Investigation Report
February 20, 2015 East Flare Odor Incident

EPA Region 10
Deemed Releasable
JULIE VERGERONT
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Date: 2023.01.28 09:43:36 -08'00'

Date & Time of the Incident:	2/20/15, 2:30 PM
Initial Investigation Began:	2/21/15
Chartered Investigation Team Start Date & Time:	2/24/15
Report Date:	4/21/2015 (Rev 4. Draft)
Investigators:	*Bill Rodio* (Operator-RP&S), *Alan McIntyre* (Process Engineer), *Patrick Mullen* (Operator-FCCU), *Sheri Baker* (Control Systems Engineer), *Tim Figgie* (Environmental Engineer)

Incident Summary:

At approximately 2 PM on Friday, February 20, 2015 partially combusted gasses were released from the East Flare. An approximately 10 mph north wind carried odors toward La Conner and the Swinomish Reservation. Odor complaints were received by Shell PSR, the Anacortes 911, Northwest Clean Air Agency (NWCAA), EPA Emergency Response Unit and the Washington State Emergency Management Division.

An investigation began February 21, 2015. This investigation report is based on information reviewed by the investigation team and is subject to change if additional information becomes available. All times listed in the report and attachments are approximate.

Situation Description:

At approximately 10:54 AM on Thursday February 19, 2015, SRU Operators initiated activities to decontaminate the East Flare system from the Knock Out (KO) Drum (19N-C3) through the East Flare tip. Decontamination was required in order prepare for an environmental compliance project and non-critical maintenance activities on this system. At that time, Operators increased makeup water flow to the Seal Pot (19N-C6) from ~1 gallon per minute (gpm) to ~40 gpm while allowing automatic level control to maintain level between 25-32%. At ~10:56 PM, Operators further increased the makeup water rate to ~85 gpm and shutoff the automatic level control system to allow the level to increase to 77% by 3:34 AM on Friday February 20th. Operators then reduced the makeup water rate back to ~1 gpm and placed the level control back in automatic to begin pumping out the KO drum. The KO Drum continued to pump out at 42 gpm from 3:34 AM until day shift arrived.

At ~8:47 AM on Friday February 20th, the East Flare was blocked in and isolated from normal process flows by closing the inlet valve upstream of the KO Drum and the outlet valve to the Flare Gas Recovery (FGR) Compressors. The East Flare pilots remained lit and purge gas remained on until 2:45 PM when purge gas was blocked in.

At 10:27 AM, 250 psig steam was introduced to the bottom of the KO Drum through a ¾" steam hose. The steam warmed the drum enough to push vapors through the Seal Pot water level, and register at the Sulfur analyzers downstream. It is estimated that the temperature in the KO Drum reached approximately 170°F.

At about 12:30 PM, 250 psig steam was introduced into the KO Drum vapor space through a 2 inch line. This began to heat up the water in the Seal Pot. At 1:13 PM, the KO drum had reached 28%.

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At ~1:13 PM, Operators realized that the Seal Pot had a water level in it, which was preventing steam from reaching the flare tip. At that point, they transferred the majority of the water from the Seal Pot into the KO Drum. The approximately 200°F water from the Seal Pot further increased the temperature of the KO Drum water, thereby generating more vapors. With the water seal removed, the vapors that were being generated in the KO Drum and the steam that was being injected into the KO drum moved into the Flare header. These events resulted in partially combusted hydrocarbons and sulfuric compounds (including mercaptans) being released to the atmosphere through the flare tip.

Sequence of Events:

Date	Date	Event
19-Feb	10:54 AM	Increased make up water rate to flush Seal pot 19NC6 and KO drum 19NC3 with fresh water.
20-Feb	3:34 AM	KO drum reaches 77%. Ops begin to pump level down.
20-Feb	8:30 AM	All talk to plant that the east flare will be OOS.
20-Feb	8:47 AM	East Flare inlet is blocked in upstream of the KO drum and outlet to FGR is blocked in.
20-Feb	10:27 AM	Steam is lined up to the bottom of the KO drum through a ¾" steam hose.
20-Feb	11:55 AM	H2S and Total Sulfur CEMS (19AI9A & 19AI10A) readings begin to increase.
20-Feb	12:30 PM	Steam to KO drum started through 2" steam out ELL into drum vapor space.
20-Feb	12:39 PM	STL begins odor patrol.
20-Feb	12:42 PM	I&E blocked in flare CEMS (H2S at >300ppm; Total S at 436ppm).
20-Feb	1:13 PM	OPS begin draining Seal Pot to KO drum.
20-Feb	1:30 PM	Seal pot level reaches ~0% (just at the bottom of the dip tube).
20-Feb	1:44 PM	Flare gas molecular weight reading (19QR12) downstream of seal pot spikes to 33.
20-Feb	1:47 PM	Flare header temperature (19TI6) downstream of Seal Pot shows steam temp (~200 F).
20-Feb	2:08 PM	Started dispersion steam to flare tip via 19FC202 to control smoke.
20-Feb	2:09 PM	OPS blocked in the ¾" steam hose to the KO drum.
20-Feb	2:18 PM	OPS begin closing off on purge gas block valve to flare header, however flow is not affected since it is dictated by the size of the restriction orifice in the line.
20-Feb	2:25 PM	2" steam valve to KO drum is 1/3 open. STL reports slight odor to the south. OPS instructed to leave steam at 1/3 open.
20-Feb	2:30 PM	Odor Complaint received from Swede's Nets.
20-Feb	2:45 PM	Steam plume visible at the flare tip. Purge gas is blocked in.
20-Feb	2:53 PM	OPS asks console OP to cut back on dispersion steam, 19FC202. LOO instructs the OO to cut back on 2" steam to the KO drum.
20-Feb	3:00 PM	19FC202 dispersion steam controller is cut back to 15% output. Console reports a flame is still visible at the flare tip
20-Feb	3:00 PM	Site notified NWCAA of potential for odor complaints (left voice mail).
20-Feb	3:08 PM	LOO instructs OO to cut back more on the 2" steam to the KO drum.

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20-Feb	3:10 PM	Odor Complaint received from Smith Chevrolet.
20-Feb	3:35 PM	Skagit County DEM contacted site.
20-Feb	3:40 PM	Console reports 19FC202 dispersion steam controller is at 5% output. Console asks LOO to cut more steam to KO drum.
20-Feb	3:41 PM	19FC202 dispersion steam is closed.
20-Feb	3:50 PM	PSR initiates CAER level 0 (site called 911).
20-Feb	4:02 PM	BFW is lined up to the KO drum for flush.
20-Feb	4:15 PM	Flare header temperature 19TI6 downstream of Seal pot begins to drop. 2" steam to the KO drum is less than 1 turn open.
20-Feb	4:16 PM	OPS lined purge gas back up to the flare at normal rate.
20-Feb	4:17 PM	OPS were instructed via the radio to put purge gas back in (already done) and shut off steam to the KO drum. Steam to KO drum was reportedly blocked in, however it appears a small amount of steam continued to leak by the block valve because KO drum pressure remained above 0.8 psig until ~ midnight.
20-Feb	4:19 PM	Odor Complaint received from Reservation Rd.
20-Feb	4:38 PM	Odor Complaint received from Air Liquide.
20-Feb	4:38 PM	KO drum reaches 30% level, BFW is shut off.
20-Feb	4:52 PM	Water is restarted to Seal pot.
20-Feb	5:00 PM	Odor Complaint received from Snee Oosh Rd.
20-Feb	5:00 PM	Odor Complaint received from Downtown La Conner.
20-Feb	5:10 PM	KO drum level is re-established.
20-Feb	5:37 PM	Seal pot level is re-established.
20-Feb	5:30 PM	Odor Complaint received from La Conner.
20-Feb	5:40 PM	Odor Complaint received from south tip of Fidalgo Island.
20-Feb	5:47 PM	Odor Complaint received from La Conner.
20-Feb	6:00 PM	Flare header temperature (19TI6) downstream of Seal pot returns to normal.
20-Feb	6:07 PM	Odor Complaint received from Shelter Bay, began at 4:45pm
20-Feb	6:20 PM	Odor Complaint received from Shelter Bay.
20-Feb	6:25 PM	Odor Complaint received from Shelter Bay.
20-Feb	8:00 PM	Odor Complaint received from Shelter Bay.

Cause Analysis:

The Cause Analysis of this incident showed that partially combusted odorous gasses were flowing through the East flare tip on February 20, 2015 from about 2:10 PM to about 4:15 PM, while the flare was being decontaminated to prepare for an environmental compliance project and non-critical maintenance activities on this system. The flare was isolated from normal service at this time. The meteorological conditions that day sent the gasses south of the refinery. Odor complaints were received from Swede's Nets and Proscapes on South March Point Road, areas of the Swinomish Reservation, the Shelter Bay area and La Conner.

ON 02/20/15 AT ABOUT 2:30 PM, AN ODOR COMPLAINT WAS RECEIVED FROM SWEDE'S NET REPAIR because:

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Partially combusted odorous gasses were released from the flare tip.
AND
The gasses contained a sufficient amount of odorous material.
AND
The odorous gasses accumulated at ground level.
AND
The concentrations of odorous compounds were above the detectable odor threshold.
AND
The wind speed and direction were sufficient to carry the odorous gasses south of the refinery.

(1) WHY WERE PARTIALLY COMBUSTED ODOROUS GASES RELEASED FROM THE FLARE TIP?

Odorous Gasses were flowing to the East Flare Tip.
AND
Conditions at the flare tip allowed odorous gasses to remain partially un-combusted. The large amount of steam being added to the flare system for decontamination lowered the heating value of the vapor, limiting the ability for complete combustion of the odorous compounds.

(2) WHY DID THE GAS CONTAIN A SUFFICIENT AMOUNT OF ODOROUS MATERIAL?

A sufficient amount of odorous gas accumulated in the vapor space of KO Drum. This occurred because only one water wash was performed instead of the normal 3 full vessel water washes. One wash left higher concentration of odorous material in the water. The odorous material was stripped from material in the KO drum with the steam. A water level remained in the Seal Pot so the steam condensed out and leaving a smaller volume of odorous vapors to vent to the flare. The Seal Pot was supposed to have been drained prior to this point and when it was drained a large volume of steam was sent to the flare along with the odorous vapors. Also, maintenance activities on other units (VPS & CRU2) were ahead of schedule and it was requested that the first maintenance day for the East flare be moved up by one day (from Monday February 23rd to Sunday February 22nd).
AND
The vapor space was allowed to flow from the KO Drum to the flare tip. (Ops emptied the water level in Seal Pot when they realized it was supposed to be empty by procedure, which allowed a rapid surge of odorous gas and steam to flow from KO Drum to the flare tip).

(3) WHY DID ODOROUS GASSES ACCUMULATE AT GROUND LEVEL?

The gas contained odorous compounds like H_2S and mercaptans. (The odorous gasses evolved from the water and sludge in the KO drum during the steam-out/decon process).
AND
The odorous compounds were heavier than air.

(4) WHY WAS THE CONCENTRATION OF ODOROUS GASSES ABOVE THE ODOR THRESHOLD?

Odorous compounds are detectable at very low concentrations.
AND
The gas contained odorous compounds like H2S and mercaptans.

(5) WHY WAS THE WIND SPEED AND DIRECTION SUFFICIENT TO CARRY THE ODOROUS GASSES TO THE LOCATION WHERE ODORS WERE DETECTED?

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The prevailing wind was from the NNW.
AND
The wind speed was 10-12 mph.

Recommendations:

The recommendations below have been developed from findings in the Causal Learning Investigation. They are intended to eliminate future offsite odor complaints from flare decon activities.

Install an isolation valve downstream of each flare seal pot (East, North, and South Flares) including necessary hardware for decontamination activities and update the flare shutdown procedures to decontaminate the flare systems with the isolation valves in place.	
What cause should be addressed?	Partially combusted odorous gases released from the flare tip.
How? What would be the solution?	The isolation block valves would allow the flares to be decontamined backwards into the main flare header where the odorous gasses would be recovered and treated in the flare gas recovery unit.
Action Plan:	Who: North Side Production Manager What: Submit a project idea form(s) to the DG1 review team for approval to begin developing project scope and ensure the project is completed during the next scheduled Flare shutdowns. Projects should be progressed such that if any of the flares required a shutdown earlier than the next planned TA, the isolation valves could be installed. When: Next scheduled flare shutdowns September 31, 2015 (East Flare) March 31, 2019 (North Flare) March 31, 2019 (South Flare)
Review the current Flare Shutdown Procedures (19FLARETA004 - East Flare, 19FLARETA002 - North Flare, and 19FLARETA003 - South Flare) and chemical cleaning plans and revise as appropriate to minimize the likelihood of odor complaints, with the current hardware configuration.	
What cause should be addressed?	Partially combusted odorous gases released from the flare tip.
How? What would be the solution?	The revised procedures will provide improved steps to ensure the odorous material in the flare KO drums and seal pots is sufficiently removed prior to steaming out to the flare tip. The revised procedures will ensure the complete combustion of any remaining residual odorous gasses that are steamed out the flare tip.

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Action Plan:	Who: North Side Production Manager What: Charter a team to review and rewrite the current flare shutdown procedures 19FLARETA004 – East Flare, 19FLARETA002 – North Flare, and 19FLARETA003 – South Flare. Ensure the procedure rewrites are complete in time for the next scheduled flare shutdowns (East Flare in September 2015). The North and South flare shutdown procedure rewrites should be completed concurrent with the East flare shutdown procedure rewrite in case of unplanned flare shutdowns. When: August 1, 2015 (All three procedures)

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Determine the need and risk to fully decon the Flare KO drums for required maintenance prior to installation of the isolation valves downstream of the seal pots.	
What cause should be addressed?	Partially combusted odorous gases released from the flare tip.
How? What would be the solution?	If full decontamination of the flare KO drums can be avoided prior to installation of the isolation block valves downstream of the seal pots (engineering solution) then the risk of odors would be reduced.
Action Plan:	Who: North Side Production Manager What: Determine the need to fully decon the flare KO drums before installation of the isolation valves downstream of the seal pots. These decisions will need to be based on the confidence in the decon procedures developed as part of recommendation 2 and the urgency to complete any maintenance items which would require a full decon of the KO drum. This assumes there is a possibility of deferring a full decon of the flare KO drums for maintenance until after implementation of the engineering solutions, without incurring additional risks by deferring the work. When: Prior to next scheduled flare shutdowns August 15, 2015 (East Flare) December 15, 2017 (North Flare) December 15, 2017 (South Flare)

Attachment 1 Cause Tree:

Cause Tree

Attachment 2 Timeline:

Timeline

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