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Contra Costa Health
Hazardous Materials



TESORO

Tesoro Refining & Marketing Company LLC
150 Solano Way
Martinez, CA 94553-1487

February 15, 2016

Mr. Randy Sawyer
Director, Hazardous Materials Division
Contra Costa Hazardous Materials Program
4585 Pacheco Blvd.
Martinez, CA 94553

Via email
Original will follow in the mail.

Subject: Root Cause Analysis Report for the December 15, 2015 Loss of 6 Boiler Causes Smoky Flaring

Dear Mr. Sawyer:

The Tesoro Golden Eagle Refinery is submitting a Root Cause Analysis report for the December 15, 2015 Loss of 6 Boiler causes Smoky Flares. This Root Cause Analysis report is submitted as partial satisfaction of the requirements set forth in County Ordinance 98-48, the "Industrial Safety Ordinance" for root cause analysis reports.

If you have any questions regarding this report, please call me at (925) 370-3279 or Ms. Sabiha Gokcen at (925) 370-3620.

Sincerely,

James Jeter
Environmental, Health and Safety Manager

Cc: Ms. Cho Nai Cheung

**Root Cause Analysis Report
Tesoro Golden Eagle Refinery
December 15, 2015 Loss of 6 Boiler causes Smoky Flaring**

Summary of Event:

On December 15, 2015, the 6 Boiler unit, which provides 600 psig steam, tripped offline due to a loss of fuel gas. Loss of 600 psig steam caused the FCCU to trip offline and a rise in pressure in the flare knock-out pot caused the flare gas recovery compressors to trip offline. This resulted in flaring from three flares which also generated smoke due to the loss of steam to the flares. A CWS level 1 was sent at approximately 11:59 hours for shut down of the 6 Boiler unit, but was inadvertently sent as a test. CWS level 1 sent out at 12:15 hours for the 6 Boiler unit shut down. A CWS level 2 was sent out at 12:19 hours due to the smoking flare and potential offsite impact. One flare compressor was restarted at 12:50 hours and all flaring stopped as of 12:51 hours. Odor, Science, & Engineering (OS&E) was dispatched to determine if there were any odors offsite; no odors were found in surrounding neighborhoods, slight odor detected in area around Highway 4 and 680 intersection. Refinery operations stabilized and event downgraded to CWS level 0 at 14:02 hours after consultation with and confirmation from CCCHMP.

A brief timeline follows:

11:47 hrs:	6 Boiler trips on loss of fuel gas
11:55:57 hrs:	West Flare Gas Compressor CP540 trips offline due to high pressure in the extraneous Knock Out pot
11:56:02 hrs:	East Flare Gas Compressor CP539 trips offline
11:56:22 hrs:	FCCU trips offline on low riser flow
11:59 hrs:	Shift Superintendent (in training) sends CWS level 1 notification to agencies (but sends as test)
12:00:32 hrs:	Flaring begins at smaller flares
12:06:26 hrs:	DCU Flare begins; small amount of smoke seen from smaller flares
12:10:32 hrs:	Flare smoking is intensified
12:15 hrs:	Shift Superintendent (in training) sends CWS level 1 notification to agencies
12:19 hrs:	Shift Superintendent (in training) sends CWS level 2 notification to agencies
12:23:26 hrs:	Flaring from DCU Flare stops; small flares still smoking
12:30 hrs:	OS&E dispatched to monitor for odors in the community
12:36 hrs:	IH monitors area near South Gate, Concord Business Park, and area South of Hwy 4. Detection for H ₂ S, SO ₂ , CO and LEL is zero. Collection plates set in locations for particulate collection
12:44:27 hrs	Flares stop smoking
12:50:33 hrs	East Flare Gas Compressor CP539 is re-started
12:51:57 hrs	All flaring stops
14:12 hrs	CCHMD downgrades event from CWS level 2 to level 0

Agency Notification and Response:

The following agencies were immediately notified: Contra Costa Hazardous Materials Program (CCHMP) via the CWS, the Bay Area Air Quality Management District (BAAQMD) via the CWS, Contra Costa Fire Protection District, and the Contra Costa County Office of Emergency Services. The following agencies responded with personnel to the scene: CCHMP and BAAQMD.

The following is a summary of the initial agency notifications made by Tesoro.

Community Warning System activation (Level 1)	12:15 hrs
Community Warning System activation (Level 2)	12:19 hrs
Cal-OES for SO2 RQ exceedance (Report# 15-7322)	12:42 hrs

[Note: Notifications over the CWS terminal: CWS level 1 notifies CCHMP, Contra Costa OES, and the Contra Costa Sheriff with a specific message. Additional notice informs BAAQMD, Contra Costa Fire Protection District, Martinez Police, Antioch Police, Pinole Police and Richmond Police. CWS level 2 notifies CCHMP, Contra Costa OES, Contra Costa Sheriff and BAAQMD with a specific message. Additional notice informs Contra Costa Fire Protection District, California Highway Patrol, California Dept. of Health, San Ramon Valley Fire, Martinez Police, Antioch Police, Pinole Police and Richmond Police. CWS level 3 notifies CCHMP, Contra Costa OES, Contra Costa Sheriff and BAAQMD with a specific message. Additional notice informs Contra Costa Fire Protection District, California Highway Patrol, California Dept. of Health, San Ramon Valley Fire, Martinez Police, Antioch Police, Pinole Police, Richmond Police, EDIS and National Weather Service. CWS level 3 also activates sirens and the news media with a shelter in place message.]

Emergency Response Actions:

No emergency response actions were required. Additional process actions were taken to accommodate the shutdown unit and loss of steam.

Material Released:

The material released was Sulfur Dioxide from the flare. The release amount was estimated as exceeding the Reportable Quantity of 500 lbs.

Meteorological Conditions:

The weather was clear and dry on 12/15/15. The average wind speed and direction, during the flaring event was 15 mph and 15 degrees respectively (wind direction primarily from the North). The temperature was about 55 degrees F.

Injuries:

No injuries were reported on or off site.

Community Impact:

There was visible flaring and smoke from the refinery flares.

Incident Investigation of the event:

This investigation focused on the loss of Fuel Gas to 6 Boiler, which caused the boiler to shutdown. This resulted in a steam shortage in the refinery causing black smoke while flaring.

Background:

#6 Boiler is one of two boilers at the Martinez Refinery. The boiler provides steam for use in heating or cooling in process units. Steam also provides a mode of force to drive some rotating equipment such as compressors and pumps. In addition, steam injection at the steam driven flares of the flare system allows for smokeless flaring. When steam is lost to the refinery, flaring will result due to the effects on the process units and the slowing down of steam-driven equipment. There will also be smoke from the flares that use steam for smokeless operation.

The 5 Gas Plant serves as the gas processing plant for the Delayed Coking Unit. In addition, 5 Gas Plant processes gas from numerous units in the refinery, including 50 Unit, 4 Gas, 3 Crude, 4HDS, 3HDS, 3 Reformer, BSU, 1HDS, 2HDS, the Alky and Hydrocracker Stage 1 and 2. The 5 Gas plant also receives the gases recovered from the flare system via the Extraneous Knock-out Pot. The 5 Gas Plant has two parallel Wet Gas Compressors that are driven by steam turbines. During steam emergencies, 5 Gas Plant is directed to slow down one of their Wet Gas Compressors per Emergency Steam Load Shedding Procedure O-099-EP-01 and Loss of 600 PSIG Steam Procedure O-003-EP-08. The reason for slowing down the steam driven compressors is to prevent major equipment damage.

The slow down or shut down of one of the 5 Gas Plant Wet Gas compressors is likely to cause a rise in pressure on either or both the Main Accumulator or Extraneous Knock-out Pot. For safety reasons, if the Main Accumulator pressure reaches 9.5 psig, the pressure control valve 2401 automatically opens to the flare system. For safety reasons, if the pressure on the Extraneous Knock-out pot reaches 7 psig, an automatic shutdown of the flare gas recovery compressors is initiated. Both of these safety actions are to protect the vessels from an overpressure situation.

At 6 Boiler, the design phase of a project to upgrade the burner management system for safety reasons was begun in 2010. A Project Evaluation Report (PER) was developed for the project PTS 11506 and MOC 7069 was established for managing the change. As part of the safety upgrade, a Safety Instrumented System (SIS) was installed for the 6 Boiler fuel gas system. This installation was completed in 2013.

Loss of Fuel Gas at 6 Boiler:

On 12/15/15 at 11:47 hours, a loss of fuel gas to 6 Boiler caused the boiler to trip offline, resulting in significant steam loss to the refinery. Several units were shut down and others reduced rate. This resulted in flaring that exceeded the reportable quantity for SO₂ and other permit/regulatory deviations with excess emissions. The Contra Costa County Community Warning System (Level 2) was activated due to visible smoke from the flare that drifted offsite. There were no injuries from this event.

Flaring was caused by the loss of the Flare Gas Compressors, which tripped offline. The trip was caused by a pressure increase in the extraneous Knock-out pot at 5 Gas Plant, which exceeded the Flare Gas Compressor shutdown point of 7 psig. Normally, the Flare Gas Compressors send recovered flare gas back to the 5 Gas Plant to avoid flaring. However, due to the steam deficiency, the 5 Gas Plant had to substantially cut back on the Wet Gas Compressors, which are powered by steam.

While troubleshooting what caused the loss of fuel gas to the boiler, an I&E Technician discovered the solenoid for FV0111 had no voltage. It was then found that the button on HS0111B was pushed in and the indicator light for HL0111 was lit. The button on HS0111B is for testing the solenoid for FV0111. FV0111 is part of the Safety Instrumented System (SIS) for 6 Boiler fuel gas control. When the test button is pushed, the solenoid de-energizes, causing FV0111 to close cutting off the fuel gas supply to 6 Boiler.

Despite numerous interviews, the investigation team was unable to determine how the button was pushed or who may have pushed it. There were staging and electrical crews working in the area during the time of the incident. In addition, the area is congested and the button is at elbow height.

An examination of HS0111B revealed there was partial guarding around the button to protect it from inadvertent operation, but nothing preventing a direct push of the button. The investigation focused on the design process for the SIS system (as part of the burner management system safety upgrade on 6 Boiler) and found that human factors were not sufficiently reviewed during the engineering design of the SIS system.

Further examination of the training material and operating procedures that had been updated as part of MOC 7069 to install the burner management system upgrade #2 project for 6 Boiler found that important information was not included in the updates of these documents. The missing information appears to have contributed to the lack of recognition by 6 Boiler personnel regarding the importance of protecting the SIS test button after the installation had been completed. The investigation also found it was difficult for operators to troubleshoot the cause of the loss of fuel gas as information was missing from procedure O-031-PR-EP-19 "Fuel Gas Supply Pressure Upset at 6 Boiler.

Interviews with some personnel indicated they recognized the potential for inadvertent operation of the test button but did not recognize the potential for the test button to shutdown 6 Boiler or they indicated the risk would be deemed acceptable.

Root Causes:

The causal analysis for this incident yielded the following root causes and corrective actions (see table):

Root Cause #1: The design process of the burner management system safety upgrade project for 6 Boiler did not sufficiently address human factors.

Root Cause #2: The execution of MOC 7069 to install the burner management system safety upgrade project for 6 Boiler did not sufficiently update operating procedures and operator training material.

Root Cause #3: The potential risk posed by inadvertent operation of the solenoid test button was unrecognized or the risk was accepted.

Corrective Actions:

	Corrective Actions	Anticipated Date of Completion	Root Cause
1	<p>Protect the test button on FY-0111 solenoid operated by HS-0111B against inadvertent operation. (A subsequent burner management safety upgrade project has removed the SIS test button. This project had been planned for installation in January 2016.)</p> <p><i>Note – the test button on HS-0111B was immediately protected from inadvertent operation by installing a cage around HS-0111B. The removal of HS-0111B was completed in January 2016.</i></p>	Complete	1
2	<p>Conduct high impact refresher training with engineering personnel to reinforce the expectation to follow all requirements of R&SI 14-08 during project design to ensure human factors is adequately addressed in project design and construction.</p>	3/31/16	1
3	<p>a) Revise information in Operations training manual for 6 Boiler to include more specific information that explains all the functions of the SIS system.</p> <p>b) Revise procedure O-031-PR-EP-19 "Fuel Gas Supply Pressure Upset at 6 Boiler" to provide more guidance on troubleshooting of the fuel gas system. Consider including a troubleshooting matrix.</p> <p>c) Update Board Operator training and refresher training on diagnosis of boiler trips and resetting permissives after a trip.</p>	<p>4/30/16</p> <p>4/30/16</p> <p>9/30/16</p>	2 and 3