Further Study Measure FS 1: ARCHITECTURAL COATINGS

Further Study Measure Description

The District amended Regulation 8, Rule 3: Architectural Coatings in 2001 based on the CARB Suggested Control Measure (SCM) for Architectural Coatings (June, 2000). The SCM was the product of nationwide surveys of available coatings conducted by CARB and discussion among districts, architectural and industrial maintenance coatings manufacturers, infrastructure owners and painting contractors. The Sacramento district was the first district to adopt amendments in June 2001, and the Bay Area adopted amendments in November 2001.

The development of the SCM on which the amendments were based was directed by the California Air Pollution Control Officers Association (CAPCOA). CAPCOA further directed that CARB and the districts evaluate South Coast's future (later than 2004) VOC limits and/or other limits to achieve the maximum possible reductions from the architectural coatings category. CARB is currently evaluating new survey data, and investigating feasible VOC standards both on a mass basis and also on a reactivity basis following the same CARB/districts workgroup format. Districts are awaiting the results of the CARB surveys and data analysis and will work together to develop future reductions in VOC emissions from architectural coatings. The CARB/districts efforts are expected to be completed in 2005.

References

CAPCOA Statement of Principles and Positions on Architectural Coatings Regulations (10/28/99)
SCAQMD Rule 1113: Architectural Coatings

Suggested Measure Reference # 131, 142, 143

Further Study Measure FS 2: COMMERCIAL CHARBROILERS

Further Study Measure Description

In 1997, the South Coast AQMD adopted Rule 1138: Control of Emissions from Restaurant Operations. Rule 1138 requires that chain driven charbroilers install catalytic oxidation equipment to control emissions. The catalytic oxidizers control particulate matter and volatile organic compounds that are emitted from the cooking process. The South Coast determined that chain driven charbroilers to be the only type of restaurant operation for which control is cost effective, although further research is being conducted on under-fire charbroilers. In 2002, the San Joaquin Valley adopted Rule 4692: Commercial Charbroiling. Both rules have the same exemption criteria: charbroilers that cook less than 875 lbs of meat per week or emit less than 1 lb of emissions per day are not subject to the rule.

The South Coast originally projected a cost effectiveness for this control measure of $4650 per ton for a combination of VOC and particulate matter. More recently, the San Joaquin APCD estimated a cost effectiveness of $3070 per ton combined VOC and PM reduced. However, for VOC alone, the cost effectiveness rises to $13,070. The South Coast assumed a control effectiveness of 90% and the San Joaquin APCD used figures for control efficiency of 83% and 86% for PM and VOC, respectively. Some additional research indicates that the emission reductions may be closer to 62%, which would raise the cost of pollutants reduced per ton 38%.

The current inventory for VOC emissions from all cooking operations in the Bay Area is 1.29 tons/day. Of that, based on a population-weighted comparison between the Bay Area and the San Joaquin Districts, emissions estimates from chain driven charbroilers are 0.08 tons/day VOC and 0.26 tons/day PM. A comparable rule would reduce emissions by 0.066 tons/day VOC and 0.22 tons/day PM. This is a de minimis amount for VOC alone.

This control measure may not be justified for VOC alone, however, considering the potential to control particulate matter, it may be justified. Also, the South Coast's efforts regarding under-fire charbroilers, scheduled to be completed this year, may increase the potential emission reductions.

References

South Coast Rule 1138: Control of Emissions from Restaurant Operations and staff report, 11/7/1997, SCAQMD
San Joaquin Rule 4692: Commercial Charbroiling and staff report, 3/21/2002, SJVAPCD

Suggested Measure Reference # 122, 137, 138, 139

Further Study Measure FS 3: COMPOSTING OPERATIONS

Further Study Measure Description

In January, 2003 the South Coast AQMD adopted Rule 1133.2: Emission Reductions from Co-composting Operations, to limit emissions of both VOC and ammonia. Co-composting is the mixing of biosolids or manure with bulking agents to produce compost. Rule 1133.2 requires new co-composting operations to be enclosed and emissions controlled by 80%, and existing co-composting operations be enclosed and emissions controlled by 70%. Existing operations are given compliance dates between 2007 and 2009, depending on throughput capacity. The rule does not apply to agricultural composting, greenwaste (gardening, agriculture and landscaping) composting, woodwaste composting, co-composting operations of less than 1,000 tons throughput per year or 35,000 tons per year throughput if no more than 20% biosolids. The rule is expected to reduce the South Coast composting emissions by 17.6%.

The Bay Area does not have a specific category in the emission inventory for composting or greenwaste. Emissions are included within the category of "waste management, landfills, point or area sources" or "waste management, other". The Bay Area requires a permit of a composting facility that processes 500 tons/year, lower than the South Coast exemption level for Rule 1133.2. The source code assigned to these operations varies, making an emissions estimate based on permitted sources uncertain. Based on the South Coast control measure and rule development staff report, the Bay Area inventory for composting operations is about 3.4 tons/day VOC and 2.35 tons/day ammonia (South Coast inventory numbers * 0.5). Consequently, this measure applied to the Bay Area would be expected to reduce VOC emissions by 0.6 tons/day.

The South Coast Rule 1133.2 staff report indicates that the cost effectiveness for this rule ranges from $8700 to $10,000 per ton of ammonia and VOC reduced and from $23,000 to $26,500 per ton of VOC reduced. This is not very cost effective compared to most Bay Area rules for VOC, but within the range of acceptable costs for VOC and ammonia combined. However, as the South Coast AQMD gains experience in implementation of this rule, cost effectiveness may be found to be less. Also, additional benefits of particulate control from the reductions in ammonia (which reacts to form secondary particles) may make the cost effectiveness more attractive as a particulate control measure.

References

SCAQMD Rule 1133.2: Emission Reductions from Co-composting Operations and staff report, Jan. 10, 2003

Suggested Measure Reference # 135, 140

Further Study Measure FS 4: FOOD PRODUCT MANUFACTURING AND PROCESSING

Further Study Measure Description

The South Coast AQMD adopted Rule 1131: Food Product Manufacturing and Processing Operations, in September, 2000. The rule addresses any facility that emits more than 440 pounds of organic compound emissions per month that produces, formulates or configures food or food products, including spices, extracts, flavorings and colorings. Bakeries, wineries and breweries are not subject to the rule. VOC emitting processes found in food product manufacturing include distillation, extraction, reaction, blending, drying, crystallization, separation, granulation, filtration and extrusion. The South Coast rule limits solvents used in food processing to 120 grams VOC/liter or requires capture and control of emissions. Solvent used for sterilization of food products is limited to 400 grams VOC/liter and, after 2005, 200 grams VOC/liter.

The South Coast rule projects an emission reduction of about 2 tons from an inventory of 2.47 tons/day. In the Bay Area, the emissions from food preparation are contained in the emission inventory categories, "Other Food and Agricultural Processing", which includes coffee roasting, grain milling, sugar refining and pet food processing. The emission inventory lists organic emissions from this category at 0.3 tons/day. However, some operations subject to the South Coast rule, such as sterilization, reaction or distillation, may have source codes that put them into other categories in the Bay Area. The South Coast staff report notes that food processing operations were exempt from the South Coast permit system. In the Bay Area, some food processing operations are exempt, including non-restaurant cooking operations of less than 1000 tons per year throughput, dry food milling, grinding, handling and packaging equipment, and small coffee, cocoa and nut roasters. Because other food processing equipment is subject to permit requirements, it may already be controlled, reducing the potential emissions reductions.

Based on the difference between the South Coast emission inventory and the Bay Area emission inventory, the differences in permitting regulations and the possibility that some sources in the Bay Area are already controlled, this measure is recommended for further study.

References

South Coast AQMD Rule 1131: Food Product Manufacturing and Processing Operations, and staff report, September, 2000.

Suggested Measure Reference # 132

Further Study Measure FS 5: LIVESTOCK WASTE

Further Study Measure Description

The South Coast AQMD has proposed Rule 1127: Emission Reductions from Livestock Waste, based on control measure WST-01 in their 2003 Air Quality Management Plan. The proposed rule would control emissions from livestock waste (primarily dairies) by requiring wastes to be transported out of the district, controlled in an approved composting operation, processed in a controlled anaerobic digestor, or spread on agricultural land approved for the spreading of manure. In 1997, the SCAQMD adopted Rule 1186 that requires livestock operations to take certain measures to reduce particulate matter, but the rule does not address livestock waste. South Coast proposed Rule 1127 is designed to reduce emissions of particulate, ammonia (which forms aerosol particulate matter) and VOC. The measure estimates that a reduction in ammonia of 50% is possible at a cost effectiveness of from $2000 to $5000 per ton ammonia. The ammonia concentration is approximately three times the VOC concentration, so as a VOC only control measure, cost effectiveness would range from $6000 to $15,000 per ton.

The Bay Area emission inventory for livestock waste is 29.81 tons/day total organic compounds. Most of that is methane. Reactive organic emissions are 8% of that total, 2.38 tons/day. Of that inventory of emissions from total livestock waste, approximately 13% (0.31 tons/day) is from dairy cattle, the basis of the South Coast measure. The ARB has raised questions about the emissions estimates, so ROG (VOC) emissions may be lower. Accordingly, the capital costs associated with control of VOC emissions would make the measure less cost effective.

The focus of the South Coast measure is to control particulate and ammonia. The measure has more utility for control of particulate and ammonia, a fine particulate precursor, than for VOC, and particularly so in the South Coast where dairy farms are concentrated in an area that is upwind from monitoring stations that record high PM10 levels. The South Coast control measure notes that a decrease in ammonia and VOC emissions of 2 to 3% per year is likely due to the increased urbanization of the region (which will decrease the number of dairies) and water quality control regulations that require manure to be removed from dairies bi-annually, or incorporated into soil at agrometric rates as quickly as possible. Due to uncertainty in the VOC inventory for this category, and the cost effectiveness, this measure is not recommended as a control measure at this time. However, because of the potential particulate matter benefits, it is recommended for further study.

References

SCAQMD Final 2003 Air Quality Management Plan, Control Measure #2003 WST-01, SCAQMD, August, 2003

Air Emissions Action Plan For California Dairies, ad hoc Dairy subcommittee of the SJVUAPCD, May, 2003

Suggested Measure Reference # 126, 127, 134

Further Study Measure FS 6: LIMITATIONS ON SOLVENTS BASED ON RELATIVE REACTIVITY

Further Study Measure Description

Further Study Measure F8 in the 2000 Clean Air Plan suggests the potential to make regulations more effective by replacing VOC limits, measured in mass VOC per volume of product, with limits based on the relative contribution to ozone formation of each of the organic species that make up the VOC of a product, or the "relative reactivity." This further study measure would examine whether a relative reactivity approach would be either more cost effective than mass reductions in VOC content or allow reductions where further reductions in mass might not be technically feasible.

The differences in ozone produced by different species of organic compounds have been recognized for many years, however, the ability to quantify the relative contributions to ozone formation of the vast number of organic species has only recently been developed. The California Air Resources Board, working with scientists and representatives of industry and air agencies, have developed a scale of incremental reactivities that is used in their aerosol paint regulation (Regulation for Reducing the Ozone Formed from Aerosol Coating Product Emissions). Currently, CARB staff have requested speciation data for architectural and automotive refinish coatings to consider whether a relative reactivity approach might be advantageous for these two source categories. US EPA staff is involved in CARB's processes to consider relative reactivity based regulations, but they have yet to approve CARB's consumer product rules into the SIP, including the aerosol paint rule. District staff participate in discussions of reactivity as it relates to potential regulatory activity. At this time, however, because the potential for emission reductions (or ozone formation reductions) cannot be assessed for any source category, this control measure is recommended for further study.

References

17 California Code of Regulations, Section 94520, 94700, Regulation for Reducing the Ozone Formed from Aerosol Coating Product Emissions, and Table of Maximum Incremental Reactivity

Further Study Measure 8, 2000 Bay Area Clean Air Plan, BAAQMD, December, 2000

Suggested Measure Reference # 145

Further Study Measure FS 7: EMISSIONS FROM COOLING TOWERS

Further Study Measure Description

The emission inventory for refinery cooling towers shows 0.45 tons/day organic emissions, based on cooling water throughput from cooling towers with District permits. AP-42 emission factors of 6 lbs organic emissions per million gallons water throughput were used in this calculation. This assumes organic compound leaks into the cooling water system are not minimized. However, if leaks are minimized, the AP-42 emission factor is 0.7 lb organic emissions per million gallons water. Further study is needed to determine whether leaks from cooling towers are currently minimized and whether there is any potential for emission reductions from regulations.

References

Compilation of Air Pollution Emission Factors (AP-42), US EPA, 1995

Suggested Measure Reference # 133

Further Study Measure FS 8: REFINERY WASTEWATER TREATMENT SYSTEMS

Further Study Measure Description

Emissions from refinery wastewater systems are being studied through further study measure FS-9 from the 2001 Ozone Attainment Plan. Refinery wastewater systems basically consist of collection systems to collect and transport hydrocarbon-containing process water, physical separation systems then separate oil and water are separated by mechanical means, and finally, treatment systems employ biological and chemical processes to treat effluent. District staff have completed a study of emissions from the wastewater collection systems and is recommending amendments to Regulation 8, Rule 8: Wastewater (Oil-Water) Separators, to reduce ROG emissions from this portion of the wastewater system. The physical separation systems, including oil-water separators and dissolved air floatation units, are already controlled by Regulation 8, Rule 8.

Water entering the treatment systems after physical separation tends to have low organic content, but most of these organic compounds must be removed by biological degradation. Some of these compounds are volatilized and emitted to the atmosphere. Reg 8-8 does not require control of biological or chemical treatment portions of wastewater systems. Water is treated until it meets the San Francisco Bay Regional Water Quality Control Board discharge requirements.

Emissions for one refinery's large treatment pond with a flow rate of 10 million gallons per day have been estimated, using EPA's WATER8 model, to be approximately 150 pounds per day. Total wastewater pond emissions for the Bay Area refineries are likely to be no more than 0.4 tons per day. The current emissions inventory estimates 0.24 tons per day organic emissions for this source category. However, staff believe that better emissions estimates could be made by a combination of sampling and refined models. A study of the emissions from the biological and chemical treatment of refinery wastewater systems, including wastewater ponds, has been initiated through a cooperative workgroup process that includes refinery personnel, ARB, District and SF Bay Regional Water Quality Control Board staff, environmental groups and consultants with expertise in developing emissions models for wastewater systems.

In addition to organic emissions, odors result when aeration ceases or is insufficient, such as when the ponds or other biological treatment processes are overwhelmed by accident or storm, or when the biota are otherwise disrupted. Considerable research is currently being conducted by universities and other institutions so that the action of treatment pond biota can be better understood and controlled. This research, some of which is being conducted by Lawrence Berkeley Laboratory, holds potential for reducing odors from wastewater ponds. In community meetings held to solicit control measure suggestions,

several requests were made to control refinery wastewater treatment ponds. Consequently, the potential for control is recommended for further study.

References

Draft Technical Assessment Document: Potential Control Strategies to Reduce Emissions from Refinery Wastewater Collection and Treatment Systems, CARB and BAAQMD, Jan., 2003

Suggested Measure Reference # 123, 124

Further Study Measure FS 9: VACUUM TRUCKS

Further Study Measure Description

This measure was analyzed in the 1994 Clean Air Plan as Control Measure B6: Control of Emissions from Cleaning Up Organic Liquids. The analysis concluded that the measure would not be cost effective. However, in addition to cleaning up spills, vacuum trucks have been observed in frequent use as part of some refinery operations, such as removing water from tank surfaces, cleaning of oil-water separators, and transport of sludges, slop oils and tank bottoms. At one refinery, it was estimated that over 1,000,000 gallons of hydrocarbon containing liquids were put in vacuum trucks per month, which is the equivalent of approximately 145,000 gallons of hydrocarbons per month. On a volume basis, at least 1.5 gallons of air is emitted for every gallon of vacuum tank capacity.

In some cases, emissions from the tanks are controlled by the use of a carbon canister that adsorbs organic vapors as they are emitted from the truck tank, primarily to control odors. Further study can determine the emissions from these activities and whether control of emissions is more cost effective than the 1994 analysis found.

References

1994 Clean Air Plan Control Measure B6: Control of Emissions from Cleaning Up Organic Liquids

Suggested Measure Reference # 118

Further Study Measure FS 10: WASTEWATER FROM COKE CUTTING OPERATIONS

Further Study Measure Description

Refineries operate high pressure water pumps to remove or "cut" coke from coking drums. During the investigation of Further Study Measure FS 9: Refinery Wastewater Systems in the 2001 Ozone Plan, it was noted that coke cutting operations at some facilities generated significant quantities of wastewater. This wastewater, at elevated temperatures, is often recycled. The wastewater from coke cutting is not part of the refinery wastewater collection and treatment system. One possible method of control would be to include coke cutting wastewater in the existing collection and treatment system. Additional research needs to be conducted to determine whether coke cutting wastewater contains significant quantities of VOC and whether there is any potential for emissions reductions from these operations. Because of these unknowns, it is recommended that coke cutting operations be studied.

References

Draft Technical Assessment Document: Potential Control Strategies to Reduce Emissions from Refinery Wastewater Collection and Treatment Systems, CARB and BAAQMD, Jan., 2003

Suggested Measure Reference # 136

Further Study Measure FS 11: NOx REDUCTIONS FROM GLASS MELTING FURNACES

Further Study Measure Description

San Joaquin Valley Unified APCD Rule 4354 imposes NOx limits for several types of glass plants: flat glass, container glass, and fiberglass. For container glass furnaces, San Joaquin's current limit is 5.5 lbs NOx / ton of glass. The limit goes to 4.0 lbs NOx / ton of glass in 2008.

In its 2002 and 2005 Rate of Progress plan for the national ozone standard, the San Joaquin District proposed to examine Rule 4354 for potential further reductions. It proposed to examine ARB achievable performance standards and the Houston, Texas SIP for potentially more stringent limits. ARB has not established an achievable performance standard for glass plants, but if it does, it is likely that it would be based on the limits in South Coast Rule 1117. That rule establishes a limit of 4.0 lbs NOx / ton glass for container glass plants. The State of Texas has not adopted standards for glass plants.

BAAQMD Reg. 12, Rule 11 imposes a NOx limit of 5.5 lbs NOx / ton glass. This limit was based on the South Coast limit but also on differences between Bay Area furnaces and South Coast furnaces. The South Coast furnaces are largely end-port furnaces. The operators of the furnaces used electric boost and flame modifications to reduce emissions to meet the SCAQMD limit. The Bay Area furnaces are side port furnaces, and flame modification techniques used in the South Coast cannot be used on these furnaces. In addition, the Bay Area furnaces used electric boost to increase production and therefore cannot use it to reduce emissions without decreasing production. Limits lower than 4.0 lbs NOx / ton glass have been achieved by an oxy-fuel system operated by Gallo in Modesto, but this plant manufactures glass for Gallo wines and does not sell to the open market. It is unclear whether oxy-fuel combustion is cost-effective in the current market.

Another relatively new technology, the Pilkington 3R process, has been developed since the SCAQMD and BAAQMD rules were adopted in the early 1990's, but has been used only in flat glass furnaces. It is unknown whether the process will prove to be suitable for container glass furnaces and whether there is any potential for emission reductions.

References

BAAQMD. 1993. Staff Report, Regulation 9, Rule 12, Nitrogen Oxides from Glass Melting Furnaces.
Blanchard, C., Tanenbaum, S. "Characterization of CCOS Intensive Operating Periods: Task 4c. Supplemental Analyses: Corroborative Analysis" (paper prepared by Envair for the Central Coast Ozone Study/ARB, 2001)
Marr, L.C., Harley, R.A. 2002. "Spectral analysis of weekday-weekend differences in ambient ozone, nitrogen oxide, and non-methane hydrocarbon time series in California." Atmospheric Environment 36, 2327-2335.

SJVUAPCD. 2002. "Final Draft Staff Report, Amendments to Rule 4354 (Glass Melting Furnaces)."
SJVUAPCD. Rule 4354.

Suggested Measure Reference # 130

Further Study Measure FS 12: STATIONARY INTERNAL COMBUSTION ENGINES

Further Study Measure Description

Gaseous Fuel Fired Engines

The District regulates NOx emissions from internal combustion engines under Regulation 9, Rule 8, which imposes NOx limits on engines fired with gaseous fuels. Reg 9-8 was adopted in 1993 pursuant to CARB pollution transport regulations (California Code of Regulations beginning at section 70600). Those regulations required the BAAQMD to adopt by 1994 BARCT for source categories that collectively amounted to 75% of the 1987 nitrogen oxides emission inventory. Because the majority of IC engine emissions came from approximately 60 large engines fired with gaseous fuels located at wastewater treatment facilities, landfills, and refineries, Reg 9-8 imposed controls only on gaseous-fueled engines. Collectively, these engines were estimated to emit 9 tons per day of NOx, and the rule was estimated to reduce emissions by 8.1 tons per day.

Under Reg 9-8, engines fired with fossil-derived fuels must meet a NOx limit of 56 ppm if rich burn and 140 ppm if lean burn. (Current BARCT limits would be, respectively, 25 ppm, or alternatively 96% reduction, and 65 ppm, or alternatively 90% reduction.) Engines fired with waste-derived fuel must meet a 140 ppm limit if lean burn and 210 ppm if rich burn. Current BARCT limits would be 65 ppm and 50 ppm respectively, or alternatively, 90% reduction for either. The inventory currently shows that NOx emissions from stationary IC engines fired with gaseous fuels are 2.37 tons per day, including engines subject to Reg 9-8 as well as smaller engines not subject to the rule. District BACT for engines requires gaseous fuel except where impractical.

Emission reductions from engines fired with gaseous fuels cannot be easily estimated. The CARB BARCT limits include alternative percentage reduction limits that allow compliance through a demonstration that, though an engine may not meet a specified exhaust concentration limit, emissions have been reduced by a specified percentage. Many of the engines are likely to comply with the BARCT alternative percentage reduction requirements so that the BARCT limits would produce no emission reduction. For other engines, emission reductions cannot be easily estimated: engine-by-engine calculations would be required, and emission reductions may be minor.

Liquid Fuel Fired Engines

NOx emissions from stationary liquid-fueled IC engines in the Bay Area are shown in the most recent BAAQMD inventory to be 4.6 tons per day. Virtually all stationary liquid-fueled engines in the BAAQMD are compression-ignited engines, almost all of which are fueled with diesel oil. The BAAQMD inventory for these engines is based on the

inventory developed by CARB for the stationary diesel ATCM. The CARB/BAAQMD inventory shows approximately 4100 diesel engines rated 25 hp or higher in the BAAQMD, of which approximately 3800 are used to drive backup generators or backup pumps. These are emergency standby engines which are exempt from the requirements of Reg 9, Rule 8. These 3800 engines account for about one-fourth of all NOx emissions from stationary sources under the District's jurisdiction. Many of the backup engines in the BAAQMD have been installed since 2000, when permits became mandatory for existing and new backup engines of at least 50 hp. New engines have been required to meet BACT NOx limits set at CARB's Tier 1 limit of 6.9 g/bhp-hr. Based on BAAQMD permit data, the CARB inventory appears to be fairly reliable in its population estimates for backup engines.

According to the CARB inventory, approximately 300 diesel engines are used to drive prime generators, prime pumps, or for other purposes. According to the CARB inventory, these engines account for approximately three-fourths of all NOx emissions (3.3 tons per day) from liquid-fueled engines and would be the primary target for controls. We believe this number greatly overstates the number of such engines in the Bay Area. This discrepancy arises because CARB, in determining how many engines should be classified as prime engines, relied on data from four air districts, including two (San Joaquin and South Coast) that have large numbers of these engines in operation in petroleum production, an activity of no significance in the Bay Area.

BAAQMD permit data shows that there are 495 engines flagged as non-standby engines. However, an examination of the data shows that some are, in fact, "standby engines" and a much larger number are used only intermittently. The permit data show that cities and counties have a large number of diesel generators that may run temporary lights for street repair, etc. Of the 495 non-standby engines, 70 of them have emissions of at least 1 pound of NOx per day, and only 47 of them have emissions of 10 pounds of NOx per day. These are the prime engines that are of concern. The collective emissions estimate for those engines of greater than one pound NOx per day is 1294 lbs per day, 0.65 tons/day, confirmation that the CARB inventory overstates the number of diesel-fired prime engines.

The California Air Resources Board adopted the ATCM on January 20, 2004. District imposed NOx controls on liquid-fueled engines may not produce emission reductions beyond those that are likely to be achieved through the implementation of the ATCM. If finalized by the Office of Administrative Law, the ATCM will result in the replacement of virtually all existing prime engines by 2011. All new engines will have to meet BACT both for particulate matter and for ozone precursors (VOC and NOx). Reductions of ozone precursors through the ATCM will exceed anything that can be achieved through retrofits on existing engines. The San Joaquin Valley Unified APCD dropped proposed requirements for diesel engines from its new Rule 4702 (adopted 8/21/03) for this reason. Due to the these factors, further study of stationary IC engines is recommended.

References

Blanchard, C., Tanenbaum, S. "Characterization of CCOS Intensive Operating Periods: Task 4c. Supplemental Analyses: Corroborative Analysis" (paper prepared by Envair for the Central Coast Ozone Study/ARB, 2001)

California Air Resources Board. 2001. "Determination of Reasonably Available Control Technology and Best Available Retrofit Control Technology for Stationary Spark-Ignited Internal Combustion Engines."

California Air Resources Board. 2003. "Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Adoption of the Proposed Airborne Toxic Control Measure for Stationary Compression-Ignition Engines."

Marr, L.C., Harley, R.A. 2002. "Spectral analysis of weekday-weekend differences in ambient ozone, nitrogen oxide, and non-methane hydrocarbon time series in California." Atmospheric Environment 36, 2327-2335.

Sacramento Metropolitan AQMD. Rule 412.

San Joaquin Unified APCD. 2003. "Final Draft Staff Report: Proposed Amendments to Rule 4701 (Internal Combustion Engines - Phase 1) and Rule 4702 (Internal Combustion Engines - Phase 2)"

San Joaquin Unified APCD. Rules 4701 and 4702.

South Coast AQMD. Rule 1110.2.

Ventura County APCD. Rule 74.9.

Suggested Measure Reference # 114, 115, 116, 120, 128, 129