

Appendix E  
Other Documents

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Dear Brenda,

Thank you for the opportunity to comment on the Mariposa Preliminary Determination of Compliance Application Number 20737. I discovered that this PDOC had been issued on September 27, 2010 during a conversation with a friend about recent power plant applications. I am on several notification lists for power plants at the districts office. I have exchanged at least 100 emails with the district and receive regular notices from the District for a number of issues. The district claimed that they notified me and sent me the two emails claiming they provided me notice with. Neither address that the district indicated is now, nor has ever been, my email address so I have never received "proper notification". I requested a 30 day extension of the comment period for this project on September 27, 2007 and the district informed me they would not extend the comment period. On September 30 the district again advised me that they would not extend the comment period. On October 15 the district sent me an email stating, "The District has decided to consider any comments submitted by you by October 27<sup>th</sup> on the Mariposa Energy project due to the mistaken email addresses that the District had for you in its records." Instead of providing a 30 day comment period as required by state and federal regulations the district has provided me with a thirteen day comment period. This is a violation of state and federal regulations. In addition the district is required to open the comment period for all of the public not just me. I therefore object and reiterate my request for an additional 30 day comment period for myself and all members of the public.

According to the PDOC, "The power plant approval process also provides opportunities for members of the public to participate in person in public hearings regarding this project. The District may hold a public meeting in accordance with Regulation 2, Rule 2, Section 405 to receive verbal comment from the public if there is sufficient reason to do so. Members of the public who would like to request that the District hold a public meeting should make such a

request, in writing, to Mr. Patil at the address set forth in the preceding paragraph prior to the end of the comment period, and should explain the reasons why a public meeting is warranted.”<sup>1</sup>

In reviewing the CEC docket log for this project it appears that many people have requested that the district hold a public hearing. Under Regulation 2 Rule 2 Section 405 I request that a public hearing be granted for the PDOC. The district is responsible for compliance with all federal requirements not the California Energy Commission so it is necessary for the district to hear and respond to the many people who have concerns about this project. The PDOC as presented does not comply with all federal and state regulations and the analysis ignores the transport of pollutants into the San Joaquin Valley. The San Joaquin Valley is classified as a serious non attainment area for the Federal 8 hour ozone standard and severe non attainment for the California 1 hour ozone standard as opposed to the BAAQMD which is classified as marginal non attainment for the federal 8 hour ozone standard and non attainment for the California 1 hour standard. Districts within the areas of origin of transported air pollutants, as identified in HSC Section 70500(c), shall include sufficient emission control measures in their attainment plans for ozone adopted pursuant to Part 3, Chapter 10 (commencing with Section 40910) of Division 26 of the Health and Safety Code, to mitigate the impact of pollution sources within their jurisdictions on ozone concentrations in downwind areas commensurate with the level of contribution. An upwind district shall comply with the transport mitigation planning and implementation requirements set forth in this section regardless of its attainment status.

### **3.2 Gas Turbine Selection Process**

The PDOC states on page 5, “As part of the turbine selection process, the turbine vendor provided performance data for both the water-injected and DLE LM6000 SPRINT gas turbines (see Table 1). As presented in Table 1, the water-injected LM6000 gas turbine (LM6000PC) would result in a higher electrical production rate compared to the DLE models. Although the LM6000PF turbine would have a lower NOx emission rate than the PC or PD models, the DLE models would have higher hydrocarbon and CO emission rates (except at the 17°F temperature case) compared to the water-injected PC turbine. Therefore, the LM6000PC turbine was selected by Mariposa Energy in order to meet the electrical output and reliability requirements outlined in the Mariposa Energy Project PPA with PG&E.”

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<sup>1</sup> PDOC Page 3

The conclusion to allow the applicant to choose to eliminate other variants of the LM-6000 turbine due to some classified information in their contract with PG&E is not only erroneous and contrary to law it precludes comparison of other LM-6000 variations and the significant advantages in both cost effectiveness and environmental performance and negatively affects the PDOC's BACT determinations.

According to the GE website the LM 6000 PF turbine which has been in operation since 2005 features high efficiency, superior fuel gas consumption and fuel flexibility, coupled with lower emissions and water usage in both the 50 Hz and 60 Hz segments. The LM 6000-PF has a superior heat rate and "avoids 15,000 metric tons of CO<sub>2</sub> emissions over the course of a 3,000-hour peaking season while producing the same electricity output, which is equivalent to the annual CO<sub>2</sub> emissions of more than 2,800 cars on U.S. roads. The LM 6000 PF can reduce natural gas consumption by more than 264,000 MMBtu, equivalent to the amount of natural gas consumed annually by more than 3,700 U.S. households, which can yield an annual fuel cost savings of \$1.58 million at \$6 per MMBtu. The LM 6000 PF can reduce NO<sub>x</sub> emissions by 815,000 pounds, which is equivalent to the annual NO<sub>x</sub> emissions of 21,000 cars on U.S. roads, when operating at 15 ppm NO<sub>x</sub> instead of 25 ppm NO<sub>x</sub> like the LM6000 PC. Most importantly the LM 6000 PF can, by incorporating DLE technology, can eliminate the use of water while lowering emissions of NO<sub>x</sub> to 15 ppm and CO to 25 ppm, unlike the typical 60 Hz, simple-cycle turbine in this range, which uses water as a diluent. This can avoid annual water consumption of 9.9 million gallons, and can yield \$100,000 per year in operational savings and eliminate the need to purchase a water treatment system<sup>2</sup>

The PDOC also states that, "the LM6000PD and LM6000PF gas turbines do not meet the project objective of being capable of generating 184 MWs during peak July conditions." GE has introduced new variants of the LM-6000 which have higher output than the LM-6000 PC but also contain significant economic and environmental features which should figure prominently in the BACT determination. The latest innovation for the LM6000 is the PH Dry Low Emissions (DLE) model. The new turbine has 90% common parts to the proven LM6000 family of

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<sup>2</sup>[http://www.gepower.com/prod\\_serv/product](http://www.gepower.com/prod_serv/product)

[http://www.gepower.com/prod\\_serv/products/gas\\_turbines\\_cc/en/downloads/GEH12985H.pdf](http://www.gepower.com/prod_serv/products/gas_turbines_cc/en/downloads/GEH12985H.pdf)

industrial Aeroderivative gas turbines, but provides more power and better efficiency in the same footprint. The improvements are being created courtesy of advanced materials, improved manufacturing process, and minor adjustments in design. Leveraging the broad experience of GE in gas turbine technology, many of these improvements have been imported from GE Aviation and the larger GE Energy aeroderivative product, the LMS100. By utilizing already proven technology, the latest updates to the LM6000 are expected to maintain comparable reliability numbers as the existing products.

As an example of one of the changes from GE Aviation, the High Pressure Turbine (HPT) rotor of the LM6000 PG has been modified based on the GE CF6-80E aircraft engine (common on many Airbus A330 fleets). The LM6000 PC, on the other hand, has a rotor based on the older GE CF6-80C2 engine. The updated HPT rotor design improvements include new higher temperature alloys and improved cooling patterns. This switch of rotor effectively raises the pounds of thrust from 60,000 to 70,000. As a result, the LP compressor can operate at higher speeds to increase the flow, and the pressure ratio has gone from 30 to 32. Additional design changes to the HPT rotor include a new bolt pattern between the rotors in the HPT that has significantly reduced material stresses. On the PC model, the HPT rotor is the cyclic life limiting part. With the updated material and design advances, the cyclic life was improved in excess of 40% for the PG model. The LM6000 PH can reduce fuel consumption by the equivalent of 33,000 barrels of oil per year, when compared to other similar aeroderivative solutions in its class. GE's LM6000 uprate also reduces carbon dioxide emissions by 6,500 tons over the course of a typical operating year - the same emissions reduction achieved by removing 2,500 cars from the road annually. Providing an increase in power and reduced fuel consumption and emissions, the first LM6000-PG unit will be installed at Turlock Irrigation District's Almond Power Plant near Turlock, Calif. Shipment to the site will be in February 2011. The new turbine technologies are technologically feasible, cost effective and commercially available.

For the LM6000, water can be used for both NO<sub>x</sub> reduction and power augmentation. The LM-600 PF and PH use water only for power augmentation and not NO<sub>x</sub> control as the employ DLE systems. Most often the discussion on gas turbine efficiency is based on fuel consumption (heat rate, efficiency), but with many global water scarcity issues, the efficient use of water can be a critical operating profile consideration. An updated control algorithm in the fuel core manages water usage for maximum efficiency for preset conditions such as NO<sub>x</sub> output, power

output, and grid frequency. For a Single Annular Combustor (SAC) LM6000 model, water usage can be up to 13,400 l/hr during full load operation (not including any water used for cooling or inlet conditioning around the package). This water usage amount accounts for NOx abatement and for a power augmentation option called SPRINT®. Roughly 2/3 of the water consumption is for NOx abatement, and the rest is used for SPRINT®. In the control system, the water table algorithm controls water usage during key transitions of the gas turbine where excess water could be consumed. Such transitions include ramping up to full power, part power operation, and SPRINT® operation turning on/off. Figure 5 has an example of SPRINT utilization running the gas turbine at part power. As mentioned, plant efficiency analyses on operating costs are starting to analyze water consumption as well as fuel consumption. If a plant operation profile includes constant starts and stops, as well as part power operation, the savings in water can be substantial. Additionally, with improved water optimization at part power comes improved fuel efficiency seen through improved heat rate of the gas turbine. All this leads to improved operating costs for the power producer.<sup>3</sup> There are numerous advantages to the new DLE LM-6000 model turbines that must be considered in the PDOC's BACT and environmental analysis both in terms of environmental performance and cost effectiveness.

## **5.2 Best Available Control Technology for Oxides of Nitrogen (NOx) for Turbines**

The PDOC examined combustion controls that will minimize the amount of NOx created during combustion; and post-combustion controls that can remove NOx from the exhaust stream after combustion has occurred.

### Combustion Controls

The PDOC's analysis of combustion controls is limited to accepting the applicant's preference of the use of water-injection as BACT for the simple-cycle gas turbines. Water-injection is technologically feasible and commonly used at facilities of this type. The use of dry low NOx combustors is also technologically feasible and commonly used at facilities of this

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<sup>3</sup> APPLICATION OF THE LATEST AERODERIVATIVE GAS TURBINE TECHNOLOGY Authors: Edward Wacekt, Warren Ferguson, General Electric [http://www.iagtcommittee.com/symposium\\_2009/papers/203%20paper%20final.pdf](http://www.iagtcommittee.com/symposium_2009/papers/203%20paper%20final.pdf) Page 2

type. In this case the use of dry low NOx combustors leads to a 40% reduction in NOx concentrations before the SCR. Water injection is capable of reducing NOx concentrations to 25 ppm while DLE systems are capable of reducing NOx concentrations to 15 ppm.

The BACT analysis must consider the collateral impacts of the additional water use and the superior NOx reduction capability of the dry low NOx products. The impacts of the treatment, transportation, and consumption of the additional water must be considered and quantified in the BACT analysis. The lower heat rate offered by other variations of the GE LM-6000 turbine must be investigated as the lower heat rate will save millions of dollars of ratepayer money and reduce greenhouse gas and criteria pollutant emissions per megawatt. The applicants contract with PG&E includes a tolling agreement where ratepayers are responsible for paying for the natural gas used by the project so the applicant has no incentive to preserve fuel costs which in turn lower emissions and greenhouse gases.

#### ***Determination of BACT emissions limit for NOx for Simple-Cycle Gas Turbines***

The District is also proposing to establish a BACT emissions limit in the permit of 2.5 ppm (averaged over one hour) utilizing SCR and pre combustion water control for NOx. SCR is capable of over 90 percent NOx removal. Therefore, when combined with water or steam injection which reduces NOx concentrations to 25 ppm before the SCR, NOx emissions levels of 2.5 ppmvd at 15 percent O2 when firing natural gas are achievable. This technology is considered feasible for MEP.<sup>4</sup>

By employing the DLE system which reduces NOx concentrations to 15 ppm the project should be able to achieve a 1.5- 2.3 ppm NOx emissions limit with the 90% control efficiency of the SCR.<sup>5</sup> The BACT emission limit should be set at 1.5- 2.3 PPM utilizing DLE and SCR. That would represent the proper BACT limit for this project.

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<sup>4</sup> [http://www.baaqmd.gov/~media/Files/Engineering/Public%20Notices/2010/20737/Application%20Correspondence%20and%20Supporting%20Documents/020-email%205-26-2010%20CH2M%20to%20Patil%20Attached%20Doc\\_3.ashx](http://www.baaqmd.gov/~media/Files/Engineering/Public%20Notices/2010/20737/Application%20Correspondence%20and%20Supporting%20Documents/020-email%205-26-2010%20CH2M%20to%20Patil%20Attached%20Doc_3.ashx) Page 8

<sup>5</sup> DLE reduces NOx concentration to 15PPM x .9 SCR 90% control efficiency = 13.5 PPM in NOx reduction for a 1.5 PPM Nox emission limit.

The proposed Riverside Energy Center has just been permitted with a 2.3 PPMVD for NO<sub>x</sub> emissions.<sup>6</sup> The project consists of two General Electric LM6000 PC SPRINT NxGen combustion turbine generators with Emission Control Modules (ECMs) equipped with inlet air chiller coils, exhaust ducting, flue gas treatment system, emission monitoring system, a common chiller package with cooling tower, and gas compressor equipment.

#### Federal NO<sub>2</sub> standard

The PDOC does not contain a demonstration of compliance with the new Federal NO<sub>2</sub> standard. Maximum NO<sub>2</sub> hourly emissions for the project are 21.276 pounds per hour.<sup>7</sup> The applicant has provided an analysis which purportedly demonstrates compliance with the new NO<sub>2</sub> standard when the maximum hourly NO<sub>2</sub> emissions are 18.5 lbs per hour for each turbine.<sup>8</sup> The higher NO<sub>2</sub> hourly emissions from commissioning tuning and maximum hourly emissions of 21.276 pounds per hour have not been analyzed.

Modeled commissioning emissions will violate the federal NO<sub>2</sub> standard as depicted in table 5.1-25 for the applicants AFC.

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<sup>6</sup> [Final Initial Study of the Riverside Energy Resource Center Power Plant Project \(08-SPPE-1\)](#), Staff Report, publication # CEC-700-2008-010-SF. Posted: December 22, 2008. (PDF file, 302 pages, **7.2 megabytes**)  
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<sup>7</sup> PDOC Page 60 in order to protect hourly air quality standards, the District is also proposing an additional hourly limit for operating hours during which startups occur. This limit is based on a reasonable need for the facility to start up twice in a one-hour period, which is not unforeseeable given the facility's operation as a peaker facility. The District is basing this proposed limit on two startups with a typical emissions profile as summarized in Table 27, using the following scenario: The first startup will last 10 minutes, followed by an 8 minute shutdown. The turbine would start up again for a total of 24 minutes, and the remainder of the hour (18 minutes) will be at steady-state BACT levels. These maximum hourly emissions with two startups are summarized in Table 29 below.

<sup>8</sup> <http://www.baaqmd.gov/~media/Files/Engineering/Public%20Notices/2010/20737/Application%20Correspondence%20and%20Supporting%20Documents/049-email%207-8-2010%20CH2M%20to%20Cabral.ashx>



TABLE 5.1-25

Turbine Commissioning Impacts Analysis—Maximum Modeled Impacts Compared to the Ambient Air Quality Standards  
Impacts Associated with Commissioning Three Turbines Simultaneously

Pollutant	Averaging Time	Maximum Modeled Concentration ( $\mu\text{g}/\text{m}^3$ )	Background Concentration ( $\mu\text{g}/\text{m}^3$ ) <sup>a</sup>	Total Predicted Concentration ( $\mu\text{g}/\text{m}^3$ )	State Standard ( $\mu\text{g}/\text{m}^3$ )	Federal Standard ( $\mu\text{g}/\text{m}^3$ )
NO <sub>2</sub>	1-hour <sup>b</sup>	216	105	321	339	—
SO <sub>2</sub>	1-hour	4.2	47.1	51.3	23,000	40,000
	3-hour	2.4	34.0	36.4	10,000	10,000
	24-hour	0.56	18.3	18.9		
CO	1-hour	205	5,039	5,244	23,000	40,000
	8-hour	69	2,645	2,714	10,000	10,000
PM <sub>10</sub>	24-hour	1.9	126	128	50	150
PM <sub>2.5</sub>	24-hour	1.9	85.3	87.2	—	35

The projects construction emissions are also expected to violate the Federal 1 NO<sub>2</sub> hour standard. Table 5.1-24 from the applicants AFC (below) shows that construction emissions by themselves will exceed the federal 1 hour NO<sub>2</sub> standard without considering background concentrations. Construction emissions combined with background will be 331 $\mu\text{g}/\text{m}^3$ . This will exceed the new Federal 1 hour NO<sub>2</sub> standard of 188  $\mu\text{g}/\text{m}^3$  by over 40%. The PDOC must analyze this impact as district regulations do not allow projects to exceed ambient air quality standards for operation of construction.

TABLE 5.1-24

Maximum Modeled Impacts from Construction and the Ambient Air Quality Standards

Pollutant	Averaging Period	Maximum Modeled Concentration ( $\mu\text{g}/\text{m}^3$ )	Background Concentration ( $\mu\text{g}/\text{m}^3$ ) <sup>a</sup>	Total Predicted Concentration ( $\mu\text{g}/\text{m}^3$ )	State Standard ( $\mu\text{g}/\text{m}^3$ )	Federal Standard ( $\mu\text{g}/\text{m}^3$ )
NO <sub>2</sub>	1-hour <sup>b</sup>	226	105	331	339	—
	Annual	19.5	18.8	38.3	57	100
SO <sub>2</sub>	1-hour	1.2	47.1	48.3	655	—
	3-hour	1.1	34.0	35.1	—	1,300
	24-hour	0.19	18.3	18.5	105	365
	Annual	0.025	5.5	5.5	—	80
CO	1-hour	957	5,039	5,996	23,000	40,000
	8-hour	416	2,645	3,061	10,000	10,000
PM <sub>10</sub>	24-hour	112	126	238	50	150
	Annual	6	27	33	20	—
PM <sub>2.5</sub>	24-hour	17.9	85.3	103.2	—	35
	Annual	1.2	13.1	14.3	12	15

<sup>a</sup>Background concentrations were the highest concentrations monitored during 2006 through 2008.

<sup>b</sup>The maximum 1-hour NO<sub>2</sub> concentration is based on AERMOD OLM output.

### PM-2.5 issues

The PDOC on page 50 states , “This facility is subject to BACT requirements for PM10 only. PM2.5, a subset of PM10, is regulated under federal requirements in 40 C.F.R. Section 52.21 (PSD) and 40 C.F.R. Part 51, Appendix S (Non-Attainment NSR). The facility is not subject to PSD or PM2.5 Non-Attainment NSR permit requirements under Section 52.21 or Appendix S because the facility is not a “major facility” for the purposes of these regulations. The District is therefore not conducting a PSD permitting analysis or an Appendix S permitting analysis for PM2.5. The District notes, however, that for combustion turbines essentially all of the PM emissions are less than one micron in diameter, so it is both PM10 and PM2.5. (See AP-42, Table 1.4-2, footnote c, 7/98 (available at <http://www.epa.gov/ttnchie1/ap42/ch01/final/c01s04.pdf>). Moreover, the same emissions control technologies that will be effective for PM10 for this facility will also be similarly effective for PM2.5. The District’s BACT analysis and emissions limit for PM10 will also therefore effectively be a BACT limit on PM2.5 emissions as well, even though the facility is not subject to the federal PM2.5 BACT requirements.”

On October 20, 2010, the USEPA issued a final rule providing modeling thresholds for evaluating impacts of PM2.5 emissions under the Prevention of Significant Deterioration (PSD) program and the Non attainment NSR program. The rule establishes Class I and Class II Increment Thresholds and Significant Impact Levels (SILs), and a Significant Monitoring Concentration (SMC) threshold. The FDOC needs to address the applicability of the new rules and compliance of the project with the new rules. The EPA rule can be found at: <http://edocket.access.gpo.gov/2010/pdf/2010-25132.pdf>.

Also the projects emissions of NOx, Sox and ammonia are precursors for PM 2.5 which must be analyzed in the FDOC.

### **5.5 Best Available Control Technology for Particulate Matter (PM) for Turbines**

BAAQMD originally proposed 2 pounds per hour PM-10 limit for the Mariposa Project.<sup>9</sup> After heavy lobbying by the applicant Mariposa Energy the PDOC proposes a 2.5 pounds per

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<sup>9</sup> GE Paper **PM10 Emissions from LM6000 for Mariposa Energy, LLC** “BAAQMD is proposing an emissions rate of 0.0041 lb/MMBtu for

hour BACT limit. The limit is proposed based on an analysis by the applicant.<sup>10</sup> In the analysis the applicant list source tests for six different facilities that all utilize the LM-6000 turbines.

The data that is listed provides a solid foundation for a BACT limitation for PM-10 emissions of 1.9 to 2.3 pounds per hour per turbine. The Gilroy Energy Center has limited PM-10 emissions to 1.9 pounds per hour over a series of 9 source tests. Over a six year period from 2003 to 2006 the Creed Energy Center has achieved an emissions limit below 2.18 pounds per hour.<sup>11</sup> Over the same time period 2003 to 2006 the Lambie Energy Center has been able to limit PM-10 emissions to less than 2.104 pounds per hour.<sup>12</sup> The Los Esteros Energy Center has limited PM-10 emissions to 2.26 pound per hour in over 20 source tests conducted between July 2005 and May 2009 a four year period. The Wolfskill Peaker has limited PM-10 emissions to 2.15 pounds per hour from 2004 to 2009. Of the six facilities examined by CH2MHIL only one facility has exceeded 2.26 pounds per hour and that is the Goosehaven Peaker. Data from five of the six facilities supports a 1.9 to 2.3 pounds per hour or less PM-10 BACT emission rate. District Rule 2-2-301 (b) defines BACT as, “The most stringent emission limitation achieved by an emission control device or technique for the type of equipment comprising such a source.” Clearly from CH2MHILL’s analysis the most stringent emission limitation achieved by the LM-6000 turbine would be 1.9 pounds per hour achieved by the Gilroy Energy Center. To comply with Rule 2-2-301 (b) the FDOC should require a 1.9- 2.3 pounds per hour emission limitation per turbine.

The project should also be required to utilize inlet air filters to remove particulate matter from the combustion air stream, reducing the amount of particulate matter emitted into the atmosphere. A lube oil coalescer should also be required which would result in the merging together of oil mist to form larger droplets. The larger droplets will return to the oil stream instead of being emitted.

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PM10 emissions. This amounts to a limit of about 2 lbs/hr of PM10 emissions for a 50 MW gas turbine out of the stack.”

<sup>10</sup> Evaluation of General Electric LM-6000 Simple-Cycle Gas Turbine Particulate (Emissions Data) April 19, 2010 CH2MHill

<sup>11</sup> Evaluation of General Electric LM-6000 Simple-Cycle Gas Turbine Particulate (Emissions Data) April 19, 2010 CH2MHill Page 1

<sup>12</sup> Evaluation of General Electric LM-6000 Simple-Cycle Gas Turbine Particulate (Emissions Data) April 19, 2010 CH2MHill Page 1

The use of an LM-6000 turbine equipped with a DLE system will also reduce PM-10 emissions. An LM-6000 turbine equipped with a DLE system for NO<sub>x</sub> control will eliminate the particulate matter from the impurities in the water used for NO<sub>x</sub> control that can contribute to particulate matter emissions. These impurities are in the form of total suspended and dissolved solids. There are several models of the LM-6000 which come equipped with the DLE system. The LM 6000 PF, LM 6000 PH, and the LM-6000 PD all can be utilized with a DLE system which would reduce PM-10 emissions from the use of water as NO<sub>x</sub> control for the project. Two thirds of the water consumption for the project could be eliminated by using a DLE system.

### **5.7 Best Available Control Technology For Startup and Shutdown Conditions for Turbines**

According to page 58 of the PDOC, “the only available approach to reducing startup and shutdown emissions from simple-cycle turbines is to use best work practices. By following the plant equipment manufacturers’ recommendations, power plant operators can limit the duration of each startup and shutdown to the minimum duration achievable. Plant operators also use their own operational experience with their particular turbines and ancillary equipment to optimize startup and shutdown emissions. There is no other available control technology or technique beyond implementing best work practices that can further reduce startup and shutdown emissions from simple-cycle turbines.”

The LM6000 standard 10 minutes start time can be improved to just 5 minutes. “By properly maintaining the package purge requirements, and by keeping the lube oil ‘warm’, approximately 2 minutes can be removed from the 10-min start sequence. Then the gas turbine acceleration rate to full load can be increased from 12MW/min to 50MW/min, reducing the time from sync idle to full load from 4 minutes down to approximately 1 minute. This reduced start time greatly enhances the LM6000’s ability to get online quickly to support a reduction in load from the wind farm due to sudden changes in wind conditions”<sup>13</sup> and also greatly reduces start up and shut down emissions for all pollutants.

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<sup>13</sup> APPLICATION OF THE LATEST AERODERIVATIVE GAS TURBINE TECHNOLOGY Authors: Edward Wacekt, Warren Ferguson, General Electric [http://www.iagtcommittee.com/symposium\\_2009/papers/203%20paper%20final.pdf](http://www.iagtcommittee.com/symposium_2009/papers/203%20paper%20final.pdf) Page 7

## **Innovation in Turbine Inlet Conditioning**

Many GE Aero-derivative gas turbines are frequently needed to perform on the hottest days to provide peak power. Unfortunately, as the inlet air temperature to a turbine goes up, the power it can generate goes down. This has driven the need for inlet-chilling systems. Traditionally, there have only been two options available to customers: evaporative or mechanical coolers. In response to customers seeking more power with less variations due to ambient effects, GE Energy has teamed with Energy Concepts, Nooter/Eriksen and The Industrial Company (TIC) to design, build and supply an inlet air chilling unit that utilizes an ammonia-based absorption refrigeration cycle which recovers the exhaust heat from a gas turbine as the heat source. In place of a mechanical chilling system, the ARCTIC unit enables the gas turbine to provide up to 5 percent more power on hot days, no requirement for 4,160V power or switchgear, improved heat rate and less maintenance requirements. The pre-engineered skid allows for less site civil work and improves system interconnection compared to existing systems today. The use of an absorption system minimizes the impact of parasitic loads at hotter ambient temperatures. The use of inlet chilling on aero-derivative gas turbines provides a substantial improvement to a turbine's power output and efficiency. An innovative solution has been developed by a partnership to equip GE's aero-derivative gas turbines with a more efficient and factory packaged inlet chilling alternative. The new system provides more hot-day power than other chilling systems available on the market today. The first commercial unit has been shipped to site with commissioning to occur in the third quarter of 2009, where it will be operating on an LM6000 PC Sprint unit serving the Electric Reliability Council of Texas (ERCOT) market. The system description, customer benefits and market potential are discussed below.

### **Technology Alternatives**

Turbine inlet chilling today is comprised of two primary technologies: mechanical chilling and evaporative cooling. Mechanical chilling uses mechanical compression to reduce the inlet air temperature to optimize the gas turbine's output. It does so, however, at the cost of high parasitic loads, which reduce the net gains achieved by chilling the inlet air. Evaporative cooling sprays water into the turbine inlet air stream where it evaporates, cooling the air. Evaporative cooling is not always as effective at increasing power output as mechanical chilling, but the capital costs

associated with it are less than the costs of mechanical chilling, as are the parasitic loads. The LM6000 has been among the most widely accepted aeroderivative gas turbine to serve the power generation segment since its commercial debut in 1992. The diversity and depth of the market experience gained has shown several key performance criteria sought by customers: Consistent net output, low parasitic load for a lower heat rate, 10-minute fast start and high reliability and low maintenance requirement. Neither traditional mechanical or evaporative cooling systems can support all of these needs, which established the design parameters for the new Absorption Refrigeration Cycle Turbine Inlet Chilling, or ARCTIC, system. This new system has the ability to provide more power on the hottest temperature days, which enables an even better heat rate than all other alternatives. There are some key economic advantages ARCTIC provides customers, notably: more power and fewer support systems. The use of absorption chilling reduces the parasitic loads associated with mechanical chiller compressors, pumps and motors. In applications where selective catalytic reduction is needed for emissions abatement, the reduced temperature of the exhaust can also eliminate the need for tempering air fans.

The system can also produce chilled air during unit startup so that more power can be produced faster than existing mechanical systems. Also, the ARCTIC system does not require 4,160 volt transformer, switchgear and cabling, thus reducing the total number of systems to interconnect. These benefits have all been enabled in a system that can be packaged in a factory for faster site installation, improving the efficiency of the overall plant.

### **Arctic System**

The employment of an ammonia-water refrigeration cycle has been used for many smaller applications over the past 100 years and its favorable properties have caused it to become the industrial refrigerant of choice. The ARCTIC system is comprised of five simple core components: turbine inlet air coil, heat recovery vapor generator, evaporative condenser, absorber cooler and ARCTIC skid. The turbine inlet air coil (TIAC) is placed in the same position within the air filter house as today's mechanical chilling coils. The thermal energy of the gas turbine is extracted from the exhaust by the heat recovery vapor generator (HRVG) tubes. These tubes carry the high-pressure ammonia into the exhaust stream where it is heated to create the working temperature gradient needed for the ammonia water separation. The working fluid

is then passed through the skid-mounted Rectifier where the separation of the ammonia water solution occurs. The ammonia is then passed through a condenser to convert the fluid back into a liquid stage before going through the TIAC. The vapor is then blended with the water-ammonia mixture loop in the absorber cooler. The process is complete when the mixture is then pressurized and passed back through the rectifier in a closed capacity before reentering the HRVG. The elegance of the ARCTIC system is the ability to provide all of these systems in a skid-mounted design that facilitates plant flexibility along with unit operability. This simplified summary of components underscores the robust engineering analysis performed on this refrigeration cycle. The system has been evaluated for its structural impact to the air filter, the airflow distribution to ensure adequate cooling and thorough reviews of the manufacturing and controls aspects as well. All applicable design practices by GE have been incorporated to the motors, controls, hazardous protection and detection systems, which the entire team has incorporated. In full, there have been over 100 drawings created and hundreds of engineering hours spent to ensure the ARCTIC system is reliable and capable of meeting or exceeding design targets.<sup>14</sup>

#### . Greenhouse Gas BACT

The PDOC contains no BACT analysis for Greenhouse gasses. There are variations of the LM-6000 turbines which result in substantial reductions in greenhouse gas emissions. **GE's** latest enhancement of its proven LM6000 aeroderivative gas turbine product line is the LM6000 PG with single annular combustor (SAC) and its dry low emissions (DLE) equivalent, the LM6000 PH. Both turbines offer a 25% simple cycle power increase.<sup>15</sup> This translates into a large reduction in Greenhouse gas emissions using a slight variation of the proposed LM-6000.

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<sup>14</sup> <http://www.powergenworldwide.com/index/display/articledisplay/5563823368/articles/power-engineering/volume-114/issue-10/features/innovation-in-turbine-inlet-conditioning.html>

<sup>15</sup> [http://www.gepower.com/about/press/en/2008\\_press/060408b.htm](http://www.gepower.com/about/press/en/2008_press/060408b.htm)

The LM 6000-PF has a superior heat rate and "avoids 15,000 metric tons of CO<sub>2</sub> emissions over the course of a 3,000-hour peaking season while producing the same electricity output, which is equivalent to the annual CO<sub>2</sub> emissions of more than 2,800 cars on U.S. roads.<sup>16</sup>

Incorporating the DLE system of the LM-6000-PF, Lm6000PH or the LM-6000 PD further reduces CO<sub>2</sub> emissions by eliminating two thirds of the water the facility uses for NO<sub>x</sub> control thus lowering the CO<sub>2</sub> emissions from the transportation, treatment and disposal of the ZLD waste.

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<sup>16</sup>[http://www.gepower.com/prod\\_serv/product](http://www.gepower.com/prod_serv/product)

[http://www.gepower.com/prod\\_serv/products/gas\\_turbines\\_cc/en/downloads/GEH12985H.pdf](http://www.gepower.com/prod_serv/products/gas_turbines_cc/en/downloads/GEH12985H.pdf)



California Pilots Association (CALPILOTS)  
c/o Andy Wilson  
31438 Greenbrier Lane  
Hayward, CA 94544  
November 9, 2010

**Via First Class Mail and EMAIL**

Bay Area Air Quality District ("BAAQMD")  
939 Ellis St.  
San Francisco, CA 94109  
Re: Mariposa Energy Project BAAQMD PDOC Application 20737  
Attention: Brenda Cabral  
(415) 749-4686

bcabral@baaqmd.gov  
Supervising Air Quality Engineer

Dear Brenda,

California Pilots Association ("CALPILOTS") respectfully submits these comments on the Mariposa Energy Project PDOC Application 20737. For the reasons set forth below, the BAAQMD should not issue the Final Determination of Compliance ("FDOC") until the PDOC includes the cumulative effect of the CEC East Altamont Power plant California Energy Commission ("CEC") East Altamont Energy Center (CEC Docket 01-AFC-AC and 01-AFC-4) power plant to include but not limited to emission effects on pilots passengers and aircraft. Until this is considered and until the appeals pending before the EPA's Environmental Appeals Board are adjudicated the PDOC is incomplete.

Currently there are five appeals challenging the Russell City Energy Center's ("RCEC") Prevention of Significant Deterioration Permit ("PSD") pending before the EPA's Appeals Board ("EAB"). See EAB Appeal Nos. PSD 10-01, et al. available at [http://yosemite.epa.gov/oa/EAB\\_Web\\_Docket.nsf/f22b4b245fab46c6852570e6004df1bd/df250cdc9ddc2bce852576ef00513d84!OpenDocument](http://yosemite.epa.gov/oa/EAB_Web_Docket.nsf/f22b4b245fab46c6852570e6004df1bd/df250cdc9ddc2bce852576ef00513d84!OpenDocument)

CALPILOTS is one of the petitioners in those appeals. The EAB heard arguments in the case on July 22, 2010, and the petitioners are now awaiting a decision. In short, the BAAQMD should not approve or issue the proposed air quality FDOC; instead should be deferred until the EAB has adjudicated the pending appeals and include cumulative effects on pilots, passengers and aircraft of both power plant plumes that would have a direct of health and safety.

CALPILOTS hereby requests a Public Hearing on this matter.

BAAQMD

Re: Mariposa Energy Project BAAQMD PDOC Application 20737

November 9, 2010

Page 2 of 2

Sincerely,

/s/

Andy Wilson

CALPILOTS Director-at-Large

CEC Intervener Mariposa Energy (Docket No. 09-AFC-3)

510-303-9027

Andy\_psi@sbcglobal.net

CC:

CALPILOTS File