

ENGINEERING EVALUATION REPORT

REVISED FLARE MONITORING AND RECORDING PLAN

Facility Information

AIR PRODUCTS & CHEMICAL, INC.
ID# 101656
TITLE V: YES
RECLAIM: NOX
ZONE: COASTAL
CYCLE: 2

Mailing Address

700 HENRY FORD AVE.
WILMINGTON, CA 90744

Equipment Address

700 HENRY FORD AVE.
WILMINGTON, CA 90744

Contact Information

CHRIS MC WILLIAMS (PLANT MANAGER)
(310) 952-9928

BACKGROUND:

Air Products & Chemical, Inc. operates a Hydrogen (H₂) production facility in Wilmington, California that produces 99.9% pure H₂ for dedicated 'over the fence' sales (via pipeline) to several neighboring refineries. The facility, known as the 'Wilmington Hydrogen Plant' (herein referenced as 'the plant'), began operations in early 1996 and has the capacity to produce up to 86.4 MMSCFD of 'pure' H₂ gas for use in refinery operations.

The plant operates one (1) ground flare that is subject to the provisions and requirements of District Rule 1118. This flare (C46) is classified as a 'Clean Service' flare. It is designed and operated to combust vent gases with relatively fixed composition from specific equipment as defined in Rule 1118(b)(1). As described later in the Process Description section of this evaluation, C46 burns vent gases that are typically predictable in gas composition and has very little sulfur content. Two years of CEMS data shows the average daily sulfur content from the worst case vent stream (process feed) to be ~ 16 ppmv H₂S. Other vent streams, from within the plant, have been tested to contain no sulfur content.

The District amended Rule 1118 on November 4, 2005 in an effort to further control and minimize flare emissions. Stricter requirements in monitoring, recordkeeping, and reporting of flare activities were imposed in this latest rule amendment to better quantify flare emissions. Reliable and accurate flare emissions data are crucial in ensuring petroleum refineries do not exceed the performance targets for SO_x emissions pursuant to section (d) of Rule 1118. Note that the Wilmington Hydrogen plant is not an affected facility (petroleum refinery) subject to the requirements of section (d). Nevertheless, a revised Flare Monitoring and Recording Plan was required to be submitted to the District by 6-30-06 pursuant to Rule 1118(f)(1)(A) for approval.

The plant submitted a revised Flare Monitoring and Recording Plan on 6-30-06 under A/N 458529. This approved plan will supersede the amended Flare Monitoring and Recording Plan

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issued on 12-2-05, which superseded the initial flare plan approved under A/N 341697 in December 2003.

FLARE OVERVIEW

The following information on C46 has been provided by the plant:

Table 1 - Flare Information

Flare Device ID	Manufacturer/ Model	Type of Service	Pilots	Pilot Gas	Stages / Burners	Purge Gas	Vent Gases	Vent Gas Recovery
C46	Callidus/BTZ-TEGF	Clean	16	Nat. Gas	6 / 48	N ₂	N ₂ , H ₂ , CO, CO ₂ , CH ₄ , C ₂ - C ₅ , H ₂ S (<40 ppmv, dictated by Rule 431.1)	None

The flare system uses inert nitrogen (N₂) as purge gas to prevent combustible mixtures caused by air infiltration into the flare system. Continuous purging of the flare header (24") and burner stages (6) take place during normal operations. There are no emissions associated with this inert N₂ purge gas.

FLARE OPERATIONS & STAGING DESIGN

The flaring operation of C46 is divided into six (6) subheaders and six (6) burner stages. The number of stage(s) in operations at any given time is dependent on the vent gas load to the flare. Each stage is equipped with a valve and fixed number of burners. The 'staging' valves are either opened or closed. Hence, they are not control valves that regulate flow and are consistent with the requirements of 'on/off flow indicator' pursuant to Rule 1118. The staging operation is designed such that the valves automatically open (sequentially) as the pressure in the flare header increases with the increase in vent gas load. As more staging valves open, additional burners are available to combust the increased gas flow. Similarly, as the vent gas flow decreases, the staging valves will close in the reverse order that it was opened (destaging). A more detailed discussion on the staging sequence and the total number of burners in service as a function of what stages are opened can be found in section 3.1.3 of the Revised Flare Monitoring and Recording Plan.

PILOT OPERATIONS

Sixteen (16) continuous burning pilots, using commercial pipeline natural gas from the Gas Company, are used to burn the gases vented to C46. The pilots are mounted on a thermocouple for flame detection and the auto ignition system will re-ignite the pilot in the event it is extinguished. The natural gas usage for the pilots is measured by a dedicated meter from the Gas Company. Rule 1118(g)(8)(C) exempts Clean Service flares from measuring and recording actual gas flow to the flare pilots. The pilot emissions will be calculated using monthly gas bills from the Gas Company (using a conversion factor of 0.0000952 MMSCF/therm). In the event

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gas bills are not available in time for preparation of the quarterly emissions report, the maximum design flow capacity of 1600 SCFH for the pilots will be used.

FLARE PROCESS DESCRIPTION

Five categories of vent gases, summarized in Table 2, are combusted by C46. The composition of each stream is fairly consistent and is shown in Section 3.4.2 of the revised flare plan. Plant performance tests have been conducted to verify the gas composition and heat content (HHV) of these vent gas streams. The report, showing the gas composition, HHV, and total sulfur content of each vent gas stream, is shown in Appendix A of the revised plan. This information is stored in the plant's Distributed Control System (DCS).

Table 2 – Vent Gases to C46

Vent Gas Stream	% Of Total Flow to C46	Source	Gas Composition	HHV, Btu/Scf
Process Feed	> 95%	Automatic Vent Valve PV-3. Blended stream of refinery offgas (from Valero & Tesoro) and commercial natural gas.	H ₂ , CO ₂ , N ₂ , CH ₄ , C ₂ H ₆ - C ₅ H ₁₂ , trace C ₂ H ₄ & C ₃ H ₄ , H ₂ S	1171
Syngas		Automatic Vent Valve PV-578. Reformer outlet to PSA Unit inlet.	H ₂ , CO ₂ , CO, CH ₄ , trace N ₂ & H ₂ O, Sulfur free	304
PSA Purge Gas		Automatic Vent Valve PV-220. PSA outlet stream (used as primary fuel to reformer burners).	CO ₂ , H ₂ , CH ₄ , CO, trace N ₂ & H ₂ O, Sulfur free	273
H ₂ Product		Automatic Vent Valve PV-223. PSA outlet stream (to product compressors).	99.9% pure H ₂ , trace N ₂ & CO, Sulfur free	324
Process Feed Gas, Syngas, PSA Purge Gas or H ₂ Product	< 5%	Miscellaneous Compressor blowdowns, miscellaneous manual and safety relief valves.	CH ₄ , C ₂ H ₆ - C ₅ H ₁₂ , CO ₂ , H ₂ , trace H ₂ S & N ₂	Dependent on vent gas stream. If not known, worst case gas composition of Process Feed Gas used (1171)

Four of the five possible vent sources are vented to the main flare header via 'automatic vent valves' which operate like control valves that regulate pressure in the process stream it serves. These four vent streams account for over 95% of the vent gases combusted in the flare. The miscellaneous gas stream portion is insignificant relative to any of these four vent streams and the worst case gas composition of process feed gas is used for emissions calculations whenever all four vent valves are fully closed and the 1st stage burner valve (XV-9012A) is opened. The operations of these automatic vent valves are monitored by the plant's DCS. Knowing what stream is venting to the flare header, gas composition, HHV, sulfur content, and total vent gas

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flow (based on the number of stages lit and manufacturer supplied capacity curve for each stage) to C46, flare emissions can be calculated. If multiple streams are venting at the same time, the worst case HHV and sulfur content stream will be used to calculate flare emissions.

Table 3 summarizes the vent gas monitoring method used by the plant.

Table 3 – Vent Gas Monitoring/Recording Method

Flare ID	Gas Flow	Gas Higher Heating Value, Btu/Scf	Total Sulfur Concentration
C46	Based on on/off flow valve of each burner stage of the flare burners and capacity curve for each stage: See Section 3.1.3 and Figure 4 of revised flare plan for staging logic and vent gas flow capacity curve.	Calculated based on composition measured during plant performance test. See Table 2 for HHV when single stream is venting to flare. When multiple or unknown streams are venting at the same time, the worst case HHV is used.	Sulfur free if vent gas source is Syngas, PSA Purge Gas, or H ₂ Product. If vent gas source is Process Feed Gas or unknown, use maximum 40 ppmv TSC as worst case emission factor.

The pilot, purge gas, and visible emissions monitoring methods are summarized in Table 4 below.

TABLE 4: Pilot, Purge Gas and Visible Emissions Monitoring Methods

Flare ID	Pilot Gas Flow	Purge Gas Flow	Pilot Flame	Visible Emissions
C46	Usage based on monthly gas bill from The Gas Company. If gas bill is unavailable, use maximum design flow rate of 1600 SCFH if gas bill not available.	Nitrogen Gas is not measured. No emissions since gas is inert	Thermocouple w/ Auto Ignite	Color Video

PLAN EVALUATION

A revised Flare Monitoring and Recording Plan shall contain, at minimum, all of the information specified by Subsections (f)(3)(A) through (f)(3)(Q) of Rule 1118. As shown in Table 5, Air Products' proposed plan meets the requirement specified in Section (f)(3) of the rule.

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TABLE 5: Checklist for a Revised Flare Monitoring and Recording Plan

Requirements	Rule 1118 (f)(3)	Yes	Comment
A facility plot plan showing locations of flares	(A)	√	See Figure 1 of the proposed plan
Flare information: (1) type of service (2) design capacity (3) operation and maintenance	(B)	√ √ √	See Section 3 of the proposed plan
Pilot and purge gas information: (1) type of gas used (2) actual set operating flow rate (3) Expected maximum total sulfur content (4) Expected average higher heating value	(C)	√ √ √ √	See Section 3.1.5 & 3.1.6 of the proposed plan.
As built process flow diagrams and drawings identifying flare header, flare stack, flare tip/ burners, purge gas system, pilot gas system, ignition system, assist system, knockout drum, water and molecular seal, etc...	(D)	√	See Appendix B of the proposed plan
Flow diagrams showing the interconnections of the flares to vapor recovery system and process unit.	(E)	√	No vapor recovery system. See Appendix B for interconnections to process units.
Descriptions of the assist system process control, flame detection system and pilot ignition system.	(F)	√	See Section 3.1.5 of the proposed plan
Description of the gas flaring process if an integrated gas flaring system is being operated.	(G)	--	Not an integrated flare system
Description of the vapor recovery system: (1) type of compressor (2) design capacity of each compressor (3) design capacity of vapor recovery system (4) method to record amount of vapors recovered	(H)	-- -- -- --	Not equipped with vapor recovery system.

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Requirements	Rule 1118 (f)(3)	Yes	Comment
Drawings with dimension showing: (1) location of sampling equipment (2) locations of HHV, TS analyzers (3) location of flow meter (4) location of on/off indicator	(I)	-- -- -- √	Flow determined by on/off flow valve for staged firing and manufacturer capacity curve. HHV calculated from plant performance test for dedicated vent streams or use worst case natural gas HHV & TS if vent stream is not known.
Manufacturer's specifications for existing and proposed flow meters and on/off flow indicator, HHV and TS analyzers: (1) make, model and type (2) range, precision and accuracy (3) calibration, maintenance and quality assurance procedures	(J)	√ √ √	No HHV or total sulfur analyzers used. Calculated values used based on plant performance test and Natural Gas SOx emission factor.
Description and data used to determine actuating and de-actuating settings for on/off flow indicator, and method to verify these settings.	(K)	√	Staging on/off valves to be used as on/off flow indicators.
Description of analytical and sampling methods or estimation method, if applicable, to determine high heating value and total sulfur content of vent gases.	(L)	√	See Sections 3.4.2 and Appendix A of the proposed plan.
Description of data recording, collection and management system.	(M)	√	See Section 4.0 of the proposed plan
Description of proposed method to determine, monitor and record total gas volume, HHV and total sulfur concentrations of vent gases.	(N)	√	See Section 4.0 of the proposed plan
Schedule for installation and operation of flare monitoring system	(O)	--	Infrastructure & equipment in place for monitoring and recording flare emissions.
Description of any proposed alternative criteria to determine a sampling event for each specific flare.	(P)	--	None proposed. HHV and TS currently calculated based on plant performance test

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Requirements	Rule 1118 (f)(3)	Yes	Comment
A request to use an alternative sampling program pursuant to paragraph (g)(4)(C)	(Q)	--	No request made

RECOMMENDATION:

The revised Flare Monitoring and Recording Plan, along with the supplemental information, submitted by Air Products Wilmington contain all the requirements pursuant to Rule 1118(f)(3). Therefore, the plan is recommended for approval with the following conditions:

1. The owner/operator shall perform monitoring and recording of the operating parameters for the flare in accordance with this approved compliance plan and other applicable requirements of Rule 1118(g). Monitoring and recording of the below flare pursuant to this approved plan shall be performed at all times, except when out of service for reasons described in Rule 1118(g)(5)(A).

Flare Device ID	Type of Service
C46	Clean

2. The owner/operator shall use the on/off status of the stage burner valves as flow indicators to C46. The operator shall implement algorithms to the plant's DCS to calculate and record continuously the volumetric flare gas flow rate based on the number of on/off staged burner valves that are opened. The calculation shall be based on the staging curve provided by the flare manufacturer and corrected to a gas molecular weight of 20.81 lb/lb-mole.
3. The start of a flare event shall be defined when the 1st stage burner valve (no. XV-9012A) is not in the fully closed position and the end of a flare event shall be defined when the 1st stage burner valve is fully closed.
4. A flare event lasting 24 hours or less shall be considered a single flare event even when the vent occurs in two consecutive days. When a flare event continues for more than 24 hours, each calendar day shall be a separate flare event.
5. The vent gas flow rate shall be assumed to be at the maximum design capacity of the flare when the last burner stage valve (no. XV-9040) is not in the fully closed position.
6. Volumetric flow rates of vent gases shall be corrected to standard conditions of 14.7 psia and 68F and recorded as one-minute averages.
7. Except for flare events originating from automatic vent valve PV-223 only (Hydrogen vent gas stream), the owner/operator shall calculate emissions of criteria pollutants for

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each flare event using the methods described in Attachment B of Rule 1118 and the appropriate HHV and Cs values specified in Section 3.4.2 of the revised FMRP. Whenever two (2) or more automatic vent valves (PV-3, PV-578, PV-220 and PV-223) are opened concurrently during a flare event, the worst case HHV and sulfur content stream will be used to calculate flare emissions.

8. The operator shall sample and analyze the Process Feed Gas, Syngas, PSA Purge Gas and Hydrogen vent streams to the flare once a year pursuant to the methods listed in Rule 1118(j). For the Process Feed Gas vent stream, the analysis shall include the gas composition, HHV and total sulfur content of the gas. For the Syngas, PSA Purge Gas and Hydrogen vent streams, the total sulfur content can be considered 0 and the analysis shall be for gas composition and HHV only. Samples shall be taken within 30 minutes, but no sooner than 15 minutes, of the start of a flare event. In the event the HHV of these vent streams deviate by 10% or more from the values shown in this approved plan, the owner/operator shall submit an application to the Executive Officer to modify the HHV used to calculate emissions pursuant to Attachment B of Rule 1118.
9. The owner/operator shall calculate emissions for a flare event that occurs even when all four (4) automatic vent valves (PV-3, PV-578, PV-220 and PV-223) are in the fully closed position by using the methods described in Attachment B of Rule 1118 and the appropriate HHV and Cs factors specified in Section 3.4.2 of the revised FMRP.
10. For flare events originating from PV-223 only, the operator shall calculate NO_x emissions using the following equation and emission factor. Emissions of other criteria pollutants (ROG, CO, PM10 and SO_x) are considered zero under this flaring scenario.

Hydrogen Vent Gas Stream		
Air Pollutant	Equation	EF
NO _x	$E_v = V_v \times 324 \times EF$	0.068 lb/mmBtu

Where:

E_v = Vent gas emissions, calculated, lbs
 V_v = Volume flow of vent gas, measured in million standard cubic foot (mmScf) at 14.7 psia and 68°F

11. The natural gas flow to the pilots shall be based on usage from monthly gas bills from the Gas Company. If gas bills are not available by the time quarterly reports are being prepared, the pilot gas usage shall be based on the maximum design capacity of 1600 SCFH for the pilots.

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12. The owner/operator shall monitor the flare at all times for presence of a pilot flame using a thermocouple that will alarm the owner/operator in the event of a flame out. The owner/operator shall reignite the pilot immediately after a pilot flame out occurs.
13. The owner/operator shall notify the Executive Officer within one hour of any unplanned flare event with emissions exceeding either 100 pounds of VOC or 500 pounds of sulfur dioxide, or exceeding 500,000 standard cubic feet of flared vent gas. The owner/operator shall also notify the Executive Officer by telephone at least 24 hours prior to the start of a planned flare event with emissions exceeding either 100 pounds of VOC or 500 pounds of sulfur dioxide, or 500,000 standard cubic feet of combusted vent gas.
14. The owner/operator shall conduct a Specific Cause Analysis for any flare event, excluding planned shutdown, planned startup and turnaround, resulting in any of the followings: (a) 100 pounds of VOC emissions. (b) 500 pounds of sulfur dioxide emissions. (c) 500,000 standard cubic feet of vent gas combusted. The analysis shall identify the cause and duration of the flare event and describe any mitigation or corrective action taken to prevent recurrence of a similar flare event in the future. Unless an extension is granted, the owner/operator shall submit a Specific Cause Analysis to the Executive Officer within 30 days of the event.
15. The owner/operator shall conduct an analysis and determine the relative cause for a flare event that results in combustion of more than 5,000 standard cubic feet of vent gas. A Specific Cause Analysis may be submitted to satisfy this condition.
16. The owner/operator shall maintain records of all the information required to be monitored and make such records available to District personnel upon request.
 - a. Flare event data collected pursuant to paragraphs (g)(3), (g)(4), (g)(5), (g)(6) and (g)(8)(C) of Rule 1118 as applicable.
 - b. Total daily and quarterly emissions of criteria pollutant from the flare and each flare event along with all information specified by Rule 1118(i)(5)(B).
 - c. Monitoring record of automatic vent valves on/off positions pursuant to Condition No. 7, 9 and 10.
 - d. Pilot flame failure report.
 - e. Planned and unplanned flare monitoring system downtime report that includes date, time and explanation for taking the system out of service.
 - f. Sample results for gas composition, HHV and Cs pursuant to Condition No. 8.
 - g. Specific Cause Analysis completed pursuant to Condition No. 14.
 - h. Relative Cause Analysis completed pursuant to Condition No. 15.
 - i. Annual acoustical pressure relief device leak survey.
 - j. Video records pursuant to Rule 1118(g)(7).

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Within 30 days after the end of each calendar quarter, the owner/operator shall submit a quarterly report to the AQMD Refinery Compliance Team at the below address. Item (a) through (h) shall be submitted quarterly in electronic format. Hard copy of item (i) shall be submitted with the quarterly report for the quarter which the survey was conducted. Item (j) shall be made available to the Executive Officer upon request.

All records required by this condition shall be certified for accuracy in writing by the responsible facility official and maintained for at least five years.

SOUTH COAST AIR QUALITY MGMT DISTRICT
REFINERY COMPLIANCE
1500 WEST CARSON STREET, SUITE 115
LONG BEACH, CA 90810

17. The operator shall comply with all provisions of this approved Flare Monitoring and Recording Plan unless the plan is suspended, revoked, modified, reissued, or denied. Violation of any of the terms of the plan is a violation of Rule 1118.