19

CALIFORNIA ENERGY COMMISSION
1516 NINTH STREET
SACRAMENTO, CA 95814-5512

May 29, 2007

Mr. Jack P. Broadbent
Executive Officer/Air Pollution Control Officer
Bay Area Air Quality Management District
939 Ellis Street
San Francisco, CA 94109

Dear Mr. Broadbent,

**AMENDED PRELIMINARY DETERMINATION OF COMPLIANCE FOR THE RUSSELL CITY ENERGY CENTER, APPLICATION 15487**

Thank you for the opportunity to comment on the Amended Preliminary Determination of Compliance (PDOC) for the proposed Russell City Energy Center (RCEC), a 600 MW combined cycle project located in the city of Hayward. In the Amended PDOC the District finds that, subject to specified permit conditions, the proposed project will comply with all applicable federal, state and Bay Area Air Quality Management District (District) rules and regulations.

In considering this project, we believe there may be better and more direct ways to reduce or avoid the cumulative impacts from ozone precursor emissions than those proposed by the project owner. We believe that there is current technology that the District should consider requiring as Best Available Control Technology (BACT) that will significantly limit the ozone precursor emissions that result from start-up and load following transitions. We believe that impact avoidance (i.e., preventing emissions) is generally a better approach than impact mitigation of air emissions through the provision of offsets when complying with the requirements of the California Environmental Quality Act.

OFFSETS

The planned operating profile of the project, frequent start-up and shutdown cycles, is creating a significant disparity between the daily emissions and the average daily offsets. The project owner is requesting that no District or Energy Commission conditions be attached to the project that would restrict the number of start-up and shutdown cycles or the annual hours of operation. They would, instead, accept a condition that would limit the facility's annual emissions to 134 tons per year (TPY) of oxides of nitrogen (NOx) and 28.5 TPY of precursor organic compounds (POC).

The Amended PDOC, per the District New Source Review (NSR) regulations, identified That RCEC will surrender emission reduction credits (ERC) in the amounts of 103 TPY of NOx and 80 TPY of POC to offset new emissions of 134 TPY of NOx and 28.5 TPY of POC. On a daily basis, including days that experience ozone violations, staff estimates that the project could emit up to 2,213 lbs of NOx, while the proposed

emission reduction credits provided would amount to only 844 lbs per day. This offset amount mitigates approximately 38 percent (844 lbs/2,213 lbs) of the project's potential emissions for NOx on any given day. Thus on those days when violations of the ozone air quality standards occur, the project's emissions would contribute to violations of the standard.

BACT

According to the Amended PDOC, each unit of the RCEC must be equipped with BACT for NOx, carbon monoxide (CO), POC, particulate matter less than 10 microns (PM10), and oxides of sulfur (SOx). The Amended PDOC states that BACT for each unit is the use of selective catalytic reduction (SCR) and CO oxidation catalyst systems to control NOx, POC and CO emissions, and the use of natural gas as BACT for PM10 and SOx.

The SCR system will maintain a normal operation NOx emissions limit of 2.0 parts per million (ppm) averaged over a one-hour period. The District determined that this meets District guidelines for BACT. Missing from this determination is consideration of the facility's potential high daily NOx emissions from multiple start-up and shutdown cycles. Energy Commission staff estimates that the facility can potentially emit 2,213 pounds per day of NOx. The hourly emissions during start-up and shutdown events are much greater than during normal operation since the SCR and ammonia injection system are not at optimal conditions. The resulting daily emissions could have a significant effect on ozone and air quality in the Bay Area air basin because the proposed NOx emission reduction credits are approximately equivalent to 844 pounds per day, well below the potential emissions of 2,213 pounds per day of NOx.

Energy Commission staff recommends that the district consider requiring, as part of their BACT analysis, hardware and software modifications to the project that can shorten start-up and shutdown events and optimize emission control systems. There is evidence that start-up and shutdown emissions from the facility can be reduced significantly with design changes to the heat recovery steam generator (HRSG) units that can include the use of the once-through HRSG (Benson Boiler). The start-up time for each turbine/HRSG unit could be reduced from the proposed 6 hours to approximately one hour, resulting in a significant reduction in start-up emissions. If the project is built with the aforementioned Fast-Start technology, the project start-up NOx emissions are expected to be reduced from the proposed 480 lbs to 22 lbs for each cold start-up event, and from 240 lbs to 28 lbs for hot or warm start-up events. This represents 95 and 88 percent reductions in NOx emissions per cold and hot or warm start-up events, respectively. In addition to reducing the facility's NOx emission liabilities, the use of Fast-Start technology at the RCEC project would result in cost savings from less fossil fuel use to create steam that is vented during start-ups. Staff has not estimated the actual fuel saving because this cost will tie directly to how many start-up and shutdown cycles the facility has during a year. According to one manufacturer (Siemens), the cost for the design changes is not significantly higher than the cost of the standard, off the shelf, HRSG.

Alternatively, the 600 MW combined cycle Palomar Project in Escondido has installed a proprietary control system, OpFlex from General Electric, and injects ammonia earlier to shorten start-up times and reduce start-up emissions at the facility. Preliminary, non-optimized results from their March 7, 2007, Petition for Variance 4703 Extension indicated that they have reduced NOx emissions from 120 lbs to 28 lbs for hot or warm start-up events.

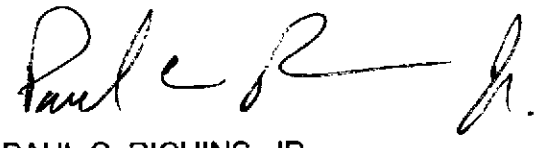
If design or process control changes to reduce the facility's start-up and shutdown emissions are implemented, the RCEC daily emissions can be reduced. These design changes could be found to be cost-effective and included as BACT for the proposed facility.

GENERAL COMMENTS

- Page 2 and page 36 of the Amended PDOC identifies the source S-5, the cooling tower, "with efficiency drift eliminators make and model to be determined" while on page 14 the drift is specified as 0.0005%.
- Page 4, Item 3.c. identifies the POC limit of 1 ppmvd @15% $O_2$. However, Table 1 on the same page identifies POC limit of 2 ppmv.
- Page 5, Table 2 identifies PM10 emissions from the cooling tower, although drift elimination efficiency was not specified on page 2 and the TDS limits are not provided.
- Page 13 and Condition 20(g) specifies that the project will burn natural gas in the turbine and heat recovery steam generator with an annual average of 0.25 grains sulfur per 100 standard cubic feet. What is the basis for this value and how will it be enforced?

Thank you for the opportunity to provide comments on the District Amended PDOC for the Russell City Energy Center. We believe that design changes to the project could significantly reduce the facility's daily potential to emit, and at the same time address the effectiveness of the applicant's proposed offset mitigation. If you have any questions regarding our comments, please contact Matt Layton at (916) 654-3868.

Sincerely,



PAUL C. RICHINS, JR
Environmental Protection Office Manager

cc: Docket (01-AFC-7)
Proof of Service List
Agency List

the emissions reduction credits provided would only equal 848 lbs per day on an equivalent basis, which is approximately 38 percent (848 lbs/2,213 lbs) of the project's potential emissions for NOx. It should be noted that the project owner has stated the staff estimated facility's daily NOx potential emissions (**AIR QUALITY Table 2**) are based on a rare event, which could only happen a few times in a year.

**Do the proposed ERCs adequately mitigate the project's expected daily emissions?**

The project owner has asserted that the more typical, normal operating day of the facility could include a hot start-up, about 16 hours of normal operation followed by a shutdown. Staff believes that this pattern is consistent with operations data from other combined cycle facilities in the state. Therefore, staff attempted to estimate a reasonably expected operating profile for the facility and the associated emissions, and verify whether the proposed ERCs could adequately mitigate the facility emissions.

Staff estimated probable daily facility NOx emissions to be approximately 1,093 lbs per day (see **AIR QUALITY Appendix 1**) from one hot start-up followed by 14 hours of normal operation and one shutdown each day for each gas turbine/HRSG power unit. Even at this level, the proposed ERCs of 848 lbs of NOx a day would mitigate only 78 percent[3] of the facility emission impacts on any given day.

The District's PDOC contains a facility NOx emissions limit of 1,553 pounds per day (BAAQMD - 2007), which is also twice the amount of ERCs proposed. Thus, regardless of whether the facility operated in maximum worst-case or reasonably expected case, the provided ERCs would not adequately mitigate the project's daily NOx emission impacts.

**Is there alternative technology that can reduce the project's emission liability?**

The project, as proposed, is designed to operate most efficiently in base load mode. The project owner is interested in operating the facility as a load-following facility, i.e., frequent, or daily start-ups and shutdowns. The majority of the facility daily NOx emissions are caused by start-up and shutdown events, as shown in **AIR QUALITY Table 2**, where hourly start-up emissions rates are six, seven and 68 times higher than normal operation for NOx, POC and CO, respectively. Because of this, staff investigated if design changes to the project could shorten start-up durations and reduce start-up emissions. Staff found that if the project used the Siemens-Westinghouse Benson Once-Through boiler technology, start-up and shutdown emissions would be significantly reduced such that the proposed offsets would be adequate to mitigate the project's daily NOx emissions. Alternatively, some projects have incorporated an auxiliary boiler or solar array to provide steam that can shorten start-up times.

According to a vendor of this technology, the Siemens-Westinghouse, Benson Once-Through or Fast-Start technology can be designed to fit the proposed 501 FD combustion turbines without additional capital costs above that of the standard, off-the-

[3] 848 lbs/day divided by 1093 lbs/day = 0.78 or 78 percent

shelf, HRSG that the project owner has proposed[4]. If the project is built with the aforementioned Fast-Start technology, the project start-up NOx emissions are expected to be reduced from the proposed 480 lbs to 22 lbs for each cold start-up event, and from 240 lbs to 28 lbs for hot or warm start-up events. This represents a 95 percent and 88 percent emission reduction of NOx for cold, and hot or warm start-up events, respectively. In addition to reducing the facility's NOx and POC emissions, the use of Fast-Start technology at the RCEC would result in cost saving from less fossil fuel used to create steam that is vented during start-ups. Staff has not estimated the actual fuel savings because this cost will tie directly to how many start-up and shutdown cycles the facility has during a year.

Staff believes that the Siemens-Westinghouse Fast-Start technology is an alternative technology that would mitigate the project impacts to the environment; Staff therefore recommends that, unless the project owner accepts conditions that restrict the start-up duration and emissions, the RCEC should be built employing the Fast-Start technology or its equivalent to reduce the start-up and shutdown event emissions. Staff's recommendation is incorporated into Condition of Certification **AQ-SC7** through **-SC10**.

Alternatively, the 600 MW combined cycle Palomar Project in Escondido has installed a proprietary control system, OpFlex from General Electric, which allows ammonia to be injected at the earliest time to shorten start-up times and reduce start-up emissions at the facility. Preliminary, non-optimized results from their March 7, 2007, Petition for Variance 4703 Extension indicated that they have reduced NOx emissions from 120 lbs to 28 lbs for hot or warm start-up events.

Staff provided a comment on May 29, 2007, to the District on the PDOC for RCEC that the District consider hardware and software modifications to the project to shorten start-up times and significantly reduce start-up emission as BACT.

**Is there alternative operational change that can reduce the facility emission liability?**

The project owner claims that redesign of the project with Fast-Start technology would involve significant costs as they have purchased some equipment and designed the project and systems. These cost increases and redesign may require extensive renegotiations with their financing entities. However, Staff notes that the El Segundo Power Redevelopment Project (00-AFC-14), in order to meet changing electricity market demands, just filed a major amendment (June 15, 2007) redesigning their project from a "traditional" combined cycle to a Rapid Response Combined Cycle that will use Siemens combustion turbines (replacing the previously approved GE CTGs) and Benson once-through boilers.

Staff has asked for and the project owner has provided an expected operational scenario for the facility. The owner states that most likely, each turbine would undergo a cold start-up and combustor tuning about once a year. This is the activity that causes the highest start-up emissions of 480 lbs of NOx per start; most other non-cold start-ups would be in the range of 30 to 40 lbs of NOx per event and there are some rare events

[4] May 2, 2007, telephone conversation with Thomas Karastamatis - Siemens Power System Sales

when the start-up emissions would exceed the 40 lbs of NOx per start[5]. Thus for most of the year the project would be either in a hot start-up event, normal operation with the SCR fully operational, shutdown event or not operating. The ERCs provide 424 lbs of NOx per day per turbine (848 lbs/day divided by two turbines). On a daily basis with about 16 hours of normal operation, the project NOx daily emissions would be 259 lbs per turbine, which leaves about 165 lbs of NOx for start-up and shutdown event emissions[6]. Thus for most days of the year, assuming typical shutdown emissions of 40 lbs of NOx per event, the remaining 125 lbs of NOx per day can be dedicated to one hot start-up event. During these days, the project owner proposed ERCs would adequately mitigate the project's probable NOx emission liability. To ensure proper mitigation during other periods, the project owner agreed to conditions that restricted the facility maximum daily emissions to 1,225 lbs per day during the ozone season (between June 1 and September 30), and will put aside additional ERCs to mitigate any NOx emissions in excess of 848 lbs/day if that happened. Thus on any one day, the project emissions would be fully mitigated with ERCs.

To facilitate the project owner concerns about the cost of redesigning the project, staff has developed and recommends the adoption of Conditions of Certification **AQ-SC7** and **AQ-SC8** to address the project emissions and its mitigation.

Condition of Certification **AQ-SC7** would place a facility maximum NOx emission limit of 1,225 lbs/day during the June 1 through September 30 time period, and that any NOx emissions greater than 848 lbs/ day shall be mitigated with ERCs.

Condition of Certification **AQ-SC8** places a NOx emission limit of 125 lbs for each hot/warm start-up event per combustion turbine and 40 lbs for each shutdown event per combustion turbine.

## Ozone Precursors: POC

Similar to the project NOx emissions, the project POC emissions also correlate strongly with the start-up and shutdown events. Staff estimated that the project potential POC emissions would be 42.5 tons per year (see **AIR QUALITY Table 2**), for which the project owner proposed to mitigate with 28.5 tons of ERCs (CH2MHILL 2007a). On a daily basis, the project potential POC emissions can be as high as 431 lbs (worst case), while the reasonable maximum daily[7] POC emissions are approximately 207 lbs/day (see **AIR QUALITY Appendix 1**). The proposed POC ERCs, on an average daily basis, would be equivalent to 157 lbs[8], thus the proposed ERCs are not enough to adequately mitigate the project's potential POC contribution to atmospheric ozone.

Similar to NOx emissions, the Fast-Start technology would be expected to reduce the combustion turbine start-up POC emissions from 96 lbs to 21 lbs per cold start-up event, and from 48 lbs to 32 lbs for a hot or warm start-up event. Staff estimated that

[5] June 1, 2007, telephone conversation with Barbara McBride - Calpine

[6] 424 lbs/day ERC - 259 lbs/day (normal operation emissions) = 165 lbs/day for start up and shut down emissions.

[7] Based on one hot start-up, 14 hours of normal operation and one shutdown for each combustion turbine/HRSG unit.

[8] (28.7 tons per year x 2000 lbs/ton) / 365 days/year = 157 lbs/day

with the Fast-Start technology, the project's POC emissions would be 223 lbs/day for the maximum (worst case) potential and approximately 163 lbs/day for the most probable (reasonable) case. The provided POC ERCs could be adequate to mitigate the project's POC contribution to the atmospheric ozone.

Alternatively, staff believes that restricting the period of cold start-up, combustor tuning activities similar to the aforementioned NOx emissions would also reduce the facility POC emission liability to the point that the project owner's provided ERCs would adequately mitigate both the POC and NOx emissions from the project. Staff recommends the adoption of Conditions of Certification **AQ-SC7** to **AQ-SC9**.

## Ozone Precursors: Simultaneous Start of Both Turbines

The project owner requested the deletion of existing Condition of Certification **AQ-22** in the Decision to enable them to simultaneously start both combustion turbine/HRSG units. The project owner believes that because the submitted air dispersion modeling shows that the NOx emissions from simultaneous start-up of both combustion turbine/HRSG units would not cause a violation of the ambient air quality standard for $NO_2$, such start-up scenarios should be allowed (CH2MHILL 2007a).

Even though the modeling shows that the $NO_2$ standard is not violated during the simultaneous start-up of both combustion turbine/HRSG units, the project owner has not provided evidence or modeling that shows that putting such a large quantity of NOx and POC emissions from a start-up (960 lbs of NOx and 192 lbs of POC for simultaneous cold start-up of both combustion turbines) would not adversely affect the 1-hour and 8-hour ozone air quality standards, which are violated on a regular basis. Again, if the facility is intended to operate as a load-following facility, then using combustion turbines with the Fast-Start technology can significantly reduce emissions.[9] In short, staff cannot recommend the deletion of simultaneous start of both turbines without the facility using Fast-Start technology or its equivalent to reduce start-up times and emissions. This requirement is incorporated into Conditions of Certification **AQ-SC9** and **AQ-SC10**.

## SOx

The project owner will provide 12.2 tons of SOx ERCs from banking certificate number 989 for emission reductions from the Potrero facility in San Francisco to mitigate the project's SOx emissions. Staff has shown the amount in **AIR QUALITY Table 4** and incorporated the amount of SOx ERCs to mitigate the project's SOx emission impacts into Condition of Certification **AQ-SC11**.

## PM10/PM2.5

The project owner stated that because the project is not required by the District to provide ERCs to mitigate its PM10 emissions, they do not have to mitigate the annual emissions liability. They proposed to mitigate the project's PM10 emissions during the times of the year when the area experiences violation of the PM10 standards, which is during the fall and winter times, or about half a year. According to this logic, the project

[9] This would facilitate staff's recommendation that the facility should be designed and built with the Siemens-Westinghouse Fast-Start technology (mentioned above) to minimize unnecessary emissions to the atmosphere.

## Staff Estimates

1. Facility's operational profile

According to the project owner, each turbine can go through one cold, one hot, two shut down events, and the rest are normal operation. Thus for every 24 hour period, each turbine can experience 9 hours of start up (6 hours for cold and 3 hours for hot) and 1 hour of shut down (0.5 hour each). The normal hours of operation would be 14 hours.

On the annual basis, each turbine can go through 52 cold, 260 hot start-ups and 312 shutdown. Thus each year, the start up and shut down hours for each turbine are:

= 52(6hr) + 260(3hr) + 312(0.5hr) = 1,248 hours

This leaves approximate 7,116 hours [(8,364 hours - 1,248 hours)] of normal steady state operation.

2. Facility's potential emissions

On a daily basis

NOx = 2 turbines [1 cold(480) + 1 hot(240) + 2 SD(80) + 14 hr(16.17)]
= 2,213 lbs/day

VOC = 2 [1(96) + 1(48) + 2(16) +14(2.82)] = 431 lbs/day

CO = 2 [1(5,028) + 1(2,514) + 2(902) +14(19.69)] = 19,603 lbs/day

PM10 = 24hrs[2(9 lbs/hr) + 2.83[a] lbs/hr) = 500 lbs/day

SOx = 24hrs[(4.38EE6 scf (1gr[b]./100scf)/7000gr/lbs) (64/32)] = 300 lbs/day

Notes:

a. Cooling tower PM10 emissions.
b. Staff estimates the facility's potential daily SOx emissions using the maximum 1 grain/100 scf sulfur content natural gas, and assumed full conversion of sulfur to sulfur dioxide.

On an annual basis

NOx = 2 turbines [52cold(480) + 260hot(240) +312SD(80) + 7116hrs(16.17)]
= 454,771 lbs/yr or 227.4 TPY

VOC = 2[52(96) + 260(48) + 312(16) + 7116(2.82)] = 85,062 lbs or 42.5 TPY

CO = 2[52(5,208) + 260(2,514) + 312(902) + 7116(19.69)] =2,691,988 lbs
or 1,346 TPY

PM10/PM2.5 = 8364hrs[2(9) + 2.83] = 174,222 lbs or 87.1 TPY

SOx = 8364hrs[4.38EE6(0.25gr/100)/7000](64/32) = 26,167 lbs or 13.08 TPY

3. Facility probable maximum daily emissions

Staff believes that the facility's estimated potential emissions (see above) would rarely happen in practice. For both gas turbines to undergo a sequence of a cold start-up, a shutdown, a hot re-start, operate for a few hours, then shut down again would require the facility to have breakdown immediately after restarting from an extended outage for maintenance. Staff explored the most probable daily emissions of ozone precursor emissions at the facility.

According to data from the project owner and operational data collected from other facilities currently in operation, staff found the following scenario to be the most probable operational profile for the RCEC facility. The facility would have a hot start in the morning, operate normally for about 14 hours and then shut down overnight. If this is the case, the facility's ozone precursors emissions would be calculated as:

NOx = 2 turbines [1 hot(240) + 1 SD(80) + 14 hr(16.17)]
= 1,093 lbs/day

VOC = 2 [1(48) + 1(16) +14(2.82)] = 207 lbs/day

4. What if the facility were built with GE Rapid Start process (see Victorville 2 Hybrid (07-AFC-1)?

The Victorville 2 Hybrid Power project is proposed to be built with GE turbines employing Rapid Start process. The start-up and shutdown NOx emissions guaranteed for the combustion turbines are 96 lbs per cold start-up, 40 lbs per hot start-up and 57 lbs per shutdown. Using these data, the RCEC worst case turbine/HRSG emissions would be:

NOx = 2 turbines [1 cold(96) + 1 hot(40) + 2 SD(57) + 14 hr(16.17)]
= 950 lbs/day

5. What if the facility were built with Siemens-Westinghouse Benson Once Through Boiler (see City of Vernon (06-AFC-1)?

The City of Vernon Power project is proposed to be built with Siemens-Westinghouse 501FD turbines employing the Benson Once-through boiler. The start-up and shutdown emissions guarantee for the combustion turbines NOx emissions are 21.6 lbs per cold start-up, 28 lbs per hot start-up and 22 lbs per shutdown. Using these data, the RCEC worst case turbine/HRSG emissions would be:

NOx = 2 turbines [1 cold(21.6) + 1 hot(28) + 2 SD(22) + 14 hr(16.17)]
= 640 lbs/day

VOC = 2 turbines [1 cold(20.5) + 1 hot(32) + 2 SD(10) + 14 hr(2.82)]
= 223 lbs/day

Most probable case

NOx = 2 turbines [1 hot(32) + 1 SD(10) + 14 hr(2.82)]
= 163 lbs/day