August 8, 2013

Ms. Aimee Wilson
U.S. EPA Region 6, 6PD
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

RE: Response to Public Notice Comments
Permit No. PSD-TX-1288-GHG
La Paloma Energy Center, LLC
Harlingen, Cameron County, Texas

Ms. Wilson:

This is a response to some of the issues raised in the Sierra Club letter dated April 19, 2013 regarding Permit No. PSD-TX-1288-GHG for La Paloma Energy Center, LLC:

1. The Sierra Club made the following comment in Footnote 21 to Comment 1: "*Revised Application, Tables 5-1 to 5-3. LPEC does not explain this difference in duct firing impacts. Sierra Club's review of the manufacturers' specifications on company websites and the 2012 Gas Turbine World Handbook provided different reference heat ratings than listed by the applicant in these tables. Some of these differences might be attributable to ongoing improvements by manufacturers, but it also appears that the applicant may have made unidentified adjustment to the published figures. The Region should review and update the current performance specifications.*"

   The Sierra Club did not provide any specific examples where they thought design heat ratings used in Tables 5-1 to 5-3 did not agree with published information. The design heat rate for the combined cycle equipment being considered for the La Paloma Energy Center are specific to: (1) the gas turbine model, heat recovery steam generator size and design, the duct burner size, and the steam turbine design being considered for the project; (2) the specific pollution control equipment specified for the project including selected catalytic reduction and oxidation catalyst and (3) specific atmospheric conditions at the La Paloma site including ambient temperature, relative humidity and atmospheric pressure. In general, it would be very difficult to find published performance data on manufacturer's websites or the Gas Turbine World Handbook that includes all of these site specific design conditions.

   Much like the data on the manufacturer's websites, the data contained in the Gas Turbine World 2012 GTW Handbook may be considered advertised data rather than project specific data. There may be many reasons for heat rates published in this handbook differ from those provided in the permit application. In the introduction of the Gas Turbine Performance Specs, Gas Turbine World states, "…ratings include *allowances* for turbine inlet and exhaust losses and parasitic power consumption of CTG and STG auxiliaries, and combined cycle balance of plant auxiliaries." The La Paloma application has been prepared with a specific site and operating conditions and the appropriate auxiliary loads specific to La Paloma have been modeled.

A definitive deference between the handbook's published data and that of the La Paloma application is the HRSG considered in these reference designs is duct firing capabilities and backpressure. The introductory pages of the handbook states the HRSG has "around 10-inch wg pressure drop for an unfired HRSG without catalyst." The HRSG's for the La Paloma facility have duct firing capability and will be equipped with a SCR catalyst grid as well as a CO catalyst grid. The catalyst grids alone can increase the back pressure to the turbine by up to 40%. In a case study example for a 530 MW plant design provided in the Gas Turbine World 2013 Performance Specs, 29th Edition, "The 530 MW net rating is based on a 10-inch pressure drop, typical of unfired HRSG without a catalytic section." The case study goes on to say, "If that same HRSG had been equipped with an SCR and CO catalyst section, flow resistance would have increased back pressure to around 14 inches." The additional back pressure has also been considered in the La Paloma data.

2. In comment 2, the Sierra Club questions the compliance margin adjustments to the Best Available Control Technology (BACT) limits for design variation, performance losses, and degradation.

   In the GHG Application, La Paloma has used the following compliance margins
   a. 3.3% Design Margin reflecting the possibility that the constructed facility will not be able to achieve the design heat rate.
   b. 6.0% performance margin reflecting efficiency losses due to equipment degradation prior to maintenance overhauls.
   c. 3.0% degradation margin reflecting the variability in operation of auxiliary plant equipment due to use over time.

   Currently, the market for contracting the engineering and construction of combined cycle power plants has a design margin of 5% for the guaranteed net MW output and net heat rate. This is the condition for which the contractor has a "make right" obligation to continue tuning the facility's performance to achieve this minimum value. In other words, contractor must deliver a facility that is capable of generating 95% of the guaranteed MW and must have a heat rate that is no more than 105% of the guaranteed heat rate. Given La Paloma's confidence surrounding the expertise and experience of combined cycle power plant construction, La Paloma has elected to reduce the 5% design margin to 3.3%.

The performance margin for equipment degradation relates to the combustion turbine and steam turbine generators. Refer to the attached California Energy Commission publication CEC-200-2010-002; Cost of Generation Model Users Guide Version 2 dated March of 2010. Figure 24 in this publication (copy attached) provides a clear illustration of the performance degradation of combustion turbines through the life of the unit. This "sawtooth curve" indicates the potential degradation and performance recovery following major service. This publication also references GE Technical Bulletin GER-3567H; GE Gas Turbine Performance Characteristics (also attached). This bulletin states, "Typically, performance degradation during the first 24,000 hours (the normally recommended interval for the hot gas path inspection) is 2% to 6%." The sawtooth curve in the CEC publication uses the view that the degradation will be limited to 2% between inspections and that 75% of that performance will be recovered resulting in a 20 year degradation of 4.5%. Considering the atmospheric conditions, high heat, humidity, and semi-corrosive salt air at the project location, La Paloma has taken a slightly more conservative view of this degradation. La Paloma projects the potential degradation to be 3% between inspections (considerably less than the potential 6%) and assuming the same 75% performance recovery; calculating a 20 year degradation of 6.0%.

The degradation margin for the auxiliary plant equipment also encompasses the heat recovery steam generators (HRSG's). This accounts for the scaling and corrosion of the boiler tubes over time as well as minor potential fouling of the heating surface of the tubes. Similar to the HRSG's, scaling and corrosion of the condenser tubes will also degrade the heat transfer characteristics and thus the performance of the steam turbine generator. Given the combustion turbine degradation accounts for the majority of the performance loss and as well as the large variation in operating parameters (fuels, temperatures, water treatment, cycling conditions, etc.), little operating data has been gathered and published that illustrate a clear performance degradation characteristic. However, the effects of the degradation must be accounted for and other applicants have utilized similar 3% degradation margins for the auxiliary plant equipment; reference the LCRA Ferguson CCPP in Marble Falls, Texas and the Russell City Energy Center in Hayward, California.

3. In comment 12, the Sierra Club asserted that there is no discussion in the Statement of Basis about any impediments to meeting the GHG BACT limit during maintenance, startup, and shutdown (MSS) MSS Emissions to be included in the overall annual BACT limit.

   As stated on page 51 of the March 12, 2013 revision to the application, while starting up the combustion turbines following ignition, a large portion of the energy input to the combustion turbine is used for heating the turbine casings and rotors, boiler tubes, main steam piping, and other portions of the thermal system rather than the production of electricity. During this startup period, the steam turbine does not generate electricity in a combined cycle mode until the thermal equipment is at an appropriate operating temperature and sufficient steam is produced in the heat recovery steam generator. The short term emissions of greenhouse gases on a pound per hour basis during a startup do not exceed hourly routine emissions but since the BACT limits are on a pound of CO2 emission per MW hour basis, compliance the BACT limit is negatively affected by startup hours. La Paloma Energy Center proposes to revise footnote 5 to Tables 1A, 1B, and 1C in the draft permit as follows: "The BACT limit for the combustion turbine does not apply during ~~MSS~~ startup hours. Startup hours excluded from the BACT limit will not exceed 500 hours per rolling 12 month period."

4. In Comment 3, the Sierra Club states that the Region has not addressed alternatives to duct burners for short-term, peak power generation.

   The installation of duct burners in the Heat Recovery Steam Generator (HRSG) is a common practice where there is a potential need for additional, or supplemental, power during specific operating conditions or electrical grid requirements. The installation of the duct burners will increase the cost of the HRSG by 10% to 15% which represents less than a 1% increase in the cost of the project. More important to the emissions discussion, the efficiency of supplementary firing is significantly higher than that of a stand-alone auxiliary boiler. The document Technology Characterization: Gas Turbines, prepared for the Environmental Protection Agency Climate Protection Partnership Division by Energy and Environmental Analysis, provides the following discussion regarding supplemental firing:

   Since very little of the available oxygen in the turbine air flow is used in the combustion process, the oxygen content in the gas turbine exhaust permits supplementary fuel firing ahead of the HRSG to increase steam production relative to and unfired unit. Supplementary firing can raise the exhaust gas temperature entering the HRSG up to 1,800 deg. F and increase the amount of steam produced by the unit by a factor of two. Moreover, since the turbine exhaust gas is essentially preheated combustion air, the fuel consumer in the supplementary firing is less than that required for a stand-alone boiler providing the same increment in steam generation. The HHV efficiency of incremental steam production from supplementary firing above that of an unfired HRSG is often 85% or more when firing natural gas.

5. EPA Region 6 asked for a more detailed breakdown of the capital cost associated with carbon capture and storage. The following is a breakdown of the estimated plant construction costs with and without carbon capture:

zephyr

Equipment	Cost without CCS	Cost with CCS	Notes
Feedwater and Misc Balance of Plant	$57,495,000	$63,196,000	
Combustion Turbine	$133,387,000	$133,033,000	
HRSG Duct and Stack	$66,528,000	$66,351,000	
Steam Turbine Generator	$69,738,000	$57,027,000	
Cooling Water System	$23,150,000	$34,664,000	
Accessory Electric Plant	$47,527,000	$62,618,000	
Instrumentation and Control	$18,457,000	$20,903,000	
Improvements to Site	$12,936,000	$12,919,000	
Buildings and Structures	$14,582,000	$13,748,000	
CO_2 Removal System		$442,849,000	Assumes 2 trains, one for each HRSG
CO_2 Compressors & Dryers		$66,691,000	Assumes 4 compressors
Total Estimated Plant Construction Costs	**$443,800,000**	**$974,000,000**	
Estimated Annual Operating and Maintenance Costs (excluding fuel costs)	$6,766,000	$11,273,000	
Annualized Construction/Operation Cost of CO_2 Transport		$1,035,466	Assumes a 15 mile pipeline length
Annualized Construction/Operation Cost of CO_2 Storage		$27,542,874	

Should you have any questions regarding this response, please contact me by email at lmoon@zephyrenv.com or by telephone at 512-879-6619 or Ms. Kathleen Smith at ksmith@coronado-ventures.com or by telephone at 281-253-4385.

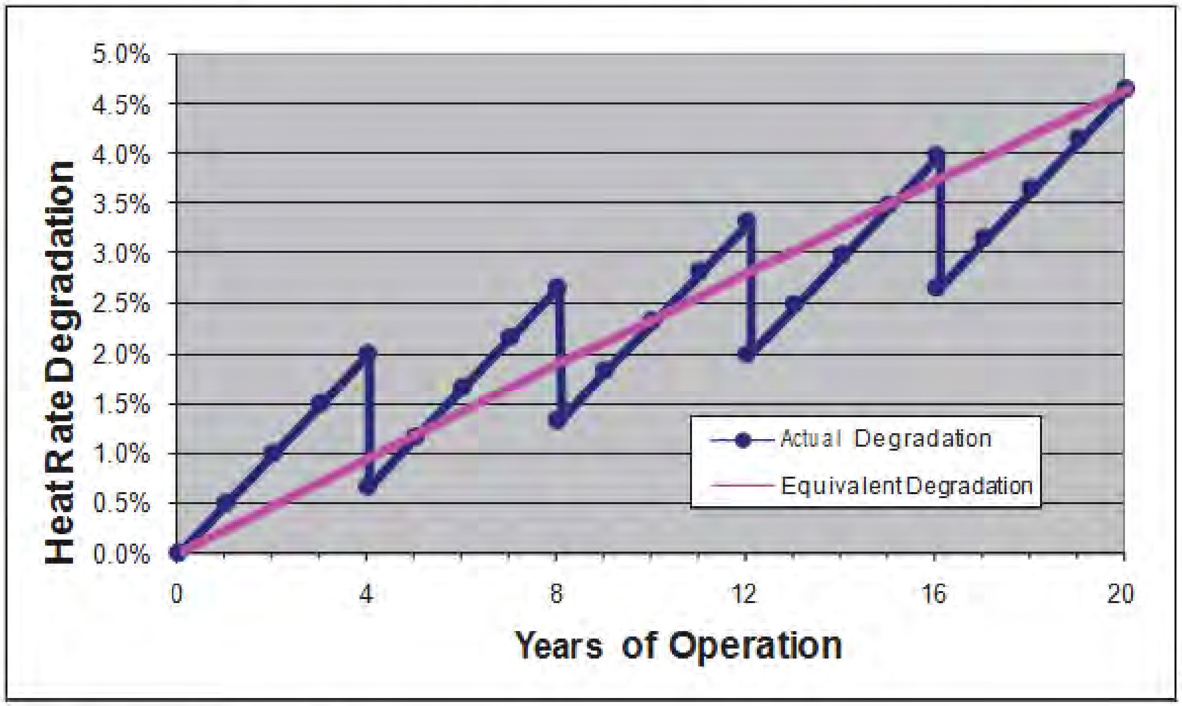
Sincerely,
ZEPHYR ENVIRONMENTAL CORPORATION

Larry A. Moon, P.E.
Principal

Attachment: Figure 24: Heat Rate Degradation – Combined Cycle

cc: Ms. Kathleen Smith, Coronado Ventures

Figure 24: Heat Rate Degradation – Combined Cycle



Source: Energy Commission