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MELISSA A. FOSTER
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June 6, 2012

VIA EMAIL

Mr. Eric Solorio, Siting Project Manager
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

Re: Pio Pico Energy Center Project (11-AFC-01)
Applicant's Additional Information to EPA re PSD Permit Application

Dear Mr. Solorio:

On behalf of Applicant Pio Pico Energy Center, LLC, please find enclosed herein for docketing additional information submitted to the U.S. Environmental Protection Agency, Region 9, related to Applicant's PSD Permit Application for the Pio Pico Energy Center Project.

Should you have any questions regarding this submittal, please contact me directly.

Very truly yours,

Melissa A. Foster

MAF:jmw
Enclosure
cc: See Proof of Service List

[redacted]

From: Steve Hill
Sent: Tuesday, June 05, 2012 4:44 PM
To: 'Roger Kohn'
Cc: Gerardo Rios
Subject: RE: PPEC PSD Permit Application: PM BACT for the Cooling System

Roger: The attached letter responds to your request.

--Steve Hill

From: Roger Kohn [mailto:Kohn.Roger@epamail.epa.gov]
Sent: Wednesday, May 23, 2012 10:14 AM
To: Steve Hill
Cc: Gerardo Rios
Subject: Re: PPEC PSD Permit Application: PM BACT for the Cooling System

Steve,

Thank you for the additional information you provided on PM BACT for the PPEC cooling system in your 5/16/12 letter. Your letter provides some, but not all, of the additional information that we need to complete our BACT analysis and send our draft permit and fact sheet to OAQPS for review. To help us propose the permit sooner, we need additional clarification on two issues.

In your letter, you state that you have eliminated dry cooling in the BACT analysis because "there are times when the ambient temperature in San Diego is too high for a 100% air-cooled system to provide sufficient cooling for the intercooler system to sustain turbine performance." Similarly, in the PSD application (p. PSD-App-1.92), you state that "The main technical issue associated with dry cooling towers for this application is the limited availability to provide adequate cooling under high-temperature conditions. The plant will use a PDCS in a closed-loop configuration that utilizes dry cooling but also
requires additional cooling capacity. For the purposes of this analysis, dry cooling was eliminated as a potential BACT option for the second stage of the cooling system because enhanced cooling is required for the plant beyond what is already being provided by the dry cooling system."

We believe we might understand your point, however, the information you have provided is not specific enough to justify eliminating dry cooling in Step 2 of the analysis on the basis of technical infeasibility. Based on your submittal, it appears that you are actually trying to explain that dry cooling alone is not technically feasible all the time and may need to be supplemented by a type of wet cooling when the ambient temperature exceeds a level that is not stated in the documentation you submitted. Please clarify if this is the case, the temperature at which the dry cooling system would not function, how often that is expected to occur, and how the supplemental cooling system could be used for those short periods of time when the dry cooling system alone would not work. Thus, you would provide the necessary information to eliminate dry cooling alone, but would show how dry cooling with intermittent use another cooling system would be technically feasible. As you outline your decision-making for the selected (and non-selected) control option, please discuss any associated trade-offs considered, such as environmental and economic trade-offs, as part of your design and operating criteria.

Also, in your 5/16/12 letter, you present a bullet list of control technologies for the BACT analysis, in descending order of control effectiveness. However, you did not include the Partial Dry Cooling System (PDCS) that PPEC proposes to use in the initial ranked list. This means that if once-through cooling and dry cooling are eliminated from the analysis, we do not know if the PDCS is the highest ranked remaining option. If it is, we do not need to eliminate the other remaining control options from the analysis. If it is not, we may require additional information to justify eliminating any other options that are more effective, or as effective, as PDCS. Please provide a complete list of all control options you considered in the analysis, ranked by control efficiency.

Thank you.

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June 5, 2012

Mr. Gerardo Rios
Chief, Permits Office
USEPA Region 9
75 Hawthorne Street
San Francisco, CA 94105

Subject: Pio Pico Energy Center (PPEC) PSD Permit Application
BACT for Cooling System

Dear Mr. Rios:

As requested by EPA in an email from Roger Kohn to Steve Hill on May 23, 2012, we are submitting clarifying information on behalf of Pio Pico Energy Center, LLC. In short, and as demonstrated below, were PPEC to use a totally dry cooling system it would require 16 MW of additional combustion generation capacity to deliver 300 nominal megawatts of power, the project's basic design and purpose. Such induced inefficiency would make the project uneconomic and result in an increase in emissions for the same power output. Using a dry cooling system only, plant capacity would begin to decrease at ambient temperatures greater than 70° F, and plant output would be no greater than 283.6 MW at the plant design maximum ambient temperature of 93° F. For this reason, a 100% dry cooling system is not technically feasible for PPEC. In addition, even if such a design were feasible, the additional cost of a totally dry cooling system would not be cost-effective, given that the $PM/PM_{10}/PM_{2.5}$ emissions from the currently proposed system are only 1.4 tons/year. Further support for these conclusions is presented below.

EPA Comment:

In your letter, you state that you have eliminated dry cooling in the BACT analysis because "there are times when the ambient temperature in San Diego is too high for a 100% air-cooled system to provide sufficient cooling for the intercooler system to sustain turbine performance." Similarly, in the PSD application (p. PSD-App-1.92), you state that "The main technical issue associated with dry cooling towers for this application is the limited availability to provide adequate cooling under high-temperature conditions. The plant will use a PDCS in a closed-loop configuration that utilizes dry cooling but also requires additional cooling capacity. For the purposes of this analysis, dry cooling was eliminated as a potential BACT option for the second stage of the cooling system because enhanced cooling is required for the plant beyond what is already being provided by the dry cooling system."

We believe we might understand your point, however, the information you have provided is not specific enough to justify eliminating dry cooling in Step 2 of the analysis on the basis of technical infeasibility. Based on your submittal, it appears that you are actually trying to explain that dry cooling alone is not technically feasible all the time and may need to be supplemented by a type of wet cooling when the ambient temperature exceeds a level that is not stated in the documentation you submitted. Please clarify if this is the case, the temperature at which the dry cooling system would not function, how often that is expected to occur, and how the supplemental cooling system could be used for those short periods of time when the dry cooling system alone would not work. Thus, you would provide the necessary information to eliminate dry cooling alone, but would show how dry cooling with intermittent use another cooling system would be technically feasible. As you outline your decision-making for the selected (and non-selected) control option, please discuss any associated trade-offs considered, such as environmental and economic trade-offs, as part of your design and operating criteria.

Response:

The PPEC closed loop cooling system provides water cooling for the High Temperature Intercooler (HTIC) at each GE LMS100 Combustion Turbine Generator (CTG). HTIC water flow requirements for all three CTGs are combined into a common system that uses the hybrid Partial Dry Cooling System (PDCS) to provide the cooling necessary for maximum performance and efficiency of the CTGs. Cooling water is used for several purposes including, for example, cooling of lubricating oil, but the principal use is for the intercooler. The intercooler is used to cool the air between various compressor stages in each gas turbine, increasing the mass flow of air, allowing more fuel to be burned and greatly increasing the output and efficiency of the turbine. The heat extracted from the air in the intercooler is dissipated by the cooling system. Cooling water leaves the intercooler at a temperature of about 175° F to 190° F, after having absorbed heat from the compressed intake air. Cooling water must enter the intercooler at a temperature of 80° F to achieve each turbine's rated output of about 100 MW.

Fundamentally, a 100% dry-cooling system cannot cool the water below the ambient dry-bulb temperature. Because the water temperature entering the intercooler needs to be 80° F, a dry-cooling system cannot meet the system requirements if the ambient temperature is greater than 80° F.

In practice, an air cooled heat exchanger must have a temperature differential between its hot side and cold side. A temperature difference of less than about 10° F from ambient is not achievable for the dry-cooling components. Therefore, at ambient temperatures above 70° F, the water entering the intercooler cannot be chilled to 80 ° F, and each turbine's output would then decrease below 100 MW. The shortfall in output would get larger as the ambient temperature increases above 70° F. The average daily high temperature in San Diego exceeds 70° F on 147 days per year (40%)[1]; these are the days when PPEC is most likely to operate.

[1] http://www.weather.com/weather/wxclimatology/monthly/graph/USCA0982 (accessed 5/31/2012)

Consequently, in order to deliver 300 MW at ambient temperatures up to the design maximum temperature of 93° F using three LMS100s, a dry-cooling system, by itself, is not technically feasible.

After determining that a 100% dry cooling system was not feasible, the PDCS design was incorporated. This system was optimized considering the capital cost of the dry cooling components; the cost of water used; and the cost of the electricity needed to drive the fans used for the dry cooling components. This optimized solution cannot achieve a water inlet temperature of 80° F based on dry cooling only with three CTGs at full load, even at an ambient temperature of 59° F.[2] As noted above, such a system requires a wet cooling component for ambient temperatures above 70° F to achieve full ouput. See Table 1 for details about how theoretical 100% dry cooling would affect power consumption and production at the facility.

Operationally, there may be times when the wet cooling system would not need to be in service, based on plant MW load demand, the number of CTGs in service, and the ambient temperature. However, under most ambient conditions under which this facility would run (above ~44° F), both the wet and dry cooling systems will be operating. The amount of water applied in the wet cooling system will vary depending on ambient temperature: the dry cooling system will reject as much heat as possible given the ambient temperature, while the wet cooling system will evaporate only as much water as is needed to get the intercooler water inlet temperature down to 80° F.

Table 1
Incremental Power Consumption and Production from 100% Dry Cooling

Ambient Conditions				
Dry Bulb, °F	59	70	80	93
Relative Humidity, %	60	57.2	37.5	21.9
All Dry Cooling				
Output Loss, kW, per CTG[a]	0	0	-1,374	-5,315
Output Loss, kW, 3 CTGs[a]	0	0	-4,122	-15,945
Air Cooled Heat Exchanger Power Consumption Loss, kW,[b]	-496	-496	-496	-496

a. CTG output loss is a comparison of output using the specified PDCS to the output if 100% dry cooling were specified.
b. Power difference between the PDCS and an all-dry cooling system. Load does not change with temperature because all dry cooling fans remain on.

The additional power consumption for the dry cooling fans, shown in Table 1, will, of necessity, result in increased emissions, as that electricity will have to be produced somewhere and, on the days when PPEC is expected to operate, the marginal source of electricity will certainly be gas-fired, with per-megawatt emissions comparable to, or higher than, those of PPEC. More direct, however, are the economic impacts. While not quantifiable, a 16 MW reduction in peak power output places the project's viability in jeopardy, as it would represent a material change from the project as presented to

[2] At 59° F, 75% of the heat rejection is taken up by the dry cooling components, and 25% of the heat rejection is taken up by the wet cooling components.

SDG&E. More relevant to EPA, perhaps, is the cost effectiveness of the possible reduction of 1.4 tpy of $PM/PM_{10}/PM_{2.5}$ associated with a totally dry cooling system (ignoring the increased emissions associated with the electricity required to run the additional dry cooling components).

In a recent rulemaking,[3] EPA rejected as too expensive additional controls on an oil-fired boiler in Hawaii:

> "For PM, the Trinity report considered the following technologies: Dry electrostatic precipitator (ESP), wet ESP, fabric filter, wet scrubber, cyclone and fuel switching. Dry ESPs, cyclones and fabric filters are not appropriate for the type of particulate emitted by this plant. A wet scrubber would work, but these types of devices are better suited to larger particulate than is emitted from an oil-fired boiler and their control efficiency would be small. A wet ESP would have good control efficiency and is technically feasible. Similarly, switching to distillate fuel would be an effective and technically feasible control for PM. Trinity estimated the cost effectiveness of a wet ESP as $13,000 per ton of PM controlled. They estimated the cost effectiveness of switching to distillate fuel as $170,000 per ton. Neither of these controls would be cost effective for PM."[4]

Although the above conclusion was reached in the context of a regional haze plan, rather than a BACT analysis, it is illustrative of recent thinking by EPA regarding cost-effectiveness of PM controls. Using the lower $13,000 per ton cost-effectiveness value cited in the rulemaking notice, and the maximum potential emission reduction of 1.4 tons/year for a totally dry cooling system for PPEC, additional PM controls would not be cost-effective if costs exceeded $18,200 per year on an annualized basis.[5] Using the lowest cost of electricity in the San Diego area for industrial facilities of $0.07711/kwh,[6] the power consumption for operating the additional dry cooling components necessary to enable totally dry cooling up to a 70° F ambient condition would be $152,986 – well above the cost/effectiveness threshold.[7] This economic analysis does not reflect the capital costs of the additional dry cooling components necessary to achieve 100% dry cooling to an ambient temperature of 70° F, nor does it include the cost of replacement generating capacity of 16 MW necessary to make up for the loss in generation associated with the use of totally dry cooling at this location for this generating technology. There is no question but that totally dry cooling is so expensive in this application as to be infeasible as a practical matter.

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[3] 77 FR 31692

[4] 77 FR 31706

[5] 1.4 x $13,000 = $18,200

[6] http://sdge.com/electric-tariff-book-commercialindustrial-rates, Schedule A. This rate is for small commercial/industrial customers. Larger customers, such as PPEC, would use a schedule such as AL-TOU, which includes a substantial monthly demand charge, combined with a lower energy cost. At the summer peak demand charge of $7.65/kw (which most closely corresponds to PPEC's operations), and the additional demand of 496 kw, the monthly demand charge would be $3,794. If PPEC's operations were compressed into five calendar months, the annual demand charge would be $18,970 per year (about $0.01/kwh) – already above the cost-effectiveness threshold, and without accounting for the energy and non-energy costs. Non-energy costs would be variable, but generally on the order of $0.01/kwh, adding another $19,840/year in costs. Energy (commodity) costs are currently $0.070 to $0.086/kwh, bringing the total cost per kwh to $0.090 to $0.106/kwh.

[7] 496 x $0.07711 x 4000 = $152,986 per year.

Comment:

Also, in your 5/16/12 letter, you present a bullet list of control technologies for the BACT analysis, in descending order of control effectiveness. However, you did not include the Partial Dry Cooling System (PDCS) that PPEC proposes to use in the initial ranked list. This means that if once-through cooling and dry cooling are eliminated from the analysis, we do not know if the PDCS is the highest ranked remaining option. If it is, we do not need to eliminate the other remaining control options from the analysis. If it is not, we may require additional information to justify eliminating any other options that are more effective, or as effective, as PDCS. Please provide a complete list of all control options you considered in the analysis, ranked by control efficiency.

Response:

The technologies identified are listed below, ranked in descending order of control effectiveness.

- Dry Cooling (closed loop cooling water cooled in heat exchanger using ambient air flowing over heat exchanger tubes)
- Once-through Cooling (Cooling water drawn from a water source. Heated water is then discharged, usually back to the original water source)
- **PDCS. Because this is a hybrid system, with a dry cooling component and a spray-enhanced dry cooling system component, it is between 100% dry cooling and spray-enhanced dry cooling on this ranked list.**
- Spray-enhanced Dry Cooling (dry cooling with heat transfer enhanced by spraying water on the outside of the heat exchanger tubes)
- Plume-abated Wet Cooling (evaporative cooling tower with a dry section that reduces the visible plume by heating the wet air from the wet section)
- Non-Plume-abated Wet Cooling Tower (conventional evaporative wet cooling tower)

If you have any questions regarding this application, please contact the applicant's representative David Jenkins at (317) 431-1004, or Steve Hill or me at (916) 444-6666.

Sincerely,

Gary Rubenstein

cc: John McKinsey, Stoel Rives LLP
David Jenkins, Apex Power Group
Steve Moore, SDAPCD

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA
1516 NINTH STREET, SACRAMENTO, CA 95814
1-800-822-6228 – WWW.ENERGY.CA.GOV

APPLICATION FOR CERTIFICATION FOR THE *PIO PICO ENERGY CENTER, LLC*

Docket No. 11-AFC-1
PROOF OF SERVICE
(Revised 3/20/12)

Pio Pico Energy Center, LLC
Letter to E. Solorio dated June 6, 2012 re Applicant's Additional Information to United States Environmental Protection Agency Region 9 Regarding PSD Permit Application

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DECLARATION OF SERVICE

I, Judith M. Warmuth, declare that on June 6, 2012:

☐ I deposited copies of the aforementioned document and, if applicable, a disc containing the aforementioned document in the United States mail at 500 Capitol Mall, Suite 1600, Sacramento, California 95814, with first-class postage thereon fully prepaid and addressed to those identified on the Proof of Service list herein and consistent with the requirements of California Code of Regulations, Title 20, sections 1209, 1209.5, and 1210.

OR

☒ I transmitted the document(s) herein via electronic mail only pursuant to California Energy Commission Standing Order re Proceedings and Confidentiality Applications dated November 30, 2011. All electronic copies were sent to all those identified on the Proof of Service list herein and consistent with the requirements of California Code of Regulations, Title 20, sections 1209, 1209.5, and 1210.

OR

☐ On the date written above, I placed a copy of the attached document(s) in a sealed envelope, with delivery fees paid or provided for, and arranged for it/them to be delivered by messenger that same day to the office of the addressee, as identified on the Proof of Service list herein and consistent with the requirements of California Code of Regulations, Title 20, sections 1209, 1209.5, and 1210.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, that I am employed in the county where this mailing occurred, and that I am over the age of 18 years and not a party to the proceeding.

Judith M. Warmuth