Proposed Amended Rule 1118: Control of Emissions from Refinery Flares

Working Group Meeting #4

October 25, 2023

Join Zoom Webinar

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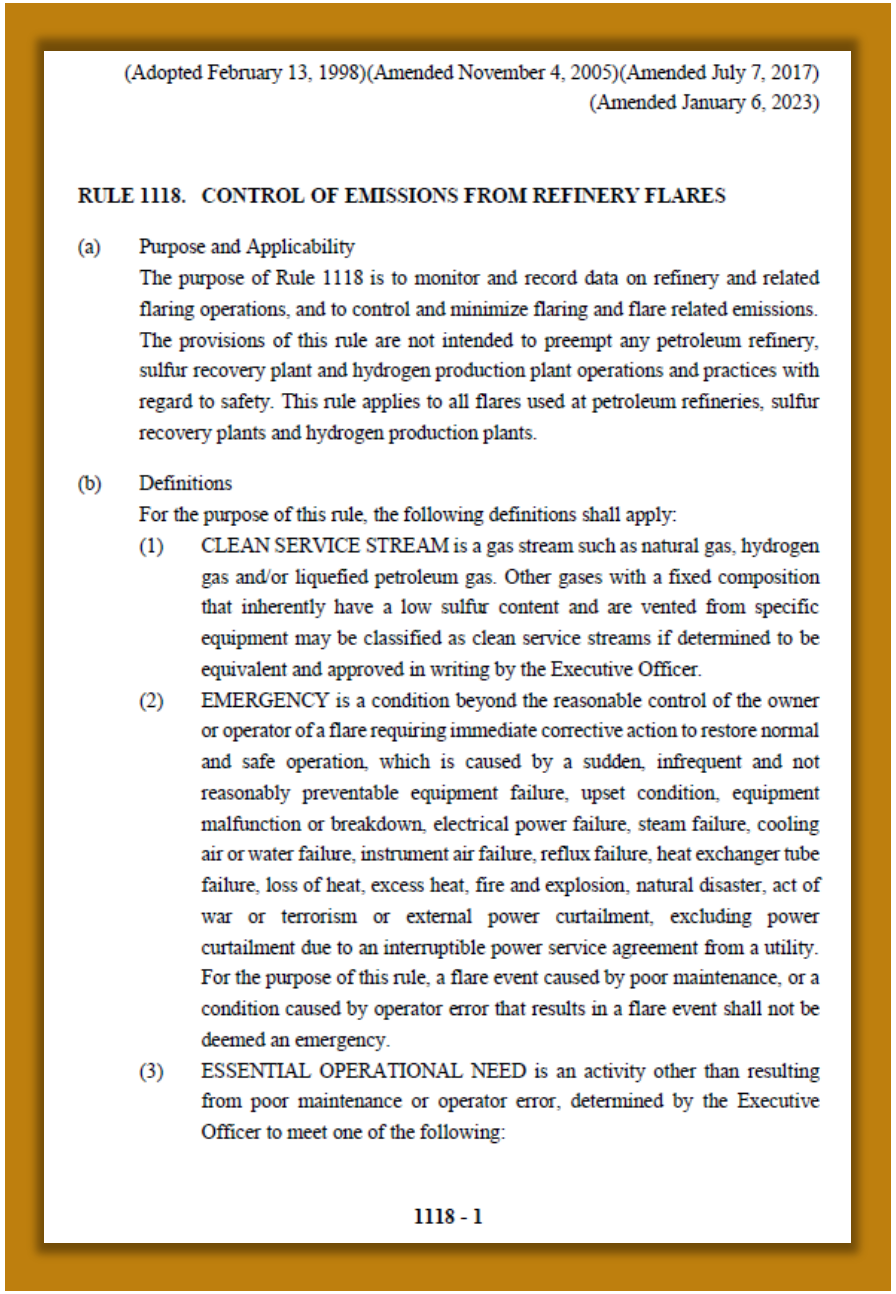
Agenda

- Regulatory Background
- Summary of Working Group Meeting #3 and Progress Since Meeting
- Presentation by an Optical Remote Sensing Technology Vendor
- SO_2 Performance Target and Mitigation Fees
- Clean Service Flares (Hydrogen and LPG Flares)
- Next Steps

Regulatory Background

Rule 1118 Background

- Rule 1118 was adopted on February 13, 1998, and was amended in 2005, 2017, and 2023
- Eight petroleum refining facilities, three hydrogen plants, and one sulfur recovery plant within Los Angeles County operate a total of 31 flares subject to Rule 1118
- Rule 1118 requires facilities to submit notifications and reports, monitor emissions, meet emissions targets, and maintain a public inquiry hotline



(Adopted February 13, 1998)(Amended November 4, 2005)(Amended July 7, 2017)
(Amended January 6, 2023)

RULE 1118. CONTROL OF EMISSIONS FROM REFINERY FLARES

(a) Purpose and Applicability

The purpose of Rule 1118 is to monitor and record data on refinery and related flaring operations, and to control and minimize flaring and flare related emissions. The provisions of this rule are not intended to preempt any petroleum refinery, sulfur recovery plant and hydrogen production plant operations and practices with regard to safety. This rule applies to all flares used at petroleum refineries, sulfur recovery plants and hydrogen production plants.

(b) Definitions

For the purpose of this rule, the following definitions shall apply:

(1) CLEAN SERVICE STREAM is a gas stream such as natural gas, hydrogen gas and/or liquefied petroleum gas. Other gases with a fixed composition that inherently have a low sulfur content and are vented from specific equipment may be classified as clean service streams if determined to be equivalent and approved in writing by the Executive Officer.

(2) EMERGENCY is a condition beyond the reasonable control of the owner or operator of a flare requiring immediate corrective action to restore normal and safe operation, which is caused by a sudden, infrequent and not reasonably preventable equipment failure, upset condition, equipment malfunction or breakdown, electrical power failure, steam failure, cooling air or water failure, instrument air failure, reflux failure, heat exchanger tube failure, loss of heat, excess heat, fire and explosion, natural disaster, act of war or terrorism or external power curtailment, excluding power curtailment due to an interruptible power service agreement from a utility. For the purpose of this rule, a flare event caused by poor maintenance, or a condition caused by operator error that results in a flare event shall not be deemed an emergency.

(3) ESSENTIAL OPERATIONAL NEED is an activity other than resulting from poor maintenance or operator error, determined by the Executive Officer to meet one of the following:

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AB 617 Background

- AB 617 signed into law in 2017
  - Statewide strategy to reduce toxic air contaminants and criteria pollutants in designated environmental justice communities
  - Establishes community-focused and community-driven actions to reduce air pollution and improve public health
- Wilmington/Carson/West Long Beach (WCWLB) is one of the first designated AB 617 communities
- Most of the refineries located in Wilmington/Carson/West Long Beach

Slide from WGM #2

AB 617 Community Emissions Reduction Plans (CERPs)

WCWLB CERP included the following action items for Rule 1118:

- Lower performance targets and/or increased mitigation fees
- Increase capacity of vapor recovery systems to store gases during shutdowns
- Header modifications for gas diversion with process controls
- Back-up power systems for key process units
- Remote optical sensing for flare emission characterization
- Lower-emission flaring technologies
- Additional flare minimization plans

WCWLB CERP: http://www.aqmd.gov/docs/default-source/ab-617-ab-134/steering-committees/wilmington/cerp/final-cerp-wcwlb.pdf?sfvrsn=8

6

Summary of Working Group Meeting #3 and Progress Since Meeting

Summary of Working Group Meeting #3

Staff discussed:

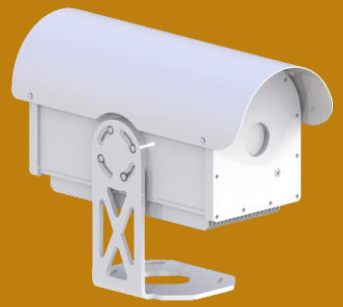
- Regulatory background of Rule 1118
- Summary of staff's assessment of site visits to facilities
- Flare events data analysis
- Summary of scoping documents prepared by facilities
- Preliminary concepts for Proposed Amended Rule 1118
  - Potential options to reduce flaring at clean and general service flares
  - Revise data substitution methodology
  - Require improved public access to flare event data
- Proposed updates to FENS

Progress Since Previous Working Group Meeting

Staff continued rule development

- Continued evaluating:
  - Flare event data and emissions
  - Control options for SO_2 emissions
  - Flaring reduction at clean service flares
- Meeting with technology vendors and stakeholders
- Drafting proposed amendments to rule language

PROVIDENCE PHOTONICS



Remote Sensing Technologies: Providence Photonics

Introducing Optical Remote Sensing Technology for Flare Monitoring

- Optical remote sensing technology primarily measures flare combustion efficiency
  - Direct measurement versus indirect
  - U.S. EPA has conducted testing using VISR technology
- Staff met with Zeeco, Providence Photonics, and EPA
- Providence Photonics will present information on their technology
  - Mantis and Mantis Light Video Imaging Spectral Radiometry (VISR) technology

SO_2 Performance Target

Considerations for Sulfur Dioxide Performance Target

- Rule 1118 establishes a performance target for sulfur dioxide (SO_2) emissions
- Current SO_2 performance target is 0.5 tons per million barrels (MMbbl) of crude processing capacity (averaged over one calendar year)
  - Staff is considering to lower the SO_2 performance target to 0.25 tons/MMbbl to address the AB 617 CERP requirement to achieve 50 percent reduction in flaring emissions
  - Require more frequent flare minimization plans (FMP) and mitigation fees
- If performance target is exceeded, facilities are required to submit an FMP and pay mitigation fees
  - Fees are determined based on the percent of emissions in excess of facility-specific performance target

$$Facility\ Specific\ Performance\ Target\ [Tons\ of\ SO_2] = Performance\ Target\ \left[\frac{Tons\ of\ SO_2}{Million\ Barrels}\right] \times Crude\ Processing\ Capacity\ [Million\ Barrels]$$

SO_2 Performance Target Calculation

- Facility-specific SO_2 performance target is calculated based on a facility's 2004 crude processing capacity
  - Processing capacity for most refineries has not changed since 2004
  - Publicly available on California Energy Commission's (CEC) website*
- Two facilities have had operational changes:
  - AltAir (World Energy) transitioned from crude oil to alternative feedstocks
    - Decreased capacity from 18.3 MMbbl/yr to 1.3 MMbbl/yr
    - Will increase capacity in coming years
  - Marathon integrated the operations of their Wilmington and Carson refineries

* *Information on California's Oil Refineries – https://www.energy.ca.gov/data-reports/energy-almanac/californias-petroleum-market/californias-oil-refineries*

SO_2 Performance Target Calculation (*cont.*)

- Staff proposing to update reference value for process capacity used to calculate facility-specific SO_2 Performance Target
  - Prior year's capacity instead of 2004
  - As listed on the CEC's website
  - If facility is not listed on CEC website, require annual process capacity report
    - Reporting requirement will apply to AltAir (World Energy)

California's Oil Refineries

(Data current as of September 1, 2023)

California Oil Refinery Locations and Capacities

Refinery Name	Barrels Per Day	% of California Crude Oil Capacity	CARB Diesel	CARB Gasoline
Marathon Petroleum Corp., Los Angeles Refinery*	363,000	21.22%	Yes	Yes
Chevron U.S.A. Inc., El Segundo Refinery	269,000	15.73%	Yes	Yes
Chevron U.S.A. Inc., Richmond Refinery	245,271	14.34%	Yes	Yes
PBF Energy, Torrance Refinery	160,000	9.35%	Yes	Yes
PBF Energy, Martinez Refinery	156,400	9.14%	Yes	Yes
Valero Energy, Benicia Refinery	145,000	8.48%	Yes	Yes
Phillips 66, Los Angeles Refinery	139,000	8.13%	Yes	Yes

Declining Annual SO_2 Performance Target

SO_2 performance target was added to Rule 1118 in 2005

- In 2005, rule was amended to require petroleum refineries to comply with a declining annual SO_2 performance target
- Target was reduced over a six-year period to gradually reduce emissions

Annual SO_2 Performance Target

Facility	Crude Oil Capacity (2004) (Million Barrels)	Facility-Specific SOx Performance Target (tons/yr)				
		2006 Target 1.5 tons/mmbbls	2008 Target 1.0 tons/mmbbls	2010 Target 0.7 tons/mmbbls	2012 Target 0.5 tons/mmbbls	Proposed Target 0.25 tons/mmbbls
Marathon Carson	95.2	142.7	95.2	66.6	47.6	24.6
Chevron USA Inc.	95.2	142.7	95.2	66.6	47.6	24.5
Phillips 66	50.9	76.3	50.9	35.6	25.4	12.7
Torrance Refining Co.	54.7	82.1	54.7	38.3	27.4	13.8
Marathon Wilmington and SRP	36.1	54.1	36.1	25.2	18.0	8.7
AltAir (World Energy)	18.3**	27.5	18.3	12.8	9.2	4.6
Valero	29.6	44.4	29.6	20.7	14.8	7.8
Total	**379.9**	**569.8**	**380.0**	**265.8**	**190.0**	**96.5**

** Table Reference (except for the Proposed Target): Rule 1118 Implementation Guidance Document (April 2006)*
*** AltAir changed operations in 2015 and the 2004 value is not longer accurate*

Proposed Reduction of SO_2 Performance Target

- Staff is proposing to further reduce SO_2 performance target to achieve emission reductions
  - Reducing from 0.50 to 0.25 tons/million barrels
  - Would be effective for the 2025 calendar year
- Proposed performance target will achieve the AB 617 CERP goal of 50 percent reduction in SO_2 emissions from flaring

Estimated Emission Reductions

Estimated Emission Reductions[a] at Proposed Annual SO_2 Performance Target 0.25 (ton/Mmbbl)					
Emissions Type	Facilities – All		Facilities – WCWLB		
	TPY	Percent	TPY	Percent	CERP Emission Reduction Target (tpy) by 2030
SO_2	16.6	30	13.8	51[b]	11
VOCs	3.3	16	3.3	20[c]	1
NOx	2.2	15	1.8	17[d]	19

[a] Emission reduction values are calculated based on emissions level in 2017 (AB 617 CERP baseline year), except for VOCs for which values are calculated based on emissions level in 2019 due to updated emission factor for VOCs effective since 2019

[b] CERP's minimum SO_2 emission reduction goal of 50% by 2030 is expected to be achieved through Rule 1118

[c] CERP's minimum VOCs emission reduction goal of 50% by 2030 is expected to be achieved through Rules 1178, 1118, and/or 1173

[d] CERP's minimum NOx emission reduction goal of 50% by 2030 is expected to be achieved primarily through Rule 1109.1 and partially through Rule 1118 – Rule 1109.1 is expected to achieve 1,643 tpy reduction in NOx emissions from WCWLB refineries

Evaluation of Proposed SO_2 Performance Target

- SO_2 performance target of 0.25 tons/MMbbl is achieved in practice at 4 out of 7 crude oil processing refineries since 2017
- Expected reductions in all types of emissions are aligned with AB 617 CERP actions
- Associated costs with reducing emissions are expected to be mainly due to the changes to the operational practices

Year	Chevron	Marathon Wilmington & SRP	Marathon Carson	AltAir	Valero	TORC	Phillips 66
2017	0.00	0.17	0.02	0.001	0.15	0.70	0.30
2018	0.11	0.01	0.03	0.001	0.01	0.20	0.74
2019	0.07	0.43	0.02	0.000	0.01	0.20	0.47
2020	0.03	0.06	0.08	0.001	1.10	0.11	0.20
2021	0.16	0.64	0.06	0.001	0.51	0.10	1.02

Exceeding performance target of 0.5 tons/MMbbl

Exceeding performance target of 0.25 tons/MMbbl

Mitigation Fees

Mitigation Fees Background

- Facilities that exceed SO_2 performance target must pay mitigation fees, determined based on the percent of emissions in excess of facility specific performance target, according to the schedule below

Excess Emissions (%)	Mitigation Fees ($/ton of Excess SO_2)
≤10	25,000
>10 to ≤20	50,000
>20	100,000

- Mitigation fees were established in 2004 and have not changed since
- Rule 1118 Amendment in 2017 included the removal of $4 million annual cap on mitigation fees that are due when a facility's SO_2 emissions exceed SO_2 performance target
- Mitigations fees have been used for certain emission reduction incentive programs
  - Port of long beach zero-emission and hybrid terminal equipment deployment and demo project
  - Zero-emission and clean energy demonstration projects

Staff Proposal for Adjusted Mitigation Fees

- Staff is proposing to increase mitigation fees, accounting for the Consumer Price Index (CPI) adjustment, according to the schedule below

Excess Emissions (%)	Mitigation Fees ($/ton of Excess SO_2)
≤ 10	39,000
> 10 to ≤ 20	79,000
> 20	158,000

- Staff is considering to require adjustment of mitigation fees annually based on the listed CPI for each year by State of California Department of Industrial Relations (https://www.dir.ca.gov/OPRL/)
  - PAR 1118 will include a new attachment to demonstrate how to calculate the mitigation fee instead of including a fix value

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Summary of Proposed Performance Target Changes

Reduce SO_2 performance target from 0.50 to 0.25 tons/MMbbl

☑ Will trigger more Flare Minimization Plans and mitigation fees

Updated calculation of facility-specific performance target based on prior year's process capacity

Increased mitigation fees to reflect increase in customer price index (CPI)

Clean Service Flares

Background

- Clean service streams are low in sulfur content
- Two categories of clean service flares
  - Hydrogen Plant
  - Non-hydrogen plant
    - Liquified Petroleum Gas (LPG) Flares
- Hydrogen Plant Flares
  - Control devices for process vapor streams during normal and abnormal operation, and hydrogen kick back by customer
  - Vent gas composition is primarily hydrogen, methane, nitrogen, and carbon dioxide
- LPG Flares
  - Dedicated to the LPG storage/loading areas of refinery
  - Connected to pressure control devices to control LPG vapors
  - Also serve as controls for large emergency release

Control of Flaring at Hydrogen Production Plants

Background

- Clean service flares at hydrogen production plants are subject to SO_2 performance target, but vent gas stream has very low sulfur content
  - No flare minimization action has been taken at hydrogen flares to comply with SO_2 performance target
  - Never triggered the requirement for a Flare Minimization Plan (FMP) or mitigation fees
    - FMPs require facilities to consider actions to reduce flare emissions
- Staff is considering to establish a NOx performance target to control emissions from flares that are solely used for vent gas streams from hydrogen production plants
  - Further information on staff's proposal will be provided at next Working Group Meeting

Control of Flaring at Liquified Petroleum Gas (LPG) Flares

Initial Considerations for LPG Flares

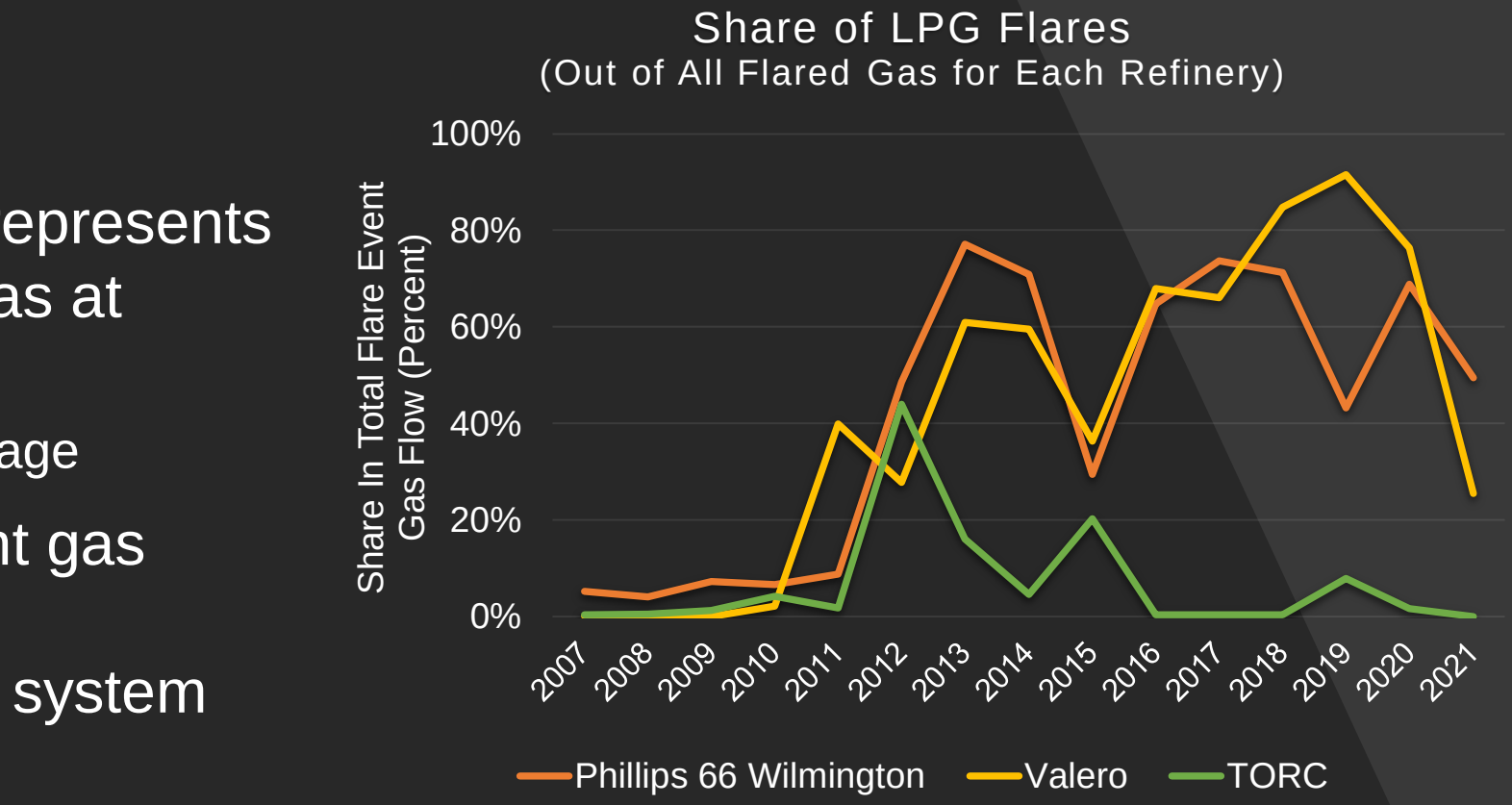
- LPG flares are similar to certain type of flares subject to Rule 1118.1
  - Rule 1118.1 regulates NOx and VOC emissions from non-refinery flares located at landfills, wastewater treatment plants, oil and gas production facilities, organic liquid loading stations, and tank farms
- Flares subject to Rule 1118.1 operating greater than the specified capacity threshold is required to, either:
  - Reduce the level of flaring to below the capacity threshold (e.g., through beneficial use strategies)
  - Replace the flare with a unit complying with the lower NOx emissions limits
- Staff proposing a similar threshold approach to minimize flaring from LPG flares

LPG Flares Background

- LPG flares only combust vent gas from LPG storage tanks
  - LPG composed mainly of propane and/or butane
  - Located at three refineries in storage area (tank farm)
  - Most are not integrated with refinery vapor recovery system
- Gas streams vent to LPG flares when:
  - Gas vapor is relieved from pressure safety valves (PSV) of storage tanks/vessels
  - LPG tanks/vessels are cleaned, inspected, or during turnaround maintenance
- Some facilities continually vent to LPG flares which accounts for majority of the gas flow rate of total refinery flaring

Total Vent Gas from LPG Flares

- 2 out of 3 LPG flares have large amount of flaring
- Gas flow from LPG flares represents high share of total flared gas at these refineries
  - Approximately 60% on average
- One LPG flare has low vent gas flow due to use of a chiller/refrigeration recycle system



Flare Annual Throughput at LPG Flares

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- Vent gas streams to LPG flares are low in sulfur, but generates NOx emissions
  - Reducing flare throughput reduces NOx emissions
- Directing vent gas streams from LPG tanks to refinery vapor recovery system is challenging due to LPG tank location
- Feasible option is to recover LPG stream and recycle back to LPG storage tanks
  - One refinery currently recovering LPG stream using an auxiliary gas chiller/refrigeration system resulting in low annual throughput
  - Recovered LPG can be sold rather than being burned resulting in cost savings

Flare Annual Throughput (MMBtu/year)			
	Phillips 66	Torrance	Valero
2017	58,627	2,200	80,656
2018	33,307	488	62,820
2019	34,600	13,140	86,730
2020	45,013	981	95,244
2021	40,400	225	78,411

Chiller/Refrigeration System for LPG Flares

- Chiller/Refrigeration system for control of emissions from LPG flares requires:
  - Major equipment
    - Compressor with motor and drive package
    - Condenser
    - Structural base
    - Piping
    - Insulation
    - Control system
    - Electrical conduit and upgrades
  - Engineering and design
  - Installation

Cost-Effectiveness and NOx Cost-Effectiveness Threshold

Cost-Effectiveness Threshold

- Established threshold of $349,000 ($325,000 adjusted for CPI) per ton of NOx reduction as a guidance for rulemakings
  - Substantial increase from the $50,000 threshold adopted in 2016 AQMP
- Derived based on a public health benefit-cost approach
  - Benefit-Cost approach is consistent with how U.S. EPA and CARB evaluate costs associated with development of their regulatory programs

Cost-Effectiveness Calculations

- Cost-effectiveness is a measure to compare costs of pollution reduction to amount of pollutant reduced
  - Measured in cost per ton of pollutant reduced
- South Coast AQMD typically uses the *Discounted Cash Flow Method* to calculate cost-effectiveness
  - **Cost-Effectiveness** = Present Worth Value/Emissions Reduced Over Equipment Life
  - **Present Worth Value** = Capital Cost + (Annual Operating Costs x *Present Worth Value Formula*)
  - **Present Worth Value Formula** = $\frac{1-\frac{1}{(1+r)^n}}{r}$
    - r = $\frac{(i-f)}{(1+f)}$
    - *i* = nominal interest rate
    - f = inflation rate
    - n = number of cycles

Cost-Effectiveness Considerations

- Staff used a 25-year equipment life
- Butane/Propane is a valuable commodity that can be recovered rather than disposing in flare:
  - Generates revenue
  - Offsets cost of regulatory compliance
    - Staff estimates cost savings of ~ $392,000 per year (0.71 cents per gallon[1] for propane at 65,000 scf/day recovered)
- Compressor for refrigeration unit require additional electricity and adds cost, but offset due to cost savings of butane/propane recovery (0.21 cents per kWh for industrial electricity rates[2])

1) U.S. Energy Information Administration - EIA – Independent Statistics and Analysis: https://www.eia.gov/todayinenergy/prices.php
2) U.S. Energy Information Administration - EIA – Monthly Table: Electric Power Monthly - U.S. Energy Information Administration (EIA)

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LPG Chiller/Refrigeration System Costs

Cost estimates for system provided from vendors and facility

- Vendor cost estimates included compressor and condenser
- Facility provided cost estimates to send to vapor recovery system and process units
  - Cost adjusted using CPI for 2022-dollar year

Cost estimate includes

- Major equipment
  - $2.5 MM
- Electrical upgrades
  - $1.8 MM
- Installation
  - $3 MM (1.2x major equipment)
- Engineering
  - $3.1 MM
- Total cost: $10.5 MM

Annual O&M costs offset by LPG recovery cost savings

- Butane cost savings ~$392,000
- Annual electricity costs ~$206,000
- Annual cost savings of ~$187,000
- Lifetime cost savings of ~$4.7 MM for category

Assumption of 90% reduction in flaring emissions

- Cost-effectiveness considered NOx emissions reductions only
- Additional co-benefit of VOC and PM emission reductions

LPG Recovery Cost-Effectiveness Summary

- Staff calculated the total installed equipment cost of $10.5 MM
  - Excluded facility with existing LPG recovery
  - Assumed 90% reduction of flaring emissions
  - Five-year average (2017 to 2021) NOx emissions data was used as baseline to account for operational variation

Cost-Effectiveness
$76,000
Estimated NOx Reductions
7.3 tons per year

Considerations for LPG Flare Reductions

Recovering LPG is technically feasible and cost-effective

- One refinery already uses a refrigeration/compression system to minimize flaring
- Reduces but does not eliminate LPG flaring

Staff evaluated a throughput threshold where installing a refrigeration/compression system becomes cost effective

- Throughput threshold can be used to trigger facilities to take action

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Establishing a Throughput Threshold for LPG Flare

Staff evaluated the minimum annual throughput at which LPG recovery was cost-effective

Larger LPG vent gas volume results in higher NOx emissions

NOx emissions calculated using NOx emission factor in rule

Annual throughput of **15,000 MMBtu/yr** or greater is below the cost-effectiveness threshold of $349,000 per ton of NOx reduced

Throughput Threshold Proposal at LPG Flares

- Staff proposing requirements to reduce LPG flaring if annual throughput exceeds 15,000 MMBtu/year
  - Action will be required for facilities that exceeded threshold for two consecutive years since 2017
    - Proposal will impact two facilities
    - Require permit submittal within one year of rule adoption
- Going forward, action will be required for facilities that exceed threshold for two consecutive years
  - Two consecutive years is established to accommodate planned tank inspection, maintenance, and cleaning

Key Staff Proposals

1. Decrease SO_2 Performance Target to 0.25 tons/MMbbl
2. Add NOx Performance Target for Flares Used Exclusively for Hydrogen Plants
3. Increase Mitigation Fees
4. Establish an Annual Throughput Threshold for Non-Hydrogen Clean Service Flares

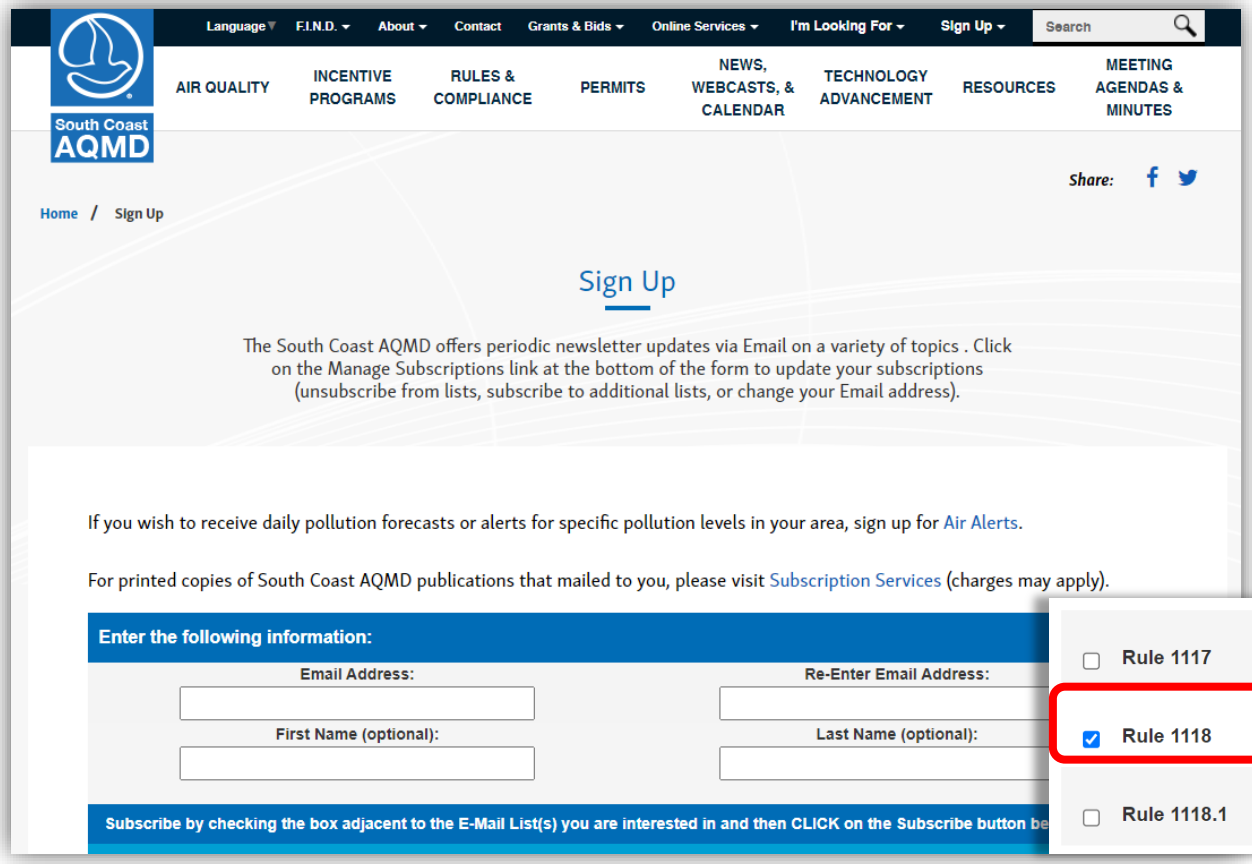
Next Steps

- Continue meeting with stakeholders
- Continue meeting with technology vendors
- Release an initial draft of the proposed amended rule language for discussion purposes
- Working Group Meeting #5 in December
- Anticipated Public Hearing 2nd Quarter of 2024

Image Courtesy: POLITICO

Staying Updated with PAR 1118

- Sign up and receive email updates via: http://www.aqmd.gov/sign-up



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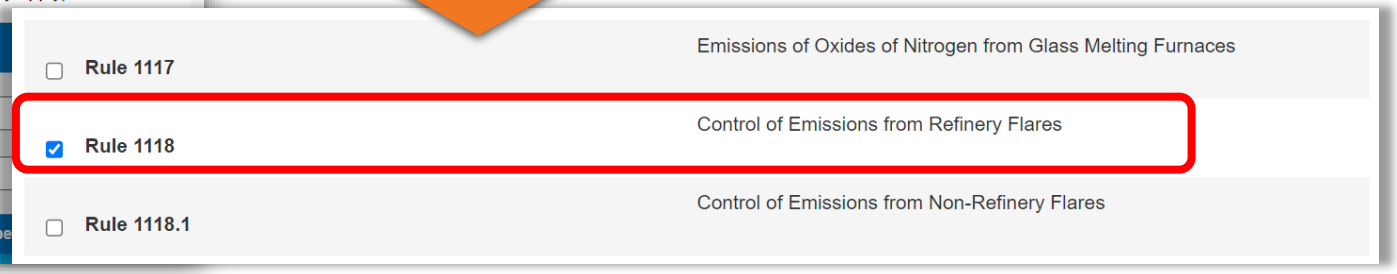

Additional Information on Rule 1118

- South Coast AQMD website has further information on Rule 1118 including:
  - Link to FENS
  - Contact information for the Rule 1118 facilities
  - Information on subscription to receive community notifications and information via email
  - Supporting documents including files from past rule amendments
  - Frequently asked questions
- Access through the following link:
  http://www.aqmd.gov/home/rules-compliance/compliance/r1118

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