



BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

DRAFT 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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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 AB32 program as well as further limits on GHG emissions. As a result, the Bay Area Air Quality Management District ("Air District") is developing a new draft rule: *Regulation 12, Rule 15: Petroleum Refining Emissions Tracking* ("Rule 12-15").

Rule 12-15 would require that all refineries:

1. Submit consistent, enhanced periodic emissions inventory information, including information about cargo carriers;
2. Submit periodic crude slate information, including volumes and composition data, for imported pre-processed feedstocks as well as for crude oil;
3. Install and operate new air monitoring facilities at refinery fence lines and in nearby communities; and
4. Submit available energy utilization analyses.

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. Improve real-time monitoring of emissions at refinery fencelines and surrounding communities;
3. Identify areas where one or more refineries could improve energy efficiency and therefore reduce GHG emissions if necessary to supplement GHG emission reductions achieved through California Air Resources Board (CARB) regulations related to state AB-32; and
4. Track crude slate changes in an attempt to determine if those changes result in increased emissions.

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 draft rule, the Air District held several workshops to discuss the draft rules and gather stakeholder input. An initial series of public workshops were held on an earlier draft of 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 of Rule 12-15 as well as guidance documents for air monitoring and developing emissions inventories. During these workshops, 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, Regulation 12-15 and 12-16 were discussed with members of the public and the regulated community.

The Air District posted an amended version of 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, Rule 12-16 is being reassessed, and the elements in Rule 12-15 that were designed to explicitly support provisions of Rule 12-16 have been removed from the current version of 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 draft 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 draft 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 included in the rule, although they are not subject to certain rule requirements (e.g., energy audits, air monitoring) 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" is required to be included in the periodic Crude Slate Report described in Rule 12-15.

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 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 (H₂S), 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 that can be precursors for ozone formation. High vapor pressure crude oil could result in more

emissions from crude oil storage and associated piping systems.

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 (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. 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.

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.

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 H₂S 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 more strict regulatory fuel requirements and potentially to process crude oil from different sources. Rule 12-15 provide 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 (NO₂) and oxides of nitrogen (NO_x);
- Particulate matter (PM) in two size ranges—diameter of 10 micrometers or less (PM₁₀), and diameter of 2.5 micrometers or less (PM_{2.5});
- Precursor organic compounds (POCs) for the formation of ozone and PM_{2.5}; and
- Sulfur dioxide (SO₂).

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 (CO₂), methane (CH₄), nitrous oxide (N₂O), and three groups of fluorinated compounds (hydrofluorocarbons, or HFCs; perfluorocarbons, or PFCs; and sulfur hexafluoride, or SF₆) 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 CO₂, CH₄, and N₂O.

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 SO₂ in exhaust gases from sulfur recovery units; 1,000 ppm by volume SO₂ 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_x 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 [H₂S] 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 SO₂ 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, as well as those 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. Rule 2-5 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, is 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 uses standardized procedures to identify health impacts resulting from industrial and commercial facilities. Health impacts are expressed in terms of cancer risk and non-cancer (acute and chronic) hazard index.

Under this program, the Air District uses a prioritization process to identify facilities that warrant further review. This prioritization process uses 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. The Air District updates the prioritization scores annually, based on the most recent toxic emissions inventory data for the facility. Currently, facilities that have a cancer risk prioritization score greater than 10 or a non-cancer prioritization greater than 1 must undergo further review. If emission inventory refinements and other screening procedures indicate that prioritization scores remain above these thresholds, the Air District requires that the facility perform a comprehensive site-wide HRA.

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 are currently under review.

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

	Site Wide Cancer Risk	Site Wide Non-Cancer Hazard Index
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 which 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 which 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_x and SO₂ 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.) ¹	TOG	NO _x	SO ₂
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
Total Emissions	915	444	6,061	4,375	4,250

Given the significance of these facilities, it is important to have a holistic and accurate understanding of their impact on the environment and surrounding communities. The proposed rule would require improved emissions inventories. These improved inventories would cover a broader set of sources than have been traditionally reported and would ensure that consistent and state-of-the-art methods are used to estimate emissions. The proposed rule would also require monitoring of emissions both at the refinery fence-line and in the surrounding community. This monitoring is important to

¹ 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.

“ground truth” the engineering estimates used in the emissions inventory and to ensure that public health is protected. In addition, the proposed rule would require submission of crude slate information, this is needed to ensure that any increase in emissions as a result of crude slate changes is appropriately permitted. Finally, the rule would require the submittal of energy efficiency data. This data is needed to ensure that the refineries are operating as efficiently as possible and not emitting an unacceptable amount of greenhouse gas pollution.

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 SO₂ emissions and may potentially contain more toxic metals. Crude oil from shale has characteristics that may lead also 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 H₂S 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, it is prudent for the Air District to improve our understanding of emissions from the refineries and set standards to ensure that public health is protected.

Accurately quantifying overall facility emissions is difficult. Improving reporting of overall refinery emissions information including deliveries from cargo carriers (e.g. ships and trains) as well as other processes under common control of the refineries would provide the public and the Air District with a more direct method of tracking overall emissions at each refinery over time, and identifying "alterations" and "modifications" as defined in Air District Regulation 2.

For optimal performance, petroleum refineries are designed to process crude oil with a narrow 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 called 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 determined 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.

**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 SO₂.

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 H₂S and mercaptans. H₂S 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 H₂S 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 CO₂ vent,
- Sulfur content in refinery process gas,
- Sulfur content in refinery fuel gas,
- Emissions of SO₂, H₂S, 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 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 (NH₃), 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 as well as 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 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. Minute amounts of metal in the feedstock can result in the deactivation of the catalyst in a catalytic cracking unit, 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 narrow 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"> • NO_x • CO • SO₂ • VOC • PM₁₀/PM_{2.5} 	<ul style="list-style-type: none"> • Crude Unit furnaces • Fluid Catalytic Cracking Unit (FCCU) • Delayed Coker • Fluid Coker • Flexicoker

Parameter	Parameter Impact	
	Pollutants	Refinery Equipment/Activity
	<ul style="list-style-type: none"> • GHGs • Toxics 	<ul style="list-style-type: none"> • Solvent Deasphalting Unit • Process unit furnaces
Sulfur Content Total Reduced Sulfur	<ul style="list-style-type: none"> • SO₂ • H₂S • Odors 	<ul style="list-style-type: none"> • Sulfur Recovery Units (SRUs) • Fuel gas combustion (furnaces, boilers, turbines, etc.) • Flares • Wastewater treatment • Storage tanks
Nitrogen Content	<ul style="list-style-type: none"> • NH₃ (a toxic) • NO_x 	<ul style="list-style-type: none"> • FCCU • Fuel gas combustion • Hydrocrackers
Vapor Pressure	<ul style="list-style-type: none"> • VOC • GHGs • Toxics 	<ul style="list-style-type: none"> • Storage tanks • Fugitive equipment leaks • Loading operations • Pressure relief devices • Process vessels
BTEX	<ul style="list-style-type: none"> • Benzene • Toluene • Ethylene • Xylene 	<ul style="list-style-type: none"> • Storage tanks • Fugitive equipment leaks • Fuel gas combustion (furnaces, boilers, turbines, etc.)
Total Acid Number	<ul style="list-style-type: none"> • NO_x • CO • SO₂ • VOC • PM₁₀/PM_{2.5} • GHGs • Toxics 	<ul style="list-style-type: none"> • Heat Exchangers • Cooling Towers • Process upsets • Flares • FCCU • Delayed Coker • Fluid Coker • Flexicoker • Solvent Deasphalting Unit
Metals Content	<ul style="list-style-type: none"> • NO_x • CO • SO₂ • VOC • PM₁₀/PM_{2.5} • GHGs • Toxics 	<ul style="list-style-type: none"> • FCCU • Flares • Fuel gas combustion (furnaces, boilers, turbines, etc.) • Delayed Coker • Fluid Coker • Flexicoker • Gas Turbine • Hydrocracker • Solvent Deasphalting Unit

B. Toxic Health Impacts to Nearby Communities

Petroleum refineries emissions of toxic compounds pose health impacts to nearby residents and workers. These toxic emissions include toxic air contaminants such as 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) and diesel PM.

California State health officials have determined that exposure to some of these compounds pose greater risk than previously thought.² Further, since health risk assessments were conducted for these facilities in the 1990s, additional compounds have been identified by CARB as toxic air contaminants, such as diesel PM, which were not addressed in these early HRAs.

Air District staff believes it is important to fully assess those emissions to not only determine their impact to exposed individuals, but also to ensure that those emissions do not pose an unacceptable health impact. Up-to-date emissions estimates are required for this assessment.

IV. PROPOSED RULE REQUIREMENTS

The draft language of 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 these proposed rules are provided below.

A. Regulation 12, Rule 15 – Administrative Procedures

Rule 12-15 would require refinery owners/operators to submit to the Air District various reports and plans, subject to review by members of the public and other interested stakeholders. Comments received would be considered by Air District staff before taking final action to approve, require revisions, or disapprove the reports and plans. Commenters would be notified of the Air District's final actions, and approved reports and 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 various types of required reports and plans are specified in Sections 12-15-402 and 404 of 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

² On March 6, 2015, the Office of Environmental Health Hazard Assessment (OEHHA) adopted revised health risk values and protocols that resulted in a general reduction of health risk values for many toxic compounds. These revisions may result in an increase in the health risk posed by various sources of toxic air contaminants such as petroleum refineries.

user an opportunity to obtain a business advantage over competitors who do not know or use it.

Section 12-15-407 of 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 "confidential" redacted.

B. Regulation 12, Rule 15 – Pollutant Coverage

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 Sections 12-15-205, 217, and 210 of the proposed rule.

The definition of TAC provided in Section 12-15-217 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. Rule 12-15 requires that emissions inventories for climate pollutants be developed and submitted to the Air District to 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. The refineries may make these changes in response to the economic incentives created by the AB32 Cap and Trade system. In addition, Air District staff will develop climate-specific rulemaking to ensure these improvements are made.

C. Regulation 12, Rule 15 – Source Coverage

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 desires to understand emissions from these mobile sources, such as when ships and trains are unloading or loading products at the refinery, and thus emissions from these operations are included in the requirements of the rule. This concept is addressed in the definition of "emissions inventory" in Section 12-15-208. Several other definitions in the proposed rule are intended to clarify source coverage. This includes the definition of "petroleum refinery"

in Section 12-15-212, the definition of "source" in Section 12-15-216 (which is the same definition used in the Air District's permit rule), and the definition of "emissions inventory" in Section 12-15-208.

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. Similar arrangements also exist for refinery terminal operations, and auxiliary facilities (e.g., cogeneration plants). The definition of "refinery owner/operator" provided in Section 12-15-213 of the proposed rule indicates that the refinery owner/operator is responsible for the submittal of required reports and plans that cover the entire refinery, including those that may be separately owned or operated. This is the same approach that is used in the implementation of Air District *Regulation 12, Rule 12: Flares at Petroleum Refineries* (e.g., for the submittal of Flare Minimization Plans).

As described earlier, there is concern that processing crude oil from different sources may result in increased emissions. As a result, Rule 12-15 would require that each refinery report its "crude slate" as defined in Section 12-15-207. The report would contain information regarding sulfur and nitrogen content, API gravity, total acid number, and other properties as described in Section 12-15-409.2. By gathering this information about crude oil fed into the refinery processes, the Air District intends to identify "alterations" and "modifications" as defined in Air District Regulation 2. Reporting the composition of the crude oil that is processed by the refinery along with total emissions from the refinery processes will assist in the development of any relationships that may exist between crude oil composition and overall facility emissions.

D. Regulation 12, Rule 15 – 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 Section 12-15-208 of 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, Air District staff believes that Rule 12-15 should not include detailed emissions inventory methodologies. As reflected in Section 12-15-405 of the proposed rule, the Air District staff would publish, and periodically update, emissions inventory guidelines for petroleum refineries that specify the methodology to be used for emissions inventories required under the rule. Section 12-15-601 indicates

that emissions inventories submitted under the rule must be prepared following the Air District-published guidelines.

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 Regulation 12-15.

E. Regulation 12, Rule 15 – Emissions Inventories and Crude Slate Report

1. Emissions Inventories Report

The establishment of annual emissions inventories would provide the basis in the new rule for determining emissions variations that occur at each refinery from year to year. In addition, each refinery 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 reported in a "crude slate report." As explained below, the Air District would use this information to assess how much of a variation in crude slate will be allowed before a refinery will need to obtain authorization from the Air District under related rule revisions being developed for the Air District's permitting regulation, Regulation 2.

As explained earlier in this report, changes in the character and composition of crude oil processed at a refinery can significantly affect emissions. If a change in crude slate will increase the refinery's potential to emit air pollution, then the change constitutes a "modification" as defined in the Air District's New Source Review (NSR) permitting requirements in Regulation 2, Rule 2, and it requires an NSR permit before the refinery can make the change. This requirement for facilities to obtain NSR permits before making such "modifications" (changes that would allow emissions to increase beyond currently-permitted levels) is designed to ensure that any such changes comply with rigorous emissions-control requirements. If a change in crude slate will result in such an increase, then the refinery needs to obtain an NSR permit from the Air District – and demonstrate that it is satisfying the applicable NSR program requirements – before it can make the change.

A concern has arisen, however, that refineries may be making crude slate changes that increase emissions in a way that constitutes a "modification" under the NSR regulations *without* obtaining an NSR permit. As petroleum refineries are highly complex operations with a large number of interrelated components, this could potentially occur if (for example) refinery managers are unaware of how the regulations apply to their facilities, or if they incorrectly estimate the emissions consequences of making a change in crude slate (among other reasons). If a refinery makes such a "modification" associated with crude slate changes without applying for or obtaining an NSR permit, it may be difficult or impossible for the Air District (and the public) to discover that the modification was

made, given the complexity of refinery operations as well as the fact that modifications associated with crude slate changes may be relatively subtle and not immediately obvious. Such a situation would present a significant compliance and enforcement concern, as it would potentially allow the facility to violate Regulation 2-2 by changing its crude slate in a way that increases emissions (and is therefore is a "modification") without first obtaining an NSR permit, but without ever facing any enforcement action or implementing the NSR requirements (e.g., using "best available control technology" and providing emission offsets).

To address this potential that refineries may be changing their crude slates in a manner that would allow emissions to increase without first getting an NSR permit under Regulation 2-2, the Air District plans to propose changes to Regulation 2 that would require *all* significant crude slate changes to get a permit, whether or not they increase emissions in a manner that constitutes a "modification" and requires an NSR permit. Requiring a permit for all significant crude slate changes will require refineries to notify the Air District in advance of making any such change, whether the refinery believes that it is an emission-increasing "modification" or not. This will allow the Air District to conduct its own, independent analysis of whether there will in fact be any potential emissions increase that would trigger the requirements of the NSR program – and if there is such an increase, to ensure that it complies with all applicable NSR requirements. These revisions involve making changes to the Air District's permitting regulations in Regulation 2, and they are proceeding as a separate rulemaking from new Regulation 12-15.

The crude slate reports required under proposed Regulation 12-15 are a critical element of these planned Regulation 2 revisions, because the information therein will be used to establish each refinery's baseline for measuring the extent of any changes in crude slate at the refinery. In addition, the information in the crude slate reports will help Air District staff assess how much of a change from that baseline constitutes a "significant" change that will require a permit under the proposal outlined above. The sooner collection of this information on the refineries' current and historical crude slates begins, the more information will be available for determining how much of a change in crude slates can be allowed before it becomes a "significant" crude slate change that requires pre-approval from the Air District.

Each refinery would be required to prepare and submit an annual refinery emissions inventory and crude slate report to the Air District as specified in Section 12-15-401 of the proposed rule. The public would be given an opportunity to provide input regarding emissions inventory reports, as described in Section 12-15-402.

2. Crude Slate Report

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

- Total volume (millions of barrels)

- API gravity as it relates to higher crude density (degrees)
- Sulfur content (percentage by weight)
- Nitrogen content (percentage by weight)
- Acid content (milligrams of potassium hydroxide per gram)
- Vapor pressure
- Total Reduced Sulfur (hydrogen sulfide [H₂S] and mercaptan content)
- 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

In addition, the refinery operators must collect monthly values of each of these parameters and report that information to the Air District on an annual basis.

F. Regulation 12, Rule 15 – Air Monitoring

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 and a community air monitoring system (see Section 12-15-403). The terms "fence-line monitoring system" and "community air monitoring system" are defined in the proposed rule in Sections 12-15-209 and 204, respectively. The air monitoring plans would need to be prepared in accordance with air monitoring guidelines that are published by the Air District (see Sections 12-15-406 and 602).

The initial 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 the proposed rule, 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. Within two years after Air District approval of the air monitoring plan, the community air monitoring systems would be required to be operational. Both systems would be installed, operated, and maintained, in accordance with the approved plan (see Sections 12-15-501 and 502 of the proposed rule).

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.

G. Regulation 12, Rule 15 – Energy Utilization Analyses

As part of CARB's implementation of AB-32, California refineries, including the five Bay Area refineries, were required to prepare "Energy Efficiency and Co-Benefits Assessments", described by CARB as follows: "Facilities [...] are required to conduct a one-time assessment of the facility's fuel and energy consumption, greenhouse gas emissions, criteria pollutants, and toxic air contaminants. This assessment must also include the identification of potential energy efficiency improvement projects for equipment, processes, or systems that cumulatively account for at least 95 percent of the facility's total greenhouse gas emissions." The submitted assessments are not publicly available. Although CARB has provided a summary report ("Energy Efficiency and Co-Benefits Assessment for Large Industrial Sources – Refinery Sector Public Report") that generally discusses projects at each refinery that are completed, ongoing, scheduled or under investigation, it does not discuss any projects that have been rejected, nor does it evaluate the completeness of the submitted assessments (except possibly in an administrative sense). For these reasons, the publicly-available information on refinery-specific opportunities to reduce energy use and GHG emissions is inadequate for the purposes of identifying areas where energy management might be improved, in the context of best industry practices. Identification of these areas would be beneficial to rule development that would lead to additional GHG emission reductions at Bay Area refineries.

Air District staff believes that each of the five Bay Area refineries has periodically participated in a detailed study of energy management practices and energy infrastructure that identifies or that provides much of the information necessary to identify areas where energy management might be improved. Although these biennial studies (HSB Solomon Associates LLC's "Worldwide Fuels Refinery Performance Analysis"), as well as the underlying methodology and the associated reports are confidential materials, Air District staff believes that as a result of this work the refineries are in a position to provide useful information regarding areas of less-than-optimum energy use and potential for improvements that would result in cost-effective GHG reductions at the refineries.

The Energy Utilization Analyses element of Section 12-15-408 would require each refinery to provide refinery data that Air District staff could use to determine the extent of less-than-optimum energy management at Bay Area refineries. If there are areas of energy management that can be significantly improved—and especially if the refineries opt to purchase GHG allowances under CARB's Cap-and-Trade rule rather than implement best practices in energy management—the Energy Utilization Analyses

would allow Air District staff to determine whether targeted rule-making could achieve GHG emission reductions at Bay Area refineries.

Section 408 does not require refineries to submit documents that are part of the HSB Solomon Associates' analysis. If a refinery chooses to use these documents to comply with Section 12-15-408, and believes the documents are entitled to protection as trade secret information, it should so indicate in its submittal consistent with Section 12-15-407. However, the Air District will evaluate compliance with Section 12-15-408 independently of whether the information submitted replicates findings in the Solomon Associates' analysis.

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. Section V.A. of this report lists the estimated costs of compliance with each element of Regulation 12, Rule 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 these proposed regulations because they do not require specific emission controls.

A. Cost of Compliance

Section	Requirement	Cost (per refinery)
12-15-401	Annual Petroleum Refinery Emissions Inventory (beginning with year 2016 data) Monthly Crude Slate Report (beginning with year 2016 data)	\$90,000 annual cost (annualized)
12-15-409	Provide Monthly Crude Slate Reports for 2012, 2013, 2014, & 2015 (one-time submittal)	
12-15-403	Fenceline and Community Air Monitoring Plans (one time submittal)	\$250,000 (one-time)
12-15-408	Provide available energy utilization data	Not significant
12-15-501	Community Air Monitoring System (construction and operation)	\$6,000,000 one-time capital cost plus \$125,000 annual cost (maintenance & operation) = \$965,000 / year (annualized)
12-15-502	Fence-line Air Monitoring System (construction and operation)	

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 draft Regulation 12-15. This analysis is based on the costs of compliance with the draft regulation 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 amendments do 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 the 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 draft Rule 12-15.

VII. ENVIRONMENTAL IMPACTS

Pursuant to the California Environmental Quality Act, the Air District has had an initial study for the proposed regulation 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 regulation. 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 will be circulated for public comment prior to the public hearing for this rule.

VIII. AIR DISTRICT COST RECOVERY

The administrative procedures in Regulation 12, Rule 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 a new fee schedule 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 regulatory proposal, 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 proposed 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: Next draft of rule developed and 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

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 rules 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; 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 new Regulation 12, Rule 15.

Appendices:

Appendix A: Draft Regulation 12, Rule 15

Appendix B: Draft Air Monitoring Guidelines for Petroleum Refineries

Appendix C: Socio-Economic Analysis

Appendix D: Regulatory Impacts List

Appendix E: CEQA Negative Declaration

Appendix F: Comments and Responses (to be provided for Public Hearing)