-road motorcycle emission standards should be technologically and commercially feasible. Expected technologies that could be deployed on motorcycle engines would probably focus on improved fuel delivery, engine modifications, catalytic converter enhancements, and engine calibration techniques.

As an additional augmentation to the control measure, it is proposed that the stringency of the currently applicable evaporative emission standards for motorcycles be increased by 50 percent. As compared to passenger cars, a motorcycle's fuel tank is directly exposed to the sun, which could potentially facilitate fuel vaporization and the escape of these vapors from the fuel tank into the atmosphere. It should be noted that evaporative emission standards were first implemented in 1971, and the technology used to control these emissions has developed significantly over the last 30 to 40 years.

EMISSIONS REDUCTIONS

The estimated emissions reductions are about 1.0 tons/day of VOC and 0.4 tons/day of NOx by 2014. Greater reductions are anticipated by 2020.

RULE COMPLIANCE AND TEST METHODS

The proposed emission standards would be applicable for the manufacturer certification of motorcycle models intended for sale in California. As part of the certification process, manufactures would follow test procedures as prescribed in CARB regulations, and submit emission test results by engine model and model-year to CARB for approval.

COST EFFECTIVENESS

Overall cost-effectiveness values of this control measure are expected to be similar to values determined for the 1998 motorcycle amendments. In this rulemaking, CARB estimated the cost-effectiveness to range from $6,000 to approximately $12,000 per ton of ROG + NOx.

IMPLEMENTING AGENCY

The implementing agency would be the California Air Resources Board.

REFERENCES

California Air Resources Board, Staff Report: Initial Statement of Reasons – Proposed Amendments to the On-Road Motorcycle Regulation, October 1998.

California Administration Code Title 13, Exhaust Emission Standards and Test Procedures – Motorcycles and Motorcycle Engines Manufactured On or After January 1, 1978

PM TESTING FOR LIGHT- AND MEDIUM-DUTY VEHICLES [PARTICULATE MATTER]

CONTROL MEASURE SUMMARY			
SOURCE CATEGORY:	DIESEL/GAS – POWERED ON-ROAD VEHICLES, UP TO 10,000 LBS GROSS VEHICLE WEIGHT RATING (GVWR)		
CONTROL METHODS:	REQUIRE A CHECK FOR VISIBLE SMOKE AS PART OF THE SMOG CHECK INSPECTION; IMPLEMENT IN-USE PARTICULATE MATTER STANDARDS AS PART OF SMOG CHECK INSPECTION		
ANNUAL AVERAGE	**2002**	**2014**	**2020**
PM10 INVENTORY	5.7	7.4	8.2
PM10 REDUCTION		0.1	0.1
PM10 REMAINING		7.3	8.1
PM2.5 INVENTORY	5.2	6.9	7.6
PM2.5 REDUCTION		0.1	0.1
PM2.5 REMAINING		6.8	7.5
CONTROL COST:	NOT DETERMINED		
IMPLEMENTING AGENCY:	BUREAU OF AUTOMOTIVE REPAIR AND CALIFORNIA AIR RESOURCES BOARD (MAY REQUIRE STATE LEGISLATION)		

DESCRIPTION OF SOURCE CATEGORY

This source category includes all on-road diesel/gas-powered cars, trucks, and miscellaneous work vehicles up to 10,000 lbs GVWR. On-road diesel/gas-powered vehicles in general significantly contribute to ozone precursor emissions as well as diesel-based particulate matter (PM) emissions in the South Coast Air Basin. Reducing oxides of nitrogen (NOx), PM, and HC emissions from this emission source is a high priority in terms of achieving ambient ozone air quality standards as well as reducing the health-based impacts of PM emissions from diesel combustion sources.

Background

Currently, California's Smog Check Program includes all gasoline-powered passenger cars and trucks up to 10,000 lbs GVWR, to be inspected at various times (typically biennially) throughout the vehicle life. Nevertheless, the Smog Check program does not require the periodic inspection and emission testing of diesel-powered vehicles. A primary impediment for inclusion of these vehicles is that separate emission test equipment and emission standards/procedures would be required to be developed and deployed. However, it appears that the technology and experience with regard to emission testing in-use diesel-powered vehicles should be sufficient at the present time to develop and deploy necessary emission test equipment and procedures necessary to include these diesel-powered vehicles into California's Smog Check Program. It should be noted that other states/countries smog check programs include light/medium duty diesel vehicles in their biennial smog check program and the State of California operates two in-use heavy-duty diesel vehicle emission testing programs. The first

program is the Heavy-Duty Inspection Program, which requires heavy-duty trucks and buses to be inspected for excessive smoke and tampering at inspection points located at CHP weigh stations and border crossings. The second program is the Periodic Smoke Inspection Program, which requires diesel and bus fleet owners to conduct annual inspections of their vehicles and repair those with excessive smoke emissions.

The current California Smog Check Program does not include an in-use standard for particulate matter. However, recent health studies indicate that fine particulate matter has significant health impacts. A proposal to incorporate an in-use standard for fine particulate matter is warranted for vehicles subject to the smog check program. Furthermore testing requirements to measure particulate matter should be incorporated in the smog check test program to ensure compliance with the in-use limits or cutpoints. It should be noted that the SCAQMD is currently working with CARB and its contractor (CE-CERT, UC Riverside) in the development of a methodology which would allow for the testing of particulate matter during a smog check test for purposes of a pilot study to repair and scrap vehicles identified as high emitters via a remote sensing program.

Regulatory History

The 1977 amendments to the Clean Air Act required areas that did not attain ambient air quality standards by 1982 to implement inspection and maintenance programs, to reduce emissions from in-use cars and light trucks. In 1982, the California Legislature approved a Basic Smog Check program for implementation beginning in 1984 targeting those portions of the State with the most serious air pollution problems, including the South Coast Air Basin. Since that time, the smog check program has been modified through state legislation and BAR regulation to gradually increase the overall stringency of the program. Only gasoline-powered vehicles have been inspected and emission tested as part of this program.

PROPOSED METHODS OF CONTROL

This control measure proposes to reduce the air pollution impact of particulate matter emissions by requiring the inclusion of diesel-powered passenger cars and trucks up to 10,000 lbs GVWR into the Smog Check program, for the purpose of checking visible smoke and testing for particulate matter pollution levels. Similar to the current Smog Check program for gasoline-powered vehicles, diesel-powered car and light truck owners would most likely be required to have their vehicles tested biennially for Smog Check inspection, and upon change of ownership. In addition, identified high emitting diesel-powered cars and light-trucks would be required to be tested off-cycle.

The second component of this proposed control measure is State adoption of in-use PM2.5 limits for both diesel and gas combustion vehicles subject to the California Smog Check Program. With the adoption of in-use PM2.5 cutpoints and testing requirements to verify compliance with such cutpoints significant reductions of PM2.5 may be realized. Fine particulate matter attributed to gas combustion vehicles, especially those identified as high emitters, has long been suspected as being underestimated in California's mobile source emissions model (EMFAC) used for planning purposes in California's State Implementation Plans. Establishment of an in-use PM2.5 cutpoint and establishment of testing procedures will ensure that contribution of fine particulate matter from this sector of the mobile source fleet is

minimized. Additionally, verification of the inventory contribution will be made with more accurate test data for fine particulate for this subset of vehicles.

EMISSIONS REDUCTIONS

This measure is part of Control Measure ONRD-01 – Smog Check Improvements. Concurrent reductions in VOC, NOx, and CO are expected with the implementation of the proposed improvements to the current Smog Check program.

RULE COMPLIANCE AND TEST METHODS

This control measure would be administered by BAR, with the expectation that detailed program design would be jointly developed by BAR and CARB. It would be expected that the existing Smog Check testing protocol for gasoline-powered vehicles would be used as a template for the program design associated with the inspection and emission testing of diesel-powered vehicles. In addition, the inspection of the diesel-powered vehicles would also incorporate a visual inspection of tailpipe emissions for excess smoke opacity.

CARB would adopt in-use emission standards for particulate matter for the smog check program in addition to testing requirements to measure particulate matter during a smog check test. Effective enforcement of in-use particulate matter limits will ensure that particulate matter emissions are minimized during the operation of those vehicles subject to smog check.

COST EFFECTIVENESS

The cost-effectiveness value for this control measure has not been quantified. However, it is expected that this value would be similar to the cost-effectiveness of the current Smog Check program, which is estimated to be approximately $5,300 per ton of hydrocarbons plus NOx reduced.

IMPLEMENTING AGENCY

The implementing agencies would be the Bureau of Automotive Repair and the California Air Resources Board. Additional state legislation may be needed to implement all or a portion of the proposed control measure.

REFERENCES

Department of Consumer Affairs/Bureau of Automotive Repair, Report to the Legislature – April 2004 Evaluation of the California Enhanced Vehicle Inspection and Maintenance (Smog Check) Program, September 2005.

CARB, Facts about California's Heavy-duty Vehicle Inspection Program, March, 2005

CARB, Facts about California's Periodic Smoke Inspection Program, March 2005

ACCELERATED PENETRATION OF PARTIAL ZERO-EMISSION AND ZERO-EMISSION VEHICLES [ALL POLLUTANTS]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY: LIGHT-DUTY PASSENGER VEHICLES (< 3,750 LBS)

CONTROL METHODS: ACCELERATED REPLACEMENT OF EXISTING LIGHT-DUTY VEHICLES WITH ALTERNATIVE FUELS AND ADVANCED TECHNOLOGY

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	2002	2014	2020
VOC INVENTORY	391.5	152.1	109.9
VOC REDUCTION		21.3	14.6
VOC REMAINING		130.8	95.3
NOX INVENTORY	346.6	116.1	71.8
NOX REDUCTION		9.1	8.9
NOX REMAINING		107.0	62.9
CO INVENTORY	3543.2	1246.4	811.6
CO REDUCTION		152.1	102.3
CO REMAINING		1094.3	
PM10 INVENTORY	5.3	7.2	8.0
PM10 REDUCTION		0.6	0.9
PM10 REMAINING		6.6	7.1
PM2.5 INVENTORY	4.8	6.7	7.4
PM2.5 REDUCTION		0.6	0.8
PM2.5 REMAINING		6.1	6.6

SUMMER PLANNING INVENTORY	2002	2014	2020
VOC INVENTORY	394.5	159.6	116.6
VOC REDUCTION		22.4	15.5
VOC REMAINING		137.3	101.1
NOX INVENTORY	330.0	110.5	68.5
NOX REDUCTION		8.6	8.5
NOX REMAINING		101.9	60.0
CO INVENTORY	3493.8	1225.4	796.1
CO REDUCTION		149.5	100.3
CO REMAINING		1075.9	695.8

CONTROL COST: NOT DETERMINED

IMPLEMENTING AGENCY: CARB

DESCRIPTION OF SOURCE CATEGORY

The purpose of this control measure is to seek emission reductions from existing light- and medium- duty passenger vehicles, pickups and trucks with gross vehicle weight rating of 10,000 lbs or less. This measure could include an accelerated vehicle replacement program combined with an advanced technology program such as plug-in hybrid-electric vehicles that have an all electric range of up to 40 miles and accelerated deployment of hybrid-electric vehicles through an enhanced old vehicle retirement program. For existing hybrid-electric vehicles, plug-in conversion kits can be used to further accelerate the introduction of this technology.

Background

Emissions from light-duty passenger vehicles continue to represent a significant and increasing portion of the emissions inventory in the South Coast Air Basin, adversely affecting regional air quality. The intent of this control measure is to mitigate impacts associated with increasing light and medium duty passenger vehicles emissions.

Regulatory History

To address California's acute air quality problems, the federal Clean Air Act granted California the unique authority to adopt and enforce rules to control mobile source emissions within California. CARB is required to adopt State requirements that are as stringent or more stringent than federal requirements. The California Clean Air Act requires CARB to achieve the maximum degree of emission reductions possible from vehicular and other mobile sources in order to attain the State ambient air quality standards by the earliest practicable date.

Significant strides have been made in reducing emissions form motor vehicles through CARB's successive mobile source regulations that apply predominately to new vehicles. As a result, a new vehicle today is approximately 99% less polluting compared to a vehicle manufactured a couple of decades ago. However, on-road and off-road mobile sources account for about 70 percent of ozone precursor emissions in the State primarily because of the contribution of the older more polluting in-use fleet. Because of the large emissions contribution, requiring the use of advanced technology such as plug-in hybrid electric vehicle technology capable of zero emission transportation is essential if clean air standards are to be realized.

PROPOSED METHOD OF CONTROL

This control measure focuses on the implementation of advanced technologies that are capable of achieving partial zero-tailpipe emissions. CARB through its fleet averaging requirements under the Low Emission Vehicle II program can ensure the availability of ATPZEVs in the California market. In conjunction with an aggressive vehicle retirement program targeting older high emitting vehicles identified via a remote sensing program, this program would offer sufficient incentives through vouchers to replace such vehicles with vehicles achieving advanced technology partial zero emitting vehicles (ATPZEVs) status. In combination with new tax credits for advanced technology vehicles and incentives to replace older high emitting vehicles with ATPZEVs, this control measure will generally replace the oldest model year vehicles with the cleanest light duty control technology commercially available. ATPZEVs such as the plug-in hybrid-electric vehicles typically employ a larger advanced technology battery pack, which is designed in a charge depleting manner to extend the electric portion of

the driving cycle, providing a zero tailpipe emission range of up to 40 miles, as well as overall improved fuel economy, lower greenhouse gas emissions, and reduced petroleum usage. Furthermore, existing charge sustaining design hybrid-electric vehicles can be converted using certified kits to further accelerate the implementation of this technology.

This control measure calls for a 50% sales target of ATPZEVs beginning in calendar year (CY) 2010 for the South Coast region. In CY 2014, the fleet of ATPZEVs will grow to 1.2 million in the South Coast. Continuing this program through CY 2020, the anticipated fleet of ATPZEVs will grow to greater than 2.5 million.

Several automobile manufacturers have also announced plans to investigate the technology, with Daimler Chrysler currently developing a plug-in capable Sprinter Van.

EMISSIONS REDUCTION

Accelerated turnover of older light- and medium-duty can result in significant emissions reductions. If the proposed control measure is fully implemented by 2014, estimated emission reductions of VOC and NOx are 21.3 and 9.1 tons/day, respectively.

RULE COMPLIANCE AND TEST METHODS

The existing CARB certification and verification programs would administer those portions of the control measure that would require CARB approval of plug-in hybrid-electric vehicles and retrofit kit designs. It is anticipated that existing certification and verification test procedures would be used to generate and document emission levels.

COST EFFECTIVENESS

This proposed control measure will affect the light-duty passenger vehicles. The current costs of the advanced batteries are high, but are expected to reduce significantly with enhanced manufacturing techniques and economies of scale.

The cost effectiveness of this control measure requires further study, and will be determined as part of CARB's rulemaking process.

IMPLEMENTING AGENCY

CARB and South Coast AQMD. CARB, subject to existing agreements with U.S. EPA, has the authority to set emission standards and certification requirements for vehicles sold in California.

REFERENCES

SCAQMD, Plug-in Hybrid Electric Vehicle Forum & Technical Roundtable, See URL: www.aqmd.gov/tao/ConferencesWorkshops/PHEV_Forum-07-12-06/Plug-in_Hybrid_Electric_Vehicle_Forum.htm

GREATER USE OF DIESEL FUEL ALTERNATIVES AND DIESEL FUEL REFORMULATION [NOX, PM]

CONTROL MEASURE SUMMARY			
SOURCE CATEGORY:	VEHICLES AND EQUIPMENT POWERED BY DIESEL FUEL		
CONTROL METHODS:	DIESEL FUEL REFORMULATION; INCREASED USE OF DIESEL FUEL ALTERNATIVES		
EMISSIONS (TONS/DAY):			
ANNUAL AVERAGE	**2002**	**2014**	**2020**
NOX INVENTORY	443.0	278.0	174.8
NOX REDUCTION		30.6	19.2
NOX REMAINING		247.4	155.6
PM10 INVENTORY	23.3	11.2	5.8
PM10 REDUCTION		2.5	1.3
PM10 REMAINING		8.7	4.5
PM2.5 INVENTORY	21.4	10.3	5.3
PM2.5 REDUCTION		2.3	1.2
PM2.5 REMAINING		8.0	4.1
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
NOX INVENTORY	446.0	279.9	176.3
NOX REDUCTION		30.8	19.4
NOX REMAINING		249.1	156.9
CONTROL COST:	NOT DETERMINED		
IMPLEMENTING AGENCY:	CARB, SCAQMD		

DESCRIPTION OF SOURCE CATEGORY

Background

The ARB has adopted minimum specifications for diesel fuel. These specifications currently allow alternative formulations which are equivalent to a base formulation with a maximum of 10% aromatic content. However, in practice, such a fuel specification is not actually provided by refiners, who chose to offer higher aromatic-containing diesel fuel through their exercise of ARB's discretion to authorize alternative "equivalent" formulations.

The specifications proposed here reflect a different approach to regulating diesel fuel. There are two aspects to this proposed measure. In the aggregate, the goal of this measure is to displace 50% of conventional diesel with a combination of the following:

Part 1: Reformulated diesel fuel, and

Part 2: Diesel fuel alternatives such as CNG, LNG, di-methly ether (DME), propane, and Fisher Tropsch diesel (i.e. gas-to-liquids or GTL).

Under Part 1, refiners would be required to meet the proposed reformulated diesel specifications. Under Part 2, a combination of user and supplier incentives would be implemented to achieve the remaining displacement of conventional diesel fuel with some combination of the listed diesel alternatives. The overall objective of this measure is to contribute to the achievement of a 25% reduction in diesel NOx.

Refiners would be given tighter specifications in general, including a maximum of 8% aromatic content. Lower aromatics have been associated with lower NOx emissions. The current aromatic hydrocarbon standard was adopted in 1988-1989 and has applied to California motor vehicle diesel fuel since October 1993 and has remained unchanged since that time.

Regulatory History

After ARB adopted its aromatic content requirements for on-road diesel fuel, in 2003 they adopted more stringent requirements which reduced sulfur levels from 500 ppm to 15 ppm. Other diesel fuel modifications have been made more recently, including the addition of lubricity requirements to address concerns of pipeline operators. Current ARB diesel requirements allow the use of alternative formulations which can greatly exceed the nominal 10% aromatic limit, as refiners are allowed the flexibility to refine diesel fuel up to 21% aromatic content.

PROPOSED METHOD OF CONTROL

This measure calls on CARB to adopt by mid-2007, enhanced diesel specifications as shown below.

Part 1:

Fuel Parameter	Current CARB Diesel Formulation	Cleaner Alternative Formulation
Sulfur *(ppm)*	15	**5 ppm**
Aromatics *(vol. %)*	Nominally 10% *(all in-use diesel > 20% via alternate certification)*	**8 % flat limit**
Alternative Forumations	Allowed up to 21%	**Not Allowed**
Cetane (minimum)	ASTM (47 – 48)	**58 average, 54 minimum**
Polycyclic Aromatic HC	< 3.5 %	**<1.0%**
Small Refiner Alternate Specs	Allowed	**Not allowed**
Cetane Averaging	Not needed	**Averaging allowed**

This proposed specification reflects the fact that tighter in-use aromatic controls are technically feasible. Improvements in sulfur control technology now allow diesel fuel to be refined down to the detection limit of sulfur. Recent test data also indicate that higher cetane levels are

associated with lower emissions of HC and NOx. The proposed formulation also reflects the application of the latest refining technology to reduce Polycyclic Aromatic Hydrocarbons which have been associated with higher levels of mutagenicity and toxic impacts relative to other diesel components, such as paraffinic compounds.

Refiners would be required to meet these specifications for any diesel fuel marketed on a statewide basis, due to the logistic and economy of scale issues involved, as well as the impact of intrastate trucking on Southern California. However, the AQMD retains the legislative authority to adopt diesel fuel standards specifically for the South Coast Air Basin if needed.

The small refiner exemptions provided in the past are no longer relevant to the current structure of the refining industry, which is considerably more concentrated than in the early 1990's. Furthermore, the competitiveness of so-called smaller refiners has grown to unprecedented levels, especially in the high crude oil price environment in effect for this decade. By eliminating the small refiner exemptions, in addition to the composite fuel changes recommended above, California would achieve the cleanest possible diesel formulation.

Part 2:

User or supplier incentives would also be established to ensure that at least 50% of current volume of conventional diesel fuel – approximately 1.5 billion gallons statewide annually – would be displaced with diesel alternatives. Incentives of approximately 15¢ per gallon or equivalent are estimated to be needed to achieve full market saturation of these cleaner formulations, based on CEC incremental cost estimates performed as part of their AB 2076 Petroleum Displacement proceeding analysis. As a result, 1.5 billion gallons of the California fuel pool (or possibly less, depending on refiner optimization) would be reformulated to the proposed Part 1 standards, while the remaining demand would be diverted to diesel fuel alternatives identified under Part 2.

It is expected that the largest portion of this diverted demand would be met through the use of GTL diesel, which has zero sulfur, <1% aromatics and cetane $\geq$ 70. Sasol, the world's largest producer of Fischer-Tropsch GTL fuels, estimates that a natural gas reserve of 20 trillion cubic feet (TCF) could supply the entire California diesel market with GTL for 30 years, and that uncommitted global stranded gas reserves exceed 2,000 TCF. The CEC estimates that the average long-term wholesale incremental cost from FT diesel would be approximately 10¢ per gallon higher than conventional diesel fuel prices, while additional controls on diesel fuel could lower this to approximately 7¢ per gallon over reformulated diesel over the longer term. In order to achieve the high penetration rates assumed in this measure, retail incentives in the range of 15 ¢ per gallon are projected as necessary.

GTL (Fischer Tropsch diesel) makes a high quality diesel blend component as well as a neat fuel option; similar to DME, it contains no sulfur or aromatic compounds. The miscibility of GTL with conventional diesel helps ensure the cost-effectiveness of the proposed regulation. The miscibility of DME with propane can also help rationalize the economics of its application to higher-volume niche propane markets with centralized fueling.

Before biodiesel can be incorporated into as an AQMP strategy, concerns about NOx emissions, and the possible need for mitigation strategies, need to be resolved. In the event that such issues are resolved, the proposed diesel fuel specifications under Part 1 could be adjusted to include biodiesel as a compliance option, contingent on the other base specifications being met as well. However, in light of current uncertainties, it is premature to incorporate biodiesel into the proposed Alternative Diesel Reformulation Specification.

EMISSIONS REDUCTION

Table 1 - 2010 Percent NOx Reductions from AQMD Proposed Diesel Formulation

	Current CARB Diesel Formulation	**Proposed Diesel Reformulation**
Part 1 – Diesel Reformulation:		
NOx reduction	7%	9-12%
Incremental NOx Reduction	0	2 – 5%
Portion of In-use Fuel Displaced:	100%	≥ 50%
Part 2 – Diesel Alternatives:		
NOx reduction	0	≤ 50%
Incremental NOx Reduction	0	≤ 50%
Portion of In-use Fuel Displaced:	0	≤ 50%

Table 2: Ton Per Day Reductions from Proposed AQMD Diesel Formulation

	TPD Inventory	**Percent Reduction**	**Market Penetration**	**TPD Reduction**
Part 1:				
HC	5.5	5 - 10%	50%	.275
NOx	116.4	2% - 5%	50%	2.91
HC + NOx				3.2
Part 2:				
HC	5.5	10%	50%	.275
NOx	116.4	17.5% [2]	50%	10.2
HC + NOx				10.5

[2] *This reflects the weighted average penetration of 75% for GTL, 15% for NG, 5% for DME and 5% for propane, and on-road emission reductions from the use of these fuels of 50% for NG, 30% for DME, 20% for propane and 10% for GTL.*

Based on this assessment, the combined NOx reduction from Part 1 and Part 2 is estimated to be approximately 13.1 tons per day from on-road sources, an 11.3% reduction overall. In addition, there is at least a 25% reduction in PM emissions from the substitution of GTL for conventional diesel.[3]

GTL substitution for conventional CARB diesel would result in up to 9.9% NOx reduction, based on test data provided to the AQMD by CE-CERT. The remaining 25% of NOx reductions would therefore require a significant portion of NG be substituted for GTL, as GTL NOx reductions are not sufficient to fully achieve the 25% overall objective from this measure. It is estimated that approximately ½ of the Part 2 diesel substitution would be achieved with GTL, with the remainder some combination of CNG, LNG, propane and DME. The cost differential for these latter four options requires additional study.

Based on the estimated penetration of diesel fuel alternatives and reformulation of the current diesel fuel, 31.4 tons/day of NOx and 2.5 tons/day of particulate matter emission reductions are expected by 2014.

COST EFFECTIVENESS

The cost of refinery upgrades to accommodate the proposed cleaner diesel specifications is estimated to be comparable to control costs imposed when CARB diesel was introduced in 1993. Cost estimates before the 1993 standards were implemented were 9¢ per gallon, while actual costs after rule adoption were found to be 30% lower, approximately 6¢ per gallon. Refinery modifications for the proposed cleaner diesel could include added desulfurization and hydrotreating as well as the blending of high cetane components such as GTL into complying diesel fuel acquired through merchant producer arrangements. GTL thus would provide refiners with the option of blending to meet tighter Part 1 requirements and also supply a growing demand for 100% GTL envisioned under Part 2.

During the initial stages of diesel alternative commercialization, the substitution of GTL, DME and other options is likely to commercialized first at specified card-lock and other fleet operations. Improved cetane requirements will tend to improve diesel engine operational efficiency slightly. A first order estimate of the cost effectiveness of proposed cleaner alternative diesel formulation is shown below:

	Reformulated Diesel	Diesel Alternatives
Per Gallon Cost	6 ¢	15 ¢
Capital Cost ($B) /	< $4 B	< $8.5 B
Incentives needed for Part 2:		
VOC + NO_x Reduction (max. potential, tpd)	3.2	10.5
Benefits lifetime (years of benefit)	20	20
Annual Fuel Cost	$90 million	$225 million
Cost Effectiveness ($ / ton of VOC + NO_x):	$77,000	$59,000

[3] Conventional diesel fuels have hydrogen / carbon ratios of 1.8 to 1.9, while GTL has a H:C molar ratio of 2.1, which means that there is an inherent lower quantity of combustible carbon with which to form PM emissions. Studies by DaimlerChrysler suggest reductions in PM on average of 30%.

The cost burden for reformulating diesel will fall disproportionately on lower income diesel purchasers, and those with higher fuel consumption rates, such as truck operators. The magnitude of these cost increases are not projected to be > 10 % of operating costs for the vehicle. Furthermore, the full cost impacts of these proposed cleaner diesel specifications are expected to diminish significantly once the capital costs of refinery modification are recovered after the first four to five years.

There will be some degree of stranded capital investment designed to accommodate the unique blending and transport requirements of DME during the early years of its introduction. However, these costs are a relatively small portion of the total costs of compliance. Furthermore, future truck engines certified to run on DME and/or GTL diesel are expected to have lower risks of in-use emission compliance issues, as these fuels are inherently cleaner than conventional diesel fuel as defined under current ARB regulations and used as the basis for EPA and ARB truck engine certification.

There are also reasonable concerns about additional market isolation for California diesel. However, the fungibility of this proposed diesel, including the miscibility of GTL diesel (sometimes referred to as Fisher-Tropsch Diesel) with the current distribution system, helps reduce the incremental cost of this proposal.

IMPLEMENTING AGENCY

CARB has the authority to establish stricter diesel specifications. Current refinery capabilities vary in the degree of modifications necessary to accommodate these proposed standards. The implementation date needs to reflect the reasonable time requirements for refiner capital modifications to their facilities. Because the diesel specified in this proposal is inherently fungible in pipelines, logistic constraints which inhibit product exchange agreements are not expected.

The lead time for full implementation of these specifications is expected to be approximately 4-5 years after adoption by the ARB.

REFERENCES

1. ARB Reformulated Diesel Fact Sheet *(Original issued in August, 1993)*
2. ARB Reformulated Diesel Fact Sheet *Updated October 6, 2000*
3. Diesel Fuel Effects on Locomotive Exhaust Emissions, SWRI, 2000
4. Summary of Diesel Fuel Alternative Formulation Certificates, 1992 through 2001
5. Durbin, T.D, et. al., Evaluation of the Effects of Alternative Diesel Fuel Formulation on Exhaust Emission Rates and Reactivity, Final Report, CE-CERT, April 1999.
6. Sasol Limited, "Gas to Liquids – Global Prospects", Pat Davies, to Deutche Bank Oil & Gas Conference, September 2003
7. CEC, AB 2076, Petroleum Displacement Report, Appendix B, Staff Paper on Option 2I, Fischer Tropsch Diesel

8. Rudolf Maly, DaimlerChrysler, "Effects of GTL Diesel Fuels on Emissions and Engine Performance", 10th Diesel Engine Emissions Reduction Conference, Coronado, California, September, 2004.

ACCELERATED RETROFITS OF HEAVY-DUTY VEHICLES [NOX, PM]

SOURCE CATEGORY:	HEAVY-DUTY DIESEL VEHICLES (14,001 LBS AND GREATER GVWR)		
CONTROL METHODS:	RETROFITTING EXISTING HEAVY-DUTY DIESEL VEHICLES TO ACHIEVE LOWER EMISSION LEVELS		
EMISSIONS (TONS/DAY):			
ANNUAL AVERAGE	**2002**	**2014**	**2020**
NOX INVENTORY	139.4	88.5	54.6
NOX REDUCTION		3.6	5.1
NOX REMAINING		84.9	49.5
PM10 INVENTORY	5.4	2.8	1.7
PM10 REDUCTION		0.3	0.4
PM10 REMAINING		2.5	1.3
PM2.5 INVENTORY	5.0	2.6	1.5
PM2.5 REDUCTION		0.2	0.4
PM2.5 REMAINING		2.3	1.2
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
NOX INVENTORY	139.5	88.7	54.8
NOX REDUCTION		3.6	5.1
NOX REMAINING		85.1	49.6
CONTROL COST:	NOT DETERMINED		
IMPLEMENTING AGENCY:	CARB		

DESCRIPTION OF SOURCE CATEGORY

Background

Emissions from heavy-duty diesel mobile sources continue to represent a significant and increasing portion of the emissions inventory in the South Coast Air Basin, adversely affecting regional air quality. The two primary pollutants resulting from diesel fuel combustion are particulate matter (PM) and oxides of nitrogen (NOx). PM typically constitutes the visible emissions from diesel engine exhaust, and it contains over 40 known cancer-causing substances. In 1998, California identified diesel PM as a toxic air contaminant based on its potential to cause cancer. In March 2000, the SCAQMD issued a report entitled "The Multiple Air Toxics Exposure Study in the South Coast Air Basin." This report concluded that about 70 percent of the carcinogenic risk associated with breathing ambient air can be attributed to diesel particulate emissions. Diesel engines also emit significant quantities of NOx, which is a precursor to ozone and secondary particulate matter formation. Additional control of diesel engine emissions is essential for attainment of ozone and PM ambient air quality standards, as well as mitigating its toxic air quality impact.

The intent of this control measure is to mitigate impacts associated with increasing heavy-duty diesel mobile source emissions. Specifically, this measure would seek emission reductions from 1988 to 2009 model-year heavy-duty diesel vehicles with gross vehicle weight ratings (GVWR) greater than 14,000 lbs by modifying the existing vehicle engines with retrofit kits to achieve lowest possible emission levels. This control measure would not apply to port related trucks.

Regulatory History

The regulation of emissions from heavy-duty diesel mobile emission sources is the responsibility of CARB and U.S. EPA. Specifically, heavy-duty truck engines are subject to specific emission standards pursuant to state and/or federal requirements. The standards, primarily affecting new units, vary in stringency and compliance dates. Currently, heavy-duty diesel engine manufacturers (OEMs) are investigating NO_x control technologies to meet a 0.2 g/bhp-hr NO_x emission standard for 2010 and subsequent model-years. For the model-years 2007 to 2009, the OEMs may phase in this technology to meet a 1.2 g/bhp-hr NO_x emission standard. For PM emissions, all new heavy-duty engines must meet a 0.01 g/bhp-hr exhaust emissions standard beginning with the 2007 model-year.

In addition to these emission requirements applicable to new engines, CARB also requires diesel engine retrofit kits to meet specific emission standard levels. CARB has established a "verification procedure" for the purpose of evaluating emission data and retrofit kit design to ensure that retrofit kits achieve real and durable emission reductions when applied to in-use diesel engines. All diesel engine retrofit kits must be "verified" by CARB prior to sale in California.

PROPOSED METHOD OF CONTROL

For this proposed measure, approximately 20,000 1988 through 2009 model-year non-goods movement related heavy-duty diesel vehicles are targeted for retrofitting by calendar year 2014. In addition, for calendar year 2020, this proposed control measure targets the additional retrofitting of 20,000 heavy-duty diesel vehicles. The numbers of vehicles proposed to be retrofitted are estimates for the purposes of this control measure, since they include heavy-heavy-duty diesel vehicles that could service the two large marine ports located in the SCAQMD, and would therefore not be included within the scope of this control measure (see ONRD-12). CARB estimated that about 38 percent of heavy-heavy-duty diesel vehicles are associated with goods movement with a majority of these trucks servicing the marine ports, several thousand vehicles targeted for retrofitting in the SCAQMD would most likely be port-related trucks.

This control measure relies on the development of heavy-duty diesel retrofit technology that would achieve maximum potential NOx and PM emission reductions. To promote technology development and commercial availability, heavy-duty diesel engine manufacturers would be required to develop these kits and offer them for sale for in-use diesel engines of their own manufacture. The supply of such kits, under some schedule, would be a condition of heavy-duty engine emission certification. CARB would also need to verify NO_x emission reductions of at least 30 percent. Truck operators garaged or registered in the South Coast Air Basin would then be required to purchase and install such NO_x retrofit kits as a condition of registering and operating their vehicles. The installation and continued function of the retrofit system could be

enforced and implemented through a heavy-duty vehicle I/M program and sticker system. It is proposed that 1988 and newer heavy-duty diesel engines without NO_x aftertreatment be retrofitted; this will likely affect all 1988 through 2006 models, and certain 2007 through 2009 models.

Heavy-duty engine OEMs are currently investigating the use of exhaust gas recirculation (EGR), selective catalytic reduction using urea injection (SCR), lean NO_x absorbers (LNA), and lean-NO_x catalysts (LNC) technologies to meet the 2007/2010 NO_x standard of 0.2 g/bhp-hr.

Technology proponents (potential component suppliers to OEMs) are developing and demonstrating various NO_x control systems with the OEMs. Besides being compatible with the upcoming new diesel engines, the basic designs generally should be "backwards compatible" and retrofitable with older, 1988 and newer diesel engines, albeit with lower NO_x reduction efficiencies than on new engines. Among these developers are:

1. Cleaire Advanced Emission Controls has verified various retrofit systems with CARB that attain a 25 percent NOx emission reduction. These systems include the Flash and Catch, (applicable to certain 1994 and later on-road model year Cummins engines), the Flash and Catch DPX (same applicability as the Flash and Catch), Longview ™ (applicable to certain 1993 to 2003 model-year onroad diesel engines), and the Flash and Match (applicable to certain 1993 and later model year Cummins engines). These retrofit technologies also attain a 25 to 85 percent PM emission reduction.
2. Johnson Matthey has verified the EGRT™ diesel engine NOx retrofit system with CARB that attains a 40 percent reduction in NOx emissions. It is approved for use with various International, Cummins, and DDC onroad diesel engines for 1998 through 2002 model-years.
3. SCR systems are under development and demonstration by several other companies including Argillon, Engelhard, ArvinMeritor, and Clean Diesel Technologies. A recently updated TIAX report, sponsored by the Engine Manufacturers Association, addressed the urea-supply issue for SCR. This report basically indicated that the development of a sufficient urea supply infrastructure is feasible to provide needed urea production for the expected diesel vehicle market in the near term.

The final selection of technologies by the OEMs for new engines may determine the predominant forms of NO_x control that could be available for retrofitting 1995 and newer diesel trucks and buses.

EMISSIONS REDUCTION

NO_x emission reductions of at least 30 percent can be achieved with the retrofit technologies discussed previously. If diesel particulate filters (DPFs) are incorporated in the system, PM could potentially be reduced by approximately 85 percent.

RULE COMPLIANCE AND TEST METHODS

The existing CARB verification program would administer those portions of the control measure that would require CARB approval of retrofit kit designs. It is anticipated that existing verification test procedures would be used to generate and document emission levels.

COST-EFFECTIVENESS

This proposed control measure will affect the heavy-duty engine manufacturers, heavy-duty diesel truck/bus owners, and heavy-duty diesel fleet operators. The engine manufacturers will need to absorb the initial cost of providing the NO_x retrofit kits to the marketplace; however, profit from kit sales would likely recover the OEM's kit development investment cost. In addition, these kits would likely be developed and marketed by technology developers under the review and approval of the engine manufacturer. Besides providing in-kind engineering support, it is questionable whether the OEMs would need to directly invest in the development of the kits.

Installation of the retrofit kit, both purchase price and labor, will cost an estimated $20,000 per heavy-duty vehicle. In addition, there will be an increase in operating costs due to either (1) a small increase in fuel consumption, or (2) a nominal cost for urea if SCR retrofits are used. These costs will need to be borne by the truck and bus owners and operators.

The cost effectiveness of this control measure requires further study, and will be determined as part of a CARB rulemaking process.

IMPLEMENTING AGENCY

CARB, subject to existing agreements with U.S. EPA, has the authority to set emission standards and verification requirements for retrofit systems sold in California. A requirement to provide NO_x and PM retrofit kits in the market place, as a condition of new engine certification, appears reasonable and technologically feasible as an emission reduction strategy. With such an OEM requirement for its own in-use engines, any compatibility and performance problems should be minimized.

REFERENCES

CARB, Staff Report for Public Hearing to Consider Amendments Adopting More Stringent Emission Standards for 2007 and Subsequent Model Year New Heavy-Duty Diesel Engines, September 7, 2001.

CARB, Summary of Adverse of Impacts of Diesel Particulate Matter, July 2005.

CARB, Background Verification or Certification, September 2006.

SCAQMD, Multiple Air Toxics Exposure Study in the South Coast Air Basin, March 2000.

IN-USE EMISSION REDUCTIONS FROM ON-ROAD HEAVY-DUTY VEHICLES [NOX, PM]

CONTROL MEASURE SUMMARY			
SOURCE CATEGORY:	HEAVY-DUTY DIESELVEHICLES (14,001 LBS AND GREATER GVWR)		
CONTROL METHODS:	ACCELERATED REPLACEMENT OF EXISTING HEAVY-DUTY VEHICLES WITH VEHICLES MEETING 2010 STANDARDS AND REPOWERING EXISTING HEAVY-DUTY VEHICLES TO ACHIEVE LOWER EMISSION LEVELS		
EMISSIONS (TONS/DAY):			
ANNUAL AVERAGE	**2002**	**2014**	**2020**
NOX INVENTORY	139.4	88.5	54.6
NOX REDUCTION		7.0	6.1
NOX REMAINING		81.5	48.5
PM10 INVENTORY	5.4	2.8	1.7
PM10 REDUCTION		0.2	0.2
PM10 REMAINING		2.6	1.5
PM2.5 INVENTORY	5.0	2.6	1.5
PM2.5 REDUCTION		0.2	0.2
PM2.5 REMAINING		2.4	1.3
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
NOX INVENTORY	139.5	88.7	54.8
NOX REDUCTION		7.0	6.1
NOX REMAINING		81.7	48.7
CONTROL COST:	NOT DETERMINED		
IMPLEMENTING AGENCY:	CARB, SCAQMD		

DESCRIPTION OF SOURCE CATEGORY

Background

Emissions from heavy-duty diesel mobile sources continue to represent a significant and increasing portion of the emissions inventory in the South Coast Air Basin, adversely affecting regional air quality. The two primary pollutants resulting from diesel fuel combustion are particulate matter (PM) and oxides of nitrogen (NOx). PM typically constitutes the visible emissions from diesel engine exhaust, and it contains over 40 known cancer-causing substances. In 1998, California identified diesel PM as a toxic air contaminant based on its potential to cause cancer. In March 2000, the SCAQMD issued a report entitled "The Multiple Air Toxics Exposure Study in the South Coast Air Basin." This report concluded that about 70 percent of

the carcinogenic risk associated with breathing ambient air can be attributed to diesel particulate emissions. Diesel engines also emit significant quantities of NOx, which is a precursor to ozone and secondary particulate matter formation. Additional control on diesel engine emissions is essential for attainment of ozone and PM ambient air quality standards, as well as mitigating its toxic air quality impact.

The intent of this control measure is to mitigate impacts associated with increasing heavy-duty diesel mobile source emissions by replacing higher-emitting engines powering existing in-use vehicles with newer engines meeting more stringent emission standards, or by replacing older diesel vehicles with newer, lower-polluting vehicles. Specifically, this measure would require the repowering (engine replacement) of existing 1988 to 2009 model-year heavy-duty diesel vehicles with engines meeting 2010 emission standards, or through an accelerated fleet turnover program with 2010 and later model-year heavy-duty diesel vehicles replacing 1988 to 2009 model-year heavy-duty diesel vehicles.

Regulatory History

The regulation of emissions from heavy-duty diesel mobile emission sources is the responsibility of CARB and U.S. EPA. Specifically, heavy-duty truck engines are each subject to specific emission standards pursuant to state and/or federal requirements. Emission standards for new diesel engines powering heavy-duty vehicles were first established for the 1973 model-year and have gradually increased in stringency over time. The most stringent set of heavy-duty engine emission standards has been established by CARB and U.S. EPA for 2010 and subsequent model-years, which includes a 0.2 g/bhp-hr NO_x emission standard. Currently, heavy-duty diesel engine manufacturers (OEMs) are investigating NO_x control technologies to meet this NOx emission limit. For the model-years 2007 to 2009, the OEMs may phase in these technologies to meet a 1.2 g/bhp-hr NO_x emission standard. For PM emissions, all new heavy-duty engines must meet a 0.01 g/bhp-hr exhaust emissions standard beginning with the 2007 model-year. It is anticipated that currently developed diesel particulate trap technology would be used to comply with this PM emission standard.

PROPOSED METHOD OF CONTROL

This control measure calls for an accelerated modernization of the heavy-duty truck fleet through replacement of older trucks (pre-2010) with trucks meeting exhaust emissions standards of 0.2 g/bhp-hr NOx and 0.01 g/bhp-hr PM or lower for trucks replaced in calendar years 2010 through 2020. Resources would be directed to the replacement of older "captive" fleets used for short to medium distance hauling. About 12,000 heavy-heavy duty diesel (HHDD) and medium-heavy duty diesel (MHDD) trucks would be targeted for replacement in the jurisdictional boundaries of the SCAQMD over a 10-year period. It is envisioned that half of the truck replacements would be diesel-powered and the remaining half powered by natural gas. In addition, it is anticipated that a monetary incentive program, potentially similar to the Carl Moyer Memorial Air Quality Standards Attainment Program, would be provided to affected truck operators to help offset the implementation cost of this control measure.

EMISSIONS REDUCTION

Heavy-duty engines meeting 2010 emission standards are expected to deploy exhaust aftertreatment technologies such as diesel particulate traps and selective catalytic reduction that will result in extremely low NOx and PM emission levels. NOx and PM emission reductions could range as high as 95 percent on a per vehicle basis for these pollutants, depending on the model-year and the specific emission characteristics of the vehicle or engine being replaced.

RULE COMPLIANCE AND TEST METHODS

The existing CARB certification program would administer those portions of the control measure associated with ensuring that 2010 and later model-year heavy-duty engines approved for sale in California meet applicable emission standards. Compliance with requirements of an incentive program(s) used to offset the costs of new heavy-duty vehicles or engines could be jointly or separately administered by SCAQMD or CARB.

COST EFFECTIVENESS

This proposed control measure will affect the heavy-duty engine manufacturers, heavy-duty diesel truck owners, and heavy-duty diesel fleet operators. The cost-effectiveness of this control measure requires further study, and would most likely be determined as part of a CARB rulemaking process. Costs of replacement engines vary depending on the specific model and vehicle application, and an evaluation would need to be conducted to determine the specific types of trucks and engine models that would be primarily affected by this control measure, as well as prioritizing vehicle applications on a cost-effectiveness basis for engine or vehicle replacement.

IMPLEMENTING AGENCY

CARB, subject to existing agreements with U.S. EPA, has the authority to set emission standards and certification requirements for vehicles sold in California. Besides emission standards for heavy-duty diesel vehicles, CARB has more stringent requirements for warranty, defects reporting, and other emission issues than the rest of the country As mentioned previously, CARB and/or SCAQMD could jointly implement an incentive program that would help offset the costs associated with engine or vehicle replacement.

REFERENCES

CARB, Staff Report for Public Hearing to Consider Amendments Adopting More Stringent Emission Standards for 2007 and Subsequent Model Year New Heavy-Duty Diesel Engines, September 7, 2001.

FURTHER EMISSION REDUCTIONS FROM OUT-OF-STATE/INTERNATIONAL REGISTERED HEAVY-DUTY VEHICLES [NOX, PM]

CONTROL MEASURE SUMMARY			
SOURCE CATEGORY:	HEAVY-DUTY VEHICLES (14,001 AND GREATER GVWR)		
CONTROL METHODS:	RETROFITTING EXISTING HEAVY-DUTY DIESEL VEHICLES TO ACHIEVE LOWER EMISSION LEVELS		
EMISSIONS (TONS/DAY):			
ANNUAL AVERAGE	**2002**	**2014**	**2020**
NOX INVENTORY	17.4	12.9	8.0
NOX REDUCTION		0.5	0.7
NOX REMAINING		12.4	7.3
PM10 INVENTORY	1.1	0.5	0.2
PM10 REDUCTION		ND	ND
PM10 REMAINING			
PM2.5 INVENTORY	1.0	0.4	0.2
PM2.5 REDUCTION		ND	ND
PM2.5 REMAINING			
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
NOX INVENTORY	17.5	12.9	8.0
NOX REDUCTION		0.5	0.7
NOX REMAINING		12.9	7.3
CONTROL COST:	NOT DETERMINED		
IMPLEMENTING AGENCY:	CARB, FEDERAL INCENTIVES (U.S. EPA, U.S. DOT)		

DESCRIPTION OF SOURCE CATEGORY

The purpose of this control measure is to seek emission reductions from non-California captive heavy-duty vehicles. These vehicles enter California on a temporary basis to deliver cargo from out-of-state locations and/or load California-based cargo for delivery to out-of state locations. It is believed that these vehicles are dominated by Class 8 line haul diesel-powered trucks. CARB estimates that approximately 25 percent of the vehicle miles traveled in California by heavy-duty trucks is generated by out-of-state trucks.

Background

Emissions from heavy-duty diesel mobile sources continue to represent a significant and increasing portion of the emissions inventory in the South Coast Air Basin, adversely affecting regional air quality. Emissions of most concern from these vehicles are oxides of nitrogen (NOx) and particulate matter (PM). California's efforts to develop specific emission control

programs that go beyond the requirements of U.S. EPA have been hindered because many truck fleet operators and individual truck owners can purchase trucks in or out of California, making it relatively easy to bypass more stringent California-based emission control regulations. Primarily for this reason, CARB development of heavy-duty vehicle emission control programs that go beyond U.S.EPA requirements has been restrained, and in recognition of this situation, California and U.S. EPA heavy-duty vehicle emission control programs have been basically harmonized since the initial implementation of heavy-duty truck emission standards.

Regulatory History

The regulation of emissions from heavy-duty diesel mobile emission sources is the responsibility of CARB and U.S. EPA. Specifically, heavy-duty truck engines are subject to specific emission standards pursuant to state and/or federal requirements. The standards, primarily affecting new units, vary in stringency and compliance dates. Currently, heavy-duty diesel engine manufacturers (OEMs) are investigating NO_x control technologies to meet a 0.2 g/bhp-hr NO_x emission standard for 2010 and subsequent model-years. For the model-years 2007 to 2009, the OEMs may phase in this technology to meet a 1.2 g/bhp-hr NO_x emission standard. For PM emissions, all new heavy-duty engines must meet a 0.01 g/bhp-hr exhaust emissions standard beginning with the 2007 model-year.

In addition to these emission requirements applicable to new engines, CARB also requires diesel engine retrofit kits to meet specific emission standard levels. CARB has established a "verification procedure" for the purpose of evaluating emission data and retrofit kit design to ensure that retrofit kits achieve real and durable emission reductions when applied to in-use diesel engines. All diesel engine retrofit kits must be "verified" by CARB prior to sale in California.

PROPOSED METHOD OF CONTROL

This control measure proposes the implementation of a Federal or U.S. EPA program that would incentivize the installation of aftermarket retrofit systems for PM and NOx reductions, targeting out-of-state truck fleets that route their trucks into California for cargo pick-up and delivery. There are a number of promising retrofit technologies that are commercially available that could be potentially used to support this program. These include retrofit systems developed by Cleaire Advanced Emission Controls, such as their Flash and Catch system, (applicable to certain 1994 and later on-road model year Cummins engines), the Flash and Catch DPX (same applicability as the Flash and Catch), Longview ™ (applicable to certain 1993 to 2003 model-year onroad diesel engines), and the Flash and Match (applicable to certain 1993 and later model year Cummins engines). In addition, Johnson Matthey has developed their EGRT ™ diesel engine NOx retrofit system which attains significant NOx emission reduction through exhaust gas recirculation. This system is approved for use with various International, Cummins, and DDC onroad diesel engines for 1998 through 2002 model-years. Finally SCR systems are currently under development and demonstration by several other companies including Argillon, Engelhard, ArvinMeritor, and Clean Diesel Technologies.

EMISSIONS REDUCTION

NO_x emission reductions of at least 30 percent can be achieved with the retrofit technologies discussed previously. If diesel particulate filters (DPFs) are incorporated in the system, PM emissions could potentially be reduced by approximately 85 percent.

RULE COMPLIANCE AND TEST METHODS

The existing CARB verification program would administer those portions of the control measure that would require CARB approval of retrofit kit designs. It is anticipated that existing verification test procedures would be used to generate and document emission levels. CARB, SCAQMD, or U.S. EPA could jointly or separately monitor affected fleet operators to verify retrofit kit installation and proper operation.

COST EFFECTIVENESS

U.S. EPA formed the National Clean Diesel Campaign to reduce emissions from diesel engines through the implementation of varied control strategies and involvement of national, state and local partners. One of the first of these efforts is to reduce emissions from various source categories which include heavy-duty trucks. The West Coast Collaborative, a partnership between federal, state, and local agencies, has funded projects to reduce emissions from trucks operating in California. The efforts of the Collaborative and that of the national program could be expanded to significantly reduce emissions in this source category especially by tapping into the U.S. Department of Transportation's CMAQ funds.

This proposed control measure will affect heavy-duty diesel truck owners and heavy-duty diesel fleet operators. Installation of the retrofit kit will cost an estimated $20,000 per heavy-duty vehicle. In addition, there will be an increase in operating costs due to either (1) a small increase in fuel consumption, or (2) a nominal cost for urea if SCR retrofits are used. Depending on available incentive programs, these costs may need to be borne by the truck and bus owners and operators. The cost effectiveness of this control measure requires further study, and will be determined with the implementation of a national program.

IMPLEMENTING AGENCY

CARB would implement those portions of this control measure regarding the approval of retrofit kits for NOx and PM reduction in existing heavy-duty diesel vehicles In addition, CARB, SCAQMD or U.S. EPA could jointly or separately implement an incentive program that would help offset the costs associated with retrofit kit installation.

REFERENCES

CARB, Staff Report for Public Hearing to Consider Amendments Adopting More Stringent Emission Standards for 2007 and Subsequent Model Year New Heavy-Duty Diesel Engines, September 7, 2001.

CARB, Summary of Adverse of Impacts of Diesel Particulate Matter, July 2005.

CARB, Background Verification or Certification, September 2006.

ENHANCED INSPECTION AND IN-USE EMISSIONS TRACKING OF HEAVY-DUTY VEHICLES [ALL POLLUTANTS]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY: HEAVY-DUTY VEHICLES (14,001 AND GREATER GVWR)

CONTROL METHODS: INSPECTION AND MAINTENANCE PROGRAM FOR HEAVY-DUTY VEHICLES USING VISUAL INSPECTIONS AND ON-BOARD DIAGNOSTICS

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	2002	2014	2020
VOC INVENTORY	25.3	14.3	13.9
VOC REDUCTION		1.6	2.8
VOC REMAINING		12.7	11.1
NOX INVENTORY	197.9	129.1	26.6
NOX REDUCTION		20.1	5.3
NOX REMAINING		109.0	21.3
CO INVENTORY	218.6	102.3	51.1
CO REDUCTION		10.1	10.7
CO REMAINING		92.2	40.4
PM10 INVENTORY	7.9	3.9	0.3
PM10 REDUCTION		0.3	>0.1
PM10 REMAINING		3.6	0.3
PM2.5 INVENTORY	7.3	3.6	0.3
PM2.5 REDUCTION		0.3	>0.1
PM2.5 REMAINING		3.3	0.3
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
VOC INVENTORY	23.7	13.7	8.9
VOC REDUCTION		1.5	1.5
VOC REMAINING		12.2	7.4
NOX INVENTORY	197.3	129.0	80.6
NOX REDUCTION		20.1	22.7
NOX REMAINING		108.9	57.9
CO INVENTORY	220.0	103.7	66.2
CO REDUCTION		10.3	10.9
CO REMAINING		93.4	55.3

CONTROL COST: NOT DETERMINED

IMPLEMENTING AGENCY: CARB AND BUREAU OF AUTOMOTIVE REPAIR

DESCRIPTION OF SOURCE CATEGORY

Heavy duty vehicles are defined as on-road vehicles weighing more than 14,000 lbs Gross Vehicle Weight Rating (GVWR), and are used in a variety of applications such as large trucks and school buses. Heavy-duty vehicles are powered with either otto-cycle (spark-ignited) or diesel-cycle (compression ignition) engines. Diesel-powered heavy-duty vehicles are the primary choice for transport of goods and material throughout the United States. Currently, about 190,000 heavy-duty vehicles operate in the SCAQMD, and this number is projected to increase to 240,000 by 2020. The oxides of nitrogen (NOx) and particulate matter (PM) emissions from heavy-duty vehicles are of great concern. For example, the in-use heavy-duty diesel truck fleet currently contributes approximately 28 percent and 16 percent to the total statewide mobile source NO_x and PM emissions inventory, respectively.

Background

Emissions from motor vehicles are generally lowest when they are new and progressively increase as the vehicles age and accumulate mileage. The causes of these emissions increases are numerous, but can be broadly categorized in terms of normal deterioration of properly functioning on-board emission control system components, malfunctioning emission control system components due to design flaws and/or lack of proper maintenance, or tampered emission control system components. In recognition that potential substantial emission reductions could be generated by programs that would regularly emission test in-use vehicles, smog check programs have been established to systematically inspect and emission test in-use vehicles for the purpose of identifying and repairing vehicles with malfunctioning and tampered emission control system components.

In California, the Smog Check program was first established in 1982, and it includes all gasoline-powered passenger cars and trucks up to 10,000 lbs GVWR to be inspected at various times (typically biennially) throughout the vehicle life. Unlike the established Smog Check program for light-duty passenger vehicles and trucks, there has been no similar program adopted in California to periodically check emissions from heavy-duty vehicles. It should be noted, however, that two programs have been implemented by CARB that begin to address the problem of excess emissions coming from heavy-duty vehicles. The first program is the Heavy-Duty Vehicle Inspection Program, which requires heavy-duty trucks and buses to be inspected for tampering and excessive smoke through the use of a snap-idle test to determine compliance with tailpipe opacity requirements, with inspections/emission testing conducted at random roadside checkpoints and border crossings. The second program is the Periodic Smoke Inspection Program, which requires diesel vehicle and bus fleet owners to conduct annual inspections of their vehicles and repair those vehicles with excessive smoke emissions.

Regulatory History

In recognition of the on-road heavy-duty vehicle fleet's significant contribution to ozone and particulate matter formation in the South Coast Air Basin and its contribution to toxic air contaminants, much more stringent NO_x and PM standards have been adopted for new heavy-duty engines. In 2004, the NO_x emission standard was reduced by over 60 percent and PM emissions standard by over 80 percent compared to the emission standards of 1990. Complying

with the 2004 standard required improved engine designs and emission control technologies, such as exhaust gas recirculation, or EGR.

In 2007, the NO_x standard was effectively reduced by 50 percent and the PM standard reduced by another 90 percent compared to the 2004 standards. Complying with the 2007 NOx and PM standards will require additional emission control system improvements including the use of more advanced EGR strategies. The most advanced engine designs, coupled with exhaust aftertreatment will be needed to comply with 2010 emission standards, primarily driven by the 0.2 g/bhp-hr NOx emission standard, representing an additional 83 percent reduction in NOx compared to the 2007 standard.

PROPOSED METHOD OF CONTROL

This measure would call on the State of California to develop an expanded inspection and maintenance (I/M) program for heavy-duty diesel trucks by 2010. Specifically, the current smoke inspection program should be expanded to include (1) a visual under-the-hood inspection of the emission control devices, (2) an electronic check of the truck's on-board computer, and (3) use of remote sensing technology to assess in-use heavy-duty diesel truck emissions.

As mentioned previously, CARB currently has the authority to conduct roadside inspections of heavy-duty diesel trucks for the purpose of determining compliance with tampering and tailpipe opacity requirements. With the advent and requirement of on-board-diagnostic (OBD) instrumentation for heavy-duty diesel engines beginning in 2010, a program can be developed to periodically monitor the operating parameters of the engine and the resultant emissions. The implementation of an expanded I/M programs for in-use heavy-duty vehicles is particularly needed in order to track the expected increased rates of emissions deterioration caused by tampering and malmaintenance of exhaust aftertreatment devices and other emission control components expected to be used in 2007 and later model-year diesel-powered heavy-duty vehicles. In addition, an expanded I/M program would help avoid a situation identified several years ago where heavy-duty diesel engines were identified with NOx defeat devices for the purposes of fuel savings at the expense of excess pollution. In an effort to address this situation the United States Environmental Protection Agency and the California Air Resources Board entered into a consent decree agreement with engine manufacturers in 1998. One requirement of this agreement was a not-to-exceed (NTE) component for 1998 and later model year engines. The NTE limits have been introduced as an additional instrument to make sure that heavy-duty engine emissions are controlled over the full range of speed and load combinations commonly experienced in use. This proposed control measure would have CARB develop NTE limits for heavy duty diesel engines prior to the 1998 model year to ensure in-use emissions are kept in check for such engines not covered by the prior consent decree order. As an additional tool to monitor compliance with NTE limits, these proposed control measures call for the implementation of a remote sensing program for purposes of measuring in-use emissions from heavy-duty trucks.

EMISSIONS REDUCTION

The emission reductions associated with this control measure depend on program design and require further study. It is expected that these emission reductions would be similar to those

achieved under the current Inspection and Maintenance Program applicable to light and medium-duty vehicles.

RULE COMPLIANCE AND TEST METHODS

As more heavy-duty diesel engine trucks become equipped with on-board diagnostic devices, the opportunity exists to develop a program requiring the periodic check of these devices to facilitate the identification and repair of malfunctioning heavy-duty engine emission control systems. Similar to the check of a light-duty vehicle OBD system, it is anticipated that test technicians in an expanded heavy-duty vehicle I/M program would check for an illuminated MIL light and/or connect a diagnostic tool into the heavy-duty vehicle's OBD system for the purpose of downloading fault codes and related information that would assist the technician in identifying emission control system malfunctions. For older existing heavy-duty vehicles not equipped with OBD technology, a remote sensing component should be developed in order to identify vehicles with potentially excessive emissions for NO_x and particulate matter.

Establishment of NTE test procedures for 1998 and older heavy-duty diesel engines could be similar to those test procedures established for 1998 and newer heavy-duty diesel engines.

COST EFFECTIVENESS

Overall cost-effectiveness values for this control measure would require additional study. As a guide, the cost-effectiveness value for the current Inspection and Maintenance Program is estimated to be approximately $5,000 per ton of pollution (ROG + NOx) reducted. In addition, the cost-effectiveness of the combined CARB Heavy-Duty Vehicle Inspection program and Periodic Smoke Inspection Program is estimated to be approximately $2,000 per ton of pollution (hydrocarbons + NOx + PM) reduced. It is expected that the cost-effectiveness for this control measure would result in similar values.

IMPLEMENTING AGENCY

The implementing agency would be the California Air Resources Board and the Bureau of Automotive Repair. These agencies currently implement the Inspection and Maintenance Program for light- and medium-duty vehicles.

REFERENCES

CARB, Staff Report for Public Hearing to Consider Amendments Adopting More Stringent Emission Standards for 2007 and Subsequent Model Year New Heavy-Duty Diesel Engines, September 7, 2001.

Department of Consumer Affairs/Bureau of Automotive Repair – Report to the Legislature – April 2004 Evaluation of the California Enhanced Vehicle Inspection and Maintenance (Smog Check) Program, September, 2005.

SCAQMD, Support Information for SCAQMD Attachment 2A Recommended Control Strategies for the State and Federal Sources, and SCAQMD Attachment 2B Suggested Control Concepts for the State and Federal Element - 2003 Air Quality Management Plan, August 2003.

CARB Staff Report for Heavy-Duty Vehicle Smoke Inspection Program and Periodic Smoke Inspection Program, October 1997.

FURTHER EMISSIONS REDUCTIONS FROM HEAVY-DUTY TRUCKS PROVIDING FREIGHT DRAYAGE SERVICES [NOx, PM]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY: HEAVY-DUTY VEHICLES (33,000 AND GREATER GVWR)

CONTROL METHODS: ACCELERATED TRUCK REPLACEMENT PROGRAM WITH TRUCKS MEETING 2007 AND 2010 EXHAUST EMISSIONS STANDARDS

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	2002	2014	2020
VOC INVENTORY	3.0	2.3	1.5
VOC REDUCTION		0.2	0.1
VOC REMAINING		2.1	1.4
NOX INVENTORY	39.7	29.3	18.2
NOX REDUCTION		3.5	3.6
NOX REMAINING		25.8	14.6
CO INVENTORY	13.7	8.3	5.3
CO REDUCTION		0.6	0.5
CO REMAINING		7.7	4.9
PM10 INVENTORY	2.5	1.1	0.5
PM10 REDUCTION		0.2	0.2
PM10 REMAINING		0.9	0.3
PM2.5 INVENTORY	2.3	1.0	0.5
PM2.5 REDUCTION		0.2	0.2
PM2.5 REMAINING		0.8	0.3
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
VOC INVENTORY	2.9	2.3	1.5
VOC REDUCTION		0.2	0.1
VOC REMAINING		2.1	1.4
NOX INVENTORY	39.8	29.4	18.3
NOX REDUCTION		3.5	3.7
NOX REMAINING		25.9	14.6
CO INVENTORY	14.1	8.8	5.7
CO REDUCTION		0.6	0.5
CO REMAINING		8.1	5.2

CONTROL COST:

IMPLEMENTING AGENCY: CARB, MARINE PORTS, SCAQMD

DESCRIPTION OF SOURCE CATEGORY

Background

On-road heavy-duty diesel vehicle (truck) travel is an integral part of Port operations moving containers from the port into the SoCAB and beyond. Almost all of these trucks are rated with a gross vehicle weight (GVW) greater than 33,000 pounds. It is not known exactly how many unique trucks service both Ports. During the development of the San Pedro Bay Clean Air Action Plan baseline emissions inventory for both the Port of Los Angeles (2001 baseline) and the Port of Long Beach (2002 baseline) approximately 7,200 license plates of trucks visiting the ports were analyzed which determined that the average age of the port specific fleet was 12.9 years (MY 1990) compared to the 2001 statewide fleet age of 12.2 years (MY 1991) in the state of California's emissions inventory model EMFAC2002. From the baseline emissions inventory data set, it was found that MY 1958 to 2002 trucks serviced the ports.

Regulatory History

The regulation of emissions from heavy-duty diesel mobile sources is the responsibility of CARB and U.S. EPA. Specifically, heavy-duty truck and bus engines are each subject to specific emission standards pursuant to state and/or federal requirements. The standards, primarily affecting new units, vary in stringency and compliance dates. Currently, heavy-duty diesel engine manufacturers (OEMs) are developing NO_x control technologies to meet 0.2 g/bhp-hr NO_x. For the model years 2007 to 2010, the OEMs may phase in this technology to meet NO_x emission standards and requirements. Beginning in 2007, all new heavy-duty engines must meet a 0.01 g/bhp-hr PM exhaust emissions standard.

Currently, both Ports are in the midst of updating their emissions inventory (EI) of port-related sources for 2005. As a part of this EI update, extensive truck visit/license plate information has been collected from seven terminals (three from POLA and four from POLB). To date, over one million (1,003,024) optical character recognition (OCR) truck visit data records have been received from the seven terminals and represent a time range of 45 to 208 days of records. From this preliminary data set, there were 35,291 unique California registered trucks identified which had an average model year age of 1994. The trucks range in age from 1941 to 2006. Efforts are still under way to try to fill in data for the remaining container terminals and estimate the entire 2005 record of truck calls for both Ports. For now however, this data represents the best data set available to analyze the trucks servicing the San Pedro Bay Ports.

PROPOSED METHOD OF CONTROL

This control measure contains two elements: an expanded truck fleet modernization program and proposals for a NO_x-control retrofit/repower program for in-use heavy-duty diesel trucks. The two elements are further discussed below.

Port Truck Modernization

Replace the older heavy heavy-duty diesel trucks that service ports, and prevent older trucks from joining the fleet. All trucks entering port service in 2007 through 2011 must meet 2003 standards. All trucks entering port service after 2012 must meet 2007 standards, and after 2015 must meet 2010 standards. Remaining pre-2007 trucks would be retired and replaced with 2010 or newer trucks by 2019.

NOx Control Retrofit/Repower Program

Accomplishing the goals of this measure is a multi-step process. Heavy-duty diesel engine manufacturers would be required to develop and offer for sale retrofit kits for in-use diesel engines of their own manufacture. The supply of such kits, under defined schedule, would be a condition of heavy-duty engine emission certification. CARB would also need to verify the NO_x emission reductions of at least 30 percent. Current retrofit devices achieving on the average of at least 30 percent NO_x include: 1) Johnson Matthey EGRT diesel engine NO_x retrofit system verified with CARB attains a 40 percent reduction in NO_x emissions 2) SCR systems that are under development and demonstration by several companies including Argillon, Engelhard, ArvinMeritor and Clean Diesel Technologies have shown to achieve on the average 50 percent reduction. Truck operators garaged or registered in the South Coast Air Basin would then be required to purchase and install such NO_x retrofit kits as a condition of registering and operating their vehicles. The installation and continued function of the retrofit system could be enforced through a heavy-duty vehicle I/M program and sticker system. It is proposed that 1995 and newer heavy-duty diesel engines without NO_x aftertreatment be retrofitted; this will likely affect all 1995 through 2006 models, and certain 2007 through 2010 models.

A parallel approach is the development of advanced transport systems that can be used to transfer containers from the port to both local and "distant" intermodal facilities thereby significantly reducing emissions from on-road trucks and existing locomotives. Such systems use magnetic levitation (maglev) or linear induction on dedicated guideways. Containers are transported relatively quietly and without direct emissions. The footprints for such systems are similar to conventional rail systems but have reduced impact on adjacent property owners including noise and fugitive dust. These systems can even be built above or adjacent to freeways or on the berm of or elevated above existing river flood control channels. Container freight systems do not carry any operators or passengers on the guideways. Current container transport concepts have been developed by California State University, Long Beach, with General Atomics (CSULB-GA), and the Texas Transportation Institute (TTI). CSULB-GA has built a prototype system at GA's San Diego facility using maglev. This Electric Cargo Conveyor (ECCO) demonstration moves 20-foot containers. The elevated ECCO system costs about $200M per mile and $2.15 per container-mile for operation. TTI's concept for its "Freight Shuttle System" FSS) uses linear induction propulsion in combination with steel wheels on a flat steel running surface, similar to conventional rail. The elevated FSS system costs about $20M per mile and $0.10 per mile in operating costs. Both systems utilize a lightweight carriage in which the containers are carried. Automatic cranes can be used to load and unload the containers. Emission reductions are not provided for this approach at this time since separate actions are needed to ensure that the displaced trucks and locomotives are not operated elsewhere in the Basin.

EMISSIONS REDUCTION

NO_x emission reductions of at least 30 percent on average can be achieved with retrofit technologies discussed previously. For this proposed measure, 20,000 Model Year 1994 thru 2009 vehicles would be retrofitted or replaced by 2014. By 2020, this proposed control measure will call for an additional 20,000 heavy duty diesel vehicles retrofitted or replaced.

Additionally, particulate matter emission reductions of at least 85 percent can be achieved through diesel particulate filter traps.

COST EFFECTIVENESS

The cost and cost-effectiveness of this measure has not been determined at this time. The current state Carl Moyer fleet modernization program provides up to 80 percent of the cost of the replacement vehicle. Additionally, affected operators may access the historical Carl Moyer program, which provides for a $14,300/ton funding assistance.

IMPLEMENTING AGENCIES

CARB, Marine Ports, SCAQMD

REFERENCES

CARB. Emissions Reduction Plan for Ports and Goods Movement in California (April 2006)

Draft San Pedro Bay Ports Clean Air Action Plan (June 2006).

GROUP 2

OFF-ROAD MOBILE SOURCES

CONSTRUCTION/INDUSTRIAL FLEET MODERNIZATION [VOC, NOx. PM]

CONTROL MEASURE SUMMARY			
SOURCE CATEGORY:	OFF-ROAD CONSTRUCTION, INDUSTRIAL ENGINES AND TRANSPORTATION REFRIGERATION UNTIS		
CONTROL METHODS:	REPLACE OLDER ENGINES WITH NEW ON-ROAD ENGINES		
EMISSIONS (TONS/DAY):			
ANNUAL AVERAGE	**2002**	**2014**	**2020**
VOC INVENTORY	20.1	8.5	6.0
VOC REDUCTION		5.6	4.4
VOC REMAINING		2.9	1.6
NOX INVENTORY	146.4	79.1	44.7
NOX REDUCTION		54.6	38.4
NOX REMAINING		24.5	6.3
PM10 INVENTORY	9.2	4.2	1.7
PM10 REDUCTION		2.8	1.5
PM10 REMAINING		1.4	0.2
PM2.5 INVENTORY	8.4	3.9	1.6
PM2.5 REDUCTION		2.6	1.4
PM2.5 REMAINING		1.3	0.2
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
VOC INVENTORY	19.5	8.1	5.5
VOC REDUCTION		5.3	4.1
VOC REMAINING		2.8	1.4
NOX INVENTORY	144.6	77.8	43.8
NOX REDUCTION		53.7	37.7
NOX REMAINING		24.1	6.1
CONTROL COST:	$6,000 TO $8,000 PER MOYER WEIGHTED TON (NOX+VOC+20*PM) OF POLLUTANTS REDUCED		
IMPLEMENTING AGENCY:	CARB		

DESCRIPTION OF SOURCE CATEGORY

The purpose of this control measure is to promote faster turn-over and voluntary emission reductions from in use construction and industrial diesel engines.

Background

Off-road heavy-duty construction and industrial equipment account for 19% and 6.9% of the total NO_x and PM emissions, respectively, in 2014. However, these equipment emissions are projected to steadily increase over other mobile sources. At least 60% of today's heavy-duty construction equipment fleets were manufactured before 1988, with higher levels of emissions than later models. Through its Diesel Risk Reduction Plan CARB is focusing on off-road fleet rules reducing primarily PM and secondarily NOx emissions through retrofits controls, engine repowers, and equipment replacement. While CARB expects to see close to 90% reduction of PM by 2020, NOx reductions will be substantially less.

Regulatory History

The Federal Clean Air Act prohibits states from regulating emissions from new engines used in construction and farming equipment less than 175 horsepower. These represent about 80% of the total number of compression ignition diesel engines operating in the Basin. Diesel engines greater than 175 horsepower are regulated by CARB.

In September 1996, CARB, U.S. EPA, and the diesel engine manufacturers signed a statement of principles, which called for a cooperative effort to reduce NO_x, VOC, and PM emissions by more than 60%. In August 1998, U.S. EPA adopted new emission standards pertaining to off-road diesel engines. Subsequently, in January 2000 and in December 2004, CARB adopted amendments to existing California emission standards to harmonize with the federal requirement. These amendments included a tiered approach starting from 1996 for Tier 1 to 2008-2012 for Tier 4.

CARB is in the process of developing an Off-Road Equipment In-Use Rule which is expected to be adopted early next year which will reduce PM emissions by close to 90% through retrofit controls, engine repowers, and equipment replacement.

PROPOSED METHOD OF CONTROL

New off-road diesel engines are required to meet Tier 2 or Tier 3 emission standards ranging between 6.0 and 2.6 g/bhp-hr NO_x and 0.6 and 0.15 g/bhp-hr PM. To comply with these standards, newer off-road diesel engines are equipped with modern and better technologies resulting in 72 % less NO_x or PM than the pre-1988 engines, and will potentially emit 85% less NO_x in 2007. While substantially improved over the pre Tier 0 and Tier 0 emission rates the new off-road standards remain significantly higher than the same model year on-road engines. On-road engine standards for the year 2010 will meet emission levels 10 to 100 times cleaner than the oldest off-road engines resulting in 90 to 99% control of emissions.

SCAQMD staff recommends that CARB introduce a program ensuring by 2014 replacement of older engines with new on-road engines meeting 2010 emission standards. In addition the program should require all existing Tier 2 and Tier 3 engines will be retrofitted with PM controls (DPFs) that will achieve better than 85% control of PM in line with CARBs developing off-road fleet rules. In 2020, the control program can be augmented to include replacement of all pre-Tier 0 through Tier 3 off-road engines with on-road engines meeting the 2010 standard. The regulations should also be flexible enough to allow application of future retrofit

technologies if equivalent reductions can be attained. Such a regulation would provide a strong incentive for the development of such systems.

EMISSIONS REDUCTION

With all pre Tier 2 engines being replaced with on-road engines meeting the 2010 standard and the remaining Tier 2 and Tier 3 engines being fitted with controls to achieve 85% PM control, emission reductions are estimated to be 54.6 tons/day (tpd) for NO_x, 5.6 tpd for VOC, and 2.6 tpd PM2.5 in 2014, and 38.4 tpd for NOx, 4.4 tpd for VOC, and 1.4 tpd for PM assuming all pre-Tier 4, engines are replaced with on-road engines meeting the 2010 standard.

COST IMPACTS

SCAQMD experience through the Carl Moyer Program where many diesel engines have been replaced with newer cleaner engines shows a cost effectiveness factor of approximately $2,000 to $3,000 per ton of total pollutants reduced. Typically, repowers have been performed with cleaner off-road engines which are less expensive than repowering with on-road engines. Assuming that repowering with on-road engines is twice as costly a cost effectiveness number of approximately $4,000 to $6,000 per ton of pollutants reduced is realized illustrating that this control measure would be very cost effective to implement. To offset the cost of accelerated repowering, a financial support program, similar to the Carl Moyer Program, may be necessary.

IMPLEMENTING AGENCY AND ISSUES

CARB has the authority to require retrofit or replacement of off-road engines. This strategy can be implemented as a command-and-control regulation, possibly complemented with market incentive programs with credits given for earlier implementation.

REFERENCES

1. CARB Presentation: Diesel Off-Road Equipment Rule Working Group Meeting: New Regulatory Concepts and Inventory Updates, July 21, 2006.

ACCELERATED TURNOVER AND CATALYST BASED STANDARDS FOR PLEASURE CRAFT [VOC, NOx, PM]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY: PLEASURE CRAFT

CONTROL METHODS: ACCELERATE TURNOVER OF PLEASURE CRAFT FLEET TO MEET MOST STRINGENT EXISTING STANDARD BY 2014 AND MEET NEW MORE STRINGENT STANDARDS IN 2021

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	**2002**	**2014**	**2020**
VOC INVENTORY	51.5	30.2	25.6
VOC REDUCTION		14.4	22.4
VOC REMAINING		15.8	3.2
NOX INVENTORY	12.2	9.6	9.0
NOX REDUCTION		4.2	7.3
NOX REMAINING		5.4	1.8
PM10 INVENTORY	5.6	3.3	3.2
PM10 REDUCTION		2.9	2.8
PM10 REMAINING		0.4	0.4
PM2.5 INVENTORY	4.2	2.5	2.4
PM2.5 REDUCTION		2.2	2.1
PM2.5 REMAINING		0.3	0.3
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
VOC INVENTORY	83.5	48.8	41.2
VOC REDUCTION		23.4	36.1
VOC REMAINING		25.4	5.1
NOX INVENTORY	19.3	15.0	14.2
NOX REDUCTION		6.6	11.3
NOX REMAINING		8.4	2.8

CONTROL COST: NOT DETERMINED

IMPLEMENTING AGENCY: CARB

DESCRIPTION OF SOURCE CATEGORY

The purpose of this control measure is to promote faster turnover of the pleasure craft fleet and development of more stringent catalyst based standards for pleasure craft.

Background

It is estimated that currently there are 250,000 two-stroke gasoline engines and 115,000 four-stroke gasoline engines in the Basin that are used for recreational marine activities. The emission inventory for the exhaust emissions from the two- and four-stroke gasoline engines is about 69 tons/day of VOC in 2014. Pleasure craft will continue to be the second largest (second to light duty passenger vehicles) contributors of VOC to the mobile source inventory, and are expected to remain one of the largest contributor in future years. By far the largest contributors to the pleasure craft VOC emissions are the 2-stroke engines which by design have significantly higher VOC and CO emissions. The purpose of this control measure is to replace existing two-stroke carbureted gasoline engines and older 4 stroke engines with significantly cleaner engines, and develop more stringent catalyst based standards for all pleasure craft gasoline categories.

Regulatory History

The regulation of emissions from mobile sources is primarily accomplished through CARB and U.S. EPA regulations. EPA's 40CFR Part 91, Control of Emissions from Marine Spark Ignition Engines, requires all spark ignited outboard marine engines to meet certain hydrocarbon and NO_x emissions standards starting with model year 1998. Also, CARB's Title 13 requires all pleasure craft spark ignited engines to meet certain hydrocarbon and NO_x emission standards. These standards are implemented in phases with the last phases be completed in 2008 or 2009. Personal water craft and outboard motors will be required to meet an average emission of approximately 17 g/kw-hr of NOx+VOC. Inboard and stern drive engines will be required to meet a standard of 5 g/kw-hr. The standards will result in engines being up to 10 times cleaner than the oldest engines in the fleet. However, the emission standards remain far above the standards for other spark ignited engine categories. For example, ARB's most recent regulation for Large Spark Ignited (LSI) engines requires engines to soon meet a 0.8 g/kw-hr emission standard (10 to 20 times lower than the most stringent pleasure craft standards) and states that with advanced technology even lower levels are achievable. While the duty cycle and operational environment (in or on the water) provide different challenges than those for land based spark ignited engines in achieving the lowest emission levels, there certainly appears to be opportunity for additional reductions through further engine modifications and the addition of exhaust catalysts.

PROPOSED METHOD OF CONTROL

CARB would implement programs to accelerate retirement or retrofit of all pleasure craft engines not meeting the most stringent emission standards by 2014, and (2) develop new emission standards and regulations that ensure that the entire pleasure craft fleet meet the new standards by 2021.

EMISSIONS REDUCTION

If through an accelerated retirement or retrofit program all personal water craft and outboard motors meet the 17 gm/kw-hr standard and all inboard and stern drive engines meet the 5 g/kW-hr standard by 2014, the reductions could potentially be 14 tons/day VOC and 4.2 tons/day NOx. Developing and implementing more stringent standards (assumed to be 5 g/kW-hr for personal water craft and outboard motors and 0.5 g/kw-hr for inboard and stern drive engines based on better catalyst and engine performance) and requiring the entire pleasure craft fleet to

meet these standards by 2020 would result in VOC reduction of approximately 22 tons/day and NOx reductions of 7.3 tons/day.

COST IMPACTS

Preliminary analysis of the costs associated with accelerated fleet turnover (i.e. replacement of older engines with the cleanest engines) show cost effectiveness numbers close to $5,000 per ton of NOx+VOC controlled. CARB during its development of the 2005 inboard/sterndirve boat regulations calculated a cost effectiveness range for complying with the proposed 5 g/kW-hr limit of between $4000 to $7000 per ton of NOx+VOC controlled. This was based on is expected to also fall close to this range of cost effectiveness values as catalyst and engine technologies improve.

IMPLEMENTING AGENCY AND ISSUES

CARB has the legal authority to require in-use retrofit controls and accelerated engine replacement programs. This strategy can be implemented as a phased, command-and-control regulation, complimented with market incentive programs.

REFERENCES

Literature

1. Emissions from Two Outboard Engines Operating on Reformulated Gasoline Containing MTBE; Peter A. Gable, U.S. EPA, and Steven M. Pyle, U.S. EPA
2. 40 CFR Part 91
3. CARB, Title 13
4. CARB, Staff Report: New Emission Standards, Fleet Requirements, and Test Procedures for Forklifts and Other Industrial Equipment, March 3, 2006.

LOWER EXHAUST STANDARDS FOR OFF-ROAD RECREATIONAL VEHICLES [VOC, NOx]

CONTROL MEASURE SUMMARY			
SOURCE CATEGORY:	OFF-ROAD RECREATIONAL VEHICLES		
CONTROL METHODS:	PROMULGATE NEW STANDARDS AND ACCELERATE FLEET TURNOVER		
EMISSIONS (TONS/DAY):			
ANNUAL AVERAGE	**2002**	**2014**	**2020**
VOC INVENTORY	14.1	19.2	21.5
VOC REDUCTION		12.8	20.8
VOC REMAINING		6.3	0.7
NOX INVENTORY	0.5	0.7	0.9
NOX REDUCTION		0.5	0.9
NOX REMAINING		0.2	>0.1
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
VOC INVENTORY	13.0	18.4	21.9
VOC REDUCTION		12.4	21.3
VOC REMAINING		6.0	0.6
NOX INVENTORY	0.4	0.6	0.7
NOX REDUCTION		0.4	0.7
NOX REMAINING		0.2	>0.1
CONTROL COST:	NOT DETERMINED		
IMPLEMENTING AGENCY:	CARB		

DESCRIPTION OF SOURCE CATEGORY

The purpose of this regulation is to develop and implement new standards and accelerate fleet turn-over to expedite emission reductions.

Background

The Off-Road Recreational vehicle category includes motorcycles and all terrain vehicles (ATV) equipped with 2- and 4- stroke engines that operate on trails and other terrain. There are approximately 250,000 of these vehicles in the South Coast today and this number is expected to increase to over 400,000 vehicles in 2020. The category is the third largest VOC off-road source behind lawn and garden equipment and pleasure craft, and is expected to grow to the second largest category in 2020. VOC emissions are estimated at 18.4 tons/day in 2014 and 21.9 tons/day in 2020.

Regulatory History

CARB adopted emission standards for off-road recreational vehicles in 1994 where all new engines would meet a 1.2 g/mile VOC or for some vehicles a 16.1 g/kW-hr (13.4 g/kW-hr for engines > 225cc) VOC+NOx exhaust standard by 1999. EPA promulgated exhaust and evaporative standards in 2002 with a final implementation deadline of 2007 and CARB will soon adopt equivalent evaporative standards. This source category has had difficulties meeting these lower levels of emissions because of the high performance demanded by the customers and offered until recently only by 2-stroke engines. Because of these difficulties, CARB set up a unique program where non-complying vehicles could be operated in California if they followed seasonal and geographic riding restrictions. EPA during its regulation development process recognized this issue and adopted slightly less stringent exhaust standards than those adopted by California to allow more high performance 4-stroke engines that met the performance characteristics wanted by off-road recreational vehicle enthusiasts.

PROPOSED METHOD OF CONTROL

New catalyst based exhaust standards as well as incentives to increase fleet turn-over are proposed. Addition of a catalyst should result in a substantial decrease in emissions and it is expected that a new standard is adopted at 5 g/kW-hr (VOC+NOx) by 2014 and incentives or regulations are implemented to increase fleet turnover so that he fleet average emissions are at 5 g/kW-hr (VOC+NOx). The standard level and the expected reduction are similar to those soon to be required of inboard and sterndrive pleasure craft engines and these are based on an addition of a catalyst. By 2021, it is expected that the technology will improve so that a new standard approximately 10 times more stringent (~ 0.5 g/kW-hr) can be adopted and incentives or regulations can be adopted accelerating fleet turn-over so that in 2021 the fleet average emission is equivalent to the a 0.5 g/kW-hr standard.

EMISSIONS REDUCTION

Assuming the fleet average emission rate is equivalent to the 5 g/kW-hr standard emission reductions of VOC and NOx in 2014 will be 13 tons/day and 0.5 tons/day respectively. In 2020, assuming the fleet average is at the 0.5 g/kW-hr level VOC and NOx reductions will be 21 tons/day and 1 ton/day respectively.

COST EFFECTIVENESS

The cost effectiveness of this control measure is expected to be similar to that estimated for other off-road engine measures where addition of a catalyst and engine modifications are proposed to meet the emission limits. Expected cost effectiveness values would range between $4,000 to $7,000 per ton of (NOx+VOC) controlled.

IMPLEMENTING AGENCY

CARB has the legal authority to adopt emission standards and accelerated vehicle replacement programs. This strategy can be implemented as a phased, command-and-control regulation, complimented with market incentive programs.

REFERENCES

CARB – Staff Report: Initial Statement of Reasons for Rulemaking – Public Hearing to Consider Amendments to the California Regulations for New 1997 and Later Off-Highway Recreational Vehicles, June 2, 2006.

EPA – Control of Emissions from Non-Road Large Spark-Ignition Engines and Recreational Engines (Land and Marine Based), Federal Register, Vol. 67, No. 217, 11/8/2002.

EVAPORATIVE STANDARDS FOR OFF-ROAD RECREATIONAL VEHICLES AND PLEASURE CRAFT [VOC]

CONTROL MEASURE SUMMARY			
SOURCE CATEGORY:	OFF-ROAD RECREATIONAL VEHICLES AND PLEASURE CRAFT		
CONTROL METHODS:	PROMULGATE NEW EVAPORATIVE STANDARDS		
EMISSIONS (TONS/DAY):			
ANNUAL AVERAGE	**2002**	**2014**	**2020**
VOC INVENTORY	14.9	17.6	19.0
VOC REDUCTION		8.6	17.1
VOC REMAINING		9.0	1.9
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
VOC INVENTORY	16.8	26.5	28.9
VOC REDUCTION		13.0	26.0
VOC REMAINING		13.5	2.9
CONTROL COST:	NOT DETERMINED		
IMPLEMENTING AGENCY:	CARB		

DESCRIPTION OF SOURCE CATEGORY

The purpose of this regulation is to develop and implement new evaporative standards for off-road recreational vehicles and pleasure craft.

Background

The pleasure craft and off-road recreational vehicle categories are the largest and third largest VOC contributors to the off-road mobile source inventory. There are approximately 350,000 pleasure craft registered in the South Coast today and these include outboard engines and personal water craft (e.g. jet skis) – the majority of which are 2-stroke engines, and larger engine inboard/sterndrive vessels. The off-road recreational vehicle category includes motorcycles and all terrain vehicles (ATV) equipped with 2- and 4- stroke engines that operate on trails and other terrain. There are approximately 250,000 of these vehicles in the South Coast today and this number is expected to increase to over 400,000 vehicles in 2020.

Regulatory History

CARB and U.S. EPA have adopted or are close to adopting exhaust and evaporative emission standards for both pleasure craft and off-road recreational vehicles. Currently, all pleasure craft and off-road recreational vehicles must meet an exhaust emission standard equivalent to approximately 16 g/kW-hr (VOC+NOx). By 2009, all new inboard/sterndrive engine vessels will need to meet a more stringent catalyst based exhaust standard of 5 g/kW-hr. Evaporative standards focusing on reducing permeation emissions from fuel tanks and fuel lines will soon be

adopted and implemented achieving upwards of 85% control of these emissions from these source categories.

PROPOSED METHOD OF CONTROL

Evaporative emissions are a significant fraction of VOC emissions from these sources. Evaporative emissions occur by several mechanisms – running evaporation, hot soak, and diurnal. Running evaporation occurs when the heat from the engine warms the fuel and vibrations from the engine agitate the fuel causing increased evaporation and emissions. Hot soak occurs immediately after the engine is stopped where the warmed fuel has increased evaporative emissions until it reaches room temperature. Most evaporative emissions are diurnal emissions and occur from the daily temperature variations and include permeation and venting emissions. A recent CARB analysis showed that approximately 55% of evaporative emissions are from permeation with the remaining emissions occurring from venting. Low permeable materials are available today and are used on many other types of mobile sources, resulting in over 90% reduction of permeation emissions. SCAQMD staff propose that CARB develop and implement regulations to reduce permeation and venting emissions by 90% through retrofits, incentives, and regulation and that measures are adopted that ensure that the pleasure craft and recreational vehicle fleet will see a 45% reduction in evaporative emissions by 2014, and a 90% reduction in evaporative emissions by 2021.

EMISSIONS REDUCTION

If evaporative emissions are reduced by 45% in 2014 and 90% in 2020, annual average emission reductions are estimated to be 9 and 17 tons per day, respectively. Evaporative emissions are estimated to be somewhat higher during the summer ozone season. As such, VOC emission reductions are estimated to be 13 and 26 tons per day for 2014 and 2020.

COST EFFECTIVENESS

CARB has estimated that the cost effectiveness of evaporative controls on lawn and garden equipment and other small off-road engines ranges from $2,000 to $6,000 per ton of VOC controlled. It is expected that this control measure will have similar cost effectiveness values.

IMPLEMENTING AGENCY

CARB has the legal authority to adopt emission standards.

REFERENCES

CARB – Staff Report: Initial Statement of Reasons for Rulemaking – Public Hearing to Consider Amendments to the California Regulations for New 1997 and Later Off-Highway Recreational Vehicles, June 2, 2006.

CARB – Staff Presentation: Setting Evaporative Emission Standards for Pleasure Craft, April 2006.

EPA – Control of Emissions from Non-Road Large Spark-Ignition Engines and Recreational Engines (Land and Marine Based), Federal Register, Vol. 67, No. 217, 11/8/2002.

FURTHER EMISSION REDUCTIONS FROM LOCOMOTIVES [NOX, PM]

CONTROL MEASURE SUMMARY			
SOURCE CATEGORY:	LOCOMOTIVE ENGINES (ALL CLASSES)		
CONTROL METHODS:	ACCELERATED REPLACEMENT OF EXISTING LOCOMOTIVE ENGINES MEETING TIER 3 OR CLEANER EXHAUST STANDARDS		
EMISSIONS (TONS/DAY):			
ANNUAL AVERAGE	**2002**	**2014**	**2020**
NOX INVENTORY	33.8	18.3	21.0
NOX REDUCTION		15.3	17.7
NOX REMAINING		3.0	3.3
PM10 INVENTORY	0.8	0.8	0.8
PM10 REDUCTION		0.7	0.7
PM10 REMAINING		0.1	0.1
PM2.5 INVENTORY	0.8	0.7	0.7
PM2.5 REDUCTION		0.6	0.6
PM2.5 REMAINING		0.1	0.1
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
NOX INVENTORY	33.8	18.3	21.0
NOX REDUCTION		15.3	17.7
NOX REMAINING		3.0	3.3
CONTROL COST:	THE COST-EFFECTIVENESS OF THIS CONTROL MEASURE WILL VARY DEPENDING ON THE TYPE OF CONTROL EQUIPMENT		
IMPLEMENTING AGENCY:	U.S. EPA		

DESCRIPTION OF SOURCE CATEGORY

Background

Diesel-electric locomotives have a large diesel engine (main traction engine) for generating electric power which in turn drives electric motors in each axle. Modern line-haul or freight locomotives have 4400-horsepower diesel engines with six drive axles. Passenger locomotives have similar engines with about 3800 horsepower and four drive axles. Switch locomotives are smaller, and usually older, four-axle locomotives, with 1200-2500 horsepower engines. EPA emission standards affect 1973-2001 locomotives upon engine rebuild and new 2002 and later locomotives. Locomotives remain in commercial service from 25 to 40 years.

Regulatory History

In December 1997, the U.S. EPA published emission standards for diesel locomotives. These standards included Tier-0 standards for 1973-2001 uncontrolled locomotives upon rebuilding of their diesel engines; more stringent Tier-1 standards for new 2002-2004 locomotives; and modestly stringent Tier-2 standards for 2005 and newer locomotives. However, these standards did not match the stringency of adopted emission standards for on-road diesel engines. As a result, in June 2004, the U.S. EPA announced it intended to adopt more stringent Tier-3 standards for new diesel locomotives, possibly starting with 2011 models. The U.S. EPA indicated that the new locomotive standards would consider emission control technologies proposed for heavy-duty on-road diesel vehicles, including selective catalytic reduction (SCR), diesel particulate filters (DPFs), and lean-NOx absorber technology.

Beside the federal emission requirements for locomotives, CARB has signed two agreements with the two Class-1 railroads operating in California, Burlington Northern Santa Fe Railway (BNSF) and Union Pacific Railroad (UP). The first agreement, the South Coast Memorandum of Understanding (MOU), was signed in 1998. Among other features, it commits these railroads to meeting Tier-2 NOx standards, on average, starting in 2010 with their locomotives operating in the South Coast Air Basin. The second CARB agreement, the Rail Yard Agreement, was published in 2005. It commits these railroads to reduce diesel emissions in and around rail yards in California including a statewide locomotive idle-reduction program, increase use of low-sulfur diesel for locomotives fueled in California, and a visible-emissions reduction and repair program.

In April 2006, CARB adopted the Emission Reduction Plan for Ports and Goods Movement in California (GMERP). This plan proposes several control measures including Tier-3 locomotive emission standards which would reduce Tier-2 NOx and PM by 90 percent starting with 2011 locomotives. California fleet penetration of Tier-3 locomotives is projected for 40 percent in 2015 and 90 percent in 2020. Another measure includes remanufacturing Tier-2 locomotives to Tier-2.5 standards with a 25-percent NOx reduction and 60-percent PM reduction over Tier-2 standards. Finally, one measure proposes the replacement of all switch locomotives in California by hybrids by 2010.

EPA has adopted a series of non-road-engine emission standards beginning with Tier-1 standards with 1996 engines and culminating with Tier-4 standards beginning in 2014. These standards also vary by maximum power rating of these essentially portable engines. Compliance with Tier-4 interim standards is required starting in 2011 and will necessitate the use of DPFs. Full Tier-4 standards start in 2014 and will require the use of both DPF's and NOx after-treatment, most likely SCR. Non-propulsion engines used on locomotives are required to be emission-controlled non-road engines.

PROPOSED METHOD OF CONTROL

The GMERP proposes a 40-percent penetration of Tier-3 locomotives in California. This measure proposes that all locomotives operating in the Basin by 2014 have Tier-3-equivalent emissions, either new Tier-3 locomotives or older Tier-2 locomotives retrofitted with DPF and

SCR systems. In addition, all locomotives moving in and out of the twin ports in the Southern California region would be equipped with Tier-3-equilvalent controls by 2011.

The replacement of conventional switch locomotives with hybrid switchers results in the use of EPA non-road engines to generate electric power. Depending upon the rated horsepower this will result in a mix of Tier-2, Tier-3, and Tier-4 Interim standard engines on these hybrid locomotives by 2014. All such engines should be retrofitted with after-treatment DPF and SCR systems to reduce them to Tier-4 non-road engine emissions. Such retrofit systems are in the process of being verified by CARB for on-road truck engines similar in power and will be available for these non-road engines to bring them to Tier-4 standards.

CONTROL TECHNOLOGY AVAILABILITY

Three technologies are currently available for controlling locomotive diesel engines: SCR, DPFs and DOCs.

SCR has been used for many years on large stationary engines for NOx control. Locomotives are propelled by engines similar to such stationary engines. By increasing the ruggedness and durability of the current SCR systems, NOx emissions can be reduced by at least 85 percent. In addition, SCR reduces PM by about 50 percent in a locomotive environment. Besides the special catalytic converter, these systems inject ammonia into the exhaust stream to enable the SCR catalyst to reduce NOx to nitrogen and water. For mobile applications, urea solution, which breaks down to form ammonia in the exhaust, is used because it is safer than ammonia in terms of maintenance and accident scenarios.

DPFs have been introduced in recent years on heavy-duty on-road trucks and buses for PM control and will be used on all 2007 model heavy-duty engines. Also, retrofit DPFs have been verified by CARB for 1994 and newer diesel engines up to 500 horsepower. DPFs generally reduce PM by at least 85 percent. Hug Engineering of Switzerland has recently developed and introduced a DPF system for switch locomotives with four-cycle engines. The American Association of Railroads (AAR) is also demonstrating these DPFs on switch locomotives with EMD two-cycle engines. Switch locomotives spend much time idling and generally have cooler diesel exhaust which does not self-initiate regeneration of the collected soot. As such, DPF systems on switch locomotives use a fuel-fired burner to assist in regeneration of collected PM. However, line-haul locomotives frequently have high exhaust temperatures which can facilitate such regeneration without burners.

Combination SCR-DPF systems are being developed and verified for on-road trucks and are expected to become commercially available within the next one to two years. Such systems would be compatible with the smaller diesel engines of hybrid switch locomotives. A minimum control efficiency of 85 percent is expected for both NOx and PM.

In recent years, DOCs have been introduced on certain heavy-duty on-road diesel engines. These DOCs oxidize a portion of the PM in the exhaust stream, usually by at least 30 percent. Recently, EPA has demonstrated retrofit DOCs on a line-haul locomotive. Such DOCs require that higher exhaust temperatures be achieved in order to burn-off collected soot from idling. DOCs, without burners or other technology, are not appropriate for switch locomotives due to low exhaust temperatures and extended idling.

CONTROL TECHNOLOGY APPLICABILITY

Tier-3 Locomotive Penetration

CARB is proposing in the GMERP a 40-percent penetration rate of Tier-3 locomotives in California in 2015. CARB's proposal could be enhanced through the retrofitting of Tier-2 locomotives with DPF and SCR technology to bring them to Tier-3 emission levels. Essentially by 2010, all locomotives being operated by BNSF and UP in the Basin will be Tier-2 due to the 1998 MOU. DPF technology is now being investigated by the US locomotive manufacturers, has been used on locomotives in Europe, and is being demonstrated on switch locomotives here in the U.S. This technology on a full-size locomotive has not been publicly demonstrated in the U.S., but such commercial DPF systems do exist in Europe. With regard to SCR systems, such a system demonstration on a full-size Metrolink locomotive will be conducted in 2007.

Hybrid Switch Locomotives with Tier-4 Controls

Hybrid-electric and multi-engine hybrid locomotives use smaller diesel engines to provide either battery or traction power. As such, these engines run at nearly full power and have high-temperature exhaust. Such operation is compatible with SCR and DPF systems. There are truck-engine-sized SCR and DPF combinations in the process of being verified by CARB, and these are expected to become commercially available in the next one to two years. Such after-treatment systems would be applicable to these locomotives and will provide maximum NOx and PM control.

The replacement of conventional switch locomotives with hybrid switchers results in the use of EPA non-road engines to generate electric power. Depending upon the rated horsepower this will result in a mix of Tier-2, Tier-3, and Tier-4 Interim standard engines on these hybrid locomotives by 2014. All such engines should be retrofitted with after-treatment DPF and SCR systems to bring them in compliance with Tier-4 non-road engine emissions. Such retrofit systems are in the process of being verified by CARB for on-road truck engines similar in power and will facilitate lowering these non-road engines to Tier-4 emission levels.

EMISSIONS REDUCTION

Full implementation of the proposed control measure would result in a 58 percent reduction in NOx and 63 percent reduction in particulate matter by 2014. Further reductions are achieved by 2020 with greater penetration of retrofits as described above.

COST EFFECTIVENESS

It is estimated that the additional cost for SCR and a DPF on new line-haul locomotives would cost about $200,000 to install. The annualized cost for such a unit would be approximately $42,000. This includes a 10 year housing life, a 5 year DPF and SCR element life and $8,000 per year for urea. The estimated cost to equip existing smaller switcher locomotives with diesel oxidation catalyst devices is about $50,000. The estimated cost to equip existing locomotives with a DPF is about $150,000 per locomotive.

IMPLEMENTING AGENCY

U.S. EPA has the legal authority to adopt emission standards for locomotives. In addition, the Ports of Los Angeles and Long Beach have authority as landlords to impose certain conditions on leases and other contractual arrangements.

REFERENCES

CARB. Emissions Reduction Plan for Ports and Goods Movement in California (April 2006)

Miratech, Inc., Personal Communications. (August 2006)

Draft San Pedro Bay Ports Clean Air Action Plan (June 2006).

CLEAN MARINE FUEL REQUIREMENTS FOR OCEAN-GOING MARINE VESSELS [NOX, SOX, PM]

CONTROL MEASURE SUMMARY			
SOURCE CATEGORY:	MARINE VESSELS		
CONTROL METHODS:	ACCELERATED USE OF 0.2 PERCENT OR CLEANER SULFUR CONTENT MARINE FUELS		
EMISSIONS (TONS/DAY):			
ANNUAL AVERAGE	**2002**	**2014**	**2020**
NOX INVENTORY	37.3	73.1	93.2
NOX REDUCTION		7.3	9.3
NOX REMAINING		65.8	83.9
SOX INVENTORY	23.2	47.5	62.1
SOX REDUCTION		45.6	59.6
SOX REMAINING		1.9	2.5
PM10 INVENTORY	3.1	6.2	8.1
PM10 REDUCTION		4.1	5.4
PM10 REMAINING		2.1	2.7
PM2.5 INVENTORY	3.0	6.0	7.9
PM2.5 REDUCTION		4.0	5.2
PM2.5 REMAINING		2.0	2.7
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
NOX INVENTORY	37.3	73.1	93.2
NOX REDUCTION		7.3	9.3
NOX REMAINING		65.8	83.9
CONTROL COST:	NOT DETERMINED		
IMPLEMENTING AGENCY:	MARINE PORTS, CARB, U.S. EPA		

DESCRIPTION OF SOURCE CATEGORY

Background

The regulation of emissions from ocean-going vessels has historically been implemented by international bodies and the federal government. Emissions from these federal sources continue to represent a significant and increasing portion of the emissions inventory in the South Coast Air Basin. The state has authority to adopt regulations setting marine fuel specifications to be used on marine vessels. Recent emissions inventory studies and forecasts for marine vessels indicate that activity and emissions from these sources are increasing.

The U.S. EPA has not adopted national rules which are sufficiently stringent to achieve the emissions reductions needed for the South Coast Air Basin to attain the federal ozone and PM air quality standard. Without adequate controls of these sources, however, the emissions reduction burden would have to be shifted to other stationary and mobile sources that have been regulated for many years, and attainment of the ozone and PM standard may not be possible.

The sulfur content of diesel oil used in the marine industry is between 150 to 500 ppmw and bunker oil is between 10,000 to 25,000 ppmw. In 2014, ships will emit almost 48 tons of SO_x per day, which is 57% of all SO_x emissions in the Basin. The NO_x emissions from ships are approximately 73 tpd. A typical medium size cargo ship burns seven tons of diesel fuel a day while at the port, and generates as much as one ton of NO_x and 100 pounds of PM daily. Emissions from diesel-fueled engines also include toxic air contaminants. Emissions from marine vessels will most likely increase in the basin due to anticipated increase in port-related activities in the next 10 to 15 years.

This control measure provides for the use of lower sulfur content marine fuels within South Coast Air Basin waters.

Regulatory History

The International Maritime Organization (IMO) established limits for NOx in Annex VI to the International Convention for the Prevention of Pollution from Ships in 1997. IMO limits apply to marine vessel engines over 130 kilowatts (kW) installed on vessels built on or after 2000. Depending upon the engine speed in revolutions per minute (rpm), the NOx standards vary between 17.0 g/kW-hr (for < 130 rpm) to 9.8 g/kW-hr (for ≥2000 rpm). While a majority of countries have ratified MARPOL Annex VI, it has not been ratified by the U.S. Despite the formal status of Annex VI, it is believed that engines manufactured after 2000 meet the standard due to the retroactive nature of the regulation (i.e., once fully in effect engines must comply, and the simplest way for that to occur is for them to be manufactured to comply)

In December 2005, CARB adopted low sulfur fuel requirements for marine auxiliary engines within 24 nautical miles (nm) of the California coastline. Starting in January 2007, it requires use of marine diesel oil (MDO) or marine gas oil (MGO) with sulfur content of equal or less than 0.5% S by weight, followed by use of marine gas oil with sulfur content of equal or less than 0.1 % S in 2010. The use of low sulfur fuel will reduce emissions of NOx, PM and sulfur oxides (SOx).

The Ports of Los Angeles and Long Beach Clean Air Action Plan include a requirement to use 0.2 percent fuel for each shipping line.

More recently, Maersk, Inc., one of the largest cargo shipping lines moving freight across the Pacific, announced their plans to use a 0.2% sulfur content effective immediately. The announcement by Maersk sets a new standard for other shipping lines to meet.

PROPOSED METHOD OF CONTROL

All ocean-going marine vessels will use low sulfur diesel fuel (0.2 percent) in main engines and auxiliary engines when operating within 40 nautical miles off of Point Fermin beginning in 2008 and 0.1 percent sulfur content fuel beginning in 2010.

EMISSIONS REDUCTION

Implementation of this control measure is expected to accelerate emission reductions during the early years of the program through the use of low sulfur content marine fuels. Full implementation of this control measure would result in over 96 percent of the estimated SOx emissions, 66 percent particulate matter emissions, and reduction of 10 percent NOx emissions from ocean-going vessels by 2014.

COST EFFECTIVENESS

The estimated cost to implement this control measure is a function of fuel supply and demand. According to Maersk, Inc., the cost is about twice as much to use a 0.2 percent sulfur content fuel compared to the current bunker fuel in use by most ocean-going vessels. There will be a need to have international recognition for the need of such fuel in order to lower costs.

IMPLEMENTING AGENCY

Marine Ports, CARB, U.S. EPA

REFERENCES

Maersk, Inc. (May 2006)

Draft San Pedro Bay Ports Clean Air Action Plan (June 2006).

FURTHER EMISSION REDUCTIONS FROM OCEAN-GOING MARINE VESSELS AND HARBOR CRAFT WHILE AT BERTH [ALL POLLUTANTS]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY: AUXILIARY ENGINES ON OCEAN-GOING MARINE VESSELS AND HARBOR CRAFT

CONTROL METHODS: USE OF SHORE-SIDE ELECTRICAL POWER OR OTHER EQUIVALENT CLEAN TECHNOLOGIES

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	2002	2014	2020
VOC INVENTORY	0.3	0.7	0.9
VOC REDUCTION		0.5	0.7
VOC REMAINING		0.2	0.2
NOX INVENTORY	12.6	30.6	37.1
NOX REDUCTION		22.6	30.4
NOX REMAINING		8.0	6.7
SOX INVENTORY	8.5	20.7	25.0
SOX REDUCTION		15.3	20.5
SOX REMAINING		5.4	4.5
PM10 INVENTORY	1.1	2.6	3.1
PM10 REDUCTION		1.9	2.6
PM10 REMAINING		0.7	0.5
PM2.5 INVENTORY	1.0	2.5	3.1
PM2.5 REDUCTION		1.9	2.5
PM2.5 REMAINING		0.6	0.6
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
VOC INVENTORY	0.3	0.7	0.9
VOC REDUCTION		0.5	0.7
VOC REMAINING		0.2	0.2
NOX INVENTORY	12.6	30.6	37.1
NOX REDUCTION		22.6	30.4
NOX REMAINING		8.0	6.7

CONTROL COST: TO BE DETERMINED

IMPLEMENTING AGENCY: MARINE PORTS, CARB, SCAQMD

DESCRIPTION OF SOURCE CATEGORY

Background

Marine vessels and portside equipment, which primarily run on diesel fuel, contribute a significant portion of NO_x, SO_x, PM, greenhouse gas and toxic emissions particularly in coastal regions and in and around shipping ports. These emissions contribute to on-shore air quality problems. In order for progress to continue meeting clean air goals, emission reductions from marine vessels and portside equipment are necessary. However, it should be recognized that there are some local voluntary efforts in reducing ship related emissions. The sulfur content of diesel oil used in the marine industry is between 150 – 500 ppmw, and that of bunker oil is between 10,000 – 25,000 ppmw. In 2014, ships will emit almost 20 tons of SO_x per day while at berth in the South Coast Air Basin. The NO_x emissions from ships are approximately 30 tpd. A typical medium size cargo ship burns seven tons of diesel fuel a day while at the port, and generates as much as one ton of NO_x and 100 pounds of PM daily. Emissions from diesel-fueled engines also include toxic air contaminants.

Ships use auxiliary engines to provide electricity for hotelling operations while berthed at ports, and to provide electrical power and steam while the ship is in operation. Hotelling includes operations on a marine vessel that require electrical energy to power operations that include, but are not limited to, lights, ventilation, heating, cooling, and loading and unloading operation. Most auxiliary engines use diesel oil and for ocean-going vessels the fuel can be bunker oil. During hotelling operations, these engines produce significant amounts of NO_x, SOx, PM, and toxic air contaminant (TAC) emissions.

This control strategy focuses on requiring ships to cold iron, which is a technology that is used to provide on-board power from the shore, while berthed at the Port of Los Angeles (POLA) and the Port of Long Beach (POLB). Other near-equivalent technologies that are currently being evaluated include a bonnet system to funnel ship exhaust emissions into filter and NOx reduction systems, and may be considered under this control measure.

Regulatory History

The regulation of emissions from mobile sources is primarily accomplished through CARB and U.S. EPA regulations. Currently, there are no regulations for cold ironing ships that are berthed at POLA and POLB. However, the shore power is being provided at one terminal at POLA. The draft San Pedro Bay Clean Air Action Plan provides for the construction of shore-side power infrastructure at all terminals.

Emission Standards for Harbor Craft Engines

The U.S. EPA has established new engine standards for new "Category 1 and 2" diesel engines – engines rated over 50 hp used for propulsion in most harbor craft. These standards are to be phased in between 2004 and 2007 and limit NOx, hydrocarbon, CO and PM, but the emissions reductions achieved are modest in the next five years. U.S. EPA expects a 24% reduction in NOx and 12% reduction in PM in 2030 when the harbor craft engine fleet is fully turned over to these new engines.

PROPOSED METHOD OF CONTROL

Electrical power for hotelling operations can be provided to a ship via electrical cables using shore power. Shore power can be locally generated at the port or obtained from the grid. Shore power can be locally generated using clean technologies such as fuel cells, gas turbines, microturbines, and combined cycle units. These stationary power generating systems can use alternative fuels such as natural gas, reducing emissions to very low levels. The in-Basin grid power generation NO_x emission factor is significantly lower than that of diesel-fueled engines especially because most stationary power generating units have installed SCRs. The use of shore power for hotelling operations is termed "cold ironing."

Due to technical and operational (i.e., frequency of calls) reasons, however, cold ironing may not be a viable option for all types of ships. Also, ships require steam for hotelling operations. If all the electrical power for hotelling is supplied by cold ironing, steam must be provided from the shore to the ships. As such, technologies that achieve equivalent emission reductions to cold ironing will be applied to these vessels.

EMISSIONS REDUCTION

The Port of Los Angeles (POLA) and Port of Long Beach (POLB) are comparable in size and in the volume of marine traffic and cargo that is handled. In 2001, 2,200 cargo ship visits occurred at POLA and each ship was berthed an average of two days. About 80% of all ship visits were made by container ships. It is has been estimated that at least 60% of the hotelling operations can be electrified. For the remaining 40 percent, vessel hotelling would be performed using alternative equivalent technologies such as the bonnet system to reduce emission levels by 90 percent or greater beginning in 2014. All vessels are assumed to be using 0.2 percent sulfur fuel. In order to achieve the targeted emission reductions by 2014, beginning in 2010, 20 percent of the ocean-going vessels calling on the ports would be required to use shore-side power and another 20 percent would be required to use alternative equivalent technologies.

Overall emission reductions are estimated to be about 75 percent in 2014 and about 84 percent by 2020.

COST EFFECTIVENESS

The cost and cost effectiveness will be provided during the CARB rulemaking process or as the marine ports implement the Clean Air Action Plan.

IMPLEMENTING AGENCY

Marine Ports, CARB

REFERENCES

CARB. Emissions Reduction Plan for Ports and Goods Movement in California (April 2006).

Draft San Pedro Bay Ports Clean Air Action Plan (June 2006).

FURTHER EMISSION REDUCTIONS FROM CARGO HANDLING EQUIPMENT [ALL POLLUTANTS]

CONTROL MEASURE SUMMARY			
SOURCE CATEGORY:	OFF-ROAD EQUIPMENT OPERATING USED TO MOVE FREIGHT CONTAINERS		
CONTROL METHODS:	ACCELERATED REPLACEMENT/RETROFIT PROGRAM		
EMISSIONS (TONS/DAY):			
ANNUAL AVERAGE	**2002**	**2014**	**2020**
NOX INVENTORY	4.6	3.6	2.3
NOX REDUCTION		1.1	0.7
NOX REMAINING		2.5	1.6
PM10 INVENTORY	0.2	0.1	0.1
PM10 REDUCTION		ND	ND
PM10 REMAINING			
PM2.5 INVENTORY	0.2	0.1	0.1
PM2.5 REDUCTION		ND	ND
PM2.5 REMAINING			
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
NOX INVENTORY	4.6	3.5	2.3
NOX REDUCTION		1.1	0.7
NOX REMAINING		2.4	1.6
CONTROL COST:	TO BE DETERMINED		
IMPLEMENTING AGENCY:	MARINE PORTS, CARB		

DESCRIPTION OF SOURCE CATEGORY

Background

Emissions from goods movement related mobile sources (e.g., ships, trains, trucks, and off-road equipment) continue to represent a significant and increasing portion of the emissions inventory in the South Coast Air Basin, adversely affecting not only the local port area, but also the regional air quality of the Basin. The purpose of this control measure is to implement programs to further reduce emissions from cargo handling equipment operated at marine ports, intermodal freight facilities, and warehouse distribution centers.

Regulatory History

The U.S. EPA's and CARB's Tier 1, Tier 2, Tier 3, and Tier 4 emissions standards for non-road diesel engines require compliance with progressively more stringent standards for hydrocarbon, CO, NOx, and PM. Tier 4 standards for non-road diesel powered equipment complement the

latest 2007 and later on-road heavy-duty engine standards requiring 90 percent reduction in NOx and PM when compared against the current level. To meet these standards, engine manufacturers will produce new engines with advanced emissions control technologies similar to those already expected for on-road heavy-duty diesel vehicles. These standards for new engines will be phased in starting with smaller engines in 2008 until all but the very largest diesel engine meet NOx and PM standards in 2015.

In December 2005, CARB adopted a regulation to reduce emissions from CHE such as yard tractors and forklifts starting in 2007. The regulation calls for the replacement or retrofit of existing engines with engines that use Best Available Control Technology (BACT). Beginning January 1, 2007 the regulation will require that newly purchased, leased, or rented CHE be equipped with either a 2007 or later on-road engine, a Tier 4 off-road engine or the cleanest verified diesel PM emissions control system which reduces PM by 90% and NOx by at least 70% for yard tractors. For non-yard tractors cargo handling equipment currently verified technologies reduce PM by 85%.

PROPOSED METHOD OF CONTROL

This measure would require implementation of commercially available NO_x retrofit technologies—diesel oxidation catalyst, emulsified diesel fuel, and combination of NO_x reduction catalysts with particulate traps—for cargo handling equipment.

A variety of commercially available NO_x emission control technologies can reduce emissions from passenger cars, light-duty trucks, and medium-duty vehicles to very low levels, and yield significant emission reductions from buses, trucks, and heavy-duty highway vehicles. The same retrofit technologies and cleaner alternative diesel fuels have been verified by CARB, and are increasingly being used to reduce NO_x and PM emissions from in-use off-road heavy-duty diesel equipment. These technologies are capable of reducing NO_x emissions by at least 25%, and include diesel oxidation catalysts, combination of NO_x reduction catalyst with particulate traps, and emulsified diesel fuels.

This measure would require the purchase of the cleanest engines meeting 2007 or 2010 on-road heavy-duty exhaust emissions standards or the cleanest off-road engines. Recent technological advancements in flywheel design have been demonstrated on a rubber tire gantry crane that resulted in about a 30 percent reduction in NOx emissions. In addition, electrification is a feasibly control option for a variety of these types of equipment. As such, for non-yard tractors, this measure calls for a 30 percent reduction in NOx emissions by 2014 and 60 percent by 2020. Implementation of this measure for non-yard tractors would begin in 2010 or earlier.

EMISSIONS REDUCTION

This measure would go beyond the current state regulation through strategies initiated by the marine ports or further amendments to the existing state regulation beginning in 2008. The estimated emission reductions shown in the table at the beginning of this section reflect the reductions achieved through the implementation of this measure only for non-yard tractors (i.e., 30 percent reduction in NOx and particulate matter emissions by 2014). Additional emission reductions would occur with an accelerated replacement of existing yard tractors with the cleanest on-road engines, beyond the requirements of the existing state regulation.

COST EFFECTIVENESS

The cost and cost effectiveness will vary depending on the type of control technologies implemented.

IMPLEMENTING AGENCY

Marine Ports, CARB.

REFERENCES

CARB. Emissions Reduction Plan for Ports and Goods Movement in California (April 2006)

Draft San Pedro Bay Ports Clean Air Action Plan (June 2006).

VESSEL SPEED REDUCTION
[NOX]

CONTROL MEASURE SUMMARY			
SOURCE CATEGORY:	MARINE VESSELS		
CONTROL METHODS:	SPEED LIMITS FOR VESSELS OPERATING AT MARINE PORTS		
EMISSIONS (TONS/DAY):			
ANNUAL AVERAGE	**2002**	**2014**	**2020**
NOX INVENTORY	23.0	38.6	51.5
NOX REDUCTION		19.3	25.7
NOX REMAINING		19.3	25.8
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
NOX INVENTORY	23.0	38.6	51.5
NOX REDUCTION		19.3	25.7
NOX REMAINING		19.3	25.8
CONTROL COST:	NOT DETERMINED		
IMPLEMENTING AGENCY:	MARINE PORTS, CARB		

DESCRIPTION OF SOURCE CATEGORY

Background

Emissions from port-related mobile sources (e.g., ships, trains, trucks, and off-road equipment) continue to represent a significant and increasing portion of the emissions inventory in the South Coast Air Basin, adversely affecting not only the local port area, but also the regional air quality of the Basin. The purpose of this control measure is to require ocean-going vessels to limit their speeds as they enter or leave South Coast marine ports. NOx emissions are directly correlated to the engine load and, generally speaking, load and NOx emissions decrease as engine load/vessel speed decreases.

Regulatory History

In May 2001, a Memorandum of Understanding (MOU) between the Port of Los Angeles (POLA), Port of Long Beach (POLB), U.S. EPA, CARB, SCAQMD, Pacific Merchant Shipping Association (PMSA), and the Marine Exchange of Southern California was signed. This MOU calls for OGVs to voluntarily reduce speed to 12 knots at a distance of 20 nautical miles (nm) from Point Fermin. Reduction in speed demands less power on the main engine, which in turn reduces NOx emissions and fuel usage.

Since its establishment in 2001, the compliance rate[4] of the VSR program program-to-date has averaged 44%. Overall compliance in 2004 was up to 50%, and the average for the first six

[4] Compliance rate is based on compliance of vessels operated by participating shipping lines, not of all vessels.

months of 2005 was 71%. This increase can be at least partially credited to the practice of assignment of gangs at the 20-mile boundary, reducing the incentive for ships to move quickly through the speed reduction zone.

The Port of Long Beach's dockage rebate incentive program currently has a compliance rate of 78% with a short-term goal to move compliance to 90% of calls by late 2006. (100% of all calls to be compliant by mid 2007). The incentive program has committed funding through FY2006/2007 at a maximum of $2.2 million dollars.

PROPOSED METHOD OF CONTROL

A voluntary VSR program currently exists under which vessels slow to 12 knots when they are within 20nm of Point Fermin. This measure establishes by 2008, a wider VSR zone with an over-water boundary of 40nm from Point Fermin. Vessels will be required to slow to 12 knots within this zone.

EMISSIONS REDUCTION

It is estimated that if all vessels limit their cruising speed to 12 knots, about 50 percent of the projected NOx emissions will be reduced by 2014.

RULE COMPLIANCE AND TEST METHODS

Vessel speeds will be monitored by the Marine Exchange and the two ports.

COST EFFECTIVENESS

Not determined.

IMPLEMENTING AGENCY

Marine Ports, CARB.

REFERENCES

CARB. Emissions Reduction Plan for Ports and Goods Movement in California (April 2006)

Draft San Pedro Bay Ports Clean Air Action Plan (June 2006).

FURTHER EMISSION REDUCTIONS FROM OCEAN-GOING VESSELS [NOX, PM]

CONTROL MEASURE SUMMARY			
SOURCE CATEGORY:	MARINE VESSELS		
CONTROL METHODS:	RETROFIT REQUIREMENTS		
EMISSIONS (TONS/DAY):			
ANNUAL AVERAGE	**2002**	**2014**	**2020**
NOX INVENTORY	29.9	45.5	58.5
NOX REDUCTION		26.4	47.4
NOX REMAINING		19.1	11.1
PM10 INVENTORY	2.2	3.8	5.1
PM10 REDUCTION		ND	ND
PM10 REMAINING			
PM2.5 INVENTORY	2.2	3.7	5.0
PM2.5 REDUCTION		ND	ND
PM2.5 REMAINING			
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
NOX INVENTORY	29.9	45.5	58.5
NOX REDUCTION		26.4	47.4
NOX REMAINING		19.1	11.1
CONTROL COST:	THE CONTROL COSTS VARY WITH THE TYPE OF CONTROL TECHNOLOGY IMPLEMENTED		
IMPLEMENTING AGENCY:	MARINE PORTS, CARB, U.S. EPA		

DESCRIPTION OF SOURCE CATEGORY

Background

Marine vessels, which primarily run on diesel oil, contribute a significant portion of NO_x, PM, greenhouse gas and toxic emissions particularly in coastal regions and in and around shipping ports. These emissions contribute to on-shore air quality problems. In order for progress to continue meeting clean air goals, emission reductions from marine vessels and portside equipment are necessary. At the present, there are no regulations to reduce emissions from this area.

Currently, the California Maritime Air Quality Technical Working Group, which is comprised of CARB, U.S. EPA, SCAQMD, and industry are exploring promising retrofit technologies to be used on marine vessels. The working group is also working on a demonstration project. The primary objectives of the marine vessel technology demonstration project are to identify technologies that are capable of reducing NO_x, PM, and greenhouse gases, identify and demonstrate emission measurement systems capable of accurately measuring pollutant

emissions in ship exhaust streams; and install the most promising technology on an in-use vessel for demonstration under real world conditions and establish the emission reduction potential in different modes of operation. After conducting an in-depth industrial survey, a wide range of technologies have been identified as promising candidates.

Ships use auxiliary engines to provide electricity for hotelling operations while berthed at ports, and to provide electrical power and steam while the ship is in operation. Hotelling includes operations on a marine vessel that require electrical energy to power operations that include, but are not limited to, lights, ventilation, heating, cooling, and loading and unloading operation. Most auxiliary engines use diesel oil and for ocean-going vessels the fuel can be bunker oil. The sulfur content of diesel oil used in the marine industry is between 150 – 500 ppmw, and that of bunker oil is between 10,000 – 25,000 ppmw.

In 2014, ships will emit about 45 tpd of NOx. A typical medium size cargo ship burns seven tons of diesel fuel a day while at the port and generates as much as one ton of NO_x and 100 pounds of PM daily. Emissions from diesel-fueled engines also include toxic air contaminants.

The purpose of this control measure is to require ocean-going vessels to deploy engine emissions control technologies that reduce NOx and/or PM emissions.

Regulatory History

The regulation of emissions from mobile port-related emission sources is traditionally the responsibility of CARB and U.S. EPA. Specifically, ships are each subject to specific emission standards pursuant to state, federal, and/or international requirements. The standards, primarily affecting new units, vary in stringency and compliance dates.

The International Maritime Organization (IMO) established limits for NOx in Annex VI to the International Convention for the Prevention of Pollution from Ships in 1997. IMO limits apply to marine vessel engines over 130 kilowatts (kW) installed on vessels built on or after 2000. Depending upon the engine speed in revolutions per minute (rpm), the NOx standards vary between 17.0 g/kW-hr (for < 130 rpm) to 9.8 g/kW-hr (for ≥2000 rpm). While a majority of countries have ratified MARPOL Annex VI, it has not been ratified by the U.S. Despite the formal status of Annex VI, it is believed that engines manufactured after 2000 meet the standard due to the retroactive nature of the regulation (i.e., once fully in effect engines must comply, and the simplest way for that to occur is for them to be manufactured to comply).

PROPOSED METHOD OF CONTROL

Main propulsion and auxiliary engines on ocean-going vessels range from 1,000 up to 70,000 hp. Control technologies that are used on stationary source engines can be used for this application. Engine retrofits can include installation of control technologies, engine and fuel system modification, and engine re-manufacturing.

The various retrofit technologies that can be installed on auxiliary ship engines and the available estimated emission reductions in % and tons/day (tpd) are presented in the following table. Most of these retrofit technologies are currently available.

Control	Control Details	Estimated Emission Reductions		
		PM	NO_x	Other
DOC	Diesel Oxidation Catalyst	25-50%	-	75-90% VOC 75-90% CO
SCR and DOC	Selective Catalytic Reduction with Urea Injection and Diesel Oxidation Catalyst	25-50%	90%	90% CO
Catalyst Based DPF	Catalyst Based Diesel Particulate Filter with Low Sulfur Diesel (<15 ppmw sulfur)	50-85%	N/A*	50-85% VOC 50-85% CO
Slide Valves	Replace existing engine values with slide valves designed to improve fuel efficiency and achieve emission reductions	-	30%	
Exhaust Gas Water Treatment	Exhaust Gas Mixes with Sea Water	80%	20%	90% SO_2
Water Injection	Humidification of Fuel-Air Mixture	10-20%	20-40%	N/A*
Injection Timing Delay	Reduces Pressure at Auto Ignition Reducing Peak Flame Temperature	10-30%	N/A*	N/A*
Engine Re-Manufacturing	Re-Manufacture Engines by Replacing All Existing Parts Except the Engine Block with New OEM Parts	15-30%	50-75%	N/A*

* Data not available

Emissions from auxiliary diesel-fueled engines can also be reduced by using diesel fuel alternative such as emulsified diesel and low sulfur diesel. Emulsified diesel can reduce NO_x and PM emissions by approximately 15% and 70%, respectively. Low sulfur diesel can reduce SO_x emissions by more than 90%.

This measure proposes that 80 percent of the ocean-going vessels entering South Coast marine ports would be equipped with slide valves in combination with other emissions control technologies to achieve a 50 percent fleet average reduction in NOx emissions by 2014 and 80 percent fleet average reduction in NOx emissions by 2020.

EMISSIONS REDUCTION

Based on the assumed penetration of control technologies, this measure could achieve about 58 percent reduction in NOx by 2014 and over 80 percent by 2020. The majority of the vessels calling at South Coast ports would be equipped with slide valves that achieve at least 30 percent reduction in NOx. Addition of add-on controls such as water injection in combination with the slide valves could achieve NOx reductions of 50 percent or greater.

COST EFFECTIVENESS

The cost and cost-effectiveness of this control measure varies on the type of control devices deployed on each vessel.

IMPLEMENTING AGENCY

Marine Ports, CARB.

REFERENCES

CARB. Emissions Reduction Plan for Ports and Goods Movement in California (April 2006)

Draft San Pedro Bay Ports Clean Air Action Plan (June 2006).

EMISSION REDUCTIONS FROM AIRCRAFT [VOC, NOx]

CONTROL MEASURE SUMMARY			
SOURCE CATEGORY:	AIRCRAFT		
CONTROL METHODS:	New Aircraft Emission Standards		
EMISSIONS (TONS/DAY):			
ANNUAL AVERAGE	**2002**	**2014**	**2020**
VOC INVENTORY	7.4	11.8	13.9
VOC REDUCTION		2.4	2.8
VOC REMAINING		9.4	11.1
NOX INVENTORY	13.0	21.9	26.6
NOX REDUCTION		4.4	5.3
NOX REMAINING		17.5	21.3
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
VOC INVENTORY	7.4	11.8	13.9
VOC REDUCTION		2.4	2.8
VOC REMAINING		9.4	11.1
NOX INVENTORY	13.0	21.9	26.6
NOX REDUCTION		4.4	5.3
NOX REMAINING		17.5	21.3
CONTROL COST:	Not Determined		
IMPLEMENTING AGENCY:	U.S. EPA		

DESCRIPTION OF SOURCE CATEGORY

More stringent national emission standards for commercial aircraft would be developed under this measure.

Background

Aircraft are estimated to contribute approximately 5% of the total mobile NO_x emissions in the South Coast Air Basin. These emissions are of heightened concern due to their local concentration in an area of high population density in the vicinity of airports.

Regulatory History

The U.S. EPA regulates emissions from aircraft engines through 40 Code of Federal Regulations (CFR) Part 87 for aircraft landing and take-off cycles (LTO), which occur for operation below 3,000 feet in altitude. The 40 CFR 87 standards mirror the International Civil Aviation Organization (ICAO) emissions standards for world-wide aircraft limits on new and newly certified gas turbine engines. The EPA adopted the same limits as ICAO's standards for smoke and VOCs in 1992 and for CO and NO_x in 1997 [1].

In 2005, U.S. EPA adopted the 1998 ICAO standards for a further 16% reduction in NO_x emissions from newly certified engines. ICAO is also developing emissions certifications during climb and at cruise altitude to compliment the LTO limit.

Operational changes can also help to reduce emissions. Several changes that could be implemented are discussed in [2]:

- Single/Reduced engine taxiing,
- Derate takeoff power, and
- Reduce use of reverse thrust.

The Intergovernmental Panel on Climate Change report [3] also discusses several non-technology-based measures [3]. For example, Zurich Airport adds an emissions surcharge to the landing fee based on the aircraft engine certification emissions; the fees are then used to implement additional emissions reduction measures at the airport. Another strategy is to implement emissions-trading for greenhouse gases.

PROPOSED METHOD OF CONTROL

This control measure proposes that U.S. EPA adopt more stringent ICAO standard to achieve a 16% NO_x reduction from newly certified engines and existing engines over a phase-in period.

Further operational changes during climb, cruise, takeoff, and landing should also be implemented to the extent safely possible. Finally, emissions surcharge fees should be considered as implemented by Zurich Airport based on the engine emission factors.

Particulate matter emissions from jet engines can be reduced during take-off and taxiing operations by the use of cleaner reformulated jet fuel. The aromatic content of jet fuel on the west coast is about 20%. If the aromatic content of the fuel is reduced, particulate matter emissions can be reduced up to 30% at the same time achieving TAC emissions reduction.

EMISSIONS REDUCTION

The total NO_x reduction can conservatively be estimated at 20% in 2014 and 2020. The Basin emissions attributed to aircraft are 33 tons/day of combined VOC and NOx, thus resulting in an emissions reduction of approximately 5.2 tons/day in 2014. This level of emissions reduction represents the same commitment as in previous SIPs.

COST IMPACT

Since aircraft are international commodities, they are currently designed to meet the ICAO standards. Modifying the EPA regulations to be consistent with upcoming international standards will be beneficial with minimal cost burden to the manufacturers.

Operational changes to reduce emissions will be dependent on airport geographic requirements. The determining factors will be safety.

The cost impact of emissions surcharge landing fees may be passed through to the customers and could impact ticket prices. However, the overall economic impact for this as well as the other measures can be determined during the EPA rulemaking process.

IMPLEMENTING AGENCY

The EPA is the implementing agency responsible for "any standard respecting emissions of any air pollutant from any aircraft or engine".[4] U.S. EPA can also consider compliance alternatives (i.e., incentives or mitigation fees) to achieve equivalent reductions.

REFERENCES

1. US EPA, "Control of Air Pollution from Aircraft and Aircraft Engines; Emissions Standards and Test Procedures", 40 CFR Part 87
2. Air Quality Procedures for Civilian Airports and Air Force Bases, FAA-AEE-97-03.
3. Intergovernmnetal Panel on Climate Change (1999) *Aviation and the Global Atmosphere*.
4. Civil Aviation Code, Section 233, "State Standards and Controls".
5. Dohn Bahr, ASME and AIAA Fellow, Personal Communication with Matt Miyasato, August 25, 2003.

LOWER EXHAUST AND EVAPORATION STANDARDS AND FLEET MODERNIZATION FOR LAWN AND GARDEN EQUIPMENT [VOC, NOx]

CONTROL MEASURE SUMMARY			
SOURCE CATEGORY:	LAWN AND GARDEN EQUIPMENT		
CONTROL METHODS:	PROMULGATE MORE STINGENT EXHAUST AND EVAPORATION STANDARDS, AND ELECTIFICATION OF FLEET		
EMISSIONS (TONS/DAY):			
ANNUAL AVERAGE	**2002**	**2014**	**2020**
VOC INVENTORY	38.1	24.0	21.6
VOC REDUCTION		6.0	10.8
VOC REMAINING		18.0	10.8
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
VOC INVENTORY	43.0	31.4	27.8
VOC REDUCTION		7.9	13.9
VOC REMAINING		23.5	13.9
CONTROL COST:	$4,000 TO $12,000 PER TON VOC+NOX CONTROLLED		
IMPLEMENTING AGENCY:	CARB		

DESCRIPTION OF SOURCE CATEGORY

The purpose of this control measure is to promulgate more stringent exhaust and evaporation standards as well as require electrification and accelerated fleet turn-over through regulation and incentives such as exchange programs.

Background

The lawn and garden category consists of spark ignition engines run mostly on gasoline, and rated at below 25 horsepower (19 kW). The category includes handheld and non-handheld equipment such as string trimmers, leaf blowers, lawn mowers, and lawn tractors. The category is the second largest VOC contributor to the off-road mobile source inventory – second only to pleasure craft. There are approximately 6,000,000 pieces of lawn and garden equipment in the South Coast emitting approximately 40 tons/day of VOC.

Regulatory History

CARB and EPA have adopted emission standards (exhaust and evaporative) for new engines used in lawn and garden equipment. The final and most stringent phases will be implemented in 2007 and 2008 and in many cases can only be met using exhaust catalysts. Emission standards range from 72 g/kW-hrs for the smaller hand-held engines to 6 g/kW-hr (VOC+NOx) for the larger engines. Evaporative standards will reduce evaporative from 50% to 85% or higher.

Over the last four years, the South Coast AQMD has implemented a lawnmower exchange program that has led to the replacement of over 15,000 gasoline powered lawnmowers with electric mowers.

PROPOSED METHOD OF CONTROL

While significant reductions will be realized by the existing and proposed exhaust and evaporative standards for this category, there still remains significant emissions. For the larger engines, better catalysts and evaporative control could yield large reductions, and electrification of some of the equipment would yield additional reductions. Large spark ignition engines are capable of meeting standards 10 times lower than the most stringent adopted emissions for this category. While the size of the engine and its market will certainly affect the sophistication and effectiveness of its emission controls, SCAQMD staff believe that newer technology and technology transfer from the lager engine categories can significantly reduce emissions from this category and recommends that CARB staff develop and implement more stringent exhaust and evaporative emission standards as well as develop incentive based programs to encourage faster turn-over of older engines and greater penetration of electric equipment for this source category.

EMISSIONS REDUCTION

An appropriate mix of more stringent standards and incentives could be developed and implemented to yield an additional 50% reduction in VOC and NOx emissions by 2014, and another 50% by 2021.

COST EFFECTIVENESS

The cost effectiveness of CARB's most recent technology regulation for lawn and garden equipment showed a cost effectiveness of between $4,000 to $12,000 per ton of combine VOC and NOx controlled, and SCAQMD staff believe that similar cost effectiveness ratios can be realized in the future as well as the control and engine design technology improves.

IMPLEMENTING AGENCY

CARB has the legal authority to require new emission standards and accelerated engine and equipment replacement programs. This strategy can be implemented as a phased, command-and-control regulation, complimented with market incentive programs.

REFERENCES

CARB

EMISSION REDUCTIONS FROM AIRPORT GROUND SUPPORT EQUIPMENT [VOC, NOx, PM]

CONTROL MEASURE SUMMARY

SOURCE CATEGORY: AIRPORT GROUND SUPPORT EQUIPMENT

CONTROL METHODS: REQUIRE FLEET ZEV MANDATES AND STRICTER FLEET AVERAGE EMISSION STANDARDS

EMISSIONS (TONS/DAY):

ANNUAL AVERAGE	2002	2014	2020
VOC INVENTORY	1.3	0.6	0.4
VOC REDUCTION		0.4	0.3
VOC REMAINING		0.2	0.1
NOX INVENTORY	6.6	3.3	2.1
NOX REDUCTION		2.5	1.6
NOX REMAINING		0.8	0.5
PM10 INVENTORY	0.2	0.1	0.1
PM10 REDUCTION		0.1	>0.1
PM10 REMAINING		>0.1	>0.1
PM2.5 INVENTORY	0.2	0.1	0.1
PM2.5 REDUCTION		>0.1	>0.1
PM2.5 REMAINING		>0.1	?0.1
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
VOC INVENTORY	1.1	0.5	0.3
VOC REDUCTION		0.3	0.2
VOC REMAINING		0.2	0.1
NOX INVENTORY	6.2	3.1	2.0
NOX REDUCTION		2.3	1.5
NOX REMAINING		0.8	0.5

CONTROL COST: TO BE DETERMINED

IMPLEMENTING AGENCY: CARB

DESCRIPTION OF SOURCE CATEGORY

Require electrification of airport ground support equipment through fleet zero emission requirements and lower CARB LSI regulation VOC + NOx emissions applicable to diesel and gasoline equipment.

Background

GSE perform a variety of functions at airports including, but not limited to starting aircraft, transporting fuel and cargo, loading cargo, transporting passengers, baggage handling, etc. The types of equipment include air starts, air conditioners, belt loader, fuel truck, service truck, aircraft tractor, etc. GSE is critical to the efficient functioning of airports. A study indicates that there were an estimated 2,065 GSE in the Basin in 1995. The 1995 estimated NO_x emission was 2.7 tons/day, and the estimated NO_x emission for 2014 is 3.3 tons/day. Diesel emissions also contain SO_x, PM, VOC, and toxic air contaminant emissions.

Regulatory History

In November 2002, CARB and the airlines executed a memorandum of understanding (MOU) to implement programs and cleaner technologies to reduce emissions from GSE. The MOU includes 17 airlines at Los Angeles International Airport, Burbank Glendale Pasadena Airport, Ontario Airport, Long Beach Airport, and John Wayne Airport. The MOU potentially includes the electrification of existing and new GSE by using zero emission vehicles by 2010. The MOU is voluntary in nature since it does not assure emission reductions by 2010 without a backstop measure. However, as of this date, the MOU is no longer in effect.

PROPOSED METHOD OF CONTROL

In 2014 and 2020, 40% of all diesel and gasoline GSE in the South Coast Air Basin could be electrified by charging on-board battery packs using grid power and some categories of GSE can potentially be powered using electrical hookups to grid power using fleet ZEV mandates as in the above MOU. In 2014 and 2020, emissions from the remaining 60% of the GSE fleet (gasoline and diesel) can be reduced by lowering the combined VOC + NOx emissions to 1.0 g/bhp-hr (2005 LSI VOC + NOx emission limit is 2.5 g/bhp-hr).

According to CARB estimate there are 3,600 GSE in various categories in the South Coast Air Basin.

EMISSIONS REDUCTION

Implementation of this measure will result in about 75 percent reduction in emissions from aircraft ground support equipment.

IMPLEMENTING AGENCY

This proposed strategy can be implemented by CARB.

REFERENCES

November 2002 CARB South Coast Ground Support Service Equipment Memorandum of Understanding.

GROUP 3

CONSUMER PRODUCTS

FURTHER EMISSION REDUCTIONS FROM CONSUMER PRODUCTS [VOC]

CONTROL MEASURE SUMMARY			
SOURCE CATEGORY:	CONSUMER PRODUCT		
CONTROL METHOD:	REQUIRE ULTRA LOW VOC PRODUCTS THIS CONTROL MEASURE WILL SEEK ADDITIONAL REDUCTIONS FROM CONSUMER PRODUCTS BY TRANSFERRING LOW- AND ULTRA-LOW VOC STATIONARY SOURCE TECHNOLOGIES TO CONSUMER PRODUCTS		
EMISSIONS (TONS/DAY):			
ANNUAL AVERAGE	**2002**	**2014**	**2020**
VOC INVENTORY	110.4	107.1	112.1
VOC REDUCTION		34.6	56.0
VOC REMAINING		72.5	56.1
SUMMER PLANNING INVENTORY	**2002**	**2014**	**2020**
VOC INVENTORY	110.4	107.1	112.1
VOC REDUCTION		34.6	56.0
VOC REMAINING		72.5	56.1
CONTROL COST:	THE COST-EFFECTIVENESS OF EMISSION REDUCTIONS FROM ADHESIVES AND CLEAN-UP SOLVENTS WERE ESTIMATED AT LESS THAN $1,000 PER TON AND LESS THAN $2,000 PER TON, RESPECTIVELY FOR STATIONARY SOURCE APPLICATIONS. REFORMULATION OF CONSUMER PRODUCTS MAY IMPACT MANUFACTURERS BY INCREASING THEIR PRODUCTION COSTS. THE INCREMENTAL COSTS WOULD BE PASSED ON TO CONSUMERS THROUGH INCREASED PRICES FOR AFFECTED CONSUMER PRODUCTS.		
IMPLEMENTING AGENCY:	CARB		

DESCRIPTION OF SOURCE CATEGORY

The purpose of this control measure is to implement low-VOC technology developed for stationary sources into categories for similar uses in Consumer Products.

Background

Consumer Products are the second largest source category of VOC emissions following the light- and medium-duty vehicle source category. VOC emissions from this source category are estimated at 107.1 tpd in 2014 and are expected to grow to 112.1 tpd in 2020. Control measures

in the 2003 AQMP were expected to reduce these emissions by up to 17 tons per day of VOC in 2010. This measure has yet to be fully implemented by CARB. However, emissions from this source category can be further reduced by transferring low-VOC technology developed for stationary sources.

Regulatory History

CARB has primary authority over consumer products and has taken several regulatory actions over the past several years to reduce the VOC emissions form consumer products. Since 1989, CARB has adopted five regulations affecting consumer products. The regulations have been amended several times and contain a total of 200 emission limits affecting 82 categories. While the 1994 SIP and the 1997 AQMP had an emission reduction commitment of 89 tons per day and 77 tons per day, respectively, for 2010 for the South Coast Air Basin (Basin), in 2006 CARB scaled back its 2014 emission reduction commitment to 9 tons per day of VOC. Although CARB has adopted CONS1 from the 2003 Plan, CONS2 has yet to by fully developed and implemented.

PROPOSED METHOD OF CONTROL

SCAQMD's aggressive stationary source regulatory program has resulted in the development of remarkably less polluting coating, adhesive and solvent technologies with exceptional performance characteristics. This proposed strategy seeks further emission reductions from consumer products by transferring the low-VOC technology developed for stationary sources to comply with rules in Regulation XI, such as Rule 1171 – Solvent Cleaning Operations, Rule 1168 – Adhesives, Rule 1122 – Solvent Degreasers and others to categories of consumer products used in similar applications. These technologies include advances in aqueous, low-VOC and non-VOC (exempt) cleanup solvents, adhesive and coating technologies. This approach is most suitable for cross-over products used in both stationary source applications and as consumer products. The following is a listing of some categories from consumer products that have the potential for significant emission reductions (50% - 75%):

- Paint Thinner – carryover technology from Rule 1171. Low- and zero-VOC technology available and effective for clean-up operations can replace high-VOC (> 700 g/l) counterparts (non-architectural paint thinners)
- Paint Stripper – carryover technology from Rule 1124 – Aerospace Operations. Waterborne strippers (VOC < 200 g/l) commonly used.
- Brake Cleaners – carryover technology from Rule 1171. Low- and zero-VOC technology available, with aerosol cleaners using CO2 or N2 as alternative propellants to hexane and other VOCs.
- Multi-Purpose Cleaning - carryover technology from Rule 1171. Low- and zero-VOC technology available
- General Purpose Cleaning - carryover technology from Rule 1171. Low- and zero-VOC technology available
- Carburetor/Choke Cleaners - carryover technology from Rule 1171. Low- and zero-VOC technology available

- Contact Adhesive – carryover technology from Rule 1168 – Adhesives
- Construction and Panel Adhesives - carryover technology from Rule 1168 – Adhesives
- Lubricants (Total of four Consumer Products Categories) – Waterborne and synthetic lubricants available and in use
- Hairspray – Non-VOC propellant and delivery by pump readily available

There is currently significant discrepancy in the level of stringency between stationary source and consumer products regulations that is not warranted in many cases. For instance, there are cleaners which when used in industrial/commercial applications and subject to Rule 1171 have to meet a VOC limit of 25 g/l, but when sold as a consumer product the same cleaner must meet a 45 percent by weight VOC limit (equivalent to approximately 400 g/l assuming an average cleaner density of 7.5 lb/gal). The cleaners meeting the Rule 1171 VOC limit the use of low- and non-VOC alternatives based on exempt solvents (e.g. acetone). These products are subject to highly demanding performance standards dictated by a highly competitive market and many of the technologies are directly applicable to consumer products. Consistency between industrial applications and consumer products can also assist rule effectiveness of existing source-specific rules.

Consumer products can come in different product forms such as aerosol, gel, liquid or solid. Current state law prohibits CARB from regulating so as to eliminate a product form. If the current state legislation can be modified, emissions from consumer products can be further reduced by phasing out certain product forms where low-VOC alternatives are available. Functioning equivalent, yet low-emitting products, do exist in many instances.

Although this measure focuses on certain categories of consumer products with a large inventory, the lower-VOC technology can be further implemented into other smaller emission categories found within Consumer Products.

EMISSIONS REDUCTION

The potential estimated emission reductions from the above-listed categories, as well as additional smaller volume categories, range from about 34 to 56 tons per day (or about 32 percent reduction in VOC emissions by 2014 and about 50 percent reduction in VOC emissions by 2020).

COST EFFECTIVENESS

The cost-effectiveness of emission reductions from adhesives and clean-up solvents were estimated at less than $1,000 per ton and less than $2,000 per ton, respectively for stationary source applications. Reformulation of consumer products may impact manufacturers by increasing their production costs. The incremental costs would be passed on to consumers through increased prices for affected consumer products. This strategy is not expected to impact competitiveness of California business compared with those outside of California because all companies that sell these products in California would have to meet the proposed requirements.

IMPLEMENTING AGENCY

CARB has primary authority over consumer products and would be responsible for regulating these categories where possible or implementing this strategy. As an alternative to CARB implementing this strategy, the AQMD would regulate these categories where possible or seek additional authority under the Health and Safety Code or request CARB to delegate its authority over consumer products to the AQMD.

If the current state legislation can be modified, emissions from consumer products can be further reduced by setting the lowest achievable VOC limits (or equivalent reductions) regardless of product types.

REFERENCES

1. CARB, California Consumer Products Regulation, Title 17 California Code of Regulations, Sections 94508, 94509, and 94513.
2. SCAQMD, Staff Report, Proposed Amended Rule 1168 – Adhesives and Sealant Applications, October 2003
3. SCAQMD, Staff Report, Proposed Amended Rule 1168 – Adhesives and Sealant Applications, January 2005
4. SCAQMD, Staff Report, Proposed Amended Rule 1171 – Solvent Cleaning Operations, August 1996
5. SCAQMD, Staff Report, Proposed Amended Rule 1171 – Solvent Cleaning Operations, September 1999
6. SCAQMD, Staff Report, Proposed Amended Rule 1171 – Solvent Cleaning Operations, August 2003
7. SCAQMD, Staff Report, Proposed Amended Rule 1171 – Solvent Cleaning Operations, May 2005
8. Institute for Research & Technical Assistance, Draft Report, Assessment, Development, and Demonstration of Low-VOC Cleaning Systems for South Coast Air Quality Management District Rule 1171, June 2003
9. SCAQMD, Staff Report, Proposed Amended Rule 1122 – Solvent Degreaser, October 2004