Bay Area Air Quality Management District

939 Ellis Street
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Proposed Amendments

Regulation 8 Rule 10: Process Vessel Depressurization

Control Measure SS-17

Draft Staff Report

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EXECUTIVE SUMMARY

Regulation 8, Rule 10 requires Bay Area refineries and chemical plants to control emissions from the depressurization of process vessels. The proposed amendments to this rule will:

- Generally prohibit opening or venting process vessels to the atmosphere unless the emissions of total organic compounds have been reduced to a concentration of below 10,000 parts per million (ppm);
- Limit the mass emissions of a limited number of vessels that exceed 10,000 ppm at opening to below 15 pounds per day;
- Expand the number of process vessels covered by this rule; and
- Add monitoring and recording requirements to measure emissions vented to atmosphere once each 24-hour period.

The vessels subject to this rule typically process hydrocarbons and other materials, often under pressure. These vessels require periodic maintenance and repairs that may involve entry into the confined space by plant personnel. To make a vessel safe for entry, it must be purged of the hydrocarbons and other materials it contains. This purging requires great care in order to minimize any risk of explosion or risk to personnel. Typically, hydrocarbons are swept from a vessel by non-combustible purge gas until the hydrocarbon content is well below the level at which an explosion may occur. Once this level is reached, air can be used to purge remaining vapors from the vessel. Personnel may then enter the vessel to perform repairs or maintenance.

The proposed amendments implement Control Measure SS-17 from the Bay Area 2001 Ozone Plan by supplementing existing requirements with a concentration standard and a mass emission limit. The amendments will reduce emissions of organic and other pollutants, including toxic compounds. Staff has identified a potential reduction of 1 ton per day of precursor organic compounds with a total implementation cost of approximately $24,500 per year. The cost effectiveness is approximately $70 per ton of precursor organic compound emissions reduced. An analysis of the socioeconomic impacts of the proposal has been prepared by Applied Development Economics of Berkeley, California. The analysis concludes that the economic and employment impacts to the Bay Area from the proposal would not be significant.

A California Environmental Quality Act (CEQA) analysis for the proposed amendments has been prepared by Environmental Audit, Inc., of Placentia, California, concluding that the proposed amendments would not have any significant adverse environmental impacts. A Negative Declaration has been prepared for the proposed amendments pursuant to Public Resources Code section 21080(c) and CEQA Guidelines section 15070 et seq., and is being circulated for public review.

The proposed amendments were developed through a workgroup that included District and ARB staff and representatives from environmental groups, the affected refineries, and the Western States Petroleum Association. The workgroup met three times on September 3, September 23, and October 22. In addition, the proposal was discussed at a public workshop October 28, 2003 in Crockett.

BACKGROUND

Emission Source

Periodic maintenance and repair of process equipment are essential to refinery and chemical plant operations. The procedure for shutting down a process unit for maintenance or repair varies from refinery to refinery and from one process vessel to another. In general, shutdowns are accomplished by first shutting off the heat supply to the unit and circulating feedstock through the unit as it cools. Gas oil may be blended into the feedstock to prevent solidification of the product as the temperature drops. The cooled liquid is then pumped out to storage facilities, leaving hydrocarbon vapors in the unit. The pressure of the hydrocarbon vapors in the unit is reduced by venting the various components in the unit to a disposal facility such as a fuel gas system, a vapor recovery system, or a flare system. The residual hydrocarbons remaining in the unit after reducing the pressure are purged with steam, nitrogen, chemical agents, and/or water. Any purged gases should be discharged to the disposal facilities. Condensed steam and water effluent that may contain hydrocarbon or malodorous compounds should be handled by closed water treatment systems.[1] Once the unit has been purged, air is then used to sweep out any remaining process gases so that personnel may safely enter the process unit.

A survey was conducted to determine the scope of applicability of the current rule and to review the methods presently used for depressurization of vessels. Plants listed in the District database were screened to determine the applicability of the existing rule. A number of the chemical plants screened were determined to be subject to other source specific regulations. An exemption has been added for these plants to clarify the applicability of the rule to chemical plants not subject to other District rules and to petroleum refineries. The five Bay Area refineries participated in workgroup meetings, and submitted site-specific depressurization methods. Site visits were conducted to review records and procedures.

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[1] Air Pollution Engineering Manual

The procedures for depressurization were relatively consistent and demonstrated compliance with a combination of the compliance options provided for in the current regulation. The procedures emphasized recovery of gases that could be used as fuel, and disposing of those gases that have low heating value and would negatively impact the quality of fuel gas. Typically, inert gases include nitrogen, and steam. The methods for emission calculations varied. Most facilities record the lower explosive limit (LEL) and estimate the mass emissions using the assumption that there are no emissions after one vessel volume turnover. No records are kept by the refineries beyond two years so there was insufficient data to verify this assumption. The proposed amendments would include a provision for daily monitoring and record retention for five years.

Rule Development History

Regulation 8, Rule 10 was adopted by the BAAQMD Board of Directors on March 17, 1982 and amended July 20, 1983. It is intended to limit emissions of precursor organic compounds from process vessel depressurization during refining unit turnarounds. It requires that organic compounds, after passing through a knockout pot to remove the condensable compounds, be: (1) recovered and combusted in the fuel gas system, (2) controlled and piped to an appropriate firebox or incinerator, (3) flared, or (4) contained and treated. Venting to the atmosphere is prohibited until the partial pressure of organic compounds in the vessel is less than 4.6 psig. Emission reductions from the implementation of the initial rule in 1982 were estimated by the Air Resource Board at over 17 tons of organics per year.[2]

In attainment plans for the state ozone standard (Clean Air Plans) from 1991 to 2000, the District included Control Measure C4: Improved Process Vessel Depressurization Rule. The measure originally focused on the control efficiency as the preferred means used to reduce emissions during depressurization. The measure proposed that carbon adsorption with a control efficiency of 95% be used. It also proposed that compressor capacity for the flare gas recovery systems be sufficient to recover flows from vessels during depressurization, thereby reducing flaring.[3] The measure was revised for the Bay Area 2000 Clean Air Plan to require abatement of emissions to continue below the pressure limit in the current rule to an unspecified lower pressure or concentration.[4]

Control Measure SS-17, Process Vessel Depressurization was included in the 2001 Ozone Attainment Plan for the national ozone standard. This measure is identical to Control Measure C4 from the 2000 Clean Air Plan. The measure identified 0.14 tons per day of precursor organic emissions as available for control. The proposal estimated a

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[2] Air Resource Board, Response to Request for Information, December 23, 1980
[3] Bay Area '91 Clean Air Plan, Vol. III, Appendix G, Control Measure # C4.
[4] Bay Area 2000 Clean Air Plan, Control Measure # C4.

reduction of 0.07 tons per day to be achieved by a concentration standard or a reduction in the allowable pressure prior to opening the vessel to atmosphere. The proposed amendments include a prohibition on venting to atmosphere unless the total organic compounds prior to release are reduced to a concentration below 10,000 ppm, expressed as methane and the total emissions from vessels having a concentration greater than 10,000 ppm be less than 15 pounds per day for a limited population of vessels.

Purpose of Proposed Regulation

The proposed amendments to Regulation 8, Rule 10, Process Vessel Depressurization are intended to implement Control Measure SS-17 from the Bay Area 2001 Ozone Attainment Plan. The purpose of the rule is to limit the amount of total organic compounds emitted to the atmosphere after a process vessel is depressurized and opened for servicing.

Means for Controlling Emissions

Prior to adoption of Regulation 8 Rule 10 in 1982, emissions from depressurized vessels were vented to the atmosphere. The regulation imposed control requirements consisting of thermal destruction or treatment until the partial pressure of hydrocarbon in a vessel was less than 4.6 psig. Although this was interpreted to mean the indicated vessel gauge pressure had to be less than 4.6 psig, depressurization typically achieved control by thermal destruction to a gauge pressure of 2-4 pounds. At this point the depressurized vessel was prepared for maintenance by venting to atmosphere any remaining emissions, with air movers. The movement of air through the vessel is essential to maintain a safe workspace. Standards for these conditions are set forth in permits required for confined space entry and county use permits.

The proposed amendments target the emissions vented to atmosphere. The options used to control emissions are left to the facility, while the level of control is mandated by the specified concentration or mass standard. These options would still include the existing methods of thermal destruction, however other options are available. These are likely to involve more extensive cleaning procedure either in the form of more time or alternate materials used for cleaning. Another option might involve portable abatement devices, for example a thermal oxidizer or carbon beds. Each of these options has unique factors to consider when choosing a compliance strategy. The facilities will have the flexibility to choose the option most suitable to their operational requirements.

The factors that need to be considered when choosing a control option include safety, cost, and degree of cleanliness. Safety issues were voiced during workgroup meetings when discussing portable abatement devices. Adding abatement collection components would add to mobility concerns in already confined spaces that occur during major maintenance turnarounds. Facility use permits might prohibit the introduction of a source of ignition within process units, such as a portable thermal oxidizer. Some suggest that an increase flammability risk might occur with contamination of carbon beds. These issues may be resolved with increased costs and proper monitoring and maintenance. The most probable choice for achieving the proposed emission standard is likely to be extended purging either with steam or chemical agents. None of the options require facilities to use any unsafe practices.

Means for Monitoring Emissions

The method for monitoring emissions is driven by Section 8-10-301.4 partial pressure of hydrocarbon less than 4.6 psig or conditions specified on the permit for confined space entry, typically 10% of the lower explosive limit (LEL). To determine the partial pressure of hydrocarbons in a vessel, a sample is collected then analyzed by gas chromatography. Confined space entry standards, OSHA regulation 29CFR1910.146 require the internal atmosphere be tested with a calibrated, direct-reading instrument for oxygen content, flammable gases, and if necessary toxic air contaminants. These checks are typically done using LEL meters which provide the percent LEL and oxygen level in the atmosphere. Other sensors may be used including for example carbon monoxide or hydrogen sulfide. A discussion of monitoring technologies is included in Appendix A. Most manufacturers suggest the meters be calibrated using a known methane or pentane standard. However, a previous National Institute for Occupational Safety and Health (NIOSH) study found that manufacturer-recommended calibration techniques do not match instrument performance when monitoring jet fuel vapors. JP-8 and Jet-A fuels are generally C9 to C16 compounds. Because most LEL meters are calibrated against n-alkanes less than C9, some meters may underestimate the explosive potential of jet fuel vapor in tanks after removal of the most volatile components.[5]

PROPOSED AMENDMENTS

The proposed amendments to Regulation 8, Rule 10, Process Vessel Depressurization would supplement the existing control requirements with a concentration standard and a mass emission limit. A new provision will add a requirement to measure total organic compounds initially upon the opening of the vessel to the atmosphere and once per 24-

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[5] *Field-Produced Jp-8 Standard For Calibration Of Lower Explosive Limit Meters Used By Jet Fuel Tank Maintenance Personnel*. S. Martin, P. Jensen, NIOSH, Morgantown, WV; J. Pleil, US EPA, Research Triangle Park, NC

hour period during the time the vessel is open. Monitoring and recording requirements are added to reflect these changes.

Section 8-10-101, Description

The applicability of the rule has been expanded from controlling emissions from depressurizing vessels during major turnarounds to controlling emissions from depressurizing and opening a process vessel.

Section 8-10-110, Exemption, Equipment Subject to Other Rules

These exemptions are proposed for adoption to eliminate duplication of standards for vessels covered by existing District regulations. Most of the referenced rules were adopted after Regulation 8, Rule 10 and impose requirements more closely tailored to the specific industry regulated by the rule.

Section 8-10-111, Chemical Plants

The exemption for chemical plants in Section 8-10-111 is proposed for deletion because it is obsolete. Though chemical plants are not exempt from the rule, very few plants are subject to the rule because most are regulated by other Regulation 8 rules. However, any chemical plant not listed in Section 8-10-110 is subject to the provisions of the rule.

Section 8-10-112, Limited Exemption, Measurement Periods

This language is necessary to distinguish emissions released due to compliance monitoring from those released from normal depressurization activities. Sample locations vary and may include sample taps, bleeder valves, and/or open manways located at various positions on the vessel. The most significant release would occur if measurements are taken from open manways. Emissions from these activities are insignificant, and the exemption is necessary to ensure that compliance monitoring is not treated as a rule violation.

Section 8-10-113, Exemption, Small Vessels

This language was added to exclude small vessels that are not large enough to enter for maintenance work. Emissions from depressurizing these small vessels are handled in the same way as those from larger vessels through recovery into the fuel gas system, flaring, or combustion in an appropriate firebox or incinerator. The emissions from opening these small vessels are insignificant.

Section 8-10-114, Exemption, Batch Processes

The existing rule applies only during turnaround activities. Almost all refinery operations are continuous processes, with constant flow of materials into and out of the processes. The current rule applies when these continuous processes are halted during a turnaround so that the process vessels can be inspected and, when necessary, repaired

Under the proposed rule amendments, depressurization requirements would apply regardless when the depressurization activity occurs (see discussion of Section 8-10-301). As a result, some routine batch process operations could become subject to the rule. In a batch process, material is placed in a vessel at the start of a process and removed at the end of the process, with no material flowing into or out of the process. Opening a batch process vessel is a routine part of the process. The rule has never applied to this type of activity.

The only refinery batch process identified by staff is delayed coking. Delayed coking is a process for upgrading residual heavy ends to higher value liquids.. Heavy ends are fed into a coke drum, and at high temperature, "cracked" to produce lighter products while leaving a solid residue called coke. Once coke reaches a certain level within the drum, the drum is isolated from the process flow, and ultimately, after cooling, opened so that coke can be cut out of the drum.

The purpose of the proposed exemption in Section 8-10-114 is to clarify that the rule continues to be inapplicable to delayed coking and other batch process operations. Emissions of organics from opening coke drums is unlikely to be significant.

Section 8-10-201, Chemical Plant

The SIC code system has been replaced by the North American Industrial Classification Standard (NAICS) code. The facilities we call “chemical plants” all appeared in the 1987 SIC (the last update to the SIC codes) under standards with numbers that began with the digits “28.” Under the NAICS, almost all of these industrial categories now have 5 or 6-digit numbers beginning with “325,” but there are some minor exceptions that are not an issue in the Bay Area (e.g., sulfur recovery from natural gas production, alumina refining, table salt manufacturing). The definition is amended to reflect this change.

Section 8-10-202, Petroleum Refinery

The proposed amendment to this section reflects the new classification for petroleum refineries under the NAICS code.

Section 8-10-204, Process Vessel

The definition of process vessel is revised for clarity. Examples of types of vessels that would be subject to the rule are added.

Section 8-10-205, Organic Compound

This definition is the same as that found in other District rules.

Section 8-10-206, Total Organic Compounds

Proposed new Section 8-10-302 specifies the concentrations of "total organic compounds" at which a vessel may be opened. Section 8-10-206 defines the term as organic compounds, as defined by the District (Section 8-10-205), plus methane. Under District rules, methane is not defined to be an organic compound, though a chemist would call it an organic compound. This unusual treatment of methane in common in ozone regulations because methane does not contribute significantly to ozone formation and is therefore excluded from those compounds for which controls are required. However, the instruments used to determine concentrations of hydrocarbons in vessels respond to methane, as well as to other hydrocarbons, and this new definition is necessary to make it clear that rule requirements are based on what the instruments measure.

8-10-301, Process Vessel Depressurizing

Proposed revisions to this section are intended primarily to simplify and clarify existing language. One significant change, however, is the deletion of language limiting applicability to process unit turnarounds. This change is intended to impose rule requirements whenever a vessel is opened, not just during turnarounds.

Section 8-10-302, Opening of Process Vessels

This section imposes a new prohibition on the opening of process vessels unless the total organic compounds have been reduced to a concentration less than 10,000 ppm, expressed as methane, along with a mass emissions standard for vessels that cannot meet the 10,000 ppm standard. Staff considered existing refinery practices, standards in rules from other air districts (Appendix B), and similar District standards to establish the concentration standard.

The mass emission limit was developed to recognize that the internal concentration for a very limited number of vessels cannot be easily reduced to 10,000 ppm, often because minor amounts of organic material remaining in a vessel cannot be readily removed until the vessel is entered. This exception to the concentration standard is very narrow. The number of vessels that can be opened over a five-year period under the exception is limited to 10% of the vessel population for the refinery or chemical plant. For example, if a facility has a total population of 150 vessels subject to the rule, the facility would be allowed to open 15 vessels over any consecutive five-year period, provided that, on any given day, mass emissions from all vessels opened under the exception, taken together, do not exceed 15 pounds. As a further limitation, the exception would not apply on days that the District predicts an excess of any Federal Ambient Air Quality Standard for ozone.

This exception was established after extensive review of refinery records and discussion in the workgroup. Discussions both in the workgroup meetings and the public workshop focused on the proposed mass limit, the method used to calculate the mass emissions, and the need for clear language to describe this very limited exemption from the 10,000 ppm requirement. The records showed that 10,000 ppm could not be achieved for

Refineries and chemical plants are already achieving the requirements imposed by Section 8-10-302. This is because safety standards more stringent than the air pollution requirements found in the existing rule guide refinery practice. Refinery practices for entering vessels are dictated by U.S. Occupational Safety And Health Administration standards found in 29 Code of Federal Regulations Part 1910 (and particularly in 29 CFR § 1910.146 - Permit-Required Confined Spaces). These standards require an employer to develop an overall program to protect employees from hazards associated with confined spaces.

One required element under the OSHA standards is evaluation testing, where the atmosphere of a confined space is analyzed using equipment of sufficient sensitivity and specificity to identify and evaluate any hazardous atmospheres that may exist or arise, so that appropriate permit entry procedures can be developed and acceptable entry conditions stipulated. Combustible gasses are tested after oxygen levels and before toxic gases because the threat of fire or explosion is both more immediate and more life threatening, in most cases, than exposure to toxic gasses and vapors. The level generally established in the industry is to achieve 10% of the lower explosive limit (LEL), although some procedures specify 2% and actual levels in practice tend towards zero. Staff reviewed these values to develop the concentration standard. A list of the LEL of various compounds can be found in Appendix C.

Section 8-10-401, Reporting

A requirement to submit an annual report is proposed to account for inventory changes and to help calculate emissions from process vessel depressurizations and openings. The frequency was selected based on the need to gather timely information for future air quality planning. The proposed amendments require an initial inventory report and yearly updates.

Section 8-10-402, Increments of Progress

This section is obsolete and is proposed to be deleted.

Section 8-10-501, Monitoring

This proposed new section specifies procedures for measuring emissions from depressurized process vessels. Measurement is required prior to the opening of a vessel. The proposed language is intended to ensure that a representative sample of the internal atmosphere of the vessel is acquired while providing some flexibility in sampling locations. Monitoring is required after the vessel is opened to verify the cleanliness of the vessel and to determine emissions after a number of air changes in the vessel. This data will be used for future air quality planning. Monitoring after vessel opening can be halted when the measured concentration drops below 100 ppm for three days. This provision is intended to reduce the cost of monitoring, given that some vessels may remain open for 30 days.

Section 8-10-502, Concentration Measurement

The specification for meter accuracy proposed in this section references EPA standards. The EPA standards include requirements for: (1) response time, (2) detection technology, (3) scale of the instrument, (4) sample flow rate, (5) response factor, and (6) calibration precision and frequency.

Section 8-10-503, Records

This proposed section adds new record keeping elements to those previously required by Section 8-10-401. Section 8-10-401 required that records include the date, time, and duration of turnarounds, vessel identification, including the volume and material processed, and the concentration and calculated mass of emissions for the vessel turnaround. The proposed new provisions require tracking the time of the vessel opening, the type of activity, the sample location, and any assumptions used in the calculation of mass emissions. In addition, the record retention period is expanded to five years to correspond to Title V requirements.

Section 8-10-601, Monitoring Procedures

This section is proposed to specify a method (EPA Method 21) to use when monitoring the concentration of organic emissions from open vessels.

EMISSIONS AND EMISSION REDUCTIONS

The amount of emissions from process vessel depressurization depends on how often the vessel goes through a turnaround. The frequency of turnarounds varies depending on the process unit. The typical time between turnarounds is generally three to four years. Some process units go for as long as ten years between turnarounds. The current rule requires retention of records for two years. This factor limits the data available for analysis. Staff requested records for the prior two years and received information from three of the five refineries. This information was used to estimate the quantity of precursor organic compounds and the potential emissions allowed by the current rule. Table 3 shows the summary of emissions.

The emissions allowed by the current rule are shown as approximately one ton per day. This is a conservative estimate and assumes that a vessel is hydrocarbon free after one volume turnover. The potential to emit is likely higher due to factors that affect the cleanliness of the vessel, such as material off-gassing from catalysts or remaining liquids, clingage to the vessel walls and internal components, and turnaround timelines.

Table 3: Estimated Precursor Organic Emissions[1]

REFINERY	REFINERY ESTIMATE[2] (pounds per day)		ALLOWED BY CURRENT RULE[3] (pounds per day)	
YEAR	2002	2003	2002	2003
Refinery A	0.56	0.42	382	148
Refinery B	0.19	0.57	340	730
Refinery C	4.22	N/A		
Refinery D[4]	N/C	N/C		
Refinery E	N/A	N/A		
Bay Area[5]	1.88	2.5	1,805	2,195

[1] Methane content at 1% (District Sample Analysis, Lab # 02-144)
[2] Calculated mass emissions from refinery records
[3] Assumes no clingage, no outgassing, no liquid in vessel, a molecular weight of 100, and a pressure of 4.6 psig
[4] Values given are as either greater or less than 10% LEL. N/C-not calculated
[5] Assumes 2 of 5 (A&B) refineries 2 yr data set is representative of all refineries

The potential emissions allowed by the current rule were calculated using refinery reported volumes, an assumed composition, one vessel volume turnover and a partial pressure of hydrocarbon at 4.6 pounds per square inch gauge (psig). Refinery practices typically achieve a partial pressure of organics within the vessel significantly less than 4.6 psig, due primarily to their requirements for confined space entry. The proposed amendments will codify the existing practices.

Economic Impacts

Socioeconomic Impacts

Section 40728.5 of the Health and Safety Code requires an air district to assess the socioeconomic impacts of the adoption, amendment, or repeal of a rule if the rule is one that "will significantly affect air quality or emissions limitations." Applied Economic Development, Berkeley, California, is preparing a cost analysis.

Costs

The proposed amendments impose requirements that differ only slightly from existing practice. There are some minor costs associated with a change in monitoring equipment for those facilities that switch to flame or photoionization detectors for surveying emissions from vessel depressurization. Generally, facilities use catalytic detectors to monitor confined space atmospheres. Although flame ionization detectors are used for fugitive surveys, for example to determine compliance with District Regulation 8, Rule 18, Equipment Leaks, some refineries reported that extra staff, specialized training, and higher quality calibration gases would be required to monitor process vessel depressurization. This would be necessary to insure compliance with OSHA standards (…a user shall be properly trained on the meter used to measure…), and the accuracy requirements of Method 21. The workgroup discussed capability of meeting Method 21 by the existing LEL technology. Manufacturers have suggested that new meters meet Method 21, and EPA has listed the technology as an approved technology in Method 21.

Industry stated that based on current depressurization procedures a few vessels would be in violation of the proposed standard. Currently, there is insufficient information available to determine the additional time and methods necessary to meet the standard. An estimate was developed based on the presumed cost of an additional day of cleaning. Table 5 is staff's estimate of the various cost items that may be imposed by the proposed rule.

Table 5: Cost Estimate Per Facility

COST ITEM	COST ITEM
Records[1]	$360
Maintenance & Calibration[2]	$1,540
Monitoring[3]	$22,500
Total	$24,500

[1] $30/hr for 12 hours (one hour per month for 12 months)
[2] 10% of equipment purchase price (EPA Cost Manual), Includes Parts and Calibration once per quarter
[3] 300 vessels, annual cost at one half-hour per vessel monitored once per day for 15 days every 3 years at $30/hr

Table 5 is an estimate of costs associated with the implementation of the proposed amendments. These amendments will reduce emissions of organic and other pollutants, including toxic compounds. Staff has estimated a total implementation cost of approximately $24,500 per year. The cost effectiveness is approximately $70 per ton of precursor organic compound emissions reduced.

Incremental Costs

Under Health and Safety Code Section 40920.6, the District is required to perform an incremental cost analysis when adopting a Best Available Retrofit Control Technology (BARCT) rule or feasible measure required by the California Clean Air Act. To perform this analysis, the District must (1) identify one or more control options achieving the emission reduction objectives for the proposed rule, (2) determine the cost effectiveness for each option, and (3) calculate the incremental cost effectiveness for each option. To determine incremental costs, the District must "calculate the difference in the dollar costs divided by the difference in the emission reduction potentials between each progressively more stringent potential control option as compared to the next less expensive control option." The proposed amendments to Regulation 8, Rule 10 are intended to implement Control Measure SS-17 from the Bay Area 2001 Ozone Attainment Plan and Control Measure C4 from the Bay Area 2000 Clean Air Plan. Because Control Measure C4 is intended to meet feasible measure requirements under the California Clean Air Act, an incremental cost analysis is required.

During the rule development process, two control options were discussed: (1) measure all vessels and determine emissions, and (2) limit emissions to 10,000 ppm. Option 1 would require monitoring and reporting of data. Option 2 would be a standard that would limit emissions to 10,000 ppm. The cost of monitoring for each option was assumed to be the same. A summary of these costs is listed in Table 5 and is discussed in the next section.
Option 1 assumes that the only additional costs would be the daily monitoring and recordkeeping requirements. This is based on existing requirements. Option 2 assumes

rental costs for regenerative systems at $5,000 per day. This assumption was based on discussions at workgroup meetings.

Table 4: Total Incremental Cost Effectiveness for All Facilities

	Cost ($/year)	Emission Reduction (tons/year)	Cost Per Ton of Emissions ($/ton)	Incremental Cost ($/ton)
Option 1	122,000	266	450	---
Option 2	228,000	298	750	300

ENVIRONMENTAL IMPACTS

Pursuant to the California Environmental Quality Act, the District's environmental consultant, Environmental Audit, Inc., prepared an initial study for the proposed rule amendments to determine whether rule adoption would result in any significant environmental impacts. In general, the initial study concludes that the proposed amendments would result in environmental benefits through ensuring that emissions from vessel depressurization are minimized. Because the proposed new requirements for vessel depressurization are in line with current practices, the initial study also concludes that the proposed amendments will not change operating practices in any way that might have adverse environmental impacts. The complete environmental document is attached as Appendix D. A Negative Declaration for the proposed amendments has been prepared and is being circulated for comment. The comment period is from December 22, 2003 to January 12, 2004.

REGULATORY IMPACTS

California Health and Safety Code section 40727.2 requires the District to identify existing federal air pollution control requirements for the equipment or source type affected by the proposed rule or regulation. The District must then note any differences between these existing requirements and the requirements imposed by the proposed rule. Regulation 8, Rule 10: Process Vessel Depressurization, applies to specific vessels in refineries and chemical plants when depressuring a vessel. The proposed amendments expand the applicability to a greater number of process vessels and limit the emissions after depressurization. No federal air pollution control requirement was identified for the equipment or source type affected by the proposed rule or regulation.

RULE DEVELOPMENT HISTORY

A workgoup was formed that included representatives from California Air Resources Board, Industry, Communities for a Better Environment, and District staff. The workgroup has met three times to discuss technical issues. The issues discussed included the definition of process vessel, current methods used to determine emissions to the atmosphere, methods used to clean and purge vessels, interpreting existing data, emission limitations and controls. A public workshop was held on October 28, 2003 to present proposed language and discuss technical issues. As of this report, no written comments have been submitted. The issue of most concern was the proposed requirement to use EPA Method 21 for monitoring emissions. Industry was of the opinion that the specifications in the method added costs with little gains. They based this opinion on the need to adhere to the calibration and performance specifications of the instrument used to measure emissions in addition to the added time for training and monitoring. This is relevant for those facilities that contract out for monitoring, and/or use a basic LEL meter. The method has flexibility in the type of meter that may be used to monitor emissions. The requirements for calibration are similar to existing procedures (OSHA requires "the use of a calibrated meter"), however some meters in use may not meet the performance specification. In these cases an increased cost would be incurred, however staff is of the opinion these costs are insignificant.

DISTRICT STAFF IMPACTS

Implementation of the proposed regulation will have a limited impact on the District's resources. However, these changes are essential and necessary in order to satisfy the commitments in the Bay Area 2001 Ozone Attainment Plan. Staff will need to verify the vessel concentration during turnarounds, review reports and records, and collect and analyze gas samples for selected vessels.

CONCLUSION

The proposed amendments to Regulation 8, Rule 10, Process Vessel Depressurization will meet the commitments made during the adoption of the 2001 Ozone Attainment Plan for Control Measure SS-17. It is intended to limit the amount of precursor organic compounds released when a vessel is being depressurized and opened for entry.

Pursuant to the Health and Safety Code Section 40727, new regulations must meet necessity, authority, clarity, consistency, non-duplicity and reference. The proposed regulation is:

- Necessary to protect public health by reducing ozone precursor emissions to meet control measure SS-17 in the Bay Area 2001 Ozone Attainment Plan. The amendments also reduce exposures to toxic air contaminants.
- Authorized by California Health and Safety Code section 40702.
- Clear, in that the new regulation specifically delineates the affected industry, compliance options and administrative requirements for industry subject to this rule,
- Consistent with other District rules, and not in conflict with state or federal law,
- Non-duplicative of other statutes, rules or regulations, and
- The proposed regulation properly references the applicable District rules and test methods and does not reference other existing law.

The proposed regulation has met all legal noticing requirements and has been discussed with all interested parties. District staff recommends adoption of Regulation 8, Rule 10: Process Vessel Depressurization.

REFERENCES

Air Pollution Engineering Manual

Field-Produced Jp-8 Standard For Calibration Of Lower Explosive Limit Meters Used By Jet Fuel Tank Maintenance Personnel. S. Martin, P. Jensen, NIOSH, Morgantown, WV; J. Pleil, US EPA, Research Triangle Park, NC.

Infrared Technology For Fail-To-Safe Hydrocarbon Gas Detection, Dr. Shankar Baliga, Senior Development Scientist, General Monitors

Century OVA 128 Portable Hydrocarbon Analyzer Product Specification Brochure

Control Measure C4, Technical Assessment Document, October 9, 1991

EPA Sector Notebook, 1995

EPA Cost Manual, January 2002

Bay Area 2001 Ozone Attainment Plan, adopted October 24, 2001

Appendicies

APPENDIX A. Discussion on Monitoring Technologies

The principle of operation of an instrument measuring % LEL is called catalytic oxidation. When exposed to a mixture containing gases and oxygen, the measuring bead coating allows the oxygen and combustibles to combine at its surface, Figure 1. The energy produced by this reaction heats the measuring bead. The rise in temperature changes the bead's resistance and is related to the concentration of the combustible gas. This rise in temperature is generated by a constant-current supplied to the sensor. The sensor signal readout is indicated as percent LEL. The catalyst employed in these sensors is critical to the accuracy and life of the sensor, and impacts the variety of combustible gases the sensor can detect.

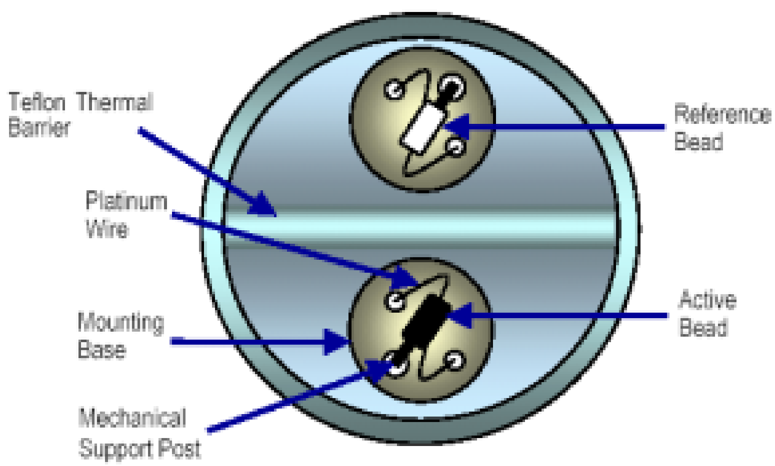

Fig. 1 Catalytic Bead Sensor

Although catalytic bead sensors have been in use for decades, the technology has some drawbacks. A main drawback is the inability to operate in an environment deficient in oxygen since the bead requires oxidation of hydrocarbon gas. Oxygen levels impact oxidation efficiency and the sensor's accuracy. Another drawback is sensor poisoning by chemical compounds such as silicones and sulfur compounds leading to a decline in catalytic activity. Contamination can show up during normal maintenance of the system as an increase in the response time to calibrate, recovery time after exposure and loss of exposure response. Since these conditions can occur without warning to the operator, electrocatalytic hydrocarbon sensors are not fail-to-safe. Fail-to-safe in this instance implies the sensor's ability to communicate its dysfunctional status to the operator.

Catalytic sensors are still the sensors of choice when it comes to operating the sensor head above 75°C.

Hydrocarbon sensors based on infrared (IR) absorption principles do not suffer from the drawbacks of catalytic bead sensors. This leads to increased reliability and a hydrocarbon monitoring system that can operate maintenance free for years. IR absorption based instruments offer fail-to-safe operation because the optical technology is an active one, able to communicate the sensor's status and faults to the operator.

The IR method of measuring gas concentration is based on the absorption of IR radiation at certain wavelengths as the radiation passes through a volume of the gas. IR hydrocarbon gas detectors can be classified into two types known as point detectors and open path detectors. For point detectors, the absorption path length is fixed, and is determined by the instrument design to be a few inches. For the open path IR detectors, the absorption path length can be as long as 100 meters.

Instruments based on IR technology use two wavelengths, one at the gas-absorbing wavelength and the other at a wavelength not absorbed by the gas. IR detectors are immune to poisoning, resistant to corrosion, operate in a deficit or surplus oxygen atmosphere, and have no reduction in sensor life from repeated exposure to gas. With the sophisticated optical and electronic designs currently used, the detectors are factory calibrated and virtually maintenance free. This is particularly desirable when sensors must be located in inaccessible areas and cannot be easily calibrated on a periodic basis. [1]

With flame ionization technology, the sample gas is mixed with a fuel (normally hydrogen) and burned in an atmosphere of "blanket air". The hydrogen delivery system provides a precise flow to the detector. Sample gathering is done by using a small diaphragm air pump. The sample delivery system provides air to the detector chamber to maintain the flame combustion and introduce the organic air contaminants for analysis. The ions formed in the burning process cause an electrical conduction between two electrodes in the combustion chamber (or detector cell) that is amplified by a highly sensitive electrometer-amplifier circuit. The electrical output of the electrometer-amplifier is directly proportional to the quantity of flame ionizable hydrocarbons present, and is linear over a wide range. Figure 2 illustrates both the hydrogen flow and air flow patterns in the OVA 128.

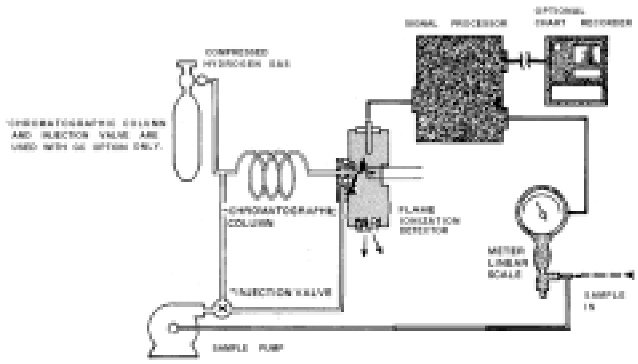

Figure 2 OVA 128[2]

Staff considered three technologies to monitor the emissions from depressured vessels. Table 1 suggests some advantages and disadvantages of each technology. The proposed amendments specify the use of a meter that meets the accuracy requirements of EPA Method 21.

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1 *Infrared Technology For Fail-To-Safe Hydrocarbon Gas Detection*, Dr. Shankar Baliga, Senior Development Scientist, General Monitors

[2] Century OVA 128 Portable Hydrocarbon Analyzer Product Specification Brochure

Table 1: Monitoring Technology Comparision

TECHNOLOGY	ADVANTAGE	DISADVANTAGE
Catalytic detectors	Robust	Catalysts can become poisoned or inactive due to contamination
	Simple to operate	The only means of identifying detector sensitivity loss due to catalytic poisons is by checking with the appropriate gas on a routine basis and recalibrating as required.
	Easy to install, calibrate and use	Requires oxygen for detection.
	Long life with a low life-cycle cost	Prolonged exposure to high concentrations of combustible gas may degrade sensor performance.
	Proven technology currently in use by refiners.	
Flame ionization	Universal organic compound response with approximately the same high sensitivity for all	The initial cost is higher than catalytic detectors.
	Flame ionization will not respond to changes in relative humidity or changes in CO and CO2 concentration.	More difficult to calibrate and maintain than catalytic detectors.
	A mass sensing detector which exhibits minimal effects from changes in temperature, pressure, or flow.	High maintenance cost compared to catalytic detectors.
	Provides excellent dynamic range and concentration linearity.	Requires a fuel source.
Infrared	High resistance to contamination and poisoning	Initial higher cost per point. IR detectors in the past have been more expensive than catalytic detectors at initial purchase, but they are rapidly coming down in price to cost parity with catalytic detectors.
	Fail-to-safe operation	Higher spare parts cost.
	Ability to operate in the absence of oxygen or in enriched oxygen	The gas to be measured must be infrared active, such as a hydrocarbon.
		Gases that do not absorb IR energy (such as hydrogen) are not detectable.
		High humidity, dusty and/or corrosive field environments can increase IR detector maintenance costs.
		Routine calibration to a different gas is not practical.
		A relatively large volume of gas is required for response testing.
		Does not perform well for multiple gas applications.
		Cannot replace the IR source in the field – must be returned to factory for repair.

APPENDIX B SUMMARY OF OTHER DISTRICT RULES

AGENCY	PROVISIONS
San Joaquin Valley Rule 4454: Refinery Process Unit Turnaround	A person shall depressurize any vessel containing VOCs unless: 4.1 The organic vapors shall either be: 4.1.1 Recovered, added to the refinery fuel gas system and combusted; or 4.1.2 Controlled and piped to an appropriate firebox or incinerated for combustion; or 4.1.3 Flared, until the pressure within the process vessel is as close to atmospheric pressure as is possible. 4.2 All process vessels shall be depressurized into the control facilities to less than 1020 mm Hg (5 psig) before venting/opening to atmosphere.
San Luis Obispo Rule 442: Refinery Process Turnarounds	A. A person shall not vent organic compounds to the atmosphere during the depressurization or the vessel purging steps of a refinery process turnaround. B. venting all uncondensed organic gases to a fuel gas system or to a flare
Santa Barbara Rule 322: Process Turnarounds	1. A person shall not vent organic compounds to the atmosphere during process depressurization or the vessel purging steps of a refinery process turnaround. 2. venting all uncondensed organic gases to a fuel gas system or to a flare
South Coast Rule 1123: Refinery Process Unit Turnaround	collected and contained for use as fuel or sent to a gas disposal system until the pressure in the vessel is below five pounds per square inch, gauge, or is within ten percent above the minimum gauge pressure at which the vapors can be collected, whichever is lower. For every refinery that uses inert gas displacement or vacuum education for process turnaround, a person operating the refinery shall submit to the Executive Officer a plan which describes at least the following: (A) the procedure used for gas displacement or education; (B) the disposition of the displaced or educed organic gases; (C) the stage in the displacement or education procedure at which the disposition is changed from a control facility to atmospheric venting (D) the criteria by which said stage is identifiable. Any vessel, or group of vessels, that has been depressurized to less than five pounds per square inch, gauge, shall be exempted
Ventura Rule 74.8: Refinery Process Turnarounds	1. A person shall not vent reactive organic compounds to the atmosphere 1. venting all uncondensed reactive organic compound gases to a fuel gas system or to a flare

APPENDIX C. **Flammable Properties**

COMPOUND	MOLECULAR WEIGHT	LEL (volume %)	LEL (PPM)	10% LEL (expressed as ppm C_1)
Methane	16.04	5.00	50,000	5,000
Ethane	30.07	3.00	30,000	6,000
Propane	44.09	2.12	21,200	6,360
Butane	58.12	1.86	18,600	7,440
Pentane	72.15	1.40	14,000	7,000
Hexane	86.17	1.18	11,800	7,080
Octane	114.23	0.95	9,500	7,600
Nonane	128.25	0.83	8,300	7,470
Decane	142.28	0.77	7,700	7,700
Ethylene	28.05	2.75	2,750	550
Propylene	42.08	2.00	2,000	600
Acetylene	26.04	2.50	2,500	500
Cyclohexane	84.16	1.26	1,260	756
Benzene	78.11	1.40	1,400	840
Toluene	92.13	1.27	1,270	889

APPENDIX D. CEQA ANALYSIS