Regulation 11, Rule 18
Reduction of Risk from Air Toxic Emissions at Existing Facilities

Greg Nudd
Deputy Air Pollution Control Officer for Policy
Overview

- Background
- Toxic Air Contaminants overview
- Rule 11-18 requirements and implementation
- Key Points
Background

- 2010: Clean Air Act includes plan to update “Toxics Hot Spots” program.
- 2015: Office of Environmental Health Hazard Assessment (OEHHA) updates the statewide guidance on Health Risk Assessments.
- 2016: Air District updates Rule 2-5 to strengthen permit reviews on new/modified sources of toxic air contaminants.
- 2016-2017: Outreach to impacted stakeholders, presentations to the Board and Stationary Source Committee.
- 2017: Board of Directors approves new Rule 11-18 for existing sources of toxic air contaminants.
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What are Toxic Air Contaminants?

- Compounds defined as toxic air contaminants (TACs) in the California Health and Safety Code
- More than 200 compounds
- Hazards to human health
  - Cancer
  - Non-cancer, chronic health impacts
  - Acute health impacts
# Example TACs and Health Impacts

<table>
<thead>
<tr>
<th>Toxic Air Contaminant</th>
<th>Cancer</th>
<th>Chronic</th>
<th>Acute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel Exhaust</td>
<td>• Lung</td>
<td>• Respiratory system</td>
<td></td>
</tr>
<tr>
<td>Benzene</td>
<td>• Leukemia</td>
<td>• Blood cells</td>
<td>• Development</td>
</tr>
<tr>
<td></td>
<td>• Myeloma</td>
<td></td>
<td>• Immune system</td>
</tr>
<tr>
<td></td>
<td>• Lymphoma</td>
<td></td>
<td>• Blood cells</td>
</tr>
<tr>
<td>1,3-Butadiene</td>
<td>• Leukemia</td>
<td>• Reproductive system</td>
<td>• Low birth weight</td>
</tr>
<tr>
<td></td>
<td>• Lymphoma</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Other types</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium (VI)</td>
<td>• Lung</td>
<td>• Respiratory system</td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td></td>
<td></td>
<td>• Development</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Nervous system</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Kidney</td>
</tr>
</tbody>
</table>
Exposure and Toxicity Determine Health Impacts

- Emission to air
- Ambient concentration
- Breathed in
- Damage to health

Exposure

Toxicity

Office of Environmental Health Hazard Assessment (OEHHA) develops guidelines
How Do We Measure Impacts?

• **Cancer Risk** – The theoretical probability of contracting cancer when continually exposed for a lifetime (30 years) to a given concentration of a substance. Presented as the number of chances in a million of contracting cancer.

• **Acute Hazard Index** - The potential non-cancer health impacts resulting from a one-hour exposure to toxic substances.

• **Chronic Hazard Index** - The potential non-cancer health impacts resulting from exposure to toxic substances usually lasting from one year to a lifetime.
Bay Area Lifetime Cancer Risk from TAC Exposure

- Diesel
- Benzene
- 1,3-Butadiene
- Others

Cancer Risk (per million, 70 year exposure)

- 1990: 4,100 in a million
- 2001: 1,800 in a million
- 2014: 690 in a million
Overall Air Pollution Down, but High Risks in Some Communities Remain

2005 – Cancer Risk

2015 – Cancer Risk
Regulatory Authority

- Bay Area Air District
  - Primary regulatory authority over stationary sources

- State Air Resources Board
  - Intrastate mobile sources—cars, trucks, cargo handling equipment

- U.S. EPA
  - Interstate mobile sources—trains, aircraft & ocean going vessels
Toxic Air Contaminant Control Programs

- California Environmental Quality Act (CEQA)
- Stationary Source Control Measures
- Community Air Risk Evaluation (CARE)
- Toxics New Source Review (Rule 2-5)
- Air Toxics Hot Spots Program (AB 2588)
- Rule 11-18 (Existing Facilities)
Overview

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Rule 11-18 – Key Policy Components

- Reduces toxic risk in overburdened communities
- Important step in AB 617 implementation
- Reduces toxic risk to the lowest levels
- Facility selects compliance path
Risk Action Thresholds

BAAQMD Rule 11-18

Lifetime Cancer Risk (chances per million)

Now 2018 2020

100/M

25/M

10/M

Lowers Non-Cancer Acute/Chronic Hazard Index
Thresholds to
2.5 in 2018
1.0 in 2020
Rule 11-18: Requirements

• Facilities above risk action level must
  – Develop a risk reduction plan for Air District approval
  – Execute plan according to plan schedule

• Potential Risk Reduction Measures
  – Reduction of emissions, including installation of Best Available Retrofit Control Technologies for Toxics (TBARCT)
  – Modification of operating hours and activity levels
  – Modification of emissions stacks

• Exemptions
  – Retail gas stations
  – Sites that have only emergency backup generators and have risk screening level < 250
Potential Risk Reduction Measures

- Install Control Technology
- Use Alternate Fuels/Materials
- Operating Time Restrictions
- Increase Stack Height
- Limit Throughput
- Change Stack Orientation
- Relocate Source
Implementation: Overview

- Prioritize Facilities
- Validate Data
- Conduct Health Risk Assessment (HRA)
- Public Comment on HRA
- Publish HRA Results to Website

6 months – 18 months

<table>
<thead>
<tr>
<th>Year Range</th>
<th>Task Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018 - 2019</td>
<td>Complete HRAs for high priority facilities</td>
</tr>
<tr>
<td>2019 – 2021</td>
<td>Complete remaining HRAs</td>
</tr>
</tbody>
</table>
Implementation: Facility Risk Reduction

1. Prepare & Submit Risk Reduction Plan
   - 180 days

2. Evaluate Risk Reduction Plan

3. Public Comment on Risk Reduction Plan
   - Up to 180 days

4. Publish Risk Reduction Plan

5. Implement Risk Reduction Measures
   - 5 years (up to 10)
Overview

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Rule 11-18: Key Points

1. Health Protective Standards
2. Flexible Methods of Compliance
3. Implementation Approach
Health Protective Standards

Why 10/Million?

– Most health protective
– Technically achievable
– Addresses smaller sources which can be cumulatively significant in CARE areas
– Benefits at least 10 times more people
  • ~50 facilities reviewed at 25/M, ~400 facilities reviewed at 10/M
  • Preliminary HRA for one refinery shows thousands of people benefit from 10/M, but only hundreds benefit from 25/M


## Health Protective Standards

10/Million is feasible for nearly all facilities

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Estimated Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refineries</td>
<td>13 - 56</td>
</tr>
<tr>
<td>Cement Manufacturing</td>
<td>9 - 40</td>
</tr>
<tr>
<td>Crematoria</td>
<td>10 – 14</td>
</tr>
<tr>
<td>Landfills</td>
<td>11 – 23</td>
</tr>
<tr>
<td>Foundries/Metal Melting</td>
<td>17 – 40</td>
</tr>
<tr>
<td>Sewage Treatment Facilities</td>
<td>9 - 40</td>
</tr>
</tbody>
</table>

If 10/M is not feasible, facilities must install TBARCT
Case Study: Richmond CARE Area - 25/M vs 10/M

At 10/M, all of the facilities on the map would be impacted by Rule 11-18 (orange and blue pins).

At 25/M, only the blue pins would be impacted.
Case Study: Oil Refinery 25/M vs 10/M

- Preliminary HRA
- 10/M – about 8,500 people benefit (orange and blue)
- 25/M – about 600 people benefit (blue only)
- Green icons indicate day care centers
Case Study: Cement Kiln – 25/M vs 10/M

- Preliminary HRA
- 10/M – about 1,500 people benefit (orange shaded area)

- 25/M – No changes at facility
Flexible Methods of Compliance

• Facilities can choose lowest-cost approach to get below 10/M
  – Change processes
  – Move, raise emission stacks
  – Reduce engine testing hours

• Facilities can receive more time to install controls

• TBARCT option if not feasible to get below 10/M
  – Cost considered in all TBARCT determinations

• Major sources addressed first
# Comparing Health Impacts of Air Pollutants

## Annual Incidences from 2015 Ambient Concentrations

<table>
<thead>
<tr>
<th></th>
<th>Diesel PM$_{2.5}$</th>
<th>Ozone</th>
<th>Other PM$_{2.5}$</th>
<th>Other Toxics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>169</td>
<td>29</td>
<td>2,307</td>
<td>8</td>
</tr>
<tr>
<td>Cancer Onset</td>
<td>13</td>
<td>n/a</td>
<td>n/a</td>
<td>9</td>
</tr>
<tr>
<td>Hospital Admissions$^2$</td>
<td>36</td>
<td>94</td>
<td>482</td>
<td>0</td>
</tr>
<tr>
<td>Nonfatal Heart Attacks</td>
<td>95</td>
<td>0</td>
<td>1,181</td>
<td>0</td>
</tr>
<tr>
<td>Asthma Emergency Room Visits</td>
<td>64</td>
<td>42</td>
<td>885</td>
<td>0</td>
</tr>
</tbody>
</table>


2. Combines respiratory and cardiovascular hospital admissions.
Next Steps

• Implement Rule 11-18
  – Start with largest, highest-polluting facilities
  – Focus on CARE areas

• Work toward a neighborhood-scale understanding of ambient PM$_{2.5}$ levels and impacts.

• Identify opportunities to reduce PM$_{2.5}$ through direct regulation and mobile source grant programs.

• Evaluate possibility of rule analogous to Rule 11-18 for PM$_{2.5}$. 
A summary of short-term PM$_{2.5}$ and adverse health outcome studies in California

Rupa Basu, PhD, MPH
Chief, Air and Climate Epidemiology Section
Office of Environmental Health Hazard Assessment

December 11, 2017
Outline: Short-term PM$_{2.5}$ and Health Outcomes

- Cardiovascular and respiratory mortality
- Hospital/emergency room (ER) visits
- PM$_{2.5}$ constituents/sources and health outcomes
- National studies including CA data
- Meta-analysis
Common Methodology

- **Study designs**
  - Time-series, case-crossover

- **Data sources**
  - California Air Resources Board, sources from USC based on emissions data
  - California Department of Public Health for health outcome data

- **Analytical approach**
  - Poisson regression, conditional logistic regression
## Percent Change in PM$_{2.5}$ and Respiratory or Cardiovascular Mortality in CA

<table>
<thead>
<tr>
<th>Study Period</th>
<th>Mean per ug/m$^3$ (Mean Range)</th>
<th>Disease Outcome/Mortality</th>
<th>Exposure Lag Days</th>
<th>Results per 10 µg/m$^3$ increase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1999 - 2002</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(14-29) Respiratory</td>
<td>2</td>
<td></td>
<td>1.30 (0.10, 2.60)</td>
<td></td>
</tr>
<tr>
<td>Avg 01</td>
<td></td>
<td></td>
<td>2.20 (0.60, 3.90)</td>
<td></td>
</tr>
<tr>
<td><strong>2000 - 03</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.6 Cardiovascular</td>
<td>0</td>
<td></td>
<td>0.55 (0.14, 0.96)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>0.55 (0.17, 0.92)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>0.30 (-0.08, 0.67)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>0.26 (-0.12, 0.65)</td>
<td></td>
</tr>
<tr>
<td><strong>2000 - 03</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.28 Cardiovascular</td>
<td>0</td>
<td></td>
<td>White: -0.14 (-1.48, 1.22)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hispanic: 1.70 (-4.28, 8.05)</td>
<td></td>
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<tr>
<td>3</td>
<td></td>
<td></td>
<td>White: 1.23 (-0.31, 2.78)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hispanic: 4.73 (0.72, 8.91)</td>
<td></td>
</tr>
<tr>
<td>0 HS Graduate: -1.23 (-2.78, 0.34)</td>
<td></td>
<td></td>
<td>non-HS Graduate: 2.72 (0.36, 5.13)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>HS Graduate: 0.27 (-1.46, 2.04)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>non-HS Graduate: 4.06 (0.84, 7.39)</td>
<td></td>
</tr>
</tbody>
</table>

**Sources:** Ostro et al. 2006, 2007, 2008, including 9, 9 and 6 counties, respectively
## Short-term PM$_{2.5}$ Exposure and Respiratory Hospital/ER Visits in CA

<table>
<thead>
<tr>
<th>Author</th>
<th>Study Period</th>
<th>Mean or (Mean Range)</th>
<th>Health Outcome</th>
<th>Lag Days</th>
<th>Effect Estimate</th>
<th>Result per 10 µg/m$^3$ increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malig 2013</td>
<td>2005 - 08</td>
<td>(5.2 - 19.8) µg/m$^3$</td>
<td>ER visits</td>
<td>0</td>
<td>Percent Change</td>
<td>0.90 (0.05, 1.60)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1.60 (0.95, 2.25)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>0.95 (0.37, 1.58)</td>
</tr>
<tr>
<td>Ostro 2016</td>
<td>2005 - 09</td>
<td>16.5</td>
<td>ER visits</td>
<td>0</td>
<td>Percent Change</td>
<td>0.88 (0.18, 1.58)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td><strong>1.05 (0.01, 2.10)</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>0.44 (-0.26, 1.14)</td>
</tr>
<tr>
<td>Yap 2013</td>
<td>2000 - 05</td>
<td>(12.75 - 24.61)</td>
<td>Hospital Admissions</td>
<td>3</td>
<td>Relative Risk</td>
<td><strong>South Coast: 1.072 (1.068, 1.076)</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Central Valley 1.00 (0.99, 1.01)</td>
</tr>
</tbody>
</table>

Asthma hospital visits for children in Orange County 35, 8 and 12 CA counties, respectively

Source: Delfino et al. 2014
Short-term PM$_{2.5}$ Constituent Exposure and Cardiovascular Mortality in CA

Source: Ostro et al. 2007
PM$_{2.5}$ constituents come from multiple sources:

- **Aged Sea Salt**: Na$^+$, NO$_3^-$, SO$_4^{2-}$
- **Biomass Burning**: EC, OC, Na$^+$
- **Oil Combustion**: EC, Na$^+$, OC,
- **Road Dust**: Al, Si, Zn
- **Resuspended Soil**: Al, Si, Fe
- **Secondary Ammonium Nitrate**: NH$_4^+$, NO$_3^-$, SO$_4^{2-}$
- **Secondary Ammonium Sulfate**: NH$_4^+$, NO$_3^-$, SO$_4^{2-}$
- **Vehicular Emissions**: EC, OC, Zn

Source: Ostro et al. 2016
National Studies Including Results from CA

- 25 counties in US Southwest (Bell et al. 2008)
- 33 counties in US West (Bell et al. 2015)
- 75 cities across the US (Dai et al. 2014)
- 16 counties in western US (Dominici et al. 2006)
- 27 US communities throughout US (Franklin et al. 2007)
- 12 US communities in the Southwest (Krall et al. 2013)
- 108 counties in the US (Peng et al. 2008)
- 20 communities throughout the US (Zanobetti et al. 2009)
- 15 cities in the Mediterranean region of the US (Zanobetti et al. 2009)
- 121 communities throughout the US (Zanobetti et al. 2014)

* Contact each of the co-authors to attempt to get CA-specific estimates
Meta-Analysis

- Meta-Analysis is the process of combining the results from several studies examining the same association to produce an overall estimate.
  - % change, relative risk, population attributable risk, years life lost
  - Not economic evaluation (Ben MAP)

- Dependent on various aspects of the study:
  - Same type of exposure (PM$_{2.5}$, PM$_{2.5}$ constituents, etc)
  - Exposure metric (daily, lag days, etc)
  - Outcome (Mortality, Morbidity, Disease-specific, etc)
  - Effect estimate (Percent change, Relative Risk, etc)
  - Vulnerable subgroups (race/ethnicity, age, urban/rural, etc)
Summary

- Many studies found associations between background ambient short-term PM$_{2.5}$ and adverse health outcomes.

- Studies also on chemical constituents to identify toxic sources.

- Less educated, minority populations, age groups greater risks of exposure and outcomes.

- Further studies are warranted for:
  - Critical time of exposure could be more acute (i.e., peak exposures)
  - Associations outside range of observed level

- Long-term PM$_{2.5}$ health studies, including adverse birth outcomes, in CA and animal studies (not good for “real world” settings) not included here.
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