



BAY AREA  
AIR QUALITY  
MANAGEMENT  
DISTRICT

**STAFF REPORT**

**PROPOSED**  
**AIR DISTRICT REGULATION 12, RULE 15:**  
**PETROLEUM REFINING EMISSIONS**  
**TRACKING**

Prepared by the staff of the  
Bay Area Air Quality Management District  
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## Acknowledgements

## EXECUTIVE SUMMARY

Bay Area refineries are among the largest stationary sources of air pollutants—criteria, toxic, and climate—in the region. Refineries process crude oil into various products, such as gasoline, diesel fuel, jet fuel, heating oil, and asphalt. Changes in the crude oil stock being processed in Bay Area refineries, along with other factors, can cause an increase in the air emissions of these pollutants. Also, refineries must be a key contributor to greenhouse gas (GHG) reductions necessary to successfully implement the state's climate change goals. As a result, the Bay Area Air Quality Management District ("Air District") has developed a new proposed rule: *Regulation 12, Rule 15: Petroleum Refining Emissions Tracking ("Rule 12-15")*.

Proposed Rule 12-15 would require that all refineries:

1. Submit consistent, enhanced periodic emissions inventory information, including information about cargo carriers;
2. Make available to the APCO historic and ongoing crude slate information, including volumes and composition data, for imported feedstocks as well as for crude oil; and
3. Install and operate new air monitoring facilities at refinery fence-lines.

These activities and the information they would provide would address the Air District goals to:

1. Accurately and fully characterize emissions of air pollutants (criteria, toxic, and climate) from all refinery-related emissions sources on an on-going basis to determine if additional rule development is required to further reduce emissions;
2. Track crude slate changes to assess whether those changes result in increased emissions
3. Improve real-time monitoring of emissions at refinery fence-lines to address public concerns about localized health impacts and to validate emissions inventories.

## I. INTRODUCTION

This report was prepared to provide information about the development of a new rule by the Bay Area Air Quality Management District ("Air District") that would apply to petroleum refineries located in the San Francisco Bay Area: *Regulation 12, Rule 15: Petroleum Refining Emissions Tracking ("Rule 12-15")*. The development of this rule was included as Action Item 4 in the Air District's *Work Plan for Action Items Related to Accidental Releases from Industrial Facilities*, which was approved by the Air District's Board of Directors on October 17, 2012.

In the development of this proposed rule, the Air District held several workshops to discuss the draft rule and gather stakeholder input. An initial series of public workshops were held on an earlier draft Rule 12-15 in Martinez on April 22, 2014; Richmond on April 24, 2014; and at the Air District offices on April 26, 2014. The Air District held a second series of workshops in Benicia on March 16, 2015; Richmond on March 17, 2015; Martinez on March 18, 2015; and at the Air District offices on March 20, 2015. At these workshops, staff presented and discussed a revised draft Rule 12-15 as well as guidance documents for air monitoring and developing emissions inventories. During these workshops, draft Rule 12-15 was presented as a companion to draft *Regulation 12, Rule 16: Petroleum Refining and Emissions Limits and Risk Thresholds ("Rule 12-16")*, which included emission-mitigation actions triggered in various ways.

The Air District hosted three open house events in September 2015, in Martinez, Benicia and Richmond. Although these events were focused on four different draft refinery rules, draft Rule 12-15 and draft Rule 12-16 were discussed with members of the public and the regulated community.

The Air District posted an amended version of draft Rule 12-15 and the air monitoring guidance as well as an interim Staff Report on September 11, 2015. (Also, see Section IX, Rule Development and Public Consultation Process, below.)

At this time, draft Rule 12-16 is being reassessed, and the elements in draft Rule 12-15 that were designed to explicitly support provisions of draft Rule 12-16 have been removed from proposed Rule 12-15.

## **II. BACKGROUND**

### **A. Bay Area Petroleum Refineries and Support Facilities**

Currently, the five petroleum refineries located in the Bay Area within the jurisdiction of the Air District that would be affected by the proposed rule are:

1. Chevron Products Company, Richmond (BAAQMD Plant #10)
2. Phillips 66 Company—San Francisco Refinery, Rodeo (BAAQMD Plant #21359)
3. Shell Martinez Refinery, Martinez (BAAQMD Plant #11)
4. Tesoro Refining and Marketing Company, Martinez (BAAQMD Plant #14628)
5. Valero Refining Company—California, Benicia (BAAQMD Plant #12626)

The five affected, refinery-related facilities ("Support Facilities" in the proposed rule) are:

1. Chemtrade West sulfuric acid plant, Richmond (BAAQMD Plant #23)
2. Eco Services sulfuric acid plant, Martinez (BAAQMD Plant #22789)
3. Air Products and Chemicals hydrogen plant, Martinez (BAAQMD Plant #10295)
4. Air Liquide hydrogen plant, Rodeo (BAAQMD Plant #17419)
5. Phillips 66 coke calcining plant, Rodeo (BAAQMD Plant #21360)

These five support facilities are subject to some provisions of the rule because their operation is closely linked to the operations of the five refineries and because they are significant sources of air pollutants.

#### 1. Petroleum Crude Oil

Petroleum refineries convert crude oil into a wide variety of refined products, including gasoline, aviation fuel, diesel and other fuel oils, lubricating oils, and feed stocks for the petrochemical industry. Crude oil consists of a complex mixture of hydrocarbon compounds with smaller amounts of impurities, including sulfur, nitrogen, oxygen, a variety of toxic compounds, organic acids, and metals (e.g., iron, copper, nickel, and vanadium). Crude oil is most often characterized by the oil's density (light to heavy) and sulfur content (sweet to sour). A more detailed explanation of these terms and others used to describe crude oil follows below.

Also, each of the properties described below, with the exception of "crude oil fractions", "nitrogen content," "total reduced sulfur," and "total acid number" are required to be included in the periodic Crude Slate Report described in proposed Rule 12-15. The District may consider adding these or other properties to Rule 12-15 in a future

amendment, if the data indicates that these properties are essential to fully understanding the emissions impact of crude slate changes.

*a. Crude oil fractions*

Crude oil is not a single substance but rather is a mixture of substances (hydrocarbons, water, metals, mineral salts, and sediments). Hydrocarbons are organic compounds composed of carbon and hydrogen atoms. Crude assays characterize petroleum fractions by boiling point ranges.

*b. API Gravity*

The industry standard measure for crude oil density is American Petroleum Institute (API) gravity, which is expressed in units of degrees, and which is inversely related to density (i.e., a lower API gravity indicates higher density; a higher API gravity indicates lower density). Refineries convert crude oils to gaseous products (propane gas for sale and "fuel gas" that is consumed at the refinery), high-value transportation fuels (gasoline, diesel and jet fuel) and lower-value heavy oils (such as "bunker fuel" that is used by ocean-going vessels). Crude oils with higher API gravity can theoretically be converted to higher-value light products with less processing than crude oils with lower API gravity. Refinery operators have asserted that, although this may suggest that a refinery operator would prefer to use high API gravity crudes exclusively, this is not the case because each refinery is designed and equipped to process crude oil with API gravity in a certain range. Processing crude oil outside of the design range—even if it is "light" crude—will result in processing bottlenecks that reduce the overall efficiency of the refinery. One of the purposes of proposed Rule 12-15 is to gather information to attempt to determine if changes in crude oil composition result in emissions increases. "Light crude" generally refers to crude oil with API gravity of 38 degrees or more; "medium crude" has API gravity between 29 and 38 degrees; and "heavy crude" has API gravity of 29 degrees or less.

*c. Sulfur Content ("Sweet" and "Sour" Crude)*

Sulfur is an impurity that occurs in crude oil and arrives in various forms including: elemental sulfur (S), hydrogen sulfide (H<sub>2</sub>S), carbonyl sulfide (COS), inorganic forms, and most importantly organic forms that include: mercaptans, sulfides, and polycyclic sulfides. "Sweet crude" is commonly defined as crude oil with sulfur content less than 0.5 percent, while "sour crude" has sulfur content greater than 0.5 percent. Sweet crude is more desirable because sulfur must be removed from the crude oil to produce more valuable refined products such as gasoline, diesel and aviation fuels.

*d. Nitrogen Content*

Nitrogen in the heavy gas oil component of crude oil is a contaminant that often requires additional processing. Nitrogen can poison catalysts used in hydrotreating and cracking processes; therefore, nitrogen removal often results in better gasoline and distillate product yields.

*e. Vapor Pressure*

Vapor pressure is a measure of crude oil volatility. Higher vapor pressure crude oil contains greater amounts of light Volatile Organic Carbon (VOC) compounds.

*f. Total Reduced Sulfur (Hydrogen Sulfide and Mercaptans) Content*

Total reduced sulfur (hydrogen sulfide and mercaptan content) is a measure of the highly odorous volatile components in crude oil.

*g. BTEX (Benzene, Toluene, Ethylbenzene, Xylene) Content*

BTEX content is a measure of the benzene, toluene, ethylbenzene, and xylene content in crude oil.

*h. Total Acid Number*

Total Acid Number is a measure of the quantity of organic acids in the crude oil.

*i. Metals (Iron, Nickel and Vanadium) Content*

The metals content of crude oil indicates both the solids contamination of crude oil and the potential for organic metals compounds in the heavy gas oil component of crude oil.

## 2. Petroleum Refining Processes

Refineries comprise the general processes and associated operations discussed below.

*a. Separation Processes*

Crude oil consists of a complex mixture of hydrocarbon compounds with small amounts of impurities such as sulfur, nitrogen, and metals. The first phase in petroleum refining is the separation of crude oil into its major constituents using distillation and "light ends" recovery (i.e., gas processing) that splits crude oil constituents into component parts known as "boiling-point fractions."



*b. Conversion Processes*

To meet the demands for high-octane gasoline, jet fuel, and diesel fuel, components such as residual oils, fuel oils, and light ends are converted to gasoline and other light fractions by various processes. These processes, such as cracking, coking, and visbreaking (a form of thermal cracking that breaks the viscosity), are used to break large petroleum molecules into smaller ones. Polymerization and alkylation processes are used to combine small petroleum molecules into larger ones. Isomerization and reforming processes are applied to rearrange the structure of petroleum molecules to produce higher-value molecules using the same atoms.

*c. Treating Processes*

Petroleum treating processes stabilize and upgrade petroleum products by separating them from less desirable products, and by removing other elements. Treating processes, employed primarily for the separation of petroleum products, include processes such as de-asphalting. Elements such as sulfur, nitrogen, and oxygen are removed by hydrodesulfurization, hydrotreating, chemical sweetening, and acid gas removal.

*d. Feedstock and Product Handling*

Refinery feedstock and product handling operations consist of unloading, storage, blending, and loading activities.

*e. Auxiliary Facilities*

A wide assortment of processes and equipment not directly involved in the processing of crude oil are used in functions vital to the operation of the refinery. Examples include boilers, wastewater treatment facilities, hydrogen plants, cooling towers, and sulfur recovery units. Products from auxiliary facilities (e.g., clean water, steam, and process heat) are required by most process units throughout a refinery. Note that as defined in proposed Rule 12-15, an operation such as a hydrogen plant that is not owned or under the operational control of the refinery would be deemed a “support facility.”

*f. Cargo Carriers*

While some crude oil is transported to refineries by pipeline, ships and trains also can be used to move large quantities of crude oil to refineries. Understanding these emissions provides a more complete picture of the environmental impact of the refinery operations.

*g. Possible Changes in Emissions Due to Changes in Crude Oil*

In the past several years, new sources of crude oil—including American shale oil and Canadian tar sands-derived oil—have become available to petroleum refineries in North

America, including the Bay Area refineries. The crude oil derived from shale, now accessible because of technological improvements in hydraulic fracturing ("fracking"), tends to be light and sweet. However, it also has higher VOC and H<sub>2</sub>S content than some other crude oils. Crude oil from tar sands, currently under development in the Canadian province of Alberta, tends to be heavy and sour.

In order to maximize production, refineries are designed to process crude oils within a certain range in compositions. For example, a refinery that is designed to process more sour crude must have the capacity to remove large amounts of sulfur from the crude oil, while a refinery designed to process sweet crude does not require as much sulfur processing capacity. Bay Area refineries traditionally process heavier and more sour crude oils and would likely need to make changes to their facilities in order to accommodate different sources of crude oil with different compositions while maintaining current production levels.

It is anticipated that refineries will update and/or modify their equipment to meet stricter regulatory fuel requirements and potentially to process crude oil from different sources. Proposed Rule 12-15 provides a means to determine if overall changes in refinery emissions occur as both processes and equipment change, and to make emissions and new monitoring information available to the public.

### 3. Air Pollutants Emitted from Petroleum Refineries

Air pollutants are categorized and regulated based on their properties and there are three primary categories of regulated air pollutants: (1) criteria pollutants; (2) toxic pollutants (toxic air contaminants, which in federal programs are referred to as "hazardous air pollutants"); and (3) climate pollutants (e.g., greenhouse gases). Additional categories of air pollutants include odorous compounds and visible emissions, although these are most often also components of one or more of the three primary categories of regulated air pollutants listed above.

Criteria pollutants are emissions for which Ambient Air Quality Standards (AAQS) have been established, or they are atmospheric precursors to such air pollutants (i.e., they participate in photochemical reactions to form a criteria pollutant, such as ozone). The AAQS are air concentration-based standards that are established to protect public health and welfare. The U.S. Environmental Protection Agency (EPA) sets AAQS on a national basis (National Ambient Air Quality Standards, or NAAQS), and the California Air Resources Board (CARB) sets AAQS for the state of California (California Ambient Air Quality Standards, or CAAQS). Although there is some variation in the specific pollutants for which NAAQS and CAAQS have been set, the term "criteria pollutants" generally refers to the following:

- Carbon monoxide (CO);
- Nitrogen dioxide (NO<sub>2</sub>) and oxides of nitrogen (NO<sub>x</sub>);

- Particulate matter (PM) in two size ranges—diameter of 10 micrometers or less (PM<sub>10</sub>), and diameter of 2.5 micrometers or less (PM<sub>2.5</sub>);
- Precursor organic compounds (POCs) for the formation of ozone and PM<sub>2.5</sub>; and
- Sulfur dioxide (SO<sub>2</sub>).

Each of these criteria pollutants is emitted by petroleum refineries.

Toxic pollutants, also known as toxic air contaminants (TACs), are emissions for which AAQS generally have not been established, but that nonetheless may result in human health risks. TACs generally are emitted in much lower quantities than criteria pollutants, and may vary markedly in their relative toxicity (e.g., some TACs cause health impacts at lower concentrations than other TACs). The state list of TACs currently includes approximately 190 separate chemical compounds and groups of compounds. TACs emitted from petroleum refineries include volatile organic TACs (e.g., acetaldehyde, benzene, 1,3-butadiene, formaldehyde, and xylenes); semi-volatile and non-volatile organic TACs (e.g., benzo(a)pyrene, chlorinated dioxin/furans, cresols, and naphthalene); metallic TACs (e.g., compounds containing arsenic, cadmium, chromium, mercury, and nickel); and inorganic TACs (e.g., chlorine, hydrogen sulfide, and hydrogen chloride).

Climate pollutants (greenhouse gases or GHGs) are emissions that contribute to climate change. Carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), and three groups of fluorinated compounds (hydrofluorocarbons, or HFCs; perfluorocarbons, or PFCs; and sulfur hexafluoride, or SF<sub>6</sub>) are the major anthropogenic GHGs, and are regulated under the federal Clean Air Act and the California Global Warming Solutions Act (AB32). The climate pollutants emitted from petroleum refineries include CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O.

## **B. Regulation of Air Pollutants from Petroleum Refineries**

### 1. Criteria Pollutants

Bay Area refineries are subject to various air quality regulations that have been adopted by the Air District, CARB, and the EPA. These regulations contain standards that ensure emissions are effectively controlled, including:

- Requiring the use of specific emission control strategies or equipment (e.g., the use of floating roofs on tanks for VOC emissions);
- Requiring that emissions generated by a source be controlled by at least a specified percentage (e.g., 95 percent control of VOC emissions from pressure relief devices);
- Requiring that emissions from a source not exceed specific concentration levels (e.g., 100 parts per million [ppm] by volume of VOC for equipment leaks unless those leaks are repaired within a specific timeframe; 250 ppm by volume SO<sub>2</sub> in exhaust gases from sulfur recovery units; 1,000 ppm by volume SO<sub>2</sub> in exhaust

- gases from catalytic cracking units);
- Requiring that emissions not exceed certain quantities for a given amount of material processed or fuel used at a source (e.g., 0.033 pounds NO<sub>x</sub> per million BTU of heat input, on a refinery-wide basis, for boilers, process heaters, and steam generators);
- Requiring that emissions be controlled sufficiently so that concentrations beyond the facility's property are below specified levels (e.g., 0.03 ppm by volume of hydrogen sulfide [H<sub>2</sub>S] in the ambient air);
- Requiring that emissions from a source not exceed specified opacity levels based on visible emissions observations (e.g., no more than 3 minutes in any hour in which emissions are as dark or darker than No. 1 on the Ringelmann Smoke Chart); and
- Requiring that emissions be minimized by the use of all feasible prevention measures (e.g., flaring prohibited unless it is in accordance with an approved Flare Minimization Plan).

Air quality rules generally do not expressly limit mass emissions (e.g., pounds per year of any particular regulated air pollutant) from affected equipment unless that equipment was constructed or modified after March 7, 1979, and is subject to the Air District's New Source Review (NSR) rule. All Bay Area refineries have "grandfathered" emission sources that were not subject to NSR but are generally regulated by equipment-specific Air District regulations or operational conditions contained in Air District permits. As a result, none of the Bay Area refineries have overall mass emission limits that apply to the entire refinery. Nonetheless, mass emissions of regulated air pollutants from Bay Area refineries are tracked at the source level, and these mass emissions generally have been substantially reduced over the past several decades.

Air pollutant emissions from Bay Area petroleum refineries have been regulated for more than 50 years, with most of the rules and regulations adopted following enactment of the 1970 Clean Air Act amendments. The Air District has the primary responsibility to regulate "stationary sources" of air pollution in the Bay Area, and the Air District has adopted many rules and regulations that apply to petroleum refineries.

In December 2015, the Air District adopted two amended rules and one new rule that affect refinery operations and emissions:

- New Regulation 6, Rule 5: Particulate Emissions from Refinery Fluidized Catalytic Cracking Units (FCCUs);
- Amended Regulation 8, Rule 18: Equipment Leaks;
- Amended Regulation 11, Rule 10: Cooling Towers

The Air District is considering additional revisions to several rules and the development of new rules that may further affect refinery operations and emissions. Rule amendments under development include:

- Regulation 1: General Provisions & Definitions;
- Regulation 2, Rule 1: Permits, General Requirements;
- Regulation 2, Rule 2: New Source Review, including GHG evaluation;
- Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants;
- Regulation 6, Rule 1: Particulate Matter General Requirements;
- Regulation 9, Rule 1: Sulfur Dioxide; and
- Regulation 9, Rule 9: Nitrogen Oxides and Carbon Monoxide from Stationary Gas Turbines.

The Air District is also developing a new rule (Regulation 9, Rule 14) to address SO<sub>2</sub> emissions from petroleum coke calcining. Regulation 12, Rule 16 is being re-assessed. The Air District is considering alternative approaches to addressing the concern that refinery emissions may increase as the refineries adopt new sources of crude oil.

In addition, the Air District currently is developing an update to its Clean Air Plan that will investigate and evaluate further measures that could result in revised and/or new rules affecting refineries.

## 2. Toxic Pollutants

The Air District uses three approaches to reduce TAC emissions and to reduce the health impacts resulting from TAC emissions: (1) Specific rules and regulations; (2) Preconstruction review; and (3) the AB 2588 Air Toxics "Hot Spots" Program.

### *a. Rules and Regulations*

Many of the TACs emitted by petroleum refineries also result in the formation of criteria pollutants. For example, benzene and formaldehyde are precursor organic compounds to the formation of ozone, while arsenic and cadmium can be found in particulate matter emissions. Thus, many regulations that reduce criteria pollutant emissions from refineries will also have a co-benefit of reducing toxic air contaminant emissions. In addition, the Air District implements EPA, CARB, and Air District rules that specifically target toxic air contaminant emissions from sources at petroleum refineries, for example, the EPA's National Emission Standards for Hazardous Air Pollutants (NESHAPS) and CARB's Reducing Toxic Air Pollutants in California Communities Act (AB1807) Rules. Additional rules dealing with TACs are listed below.

### *b. Preconstruction Review*

The Air District's Regulation 2, Rule 5 is a preconstruction review requirement for new and modified sources of TACs implemented through the Air District's permitting process. Regulation 2, Rule 5 includes health impact thresholds, which require the use of the best available control technology for TAC emissions (TBACT) for new or modified equipment, and established health risk limits that cannot be exceeded for any proposed project.

*c. Air Toxics "Hot Spots" Program*

The Air Toxic "Hot Spots" program, or AB 2588 Program, was a statewide program implemented by each individual air district pursuant to the Air Toxic "Hot Spots" Act of 1987 (Health and Safety Code [H&SC] Section 44300 *et seq.*). The Air District used standardized procedures to identify health impacts resulting from industrial and commercial facilities. Health impacts were expressed in terms of cancer risk and non-cancer (acute and chronic) hazard index.

Under this program, the Air District used a prioritization process to identify facilities that warrant further review. This prioritization process used toxic emissions data, health effects values for TACs and Air District–approved calculation procedures to determine a cancer risk and non-cancer prioritization score for each site. Facilities that had a cancer risk prioritization score greater than 10 or a non-cancer prioritization greater than 1 were subject to further review. If emission inventory refinements and other screening procedures indicated that prioritization scores remain above these thresholds, the Air District required that the facility perform a comprehensive site-wide HRA. The Air District updates the prioritization scores annually, based on the most recent toxic emissions inventory data for the facility.

An HRA conducted in accordance with AB 2588 estimates the health impacts from a site due to stationary source TAC emissions. The HRA must be conducted in accordance with statewide HRA guidelines developed by the Office of Environmental Health Hazard Assessment (OEHHA) in the Guidance Manual for Preparation of Health Risk Assessments. This manual includes health effects values for each TAC and establishes the procedures to follow for modeling TAC transport, calculating public exposure, and estimating the resulting health impacts. OEHHA periodically reviews and updates the Guidance Manual through a Scientific Review Panel and public comment process. The HRA guidelines were approved in 2003, but OEHHA proposed major revisions to these HRA guidelines in June 2014. The proposed revisions to the Guidance Manual were adopted March 6, 2015.

In 1990, the Air District Board of Directors adopted the current risk management thresholds pursuant to the Air Toxic "Hot Spots" Act of 1987. These risk management thresholds; summarized in Table 1, below, set health impact levels that require sites to take further action, such as conducting periodic public notifications about the site's health impacts and implementing mandatory risk reduction measures. These thresholds as well as other methods to address and lower emissions or TACs are currently under review.

**Table 1**  
**Summary of Current Bay Area Air Toxics "Hot Spots" Program Risk Management Thresholds**

	<b>Site Wide Cancer Risk</b>	<b>Site Wide Non-Cancer Hazard Index</b>
Public Notification	10 in a million	1.0
Mandatory Risk Reduction	100 in a million	10

### 3. Climate Pollutants

CARB recently adopted rules to reduce emissions of GHGs from mobile and stationary sources in California. All refineries in California are subject to CARB's Cap on Greenhouse Gas Emissions and Market-based Compliance Mechanisms ("Cap-and-Trade Rule"). The Cap-and-Trade Rule will reduce GHG emissions collectively from all subject sources using a market-based approach, although there is no requirement that any specific source reduce its emissions. The Cap-and-Trade system will reduce emissions from subject sources to 1990 levels by 2020, a roughly 15 percent reduction.

The Air District's recently adopted Ten Point Climate Action Work Program calls for enhanced GHG emissions inventory and forecasting, the implementation of GHG emissions monitoring and additional rule development specifically addressing GHG emissions; all of which will affect the five Bay Area refineries and support facilities.

### 4. Accidental Release Regulation

In addition to Air District regulations, petroleum refineries are also subject to regulatory programs that are intended to prevent accidental releases of regulated substances. Accidental release prevention programs in California are implemented and enforced by local administering agencies, which, in the case of the Bay Area refineries, are Solano County (for the Valero Refining Company) and Contra Costa County (for Chevron Products Company, Phillips 66 Company, Shell Martinez Refinery, and Tesoro Refining and Marketing Company).

The primary regulatory programs of this type are based on requirements in the amendments to the 1990 Clean Air Act as follows: (1) the Process Safety Management (PSM) program, which focuses on protecting workers, and is administered by the U.S. Occupational Safety & Health Administration (OSHA); and (2) the Accidental Release Prevention program (commonly referred to as the Risk Management Program, or RMP), which focuses on protecting the public and the environment, and is administered by EPA. Bay Area refineries are subject to Cal/OSHA's PSM program, which is very similar to the federal OSHA program focusing on worker safety, but with certain more stringent state provisions. Bay Area refineries are subject to the California Accidental Release

Prevention (CalARP) Program, which is very similar to EPA's RMP program to limit exposure of the public, but with certain more stringent State provisions. In addition, Contra Costa County and the City of Richmond have both adopted an Industrial Safety Ordinance (ISO). These ISOs are very similar to CalARP requirements, but with certain more stringent local provisions.

## 5. Air District Rules Affecting Refineries

The following is a partial list of the air pollution rules and regulations that the Air District implements and enforces at Bay Area refineries:

- Regulation 1: General Provisions and Definitions
- Regulation 2, Rule 1: Permits, General Requirements
- Regulation 2, Rule 2: New Source Review
- Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants
- Regulation 2, Rule 6: Major Facility Review (Title V)
- Regulation 6, Rule 1: Particulate Matter, General Requirements
- Regulation 6, Rule 5: Particulate Emissions from Refinery Fluidized Catalytic Cracking Units;
- Regulation 8, Rule 1: Organic Compounds, General Provisions
- Regulation 8, Rule 2: Organic Compounds, Miscellaneous Operations
- Regulation 8, Rule 5: Storage of Organic Liquids
- Regulation 8, Rule 6: Terminals and Bulk Plants
- Regulation 8, Rule 8: Wastewater (Oil-Water) Separators
- Regulation 8, Rule 9: Vacuum Producing Systems
- Regulation 8, Rule 10: Process Vessel Depressurization
- Regulation 8, Rule 18: Equipment Leaks
- Regulation 8, Rule 28: Episodic Releases from Pressure Relief Devices at Petroleum Refineries and Chemical Plants
- Regulation 8, Rule 33: Gasoline Bulk Terminals and Gasoline Delivery Vehicles
- Regulation 8, Rule 44: Marine Vessel Loading Terminals
- Regulation 9, Rule 1: Sulfur Dioxide
- Regulation 9, Rule 2: Hydrogen Sulfide
- Regulation 9, Rule 8: Nitrogen Oxides and Carbon Monoxide from Stationary Internal Combustion Engines
- Regulation 9, Rule 9: Nitrogen Oxides and Carbon Monoxide from Stationary Gas Turbines
- Regulation 9, Rule 10: Nitrogen Oxides and Carbon Monoxide from Boilers, Steam Generators and Process Heaters in Petroleum Refineries
- Regulation 11, Rule 10: Cooling Towers
- Regulation 12, Rule 11: Flare Monitoring at Petroleum Refineries
- Regulation 12, Rule 12: Flares at Petroleum Refineries
- 40 CFR Part 60, Subpart J: Standards of Performance for Petroleum Refineries



(NSPS)

- 40 CFR Part 61, Subpart FF: Benzene Waste Operations (NESHAP)
- 40 CFR Part 63, Subpart CC: Petroleum Refineries (NESHAP)
- 40 CFR Part 63, Subpart UUU: Petroleum Refineries: Catalytic Cracking, Catalytic Reforming, and Sulfur Plant Units (NESHAP)
- State Airborne Toxic Control Measure for Stationary Compression Ignition (Diesel) Engines (ATCM)

### III. NEED FOR REGULATORY ACTION

Refineries are among the largest single sources of criteria pollutants, precursors to the formation of criteria pollutants and climate pollutants in the Bay Area. Further, the five Bay Area refineries rank among the top ten facilities in the Bay Area for risk-weighted emissions of TACs, based on an evaluation of emissions from stationary sources in 2012 and using risk factors for cancer and chronic hazard index. Bay Area refineries are also some of the largest individual sources of NO<sub>x</sub> and SO<sub>2</sub> in the region. Bay Area refineries are also the largest industrial sources of greenhouse gas emissions. While historically, refinery emissions have tended to decrease overall over time; there are occasions when some emissions have increased despite the regulatory environment in which they operate. Some of the factors that can result in increased refinery emissions include higher production rates to meet increased demand or to compensate for loss of production in other regions, upset conditions and accidents, and changes in crude oil or product slates.

Table 2 includes the most recent criteria pollutant emissions data for the five affected refineries and five affected support facilities.

**Table 2: Baseline Emissions from the Refineries and Associated Facilities**

Facility Name	Average Annual Emissions (tons/year)				
	PM (filterable)	PM (cond.) <sup>1</sup>	TOG	NO <sub>x</sub>	SO <sub>2</sub>
Chevron	173	255	2,187	910	339
Phillips 66	53	—	337	266	409
Shell	409	98	1,749	971	1,084
Tesoro	80	91	1,200	763	572
Valero	123	—	494	1,205	111
Chemtrade West	4	—	55	3	127
Eco Services	18	—	1	13	362
Air Products	10	—	9	3	2
Phillips 66 (Carbon Plant)	29	—	0	239	1,242
Air Liquide	16	—	29	2	2
<b>Total Emissions</b>	<b>915</b>	<b>444</b>	<b>6,061</b>	<b>4,375</b>	<b>4,250</b>

Given the significance of these facilities, it is important to have a wholistic and accurate understanding of their impact on the environment and surrounding communities. The improved emissions inventories required by the proposed Rule 12-15 will help accomplish this goal. These improved inventories would cover a broader set of sources

<sup>1</sup> Condensable PM emissions are estimated based on a very small number of non-standard tests on FCCUs. These numbers will change as more testing is completed at the refineries.

than have been traditionally reported and would ensure that consistent and state-of-the-art methods are used to estimate emissions.

Proposed Rule 12-15 would also require monitoring of emissions at the refinery fence-line. This monitoring is an important complement to the effort to improve emissions inventories because it will help “ground truth” the engineering estimates used in the emissions inventory, with the ultimate goal of ensuring that public health is protected.

In addition, proposed Rule 12-15 would require refineries to provide to the Air District crude slate and non-crude feedstock information. This will enable the Air District to determine whether there is a correlation between changes in crude slate and feedstock changes and increases in emissions. Determination of a correlation (or lack thereof) will help the Air District decide whether such changes should be addressed in future regulations. Apart from future rule development, any relationship between changes in feedstocks and increased emissions would also be relevant to implementation of the Air District’s current new source review program codified in Air District Regulation 2, Rule 1 and Rule 2. Under some circumstances, a change in process feed materials could be an “alteration” or “modification” as defined in Regulation 2, Rule 1, and thus require a permit.

#### **A. Crude Slate and Emissions**

As new sources of North American crude oil become available, the refining of these different crude oils may also lead to increased emissions. As mentioned above, heavy, sour crude from Canadian tar sands may increase GHG emissions due to the need for more intensive processing. The high sulfur content of crude oil from tar sands may also lead to higher SO<sub>2</sub> emissions and may potentially contain more toxic metals. Crude oil from shale has characteristics that may also lead to increases in other emissions. The crude from shale is lighter and, therefore, more easily converted to products, which may lead to lower GHG emissions. However, this crude has higher VOC and H<sub>2</sub>S content, which may lead to increased emissions of these pollutants from storage and loading operations and from equipment leaks. Because of the potential for changes in the sources of crude oil, the Air District seeks to improve our understanding of the relationship between these changes and resulting changes in emissions. This section (III.A.) of the staff report discusses the theory underlying the relationship between crude oil composition and refinery air emissions.

For optimal performance, petroleum refineries are designed to process crude oil with a certain range of characteristics. A refinery may either directly purchase crude oil that has parameters within these ranges or purchase crude oils that do not and then blend these crude oils to create a blended crude oil that does. The crude oils and crude oil blends that a refinery may process is commonly referred to as a refinery’s “crude slate.”

Key crude oil parameters include:

- Crude oil fractions
- API Gravity (Density)
- Sulfur content
- Nitrogen content
- Vapor pressure
- Benzene, Toluene, Ethylene, and Xylene content
- Total Acid Number
- Metals content


These parameters are measured through tests on crude oil called "crude assays." Through the crude assay, refiners are able to determine the values of each of the parameters listed above.

*Crude oil fractions*

Crude oil is not a single substance but rather is a mixture of substances (hydrocarbons, water, metals, mineral salts, and sediments). Hydrocarbons are organic compounds composed of carbon and hydrogen atoms. Crude assays characterize petroleum fractions by boiling point ranges. Typical crude oil fraction boiling points are shown in Table 3.

**Table 3  
Typical Boiling Point Ranges of Crude Oil Fractions**

Product	Boiling Point Range (° F)
Propane, Butanes, and Other Gases	< 85
Gasoline	85 – 185
Naphtha	185 – 350
Kerosene	350 – 450
Diesel	450 – 650
Gas Oil	650 – 1050
Residue (e.g. asphalt)	> 1050




The first step in crude oil refining (after cleaning the crude oil) is heating the crude oil to over 1000 °F to separate the crude oil fractions. Crude oils that have more diesel, gas oil, and residue fractions than gasoline, naphtha, and kerosene fractions require more heating and are, therefore, more energy intensive, resulting in more emissions of GHGs and other combustion products such as NOx and possibly SO<sub>2</sub>.

*API Gravity (Density)*

Density is a ratio of how much something weighs relative to its volume (e.g., pounds per gallon). Because of the manner in which API gravities are determined, more dense ("heavier") crude oils will have lower API gravities while less dense ("lighter") crude oils will have higher API gravities as shown in Table 4.

**Table 4  
Crude Oil Classification Based on API Gravity**

Category	API Gravity
Light Crudes	> 38
Medium Crudes	29 to 38
Heavy Crudes	8.5 to 29
Very Heavy Crudes	< 8.5

Lighter  
  
 Heavier

Heavier crude oils will have greater amounts of heavier crude oil fractions. Because heavier crude oils and crude oil fractions are denser, they require more power to pump. Power at a refinery is typically supplied by refinery gas turbines. Therefore, an increase in required power directly increases the amount of emissions from gas turbines. Heavier crude oils also require more heating from refinery furnaces and process heaters, directly increasing emissions.

#### *Sulfur Content*

The total amount of sulfur (in all forms) is reported in crude assays as sulfur content in percentage by weight. Typically, crude oils with sulfur content greater than 0.5 percent by weight are called "sour" while crude oils with sulfur content less than 0.5 percent by weight are called "sweet." Sour crude oils require more treatment to remove the sulfur. This directly results in higher emissions from sulfur treatment plants.

Crude assays also include the concentration (in units of parts per million by weight) of a subset of sulfur compounds including H<sub>2</sub>S and mercaptans. H<sub>2</sub>S is considered a toxic air contaminant that has an odor similar to rotten eggs while mercaptans are organic compounds that have a particularly strong odor similar to rotting cabbages. Crude oils with more H<sub>2</sub>S and mercaptans may result in more odors from storage tanks storing crude oil and recovered oil. Odors from such tanks have resulted in public nuisances in nearby communities.

Increased crude oil sulfur content will increase the:

- Amount of hydrogen needed in refinery hydrotreaters,
- Emissions from hydrogen plant furnaces and CO<sub>2</sub> vent,
- Sulfur content in refinery process gas,
- Sulfur content in refinery fuel gas,
- Emissions of SO<sub>2</sub>, H<sub>2</sub>S, and SAM from refinery fuel gas combustion, and
- Elemental sulfur produced and resulting number of trucks carrying sulfur offsite.

#### *Nitrogen Content*

Crude oils typically contain very low amounts of nitrogen compounds, but have a great significance in refinery operations. Nitrogen compounds can destroy or "poison" refinery

catalysts used in fluid catalytic crackers, hydrocrackers, and catalytic reformers. Poisoned catalyst will require more processing of the feedstock, which will increase emissions from those types of equipment.

Nitrogen compounds are also removed in refinery hydrotreaters; but are harder to remove than sulfur. Similar to sulfur, higher nitrogen content will require more hydrogen treatment resulting in more emissions from refinery hydrogen plant furnaces and vents. When treated with hydrogen, nitrogen compounds are transformed to ammonia (NH<sub>3</sub>), a toxic air contaminant. Ammonia may then be carried over in refinery fuel gas and combusted at refinery equipment (boilers, furnaces, etc.) as well as be emitted in fluid catalytic crackers.

#### *Vapor Pressure*

Vapor pressure is an indication of a liquid's evaporation rate. Materials with higher vapor pressure are more volatile. For crude oils and crude oil products, vapor pressure is reported as Reid Vapor Pressure (RVP), which is the vapor pressure determined in a volume of air four times the liquid volume at 100 °F. Crude oils with higher RVP will evaporate more easily, leading to more emissions from storage tanks and as fugitive equipment leaks in refinery components (valves, pumps, flanges, etc.).

#### *Benzene, Toluene, Ethylbenzene, and Xylene*

Benzene, toluene, ethylbenzene, and xylenes are collectively called "BTEX" and each is considered a toxic air contaminant. BTEX are VOCs and toxic air contaminants lead to the formation of criteria pollutants. Crude oils and petroleum feedstocks with higher BTEX will result in increased BTEX and VOC emissions from storage tanks and fugitive equipment leaks from refinery equipment (valves, pumps, flanges, etc.).

#### *Total Acid Number*

Total acid number (TAN) is a measurement of the acidity of crude oil and is a measurement of potential corrosivity of a crude oil. Corrosive crude oils may result in deactivated catalysts, which will require more processing of materials to get the same amounts of product and will increase emissions. Corrosive crude oils may also result in the corrosion of crude unit internal components, piping and process vessels. Corrosion in crude unit components will reduce the efficiency of the crude unit and require more processing of the crude oil to get the same amount of products. More processing will require more heat from crude unit furnaces, directly increasing emissions. Corrosion of piping and process vessels may lead to fugitive equipment leaks and unexpected fires, explosions, and large quantities of emissions.

#### *Metals Content (Iron, Nickel, and Vanadium)*

Metallic compounds exist in all crude oils. Metals cause operational problems by poisoning catalysts used for hydroprocessing and cracking. All metals are considered a pollutant (particulate matter and possibly a toxic air contaminant) when emitted.

Solids contamination of crude can lead to air emissions when these metals settle in the heavy fuel oil or in the petroleum coke produced by the refinery. Air emissions of these metals can occur when the fuel oil or petroleum coke is burned. The organic metals in heavy gas oils are also a concern when the organic metals deposit on the coke formed in the fluid catalytic cracking (FCC) unit. This coke is burned in the FCC regenerator and these metals deposit on the catalyst. A portion of this catalyst is emitted from the FCC as particulates containing these metal compounds. In addition, metals in the feedstock can result in the deactivation of the catalyst in a FCC, which results in increased coke formation, which in turn, results in increased emissions.

Iron, nickel, and vanadium are especially problematic for a refinery. Iron can cause corrosive compounds such as iron oxide (rust) and iron sulfide. Also, high levels of iron may cause iron deposits in refinery pumps, resulting in more power to pump materials. Iron deposits in heat exchangers result in a decrease in the heat transfer efficiency, requiring more heat from boilers, furnaces, or process heaters directly increasing emissions from boilers, furnaces, or process heaters. Iron deposits in pumps, piping, and heat exchangers may also cause metal to corrode creating holes in the equipment and creating fugitive equipment leaks or cooling tower emission leaks.

Nickel can cause corrosion of crude distillation towers and gas turbines and catalytic poisoning. Nickel may be emitted when combusting refinery fuel gas. When directly emitted, nickel is considered a carcinogen and a toxic air contaminant.

For high temperature power generators (gas turbines), the presence of vanadium in refinery fuel gas may lead to ash deposits on the turbine blades, cause severe corrosion, and ultimately may cause a refinery power plant to fail. An unexpected shutdown of a refinery power plant leads to refinery imbalances in fuel gas, steam, and power resulting in unplanned flaring and flared emissions.

Vanadium in refinery fuel gas may also cause the deterioration of refractory furnace linings. A deteriorated refractory lining will result in less heat transfer in a boiler, furnace or process heater. To get the same amount of heat from a boiler, furnace, or process heater with a deteriorated refractory lining; a refinery will have to increase the amount of fuel burned, which directly increases emissions from the boiler, furnace, or process heater.

### *Refinery Configuration*

As previously mentioned, refineries are designed and operated ("configured") to process crude oil and petroleum feedstocks within certain ranges of: API gravity, sulfur content, nitrogen content, TAN, and metals content. If crude oil and/or petroleum feedstocks with parameters outside of these ranges are processed, "routine" emissions could increase and catastrophic failures may occur resulting in refinery fires or explosions and unexpected shutdowns of refinery process units and excessive flaring. Unexpected shutdowns of refinery equipment generate large amounts of emissions. A summary of

refinery emissions impact by crude oil parameter and refinery equipment is listed in Table 5.

**Table 5  
Summary of Refinery Emissions Impact by Crude Oil Parameter**

Parameter	Parameter Impact	
	Pollutants	Refinery Equipment/Activity
API Gravity	<ul style="list-style-type: none"> <li>• NO<sub>x</sub></li> <li>• CO</li> <li>• SO<sub>2</sub></li> <li>• VOC</li> <li>• PM<sub>10</sub>/PM<sub>2.5</sub></li> <li>• GHGs</li> <li>• Toxics</li> </ul>	<ul style="list-style-type: none"> <li>• Crude Unit furnaces</li> <li>• Fluid Catalytic Cracking Unit (FCCU)</li> <li>• Delayed Coker</li> <li>• Fluid Coker</li> <li>• Flexicoker</li> <li>• Solvent Deasphalting Unit</li> <li>• Process unit furnaces</li> </ul>
Sulfur Content Total Reduced Sulfur	<ul style="list-style-type: none"> <li>• SO<sub>2</sub></li> <li>• H<sub>2</sub>S</li> <li>• Odors</li> </ul>	<ul style="list-style-type: none"> <li>• Sulfur Recovery Units (SRUs)</li> <li>• Fuel gas combustion (furnaces, boilers, turbines, etc.)</li> <li>• Flares</li> <li>• Wastewater treatment</li> <li>• Storage tanks</li> </ul>
Nitrogen Content	<ul style="list-style-type: none"> <li>• NH<sub>3</sub> (a toxic)</li> <li>• NO<sub>x</sub></li> </ul>	<ul style="list-style-type: none"> <li>• FCCU</li> <li>• Fuel gas combustion</li> <li>• Hydrocrackers</li> </ul>
Vapor Pressure	<ul style="list-style-type: none"> <li>• VOC</li> <li>• GHGs</li> <li>• Toxics</li> </ul>	<ul style="list-style-type: none"> <li>• Storage tanks</li> <li>• Fugitive equipment leaks</li> <li>• Loading operations</li> <li>• Pressure relief devices</li> <li>• Process vessels</li> </ul>
BTEX	<ul style="list-style-type: none"> <li>• Benzene</li> <li>• Toluene</li> <li>• Ethylene</li> <li>• Xylene</li> </ul>	<ul style="list-style-type: none"> <li>• Storage tanks</li> <li>• Fugitive equipment leaks</li> <li>• Fuel gas combustion (furnaces, boilers, turbines, etc.)</li> </ul>
Total Acid Number	<ul style="list-style-type: none"> <li>• NO<sub>x</sub></li> <li>• CO</li> <li>• SO<sub>2</sub></li> <li>• VOC</li> <li>• PM<sub>10</sub>/PM<sub>2.5</sub></li> <li>• GHGs</li> <li>• Toxics</li> </ul>	<ul style="list-style-type: none"> <li>• Heat Exchangers</li> <li>• Cooling Towers</li> <li>• Process upsets</li> <li>• Flares</li> <li>• FCCU</li> <li>• Delayed Coker</li> <li>• Fluid Coker</li> <li>• Flexicoker</li> <li>• Solvent Deasphalting Unit</li> </ul>
Metals Content	<ul style="list-style-type: none"> <li>• NO<sub>x</sub></li> <li>• CO</li> <li>• SO<sub>2</sub></li> <li>• VOC</li> <li>• PM<sub>10</sub>/PM<sub>2.5</sub></li> <li>• GHGs</li> <li>• Toxics</li> </ul>	<ul style="list-style-type: none"> <li>• FCCU</li> <li>• Flares</li> <li>• Fuel gas combustion (furnaces, boilers, turbines, etc.)</li> <li>• Delayed Coker</li> <li>• Fluid Coker</li> <li>• Flexicoker</li> <li>• Gas Turbine</li> <li>• Hydrocracker</li> <li>• Solvent Deasphalting Unit</li> </ul>



## **IV. PROPOSED RULE REQUIREMENTS**

Proposed Rule 12-15 is included in Appendix A of this report. The air monitoring guidance document is included in Appendix B. Explanations of the various provisions of proposed Rule 12-15 are provided below.

### **A. Administrative Procedures**

Proposed Rule 12-15 would require refinery owners/operators to submit to the Air District emission inventories and air monitoring plans, subject to review by members of the public and other interested stakeholders. For air monitoring plans, comments received would be considered by Air District staff before taking final action to approve, require revisions, or disapprove the plans. Comments on emission inventories would be considered by Air District staff with no time limit, which is consistent with inventories being "living documents" that may change as best practices evolve. Emission inventories and air monitoring plans would be posted on the Air District's website.

The administrative procedures by which the Air District would review and take final action to approve or disapprove the inventories and plans are specified in Sections 12-15-402 and 404 of proposed Rule 12-15.

It should be noted that California law specifies that "trade secrets" are not public records. While air pollutant emissions data and air monitoring data may not be considered trade secrets, many other types of information may be (e.g., production data used to calculate emissions data). The definition of "trade secrets" provided in Section 6254.7 of the California Government Code follows:

"Trade secrets," as used in this section, may include, but are not limited to, any formula, plan, pattern, process, tool, mechanism, compound, procedure, production data, or compilation of information which is not patented, which is known only to certain individuals within a commercial concern who are using it to fabricate, produce, or compound an article of trade or a service having commercial value and which gives its user an opportunity to obtain a business advantage over competitors who do not know or use it.

Section 12-15-407 of proposed Rule 12-15 specifies that a refinery owner/operator may designate as confidential any information required to be submitted under the rule that is claimed to be exempt from public disclosure under the California Government Code. The owner/operator is required to provide a justification for this designation, and must submit a separate public copy of the document with the information that is designated "trade secret" redacted. These provisions are intended to facilitate processing of trade secret information by expediting release of related public information while helping ensure that trade secret portions are not inadvertently released. The purpose of Section 407 is purely administrative. Actual trade secret protections derive from the Government Code. The Air District's Administrative Code sets forth procedures for how the Air District will handle trade secret information that is responsive to Public Records Act requests.

## **B. Pollutant Coverage**

Proposed Rule 12-15 would cover the three primary categories of regulated air pollutants: (1) criteria pollutants (and their precursors), (2) toxic pollutants, i.e., toxic air contaminants (TACs), and (3) climate pollutants, e.g., greenhouse gases. These terms are defined in the proposed rule.

The definition of TAC refers to the California State TAC list and includes those state-identified TACs that have a basis for the evaluation of health effects under guideline procedures adopted by OEHHA for the Air Toxics "Hot Spots" Program.

The Air District realizes the importance of reducing climate pollutants and staff has developed the *Regional Climate Protection Strategy, 10-Point Climate Action Work Program* and created a new department, the Climate Protection Section, to investigate and implement ways to reduce climate pollutants. Proposed Rule 12-15 requires that emissions inventories for climate pollutants be developed and submitted to the Air District. This information will help the Air District begin to address climate change issues. Air District staff will assess emissions of climate pollutants and the refineries' abilities to make feasible improvements in their operations to reduce climate pollutants. While the Statewide AB32 Cap-and-Trade system represents a major effort towards control of climate pollutants, the Air District intends to explore ways to further reduce these pollutants in a manner that complements, and does not conflict with, the Cap-and-Trade system.

## **C. Source Coverage**

Proposed Rule 12-15 would apply to air emissions from "stationary sources" at petroleum refineries. Stationary sources, as opposed to mobile sources such as trucks and other vehicles, are the sources over which the Air District has regulatory jurisdiction. However, there are instances in which the Air District has a need to understand emissions from these mobile sources, in order to have a complete understanding of refinery emissions as sources of crude oil change. Thus emissions from these regulated operations are included in the requirements of the rule. This concept is addressed in the definition of "Emissions Inventory". Several other definitions in the proposed rule are intended to clarify source coverage.

Proposed Rule 12-15 would apply to petroleum refinery operations whether or not these operations are owned or operated by different entities. For example, some Bay Area refineries include co-located hydrogen plants that are owned or operated by separate companies, but that provide hydrogen for refinery operations. The definition of "Support Facility" in the proposed rule identifies these independently-controlled facilities that are subject to the rule.

## D. Emissions Inventory Development

Emissions inventories are used in a variety of air quality programs, and methodologies for establishing these inventories are provided in various publications. Depending on the specific type of source, and the specific type of air pollutant emitted, "state-of-the-art" emissions inventory techniques may involve continuous emission monitors, source-specific emission tests, general emission factors (i.e., representative values that relate the quantity of a pollutant emitted with an activity associated with the release of that pollutant), material balances, or empirical formulae. The term "Emissions Inventory" is defined in the proposed rule.

Because of the diversity of emissions inventory methodologies that exist, and the need to update these methodologies on an on-going basis due to improvements in scientific understanding and available data, the Air District has decided not to include detailed emissions inventory methodologies in the rule itself. Doing so would make the rule language extremely cumbersome, and would necessitate frequent rule amendments as the state of the art progresses. As reflected in Section 12-15-405 of proposed Rule 12-15, the Air District staff will continue to publish, and periodically update, emissions inventory guidelines for petroleum refineries that set the most accurate available methodologies to be used for emissions inventories required by proposed Rule 12-15. Inventories submitted by refineries will be evaluated on a case-by-case basis. Any inconsistencies between the submitted inventories and Air District guidance will be judged based upon whether the refinery has provided an adequate justification for methodologies used.

The Air District previously published a refinery emissions inventory guidelines document ("*Refinery Emissions Inventory Guidelines: An Assessment of EPA Document Emission Estimation Protocol for Petroleum Refineries*") in 2013, and expects to publish updated guidelines prior to the public hearing for adoption of proposed Rule 12-15.

The Emissions Inventory described in proposed Rule 12-15 serves the same purpose as the "permit renewal questionnaire" that is currently sent to each refinery (and every other permitted facility) on an annual basis. This questionnaire is required to be completed by the refinery as a condition of permit renewal, and is the basis for the refinery's estimated emissions. The new Emissions Inventory will eventually replace the "permit renewal questionnaire," with possible duplication of these two documents necessary for 2016 calendar year data. The new Emissions Inventory, like the current "permit renewal questionnaire," is a necessary element of the Air District's permitting program (required by EPA) and also necessary for the Air District to meet its obligation to provide emissions data to CARB. The authority for both the current "permit renewal questionnaire" and the new Emissions Inventory is Healthy & Safety Code Sections 41511 and 42303.

## **E. Emissions Inventories and Crude Slate Report**

### 1. Emissions Inventories Report

The establishment of annual emissions inventories would provide a basis for determining emissions variations that occur at each refinery from year to year.

Each refinery would be required to prepare and submit an annual refinery emissions inventory report. The public would be given an opportunity to provide input regarding emissions inventory reports, as described in Section 12-15-402 of proposed Rule 12-15.

### 2. Crude Slate Report

Each refinery, but not support facilities, would be required to provide information on the crude oil volume and composition, or "crude slate," processed at its crude units as described above, as well as the volume and composition of pre-processed feedstock processed at other process units. The combined information would be included in a "crude slate report." As explained below, the Air District would use this information to determine if significant crude slate changes lead to increased emissions.

The crude oil and pre-processed feedstock parameters required for the crude slate report are:

- Total volume (thousands of barrels)
- API gravity as it relates to higher crude density (degrees)
- Sulfur content (percentage by weight)
- Vapor pressure (psia)
- Benzene, toluene, ethylbenzene, and xylenes (BTEX) contents
- Selected metals (iron, nickel and vanadium) content as an indicator of potential heavy metals that may be released when coke is burned in the fluid catalytic cracking unit

The refinery operators must collect monthly values of each of these parameters and provide this information to the Air District.

Parameters such as nitrogen content, acid content, and total reduced sulfur may be required in future updates of this rule if the Air District deems that data to be necessary to determine the relationship between crude slate and emission rates.

The Authority for this requirement is Health & Safety Code Sections 41511 and 42303. Section 42303 gives the Air District broad authority to require the submittal of information that "will disclose the nature, extent, quantity, or degree of air contaminants which are, or may be, discharged" by a source. Section 41511 expressly allows this authority to be exercised through rulemaking, and gives the Air District authority to adopt rules requiring sources of air pollution to take actions deemed reasonable to determine the amount of air emissions.

These statutory authorities do not limit the Air District's authority to requesting only information about actual emissions. As explained above, crude slate composition can affect air emissions in a myriad of ways. Tracking changes in crude slate is thus reasonably calculated to "disclose the nature, extent, quantity, or degree of air contaminants."

The Air District acknowledges that there is uncertainty regarding the relationship between crude slate changes and refinery air emissions. Refinery representatives have contended throughout the development of this rule either that there is no relationship, or that any such relationship is obscured by intermediary variables. While the Air District does not entirely discount these arguments, the refineries' position is by no means self-evident. As explained above, it is apparent that the potential for changes in crude slate to affect air emissions is significant. The crude slate requirements of proposed Rule 12-15 establish a process to determine whether and to what extent air emissions vary according to changes in crude slate and other feedstocks.

The crude slate requirements of proposed Rule 12-15 will not be burdensome for the refineries. These requirements use information already in refineries' possession, without the need for additional testing or other procedures. The information is being required in a form that does not reveal data that a refinery might reasonable deem "trade secret."

In balancing the degree of uncertainty regarding the relationship of crude and feedstock changes to refinery air emissions, the high potential for an impact upon the breathing public if the relationship is positive, and the minimal burden on the refineries associated with complying with the provisions of this rule, the Air District believes it has struck an appropriate balance and that the crude slate report requirements of proposed Rule 12-15 are "reasonable" within the meaning of Health & Safety Code Section 41511.

## **F. Air Monitoring**

Proposed Rule 12-15 would require the refinery owner/operator to prepare and submit to the Air District an air monitoring plan for establishing and operating a fence-line monitoring system. The term "fence-line monitoring system" is defined in the proposed rule. The Air District will publish guidelines describing the factors it will use in evaluating air monitoring plans (see Sections 12-15-406).

Monitoring plans submitted by refineries will be evaluated on a case-by-case basis. Any inconsistencies between plans and Air District guidance will be evaluated based upon whether the refinery has adequately explained why the plan meets the requirements of proposed Rule 12-15 notwithstanding the inconsistency with the guidance. The same standard of review will be applied to plan updates.

An air monitoring guideline document was developed concurrently with Rule 12-15. Much of the information gathering for the guideline document was completed under Action Item 3 of the Air District's *Work Plan for Action Items Related to Accidental*

*Releases from Industrial Facilities.* Under this Action Item, Air District staff retained a contractor to create a report that identifies equipment and methodological options for monitoring systems. A panel of monitoring experts was gathered from academia, industry, the community, and other government agencies to discuss and weigh the various options and the expert panel provided input to guide the Air District in developing the air monitoring guidelines.

Under proposed Rule 12-15, within one year of Air District approval of a refinery's air monitoring plan, the refinery owner/operator would be required to ensure that fence-line monitoring systems are operational. The systems would be installed, operated, and maintained, in accordance with the approved plan (see Section 12-15-501 of proposed Rule 12-15).

The Air District would review the initial air monitoring guideline document within a five-year period of the publication of the initial guideline document. The guidelines would be updated if necessary in consideration of advances in monitoring technology, updated information regarding the health effects of air pollutants, and review of data collected by existing monitoring systems required under the rule. Updated guidelines would be subject to Air District Board approval. The refinery owner/operator would be required to implement any needed modifications to existing monitoring systems within one year of publication of the updated guidelines.

The fence-line monitoring required by proposed Rule 12-15 is an important element in the effort to improve understanding of refinery emissions. Data in emissions inventories is based to a large extent on emissions factors, which can be described very broadly as multipliers applied to throughput data to yield estimates of actual emissions. Fence-line monitors, by contrast, measure actual emissions. While fence-line monitoring alone is not sufficient to assess total emissions from a refinery, it can provide vitally important reference points to help "ground truth" emissions inventories.

The Authority for this requirement is Health & Safety Code Sections 41511 and 42303.

## V. ECONOMIC IMPACTS

The California Health and Safety Code generally requires two different economic analyses for proposed regulations by an air district. The first (H&S Code §40728.5) is a socioeconomic analysis of the adverse impacts of compliance with the proposed regulation on affected industries and business. The second analysis (H&S Code §40920.6) is an incremental cost effectiveness analysis when multiple compliance approaches have been identified by an air district. Table 6 in Section V.A of this report lists the estimated costs of compliance with each element of proposed Rule 12-15 that has a significant cost. Section V.B of this report discusses the required socioeconomic analysis that is based on the costs in Section V.A. Section V.C of this report discusses the incremental cost analysis, which is not applicable to this proposed rule because they do not require specific emission controls.

### A. Cost of Compliance

<b>Table 6 - Regulation 12, Rule 15 Costs</b>		
<b>Section</b>	<b>Requirement</b>	<b>Cost (per refinery)</b>
12-15-401	Prepare Annual Petroleum Refinery Emissions Inventory (beginning with year 2016 data)	\$90,000 annual cost (annualized)
12-15-408.2	Prepare Monthly Crude Slate Report (beginning with year 2017 data)	
12-15-408.1	Prepare Historical Monthly Crude Slate Reports for 2013, 2014, 2015 and 2016	
12-15-403	Prepare Air Monitoring Plans (one time submittal)	\$250,000 (one-time)
12-15-501	Fence-line Air Monitoring System (construction and operation)	\$2,000,000 one-time capital cost (\$280,000 / year annualized basis)  PLUS \$50,000 annual maintenance & operation cost

### B. Socioeconomic Analysis

Section 40728.5 of the California 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 Development Economics of Walnut Creek, California has prepared a socioeconomic analysis of proposed Rule 12-15. This analysis is based on the costs of compliance with the proposed rule discussed in Section V.A, and is attached to this report as Appendix C. The analysis concludes that the socio-economic impacts of compliance with the requirements of these rules is less than significant.

### **C. Incremental Cost Effectiveness**

Section 40920.6 of the California Health and § Code requires an air district to perform an incremental cost analysis for any proposed Best Available Retrofit Control Technology (BARCT) rule or for a rule that is part of an Alternative Emission Reduction Strategy as described in Section 40914 of the Health and Safety Code. This analysis is omitted here because the proposed rule does not include either of these elements.



## **VI. REGULATORY IMPACTS**

Section 40727.2 of the California Health and Safety Code requires an air district, in adopting, amending, or repealing an air district regulation, to identify existing federal and air district air pollution control requirements for the equipment or source type affected by a proposed change in air district rules. The air district must then note any differences between these existing requirements and the requirements imposed by the proposed change. Appendix D of this report identifies the federal and air district control requirements that affect the sources potentially impacted by proposed Rule 12-15.

## **VII. ENVIRONMENTAL IMPACTS**

Pursuant to the California Environmental Quality Act, the Air District has had an initial study for the proposed rule prepared by Environmental Audit, Inc. of Placentia, California. The initial study concludes that there are no potential significant adverse environmental impacts associated with the proposed rule. A negative declaration will be proposed for adoption by the Air District Board of Directors and is included as Appendix E of this report. The initial study and negative declaration were circulated for public comment prior to the public hearing for this rule.

## **VIII. AIR DISTRICT COST RECOVERY**

The administrative procedures in proposed Rule 12-15 (described in Section IV.A of this report) represent a significant workload increase for the Air District. Although most of these procedures are one-time events and processes, they cannot be completed on the required schedule with existing staff.

The Air District has the authority to assess fees to regulated entities for the purpose of recovering the reasonable costs of implementing and enforcing applicable regulatory requirements. On March 7, 2012, the Air District's Board of Directors adopted a Cost Recovery Policy that specifies that newly adopted regulatory measures should include fees that are designed to recover increased regulatory program activity costs associated with the measure (unless the Board of Directors determines that a portion of those costs should be covered by tax revenue).

In accordance with the adopted Cost Recovery Policy, Air District staff is developing new fee schedules to be included in Regulation 3, Fees, through a separate rule development process.

## IX. RULE DEVELOPMENT AND PUBLIC CONSULTATION PROCESS

Since July 2012, Air District staff has engaged in an extensive and comprehensive rule development process involving a wide range of stakeholders that has resulted in this proposed rule, Emissions Inventory Guidelines, Air Monitoring Guidelines, and staff report.

In October of 2012, a *Work Plan for Action Items Related to Accidental Releases from Industrial Facilities* was adopted by the Board of Directors that included development of a Petroleum Refinery Emissions Tracking Rule. In March of 2013 a workshop report and initial draft rule were issued and the rule development process began.

The following meetings and efforts to work with the interested public and affected industry then took place:

- Apr. 2013: Public workshops held (Martinez, Richmond, District office via webcast).
- May 2013: Stationary Source Committee briefing.
- Jul. 2013: Desert Research Institute (DRI) report on air monitoring finalized documenting air monitoring options and methodologies that might be utilized to measure air quality impacts in communities near refineries.
- Jul. 2013: Panel of national air monitoring experts convened that expanded on the air monitoring options and methodological information contained in the DRI report via webcast.
- Sep. 2013: Draft refinery emissions inventory guidelines issued.
- Sep. 2013: Stakeholder Technical Work Group meeting.
- Jan. 2014: Revised draft rule and preliminary responses to comments issued.
- Jan. 2014: Stakeholder Technical Work Group meeting.
- Feb. 2014: Stationary Source Committee briefing.
- May 2013–Apr. 2014: Additional meetings with stakeholders held.
- Apr. 2014: Stationary Source Committee briefing.
- Jun. 2014: Amended draft Rule 12-15 posted on the Air District website.
- Aug. 2014: Air monitoring guidance draft released and comments accepted.
- Aug.–Oct. 2014: Continued meetings with stakeholders.
- Jan. 2015: Comment period opened.
- Mar. 2015: Public workshops held (Martinez, Richmond, Benicia, Air District Office via webcast).
- Sep. 2015: Comments addressed; interim staff report and revised draft rules released.  
Three open houses for four refinery emission reduction rules

- (Martinez, Richmond, Benicia).
- Jan. 2016: Draft Rule 12-15, staff report, and associated documents posted for public review.
  - Mar. 2016 Amended draft Rule 12-15 posted for public review.

A number of substantive changes were made to the January 2016 version of draft Rule 12-15 in response to comments from stakeholders. This is why a draft rule was re-posted in March 2016. A summary of the changes and the reasoning behind them is listed below:

### Community Air Monitoring

Several commenters expressed concerns about the refinery operators being responsible for siting and operating community air monitors. The Air District has decided to take the responsibility for siting and operating these monitors. The monitoring stations will be funded with a broad-based fee through the pending update to Regulation 3: Fees. This approach will offer the same level of information to the Air District and the public, while addressing concerns raised by both the refineries and community groups.

### Crude Slate Reporting

The definitions and administrative requirements for crude slate reporting have been clarified and the data requirements have changed. The purpose of these changes is to focus on the data elements most relevant to emissions: volume, API gravity, sulfur content, vapor pressure, BTEX<sup>2</sup> content and certain metals. Other changes were made to address refinery operator concerns about confidential business information and to clarify how the data is to be summarized for use by the Air District.

### Emissions Inventory

The process for public participation in the emissions inventory development has been modified to ensure that Air District-approved inventories are made available to the public as quickly as possible. The public will have the opportunity to review the emissions inventories and provide comments to the Air District after they are posted. The Air District will correct deficiencies identified to ensure a more accurate and complete emissions inventory.

In addition, refinery operators will not be responsible for providing data on the emissions of support facilities. Those facilities will provide emissions inventory data directly to the Air District.

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<sup>2</sup> BTEX is an acronym for benzene, toluene, ethylbenzene and xylene. These are toxic organic compounds found in some crude oils.

## Energy Utilization

The requirement to submit energy utilization reports has been removed. The Air District is continuing to evaluate various approaches for addressing greenhouse gas emissions from refineries. Some of these approaches require this information and some do not. If needed, this information will be required in future rulemaking actions.

The Air District received several comments on draft Rule 12-15. A full response to comments will be included in the package that is presented at the Board Hearing.

## **X. CONCLUSION**

Pursuant to Section 40727 of the California Health and Safety Code, the proposed new rule must meet findings of necessity, authority, clarity, consistency, non-duplication, and reference. Proposed new Regulation 12, Rule 15 is:

- Necessary to ensure the maintenance of the NAAQS and ensure protection of the public from toxic air contaminants given the size and impact of the refineries and the possibility of changes to the properties of crude oil processed at these refineries;
- Authorized under Sections 40000, 40001, 40702, 40725 through 40728, and 44391 of the California Health and Safety Code;
- Written or displayed so that their meaning can be easily understood by the persons directly affected by them;
- Consistent with other Air District rules, and not in conflict with state or federal law;
- Non-duplicative of other statutes, rules or regulations. To the extent duplication exists, such duplication is appropriate for execution of powers and duties granted to, and imposed upon, the Air District; and
- Implementing, interpreting or making specific the provisions of the California Health and Safety Code Sections 40000, 40702, and 44391.

The proposed new rule has met all legal noticing requirements, has been discussed with the regulated community, and reflects consideration of the input and comments of many affected and interested parties. Air District staff recommends adoption of proposed new Regulation 12, Rule 15.

### **Appendices:**

Appendix A: Proposed Regulation 12, Rule 15

Appendix B: Air Monitoring Guidelines for Petroleum Refineries

Appendix C: Socio-Economic Analysis

Appendix D: Regulatory Impacts Analysis

Appendix E: CEQA Initial Study / Negative Declaration

## ACKNOWLEDGEMENTS

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