July 1, 2011

113-87509
Via Electronic Delivery

Susan Jenkins
Stationary Source Permitting Program
Georgia Environmental Protection Division
4244 International Parkway, Suite 120
Atlanta, GA 30354

RE: PSD PERMIT APPLICATION NO. 19810
MACKINAW POWER, LLC – EFFINGHAM COUNTY POWER PLANT
EMISSIONS ESTIMATES DURING OIL-FIRING STARTUP SCENARIO

Dear Ms. Jenkins:

In response to your request in your e-mail dated June 15, 2011, Golder Associates Inc. (Golder) has performed detailed calculations for information on carbon monoxide (CO), particulate matter (PM), PM with aerodynamic diameter of 10 microns or less (PM_{10}), and PM with aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$), volatile organic compounds (VOC), sulfuric acid mist (SAM), and lead emissions for the hybrid combustion turbines (CTs) startup scenario discussed in the June 3, 2011 letter. The calculations are based on the same heat input data presented in Tables 2-3a through 2-3e submitted with the June 3, 2011 letter. The emissions calculation for CO and VOC are presented in attached Tables 2-3f and 2-3g, respectively. Calculation for PM/PM_{10}/$PM_{2.5}$, SO_2, SAM, and lead are presented in Table 2-3h.

The attached tables demonstrate that the average CO emission rate during the hybrid cold start scenario with or without the oxidation catalyst system is lower than the average rate during natural gas-firing cold-start scenario presented in Table 2-3 of the PSD application. The average VOC emission rate for the hybrid scenario is also lower than the natural gas-firing scenario. As a result, a modeling analysis for CO for the hybrid scenario to demonstrate compliance with ambient standards should not be required.

The average SO_2 and PM/PM_{10}/$PM_{2.5}$ emission rates for the hybrid scenario are estimated to be greater than the average rates estimated for the natural gas-firing startup scenario presented in Table 2-3 of the PSD application. However, these rates are lower than the baseload fuel-oil firing hourly emission rates presented in Table 2-2 of the PSD application, for which modeling demonstrations were presented in the PSD application. As a result, modeling analyses for SO_2 and PM/PM_{10}/$PM_{2.5}$ to demonstrate compliance with ambient standards should also not be required.

As described in the June 3 letter, the 5-hour cold startup scenario assumes natural gas-firing in the first hour and then fuel oil-firing for hours 2 to 5. The following assumptions and steps were used in the calculation for criteria air pollutants other than nitrogen oxides (NO_X):

- The oxidation catalyst (OC) system will be available at all times. However, since it may take approximately 30 minutes for the temperature of the catalyst bed to be in the optimum operating range, the control efficiency in hour 1 is assumed to be 50 percent of the typical control efficiency.
- Typical OC control efficiencies for CO is assumed to be 80 percent.
- Uncontrolled CO emissions for firing natural gas (hour 1) and fuel oil (hours 2, 3, and 4) are obtained from available GE information available on-line [Gas Turbine Emissions and Control by Rooniton Pavri and Gerald Moore, GE Energy Services, (http://site.ge-energy.com/prod_serv/products/tech_docs/en/downloads/ger4211.pdf)] and prior

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experience with permitting GE 7FA CTs (the existing CT startup data were based on natural gas-firing).

The following emissions rates were assumed:

- CO, natural gas-firing – 160 ppmvd @15% O_2
- CO, fuel oil-firing – 110 ppmvd @15% O_2

- Uncontrolled CO emission of 20 ppmvd at 15% O_2 for hour 5 (CT average load 68.5%) is based on the uncontrolled emission rates presented in the PSD application for 50% load scenario at 59 ^{o}F ambient temperature (see Table A-12, PSD application).
- Emissions rates for VOC, SO_2, and $PM/PM_{10}/PM_{2.5}$ are based on the average heat input rate for the hour and emission factors, in lb/MMBtu, for the 50% operating load scenario (at 59 ^{o}F ambient temperature) presented in Tables 2-1 (for natural gas) and 2-2 (for fuel oil) of the PSD application. For hour 5, the emission factor, in lb/MMBtu is based on the 75% operating load scenario (at 59 ^{o}F ambient temperature) presented in Tables 2-1 and 2-2.
- Emission rate of SAM is based on the assumption that 10% of SO_2 will convert to SAM [i.e., SAM emission rate (lb/hr) = SO_2 emission rate x 10% x (98/64), where 98/64 is the molecular weight ratio of SAM and SO_2].
- Emission rate of lead is based on the average heat input rate for the hour and emission factor from Table 3.1-2a of EPA AP-42, Compilation of Air Pollutant Emission Factors.

If you have any questions, please do not hesitate to call us at (352) 336-5600.

Sincerely,

GOLDER ASSOCIATES INC.

Robert C. McCann, Jr.
Principal and Air Group Leader

Salahuddin Mohammad
Senior Project Engineer

cc: Matthew Lydon, Mackinaw Power

Enclosures

RCM/SKM/edk

TABLE 2-3f
STACK, OPERATING, AND CO EMISSIONS DATA FOR THE CT - SWITCHING TO FUEL OIL DURING STARTUP

Hour	Fuel	Heat Input [a] (MMBtu)	Power Output [a] (MW)	Load [a] (%)	Pre-OC CO [b] (ppmvd @15% O2)	Stack O_2 (Dry) (%)	CO Concentration (ppmvd actual)	CO Concentration (Cd, lb/dscf)	Fuel F Factor (F_d, dscf/MMBtu)	CO Emission Factor (lb/MMBtu)	Uncontrolled CO Emission Rate (lb/hr)	OC Control Efficiency (%)	Stack CO Emission Rate (lb/hr)
1.0	NG	529.8	13.1	8.0%	160.0	18.4	66.5	4.83E-06	8,710.0	0.3587	190.0	40.0	114.0
2.0	NG→Fuel Oil	576.3	17.1	10.4%	110.0	17.7	59.4	4.32E-06	9,190.0	0.2602	149.9	80.0	30.0
3.0	Fuel Oil	584.1	17.5	10.7%	110.0	17.2	68.7	4.99E-06	9,190.0	0.2602	152.0	80.0	30.4
4.0	Fuel Oil	718.3	31.7	19.4%	110.0	16.3	85.3	6.20E-06	9,190.0	0.2602	186.9	80.0	37.4
5.0	Fuel Oil	1,339.5	112.2	68.5%	20.0	14.9	20.4	1.48E-06	9,190.0	0.0473	63.4	80.0	12.7
	Average =										148.4		44.9

TABLE 2-3g
VOC MISSIONS DATA FOR THE CT - SWITCHING TO FUEL OIL DURING STARTUP

Hour	Fuel	Heat Input [a] (MMBtu)	Uncontrolled VOC Emissions [c] (lb/MMBtu)	Uncontrolled VOC Emissions [c] (lb/hr)	OC Control Efficiency [d] (%)	VOC Emissions (lb/hr)
1.0	NG	529.8	0.0026	1.4	25.0	1.0
2.0	NG→Fuel Oil	576.3	0.0047	2.7	50.0	1.4
3.0	Fuel Oil	584.1	0.0047	2.7	50.0	1.4
4.0	Fuel Oil	718.3	0.0047	3.4	50.0	1.7
5.0	Fuel Oil	1,339.5	0.0047	6.3	50.0	3.1
	Average =					1.72

TABLE 2-3h
SO_2 AND $PM/PM_{10}/PM_{2.5}$, SAM, AND LEAD MISSIONS DATA FOR THE CT - SWITCHING TO FUEL OIL DURING STARTUP

Hour	Fuel	Heat Input [a] (MMBtu)	Stack Emissions: SO_2 [c] (lb/MMBtu)	SO_2 [c] (lb/hr)	$PM/PM_{10}/PM_{2.5}$ [c] (lb/MMBtu)	$PM/PM_{10}/PM_{2.5}$ [c] (lb/hr)	SAM [d] (% of SO2)	SAM [d] (lb/hr)	Lead [e] (lb/MMBtu)	Lead [e] (lb/hr)
1.0	NG	529.8	0.0014	0.7	0.0078	4.1	10%	0.11	No Data	--
2.0	NG→Fuel Oil	576.3	0.0016	0.9	0.014	8.1	10%	0.14	1.4E-05	0.008
3.0	Fuel Oil	584.1	0.0016	0.9	0.014	8.2	10%	0.14	1.4E-05	0.008
4.0	Fuel Oil	718.3	0.0016	1.1	0.014	10.1	10%	0.18	1.4E-05	0.010
5.0	Fuel Oil	1,339.5	0.0016	2.1	0.011	14.7	10%	0.33	1.4E-05	0.019
	Average =			1.2		9.0		0.2		0.011

[a] Average value for the hour based on actual operating data.
[b] Uncontrolled CO rates for hours 1-4 are estimated based on the report "Gas Turbine Emissions and Control by Roointon Pavri and Gerald Moore," GE Energy Services, Atlanta, GA. (http://site.ge-energy.com/prod_serv/products/tech_docs/en/downloads/ger4211.pdf)
Uncontrolled emissions for hour 5 are based on 50% load emission rates at 59 °F ambient temperature presented in Table A-12 of the PSD application.
[c] VOC, SO_2 and $PM/PM_{10}/PM_{2.5}$ emissions rates are based on 50%-load emissions rates (at 59 °F) in lb/MMBtu for hours 1-4 and 75%-load emission rates (at 59 °F) in lb/MMBtu for hour 5 (see Table 2-1 for NG and Table 2-2 for fuel oil) for the proposed CTs and the actual hourly heat input rate during the hour.
[d] Based on assumed 10-percent of SO2 will convert to SAM and molecular weight ratio of 98/64 for SAM/SO2.
[e] EPA AP-42 Table 3.1-2a, Compilation of Air Pollutant Emission Factors.

Source: Mackinaw Power, 2011; Golder, 2011.