Blue Ridge Environmental Defense League

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April 1, 2019

Cassandra Frysinger
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Department of Environmental Quality
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RE: Columbia Gas Transmission L.L.C., Shenandoah Compressor Station
Location: 1656 Newport Road, Shenandoah, VA 22849
Permit Number: VRO81139

Dear Ms. Frysinger:

On behalf of the Blue Ridge Environmental Defense League and out members in Virginia, I submit the following remarks regarding the Shenandoah Compressor Station. For the reasons stated below, we oppose the issuance of this permit as drafted.

Background

The Shenandoah Compressor Station, located in Page County, operates under NAICS Code 486210 as part of the Columbia Gas Transmission pipeline. It pumps natural gas received via the pipeline to a downstream station. To do this, the compressor operates two natural gas-powered turbines each rated at 5,027 horsepower. Auxiliary equipment includes an emergency generator rated at 135 hp and a 2.1 MMBtu/hr boiler. The Shenandoah Compressor Station is permitted by DEQ as a major source for nitrogen oxides and an area source for hazardous air pollutants. DEQ's Statement of Basis lists annual facility-wide potential to emit which are listed in Table A on the following page.[1]

The draft permit prescribes the following conditions to control air pollutant emissions: NOx and CO emissions controlled by lean fuel-to-air ratio; SO_2 emissions controlled by limiting sulfur content in the fuel to no greater than 20 grains per 100 standard cubic feet, or 0.068% by weight; fuel consumption limits and a Visible Emission limit of five percent opacity.

Comments

Combustion turbines are remarkable for their lack of efficiency in converting chemical energy to mechanical energy. Part of the output is lost the in compressor where intake air is compressed up to 30 atmospheres of pressure, before the fuel is burned. Accordingly, "More than 50 percent of the shaft horsepower is needed to drive the internal compressor

[1] Department of Environmental Quality, Shenandoah Compressor Station, Draft Statement of Basis, Attachment A: 2017 Annual Emissions Update, Permit No. VRO81139

and the balance of recovered shaft horsepower is available to drive an external load."[2] The simple cycle is the most basic operating cycle of gas turbines with a thermal efficiency ranging from 15 to 42 percent. Combined cycle units that utilize heat recovery steam generators have an efficiency of 38 to 60 percent. This means that from 40 to 85 percent of the fuel burned produces no electric power. But air pollution and global warming gases are created by combustion whether power is produced or not.

Table A: Facility Total Potential To Emit (PTE)	
Pollutant	**Tons per year**
Criteria Pollutants	
CO_2e	44,406.00
PM-10	2.51
PM-2.5	2.51
VOC	5.69
NO_x	141.36
CO	99.17
SO_2	0.27
Pollutant	**Tons per year**
Hazardous Air Pollutants (HAP)	
CH_2O formaldehyde	0.27
Total HAP	0.40

Moreover, how the turbines are managed and the conditions under which they operate affect efficiency and air pollution emissions. Figure 1 illustrates the problem.

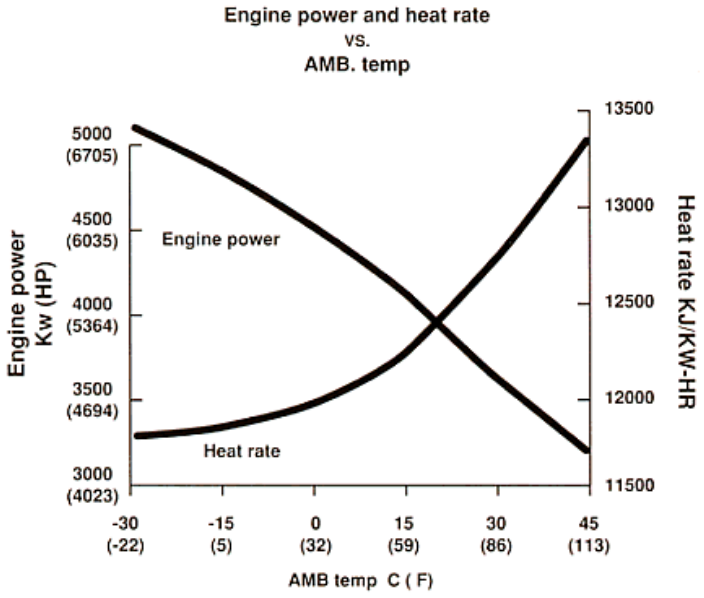

Figure 1: Allison Gas Turbine Engine Power vs. Ambient Temperature[3]

[2] US EPA Air Pollution Emission Factors, AP-42, Stationary Gas Turbines, Section 3.1.2 Process Description

[3] International Power Technology at http://www.intpower.com/engine_specs/501-kb5s_facts.htm

The graph, generated by turbine manufacturer Rolls-Royce Allison, shows that the ambient temperature on a given day determines efficiency of operation and, therefore, emissions of air pollution. This phenomenon can result in wide fluctuations and underestimated rates of toxic air pollution. The products of incomplete production—carbon monoxide and PM-10—increase with reduced operating loads. According to the US Environmental Protection Agency:

> Available emissions data indicate that the turbine's operating load has a considerable effect on the resulting emission levels. Gas turbines are typically operated at high loads (greater than or equal to 80 percent of rated capacity) to achieve maximum thermal efficiency and peak combustor zone flame temperatures. With reduced loads (lower than 80 percent), or during periods of frequent load changes, the combustor zone flame temperatures are expected to be lower than the high load temperatures, yielding lower thermal efficiencies and more incomplete combustion.[4]

According to DEQ, "As with all turbines, the compressor turbines are sensitive to ambient temperatures which in turn affects the horsepower output and emissions from the turbines."[5] Before issuing this permit, the DEQ must assess the impacts of operating factors on emissions. Best available control technology for criteria pollutants and maximum achievable control technology for hazardous air pollutants are the standards.

The gas at the proposed Shenandoah Compressor Station will be supplied in part by hydrofracking, with serious consequences for climate change. The Shenandoah Compressor Station has the potential to emit over 44 thousand tons of greenhouse gas annually. According to the Union of Concerned Scientists:

> The drilling and extraction of natural gas from wells and its transportation in pipelines results in the leakage of methane, primary component of natural gas that is 34 times stronger than CO2 at trapping heat over a 100-year period and 86 times stronger over 20 years. Preliminary studies and field measurements show that these so-called "fugitive" methane emissions range from 1 to 9 percent of total life cycle emissions. Whether natural gas has lower life cycle greenhouse gas emissions than coal and oil depends on the assumed leakage rate, the global warming potential of methane over different time frames, the energy conversion efficiency, and other factors. One recent study found that methane losses must be kept below 3.2 percent for natural gas power plants to have lower life cycle emissions than new coal plants over short time frames of 20 years or fewer. And if burning natural gas in vehicles is to deliver even marginal benefits, methane losses must be kept below 1 percent and 1.6 percent compared with diesel fuel and gasoline, respectively. Technologies are available to reduce much of the leaking methane.[6]

[4] *Id.* US EPA, Page 3.1-3
[5] Department of Environmental Quality, Shenandoah Compressor Station, Draft Statement of Legal and Factual Basis, Permit No. VRO81139, page 5
[6] Environmental Impacts of Natural Gas, http://www.ucsusa.org/clean-energy/coal-and-other-fossil-

The natural gas industry recognizes the major greenhouse gas contribution of pipeline compressors: "Compressors represent one-third of the CH_4 emissions from the natural gas fuel cycle."[7] Far from being a "bridge fuel," natural gas offers no advantage in terms of halting and reversing climate change because it does not reduce the overall emissions of greenhouse gases.

The potential emissions of formaldehyde may affect the children attending the Page County High School and Middle School, as illustrated in Figure 2, each located less than a mile from the Shenandoah Compressor Station.

Distance Page County High School = 3428 feet = 0.65 miles
Distance Page County Middle School = 4571 feet = 0.86 miles

Figure 2: Shenandoah Compressor Station Site Map

Formaldehyde emissions are uncontrolled by any pollution control device listed in the permit, the annual emission level 540 pounds. Its negative health impacts are well known:

> [F]ormaldehyde was the major contributor to the overall cancer risk in 39 of the approximately 550 risk assessments reporting a total cancer risk equal to or greater than 1 in 1 million and contributed to the total cancer risk in 297 of these risk assessments. Formaldehyde also was the major contributor to the overall cancer risk in 3 of the approximately 130 risk assessments reporting a total

fuels/environmental-impacts-of-natural-gas#bf-toc-1

[7] *Handbook of Natural Gas Transmission and Processing*, 2nd Edition, Mokhatab S, Poe WA, ISBN: 978-0-12-386914-2 (2012) Page 625

> cancer risk equal to or greater than 10 in 1 million, and contributed to the total cancer risk in 82 of these risk assessments (OEHHA, 1996a)…. Non-Cancer: Vapors are highly irritating to the eye and respiratory track. Acute effects include nausea, headaches, and difficulty breathing. Formaldehyde can also induce or exacerbate asthma. Chronic exposure is associated with respiratory symptoms and eye, nose, and throat irritation. [8]

The negative health impacts on teenage and younger children are especially problematic because of their physiology. The DEQ must take steps to reduce this and other hazardous air pollutants at this compressor station.

Respectfully submitted,

Louis A. Zeller

[8] Toxic Air Contaminant Identification, California Air Resources Board, 1997