Attachment III

Causal Analysis Report

Chevron Richmond Refinery
Reportable Flaring Events

March 6, 2019
Refinery Power Outage

1. Date on which the report was drafted: May 30, 2019

2. The refinery name and site number:
Refinery: Chevron Richmond Refinery
Refinery Site Number: A0010

3. The assigned refinery contact name and phone number:
Contact Name: Laura Kurt
Contact Phone Number: (510) 242-5219

Is this a rescission/modification of a previous report: No.

Date of initial report: N/A

Reason for rescission/modification: N/A

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4. Identification of flare (s) at which the reportable event occurred by reviewing water seal monitoring data to determine which seals were breached during the event

Flare	Reportable Event (SO2 or Vent Gas Volume)
LSFO (S-6010)	SO2, Vent Gas Volume
FCC (S-6016)	None
NISO (S-6013)	SO2
SISO (S-6012)	None
RLOP (S-6039)	None
Alky (S-6019)	None

**Note: The Hydrogen Plant (H2) flare S-6021 exceeded 500,000 SCF on March 6, 2019. Flaring at the H2 flare was caused by Hydrogen Plant Train 2 start-up and commissioning activities and is reported as a separate reportable flaring event in Attachment 2.*

5. The flaring event duration for each affected flare

Flare (Source Number): LSFO (S-6010)
The Date(s) of the event: March 6, 2019
The start time of the event: 2:12
The end time of the event: 4:16
The net duration of event (in hours and minutes): 2 Hours, 4 Minutes

Flare (Source Number): FCC (S-6016)
The Date(s) of the event: March 6, 2019
The start time of the event: 2:10
The end time of the event: 7:29
The net duration of event (in hours and minutes): 4 Hours, 18 Minutes (intermittent)

Flare (Source Number): NISO (S-6013)
The Date(s) of the event: March 6, 2019
The start time of the event: 2:32
The end time of the event: 4:14
The net duration of event (in hours and minutes): 1 Hours, 42 Minutes

Flare (Source Number): SISO (S-6012)
The Date(s) of the event: March 6, 2019
The start time of the event: 2:12
The end time of the event: 7:30
The net duration of event (in hours and minutes): 0 Hour, 33 Minutes (intermittent)

Flare (Source Number): RLOP (S-6039)
The Date(s) of the event: March 6, 2019
The start time of the event: 3:32
The end time of the event: 3:37
The net duration of event (in hours and minutes): 0 Hour, 5 Minutes

Flare (Source Number): Alky (S-6019)
The Date(s) of the event: March 6, 2019
The start time of the event: 2:32
The end time of the event: 3:35
The net duration of event (in hours and minutes): 0 Hour, 5 Minutes (intermittent)

6. A brief description of the flaring event –

As reported in Attachment I of the February 2019 Flaring Causal Analysis Report, on February 1, 2019 at 11:59PM, a pair of redundant 115kV overhead electrical transmission lines ("Tap 1" and "Tap 2") experienced electrical faults. At 11:59PM, Tap 1 experienced a phase-to-ground and then phase-to-phase fault. An automatic action by electrical system protection equipment isolated Tap 1 within 0.13 seconds. 0.14 seconds later, Tap 2 experienced a phase-to-phase fault and electrical system protection equipment de-energized Tap 2 within 0.12 seconds. With both Tap 1 and Tap 2 de-energized, two of the refinery's substations experienced a complete loss of power, resulting in the shutdown of all electrically powered equipment. During the electrical faults, high currents flowed through the refinery's main 115 kV substation. Consequently, the refinery's main substation and all connected refinery substations experienced significant voltage sags for the duration of the fault. The voltage sag shutdown miscellaneous electrical equipment, including the induced and forced draft fans at the Hydrogen Trains. Safety systems immediately shutdown the Hydrogen Trains and, without manufactured hydrogen available, all hydroprocessing units initiated emergency procedures to safely shutdown.

At 2:08AM on March 6, 2019, Tap 1 and Tap 2 again experienced electrical faults (phase-to-ground on Tap 1 and phase-to-phase-to-ground on Tap 2). Automatic action by electrical system protection equipment isolated Tap 1 and Tap 2 within 0.11 seconds, resulting in complete loss of power at #3 substation (Distillation and Reforming Area Business Unit) and #6 substation (Cracking Area Business Unit). The loss of power resulted in the shutdown of units in the Distillation and Reforming Area Business Unit, Cracking Area Business Unit, and Hydroprocessing Area Business Unit. Flaring started at 2:10AM on March 6, 2019 at the FCC flare and subsequent flaring occurred at the LSFO, North Isomax (NISO), South Isomax (SISO), RLOP and Alky flares.

The sulfur dioxide (SO2) emissions from only the NISO and LSFO flares exceeded 500 pounds on March 6, 2019. The vent gas volume from only the LSFO flare exceeded 500,000 SCF on March 6, 2019.

7. A process flow diagram showing the equipment and process units that were the primary cause of the event.

See Attachment IIIa

8. The total volume of vent gas flared (MMSCF) throughout the event

Flare	Volume (MMSCF)
LSFO (S-6010)	0.555
FCC (S-6016)	0.031
NISO (S-6013)	0.494
SISO (S-6012)	0.022
RLOP (S-6039)	0.001
Alky (S-6019)	0.003

Assumptions used to calculate volumes – consistent with the reporting under Reg. 12-11.

9. The emissions associated with the flaring event per calendar day

Flare	Calendar Day	CH4 (lbs.)	NMHC (lbs.)	SO2 (lbs.)
LSFO (S-6010)	March 6, 2019	50.5	758.9	1368.9
FCC (S-6016)	March 6, 2019	4.9	56.8	0
NISO (S-6013)	March 6, 2019	113.3	571.2	8327.2
SISO (S-6012)	March 6, 2019	7.9	22.0	136.4
RLOP (S-6039)	March 6, 2019	0.1	1.2	2.8
Alky (S-6019)	March 6, 2019	0.4	1.9	15.1

Assumptions used to calculate emissions – consistent with the reporting under Reg. 12-11.

10. A statement as to whether or not the gas was scrubbed to eliminate or reduce any entrained compounds and a list of the compounds for which the scrubbing was performed.

The H2S Emergency Scrubber (C-840) was used remove H2S from the relief gas.

11. The primary cause of the flaring event including a detailed description of the cause and all contributing factors. Also identify the upstream process units that contributed vent Gas flow to the flare header and provide other flow instrumentation data where available.

A root cause investigation found that Tap 1 and Tap 2 on the 115kV transmission line experienced electrical faults at Tower 47. Through consultation with subject matter experts and in conjunction with the root cause analysis, it is believed that a combination of venting and atmospheric conditions at the location of the transmission line enabled the electrical faults experienced during the events. Primary conditions of interest are steam and hydrogen vents and weather conditions. The contribution of the atmospheric conditions individually is not known with certainty.

Vent gas flow originated from process units in the Distillation and Reforming Area Business Unit, the Hydroprocessing Area Business Unit, and the Cracking Area Business unit.

12. Describe all immediate corrective actions to stabilize the flaring event, and to reduce or eliminate emissions (flare gas recovered or stored to minimize flaring during the event). If a decision was made not to store or recover flare gas, explain why.

Operations initiated emergency procedures and automatic safety systems activated per design to safely posture the refinery. Operators initiated the use of the H2S Emergency Scrubber (C-840) in order to remove H2S from the relief gas.

13. Was the flaring the results of an emergency? If so, was the flaring necessary to prevent an accident, hazard or release to the atmosphere?

The flaring was the result of an emergency, as defined in Regulation 12-12 (a condition at a petroleum refinery beyond the reasonable control of the owner or operator requiring immediate corrective action to restore normal and safe operation that was caused by a sudden, infrequent and not reasonably preventable

equipment failure). The flaring was necessary per emergency procedures to safely posture the refinery. The refinery has requested breakdown relief for emissions excesses at other refinery sources, sharing the same root cause (#07L38).

14. If not the result of an emergency and necessary to prevent an accident, hazard or release to the atmosphere, was the flaring consistent with an approved FMP? If yes, provide a citation to the facility's FMP and any explanation necessary to understand the basis for this determination.

The flaring was the result of an emergency. The flaring is also consistent with Chevron's FMP Section 5.4 Figure 5-1. This event was unplanned. Causes for the flaring were analyzed through a TapRoot® investigation and the corrective actions have been implemented to reduce the likelihood of a recurrence of flaring resulting from the same causes.

15. If the flaring was due to a regulatory mandate to vent to flare, why couldn't the gas be recovered, treated, and used as fuel gas?

N/A. Flaring was not due to regulatory mandate.

16. Identify and describe in detail each prevention measure (PM) considered to minimize flaring from the type of reportable flaring event that occurred.
a) State whether the PM is feasible (and will be implemented), or not feasible
b) Explain why the PM is not feasible, if applicable

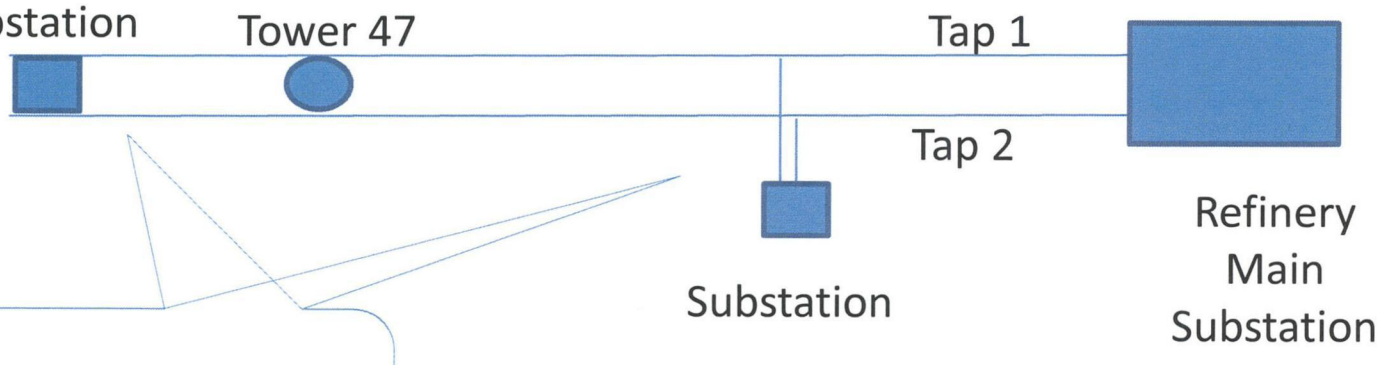
The refinery has identified the following prevention measure as having a high probable effectiveness to reduce the likelihood of a recurrence of a flaring incident resulting from the same root cause and contributing causes: Relocate the hydrogen vent further away from Tower 47.

The prevention measure is feasible and has been implemented. The hydrogen vent relocation completed on April 17, 2019.

Refinery Power Outage

1. At 2:08AM on March 6, 2019, Tap 1 and Tap 2 experienced electrical faults at Tower 47. Electrical equipment protection equipment de-energized Tap 1 and Tap 2

3. The Cracking Area Business Unit, the Distillation and Reforming Area Business Unit, and the Hydroprocessing Area Business Unit initiated emergency procedures to shutdown units and safely posture the refinery. Flaring occurred at the FCC, LSFO, NISO, SISO, RLOP, and ALKY flares as a result of plant shutdowns and stabilization.



2. With Tap 1 and Tap 2 de-energized, two of the refinery's substations experienced a complete loss of power

Chevron Richmond Refinery

Attachment IIIa