Bay Area Air Quality Management District

375 Beale Street
San Francisco, CA 94105

Assembly Bill 617
Industrial Cap-and-Trade Sources
Expedited BARCT Implementation Schedule

FINAL STAFF REPORT
December 2018

Prepared by:
Guy Gimlen – Principal Air Quality Engineer
David Joe, P.E. – Principal Air Quality Engineer
Steve Maltby, P.E. – Senior Air Quality Engineer

ACKNOWLEDGEMENTS

The following people contributed to development this Staff Report for an Expedited BARCT Implementation Schedule that meets the requirements of Assembly Bill 617. Each deserves recognition for their important contributions.

Brian Bunger, Esq. – Legal
Todd Gonsalves, Esq. – Legal
Jeff Gove – Compliance & Enforcement
Pam Leong – Engineering
Jerry Bovee – Meteorology & Measurements
Victor Douglas – Community Engagement & Policy
Laura Cackette – Community Engagement & Policy
David Holstius – Assessment, Inventory and Modeling
Aneesh Rana – Community Engagement & Policy

Table of Contents

I. EXECUTIVE SUMMARY

Assembly Bill 617 (AB 617), approved July 26, 2017, amends California Health and Safety Code section 40920.6 et seq. and requires each air district that is a nonattainment area for one or more air pollutants to adopt an expedited schedule for implementation of best available retrofit control technology (BARCT) on specified facilities by the earliest feasible date, but no later than December 31, 2023. Local air districts are required to adopt this schedule before January 1, 2019. This requirement applies to each industrial source subject to California Greenhouse Gas (GHG) Cap-and-Trade requirements. The schedule must give priority to any sources that have not had emissions limits modified for the greatest period of time. The schedule does not apply to sources that have implemented BARCT since 2007.

The overall purpose of BARCT implementation is to reduce criteria pollutant emissions from significant industrial sources that currently participate in the GHG Cap-and-Trade system. Emissions of criteria pollutants and toxic air contaminants are often associated with GHG emissions, and these criteria and toxic pollutants may impact local communities that are already suffering a disproportionately higher burden from air pollution.

The Bay Area Air Quality Management District (Air District) is proposing an Expedited BARCT Implementation Schedule to meet the requirements of AB 617. Staff conducted background research and analysis to identify pollutants of concern and affected sources, conduct preliminary BARCT evaluations, and identify and prioritize potential BARCT rule development projects. The schedule includes six potential rule development projects, each of which is listed in Table ES-1, along with estimates of potential emission reductions and cost effectiveness where available.

Table ES-1: Rule Development Projects with Potential Emission Reductions and Cost Effectiveness

Rule Development Projects		**Potential Emission Reductions** (tpy)[1]	**Cost Effectiveness** ($/ton)[2]
1	Rule 8-5: Organic Liquid Storage Tanks	ROG: 75 to 125 tpy	ROG: $10,000 to $20,000
2	Rule 8-8: Petroleum Wastewater Treating	ROG: Unknown	ROG: Unknown
3	Rule 9-13: Portland Cement Manufacturing	PM: Unknown SO_2: 698 tpy	PM: Unknown SO_2: $2,100
4	Rule 6-5: Refinery Fluid Catalytic Crackers and CO Boilers	PM: Unknown SO_2: 567 tpy	PM: Unknown SO_2: $4,000 to $47,000
5	Rule 8-18: Refinery Heavy Liquids Leaks	ROG: Unknown	ROG: Unknown
6	Rule 9-14: Petroleum Coke Calcining Operations	NOx: Unknown	NOx: Unknown

[1] More detailed information and further discussion on potential emission reductions for the rule development projects can be found in the individual project scopes in Attachment A.
[2] More detailed information and further discussion on costs and cost effectiveness for the rule development projects can be found in the individual project scopes in Attachment A.

Rule development activity for the projects listed in the schedule will follow the standard rule development process, and is anticipated to occur throughout the period from 2018 to 2021.

An analysis of the potential environmental impacts of the proposed Expedited BARCT Implementation Schedule was conducted pursuant to the California Environmental Quality Act (CEQA). The Environmental Impact Report concluded that the project may result in potential significant impacts in the following resources areas: Air Quality and Water Resources.

Staff recommends the Board of Directors adopt the proposed Expedited BARCT Implementation Schedule and certify the associated CEQA Environmental Impact Report at the Public Hearing scheduled for December 2018.

II. BACKGROUND

Regulatory framework

California’s air quality programs have significantly improved public health through statewide and regional air quality planning requirements, advancement of technology-based solutions, and risk reduction efforts. However, certain communities continue to experience a disproportionately higher burden from air pollution, including communities near ports, rail yards, warehouses, and freeways and areas with high concentrations of industrial facilities. AB 617 requires new community-focused and community-driven action to reduce air pollution and improve public health in communities that experience disproportionately higher burdens from exposure to air pollutants. AB 617 directs air districts to apply BARCT to all industrial sources subject to Cap-and-Trade, and to identify communities with a “high cumulative exposure burden” to air pollution. Districts must then prioritize these communities for community air monitoring projects and/or emission reduction programs, which must be developed through a community-based process. Implementing and updating BARCT controls at industrial sources should also provide some emission reductions for these community programs.

The Air District 2017 Clean Air Plan includes a long-range goal to eliminate disparities in air pollution exposure in the San Francisco Bay Area. The Air District has been explicitly working towards this goal since 2006, with the initiation of the Community Air Risk Evaluation (CARE) program. The CARE program identifies and assists communities that have higher air pollution levels and may experience more air pollution-related health impacts. Emissions from mobile sources, small and large stationary sources, and goods-movement related indirect sources can have localized impacts on pollution levels or contribute to cumulative levels of pollution that are experienced by nearby communities. The CARE program provides a framework for the Air District to target its incentive and enforcement efforts in the most impacted communities. However, many communities remain overburdened and there is more that must be learned and done. The Air District, through a partnership with local communities and the state, has an opportunity to better understand local air pollution, its sources, and impacts, and to develop strategies to better reduce people’s exposure to air pollution.

AB 617 Overview

AB 617 requires the following:

- Air districts in nonattainment areas must implement BARCT on all industrial sources subject to the AB 32 Cap-and-Trade Program (the subject of this Staff Report).
- The California Air Resources Board (CARB) must establish and maintain a clearinghouse of best available control technology (BACT), and best available retrofit control technology (BARCT).
- Maximum penalties for air pollution violations are increased and will adjust with inflation.
- CARB must prepare an air monitoring plan for all areas of the state by October 1, 2018.

- Based on air monitoring plan information, CARB must select communities with high cumulative exposure burden from both toxic and criteria air pollutants by July 1, 2019.
    - Each air district with a high cumulative burden community must deploy a community air monitoring system in that community within one year of selection and provide the air quality data to CARB for publication.

- By January 1, 2020, and each January 1 thereafter, CARB will select additional communities with high cumulative exposure burden.
    - Each air district with a high burden community must deploy a community air monitoring system in that community within one year of selection and provide the air quality data to CARB for publication.

- CARB must prepare a state-wide strategy to reduce emissions of toxic and criteria pollutants in communities affected by high cumulative exposure burden, by October 1, 2018, and update the strategy every five years. The state-wide strategy must include:
    - A methodology for assessing and identifying contributing sources and estimating their relative contribution to elevated exposure (source apportionment);
    - An assessment of whether an air district should update and implement the risk reduction audit and emissions reduction plan for any facility if the facility causes or significantly contributes to the high cumulative exposure burden;
    - An assessment of available measures for reducing emissions including BACT, BARCT, and best available control technology for toxics (TBACT); and
    - A priority on disadvantaged communities and sensitive receptor locations.
- CARB will select locations for preparation of Community Emission Reduction Plans by October 1, 2018. CARB will select additional locations annually thereafter.
    - Within one year of selection, the air district will adopt Community Emission Reduction Plans in consultation with CARB, individuals, community-based organizations, affected sources, and local governmental bodies.
    - The Community Emission Reduction Plans must be consistent with the state-wide strategy, and include emission reduction targets, specific reduction measures, a schedule for implementation of the measures, and an enforcement plan.
    - The Community Emission Reduction Plans must be submitted to CARB for review and approval.
        - CARB must initiate a public process to achieve an approvable Community Emission Reduction Plan if the Plan is initially not approvable.
        - CARB must develop and implement applicable mobile source elements in the Community Emission Reduction Plans to achieve emission reductions.
    - The Community Emission Reduction Plans must achieve emission reductions in the community, based on monitoring or other data.

- The air district must prepare an annual report summarizing the results and actions taken to further reduce emissions.

- CARB will provide grants to community-based organizations for technical assistance and to support community participation in the identification of communities with high exposure burden, and development and implementation of the Community Emission Reduction Plans.

AB 617 represents a significant enhancement to the approach that CARB and local air districts take in addressing local air quality issues. The Air District has implemented and established a number of programs that support the goals and intent of AB 617; these programs include the Community Air Risk Evaluation (CARE) Program, Health Risk Assessments for the AB 2588 Air Toxics "Hot Spots" Program, and Air District Regulation 11, Rule 18: Reduction of Risk from Air Toxic Emissions at Existing Facilities. However, the requirements of AB 617 formalize new programs and establish challenging goals and timelines for implementation.

AB 617 Expedited BARCT Implementation Schedule Requirements

AB 617 requires each air district that is in nonattainment for one or more air pollutants to adopt an expedited schedule for implementation of BARCT by the earliest feasible date, but no later than December 31, 2023. The expedited schedule must be adopted no later than January 1, 2019. The BARCT requirements apply to each industrial source subject to California GHG Cap-and-Trade requirements. The schedule must give priority to any sources that have not had emissions limits modified for the greatest period of time and does not apply to sources that have implemented BARCT since 2007. When developing and adopting an expedited schedule, air districts should take into account the local public health and clean air benefits to the community, cost effectiveness of control options, and air quality and attainment benefits of control options.

BARCT is defined in the California Health and Safety Code as an emission limitation that is based on the maximum degree of reduction achievable, taking into account environmental, energy, and economic impacts by each class or category of source.[3] The Air District typically determines BARCT during the rulemaking process for a given source category on a pollutant-by-pollutant basis, and develops and adopts rules reflecting BARCT. AB 617 does not expand or limit the Air District's ability to adopt or amend rules; but it does set a requirement for developing an expedited schedule for rule development and places a priority on adopting rules requiring BARCT implementation on sources at industrial Cap-and-Trade facilities.

Technical review

Air District staff conducted a review of all affected industrial sources and developed preliminary BARCT evaluations to determine which sources are appropriate for rule

[3] California Health and Safety Code § 40406.

development. Staff's process for identifying potential BARCT rule development projects and developing the expedited schedule involved:

- Identifying pollutants of concern and affected facilities and sources
- Identifying sources subject to the expedited schedule requirements and sources with the greatest potential BARCT emission reductions
- Conducting preliminary BARCT evaluations
- Identifying and prioritizing potential BARCT rule projects

Pollutants of Concern

The Bay Area air basin is in attainment with both the National Ambient Air Quality Standards and California Ambient Air Quality Standards for carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and lead. The air basin is designated as nonattainment for ozone (O_3) and particulate matter ($PM_{2.5}$ and PM_{10}) California Ambient Air Quality Standards;[4,5] therefore, the BARCT review was conducted focusing on the following pollutants:

- Nitrogen Oxides (NOx)
- Reactive Organic Gases (ROG)
- Particulate Matter less than 10 microns (PM_{10})
- Particulate Matter less than 2.5 microns ($PM_{2.5}$)
- Sulfur Dioxide (SO_2).

Note that NOx and ROG are included because they are precursors for ozone formation. SO_2 may contribute to the formation of condensable PM (i.e. formed in the emissions plume from the stack) at certain types of sources, so PM control strategies may include SO_2 limits. Preliminary studies and testing indicate that these condensable PM emissions may be substantial, therefore SO_2 sources that are likely to form condensable PM are included in this BARCT determination study. Sulfur dioxide can also be a precursor for secondary PM (i.e. ammonium sulfate formed in the atmosphere through reactions with ambient ammonia); however, these secondary PM impacts from SO_2 may not be a significant contributor to exceedances of PM ambient air quality standards. Therefore, SO_2 sources that do not have condensable PM potential are not included in this BARCT review and evaluation study at this time.

Affected Facilities and Sources

A list of facilities that are subject to Cap-and-Trade, including sources and emissions, was developed from the 2016 Reporting Year Emissions Inventory. The Bay Area has 80 facilities that are subject to Cap-and-Trade, which encompass 3,246 individual sources in 61 source categories. AB 617 requires that the expedited schedule for BARCT implementation apply to each industrial source subject to the Cap-and-Trade program. The

---

[4] United States Environmental Protection Agency (EPA), 2018a. Eight-Hour Ozone (2015) Nonattainment Areas by State/County/Area. Data is current as of September 30, 2018. https://www3.epa.gov/airquality/greenbook/jncty.html

[5] United States Environmental Protection Agency (EPA), 2018b. PM-2.5 (2006) Designated Area Area/State/County Report, Data is current as of September 30, 2018. https://www3.epa.gov/airquality/greenbook/rbca.html#PM-2.5.2006.San_Francisco

term “industrial source” is not explicitly defined in the AB 617 language, however the Cap-and-Trade program does include particular provisions that refer to “industrial sectors”, “industrial covered entities”, “industry assistance”, and “industrial facilities.”[6] These provisions relate the term “industrial” to certain covered entities or facilities that are eligible for free allowance allocation under the Cap-and-Trade program.[7] Under the Cap-and-Trade program, these free allowance allocations are provided to certain industrial sectors to minimize potential leakage of economic activity and emissions.[8] The usage of the term “industrial sources” in the AB 617 language has subsequently been clarified by CARB staff,[9] and is understood to be consistent with the usage of the term “industrial” in the Cap-and-Trade program. CARB provided a list of these “industrial” facilities that includes all covered entities that are eligible for free allowance allocations in accordance with the Cap-and-Trade requirements based on their engagement in an activity within a particular North American Industrial Code System (NAICS) Code listed in Table 8-1 of the Cap-and-Trade regulation.[10] The list excludes opt-in covered entities,[11] and any industrial sources that became subject to the Program after January 1, 2017. This screening for “industrial sources” reduces the number of affected facilities to 19 industrial Cap-and-Trade facilities, which encompass 1,899 individual sources in 50 source categories.

Source Screenings

Staff performed pollutant-by-pollutant screenings on this population of potentially affected sources to determine which sources and source categories required further BARCT evaluation. Staff initially identified and included sources where potential emission reductions from additional controls may be cost effective. Controls that are not cost effective would not meet the criteria to be considered BARCT. In such cases, the source would already be considered to be implementing and achieving BARCT, and therefore no further BARCT controls would be required. Staff identified and included sources that emit more than 10 pounds per day of a given pollutant (1.8 tons per year). This level of emissions is consistent with the Air District’s threshold for new sources required to install best available control technology (BACT) per Rule 2-2: New Source Review, Section 2-2-301. Given that sources below this threshold would have relatively low annual emissions, potential emissions reductions at these sources would be small and are not likely to be cost effective. This approach reduced the population of sources as shown in Table 1.

---

[6] 17 CCR §§ 95870, 95890, and 95891.
[7] 17 CCR §§ 95870(e) and 95891(a).
[8] “Leakage” refers to potential production shifts away from a jurisdiction due to increased compliance costs and prices. The reduction in production and emissions in the implementing jurisdiction may be offset by increased production and emissions elsewhere.
[9] Email correspondence between K. Magliano, CARB and A. Abbs, CAPCOA, “BARCT List.” June 18, 2018.
[10] 17 CCR § 95890(a).
[11] 17 CCR § 95802(a)(259).

Table 1: AB 617 BARCT Initial Screening Results for Affected Industrial Sources

Pollutant	Number of Source Categories	Number and Percentage of Sources[12]	Amount and Percentage of Emissions[13]
NOx	24	214 / 41%	5,722 tpy / 98%
ROG	23	259 / 16%	4,430 tpy / 93%
PM	17	126 / 16%	1,857 tpy / 92%
SO_2	16	104 / 19%	5,043 tpy / 98%

As shown in Table 1, the resulting population of sources accounts for a large majority of the total emissions at affected industrial Cap-and-Trade facilities (92 to 98 percent). These results also indicate that the low emitting sources, while numerous, account for only a small percentage of the total emissions at affected industrial Cap-and-Trade facilities. Given the relatively small total emissions from the low emitting sources, additional controls on these sources would have limited potential to achieve substantial emission reductions and effectively provide meaningful air quality and attainment benefits. As discussed previously, additional controls on low emitting sources are also not likely to be cost-effective, and therefore would not be anticipated to meet the criteria to be considered BARCT.

Staff then selected sources where BARCT has not already been applied for each nonattainment pollutant. Per AB 617, the requirements for an expedited BARCT schedule do not apply to sources where BARCT implementation has occurred since 2007. Regulations with emission limits that have been amended and/or adopted since 2007 are generally considered to reflect current BARCT levels for that pollutant, and sources subject to these limits are therefore already assumed to meet BARCT for those nonattainment pollutants. In such cases, no further BARCT determination or rulemaking is required for the expedited schedule. After selecting sources where BARCT has not already been achieved for the given pollutant, the population of sources was reduced as shown in Table 2.

[12] Percentage values shown indicate the percentage relative to the total number of sources at affected industrial Cap-and-Trade facilities

[13] Percentage values shown indicate the percentage relative to the total emissions at affected industrial Cap-and-Trade facilities

Table 2: AB 617 BARCT Final Screening Results for Affected Industrial Sources

Pollutant	Number of Source Categories	Number and Percentage of Sources[14]	Amount and Percentage of Emissions[15]
NOx	21	73 / 34%	1,764 tpy / 30%
ROG	23	259 / 16%	4,430 tpy / 93%
PM	16	124 / 15%	1,851 tpy / 92%
SO_2	15	102 / 19%	3,651 tpy / 71%

These sources and source categories require further evaluation and BARCT determination.

BARCT Determination Process

Staff reviewed available information on current achievable emission limits and potential controls for each source category and each nonattainment pollutant. This information included guidelines and recent determinations of BACT, reasonably available control technology (RACT), and lowest achievable emission rate (LAER) from EPA, CARB, and other air districts. Staff determined:

- Current levels of BACT/RACT/LAER controls and emissions (and next more stringent levels of BACT/RACT/LAER controls, if available);
- Potential emission reductions (and incremental additional potential emission reductions, if available); and
- Estimated capital and annual costs for retrofit of controls to existing facilities.

Preliminary estimates of cost effectiveness (and incremental cost effectiveness, where appropriate) were calculated, and any controls and emission limits with a cost effectiveness within reasonable bounds, consistent with recent BARCT determinations, were considered for potential rule development projects. Additional information on the estimates of emissions reductions and control costs can be found in Section IV and in the project scopes included in Attachment A.

Based on these preliminary BARCT determinations, staff proposes six potential high priority rule development projects for inclusion in the Expedited BARCT Implementation Schedule. Criteria for the selection and prioritization of these six projects include:

- Potential for localized clean air and public health benefits through reduction of localized exposure to harmful pollutants, including potential toxic emission reduction co-benefits;
- Potential for substantial emissions reductions (greater than ten tons per year), with a focused consideration of potential PM emissions reductions for reducing localized PM health impacts;
- Prioritization of source categories where BARCT rules have not been adopted or evaluated for the greatest period of time; and
- Cost effectiveness of potential rule development project controls.

[14] Percentage values shown indicate the percentage relative to the total number of sources at affected industrial Cap-and-Trade facilities

[15] Percentage values shown indicate the percentage relative to the total emissions at affected industrial Cap-and-Trade facilities

High priority potential rule development projects are shown in Table 3. Project scope descriptions for each of these projects are included in Attachment A.

Table 3: Potential Rule Development Projects

	Rule Development Projects	PM	NOx	ROG	SO_2
1	Organic Liquid Storage Tanks (Rule 8-5)			**X**	
2	Petroleum Wastewater Treating (Rule 8-8)			**X**	
3	Portland Cement Manufacturing (Rule 9-13)	**X**			**X**
4	Refinery Fluid Catalytic Crackers and CO Boilers (Rule 6-5)	**X**			**X**
5	Refinery Heavy Liquid Leaks (Rule 8-18)			**X**	
6	Petroleum Coke Calcining (Rule 9-14)		**X**		

Through this BARCT evaluation and review process, staff also identified 12 additional source categories for further study and consideration, as shown in Attachment C. Based on the preliminary review process, staff believes that there is limited potential to apply additional BARCT controls and achieve substantial reductions at these sources. Staff identified a number of factors that may limit the potential emissions reductions and efficacy of further controls at these sources:

- Potential emissions reductions are relatively small;
- Estimates of emissions and emissions reductions may be uncertain and require further study;
- Control options may not be technologically feasible or may not be suitable for retrofit; and
- Many control options identified may not meet BARCT cost effectiveness requirements.

Additionally, further controls on these sources may have limited potential to effectively impact localized exposures in communities and attainment of ambient air quality standards. Based on the limited potential for substantial controls and emissions reductions, staff does not recommend that these potential rule projects be included as priority rule development projects in the Expedited BARCT Implementation Schedule at this time. Staff believes that these projects merit further study, and actions on these source categories may be more appropriately considered during development of local Community Emission Reduction Plans. Staff anticipates that further evaluation and study during the AB 617 community-based monitoring, modeling, and planning activities, will inform future potential actions for these source categories. Further information on these 12 additional source categories can be found in Attachment C.

III. PROPOSED EXPEDITED BARCT IMPLEMENTATION SCHEDULE

Rule Development Project Schedules

Figure 1 shows the estimated schedule for each of the six potential rule development projects. This schedule is also included in Attachment B. This schedule assumes the Air District rule development group operates at full staffing, with various phases of the different rule development process occurring in parallel over four consecutive years. Note that staff anticipates that these projects would be developed along with other rule development projects outside of the Expedited BARCT Implementation Schedule, including rules currently being developed as part of the 2017 Clean Air Plan implementation.

Figure 1: Expedited BARCT Implementation Schedule

Project	2018				2019				2020				2021			
Rule 8-5: Organic Liquid Storage Tanks																
Rule 8-8: Petroleum Wastewater Treating																
Rule 9-13: Portland Cement Manufacturing																
Rule 6-5: Refinery Fluid Catalytic Crackers and CO Boilers																
Rule 8-18: Refinery Heavy Liquids Leaks																
Rule 9-14: Petroleum Coke Calcining Operations																

Rule Development Project Timelines

Most rule development projects take approximately 12 months from initiation to rule adoption at a Public Hearing. Staff assumes the first nine months of a project require a full-time staff person to perform and coordinate regulatory development activities, which may include:

- Establishing scope with internal workgroup
- Identifying all affected sources
- Verifying and refining emissions estimates
- Completing research on possible controls
- Refining estimates of emission reductions
- Confirming and refining capital and annual cost estimates
- Determining cost effectiveness (and incremental cost effectiveness, if applicable)
- Working with and gathering input from affected parties
- Drafting rule language and workshop report
- Reviewing/revising workshop documents
- Conducting workshops
- Initiating California Environmental Quality Act (CEQA) and Socioeconomic Analyses
- Receiving and incorporating comments from workshops into final documents
- Reviewing CEQA and Socioeconomic Analyses
- Finalizing Public Hearing documents

Staff assumes the remaining three months of the project require about half-time staff person to complete the public hearing, assist in implementation, and submit proper documentation to CARB.

Staff recognizes that some rule development projects may take more time during the technical assessment phase, especially if emission estimates from various sources are inconsistent, or additional source testing or emissions profile testing is required. This information gathering phase can extend a project timeline from six to 12 months. As shown in the Expedited BARCT Implementation Schedule in Figure 1, staff anticipates that additional emissions information gathering and/or testing will be required for rule development projects regarding Organic Liquid Storage Tanks, Petroleum Wastewater Treating, Cement Manufacturing, and Refinery Fluid Catalytic Crackers and CO Boilers. Further information on additional data collection and other testing considerations for each rule development project can be found in the project scope descriptions in Attachment A.

IV. EMISSION REDUCTION BENEFITS & COMPLIANCE COSTS

This section of the Staff Report summarizes the methods used to estimate emission reductions that can occur when applying BARCT to sources emitting nonattainment pollutants. More detailed information on the current emissions, potential emission limits, emission reductions, and costs and cost effectiveness for each specific priority rule development project can be found in the project scopes in Attachment A.

Current Emissions

Current emissions are based on Reporting Year 2016 Emissions Inventory reported to CARB by August 1, 2017. These emissions are based on operating year 2015 for most facilities.

Potential Emission Limits

As described in Section II, staff reviewed available information on current achievable emission limits and potential controls for each source category and each nonattainment pollutant. This information included guidelines and recent determinations of best available control technology (BACT), reasonably available control technology (RACT), and lowest achievable emission rate (LAER) from EPA, CARB, and other air districts. These determinations often provide limits in the form of emission factors (e.g., mass of pollutant emitted per unit of input or per unit of output) and describe the type of controls typically required to achieve the stated emission limit. Where there is a wide array of emission limits for a given control technique, staff typically used the average level of control achieved, leading to somewhat conservative estimates for potential emission reductions.

This BACT/RACT/LAER information is available in the EPA clearinghouse, CARB clearinghouse, or through BACT determinations available from California air districts. Note that the Air District has been coordinating and collaborating with CARB and other California air districts to support CARB's efforts to improve availability and access of this information.

Emission Reduction Estimates

Staff estimated potential emission reductions based on the current performance of the affected sources and the potential limit or level of control identified in the preliminary BARCT review. Current performance of the affected sources was based on Air District 2016 Reporting Year emissions, as well as other additional supplemental information available. The difference between the current performance and the preliminary BARCT level identified was used to calculate potential emission reductions from BARCT implementation. Priority rule development projects included in the Expedited BARCT Implementation Schedule were identified to have potential emission reductions greater than 10 tons per year (tpy) and provide a significant opportunity for emission reductions and public health benefits. Estimates of potential emission reductions for the rule development projects (where available) are shown in Table 4. More detailed information and further discussion on potential emission reductions for the rule development projects can be found in the individual project scopes available in Attachment A.

Capital and Operating Cost Estimates

Staff estimated control costs using a variety of sources. Costs of controls are most often obtained from the EPA Cost Models,[16] readily available on the EPA website. Control cost data are also available from cost studies performed and published by EPA, CARB, or other air districts, often as part of the evaluation and analysis of regulations, rules, and engineering determinations. Control equipment vendors and affected industries may also generate estimates for control costs. These estimates may need to be adjusted to account for cost uncertainties, as well as differences and changes in market conditions. Although these studies and cost estimates are often updated regularly, cost estimates may sometimes need to be reassessed to reflect today's changing conditions and actual costs. The Chemical Engineering Magazine Plant Cost Index can be used to adjust historical costs to today's cost values. Costs may also need to be adjusted to reflect higher costs in the San Francisco Bay Area, as cost models and estimates may differ when compared to lower cost regions throughout the country. Staff typically applies additional factors to capital and/or operating costs to reflect these uncertainties, market differences, and other adjustments.

Capital costs are normally amortized based on control equipment project life and prevailing interest rates, and assumptions and opinions on these parameters may vary. For this preliminary BARCT evaluation, amortized capital cost estimates are based on 11 percent amortization, 1 percent tax, 1 percent insurance, and 2 percent maintenance costs, totaling 15 percent amortization of capital. More detailed or specific amortization data and assumptions may also be used where appropriate. Operating costs are normally based on costs for energy, water, air, catalyst/reagent, and labor costs in the cost models or cost estimates. For preliminary BARCT evaluations where these operating cost data were not available, any control system that is likely to require significant energy, utilities, or catalyst usage is estimated to have total operating costs equal to 5 percent of capital cost. This approach provides a conservative initial estimate of operating costs for all the but most

---

[16] United States Environmental Protection Agency (EPA), 2018c. Cost Analysis Models/Tools for Air Pollution Regulations, https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-analysis-modelstools-air-pollution. Updated May 23, 2018.

energy intensive control methods.

Cost Effectiveness and Incremental Cost Effectiveness

California Health and Safety Code (H&SC), Section 40703 requires the Air District to consider the cost effectiveness of a control measure when adopting any regulation. Cost effectiveness is calculated by dividing the annual costs (including capital amortization and operating costs) by the total number of tons of emission reductions expected each year. The result is the cost effectiveness of implementing the control method retrofit at the existing source.

H&SC Section 40920.6 requires the Air District to identify one or more potential alternative control method that achieves the emission reduction objectives of the rule or regulation and estimate the incremental cost effectiveness between the proposal and the alternative. Incremental cost effectiveness is calculated when two (or more) control methods are being considered. First, cost effectiveness is calculated for the less stringent control method, as described above. Incremental cost effectiveness is then calculated by: 1) calculating the incremental increase in cost between the first control method and the second more stringent control method, and 2) dividing the incremental increase in cost by the incremental increase in emission reductions from the second more stringent control method. This analysis is used to help determine which controls should be recommend when multiple options are available.

Estimates of cost effectiveness for the rule development projects (where available) are shown in Table 4. More detailed information and further discussion on costs and cost effectiveness for the rule development projects can be found in the individual project scopes in Attachment A.

Table 4: Potential Emission Reductions and Cost Effectiveness

Rule Development Projects		**Potential Emission Reductions** (tpy)[17]	**Cost Effectiveness** ($/ton)[18]
1	Rule 8-5: Organic Liquid Storage Tanks	ROG: 75 to 125 tpy	ROG: $10,000 to $20,000
2	Rule 8-8: Petroleum Wastewater Treating	ROG: Unknown	ROG: Unknown
3	Rule 9-13: Portland Cement Manufacturing	PM: Unknown SO_2: 698 tpy	PM: Unknown SO_2: $2,100
4	Rule 6-5: Refinery Fluid Catalytic Crackers and CO Boilers	PM: Unknown SO_2: 567 tpy	PM: Unknown SO_2: $4,000 to $47,000
5	Rule 8-18: Refinery Heavy Liquids Leaks	ROG: Unknown	ROG: Unknown
6	Rule 9-14: Petroleum Coke Calcining Operations	NOx: Unknown	NOx: Unknown

[17] More detailed information and further discussion on potential emission reductions for the rule development projects can be found in the individual project scopes in Attachment A.
[18] More detailed information and further discussion on costs and cost effectiveness for the rule development projects can be found in the individual project scopes in Attachment A.

Note that for some of the potential rule development projects in Table 4, estimates of emission reductions and cost effectiveness may be unknown or uncertain at this time. For particular sources or pollutants, there may be uncertainties associated with emission estimates or the level of control and emission reductions achievable, and further study and evaluation would be required to develop more detailed estimates. For example, potential emission reductions of condensable PM are often difficult to quantify due to the complex nature of condensable PM formation. This formation can be highly dependent on site-specific source parameters, including flue gas properties and composition. Because control strategies typically involve the reduction of condensable components and precursors (such as ammonia and SO_2) instead of a direct limit on condensable PM, reductions of condensable PM emissions associated with these precursor controls may be difficult to estimate without further characterization and evaluation. More detailed information and further discussion on the potential emission reductions, costs, and cost effectiveness for the rule development projects can be found in the individual project scopes in Attachment A.

V. ENVIRONMENTAL IMPACTS

Review of Potential Environmental Impacts Under CEQA

The California Environmental Quality Act (CEQA), Public Resources Code Section 21000 et seq., requires that the potential environmental impacts of proposed projects be evaluated and that feasible methods to reduce or avoid identified significant adverse environmental impacts of these projects be identified. The Air District contracts with an independent consultant to conduct a CEQA analysis of potential environmental impacts from any rule making projects. Since the Expedited BARCT Implementation Schedule would consist of the implementation of several rule development projects to fulfill the requirements of AB 617, a CEQA analysis was conducted for the entire suite of potential rule development projects.

The Air District prepared a Notice of Preparation and an Initial Study (NOP/IS) for the Draft Environmental Impact Report (DEIR) for the Expedited BARCT Implementation Schedule. The NOP/IS was distributed to interested parties and published on the Air District's website on August 7, 2018 for review and comment. A CEQA scoping meeting was conducted on August 24, 2018, where minimal public comments were received. Written comments on the NOP/IS were accepted through September 7, 2018. The Air District prepared a Draft Environmental Impact Report to address the potential environmental impacts associated with the Expedited BARCT Implementation Schedule. The Draft EIR was published on October 23, 2018 for review and comment, and written comments were accepted through December 7, 2018. One comment letter on the Draft EIR was received during the comment period, and responses to the comments are included in the Final EIR. Prior to making a decision on the adoption of the proposed Expedited BARCT Implementation Schedule, the Air District's Board of Directors must review and certify the Final EIR as providing adequate information on the potential adverse environmental impacts of implementing the proposed schedule. The EIR concluded that air quality impacts during the construction of additional pollution control equipment were found to remain potentially significant after mitigation and cumulatively considerable. Hydrology and water quality impacts associated with water demand from the operation of control equipment were found to remain potentially significant after mitigation and cumulatively considerable.

VI. SCHEDULE DEVELOPMENT/PUBLIC CONSULTATION PROCESS

Schedule Development Process

The process for development of the AB 617 Expedited BARCT Implementation Schedule has been adjusted slightly from the typical rule development process. Because AB 617 requires the Air District to develop a schedule for developing BARCT rules before developing the individual rules themselves, the development of the Expedited BARCT Implementation Schedule is more comparable in scope to an air quality plan, such as the Air District's 2017 Clean Air Plan. Similar to an air quality plan, the Expedited BARCT Implementation Schedule identifies and describes potential regulatory strategies, rules, and rule amendments, which would be further developed in the future. Therefore, development of the Expedited BARCT Implementation Schedule follows most of the Air District's typical steps for developing rules and plans.

Air District staff initially reviewed requirements of AB 617, including markups of the pertinent sections of the H&SC. Staff developed the emissions inventory information for affected facilities to perform the preliminary BARCT review and evaluation. This process involved screening sources to identify source categories with significant potential for emission reductions, researching BACT/RACT/LAER controls and emissions levels, identifying a preliminary BARCT level, and determining potential emission reductions. Staff also estimated retrofit capital costs and annual cost of controls, and calculated cost effectiveness of emission reductions. Staff then identified and prioritized the potential rule development projects based on health benefits, air quality impacts, cost effectiveness, and the length of time since these sources had last been addressed through rules or permit limits. Staff developed detailed project scope papers for each potential rule development project to further discuss the preliminary evaluation process, and to identify and review current source information, available controls and costs, potential emission limits, cost effectiveness, and any further considerations and issues. Finally, staff developed a concept paper describing the BARCT determination process and potential rule development projects included in the Expedited BARCT implementation schedule.

Air District staff published the concept paper and rule development project scope papers for the draft schedule on the Air District website on May 24, 2018 and accepted written comments on the documents through June 15, 2018. Staff also met with representatives from affected facilities and industries, such as refinery and cement manufacturing plant representatives. Staff discussed this AB 617 Expedited BARCT Implementation Schedule with community members and environmental groups and presented on the status of the project at a Board of Directors Stationary Source Committee meeting on May 21, 2018.

Staff received input from these sources and prepared an Initial Staff Report and revised rule development scope papers. Staff published these documents on the Air District website on September 5, 2018 and accepted comments on these documents through October 5, 2018. An update on the Expedited BARCT Implementation Schedule was presented at the Air District's Board of Directors meeting on September 5, 2018.

Air District staff considered input received on the Initial Staff Report and related materials, and continued to conduct further analysis, coordinate with CARB and other air districts, and meet with affected facilities and industries. Staff published the proposed Expedited BARCT Implementation Schedule and Staff Report for public review and comment on October 23, 2018 and accepted written comments through December 7, 2018. Three comment letters on the proposed BARCT Schedule and Staff Report were received, and staff prepared a summary of comments received and responses for inclusion in the final proposal package. Staff will present final proposals to the Air District's Board of Directors for their consideration. At the Public Hearing, the Air District Board of Directors will consider the final proposal and receive public input before taking any action on the Expedited BARCT Implementation Schedule.

Note that each individual rule development project will also follow the standard rule development process. As described in the schedule, rule development activity is anticipated to occur throughout the period from 2018 to 2021.

Public Outreach and Consultation

In developing the proposed Expedited BARCT Implementation Schedule and Final Staff Report materials, staff solicited public comments on the concept paper, Initial Staff Report, and Staff Report, and conducted early stakeholder engagement with affected facilities, as described above. Input received during these outreach efforts, along with further investigation and analysis by staff, were used to develop the final proposals for consideration by the Air District's Board of Directors. Throughout the outreach process for the development of the schedule, Air District staff also engaged in additional early outreach with stakeholders for individual rule development projects, and will continue those efforts as those projects progress.

VII. CONCLUSION/RECOMMENDATIONS

The AB 617 requirements for the Expedited BARCT Implementation Schedule are described in H&SC 40920.6(c). This section requires that each air district in nonattainment for one or more air pollutants adopt an expedited schedule for implementation of BARCT by the earliest feasible date, but no later than December 31, 2023. The Air District is in non-attainment for ozone and PM. [19,20] The expedited schedule must be adopted no later than January 1, 2019. The section states that the schedule shall apply to each industrial source subject to California GHG Cap-and-Trade requirements and must give priority to any sources that have not had emissions limits modified for the greatest period of time. The schedule shall not apply to sources that have implemented BARCT since 2007. As described in Section II and Section III of this report, Air District staff has evaluated and identified sources subject to these requirements and conducted analyses to determine the appropriate applicability of the schedule. The proposed schedule identifies the potential

[19] United States Environmental Protection Agency (EPA), 2018a. Eight-Hour Ozone (2015) Nonattainment Areas by State/County/Area. Data is current as of September 30, 2018. https://www3.epa.gov/airquality/greenbook/jncty.html

[20] United States Environmental Protection Agency (EPA), 2018b. PM-2.5 (2006) Designated Area Area/State/County Report, Data is current as of September 30, 2018. https://www3.epa.gov/airquality/greenbook/rbca.html#PM-2.5.2006.San_Francisco

rule development projects that would evaluate and implement BARCT controls at the affected sources and includes timelines for the rule development process to address these AB 617 requirements no later than December 31, 2023.

The AB 617 requirements for adoption of the Expedited BARCT Implementation Schedule are described in H&SC 40920.6(d). This section states that prior to adopting the schedule, the Air District shall hold a public meeting and take into account the local public health and clean air benefits to the surrounding community, the cost effectiveness of control options, and air quality and attainment benefits of control options. As described in Section II and Section III of this report, the staff's process for reviewing BARCT controls and developing the proposed BARCT schedule involved evaluating potential emission reductions, identifying the potential for toxic emission reduction co-benefits, and considering the cost-effectiveness of control options. These are further described for the potential rule development projects in their respective individual project scopes included in Attachment A. As such, these considerations were taken into account during the development of the proposed Expedited BARCT Implementation Schedule and support the adoption of the proposed schedule. The Air District will present the final proposal to the Air District Board of Directors at a Public Meeting for consideration. In addition, the Air District solicited comments from the public and affected facilities and industries throughout the development process, held a CEQA Scoping Meeting on August 24, 2018, and presented updates on the development of the Expedited BARCT Implementation Schedule at the Air District Stationary Source Committee and Board of Directors meetings, as described in Section VI of this report.

Staff recommends the Air District Board of Directors adopt the proposed Expedited BARCT Implementation Schedule and certify the associated CEQA Environmental Impact Report.

VIII. REFERENCES

Email correspondence between K. Magliano, CARB and A. Abbs, CAPCOA, "BARCT List." June 18, 2018.

United States Environmental Protection Agency (EPA), 2018a. Eight-Hour Ozone (2015) Nonattainment Areas by State/County/Area. Data is current as of September 30, 2018. https://www3.epa.gov/airquality/greenbook/jncty.html

United States Environmental Protection Agency (EPA), 2018b. PM-2.5 (2006) Designated Area Area/State/County Report, Data is current as of September 30, 2018. https://www3.epa.gov/airquality/greenbook/rbca.html#PM-2.5.2006.San_Francisco

United States Environmental Protection Agency (EPA), 2018c. Cost Analysis Models/Tools for Air Pollution Regulations, https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-analysis-modelstools-air-pollution. Updated May 23, 2018.

ATTACHMENT A

Scope Papers for Potential Rule Development Projects in Expedited BARCT Implementation Schedule

1. Organic Liquid Storage Tanks
2. Petroleum Wastewater Treating
3. Portland Cement Manufacturing
4. Refinery Fluid Catalytic Crackers and CO Boilers
5. Refinery Heavy Liquid Leaks
6. Petroleum Coke Calcining

This page intentionally blank

ATTACHMENT B

Proposed AB 617 Expedited BARCT Implementation Schedule

Rule Development Project	**Pollutants Addressed**	**Anticipated Development Schedule**	**2018**	**2019**	**2020**	**2021**
Rule 8-5: Organic Liquid Storage Tanks	ROG	Q4 2018 – Q1 2020				
Rule 8-8: Petroleum Wastewater Treating	ROG	Q1 2019 – Q3 2020				
Rule 9-13: Portland Cement Manufacturing	PM, SO_2	Q2 2019 – Q2 2021				
Rule 6-5: Refinery Fluid Catalytic Crackers and CO Boilers	PM, SO_2	Q1 2019 – Q4 2020				
Rule 8-18: Refinery Heavy Liquids Leaks	ROG	Q1 2019 – Q4 2019				
Rule 9-14: Petroleum Coke Calcining Operations	NOx	Q3 2020 – Q3 2021				

ATTACHMENT C

Additional Source Categories for Further Study and Consideration with Local Community Emission Reduction Plans

Other Source Categories Being Considered	**PM**	**NOx**	**ROG**	**SO_2**
Cooling Towers	**X**			
Fuel Gas Combustion Practices • Boilers • Gas Turbines • Hydrogen Furnaces • Process Heaters	**X**		**X**	
Internal Combustion (Reciprocating) Engines			**X**	
Incinerators		**X**		
Marine Terminal Loading			**X**	
Natural Gas Furnaces		**X**	**X**	
Natural Gas Dryers		**X**	**X**	
Refinery Flares		**X**	**X**	
Solvent Cleaning			**X**	
Sulfur Plants	**X**	**X**		
Thermal Oxidizers		**X**		
Wallboard Manufacturing	**X**			

As shown in the table above, Air District staff identified 12 additional source categories for further study and consideration. Based on the preliminary review process, staff believes that there is limited potential to apply additional BARCT controls and achieve substantial reductions at these sources. Staff identified a number of factors that may limit the potential emissions reductions and efficacy of further controls at these sources:

- **Potential emissions reductions are relatively small –** For many of the source categories identified, staff's research indicates that more stringent controls or limits may have been achieved at other facilities, but potential emission reductions from current levels may be relatively small or incremental in nature due to the existing controls or limits at affected facilities. In such cases, implementation of additional controls may not achieve substantial emission reductions and may be constrained by issues regarding technological feasibility and cost effectiveness.
- **Estimates of emissions and emissions reductions may be uncertain and require further study –** Certain emissions and emission sources have historically been difficult to characterize and quantify, resulting in uncertainties regarding

current impacts and potential reductions. For example, PM emissions from cooling towers have been difficult to accurately measure and estimate due to the large physical size of the source, configuration of cooling tower emissions points that prevent proper source testing, and the nature of the organic and inorganic salt content of these PM emissions. Current emissions estimates may not adequately reflect the actual emissions and efficacy of existing controls, therefore additional research and study would be needed to evaluate potential emission reductions and control options.

- **Control options may not be technologically feasible or may not be suitable for retrofit –** Some control options may not be feasible for retrofit at certain sources. For some sources with existing control equipment, it may be possible to upgrade, modify, or add capacity to the existing control system, however there may be cases where an additional level of control would require complete rebuilding or replacing control equipment. In such cases, these additional considerations may result in certain control options being deemed infeasible or not cost effective.
- **Many control options identified may not meet cost effectiveness criteria to be considered BARCT –** Cost effectiveness is calculated by dividing the annual control costs by the annual tons of anticipated emission reductions. Because the potential emission reductions identified for these sources are small and incremental in nature, many control options that involve substantial capital and operating costs would not meet the cost effectiveness criteria to be considered BARCT.

Additionally, further controls on these sources may have limited potential to effectively impact localized exposures in communities or attainment of ambient air quality standards. Based on the limited potential for substantial controls and emissions reductions, staff does not recommend that these potential rule projects be included as priority rule development projects in the Expedited BARCT Implementation Schedule at this time. Staff believes that these projects merit further study, and actions on these source categories may be more appropriately considered during development of local Community Emission Reduction Plans. Staff anticipates that further evaluation and study, during the AB 617 community-based monitoring, modeling, and planning activities, will inform future potential regulatory actions for these source categories.

Organic Liquid Storage Tanks – Rule Development Project Scope

Summary

This rule development project would address emissions of reactive organic gases (ROG) from organic liquid storage tanks. Staff estimates that preliminary best available retrofit control technology (BARCT) levels may result in ROG emission reductions, as well as reductions of associated toxic air contaminant (TAC) emissions from organic liquid tank storage. Staff recommends considering amending Regulation 8, Rule 5: Storage of Organic Liquids to specifically address these ROG and TAC emissions from external floating roof tanks storing organic liquids. Rulemaking for emissions of oxides of nitrogen (NOx), sulfur dioxide (SO_2), and particulate matter (PM) is not anticipated at this time.

Background

The Air District has regulated emissions from tanks storing organic liquids for nearly 50 years, first under former Regulation 3, which was adopted in 1967, and later under Regulation 8, Rule 5: Storage of Organic Liquids. Rule 8-5 was originally adopted in 1978 and has been amended several times. By 1993, this rule included most of the control strategies found in the current rule, including gap standards for floating roof rim seals, pressure vacuum valve setpoint requirements for fixed roof tanks, closure requirements for tank roof fittings, and tank degassing requirements. Amendments in 2006 improved the rule, primarily in the area of non-routine operations, such as tank degassing and cleaning.

Storage vessels containing organic liquids can be found in many industries, including petroleum producing and refining, petrochemical and chemical manufacturing, bulk storage and transfer operations, and other industries consuming or producing organic liquids. Organic liquids in the petroleum industry, usually called petroleum liquids, generally are mixtures of hydrocarbons having dissimilar true vapor pressures (for example, gasoline and crude oil). Organic liquids in the chemical industry, usually called volatile organic liquids, are composed of pure chemicals or mixtures of chemicals with similar true vapor pressures (for example, benzene or a mixture of isopropyl and butyl alcohols).

Six basic tank designs are used for organic liquid storage vessels: fixed roof (vertical and horizontal), external floating roof, domed external (or covered) floating roof, internal floating roof, variable vapor space, and pressure tanks (low and high).

ROG

Regulatory Context and Preliminary BARCT Level

Emissions from organic liquids in storage occur because of evaporative loss of the liquid during its storage and as a result of changes in the liquid level. The emission sources vary with tank design, as does the relative contribution of each type of emission source. Emissions from fixed roof tanks are a result of evaporative losses during storage (known as breathing losses or standing storage losses) and evaporative losses during filling and emptying operations (known as working losses). External and internal floating roof tanks are emission sources because of evaporative losses that occur during standing storage and withdrawal of liquid from the tank. Standing storage losses are a result of evaporative losses through rim seals, deck fittings, and/or deck seams.

Existing Applicable Regulations

Tanks used for bulk storage of organic liquids or liquid mixtures containing organic compounds are regulated under Air District Rule 8-5. Such tanks are typically found at petroleum refineries and chemical plants, as well as gasoline bulk plants and terminals. Underground gasoline storage tanks located at gasoline stations are regulated under Air District Regulation 8, Rule 7: Gasoline Dispensing Facilities, and are not addressed in Rule 8-5.

Federal tank regulations include new source performance standards (NSPS) in 40 CFR 60 Subpart Kb, and Maximum Achievable Control Technology (MACT) standards in 40 CFR 63 Subpart CC. Each of these federal requirements require certain storage vessel provisions in terms of control, monitoring, and recordkeeping.

South Coast Air Quality Management District (SCAQMD) maintains their tank regulations in Regulation 1178. The rule applies to all aboveground storage tanks with capacities greater than or equal to 75,000 liters (19,815 gallons) that are used to store organic liquids with a true vapor pressure greater than five millimeters of mercury (mm Hg) (0.1 psi) absolute under actual storage conditions, and are located at any petroleum facility that emits more than 40,000 pounds (20 tons) per year of volatile organic compounds (VOC) in any emission inventory year, starting with the emission inventory year 2000. The rule also includes requirements for domed roofs. Several exemptions are also listed in the rule, the most notable of which include: 1) exemption from doming requirements for crude oil tanks, 2) exemption of facilities with an emission cap equal to or less than 20 tons per year, and 3) exemption from doming requirements for tanks with true vapor pressure limits less than 3 psia.

Review of BACT and Potential Controls

Best Available Control Technology (BACT) for external floating roof storage tanks containing organic liquids is found in the Air District BACT Guideline 167.1.2 dated September 2011. This BACT guideline includes information on two categories of BACT: 1) “technologically feasible and cost effective” and 2) “achieved in practice”. The first category of BACT is a more stringent level of control, and generally refers to advanced control devices or techniques. The guideline indicates that a vapor recovery system (VRU) with an overall system efficiency of at least 98 percent would constitute BACT that is “technologically feasible and cost effective”. Typical technology implemented for this BACT level includes a thermal incinerator, carbon adsorber, refrigerated condenser, or an Air District-approved equivalent.

The guideline indicates that the BACT level “achieved in practice” is an Air District-approved roof with liquid mounted primary seal and zero gap secondary seal, all meeting the design criteria of Rule 8-5. The tank system must have no ungasketed roof penetrations, no slotted pipe guide pole (unless equipped with a float and wiper seals), and no adjustable roof legs (unless fitted with vapor seal boots or equivalent). Additionally, a dome is required for tanks that meet the following criteria: 1) capacity greater than or equal to 19,815 gallons, 2) located at a facility with greater than 20 tons per year of VOC emissions since the year 2000, and 3) storing material with a vapor pressure equal to or greater than 3 pounds per square inch absolute (psia) (except for crude oil tanks that are permitted to contain more than 97 percent crude oil by volume).

Potential Emission Reductions and Impacts

Emissions generated from organic liquid storage tanks for AB 617 identified sources in the Air District are nearly 840 tons per year from approximately 100 tanks. Table 1 below shows AB 617 identified floating roof (non-crude), coned roof (non-crude), and crude tank storage.

Table 1. AB 617 Organic Liquid Storage Tank Emission Summary

Tank Type	**Number of Identified Tanks**	**Annual[1] Emissions** (TPY)
Floating Roof[1]	30	400
Coned Roof	47	300
Other	9	40
Crude	14	100
Total	100	840

[1] Floating roof tanks include both external floating roof and internal floating roof. Further distinction between these two types has not yet been identified.
[2] 2016 emissions referenced in Air District data files. Emission factors vary from AP-42, 7.1 to Tanks 4.09D emission calculations.

Crude units identified above include both coned and floating roof tank types. Tanks associated with refineries comprise over 95 percent of the AB 617 organic liquid storage tanks identified above. Additional tanks were identified in the AB 617 analysis but excluded from further BARCT analysis, as ROG emissions for each of these tanks were less than 10 pounds per day (1.8 TPY).

Potential ROG emission reductions may be achieved by installing domes on external floating roof tanks, and by capturing vented emissions from internal floating roof or coned roof tanks and removing ROG emissions through a vapor recovery unit (VRU) flowing back to the tank(s) or to a thermal incinerator. Domed roofs on external floating roofs without capture will reduce ROG by limiting wind effects. Tables 2, 3, and 4 below describe the potential emission reductions and cost effectiveness from these different control options at floating roof tanks. Note that each of the estimates for total capital cost and total annual costs below are based on approximately 10 tanks with Rule 8-5 applicability as external floating roof tanks (EFRTs).

Table 2. AB 617 Organic Liquid Storage Tanks BARCT Summary – Dome

Current Emissions, Floating Roof Tanks (tpy)	400
Potential Emission Reductions (tpy)	75
Preliminary BARCT Level	EFRT Dome with 75% Evaporation/Wind Effect Reduction
Controls Required	EFRT Dome
Total Capital Cost	$6,250,000
Total Annual Cost	$750,000
Cost-Effectiveness ($/ton)	$10,000

Table 3. AB 617 Organic Liquid Storage Tank BARCT Summary – Dome + VRU

Current Emissions, Floating Roof Tanks (tpy)	400
Potential Emission Reductions (tpy)	100
Preliminary BARCT Level	EFRT Dome + 98% Efficiency Vapor Recovery Unit
Controls Required	EFRT Dome + 98% Efficiency Vapor Recovery Unit
Total Capital Cost	$8,500,000
Total Annual Cost	$1,500,000
Cost-Effectiveness ($/ton)	$15,000

Table 4. AB 617 Organic Liquid Storage Tank BARCT Summary – Dome + VRU + Incinerator

Current Emissions, Floating Roof Tanks (tpy)	400
Potential Emission Reductions (tpy)	125
Preliminary BARCT Level	EFRT Dome + 98% Efficiency Vapor Recovery Unit + Incinerator
Controls Required	EFRT Dome + 98% Efficiency Vapor Recovery Unit + Incinerator
Total Capital Cost	$12,000,000
Total Annual Cost	$2,500,000
Cost-Effectiveness ($/ton)	$20,000

Dome installation on an external floating roof tank cost estimates assume a dome cost of approximately $40 per square foot, with a construction cost of $50,000. Using an average tank size of 135-foot diameter (based on Valero refinery gasoline tanks), dome capital costs (including installation) would be approximately $625,000 per tank. Total annualized cost would be approximately $75,000 per tank. Additional considerations would need to be made for tank age, earthquake structural supports, and fire suppression on certain tanks.

Vapor recovery units (VRU) capital costs are estimated to be approximately $225,000 per single tank. There would likely be cost savings for VRU systems that are applied to multiple tanks with an associated increase in compressor size. Incinerators are estimated to require an additional

$350,000 in capital costs per tank, with potential cost savings for systems combining several tanks into one VRU header prior to incineration. Additional fuel costs for incineration may also need to be considered and evaluated further.

In lieu of converting fixed roof tanks to internal floating roof tanks, operators may instead choose to vent the vapor losses from these fixed roof tanks to a vapor control system or a vapor recovery system for ROG control. Facilities with an existing vapor control or vapor recovery system on site may be able to accommodate the additional vapor recovery load without installation of additional systems or capacity. In this scenario, the costs of implementing this control option would be anticipated to be minor. However, the cost and cost effectiveness could vary significantly with each individual scenario depending on the location of the tanks, the size of the existing compressors, and the types of vapor control or vapor recovery system the facility would choose to use.

Further Considerations

Staff recommends working with stakeholders to collect additional tank design data and emission information associated with the organic liquid storage tanks at AB 617 identified facilities. Staff recommends forming an OLST (Organic Liquid Storage Tank) Working Group that may include representatives of affected facilities, environmental organizations, and manufacturers of domed roofs to discuss relevant control technologies for storage tanks. In parallel, staff may also perform site visits of the affected facilities to assess actual operating conditions. Additional refinements to estimates of current emissions and potential reductions would be needed to appropriately evaluate BARCT control options. This further study and refinement may involve additional estimation of ROG emissions through site visits, testing, monitoring, or assessment of emission estimation protocols and programs, such as the United States Environmental Protection Agency (EPA) TANKS version 4.09D program. Staff would also seek input through OLST Working Group meetings, public workshops, and numerous individual site visits and meetings with stakeholders.

SO_2

Organic liquid storage tanks do not typically generate substantial SO_2 emissions that would require additional controls. Therefore, further BARCT evaluation and rulemaking are not anticipated at this time. There could be a slight increase in SO_2 emissions due to possible ROG vapor recovery system combustion; however, no additional rulemaking for SO_2 will be considered at this time.

NOx

Organic liquid storage tanks do not typically generate substantial NOx emissions that would require additional controls. Therefore, further BARCT evaluation and rulemaking are not anticipated at this time. There could be a slight increase in NOx emissions due to possible ROG vapor recovery system combustion; however, no additional rulemaking for NOx will be considered at this time.

Particulate Matter

Organic liquid storage tanks do not typically generate substantial PM emissions that would require additional controls. Therefore, further BARCT evaluation and rulemaking are not anticipated at this time. There could be a slight increase in PM emissions due to possible ROG vapor recovery system combustion; however, no additional rulemaking for PM will be considered at this time.

Petroleum Wastewater Treating – Rule Development Project Scope

Summary

This rule development project would address emissions of reactive organic gases (ROG) from petroleum wastewater treating operations. Staff estimates that preliminary best available retrofit control technology (BARCT) levels could result in potential ROG emission reductions. The Air District has addressed ROG emissions from petroleum wastewater treatment facilities in previous rule developments (Rule 8-8 Wastewater Collection and Separation Systems), but staff recommends reviewing each of the five Bay Area refineries for additional opportunities for reduction of wastewater ROG. This review may include on-site air emissions testing, which will require refinery cooperation. Any recommended and implemented ROG controls in addition to current regulatory requirements are also anticipated to reduce toxic air contaminant (TAC) emissions. Rulemaking for emissions of oxides of nitrogen (NOx), sulfur dioxide (SO_2), and particulate matter (PM) is not anticipated at this time.

Background

All refineries employ some form of wastewater treatment so that water effluents can be safely returned to the environment or reused in the refinery. The designs of specific wastewater treatment plants are complex, and are complicated by the diversity of refinery pollutants, including oils, phenols, sulfides, dissolved solids, and toxic chemicals. Although the treatment processes employed by refineries vary greatly, they generally include drain systems, neutralizers, oil/water separators, settling chambers, clarifiers, dissolved air flotation systems, coagulators, aerated lagoons, and activated sludge ponds.

Drain systems consist of individual process drains, where oily water from various sources is collected, and junction boxes, which receive the oily water from multiple drains. Oil-water separators (OWS) generally represent the first step in the treatment of refinery wastewater. The separation and removal of the oil from the water are accomplished through density differences that cause oil to rise to the top and enable it to be skimmed off. Air flotation usually follows the oil-water separator and is used to remove remaining oil and solids by introducing air bubbles into the wastewater by mechanical means. The factors influencing emissions from these systems are wastewater composition, equipment design, and climatic factors.

ROG

Regulatory Context and Preliminary BARCT Level

The purpose of an amended rule would be to reduce ROG emissions from petroleum wastewater treatment operations located in the Air District. The main components of atmospheric emissions from wastewater treatment plants are fugitive ROGs and dissolved gases that evaporate from the surfaces of wastewater residing in open process drains, separators, and ponds. Treatment processes that involve extensive contact of wastewater and air, such as aeration ponds and dissolved air flotation, have an even greater potential for atmospheric emissions.

The control of wastewater treatment plant emissions involves covering systems where emission generation is greatest (such as oil-water separators and settling basins) and removing dissolved gases from water streams with sour water strippers before contact with the atmosphere. These control techniques potentially can achieve greater than 90 percent reduction of waste water system emissions.

Emission Estimates

Current ROG emission estimates associated with refinery wastewater operations may vary widely and may not be consistently characterized between different systems and components. Some facilities report total wastewater ROG emissions for the overall treatment system, while others may delineate between OWS emissions and fugitive emissions. Additionally, other facilities may report no discernable ROG emission contributions from wastewater treatment components and systems. Considering these caveats and limitations, a reasonable estimate of annual ROG emissions attributable to refinery wastewater treatment systems is 300 to 600 tons per year. Additional review and study of current emissions inventories, refinery emission reporting methodology, emission factors, and calculations would be needed to appropriately inform future rule development.

Review of BACT and Potential Controls

Recent best available control technology (BACT) determinations from the United States Environmental Protection Agency (EPA) RBLC[1] database indicate that controls for refinery wastewater systems include requirements for process wastewater effluent treatment to utilize a covered system. All lift stations, manholes, junction boxes, conveyances, and any other wastewater facilities should be covered, and all emissions routed to a vapor combustor with a guaranteed destruction/removal efficiency (DRE) of 99 percent for control. Additionally, BACT includes a general requirement of good control practices.

The Air District lists a BACT determination of an OWS system with capacity greater than 250 gallons per minute. The determination includes a recommendation of a vapor tight fixed cover vented to a vapor recovery system with combined collection and destruction/removal efficiency greater than 95 percent.

Existing Applicable Regulations

Current Air District Rule 8-8: Wastewater Collection and Separation Systems requires oil-water separators to be covered. Additionally, Air District Rule 8-18: Equipment Leaks also requires refining operations to test for potential equipment leaks related to wastewater operations.

Applicable federal requirements include 40 CFR Part 60, Subpart QQQ; and 40 CFR Part 61, Subpart FF. Subpart QQQ focuses on the control of air emissions from process drains, junction

[1] RACT/BACT/LAER/Clearinghouse

boxes, and oil-water separators. Subpart FF pertains to benzene waste operations NESHAPSs[2] (BWON). 40 CFR 63 Subpart CC (MACT[3] 1) targets miscellaneous wastewater process vents.

Further Considerations

Refineries generate a large amount of wastewater that has both process and non-process origins. Depending on the type of crude oil, composition of condensate, and treatment processes, the characteristics of refinery wastewater can vary widely according to refinery-specific factors. Therefore, there is no singular approach to handling and treating refinery wastewater.

Accordingly, strategies to further reduce ROG emissions will require development and refinement of emissions testing protocols, as well as individual refinery cooperation with the Air District measurements and testing staff. Further evaluation of the potential control options identified, as well as their efficacy, feasibility, and cost-effectiveness, would depend heavily on these additional study and research efforts. In addition to the wastewater treatment system components discussed, aeration ponds can also be a large area source of ROG emissions in the petroleum wastewater treatment process. Control strategies for this type of source are unknown at this time, but would also need to be studied further.

Additional coordination between individual facilities and the Air District Measurements and Meteorology Division and Engineering Division staffs will be required to determine individual refinery specific measurement data, coordinate emission factor development across refineries, and review emission estimation techniques and methodologies. Previous Air District efforts, including studies of refinery wastewater conducted in 2006, would be reviewed and referenced in developing these further analyses and efforts. Staff recommends additional evaluation and research prior to development of a draft BARCT limit or rule.

SO_2

Petroleum refinery wastewater treatment processes do not typically generate substantial SO_2 emissions that would require additional controls. Therefore, further BARCT evaluation and rulemaking are not anticipated at this time.

NOx

Petroleum refinery wastewater treatment processes do not typically generate substantial NOx emissions that would require additional controls. Therefore, further BARCT evaluation and rulemaking are not anticipated at this time.

Particulate Matter

Petroleum refinery wastewater treatment processes do not typically generate substantial PM emissions that would require additional controls. Therefore, further BARCT evaluation and rulemaking are not anticipated at this time.

[2] National Emissions Standards for Hazardous Air Pollutants
[3] Maximum Achievable Control Technology

Portland Cement Manufacturing – Rule Development Project Scope

Summary

This rule development project would address emissions from Portland cement manufacturing operations. Staff estimates that preliminary best available retrofit control technology (BARCT) levels may result in potential emission reductions of particulate matter (PM) and sulfur dioxide (SO_2). Rulemaking for emissions of oxides of nitrogen (NOx) and reactive organic gases (ROG) is not anticipated at this time.

Background

Portland cement is used as a component of concrete, which can be used in a variety of construction projects. The Portland cement manufacturing process involves the mining of limestone, crushing and blending of the limestone with other raw materials (such as clay, sand, and alumina), calcining of the mixture in a cement kiln to produce clinker, and the subsequent cooling, grinding, and mixing of the clinker with gypsum and additional limestone to produce cement. Cement kiln operations can generate substantial PM, NOx, and SO_2 emissions from the combustion of fuel and the heating and calcining of feed materials. PM emissions also arise from other aspects of material handling, including crushing, mixing, storage, and clinker cooling. One Portland cement manufacturing facility operates within the San Francisco Bay Area.

Particulate Matter

Regulatory Context and Preliminary BARCT Level

Federal rules that address emissions from Portland cement manufacturing include New Source Performance Standards (NSPS) Subpart F and National Emissions Standards for Hazardous Air Pollutants (NESHAP) Subpart LLL. The NSPS and NESHAP subparts include multiple PM emission limits for new and existing cement kilns. The Air District adopted Regulation 9, Rule 13 (Rule 9-13): Nitrogen Oxides, Particulate Matter, and Toxic Air Contaminants from Portland Cement Manufacturing in 2012 (with subsequent amendments in 2016), which contains the following PM emission limits: 0.04 pounds of filterable PM per ton clinker (lb/ton clinker) from cement kilns and 0.04 lb/ton clinker from clinker coolers. Staff's review of existing best available control technology (BACT) guidelines and recent determinations indicates that PM emission levels of 0.01 grains of filterable PM per dry standard cubic foot (gr/dscf) and 0.02 lb/ton clinker have been achieved at cement kilns.

The existing regulatory limits, guidelines, and determinations described above are based on methods for monitoring and measuring filterable particulate matter only. Recent advancements in the understanding and quantification of condensable particulate matter formation indicate that cement kilns may emit substantial amounts of condensable PM in addition to filterable PM. Therefore, staff believes that the PM limits in BAAQMD Rule 9-13 adopted in 2012 may not reflect current BARCT levels for addressing total (filterable and condensable) PM. Staff believes that substantial reductions of condensable PM emissions are achievable, however research of potential control options for cement kilns is ongoing, and a preliminary BARCT level is still under development. Controls may involve reduction of SO_2, ammonia (NH_3), or other condensable components and precursors. Note that further discussions on SO_2 controls and BARCT levels are included in the SO_2 section of this scope. Staff believes that SO_2 emission reductions would also be an integral part of reducing these condensable PM emissions, and anticipates that these SO_2 and PM control efforts would be considered and developed in concert.

Potential Emission Reductions and Impacts

Because a preliminary BARCT emission level for condensable PM has not yet been identified, estimates of potential emission reductions and control costs are not currently available. Staff estimates that cement manufacturing emits approximately 600 tons per year of total PM (including filterable and condensable PM), and the potential for substantial emission reductions should be further evaluated.

Further Considerations

Additional testing and study of the cement kiln are likely necessary to properly characterize condensable PM emissions. Potential control options, as well as their efficacy, feasibility, and cost-effectiveness, would depend heavily on this evaluation. Efforts towards development and/or implementation of cement kiln SO_2 BARCT controls should also be considered in any future study and evaluation of cement kiln condensable PM emissions.

SO_2

Regulatory Context and Preliminary BARCT Level

Federal NSPS Subpart F includes an emissions limit of 0.4 lb SO_2 per ton clinker on a 30-day rolling average basis; however, this limit only applies to cement kilns constructed, reconstructed, or modified after June 16, 2008. Air District Rule 9-13 addresses Portland cement manufacturing emissions, but does not include limits on SO_2 emissions.

Staff's review of existing BACT guidelines and recent determinations indicate that performance levels of 0.16 to 1.0 lb SO_2 per ton clinker have been achieved at cement kilns. Typical controls include judicious selection and use of raw materials, use of low sulfur fuels, dry scrubbing, and dry sorbent injection. Based on this review, staff has identified a preliminary BARCT level of 1.0 lb SO_2 per ton clinker. This preliminary BARCT level is used for staff's evaluation of potential BARCT controls, compliance costs, and emissions reductions, but may change as controls are further evaluated.

Potential Emission Reductions and Impacts

Based on staff's identified preliminary BARCT level and understanding of current performance of the potentially affected sources, staff estimates a potential emission reduction of 698 tons per year of SO_2. The facility currently operates lime injection and sodium carbonate systems for control of HCl emissions, but staff anticipates that additional lime injection capacity or an additional dry sorbent injection system would be required to meet the preliminary BARCT level for SO_2. The capital cost of the current lime injection system was $700,000, with operating costs of $1.26 million per year.[1] Based on EPA cost estimating methods and assumptions for lime injection systems at cement kilns,[2] the capital cost of an appropriately sized system for the facility is estimated to be less than $500,000, with annual operating costs of approximately $1 million dollars. Based on the costs of the facility's current lime injection system and EPA cost estimates of dry lime injection systems for SO_2 control, staff conservatively estimates capital costs of the additional control system to be approximately $1.4 million dollars. Total annualized cost of the additional control (including amortized capital and operating costs) is estimated to be $1.47 million dollars per year, resulting in a cost-effectiveness of approximately $2,100 per ton of SO_2.

Table 1. Portland Cement Manufacturing SO_2 BARCT Summary

Current Emissions (tpy)	1,298
Potential Emission Reductions (tpy)	698
Preliminary BARCT Level	1.0 lb SO_2 per ton clinker
Controls Required	Hydrated lime injection
Total Capital Cost	$1,400,000
Total Annual Cost	$1,470,000
Cost-Effectiveness ($/ton)	$2,100

Further Considerations

Sulfur dioxide emissions from the cement kiln are highly dependent on the sulfur content of the fuel and raw material being processed. Therefore, the efficacy of a lime injection system for SO_2 control and achievable limit may or may not be comparable from one cement manufacturing plant to another. Further site-specific analysis of the affected facility would be needed to appropriately evaluate the impact of existing controls on SO_2 emissions and better characterize the efficacy of additional controls. This may involve testing and optimization of additional lime injection, use of different sorbents, and modification of control equipment parameters, as well as further source testing (including speciation of condensable PM). Further refinements to the evaluation of control costs and cost-effectiveness are also needed. Draft and final proposed BARCT limits may change throughout the rule development process as additional testing, research, and evaluation is conducted.

NOx

Regulatory Context and Preliminary BARCT Level

Federal NSPS Subpart F includes an emission limit of 1.5 lb NOx per ton clinker on a 30-day rolling average basis; however, this limit only applies to cement kilns constructed, reconstructed, or modified after June 16, 2008. Air District Rule 9-13 addresses Portland cement

[1] BAAQMD, 2012. Staff Report – Regulation 9, Rule 13: Nitrogen Oxides, Particulate Matter, and Toxic Air Contaminants from Portland Cement Manufacturing. July.

[2] EPA, 2010. Summary of Environmental and Cost Impacts of Final Amendments to Portland Cement NESHAP. August.

manufacturing emissions, and contains an emission limit of 2.3 lb NOx per ton clinker on a 30-operating day rolling average.

Staff believes that the NOx limits in Rule 9-13 adopted in 2012 reflect BARCT for NOx, and further BARCT evaluation and rulemaking is not anticipated at this time.

ROG

Regulatory Context and Preliminary BARCT Level

The federal rules that address emissions from Portland cement manufacturing (NSPS Subpart F and NESHAP Subpart LLL), do not contain limits on ROG, although NESHAP Subpart LLL does include limits to control total hydrocarbon emissions. Air District Rule 9-13 does not contain a ROG emissions limit for Portland cement manufacturing, but contains an emission limit of 24 ppmv (dry at 7 percent O_2) for total hydrocarbon.

The cement kiln does not generate substantial ROG emissions (approximately 1.3 tons per year), and staff believes that BARCT controls to further reduce these emissions are not likely to be cost-effective. Therefore, further BARCT evaluation and rulemaking are not anticipated at this time.

Fluidized Catalytic Crackers and CO Boilers – Rule Development Project Scope

Summary

This rule development project would address emissions from fluidized catalytic cracking units (FCCU) and carbon monoxide (CO) boilers at petroleum refineries. Staff estimates that preliminary best available retrofit control technology (BARCT) levels may result in potential emission reductions of particulate matter (PM) and sulfur dioxide (SO_2). Rulemaking for emissions of oxides of nitrogen (NOx) and reactive organic gases (ROG) is not anticipated at this time.

Background

FCCUs are complex processing units at refineries that convert heavy components of crude oil into light, high-octane products that are required in the production of gasoline. FCCUs use a powdered catalyst to promote the hydrocarbon cracking process, and this catalyst becomes coated with carbonaceous material (coke) during its exposure to the hydrocarbon feedstock. Each FCCU includes a reaction vessel where the catalyst and feedstock are mixed, as well as a catalyst regenerator where coke is burned off the surface of the catalyst to restore its activity so that it can be re-used. Catalyst regenerators may be designed to burn the coke completely to carbon dioxide (CO_2) (full burn) or to only partially burn the coke to a mixture of CO and CO_2 (partial burn). Because the flue gas from these partial burn regenerators have high levels of CO, the flue gas is vented to a CO boiler where the CO is further combusted to CO_2. FCCUs and associated CO boilers can generate substantial PM, NOx, and SO_2 emissions.

Four of the five refineries in the San Francisco Bay Area operate FCCUs: Chevron Richmond, Shell Martinez, Andeavor Martinez, and Valero Benicia. Shell Martinez operates a partial burn regenerator and three CO boilers. Valero Benicia also operates a partial burn regenerator and two CO boilers, which are abated by a wet gas scrubber. Andeavor Martinez operates one CO boiler that processes flue gas from its FCCU regenerator. Andeavor's regenerator operates in full burn mode, but does operate in partial burn mode for limited periods under unusual circumstances. Chevron Richmond operates a full burn FCCU and does not have CO boilers.

Particulate Matter

Regulatory Context and Preliminary BARCT Level

Federal rules that address emissions from FCCUs and CO boilers include New Source Performance Standards (NSPS) Subparts J and Ja, and National Emissions Standards for Hazardous Air Pollutants (NESHAP) Subpart UUU. NSPS Subpart J contains a PM emission limit of 1.0 kilograms of filterable PM per megagram (kg/Mg) (2.0 lb/ton) of coke burnoff in the catalyst regenerator and an opacity limit of 30 percent. NSPS Subpart Ja has a PM emission limit of 1.0 g/kg of coke burnoff for FCCUs reconstructed or modified after May 14, 2007, and a limit of 0.5 g/kg of coke burnoff for FCCUs newly constructed after May 14, 2007. NESHAP Subpart UUU includes various PM emission limit options for compliance. Air District Regulation 6, Rule 1: Particulate Matter – General Requirements contains an opacity limit of 20% for all sources, including FCCUs and CO boilers.

These existing federal and Air District limits are based on methods for monitoring and measuring filterable particulate matter only. Recent advancements in the understanding and quantification of condensable particulate matter formation indicate that FCCUs and CO boilers may emit substantial amounts of condensable PM in addition to filterable PM. The Air District adopted Regulation 6, Rule 5: Particulate Emissions from Refinery Fluidized Catalytic Cracking Units (Rule 6-5) in 2015 to reduce condensable PM emissions through reduction of ammonia injection. Ammonia is injected in FCCU flue gas to suppress NOx formation and improve the efficacy of electrostatic precipitators (ESP) for filterable PM abatement, but unreacted ammonia may be present in the exhaust stream (ammonia slip) and contribute to condensable PM formation. Rule 6-5 requires FCCUs to meet ammonia slip limits or conduct optimization of ammonia injection.

Implementation of BAAQMD Rule 6-5 is ongoing, with optimization testing having occurred through 2016 and 2017. Testing indicates that reduction of ammonia injection has the potential to substantially reduce condensable PM emissions. However, because ammonia injection is used as a component of abatement systems for filterable PM, injection rate reductions may be limited by compliance issues with filterable PM and opacity operating limits. Staff believes that substantial reductions of the condensable PM emissions are achievable, however evaluation of control options is ongoing, and a preliminary BARCT level is still under development. Control options may involve further optimization and reduction of condensable components and precursors (such as ammonia and SO_2) or operation of a wet gas scrubber.

Staff is evaluating additional amendments to Rule 6-5 to further reduce ammonia slip following the conclusion of the current ammonia injection optimization process. Enhancements may include modifications to the ammonia optimization requirements and/or ammonia slip limit. Enhanced ammonia slip requirements and limits may require the upgrade or installation of additional ESP capacity to improve filterable PM removal and reduce the need to ammonia injection, or use of alternative flue gas conditioning agents. Results from the current ammonia optimization testing may provide information on the level of controls needed and the achievable ammonia slip levels. Staff may also consider additional amendments or adjustments to the existing filterable PM and opacity limits to better harmonize with new condensable PM rule development efforts and focus on potentially large reductions in total PM.

Potential Emission Reductions and Impacts

Staff estimates that FCCUs and CO boilers emit approximately 480 tons per year of total PM, and the potential for substantial emission reductions should be further evaluated. Estimates of potential emission reductions would also be highly dependent on the efficacy of the current Rule 6-5 implementation process and ammonia optimization. Therefore, emission reductions and cost-effectiveness of these controls may be more appropriately evaluated following the conclusion of the current Rule 6-5 implementation. Additional baseline testing of current condensable PM emissions should also be conducted as part of this ongoing evaluation.

Costs of additional controls for reducing ammonia slip may vary depending on the types of control options required. Staff reviewed ESP cost data and information from previous analyses from South Coast Air Quality Management District (SCAQMD)[1] and EPA,[2] and estimated that capital costs of additional ESP capacity or upgrades may range from $20 million to $50 million per facility. Implementation of alternative conditioning agents would be anticipated to require lower capital and operating costs compared to ESPs. Further site-specific considerations of current ESP and ammonia injection performance, additional control costs, and space constraints would be needed to appropriately evaluate the potential for achieving substantial condensable PM reductions. As discussed previously, evaluation of potential emission reductions and cost-effectiveness of these additional controls would be more appropriate following the conclusion of the current Rule 6-5 implementation.

Further Considerations

Additional testing and study of the FCCUs and CO boilers are likely necessary to properly characterize condensable PM emissions. This further study would be expected to inform the evaluation of efficacy, feasibility, and cost-effectiveness of various potential control options. Potential controls involving ESP improvements or additional capacity would need to be evaluated for costs and space constraints, and the feasibility of achieving the ammonia slip limit would need to be analyzed on a site-specific basis. Potential controls involving wet gas scrubbing would also need to be evaluated for other potential environmental impacts, as wet gas scrubbers may require substantial water usage.

SO_2

Regulatory Context and Preliminary BARCT Level

Federal NSPS Subpart J contains SO_2 emission limits of 9.8 kg/Mg (20 lb/ton) of coke burnoff, and 50 parts per million by volume (ppmv) SO_2 for an FCCU with an add-on control device. NSPS Subpart Ja contains SO_2 emission limits of 50 ppmv SO_2 on a seven-day rolling average basis and 25 ppmv SO_2 on a 365-day rolling average basis for FCCUs constructed, reconstructed, or modified after May 14, 2007. The Air District adopted Regulation 6, Rule 5: Particulate Emissions from Refinery Fluidized Catalytic Cracking Units in 2015 to reduce condensable PM emissions. Rule 6-5 does not currently contain SO_2 emission limits, but the role of SO_2 as a PM precursor was recognized during the adoption of Rule 6-5, with the intent of addressing SO_2 in future rule amendments.

Staff's review of existing best available control technology (BACT) guidelines and recent determinations indicates that emission limits of 50 ppmv SO_2 on a seven-day rolling average basis and 25 ppmv SO_2 on a 365-day rolling average basis (equivalent to NSPS Subpart Ja standards for newly constructed, reconstructed, and modified units) have been applied and

---

[1] SCAQMD, 2003. Final Staff Report – Proposed Rule 1105.1 Reduction of PM10 and Ammonia Emissions from Fluid Catalytic Cracking Units. September 2003.
[2] EPA, 2008. Regulatory Impact Analysis of the Petroleum Refinery NSPS. April 2008.

achieved at FCCUs and CO boilers. Typical controls include SO_2-reducing catalyst additives or wet gas scrubbers. Based on staff's review, staff has identified a preliminary BARCT level of 50 ppmv SO_2 on a seven-day rolling average basis and 25 ppmv SO_2 on a 365-day rolling average basis. This preliminary BARCT level is used for staff's evaluation of potential BARCT controls, compliance costs, and emissions reductions, but may change as controls are further evaluated.

Potential Emission Reductions and Impacts

Three of the four refineries operating FCCUs currently have permit limits equivalent to the preliminary SO_2 BARCT level, and no further emission reductions or additional controls would be anticipated. One refinery does not currently meet the preliminary BARCT level for FCCUs and CO boilers, and would potentially be required to install a wet gas scrubber or optimize use of enhanced SO_2-reducing catalyst additives. The facility operates a partial burn FCCU and currently utilizes an SO_2-reducing catalyst additive, however recent advances have been made in the performance and efficacy of catalyst additives, specifically for partial burn operating modes. Staff believes there is potential to reduce SO_2 emissions through optimization of these newer catalyst additives and/or use of wet gas scrubbing.

Based on staff's preliminary BARCT level and understanding of current performance of the potentially affected sources, Staff estimates a potential emission reduction of up to 567 tons per year of SO_2. For this preliminary evaluation, staff estimated potential emission reductions and costs for control options involving enhanced catalyst additive optimization and wet gas scrubbing.

Optimized use of enhanced partial burn catalyst additive would result in one-time costs for optimization testing, as well as continued costs of the enhanced catalyst additive. Staff conservatively estimates that optimization testing may result in costs up to $5 million dollars, and costs of continued addition and use of enhanced catalyst additive may be up to $1 million dollars per year. Note that these current estimates do not account for any cost savings from reduced additive usage that may occur as a result of the optimization. Based on these estimates, the annualized cost of the control strategy (including amortized optimization costs and operating costs) is estimated at approximately $1.8 million dollars per year. This would result in a cost-effectiveness of approximately $4,000 per ton of SO_2. Note that these further study is needed to determine if this optimization option would achieve the preliminary BARCT level and associated emission reductions.

Capital and operating costs of wet gas scrubbing would likely have higher total costs compared to other control options. Based on staff's review of wet gas scrubber costs from vendor estimates and previous projects and evaluations, capital costs of a wet gas scrubber are estimated at $135 million dollars, with the annualized cost of the control system (including amortized capital costs and operating costs) estimated at approximately $27 million dollars per year. This would result in a cost-effectiveness of approximately $47,000 per ton of SO_2.

Table 1. FCCUs and CO Boilers SO_2 BARCT Summary

Current Emissions (tpy)	1,044
Potential Emission Reductions (tpy)	567
Preliminary BARCT Level	50 ppmv SO_2, 7-day rolling average 25 ppmv SO_2, 365-day rolling average
Controls Required	Optimized SO_2-reducing catalyst additive; Wet gas scrubber
Total Capital Cost	$5,000,000 (enhanced catalyst additive) to $135,000,000 (wet gas scrubber)
Total Annual Cost	$1,800,000 (enhanced catalyst additive) to $27,000,000 (wet gas scrubber)
Cost-Effectiveness ($/ton)	$4,000 (enhanced catalyst additive) to $47,000 (wet gas scrubber)

Further Considerations

Optimization of partial burn SO_2-reducing catalyst additives may or may not be able to achieve preliminary BARCT levels. Therefore, estimates of emission reductions and cost-effectiveness for this control option may change with additional testing, research, and study of these sources and enhanced catalyst additives. Further refinements to the evaluation of cost-effectiveness and technological feasibility for both additive optimization and wet gas scrubbing are also needed.

NOx

Regulatory Context and Preliminary BARCT Level

Federal NSPS Subpart Ja includes an emission limit of 80 ppmv NOx for newly constructed, reconstructed, or modified FCCUs. The Air District adopted amendments to Regulation 9, Rule 10: Nitrogen Oxides and Carbon Monoxide from Boilers, Steam Generators and Process Heaters in Petroleum Refineries (Rule 9-10) in 2013, which contains NOx limits for non-partial burn CO boilers (150 ppmv on an operating day average, and 45 ppmv on a calendar year average) and partial burn CO boilers (125 ppmv on an operating day average, and 85 ppmv on a calendar year average). Staff's review of existing BACT guidelines and recent determinations indicates that NOx emission levels of 20 ppmv NOx on a 365-day rolling average basis have been achieved at some FCCUs with selective catalytic reduction (SCR) systems and/or low temperature oxidation (LoTOx) controls.

Staff believes that the NOx limits in Rule 9-10 adopted in 2013 reflect BARCT for NOx emissions from FCCUs with CO boilers, and further BARCT evaluation and rulemaking is not anticipated at this time. The FCCU at the Chevron Richmond Refinery does not have a CO boiler, and is therefore not subject to Rule 9-10 NOx limits. However, this FCCU is subject to facility permit limits of 20 ppmv NOx on a 365-day rolling average basis and 40 ppmvd NOx on a seven-day rolling average basis, which are comparable to the BACT levels reviewed. Staff believes that these limits reflect BARCT for NOx emissions from FCCUs, and further BARCT evaluation and rulemaking are not anticipated at this time.

ROG

Regulatory Context and Preliminary BARCT Level

Federal rules NSPS Subparts J and Ja and NESHAP Subpart UUU for FCCUs and CO boilers do not address ROG emissions, although NESHAP Subpart UUU does include limits on total organic hydrocarbon and organic hazardous air pollutant emissions.

Staff's review of existing BACT guidelines and recent determinations indicate that BACT for ROG is typically good combustion practice. Good combustion practices are generally required for complete combustion and control of CO emissions, and staff believes that these sources currently implement these practices. Therefore, further BARCT evaluation and rulemaking are not anticipated at this time.

Refinery Heavy Liquid Leaks – Rule Development Project Scope

Summary

This rule development project would address emissions of reactive organic gases (ROG) from petroleum refineries, chemical plants, bulk terminals and bulk plants, and other facilities that store, transport and use organic liquids. Amendments to Regulation 8, Rule 18: Equipment Leaks (Rule 8-18) in December 2015 addressed equipment that service heavy liquids at these sources, but those amendments have not yet been fully implemented due to uncertainty regarding proper emissions factors for heavy liquid fugitive emissions. Air District staff is coordinating with each of the five Bay Area refineries to conduct a Heavy Liquid Leak Study. These studies are designed to determine appropriate emission factors for heavy liquid leaks. The results of these studies are expected by Spring 2019. Staff recommends using results of the Heavy Liquid Leak Study to amend Rule 8-18, and address the current issues with the 2015 amendments. Any recommended and implemented requirements to address ROG emissions from these sources are also anticipated to reduce toxic air contaminant (TAC) emissions. Rulemaking for emissions of oxides of nitrogen (NOx), sulfur dioxide (SO_2), and particulate matter (PM) is not anticipated at this time.

Background

Oil refineries, chemical plants, bulk plants, bulk terminals, and other facilities that store, transport, and use volatile organic liquids may occasionally have leaks wherever there is a connection between two pieces of equipment, and lose some organic material as fugitive emissions. Valves, pumps, and compressors can also leak organic material. Air District Rule 8-18 requires such facilities to maintain a leak detection and repair (LDAR) program.

The purpose of the LDAR program is to ensure that all equipment is inspected regularly and, if a leak is found to exceed the leak threshold, that the equipment is repaired, replaced, or placed on a limited list of non-repairable equipment. Component leaks commonly occur at the joints or connections between sections of piping, at valves, at pumps or from barrier fluid contained between seals, and at leaking pressure relief devices (PRDs).

Rule 8-18 was amended in December 2015 to extend the requirements of the LDAR program to include equipment in hydrocarbon heavy liquid service.[1] Inclusion of heavy liquids is costly because equipment in heavy liquid service expands the LDAR program by approximately one-third more equipment than is currently being monitored. The Heavy Liquid Leak Study was originally projected to be completed within a year. However, completion of the heavy liquid leak study mentioned above has been problematic, because some heavy hydrocarbon liquids are condensing and coating the leak detection sensors. These equipment problems have prevented

[1] Heavy hydrocarbon liquids are defined as having an initial boiling point greater than 302°F.

proper collection of all the data needed. Study participants are re-configuring the study approach, and anticipate having useful data by the Spring of 2019.

ROG

Regulatory Context and Preliminary BARCT Level

The Air District originally adopted Rule 8-18 in 1980, and has amended the rule in 1992, 2004, and 2015. In addition, some minor changes were made to the rule in 1998 and 2002. The original intent of the rule was to control fugitive organic gas leaks from valves and connectors at refineries, chemical plants, bulk plants, and bulk terminals. Rule amendments adopted in 1992 significantly lowered the allowable leak concentration limits to the lowest levels in the country and required more effective inspection and repair programs to reduce emissions and promote self-compliance. The 1992 amendments reduced emissions by an estimated 1.2 tons per day (tpd).

The allowable leak standard is 500 parts per million volume (ppmv) for pumps, compressors, and PRDs.[2] For valves and other equipment, the allowable leak standard is 100 ppmv. Leaks are detected using a portable combustible gas indicator.

The U.S. Environmental Protection Agency (EPA) standards in 40 CFR parts 60 and 63 include LDAR provisions for monitoring and repairing equipment in heavy liquid service and do not rely on instrument monitoring, but instead rely on “visual, audible, olfactory, or any other detection method.” The concern with visual, audible, and olfactory monitoring is that these methods only identify large leaks (typically 10,000 ppm or more). Instrument monitoring can identify much smaller leaks (in the 100 – 500 ppm range).

Potential Emission Reductions and Impacts

The 2015 emissions inventory estimates that fugitive hydrocarbon leaks from the five refineries in the Bay Area total approximately 1,172 tons per year of ROG based on emission factors at that time. As mentioned previously, uncertainties associated with these heavy liquid leak emission estimates are being evaluated, and staff is currently coordinating with Bay Area refineries to conduct a Heavy Liquid Leak Study to determine appropriate emission factors and refine these estimates. Refined estimates of heavy liquid leak emissions will be quantified based on the results of the Heavy Liquid Leak Study.

Due to the uncertainties associated with emission estimates from heavy liquid leaks, estimates of potential emission reductions from expanded LDAR controls are uncertain at this time. Note that potential emission reductions from expanded LDAR requirements were previously estimated during the development of the 2015 amendments to Rule 8-18. At that time, ROG emissions from heavy liquid leaks were estimated to be approximately 1,476 tons per year, and the 2015 amendments were anticipated to reduce emissions by over 80 percent (1,227 tons per year) based on conservative assumptions of leak occurrences and concentrations in the controlled scenario. As mentioned previously, the need for more certainty regarding heavy liquid

[2] PRDs are also subject to the requirements of Air District Regulation 8, Rule 28: Episodic Releases from Pressure Relief Devices at Petroleum Refineries and Chemical Plants.

emission factors has delayed implementation of the 2015 amendments and has prompted efforts to refine these estimates and the characterization of leaks. Staff anticipates re-evaluating these estimates of potential emission reductions following the completion of the Heavy Liquid Leak Study.

Potential capital and annualized costs for implementation of expanded LDAR requirements were also estimated during the development of the 2015 amendments to Rule 8-18. These cost estimates are included in Table 1 for informational purposes, and will also be re-evaluated following the completion of the Heavy Liquid Leak Study.

Table 1. Refinery Heavy Liquid Leaks ROG BARCT Summary

Current Emissions (tpy)	1,172 tpy
Potential Emission Reductions (tpy)	Uncertain
Preliminary BARCT Level	TBD
Controls Required	LDAR for heavy liquid equipment
Total Capital Cost	$250,000
Total Annual Cost	$6,800,000
Cost-Effectiveness ($/ton)	Uncertain

Further Considerations

Rule 8-18 will require amendments based on results of the Heavy Liquid Leak Study. Therefore, estimates of emission reductions and cost-effectiveness for this control and monitoring may change as the study progresses. Results of the study are also expected to inform health risk analyses required by Regulation 11, Rule 18: Reduction of Risk from Air Toxic Emissions at Existing Facilities (Rule 11-18), so further controls based on implementation of Rule 11-18 may also be taken into consideration when evaluating further rulemaking activity.

Particulate Matter

Heavy liquid leaks do not typically generate substantial PM emissions that would require additional controls. Heavy liquids that may become aerosols (and any toxic air contaminant components) would be controlled by a heavy liquid leak LDAR program for ROG emissions. Therefore, further BARCT evaluation and rulemaking are not anticipated at this time.

NOx

Heavy liquid leaks do not typically generate substantial NOx emissions that would require additional controls. Therefore, further BARCT evaluation and rulemaking are not anticipated at this time.

SO_2

Heavy liquid leaks do not typically generate substantial SO_2 emissions that would require additional controls. Therefore, further BARCT evaluation and rulemaking are not anticipated at this time.

Petroleum Coke Calcining – Rule Development Project Scope

Summary

This rule development project would address oxides of nitrogen (NOx) emissions from petroleum coke calcining operations. Staff estimates that preliminary BARCT levels could result in significant emission reductions of NOx; however, NOx control options for petroleum coke calcining appear limited in practice in the United States. The Air District has not addressed NOx emissions concerning petroleum coke calcining in previous rule developments. Staff recommends potentially amending Regulation 9, Rule 14: Petroleum Coke Calcining Operations (Rule 9-14), which only address sulfur dioxide (SO_2), to include NOx emissions if socioeconomic impacts, cost effectiveness, and control technology application can be justified as BARCT. Technologies potentially available for NOx reduction for this process may not be commercially available nor demonstrated in practice, and therefore may be considered Lowest Achievable Emission Rate (LAER). Rulemaking for emissions of sulfur dioxide (SO_2), reactive organic gases (ROG), and particulate matter (PM) is not anticipated at this time.

Background

Petroleum coke calcining operations in the Bay Area occur only at the Phillips 66 Carbon Plant. It is one of two such facilities in California; the other facility is located in Southern California. The Carbon Plant processes green coke from the Phillips 66 San Francisco Refinery to purify it and sell it to industry that is primarily offshore. The facility commenced calcining operations with a single kiln in 1960, and a second kiln was added to the facility in 1968. The Carbon Plant sells the majority of its calcined coke to a single company that uses the refined coke to produce titanium dioxide, which is a photocatalyst commonly used to manufacture white pigments that are incorporated into a wide range of applications, including skincare products, plastics, food coloring, paint, and coating products.

<u>Phillips 66 Carbon Plant Operations</u>

The Phillips 66 Carbon Plant operates two process trains that include a natural gas kiln burner with a rating of approximately 60 million British thermal units (MMBtu/hr) each, and that have a combined permitted maximum coke throughput of 250 tons per hour. Each train includes a pyroscrubber and baghouse with a separate exhaust stack. Annual production is limited to 262,800 tons of coke produced per train.

Petroleum coke is received from the Phillips 66 Refinery coker and is stored on-site at the Carbon Plant. Coke is conveyed to the coke calciner where it is calcined (heated). This process removes impurities from the coke, including sulfur and volatiles. The hot waste gases from the calciner are sent to the pyroscrubber that removes particulates through a combination of settling and incineration. Sulfur compounds are oxidized to SO_2. The hot waste gases are sent to a heat recovery steam generator to produce steam for the generation of electricity. The cooled waste gases pass through a baghouse and tall stack and are emitted into the atmosphere. The resulting calcined coke is then sold.

Petroleum Coke

Petroleum coke is a carbon by-product that remains from petroleum refining processes. It is a black solid residue that results from the thermal processing of petroleum derived from feedstocks, tar, pitch, or vacuum tower bottom blends that have been cracked or otherwise processed in a coker to remove low boiling fractions. Coke consists mainly of carbon (90 to 95 percent) and is created by heat-treating the residual oil (more accurately described as tar) to a temperature high enough to polymerize it to form a non-melting solid carbonaceous material.

Coke is used as a feedstock in coke ovens for the steel industry, for heating purposes, for electrode manufacturing, and for the production of chemicals. Coke, as it is removed from the petroleum coking process, is referred to as "green coke." Green petroleum coke may contain approximately 15 to 20 percent residual hydrocarbon materials. Such hydrocarbons are compounds that do not polymerize in the coke cracking process and cannot be removed from the coke substrate due to process limitations. Thus, green coke is calcined to remove hydrocarbons and other impurities to make it a more marketable product.

Calcining Process

Calcined petroleum coke is manufactured by heating green coke in a rotary kiln to a temperature that ranges between approximately 2,200 to 2,500 degrees Fahrenheit (°F). This roasting process combusts virtually all of the residual hydrocarbons and also removes sulfur compounds and moisture from the coke. The coke's crystalline structure is refined and thus enhances the coke's physical properties such as electrical conductivity, density and oxidation characteristics. A rotary kiln is a long, refractory lined cylindrical device that rotates on its own axis and drives off contaminants from the green coke by bringing the contaminants into direct contact with heated gas. As the petroleum coke slides down the rotating kiln it flows counter-current to the rising hot combustion gas produced by burning natural gas.

NOx

Regulatory Context and Preliminary BARCT Level

The purpose of a new rule would be to reduce NOx emissions from petroleum coke calciners located in the Air District. NOx emissions from gas-fired combustion kilns result primarily from oxidation of atmospheric nitrogen during the combustion of natural gas and coke fines. NOx formation is favored when both high combustion temperatures and high excess oxygen (O_2) levels are present. Thermal NOx formation increases exponentially as a function of temperature, with the rate of formation rising very rapidly at temperatures above about 2,400 °F. NOx can also be formed if nitrogen is present in the fuel. Currently, there are no federal or Air District NOx requirements applicable to petroleum coke calcining operations.

When the Phillips 66 Carbon Plant calcines green coke under fully operational conditions, the total NOx emissions are approximately 2,000 pounds per day; this translated to approximately 350 tons per year in 2015. In previous years, NOx emissions from the facility have exceeded 500 tons per year. Staff believes that substantial reductions of NOx emissions may be achievable, however research of potential control options is ongoing, and a preliminary BARCT level is still under development. Potential control technologies are discussed in the section below.

Further Considerations

NOx control for petroleum coke calcining operations appears to be unproven and not necessarily commercially available. There were no best available control technology (BACT) determinations for NOx emissions found for the process in the United State Environmental Protection Agency RBLC[1] database. However, South Coast Air Quality Management District (SCAQMD) published a 2000 BACT guideline for NOx at 44 ppmvd at 3 percent O_2. Further research is needed to determine if possible control options have been achieved in practice in SCAQMD or other parts of the US. Typical NOx control options include selective catalytic reduction (SCR) and LoTOx, which may be considered by some as a LAER control for this process.

<u>SCR</u>

SCR is a post-combustion control technology that, for combustion unit applications, typically employs ammonia (NH_3) in the presence of a catalyst to convert NOx to nitrogen and water according to the following overall reactions:

$$4NH_3 + 4NO + O_2 \rightarrow 4N_2 + 6H_2O$$
$$4NH_3 + 2NO_2 + O_2 \rightarrow 3N_2 + 6H_2O$$

An SCR system typically utilizes an injection grid to evenly disperse the NH_3 into the combustion unit exhaust gas upstream of a catalyst. The function of the catalyst is to lower the activation energy of the NH_3-NOx reduction reactions. Operating temperatures between 500 °F and 800 °F are often required of the gas stream at the catalyst bed. NOx removal rates can exceed 90 percent with a well-designed system.

SCR has been successfully installed at a petroleum coke calcining facility in Germany, however additional firing was required to heat the gases back up to 500 °F prior to flow through the SCR catalyst bed, increasing GHG emissions.

Additional study of this control option would be required to appropriately evaluate this control strategy and achievable BARCT limits. Further considerations of efficacy, feasibility, and cost-effectiveness would need to be analyzed on a site-specific basis. Draft and final proposed BARCT limits may change throughout the rule development process as additional testing, research, and evaluation is conducted.

<u>LoTOx</u>

In the LoTOx system, ozone is injected into the flue gas stream and oxidizes insoluble NOx to soluble oxidized compounds. LoTOx is a low temperature system; therefore, it does not require heat input to maintain operational efficiency or to prevent the “slip” of treatment chemicals (such as ammonia), as is common with SCR and selective non-catalytic reduction (SNCR) systems.

---

[1] RACT/BACT/LAER Clearinghouse

Ozone rapidly reacts with insoluble nitric oxide (NO) and nitrogen dioxide (NO_2) molecules to form soluble dinitrogen dioxide (N_2O_2). The species N_2O_2 is highly soluble and will rapidly react with moisture in the gas stream to form nitric acid. The conversion of NOx into the aqueous phase in the scrubber is rapid and irreversible, allowing nearly complete removal of NOx. The nitric acid, along with unreacted N_2O_2 and nitrous acid formed by reaction of NO_2 with water, can be easily scrubbed out of the gas stream in a wet scrubber with water or neutralized with a caustic solution.

Additional study of this control option would be required to appropriately evaluate this control strategy and achievable BARCT limits. Increased water use associated with the LoTOx system would need to be evaluated, as substantial water consumption may be a concern. Additional research is also required to determine commercial availability for this application. Further considerations of efficacy, feasibility, and cost-effectiveness would need to be analyzed on a site-specific basis. Draft and final proposed BARCT limits may change throughout the rule development process as additional testing, research, and evaluation is conducted.

SO_2

Regulatory Context and Preliminary BARCT Level

In April 2016, Air District Rule 9-14 was promulgated limiting SO_2 emissions from petroleum calcining operations. Staff believes that these limits reflect BARCT for SO_2, and further BARCT evaluation and rulemaking is not anticipated at this time.

ROG

Regulatory Context and Preliminary BARCT Level

Natural gas fired pyroscubbers control ROG emissions. The main function of a pyroscrubber in petroleum coke calcining process is to oxidize the carbonaceous contents, including hydrocarbon volatiles, of the exhaust gas from the coke calcination kiln. Staff believes that this level of control reflects BARCT for ROG at the source, and further BARCT evaluation and rulemaking is not anticipated at this time.

Particulate Matter

Regulatory Context and Preliminary BARCT Level

Natural gas fired pyroscubbers and baghouses are located on each train to control PM emissions. Current permit requirements include keeping the baghouses in good operating condition, meeting 12-month rolling average PM limits, and incorporating monitoring and recordkeeping as specified per the Title V operating permit conditions. Staff believes that this level of control reflects BARCT for PM at the source, and further BARCT evaluation and rulemaking is not anticipated at this time.