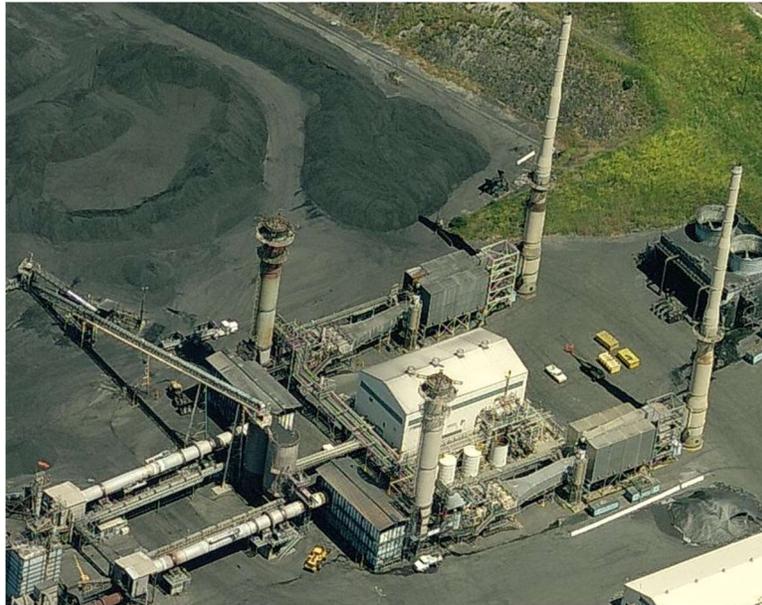




BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

STAFF REPORT

PROPOSED REGULATION 9, RULE 14: PETROLEUM COKE CALCINING OPERATIONS



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

April 2016

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Petroleum Coke Calcining Operations: Staff Report

I. EXECUTIVE SUMMARY

The Bay Area Air Quality Management District (Air District) has developed a four-part strategy for addressing air pollution from Bay Area petroleum refineries (known as the Refinery Strategy). This strategy stems from a resolution (2014-17) the Air District Board of Directors adopted in October 2014, instructing staff to develop a regulatory strategy that would further reduce emissions from petroleum refineries, with a goal of an overall reduction of 20 percent (or as much as feasible) no later than 2020. The strategy targets a spectrum of criteria pollutants, including precursors such as volatile organic compounds (VOC), particulate matter (PM), sulfur dioxide (SO₂), and oxides of nitrogen (NO_x). The first three of these rules, Regulation 6, Rule 5: *Particulate Emissions from Refinery Fluidized Catalytic Cracking Units*, amendments to Regulation 8, Rule 18: *Equipment Leaks*, and amendments to Regulation 11, Rule 10: *Cooling Tower Operations*, were adopted by the Board of Directors in December 2015 to reduce emissions. The adoption of these rules is expected to reduce overall emissions from petroleum refineries by approximately 14 percent. If approved, this rule will reduce overall refinery emissions by an additional 1 percent.¹

This staff report addresses the proposed adoption of Regulation 9, Rule 14: *Petroleum Coke Calcining Operations* (Rule 9-14) as part of the Refinery Strategy. Rule 9-14 is designed to reduce sulfur dioxide (SO₂) emissions from petroleum coke calcining operations at the Phillips 66 Carbon Plant located in the City of Rodeo. Since SO₂ is a precursor to the formation of PM, this rule also would reduce associated formation and emission of fine particulate matter (PM_{2.5}).²

Overview of Proposed Rule

Rule 9-14 is a new proposed rule that would apply to the only petroleum coke calcining operation and largest single source of SO₂ in the Air District. The anticipated emissions reductions resulting from the adoption of Rule 9-14 will make progress toward the achievement and maintenance of the state and federal ambient air quality standards. When the Carbon Plant is fully operational with both kilns running 24 hours per day, seven days per week, the total SO₂ emissions are approximately 4 tons per day.³ The Air District committed to examining potential reduction of SO₂ from petroleum coke calcining operations in Control Measure SSM-8 of the Air District's Bay Area 2010 Clean Air Plan. The plan sets a path to achieve the National and State particulate

¹ The Air District selected calendar year 2012 as the base year for the 20 percent comparison. This happened to be a low production year for the coke calciner. If this rule were in place at that time, it would have reduced emissions by 192 tons.

² PM_{2.5} is the portion of particulate matter with an aerodynamic diameter of less than 2.5 micrometers.

³ Bay Area Air Quality Management District Emissions Inventory.

matter standards as well as other air quality standards.⁴ The regulation was already under development when it was included in the Refinery Strategy as the Strategy was being developed in 2014.

When the rule is fully implemented, staff estimates that proposed Rule 9-14 would reduce the Carbon Plant's SO₂ emissions by 430 tons per year (tpy) in a typical production year. The proposed rule would be completely implemented by January 1, 2020. Once the rule takes full effect, the plant will have to reduce SO₂ emissions from a typical 1,480 TPY to 1,050 TPY. The facility will also have to comply with an hourly SO₂ emission rate of 320 pounds per hour combined from both kilns.

As required by the California Environmental Quality Act (CEQA), the Air District has prepared an initial study to analyze potential environmental impacts from the proposed rule. The initial study concludes that there would be no significant adverse environmental impacts associated with the adoption of this rule.

Staff has determined that it would be cost effective for the Carbon Plant to achieve the 1,050 tpy SO₂ emission limit; which is the equivalent to a 59% emission reduction. The cost to control SO₂ emissions to this level is approximately \$4,400 per ton.

II. BACKGROUND

This report and the proposed rule reflect the input of stakeholders as a result of the Request for Comment on the Initial Report released in May 2015, Open House Workshops conducted in refinery communities in September 2015, and publishing of the public hearing package for these regulatory items, and internal staff deliberations. Staff considered the input received in drafting the proposed rule and the final staff report.

A. Air Quality Standards and Attainment Status

The Air District is a nonattainment area for the California PM₁₀ and PM_{2.5} clean air standards and for the National PM_{2.5} standards.

Particulate Matter

Particulate matter (PM) comes from natural sources (dust, sea salt), motor vehicles (mostly diesel soot), and industrial sources (catalyst emissions from refineries, black carbon from power plants). Particulates can also form in the air from reaction of ammonia with NO_x and sulfur oxides (SO_x). Exposure to PM pollution has the greatest health impact because the smallest particles can penetrate deep into the lungs, causing damage to lung tissue. The finest of these particles can penetrate through lung tissue into the bloodstream causing a large variety of health issues, as discussed below. PM is classified by size – the term Total Suspended Particulates (TSP) describes the entire

⁴ Bay Area Air Quality Management District; "SSM 8 – Petroleum Coke Calcining Operations, Bay Area 2010 Clean Air Plan, Volume 2; September 2010.

range of particulate matter size. PM smaller than 10 microns is known as PM₁₀, and fine PM smaller than 2.5 microns is known as PM_{2.5}.

PM₁₀ Levels in the Bay Area

Table 1 provides a summary of the number of times and locations the California PM₁₀ standards have been exceeded in each of the last 5 years.

Table 1: PM₁₀ Standards, and Exceedances⁵

Standard	Year	Exceedances	Monitoring Locations
Annual = 20 µg/m ³	2011	1 day (20.2 µg/m ³)	Napa
	2013	1 day (22.2 µg/m ³)	San Jose
24 hour = 50 µg/m ³	2010	12 days	Bethel Island, San Rafael
	2011	24 days	Concord, Napa, San Pablo, San Rafael
	2012	15 days	Bethel Island, San Francisco, San Jose
	2013	21 days	San Jose, San Rafael
	2014	3 days	San Jose

PM_{2.5} Levels in the Bay Area

Of all the criteria pollutants, PM_{2.5} causes the greatest health impacts. PM_{2.5}, sometimes called fine PM, can penetrate deeply into sensitive parts of the lungs and cause or worsen respiratory disease, such as emphysema and bronchitis, even for short exposure times. Fine PM pollution can also aggravate existing heart disease, leading to increased hospital admissions and premature death. The Air District continues to exceed the federal 24-hour standard of 35 µg/m³ several times per year. On days where there are high concentrations of PM_{2.5}, people can experience health problems that affect their ability to go about daily activities normally, especially vulnerable and susceptible parts of the population.

Table 2 provides a summary of the number of times and locations the California and federal PM_{2.5} standards have been exceeded in each of the last 5 years.

⁵ <http://www.arb.ca.gov/adam/select8/sc8display.php>

Table 2: PM_{2.5} Standards, and Exceedances⁶

Standard	Year	Exceedances	Monitoring Locations
Annual = 12 µg/m ³	2013	1 day (12.8 µg/m ³)	Oakland
	2013	1 day (12.4 µg/m ³)	San Jose
Federal 24 hour standard* = 35 µg/m ³	2010	11 days	6 locations
	2011	15 days	8 locations
	2012	3 days	2 locations
	2013	21 days	9 locations
	2014	7 days	6 locations

* The federal PM_{2.5} air quality standard is 35 micrograms per cubic meter (µg/m³) measured on a 24-hour basis. Ambient measurements are used to calculate a statistic that is compared to these standards called a design value. The Air District's most recent 24-hour design value was 32 µg/m³. While the design values have been below the federal standards since 2010, 35 µg/m³ represents the daily limit beyond which significant health impacts may occur.

SO₂ Levels in the Bay Area

The Air District currently attains the primary federal SO₂ air quality standard of 75 parts per billion (ppb) measured over a 1-hour period. Since 2010, when this standard went into effect, there has not been an exceedance of any federal SO₂ standard measured in the Bay Area. Since 2010, the maximum measured 1-hour SO₂ concentration at any Air District monitor was 68 ppb at 21st Street in West Oakland in 2012. The next highest was 65 ppb at Crockett in 2013.

B. Targeted Pollutant

The Refinery Strategy is intended to reduce emissions from the five Bay Area refineries and associated facilities of several pollutants including PM and SO₂.

- PM includes directly emitted filterable PM and condensable PM, as well as precursor compounds that form PM_{2.5} as a result of chemical reactions in the atmosphere. Condensable PM is particulate matter that forms after the hot emissions from an industrial stack cool to ambient temperatures. These emissions are not quantified by traditional particulate testing methodologies because the sampling system does not operate at atmospheric temperatures and the condensable PM is a vapor at higher temperatures.
- SO₂ is a precursor to the formation of PM_{2.5} in the atmosphere.

⁶ <http://www.arb.ca.gov/adam/select8/sc8display.php>

Concerns about SO₂ emissions

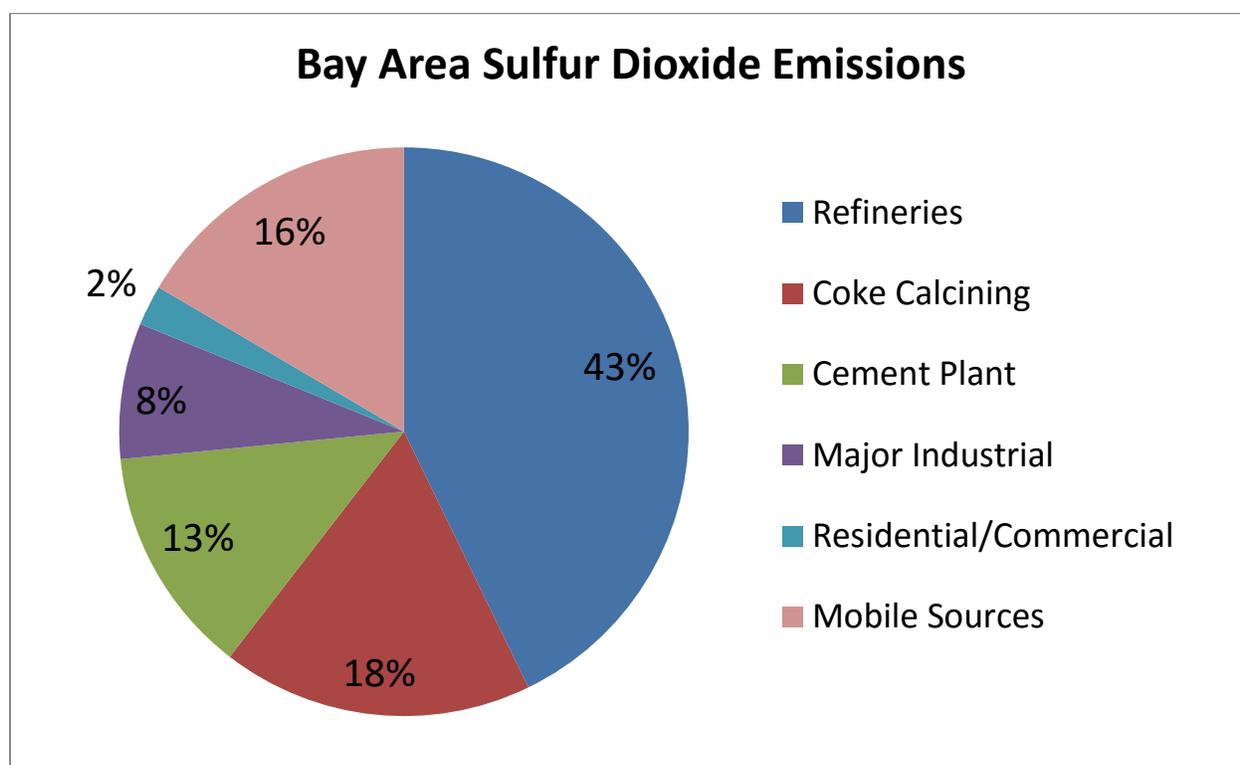
SO₂ is different than the other targeted pollutants, because the Bay Area is in attainment with the SO₂ clean air standards. However, because it contributes to fine PM_{2.5} formation, it must be addressed.

SO₂ is a pungent-smelling gas commonly formed from the burning of fossil fuel materials that contain sulfur, such as coal or oil, and from certain industrial processes, such as petroleum refining, chemical production, and metal smelting. It is also formed from the breakdown of vegetation and other organic materials under natural processes.

Once emitted into the atmosphere, SO₂ reacts with chemicals in the air, such as ozone, or in the presence of water to form sulfuric acid and eventually reacts with ammonia in the air to form ammonium sulfate, a component of PM_{2.5}.

Bay Area Sources of SO₂

According to the Air District's 2012 emission inventory, the major sources of sulfur dioxide in the Bay Area are as shown in the following graph:



The Air District has rulemaking jurisdiction over stationary sources — 82 percent of the emissions of SO₂ are from large, industrial or commercial stationary sources. By contrast, only 27 percent of directly-emitted PM_{2.5} pollution is from these sources. It is therefore important for the Air District to address SO₂ from stationary sources to attain and maintain the PM_{2.5} air quality standards.

SO₂ Conversion to PM_{2.5}

SO₂ is converted to PM_{2.5} two ways.⁷ SO₂ gas can react with ozone (and other related oxidizing agents) and water to form sulfuric acid. Sulfuric acid further reacts with ammonia to form ammonium sulfate, a component of PM_{2.5} and a visibility reducing substance. More commonly, SO₂ can be absorbed by water droplets in fogs or clouds and then can go through a variety of reaction pathways to form ammonium sulfate. The ammonium sulfate in these droplets remains in the air as a component of PM_{2.5} after the fog or cloud evaporates.

Health Impacts of SO₂

Current scientific evidence links short-term exposures to high levels of SO₂, ranging from 5 minutes to 24 hours, with various adverse respiratory effects, such as constriction of the airways and increased asthma symptoms.⁸

Studies also show a connection between short-term exposures to high levels of SO₂ and increased visits to emergency departments and hospital admissions for respiratory illnesses, particularly in at-risk populations including children, the elderly, and people with asthma.

As discussed above, much of the SO₂ emitted into the atmosphere forms fine particle pollution, or PM_{2.5}. The health impacts of PM_{2.5} have been discussed previously.

III. PROPOSED RULE

Staff proposes the major provisions in new proposed Regulation 9, Rule 14 listed in Table 3.

Table 3: Major Provisions in Proposed New Rule 9-14

Rule Section	Description
§ 9-14-200	Creation of definitions for the new rule especially with respect to standards, administrative requirements and monitoring requirements.
§ 9-14-301	Requires the Carbon Plant to meet an SO ₂ emission limit of 320 pounds per hour for both kilns combined and to meet a combined annual emission limit of 1,050 tpy for both kilns.
§ 9-14-501	Emissions monitoring and recordkeeping requirements.
§ 9-14-502.1.1	Recordkeeping requirements for amount of sorbent used annually in each kiln.
§ 9-14-502.1.2	Requires the Carbon Plant to install a load cell on each kiln to measure the rate of sorbent injection on an hourly basis. Installation to be completed by January 1, 2019.
§ 9-14-601	Manual of Procedures requirements for the use of continuous emission monitors.

⁷ Seinfeld, J. and Pandis, S. (2006) Atmospheric Chemistry and Physics: From Air Pollution to Climate Change, 2nd Ed. Wiley.

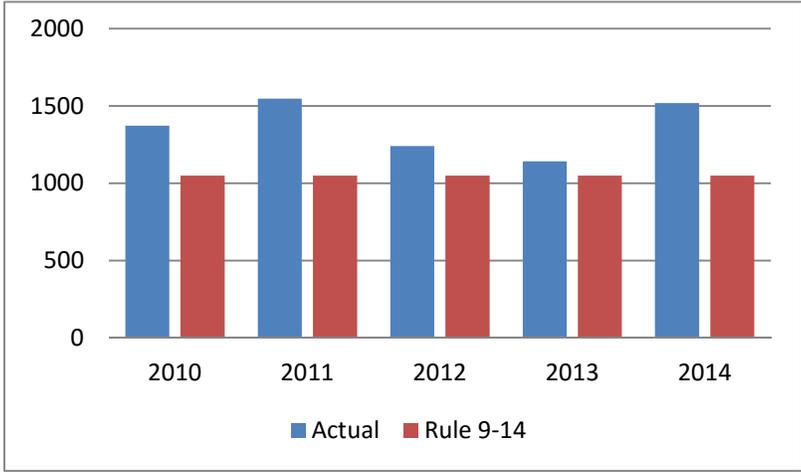
⁸ See <http://www3.epa.gov/airquality/sulfurdioxide/health.html>.

IV. EMISSIONS AND EMISSION REDUCTIONS

The Air District has established a baseline emissions inventory for estimating emissions reductions from the calcining operation by averaging three years of emissions reported between 2010 and 2014. Since the facility’s kilns were not operating at normal capacity, emissions data from 2012 and 2013 were not included in this average.⁹ Emissions inventory from this timeframe represents the most complete and up-to-date SO₂ emissions data the Carbon Plant has reported to the Air District. The three-year average for SO₂ emissions during this timeframe was 1,479.8 tpy. Regulation 9, Rule 14 will limit overall SO₂ emissions from the Carbon Plant to 1,050 tpy. The difference between the Carbon Plant’s average emission rate and the new emission limit they must comply with when the rule goes into effect equals 430 tpy. This represents the anticipated emission reduction Regulation 9, Rule 14 will achieve.

Staff has determined the cost to reduce SO₂ emissions by 430 tpy to be approximately \$1,870,179 which represents a cost effectiveness of approximately \$4,351 for every ton of SO₂ reduced. The graph below provides a year by year comparison of emission reductions for 2010 through 2014 that would have been achieved with the proposed SO₂ emission limit of 1,050 tpy in place:

	2010	2011	2012	2013	2014
Actual Emissions (TPY)	1372	1548	1242	1142	1519
Rule 9-14 Limit	1050	1050	1050	1050	1050



⁹ The 2013 reporting year emissions correspond to emissions from calendar year 2012.

The table and chart above show that the actual emission reductions will vary from year-to-year depending on production rates at the facility. On average, the emission reductions will be approximately 430 tons per year.

V. ECONOMIC IMPACTS

Pursuant to the California Health & Safety Code (H&SC), the Air District is required to perform two different types of economic analysis for rule development activities. The two required analyses are (1) a socioeconomic analysis under Health and Safety Code section 40728.5, and (2) an incremental cost analysis under H&SC section 40920.6. In developing regulations to achieve air quality objectives, air districts shall consider the cost effectiveness of their air quality programs, rules, regulations, and enforcement practices in addition to other relevant factors, and shall strive to achieve the most efficient methods of air pollution control. However, priority shall be placed upon expeditious progress toward the goal of healthful air.

Control Costs and Cost Effectiveness

Based on discussions with the Carbon Plant and vendors of control equipment, staff has estimated that it will cost between \$4 million to \$5 million to upgrade the existing SO₂ controls system to meet the requirements of this rule. Under the Air District's standard method for distributing one-time capital costs over the life of the equipment, that translates to an annual cost of \$680,000/year. Another significant cost is the purchase of dry sorbent material to react with the SO₂ in the process stream and convert it to an inert solid that is captured in the existing particulate matter control system. Based on cost quotes from a sorbent supplier, the Air District estimates these costs to be \$500 per ton of additional sorbent.

The rule as proposed has been structured to be cost effective. An analysis of cost effectiveness follows.

Cost effectiveness is the sum of costs to comply with the proposed rule on an annual basis divided by the expected emissions reduction on an annual basis. Cost effectiveness is expressed by the following equation:

$$\text{C.E.} = \text{Costs} / \text{emissions reductions}$$

Where C.E. is the cost effectiveness expressed in dollars per ton

The estimated annual cost for the Carbon Plant to improve their current Dry Sorbent Injection (DSI) system to comply with the rule's 1,050 tpy emission requirement is approximately \$1.87 million. This would reduce emissions by 430 tons in a typical year.

$$\text{C.E.} = \$1,870,000 / 430 \text{ tons} = \$4,348 / \text{ton SO}_2 \text{ reduced}$$

The rule is considered to be cost effective. As a comparison, Air District organic compound control rules typically range from several thousand to over fifteen thousand dollars per ton of emissions reductions, and rules to reduce NO_x typically range from about seven thousand to around twenty thousand dollars per ton of emissions reduced.

Socioeconomic Impacts

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 new Regulation 9, Rule 14. This analysis is based on the costs of compliance with the proposed regulation, and is attached to this report as Appendix C. It would have cost the Carbon Plant \$2.38 million/year to comply with the SO₂ emission limits in the December 2015 version of the proposed rule. The socioeconomic analysis for that version of the rule indicated that maximum possible regional loss of jobs, both direct and indirect, could total as many as 4.1 Full Time Employees (FTEs). The proposed rule was amended to address the socioeconomic impacts by lowering the required SO₂ emission limits and by removing requirements that were no longer necessary. Setting a higher emission limit, also tends to minimize the costs in years when calcined coke production is lower and therefore the facility’s revenue is lower. Nevertheless, the updated socioeconomic analysis concludes that the proposed rule may still have a significant economic impact on the Carbon Plant and may lead to regional loss of jobs totaling 3.2 FTEs. When considering this analysis as well as comments received during the rule development process, staff worked to strike a balance between economic impacts and emissions reductions. The proposed rule is intended to minimize socioeconomic impacts by allowing the Carbon Plant to meet a 1,050 tpy annual limit in lieu of achieving 80 percent control as required in other jurisdictions. This will minimize the socioeconomic impacts while still ensuring significant emission reductions every year.

Incremental Cost Analysis

Health and Safety Code Section 40920.6 requires an air district to assess the incremental cost-effectiveness for a regulation that identifies more than one control option to meet the same emission reduction objectives. Incremental cost-effectiveness is defined as the difference in costs divided by the difference in emission reductions between one level of control and the next. As discussed above, the cost-effectiveness for the requirement to use control technology to comply with 1,050 tpy mass emission SO₂ limit is estimated to be \$4,348 per ton of SO₂ emissions reduced.

Other air districts have required petroleum coke calcining plants to control SO₂ emissions by 80% in a typical year; this is equivalent to a 511 tpy emission limit. If one assumes that this limit could be met with only additional sorbent, and no additional capital cost, Air District staff estimates that it would cost an additional \$1.521 million per year to meet the 511 tpy limit in a typical production year.

The incremental cost between two options is calculated as follows:

$$\text{\$1.521 million per year} / (1050 \text{ tpy} - 511 \text{ tpy}) = \text{\$2,821/ton}$$

Additional SO₂ controls are cost effective, especially if the upgrades to the sorbent injection system are sufficient. However, the Air District must also consider the economic feasibility of the controls. The 1,050 tpy level was set to minimize the socioeconomic impacts of the rule while still ensuring significant reductions each year.

VI. ENVIRONMENTAL IMPACTS

Pursuant to the California Environmental Quality Act, the Air District has had an initial study prepared by Environmental Audit, Inc. of Placentia, California for the proposed new Regulation 9, Rule 14. The initial study concludes that there are no potential significant adverse environmental impacts associated with the proposed rule. A negative declaration is proposed for approval by the District Board of Directors. The negative declaration and initial study are available to the public for comment (see Appendix B).

VII. REGULATORY IMPACTS

Section 40727.2 of the Health and Safety Code requires an air district, in adopting, amending, or repealing an air district regulation, to identify existing federal and district air pollution control requirements for the equipment or source type affected by the proposed change in district rules. The district must then note any differences between these existing requirements and the requirements imposed by the proposed change. The Carbon Plant is subject to some specific federal requirements as well as existing Air District Rules.

Regulation	Requirement
BAAQMD 6-1-301	Opacity limit, Ringelmann 1
BAAQMD 6-1-310	Particulate limit, 0.15 grain/cubic foot
BAAQMD 6-1-311	Process weight based particulate matter limit
BAAQMD 9-1-301	Maximum ground level SO ₂ concentration not to exceed
BAAQMD 9-1-310.2	SO ₂ limit of 400 parts per million (ppm) or 113 kilograms/hour (247 lb/hr), whichever is more restrictive
40 CFR Part 70 Title V Operating Permits	Facility is a major facility and required to maintain a Title V permit since it has the potential to emit of a regulated air pollutant exceeding 100 tons/year.
40 CFR 64 Compliance Assurance Monitoring	Facility utilizes controls for SO ₂ and PM ₁₀ to meet federally enforceable emission limitations and is subject to Compliance Assurance Monitoring requirements under 40 CFR Part 64.
40 CFR 63 ZZZZ NESHAP Requirements	Facility operates two diesel engines subject to Subpart ZZZZ. Engines are required to meet operational limitations that include scheduled maintenance and recordkeeping requirements.

Adoption of Regulation 9, Rule 14, would not conflict with any existing federal or Air District requirement. It would be more restrictive than the current 247 lb/hr per kiln limit (494 lb/hr total) in Regulation 9, Rule 1 by limiting total SO₂ emissions from both kilns to a total of 320 lb/hr.

VIII. RULE DEVELOPMENT AND PUBLIC CONSULTATION PROCESS

During this development of Rule 9-14, staff endeavored to engage all interested stakeholders, including affected industry, nearby community members, environmental organizations, other governmental agencies, the media, and other interested parties. There are several aspects to this public engagement, including:

- Development of conceptual versions of draft rules with discussions of those concepts;
- An advanced Call for Comments, released May 26, 2015, which included:
 - Petroleum Refinery Emissions Reduction Strategy: Initial Report
 - Draft rule and rule amendment language
- Hosting a series of Refinery Rules Open House Workshops to solicit public input / comment on Rule 9-14 as part of the Petroleum Refinery Emissions Reduction Strategy: Workshop Report, and for Rule 9-14 and rule amendments. The Open Houses were held in the following locations:
 - Martinez on September 15, 2015,
 - Benicia on September 17, 2015, and
 - Richmond on September 28, 2015;
- Meetings and consultations (face-to-face meetings, phone conversations and emails with industry) to discuss rule concepts, economics and other potential concerns and issues;
- Preparation of a regulatory package for the consideration of the Air District Board of Directors, including:
 - Proposed regulatory language;
 - A Staff Report presenting the staff's findings, a description of the petroleum coke calcining process, regulatory history, summary and explanation of the proposal, emissions and emission reductions estimates, costs, cost effectiveness and incremental cost effectiveness, environmental and socioeconomic impacts, a schedule of implementation (when the provisions of the rule become effective if adopted), and staff recommendations to the Board of Directors;
 - An environmental analysis report;
 - A socioeconomic analysis report;
 - A discussion of and responses to comments received on the proposed rule, staff report, and environmental and socioeconomic analyses; and
- An informational Board meeting held on November 30, 2015 where presentations were made by Communities for a Better Environment and the Western States Petroleum Association and public testimony was provided by 43 individuals.
- Call for comments on the Board Package in September of 2015.
- Public Hearing, where the staff's presentation is made and stakeholders may provide testimony to the Board of Directors on the staff proposal and at which the Board would consider the adoption of the proposed rule.

The final proposed rule and staff report were posted for public review on January 29, 2016. A comment summary and staff responses are included in Appendix D of this report.

IX. 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 9, Rule 14 is:

- Necessary to ensure the attainment and maintenance of the National Ambient Air Quality Standards (NAAQS) and California Ambient Air Quality Standard (CAAQS)¹⁰;
- Authorized under Sections 40000, 40001, 40702, 40725 through 40728, and 44391 of the California Health and Safety Code;
- Written or displayed so that its 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 reflect consideration of the input and comments of many affected and interested parties. Air District staff recommends adoption of proposed new Regulation 9, Rule 14.

APPENDICES

Appendix A: Rule 9-14: Coke Calcining Operations

Appendix B: California Environmental Quality Act, Initial Study / Negative Declaration

Appendix C: Socio-Economic Analysis

¹⁰ The Bay Area is designated as a non-attainment area for the State 8-hour and 1-hour standard and the National 8-hour standard for ozone; and the State standards for fine particulate matter (PM_{2.5}) and particulate matter (PM₁₀); and National Standard for PM_{2.5}. [<http://www.baaqmd.gov/research-and-data/air-quality-standards-and-attainment-status>]

ACKNOWLEDGEMENTS

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