UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET
ATLANTA, GEORGIA 30365

JUN - 1 1987

4APT/APB-1jf

DER

JUN 4 1987

BAQM

Mr. Clair Fancy, P.E.
Deputy Chief
Bureau of Air Quality Management
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301

Re: Kissimmee Utilities (Osceola County)

Dear Mr. Fancy:

This is in regard to your letter of April 10, 1987, forwarding the above company's request to increase the allowable nitrogen oxides emissions from their 49.9 MW combined cycle gas turbine. They have requested to increase their allowable emissions concentration limit from 79 ppm to 130 ppm using the fuel bound nitrogen credit as provided for in the New Source Performance Standards, Subpart GG.

We have reviewed the company's request to use the nitrogen content of their natural gas supply in calculating the emissions rate from equations contained in Subpart GG, New Source Performance Standards. During our review, we contacted the Office of Air Quality Planning and Standards regarding the definition of fuel bound nitrogen and data regarding measured concentrations of fuel bound nitrogen in natural gas. Their response was that natural gas does not contain measurable amounts of fuel bound nitrogen and that the nitrogen content reported by the supplier is probably atmospheric nitrogen which is not credible as fuel bound nitrogen. Therefore, the company's analysis supporting their request to increase their nitrogen oxides emissions rate is not valid.

In summary, the company's request to increase nitrogen oxides emissions when burning natural gas should be denied on the basis that the reported nitrogen content of the natural gas is not fuel bound nitrogen. Unless the supplier is able to provide an analysis of their natural gas which determines fuel bound nitrogen only, with supporting documentation of test methods and procedures, credit cannot be given in the calculation of allowable nitrogen oxide emissions as provided under the New Source Performance Standards, Subpart GG.

If you have any questions regarding this determination, you may contact Michael Brandon of my staff at (404) 347-2864.

Sincerely,

Bruce P. Miller

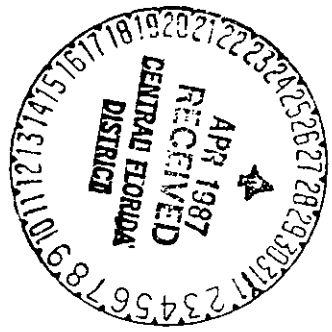
Bruce P. Miller, Chief
Air Programs Branch
Air, Pesticides and Toxics
Management Division

P7

John, CAPS may need this info to change #175 A7
the NO_x emission limit. I don't think it is
appropriate for us to do that prior to the
CAPS determination. Tom.

Air Consulting and Engineering

April 27, 1987
151 87 01



Mr. John Turner
Florida Department of
Environmental Regulation
3319 Maguire Blvd., Suite 232
Orlando, Florida 32803

RE: Kissimmee Utilities Gas Turbine (AO 49-093754)

Dear John:

In response to your "Completeness" inquiry of March 27, 1987, please accept the following responses:

Item 1: Estimate of actual NO_x emissions at 130 and 79 ppm.

$$\text{High Load Volumetric Flow} = \left(30.9\ \text{MW}\right)\left(1000\ \text{KW/MW}\right)\left(\frac{14735\ \text{BTU}}{\text{KW}}\right)\left(9180\ \frac{\text{SCF}}{10^6\text{BTU}}\right)\left(\frac{20.9}{20.9-15.0}\right)$$

$$= 14{,}806{,}000\ \text{SCFH} = 246{,}770\ \text{SCFMD}$$

$$NO_x\ \text{lb/Hr} = \text{ppm}\ (1.194 \times 10^{-7})(14806000\ \text{SCFH}) =$$
$$= 229.8\ \text{lb/Hr @ 130 ppm}$$
$$= 139.7\ \text{lb/Hr @ 79 ppm}$$

Note: These values are conservative as the 130 and 79 ppm values are corrected to ISO ambient conditions. Actual emissions will be as much as 20% less depending on atmospheric conditions (for example, they were 7.14% less during 2/25/87 compliance test).

Item 4: CO emissions at NO_x concentrations of 130 and 79 ppm.

The CO concentrations were about 23 ppm at high load with water injection to control NO_x ≤79 ppm.

$$\text{CO lb/Hr} = 23(7.266 \times 10^{-8})(14806000\ \text{SCFH}) = 24.74$$

DER
APR 30 1987
BAQM

2106 N.W. 67th Place, Suite 4 • Gainesville, Florida 32606 • (904) 335-1889

DEPARTMENT OF ENVIRONMENTAL REGULATION

ROUTING AND TRANSMITTAL SLIP

ACTION NO

ACTION DUE DATE

TO: (NAME, OFFICE, LOCATION)	Initial	Date
1. Bill Thomas		
2. Bureau of Air Quality Manag		
3.	Initial	Date
4. Barry Andrews DER	Initial	Date

REMARKS:

APR 30 1987

BAQM

Response to our previously forwarded incompleteness letter being handled by CAPS.

Faxed 5/11/87

FROM: John Turner

DATE 4/29/87

PHONE SC 325-1403

INFORMATION
- Review & Return
- Review & File
- Initial & Forward

DISPOSITION
- Review & Respond
- Prepare Response
- For My Signature
- For Your Signature
- Let's Discuss
- Set Up Meeting
- Investigate & Report
- Initial & Forward
- Distribute
- Concurrence
- For Processing
- Initial & Return

More importantly, however, CO emissions at low loads were 76.75 lb/Hr because it still took a degree of water injection to keep NO_x below 79 ppm at that load. It is expected that reduction of water injection rates to a level necessary to keep NO_x ≤130 ppm would reduce CO emissions to near zero at all loads.

Items 3 and 4: Are addressed by KUC (attached).

Please contact me if I can be further assistance.

Respectfully,

AIR CONSULTING AND ENGINEERING

Stephen L. Neck, P.E.

SLN:ctg

cc: Mr. Jeff Ling, KUA

More importantly, however, CO emissions at low loads were 76.75 lb/hr because it still took a degree of water injection to keep NO_x below 75 ppm at that load. It is expected that reduction of water injection rates to a level necessary to keep $NO_x \leq 130$ ppm would reduce CO emissions to near zero at all loads.

<u>Items 3 and 4</u>: Are addressed by KUC (attached).

Please contact me if I can be further assistance.

Respectfully

AIR CONSULTING AND ENGINEERING

Stephen L. Neck, P.E.

SLN:ctg

cc: Mr. Jeff Ling, KUA

File C87

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32399-2400

BOB MARTINEZ
GOVERNOR

DALE TWACHTMANN
SECRETARY

April 10, 1987

Mr. Bruce Miller
Chief, Air Facilities Branch
Air & Waste Management Division
USEPA - Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30365

Dear Mr. Miller:

Re: PSD-FL-087
Kissimmee Utilities (Osceola County)

Attached, for your information, is a copy of Kissimmee Utilities' request to increase NOx emission concentrations from their 49.9 MW-Combined Cycle Gas Turbine.

The construction permits for this unit, PSD-FL-087 and AC 49-46521, were originally issued on February 19, 1982, and November 25, 1981, respectively.

In 1983, the Company failed to apply for an operating permit within the time allowed by the construction permit. Therefore, we requested a submission of a new application. The application was reviewed and a new state permit was issued on March 30, 1984.

On April 1, 1984, we received the above mentioned request. Currently, we are in the process of modifying the BACT determination and specific conditions for state permits AC 49-74856 and AO 49-093754.

If you have any questions, please call Teresa Heron (Review Engineer) or Barry Andrews (BACT Coordinator) at (904)488-1344.

Sincerely,

Clair Fancy, P.E.
Deputy Chief
Bureau of Air Quality
Management

CHF/TH/s
Attachments: sent 4/13/87 BAR
-cc: John Turner, DER Orlando

W. MAX ALDERMAN, MANAGER
GENERATION & TRANSMISSION

KUA
KISSIMMEE
UTILITY
AUTHORITY

P. O. BOX 2148 - KISSIMMEE, FLORIDA 32742-2148
305/847-6011

April 6, 1987

Mr. Stephen L. Neck, P.E.
Air Consulting & Engineering
2106 N. W. 67th Place, Suite 4
Gainesville, FL 32606-1608

RE: NO_X Emission Change Order

Dear Steve:

The following information is in reference to our recent telephone conversations in connection with the application for a change of NO_X emission limit.

ITEM 2 - Asks for the source of the figure of 14,735 BTU/kWh. Please see attached worksheet from our last heat rate test for an output of 30 MW from the G.T.

ITEM 3 - The effect water injection has on efficiency and maintenance with an airflow of 353 lb/sec at full load, each 1% of water injection will result in an increase of the heat rate by 1.3% (efficiency decrease).

Water injection increases the occurances of cracking in the combustor baskets due to localised cooling, particularly in the dome area around the burner nozzle. This results in shorter basket life as well as increased maintenance and down time costs.

Up to the present time, we have had costs of approximately $16,000 for basket repairs and $36,000 for a standby set of burner nozzles.

Mr. Stephen L. Neck, P.E.
RE: NO_x Emission Change Order
April 6, 1987

Downtime has cost us anywhere up to $5,000 per day, according to the situatin on system external to KUA. Up to the present time no work has been carried out on the turbine section of our machine, other than visual inspection.

This has however, revealed deposits building up on the blades and vanes, in excess of what would normally be expected with the hours that the machine has run.

It is felt that the majority of the deposit buildup is due to the use of water injection at the rate required to comply with the present emission rates. We therefore expect that we will have to decrease the period between major turbine inspections, to take into account the increased fouling rate found in the turbine.

As both Westinghouse and KUA have only a short operating experience using water injection, it is not possible to draw on any further data than that noted above.

Regards,

KISSIMMEE UTILITY AUTHORITY

Jeff Ling
Power Plant Superintendent

JL/rk

cc - Max Alderman

MONDAY DATE: OCT 06 1986

DAILY HEAT RATE & FUEL COST CALCULATION SHEET

1300 To 1400
Load @ 30 M.W.

UNIT	GAS METER DIFF.	FT³-GAS A X 1,000	BTU-GAS B X 1024	THERMS. C ÷ 100,000	GAS COST D X GAS COST/THERM.	FUEL OIL METER DIFF.	BTU-OIL F X 137,028	OIL COST F X OIL COST/GALLON	TOTAL BTU C + G	TOTAL COST E + H	KWH METER DIFF. X MULTI.	BTU-KWH I ÷ K	$/MWH J ÷ MWH
	A	B	C	D	E	F	G	H	I	J	K	L	M
GT	423	423000	433152000	4332	896.62	——	——	——	433152000		30000	14430	29.88
2&23												14735	30.50
OTAL													

Corrected figure for Btu Content & Cost per therm

	METER DIFF. X 100	A X 7.94321	B X 1024	C ÷ 100,000	D X GAS COST/THERM.	METER DIFF.	F X 137,028	F X OIL COST/GALLON	C + G	E + H	METER DIFF. X MULTI.	I ÷ K	J ÷ MWH	L/O Added
ENG.														
ENG.														
ENG.														
ENG.														
ENG.														
ENG.														
ENG.														
ENG.														
ENG.														
TAL														
CC														
ESELS														
ANT	XXXX													

Mon 1023 (1020 - 1026)
1045

.190

FT³ GAS= 1024 BTU GAL. OIL = 137,028 BTU GAS COST 0.207 /THERM. FUEL OIL COST _____ /GAL. THERM.= 100,000 BTU

SECTION XXIV - 123.2

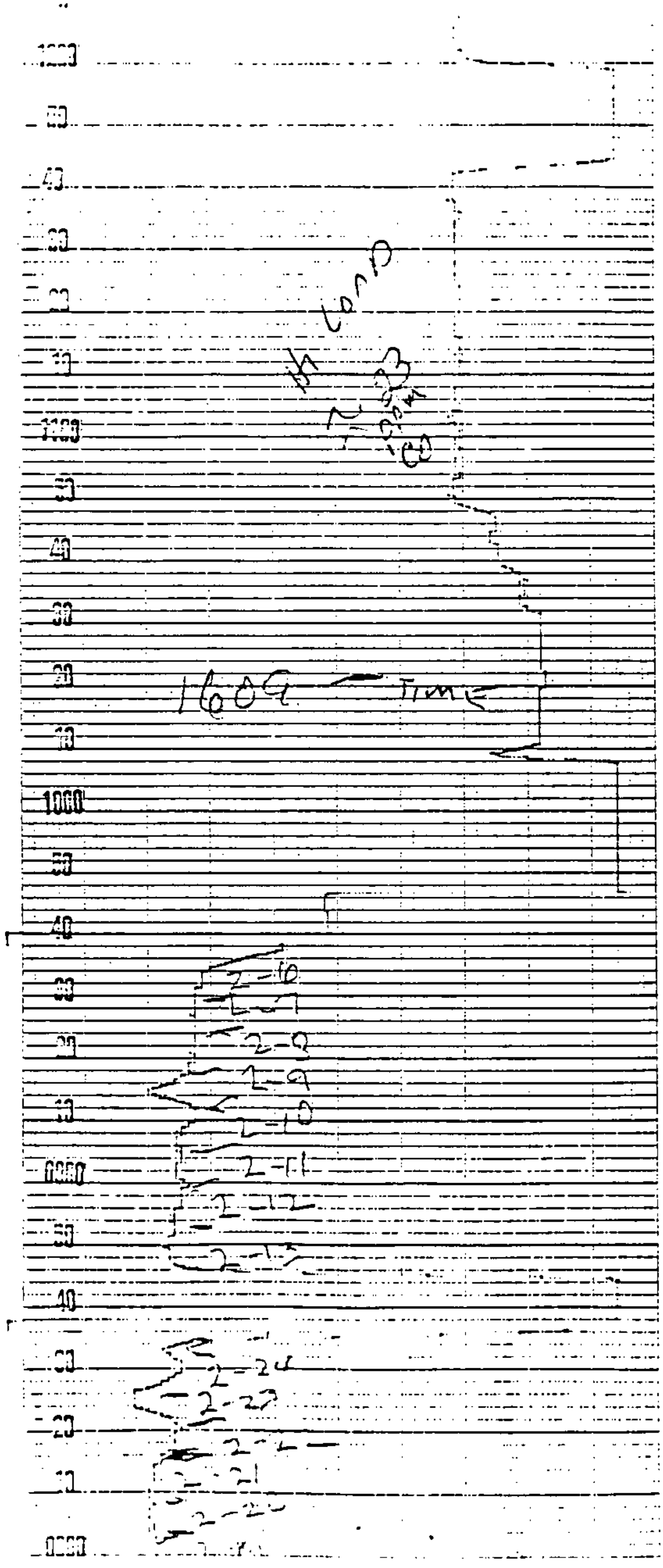
8/31/84

Table 1 CO, NO_x Emission Summary
Kissimmee Utilities Authority
February 25, 1987

Load Average MW	NO_x ppm dry	O_2 %	NO_x ppm dry 15% O_2	DB °C	Relative Humidity %	Specific Humidity	Barometric Pressure "Hg	Temperature Correction Factor	Humidity Correction Factor	Pressure Correction Factor	NO_x* ppm	CO ppm
18	41	17.0	62	24.7	68	0.0134	30.08	0.950	1.144	0.997	67	64
23	42	16.4	55	20.4	83	0.0127	30.08	0.972	1.129	0.997	60	--
28	52	15.6	58	21.9	73	0.0122	30.08	0.964	1.118	0.997	62	--
32	63	15.2	65	24.6	68	0.0134	30.08	0.951	1.144	0.997	70	--

*Permitted Rate = 79 ppm

CO Emission Rate = (64)(2.595 x 10^{-9})(28)(275080)(60) = 76.75 lb/Hr


1609 — Time
1000
40
2-10
2-9
2-9
2-10
2-11

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

CENTRAL FLORIDA DISTRICT
3319 MAGUIRE BOULEVARD
SUITE 232
ORLANDO, FLORIDA 32803-3767

March 27, 1987

COMPLETENESS SUMMARY AIR POLLUTION SOURCES

SOURCE NAME: Kissimmee Utilities
Combined Cycle Gas Turbine
(AO49-093754)

DATE RECEIVED: 3/2/87

DATE REVIEWED: 3/25/87

APPLICANT NAME: Stephen L. Neck, P.E.

REVIEWED BY: John Turner

APPLICANT ADDRESS: Air Consulting & Engineering
2106 N. W. 67th Place, Suite 4
Gainesville, Florida 32606

Your application for a permit to construct/operate this referenced project has been received, and reviewed for completeness. The following checked items are needed to complete your application.

( ) Application fee of $_____. Make check payable to the Department of Environmental Regulation.

( ) Letter authorizing applicant to represent owner.

( ) 8-1/2" x 11" diagram of flow process.

( ) 8-1/2" x 11" location map.

( ) 8-1/2" x 11" plant layout sketch showing emission points.

( ) Test results showing compliance with emission limitations of the department. (see next page)

( ) Air diffusion modeling results showing compliance with ambient air standards and PSD increment.

( ) Engineer's report pursuant to Florida Administrative Code Rule 17-4.21(1)(c).

( ) See comments on application attached.

(X) Other: (Any section of the application which is incomplete or lacks sufficient information to be evaluated).

1) Submit estimates of actual NO_x emissions for NO_x concentrations of 130 ppm and 79 ppm.

2) Explain the source of the 14,735 BTU/KwH in Attachment - 6.0.

DER Form 17-1.202(2), Effective Date November 30, 1982

3) Provide data and further information supporting the statements that the water injection rates used to maintain emissions of NO_x at or below 79 ppm results in decreased efficiency, and considerable combuster and turbine damage, and provide an economic analysis concerning the increased operating and maintenance costs.

4) Provide estimates of the CO emissions for NO_x concentrations of 130 ppm and 79 ppm.

5) Please provide a copy of your February 25, 1987 letter which bears your P.E. seal.

Pursuant to Section 120.60(2) Florida Statutes, the department may deny an application if the applicant, after receiving timely notice fails to correct errors, omissions or supply additional information within a reasonable period of time.

Your request has been forwarded to Central Air Permitting for further processing. Please direct future correspondence on this matter to Mr. Bill Thomas, and send a copy to our Central Florida District Office.

Sincerely,

A. T. Sawicki

A. T. Sawicki, P.E., Supervisor
Air Engineering

ATS/jte

cc: James D. Welsh, Utilities Director
Bill Thomas, BAQM

Natural Gas : A combustible, gaseous mixture of low-molecular-weight paraffin hydrocarbons, generated below the surface of the earth; contains mostly methane and ethane with small amounts of propane, butane, and higher hydrocarbons, and sometimes nitrogen, carbon dioxide, hydrogen sulfide, and helium

CH_3

Bound Water : Water that is portion of a system such as tissues or soil and does not form ice crystals until the material's temperature is lowered to about -20°C

$Ca(SO_4) \cdot 2H_2O$ Bound water

$pb + H_2O$ — water not bound

Air Consulting and Engineering

February 25, 1987
151 87 01

DER
APR 1 1987
BAQM

Mr. A.T. Sawicki
Florida Department of
Environmental Regulation
3319 Maguire Blvd., Suite 232
Orlando, Florida 32803

RE: Kissimmee Utilities Commission Gas Turbine Allowable NO_x Emissions As Specified In Permit Number AO-49-093754

Dear Mr. Sawicki:

On behalf of Kissimmee Utilities Commission (KUC), Air Consulting and Engineering (ACE) has investigated the current maximum allowable emissions specified in the referenced operating permit. It would appear from the information and calculations included in this submittal, that KUC should be allowed a maximum NO_x emission of 130 ppm corrected to standard conditions versus the current limit of 79 ppm. This adjustment is necessary in accordance with Subpart GG NSPS standards which allows credit for fuel bound nitrogen. It is my belief that the fuel bound nitrogen content of natural gas was either never investigated during the original permitting effort or that the fuel analysis has changed since that time period.

Please review the enclosed data. If you agree with my assessment, I wish to ask for a permit change to reflect the higher allowable emission. I would also like to point out that the high water injection rates that are now necessary to ensure a maximum emission of 79 ppm results in greater fuel usage (decreased efficiency) and considerable combuster and turbine damage (increased maintenance cost). The high water rates also result in higher than necessary carbon monoxide emissions at all loads.

Please contact Mr. Jeff Ling of KUC or me if you have any questions regarding this request.

Respectfully,

AIR CONSULTING AND ENGINEERING

Stephen L. Neck, P.E.

SLN:ctg

attachments

cc: Mr. Jeff Ling (KUC)

2106 N.W. 67th Place, Suite 4 • Gainesville, Florida 32606 • (904) 335-1889

TABLE 1
ALLOWABLE EMISSION LIMITS
49.9 MW Combined Cycle Combustion Turbine

Pollutant	Standard	Gas Turbine[a]	Boiler	Basis
NO_x[a]	$0.0075 \frac{(14.4)}{Y} + F$	79 PPM (gas) and 129 (oil) at 15 percent oxygen on a dry basis		NSPS, BACT
SO_2	0.8 percent S by weight 0.015 percent by volume at 15 percent oxygen on a dry basis	0.5 percent S by weight and 255 lb/hr	0.5 percent S by weight	NSPS, BACT
PM[b]	20% opacity	20% opacity or 22 lb/hr	20% opacity	BACT
VOC	-	19 lb/hr		BACT
CO	-	80 lb/hr		BACT
Mercury (Hg)	-	0.0004 lb/hr		Estimated by Applicant
Beryllium (Be)	-	0.00004 lb/hr		EPA 600/57-81-003b

(a) The allowable NO_x emission rate for the gas turbine was determined by the following formula:

$STD = 0.0075 \frac{(14.4)}{Y} + F$ where:

STD = allowable NO_x emissions (percent by volume at 15 percent oxygen and on a dry basis).

Y = manufacturer's rated heat rate at manufacturer's rated load (kilojoules per watt hour) or, actual measured heat rate based on lower heating value of fuel as measured at actual peak load for the facility. The value of Y shall not exceed 14.4 kilojoules per watt hour. The efficiency factor must be based on the gas turbine efficiency itself, not the overall efficiency of the gas turbine combined with other equipment.

NO_x = 79 PPM when burning natural gas

NO_x = 129 PPM when burning fuel oil No. 2

F = NO_x emission allowance for fuel-bound nitrogen as follows:

Fuel-bound nitrogen (Percent by weight)	F (NO_x percent by volume)
N<0.015	0
0.015<N<0.1	0.04(N)
0.1<N<0.25	0.04+0.0067(N-0.1)
N>0.25	0.005

where: N = the nitrogen content of the fuel (percent by weight)

N>0.25 is proposed by the applicant

(b) Visible emissions: Not to exceed 20% opacity; 40% opacity is permitted for not more than two-minutes in any one hour.

ATTACHMENT

1.0 Amount of H_2O in combustion gases

Basis: N atoms of H produce n/2 moles of H_2O.

Methane (CH_4)	4 atoms of H	produces 2 moles H_2O
Ethane (C_2H_6)	6 atoms of H	produces 3 moles H_2O
Propane (C_3H_8)	8 atoms of H	produces 4 moles H_2O
Butane (C_4H_{10})	10 atoms of H	produces 4 moles H_2O
Pentane (C_5H_{12})	12 atoms of H	produces 6 moles H_2O
Hexane (C_6H_{14})	14 atoms of H	produces 7 moles H_2O

Therefore, moles of H_2O produced per mole of gas is equal to:

$$0.96222(2) + 0.02214(3) + 0.0022(4) + (0.00006 + 0.00005)(5) + (0.00004 + 0.00002)(6) + 0.00022(7) = 2.00187$$

2.0 Molecular Weight Of Gas

Nitrogen (as N)	(MW=14)	14 (.00432) +	
Carbon Dioxide	(MW=44)	44 (.00873) +	
Methane	(MW=16)	16 (.96222) +	
Ethane	(MW=30)	30 (.02214) +	
Propane	(MW=44)	44 (.0022) +	
Butane	(MW=58)	58 (.00011) +	
Pentane	(MW=72)	72 (.00006) +	
Hexane	(MW=86)	86 (.00022)	= 16.631

3.0 Weight Of Water Per Dry Ft^3 At 60°F And 14.7 PSIA

$$2.00187 \frac{\text{moles } H_2O}{\text{mole gas}} \times \frac{18 \text{ lb gas}}{1 \text{ mole } H_2O} \times \frac{1 \text{ mole gas}}{16.631 \text{ lb gas}} \times \frac{0.0765 \times .5779 \text{ lb gas}}{Ft^3 \text{ gas}}$$

$$= 0.096 \frac{\text{lb } H_2O}{Ft^3 \text{ gas}}$$

4.0 Lower Heating Value Of Gas

$$LHV = HHV - \frac{\text{lb } H_2O}{Ft^3 \text{ gas}} \times \frac{1023 \text{ Btu}}{\text{lb } H_2O}$$

$$= 1005 - [(.096)(1023)] = 907.0 \frac{\text{Btu}}{Ft^3}$$

5.0 Percent Nitrogen In Fuel

$$\left(0.00432 \frac{\text{moles N}}{\text{mole gas}}\right)\left(\frac{14 \text{ lb N}}{\text{lb mole}}\right)\left(\frac{1 \text{ mole gas}}{16.631 \text{ lb gas}}\right) = 0.00364$$

OR 0.364% N

6.0 Calculation Of Y Using Lower Heating Value

$$Y = \left(\frac{907}{1045}\right)\left(14{,}735 \frac{\text{Btu}}{\text{KwH}}\right) = 12{,}789 \frac{\text{Btu}}{\text{KwH}}$$

Convert To KJ/WH,

$$\left(12{,}789 \frac{\text{Btu}}{\text{KwH}}\right)\left(3600 \frac{\text{KJ}}{\text{Btu}}\right)\left(\frac{1 \text{ Kw}}{1000 \text{ W}}\right) = 13.49 \frac{\text{KJ}}{\text{WH}}$$

KUC ALLOWABLE EMISSION RATE:

$$\text{STD} = 0.0075\left(\frac{14.4}{Y}\right) + .005$$

Where: F = NO_x percent by volume
Y = heat rate (Kj/WH)

$$\text{STD}_{\text{KUC}} = 0.0075\left(\frac{14.4}{13.5}\right) + .005$$

= .0080 + .0050 = 0.013% by volume

= 130 ppm_v corrected to 15% O_2 ISO ambient conditions

W. MAX ALDERMAN, MANAGER
GENERATION & TRANSMISSION

KUA
KISSIMMEE
UTILITY
AUTHORITY

P. O. BOX 2148 - KISSIMMEE, FLORIDA 32742-2148
305/847-8011

February 16, 1987

Mr. Stephen L. Neck, P.E.
Air Consulting and Engineering
2106 N. W. 67th Place, Suite 4
Gainesville, FL 32606

Dear Steve:

Enclosed is a copy of the gas analysis supplied to me by Florida Gas Transmission. I trust that this is to your requirements.

Sincerely,

KISSIMMEE UTILITY AUTHORITY

Jeff Ling
Power Plant Superintendent

JL/rk

Enclosure

12/09/86

FLORIDA GAS TRANSMISSION CO.
TECHNICAL OPERATIONS DEPT.
P. O. BOX 44
WINTER PARK FL 32790-0044

FGT - MARKET SERVICES
MR. JIM DOWDEN
P. O. BOX 44
WINTER PARK FL 32790

GAS ANALYSIS ID NUMBER 86 0780 MEAS. DIST. 07

METER STATION NAME FLA HYDROCARBON - OUTLET STATION NO.

FIELD DATA TAKEN BY B S DATE TAKEN 11-
PRESSURE 634 TEMPERATURE 0 SPEC GRAV 0.5800
BTU 1016 WATER 0.0000 H2S 0.7 /
DATA ANALYZED BY M P. C DATE ANAL. 12-03-86

COMPONENT	MOLE %	B.T.U.	GPM	SPEC GRAV
OXYGEN	0.0000	0.0000	0.0000	0.0000
NITROGEN	0.4320	0.0000	0.0000	0.0042
CARBON DIOXIDE	0.8730	0.0000	0.0000	0.0133
METHANE	96.2220	956.9300	0.0000	0.5331
ETHANE	2.2140	38.5700	0.0000	0.0230
PROPANE	0.2200	5.4500	0.0606	0.0033
I BUTANE	0.0050	0.1600	0.0016	0.0001
N BUTANE	0.0060	0.1900	0.0019	0.0001
I PENTANE	0.0040	0.1600	0.0015	0.0001
N PENTANE	0.0020	0.0800	0.0007	0.0000
HEXANE PLUS	0.0220	1.1300	0.0097	0.0007
TOTALS	100.0000	1002.6700	0.0760	0.5777

BTU/CU FT AT 14.73 PSIA 60 DEG F CORRECTED FOR Z

CALCULATED SATURATED 1005 DRY 1023 0.0000 LB/MMCF 1023
CALORIMETER SATURATED 1003 DRY 1021
SPECIFIC GRAVITY - AIR = 1.0000 CALC 0.5779 RANAREX 0.5780

COMPRESSIBILITY FACTOR - Z = 0.9979
SUPERCOMPRESSIBILITY FACTOR CALC AT 0.5780 SP GR 600 PSIG 90 DEG
BY TEST WITH BURNETT APPARATUS 1.0340
CALC AGA-NX-19 NO DILUENTS 1.0366
CALC AGA-NX-19 ADJUSTED FOR DILUENTS 1.0353

NOTES PHYSICAL CONSTANTS FROM AGA 3
GPM FROM NGPA PUB NO 2145-84
HEXANE PLUS DERIVED FROM PHILLIPS REF STANDARD

REMARKS 3000
P

B A
AGA-NX-19
(0.126).