Bay Area Air Quality Management District
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Workshop Staff Report

FURTHER STUDY MEASURE 8

Atmospheric Blowdown Systems

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I. INTRODUCTION

A. Summary of Proposal

District staff has determined that it is not necessary to initiate rulemaking to control emissions from refinery blowdown systems (BDS) because the inputs to those systems are already regulated. Blowdown systems at all but one refinery in the Bay Area Air Quality Management District are currently vented to a flare or fuel gas recovery system. The one refinery with uncontrolled, or atmospheric, blowdown systems is the Tesoro Refinery in Contra Costa County. Staff has analyzed the four atmospheric blowdown systems at the Tesoro Refinery and has determined that the inputs to those systems are subject to existing District rules and that additional controls on the blowdown systems themselves would be redundant.

Blowdown systems have two types of inputs: *episodic emissions* from pressure relief devices (PRDs) that vent into the blowdown systems and *periodic emissions* from cleaning and maintenance operations during shutdowns. Episodic emissions from PRDs are subject to the requirements of Regulation 8, Rule 28: Episodic Releases from Pressure Relief Devices in Petroleum Refineries and Chemical Plants. Periodic emissions from shutdowns, startups, cleaning and maintenance operations are subject to the requirements of various rules, most notably Regulation 8, Rule 10: Process Vessel Depressurization, or Regulation 8, Rule 2: Miscellaneous Operations. Because inputs to atmospheric BDSs are already fully regulated, staff does not recommend new rulemaking to further control emissions from these systems.

II. BACKGROUND

A. Description of Blowdown Systems

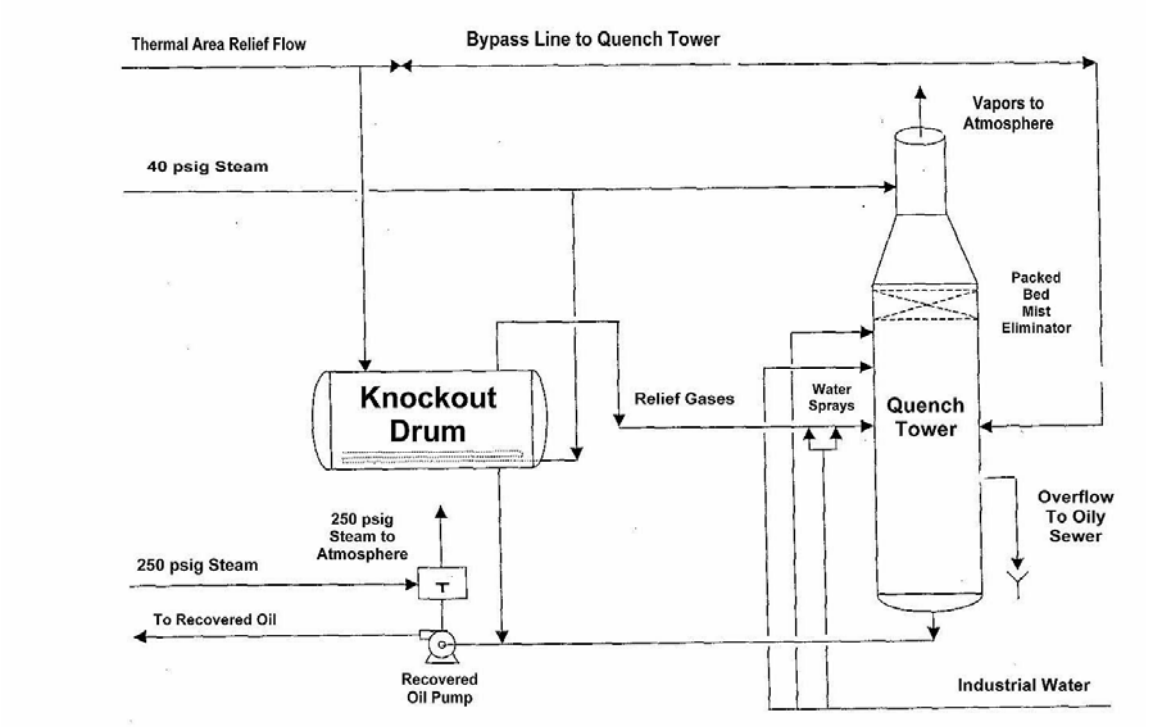
All process units in refineries can be expected to experience operational upsets that must be handled in a safe and effective manner. Upsets include instrument failures, loss of cooling water, loss of steam, loss of power and a number of atypical operating conditions. In order to protect process vessels from over-pressurization and rupture during upsets, vessels are equipped with pressure relief devices (PRDs) so that gases and fluids can be released safely. PRDs may vent directly to the atmosphere or to a blowdown system. BDSs provide for the safe disposal of hydrocarbons, liquids and gases that are either automatically vented from the process component through PRDs or manually drawn from units using control valves or block valves. The BDSs separate liquids from vapors and recover any condensable oil and water. Gases in the typical blowdown system are then sent to fuel gas recovery, or to a flare.

There are many BDSs at refineries operating in the District. Only four of the BDSs are vented to the atmosphere; all four of these atmospheric blowdown systems are located at the Tesoro Refinery in Avon, California near Martinez. Relief flows from PRDs and process vents, including high pressure steam, are

plumbed to atmospheric BDSs. Other materials that can enter a BDS include industrial water, steam, gasoline and diesel fuel used to clean out process vessels during maintenance. Process units are typically purged to the BDS during shutdown and prior to startup. The separated vapors are usually combined with high pressure steam to prevent the potential for explosive or combustible concentrations of hydrocarbons, and then released to the atmosphere. This provides for some reduction in emissions.

Figure 1 is a simplified flow diagram of one of the four atmospheric BDSs. Each of the four BDSs is unique.

Figure 1
Atmospheric Blowdown System



Each atmospheric BDS services a different section of the Tesoro Refinery: Crude Unit 50, Crude Unit 3, the Fluid Catalytic Cracking Area, and the Coker Area. The Crude Unit 3 blowdown system is shown in Figure 2. In each of the four areas, relief gases are transported to the top of a knockout drum. Typically, there should be no flow to the drum. Flow should only be present during startup, shutdown, or upset conditions. The purpose of the knockout drum is to separate gases from liquids. Liquids fall to the bottom and are manually pumped to tanks for reprocessing. There are a number of ways an operator determines that flow is present, including communication with refinery staff, high temperature, high pressure, spray flow alarm, or high level alarm.

Knockout drums on two of Tesoro's atmospheric BDSs have a steam coil. The steam coil keeps heavy hydrocarbons fluid. Vapors and mist exit the top of the

drum and proceed to the side of the quench tower. Water sprays are used to remove condensable hydrocarbons, which fall to the bottom of the quench tower. The liquid hydrocarbons overflow to the oily sewer, where they are separated for reprocessing and wastewater treatment. The remaining vapors exit through the top of the tower. Steam flows into the stack to prevent air from entering and creating an explosive mixture.

Figure 2: Crude Unit 3 Blowdown System

III. REGULATORY HISTORY

A. Further Study Measure 8 (2001 Ozone Attainment Plan)

In the 2001 Ozone Attainment Plan the District discussed the need to study whether regulatory controls for blowdown systems should be implemented (Further Study Measure 8; Pressure Vessels, Blowdown Systems, and Flares). With regard to BDSs,[1] the study was intended to evaluate the volume of gases sent to atmospheric BDSs and the contribution of pressure relief devices (PRDs) to these flows. The study was also intended to consider, as appropriate, the feasibility, cost and safety of emissions reductions by reducing flows from BDSs to the flares.

[1] The other commitments discussed in the 2001 Ozone Plan FS-8 have been or are being addressed through other control measures. These include adopted Regulation 12, Rule 11: Flare Monitoring at Petroleum Refineries and Regulation 12, Rule 12: Flares at Petroleum Refineries and proposed amendments to Regulation 8, Rule 28: Episodic Releases from Pressure Relief Devices at Petroleum Refineries and Chemical Plants.

B. 2002 Pressure Relief Valve Audit

In 2002, the District audited pressure relief devices at all five Bay Area refineries to determine compliance with Rule 8-28 and to make recommendations for rule improvement. The findings of the audit directly relate to blowdown systems for the pressure relief devices that vent into the blowdown system. The District is currently developing proposed changes to Rule 8-28, accessible at http://www.baaqmd.gov/pln/ruledev/workshops.htm, which apply to all PRDs including those that vent to blowdown systems.

C. 2002 Technical Assessment Document

In 2002, the District released a draft Technical Assessment Document (TAD) to address emissions from blowdown systems. The TAD calculated emissions from an incident in May, 2001 to determine a range of flow rates from the BDS and estimated emissions using an EPA AP-42 emission factor. As explained below, use of this emission factor significantly overstated emissions from these BDSs. The TAD stated that emissions from blowdown systems could be reduced by prevention measures or control measures such as venting emissions sources into an abatement device. The TAD recommended monitoring for each blowdown system. The TAD can be reviewed on the District's website at: http://www.baaqmd.gov/enf/further_study_measures/flares/blowdown_tad_draft2_dec2002.pdf.

IV. SUMMARY OF TECHNICAL REVIEW

A. Emissions

The typical source of emissions from blowdown systems is a pressure relief device. One or more PRDs that feed into the blowdown system may experience a release to relieve an over-pressure situation, or an improperly reseated PRD may leak emissions into the BDS. These are *episodic* emissions. Other causes of emissions to the BDS are processes that occur intentionally but are not part of the normal refinery operation, such as a shutdown or cleaning or maintenance when valves are manually opened. These are *periodic* emissions. The 2002 Blowdown System TAD estimated that the emissions average 7 tons of organic compounds per day from the four Tesoro BDSs, but this value is misleading and should be clarified.

The TAD estimate was based on EPA emission factors and assumed flow rates that are atypical. The emissions calculation assumed that 15 percent of the refinery feed (crude oil) emissions go to the atmospheric blowdown systems. The EPA factor for blowdown systems, 580 pounds for each 1000 barrels crude oil processed, assumes the blowdown systems are uncontrolled. However, in the EPA emission factor, "uncontrolled" means that not only the blowdown system itself is uncontrolled or atmospheric, as are Tesoro's BDSs, but that the input streams are not controlled by PRDs or manual valves. The EPA factor,

therefore, is not applicable to these blowdown systems. The TAD also estimated flows of 1 to 5 million cubic feet per day, based on an incident that occurred in 2001. Flow rates are more typically non-existent, unless, as mentioned above, pressure is being relieved or there is some process where valves are intentionally open, such as vessel depressurization or cleaning. In addition, there exists the possibility of a leak into the BDS from a valve left open or where there is some valve failure.

The TAD also relied on District source test data for an incident that occurred during a five day period from June 16 though 21, 2002. During this incident, the #50 Crude Unit was pressurized and de-pressurized three times with nitrogen as part of unit start-up. During that time, it was discovered that a check valve, not normally opened, had failed, resulting in hydrocarbon emissions that were detected during the source test. Use of emissions data from this atypical event provides a inflated picture of normal blowdown system emissions. Neither the forced flow from nitrogen pressurization and de-pressurization nor the check valve leakage is a normal operating condition.

Other source tests conducted at Tesoro during the past three years have been unable to detect any flow coming out of the blowdown systems. The District monitored the blowdown system serving the #50 Crude Unit from February 5 through December 19, 2003. During that time, with the exception of fewer than five hours in total, the monitoring equipment was unable to detect any flow.

B. Characterization of Input Streams

Staff reviewed schematic diagrams for the four atmospheric BDSs located at the Tesoro Refinery. The diagrams indicate that there are 167 uniquely identified streams plumbed into the four BDSs. 42 of the streams are dedicated solely to PRDs. The table in Appendix 1 summarizes the types, source, quantities, and characterization of the identified input streams for the four BDSs at Tesoro.

The table provides an estimate of emissions from blowdown systems for each type of event. As previously described, there are not normally flows to (or, therefore, emissions from) the blowdown systems. There have been eight PRD releases into the blowdown towers since July, 1998 (when reporting of PRD releases became mandatory under Regulation 8, Rule 28). The emissions from these episodic releases total 13.7 tons.[2] Periodic emissions from cleaning and maintenance activites, or from depressurization when manual valves are opened into the BDSs, can be calculated from concentration of gases or the vapor pressure and quantities of liquids in the BDS before being drained into slop oil vessels. For example, the VOC emissions from 20 barrels of gasoline in a BDS is 2.81 pounds. The emissions from 20 barrels of diesel is 0.014 pounds VOC.[3] These amounts might be used to clean process vessels as described in the

[2] 50 Crude Unit, 5 releases, 270 lbs; Coker, 3 releases, 27,150 lbs; #3 Crude Unit and Cat. Cracker, no releases.

[3] Assumes 90^{o}F and that 20 barrels of liquid fully displaces the equivalent volume of vapors.

Appendix table. The table lists materials, amounts and frequency of use for various maintenance operations. These emissions are likely overstated, as they do not account for any cooling effect from the quench towers or packed bed mist eliminators in the blowdown systems. The episodic and periodic nature of emissions from blowdown systems do not lend themselves to an annual average calculation expressed in terms of tons or pounds per day.

C. Rules Affecting BDS Input Streams

Emissions from PRDs, whether vented directly to atmosphere or to a BDS, are regulated by Regulation 8, Rule 28: Episodic Releases from Pressure Relief Devices at Petroleum Refineries and Chemical Plants. Similarly, any fugitive leakage of hydrocarbons past PRDs would be subject to the requirements in Regulation 8, Rule 18: Equipment Leaks. Input streams to Tesoro's atmospheric BDSs that are not controlled by PRDs are controlled by manual valves. These are used during shutdowns and maintenance. Regulation 8, Rule 10: Process Vessel Depressurization applies during the shutdown of a pressure vessel. Once a valve is opened and a process component is flushed into the BDS with steam and/or diesel, the operation is subject to the provisions of Regulation 8, Rule 2: Miscellaneous Operations. Table 1 summarizes District rules applicable to BDS input streams. It must be noted that more than one rule may be applicable to a single input stream depending on the nature of the emissions and source. For example, one input may originate from a process vessel that may be depressurized only once every few years. Emissions from the depressurization would be regulated under Rule 8-10: Process Vessel Depressurization. However, if material leaks past the valve that controls the depressurization, then those fugitive emissions would be regulated under Rule 8-18: Equipment Leaks.

Table 1
District Rules Applicable to Blowdown System Input Streams

District Rule	Description
Rule 8-2	Limits organic emissions from miscellaneous operations to no more than 300 ppm concentration and 15 lbs per day.
Rule 8-10	Prohibits opening pressurized vessels until pressure is less than 1000 mm Hg pressure (4.6 psig) and organic compound concentration less than 10,000 ppm before being opened.
Rule 8-18	Applies to fugitive emissions from valves, pumps, compressors, pressure relief devices and other refinery components. The rule sets emission standards for each category and allows a small fraction of leaking components to be placed on a "non-repairable" provided the leak is less than 10,000 parts per million on a volume basis (ppmv).
Rule 8-28	Regulates emissions from pressure relief devices (PRDs) at refineries and chemical plants. The rule requires that PRDs be equipped with a telltale indicator following one "Release Event" (10 pounds or more of VOC). Control is required for all PRDs on a process component following the second release event within five years on that process component. Rule 28 is concurrently being considered for amendment.

D. Controls for Blowdown Systems

Blowdown systems could be further controlled in various ways, although doing so would not be a simple matter. A pressure relief device that vents into a BDS could theoretically be routed to a control system such as a flare or fuel gas recovery system. Tesoro has been able to control a select group of PRDs by venting them into an existing fuel gas recovery system. However, there are significant difficulties to be overcome for either of these control options. Atmospheric blowdown systems are designed to operate at or near atmospheric pressures, as are the input streams that feed into the BDSs. In order to control these systems by routing them to a flare or fuel gas recovery system, the pressures at which these equipment typically operate would have to be adjusted so that back pressure associated with the control system would not over-pressurize and potentially damage the equipment. The components that operate at atmospheric pressure, such as the manual valves serving drains and pumps, could not be routed to a flare or fuel gas system without additional equipment such as pumps or compressors to increase the pressure of these streams. More likely, the blowdown units would have to be completely scrapped and another system re-designed and constructed.

It may be possible to isolate PRDs and route those to a control device without controlling the atmospheric BDSs. The costs of such an approach would be consistent with the cost estimates for controlling pressure relief devices. This is a control option that was considered as part of the larger PRD regulation. Amendments to Regulation 8, Rule 28: Episodic Pressure Relief Devices at Petroleum Refineries and Chemical Plants are currently being considered. Information concerning the draft amendments can be found on the District's website at http://www.baaqmd.gov/pln/ruledev/workshops.htm.

V. SUMMARY OF PUBLIC CONSULTATION PROCESS

Blowdown systems, because of their intimate relationship with pressure relief devices, have previously been discussed concurrently with other work on Further Study Measure 8 concerning flares and pressure relief devices. In June, 2003, the District Board adopted new Regulation 12, Rule 11: Flare Monitoring at Petroleum Refineries. A workgroup was initiated in January, 2002 to provide technical assistance in developing that rule. During workgroup meetings to develop Reg. 12-11, it was decided that splitting FS-8 into separate technical assessments was most efficient, in part because atmospheric blowdown systems are only found at one refinery.

The Technical Assessment Document was distributed and posted to the District's web site in December, 2002. No comments on the TAD were received. Following the District's investigation of inputs to the four blowdown systems at Tesoro, a workgroup meeting was held on September 15, 2005. Preliminary results were presented and the question of the need for a separate regulation specifically targeting blowdown systems was discussed. As mentioned above, inseparable from the question of regulation of blowdown systems is the question

of whether PRDs should be controlled to a more stringent standard than is required in the current Regulation 8, Rule 28. Much of the discussion at the BDS workgroup meeting focused on that issue. This document and recommendation reflect the input staff received during that workgroup meeting.

A public workshop to receive comment on the proposal is scheduled for 6 pm on Thursday, October 27 in Martinez, located near the Tesoro refinery. At that time, the public will have an opportunity to comment on the staff's determination that a separate regulation addressing emissions from atmospheric blowdown systems is not necessary or appropriate at this time.

VI. EXPLANATION FOR NOT PROCEEDING WITH RULEMAKING AT THIS TIME

The inputs that are responsible for emissions from atmospheric blowdown systems are subject to existing District regulations. Regulation 8, Rule 28, requiring control of all pressure relief devices on any component that vents twice is the most stringent rule of its sort in existence, and one of only two to control episodic PRD releases in California. Regulation 8, Rule 10 was amended in January, 2004 to establish more stringent standards to reduce emissions from vessel depressurization, and Regulation 8, Rule 18 is the most stringent rule regulating fugitive emissions in the United States. Finally, Regulation 8, Rule 2 controls emissions from miscellaneous operations such as flushing diesel into the blowdown tower during cleaning and maintenance and also would limit emissions in the event of a valve left open inadvertently. Atmospheric blowdown systems do complicate enforcement of the requirements for the various inputs to the system. However, proper monitoring of emissions by measurement of flows and measurement or calculation of hydrocarbon concentration provides sufficient means to enforce these rules.

Staff has determined, therefore, that a second level of regulatory control, i.e., controlling emissions from atmospheric blowdown systems, which receive only regulated inputs, is not warranted under existing circumstances. Therefore, staff does not propose to undertake additional rulemaking related to atmospheric blowdown systems at this time.

APPENDIX 1
Characterization of the Various Input Streams to Atmospheric Blowdown Systems

Source	No. of Inputs	Material in Stream	Total Amounts	Conditions of Use	Access to Blowdown
PRDs	(42)	Hydrocarbons	Varies	Process Upset	PRD
Heat Exchanger Drains (83)	(29)	Slurry, heating oil, Product Feed, Light gas oil, Gasoline, Steam, LPG, Decant Oil	170 - 11,575 gal	Shutdown	Manual valve
	(33)	Diesel	66 bbls	Clean & repair, once each 6 yrs	Manual valve
	(19)	Gasoline, steam & water	2-42 bbls	Clean & repair, once each 3 yrs	Manual valve
	(1)	Steam / water	10 bbls	Never	Manual valve
Pumps / Compressors (5)	(1)	Glycol / Gasoline	1 gal/min	Flushing following emergencies – inner seal failure	Manual valve
	(2)	Decant Oil / gasoline	5 -25 gal	Flushing during Shutdown	Manual valve
	(1)	Gasoline vapor Gasoline liquid	5 cf 10 gal	Intermittent flushing	Manual valve
	(1)	Slurry HGO	0 gal 0 gal	Shutdown (not used)	Locked closed
PRD Flush	(1)	Diesel	10 bbls	Flushing following episodic PRD lift	Manual valve
BDT level glass flush Line	(2)	Wash oil	0	Used to flush BDT level glass	Manual valve, locked closed
Valve Flush (2)	(1)	Slurry (15 gal) LGO (45 gal)		Shutdown	Manual valve
	(1)	LGO (0 gal)	0	Shutdown – never used	Locked closed
Vessels (3)	(3)	Foul water / LPG	0	Not used	Locked closed
Blowdowns (from PRDs)	(2)	n/a	0	Never used	Double blocked valves -- locked closed
Fractionator	(1)	n/a	0	Never used	Manual valve, locked closed
Vent (8)	(1)	Gasoline / LPG	15 MMSCF	Emergencies – high accumulation & flare pressure	Manual valve
	(1)	Steam	4000 scf	Turnaround, once each 6 yrs	Manual valve
	(3)	Crude, gasoline	20-200 bbls	Clean & repair, once each 3 yrs	Manual valve
	(2)	Gasoline	20 bbls	Shutdown & startup, once each 6 yrs	Manual valve
	(1)	Various Light materials		Normally to flare. Has tie into blowdown – not used	Locked closed
Condensate	(2)	Steam condensate	100 – 200 lbs/hr	Intermittent	Manual valve
Drain (Purge gas)	(2)	Natural Gas	8-10 lbs	1 / 2 days	Manual valve
Drain (steam line)	(1)	Steam condensate	0 -10 Mlb/hr	Startup – 1 / 2 yrs	Manual valve
Drain (PRD)	(2)	Gasoline	80 bbls	Following PRD lift	Manual valve
Drain (valve)	(2)	Water / liquid	4 gals	2/yr	Manual valve
Outlets	(4)	Gasoline	25-90 bbls	Shutdown & startup, twice in 3 yrs	Manual valve
Coil Outlet	(3)	Diesel	60 bbls	Shutdown & startup, twice per year	Manual valve
Flare Header	(1)	HC Gas	0	Never used	Locked closed
40# Steam	(1)	Steam	0.5 – 30 Mlbs/hr	Continuous minimum flow	open
250# Steam	(1)	Steam	0	Never used	Locked closed