Public Hearing on Proposed Regulation 13: Climate Pollutants, Rule 5: Industrial Hydrogen Plants

Board of Directors Meeting
May 4, 2022

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Provide information for consideration of the adoption of:

• Proposed New Regulation 13: Climate Pollutants, Rule 5: Petroleum Refinery Hydrogen Plants

and

• Proposed Amendments to Regulation 8: Organic Compounds, Rule 2: Miscellaneous Operations.
Presentation Outline

• Recent Rule Development History
• Background
• Summary of Proposed New Rule Provisions
• Impacts of proposed amendments
• Comments and responses
• Recommendations
Presentation Requested Action

• Consider adoption of proposed Rule 13-5: Industrial Hydrogen Plants and proposed amendments to Regulation 8, Rule 2: Miscellaneous Operations.

• Consider certification of the Draft Environmental Impact Report.
Recent Rule Development History

- June 2021 – Request for Comments on revised draft rule and Notice of Preparation and Initial Study for Draft Environmental Impact Report
- July 2021 – California Environmental Quality Act Scoping Meeting
- July 2021 – Presentation to Stationary Source and Climate Impacts Committee
- September 2021 – Discussion and Review of Alternative Reduction Measures proposed by Refiners
- January 2022 – Published Notice of Completion of Draft Environmental Impact Report and Public Hearing Notice
- March 2022 – Published Notice of Rescheduled Public Hearing
• Climate Protection Goals:
  • Reduce GHG emissions to 40 percent below 1990 levels by 2030, and 80 percent below 1990 levels by 2050.

• Methane:
  • Potent and short-lived climate pollutant
  • Global warming potential:
    • 34 times that of carbon dioxide on a 100-year time horizon
    • 86 times that of carbon dioxide on a 20-year time horizon

• Proposed New Rule 13-5, Industrial Hydrogen Plants:
  • Limits vented emissions of total organic compounds (including methane)
  • Affects hydrogen production and carrying systems
  • Includes alternative compliance option for equivalent control of GHG emissions
  • Affected sources exempt from Rule 8-2: Miscellaneous Operations
Background: Hydrogen Production via Steam Methane Reformation

Step 1: Purification of the feed gas.

Step 2: Steam methane reformation reaction:

\[ \text{CH}_4 + \text{H}_2\text{O} \rightarrow \text{CO} + 3 \text{H}_2 \]

Step 3: Temperature shift reaction:

\[ \text{CO} + \text{H}_2\text{O} \rightarrow \text{CO}_2 + \text{H}_2 \]

Step 4: Final product purification step.

- Pressure swing adsorption (PSA) system
- Solvent-based CO$_2$ removal system.
Background: Hydrogen Production via Electrolysis

• Electrolysis produces hydrogen by using electricity to split water into hydrogen and oxygen.

• Significant amounts of water are needed for hydrogen production by electrolysis.

• Limitations to producing hydrogen via electrolysis
  • 1 kg of hydrogen can require 18 to 126 kg of water (Source: IRENA 2020)
  • Requires renewable electricity source to avoid increase in greenhouse gas emissions due to increased electricity demand. (Source: US DOE)
  • Meeting the hydrogen demands of refineries through electrolysis is not currently viable due to technology limitations.
Background: Why Do Hydrogen Vent Emissions Occur?

• Excess hydrogen is required by refineries due to safety reasons.
• Sudden changes in hydrogen supplied and/or demand between the hydrogen plant and the hydrogen consumers can lead to a hydrogen imbalance.
• When a hydrogen imbalance occurs, excess hydrogen is removed by venting to the atmosphere or control device.
• Vented or controlled hydrogen gas may or may not contain methane depending on the refinery and controls in place.
## Background:
### Overview of Hydrogen Plant Configurations

<table>
<thead>
<tr>
<th>Facility</th>
<th>Purification Method</th>
<th>Vent Control Method</th>
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<tbody>
<tr>
<td>Chevron</td>
<td>PSA System</td>
<td>Hydrogen Flare</td>
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<tr>
<td>Marathon (2)</td>
<td>PSA System</td>
<td>None</td>
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<tr>
<td>Air Products</td>
<td>CO₂ Removal</td>
<td>Refinery Flare</td>
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<tr>
<td>Marathon</td>
<td>PSA System</td>
<td>None</td>
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<tr>
<td>PBF Energy (3)</td>
<td>PSA System</td>
<td>None</td>
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<tr>
<td>Air Products</td>
<td>PSA System</td>
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<tr>
<td>PBF (2)</td>
<td>CO₂ Removal</td>
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<tr>
<td>Phillips 66 (Air Liquide)</td>
<td>PSA System</td>
<td>None</td>
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<tr>
<td>Valero</td>
<td>CO₂ Removal System</td>
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• Limits emissions of Total Organic Compounds (methane and other organics) to 15 pounds per day and 300 parts per million

• Alternative Compliance Plan (ACP) option provided for Overall 90% control of Methane
  • Up to 20% of emissions reductions may be GHGs other than Methane on a CO₂e basis
  • Provides flexibility to meet equivalent GHG emissions reductions without construction of new flares

• Alignment of permitting deadlines for control devices and alternative compliance measures (3 years from rule adoption)
Rule 8-2 Proposed Amendments

- Added exemption for sources complying with the control requirements of Section 13-5-301.
- Added amendments to allow for alternative test methods to ensure that facilities processing non-petroleum products utilize the appropriate test methods for those materials.
Potential NOx and Greenhouse Gas Emissions Impacts of a Flare

- 35 tons per year potential NOx increase
  - 2% of the NOx inventory for both affected facilities
- 77,500 metric tons per year CO$_2$e net emissions reductions of methane
  - 1.2% of GHG emissions inventory for both affected facilities
  - Equivalent to 770 passenger vehicles removed
Net Annual Greenhouse Gas Emissions from Potential Operation of a Flare

-90,000  -70,000  -50,000  -30,000  -10,000  10,000  30,000  50,000  70,000  90,000

Greenhouse Gas Emissions (CO₂e Metric Ton)

-90,000  -70,000  -50,000  -30,000  -10,000  10,000  30,000  50,000  70,000  90,000

Greenhouse Gas Emissions (CO₂e Metric Ton)

-90,000  -70,000  -50,000  -30,000  -10,000  10,000  30,000  50,000  70,000  90,000

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Aesthetic Impact of Potential New Flares

Source: Draft EIR, Chapter 3.1 Aesthetics. Environmental Audit, Inc.
Aesthetic Impact: Visible Emissions from Flares

Source: Hydrogen Tools-H2Tools
Aesthetic Impact:
Visible Emissions from Flares, cont.

Source: Hydrogen Tools-H2Tools
Visible Emissions from Flares, cont.

• More complex, heavier hydrocarbon gases typically generate more smoke than simpler, lighter hydrocarbon gases

• Hydrogen burns with a dim blue flame that may be invisible in daylight

• A flaring event associated with a hydrogen plant is expected to produce a clean burning flame with little-to-no smoke
Cost and Cost Effectiveness Analysis

- Total annualized cost associated with flares = $15.5 M per year
- Total methane reduction = 77,500 metric ton CO$_2$e per year
- Cost-effectiveness of flares = $6,800 per metric ton
- Total annualized cost associated with pressure swing adsorption (PSA) system = $60.7 M per year
- Incremental cost-effectiveness between flare and PSA system = $186,000 per metric ton
Socioeconomic Impacts

- **$ Significant** impacts expected when costs exceed **10%** of net income

- **Potential Significant** impacts at one facility
  - Total compliance cost for all facilities = $15.3 to 17.7 M per year.
  - Total compliance cost for all facilities / net income = 1.9 to 2.2 % of net income
  - Cost of compliance for Air Liquide = 7.5 to 11.3% of net income

- **Cost mitigation measures** available.
  - Carbon credit value for methane reduction = $1.3M to $2.1M
  - Social cost of carbon = $1.7M to $9.8M per year
• California Environmental Quality Act (CEQA)
• Analysis found air quality impact would be potentially significant after mitigation.
Statutory Findings

• Before adopting, amending, or repealing a rule the Board of Directors must make findings of necessity, authority, clarity, consistency, non-duplication and reference (California H&SC Section 40727)

  • Necessity – H&SC Section 40727(b)(1)
  • Authority – H&SC Section 40727(b)(2)
  • Clarity – H&SC Section 40727(b)(3)
  • Consistency – H&SC Section 40727(b)(4)
  • Non-duplication – H&SC Section 40727(b)(5)
  • Reference – H&SC Section 40727(b)(6)
Implementation of proposed amendments will require a new fee to fund staffing of the additional full-time equivalents (FTE) staff resources:

- Engineering: 2 additional FTEs
- Meteorology and Measurement: 1 additional FTEs
- Compliance and Enforcement: 1 additional FTE

Consideration in future amendments to Regulation 3: Fees
Recommended Action

1. Adopt proposed new Regulation 13: Climate Pollutants, Rule 5: Industrial Hydrogen Plants (Rule 13-5);
2. Adopt proposed amendments to Regulation 8: Organic Compounds, Rule 2: Miscellaneous Operations (Rule 8-2);
3. Certify Final Environmental Impact Report