

Bay Area Air Quality Management District

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Workshop Staff Report

**Proposed Amendments to
BAAQMD Regulation 8, Rule 44:
Marine Vessel Loading Operations**

**Proposed Deletion of
BAAQMD Regulation 8, Rule 46:
Marine Tank Vessel to Marine Tank Vessel Loading**

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WORKSHOP STAFF REPORT

Proposed Amendments to Regulation 8, Rule 44 Proposed Deletion of Regulation 8, Rule 46

I. INTRODUCTION

A. Summary of Proposal

This report explains a draft proposal to amend the Air District rules that control air pollution from marine tank vessel (oil tanker) activities. The activities affected by the rules are those that release vapors from vessel cargoes such as crude oil and petroleum products. The proposed amendments would (1) require controls for all liquids with a Reid vapor pressure greater than 2.0 pounds per square inch absolute (psia), not just for the five liquids regulated by the current rules, (2) impose more stringent leak standards on the equipment that controls emissions, (3) clarify and extend requirements for various activities - tank washing, purging, and gas freeing - that can vent tank emissions to the atmosphere, and (4) consolidate all requirements in one rule. The District has prepared draft amendments to the District rules and will solicit comments on the proposal at a public workshop.

B. Background

Marine tank vessels operate in the Bay Area in two primary trades: the delivery to the Bay Area of refinery inputs such as crude oil, and the delivery to markets outside the Bay Area of a variety of refinery outputs such as gasoline, distillate oils, and residual oils.

The two District rules that would be changed by the proposal are Regulation 8, Rules 44 and 46. Rule 44 applies to loading activities that release organic compounds contained in the cargo tanks of marine tank vessels. Rule 46 applies to lightering, the transfer of cargoes from a large oil tanker with a draft greater than can be accommodated by the relatively shallow San Francisco Bay into a smaller vessel capable of delivering the cargo. In the Bay Area, virtually all lightering activity involves transfer of crude oil to smaller vessels for delivery to Bay Area refineries.

The current rules are intended to reduce emissions of organic compounds that lead to the formation of ozone, the primary constituent of smog. The rules were adopted in 1989 and apply to the five cargoes that account for most emissions: crude oil, gasoline, gasoline blending stock, aviation gasoline, and JP-4 jet fuel

Various tanker operations produce organic compound emissions subject to the rule. Loading or lightering of one of the five regulated liquids produces emissions when vapors from evaporation of the liquid are forced out of the tank by the incoming liquid. Loading or lightering of an unregulated organic liquid may also produce emissions if the liquid displaces vapors remaining from a prior cargo of one of the regulated liquids. Ballasting – the introduction of seawater into

a tank in order to ensure proper propeller, rudder, and hull immersion – may be conducted after cargo delivery and may produce emissions if the tank receiving ballast water contained a regulated liquid cargo. Ballasting emissions are now relatively uncommon as most tankers calling on the Bay Area have segregated ballast tanks that are used only for ballast water. Other activities – tank washing, purging, and gas freeing – may also produce emissions subject to the rule if they involve any venting of vapors from a regulated liquid.

Regulation 8, Rule 44 was primarily intended to control loading emissions. The rule limits emissions from loading to 2 pounds of organic compounds per thousand barrels of liquid loaded (2 lb/1000 bbl). By defining loading to include any “loading into a tank vessel when the prior cargo was an organic liquid,” the standard was also intended to apply to ballasting. Regulation 8, Rule 46 extended the same standard to lightering. Though the rules do not directly address emissions from tank washing, purging, and gas freeing, the District has interpreted the rules to apply to these activities when the activities are associated with a regulated loading or lightering activity.

C. 2002 Study of Marine Tank Vessel Activities

In 2001, the Air District prepared a 2001 Bay Area Ozone Attainment Plan to attain the national 1-hour ozone standard in the Bay Area. The 2001 Plan included a study measure (FS-11, “Marine Tank Vessel Activities”) that proposed to examine whether significant additional emission reductions were available from further regulation of marine tank vessel operations. The results of this study were published in December 2002 in a draft technical assessment document (TAD), available at

http://www.baaqmd.gov/enf/further_study_measures/marine_loading/tad_draft3_dec2002.pdf.

In the draft TAD, the District attempted to determine whether significant emission reductions could be cost-effectively achieved by: (1) regulating currently unregulated liquids, (2) imposing more stringent control requirements, (3) tightening leak standards, and (4) regulating activities that vent tank vapors to the atmosphere.

1. Unregulated Liquids

The primary question addressed by the TAD was whether controls on low-vapor-pressure cargoes like distillate oils and residual oils would produce significant emission reductions. The District obtained records for all Bay Area loading of organic liquids that occurred during the period from September 2000 through August 2001. The various commodities loaded were classified as "light," "medium," or "heavy" cargoes. Currently-regulated cargoes were classified as light cargoes. This data was summarized in the draft TAD.

In attempting to determine whether emissions from loading of medium and heavy cargoes are significant, the District conducted 5 marine loading source tests and summarized the results in the TAD. The TAD also included a summary of test data from other agencies. Though some tests of distillate or residual oil loading indicated an uncontrolled emission factor greater than 2 lb/1000 bbl under circumstances that would not require control under the existing provisions of Rules 44 and 46, others showed the uncontrolled emission factor to be less than 2 lb/1000 bbl.

This testing also revealed that a number of variable factors, besides the properties of the liquid being loaded, may have a large effect on the overall emission rate during loading. These variable factors include the size of the load and of the loaded tanks, the prior cargo held in the tanks being loaded, the temperature of the tanks and of the loaded liquid, the condition of the loaded tank (clean, flushed with diesel, filled with inert gas). In part because so many variable factors are involved, the testing performed during the development of the FS-11 TAD was not sufficient to establish reliable emission factors for currently-unregulated cargoes. However, the results of District testing and results obtained by other agencies suggest that an emission factor of 2 lb/1000 bbl is a conservative assumption for the emissions produced by the loading of distillate fuel oils, including diesel, and residual fuel oils.

2. More Stringent Control Requirements

In the draft TAD, the District compared Regulation 8, Rule 44 to rules from other air districts and found that the current District abatement standard (2 lb/thousand bbl or 95% by weight) is at least as stringent as corresponding standards in the South Coast AQMD, San Luis Obispo County APCD, and Santa Barbara County APCD. The document did not include a recommendation for a more stringent control standard.

3. More Stringent Leak Standard

In the draft TAD, the District found that the current “gas tight” standard for tanks and connectors subject to control requirements (10,000 ppmv) is less stringent than the standard in the South Coast AQMD and San Luis Obispo County APCD (both 1,000 ppmv).

4. Purging and Gas Freeing

In the draft TAD, the District found that the South Coast AQMD and San Luis Obispo County APCD require control of gas venting operations where air or inert gas is introduced into a marine tank previously loaded with regulated cargo, usually for safety reasons. As noted, the District rules do not directly regulate gas venting operations, but have been interpreted by the District to apply to some of these activities when they are related to loading or lightering.

II. PROPOSED RULE AMENDMENTS

A. Proposed Control of Currently Unregulated Liquids

The Air District is proposing to extend control requirements to all cargoes with a Reid vapor pressure greater than 2.0 psia. It does so for four reasons: (1) data shows that there is significant Bay Area traffic in unregulated commodities with vapor pressures exceeding 2.0 psia, (2) these cargoes can be readily identified prior to loading, (3) liquids with a vapor pressure over 2.0 psia are extremely volatile and therefore produce significant emissions, and (4) control of emissions from the currently-regulated liquids, each of which has a vapor pressure that exceeds 2.0 psia, has proven to be both feasible and cost effective.

In making this proposal, the District examined the most recent data available to determine types and quantities of organic liquid cargoes passing through the Golden Gate. This data, from the Army Corps of Engineers, is summarized below.

2003 Golden Gate Commodity Traffic		
Commodity (note 1)	2003 Volume (1,000 bbls)	Emissions Controlled by Current Rule 8-44?
Crude oil	161,000	yes
Gasoline	38,000	yes
Kerosene	180	no
Distillate fuel oils including diesel	17,000	no
Residual fuel oils	11,600	no
Fuel intermediates (naphtha, others)	2,200	yes (note 2)
Heavy refined products (lube oil, grease, wax, asphalt)	7,600	no
Organic chemicals (benzene, toluene, alcohols, others)	8,500	no (note 2)

Notes:

1. In addition to the traffic shown in this table, area refineries also receive crude oil by pipeline from California oilfields, and distribute gasoline, jet fuel and other products via pipeline, tanker truck, and rail.
2. Only fuel intermediates used in gasoline production are regulated by Rule 44; intermediates used in diesel production are not currently regulated. Miscellaneous organic chemicals, including benzene and toluene, may be used as fuel blending stocks and are regulated by Rule 44 if used in gasoline production.

1. Organic Chemicals

As shown in the table, there is significant traffic in a category the Army Corps of Engineers calls “organic chemicals.” This cargo consists of volatile organic chemicals such as benzene and toluene with high unabated loading emission factors similar to those for currently-regulated materials. These cargoes are not currently regulated by Regulation 8, Rule 44 unless they are used as gasoline blending stocks. Assuming a very conservative average factor of 10 lb/1,000 bbl, the emissions subject to control would be:

$$(8,500,000 \text{ bbl/yr}) (10 \text{ lb}/1,000 \text{ bbl}) (\text{ton}/2,000 \text{ lb}) = 42.5 \text{ ton/yr or } 0.12 \text{ ton/day}$$

Emission reductions from controlling these cargoes would be:

$$(8,500,000 \text{ bbl/yr}) ((10 - 2) \text{ lb} / 1,000 \text{ bbl}) (\text{ton}/2,000 \text{ lb}) = 34 \text{ ton/yr or } 0.09 \text{ ton/day}$$

A significant portion of these emissions consists of compounds, including benzene and toluene, that are categorized as toxic air contaminants. To the extent that some cargoes included in this category may already be subject to control requirements if they are used as gasoline blending stocks, the emission reduction would be lower.

2. Distillate and Residual Oils

The District is not proposing to require controls for distillate and residual oils. Even if all petroleum distillate fuels and diesel fuels shown in Table 1 were controlled, emissions subject to control would be very small. Assuming an emission factor of 2.0 lb/1000 bbl loaded, uncontrolled emissions from the total 2003 category of petroleum distillate fuels would be 57,200 lbs, or 28.6 tons per year (0.08 tons/day). Though the emissions estimate is 1/3 less than that for organic chemicals, the volume of commodities for which controls would be required is over 3 times as great.

Even if emission reductions from controlling emissions from these cargoes were greater, they might come at prohibitive cost. In 2002, during development of the technical assessment document for marine loading, representatives of Bay Area refineries submitted data showing that the annual operating cost of equipment necessary to control emissions from all low-volatility cargoes could be as high as \$2.4 million, resulting in a cost effectiveness of \$84,000 per ton of emissions without considering capital costs, which were estimated by refinery operators to range from \$10 million to \$25 million for all five refineries taken together. These figures also do not include operating and capital costs for independent terminals. The District plans to review a variety of cost data to more precisely determine how much it would cost to control emissions from low-volatility cargoes.

Because of the uncertainty regarding emission factors for low-volatility cargoes, and despite the minor potential emission reductions even assuming emissions of 2 lb/1000 bbl, the District proposed in 2003 to modify Regulation 8, Rule 44 to require controls based on an event-specific parameter, such as the concentration of organic vapors in the headspace of a marine tank, rather than on the type of commodity being loaded. This approach was prompted by the available data, which suggested that only a minor subset of distillate and residual oil cargoes had emissions above 2 lb/1000 bbl. With the 2003 proposal, only loading events that generate an emission stream with an organic concentration above a specific trigger would require emission controls.

In response, operators of marine tank vessels and terminals indicated that the current format of the rule allows operators to easily plan for the use of emission control equipment based simply on the type of material being loaded or the prior cargo. If the rule were changed to require controls based on an event-specific parameter, operators expressed concern that they would no longer know in advance when emission controls are required and that they would be forced to apply emission controls on every loading event, no matter how low the emissions might be, or to interrupt loading to connect emission control equipment, possibly requiring the vessel to be moved to a berth equipped with vapor recovery. In either case, a considerable delay and associated costs would result.

The District is proposing to gather more data for currently unregulated cargoes by requiring that operators measure the organic concentration in cargo tanks during loading operations. Operators would be required to measure organic concentration at hourly intervals during loading operations, to record other loading parameters, and to submit this data to the District. With this data, the District expects to be able to identify more exactly the types of organic liquid cargoes loaded in the Bay Area, to quantify more exactly the amount of traffic for these materials, and to establish emission factors for low-volatility organic materials with significant loading activity.

With this information, the District may be able to determine whether certain low-volatility organic materials under certain conditions should be subject to emission control requirements.

B. Proposed More Stringent “Gas Tight” Standard

As noted, the District’s current “gas tight” standard of 10,000 ppmv for marine tanks and connectors subject to control requirements is less stringent than the standard in the South Coast AQMD and the San Luis Obispo County APCD (1,000 ppmv).

In October 2003, the District proposed to lower the standard to 100 ppm to match the standard in Regulation 8, Rule 18 (“Equipment Leaks”), which applies to refineries and chemical plants. In response, marine equipment operators indicated that connectors and other fugitive sources in marine service cannot meet the same low level of leakage achieved in non-marine service because of the harshness of the environment and because loading hoses must be connected and disconnected for each loading event.

Because a 1,000 ppmv standard is in effect in the South Coast AQMD and the San Luis Obispo County APCD, the California Air Resources Board considers such a standard to be a feasible control measure. The District is therefore proposing to include this standard in the rule.

Reduction of the “gas tight” standard is expected to produce a minor reduction in emissions of approximately 0.05 tons per day. It is not expected that improved equipment or maintenance practices will be necessary to achieve compliance with the new standard.

C. Proposed Control of Gas Venting Operations

The Air District rules do not directly address emissions from tank washing, purging, and gas freeing. In a March 2005 compliance advisory, the District interpreted the rules to apply to these activities when the activities are associated with a regulated loading or lightering activity. The District is now proposing to require controls for all “venting” activities that involve release of vapors from regulated cargoes.

Tank inerting, cleaning, purging, and gas freeing carried out by marine tank vessel operators may result in the venting of tank vapors. All tankers that serve the Bay Area have inert gas generators that are used to introduce inert gas, typically scrubbed exhaust from a vessel’s engines or from a dedicated engine, into tanks. This inert gas ensures that tank atmospheres remain outside the explosive range. During inerting, the inert gas introduced into a tank may displace hydrocarbon vapors, which are vented through tank vents. Venting may also occur when the inert gas generator is run during cargo discharge so that inert gas replaces the offloaded cargo.

Venting may also occur during various activities related to tank cleaning. Although most of the marine tank vessels that serve the Bay Area are in dedicated service and carry one narrow range of cargoes, tank cleaning may be required when a vessel loads a cargo different from those it typically carries. Tank washing is frequently done with machines – often called “Butterworths” after one brand name – and inerting and associated venting may occur during this process. If tank entry is required for final cleaning or to perform repairs, a vessel’s inert gas system may be

used to purge all hydrocarbon vapor from the tank. Gas freeing, which is the introduction of fresh air to replace inert or other gas for tank entry, may also result in venting of hydrocarbons.

The Air District estimates that approximately 2 to 4 venting events per month of crude oil tankers occurred in San Francisco Bay prior to issuance in March 2005 of a compliance advisory stating that most venting violated Regulation 8, Rules 44 or 46. It is unclear whether some venting activity continues to occur. The emissions from venting a crude oil tanker after cargo discharge are significant. Using the AP-42 emission factor for crude tanker ballasting, 46 lb/1000 barrels, emissions from fully purging a typical 120,000 dead weight ton (dwt) crude oil tanker with a capacity of 750,000 barrels would be 17 tons. Even if only one such tanker were purged per month, emissions could be as high as 200 ton/yr. Requiring controls for these activities would reduce emissions by approximately 190 ton/yr or 0.52 ton/day.

Because emissions from a single venting activity are often very large, these activities have great potential to cause public impacts. In October, 2003, the Air District received a substantial number of complaints from residents of Alameda and Oakland due to tank cleaning activities carried out by a 96,000 dwt crude oil tanker anchored south of the Bay Bridge at Anchorage 9. In addition, the Office of Emergency Services received over 100 complaints. The complaints resulted in the issuance of a violation notice for a public nuisance.

Given the significant emissions involved and the potential for public nuisance and other impacts, the Air District is proposing to require controls for venting activities carried out within the District or in District waters extending offshore west of the District. If venting emissions are controlled at a terminal, current costs for use of an existing abatement device are roughly \$15,000 per venting event. The District also expects that barges carrying control equipment similar to that used for cleaning tanks at refineries are likely to be available. Given the magnitude of the emissions from each venting event, cost effectiveness for these controls is expected to be well below \$15,000 per ton.

D. Proposed Consolidation of Rules 44 and 46

Currently, Regulation 8, Rule 44 applies to loading of marine vessels at terminals while Rule 46 applies the same standards to vessel-to-vessel loading. These rules were adopted separately in 1989 because resource limitations did not allow rulemaking for both aspects of marine loading to be completed at the same time. However, consolidation of these largely identical rules at this time will simplify Air District regulations. The draft amendments would eliminate Rule 46 and consolidate all marine loading requirements in Rule 44.

III. WORKSHOP AND RULE DEVELOPMENT PROCESS

The October 2005 workshop will be the most recent step in a rule development process that began in 2002. Earlier efforts included workgroup meetings in 2002 and 2003 and a prior workshop in October 2003.

A. Workgroup Meetings

The workgroup was formed in 2002 and consisted of representatives from Western States Petroleum Association, the refineries, independent terminal operators, ship operators, engineering consultants, Communities for a Better Environment, and CARB and Air District staff. The workgroup met 6 times between June 2002 and June 2004 to discuss various technical issues.

B. 2003 Workshop

On October 16, 2003, staff held a workshop at the Crockett Community Center to discuss proposed amendments. Major issues discussed at the workshop were that the affected facilities need a clear method to determine whether to control loading such as exists in the current rule, that the cost of controlling additional loads would be excessive, and that control would require the use of natural gas and would generate secondary pollutants such as NO_x to reduce a small amount of organic compound emissions.

C. October 2005 Workshop

At the October 2005 workshop, the Air District will seek comments on the District's current draft of the proposed rule amendments. The District will also respond to questions about information in this document.