Revised section 2.2.11 follows. New text is underlined.

2.2.11 Delayed Cokers

Delayed coking is a thermal cracking process whereby vacuum residuum is converted to lighter liquid products and petroleum coke. The HEC refinery will include two Delayed Cokers, each using a semi-continuous process that employs two pairs of large coke drums that are alternately switched on- and off-line after filling with hot vacuum residuum.

The vacuum residuum feed is heated by heat exchangers and fed to the bottom of the fractionator column where it mixes with the fractionator column bottoms. The combined stream of vacuum residuum and fractionator bottoms is heated in the gas-fired process heaters to initiate coke formation in the coke drums. The formation of coke is a thermal cracking process in which the hot vacuum residuum thermally decomposes (i.e., “cracks”) into hydrocarbon vapors and coke. The hydrocarbon vapors leave the coke drum overhead and flow to the fractionator column. This column separates the cracked hydrocarbons into fuel gas, LPG, naphtha, light gas oil, and heavy gas oil.

After coking reactions are complete, the full coke drum is switched off-line and is steamed out and cooled. During these steps, the vapors exiting the drum are captured by the closed blowdown system and recovered in the fractionator. After quenching and cooling, the coke drum is depressurized to atmosphere through a steam vent before the bottom and top heads of the drum are opened. The coke is cut from the drum with a water jet and dropped into a pit where the free water is separated from the coke and recycled. A bridge crane is used to transfer the wet coke from the pit to a crusher. During the drum decoking process the coke is very wet because of the water jet cutting, and fugitive dust emissions are minimal. The crushed, wet coke is transferred via an enclosed belt conveyor to a storage building. The enclosed belt conveyor and storage building will exhaust to fabric filter baghouses to minimize fugitive coke dust emissions.

Emissions from the Delayed Cokers include combustion products from the gas-fired coker furnaces; particulate matter, CO, and VOC emissions from the coke drum steam vents; fugitive VOC emissions from valves, flanges, seals on rotating equipment, and from the coke pad; and fugitive particulate matter emissions from coke handling and transfer.

Revised Tables 1.4-1 and 5.0-1 follow:

TABLE 1.4-1. Summary of HEC Air Pollutant Emissions

Pollutant	Petroleum Refinery (tpy)	IGCC Power Plant (tpy)	Diesel Engines (tpy)	Total (tpy)
Carbon Monoxide	1,659	338	8	2,005
Nitrogen Oxides	424	337	15	776
PM	110	214	0	324
PM-10	352	697	0	1,050
PM-2.5	352	697	0	1,050
Sulfur Dioxide	676	187	0	863
VOC	440	67	1	507
Hydrogen Sulfide	6	19	0	25
Sulfuric Acid Mist	63	16	0	80
Hydrogen Chloride	49	0	0	49
Organic HAP	103	27	0	130
Ammonia	77	197	0	273

TABLE 5.0-1. Summary of HEC Air Pollutant Emissions

Pollutant	Petroleum Refinery (tpy)	IGCC Power Plant (tpy)	Diesel Engines (tpy)	Total (tpy)
Carbon Monoxide	1,659	338	8	2,005
Nitrogen Oxides	424	337	15	776
PM	110	214	0	324
PM-10	352	697	0	1,050
PM-2.5	352	697	0	1,050
Sulfur Dioxide	676	187	0	863
VOC	440	67	1	507
Hydrogen Sulfide	6	19	0	25
Sulfuric Acid Mist	63	16	0	80
Hydrogen Chloride	49	0	0	49
Organic HAP	103	27	0	130
Ammonia	77	197	0	273

New section 4.18 follows.

4.18 Coke Drum Steam Vents

As described in Section 2.2.11 herein, near the end of each coke drum cycle, the drum is steam stripped, cooled, and depressurized before the bottom and top heads of the drum are opened. The gases exiting the coke drum during the steam stripping, cooling, and depressurization steps are a potential source of particulate matter, CO, and VOC emissions.

4.18.1 Particulate Matter, CO, and VOC Emissions

4.18.1.1 BACT Baseline

In the preamble to the proposed NSPS for Petroleum Refineries, U.S. EPA recently determined that the only available and technically feasible control strategy for minimizing emissions from coke drum depressurization is to maximize the use of the closed blowdown system for recovery:

> When the delayed coking cycle is completed, the coke-filled vessel is steam stripped. Most of the gases from this process continue to be sent to the coking unit distillation column. At some point in time, the steam gas discharge is diverted to the blow-down system. The delayed coking unit typically has a fuel gas recovery system (compressor) due to the quantity of fuel gas produced by the unit. Therefore, it is cost-effective to require the blow-down system gases to be recovered in the unit's fuel gas recovery system, in keeping with the proposed work practice standard that fuel gas from fuel gas producing units will not be routinely flared.
>
> As the process unit continues to depressurize, there is a point where the gases can no longer be discharged to the blow-down system or fuel gas recovery line, at which point the remaining steam and gases are vented to the atmosphere. To achieve maximum reduction of uncontrolled releases, the unit should be depressurized to as low a pressure as possible before venting to the atmosphere. Below a pressure of 5 pounds per square inch gauge (psig) in the delayed coking unit drum, it is not technically feasible to divert the emissions for recovery.[1]

Accordingly, based on the proposed standards under subpart Ja of 40 CFR part 60, the least stringent emission limit which would meet BACT requirements for the Delayed Coking Units at the HEC refinery is a work practice requirement. Specifically, the NSPS would require that the coke drum be depressurized to 5 psig before the exhaust gases can be vented to atmosphere.

[1] See *Federal Register*, May 14, 2007 (72 *Fed. Reg.* 27178).

4.18.1.2 Steps 1-4

The Delayed Coking Units at the HEC will be designed for inherent recovery of all gases purged from the coke drums while the drum pressure is 5 psig or more, consistent with U.S. EPA's recent finding and the proposed requirements of NSPS subpart Ja. The equipment design elements and work practices associated with this provision will prevent releases to the coker flare header during the steam stripping step and will minimize the amount of atmospheric venting during the cooling and depressurization steps.

Notwithstanding U.S. EPA's recent determination that it is technically infeasible to recover the coke drum blowdown vapors at a drum pressure less than 5 psig, RTP conservatively assumed for the purposes of this BACT analysis that it would be feasible to use liquid ring compressors to recover the blowdown vapors down to a drum pressure of 2 psig. This additional blowdown vapor recovery equipment would further reduce the amount of gas exhausted to atmosphere during coke drum depressurization.

As described in Section 5.1.11 herein, the total annual emissions from coke drum depressurization in both Delayed Coking Units are 3.3 tons PM-10, 0.3 tons CO, and 33.3 tons VOC per year. These values are based on venting to atmosphere through the coke drum steam vents at a drum pressure of 5 psig inherent to the design of the HEC Delayed Coking Units.

Using liquid ring compressors to depressurize the coke drums to a maximum pressure of 2 psig before atmospheric venting would achieve emission reductions of 1.9 tons PM-10, 0.1 ton CO, and 19.3 tons VOC per year. This more effective control option would not have any significant, adverse environmental or energy impacts. However, this control option would have unacceptable, adverse economic impacts. Even without taking into account the anticipated maintenance and operational costs, which would likely be significant due to the unfavorable operating conditions, the annualized cost of installing and operating liquid ring compressors for coker blowdown vapor recovery to a drum pressure of 2 psig is estimated to be $0.9 million per year. The cost effectiveness of this control option is approximately $500,000 per ton of PM-10 emissions; $9 million per ton of CO emissions; and $50,000 per ton of VOC emissions. The use of liquid ring compressors for enhanced coker blowdown vapor recovery does not represent BACT.

4.18.1.3 Step 5 – Establish BACT

RTP proposes that the work practice requirements proposed for inclusion in subpart Ja of 40 CFR part 60 be established as the BACT emission limits for particulate matter, CO, and VOC emissions from the Delayed Coking Units at the HEC refinery. Specifically, the work practice requirement proposed by RTP would require that each coke drum be depressurized to 5 psig before the exhaust gases can be vented to atmosphere.

New Section 5.1.11 follows:

5.1.11 Coke Drum Steam Vents

Hourly and annual emissions from coke drum depressurization are presented in Table 5.1-12. Emissions of all pollutants were calculated as the product of the volume of blowdown vapors released per drum cycle, the number of drum cycles per year, and the estimated pollutant concentration in the blowdown vapors.

TABLE 5.1-12. Summary of Estimated Emissions from Coke Drum Steam Vents

POLLUTANT	lb/hr	tpy
CO	0.3	0.3
PM	3.0	3.3
PM-10	3.0	3.3
VOC	30.4	33.3

Revised Section 5.3 follows:

5.3 Diesel Engines

Hourly and annual emissions from each of the six internal combustion engines at the proposed refinery are presented in Table 5.3-1. Emissions of all pollutants from internal combustion engines were calculated as the product of the output capacity in kilowatts (kW) and an emission factor in grams per kilowatt-hour (g/kWh). Each internal combustion engine is proposed to be subject to a fuel use restriction that limits its operation to the equivalent of 300 hours per year, based on equivalent full-load operation. Thus, annual emissions are calculated assuming the hourly emission rate for 300 hours per year. Emission factors used to calculate emissions from internal combustion engines are shown in Table 5.3-1 and represent the proposed BACT emission standards. For SO_2, the emission factor is derived from Section 3.4 of AP-42, using the maximum allowable fuel sulfur level of 15 parts per million by weight. For the purpose of calculating NO_X emissions, it is assumed that zero VOC is emitted, *i.e.*, that the NO_X emission rate from each engine is equal to the allowable NO_X + NMHC emission limit. Potential VOC emissions are calculated using the emission factor from Section 3.4 of AP-42.

TABLE 5.3-1. Emissions from Diesel Engines

PARAMETER		Fire water pumps (each of 2)	Emergency Generators (each of 4)	Total
Output	kW	2,250	600	
Operation	hrs/yr	300	300	
	kWh/yr	675,000	180,000	
Emission Factors g/kWh	NO_X	6.4	6.4	
	VOC	0.3	0.3	
	CO	3.5	3.5	
	SO_2	0.007	0.007	
	PM-10	0.2	0.2	
Emission Rates lb/hr	NO_X	31.7	8.5	97.4
	VOC	1.7	0.4	5.1
	CO	17.4	4.6	53.2
	SO_2	0.04	0.01	0.1
	PM-10	1.0	0.3	3.0
Emission Rates tons/yr	NO_X	4.8	1.3	14.6
	VOC	0.2	0.1	0.8
	CO	2.6	0.7	8.0
	SO_2	0.0	0.0	0.0
	PM-10	0.2	0.0	0.5