San Joaquin Valley
Unified Air Pollution Control District

Best Available Control Technology (BACT) Guideline 7.X.X

Emissions Unit: Hydrogen Production – Process Vents

Equipment Rating: All **Last Update:** March 1, 2024

Pollutant	Achieved in Practice or contained in SIP	Technologically Feasible	Alternate Basic Equipment
VOC	VOC emissions from process vents not to exceed 0.5 lb/MMscf of hydrogen produced (Equivalent to 96% capture and control)	Use of a Thermal Oxidizer Achieving 99% overall capture and control	

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

***This is a Summary Page for this Class of Source - Permit Specific BACT**

Best Available Control Technology Analysis

District BACT Guideline 7.X.X

Hydrogen Production: Process and Wastewater Treatment Unit Vents

Prepared by:
James Harader, Supervising Air Quality Engineer

Reviewed by:
Nick Peirce, Permit Services Manager

I. Introduction

BACT is triggered for VOC emissions from the process vents associated with the hydrogen production unit and the wastewater treatment units associated with this facility. The District's BACT Clearinghouse does not include a BACT Guideline for this type of operation; therefore, a new BACT Analysis will be performed to determine BACT for this operation.

II. Source of emissions

The HPU consists of the following series of reactors:

- Hydrotreater – Converts organic sulfur compounds in the reformer feed into hydrogen sulfide and converts olefins to saturated hydrocarbons using a Co-Mo catalyst.

- Desulfurization Absorber – Removes the hydrogen sulfide from the process gasses using a zinc-oxide catalyst.

- Pre-Reformer – Converts long chain hydrocarbons into naphtha and methane using a zinc catalyst, preparing the gas stream for the Reformer that processes methane and naphtha

- Reformer – Converts methane and naphtha to CO and H_2 using steam and a zinc catalyst.

- High Temperature Shift Converter – Converts remaining CO with H_2O to H_2 and CO_2 using steam and an iron-chromium catalyst.

- Pressure Swing Adsorber (PSA) – removes impurities to produce pure hydrogen (99+%). The removed off gas is reused as fuel in the Reformer.

VOC emissions are emitted from the reactor vents associated with the hydrogen production unit. These VOC emissions are routed to RTO #1 for control of the VOC emissions.

Additionally, a wastewater treatment unit produces clean water for the hydrogen production unit. The wastewater treatment unit includes a digester that creates digester gas laden with VOCs. The digester gas is routed to RTO #1 for control of the VOC emissions.

Emissions from the processes routed to RTO #1 are greater than 2.0 lb-VOC/day; therefore, BACT is triggered for VOC emissions.

III. Top-Down BACT Analysis

BACT analysis for VOC Emissions

Step 1 - Identify All Possible VOC Control Technologies

The following BACT clearinghouse references were reviewed to determine whether any hydrogen product plants have been required to employ VOC controls for emissions from reaction vessel vents and wastewater treatment unit vents.

- EPA RACT/BACT/LAER clearinghouse
- CARB BACT clearinghouse
- South Coast AQMD (SCAQMD) BACT clearinghouse
- Bay Area AQMD (BAAQMD) BACT clearinghouse
- Sacramento Metro AQMD (SMAQMD) BACT clearinghouse
- San Joaquin Valley APCD (SJVAPCD) BACT clearinghouse

The EPA RACT/BACT/LAER Clearinghouse was searched. The following determinations were identified:

RBLC ID: IL-0115 – Wood River Refinery
Process: Hydrogen Plant 2 Vents
Control Requirement: Good Air Pollution Control Practices

RBLC ID: CA-1250 – Taft Ammonia
Process: Hydrogen Product
Control Requirement: Not listed, no add-on controls

RBLC ID: CA-1252 – Taft Ammonia
Process: Hydrogen Product
Control Requirement: Not listed, no add-on controls

RBLC ID: LA-0211 – Garyville Refinery
Process: Hydrogen Plant Steam Vent, Deaerator Vent, and Hydrogen Vent
Control Equipment: None

A search of South Coast AQMD BACT Clearinghouse identified the following requirements:

South Coast BACT Requirements for Non-Major Polluting Facilities	
Category	**BACT Requirement for VOCs**
Reactor with Atmospheric Vent	-Carbon Adsorber; or -Afterburner; or -Refrigerated Condenser; or -Scrubber with Approved Liquid Waste Disposal

Bay Area Air Quality Management District's Clearinghouse and Sacramento Metropolitan AQMD's BACT Clearinghouse did not include any guidelines for hydrogen production plant - reaction vessel vents and wastewater treatment vents.

The SJVAPCD Clearinghouse was searched and does not include any guidelines for hydrogen production plant - reaction vessel vents and wastewater treatment vents.

The only Federal, State, or local Rule found that addresses hydrogen production process vents is South Coast Rule 1189, "Emissions from Hydrogen Plant Process Vents". This rule limits the total VOC emissions from process vents to 0.5 pounds per million standard cubic feet of hydrogen produced. This emission limit is equivalent to approximately 96% control of VOC emissions[1]

A review of District permits for chemical plants revealed the following hydrogen production operations:

Facility Permit	**VOC Control Requirement for Leaks**
Alon Bakersfield Refining S-33-55-23	No controls for reactor vessel vents or wastewater treatment vents listed on permit.

The following control options were identified based on the above information:

Option 1: Limit Emissions from Process Vents to 0.5 lb-VOC/MMSCF

This option is required by SCAQMD Rule 1189. Since this Rule is SIP-approved, the requirement is achieved in practice.

[1] South Coast Rule 1189 considers an emission limit of 2.5 lb-VOC/mmscf of hydrogen produced to be equivalent to 80% control of VOC emissions from the baseline emissions from hydrogen vents. Using these values, the uncontrolled emissions from hydrogen vents is equal to 12.5 lb-VOC/mmscf of hydrogen produced (2.5 lb/mmscf ÷ (1-0.8)).

Option 2: Use of a Thermal Oxidizer achieving 99% overall capture and control of VOC emissions

No facilities using this control technology were identified; however, this is a technologically feasible control.

Option 3: Good Air Pollution Control Practices

This option is less stringent than Option 1, which is achieved in practices. Therefore, this option will be removed from consideration.

Step 2 - Eliminate Technologically Infeasible Options

All of the items listed in step 1 are technologically feasible. Therefore, none can be eliminated.

Step 3 - Rank Remaining Control Technologies by Control effectiveness

Rank	Capture and Control Efficiency	Status
1. Use of a Thermal Oxidizer achieving 99% capture and Control of VOC emissions.	99%	Technologically Feasible
2. VOC emissions from process vents not to exceed 0.5 lb/MMscf of hydrogen produced (Equivalent to 96% capture and control).	96%	Achieved in Practice

Step 4 - Cost Effectiveness Analysis

The applicant is proposing the most effective control technology identified. Therefore, a cost effectiveness analysis is not required.

Step 5 - Select BACT

The applicant is proposing the most effective control technology identified, the use of a thermal oxidizer with an overall VOC control and capture efficiency of 99%. Therefore, BACT for VOC emissions is satisfied.