August 15, 2014

Mr. Joseph Hurt

Engineer, Air Division

Arkansas Department of Environmental Quality

5301 Northshore Drive

North Little Rock, AR 72118-5317

Re: Feasibility of Heat Rate Improvements under Building Block 1

Dear Mr. Hurt,

In response to the Agency's request to provide feedback regarding the feasibility of the heat rate improvement value(s) from existing coal facilities under Building Block 1, please find below information for which we respectfully request ADEQ consider for the sole purpose of making comments regarding the proposed federal rule, *Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Generating Units*.

It is our understanding the list of possible improvements previously identified in the July 9, 2014 letter was sourced from the 2009 Sargent & Lundy Report, *Coal-Fired Power Plant Heat Rate Reductions*. Therefore, we have structured our responses in light of the information presented in that report, along with additional information from our own internal improvement efforts to date. The potential area of improvement will be listed first followed by our response on feasibility as it applies to Plum Point Energy Station (PPES).

PPES began commercial operations in Q3, 2010 and was constructed with commercially proven pulverized coal-fired boiler technology and advanced emissions controls. Environmental control technologies include low NO_x burners, over-fire air for NO_x emissions reduction, selective catalytic reduction for NO_x emission control, dry flue gas de-sulfurization for SO_2 emission control, fabric filters for particulate matter emission control, and sorbent injection for mercury emissions control. Additionally, PPES utilizes advanced intake design technology to be compliant with 316 B water intake requirements. PPES burns low-sulfur, Powder River Basin coal exclusively. The facility was originally constructed to be fully capable of compliance with the Mercury and Air Toxics Rule without additional pollution control equipment.

We appreciate the Agency's request for input from the regulated community and stakeholder inclusion efforts on the proposed Clean Power Plan rule.

Sincerely,

Kellee C. Fletcher

Kellee Fletcher, CSP, CHMM
EHS Manager on behalf of Plum Point Services Company, LLC

Discussion of Heat Rate Improvement Feasibility at Plum Point Energy Station

Actual net heat rates are higher (less efficient) than original guaranteed net heat rate, because the guaranteed net heat rate is based on new conditions and is determined at maximum output and very specific design ambient and operating conditions. In contrast, the actual net heat rate over ‘x’ period of time considers startups, shutdowns, partial load operation, and operation at various ambient conditions, and auxiliary loads for coal unloading and handling equipment. Heat rate and plant efficiency has and continues to be a key focus for engineering and operating personnel. Some of the past activities undertaken and efficiency improvements already realized include:

- Improvements to coal sampling procedures, equipment, and training were increased to ensure accurate analysis for heat rate calculations
- Quarterly coal pulverizer dirty air and fineness testing, and adjustments, along with inspections during outages
- Other ongoing initiatives are in place to ensure that measurement devices including both of the reclaim scales, the coal unloading scale, and all coal feeders are properly maintained and totals reconciled each month to ensure accurate reporting. This includes inspections with the equipment offline, quarterly feeder calibrations, and semi-annual scale calibration.
- Ultrasonic and thermal imaging surveys are made on a regular basis to ensure that drain valves and other efficiency-impacting sources are checked and scheduled for repair where necessary.
- On-going burner and boiler tuning
- Targeted monitoring and adjustment of operator controllable parameters to maintain the best heat rate
- Optimization of the lime slaking and feed process and SDA performance

Due to the relative young age of this station and the fact that the station already uses highly efficient technology, there is little opportunity to undertake large heat rate improvement projects. As the Agency is aware, power plants have historically avoided some measures to improve heat rate as those projects may be considered major modifications and thereby trigger a permitting process for New Source Review (NSR). NSR can raise the cost of improving efficiency if the facility has to permit and install additional pollution abatement equipment.

Materials Handling

PPES currently utilizes a submerged flight conveyor for bottom ash handling which was adequately designed and sized for the application. As the equipment ages, the plant will ensure that the design and efficiency is adequate for the application and make the decision to upgrade or modify at that time. There might be potential room for improvement in this area, but the impact is currently unknown and in consideration of facility's age, the potential for any improvement over the 2012 condition and efficiency of the system is likely miniscule.

Boiler Operation/Overhaul with New Heat Transfer Surface

PPES's boiler is a single drum, natural-circulation type with a water-cooled furnace, superheater, reheater, and economizer. The natural-circulation system consists of a drum, downcomers, feeders, evaporator tubes, and risers. The downcomers are taken from the drum's bottom for feeding to each furnace wall and are arranged to give optimal mixing of circulating water entering each independent circulating section. In each circuit, where heat absorption rates differ, the feeders, evaporator tubes, and risers and arranged to from a circulation section with each section being physically independent of adjacent sections. This design allows for a self-compensating characteristic, that is, an increase in heat input causes an increase in flow in the corresponding tube. This characteristic partially counteracts the increase of steam quantity, which must occur in a tube receiving a higher amount of heat than those around it.

The heat transfer surfaces that represent this design have been in service less than four years and are the result of many innovations in boiler efficiency. In addition, PPES burns only select PRB coal within a design BTU range. For these reasons, the plant has no plans to upgrade its heat transfer surfaces at this time, nor is there any reason to anticipate heat rate improvements could be gained in this area.

Neural Network (NN) & Intelligent Sootblowers (ISB)

PPES does not currently have any type of neural network system installed. In lieu of having a neural network system, the plant does regularly perform combustion tuning to reduce NOx, CO, and auxiliary power through reduction of excess O_2. Boiler tuning exercises have proven effective to reduce heat rate but not beyond design value. On an annual basis, the plant brings in outside contractors to temporarily install emissions monitoring probes and provide snapshots of the unit which allows plant personnel to make adjustments as necessary. In between tuning cycles, performance monitoring software and flue gas testing is used to make spot adjustments where necessary to keep O_2, CO, and NOx at balanced and appropriate levels.

In regards to intelligent soot blowing systems, the plant currently uses pre-programmed soot blowing sequences to clean certain areas of the boiler. Operator intervention is required to clean areas individually when the need exists. In the furnace, water cannons are utilized for cleaning with a system similar to intelligent soot blowing. The unit has 24 heat flux sensors built in to water wall tube sections throughout the furnace. As heat transfer degrades in an area of the boiler, the water canon PLC initiates cleaning in that area. This method helps reduce buildup and also prevents the spraying of bare wall.

In summary, there is some potential in these two areas for reduction of heat rate but separate improvements do not necessarily result in cumulative heat rate improvements. In consideration of the plant's relative young age, the estimated improvement in boiler efficiency would be well below the 75 Btu/kWh (0.8%) median heat rate reduction estimated by the EPA. .

Air Heaters

PPES uses two regenerative type, tri-sector, dual-layer, vertical shaft air heaters during normal operations. These air heaters utilize post seals, radial seals, axial seals, and circumferential bypass seals in an effort to control air leakage to a design value of 6.1%. This seal design, however, has not been able to withstand prolonged operation of the unit. During normal operation, it is not uncommon for radial seals to become detached which results in increased air leakage and decreased boiler efficiency between outages. PPES's air heaters have also had issues with damage to the cold-end baskets due to soot blower operation. This was attributed to original design. These two factors have led to an average decrease of about 10% air heater efficiency, elevated outlet temperatures, and leakage approaching 10% within months of seal repairs. The overall heat rate impact is around 1.5%.

As a result, PPES spent a great deal of time researching improvements to the existing design to accommodate actual operating conditions. In June 2014, a purchase order was issued for a new cold-end basket design that is not only more resistant to soot blowing, but includes pressure relief channels that relieve excess steam pressure and help prevent basket deformation. This order also includes new radial seals, bypass seals, post seals, and axial seals. The radial seals are a contact design which reduces the potential for air bypass. Following installation, PPES is confident that the lost efficiency can be regained but no improvement beyond design heat rate is anticipated.

Turbine Overhaul

PPES has a high-efficiency tandem, compound, 3-cylinder, 4 flow exhaust steam turbine. This includes a 7-stage HP turbine, a 5-stage IP turbine, and two 6-stage by 4 flow LP turbines. The turbine is of a very modern design, and it is not reasonable to assume that any significant heat rate improvements could be achieved through turbine upgrades.

PPES closely monitors turbine performance and routinely performs performance testing to allow for long term tracking of overall efficiency. This performance monitoring coupled with routine maintenance at standard industry intervals will determine the need for any modifications. At this time, the steam turbine operates very efficiently with only a slight decrease from the original design. The turbine is due for a major maintenance cycle in the next few years, and the results of any findings along with performance data will show whether there is any need for improvements. The plant does not foresee any large-scale upgrades, only OEM retrofits, repairs, and upgrades as necessary.

Feedwater Heaters

PPES was designed with eight feedwater heaters. This optimum design was based on a combination of capital cost and economic payback analysis for improved feed water cycle efficiency. This design analysis indicates that there is no additional benefit with the addition of another feed water heater. This include four low pressure feedwater heaters, a deaerator with direct contact heating, and three high pressure feedwater heaters after the boiler feed pumps. Since commissioning, there have been many issues with the #5 Feedwater Heater which is the first high pressure heater. Aside from the loss of efficiency from colder feedwater being introduced further down the line, all HP feedwater heater drains that would normally pass through the #5 Feedwater Heater to the deaerator must be diverted to the condenser.

PPES is replacing #5 Feedwater Heater this fall to address issues originating from commissioning that will bring turbine cycle performance back to design levels. Following installation, PPES is confident that the lost efficiency can be regained but no improvement beyond design heat rate is anticipated. The performance of the remaining feedwater heaters is tracked closely and has consistently run at or close to design parameters.

Condenser

PPES has two surface condensers installed; one for each LP steam turbine section. The condensers contain stainless steel tubes and are designed to efficiently remove air and non-condensables. Cooling water is via a closed circulating water system which uses clean, treated water. Each condenser is a once-through design with the second shell in series with the first. This results in a multi-pressure condensing system. Performance is closely monitored with other plant parameters and to date has shown close to design performance. Cleanliness is also monitored and due to the tube design and circulating water quality, no tube leaks or fouled tubes have been found to date. Routine cleaning will be accomplished during a future outage. The condensers at PPES contain the latest technology in instrumentation which allow for operators to ensure back pressure is regulated properly. Cooling tower design helps tremendously and the plant has no issues running at full load and being able to effectively maintain back pressure. PPES currently has no plans to upgrade or retrofit existing condensers, as nothing would be gained by such actions.

Boiler Feed Pumps

PPES has two 14,000 HP motor-driven, 50% capacity boiler feed pumps with variable speed hydraulic couplings. Pump performance is routinely monitored along with the motor and hydraulic coupling. To date, the plant has seen some issues with pump performance as a result of leaking seals, improperly tuned and sized recirculation valve, and wear in parts on the variable-speed hydraulic coupling. The manufacturers of each product have been brought in to determine the root cause of each issue and help us find solutions to resolve these problems. As a result, the boiler feed pumps have returned to near-design performance.

ID Fans

PPES has two axial ID fans with variable position inlet dampers. The ID fan motors are also capable of running at two different speeds. In normal operation, both fan motors run in low speed with inlet vane position being dependent on boiler draft. High speed operation has only been utilized with one fan out of service for repairs. This design is one of the more efficient technologies for this application and any retrofits are upgrade would yield very little efficiency improvement.

Variable-Frequency Drives

PPES currently does not have VFDs on large motors for fans (induced draft, primary air, and forced draft) or pumps (boiler feed pumps and circulating water pumps). As discussed in the ID fan section, all fans have variable position inlet dampers that move with air demand. Unlike the ID fans, the PA and FD fans do not have the ability to operate at multiple speeds. Boiler feed pump motors are dual shaft devices that power both the boiler feed booster pumps as well as the boiler feed pumps. The boiler feed pump speed is controlled through a hydraulic coupling. Circulating water pumps have single speed motors with no ability to change the speed. While there is room for improvement here through the use of VFDs, the size of the equipment would significantly drive up O&M costs. The installation of these components would also be very costly, as many modifications would have to be made to the electrical system, the protective relaying, and other considerations such as pump and fan speed/torque curves on existing fans and equipment would drive the decision for this large capital improvement.

We have not conducted studies to understand the capital costs involved or heat rate reduction potentials examined in the 2009 Sargent & Lundy Report as applies to PPES. That would involve a significant effort and one that cannot be accomplished in the limited comment period currently available under the proposed rule. In addition, variable speed drives provide economies only at reduced output, and as one of the lowest cost, most efficient units in the area, Plum Point has historically operated at a capacity factor very close to its availability (at near full rated output most of the time).

FGD System

PPES is equipped with a dry scrubber; therefore, venturi throat removal and shutoff spray level control is not an option. In regards to turning vanes and perforated gas distribution plates, PPES was built using the latest (21st Century) flow modeling technology. To date, the plant has not performed any large scale flue gas flow studies, but the long term plans call for this in both the SCR and in the FGD system. The 1-2 BTU/kWh (0.02%) heat rate savings is achievable here, but benefits of these modifications will mainly come in the form of reliability and reduced erosion.

Particulate Control System

PPES is equipped with a baghouse and not an ESP; therefore, the efficiency improvements described in the Sargent & Lundy Report are not applicable. Heat rate improvement feasibility is 0%.

SCR System

PPES has two 50% capacity SCR reactors, each with two layers of catalyst for NOx reduction. Each reactor has the capability to support a third layer of catalyst if the need exists. Dilution air used to convey ammonia into the reactors is fed from the forced draft air system following pre-heat from the steam coil heaters which are just prior to the rotary air heaters. The original reactor design does have issues in regards to uniform flow of flue gas across each layer. PPES has taken a number of steps to combat these problems, however.

On an annual basis, an outside contractor is brought in to perform ammonia injection grid tuning. This is done to ensure that there is an even ratio of ammonia to flue gas across the reactors which enable the plant to more effectively reduce NOx and ammonia slip. Also, due to plugging, the plant purchased plate catalyst, versus the honeycomb already installed, to replace the top layer when the first change out of catalyst was due. Preliminary results are good and ash buildup which contributes to poor flow distribution has been minimized. The plant also performs catalyst testing on a no less than annual basis to ensure that the catalyst has enough remaining activity to efficiently perform its function.

The items listed above are short term projects. Long term plans include the addition of a large particle ash screen, flow modeling with potential for modification of turning vanes, and additional sonic horns or air sweepers. Over a period of time, these projects have the potential to reduce station heat rate within the S&L reduction value of up to 10 BTU/kWh (0.1 %), although greater benefit will be seen in ammonia consumption and deNOx.

Boiler Water Treatment

PPES operates a sub critical (2500 psig) drum boiler system. Boiler feedwater treatment is oxygenated treatment (OT). Oxygen is added to the feedwater to maintain 20-50 ppb in the feedwater. Boiler water and boiler feedwater pH is controlled with ammonia fed to condensate after the polishers. The feedwater consists of condensate and high quality demineralized water. The condensate is 100% polished through mixed bed polishers.

Demin makeup is high quality, low conductivity water produced in the water treatment plant. Pretreatment consists of clarified Mississippi River water that is filtered through multimedia filters then stored in the Service Water tank. From the service water tank, the water is then softened through sodium zeolite softeners. The water then passes through 1 micron cartridge filters before the reverse osmosis system to the permeate tank. From there the water is further demineralized through a pair of mixed bed demineralizers, and then stored in the demin storage tank.

In this setup, there is little to no room for heat rate improvements.

Cooling Water Treatment & Advanced Cooling Tower Packing

PPES's cooling tower is a counter flow induced draft tower. It's constructed of fiberglass and is an 18 cell tower with a 2x9 arrangement with a flow rate design of 280,000 gpm. The cooling tower is properly designed for the ambient conditions at the site and there are no modifications that would enhance the heat rate. Make up to the tower consist of treated clarified water from the Mississippi River. Corrosion control is done mechanically and chemically. Mechanically it is achieved by design, fabrication, metallurgy and protective coatings. Chemically it is controlled by PH adjustment and corrosion/scale inhibitors. Biological control is maintained by Sodium Hypochlorite feed. Blowdown is used to control solids and conductivity of the tower. There might be potential room for improvement in this area, but the impact is currently unknown and in consideration of facility's age, the potential is likely minimal.

Other Potential Improvements

Motors at PPES are continuously monitored through periodic maintenance and testing. In general, all motors are of a new and efficient design. As motors reach their end of life, evaluations will be made to ensure that the efficiency and overall cost makes sense to keep a like-kind motor type for that application. There might be potential room for improvement in this area, but the impact is currently unknown and in consideration of facility's age, the potential is likely minimal.

CO2 emissions for 2012 & 2013

Year	CO2 (short tons)	Corrected CO2 (short tons)	Generation (Net MWhs)
2012	4,944,118.2	4,944,118.2	4,366,528
2013	4,326,892.3	4,412,203.8*	3,995,847

*December 2013, PPES filed a petition with USEPA pursuant to 40CFR§75.66(a) and (1) to use an alternative data substitution methodology to replace certain hourly CO2, SO2, and NOx concentration values recorded during Q1 & Q2 of 2013 during the period which the CEMS sample line was leaking. PPES is still waiting approval of that petition. Corrected CO2 data represents application of the correction factors presented in the petition.