Bay Area Air Quality Management District

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Proposed Revision and Consolidation of Regulation 8, Rule 44 and Rule 46: Marine Loading Operations

Draft Staff Report

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I. EXECUTIVE SUMMARY

The 2001 San Francisco Bay Area Ozone Attainment Plan in Further Study Measure 11 committed to examine marine loading operations for potential emission reductions of organic compounds from loading activities at marine terminals and between ships (lightering). In addition, potential emission reductions from ballasting and housekeeping operations were examined. The results of Further Study Measure 11 indicated significant emissions for possible control, including loading of currently unregulated cargos. In addition, emissions of toxic compounds such as benzene, toluene, and xylene could be reduced.

Organic emissions from marine vessels are generated when organic liquids are loaded into a vessel's cargo tank from either a terminal or another marine vessel. As the organic liquid is loaded into the tank, organic vapors are created in the headspace, in addition to vapors present from previous loading events. The liquid displaces these vapors from the cargo tank into the atmosphere when the loading is uncontrolled.

Currently, Regulation 8, Rule 44 limits precursor organic compound (POC) emissions from loading operations at marine terminals. The rule affects mostly petroleum refineries, chemical plants, bulk terminal distribution facilities, and shipping companies. Regulation 8, Rule 46 applies to marine vessel to marine vessel loading operations. Regulation 8, Rule 44 and Rule 46, currently require control for loading of specified cargos such as gasoline, gasoline blending stocks, aviation gas, JP-4 aviation fuel, and crude oil. The standard for loading these cargos is 2 pounds of POC emissions per thousand barrels of organic liquid loaded or 95% reduction of POC emissions.

The estimated emission reductions of organic compounds from these proposed changes are approximately 100 to 200 tons per year or 0.3 to 0.5 tons per day.

The major amendments to Regulation 8, Rule 44 include:

- Consolidate Regulation 8, Rule 46 requirements into Regulation 8, Rule 44. Delete Regulation 8, Rule 46.
- Change the applicability of the rule from POC emissions to Total Organic Compound (TOC) emissions.
- Change strategy from a cargo specific regulation to a standard based regulation. This would require controls on any cargo based on emissions, not type of cargo.
- Provide an incentive to use recovery technology. Require all loading events to control organic emissions to 1 pound per thousand barrels loaded when using combustion control or 2 pounds per thousand barrels loaded when using non-combustion control.
- Require control of emissions from housekeeping activities.

- Strengthen the leak standard from 10,000 ppm (expressed as methane) above background to 100 and 500 ppm to be consistent with the leak standard in District Regulation 8, Rule 18 (Equipment Leaks).
- Modify definition of a loading event to include activities that may cause any release of organic compound emissions in District Waters.
- Clarify Leak Free and Gas Tight requirements and require monitoring.
- Require reporting of marine loading activity.
- Verify performance of vapor recovery control equipment annually.
- Add the testing protocol developed during Further Study Measure 11 into the District's Manual of Procedures.
- Streamline permit condition requirements.

II. BACKGROUND

A. Introduction

In the 2001 San Francisco Bay Area Ozone Attainment Plan, District staff examined potential emission reductions for marine loading activities including enhancing enforcement, requiring additional controls, and/or expanding the applicability of the rule to include loading events that are not currently controlled. In addition, potential emissions reductions from ballasting and housekeeping operations, such as venting, purging, and gas freeing, were considered.

Emissions generated when loading into marine tank vessels are similar to loading into land-based storage tanks. As a tank is filled with liquid, the contents of the headspace of the tank are displaced. There are three emission scenarios to consider, 1) cargo loaded into a tank free of organic vapors, 2) cargo loaded into a tank with organic vapors present in the headspace, or 3) inorganic material such as ballast water loaded into a tank containing organic vapors. In the first case, emissions from a clean tank receiving cargo are generated by evaporation of the cargo being loaded due to the volatility of the cargo itself. In the second case, organic vapors in the headspace from previous organic liquids, vapors evaporated from the organic liquid itself, from piping connecting the headspace of other tanks, or from inert gas generators. In the third case, the material loaded is not an organic liquid, however, any organic vapors in the headspace would be displaced into the atmosphere.

Several technologies are available to control emissions from marine loading operations. Examples are incineration, carbon adsorption, recovery, vapor balance, refrigeration/condensation, or a combination of these methods. Currently, incineration and carbon adsorption are the two primary methods used within the District.

B. Jurisdiction

When the District proposed regulating emissions from marine vessels in the 1980s, several groups questioned the District's jurisdiction. The State Attorney General affirmed the District's jurisdiction to regulate marine loading operations[1]. The Air Resources Board also separately and independently affirmed the District's jurisdiction.

The Attorney General recognized the District's need to comply with the National Ambient Air Quality Standards in the Federal Clean Air Act. It noted that the Bay Area's air is affected by pollution within 90 miles of shore, the regulation does not affect operation of vessels on the high seas, does not burden international ships,

[1]Attorney General letter dated 10/12/88 to Milton Feldstein

and the Commerce Clause of the Constitution precludes discrimination against out-of-state goods. In addition, it noted that Laws reflecting legitimate state interests with incidental effects on interstate commerce are proper as long as national uniformity is not required and that the Port and Waterways Safety Act does not preempt local environmental regulation of ship emissions.

C. Enforcement Practices

Presently, compliance inspections are announced in advance because there is no notification requirement and the difficulties associated with coordinating activities without schedules. This allows the District to view operations only when all parties know an inspector will be on site in advance. A number of questions have arisen about effectiveness of the rule when an inspector is not present. The new rule proposal requires advance notification and reporting. This will allow the District to conduct unannounced inspections to verify compliance. This will provide the District more certainty about rule effective.

III. PROPOSED AMENDMENTS

The following is a summary of proposed amendments to Regulation 8, Rule 44. In addition, Regulation 8, Rule 46 requirements will be incorporated into Regulation 8, Rule 44. Rule 46 will be deleted. Editorial changes are not included.

Summary of Proposed Amendments to Regulation 8, Rule 44

Regulation Section #	Change
100	Changes and clarifies applicability to include lightering, ballasting, and housekeeping activities. The rule would limit emission of TOC emissions rather than POC emissions.
110	Amend this section to apply to loading events that emit below a de minimis level of 15 pounds per event. For example a bunker oil or diesel load less than 8,000 barrels.
111	Modifies language to clarify that the exemption does not apply to associated blending or loading by transport marine vessels prior to actual fueling.
112	Deletes the exemption since lightering requirements will be addressed in Regulation 8, Rule 44.
113	Deletes this exemption since it no longer applies.
114	Deletes this exemption since it no longer applies.
115	Allows time for facilities to achieve compliance with the amended leak standard.
204	Provides a sunset clause for the definition of Organic Liquid until the new definition takes affect. Amends the definition of Organic Liquid because the proposed Regulation will be based on a standard rather than specific cargos. A standard based regulation is currently in effect in the South Coast AQMD.
207	Modifies language to cover lightering operations. Amend language to apply to emissions related to Marine Loading Operations that occur in Bay Area Waters. Language is similar to the South Coast AQMD.
209	Modifies language similar to Districts Regulation 8, Rule 18. The standard is moved from the definition section to the standard section of the rule.
212	Deletes the definition for Infrequent Visits since it no longer applies.
213	Deletes the definition for Small Terminal since it no longer applies.
214	Adds a definition of Bay Area Waters. Coordinates are derived from Air Resources Board definition of California Waters. See attached map in the appendix.
215	Adds a definition for Total Organic Compounds.
216	Adds a definition for Vapor Collection System.

Regulation Section #	Change
217	Adds a definition of Lightering. This is needed since Regulation 8, Rule 46 requirements will be incorporated into Regulation 8, Rule 44.
218	Adds a definition of Ballasting.
219	Adds a definition of Housekeeping Activity.
220	Adds a definition of Uncontrolled Cargo.
221	Adds a definition of Marine Loading Equipment.
301	Modifies language to apply to the amended definition of loading event, ballasting, and housekeeping activity.
301.1	Adds a sunset clause for old emission standard.
301.2	Adds a standard for Marine Loading Activities when using combustion vapor control equipment.
301.3	Adds a standard for Marine Loading Activities when using non-combustion vapor control equipment. The intent is to promote control technology that does not generate combustion emissions.
301.4	Adds a standard for loading uncontrolled cargos.
302	Provides clear language for access to marine vessels.
303	This section requires the pressure in marine tank vessels be below 80% of the lowest set pressure of the pressure relief value. The intent is to prevent an uncontrolled venting of organic compounds during loading. This requirement is present in some marine terminal permit conditions.
304	Adds language from previous Section 8-44-303. The intent is to consolidate equipment maintenance into one section.
304.1	Previous language in Section 8-44-304.1 was renumbered to Section 8-44-304.2. The gas tight standard is moved from the definition section to the appropriate section. The gas tight standard is reduced from 10,000 ppm measured as methane to 100 ppm for equipment except pumps, compressors, and atmospheric pressure relief devices. For pumps, compressors, and atmospheric pressure relief devices the standard is 500 ppm. The intent is to make the requirement consistent with Regulation 8, Rule 18.
304.2	Previous language in Section 8-44-304.2 was renumbered to Section 8-44-304.3. Clarifies requirements for providing certification of leak free and gas tight.
304.3	Adds language from previous Section 8-44-304.2.
305	Until the requirements of the amendments are phased-in, prohibit uncontrolled marine loading operations that emit more than 2 pounds per 1,000 barrels on predicted ozone excess days for all cargos. The intent is limit the impact of marine loading operations when the ozone standard may be exceeded.
401	Provides a compliance schedule for equipment modifications necessary to comply with the amended requirements. The intent is to give facilities adequate time to install equipment to achieve compliance.

Regulation Section #	Change
403	Adds a notification requirement to allow District to observe, inspect, or verify compliance. The intent is to coordinate with other agencies that may have the information already reported to them.
404	Adds a requirement to annually verify that the vapor recovery equipment is achieving the required standard. The intent is to confirm that emission control systems are performing properly.
405	Adds a requirement to demonstrate uncontrolled cargos meet the standards in section 301.
501	Enhances recordkeeping requirements to include lightering activity, ballasting, housekeeping activity, standard information on the loading event, leak free and gas tight certifications, and leak repairs, and any release of emissions.
502	Modifies language such that adequate monitoring or data is available to demonstrate that applicable cargos are controlled to meet the requirements in Section 8-44-301. Language to be determined. The intent will be to have flexibility to those subject to Section 8-44-301 at the same time ensuring that loading event is in compliance. A review of permit conditions shows that there is a wide range of requirements to demonstrate compliance such as minimum temperature on combustion equipment, hydrocarbon analyzers, or concentration monitors.
503	Adds a new requirement in the regulation that requires that the pressure of the marine tank vessel be monitored into order to comply with Section 8-44-303. This requirement is present in some marine terminal permit conditions.
504	Adds a new requirement in the regulation that requires demonstration that the loading events are meeting the leak free and gas tight standards through monitoring and records. This requirement is present in some marine terminal permit conditions.
505	Adds a new requirement monitoring and records for loading events that result in de minims emissions.
601	Incorporate the testing protocol that was developed during the Further Study process into the Manual of Procedures. Update test method citations.
602	Updates test method citations
604	Adds a procedure to measure vent gas concentration.

IV. EMISSIONS AND EMISSION REDUCTIONS

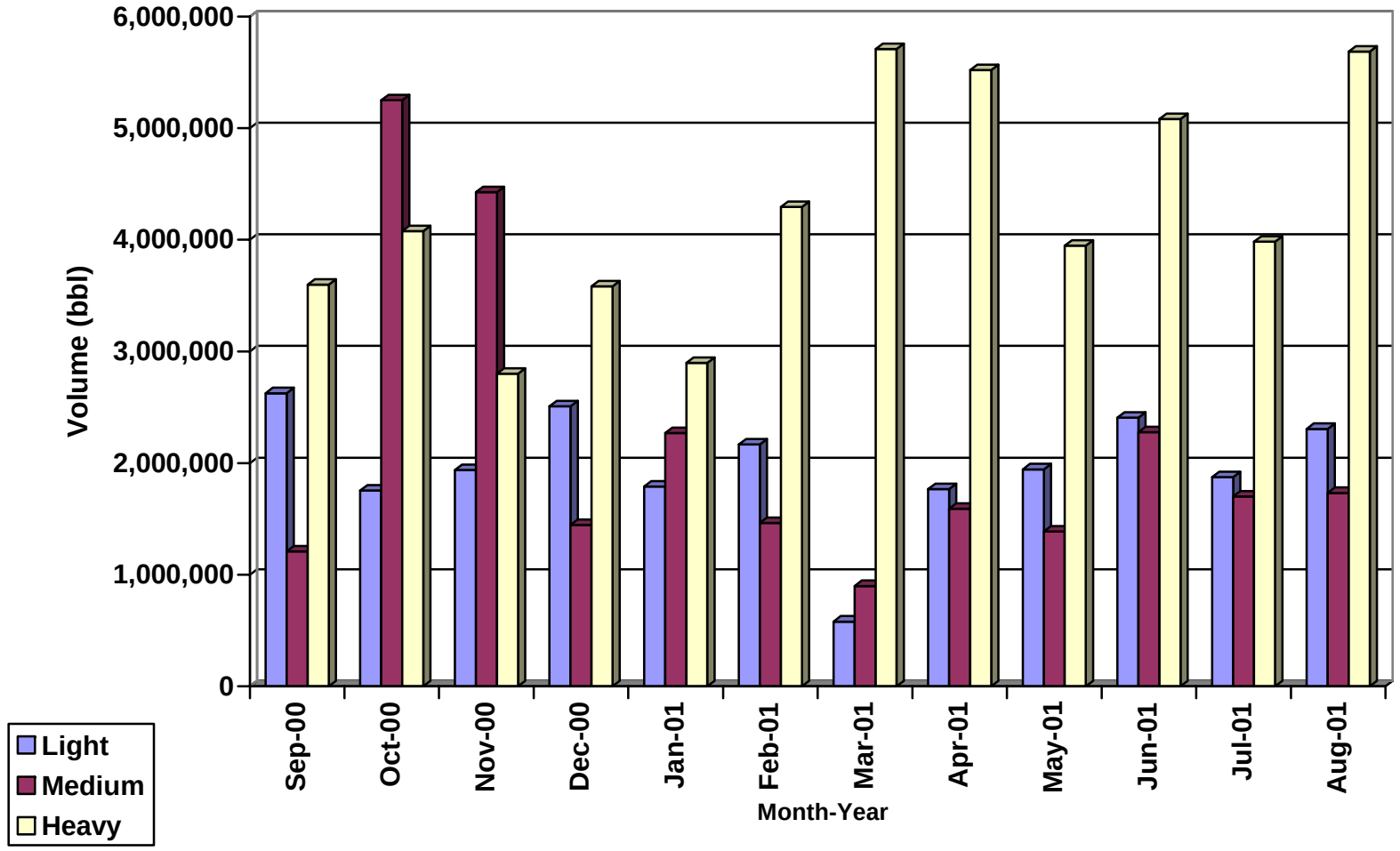
A. Introduction

A study was undertaken in order to determine emissions from loading organic material into marine vessels which are presently exempt. The study consisted of a literature search for existing studies and test data, sampling of material loaded and emissions displaced by loading. The study found that emission for specific cargos could vary significantly during marine loading. The type of organic material loaded into a tank vessel is one dominant factor that determines the amount of potential organic compound emissions that result from a marine loading event. Other factors that affect organic compound emissions from marine vessels include but are not limited to the configuration of the cargo tank, the prior cargo, whether the tank was cleaned, the loading temperature, the ambient temperature, the blending of organic liquids, and the composition of any inert blanketing system.

Emissions from loading events occur on a periodic basis. There can be many days when no loading occurs. Although the daily average emissions are low, the emissions can be significant when a particular loading event occurs or a series of loading events occur on the same day. Presently, the District regulates only four cargos, gasoline, gasoline blending stock, crude oil, and aviation gas, and vessels that carried a prior load of these cargos. All other cargos are presently unregulated. These cargos include materials such as varieties of gas oil, fuel oil, diesel, jet fuel, etc. The majority of cargo shipments are unregulated. Figure 1 shows the total emissions from marine loading at all terminals from September 2000 to August 2001. The data is separated into three categories, light, medium, and heavy cargos. The following table shows the material and the associated category. These categories do not necessarily correlate with an associated emission factor.

Light Cargo	**Medium Cargo**	**Heavy Cargo**
Gasoline	Jet fuel	Fuel oil
Crude oil	Diesel oil	Bunker oil
Aviation gas & aviation fuel (JP-4)	Cutter stock	Lube oil
Gasoline blending stock	Alkane	Charge stock
Naphtha	Kerosene	Cat Cracker Feed
Ortho-Benzene	Diesel blending stock	Gas oil
	Light Cycle Oil	Black oil
		Residual oil
		Polymers

Figure 1: Marine Loading at All Terminals



The frequency of housekeeping activities is difficult to quantify because monitoring and records were not previously required. Ballasting, the loading of water to maintain ship stability, into tank vessels that previously carried a regulated cargo is required to be controlled. Most vessels are equipped with tanks to carry segregated ballast. During high seas, additional ballasting may occur as ships leave the San Francisco Bay. The frequency of ballasting beyond the terminal in non-segregated tanks is not known.

B. District Testing

The District tested unregulated loading events starting in November 2001. A testing protocol and a checklist were developed to standardize procedures. The protocol is located in the Appendix. Either continuous or integrated canister sampling for the entire loading was performed on a majority of the tests to provide speciation data. When continuous sampling was not available or practical, integrated evacuated canisters were utilized. For quality assurance, samples were split with the Air Resources Board for the May 22, 2002 and June 11, 2002 tests, and were shown to be comparable. The following is a summary of loading events tested by staff.

Test Date	Material	Loaded, barrels	NMHC Emission Factor, lbs/1000 bbl	Prior Cargo	Load Temp	Flash Point	Ambient Temp	House-keeping	Inerted ?
11/1& 11/2/01	Flash Distillate Oil	157,968	District result 2.1	NA	153°F	NA	NA	NA	Yes
5/22/02	Diesel Oil	1,000	District result 2.0 ARB result 2.0	Diesel	82°F	125 to 180°F	75°F	NA	No
6/11/02	Fuel Oil #6	10,327	District result 1.4 ARB result 1.6	Fuel Oil #6	171°F	>150°F	61°F	None	No
6/18/02	High Sulfur Fuel Oil, 2.95 wt% S	110,063	District result 4.7	Fuel Oil	125°F	202°F	74°F	None	Yes
10/22/02	JP-8 Jet Fuel*	17,370	District result 2.1	JP-8 Jet Fuel	63°F	150°F	NA	NA	Yes
12/17/02	Bunker Oil	7,000	District result 2.0	IBF 380	146°F	NA	60°F	None	No
2/2/03	Jet Fuel #5	231,578	District result 1.4	JP-8 Jet Fuel	40-62°F	NA	40-62°F	NA	Yes
3/17/03	Blended Fuel Oil	8,500	District result 7.8	IFO #6	122°F	NA	53-64°F	NA	Yes

NA = not available
* average of two grab samples

Ambient and loading temperatures were taken at the start of the test but were not monitored for the duration of the test.

The majority of the continuous sampling on individual compartments showed little variation of non-methane hydrocarbon (NMHC) emissions during the testing

period. The methane contribution of the emissions ranged between negligible to 0.5 pounds per thousand barrels loaded.

C. Emission Estimates

The following table illustrates the highest potential emissions from a single loading event of currently unregulated cargos using emission factors from this study and the highest loaded amounts provided by industry.

Material	NMHC Emission Factor, lb/1000 bbl	Volume Loaded, barrels	Total Emissions, tons	Emission Reduction at 2 lb/1000 bbl, tons	Emission Reduction at 1 lb/1000 bbl, tons
Fuel oil	1.5	250,000	0.2	0.0	0.1
Fuel oil	7.8	250,000	1.0	0.7	0.9
Light Cycle Oil[2]	34.1	250,000	4.3	4.0	4.1
Crude Oil Ballasting[3]	17 to 180	200,000	2 to 18	1.5 to 17.8	1.6 to 17.9

The above table is based on a single high volume loading event of 250,000 barrels for fuel oil and light cycle oil. Ballasting volume is based on a 10% capacity of a 2 million barrel vessel. If more than one loading event occurs on the same day, the emissions would be larger.

Results of the evacuated canister samples taken during the study showed that the vent gases contained notable levels of light-end hydrocarbons and cyclical aromatic compounds such as benzene, toluene, and xylene. See Appendix for a summary of the results. Toxic emissions from BTEX compounds (benzene, toluene, ethylbenzene, and xylene) are estimated to be as high as 0.4 pounds per thousand barrels.

D. Comparison with EPA Emission Factors

In general, the commonly used emission factors underestimate emissions from marine loading activities.

According to EPA AP-42[4] for loading events on barges, Fuel Oil #6 has a total organic compound (TOC) emissions factors of 0.004 pounds per thousand barrels of cargo loaded. The District's source test for Fuel Oil yielded a range from 1.4 to 8.3 pounds of TOC emissions per thousand barrels transferred (1.4 to 7.8 pounds of NMHC emissions per thousand barrels transferred) or up to 1950 times AP-42. The ARB split the sample during this same test. Their analysis gave comparable results.

[2] Reference #7
[3] Reference #3
[4] AP-42 Fifth Edition, 1995

In a final report dated October 22, 1990, Alyeska Pipeline, ARCO, Exxon, and BP did a comprehensive study to determine hydrocarbon vapor emissions from crude oil tanker loading. The study noted that the most significant factors affecting the emission factor were the volume loaded, temperature of the crude loaded, hydrocarbon content of the arriving tanker, tanker size, and tanker configuration. From their 81 tests, emissions of TOC ranged from 59 to 285 pounds per thousand barrels transferred and benzene emissions ranged from 1.4 to 6.8 pounds per thousand barrels transferred. AP-42 shows the TOC emission factor to be 25.6 pounds per thousand barrels transferred for ships and 42 pounds per thousand barrels transferred for barges. The emission factors from Alyseka study are 1.4 to 11 times higher than AP-42.

E. Adjustments to District Inventory

The current District emissions inventory needs two adjustments. The current District emissions inventory is based on the assumption that all loading events are controlled to 95% efficiency, which is not the current practice for uncontrolled cargos. Based on the results of this study, the emission factors need to be updated. The fuel oil example has a TOC emission factor between 1.4 and 8.3 pounds per thousand barrels loaded. The current inventory effectively uses 0.000125 pounds per thousand barrels.

F. Specific Emission Reductions from Amendments

Proposed Sections 8-44-207 and 214. The proposed clarification is intended to ensure that emissions that are within the District's jurisdiction are subject to this rule. Since the District did not require records of activity beyond the actual loading of material, there is no basis for quantification of an emission reduction.

Proposed Sections 8-44-209, 304, 304.1 and 504. The "gas tight" criteria would be reduced from 10,000 ppm to 100 ppm for equipment associated with marine loading events except pumps, compressors, and atmospheric pressure relief devices. For pumps, compressors, and atmospheric pressure relief devices, the limit is 500 ppm. This will make the standard consistent with other District equipment leak standards. Monitoring is required to ensure compliance. This change is likely to result in emission reductions. However, these reductions have not been quantified, partly because of the inherent difficulty in accurately quantifying emissions from fugitive emission sources such as leaking valves and connectors.

Proposed Sections 8-44-101, 204, 301, 401, and 502. Currently, the rule covers the loading of crude oil, gasoline, gasoline blending stock, aviation gas, and aviation fuel. These amendments are likely to lead to significant emission reductions by increasing the applicability to all loading events and associated activities that exceed the standard. Marine loading operations are not continuous activities. When there is no loading, the emissions are zero. If there is significant loading either as a single event or a number of events, the emissions can be on the order of 0.3 to 0.9 tons of organic compounds for certain loading events. Emission reductions from ballasting are difficult to quantify since recordkeeping of ballasting into unsegragated tanks was not previously required.

Emission reductions from housekeeping activities are difficult to quantify since recordkeeping was not previously required.

Proposed Sections 8-44-303 and 503. This section ensures that the loading event be performed below the lowest set pressure of the marine vessel's pressure relief valves. This is a new requirement in the rule, but some facilities are already subject to this requirement via existing permit condition. Since recordkeeping for ventings was not previously required, the frequency are not known. When a release occurs, the emissions can be significant, depending on the amount and type of loading event.

Proposed Section 8-44-305. This section is an interim prohibition of uncontrolled loading events on predicted ozone excess days until all of the requirements of the proposed rule are in effect. Since predicted ozone excess days and marine loading events are not scheduled, it is difficult to quantify the emissions before they occur. This will allow the District with an immediate benefit when optimum meteorological conditions exist for the formation of ground-level ozone. Loading events can be deferred rather than controlled on a predicted ozone day.

Proposed Section 8-44-403. This section would add reporting requirements on marine loading activities to allow enforcement staff a better opportunity to conduct inspections. This is a new requirement. Inspections will ensure emission reductions are achieved. There is not an adequate basis for quantification of the effectiveness.

Proposed Section 8-44-404. This section would add annual performance verifications on vapor recovery equipment. This is a new requirement. Although equipment performance verifications may result in emission reductions, there is not an adequate basis for quantification.

Proposed Section 8-44-501. These sections contain new recordkeeping requirements associated with other proposals. No emission reductions are expected from these requirements although they are necessary to make other requirements enforceable.

V. ECONOMIC IMPACTS

A. Costs

ADDITIONAL COST DATA TO BE GATHERED

The costs of Equipment Control Strategies vary depending on available capacity of current equipment and type of any additional control equipment selected to comply with emission requirements. Vapor balance and refrigeration strategies recover organic vapors. Carbon adsorption requires handling of spent carbon beds and incineration strategies require fuel to assist in the combustion.

The economic impact from the implementation of further controls would affect the marine terminals and the shipping industry. These impacts would include possible retrofit costs incurred by the terminals and vessel owners/operators as well as possible loss of revenue due to diversion of loading to other locations or other means of transport.

The proposed concentration limit for combustion control equipment may cause at least one facility to modify its control system in order to comply. When the rule was originally adopted in 1989, District staff sent questionnaires to determine the capital costs as a result of the regulation. The facilities subject to the rule spent between $1 million to $30 million per control system at each terminal. Ship modifications cost between $100,000 to $2 million for each vessel. The cost of the systems depended on the type of control system and the additional piping needed based on the system's configuration.

Only one marine terminal that presently handles unregulated cargos does not have emission control equipment. This facility does not presently load material on ships. If this facility desires the option to load material that exceeds the limit, then they would need to install control equipment.

Carbon adsorption is installed on some ships and barges. This technology can be used to control emissions from currently unregulated cargos.

For incineration control systems, natural gas usage would increase because the number of cargos subject to control would increase. For lower volatile cargos, additional fuel would be required to enrich the vapors for combustion.

If terminal activity increases dramatically, additional vapor recovery systems may be to give facilities added flexibility or operating costs may increase.

If additional loading events required control, operating costs for the vapor control equipment would increase. Examples include fuel for thermal oxidizers or carbon

replacement. Maintenance for the vapor recovery equipment would likely increase and its life expectancy would likely decrease because of the added use.

Some operators estimated the operating costs of controlling a load of presently unregulated cargos are between $9,000 to $10,000. Different terminals may experience higher or lower costs depending on the type of controls and details of operation.

Records show that multiple vessels do not load at the same time at the same terminal. Unless activity increases, abatement equipment currently used at the terminals could be used to control additional cargos. If a vessel had to wait for abatement equipment to be available, the cost would be approximately $70,000 to wait an additional day. Proper scheduling of vessels may eliminate these costs.

The costs for controlling the currently unregulated cargos are not expected to differ widely from those experienced by the regulated cargos.

B. Socioeconomic Impacts

Section 40728.5 of the California Health and Safety Code (H&SC) requires districts to assess the socioeconomic impacts of amendments to regulations that, "...will significantly affect air quality or emissions limitations." TO BE DEVELOPED…

C. Incremental Costs

Under Health and Safety Code Section 40920.6, the District is required to perform an incremental cost analysis for a proposed rule under certain circumstances. For the purposes of this analysis, the incremental costs are based on NMHC emissions.

Staff reviewed these options for control. Option 1 was maintaining the existing rules. Option 2 was lowering the emission standard. Option 3 was lowering the emission standard and expanding the rule.

Option 1 had no additional costs but also failed to get any emission reductions. Option 2 was to reduce the standard from 2 pounds per thousand barrels to 1 pound per thousand barrels. Because all facilities presently meet the 1-pound standard, no additional cost would be required for existing regulated cargos (gasoline, gasoline blending stock, crude oil, aviation gas, aviation fuel). The NMHC emission reductions associated with Option 2 would be approximately 100 pounds per day, 1 ton per month, or 12 tons per year. Option 3 was to expand the applicability of the regulation to include all cargos with TOC emissions greater than 2 pounds per thousand barrels and to reduce the standard for events controlled by incineration. The NMHC emission reductions associated with Option 3 would be approximately 1 to 2 tons on the highest day. Annually, they

are expected to be 100 to 200 tons of NMHC emissions per year. The capital costs were estimated to be $2 million. The operating costs are expected to be $10,000 per load when controlling emissions using incineration. If carbon adsorption is used, the operating costs are expected to be $5,000 per load.

In order to estimate costs, a scenario was selected that would work to control these emissions. It was based on existing equipment at several marine terminals. Based on these scenarios, the cost of control may be as high as $22,000 per ton of NMHC emissions. Actual cost may be significantly less because existing equipment could be used to control these emissions.

D. Staff Impacts

Implementation of the proposed amendments will have a moderate impact on the District's resources. These changes are necessary to achieve the necessary emission reductions and to verify compliance.

VI. ENVIRONMENTAL IMPACTS

The District is required to adhere to the requirements of the California Environmental Quality Act in adoption of District rules. Although it is expected that adoption of the proposed amendments will create a net positive environmental benefit from a reduction in emissions of both total and toxic organic compounds, an examination of any potential adverse impacts of the project is required. Jones and Stokes of Sacramento, California will prepare a complete environmental analysis of the proposed amendments.

Marine loading, and control of marine loading emissions, occurs in industrial settings, wharf areas specific to refineries and terminals. The proposed amendments may result in one terminal installing control equipment that does not currently have any, and may result in modifications to existing control equipment to increase capacity. The additional construction in these industrial areas is not anticipated to have any significant adverse impacts. Should more restrictive limits result in an increase in the use of control equipment (as well as an additional terminal controlling loading), there may be an impact from increased combustion if incineration is the control technology employed. Increased combustion results in increases in NO_X emissions. If carbon adsorption is used, spent carbon most likely will be regenerated off-site. No regeneration facilities are located in the Bay Area. This would result in a minor increase in traffic emissions and could result in an increase in hazards from transportation of saturated carbon, should an accident or spill occur. If carbon adsorption is selected as the primary control technology at any terminal, the carbon regeneration could be installed on-site. This option would not increase transportation impacts, but could require the use of an additional source of power, heat, or steam, utilizing natural gas (or possibly refinery fuel gas) potentially causing additional NO_X emissions. In any case, staff does not believe the additional NO_X emissions would result in any significant adverse impacts to air quality.

VII. REGULATORY IMPACTS

Section 40727.2 of the Health and Safety Code requires an air district, in adopting, amending, or repealing an air district regulation, to identify existing federal and district air pollution control requirements for the equipment or source type affected by the proposed change in district rules. The district must then note any differences between these existing requirements and the requirements imposed by the proposed change. See table on Page19, comparing various requirements.

VIII. RULE DEVELOPMENT HISTORY

The BAAQMD was the first district in the country to have a broad regulation to control organic emissions from marine tank vessel loading operations. Regulation 8, Rule 44 limits organic emissions from loading operations at marine terminals. The rule affects mostly petroleum refineries, chemical plants and bulk terminal distribution facilities. The rule was originally adopted in 1989 and has never been amended. Regulation 8-46 applies to marine vessel to marine vessel loading operations (lightering). The rule was originally adopted in 1989 and has never been amended. Regulation 8, Rule 44 and Rule 46, currently requires control for loading of specified cargos such as gasoline, gasoline blending stocks, aviation gas, JP-4 aviation fuel, and crude oil. Currently, the standard for these rules is 2 pounds of POC emissions per thousand barrels of organic liquid loaded or 95% reduction of POC emissions.

On July 19, 1991, the South Coast Air Quality Management District (SCAQMD) adopted Rule 1142 for Marine Loading Operations. The San Luis Obispo County Air Pollution Control District (SLOCAPCD) adopted a Marine Tanker Loading rule, Rule 427, on April 26, 1995. The Santa Barbara County Air Pollution Control District (SBCAPCD) marine tanker loading regulation is Rule 327. These air districts have one rule for marine loading activities at terminals and lightering. The following table is a comparison of the regulations.

Regulation & Year Last Modified	Applicable Cargos	Loading Standard or Efficiency	Vapor Tight Standard	House-keeping & ballasting
BAAQMD Reg. 8-44 & 8-46 (1989)	Gasoline, gasoline blending stocks, aviation gas, aviation fuel, crude oil	2.0 lb POC/1000 bbl or 95% reduction	10,000 ppmv	No standard for housekeeping. Control for ballasting into tanks whose prior cargo was regulated.
SCAQMD Rule 1142 (1991)	All cargos	2.0 lb VOC/1000 bbl or 95% reduction	1,000 ppmv	Yes for both
SLOCAPCD Rule 427 (1995)	Gasoline, gasoline blending stocks, aviation gas & fuel, intermediate petroleum distillates, crude oil	2.0 lb VOC/1000 bbl or 95% reduction w/o combustion control or 98% with combustion control	1,000 ppmv	Yes for both
SBCAPCD Rule 327 (1985)	Including but not limited to petroleum residuum & distillates, crude oil	3.1 lb organic vapor/1000 bbl or 95% reduction	No standard	No standard
Federal 40 CFR 63 (1995)	Crude oil & gasoline	1,000 ppmv	Yes	No

The SCAQMD and SBCAPCD marine loading regulations are not cargo specific. All cargos are required to be controlled based on an emission standard.

IX. CONCLUSION

TO BE DEVELOPED

X. REFEREENCES

1) 8-31 Marine Emissions Study Final Report, 8-31 Technical Advisory Committee, December 1978

2) The Flammability Hazards Associated with the Handling, Storage and Carriage of Residual Fuel Oils, Oil Companies International Marine Forum, December 1989

3) Report on Valdez Tanker Loading Vapor Emission Testing and Evaluation, Alyeska Pipeline Service Company, Document Number VVE-1990, October 22, 1990

4) Determination of Reasonably Available Control Technology and Best Available Retrofit Control Technology for Marine Vessel Loading Operations, California Air Resources Board, January 8, 1991

5) Report of the Emissions Testing of the Vent Stacks Serving the Chevron Tanker Oregon During Loading Operations at Chevron's El Segundo, CA Terminal, Radian Corporation, March 1994

6) Final Report: Rule 1142 Compliance Test Methodology, Western States Petroleum Association, Eichleay Engineers Inc. of California, Project 4491, June 1994

7) Source Test Results of Loading Light Cycle Oil onto the Honshu Spirit on May 9, 1995 for Arco Pipeline in Long Beach, CA, Almega Environmental & Technical Services, Inc., Report C7344, June 1995

8) Environmental Contaminants Encyclopedia Fuel Oil Number 6 Entry, Roy J. Irwin, et. al., National Park Service, Water Resources Division, Water Operations Branch, July 1, 1997

9) No.6 Fuel Oil Material Safety Data Sheet, Amerada Hess Corporation, MSDS No. 9907, Revision Date February 28, 2001

10) Source Test Results of Loading Flash Distillate onto the Seabridge vessel at the Martinez Refining Company November 1 & 2, 2001, Bay Area Air Quality Management District, Report 02103, December 2001

11) Source Test Results of Loading #2 Diesel Oil at IMTT on May 22, 2002, Bay Area Air Quality Management District, Report 02175, June 2002

12) Stationary Source Test for Air Kinetics at BP/ARCO Fuel Transfer Barge in Long Beach, CA, Eichleay Engineers Inc. of California, Project #30386, July 1, 2002

13) Source Test Results of Loading Cutter Stock (TKN) into the “Crowley Barge No. 450-11” at the Chevron Richmond Long Wharf on October 9, 2001, Fuel and Marine Marketing LLC, Report 082102, January 2002

14) Source Test Results of Loading High Sulfur Fuel Oil onto the “Ambermar” vessel at Martinez Shore Terminals on June 11, 2002, Bay Area Air Quality Management District, Report 02199, July 2002

15) Source Test Results of Loading Fuel Oil #6 onto the “Foss 248-PS” vessel at Phillips 66 Company on June 18, 2002, Bay Area Air Quality Management District, Report 02200, July 2002

16) Source Test Results of Loading Jet Fuel #8 onto the “Samuel L. Cobb” vessel at Selby Shore Terminals on October 22, 2002, Bay Area Air Quality Management District, Report 030701, November 2002

17) Source Test Results of the Inert Blanketing System on the “Chevron Washington” vessel at Chevron on December 13, 2002, Bay Area Air Quality Management District, Report 03127, March 2003

18) Source Test Results of Jet Fuel #5 onto the “Samuel L. Cobb” vessel at ST Services - Selby on February 2 & 3, 2003, Bay Area Air Quality Management District, Report 03115, March 2003

19) Source Test Results of Loading IFO #6 Black Oil onto the “Ambermar” vessel at ST Services - Martinez on March 17, 2003, Bay Area Air Quality Management District, Report 03134, April 2003

Glossary

ARB: California Air Resources Board

BAAQMD: Bay Area Air Quality Management District

Ballasting: The loading of water or other liquid into a marine vessel's cargo tank to obtain proper stability.

bbl: barrel

Blending Stock: An organic liquid that can be blended into gasoline without further processing. Examples: Naptha or MTBE

BTX concentration: the cumulative concentration of benzene, toluene, ethylbenzene, p/m xylene, and O-xylene

EPA: The United States Environmental Protection Agency

Gas Freeing: A process of opening the cargo tanks to the atmosphere after the hydrocarbons concentration reaches below the explosive level.

Housekeeping Activity: Any activity which would cause the release of organic compounds from a tank vessel into the atmosphere. These activities include but are not limited to tank washing, gas freeing, purging, or tank venting.

Inert Blanketing System: A system that injects a gas, usually diesel exhaust, to prevent air/vapor mixtures from reaching the explosive level.

NMHC: Non-methane hydrocarbons

Purging: A process of cleaning where cargo tanks are flushed with an inert gas to remove hydrocarbons.

SJV Crude: San Joaquin Valley crude oil

BTEX Testing Summary

The table below shows the concentration levels from the evacuated cylinders and grab samples. BTEX concentration is the cumulative concentration of benzene, toluene, ethylbenzene, p/m xylene, and o-xylene.

Date of Test	Tank #	Hydrocarbons less than C5, ppm as C1	BTEX Concentration, ppm as C1
11/1/01	ST-447	1,350	1,870
11/1/01	ST-436*	1,110	1,770
11/1/01	ST-435	1,840	1,450
11/1/01	ST-438*	2,420	1,330
11/1/01	ST-417	2,610	1,240
11/1/01	ST-434*	1,410	1,610
6/11/02	ST-408	360	520
6/11/02	ST-414	540	330
6/18/02	ST-449	7,400	1,530
6/18/02	ST-450	7,940	1,430
6/18/02	ST-451	9,100	1,600
6/18/02	ST-407	9,100	1,530
10/22/02	ST-408	2,650	150
10/22/02	ST-413	2,390	150
10/22/02	ST-449	460	60
12/17/02	ST-409	265	320
12/17/02	ST-411	335	850
12/17/02	ST-414	485	1,530
2/2/03	ST-414	1135	1480
2/2/03	ST-450	1235	820
2/2/03	ST-409	1090	500
2/2/03	ST-449	1120	635
2/2/03	ST-417	1000	685
2/2/03	ST-418	505	400
2/2/03	ST408	845	665
3/17/03	ST-408	14100	1200
3/17/03	ST-409	13700	1200
3/17/03	ST-414	13700	1100
3/17/03	ST-418	13350	1030
3/17/03	ST-450*	4500	450
3/17/03	ST-449*	14550	1275

* Grab sample

Marine Loading Testing Protocol

1. Objective:

1.1. Determination of total Non Methane Organic Carbon (NMOC) emissions from cargo ships on-loading exempt organics. Total NMOC emissions shall be determined based on sampling emissions during loading and analyzing the trends in the data collected. Sampling will be conducted in a manner having minimal impact on normal ship operations.

2. Procedure:

2.1. Whenever possible, emission sampling shall be conducted for the entire loading event, as determined to represent average emissions for a given product, which is filling the full depth of a tank or collection of tanks. The minimum acceptable sampling period is the final 50% of the loading event. Shipboard sample collection equipment will consist of the following:

2.1.1. Grounded Teflon sample line

2.1.2. Plastic bucket containing water at ambient temperature

2.1.3. Three (3) glass condensate knockouts

2.2. A Teflon sample line will be inserted into the shipboard emission point. (**Note:** Emission points will vary on each vessel. Verify the correct location with responsible vessel personnel). The sample line will lead directly into a plastic bucket containing condensate knockouts immersed in ambient temperature water. One of the glass condensate knockouts is to function as a water seal. The water seal knockout will be pre-charged with 100ml of distilled water. (**Note:** The sample line must be adequately grounded at both the bucket and sample collection ends).

2.3. After the bucket, the Teflon line will be routed to the pier and continue to the sample collection area. Test personnel will expeditiously remove the sample line at the conclusion of loading.

2.4. Testing Option #1 (preferred) – Mobile Test Van

2.4.1. The van is equipped with sample extracting pumps, and rack mounted instrumentation will be utilized in combination with evacuated canisters.

2.4.1.1. A continuous sample extracted from the ship's emission point by the van's pumps will be drawn into the sample collection area.

2.4.1.2. Vapor samples will be conditioned using iced knockouts to protect the van's instrumentation and plumbing from high level hydrocarbon saturation.

2.4.1.3. Sample flow will be metered and knockout condensate collected will be analyzed for determination of total hydrocarbons. Data generated by the van's rack mounted instrumentation will be continuously recorded by the data logging system. NMOC (or Total Organic Carbon (TOC) and methane), carbon dioxide, carbon monoxide and oxygen will be determined.

2.4.1.4. Prior to the van's iced knockouts a "T" will be inserted in the sample line and a portion of the sample will be directed into two parallel XonTech samplers. The XonTech samplers will slowly meter a controlled amount of emission samples into "Summa" type evacuated canisters.

2.4.1.5. For each test, up to six integrated Summa canister samples will be collected utilizing each XonTech sampler. One set of the parallel collected canisters will be under the control of California Air Resources Board (CARB) staff who will independently analyze the contents as specified in the CARB canister protocol. The set from the second XonTech will be submitted to the BAAQMD laboratory for analysis.

2.4.2. Testing Option #2 – Direct Sample, Canister Only

2.4.2.1. A continuous sample extracted from the ship's emission point by the van's pumps will be drawn into the sample collection area.

2.4.2.2. A small sample pump will operate in the sample collection area.

2.4.2.3. Prior to the pump, a portion of the sample will be directed to a sample line "T" and into two parallel XonTech samplers. The XonTech samplers will slowly meter a controlled amount of emission samples into "Summa" type evacuated canisters.

2.4.2.4. For each test, up to six integrated Summa canister samples will be collected utilizing each XonTech sampler. One set of the parallel collected canisters will be under the control of California Air Resources Board (CARB) staff who will independently analyze the contents as specified in the CARB canister protocol. The set from the second XonTech will be submitted to the BAAQMD laboratory for analysis.

3. Test Methodologies:

3.1. Organic Compounds, BAAQMD ST-7, Continuous Sampling

3.2. Oxygen, BAAQMD ST-14, Continuous Sampling

3.3. Carbon Dioxide, BAAQMD ST-5, Continuous Sampling

3.4. Carbon Monoxide, BAAQMD ST-6, Continuous Sampling

3.5. Evacuated Canisters (SUMMA Canisters), CARB Protocol for Collecting Canister Samples from Cargo Ships On-loading Exempt Organics

3.6. Bulk and Marine Loading Terminals Vapor Recovery Units, BAAQMD ST-34

4. Safety Procedures:

4.1. Test personnel will strictly observe all terminal and shipboard safety procedures. Test personnel will comply with all facility requirements regarding visitors performing work at the facility. Correct personal protective equipment will be worn when in the terminal area.

4.2. Flowing vapors can create a buildup of static electricity. The Teflon sample line must be adequately grounded at both the bucket end of the hose and at the sample collection point (Mobil Van or sample canister).

4.3. Test personnel must understand that sampling emissions of flammable materials requires a maximum degree of safety. Test personnel must remain alert and observe all applicable safety procedures for operation of sampling equipment in areas where loading of flammable materials is occurring.

5. Testing Data and Variables:

5.1. Primary data and variables to be gathered by the source test team are those necessary to calculate the NMOC emissions and document basic test parameters. These data are:

5.1.1. Vessel name and registry

5.1.2. Vessel type (tankship, tankbarge)

5.1.3. Inert Gas System Type (generator, nitrogen, flue gas, etc.)

5.1.4. Vapor (vent line) configuration (manifold / non-manifold)

5.1.5. Prior load history by tank

5.1.6. Prior tank ballasting or housekeeping activities (type & method) including tank washing, gas freeing, purging, or tank venting

5.1.7. Product loaded (type, temperature, total load, liquid sample)

5.1.8. Product loading rate

5.1.9. Ambient temperature (during load)

5.1.10. Times of loading start and sampling start

5.1.11. Times when integrated Summa canister samples were taken

5.1.12. Times of loading completed and sampling completed

5.2. Test parameters that are not necessary for the calculation of the NMOC emissions but may aid in the analysis of the final test results are listed below. The source test team will not gather them as a component of the test. These parameters are:

5.2.1. Tank configurations (L, W, D)

5.2.2. Inert Gas System (Fuel Specification, Exhaust Composition)

5.2.3. Temperature of tank vapor space

5.2.4. Pressurization of tank vapor space (Continuous reading if possible)

5.2.5. Verification of any product in tanks remaining from previous loading(s)

5.2.6. Product loaded (Flash, RVP)

5.2.7. Product Loading Plan

5.2.8. Percent sulfur in product

5.2.9. Positive confirmation of all vapor vent valves positions

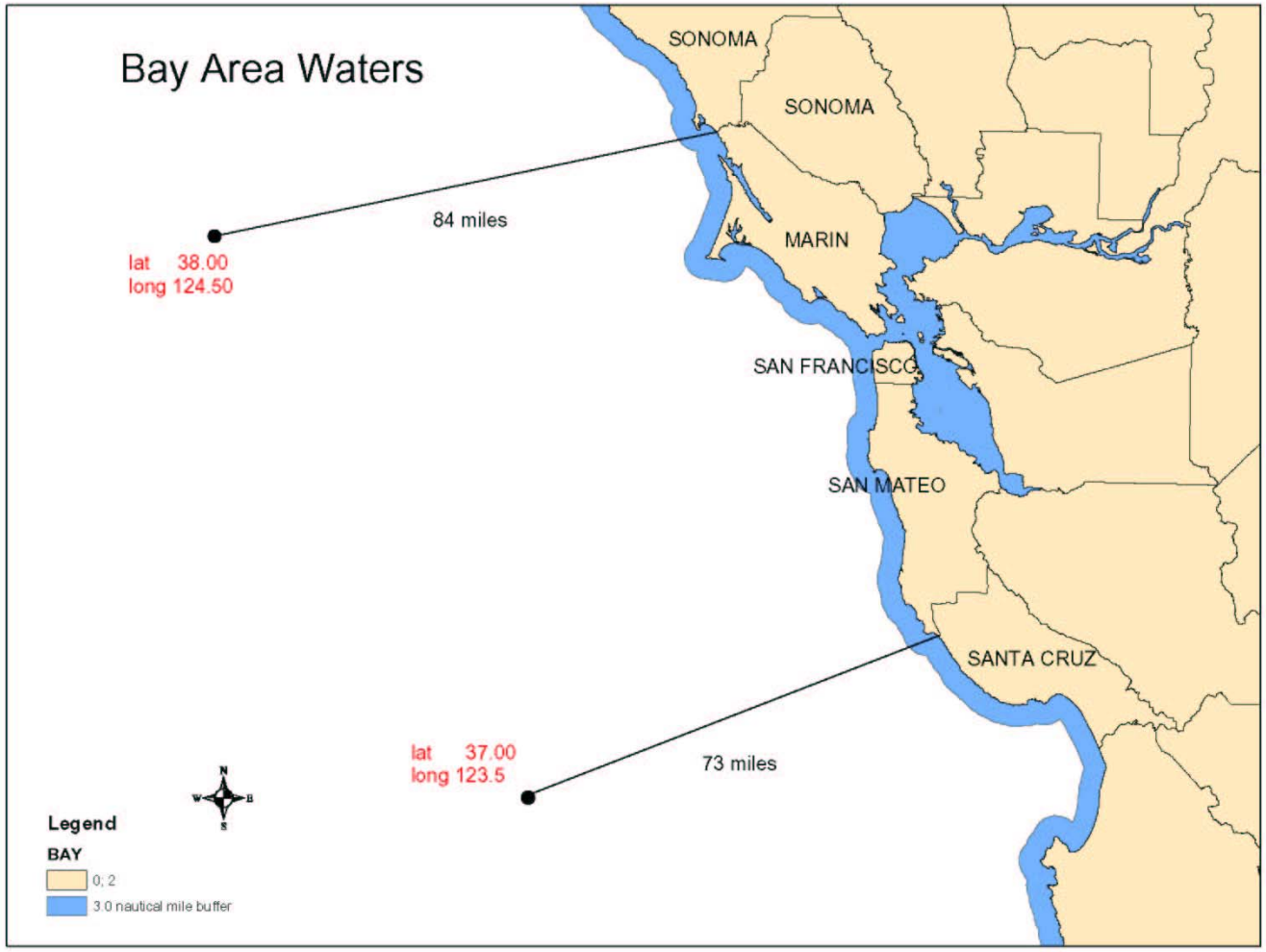
5.2.10. Source test of existing vapor space

5.2.11. Time and description of any vapor (vent) connection operational change

5.2.12. Time and description of any product transfer operational change (switching tanks, adding new tanks, stopping tank load, etc.)

Marine Loading Testing Checklist			
Date	Terminal	Start of Loading	AM PM
Vessel			
Vessel Name & Registry			
Vessel Type	☐ Tankship ☐ Tankbarge ☐ Other (specify):_____		
Inert Gas System	☐ Generator ☐ Nitrogen ☐ Other (specify):_____		
Vapor vent line configuration	☐ Manifold ☐ Non-manifold		
Vessel History			
Prior Load History by Tank:			
Prior Tank ballasting or housekeeping activities (type and method): (Including tank washing, gas freeing, purging or tank venting)			
Product			
Product Type		Total Load	
Product Temp	°F °C	Ambient Temp:	°F °C
Loading Rate		Liquid Sample (Y/N)	
Sampling			
Sampling Equipment (Check off)	☐ Grounded Teflon Sample Line ☐ Plastic Bucket with water ☐ Three (3) Glass Condensate Knockouts		
Test Van available ☐ Yes ☐ No (If Yes, collect continuous samples and analyze)			
Start of Sampling	AM PM		
1. Insert grounded Teflon sample line into shipboard emission point. 2. Lead sample line into plastic bucket with condensate knockout immersed in ambient temperature water. 3. Collect continuous samples at the Test Van, if available. 4. Collect two pairs of six Summa canister samples from two parallel XonTech samplers. 5. Remove sample line at conclusion of loading.			
Time of Summa canister samples	AM PM	End of Sampling	AM PM
Sampling by: _____		End of Loading	AM PM

Bay Area Waters



XI. COMMENTS AND RESPONSES

To be added