Bay Area Emissions and Air Quality: Trends & Refinery Overview

Stationary Source Committee
October 1, 2014

Henry Hilken
Director of Planning, Rules and Research

Wayne Kino
Director of Compliance and Enforcement
Refinery Overview
District Refinery Regulations

REGULATION 1 - GENERAL PROVISIONS
REGULATION 2 - PERMITS
REGULATION 6 - PARTICULATE MATTER AND VISIBLE EMISSIONS
REGULATION 7 - ODOROUS SUBSTANCES
REGULATION 8 - ORGANIC COMPOUNDS:
   Rule 1 - General Provisions
   Rule 2 - Miscellaneous Operations
   Rule 5 - Storage of Organic Liquids
   Rule 6 - Terminals and Bulk Plants
   Rule 8 - Wastewater (Oil-Water) Separators
   Rule 10 - Process Vessel Depressurization
   Rule 18 - Equipment Leaks
   Rule 28 - Episodic Releases From Pressure Relief Devices
   Rule 37 - Natural Gas and Crude Oil Production Facilities
   Rule 43 - Surface Coating of Marine Vessels
   Rule 44 - Marine Vessel Loading Terminals
   Rule 46 - Marine Tank Vessel to Marine Tank Vessel Loading
REGULATION 9 - INORGANIC GASEOUS POLLUTANTS:
   Rule 1 - Sulfur Dioxide
   Rule 2 - Hydrogen Sulfide
   Rule 3 - Nitrogen Oxides from Heat Transfer Operations
   Rule 7 - Nitrogen Oxides And Carbon Monoxide from Industrial, Institutional, and Commercial

Boilers, Steam Generators, And Process Heaters
Rule 8 - Nitrogen Oxides And Carbon Monoxide from Stationary Internal Combustion Engines
Rule 10 - Nitrogen Oxides And Carbon Monoxide From Boilers, Steam Generators And Process Heaters in Petroleum Refineries

REGULATION 10 - STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES: This Regulation establishes emission and/or performance standards for new plants and other sources by reference to the provisions of Part 60, Chapter 1, Title 40, of the Code of Federal Regulations.

REGULATION 11 - HAZARDOUS POLLUTANTS
   Rule 1 - Lead
   Rule 2 - Asbestos Demolition, Renovation and Manufacturing
   Rule 7 - Benzene
   Rule 10 - Hexavalent Chromium Emissions From Cooling Towers
   Rule 11 - National Emission Standard For Benzene Emissions From Coke By-Product Recovery Plants and Benzene Storage Vessels
   Rule 12 - National Emission Standard For Benzene Emissions From Benzene Transfer Operations and Benzene Waste Operations

REGULATION 12 - MISCELLANEOUS STANDARDS OF PERFORMANCE:
   Rule 11 – Flare Monitoring
   Rule 12 – Flare Control
Refinery Sources of Emissions

8 Regulations
18 Rules

9 Regulations
12 Rules

8 Regulations
18 Rules
Fugitive Emissions:

- 100 parts per million leak standard adopted in 1992
- First regulation to control Greenhouse Gases (methane)
- South Coast AQMD and EPA at 500 ppm
- Collaboration between Communities, Environmental Groups and Industry
Flare Rules: Goal to limit flaring to emergency events

- Rule 11 required state of the art monitoring in 2003
- Rule 12 required Annual Flare Management Plans in 2006
  - Causal Analysis for Each Flaring Event
  - Identify and Implement Prevention Measures
- Collaboration between Communities, Environmental Groups and Industry
Compliance Verification Inspections
- 10,130

Complaint Investigations
- 3,320

Incident Investigations
- 442 Episodes, 82 Breakdowns, 2 Major Incidents

Compliance Audits & Refinery Program Review
- Tank Degas Audit
- Regulation 8-18 Audit
- Marine Terminals Audit
Distribution of 2013 Annual Average Emissions

- **NOx**: 291 tpd
  - Consumer Products (ROG) / Geologic Dust (PM2.5): 53%
  - On-Road (cars, trucks, etc.): 30%
  - Off-Road (construction, ships, trains, etc.): 3%
  - Evaporation (paints, fuels, solvents): 5%
  - Refinery (processes and combustion): 8%
  - Other Industrial / Commercial: 2%
  - Combustion (residential): 4%
  - Combustion (industrial): 22%

- **ROG**: 258 tpd
  - Consumer Products (ROG) / Geologic Dust (PM2.5): 26%
  - On-Road (cars, trucks, etc.): 20%
  - Off-Road (construction, ships, trains, etc.): 21%
  - Evaporation (paints, fuels, solvents): 4%
  - Refinery (processes and combustion): 23%
  - Other Industrial / Commercial: 2%
  - Combustion (residential): 12%
  - Combustion (industrial): 26%

- **PM2.5**: 47 tpd
  - Consumer Products (ROG) / Geologic Dust (PM2.5): 25%
  - On-Road (cars, trucks, etc.): 13%
  - Off-Road (construction, ships, trains, etc.): 11%
  - Evaporation (paints, fuels, solvents): 6%
  - Refinery (processes and combustion): 14%
  - Other Industrial / Commercial: 2%
  - Combustion (residential): 7%
  - Combustion (industrial): 24%

- **SO2**: 22 tpd
  - Consumer Products (ROG) / Geologic Dust (PM2.5): 11%
  - On-Road (cars, trucks, etc.): 6%
  - Off-Road (construction, ships, trains, etc.): 2%
  - Evaporation (paints, fuels, solvents): 4%
  - Refinery (processes and combustion): 32%
  - Other Industrial / Commercial: 12%
  - Combustion (residential): 26%
  - Combustion (industrial): 22%
All Source

ROG (tpd)

PM$_{2.5}$ (tpd)

NOx (tpd)

SO$_2$ (tpd)

- Consumer Products (ROG) / Geologic Dust (PM$_{2.5}$)
- On-Road
- Off-Road
- Evaporation
- Refinery
- Other Industrial
- Combustion

**ROG (tpd)**
- Other Combustion
- Power Plants & Cogeneration
- Evaporation
- Domestic Combustion

**PM$_{2.5}$ (tpd)**

**NOx (tpd)**
- Other Industrial / Commercial
- Refinery
- Commercial Cooking

**SO$_2$ (tpd)**


- **ROG (tpd)**
- **PM$_{2.5}$ (tpd)**
- **NOx (tpd)**
- **SO$_2$ (tpd)**
Risk from Toxic Air Contaminants Declining in the Bay Area

Measurement-based Trends

- **1990**: 1,330 in a million
- **2001**: 625 in a million
- **2012**: 300 in a million

- **diesel PM**
- **benzene**
- **1,3-butadiene**
- **Others**
## Board Actions Requiring Emissions Reductions at Refineries 1992-2013

<table>
<thead>
<tr>
<th>Date</th>
<th>Reg.-Rule</th>
<th>Description</th>
<th>Pollutant</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/92, 1/98, 11/02, 1/04</td>
<td>8-18</td>
<td>Equipment leaks at refineries</td>
<td>ROG</td>
</tr>
<tr>
<td>3/92</td>
<td>8-22, 8-25</td>
<td>Leaks from valves and flanges</td>
<td>ROG</td>
</tr>
<tr>
<td>1/93, 12/99, 10/06</td>
<td>8-5</td>
<td>Storage tanks</td>
<td>ROG</td>
</tr>
<tr>
<td>1/94, 12/10, 10/13</td>
<td>9-10</td>
<td>Boilers, steam generators, process heaters</td>
<td>NO_x</td>
</tr>
<tr>
<td>12/97, 3/98, 12/05</td>
<td>8-28</td>
<td>Leaks from pressure relief valves</td>
<td>ROG</td>
</tr>
<tr>
<td>6/03</td>
<td>12-11</td>
<td>Refinery flare monitoring</td>
<td>All</td>
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<tr>
<td>1/04</td>
<td>8-10</td>
<td>Process vessel depressurization</td>
<td>ROG</td>
</tr>
<tr>
<td>9/04</td>
<td>8-8</td>
<td>Refinery wastewater separators</td>
<td>ROG</td>
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<tr>
<td>7/05</td>
<td>12-12</td>
<td>Refinery flares</td>
<td>All</td>
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<tr>
<td>12/05</td>
<td>8-44</td>
<td>Marine loading operations</td>
<td>ROG</td>
</tr>
<tr>
<td>7/07</td>
<td>9-8</td>
<td>Stationary internal combustion engines</td>
<td>NOx, PM</td>
</tr>
<tr>
<td>4/09</td>
<td>8-33, 8-39</td>
<td>Gasoline bulk terminals</td>
<td>ROG</td>
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<td>4/12</td>
<td>8-53</td>
<td>Vacuum trucks</td>
<td>ROG</td>
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Emissions Reductions from Air District Rules 1992-2013

Stationary Source Emissions Reductions from Air District Rules 1992-2013
[tons per day]

**ROG**
- Total: 68.4 tpd
  - Refineries: 16.3 tpd
  - Other: 52.1 tpd

**NO\textsubscript{X}**
- Total: 92.6 tpd
  - Refineries: 22.6 tpd
  - Other: 70.0 tpd

**PM**
- Total: 4.7 tpd
  - Refineries: 0.2 tpd
  - Other: 4.5 tpd
Bay Area Refinery Emissions per Production Capacity, 2012

- Chevron
- Shell
- Valero
- Tesoro
- Phillips 66

Graph showing emissions in Tons per Million Barrels for PM10, SO2, NOx, and ROG.
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<tr>
<td>Reduce SO$_2$ from coke calcining</td>
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<tr>
<td>Reduce PM from Fluid Catalytic Cracking Units</td>
<td>Reduce condensable PM and precursor emissions</td>
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<td>Further reduce equipment leaks (tanks, valves, other)</td>
<td>Reduce ROG and toxic emissions</td>
<td>Draft control measure for 2015 Clean Air Plan (CAP)</td>
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<td>Limit sulfur content of refinery fuel gas</td>
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<td>Review of SO$_2$ emissions from refineries</td>
<td>Determine if substantial SO$_2$ reductions are available</td>
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<td>Further reduce NO$_x$</td>
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Summary and Next Steps

- Significant emissions reductions have been achieved in the Bay Area, Bay Area air quality has improved
- Increased focus on fine particulate
  - Smaller particles (TSP > PM10 > PM2.5 > ultrafine)
  - More complex sources – secondary PM and condensable PM
- Continuing challenges
  - Low hanging fruit is gone
  - State and national AQ standards regularly revised, tightened
  - Local areas with high pollution exposure, poor health outcomes
  - GHGs
- Each refinery is unique
- Refinery emissions will continue to be focus of District rulemaking and analysis
Regulations to Track and Reduce Emissions from Petroleum Refineries

Board of Directors
Stationary Source Committee
October 1, 2014

Eric Stevenson
Director of Technical Services
Enhanced Approach

• Proceed with latest version of Regulation 12, Rule 15 (12-15), Petroleum Refining Emissions Tracking Rule
• Develop a companion rule concurrently to 12-15 to mitigate refinery emissions increases
  • Both rules to the Board for consideration by March of 2015
• Develop a Board of Directors Resolution to guide further rule development efforts to reduce emissions
• Expedite rule development
Current 12-15 Elements

• **Annual emissions inventories** of all regulated air pollutants based on upgraded methods, including emissions from cargo carriers

• **Petroleum Refinery Emissions Profile (PREP)**; require that on-going inventories include comparisons with PREP

• **Crude oil composition characteristics** with annual emissions inventories (e.g. sulfur, nitrogen content, API gravity, Total Acid Number)

• **Health Risk Assessments (HRA)** with enhanced emissions inventories and revised OEHHA HRA guidelines

• **Enhance fence line monitoring systems and establish community air quality monitoring systems**
Companion Rule to 12-15

- Mitigate emissions increases of criteria pollutants, Toxic Air Contaminants (TAC) and greenhouse gases (GHG) based on PREP
  - Require causal analysis of any increase
  - Require mitigation plan to be submitted
  - Require public review of mitigation plan
- This will help ensure that crude oil composition changes do not increase emissions
- This will help identify processes that contribute to emissions increases
Approaches for Decreasing Emissions

• Investigate emission reduction opportunities
  • VOC’s at tanks, and other fugitive sources
  • PM at Fluidized Catalytic Cracking Units (FCCUs) and other combustion sources
  • Reductions to NO\textsubscript{X} sources will be limited due to recent regulatory action
  • SO\textsubscript{2} in fuel gas and coke calcining
  • Potentially reduce risk by amending Regulation 2, Rule 5

• Develop resolution directing staff to evaluate emissions reduction approaches and recommend a strategy
  • Consider reduction approaches, including those by advocates and industry
  • Provide a strategy to reduce refinery emissions with an expedited timeline
  • Resolution for Board consideration by December of 2014
## 2015 Clean Air Plan
### Preliminary Draft Control Measures & Further Study Measures for Refineries

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• Present 12-15 for Board consideration
  • Air monitoring, HRA and emissions inventory provide a means to track impacts within the immediate communities and throughout the Bay Area

• Development of companion rule and present to Board for consideration
  • Mitigate increases in refinery emissions

• Develop resolution for Board consideration
  • Guide further rule devolvement to reduce refinery emissions