Potential Amendments to District Rule 4354
(Glass Melting Furnaces)

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San Joaquin Valley Air Pollution Control District

webcast@valleyair.org
Valley’s Air Quality Challenges

• Valley’s challenges in meeting federal air quality standards unmatched due to unique geography, meteorology, and topography
• Valley designated as “Extreme” non-attainment of the 8-hour Ozone NAAQS; “Serious” non-attainment of federal standards for fine particulate matter (PM2.5)
  – Substantial emission reductions needed to achieve federal standards – need to go beyond already strict control limits
• Combustion is a significant source of NOx emissions, primary precursor to ozone and PM2.5 formation
  – Comprehensive strategy in 2018 PM2.5 Plan includes commitment to reduce emissions from mobile sources and a number of stationary source categories, including glass melting furnaces
Health Benefits of Reducing Emissions in the Valley

• Exposure to PM2.5 and Ozone linked to a variety of health issues, including (but not limited to):
  – Asthma, chronic bronchitis, irregular heartbeat, and respiratory/cardiovascular hospitalizations

• District implements control measures to lower direct and precursor emissions throughout the Valley
  – NOx emissions are key precursor to formation of ammonium nitrate, which is large portion of total PM2.5 winter
  – NOx is also chemical precursor to formation of Ozone

• Proposed rule amendment will support goal of attaining health-based federal ambient air quality standards for both PM2.5 and Ozone, and help to protect public health
Glass Melting Facilities in San Joaquin Valley

- Valley home to six glass-making facilities with glass melting furnaces
  - **Container glass**: Any glass manufactured by pressing, blowing in molds, rolling, or casting (i.e. into bottles)
  - **Fiberglass**: Material consisting of fine filaments of glass
  - **Flat glass**: Glass produced by the float, sheet, rolled, or plate glass process - used in windows, windshields, etc.
NOx Emissions from Glass Melting Furnaces in the Valley

All NOx Emissions in the Valley Mobile, Stationary, & Area Sources

- Other NOx Sources: 98.4%
- Glass Melting Furnaces: 1.6%

NOx Emissions from Stationary Sources

- Other Stationary Sources: 88.4%
- Glass Melting Furnaces: 11.6%
Rule 4354 Overview

• District Rule 4354 first adopted September 14, 1994
  – Sixth generation rule
• Rule limits emissions of NOx, CO, VOC, SOx, and PM10 from glass melting furnaces
  – Through rule requirements, NOx emissions reduced by 75% to date
• Control technology required for glass melting furnaces to meet existing stringent limits
  – Rule requirements approved as meeting Most Stringent Measures (MSM) by U.S. EPA in July, 2020
• Specific types of glass melting furnaces have different limits, due to variations in the glass production process, residency time in the furnace, temperature requirements, etc.
Commitments from 2018 PM2.5 Plan

• Per 2018 PM2.5 Plan commitments, District pursuing potential opportunities to reduce NOx from container glass furnaces, as technologically and economically feasible
  – Evaluating lowering NOx limit from 1.5 lb/ton to between 1.0-1.2 lb/ton glass pulled or lower, based on rolling 30-day average

• District also evaluating feasibility of lower NOx emission limits for other glass melting furnaces
Current NOx Controls In Use At Valley Glass Plants

- **Selective Catalytic Reduction (SCR)**
  - Advanced active emissions control system that injects an ammonia-type reagent into a catalyst in the exhaust stream
- **Oxy-Fuel fired furnaces**
  - Furnace technology adds oxygen to fuel and reduces NOx emissions by minimizing the availability of nitrogen in combustion process
- **Selective Non Catalytic Reduction (SNCR)**
  - Reduces NOx emissions through injection of ammonia type reagent into furnace/exhaust stream

*Image credit: Babcock & Wilcox, 2016*
Additional Controls In Use At Valley Glass Plants

Particulate Matter Control Technologies

– Electrostatic Precipitator (ESP)
  • Removes particles from a gas stream by using electrical energy to charge particles and attract them to oppositely charged collector plates

– Ceramic filter system
  • Removes particles from gas stream through direct impaction

SOx Control Technologies

– Dry Scrubber Systems
– Semi-dry Scrubbers Systems
  • Powdered alkaline sorbent injected into exhaust stream to reduce sulfur compound emissions

Images credit: Babcock & Wilcox, 2016
Further NOx Control Technology Under Evaluation

- Ceramic Catalytic Filters
  - Tri-Mer UltraCat Catalytic Filter System
- Oxy-Fuel Combustion
- Selective Catalytic Reduction (SCR)
- Combination of control technologies
Cost Assessment of Further Control Technology

• Sources for costs
  – Actual costs provided by facilities, engineering estimates, and control technology vendors & manufacturers
  – Various sources for the cost of electricity, fuel, and replacement parts
  – Cost factors from EPA's Office of Air Quality Planning and Standards
• Staff held virtual meetings with facilities, vendors, manufacturers, and other stakeholders to gather cost figures
Ceramic Catalytic Filter

• Ceramic Catalytic Filters
  – Tri-Mer UltraCat Catalytic Filter System; controls PM, SOx, NOx, and more with a single integrated system
  – Total Capital Cost:
    • $5M (housing already installed)- $17.5M (full system cost)
  – Operation & Maintenance Cost:
    • $600K - $2.4M
Selective Catalytic Reduction (SCR)

- Reduces NOx emissions through injection of ammonia type reagent into furnace
- Total Capital Cost: $2M-$6.9M
- Operation & Maintenance Cost: $6K-1M
Oxy Fuel Combustion

- Oxy-Fuel Combustion
  - Adds oxygen to fuel and reduces NOx emissions by minimizing the availability of nitrogen
  - Total Capital Cost: $24M
  - Operation & Maintenance Cost: ~$3.1M
Combination of Controls

- Combination of control technologies such as Oxy-fuel and Ceramic Catalyst Filtration have the potential to achieve significantly lower emission limits.
Electric Furnace Technology Evaluation

• District in process of conducting analysis of potential feasibility of conversion to electric furnace technology

• Preliminary analysis shows:
  – Electric furnaces not available in size needed to support plant production throughput levels (process limits furnace capacity under 300 tons/day)
  – Commercially available technology does not support use of recycled glass
  – Current electric furnace design not suitable for flat glass production
  – More than 10 MW of electrical capacity needed to replace just one furnace at Valley plant (enough to power 2,600 homes for a year)

• Significant cost of electricity to operate electric furnaces
• Life of electric furnaces significantly shorter than traditional
• District continuing to evaluate electric furnace technology

Image credit: Glass Worldwide, 2021
Cost-Effectiveness (CE) Analysis

• Cost-Effectiveness is cost (capital and annual) over emission reductions for the life of the equipment ($/ton)
• Two major cost elements
  – Capital Costs (Equipment, Infrastructure, Engineering, Installation, Tax, Freight)
  – Annual Costs (Operation & Maintenance)
• Emission reductions based on current emission levels (baseline) to proposed emission limit
Rule 4354 Amendments Under Consideration: Container Glass Melting Furnaces

• District proposing to lower existing NOx emissions limits with phased compliance schedule for container glass facilities
  – Current NOx limit 1.5 lb/ton glass pulled
  – Proposed **Phase I limit** between 1.0-1.2 lb-NOx/ton glass pulled based on rolling 30-day average (Jan. 1, 2024 compliance deadline)
  – Proposed **Phase II limit** 0.75 lb-NOx/ton glass pulled based on rolling 30-day average
    • Phase-in by furnace rebuild schedule starting in 2024, no later than 2029

• Proposing to lower existing PM10 emission limits
  – Current limit 0.5 lb/ton glass pulled
  – Considering lowered limit of 0.15 - 0.2 lb/ton based on 24-hr block avg. (2024)

• Proposing to lower existing SOx emission limits
  – Current rule limit for SOx 1.1 lbs/ton glass pulled
  – Considering limit between 0.6 lbs/ton – 0.8 lbs/ton on 24-hr block avg. (2024)
Rule 4354 Amendments Under Consideration: Flat Glass Melting Furnaces

• District proposing to lower existing NOx emissions limits with phased compliance schedule for flat glass facilities:
  – Current NOx rule limit 3.2 lb/ton glass pulled (2.9 for Early Enhanced Schedule) on 30-day average
  – Proposed **Phase I limit** of 2.5 lb-NOx/ton glass pulled (30-day rolling avg.)
    • January 1, 2024 compliance deadline
  – Proposed **Phase II limit** as low as 1.5 lb-NOx/ton glass pulled (30-day rolling avg.)
    • Phase in by furnace rebuild schedule starting in 2024, no later than 2029

• Lower existing PM10 emission limits
  – Current limit 0.7 lb/ton glass pulled
  – Considering limit of 0.2 lb/ton glass pulled based on 24-hr block avg. (2024)

• No proposed changes to S0x limits for flat glass melting furnaces
Next Steps

• Requesting comment on rule concepts by October 14
  – Draft rule to be published in coming weeks, with associated comment period
• Continued analysis of costs, cost-effectiveness of various controls, and feasibility of control requirements
• Socioeconomic Impact Analysis underway by third-party consultant to evaluate the regional economic impacts of proposed amendments
  – Characterization of the Valley’s economic climate
  – Evaluation of economic impacts
  – Socioeconomic Impact Analysis report
  – Results of analysis will be included with proposed rule packages
• Ongoing public engagement process
Next Steps: Public Engagement Process for Rule 4354 Amendments

1. **Public Workshop**
2. Publication of proposed rule package to the District web
3. **Public Comment Period**
4. **Governing Board Public Hearing**

Public Participation and Comment Invited throughout Process
Contact

Contact: Ariana Hooks
Mail: San Joaquin Valley APCD
1990 E. Gettysburg Ave
Fresno, CA 93726
Phone: (559) 230-5800
Fax: (559) 230-6064
Email: Ariana.hooks@valleyair.org
Listserv: http://lists.valleyair.org/mailman/listinfo/glass_melting_furnaces
Comments/Questions

webcast@valleyair.org