



Phillips 66
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ESDR-056-20
 02-E-01-B

Via E-Mail at Compliance@BAAQMD.gov

Mail Stop FM1
 Bay Area Air Quality Management District
 939 Ellis Street
 San Francisco, CA 94109

**Subject: Determination and Reporting of Cause:
 Main Flare (S-296) December 11, 2019
 BAAQMD 12-12-406 & Consent Decree 167 – 169
 Phillips 66, San Francisco Refinery (Plant 16)**

As required by BAAQMD 12-12-406 and the Phillips 66 Consent Decree, a Causal Analysis was conducted on the following hydrocarbon flaring incident. A Causal Analysis is required when the volume flared exceeds 0.5 MMSCF or sulfur dioxide emissions are greater than 500 pounds. The flaring occurred on December 11, 2019 from approximately 7:52 a.m. until 11:40 a.m. There were also few periods of minor, brief flaring (<10 minutes) related to this event that occurred periodically on December 11 and 12, 2019. The report contents are based on requirements of the Phillips 66 Consent Decree (CD) and the BAAQMD June 25, 2007 Compliance Advisory (BCA) and are referenced as such.

- The BAAQMD and Consent Decree 500 lb SO₂ report threshold was exceeded.
- The BAAQMD 500,000 scf/calendar day flow threshold was also exceeded.

Total Volume and Emissions from Affected Flares [BCA 4, 5, 8, 9; CD 153(a) & (b)]:

Refinery Main Flare (S-296):

Date/Flare	Start Time	End Time	Duration (Hrs:Min)	Gas Flow Rate, MSCF	Avg. S Mole	SO ₂ , lb	CH ₄ , lb	NMHC, lb
12/11/2019	7:52 AM	11:40 AM	3:48	513	8.78%	7,473	8	14
Totals				513		7,473	8	14

SO₂ emissions are calculated using the following equation:
 $SO_2 \text{ (lb)} = (FR) * (H_2S \text{ conc.}) * (0.1689)$
 FR = total flow rate during flaring, scf
 $0.1689 = [lb\text{-mol } H_2S / 379 \text{ scf } H_2S] * [64 \text{ lb } SO_2 / \text{mol } H_2S]$

Flaring Event Description [BCA 6, 7, 10, 11]

At approximately 5:00 AM an upset began at the Sulfur Recovery Unit 235 (U235). Shortly after the Sulfur Recovery Unit 236 (U236) also began to show indications of upset conditions. In light of the upset conditions at U235 and U236 and resulting impacts to the Refinery fuel gas system, the Refinery Emergency Operating Procedure (REOP-10) "Unplanned Sulfur Plant Shutdown or Loss of DGA Circulation" was implemented. One of the elements of this procedure is to circulate the Flare Gas Recovery Compressors (FGRCs), which resulted in flaring of unscrubbed gas. Flaring occurred primarily from 7:52 AM to 11:40 AM. There were a few other brief (<10 minute individual) minor periods of flaring during the day.

Primary Cause and Contributing Factors [BAAQMD 12-12-406.1, BCA 11, CD 153(d):

The shutdown of the FGRCs as directed in REOP-10 resulted in flaring. This shutdown of the FGRCs was necessary and undertaken in response to the Unit 235 and Unit 236 upsets.

During normal operation, gas flow within the Unicracker (U240) flows through the F-304 sponge oil pre-saturator before being sent to the D-401 contactor where lean DGA (DGA with no H₂S) is used to remove the H₂S from the gas. The rich DGA (DGA saturated with H₂S) exiting D-401 is then sent to the DGA regenerators for processing. On the morning of December 11, at approximately 5:00 a.m. following the failure of the F-304 level controller, condensed hydrocarbon liquids carried over into D-401. The hydrocarbons in D-401 were then pumped along with the rich DGA to the DGA regenerators. The overhead of the regenerators normally sends feed gas with negligible hydrocarbons to the SRUs. In this event, a higher concentration of hydrocarbons went overhead with the feed gas to the refinery SRUs.

The amount of air injected into the reaction section of the sulfur plants to adequately treat H₂S is determined by an air-to-acid gas ratio controller. As hydrocarbons entered the SRUs and were combusted, the air injected into the unit was consumed. Therefore, insufficient air was available to create the required chemistry for conversion of H₂S to elemental sulfur. Elevated SO₂ concentrations were then detected from U235 and U236. The Unit 235 and U236 sulfur plants were shut down ultimately because of hydrocarbons in the feed. The SRU feed was then routed to the Unit 233 fuel gas treatment unit where the amount of H₂S in the gas overwhelmed the capacity of the unit, causing elevated H₂S to be present in the refinery fuel gas being combusted in downstream sources.

Per REOP-10 the FGRCs were then shut down to direct the high H₂S containing material to be combusted at the elevated flare stack rather than at lower individual heater stacks.

Measures to Limit Duration/Quantity [BCA 10, 11, 12, CD 153(c)]

REOP-10 was implemented to minimize the potential environmental impact of this event. As part of REOP-10, Unit 200 Coker feed rate was reduced by bypassing one-half of Unit 200 Coker at approximately 6:15 a.m. to limit the amount of sour gas requiring treatment. In addition, Unit 250 and Unit 246 were reduced to minimum processing rates. At 8:00 a.m. fresh DGA was added to the system to restore H₂S stripping capacity. SRU 236 was stabilized at approximately 8:00 a.m. to resume sour gas treatment, and SRU 235 was stabilized at approximately 1:50 p.m.

Upon discovery of the hydrocarbon carryover, liquid levels within the process vessels at the Unicracker were verified by visual inspections. During these visual inspections it was determined the level indicator on F-304 had malfunctioned. The F-304 vessel discharge pump was then manually started to reduce the level in the vessel and prevent it from continuing to carryover hydrocarbon into the gas line to the D-401 contactor.

During this event, the refinery received no complaints from the public or outside agencies. In addition, no excess emissions were detected by the facility outer perimeter Ground Level Monitors or the fenceline monitoring system. A breakdown request was filed with BAAQMD.

Prevention Measures [BAAQMD 12-12-406.2, BCA 16, CD 153(e) & 154]:

The following preventative measures have been identified:

Root Cause Finding	Action Item(s)	Date
Sponge oil pre-saturator vessel F-304 level indicator LI-004 malfunctioned during unit start up. Vessel hydrocarbons carried over to the DGA system.	1. Upon discovery of the failed level indicator, liquid level in F304 was manually lowered and the level indicator was corrected.	COMPLETED 12/11/19
	2. Schedule re-occurring preventative maintenance testing plan for LI-004.	3/15/2020
	3. Update Unit 240 Plant 3 start up procedure to require visual level verification of F-304 throughout start up activities.	3/15/2020
	4. Include weekly visual level verification using sight glass in unit operator rounds	3/15/2020

Was the Flaring the Result of an Emergency [BAAQMD 12-12-406.4, BCA 13]:

Yes.

Was flaring due to a Regulatory Mandate to Vent to a Flare [BAAQMD 12-12-406.4, BCA 15]:

No.

Consistency with Flare Minimization Plan (FMP) [BAAQMD 12-12-406.3, BCA 14]:

The activities described that resulted in flaring are consistent with activities included in the Flare Minimization Plan. Specifically, these activities can be found described in the FMP in more detail in Section 4.2 as described below:

- Upset/Malfunction (4.2.1.4) – Failure of instrumentation, valve, pump, compressor, etc. to function as designed.
- Upset/Malfunction (4.2.1.4) – Fuel quality upsets

Please contact Jennifer M. Ahlskog at (510) 245-5856 if you have any questions.

Sincerely,



Brent P. Eastep
Environmental Team Leader

Attachment

PFD Refinery Flare & Blowdown System (RVR-ENVRNM-YF-FLRE-001)

PFD U240 Plant 3 Gas Plant Sponge Column 3D-304 (2403-YD-001-004) **Confidential**

cc:

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