



BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

Refinery Emissions Reduction Strategy

Board of Directors Meeting
December 16, 2015

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Rule Development Manager





Overview

- Need for Refinery Emission Reductions
- Summary of Estimated Emission Reductions and Costs
- Rule Development Process
- New Regulation 6, Rule 5 – Fluid Catalytic Cracking Units
- Amendments to Regulation 8, Rule 18: Equipment Leaks
- Amendments to Regulation 11, Rule 10: Cooling Towers
- Environmental Impact of Rules
- Socioeconomic Impact of Rules
- Recommendations



Estimated Emission Reductions and Costs

Title	Pollutant	Amount Reduced [tons/yr]	Annual Cost [million \$/yr]
Rule 6-5: Fluid Catalytic Cracking Units	PM	222	\$0.3
Rule 8-18: Equipment Leaks	ROG, toxics	1,227	\$6.8
Rule 11-10: Cooling Towers	ROG, toxics	861	\$2.2

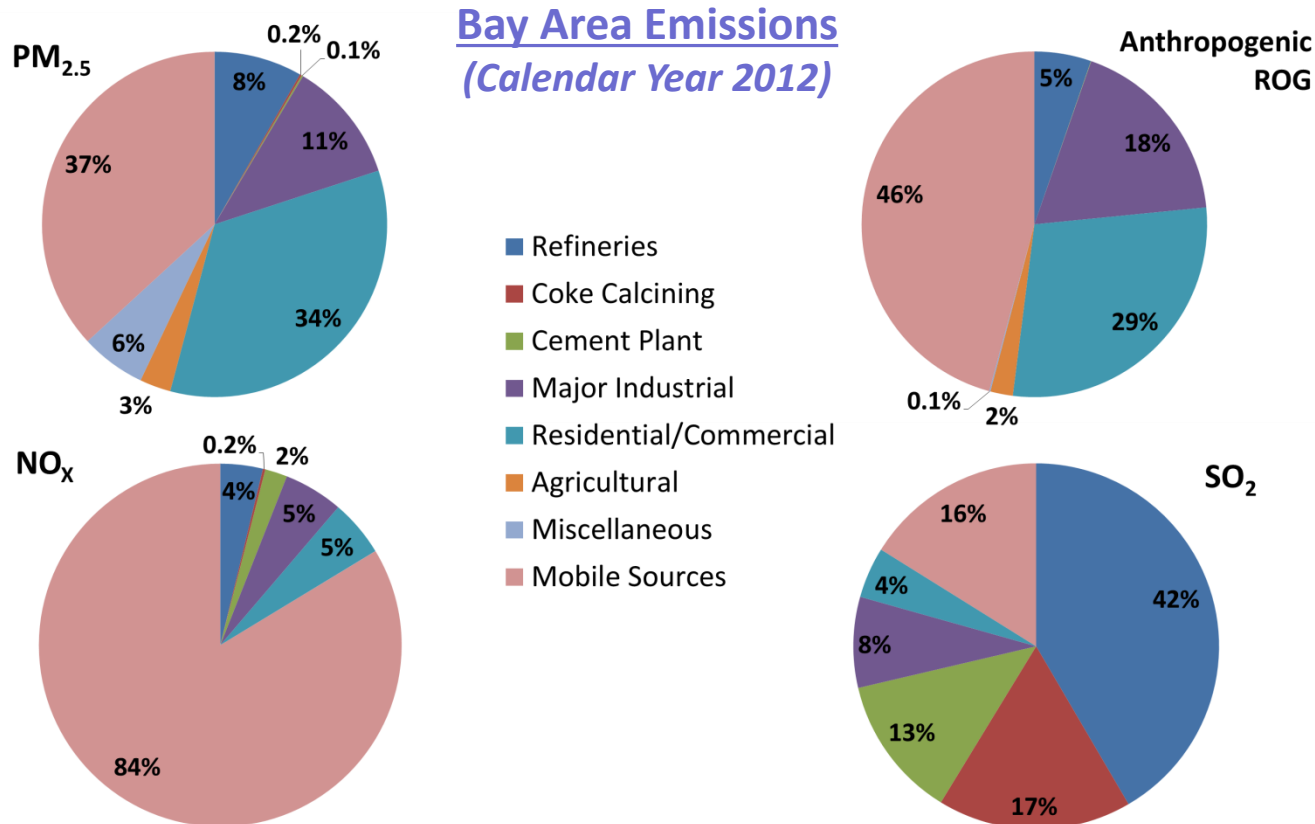
Total Reductions for 2015: **2,310 tons per year or 14%** of total refinery criteria pollutant emissions.

Phase II rulemaking planned for 2016 likely to exceed goal of 20% reductions by 2020.

Total costs are **less than 0.5%** of estimated refinery profits.

Need to Reduce Refinery Emissions cont.

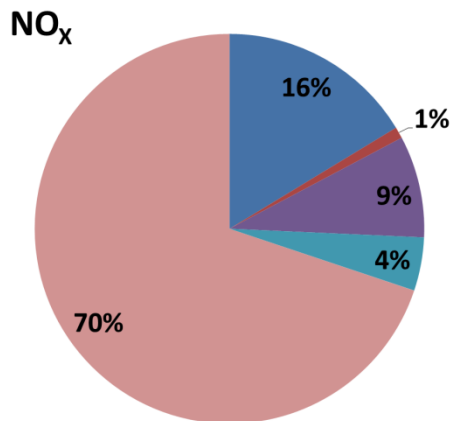
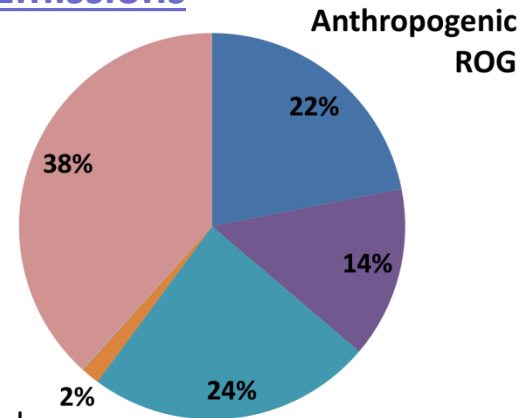
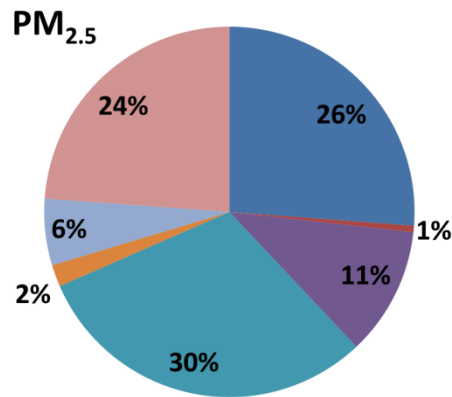
Refineries are a major source of ozone precursor pollutants, directly emitted $PM_{2.5}$ and $PM_{2.5}$ precursor pollutants.



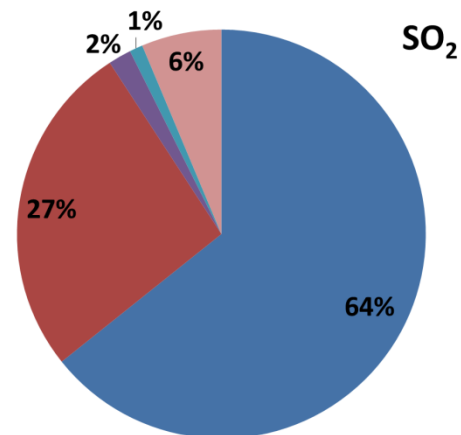
Need to Reduce Refinery Emissions cont.

Refinery emissions disproportionately impact Contra Costa and Solano Counties.

Contra Costa and Solano County Emissions
(Calendar Year 2012)



- Refineries
- Coke Calcining
- Major Industrial
- Residential/Commercial
- Agricultural
- Miscellaneous
- Mobile Sources





Rule Development Process

- May 16, 2015: Advance call for comments
- Sep. 15-28, 2015: Open Houses in Martinez, Benicia and Richmond
- Several in-person meetings with industry and community stakeholders throughout 2015.
- Several presentations to the Stationary Source Committee and full Board.
- Oct. 23, 2015: Hearing package published for comments.
- Nov. 30, 2015: Special Board meeting
- Nov. 23 – Dec. 11, 2015: Evaluated and responded to over 300 comments.

A background image showing the San Francisco skyline at night, with the city lights reflecting on the water. The title text is overlaid on the right side of the image.

First Rule: Regulation 6, Rule 5

- Regulation 6, Rule 5 is for Fluid Catalytic Cracking Units (FCCUs)
- FCCUs are typically the largest emission source at a refinery.
- This rule will reduce $PM_{2.5}$ emissions by reducing or optimizing the ammonia injected into FCCU exhaust.
- More rulemaking will be proposed in 2016 to reduce SO_2 emissions from FCCUs.



Rule 6-5: Major Provisions

Rule Section	Description
§ 6-5-301	Establish a new 10 ppmvd (at 3% oxygen concentration, daily average basis) ammonia emission limit from FCCUs effective January 1, 2018.
§ 6-5-401	Require submission of a control plan to comply with Section 6-5-301 and permit applications to perform required equipment modifications by January 1, 2017.
§ 6-5-402	Require submission of a monitoring plan to ensure compliance monitoring for Section 6-5-301 by January 1, 2017.
§ 6-5-403	As an alternative to compliance with Section 6-5-301, an FCCU operator may perform an optimization study leading to a new ammonia emission limit (presumably higher than the limit in Section 6-5-301) that is demonstrated to result in the greatest reduction in PM _{2.5} emissions from the FCCU that is achievable given other existing requirements on the FCCU.



Rule 6-5: Costs and Estimated Reductions

Facility	Condensable PM _{2.5} Reduction (tpy)	Capital Cost (\$M)	Annual Cost (\$M)	Total Annualized Cost (\$M)
Chevron	128	0.5	0.025	0.093
Shell	49	0.5	0.025	0.093
Tesoro	46	0.5	0.025	0.093

- Costs are for installation and operation of an ammonia monitor.
- Emission reductions assume a 50% reduction in condensable PM_{2.5}.



Rule 6-5: Cost Effectiveness

Facility	Total Annual Cost (\$)	Condensable PM _{2.5} Annual Reduction (ton)	Cost-Effectiveness (\$/ton of PM reduction)
Chevron	93,000	64	1,500
Shell	93,000	24	3,900
Tesoro	93,000	23	4,000



Regulation 6 Rule 5

Area of Controversy

Compliance Timeline

A photograph of the Golden Gate Bridge in San Francisco, California, spanning across the water. The bridge is a suspension bridge with two large towers and numerous cables. The sky is clear and blue, and the water is a deep blue. In the foreground, there are some green hills and a building.

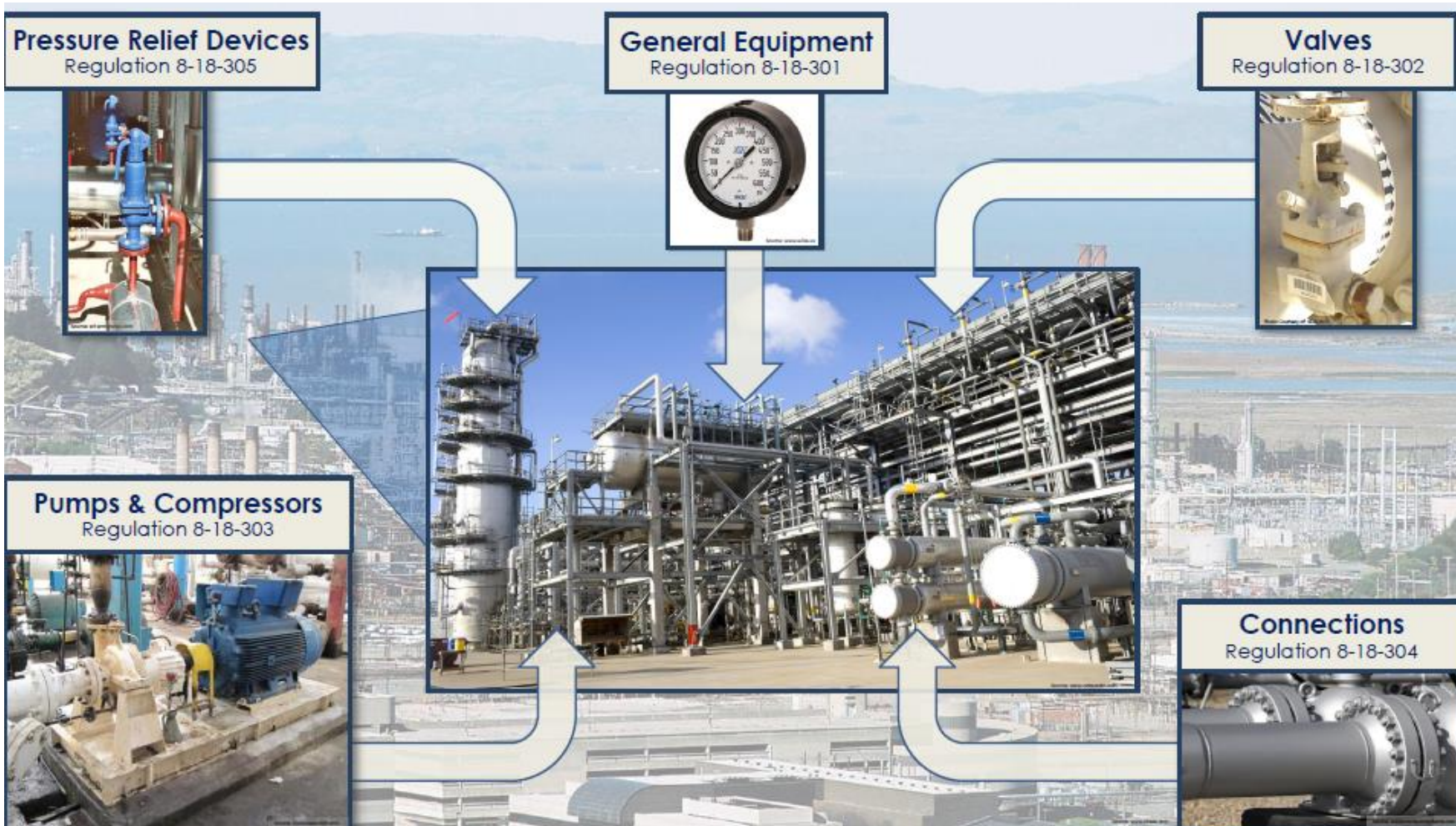
Regulation 6 Rule 5

- Regulatory Amendments
 - Response to October 23, 2015 comments
 - Amended Sections 6-5-402 and 6-5-501 to allow an affected refinery to propose an alternative to the CEMs-based monitoring described in the rule.

Second Rule

Rule 8-18: Equipment Leaks

Types of Fugitive Equipment



Rule 8-18: Equipment Leaks

Leak Monitoring

Facility's Leak Detection & Repair Program (LDAR)

- Component Identification & Labeling
- Inventory of Equipment
- Monitoring
 - Utilize handheld flame ionization detector (FID)
 - Follow EPA Method 21
 - Minimize/Repair Leaks below standard
- Records
 - Track leaking equipment repairs
 - Record routine monitoring
 - Maintain equipment inventory





Rule 8-18: Major Provisions

Rule Section	Description
§ 8-18-113	Require identification and monitoring of heavy liquid service equipment and subject heavy liquid service equipment to leak minimization and repair requirements.
§ 8-18-200	Additions to and clarification of definitions
§ 8-18-306	Reduce the allowable amount of equipment placed on non-repairable list.
§ 8-18-306.1	Add a maximum leak concentration (10,000 ppm) and require mass emission monitoring for all equipment placed on the non-repairable equipment list.
§§ 8-18-306.1 & 311	Establish a maximum mass emissions limit for fugitive equipment subject to the rule.
§ 8-18-401.11	Require the identification of the cause of any background reading greater than 50 ppmv.
8-18-502.6	Require submission of Piping and Instrumentation Diagrams (P&IDs) for equipment in heavy liquid service.



Rule 8-18: Emission Reductions

Equipment	Emissions Reduction Estimates (tons/year)					
	Chevron	Phillips 66	Shell	Tesoro	Valero	All
Valves	50	10	20	17	24	120
Pumps	334	53	60	45	35	526
Connectors	253	54	74	76	112	569
PRDs	5	0	2	6	0	12
Total	641	117	156	143	170	1228



Rule 8-18: Cost Effectiveness

Facility	Emission Reduction (tpy)	Capital Cost (\$ M)	Total Annual Cost (\$ M)	Cost Effectiveness (\$/ton)
Chevron	641	\$0.11	\$2.6	4,056
Phillips 66	117	\$0.02	\$0.70	5,982
Shell	156	\$0.04	\$0.90	5,769
Tesoro	143	\$0.03	\$1.4	9,790
Valero	170	\$0.05	\$1.2	7,058
Total	1,227	\$0.25	\$6.8	5,542



Rule 8-18:

Areas of Controversy

- Identification and monitoring of heavy liquid equipment
- Cost estimates
- Reduced non-repairable equipment allowance
- Lower mass emissions limit
- Requiring mass emissions testing on all equipment placed on non-repairable list
- Did not account for other facilities subject to rule



Rule 8-18: Additional Amendments

- Response to October 23, 2015 comments
 - Add- Limited Exemption 8-18-119, Open Ended Valve or Line

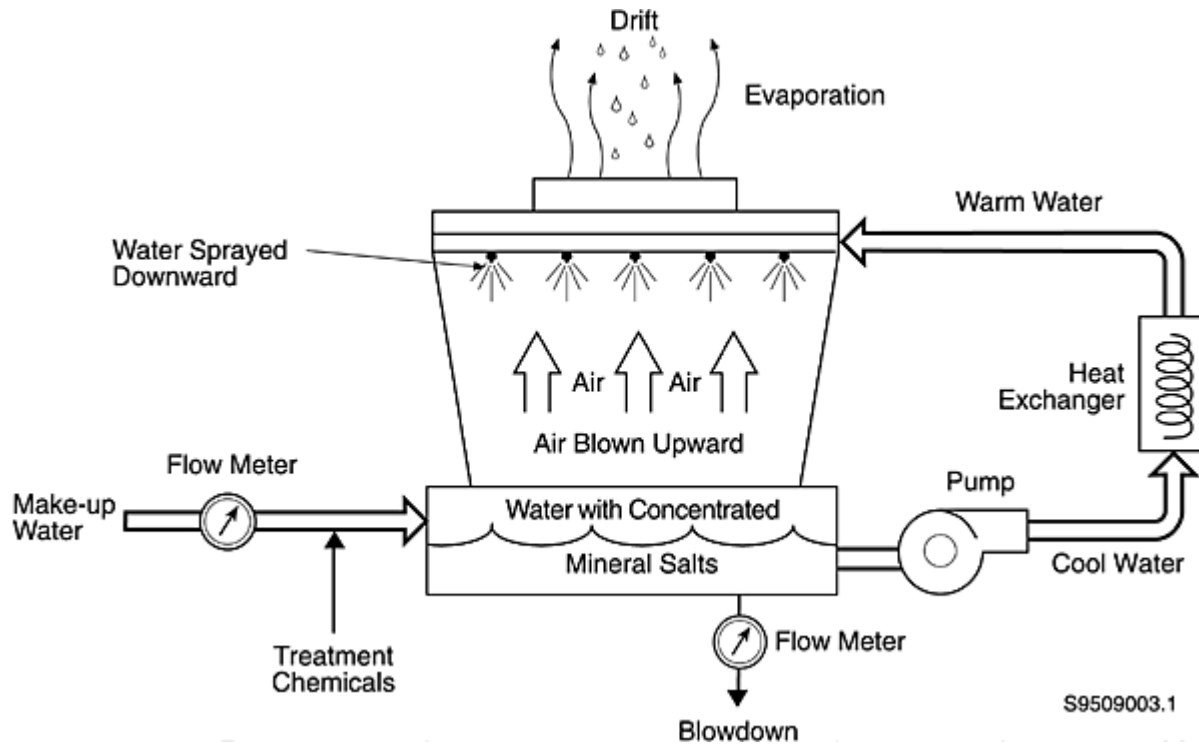
Address open-ended valves or lines in an emergency shutdown system designed to open automatically in the event of a process upset, and open-ended valves or lines containing materials which would autocatalytically polymerize or would present an explosion, serious overpressure, or other safety hazard if capped or equipped with a double block and bleed system
 - Add - Limited Exemption 8-18-120, Non-repairable Equipment

Include an effective date in which the new standards will not apply to the equipment currently on the non-repairable list.
- Response to December 11, 2015 Board Package comments
 - Add – Effective date of January 1, 2017 for connector identification to Section 8-18-402.1

To allow facilities time to identify connectors in their database following adoption of the rule.

Third Rule

Rule 11-10: Cooling Towers



Purpose: To minimize emissions of total hydrocarbons from refinery process cooling towers by requiring rapid detection and expeditious repair of leaks .



Rule 11-10: Cooling Towers

- Cooling towers are designed to keep the hot process fluids separate from the cooling water. So they typically do not leak.
- It's not obvious when a cooling tower is leaking.
- But, when they leak, they can leak a lot.
 - 2010 Bay Area Cooling Tower Leak:
 - Took weeks to find
 - Recorded 52 tons of emissions in only 16 days



Rule 11-10: Major Provisions

Rule Section	Description
§ 11-10-200	Addition of new definitions for the new THC leak monitoring and leak repair provisions.
§ 11-10-304	THC leak monitoring requirements provide refineries three options: Continuous monitoring, daily water sampling, other APCO approved method daily
§ 11-10-305	Progressive steps for leak action repair requirements.
§ 11-10-400	Leak reporting requirements and “Best Modern Practices” requirements.



Rule 11-10: Emission Reductions

Facility	BAAQMD Estimate (tpy)	ICR Data (tpy)
Chevron	245	311
Shell	227	161
Tesoro	312	18
Phillips 66	3	n/a
Valero	74	80
TOTAL	861	570

Given the refinery-operators' concerns about the Air District emission reduction estimates, we are also presenting emission reduction estimates based on data that the refiners submitted to EPA as part of EPA's Information Collection Request (ICR) to support recent federal rulemaking.



Rule 11-10: Cost Effectiveness

Cost Effectiveness of Fixed Continuous Analyzers

Refinery	Capital Cost (\$)	Operating Cost (\$/year)	Total Annual Cost (\$/year)	BAAQMD Cost Effectiveness (\$/ton reduced)	ICR Cost Effectiveness (\$/ton reduced)
Chevron	1,875,000	50,000	305,000	1,243	982
Phillips 66	2,100,000	50,000	335,000	122,625	n/a
Shell	375,000	25,000	76,000	335	472
Tesoro	3,900,000	50,000	580,400	1,861	31,407
Valero	300,000	25,000	65,800	889	822
Total Cost	8,550,000	200,000	1,362,800		
Average Cost Effectiveness				1,393	2,388



Rule 11-10: Areas of Controversy

- Baseline emission rates
- Cost estimates
- Sufficiency of EPA requirements
- Appropriate testing interval
- Appropriate repair time
- Potential problems with reclaimed water



Regulation 11 Rule 10

- Regulatory Amendments

- Response to October 23, 2015 comments

- Add – Exemption 11-10-107, Cooling Towers Servicing Hydrogen Production, Carbon Dioxide and Power Generation Facilities

Such facilities were never intended to be subject to the leak detection requirements of this rule and are thus exempt.

- Clarification Edit

- A single word was changed in Section 11-10-205 to make it clear that both actions 205.1 and 205.2 were not required:

A leak repair shall reduce the concentration of total hydrocarbons in cooling tower water to comply with the applicable leak action level and ~~shall~~ may include but not be limited to the following actions ...

The image shows a scenic view of the Golden Gate Bridge in San Francisco, California. The bridge's iconic orange-red towers and suspension cables are prominent against a clear blue sky. In the foreground, the bridge's approach spans across a body of water, with a large, light-colored building situated on the shore. The overall scene is bright and clear, capturing the bridge's architectural details and the surrounding environment.

Regulation 11 Rule 10

- Regulatory Amendments - Continued

- Lab Methodology Edit

EPA water analysis Method 8015D was incorporated into the rule to replace EPA Methods 8260 and 8270. Method 8015 is more appropriate and will cost less because it requires a single analysis.



Total Socioeconomic Impacts

	Total (million \$)	Chevron	Tesoro	Shell	Valero	Phillips 66
Annual Net Profit	2,070	653	442	416	351	208
Rule 6-5 Annual costs	0.3	0.3	0.3	0.3	0	0
Rule 8-18 Annual Costs	6.8	2.6	1.4	0.9	1.2	0.7
Rule 11-10 Annual Costs	2.2	0.5	0.8	0.3	0.2	0.4
Total Costs	9.3	3.2	2.3	1.2	1.4	1.1
Total as % of Profits	0.44%	0.49%	0.53%	0.30%	0.39%	0.53%

For Rule 11-10, the most expensive option (daily water sampling) was assumed for the socioeconomic review.

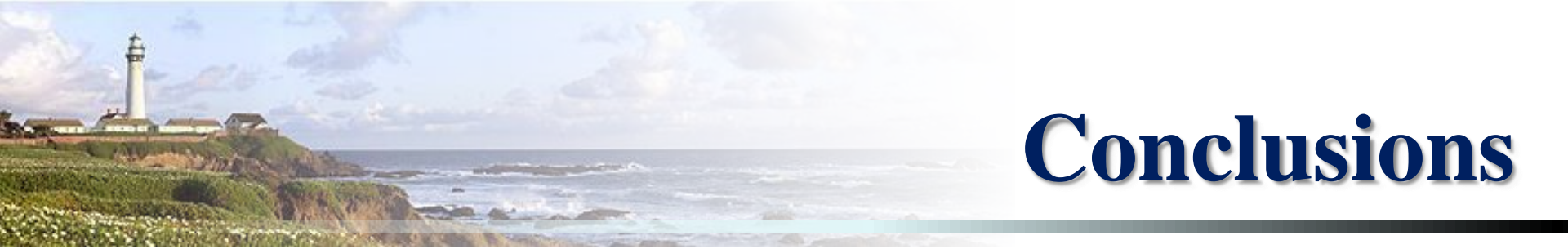


Environmental Impacts

CEQA Initial Study / Neg Dec

- Proposed New Rule 6-5
- Proposed Amendments to Rules 8-18 and 11-10

Conclusion: “No potential significant adverse environmental impacts associated with these proposed amendments.”



Conclusions

Proposals:

- First steps to achieve goal of 20% reduction
- Significant emissions reductions
- Necessary to achieve and maintain ambient air quality standards
- Cost effective with no significant socioeconomic impacts (total costs less than 0.5% of profits)
- No significant environmental impacts

A background image showing the San Francisco skyline at night, with the city lights reflecting on the water. A large sailing ship is visible on the left side of the water.

Recommendations

- Approve CEQA Initial Study / Neg Dec
- Adopt:
 - Proposed New Rule 6-5
 - Proposed Amendments to Rule 8-18
 - Proposed Amendments to Rule 11-10