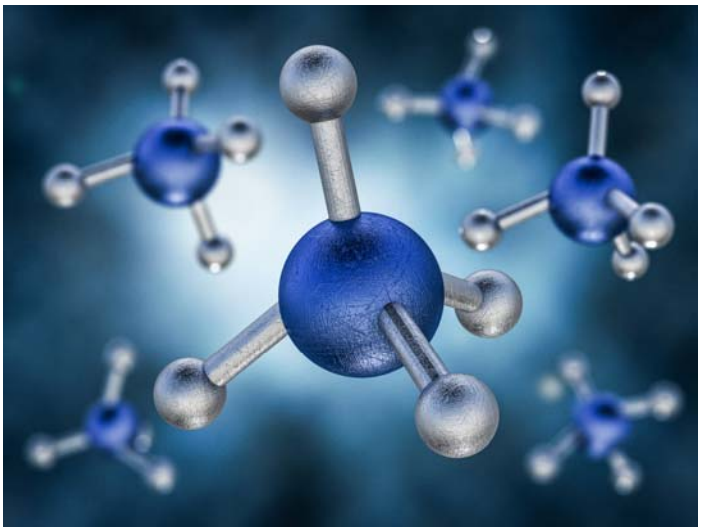
BAY AREA AIR QUALITY MANAGEMENT DISTRICT

Bay Area Air Quality Management District

D R A F T
Regulation 13: Climate Pollutants
Rule 1: Significant Methane Releases



Workshop Report

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I. INTRODUCTION AND SUMMARY

This Workshop Report provides preliminary information regarding development of a new regulation by the Bay Area Air Quality Management District (BAAQMD or Air District), draft Regulation 13: Climate Pollutants, Rule 1: Significant Methane Releases (Rule 13-1). Draft Rule 13-1 would limit significant methane releases from all sources throughout the Air District. If adopted, it would be the first Air District rule to focus on climate protection by regulating methane emissions.

The Air District has published this report to explain draft Rule 13-1 to members of the public, affected industry, and other interested parties. Draft regulatory language for Rule 13-1 has been developed and is available for review as well. Staff would appreciate input from any and all stakeholders. The Air District has planned two public workshops during the month of August to discuss the Draft Rule and invite stakeholder input on all aspects of the draft rule. Feedback can be provided in person at the workshops or can be submitted to the Air District (verbally or in writing) during the comment period. Following the workshop, in the final phase of this rule development effort, staff will prepare a Public Hearing package—containing the proposed regulatory version of Rule 13-1, a draft staff report, a socioeconomic analysis, and a California Environmental Act (CEQA) environmental analysis—that would be presented to the Air District's Board of Directors for its consideration.

Summary

The Air District has a policy goal of reducing Bay Area greenhouse gas (GHG) emissions to 40 percent below 1990 levels by 2030, and 80 percent below 1990 levels by 2050. Methane (CH_4) is a potent and short-lived GHG; its global warming potential is 86 times stronger than that of carbon dioxide (CO_2), when compared on a 20-year time horizon.[1,2] Methane represents the second largest emissions of GHGs in the region, after CO_2. In 2015, all methane sources located within the Air District boundaries emitted an estimated 10 million metric tons of CO_2 equivalent (MMT CO_2e) about 10 percent of the Bay Area's GHG inventory. These sources include stationary sources such as landfills, wastewater treatment, refineries, the natural gas production and distribution systems, mobile sources such as cars and trucks, and natural sources such as wetlands. Given the importance of controlling methane, the Air District has developed a comprehensive Basin-wide Methane Strategy as part of its 2017 Clean Air Plan. The Methane Strategy is an agency-wide effort to better quantify and reduce the region's methane emissions. Draft Rule 13-1 would be the first rule developed as part of this Strategy. The Rule's purpose is to limit emissions from significant methane releases throughout the Bay Area. Subsequent source-specific methane rules will be adopted to address emissions from specific operations.

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[1] Based on the 20-year GWP reported for methane in the IPCC Fifth Assessment Report.

[2] Unless otherwise stated, this report uses the 20-year global warming potential (GWP) of 86 when calculating the carbon dioxide equivalent of methane emissions since the emission reduction actions being considered are within that time frame.

A recent example of a significant methane release event is the Aliso Canyon natural gas leak that occurred in the South Coast Air Basin. A continuous natural gas leak at the Southern California Gas Company's underground natural gas storage facility in Aliso Canyon occurred from October 23, 2015 until February 18, 2016. The California Air Resources Board (CARB) determined that up to 109,000 metric tons (MT) of methane were released during that period, amounting to 9.4 million MT CO_2e. This methane release - comparable in scale to the total GHG emissions emitted during 2015 in the Bay Area - is the largest documented leak in the United States to-date. While it was occurring, the leak was responsible for approximately 20 percent of all methane emissions in the State of California.[a]

Draft Rule 13-1 would address very large methane releases similar to the Aliso Canyon leak and other smaller (but also significant) methane releases. Draft Rule 13-1 addresses methane releases over 10,000 parts per million (ppm) at any Bay Area source. In order to focus on large methane releases, the draft Rule also includes a provision to exempt low-volume (but high concentration) methane releases; such releases are defined as those that are above 10,000 ppm but with mass emissions below 10 pounds per day (lb/day).

In order to provide additional context for the draft Rule, this report includes background on both State and Air District methane efforts and describes the methane inventory and top sources for the Bay Area region. The report discusses the purpose of draft Rule 13-1, its emission standards, how compliance with the rule would be determined and monitored, estimated emission reductions, and associated costs.

II. BACKGROUND

A. State Efforts on Methane

A suite of ambitious GHG reduction actions has been identified and adopted by the State of California over the past 13 years. As climate change is a multi-faceted challenge, these actions include various goals and targets that cover different timespans and pollutant-types.

Greenhouse gases

For GHGs in general, the State has established a 2020, a 2030, and a 2050 reduction target. In 2005, Governor Arnold Schwarzenegger set a short- and long-term target, calling for the State to reduce GHG emissions to 1990 levels by 2020 and to 80 percent below 1990 levels by 2050. In 2006, the adoption of AB 32[3] codified the 2020 reduction target into law. Additionally, in April 2015, Governor Jerry Brown issued Executive Order B-30-15, announcing an interim GHG reduction target for the 2030 timeframe. In Fall 2016, the adoption of Senate Bill 32[4] then codified that target, dictating that CARB "ensure that statewide GHG emissions are reduced to 40 percent below the 1990 level by [the end of] 2030". The State is currently on track to meet

[3] AB 32, Nunez. Air pollution: greenhouse gases: California Global Warming Solutions Act of 2006.
[4] SB 32, Pavley. California Global Warming Solutions Act of 2006: emissions target.

the 2020 target[5] called for in AB 32. That leaves 2030 as the next target to achieve. California's Climate Change Scoping Plan, of which the latest iteration was released in late 2017, outlines the State's strategy for meeting its 2030 and 2050 goals.

SLCPs and Methane

In addition to limiting emissions of GHGs as a whole, the State of California has policies focusing on certain categories of climate pollutants. Within the 2030 Scoping Plan strategy, there are several areas specific to methane: Senate Bills 605[6] and 1383[7] mandated a short-lived climate pollutant (SLCP) Strategy for the State, CARB adopted an Oil and Gas regulation[8] for methane emissions, and SB 1371[9] and SB 887[10] called for work to be done addressing natural gas[11] leaks from equipment.

In Governor Jerry Brown's inaugural address, he identified SLCPs (such as methane) as one of the key categories the State needed to address to meet future climate goals. The adoption of SB 605 charged CARB with developing a comprehensive strategy to reduce SLCPs. Additionally, in September 2016, SB 1383 mandated that CARB approve and begin implementing the SLCP Strategy by January 1, 2018. SB 1383 also decreed that the strategy should "achieve a reduction in methane by 40 [percent]...below 2013 levels by 2030".

While a majority[12] of the methane emissions in California come from organic waste in landfills and dairy and livestock sources, CARB also notes that unintentional methane emissions are an area that needs to be addressed in terms of emissions reductions. The SLCP strategy includes a 40 to 45 percent reduction in fugitive methane emissions from all sources, including the oil and gas sector. In line with this target, CARB adopted Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities in the second half of 2017. The regulation addresses fugitive and vented methane emissions from crude oil and natural gas facilities. Furthermore, SB 887 requires leak monitoring for natural gas storage facilities. In addition, SB 1371 requires the California Public Utilities Commission (CPUC) to work with investor-owned utilities to address methane leaks from California's natural gas distribution network.

Air districts play a critical role in the efforts to meet California's methane emissions reduction goals as they have regulatory authority over methane emissions from stationary sources and possess extensive experience permitting and regulating these sources. To complement and

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[5] California's 2017 Climate Change Scoping Plan, Executive Summary
[6] SB 605, Lara. Short-lived climate pollutants.
[7] SB 1383, Lara. Short-lived climate pollutants: methane emissions: dairy and livestock: organic waste: landfills
[8] CARB. Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities. Adopted March 23, 2017. Available at: https://www.arb.ca.gov/regact/2016/oilandgas2016/ogfro.pdf
[9] SB 1371, Leno. Natural gas: leakage abatement.
[10] SB 887, Pavley. Natural gas storage wells.
[11] Natural gas is a colorless, odorless, gaseous hydrocarbon mixture that consists mainly of methane, with traces of several other chemicals including ethane, CO_2, oxygen (O_2), propane, butane, and nitrogen.
[12] https://www.arb.ca.gov/cc/shortlived/meetings/03142017/final_slcp_report.pdf

build upon California's strategy, the Air District also has established a portfolio of GHG actions. A number of the initiatives in this portfolio focus on methane.

B. Basin-wide Methane Strategy

In the 2017 Clean Air Plan, the Air District focuses on two closely-related goals: protecting public health and protecting the climate. The 2017 Plan lays out the foundation for a long-term effort to reduce Bay Area GHG emissions 40 percent below 1990 levels by 2030, and 80 percent below 1990 levels by 2050. These emissions reduction goals are consistent with the GHG reduction targets adopted by the State of California. Directing GHG control efforts towards short-lived climate pollutants, such as methane, is a high-impact strategy to combat climate change.

The latest research underscores the need to reduce emissions of SLCPs, or "super GHGs", in order to avoid the worst impacts on the climate (IPCC, 2014). Methane is a potent and short-lived GHG, with a GWP of 86 and an atmospheric half-life (average lifespan) of 12 years (compared to 20 to 200 years for CO_2) (IPCC, 2014). Due to these factors, actions to reduce methane emissions can provide significant and immediate climate benefits. When paired with steady reductions in CO_2 emissions, these actions can help to achieve long-term climate stability.

Furthermore, curbing methane emissions would reduce emissions of associated co-pollutants, which can include key climate, criteria, and toxic pollutants, resulting in added climate benefits and improvements to public health. For example, natural gas and crude oil production can emit toxic and volatile organic compounds (VOCs) along with methane. Given the importance and potential co-benefits of controlling methane, the Air District has included a comprehensive Basin-wide Methane Strategy (Measure SS16) as part of its 2017 Clean Air Plan. The Methane Strategy is an agency-wide effort to better quantify and reduce the region's methane emissions.

Air District staff is currently working on several of the key elements of the Methane Strategy: 1) development of Rule 13-1 to address significant methane releases throughout the Air District, 2) intensifying efforts to improve the Air District's methane emissions inventory, 3) collaborating with State agencies on their methane regulations under development, 4) identifying cost effective and technically feasible methane emissions reduction opportunities throughout the Bay Area, and 5) considering the removal of methane exemptions from existing Air District rules when appropriate.

The adoption of Regulation 13: Climate Pollutants, Rule 1: Significant Methane Emissions would be the first step in implementing the Air District's Basin-wide Methane Strategy. Currently, there is no Air District rule designed to specifically address large emissions of methane. Air District Rule 8-2: Miscellaneous Operations prohibits leaks of organic compounds that exceed 15 lb/day (and a concentration of 300 ppm); however, methane and natural gas emissions are exempted from that prohibition. Two other Air District regulations may apply when methane is released into the ambient air: Regulation 7: Odorous Substances, and Regulation 1: General Provisions and Definitions (Section 1-301), which prohibits the creation of public nuisances.

However, these regulations may only apply if methane is emitted along with odorous compounds (pure methane is odorless). For instance, methane can be emitted when odorized natural gas is leaked. Federal Pipeline Safety Regulations (49 CFR 192.625) mandate that operators of distribution lines and certain transmission lines add an odorant to natural gas, in the form of a mercaptan, a class of organosulfur compounds. The odorant allows the combustible gas to be detectable by a person with a normal sense of smell at a concentration below the lower explosive limit, for safety reasons. Air District staff has investigated the circumstances for potential public nuisance violations when odorized natural gas was emitted into the ambient air near populated areas, resulting in odor complaints. Another example includes biological methane, which is sometimes co-emitted with odorous compounds such as ammonia (NH_3) and hydrogen sulfide (H_2S). Thus, methane releases can result in violations of existing Air District regulations, especially if the release occurs in a populated area.

However, significant methane releases are of concern to the Air District even if they do not present a public nuisance or odor problem because methane is a potent greenhouse gas. Thus, the Air District has developed draft Rule 13-1 to establish a limit above which methane releases must be addressed in the region. This limit would apply to all Air District-regulated stationary sources, including methane releases from certain natural gas facilities, landfills, underground storage facilities, refineries, and oil and gas production operations. Draft Rule 13-1 would serve as a near-term action, or backstop, while additional regulatory efforts to address specific sectors are developed and finalized.

C. Methane Emissions in the Bay Area

Methane is the second leading greenhouse gas emitted in the Bay Area. In 2015, methane sources in the Bay Area Air Basin emitted an estimated 10 million metric tons of CO_2 equivalent (MMT CO_2e), about 10 percent of the total GHG inventory. According to a recent study that was commissioned by the Air District to evaluate its methane inventory (Fischer and Jeong, 2016), three source categories represent approximately 84 percent of these emissions. These categories are mainly related to human activities; landfills are the largest source by far, accounting for 53 percent of these emissions, followed by livestock (16 percent) and natural gas production and distribution (15 percent). These emissions estimates carry a large uncertainty (50 percent or more), consistent with two recent studies that suggest the methane emissions in the Air District's "bottom-up" inventory[13] are 1.3 to 2.3 times lower than those calculated[b,c] using top-down measurements.[14] This "methane gap" has been repeatedly observed in California and the U.S. as well, where top-down observations that account for ambient

[13] The Air District traditionally develops its emissions inventory through a bottom-up methodology. In this approach, established emission factors (e.g., methane emitted per unit of natural gas burned) are combined with activity data (e.g., throughput of natural gas) to generate source-specific emissions estimates.

[14] Top down estimates are emission estimates derived from ambient concentrations of an air pollutant (i.e., what rate of methane emissions would be required to result in these ambient concentrations of methane given atmospheric factors that may affect methane, such as removal rate)

methane concentrations also suggest that there are large, unaccounted for methane emissions in bottom-up inventories.[d,e,f,g]

The Air District is currently seeking to improve and update its methane emissions inventory. Air District staff has designed a tiered approach to better quantify and attribute the "missing methane" in our Bay Area methane emissions inventory. This approach involves comparing the current bottom-up inventory with emissions estimates derived from measurements at the regional- and facility-scale (Tiers 1 and 2) and at the source level (Tier 3). At this time, the Air District has limited data from these top-down measurements for four sectors: refineries, landfills, wastewater treatment and livestock. Preliminary "top-down" methane emissions estimated based on these data seem consistent with the current "bottom-up" inventory for the wastewater treatment and livestock sectors. However, these "top-down" estimates indicate that the landfill and refinery sectors may be underestimated in the Air District's current methane inventory. The methodology and initial results from this effort will be shared in more detail in an upcoming Air District report, expected to be released by late 2018.

Table 1 below summarizes current methane emission estimates in the Bay Area by sector, based on a bottom-up methodology (see Footnote 13 for further description of this methodology). These estimates may change as the efforts to update and improve the methane emissions inventory continue.

Table 1. Summary of 2012 Methane (CH_4) Emissions for BAAQMD by Sector (derived from Table 1; Fischer et al., 2016)

Sector	Current "Bottom-up" Emissions Estimate (MT CH_4/year)	Percent of Current "Bottom-up" Emissions Estimate
Livestock	18,257	15.2
Landfill	61,478	51.2
Natural gas	17,499	14.6
On-road mobile	2,164	1.8
Refinery	1,931	1.6
Wastewater	6,984	5.8
Others***	8,092	6.7
Anthropogenic total	*116,405*	*96.9*
Wetland#	3,738	3.1
Total	**120,143**	**100**

The four largest stationary sources of methane emissions in the current estimate are landfills, the natural gas sector, livestock, and wastewater treatment facilities. The livestock and wetland

*** Includes emissions from other stationary combustions, aircraft, off-road emissions and other minor sources
# Taken from Jeong et al. (2013) for BAAQMD.

sectors account for approximately 18 percent of overall methane emissions in the Bay Area. While more research is needed to understand emissions from these sectors, it may not be possible to abate them in a cost-effective manner through regulation. Livestock emissions can be addressed in part by promoting methane capture for on-site energy production, and by engaging with the agriculture community to develop best practices to address enteric fermentation emissions. See the 2017 Clean Air Plan (Measures AG2: Dairy Digesters and AG3: Enteric Fermentation) for further details.

D. Overview of Top Methane Sources

The following is a brief overview of each of the highest emitting sectors in the Bay Area:

Natural Gas Operations

Pacific Gas and Electric Company (PG&E) is the primary provider of natural gas to the Bay Area; however, there is at least one municipality, the city of Palo Alto, that purchases natural gas from PG&E and distributes it via their own pipeline system, to residents and businesses. Also, a company named Lodi Gas Storage, L.L.C., stores natural gas at a facility in Solano County for distribution to San Joaquin and Sacramento areas. PG&E and Lodi Gas store natural gas underground and distribute the gas via pipeline systems. Natural gas is a colorless, odorless, gaseous hydrocarbon mixture that is stored in different ways. In the Bay Area, natural gas is most commonly stored in underground reservoirs of depleted oil and/or natural gas fields though it sometimes can be stored in liquid or gaseous form in aboveground tanks. Natural gas consists mainly of methane with traces of several other chemicals including ethane, CO_2, oxygen (O_2), propane, butane, and nitrogen. Methane leaks can occur from all areas of the natural gas system including production, storage, transmission, processing, and distribution. Fugitive methane emissions can result from different equipment at natural gas production facilities including wells, separator and tank systems, dehydration units, equipment components and connections, and storage tanks. Methane releases at natural gas storage facilities may potentially occur at metering stations, pipelines, compressors, injection wells and injection systems. Methane emissions from both natural gas production and underground storage facilities are regulated under CARB's Oil & Gas Rule. The natural gas sector is also regulated by the CPUC's Natural Gas Leak Abatement Program, developed with CARB, in response to SB 1371. The program requires utilities to report system-wide methane emissions annually and to follow 26 mandatory best practices that include leak prevention, detection and repair.

Figure 1*- Infrared image showing a methane emissions plume from the Aliso Canyon natural gas storage facility*[15]

Petroleum Refineries

The petroleum refining industry consumes fossil fuels for combustion and is, thus, a significant source of GHG emissions. Methane emissions from petroleum refineries can come from process equipment leaks, crude oil storage tanks, delayed coking units, wastewater oil separators, vapor recovery units, oily sewer systems, and blow down systems. Asphalt blowing and flaring of waste gas also contribute to methane emissions at some refineries. In a preliminary meeting with refinery representatives, staff learned that methane emissions associated with certain operations may be difficult to quantify and abate.

One of these operations is flaring. At a stakeholder meeting in March 2018, refinery representatives stated that a new Environmental Protection Agency (EPA) rule requires refineries to supplement waste gases, regulatory gases and certain operational gases when such gases are vented to flares in order to optimize the combustion process. The minimal requirement is for flare vent gas content to be above 270 British thermal units (Btu) per standard cubic feet. While refineries have the choice to use any vent gas that meets the federal requirements, some refineries have chosen natural gas as their supplemental gas for flare combustion.[h] Even with the use of supplemental natural gas to optimize combustion efficiency, complete combustion may not be achieved; thus, some unburned methane may be released into the atmosphere. The quantity and concentration of methane emitted in such circumstances is currently unknown. Nevertheless, preliminary analyses by Air District staff

[15] Image Source: http://www.ibtimes.com/obama-canadas-justin-trudeau-vow-tackle-methane-emissions-oil-gas-sector-2334145

suggest that it is unlikely that methane emissions from refinery flares routinely exceed 10,000 ppm. It should be noted that it is staff's understanding that the new EPA requirements – 40 CFR §§ 63.670 and 63.671 – to supplement flare gas do not specifically require methane as the supplement gas.

Refinery representatives also expressed concern that marshlands adjacent to certain refinery properties may potentially be a confounding source of methane to consider. The representative of one refinery asserted that the marshlands may emit methane in fluctuating concentrations that vary with time of day, season, and prevailing wind direction. However, the refinery has not been able to verify this claim or differentiate between the marshland's methane emissions and methane releases from refinery sources. The Air District is currently in discussions with Bay Area refineries about conducting methane quantification and source differentiation at their facilities.

There were additional concerns expressed at our second stakeholder meeting in June 2018; refinery representatives mentioned that refinery process vent emissions already subject to CARB's GHG mandatory reporting requirements, such as the process gases vented from hydrogen plants, might frequently exceed the 10,000-ppm threshold in draft Rule 13-1. Other sources of concern include methane emissions from storage tanks.

Wastewater Treatment Operations

Wastewater from both industrial and domestic sources is often treated to remove soluble organic matter, suspended solids, pathogenic organisms, and chemical contaminants. Soluble organic matter is usually removed using biological treatment methods in which microorganisms consume the organic matter for maintenance and growth. Methane emissions from wastewater treatment are primarily dependent on the organic content present in the wastewater system and how the wastewater is treated. During collection and treatment, wastewater is sometimes managed under anaerobic conditions that can be a source of methane emissions. Additionally, the subsequent sludge may be further biodegraded under anaerobic conditions. Untreated wastewater may also produce methane if it is stored in a manner that produces anaerobic conditions.

Anaerobic digesters or storage spheres are also sources of methane emissions. Prior to the cleaning or inspection of an anaerobic digester or a storage sphere, the biogas must be evacuated. This procedure generally involves lowering the production of biogas and then venting the remaining biogas to the atmosphere. Another potential source of methane emissions is flaring at these facilities. The Air District is currently working with the Bay Area Clean Water Agencies (BACWA) to better understand these emissions and their potential to exceed the thresholds in draft Rule 13-1.

Solid Waste Disposal

Landfill gas (LFG), a natural byproduct from the decomposition of organic materials, is composed of approximately 50 percent methane, 50 percent CO_2, and a small amount of non-

methane organic compounds.[i] Typical sources of methane emissions in solid waste landfills include wellheads, gas collection systems, landfill surfaces and flares that are non-operational or not operating at maximum efficiency. Some landfills also include composting operations, which may be an additional source of methane emissions when best operations practices are not employed. At least one Bay Area landfill captures and converts LFG into renewable energy as a way of abating methane emissions. However, LFG collection efficiency at Bay Area facilities can range widely, anywhere from 10 to 90 percent.[j]

LFG emissions are subject to federal, State and Air District regulations. These regulations require landfills of a certain size to install and operate a gas collection and control system. Additionally, since 2011, the Air District has enforced a CARB MOU regulating GHG emissions from landfills.[k] Also, Air District Rule 8-34 limits methane and non-methane organic emissions from landfills handling one million tons of decomposable solid waste or more. Rule 8-34 exempts smaller, closed, or inactive landfills as well as certain areas such as the active face.

III. DRAFT REGULATION 13, RULE 1: SIGNIFICANT METHANE RELEASES

Regulation 13, Rule 1 is the first Air District rule to focus on climate protection by regulating methane emissions. This section describes the purpose of this draft Rule, outlines its emissions standards, and explains how compliance with these standards would be determined. In addition, this section discusses estimated emissions from significant methane releases in the Bay Area and expected methane emissions reductions, costs and cost effectiveness associated with draft Rule 13-1.

A. Major Definitions

Section *13-1-201 Abate*: This definition expresses the maximum allowable methane emission concentration (500 ppm) that a significant methane release must comply with after it is abated. This definition also provides examples of common abatement methods.

Section *13-1-204 Methane Release*: This definition explains what a methane release is, states the two types of sources that are likely to release methane, and provides examples of such sources.

Section *13-1-205 Methane Release Emission Concentration*: This definition expresses the unit of measurement for methane release concentrations in parts per million (ppm).

Section *13-1-206 Methane Release Mass Emission Rate*: This definition references the allowable methods for determining methane mass emissions rates in pounds per day.

Section *13-1-207 Minimization*: This definition states the requirement to take practical, immediate steps to reduce methane emissions to the lowest achievable concentration before action is taken to reduce the release to comply with abatement requirements.

Section *13-1-208 Recurrent Methane Releases*: This definition clarifies what constitutes multiple releases from the same source, and thus, what is considered a problematic source of methane emissions requiring closer scrutiny and timely abatement action.

Section *13-1-209 Significant Methane Release*: This definition expresses the emission threshold for a significant methane release, thus requiring action from the owner/operator of the facility.

Section *13-1-211 Type A Source*: This definition clarifies the type of sources that typically release methane in a manner that can be measured using traditional source test techniques.

Section *13-1-212 Type B Source*: This definition distinguishes Type B sources from Type A sources by requiring methane emission measurement methods that are different from those used by Type A sources. Such methods are known as flux methods and require APCO approval prior to use.

B. Purpose of Rule 13-1

Currently, there is no Air District rule specifically designed to address large releases of methane. Air District Regulation 8, Rule 2: Miscellaneous Operations (Rule 8-2) prohibits releases of organic compounds that exceed 15 (lb/day) (and a concentration of 300 ppm) throughout the region but methane and natural gas are excluded from that prohibition. As mentioned previously in this report, Air District Regulation 7: Odorous Substances addresses odor complaints while Regulation 1, Section 1-301 addresses public nuisances, which can and have occurred as a result of a significant methane release, especially when a release of odorized methane occurs near a populated area. However, significant methane releases are of concern to the Air District even if they do not present a public nuisance because methane is a potent greenhouse gas. Thus, the Air District is developing draft Rule 13-1 which seeks to establish a concentration threshold (in ppm) above which methane releases would be prohibited in the region. This limit would apply to all District-regulated stationary sources, including methane leaks from landfills, natural gas facilities, refineries, wastewater treatment operations, bulk plants and bulk terminals. This rule would serve as a near-term action, or backstop, while additional regulatory efforts to address industry-specific sectors are developed. Draft Rule 13-1 would apply to methane sources excluded from other rules limiting organic emissions.

The purpose of draft Rule 13-1 is to limit emissions from significant methane releases throughout the Bay Area. For the purposes of this draft Rule, the term "release" includes all manners in which methane is discharged into the ambient air including planned venting and fugitive emissions. Examples of methane releases include fugitive leaks, process upset bypasses, blowdowns,[16] turnarounds[17] and combustion emissions. The term "minimization" refers to the requirement for the owner or operator of a source to reduce a significant methane

[16] Defined as the removal of liquids or solids from a vessel or line via the use of pressure
[17] Defined as the scheduled shutdown of a process unit for maintenance or repair work

release as soon as is practicable by using best practices immediately upon detection of the release. The term “abate” refers to the requirement for the owner or operator of a source to reduce a significant methane release to an emission concentration below 500 ppm within the timeframe prescribed by Rule 13-1.

While draft Rule 13-1 would apply to all Air District-regulated facilities and operations, it would likely only affect those facilities that process, store, or use large amounts of natural gas or products containing methane. The types of sources most likely to be subject to the requirements of Rule 13-1 would include natural gas facilities, petroleum refineries, landfills, and wastewater treatment operations. Staff is also evaluating potential Rule 13-1 impacts on other sectors including bulk plants, bulk terminals and gasoline terminals.

While Air District staff has identified most sources that may potentially have methane releases above the abatement requirement threshold in Rule 13-1, it is not practical to identify each and every single potential source because there may be natural gas consumers unknown to the Air District that have the potential to cause a significant methane release. Thus, this Rule would apply to all Bay Area facilities and operations that are the cause of such a release. As mentioned earlier in this Report, sources of methane emissions in some sectors are currently regulated by federal, State or Air District rules or regulations that may directly or indirectly limit these emissions. Thus, it is unlikely that these sources will release methane gas in sufficient quantity to trigger abatement requirements in Rule 13-1 with any regularity. However, preliminary discussions with industry representatives indicate that methane may be released from certain operations not regulated by existing rules, and in significant quantities to potentially be subject to Rule 13-1 requirements. Staff is in the process of quantifying emissions from these operations and identifying cost-effective control options, if available. Moreover, other industrial sectors not currently subject to methane regulations may potentially release methane gas in high enough concentrations to potentially subject them to the requirements in draft Rule 13-1. Thus, Rule 13-1 would cover all sectors as a backstop rule, addressing methane releases in the Bay Area that are not addressed by industry- or operational-specific methane rules.

Bay Area sources emit methane gas at various frequencies and in various concentrations and amounts depending on a multitude of factors. Although it is an organic compound, methane is not historically a regulated air contaminant because it is not a precursor to ozone formation and, as such, has been excluded from most of the Air District rules regulating organic compounds. However, facilities subject to Air District Regulation 8, Rule 18 (Rule 8-18): Equipment Leaks, and to Air District Regulation 8, Rule 34 (Rule 8-34): Solid Waste Disposal Sites, are subject to provisions within those rules that abate all organic emissions, including methane. Nevertheless, draft Rule 13-1 would address potential sources of methane that are not subject to the requirements of these rules within facilities subject to the provisions of Rule 8-18 and Rule 8-34. Examples include Type A sources such as such as flares and vented biogas from anaerobic digester maintenance, and Type B sources such as wastewater ponds and composting piles. For the purposes of Rule 13-1, a Type A source, such as a stack, is defined as a source with sufficient geometry whereby emissions can be quantified via traditional source test techniques. A Type B source, on the other hand, such as a compost pile or a wastewater pond,

is defined as a source that is not a Type A source whereby emissions can be quantified via flux methods.

C. Emissions Standards

Draft Rule 13-1 covers both unplanned and planned significant methane releases, including those that result from maintenance or repair operations. Unplanned significant releases are an emission of a gas or product containing methane from a leak, rupture or similar event whereas planned releases include expected or anticipated venting of a gas or product containing methane as a result of maintenance, inspection, safety or repair of equipment.

Significant Methane Releases

Should a source experience a methane release that has a concentration of 10,000 ppm or greater, the leak must be repaired as required in Sections 13-1-301 and 302. Methane releases equal to or greater than 10,000 ppm, with mass emissions of less than 10 lb/day may be granted a limited exemption. This exemption would require the facility operator to determine daily mass emissions over three consecutive days, using the methods described in Section 13-1-602, to establish that the release is under 10 lb/day on each of those days and, therefore, even though the release is over 10,000 ppm, the release emits less than a significant mass of methane in the Air District's view. The mass emission limited exemption is based on a Washington State University study[i] that demonstrated leaks over this threshold were responsible for over half of the emissions from the natural gas local distribution system. PG&E, a local natural gas and power company, has conducted extensive methane emission studies on their natural gas storage and distribution network to validate these results for their system. In stakeholder discussions, PG&E representatives have shared their analysis showing that methane releases above 10 standard cubic feet per hour (equals approximately 10 lb/day) comprise a majority of emissions from their pipelines. The mass emission exemption is also partially based on the Air District Regulation 2, Rule 2 requirement for Best Available Control Technology (BACT) reviews of non-precursor organic compounds when emissions exceed 10 lb/day.[18] Daily mass emissions may not be averaged, but rather must be under the 10 lb/day threshold on each day of that period. A limited exemption must be petitioned for and approved by the Air District.

Other Limited Exemptions

As mentioned earlier in this report, a small percentage of methane leaks account for a significant percentage of methane emissions; however, leaks do not account for all methane emissions. Methane gas is sometimes released into the atmosphere to address specific situations. Examples of these planned releases include releases from pressure relief valves and pneumatic valves for safety reasons, venting of gas from wastewater plant spheres in preparation for maintenance, and releases from landfill gas wells during maintenance

[18] http://www.baaqmd.gov/~/media/files/engineering/bact-tbact-workshop/bact-tbact-policy-and-implementation/introduction.pdf?la=en

procedures. A variety of these planned releases are subject to limited exemptions, described in Section 13-1-104 for maintenance and repair activities, and Section 13-1-105 for the landfill working face. While some planned releases can be abated readily, or in such a way that would not trigger the 10,000-ppm threshold for abatement requirements, other types of planned releases, such as the venting of wastewater treatment spheres or blowdowns from natural gas pipeline replacement projects may trigger abatement requirements., These types of processes can sometimes release very significant amounts of methane gas. Staff has included a limited exemption provision that would allow such operations to occur; however, the methane release would have to be abated in a shorter period of time compared to unplanned releases in order to lessen methane emissions normally produced by such operations. Section 13-1-103 is a limited exemption that will allow another type of significant methane release, petroleum refinery flaring operations, to occur provided the refinery owner/operator can demonstrate each flare is in compliance with the Environmental Protection Agency's control requirements for flares – 40 CFR § 63.670 that go into effect in January 2019.

Defining a Significant Methane Release

Both planned and unplanned methane releases can result in methane emissions in quantities that can be significant. The purpose of draft Rule 13-1 is to regulate all potential sources of significant releases in the Bay Area by requiring them to abate the release upon detection or as soon as possible. In some cases, methane releases may be abated by a simple turn of a valve or screw, in other cases, equipment parts might have to be replaced, or the release might have to be controlled with a thermal oxidizer or other portable technology.

Air District staff proposes that methane releases with a concentration above 10,000 ppm be considered a significant release under draft Rule 13-1. This emission limit is based on the detection capabilities of portable methane gas screening technologies currently available that can detect methane from a distance. Methane releases with a concentration of at least 10,000 ppm can be detected remotely by using optical gas imaging cameras (sometimes referred to as FLIR cameras) and other technologies. This standard is also consistent with the 10,000-ppm methane concentration emission limit that was included in the recently adopted leak detection and repair provision in the CARB Oil and Gas Rule.[m] Staff has determined that within the entire range of potential methane releases, 10,000 ppm is a logical threshold to define significant releases on a region-wide scale. This threshold is staff's initial draft emission limits but the Air District seeks input from interested stakeholders on the efficacy and appropriateness of this value. It should be noted, however, that 10,000 ppm does not always equate to a significant amount of mass emissions. If the release flow rate is relatively low, the volume of the leak has the potential to be small. Thus, a low-volume exemption has been included in the emissions standards for draft Rule 13-1. For all types of sources, if an owner or operator can demonstrate that the 10,000 ppm or greater release has mass emissions that are less than 10 lb/day, the release does not have to be abated. However, it does still have to be monitored and recorded.

Based on preliminary internal and external stakeholder comments, staff considered an alternative approach of defining significant release thresholds based solely on mass emissions. In this approach, draft Rule 13-1 would have provided a mass emission limit of 10 lb/day

instead of the 10,000-ppm concentration threshold. Advantages of a mass emission limit could have included providing additional compliance options and reducing costs for certain industries since it could potentially reduce the need to purchase additional leak detection equipment. Disadvantages of this approach could have included the potential of conducting more measurements to determine compliance, because to calculate mass emissions the releases must be determined at the source (and cannot be screened from a distance). Furthermore, methane mass emissions can be determined more readily by some industries than others. Staff has decided not to pursue a mass emission limit as the only emission standard since the disadvantages currently outweigh the advantages.

D. Determination of Compliance

Detection of Significant Methane Releases

Draft Rule 13-1 does not require monitoring for methane releases through a formal LDAR program prior to the initial detection of a significant release; however, facilities that are already required by State or federal regulations to monitor for methane leaks will detect significant methane emissions, and thus, abate them in accordance with the proposed requirements in the 300 Section of draft Rule 13-1. Facilities may also become aware of an unplanned significant release via process upset indicators or odor complaints from the general public. Some facilities or operations are already monitoring for methane at different frequencies per existing federal, State or Air District rules. Table 2 below lists all existing requirements – State and federal – that some industrial sectors must currently comply with to monitor for methane emissions.

Authority Body	Rule/Regulation/Statute
BAAQMD	Regulation 8, Rule 18: Fugitive Leaks
BAAQMD	Regulation 8, Rule 34: Solid Waste Disposal Sites
CARB	Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities
CA Legislature	California Global Warming Solutions Act of 2006 – AB 32 (Reporting Requirement for GHGs)
CA Legislature	SB 887 – Pavley. Natural gas storage wells
CA Legislature	SB 1371 – Leno. Natural gas: leakage abatement
EPA	2016 New Source Performance Standards (NSPS) – 40 CFR Part 60 Subpart OOOO*

*EPA proposing to stay certain parts of this rule.

The Air District is planning to include a leak detection and repair (LDAR) program frequency and other parameters in sector-specific methane rules, in coordination with requirements from existing regulations.

Measurement Methodology

Unlike other Air District rules requiring organic compound measurements be performed at the source using specific technology, draft Rule 13-1 would allow the use of a variety of technologies to detect and quantify methane releases provided the equipment meets stipulated parameters in Rule 13-1. For detection, Rule 13-1 would allow any methane

screening detection device demonstrated to be capable of measuring concentrations of at least 10,000 ppm, such as certain Forward Looking Infrared (FLIR) cameras. For compliance with abatement standards, laser equipment or handheld combustible gas indicators capable of measuring methane concentrations of at least 100 ppm are suitable. All detectors must be approved by the Air District to measure methane releases prior to their use for compliance with draft Rule 13-1. Air District staff is developing methods to measure the methane concentration of a release from both Type A and Type B sources. The Air District is seeking comment from stakeholders on potential methane measurement methodologies that may be suitable for this rule.

To apply for the limited exemption for methane releases emitting less than 10 lb/day, Draft Rule 13-1 requires the use of EPA Protocol for Equipment Release Emissions Estimates, Chapter 4, Mass Emissions Sampling to determine methane mass emissions rates for any Type A sources or an APCO-approved alternative (Section 13-1-602). Air District staff is developing a method to determine methane mass emission rates for releases from Type B sources. The Air District is seeking comment from stakeholders on methodologies suitable for this rule.

E. Estimated Emissions and Emissions Reductions

Draft Rule 13-1 would prohibit significant methane releases with a concentration above 10,000 ppm (one percent by volume) from all sources in the Bay Area region. The Rule exempts significant releases below 10 lb/day, if the facility owner or operator can demonstrate that the mass emissions stay under this threshold for three consecutive days. Estimating a range of potential emissions from "typical" scenarios featuring a significant methane release can help provide context on the magnitude of these releases. As a lower emission scenario, staff considered a methane release with the lowest leak rate still considered as significant by the draft Rule (10 lb/day) and a duration of 90 days (discovered by a quarterly inspection). GHG emissions for this scenario would be approximately 35 MT CO_2e, roughly equivalent to the yearly GHG emissions produced by seven typical cars on the road.[n] On the higher emissions scenario, methane would be released at rate of 40 pounds per day for three years (a typical natural gas distribution leak survey frequency). Various studies have measured similar or higher leak rates from components at natural gas production or gathering facilities.[o] In this plausible scenario, one methane leak could result in approximately 1,700 MT CO_2e, comparable to the GHG emissions of about 363 typical cars driving on the road for a year.

In the Aliso Canyon event, the leak had a duration of almost four months and a leak rate of 1 – 3 million pounds per day, resulting in approximately 109,000 MT of methane (or 9.4 million MT CO_2e). Methane releases of this magnitude have not been recorded in the Bay Area. CARB's Oil & Gas regulation has imposed continuous monitoring and repair requirements on natural gas underground storage facilities that help to minimize the possibility of a catastrophic significant release event similar to the Aliso Canyon natural gas leak. However, there is always the possibility of a significant methane release from these and other sources in the Bay Area.

The next section will discuss our current knowledge of emissions from different sectors and factors that will affect potential emissions reductions from implementing draft Rule 13-1.

Oil & Gas Sector

Natural Gas System

According to the most recent Air District methane emissions inventory estimate, the Bay Area natural gas system emitted roughly 1.5 million MT CO_2e in 2012. These emissions resulted from leaks, component emissions, and venting from equipment used in the storage, transmission and distribution of natural gas in the Bay Area. Methane emissions from this system are subject to annual mandatory reporting and to 26 best practices required by CPUC's SB 1371 Natural Gas Abatement Program. These best practices include leak prevention, detection (including system-wide leak surveys every three years and enhanced methane detection), and repair. The leak repair best practice (BP 21: "Find It/Fix It") states that "Utilities shall repair leaks as soon as reasonably possible after discovery, but in no event, more than three years after discovery. Utilities may make reasonable exceptions for leaks that are costly to repair relative to the estimated size of the leak". Given the updated methane emissions information being made available for this sector by the SB 1371 program, as well as the mandatory best practices for the industry, the Air District is working on better quantifying emissions and potential emissions reductions due to draft Rule 13-1 for this system.

Natural Gas & Crude Oil Production

CARB estimated that 68 active crude oil and natural gas facilities in the Air District emitted a total of approximate 0.2 million MT CO_2e, during 2007. However, significant methane releases from these facilities are already be subject to CARB's Oil & Gas regulation. Therefore, no additional emissions reductions from this sector are expected from draft Rule 13-1.

Petroleum Refineries

Currently, methane emissions from refineries are estimated to constitute approximately two percent of the methane emitted in the Bay Area. However, recent study findings indicate that refinery methane emissions may be closer to eight percent of the Bay Area inventory (see *Methane Emissions in the Bay Area* section). The Air District is currently conducting and collaborating on research to better quantify methane emissions from this sector. Air District staff is also working with WSPA and the Bay Area refineries to identify, characterize, and quantify different sources of methane emissions at individual facilities. Therefore, emissions reductions from implementing draft Rule 13-1 at refineries are difficult to quantify at this time.

Sources of Biological Methane

Landfills

Landfills are estimated to be responsible for about 51 percent of all the Bay Area methane emissions (approximately 5.3 million MT CO_2e per year), though recent work contracted by the Air District has indicated that this sector's methane emissions may be up to two and a half times higher (see *Methane Emissions in the Bay Area* section). The Air District is currently researching methane and other emissions from landfills to better understand the individual emission sources and patterns (e.g., large releases vs. small distributed emissions) within these

facilities. As such, it is difficult to quantify potential emissions reductions from implementing draft Rule 13-1 at this time.

Composting and Wastewater Treatment Operations
The Air District is actively trying to improve our understanding and better quantify emissions from these methane sources. The Air District is currently working with BACWA to assess wastewater treatment emissions and their potential to exceed the thresholds in draft Rule 13-1. Air District staff is also conducting research to better characterize methane emissions from composting facilities, particularly given the increase in organic materials being processed at some of these facilities to meet the State's organics diversion goals. Methane emissions from significant methane releases and potential emissions reductions from implementing draft Rule 13-1 at composting and wastewater treatment facilities cannot be estimated at this time.

F. Costs

The costs to abate methane releases are expected to vary widely depending on the type of source and nature of the release. There are four types of costs to consider: 1) the cost for technology to initially detect potential releases, to monitor each release during the abatement process and to detect recurring releases; 2) the cost to determine mass emissions; 3) the cost to minimize and ultimately abate the releases; and, 4) the cost for staff time.

In some cases, facilities already own and operate methane detection devices. Because draft Rule 13-1 would not require an LDAR program for the initial detection of a significant leak, staff assumes the owner or operators that do not currently own methane detection devices would prefer to rent rather than purchase a device when it is necessary to use one. The costs of renting portable methane detection devices such as flame ionization detectors, infrared detectors and laser-type detectors range between $300 to $500 per week while the costs to purchase these devices range between $20,000 to $100,000.[p,q] The most expensive device to purchase, which is a screening tool and cannot be used to verify compliance with the 500 ppm emission requirement, is an Optical Gas Imaging Camera (OGI) that is based on infrared technology. Owners or operators would need to use a device capable of measuring methane concentrations as low as 100 ppm to verify compliance with the 500-ppm limit. Costs to hire a contractor to survey one acre of property is approximately $1,000 per day, using one person to conduct the survey.[r] Assuming it takes approximately a total of three hours to gather necessary data, including flow rates and concentrations, staff estimates the cost for two facility workers to determine mass emissions from Type A sources will range between $400 to $500. Assuming a facility has built their own flux chamber at a one-time cost of $4,500 to $5,500, including parts and labor, staff estimates a cost of $600 to $700 to perform a flux sampling procedure to determine mass emissions from a Type B source. Based on discussions with a vendor, the cost to hire a contractor to perform a flux test to determine mass emissions from a Type B source will range between $1,400 to $1,600.[s]

It is not reasonable to attempt to estimate how many significant releases are likely to occur in a given span of time in the BAAQMD air basin nor can staff estimate the magnitude of each

significant release. Because of this uncertainty, staff has estimated costs based on a range of significant release scenarios from best-case to worse-case scenario. The majority of costs the facility will incur to abate a significant release are more directly related to the abatement of the release, rather than the detection of the release, because draft Rule 13-1 does not include an LDAR requirement for the initial detection of a release. Costs for recurring releases are difficult to estimate due to the variety of factors that can cause significant releases to occur repeatedly in a wide range of industry sectors. Staff assumes the cost for industry to address a second release from the same source (including both the cost to detect and to abate the release) to be similar to the cost incurred for dealing with the initial release. Section 13-1-302 would require the source of a recurring release to be replaced or shut down upon experiencing a third significant release. The costs to replace or shut down a source of recurring significant methane releases are not possible to estimate due to the numerous types of equipment and operations, within a wide range of industry sectors, that are potentially subject to this rule.

It is not possible to estimate the costs to abate releases due to the array of source types in different industry sectors with the potential to release methane significantly. At times, it may be possible to effectively abate a release by repairing the source of the release. Other times, equipment and other components may have to be replaced. Furthermore, abatement of a release may require the leasing of control equipment, such as a thermal oxidizer or an in-line natural gas compressor. Costs to rent such equipment range between $5,000 per day for a thermal oxidizer and $15,000 to $200,000 per month to lease in-line compressors to recover natural gas range depending on the compressor's flowrate handling capacity.[t] When leased for 30 days, in-line compressors are generally used for multiple, coordinated projects to maximize the cost effectiveness.

The cost for staff time during a significant release event will also vary. A best-case significant release scenario assumes that a release can be abated quickly by turning a couple of bolts or a couple of screws to tighten down a loose piece of equipment. In this scenario, costs reflect the total time to measure and abate the release is two hours. Costs also reflect two to three hours of staff time to report the event to the Air District. This includes time to perform calculations – if necessary. Total costs for staff time in a best-case scenario will range from approximately $210 to $265. In a middle of the road scenario, faulty equipment might have to be repaired or replaced. The cost for staff time could range from $510 to $2,110 depending the number of field staff necessary to abate the release. The cost to repair or replace equipment could cost between $500 to $10,000. Total cost for a middle of the road scenario is estimated to range from $1,700 to $12,110. A worst-case (non-catastrophic) significant release scenario assumes that it may take up to 60 days to fully abate an ongoing release event using multiple field staff working on the source of the release. Such a scenario would assume 12 to 18 hours of staff time to work on source of the release and another 12 to 18 hours of office staff time to coordinate with operators, contractors and to report the events to the Air District multiple times for the ongoing release. This includes time to perform calculations if necessary. Costs to abate the release are assumed be at least $100,000, which include labor to operate special

equipment to provide access to the source of the leak release and to abate the release including the cost for replacement equipment in the case of a recurring release event. Total costs for a worst-case scenario is estimated to range from $104,910 to $107,310. By comparison, costs for the SoCalGas Company stemming from the catastrophic Aliso Canyon leak approached 1 billion dollars,[19] including environmental repair and other expenses.

Costs assume the total compensation for field staff spanning a cross-section of industry is $50 per hour. Assumed total compensation for office staff responsible calculating emissions and reporting significant release events to the Air District is $55 per hour.

The Air District is requesting stakeholder input on potential costs to comply with the requirements of draft Rule 13-1 for different sectors and operations.

IV. RULE DEVELOPMENT / PUBLIC CONSULTATION PROCESS

In developing this draft of Regulation 13, Rule 1: Significant Methane Releases, Air District staff conducted extensive research on the topic of methane emissions. As part of this process, staff convened and met with an expert panel consisting of representatives from academia, industry, and non-governmental organizations such as 350 Bay Area and the California Environmental Defense Fund. Staff also conducted multiple stakeholder meetings with representatives from the five Bay Area petroleum refineries and the Western States Petroleum Association (WSPA) on March 5, 2018 and again on June 6, 2018, the California Council for Environmental and Economic Balance (CCEEB) on March 5, 2018, PG&E on March 13, 2018, wastewater treatment facilities on March 13, 2018, and landfills on March 22, 2018 to request feedback on early concepts of draft Rule 13-1. A follow-up meeting with PG&E occurred on Thursday August 9, 2018 to discuss their accelerated detection program to repair super emitter methane leaks. Staff met on August 14, 2018 with representatives from WSPA and bulk plants/bulk terminals, and on the following day August 15, 2018 with representatives from WSPA and petroleum refinery hydrogen plants, to discuss the applicability of Rule 13-1 to their operations. Feedback from these two meetings will be addressed during the workshops.

The Air District will conduct two public workshops approximately 30 days after the publication of the draft rule and this workshop report to solicit comments from the public on draft Regulation 13, Rule 1. The first workshop will be scheduled in or near the city of Fremont, CA. The second workshop will be scheduled in the Yerba Buena Room at the Air District Office (375 Beale Street, San Francisco, CA 94105).

During the workshops, Air District staff will seek comments and answer questions on the Draft Rule and the material presented in this report. Staff will review and consider all comments received during the public workshop and revise the proposed rule as appropriate. Staff is

[19] https://www.scpr.org/news/2018/02/27/81190/costs-from-aliso-canyon-gas-blowout-near-1-billion/

specifically seeking comment from potentially affected facilities and other interested parties on the feasibility of the Draft Rule.

Staff will prepare an analysis of the anticipated environmental impacts according to the California Environmental Quality Act (CEQA), a socioeconomic analysis, a final Proposed Rule and a staff report. All items will be available for public comment prior to finalization of the proposed rule. A proposed rule will then be submitted as an item for consideration at a public hearing before the Air District's Board of Directors.

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