Bay Area Air Quality Management District

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Workshop Report

Proposed Amendments to BAAQMD Regulation 8, Rule 5: Storage of Organic Liquids

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I. Introduction

The proposed amendments to Bay Area Air Quality Management District (BAAQMD or District) Regulation 8, Rule 5: Storage of Organic Liquids are intended to implement Control Measure SS 9 in the Bay Area 2005 Ozone Strategy. Control Measure SS 9 proposes to reduce reactive organic gas (ROG) emissions from storage tanks by supplementing existing requirements in Rule 8-5.

Tanks regulated under Rule 8-5 are used for bulk storage of organic liquids or liquid mixtures containing organic compounds. Such tanks are typically found at petroleum refineries and chemical plants, as well as gasoline bulk plants and terminals. Underground gasoline storage tanks located at gasoline stations are regulated under District Regulation 8, Rule 7 and are not addressed in Rule 8-5 or in this report.

In the Bay Area 2005 Ozone Strategy, the District estimates that ROG emissions from storage tanks are 5.26 ton/day in 2006. Most of these tanks are subject to Rule 8-5. This emission inventory includes tank cleaning emissions for tanks located at petroleum refineries.

The proposed amendments will improve monitoring for all standards in the rule and especially for tank degassing operations used to prepare a tank for internal cleaning. New standards are proposed to reduce emissions related to tank cleaning operations. Also, a new self-inspection and repair program is proposed to encourage frequent self-inspections and timely preventative maintenance by tank operators. Other minor and editorial amendments are also proposed.

II. Background

A. Source Description

Tanks subject to Rule 8-5 have one of four basic designs: fixed roof, pressure, external floating roof and internal floating roof.

Figure 1 shows a typical large fixed roof tank. The pressure/vacuum vent is designed to remain closed as long as the tank pressure deviates from atmospheric pressure by a small amount, such as when daytime temperatures cause the tank pressure to rise slightly, or when cooler night temperatures cause a slight tank vacuum. However, large pressure variations, such as those caused by draining a large quantity of liquid from the tank or by adding a large quantity of liquid to the tank, may cause the vent to open, thereby releasing organic vapors to the air or admitting air into the tank where it becomes saturated with organics. The pressure/vacuum vent is the only emission point on a fixed roof tank.

Pressure tanks operate in the same way as fixed roof tanks, but are designed to store high-pressure liquids. Pressure tanks are typically long cylinders with hemispherical ends oriented horizontally rather than vertically.

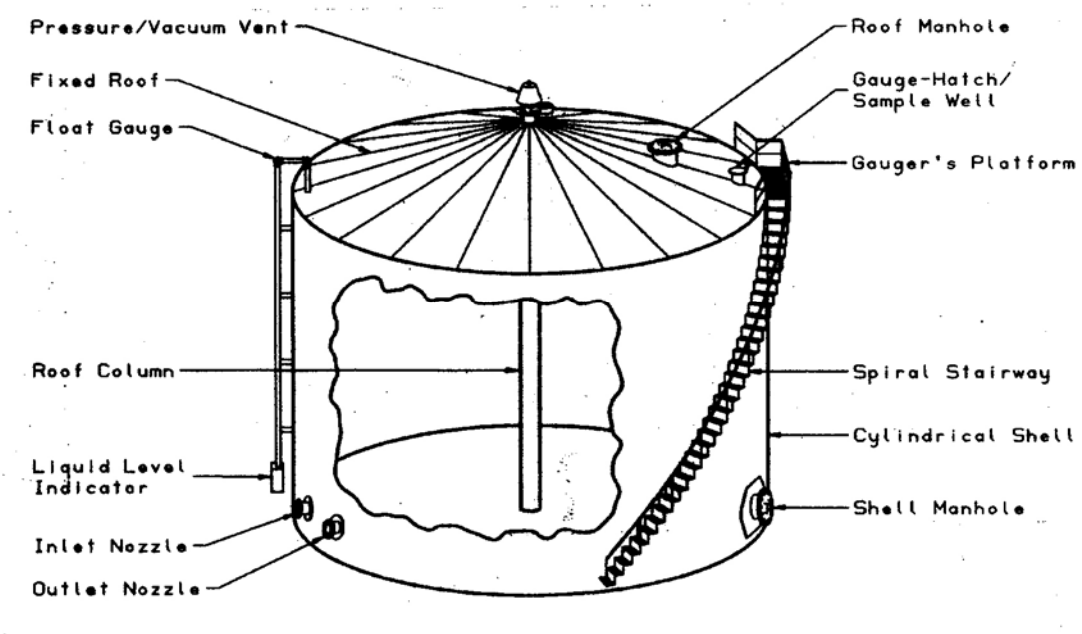

Figure 1. Fixed Roof Tank (source: U.S. EPA)

Figure 2 shows a typical external floating roof tank (EFRT). An EFRT has a cylindrical shell with no fixed roof or cover. Instead, the roof floats on top of the liquid and moves up and down as the liquid level changes. Because there is no vapor space between the roof and the surface of the stored liquid, tank pressure does not rise when liquid is added to the tank and vapors are not expelled from the tank, as they are with a fixed roof tank. However, a floating roof design has two emission points not found on fixed roof tanks: vapor leaks from rim seals and roof fittings. Organic liquid may evaporate in the space between the outer edge of the floating roof and the inside tank wall. Although rim seals of various designs are used to reduce these emissions, some organic vapors are emitted at these rim seals. Roof fittings such as deck legs, guidepoles and sample hatches penetrate the roof and provide a potential route for evaporative emissions to occur. Although cover gaskets and other closure mechanisms may reduce these emissions, some organic vapors are emitted at roof fittings. Nonetheless, a floating roof tank typically reduces overall emissions 60% to 99% more than a fixed roof tank in the same service.

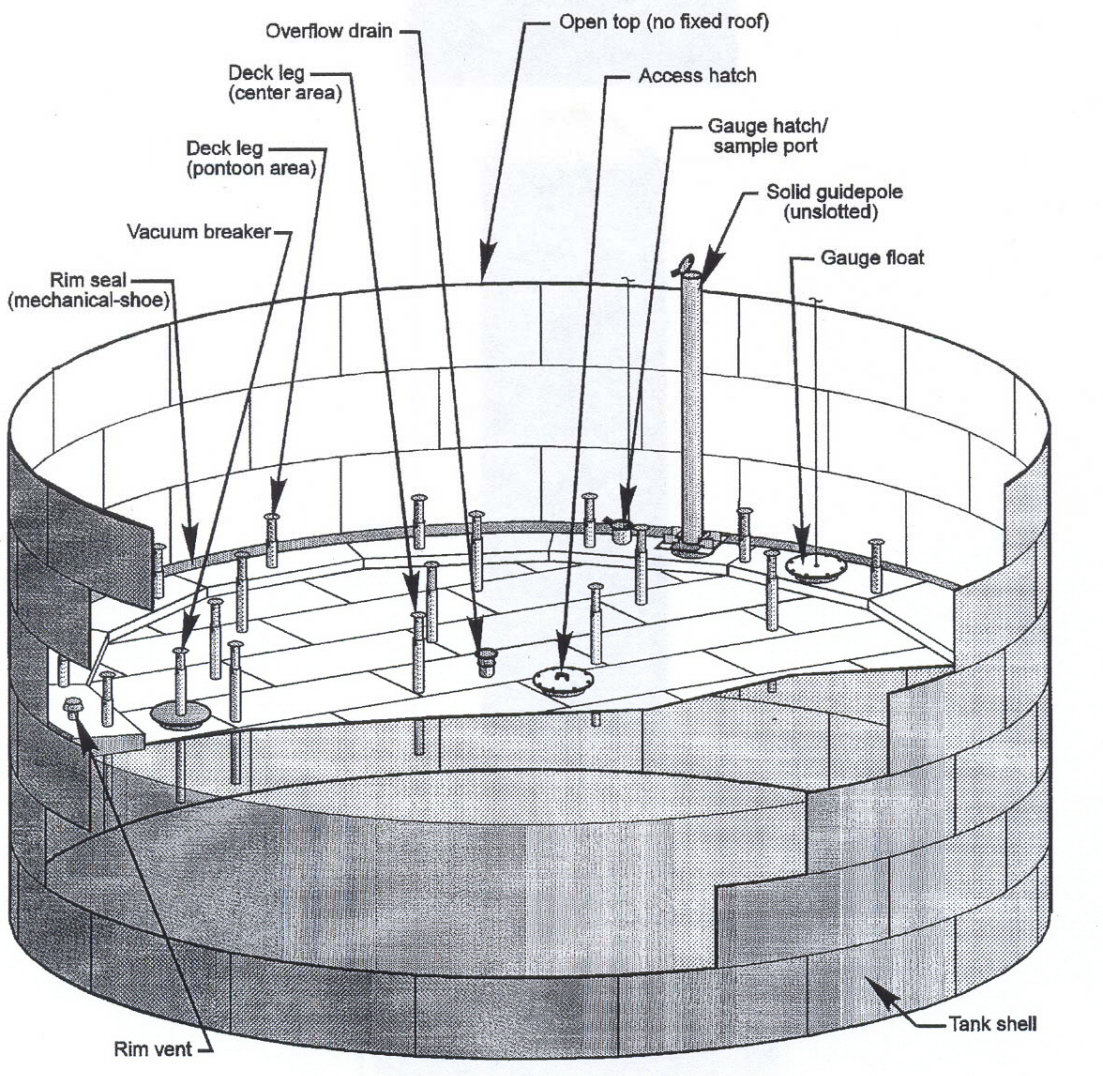

Figure 2. External Floating Roof Tank (source: U.S. EPA)

Figure 3 shows a typical internal floating roof tank (IFRT). An IFRT is basically an EFRT with an additional fixed roof on top of the tank shell. The emission mechanisms for an IFRT are the same as for an EFRT, but the fixed roof eliminates wind exposure at the floating roof rim seal and roof fittings. Because wind exposure increases the emission rate at these points, an IFRT will have a lower emission rate from the rim seal and roof fittings compared to an otherwise identical EFRT. However, because the fixed roof creates a potentially dangerous environment by allowing organic vapors to concentrate above the floating roof, IFRTs are subject to much less stringent inspection requirements than EFRTs and their floating roofs are not easily accessible for preventative maintenance. This suggests that the condition of IFRT floating roof rim seals and roof fitting closures may be inferior to that on EFRTs, so it is not clear that an IFRT will have lower emissions than an EFRT in actual service.

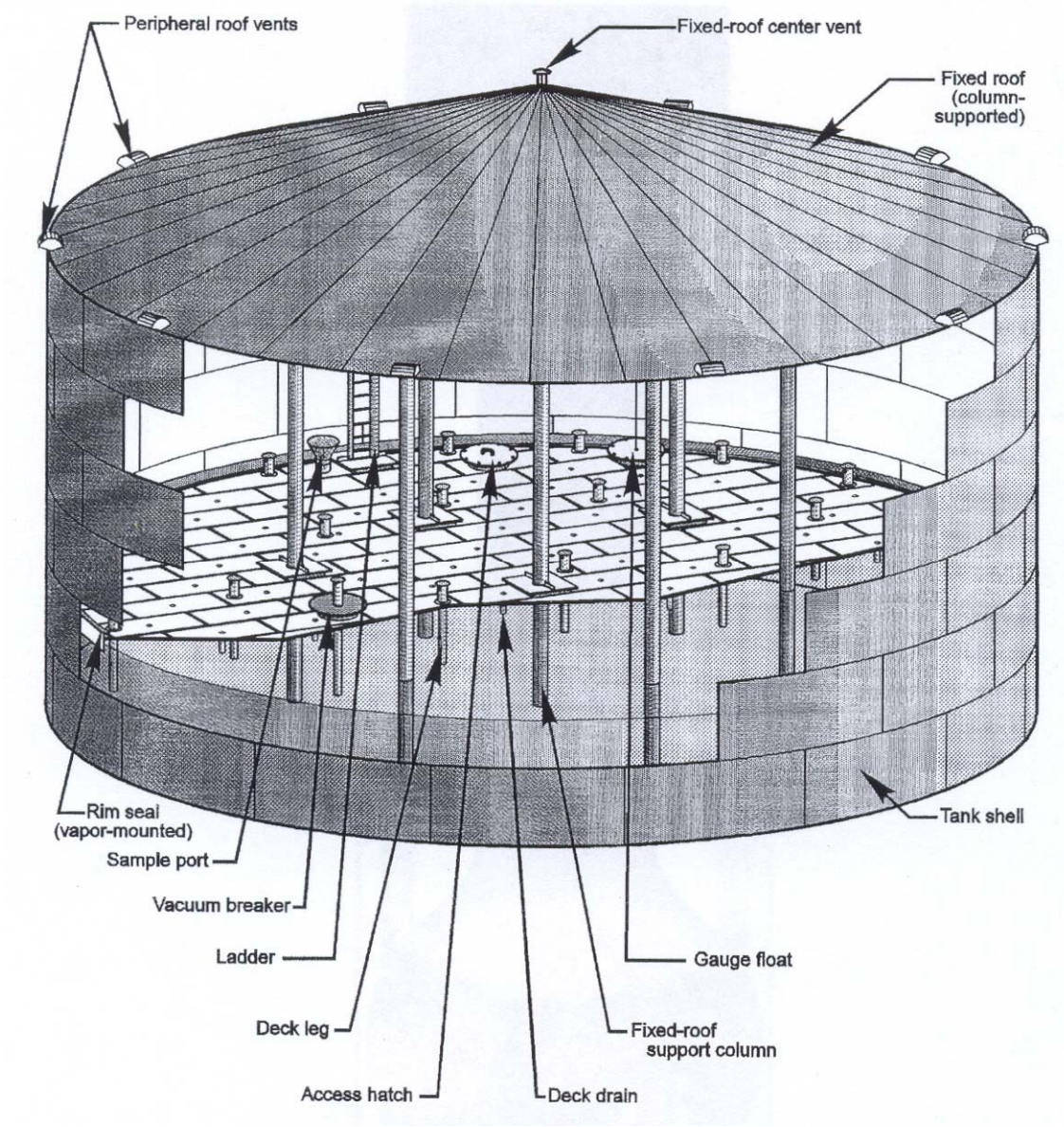

Figure 3. Internal Floating Roof Tank (source: U.S. EPA)

BAAQMD data show that there are 3,282 tank sources within the District, including both permitted tanks and tanks that are exempt from permit requirements. This total includes internal floating roof tanks (IFRTs), external floating roof tanks (EFRTs), fixed roof tanks and pressure tanks, but excludes fuel tanks at retail service stations. This total also includes tanks that primarily hold water or inorganic liquids. An estimated 499 tanks have floating roofs. Most floating roof tanks have welded shells, but an estimated 31 tanks have riveted shells. Rivets in the tank shell reduce the effectiveness of floating roof rim seals compared to a welded tank shell. Table 1 provides a summary of tanks in the Bay Area.

Table 1 - BAAQMD Tank Inventory	
Fixed Roof Tanks	2,636 (at 294 facilities)
Floating Roof Tanks	499 (at 33 facilities) 309 EFRTs (18 riveted) 190 IFRTs (13 riveted)
Pressure Tanks	147 (at 25 facilities)
Total Tank Sources	3,282 (at 301 facilities)

About 50% of the 3,282 total tank sources are classified as exempt from permit requirements, either because they are very small or because they do not store liquids that contribute significantly to air pollution. Only 47 facilities have 10 or more tanks, and these 47 facilities account for about 73% of the total tanks and about 95% of the floating roof tanks.

In the Bay Area 2005 Ozone Strategy, the District estimates that ROG emissions from storage tanks are 5.26 ton/day in 2006, including tank cleaning emissions for tanks located at petroleum refineries.

B. Regulatory History

The BAAQMD has regulated emissions from tanks storing organic liquids for almost 40 years, first under former Regulation 3, which was adopted in 1967, and later under Regulation 8, Rule 5. Regulation 8, Rule 5 was originally adopted in 1978 and has been amended a number of times. By 1993, this rule included most of the control strategies found in the current rule, including gap standards for floating roof rim seals, pressure vacuum valve setpoint requirements for fixed roof tanks, closure requirements for tank roof fittings and tank degassing requirements. For over a decade, Rule 8-5 has been the most stringent storage tank rule in California with regard to normal tank operations. However, opportunities to improve the rule exist, primarily in the area of non-routine operations, such as tank degassing and cleaning. These opportunities are discussed in Section III.

III. Technical Review

A. Control Measure SS 9

The proposed methods of control in Control Measure SS 9 in the Bay Area 2005 Ozone Strategy are based on the recommendations in the District's Technical Assessment Document (TAD) that was published in January 2004. The proposed methods are: 1) improving standards for tank degassing and cleaning, and for handling sludge removed from tanks during cleaning; and 2) implementing a voluntary self-inspection and maintenance (I&M) program to encourage more frequent inspections and timely preventative maintenance. Additional control methods not addressed in the TAD are discussed in Section III.B.

1a. Tank Degassing

Tank degassing is the process of removing organic vapors from the interior of a tank that has been drained of organic liquid prior to opening the tank to the atmosphere. Degassing is the first step in making the tank interior safe for workers prior to maintenance. Regulation 8-5-328.1 requires that organic gas emissions from degassing be reduced by at least 90% and that abatement continue until the residual organic concentration in the tank falls below 10,000 ppm. This treatment is performed in various ways. At refineries, where waste gases are routinely collected for use as fuel, the organic gases may be vented to a fuel gas collection system. Residual gases may also be converted to a liquid form with a condenser and re-used, captured with a carbon adsorbent, or destroyed with an internal combustion engine or an oxidizer.

Several amendments are proposed to improve and clarify rule requirements for degassing. Regulation 8-5-502 currently requires that abatement devices used to comply with Section 8-5-328.1 undergo an annual source test, and Section 8-5-404 requires that a report be submitted to the District describing the results of the source test. First, the proposed amendments include a measurement requirement that would ensure that the residual organic concentration in a tank is reduced to less than 10,000 ppm before degassing ceases. Second, the proposed amendments would clarify exactly who is responsible for the performance of the test (the abatement device is often operated by a contractor who is not the tank operator), when the test must be performed, and under what circumstances a test is required.

The 2004 TAD noted that some California air districts require a minimum abatement efficiency during degassing of 95%. Increasing the BAAQMD standard from 90% to 95% would probably not result in significant emission reductions because the most common control technologies - collection with a fuel gas collection system or activated carbon, or destruction with combustion-based abatement devices - already result in abatement efficiencies of at least 95%. A less common abatement technology - condensation - has significant environmental benefits because it recovers organic liquid for re-use and does not produce secondary combustion emissions. However, condensation probably will not achieve 95% abatement efficiency consistently unless it is used in combination with a secondary abatement device (such as a carbon adsorber or combustion device), which would raise the overall operating cost significantly. Therefore, in order to preserve the option of

condensation as a cost-effective control technology, no increase in the minimum abatement efficiency is proposed.

1b. Tank Cleaning

After a tank has been degassed, the interior is vented of residual gases prior to being cleaned internally. Cleaning allows the tank interior to be inspected and repaired and removes accumulated sludge from the tank floor. Sludge may adversely affect the quality of material stored in the tank and may accumulate to the point that the working capacity of the tank is significantly reduced. Rule 8-5 does not currently address emissions from tank cleaning operations and no other District rule regulates the cleaning of tank interiors. Other California air districts, including the San Joaquin Valley Unified APCD (Rule 4623), the South Coast AQMD (Rule 1149) and the Ventura County APCD (Rule 74.26) do address these potential emissions. In general, these rules require that the residual organic concentration or vapor pressure in the tank must be reduced to some target level through degassing, with this concentration or vapor pressure maintained during subsequent cleaning operations, or that the emissions during cleaning be abated.

Because Rule 8-5 does not require emission controls during cleaning, as it does during degassing, the use of cleaning agents that contain significant levels of organic compounds could negate the benefits of controlling degassing emissions. Also, the use of steam as a cleaning agent tends to heat and vaporize organic liquids that might otherwise be removed from the tank as a liquid or semi-solid sludge, thus increasing the level of emissions during cleaning. Rule 8-5 also currently has no limitations on the type of cleaning agents that may be used. In order to ensure that inappropriate cleaning agents are not used, Section 8-5-331 is proposed to be added to impose limitations on the VOC content of cleaning agents and the use of steam cleaning. The limitations are based on new standards in the May 2005 amendments to San Joaquin Valley Unified APCD Rule 4623. Section 8-5-332 is proposed to be added to impose minimum containment standards for sludge removed from tanks during cleaning. Also, Section 8-5-606 is proposed to be added to provide appropriate test methods to allow enforcement of the proposed limitations. The use of an abatement device would be allowed as an alternative to these cleaning agent limitations.

2. Self-Inspection and Maintenance Program

Rule 8-5 includes the most stringent seal gap standards and fitting standards for floating roof tanks of any tank rule in the country. As the stringency of the rule has increased, so has the difficulty in finding opportunities for further emission reductions from storage tanks. However, one opportunity appears to be a reduction in the number of minor violations of the rule's standards. Because the current standards are so stringent, it is relatively easy for tank seals to fall out of compliance given that tank walls almost inevitably show minor departures from a perfectly circular shape and given the normal wear and tear on seal edges. It is therefore not uncommon for tank operators or District inspectors to find minor violations of rim seal gap standards in a small circumferential area of a rim seal, or minor wear damage in a required secondary rim seal or fitting cover. In most cases these violations may be repaired soon after discovery. Many of these violations would not be violations of the less stringent

rules in other air districts. Given the minor nature of these violations, it seems likely that earlier or more frequent inspections would prevent their occurrence.

To limit the frequency of minor departures from rule requirements, District staff is proposing a voluntary self-inspection and repair program through new Sections 8-5-119 and 411. The proposed program would require increased inspection frequencies for a prescribed fraction of the tank population at a facility, while allowing self-discovered violations of certain standards at all tanks to be repaired without constituting a rule violation. The proposed program excludes violations of standards related to internal floating roof tanks because these tanks are subject to less stringent and less frequent inspections than fixed roof, external floating roof or pressure tanks. The proposed program also excludes violations of design standards that would result in significant emissions or that would require a significant tank modification for correction. Violations of any standards discovered by the District would continue to be subject to enforcement action. This enhanced inspection program would allow operators to devote resources to inspections and preventative maintenance rather than on administrative requirements related to minor rule violations and would not relax any rule standards.

B. Other Proposals

1. Add Standards for Tank Shells and Pontoons

Rule 8-5 requires that floating tank roofs and certain tank fittings be in "good operating condition". However, this standard is undefined and does not apply to tank shells, no matter how large the leak. In order to promote consistent application of this standard, a definition for this standard is proposed to be added in Section 8-5-225. A standard for tank shell integrity is also proposed to be added for fixed and floating roof tanks in Sections 8-5-304.5, 305.6 and 307.1. It should be noted that tank shell leaks are not common on most tanks, since over 94% of the floating roof tanks in the District have welded steel shells. However, minor leaks sometimes occur on older tanks with riveted shells.

Many floating roofs are made buoyant by pontoons that are arranged along the outer circumference of the roof. These pontoons are formed from welded steel sheets and are typically provided with loose-fitting covers that are accessible from the roof deck. Occasionally, a pontoon weld will crack, allowing liquid to collect in the bottom of the pontoon. Evaporation of this liquid creates an organic vapor space inside the pontoon and results in organic emissions at the pontoon cover. Rule 8-5 does not currently address such leaks. Section 8-5-304.4 is proposed to be amended to prohibit such leaks on external floating roof tanks. In some cases, pontoon leaks may be temporarily repaired with the tank in service by applying a sealer to the inside of the leaking pontoon. No prohibition is proposed for internal floating roof tanks because pontoons on these tanks are not accessible for inspection while the tank is in service.

2. Add Inspection Requirements for Pressure Relief Devices (PRDs)

Regulation 8-5-307 imposes a "leak tight" standard on PRDs that are vented to the atmosphere. However, this standard has no monitoring requirement. In order to ensure compliance with this standard, a semi-annual inspection requirement is proposed in 8-5-403. This requirement and inspection frequency is consistent with other leak tight standards in Rule 8-5.

IV. Rule Development / Public Consultation Process

The District convened a technical workgroup of interested stakeholders to explore issues related to regulation of organic liquid storage tanks. Workgroup meetings were held on April 23, 2003 and May 9, 2005. Members of the Western States Petroleum Association (WSPA) and Communities for a Better Environment (CBE) participated in these meetings. An industry training course for Rule 8-5 was held by the District on June 28, 2004. Staff has also met with the staff of U.S. EPA Region 9 to discuss amendments to Rule 8-5. The proposed workshop is the next step in the rule development process. Based on the input staff receives prior to and at the workshop, staff will decide whether changes to the proposal are necessary prior to a public hearing before the District's Board of Directors.

V. References

Bay Area Air Quality Management District: *Bay Area 2005 Ozone Strategy*, Volume 2: Control Measure SS 9: *Organic Liquid Storage Tanks*; January 2006

Bay Area Air Quality Management District: Technical Assessment Document for Further Study Measure FS 10 from Bay Area 2001 Ozone Attainment Plan; January 2004

U. S. Environmental Protection Agency: AP-42, 5th Edition: *Compilation of Air Pollutant Emission Factors*, Volume 1, Chapter 7.1: *Organic Liquid Storage Tanks*; September, 1997. Washington, D.C.

U. S. Environmental Protection Agency: *TANKS 4.09b* computer program for the Windows operating system. Washington, D.C.

San Joaquin Valley Unified Air Pollution Control District: Rule 4623, *Storage of Organic Liquids*, May 2005

South Coast Air Quality Management District: Rule 1149, *Storage Tank Cleaning and Degassing*, July 1995

Ventura County Air Pollution Control District: Rule 74.26, *Crude Oil Storage Tank Degassing Operations*, January 1995