Region 2 Enforcement & Compliance Assurance Division
Air Compliance Branch

CAA Inspection Report

Inspection Date: 5/9/2024

Facility Name: PBF Energy Paulsboro

Facility Address: 800 Billingsport Road in Paulsboro, New Jersey 08066

ICIS-Air ID #: NJ0000003401500002

EPA Lead Inspector: Harish Patel, EPA Region 2 Air Compliance Branch, patel.harish@epa.gov

EPA Asst. Inspector: Ralph Lonergan, EPA Region 2 Air Compliance Branch, lonergan.ralph@epa.gov

Facility Contact: Bob Muche, Environmental Manager, robert.muche@pbfenergy .com

State Inspector(s): Rob Siracusa, New Jersey Department of Environmental Protection

Other Inspector(s): N/A

Table 1. INSPECTION TEAM MEMBERS

Team Member	Organization
Brianna Leiker	National Enforcement Investigations Center (NEIC)
Mike Lukowich	NEIC
Cindy Schafer	NEIC
Matt Schneider	NEIC
Emily Oblath	NEIC
Melissa Rosa	NEIC
Harish Patel	EPA Region 2
Ralph Lonergan	EPA Region 2
Jillian Harvey-Shepard	EPA Region 2
James Crossmon	EPA Region 2
Nick Ferreira	EPA Region 2
Patrick Foley	EPA Air Enforcement Division
Rob Siracusa	New Jersey Department of Environmental Protection

Pertinent Regulatory Requirements

- 40 CFR Part 63, Subpart CC – National Emissions Standards for Hazardous Air Pollutants from Petroleum Refineries (MACT CC)
- 40 CFR Part 61, Subpart FF – National Emission Standard for Benzene Waste Operations (BWON)
- 40 CFR Part 60, Subpart QQQ – Standards of Performance for VOC Emissions From Petroleum Refinery Wastewater Systems (NSPS QQQ)

Summary of Onsite Observations

FACILITY OVERVIEW

PBF Energy Paulsboro (Paulsboro) is a petroleum refinery. According to the company website, the facility is approximately 950 acres, processes approximately 155,000 barrels of crude oil per day, and "specifically manufactures Group I lubricant base oils and is the largest producer of Asphalt on the East Coast."

Paulsboro employs approximately 300 people at the refinery, not including contractors. Products manufactured on-site are gasoline components, finished jet fuel, ultra-low sulfur diesel, propane, butane, Group 1 lubricant base stocks, and asphalt.

The refinery has two crude processing units. Other process units in service at Paulsboro are two catalytic hydrodesulfurization (CHD) units, one propane de-asphalting unit, two furfural units, one Mobil lubes dewaxing (MLDW) unit, one naphtha hydrotreater (NHT) unit, one continuous catalyst regeneration (CCR) unit, two sulfur recovery units (SRUs), two tail gas treating units, and one benzene recovery unit (BRU). The refinery also has two flare systems, two flare gas recovery (FGR) systems, and a wastewater treatment plant (WWTP).

The WWTP's treatment systems are oil and solids separation, dissolved air flotation, activated sludge biological treatment, secondary clarification, tertiary filtration, and disinfection. Effluent from the WWTP is discharged into the Delaware River. During normal operations, except under severe precipitation events, all collected storm water is treated through the WWTP before discharge into the river. The refinery also has an emergency retention basin to temporarily store storm water and comingled process water when the WWTP's operating capacity is exceeded during "extreme" precipitation events.

Beginning in 2020, refinery operations were modified to produce less motor fuels and more lubricants. The gasoline components produced at Paulsboro are shipped off-site for blending. Because of the change in refinery operations, the fluidized catalytic cracker (FCC), FCC gasoline desulfurization (FGD), coker, and alkylation units were out of service at the time of the on-site inspection. The CCR unit was shut down in 2020 and brought back into service at the end of calendar year 2023.

Paulsboro operates under a CAA Title V operating permit (permit No. BOP210001) issued by the New Jersey Department of Environmental Protection, which was initially approved February 11, 2002; expired February 10, 2022 (Paulsboro is operating under the application shield after submitting a timely and administratively complete renewal application); and had a modification most recently approved February 23, 2024. The permit specifies emission limits and testing, monitoring, recordkeeping, reporting, and other specific operating requirements.

Paulsboro also operates under a consent decree, which was originally issued to previous ownership of the refinery, Valero. The consent decree requires installation of equipment and implementation of controls to achieve improvements in air quality control. The consent decree was filed June 16, 2005.

FACILITY OPERATIONS SUMMARY

The refinery's two crude units (CU-6 and CU-7) both have their own atmospheric and vacuum distillation columns. Both crude units also have a stabilizer column that further distills overhead product from that unit's atmospheric distillation column.

The refinery's two catalytic hydrodesulfurization units, CHD-1 and CHD-2, treat process streams from the crude units with hydrogen to upgrade feedstocks to heating oil and diesel product stream (CHD-1) and to upgrade jet/kerosene-cut feedstocks into finished products (CHD-2). Additionally, hydrotreating converts the nitrogen, sulfur, oxygen, and chlorine in the incoming feedstocks to ammonia, hydrogen sulfide, water, and hydrogen chloride, respectively. These four byproducts are removed from finished products using stream stripping.

The propane de-asphalting unit produces propane-de-asphalted tar by removing asphaltic substances in heavy feedstocks from CU-7 using propane flow through a distillation column. Overheads from the column are separated in a high-pressure column and a low-pressure column; the propane is compressed for reuse in the system and the de-asphalted oil is further treated in a furfural unit. The propane-de-asphalted tar in the column bottoms are sent to asphalt blending.

The two furfural units process lubricating oil fractions from the crude units and the de-asphalted oil from the propane de-asphalting unit. Furfural is used as a solvent in a liquid-liquid extraction process that produces a lube-quality, waxy raffinate that is further processed in the MLDW unit.

The remaining products are sent for sales or are used in product blending.

In the MLDW unit, the waxy raffinate from the furfural units and hydrogen are preheated then passed through catalyst beds, where the wax is cracked into smaller, lighter hydrocarbons, which are now in oil form rather than wax form. A separate hydrofinishing catalyst removes sulfur and stabilizes the oil. Further separation downstream produces a finished lube oil stock.

The NHT unit combines naphtha and hydrogen in the presence of a catalyst to produce a low-sulfur feed for the downstream CCR unit. The NHT unit's feedstocks are naphtha from both crude units as well as purchased naphtha. In the CCR unit, reforming catalyst converts the naphtha from the NHT unit into reformate, hydrogen, and liquefied petroleum gas. The CCR unit's catalyst is continuously regenerated.

The two SRUs recover elemental sulfur from the sour gases produced elsewhere in the refinery using the Claus process. Tail gases from both SRUs are treated in a tail gas treating unit. In the two tail gas treating units, the hydrogen sulfide and carbon dioxide in the SRU tail gas are absorbed into an amine-based solvent. Downstream from the absorber, the other gases containing less than 10 parts per million (ppm) hydrogen sulfide are released to the atmosphere, and the solvent is heated in the solvent regenerator. The hydrogen sulfide and carbon dioxide are released from the heated solvent and are recycled back to the SRUs.

Paulsboro has four flares in service and one flare (B-2) out of service. The four in-service flares are situated in two flare systems: the B-1 and B-5 flares are in the north flare system and the B-3 and B-4 flares are in the south flare system. All four in-service flares are steam-assisted and elevated. During the on-site inspection, flare B-1 was idled.

Paulsboro has two FGR systems: the north plant FGR unit (compressing and redirecting hydrocarbon vapors that would otherwise be routed to the B-1 [when not idled] and B-5 flares) and the south plant FGR unit (compressing and redirecting hydrocarbon vapors that would be otherwise routed to the B-3 and B-4 flares). Compressed flare gas from the four liquid-ring compressors in the north plant FGR unit and two liquid-ring compressors in the south plant FGR unit is treated to remove hydrogen sulfide and then sent to the refinery fuel gas system. Small streams of recovered liquid hydrocarbons and water from both FGR units are sent to the sour water stripper.

Process wastewater that is generated in process units is conveyed through individual drain systems to the refinery's WWTP. Wastewater that is expected to contain substantial concentrations of benzene are collected in one of two external floating roof collection tanks (tanks 640 and 641), which alternate in service to allow oil to separate. Oil separated in tanks 640 and 641 is skimmed to the slop oil system for reprocessing in the crude units. The collection tanks feed another external floating roof tank that is the feed tank (tank 3592) for a steam stripping operation, called the benzene reduction unit (BRU). The sources of higher benzene concentration wastewater that are treated in the BRU include effluent from the desalters and atmospheric column blowdown from the crude units, as well as tank water draws from tanks that store products (naphtha and/or reformate, for example) that are expected to contain benzene in appreciable concentrations.

The stripped wastewater is discharged into the refinery oily-water sewer system, which is not controlled for benzene emissions per the requirements of 40 CFR Part 61, Subpart FF (BWON). Overheads from the steam stripper are condensed and collected into a hydrocarbon phase separator. A vacuum pump pulls non-condensible vapors to the FGR system. The hydrocarbons that are collected in the phase separator are pumped back to the BRU feed tanks, where the oil is skimmed to slop oil tanks and recovered through the crude units. Benzene-rich water underflows the phase separator and is recycled back into the BRU. A skid sump system collects pulldowns (containing water that is contaminated with benzene) from the BRU, which are pumped back to the BRU feed tanks to be reprocessed.

The refinery oily-water sewer collects the BRU effluent and individual drains from process units, as well as storm water that falls within process units. The wastewater from the oily-water sewer is combined with sanitary wastewater, offsite wastewater/storm water, runoff from the storm water tank and storm water retention ponds, utility wastewater from the river water treatment system, cooling tower blowdown, and boiler blowdown through a bar screen and splitter box prior to being processed in the API oil-water separator (API). During excessive rain events and prior to treatment, a static control structure diverts excess flow into the emergency retention basin, which is a lined pond. Comingled storm water and wastewater from the emergency retention basin is pumped back to the treatment system when flows have subsided.

Slop oil that is skimmed from the API is pumped to the slop oil recovery system to be reprocessed in the crude unit. Sludge that is removed from the API was previously reprocessed in the coker, but the coker has been out of service for several years. With the coker down, API sludge is now shipped off-site as hazardous waste. The effluent from the API is further treated in dissolved gas floatation units prior to biological treatment.

FIELD ACTIVITIES SUMMARY

The EPA inspection team (EPA inspectors) consisted of Brianna Leiker, Mike Lukowich, Cindy Schafer, and Matt Schneider from NEIC, James Crossmon, Nick Ferreira, Jillian Harvey-Shepard, Ralph Lonergan, and Harish Patel from EPA Region 2, Patrick Foley from EPA Air Enforcement Division, and Rob Siracusa from the New Jersey Department of Environmental Protection. On May 6, 2024, EPA inspectors conducted an opening meeting and presented credentials to Bob Muche, Paulsboro's Environmental Manager.

The scope of the CAA inspection was Paulsboro's compliance with applicable CAA federal regulations and permit requirements with a focus on 40 Code of Federal Regulations (CFR) Part 63, Subpart CC – National Emissions Standards for Hazardous Air Pollutants from Petroleum Refineries (MACT CC); 40 CFR Part 61, Subpart FF – National Emission Standard for Benzene Waste Operations (BWON); and 40 CFR Part 60, Subpart QQQ – Standards of Performance for VOC Emissions From Petroleum Refinery Wastewater Systems (NSPS QQQ). EPA inspectors conducted process discussions with facility personnel, interviewed facility personnel, conducted process area walkthroughs, reviewed records, performed field measurements, and collected photographs and videos.

1. Wastewater

As a petroleum refinery, Paulsboro is subject to the BWON. EPA inspectors discussed the various sources of waste streams and the facility's management of these wastes in detail with Paulsboro's environmental staff and operators. Relevant records, including recent total annual benzene (TAB) reports, required inspections, and continuous monitoring data of operations were requested and reviewed.

The TAB reports and other information indicate that the facility's aqueous waste contains more than 10 megagrams per year (Mg/yr) of benzene; therefore, the facility is subject to the benzene control requirements of the BWON. Paulsboro has chosen the compliance option described in 40 CFR § 61.342(e), known as the "6BQ compliance option." Under the 6BQ compliance option, Paulsboro must manage and treat facility waste with a flow-weighted annual average water content of less than 10 percent (organic wastes) in controlled waste management units. Paulsboro must also manage and treat facility waste with a flow-weighted annual average water content of 10 percent or greater (aqueous wastes) and any waste stream that is mixed with such waste stream such that the benzene quantity from these waste streams and any uncontrolled aqueous waste streams at the points of exposure to the atmosphere is less than 6.0 Mg/yr.

As described earlier in this report, wastewater streams containing higher concentrations of benzene are processed in the BRU to remove benzene prior to discharge into the oily-water sewer. The BRU effluent combined with all other wastewater streams managed in uncontrolled (per the BWON) waste management units at the facility are reported by Paulsboro to contain less than 6.0 Mg/yr benzene.

Information provided by Paulsboro in a site-specific BWON compliance document indicates the BRU was installed in 1992 to comply with the BWON; as such, new individual drain systems were installed, which would have triggered a modification to the aggregate facility, which includes the downstream sewer lines, junction boxes, and oil-water separators as defined in NSPS QQQ. The installation of flare gas recovery systems and associated individual drain systems also triggered requirements for NSPS QQQ controlled sewer lines. EPA inspectors requested, but did not receive, a list of process units with individual drain systems that had been modified since May 4, 1987, to determine NSPS QQQ applicability. Nevertheless, the individual drain systems from all process units eventually connect to the main branch of the refinery oily-water sewer and are processed in the API oil- water separator, which are collectively subject to the control requirements of NSPS QQQ.

Because information about which process units were subject to the control requirements was not provided, EPA inspectors were unable to comprehensively evaluate NSPS QQQ compliance while on-site; however, EPA inspectors did inspect several NSPS QQQ-subject junction boxes and the equipment located at the wastewater treatment plant that is subject to NSPS QQQ. Relevant records, including required inspection records and control device monitoring data, were reviewed.

EPA inspectors performed EPA Method 21 (Method 21) monitoring using TVAs at select equipment at the facility subject to the BWON and NSPS QQQ to evaluate compliance with the requirements to operate the waste management equipment with tight seals, no detectable emissions, or both. EPA inspectors, also performed optical gas imaging (OGI) surveys of this equipment to identify and document sources of detectable emissions.

2. Flaring

As part of the inspection, EPA inspectors requested and received relevant documents describing the flare systems (e.g., the most recent flare management plan) and certain continuous parameter monitoring data for each flare. EPA inspectors also interviewed Paulsboro personnel on-site regarding flare operations and to clarify questions related to the flare systems, their operating status, and flare parameter monitoring data and equipment locations. EPA inspectors also visited the refinery's DCS building to further discuss some of the specifics of how process operations work, to discuss the monitoring equipment used and their locations within the north and south plant flare systems, and to observe control screen monitors for the flares in both the north and south plant flare systems.

As described above, Paulsboro uses four steam-assisted flares to combust any waste gases that are not recovered by the FGR units in the refinery's north plant flare system and south plant flare system. Sources of waste gases connected to flare headers in both locations are related to various equipment depressurizations; purging related to maintenance turnarounds, startups, and shutdowns; and pressure relief devices and other safety control valves to handle upsets, malfunctions, and emergency releases. According to Paulsboro, the FGR units for the north and south plant flare systems have the capacity to recover routine excess vapors in the flare header and higher than normal flows during most maintenance activities, but they are not designed to capture the potential higher flows from the flare system, which is designed based on the need to incinerate much larger quantities of gases, such as during an emergency situation. If the waste gas volumes at the flare header exceed the capacity of the compressors for each FGR system, gases are routed to their respective flares. During the on-site inspection, EPA inspectors did not witness and were not otherwise made aware of any flaring event by Paulsboro.

The two north plant system flares (B-1 and B-5) are each operated with water seals set in a non-cascading configuration. During the inspection, flare B-1 was idled (not on standby - no pilot lit), so all potential waste gas in the north plant would have been routed to B-5. The south plant flares (B-3 and B-4) are operated as a cascading flare system with each flare having a water seal. The primary flare (or "lead flare") has the lower water seal level while the secondary flare (or "lag flare") has the higher water seal level. According to Paulsboro, the south plant flare system can alternate between which is the primary flare and which is the secondary flare. Each refinery flare is equipped with a water seal, which ensures no flare header gas is routed to the flare stacks until the FGR unit compressors capacity to handle the waste gas flows in the flare header is exceeded. When the flare header flow exceeds the capacity of the FGR unit compressors and the header pressure exceeds the water seal level pressure, waste gases are routed to the flare stacks.

According to Paulsboro personnel, purge gas (natural gas) is added downstream from the water seals to maintain a positive pressure between the water seal and flare tips. The flow rate of natural gas for each individual flare is increased (supplemental fuel) as needed to maintain each flare's net heating value in the combustion zone (NHVcz) greater than 270 British thermal units per standard cubic feet (Btu/scf). Supplemental fuel is added at the same location as the purge gas.

Flaring events are primarily determined by Paulsboro based on continuous monitoring data for vent gas pressure in each flare gas header, which is measured upstream from each flare's knock out drum, in conjunction with water seal monitoring data for each flare. According to Paulsboro, when each flare's vent gas pressure is within 3 inches of water of the water seal pressure, Paulsboro assumes flaring has commenced and begins making adjustments related to supplemental fuel flow and steam flow. Paulsboro's flares are controlled by an "IQ" system, which is an automated system that begins making these steam and supplemental fuel adjustments once an assumed flaring event has begun. The amount of supplemental natural gas added and steam flow is adjusted by the IQ system based on a minimum set point of 300 BTU/scf for the NHVcz. Paulsboro also has the ability to make manual adjustments to supplemental fuel and steam flows based on other factors. For example, Paulsboro reviews real-time photos in the DSC building for smoke, which can be used to manually increase a flare's steam flow.

Several continuous parameter monitors are similarly configured for each of Paulsboro's flares. As noted above, waste gas pressure in the flare header is monitored upstream from each flare's water seal. Downstream from each water seal, the net heating value of the vent gas (NHVvg), vent gas flow rate, and hydrogen sulfide (H_2S) concentration is continuously monitored. These monitors are all located in approximately the same location. The vent gas components monitored include waste gas that has released through the flare's water seal, purge gas, and any added supplemental natural gas. Paulsboro uses calorimeters to monitor NHVvg for each flare. For purposes of calculating NHVcz, Paulsboro does not separately monitor for hydrogen. Steam flow rate is also measured upstream from the burner tips where it is added. Hydrogen sulfide is continuously monitored and used to calculate total sulfur concentration using a correlation factor and weekly grab sample analysis of total sulfur versus hydrogen sulfide.

3. Storage Tanks

Paulsboro operates two tank farms at the refinery. One tank farm is primarily used to store feed (crude oil which is received by barge) and intermediates and the other tank farm is used to primarily store refined saleable products (gasoline, diesel, propane, butane, lube oil, and asphalt). Paulsboro also uses some storage tanks for managing slop oil before it is pumped back to the crude tanks.

As a petroleum refinery, storage tanks that meet size thresholds and store liquids greater than a threshold vapor pressure are subject to certain storage vessel requirements under MACT CC. EPA inspectors requested specific information related to all of the facility's "Group 1" storage vessels under MACT CC. Group 1 storage vessels have more stringent requirements than Group 2 storage vessels under MACT CC.

The EPA field team focused its investigation on tanks storing crude oil, higher-volatility intermediates and products such as naphtha and gasoline, and tanks used to manage slop oil. According to information provided by Paulsboro, these tanks are considered Group 1 storage vessels under MACT CC. EPA inspectors conducted OGI surveys from the top platforms and associated catwalks of the following 12 external floating roof (EFR) tanks: S-74, S-75, S-76, S-77, S-78, S-79, S-82, 725, 802, 1320, 2940, and 2941. EPA inspectors also conducted an OGI survey from either the ground or the top platform of the following eight internal floating roof (IFR) tanks (some of these are retrofitted EFR tanks): S-81, 724, 1023, 1064, 1065, 1115, 1319, and 3018. Based on EPA inspector observations from OGI surveys, NEIC requested additional documents related to tank inspections for certain storage tanks at the facility.

On May 9, 2024, EPA inspectors conducted a closeout meeting with Paulsboro representatives. During the closeout meeting, EPA inspectors provided a summary of the team's observations and indicated that additional information and documents may be requested after the inspection.

Lead Inspector's Name: Harish Patel

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Lead Inspector

Assisting Inspector's Name: Ralph Lonergan

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Assisting Inspector

Supervisor's Name: Robert Buettner

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Supervisor