Shell Oil Products US

Martinez Refinery
P.O. Box 711
Martinez, CA 94553-0071

August 31, 2018

RECEIVED
SEP 10 2018
Contra Costa Health
Hazardous Materials

Via electronic copy to CCC Health Services

Randall L. Sawyer
Chief Environmental Health and Hazardous Materials Officer
Contra Costa Hazardous Materials Programs
4585 Pacheco Boulevard, Suite 100
Martinez, CA 94553

Re: Investigation Report for 07/06/18 Incident

Dear Mr. Sawyer,

As requested by Contra Costa County Health Services, attached is the Incident Investigation report for the incident which occurred at Shell Martinez Refinery on July 6, 2018. This report meets the requirements in the "Hazardous Materials Incident Notification Policy" dated January 22, 2016.

If you have any questions, please contact Nicola Maher at 925-313-8686 or via email at Nicola.maher@shell.com.

Sincerely,

Nicola Maher
Process Safety Manager

Attachment: Investigation Report for 07/06/18

CC: ChoNai Cheung, CCCHSD
Michael Dossey, CCCHSD

INVESTIGATION REPORT

Updated 8/28/2018
Shell Oil Products US Martinez, California Refinery
Release at LOP (Light Oil Processing) Flare

INTRODUCTION

This report documents the investigation team's findings and recommendations regarding the incident at the Equilon Enterprises LLC d/b/a/ Shell Oil Products US (Shell) Martinez, California Refinery in which unburned flare gas was released from the elevated flare in Light Oil Processing at 03:11 AM on 7/6/2018.

Date & time of incident: 7/6/2018 03:11 AM – 03:54 AM

Material released	Flaring at 3:10am	Flaring at 1:03am	TOTAL
H2S	257 lbs	0 lbs	257 lbs
H2	859 lbs	1 lbs	860 lbs
Methane	925 lbs	556 lbs	1481 lbs
Non-Methane Hydrocarbon	5619 lbs	37 lbs	5656 lbs

NAICS Code: 324110
Type of Release Event and Source: Release of unburned flare gas from the LOP flare containing 257 lbs of H2S. A CWS level 2 was called.
Weather Conditions: Winds 3.7mph, from 234 degrees (SSW)
Onsite Impacts: A release of unburned flare gas with. no impact on people or assets.
The refinery's Ground Level Monitors located on the facility fence-line showed no detection of any H2S or SO2 above background levels. Community sampling did not detect any offsite readings. Required agency notifications were made, but no offsite responders deployed.

The investigation process began immediately after the incident occurred on 7/6/2018 with evidence collection.

An investigation team was chartered with identifying the mechanism(s) that led to the extinguishment of the pilot burners on the elevated LOP flare, resulting in unburned flare gas being released to the atmosphere. This included identifying the causal factors of the release including human factors, latent conditions, and management systems. The investigation team was comprised of an experienced investigation facilitator, operations representative, and two staff engineers who are knowledgeable in the LOP flare system and associated process units.

This report is based on information available to the team at the time of the investigation. Times and quantities referenced in this report are approximations and are based on a variety of information sources. All times are reported in a 24-hour format.

EXECUTIVE SUMMARY

At approximately 01:03 AM the LOP flare pilots were extinguished by the carryover of water from the flare lines to the flare tip during a flaring event. At approximately 03:10 AM a second flaring event caused a release of unburned flare gas from the LOP Flare.

The first root cause was identified as an ineffective drain system on the flare line which caused significant accumulation of water in the flare line. The source of the water was primarily steam condensing at the flare tip and flowing back into the flare line towards the drain manifold. The water in the line was carried out of the flare tip during a flaring event causing the extinguishment of the LOP flare pilot flames.

The second root cause was identified as plugging of the flame front generator lines potentially with a combination of corrosion product and water which caused a delay in the relighting of the pilot flames. This caused the pilots to remain unlit during the second flaring event even though operations had started trying to relight the pilots quickly after the loss of pilots.

Two flaring events contributed to the event. The initial flaring event at approximately 01:03 AM, which extinguished the pilots, was created by a loss of pressure in the instrument air header that caused a de-pressuring valve on a separator vessel to open. A mechanical failure on an air drier caused the loss of pressure on the instrument air header

The second flaring event at approximately 03:10 AM was caused by an automatic trip of the second stage Hydrocracker Unit (HCU) due to a high rate of rise of reactor temperatures. This occurred because feed flow was lost to the second stage due to a trip of the HCU first stage, which in turn was caused by a small lubrication oil fire on the first stage recycle gas compressor. Most likely the fire was caused by the release of lubrication oil from the bearing when it came into contact with the hot surface of the case of the turbine or the 650 psig steam piping located below the compressor deck.

DESCRIPTION OF THE FACILITY/EQUIPMENT INVOLVED IN THE INCIDENT

The elevated flare is used to combust flare gas in a controlled way when unit upsets occur in the refinery. A 24" line is used to transport flare gases from a water seal vessel to the flare tip. This line is sloped to drain liquid back to a collection manifold. The flare header drain pot continually pumps liquid out of the collection manifold. Operations also drains the collection manifold on a weekly basis using one of three pumps which were connected to the manifold. In addition to the 24" line, there are two other lines connected to the collection manifold, an 8" line and a 10" line, which are both blinded upstream and downstream of the collection manifold. See figure 1.

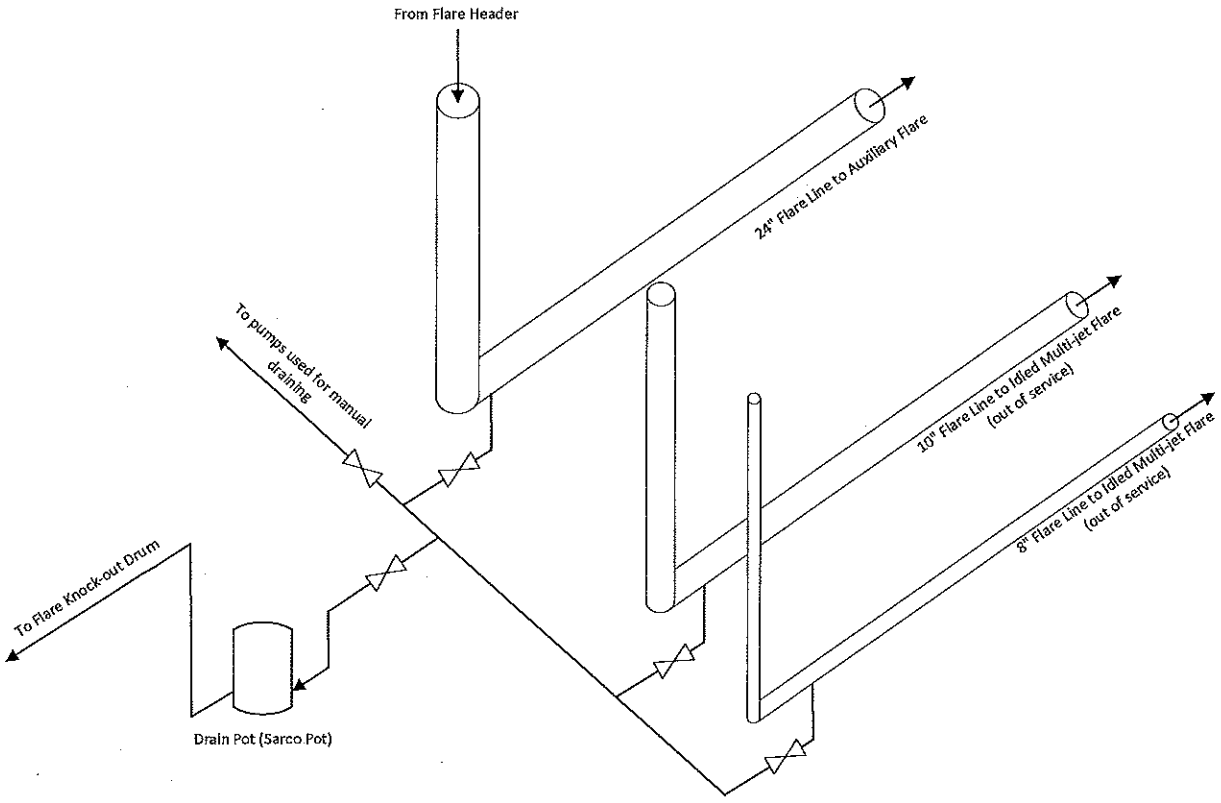

Figure 1 Overview of flare drain system

Three pilot burners fueled by natural gas are continuously operating at the flare tip to ignite any flare gas sent to the elevated flare. The pilot burners are initially lit/re-lit with a flame front generator lighting system. This system fills a ¾" pipe with a combustible air/fuel mixture between a remote ignition station and the flare pilot burner. When the pipe is fully primed with a combustible air/fuel mixture the mixture is ignited and the flame travels to the pilot burner to ignite it. See figure 2.

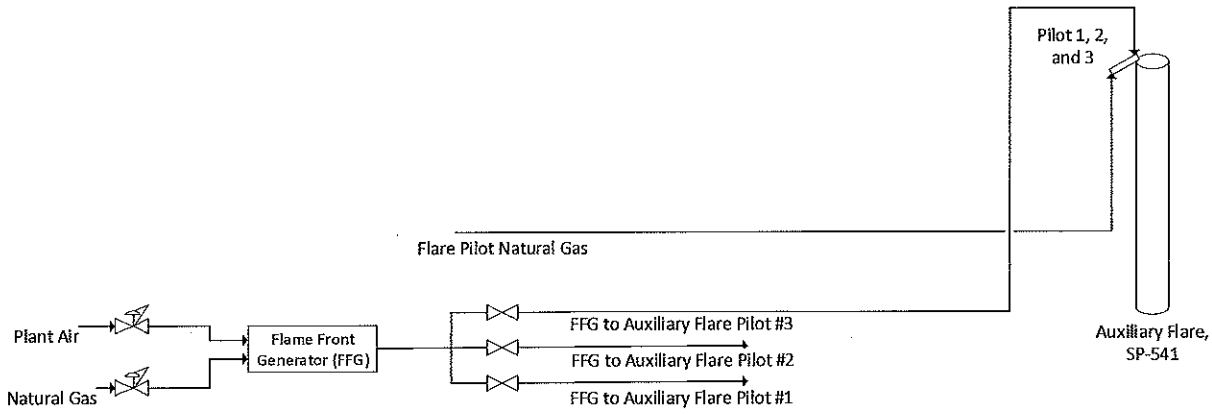

Figure 2 Overview of flame front generator system

NARRATIVE TIMELINE

On July 6th, 2018 between 00:30 AM and 00:57 AM the instrument air header pressure dropped in steps from 109 psig to 76 psig, which likely caused a de-pressuring of the CFH (Cat Feed Hydrotreater) LPLT (Low Pressure Low Temperature) separator. Immediately after this event, at 01:03 AM, the temperatures on all three pilot burners started to drop from 1050°F to ambient temperature, indicating a loss of flare pilots. At 01:30 AM operations attempted to relight the flare pilot burners per procedure. The relighting effort occurred in the flare area as this is where the flame front generator system is located. However, at 02:50 AM operations personnel were forced to evacuate the area before any of the flare pilots were lit successfully. The reason for the evacuation was an increased risk of flaring due to a shutdown of the first stage recycle gas compressor in the Hydrocracker Unit (HCU). The loss of this compressor caused a loss of flow rate to the HCU second stage reactors, which in turn caused the reactor temperatures to increase. At 03:03 AM the HCU second stage tripped on high rate-of-rise of reactor temperatures, and at 03:10 AM unburned flare gas from the HCU second stage was released from the flare. The flare gas consisted mainly of hydrogen, with a smaller amount of hydrogen sulfide. At 03:54 AM the flow of unburned gas from the flare was stopped once the unit was de-pressured and shutdown.

ROOT CAUSE INVESTIGATION METHODOLOGY

Shell used a Cause and Effect Analysis method to conduct the Root Cause Analysis (RCA) investigation. This method includes features that 'test for cause' and examine data quality. In addition, the team used the Latent Conditions checklist[1] as an aid to the investigation.

The investigation team conducted interviews, reviewed documentation, and visited the incident site as part of the investigation.

As part of the investigation the team reviewed the Process Hazard Analysis (PHA) and Corrosion Control Document (CCD) for the LOP Flare.

INCIDENT INVESTIGATION TEAM FINDINGS

The release from the LOP flare was caused by a flaring event while the flare pilots were extinguished. The LOP flare pilots were extinguished by the carryover of water from the flare lines to the flare tip during an earlier flaring event.

Root Causes

The following root causes were identified:

1. An ineffective drain system on the flare line caused significant accumulation of water in the flare line. Accumulation of water in the 24" flare line comes primarily from steam condensing at the flare tip and flowing back into the flare line towards the collection manifold. Water is drained from the collection manifold using the flare header drain pot as well as routine weekly draining by operations using a pump. The investigation discovered that prior to this incident the flare header drain pot was ineffective at removing the water. In

[1] Latent conditions are the hidden causes that may contribute to human errors. The Latent Conditions Checklist used is based upon the Contra Costa County Health Services Department Human Factors Program Guidance Document.

addition, the weekly draining by operations did not successfully remove all the water since operations was only able to determine that the manifold was drained by hearing the drain pump speed up, which indicated that only vapor was being pumped. However, in this investigation it was determined that there was likely another source of vapor in the form of purge nitrogen which was flowing to the 8" & 10" flare lines connected to the same collection manifold. This caused the pump to speed up, leading to a belief that the line was empty and an early shut down of the pump by operations with water remaining in the 24" flare line

2. Plugging of the flame front generator lines potentially with a combination of corrosion product and water which caused a delay in the relighting of the pilot flames. This caused the pilots to remain unlit during the second flaring event even though operations had started trying to relight the pilots quickly after the loss of pilots.

Contributing Causes

Two events occurred that caused a release of flare gas to the LOP flare:

- Between 00:30AM and 00:57 AM the instrument air header pressure dropped from 109 psig to 76 psig due to a failure of a mechanical linkage between two valves on an instrument air dryer, causing the instrument air header to de-pressure to atmosphere. When the instrument air header pressure dropped, the de-pressuring valve on the CFH LPLT separator opened. The de-pressuring valve is designed for an instrument air supply pressure of 60 psig and it is likely that a leakage on the valve actuator caused the valve to open prematurely. This initial flaring event carried water from the LOP flare lines to the flare tip, extinguishing the LOP pilot burners.

- At 03:10 AM the second release of flare gas started when the HCU second stage tripped on high rate-of-rise of reactor temperatures due to the shutdown of the HCU first stage. The HCU first stage shutdown when the hydrogen recycle compressor had a small lubrication oil fire at one of its bearings. The fire was most likely caused by the release of lubrication oil from the bearing which lit off when it came into contact with the hot surface of the case of the turbine or the 650 psig steam piping located below the compressor deck. It is believed that the compressor tripped when the sensor wires melted due to the fire. The exact reason for the release of lubrication oil from the bearing is currently unknown, see recommendation #12

PHA & CCD review

The PHA & CCD for the LOP flare were reviewed by the team:

- It was found that the PHA for the LOP flare did not include the scenario for water in the flare line creating a loss of flare pilots, see recommendation #11

The corrosion of the flame front generator lines in combination with water entering the flame front generator lines likely created plugging of the lines, however, as this does not impact the integrity of the line, the CCD does not have to be updated. The lines however will be upgraded to stainless steel to prevent the corrosion product plugging the lines, see recommendation #6.

Recommendations

Recommendation	Is recommendation specific only to the process/equipment involved in the incident, or also to other processes/ equipment?	FIM action #	Due date
1. Interim mitigation: Block in the nitrogen to the 8" and 10" lines as well as the valves from the 8" and 10" lines to the collection header to mitigate the potential of vapor entering the system via that route. Increase the draining frequency to two times per week.	Specific to only the process/equipment involved in the incident.	Completed	Completed
2. Evaluate the current functioning of the flare line drain pot (Sarco pot, which is a water drain pot with internals). If the drain pot is not functioning as expected, troubleshoot the issue and ensure the drain pot is repaired.	Specific to only the process/equipment involved in the incident.	1005553	January 6 2019
3. Evaluate the draining of the flare liquid collection system, including both the flare line drain pot (Sarco pot, which is a water drain pot with internals) and the pumps used in routine draining of the collection header. Develop a path forward. If a project is required, develop an engineering request for the mitigation of the risk of water accumulation in the flare line downstream of the seal pot	Specific to only the process/equipment involved in the incident.	1005554	January 6 2019
4. Determine clear ownership for technical assurance of Sarco drain pots (water drain pot with internals) at site	Covers all Sarco drain pots	1005555	January 6 2019
5. Update flare pilot relighting procedure SRU-3390: - Add instructions on how and when the flame front generator lines need to be blown out. - Update the time required to purge the lines prior to igniting the mixture.	Specific to only the process/equipment involved in the incident.	1005556	January 6 2019

Recommendation	Is recommendation specific only to the process/equipment involved in the incident, or also to other processes/ equipment?	FIM action #	Due date
6. Evaluate the carbon steel portions of the flame front generator lines, that are not part of ongoing project to upgrade portions of flame front generator lines to stainless steel, and determine whether these also require upgrades to stainless steel.	Specific to only the process/equipment involved in the incident.	1005557	January 6 2019
7. Identify flare pilot system and pilot ignition system for all flare systems as Safety Critical Equipment (HEMP). Ensure the critical activities to maintain the equipment in good condition are identified and implemented.	Covers all flare pilot and pilot ignition systems	1005558	January 6 2019
8. Pull the CFH (Cat Feed Hydrotreater) LPLT (Low Pressure Low Temperature) separator de-pressuring valve (6HV-326) to inspect and verify the condition of the actuator. Repair if necessary.	Specific to only the process/equipment involved in the incident.	1005559	January 6 2019
9. Install jam nuts on all set screws for valve linkages on instrument air driers.	Specific to only the process/equipment involved in the incident.	Completed	Completed
10. Replace any keys that are not a good fit for the valve stem or valve collar on instrument air driers.	Specific to only the process/equipment involved in the incident.	Completed	Completed
11. Update the LOP (Light Oil Processing) flare PHA during the next revalidation cycle to include the scenario of liquid accumulation in the flare line causing the flare pilots to be extinguished	Specific to only the process/equipment involved in the incident.	1005560	January 6 2020
12. Conduct a PHA for the scenario of liquid accumulation in the flare line causing the flare pilots to be extinguished and determine if safeguards are adequate. If necessary, develop recommendations to ensure adequate safeguards are present.	Specific to only the process/equipment involved in the incident.	1007379	January 6 2019

Recommendation	Is recommendation specific only to the process/equipment involved in the incident, or also to other processes/ equipment?	FIM action #	Due date
13. Investigate the causes of the fire at the HCU (HydroCracker Unit) first stage hydrogen recycle gas compressor, J-97, that occurred on July 6 2018. When the causes are determined, develop recommendations.	Specific to only the process/equipment involved in the incident.	1005561	January 6 2019