


Florida Department of Environmental Protection

Memorandum

TO: Scott Sheplak

FROM: Michael P. Halpin 

DATE: October 11, 2002

SUBJECT: JEA Brandy Branch Facility
170 MW Simple Cycle Combustion Turbines
DEP File No. 0310485 (PSD-FL-267)

I was asked by Al Linero to review and respond to the attached "engineering report" from JEA. As indicated by JEA, this is in reference to the following permit condition:

- 22. *Carbon Monoxide (CO) emissions: The concentration of CO in the exhaust gas when firing natural gas shall not exceed 15 ppmvd when firing natural gas and 20 ppmvd when firing fuel oil as measured by EPA Method 10. CO emissions (at ISO conditions) shall not exceed 48.0 lb/hr (when firing natural gas) and 65.0 lb/hr (when firing fuel oil) as indicated by EPA Method 10. [Rule 62-212.400, F.A.C.]*
- *Within 18 months after the initial compliance test on any individual CT, the permittee shall prepare and submit for the Department's review and acceptance an engineering report regarding the lowest CO emission rate that can consistently be achieved firing natural gas. This lowest recommended rate shall include a reasonable operating margin, taking into account long-term performance expectations and good operating and maintenance practices. The Department may revise the CO emission rate based upon this report. [BACT determination]*

Al had noted within his request, the following "G.E. now guarantees very low numbers. I would think [that a] limit of 10 would be supportable". I cannot dispute that setting a CO limit at 10 ppmvd may be supportable, but I do not recommend such an action. Although the report submitted by JEA lacks much engineering detail, I recommend that the limit be left as is. The following summarizes the points which I believe are key.

- 1) This condition was written as a result of our limited knowledge of the actual CO emissions on an F-frame machine. When drafting the condition, I had anticipated an equal likelihood that the limit might ultimately be set above or below the preliminary settings.
- 2) The establishment of a CO limit for a peaking (simple cycle) unit should be set above that for a base-loaded (combined cycle) unit. By definition, during a day when required, a peaking unit would typically start up, ramp up in output (MW) quickly, remain on load control for a few hours (in a regulating mode), ramp back down in output and ultimately shut down. It is fair to assume that simple-cycle units (unlike base-loaded units) are normally incurring rapid changes in output, resulting in rapid changes in air and fuel demand. Since air/fuel ratio mismatches are more likely to occur for simple cycle units, the generation of CO (an indication of incomplete combustion) is also more likely to occur. The BACT Determinations for CO, which have been made for combined cycle units in Florida typically range from 8 to 15 ppmvd. Two of these three JEA CT's are currently being modified for combined cycle operation, with BACT limits of 14 ppmvd. As indicated, setting the limit for the third (unmodified) simple cycle unit at a level lower than 14 ppmvd would appear illogical.

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- 3) Compliance with the CO emissions limit for these units is based upon an annual stack test, consisting of three 1-hour runs, meaning that (in essence) we have established a 3-hour standard. The NAAQS for CO are 9 ppm and 35 ppm, for 1 hour and 8 hours respectively. A linear interpolation of a 3 hour NAAQS results in approximately 16 ppm, meaning that the achievement of 15 ppm over a 3 hour period likely results in air quality that is safe to breathe (with respect to CO only).
- 4) No actual benefit to the environment will be received by lowering the CO limit from 15 to 10. Some might argue that by lowering the limit, O&M practices would improve, but my sense is otherwise. Since the units are not outfitted with CEMS, no real-time feedback exists for the operating staff as to actual CO emissions. Accordingly, it is unlikely that the lowering of the limit from 15 ppm to 10 ppm will have any measurable impact on the operation. Concerning maintenance practices, these are not routinely based upon annual stack tests, but rather manufacturers guidelines and industry "best practices". However, in the event that the operating staff observes worsening trends in equipment performance, new and additional maintenance inspections are implemented. It is my belief that if such a worsening trend in annual CO stack test results was to exist, such maintenance inspections would have already been implemented, whether the limit were established at 10 ppm or 15 ppm, suggesting that lowering the limit would not impact maintenance practices either.
- 5) Due to the relative "newness" of the F-frame units, no long-term history exists.

In summary, I recommend that we accept JEA's submittal. In the event that I can be of further assistance, please advise.

21 West Church Street
Jacksonville, Florida 32202-3139

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October 2, 2002

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BUREAU OF AIR REGULATION



Mr. Scott Sheplak, P.E.
Administrator
Bureau of Air Regulation
Division of Air Resources Management
Florida Department of Environmental Protection
2600 Blair Stone Road
Tallahassee, FL 32399-2400

ELECTRIC

WATER

SEWER

RE: Brandy Branch Generating Station
Simple Cycle Combustion Turbines 1, 2, and 3
CO Emissions During Gas-Firing
Permit No. 0310485-001-AC

Dear Mr. Sheplak:

Specific Condition 22 of the above referenced permit reads, in part, as follows:

“Within 18 months after the initial compliance test on any individual CT, the permittee shall prepare and submit for the Department’s review and acceptance an engineering report regarding the lowest CO emission rate that can consistently be achieved firing natural gas. This lowest recommended rate shall include a reasonable operating margin, taking into account long-term performance expectations and good operating and maintenance practices. The Department may revise the CO emission rate based upon the report. [BACT determination]”

This letter constitutes the aforementioned engineering report regarding the subject matter.

Attached are recently obtained CO stack test results, as well as the initial stack test results for the Brandy Branch combustion turbines while operating on natural gas at base load. Also attached are CO stack test results from an identical simple cycle turbine at JEA’s Kennedy Generating Station. While the CO emissions from these new and clean units are significantly lower than the permit limit of 15 ppm, it is unclear how these units will perform over their 20 years or more of expected life. Extrapolating 20 years or more based on very limited data would be highly speculative.

Mr. Sheplak, P.E.
October 2, 2002
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As can be seen, the results (on a per run basis) range from a low of 0.27 ppm to a high of 4.80 ppm, a variability of 1778%. This degree of variability is seen among four identical, new and clean units. Allowing for "a reasonable operating margin, taking into account long-term performance expectations and good operating and maintenance practices", the permitted value of 15 ppm is reasonable and justifiable. Units 2 and 3 will be converted to combined cycle operation within two or three years, and a BACT limit of 14 ppm CO was permitted for combined cycle operation of these two units.

Please note that the entire JEA system accounts for only about 2% of the CO inventory in Duval County, with the Brandy Branch units comprising a tiny fraction of 1% of the Duval CO inventory. Removing these units completely would have no noticeable effect on ambient CO concentrations in Duval or the surrounding counties. It is also noted that these units are the cleanest (lowest emitting) in the JEA system and among the cleanest in the world as currently permitted.

Due to the limited information available, the lack of any benefit to be gained by reducing the CO permit limit of these units, realizing that any 20-year extrapolation of CO emissions would be speculative and arbitrary, taking into account the need for a reasonable operating margin and long-term performance expectations, and understanding that the CO emission rate has to be achieved consistently, there is no compelling reason to reduce the permitted CO emission rate of these units.

If you have any questions regarding this submittal, please call me at (904) 665-6247.

Sincerely,



N. Bert Gianazza, P.E.
Environmental Services

Attachments: As Noted

cc: Steve Pace, P.E., RESD
Chris Kirts, P.E., DEP-NED

Jacksonville Electric Authority

Brandy Branch Combustion Turbine Number BCT-1

Fired on Natural Gas at Base Load

Summary of CARBON MONOXIDE (CO) Emissions

June 15, 2001

RUN NUMBER	START TIME	END TIME	CO, ppm	O2, %	CO, ppm @ 15% O2	FLOW, scfm-dry	CO, lbs/hr	PERMITTED EMISSION LIMIT
1	11:46	12:49	0.49	13.65	0.40	733749	1.58	15 ppm
2	13:05	14:08	0.70	13.92	0.59	785093	2.40	
3	14:40	15:43	0.56	13.87	0.47	766471	1.87	
AVERAGE			0.58	13.82	0.49	761771	1.95	PASS

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Jacksonville Electric Authority

Brandy Branch Combustion Turbine Number BCT-2

Fired on Natural Gas at Base Load

Summary of CARBON MONOXIDE (CO) Emissions

June 18, 2001

RUN NUMBER	START TIME	END TIME	CO, ppm	O2, %	CO, ppm @ 15% O2	FLOW, scfm-dry	CO, lbs/hr	PERMITTED EMISSION LIMIT
1	13:46	14:49	0.44	13.76	0.36	808010	1.54	15 ppm
2	15:03	16:06	0.33	13.70	0.27	835827	1.19	
3	16:26	17:29	0.36	13.68	0.30	821919	1.30	
AVERAGE			0.37	13.71	0.31	821920	1.34	PASS

Jacksonville Electric Authority

Brandy Branch Combustion Turbine Number BCT-3

Fired on Natural Gas at Base Load

Summary of CARBON MONOXIDE (CO) Emissions

October 17, 2001

RUN NUMBER	START TIME	END TIME	CO, ppm	FLOW, scfm-dry	CO, lbs/hr	PERMITTED EMISSION LIMIT
1	12:50	13:49	0.78	927540	3.18	15 ppm and 48.0 lbs/hr
2	14:07	15:06	0.77	888466	2.98	
3	15:22	16:21	0.74	880886	2.83	
AVERAGE			0.76	898964	2.99	PASS

Jacksonville Electric Authority

Brandy Branch Combustion Turbine Number BCT-1

Fired on Natural Gas at Base Load

Summary of CARBON MONOXIDE (CO) Emissions

August 13, 2002

RUN NUMBER	START TIME	END TIME	CO, ppm	O2, %	CO, ppm @ 15% O2	FLOW, scfm-dry	CO, lbs/hr	PERMITTED EMISSION LIMIT
1	12:25	14:10	1.07	13.76	0.89	638736	3.19	15 ppm
2	14:37	16:11	1.04	13.72	0.86	622934	3.03	
3	16:26	17:46	1.04	13.68	0.85	665675	3.24	
AVERAGE			1.05	13.72	0.87	642448	3.15	PASS

Jacksonville Electric Authority

Brandy Branch Combustion Turbine Number BCT-2

Fired on Natural Gas at Base Load

Summary of CARBON MONOXIDE (CO) Emissions

August 14, 2002

RUN NUMBER	START TIME	END TIME	CO, ppm	O2, %	CO, ppm @ 15% O2	FLOW, scfm-dry	CO, lbs/hr	PERMITTED EMISSION LIMIT
1	14:35	16:03	1.57	13.71	1.29	788740	5.79	15 ppm
2	16:21	17:41	1.26	13.68	1.03	774493	4.56	
3	18:00	19:20	1.20	13.81	0.99	724035	4.06	
AVERAGE			1.34	13.73	1.10	762423	4.80	PASS

TABLE 4-3

Jacksonville Electric Authority

Brandy Branch Generating Station Combustion Turbine Number BBCT-3

Fired on Natural Gas at Base Load

Summary of CARBON MONOXIDE (CO) Emissions

August 8, 2002

RUN NUMBER	CO, ppm	O2, %	CO, ppm @ 15% O2	FLOW, scfm-dry	CO, lbs/hr	PERMITTED EMISSION LIMIT
1	1.36	13.90	0.58	699670	0.44	15 ppm
2	1.29	13.99	0.57	731392	0.44	
3	1.28	14.00	0.57	660946	0.40	
AVERAGE	1.31	13.96	0.57	697336	0.43	PASS

TABLE 4-3

There is an error somewhere.

**TABLE 1. JEA KENNEDY STATION (ARMS Emission Unit 015)
Summary of Test Program Results**

Parameter	Run 1	Run 2	Run 3	Average	comments
Date	June 6, 2000		June 7, 2000		
Run time	1242-1346	1428-1532	1557-1701		
Nitrogen Oxides ppm, dry	8.49	8.55	8.83	--	All data is drift and bias corrected
ppm at 15% O ₂ (iso)				--	
ppm at 15% O ₂	7.61	7.67	7.88	7.7	Allowable is 15
lb/hr	41.02	42.07	44.42	42.5	
Carbon Monoxide ppm, dry	3.42	3.68	4.80	3.97	All data is drift and bias corrected
ppm at 15% O ₂	3.07	3.31	4.28	3.6	
lb/hr	11.25	12.25	16.46	13.3	Allowable is 48
Total Hydrocarbons, <u>As Methane</u> ppm, wet	2.01	1.47	2.36	1.95	All data is drift and bias corrected
ppm, dry	1.83	1.34	2.17	1.78	
ppm methane, wet	2.04	1.49	2.32	1.95	
ppm methane, dry	1.85	1.36	2.13	1.78	
ppm, dry, non-CH ₄	-0.03	-0.02	0.04	0.00	
ppm at 15% O ₂ (iso)					
<u>As Propane</u> ppm, dry	0.61	0.45	0.72	0.59	No CH ₄ correction Allowable is 1.4 Allowable is 2.9
ppm, at 15% O ₂	0.55	0.40	0.65	0.53	
lb/hr, as propane	2.82	2.11	3.47	2.80	
Oxygen, %	14.32	14.33	14.28	14.31	
Carbon Dioxide, %	5.58	5.55	5.57	5.57	
Stack Temp, °F	1,131	1,132	1,125	1,129	Method 1,2 data
Moisture, %	9.0	8.4	8.0	8.5	Method 4 data
Volumetric Flow ACFM	2,505,400	2,525,300	2,566,600	2,532,400	Method 1,2 data All values rounded
DSCFM	753,400	762,500	785,400	767,100	

JACKSONVILLE ELECTRIC AUTHORITY - KENNEDY PLANT CT # 7
NOX AND O2 RATA, CO COMPLIANCE TEST JUNE 7-8, 2001

	NOX PPM	CO PPM	O2 %	CORRECTED TO 15 % O2	
				NOX PPM	CO PPM
RUN 1 Average	8.34	0.66	13.71	6.85	0.28
RUN 2 Average	8.38	0.59	13.77	6.93	0.25
RUN 3 Average	8.21	0.53	13.73	6.76	0.22
RUN 4 Average	8.13	0.64	13.74	6.70	0.27
RUN 5 Average	8.06	0.72	13.71	6.61	0.30
RUN 6 Average	8.02	0.70	13.69	6.57	0.29
RUN 7 Average	8.68	0.47	13.75	7.16	0.20
RUN 8 Average	8.65	0.53	13.74	7.12	0.23
RUN 9 Average	8.62	0.43	13.74	7.10	0.18
RUN 10 Average	8.52	0.50	13.73	7.02	0.21
RUN 11 Average	8.18	0.46	13.68	6.68	0.19
RUN 12 Average	8.22	0.46	13.75	6.78	0.19
Test Average	8.34	0.56	13.73	6.86	0.23

Jacksonville Electric Authority

Kennedy Generating Station Combustion Turbine Number KCT-7

Fired on Natural Gas at Base Load

Summary of CARBON MONOXIDE (CO) Emissions

August 6, 2002

RUN NUMBER	CO, ppm	O2, %	CO, ppm @ 15% O2	FLOW, scfm-dry	CO, lbs/hr	PERMITTED EMISSION LIMIT
1	0.63	13.81	0.52	697891	0.21	15 ppm
2	0.45	13.70	0.37	680678	0.14	
3	0.44	13.78	0.37	671076	0.14	
AVERAGE	0.51	13.76	0.42	683215	0.16	PASS