UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

NOV 2 2 1999

4 APT-ARB

Mr. A. A. Linero, P.E.
Florida Department of Environmental Protection
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

SUBJ: Preliminary Determination and Draft Permit for Kissimmee Utility Authority (KUA) - Cane Island Power Park Units No. 1 and 2 (PSD-FL-182A) located in Osceola County, Florida

Dear Mr. Linero:

Thank you for sending the preliminary determination and draft permit dated November 10, 1999, for the above referenced facility. The preliminary determination is for the proposed modification of the permitted levels of nitrogen oxides (NO_x) emissions, potential to emit, hours of operation and method of compliance for the Cane Island Units No. 1 and 2, located in Osceola County, Florida. The existing facility consists of a 40 MW simple cycle combustion turbine (Unit No. 1) and a 120 MW combined cycle combustion turbine (Unit No. 2). The permitted emission rates for NO_x emissions while firing natural gas/fuel oil are 25/42 ppm and 15/42 ppm, respectively. Effective January 1, 2000, the permitted NO_x emission rates for Unit No. 1 will decrease to 15 ppm while firing natural gas. KUA is requesting that the NO_x emission rate while burning natural gas remain at the 25 ppm level, thereby foregoing the planned 54.3 tons per year (TPY) reduction of NO_x emissions. To counteract this increase in potential emissions, KUA is proposing to limit the number of operating hours for both Units No. 1 and 2. The total emissions from the proposed modification are below the thresholds requiring Prevention of Significant Deterioration (PSD) review for NO_x; however, since this is a relaxation of the previous permit terms, this modification is still subject to PSD review.

Based on our review of the preliminary determination and draft permit, we do not have any significant comments. However, we recommend that KUA continue working with the Unit No. 1 combustion turbine vendor (General Electric) to achieve the NO_x emission rate goal of 15 ppm.

If you have any questions regarding these comments, please direct them to either Katy Forney at 404-562-9130 or Jim Little at 404-562-9118.

Sincerely,

Douglas Neeley

R. Douglas Neeley
Chief
Air and Radiation Technology Branch
Air, Pesticides and Toxics
Management Division

CC: M. Halpin, BAR
NPS
CD
A.K. Sharma, IQA

The Orlando Sentinel

Osceola County
804 W. Emmett Street
Kissimmee, Florida 34741

Date: Nov 19, 1999

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Advertising Account Executive
The Osceola Sentinel

STATE OF FLORIDA
COUNTY OF OSCEOLA

I, the undersigned authority, hereby certify that the foregoing is a true and correct copy of the instrument presented to me by Refik Fortner as the original of such instrument.

WITNESS my hand and official seal, this 19th day of Nov., 1999.

CYRISE A. FRANEY
My Comm Exp. 1/23/2002
No. CC697517
[ ] Personally Known [ ] Other I.D.

Cyrise A. Franey
Notary Public
State of Florida at Large

My commission expires Jan. 23, 2002.

CC: Halpin, BAR
NPS
CD
EPA

PUBLIC NOTICE OF INTENT TO ISSUE AIR CONSTRUCTION PERMIT MODIFICATION

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Kissimmee Utility Authority, Cane Island Power Park
DEP File No. PSD-FL-182A, 0970043-007-AC
Osceola County

The Department of Environmental Protection (Department) gives notice of its intent to issue a modification of a Prevention of Significant Deterioration (PSD) Permit to Kissimmee Utility Authority (KUA) for its Cane Island Power Park located in Osceola County. A Best Available Control Technology (BACT) determination was required for this modification pursuant to Rule 62-212.400, F.A.C. Prevention of Significant Deterioration (PSD). The applicant's name and address are: Kissimmee Utility Authority, 1701 West Carroll Street, Kissimmee, Florida 34741.

This is an existing facility consisting of a 40 Megawatt simple cycle combustion turbine (Unit 1) as well as a 120 Megawatt combined cycle unit (Unit 2). Both units fire natural gas and No. 2 fuel oil with gas/oil heat inputs of 367/372 and 869/928 MMBtu/hr respectively (at an ambient temperature of 59°F). These units have a Title V permit (0970043-001-AV) issued by the State of Florida.

The permitted emission rates of nitrogen oxides (NOx) for Units 1 and 2 while firing gas/oil are 25/42 ppm and 15/42 respectively. On an annual basis the permitted tons per year (TPY) of potential NOx emissions are 171.2 and 290.6 respectively. Effective January 1, 2000 the permitted NOx emission rate for Unit 1 decreases to 15 ppm while firing natural gas firing, causing the potential TPY of NOx to equal to 116.9 (a reduction of 54.3 TPY).

KUA requests that the aforementioned NOx emission rate for Unit 1 remain at 25 ppm while firing natural gas, thereby eliminating the emission rate reduction slated for January 1, 2000. In order to ensure that the potential annual emissions (TPY) of NOx do not remain at the higher levels, further emission limits are proposed as described below. These emission limits will be accomplished by a reduction in the permitted operating hours of Unit 1 as well as an annual NOx cap for the combined operation of Units 1 and 2. No. Other emission limit increases are requested.

	Unit 1 potential NOx emissions	Unit 2 potential NOx emissions	Units 1 and 2 combined potential NOx emissions
As currently permitted	171.2	290.6	461.8
As permitted effective 1/1/00	116.9	290.6	407.5
As requested effective 1/1/00	103.5	290.6	366.1 (annual cap)

In addition to the above, a number of other Unit 1 pollutant emissions have the potential to be reduced. These are itemized below.

Pollutant - Tons per year (TPY)	Permitted Unit 1 Potential Emissions effective 1/1/00	Requested Unit 1 Potential Emissions effective 1/1/00	Unit 1 Potential Emissions Reductions
Particular Matter (PM/PM10)	40.9	24	16.9
Volatile Organic compounds (VOC)	6.9	4.3	2.6
Carbon Monoxide (CO)	193.2	121.5	71.7

It is noted that emissions from Unit 1 have ranged from 6 to 29 tons per year of NOx over a 5 year period. This reflects the peaking characteristics of the Unit. These values are less than significant for PSD and it is expected that the unit will typically operate in a similar manner in the future regardless of potential emissions.

The Department will issue the final permit modification with the attached conditions unless a response received in accordance with the following procedures results in a different decision or significant change of terms or conditions.

The Department will accept written comments concerning the proposed permit issuance action for a period of 14 (fourteen) days from the date of publication of "Public Notice of Intent to Issue PSD Permit Modification." Written comments should be provided to the Departments Bureau of Air Regulation at 2600 Blair Stone Road, Mail Station #5505, Tallahassee, FL 32399-2400. Any written comments filed shall be made available for public inspection. If written comments received result in a significant change in the proposed agency action, the Department shall revise the proposed permit and require, if applicable, another Public Notice.

The Department will issue the permit modification with the attached conditions unless a timely petition for an administrative hearing is filed pursuant to Sections 120.569 and 120.57 F.S., before the deadline for filing a petition. The procedures for petitioning for a hearing are set forth below. Mediation is not available in this proceeding.

A person whose substantial interests are affected by the proposed permitting decision may petition for an administrative proceeding (hearing) under sections 120.569 and 120.57 of the Florida Statutes. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station #35, Tallahassee, Florida, 32399-3000. Petitions filed by the permit applicant or any of the parties listed below must be filed within fourteen days of receipt of this notice of intent. Petitions filed by any persons other than those entitled to written notice under section 120.60(3) of the Florida Statutes must be filed within fourteen days of publication of the public notice or within fourteen days of receipt of this notice of intent, whichever occurs first. Under section 120.60(3), however, any person who asked the Department for notice of agency action may file a petition within fourteen days of receipt of that notice, regardless of the date of publication. A petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. The failure of any person to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under sections 120.569 and 120.57 F.S., or to intervene in this proceeding and participate as a party to it. Any subsequent intervention will be only at the approval of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205 of the Florida Administrative Code.

A petition that disputes the material facts on which the Department's action is based must contain the following information: (a) The name and address of each agency affected and each agency's file or identification number, if known; (b) The name, address, and telephone number of the petitioner, the name, address, and telephone number of the petitioner's representative, if any, which shall be the address for service purposes during the course of the proceeding; and an explanation of how the petitioner's substantial interests will be affected by the agency determination; (c) A statement of how and when petitioner received notice of the agency action or proposed action; (d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate; (e) A concise statement of the ultimate facts alleged, as well as the rules and statutes which entitle the petitioner to relief; and (f) A demand for relief.

A petition that does not dispute the material facts upon which the Department's action is based shall state that no such facts are in dispute and otherwise shall contain the same information as set forth above, as required by Rule 28-106.301.

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department's final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department on the application have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

A complete project file is available for public inspection during normal business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at:

Department of Environmental Protection
Bureau of Air Regulation
111 S. Magnolia Drive, Suite 4
Tallahassee, Florida 32301
Telephone: 850/488-0114
Fax: 850/922-6979

Department of Environmental Protection
Central District Office
3319 Maguire Blvd., Suite 232
Orlando, Florida 32803-3767
Telephone: 407/894-7555
Fax: 407/897-2966

The complete project file includes the Draft Permit modification, the application, and the information submitted by the responsible official, exclusive of confidential records under Section 403.111, F.S. Interested persons may contact the New Resource Review Section at 111 South Magnolia Drive, Suite 4, Tallahassee, Florida 32301, or call 851/488-0114, for additional information.

Fold at line over top of envelope to the right of the return address

SENDER:
- Complete items 1 and/or 2 for additional services
- Complete items 3, 4a, and 4b
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "*Return Receipt Requested*" on the mailpiece below the article number.
- The Return Receipt will show to whom the article was delivered and the date delivered.

I also wish to receive the following services (for an extra fee).
1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:
Mr. A.K. Sharma
Director of Power Supply
KUA
1701 W. Carroll St.
Kissimmee, Fl
34741-6804

4a. Article Number
P 265 659 306

4b. Service Type
☐ Registered ☒ Certified
☐ Express Mail ☐ Insured
☐ Return Receipt for Merchandise ☐ COD

7. Date of Delivery
9-27-99

5. Received By: *(Print Name)*

8. Addressee's Address *(Only if requested and fee is paid)*

6. Signature: *(Addressee or Agent)*
X

PS Form **3811**, December 1994 102595-98-B-0229 Domestic Return Receipt

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Thank you for using Return Receipt Service.

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US Postal Service
Receipt for Certified Mail
No Insurance Coverage Provided.
Do not use for International Mail *(See reverse)*

Sent to: A.K. Sharma	
Street & Number: KUA	
Post Office, State, & ZIP Code: Kissimmee Fl	
Postage	$
Certified Fee	
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	
Return Receipt Showing to Whom, Date, & Addressee's Address	
TOTAL Postage & Fees	$
Postmark or Date: 9-24-99	

PS Form **3800**, April 1995

0970043-007-AC
PSO-FI-182A

BLACK & VEATCH

8400 Ward Parkway
P.O. Box 8405
Kansas City, Missouri 64114

Tel: (913) 458-2000

Black & Veatch Corporation

Kissimmee Utility Authority
Cane Island – Unit 1 PSD Permit Amendment Request

B&V Project 24489.018
B&V File 32.0000
October 20, 1999

Florida Department of Environmental Protection
Division of Air Resource Management
Bureau of Air Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Subject: Response to Request for Additional Information

Attention: Al Linero
Administrator, New Source Review Section

Gentlemen:

On behalf of Kissimmee Utility Authority (KUA, the Applicant), Black & Veatch (B&V) is herewith submitting the additional information requested in Florida Department of Environmental Protection's (FDEP) September 24, 1999 response to the Applicant's Unit 1 permit amendment application of August 31, 1999. As FDEP is aware, General Electric (GE) has not been able to develop the technology for a dual fuel LM6000PA unit to meet a 15 ppmvd natural gas NOx emission rate, and cannot guarantee when, if ever, such technology may be available. Thus, KUA is requesting an amendment to Construction Permit No. AC49-205703 (PSD-FL-182) and the Initial Title V Air Operating Permit, Permit No. 0970043-002-AV, to modify Unit 1's NOx emission limit during natural gas firing from 15 to 25 ppmvd, based on the revised BACT analysis and an operating limit of 5,000 hours per year. As a result of the requested permit amendment, annual potential emissions from Unit 1 will be less than those currently allowed. FDEP's specific information requests, along with the Applicant's responses, are provided below.

Request Item 1:

What are the lowest levels of NO_X that can possibly be consistently achieved with water injection with the LM6000PA engine, based on the experience of KUA and the engine manufacturer? Are lower emissions achievable with higher water injection rates?

Response:

Historical Unit 1 emission test data and relative accuracy test audit (RATA) data (Attachment A) from 1995 through 1998 indicate that natural gas fired NOx emission levels have ranged from approximately 20 ppmvd @ 15% O_2 to just under 25 ppmvd @ 15% O_2 with water injection. The lowest levels consistently achieved are best represented by recent continuous emissions monitoring (CEM) data from October 12, 1999. These data, included as Attachment B, reveal an average NOx emission level for Unit 1 of 21.4 ppmvd @ 15% O_2 for a 3-hour period on October 12, 1999. The average water-to-fuel injection ratio during this period was 1.03:1.

The water injection control systems for Unit 1 were configured by GE to achieve the delicate balance of minimizing NOx emissions while optimizing turbine performance and limiting CO formation. GE's recommended water-to-fuel ratio for LM6000PC combustion turbines firing natural gas is typically 1.18:1 to achieve NOx levels of 25 ppm, while KUA's experience firing natural gas in the LM6000PA combustion turbine demonstrates that approximately a 1:1 water-to-fuel ratio is necessary to achieve NOx emission levels less than 25 ppm. While higher water-to-fuel ratios may result in limited additional NOx reduction (certainly not down to the 15 ppm level), such ratios are not recommended by GE, and may result in reduced combustor life and increased combustor inspections, increased equipment erosion and maintenance costs, unstable combustor flames and potential flame extinction, and high combustor dynamic pressures. GE does not recommend any higher water injection rates than are necessary to achieve NOx emission levels of 25 ppm. Please refer to GE's letter of October 19, 1999 to KUA regarding this issue (included as Attachment C).

Request Item 2:

Please evaluate the applicability of spray intercooling to reducing NO_X emissions from this engine.

Response:

GE currently offers LM6000PC combustion turbines with spray intercooling technology, also known as SPRINT. There have been several inquiries to GE relative to use of SPRINT technology on LM6000PA combustion turbines, but these have been with an emphasis on providing hot day power augmentation (increasing turbine output on high end days), rather than as a method for enhanced NOx control. To date, SPRINT technology has not been used for emission reductions from a LM6000PA combustion turbine, nor has a decision been made whether GE will consider adapting SPRINT technology for modification of LM6000PA field machines. Please refer to GE's letter of October 19, 1999 included as Attachment C.

Request Item 3:

The analysis provided proposed reducing allowable hours of operation firing gas from the current 8760 hours per year to 5000 hours per year. The application information for potential NO_X emissions shows that KUA proposes no reduction in hours of operation for fuel oil firing, allowing for a total of 6000 hours of operation per year (5000 hours for gas firing plus 1000 hours for oil firing). Based on information provided in annual operation reports, Unit 1 has operated 1096 hours in 1996 and 774 hours in 1997, for an average of 935 hours (firing primarily gas). Comparing past actual operation with proposed future operation shows that NO_X emissions will increase by approximately 105 tons per year. Please address this issue.

Response:

It is the Applicant's position that a hot-side SCR for Unit 1 became cost ineffective in the best available control technology (BACT) analysis when the annual hours of natural gas firing were limited to 5,000 h/yr. Furthermore, it is also ineffective at 8,760 h/yr. Results of the revised BACT analysis submitted with the application were intended to substantiate the requested modification of Unit 1's natural gas NOx emission limit from 15 ppmvd @ 15% O_2 to 25 ppmvd @ 15% O_2 on January 1, 2000. A reduction in fuel oil firing hours is neither relevant to the natural gas NOx limit for Unit 1, as it plays no role in achieving lower gas fired NOx emission limits, nor practical for KUA, who's natural gas fuel contracts and partnership with Florida Municipal Power Agency (FMPA) depend on the level of dual-fuel capability currently allowed.

Test data while firing distillate fuel oil (Included in Attachment A) clearly indicate Unit 1's ability to achieve compliance with the 42 ppmvd @ 15% O_2 NOx emission limit. For these reasons, KUA is not proposing a reduction in the distillate fuel oil firing capability of Unit 1.

A comparison of past actual emissions to future potential emissions is typically performed to determine whether or not a modification (physical change or change in the method of operation of an emission unit) results in a significant emission increase with respect to Prevention of Significant Deterioration (PSD) applicability. It must however be made very clear that KUA is neither proposing a physical modification nor change in the method of operation of Unit 1, but merely a relaxation of the 15 ppm NOx emission limit for natural gas firing scheduled to take effect January 1, 2000. The 15 ppm was based on the specific representations from GE, that GE had emerging technology designed to lower LM6000PA emissions to 15 ppm during natural gas firing. A more accurate and representative comparison of NOx emissions, with regard to the proposed request, is to compare the current permit "Potential Emissions" and future proposed permit "Potential Emissions". The following comparison of "Potentials" to "Potentials" illustrates a 49.7 tpy reduction in NOx emissions from Unit 1 based on an emission limit of 25 ppm and 5,000 h/yr of natural gas operation.

Permitted Emission Levels

(36 lb/h (25ppm) * 7,760 h/yr) + (63 lb/h (42 ppm) * 1,000 h/yr) = 171.2 tpy

Proposed Emission Levels

(36 lb/h (25ppm) * 5,000 h/yr) + (63 lb/h (42 ppm) * 1,000 h/yr) = 121.5 tpy

Additional Emissions Reduction

(171.8 tpy (Permitted Emission Level) – 121.5 tpy (Proposed Emission Level)) = 49.7 tpy

Request Item 4:

The application proposes no reduction in hours for oil firing even though annual operation reports show that the greatest amount of oil firing was in 1998 with approximately 13 full load hours on oil. It appears that KUA could propose a dramatic reduction in allowable hours for oil firing without compromising the ability to operate the unit. Please comment and provide historical data showing the actual hours of operation firing gas and oil as well as the fuel consumption by fuel type for calendar years 1998 through 1994. We wish to confirm the information available in our records from annual operation reports.

Response:

As previously stated in response to Item 3, KUA is currently meeting the permitted fuel oil emission limit of 42 ppm, and does not intend to propose a reduction in allowable hours of fuel oil

Unit 1 – Historical Operating Hours and Fuel Consumption

Year	Fuel	Maximum Documented Operation (h/yr)	Fuel Consumption[a]
1995	Natural Gas Fuel Oil	2,201 2	762.2 Mscf/yr 4,835.4 gal/yr
1996	Natural Gas Fuel Oil	404 1	139.9 Mscf/yr 2,417.7 gal/yr
1997	Natural Gas Fuel Oil	772 2	267.3 Mscf/yr 4,835.4 gal/yr
1998	Natural Gas Fuel Oil	1079 17	373.7 Mscf/yr 41,100.9 gal/yr

[a]The fuel consumption calculations are based on a fuel oil of heat content of 138,064 Btu/gal (HHV) and average fuel oil heat input of 338.8 MBtu/h, and a natural gas heat content of 1,042.5 Btu/scf (HHV) and average heat input of 361.0 MBtu/h.

firing. The fuel oil capability is required for backup capability due to the nature of natural gas and purchase power contracts for both KUA and FMPA. The following table summarizes Unit 1's actual operating hours and fuel consumption as requested.

Request Item 5:

Overall, the control cost effectiveness seems high. The analysis does not appear to have been based upon a vendor's quote for a hot SCR system for this installation; an actual quote should be obtained for this analysis. Below are specific points which appear questionable. The contingency of 25% (particularly on top of a 6% retrofit factor) seems very high given that this is commercially available technology.

A. The contingency of 25% (particularly on top of a 6% retrofit factor) seems very high given that this is commercially available technology.

B. The indirect capital costs were generally calculated as a percentage of the total direct capital cost, although more typically the direct installation costs (in the analysis shown as "balance of plant") are not used to estimate the indirect capital costs.

C. The rate for administrative charges, taxes and insurance at 5.75% is higher than a more typical 4% rate.

D. The nominal interest rate used for the capital recovery factor was 10% (the "real interest rate" shown of 5.5% plus apparently an anticipated annual rate of inflation of 4.5%) although 7% is more typical.

E. The charge for lost power generation from backpressure seems excessive, as does the stated increase in back pressure of 6 inches of water.

F. Catalyst life seems low at 3 years, particularly for a unit that fires primarily gas. The Department is aware of at least one vendor that will guarantee a catalyst life of 3 years inclusive of 1000 hours of annual oil firing, yet no NO_X reductions due to oil firing were included in the analysis.

G. The analysis did not consider the control effectiveness for the allowable use of fuel oil, and did not consider any reduction in annual Title V fees associated with the overall decrease in NO_X emissions from both gas and oil firing.

H. There is no description of what constitutes the "annual distribution check", or justification for this cost.

I. The economic analysis was based on only 5000 hours of operation on gas, although with installation of SCR there would be no reason to limit operation to less than 8760 hours per year.

J. The "starting point" for determining the NO_X reductions appears to presume the continuance of water injection. In the event that an SCR is installed, water injection (for gas as well as oil firing) should be able to be eliminated (or at least reduced). A higher "starting point" should therefore be assumed.

Accounting for these comments would serve to improve the cost effectiveness of SCR. Please provide the basis for costs used in the analysis where they differ from the recommendations in the above comments.

Response:

A quote was not obtained directly for this project. However, B&V had a current quote for a similar project that had been obtained only a month before the cost analysis was being developed for Unit 1. This quote is included as Attachment D along with the calculation

performed to adjust this quote to the conditions associated with Unit 1. As illustrated by the costs in the quote, high temperature SCR catalysts are extremely expensive in comparison to conventional SCR catalyst. Changes have been made to the revised BACT cost tables based on FDEP comments. These changes are shown in the enclosed Tables 1 and 2 of Attachment E. It should be noted, however, that these changes do not change the conclusions of the revised BACT analysis which show that installing a high temperature SCR on the Cane Island Unit 1 combustion turbine is not cost effective.

5a. The contingency of 25 percent is typical for studies of this level of detail and is the right level of contingency for this estimate. The contingency accounts for the fact that this is a preliminary design. The following items, which are not resolved at this stage in the project, can significantly impact the cost:

- An exact layout of the new SCR ductwork is not complete
- Location of ammonia storage is not established
- Catalyst prices are in state of fluctuation due to the NOx SIP call being proposed by the EPA for coal fired units
- Structural steel costs are currently volatile
- Labor costs are volatile

Table 3, included in Attachment F shows a comparison of the costs with and without the contingency included. It reasoned from Table 3, that removing the contingency does not result in the high temperature SCR being cost effective.

The six percent retrofit factor is required due to the additional costs associated with retrofit work. The following costs are included in the six percent value:

- Costs associated with lost power generation during the outage to tie in the new equipment.
- Costs associated with additional construction labor required to work around existing equipment at the plant.

5.b. Changes have been made to the costs in accordance with FDEP's comment. Revised costs are reflected in Tables 1 and 2 in Attachment E. Specifically, the Purchase Equipment Cost consists of catalyst and ammonia, ductwork and catalyst reactor, control/instrumentation, and ammonia storage.

5.c. Changes have been made to the costs in accordance with FDEP's comment. Revised costs are reflected in Tables 1 and 2 in Attachment E.

5.d. The capital recovery factor for this project was calculated incorrectly. It should have been based on an interest rate of 5.5 percent. Revisions to the costs using the correct capital recovery factor are shown in Tables 1 and 2 in Attachment E. Please note that this interest rate is less than the seven percent referenced in FDEP's Request for additional information.

5.e. The charge for lost power is based on taking the backpressure on the combustion turbine and converting it to lost kilowatts (kW's). This calculation is based on a graph provided to B&V by Westinghouse on another project. This is the standard calculation used by B&V for calculating lost generation. Once kW's are calculated, the kW's are multiplied by the hours of operation per year and the energy costs (in $/kWh) listed in Table 1 of the revised BACT included in the "Application". The back pressure of 6 inches w.g. was developed by taking the

4.5 in w.g. from the catalyst quote plus an additional 1.5 in w.g. due to the additional ductwork that will be required in Unit 1's retrofit. The extra 1.5 in w.g. would not be required for a new unit.

5.f. The catalyst in the quote has been guaranteed for 3 years worth of operating hours. Therefore, for Unit 1 (with only 5,000 hours of operation), the actual catalyst life is equivalent to 5.3 years. The catalyst costs listed in the revised BACT are for 5.3 years not 3 years. Manufacturers are guaranteeing a catalyst life of three years worth of operating hours. However, there are concerns about how well high temperature SCR's will last on a unit which has the potential to fire fuel oil. Included as Attachment G is a telephone memorandum discussing three oil fired units in Puerto Rico which have rapidly degrading, high temperature SCR catalysts. It should be noted that due to impurities in the oil, fuel oil firing degrades the catalyst even when ammonia is not being injected.

5.g. As previously discussed, no reduction in fuel oil fired emissions are required in this request for modification of the natural gas NOx emission limit and no evaluation of fuel oil NOx reduction is required or relevant to this process. Title V fee savings are not included in the BACT cost analysis, but neither are the training and development costs associated with the Title III - Risk Management Program which are required when ammonia is stored onsite. It is expected that the savings and incurred costs of these two items would nearly offset each other, and therefore were not included in the BACT cost analysis.

5.h. An annual distribution check is required to ensure the ammonia slip is minimized in the SCR system and to track catalyst life. The activities associated with this include NOx testing of the SCR catalyst inlet and outlet. Ammonia testing of the catalyst outlet is included and catalyst activity tests are also included. The costs are based on testing quotes from other projects.

5.i. A revised BACT analysis was performed based on the operating scenario of the Cane Island Power Park. If KUA proposed that Unit 1 would be operated 8,760 hours per year, then the revised BACT analysis would have been performed for 8,760 hours per year. However, we are proposing an operating limitation of 5,000 hours per year. Therefore, this is the operating scenario that should be used to perform the BACT analysis and is the information contained in the revised BACT submitted to FDEP as Attachment D of the "Request Letter".

5.j. As stated in the revised BACT, the analysis follows a "Top Down" approach as USEPA guidance authorizes, and the most stringent NOx control should be compared to the next most stringent NOx control technology analysis. Therefore, an SCR is compared to the next most stringent NOx control (water injection). If the revised BACT had compared SCR to conventional combustors without water injection, it would have skipped an important step in the NOx control alternatives. In addition, the revised BACT analysis would not have followed regulatory guidelines, which require a "Top Down analysis in which the most stringent technology is compared to the next most stringent technology. It seems inconsistent to suggest comparing SCR to conventional combustors when FDEP has a documented history of promoting in-combustion controls over post-combustion controls.

Request Item 6:

Please indicate whether any other (additional) means are available to obtain real offsetting reductions in NO_X emissions from the facility as a whole.

Response:

Short of installing SCR systems, which are clearly contrary to FDEP's documented history of promoting in-combustion controls over post combustion controls, limited annual operation of Unit 1 is the only practical option available to obtain real offsetting NOx reductions.

If you have any questions regarding this submittal, please do not hesitate to call me at 913-458-7928.

Very truly yours,

BLACK & VEATCH

Timothy M. Hillman
Air Permit Coordinator

kjl
Enclosure[s]

cc: Ben Sharma (KUA)
Jeff Ling (KUA)
Tasha Buford

ATTACHMENT A

NOx EMISSION SUMMARY for RELATIVE ACCURACY TEST AUDITS
COMBUSTION TURBINE 1
CANE ISLAND PLANT
KISSIMMEE UTILITIES AUTHORITY
INTERCESSION CITY, FLORIDA
NOVEMBER 15, 1995

FIGURE 1 - RELATIVE ACCURACY DETERMINATION(NOx)

RUN NO.	TIME	NOx PPM @ 15% O2			CT LOAD	NOx LB/MMBTU		
		RM	M	DIFF	MW	RM	M	DIFF
1	0750-0814	22.19	22.39	-0.2	40.0	0.082	0.082	0
2	0837-0901	23.7	22.89	0.81	40.0	0.087	0.084	0.003
3	0909-0933	23.58	23.65	-0.07	40.0	0.087	0.087	0
4	0945-1009	24.32	23.95	0.37	40.0	0.09	0.088	0.002
5	1016-1040	23.94	23.41	0.53	40.0	0.088	0.086	0.002
6	1047-1111	22.99	22.97	0.02	40.0	0.084	0.085	-0.001
7	1121-1145	23.89	23.12	0.77	39.8	0.088	0.085	0.003
8	1152-1216	23.6	23.08	0.52	39.9	0.087	0.085	0.002
9	1224-1248	23.54	23.08	0.46	39.7	0.086	0.085	0.001
TOTAL DATA POINTS:				9				9
AVERAGE :		23.53	23.17	0.357		0.0866	0.0852	0.0013
Sd:				0.362				0.0014
CC:				0.278				0.0011
RA:				**2.70**				**2.80**
BAF(BIAS ADJUSTMENT):				1.015				1.016

Table 1 Emission Summary
Units 1 and 2
Cane Island Facility
Kissimmee Utility Authority
Intercession City, Florida
October 8-9, 1996

Unit 1 - Number 2 Diesel Firing - October 9, 1996

Run No.	Time	Actual Heat Input GPM	MMBTUH HHV	O2%	NOx Emissions ppmvd	15% O2 ppmvd	ISO ppmvd	lbs/MMBTU	
1	0952-1059	38.1	315.61	14.92	38.12	37.59	44.47	0.147	4
2	1122-1231	38.7	320.6	14.65	38.71	36.55	44.19	0.142	4
3	1245-1352	44.1	365.3	14.92	37.99	37.49	46.00	0.146	5
Average		40.3	333.8	14.83	38.27	37.21	44.89	0.145	4

Unit 1 - Natural Gas Firing - October 9, 1996

Run No.	Time	Actual Heat Input KSCFH	MMBTUH HHV	O2%	NOx Emissions ppmvd	15% O2 ppmvd	ISO ppmvd	lbs/MMBTU	
1	1458-1648	339.85	354.3	15.41	22.82	24.5	29.97	0.090	3
2	1701-1845	339.85	354.3	15.33	23.02	24.39	29.18	0.090	3
3	1857-2024	359.04	374.3	15.39	23.06	24.68	30.46	0.091	3
Average		346.25	361.0	15.38	22.97	24.52	29.87	0.090	3

Unit 2 - Natural Gas Firing - October 8, 1996

Run No.	Time	Actual Heat Input KSCFH	MMBTUH HHV	O2%	NOx Emissions ppmvd	15% O2 ppmvd	ISO ppmvd	lbs/MMBTU	
1	1405-1512	800	834	15.08	7.89	7.99	10.02	0.030	24
2	1532-1639	810	844	15.01	7.91	7.93	10.04	0.029	24
3	1653-1800	815	850	15.12	8.06	8.23	9.90	0.030	25
Average		808	843	15.07	7.95	8.05	9.99	0.030	24

NOTES: ISO = emissions at 59°F, 40% RH, 29.92" Hg
HHV Oil = 138064 BTU/Gal
HHV Gas = 1042.5 BTU/SCF
lbs/MMBTU = ppm $(2.595 \times 10\text{-}9)(M)(Fd)\left(\frac{20.9}{20.9 - \%O2}\right)$
lbs/Hr = lbs/MMBTU x MMBTUH

TABLE 1 - NOx RATA RESULTS
COMBUSTION TURBINE CT-1
KISSIMMEE UTILITIES AUTHORITY
CANE ISLAND PLANT
10/16/97
NATURAL GAS FIRING

RELATIVE ACCURACY DETERMINATION(NOx/DILUENT)

RUN NO.	TIME	REFERENCE METHOD			NOx COMBINED SYSTEM(LB/MMbtu)		
		NOx PPM	O2 %	LB/MMbtu	RM	M	DIFF
1	1007-1037	22.61	15.27	0.087	0.087	0.077	0.010
2	1047-1117	21.15	15.24	0.081	0.081	0.074	0.007
3	1132-1202	20.89	15.23	0.080	0.080	0.074	0.006
4	1210-1240	21.19	15.22	0.081	0.081	0.075	0.006
5	1253-1323	21.50	15.24	0.083	0.083	0.077	0.006
6	1331-1401	22.36	15.23	0.086	0.086	0.076	0.010
7	1410-1434	22.87	15.32	0.089	0.089	0.077	0.012
8	1441-1505	21.82	15.25	0.084	0.084	0.078	0.006
9	1514-1538	21.58	15.17	0.082	0.082	0.077	0.005
TOTAL DATA POINTS:				9			9
AVERAGE DIFF. :		21.78	15.24	0.084	0.084	0.076	0.008
Sd:							0.002
CC:							0.002
RA:							**11.29**
BAF(BIAS ADJUSTMENT):							1.099

TABLE 1 - NOx RATA RESULTS
COMBUSTION TURBINE CT-1
KISSIMMEE UTILITIES AUTHORITY-CANE ISLAND
INTERCESSION CITY, FLORIDA
10/6/98
NATURAL GAS FIRING

RELATIVE ACCURACY DETERMINATION(NOx/DILUENT)

RUN NO.	TIME	REFERENCE METHOD			NOx COMBINED SYSTEM(LB/MMbtu)		
		NOx PPM	O2 %	LB/MMbtu	RM	M	DIFF
1	1025-1045	21.53	14.64	0.075	0.075	0.079	-0.004
2	1059-1119	20.33	14.75	0.072	0.072	0.081	-0.009
3	1130-1150	19.90	14.69	0.070	0.070	0.082	-0.012
4	1205-1225	22.02	14.71	0.077	0.077	0.083	-0.006
5	1235-1255	20.82	14.72	0.073	0.073	0.083	-0.010
6	1309-1329	20.30	14.77	0.072	0.072	0.083	-0.011
7	1346-1406	21.71	14.76	0.077	0.077	0.083	-0.006
8	1418-1438	21.65	14.70	0.076	0.076	0.083	-0.007
9	1448-1508	22.20	14.71	0.078	0.078	0.083	-0.005
TOTAL DATA POINTS:				9			9
AVERAGE DIFF. :		21.16	14.72	0.074	0.074	0.082	-0.008
Sd:							0.003
CC:		PASSED WITH AVERAGE DIFFERENCE < 0.01					0.002
RA:							13.36
BAF(BIAS ADJUSTMENT):							1.000

ATTACHMENT B

October 12,1999
Unit 1

	NOx_cor_1	H2O_INJ_1	GAS_FL_1	LOAD_1	Gas pph	H2o pph	water to gas ratio
16:30	21.7	27.44	5228	30	14220.9212	13730.976	0.965547577
16:31	21.5	27.39	5219	30.01	14196.43989	13705.956	0.965450219
16:32	24.3	27.55	5218	30.01	14193.71974	13786.02	0.971276047
16:33	20.9	27.63	5224	30.06	14210.04061	13826.052	0.972977655
16:34	21.2	27.83	5223	30.02	14207.32047	13926.132	0.980208198
16:35	21	27.79	5227	30.01	14218.20105	13906.116	0.978050314
16:36	20.9	27.45	5225	30.01	14212.76076	13735.98	0.966454036
16:37	21.4	28.04	5220	30.03	14199.16003	14031.216	0.988172256
16:38	20.9	27.54	5216	30.04	14188.27945	13781.016	0.971295783
16:39	21.2	27.68	5230	30.01	14226.36149	13851.072	0.973620136
16:40	21.1	28.11	5222	30.06	14204.60032	14066.244	0.990259752
16:41	20.8	27.71	5224	30.01	14210.04061	13866.084	0.975794818
16:42	21.2	27.91	5223	30	14207.32047	13966.164	0.983025901
16:43	20.7	30.36	5610	33.09	15260.01682	15192.144	0.995552245
16:44	22.9	32.81	5781	33.94	15725.16171	16418.124	1.044067101
16:45	20.9	31.94	5785	33.89	15736.0423	15982.776	1.015679527
16:46	21.9	32.35	5778	33.81	15717.00128	16187.94	1.02996365
16:47	21.1	32.24	5775	33.84	15708.84084	16132.896	1.026994682
16:48	21.5	32	5778	33.84	15717.00128	16012.8	1.018820303
16:49	21.6	32.45	5782	33.85	15727.88186	16237.98	1.03243273
16:50	21.1	32.1	5774	33.88	15706.12069	16062.84	1.02271212
16:51	21.5	32.64	5779	34.02	15719.72142	16333.056	1.039016886
16:52	21.2	32.21	5785	34.05	15736.0423	16117.884	1.024265422
16:53	21.5	32.77	5777	33.99	15714.28113	16398.108	1.043516268
16:54	21.1	31.82	5762	33.86	15673.47895	15922.728	1.015902599
16:55	21.9	32.6	5766	33.8	15684.35953	16313.04	1.040083273
16:56	21	32.04	5764	33.81	15678.91924	16032.816	1.022571502
16:57	21.4	32.13	5779	33.86	15719.72142	16077.852	1.022782247
16:58	21.5	32.31	5768	33.81	15689.79982	16167.924	1.030473568
16:59	21.4	32.32	5777	33.89	15714.28113	16172.928	1.029186627
17:00	21.4	32.49	5778	33.94	15717.00128	16257.996	1.034420989
17:01	21.4	32.41	5775	33.89	15708.84084	16217.964	1.032409976
17:02	51.8	32.95	5773	33.92	15703.40055	16488.18	1.049975128
17:03	20.2	33	5774	33.88	15706.12069	16513.2	1.051386292
17:04	20.5	32.16	5775	33.89	15708.84084	16092.864	1.024446308
17:05	21.3	32.69	5773	33.93	15703.40055	16358.076	1.041690043
17:06	20.9	32.58	5770	33.94	15695.24011	16303.032	1.0387246
17:07	21.3	32.38	5775	33.85	15708.84084	16202.952	1.031454336
17:08	21.1	32.33	5744	33.75	15624.51633	16177.932	1.0354197
17:09	21.1	32.23	5767	33.84	15687.07968	16127.892	1.028100343
17:10	21.3	32.41	5770	33.78	15695.24011	16217.964	1.033304612
17:11	21.1	32.04	5734	33.76	15597.31487	16032.816	1.027921545
17:12	21.4	32.68	5741	33.77	15616.35589	16353.072	1.04717593
17:13	20.7	32.31	5746	33.72	15629.95662	16167.924	1.034418994
17:14	21	32.3	5740	33.71	15613.63574	16162.92	1.035179779
17:15	21	31.95	5736	33.7	15602.75516	15987.78	1.024676721
17:16	21.2	32.41	5725	33.7	15572.83356	16217.964	1.041426657
17:17	20.8	32.55	5747	33.77	15632.67676	16288.02	1.041921371
17:18	20.8	32.15	5754	33.91	15651.71778	16087.86	1.027865454
17:19	21.5	32.91	5758	33.92	15662.59836	16468.164	1.051432439

17:20	20.6	32.68	5773	33.92	15703.40055	16353.072	1.041371386
17:21	20.8	32.51	5757	33.84	15659.87822	16268.004	1.038833366
17:22	21	32.34	5758	33.76	15662.59836	16182.936	1.033221668
17:23	21.1	32.06	5721	33.66	15561.95298	16042.824	1.030900429
17:24	21	32.09	5714	33.58	15542.91196	16057.836	1.033129187
17:25	21.1	31.94	5714	33.55	15542.91196	15982.776	1.028299976
17:26	21	32.12	5713	33.52	15540.19181	16072.848	1.034276037
17:27	20.9	32.12	5721	33.61	15561.95298	16072.848	1.03282975
17:28	21	32.45	5740	33.77	15613.63574	16237.98	1.039987116
17:29	20.8	32.4	5756	33.76	15657.15807	16212.96	1.035498264
17:30	20.9	32.52	5751	33.77	15643.55735	16273.008	1.040237054
17:31	21	32.16	5759	33.77	15665.31851	16092.864	1.027292486
17:32	33.1	31.74	5735	33.74	15600.03502	15882.696	1.018119253
17:33	21.4	31.77	5749	33.7	15638.11705	15897.708	1.016599885
17:34	21.4	32.23	5753	33.79	15648.99764	16127.892	1.030602239
17:35	20.9	32.1	5761	33.92	15670.7588	16062.84	1.025019924
17:36	21.7	32.48	5773	33.95	15703.40055	16252.992	1.034998244
17:37	21.1	32.41	5778	33.97	15717.00128	16217.964	1.031873938
17:38	21.3	32.11	5775	33.91	15708.84084	16067.844	1.022853574
17:39	21.5	32.4	5776	33.93	15711.56099	16212.96	1.031912743
17:40	21.3	32.56	5782	33.97	15727.88186	16293.024	1.035932502
17:41	21.1	32.22	5784	33.96	15733.32215	16122.888	1.024760559
17:42	21.6	31.92	5775	33.83	15708.84084	15972.768	1.016801186
17:43	21.4	32.06	5757	33.78	15659.87822	16042.824	1.024453944
17:44	21.4	32.18	5774	33.81	15706.12069	16102.872	1.025260936
17:45	21.2	32.19	5766	33.8	15684.35953	16107.876	1.027002471
17:46	21.3	32.17	5757	33.77	15659.87822	16097.868	1.027968914
17:47	21.2	32.21	5770	33.87	15695.24011	16117.884	1.026928157
17:48	21.4	32.42	5784	33.92	15733.32215	16222.968	1.03112158
17:49	21.3	32.67	5790	33.89	15749.64302	16348.068	1.037996098
17:50	20.9	32.02	5753	33.9	15648.99764	16022.808	1.023887176
17:51	21.2	32.47	5761	33.83	15670.7588	16247.988	1.036834796
17:52	21	32.23	5757	33.9	15659.87822	16127.892	1.02988617
17:53	21.2	32.62	5793	33.95	15757.80346	16323.048	1.03587077
17:54	20.9	32.3	5778	33.97	15717.00128	16162.92	1.028371743
17:55	21.3	32.56	5801	33.99	15779.56463	16293.024	1.032539515
17:56	21.1	32.77	5796	33.99	15765.9639	16398.108	1.040095493
17:57	20.8	32.08	5787	33.93	15741.48259	16052.832	1.019778913
17:58	21.3	32.68	5786	33.88	15738.76244	16353.072	1.03903163
17:59	20.7	31.76	5759	33.79	15665.31851	15892.704	1.014515216
18:00	21.3	32.51	5760	33.8	15668.03866	16268.004	1.038292307
18:01	20.7	32.22	5776	33.82	15711.56099	16122.888	1.026179895
18:02	45.4	32.08	5759	33.81	15665.31851	16052.832	1.024737032
18:03	20.5	31.92	5754	33.75	15651.71778	15972.768	1.020512139
18:04	20.6	32.56	5758	33.76	15662.59836	16293.024	1.040250386
18:05	20.3	32.74	5764	33.91	15678.91924	16383.096	1.044912328
18:06	20.5	32.52	5766	33.85	15684.35953	16273.008	1.037530922
18:07	20.4	32.55	5764	33.79	15678.91924	16288.02	1.03884839
18:08	20.5	32.79	5772	33.79	15700.6804	16408.116	1.045057639
18:09	20.4	32.61	5772	33.94	15700.6804	16318.044	1.039320818
18:10	20.5	32.82	5776	33.96	15711.56099	16423.128	1.04528939
18:11	20.6	32.52	5776	33.87	15711.56099	16273.008	1.035734642
18:12	20.9	32.62	5783	33.95	15730.602	16323.048	1.037662004
18:13	20.6	32.65	5791	33.97	15752.36317	16338.06	1.037181522
18:14	20.7	32.43	5792	34.06	15755.08332	16227.972	1.030014991
18:15	20.9	32.8	5797	34.04	15768.68404	16413.12	1.040868087

18:16	20.7	32.53	5764	33.95	15678.91924	16278.012	1.03821008
18:17	20.6	32.68	5765	33.87	15681.63938	16353.072	1.042816481
18:18	20.5	32.06	5776	33.97	15711.56099	16042.824	1.021084029
18:19	21	32.6	5783	34.03	15730.602	16313.04	1.037025792
18:20	20.6	32.5	5787	34.08	15741.48259	16263	1.033130133
18:21	20.8	32.71	5819	34.17	15828.52725	16368.084	1.034087616
18:22	20.9	32.5	5810	34.17	15804.04594	16263	1.029040289
18:23	21	32.65	5800	34.17	15776.84448	16338.06	1.035572102
18:24	21	32.74	5811	34.13	15806.76608	16383.096	1.036460963
18:25	21	32.41	5796	34.07	15765.9639	16217.964	1.02866936
18:26	21	32.44	5795	34.01	15763.24375	16232.976	1.029799212
18:27	21.1	32.47	5787	33.97	15741.48259	16247.988	1.032176474
18:28	21	32.76	5795	34.06	15763.24375	16393.104	1.039957528
18:29	20.7	32.55	5794	34.06	15760.52361	16288.02	1.033469471
18:30	20.8	32.8	5798	34.15	15771.40419	16413.12	1.040688565
18:31	20.9	32.87	5814	34.19	15814.92652	16448.148	1.040039483
18:32	4.7	33.01	5807	34.21	15795.8855	16518.204	1.045728269
18:33	17.5	33.17	5809	34.2	15801.32579	16598.268	1.050435148
18:34	20.2	32.28	5821	34.26	15833.96754	16152.912	1.020143054
18:35	21.3	32.66	5822	34.27	15836.68768	16343.064	1.031974888
18:36	20.9	32.71	5822	34.24	15836.68768	16368.084	1.033554764
18:37	21	32.48	5807	34.24	15795.8855	16252.992	1.028938327
18:38	21.3	32.89	5840	34.26	15885.6503	16458.156	1.036039173
18:39	20.8	32.87	5817	34.26	15823.08696	16448.148	1.039503104
18:40	21.1	32.63	5810	34.21	15804.04594	16328.052	1.03315645
18:41	21.2	32.71	5813	34.32	15812.20637	16368.084	1.035154969
18:42	21.4	32.99	5839	34.3	15882.93016	16508.196	1.039367159
18:43	21.1	32.76	5835	34.33	15872.04958	16393.104	1.032828427
18:44	21.2	33.03	5815	34.25	15817.64666	16528.212	1.044922317
18:45	21	33.13	5816	34.24	15820.36681	16578.252	1.047905665
18:46	20.9	32.67	5818	34.23	15825.8071	16348.068	1.033000585
18:47	21.3	32.5	5820	34.27	15831.24739	16263	1.027272179
18:48	21.4	32.78	5823	34.28	15839.40783	16403.112	1.035588715
18:49	21.4	32.68	5826	34.23	15847.56827	16353.072	1.031897874
18:50	21.4	32.6	5825	34.28	15844.84812	16313.04	1.029548524
18:51	21.4	32.77	5821	34.27	15833.96754	16398.108	1.035628497
18:52	21.3	32.8	5834	34.26	15869.32943	16413.12	1.034266764
18:53	21.4	32.68	5820	34.27	15831.24739	16353.072	1.032961686
18:54	20.8	32.35	5825	34.21	15844.84812	16187.94	1.021653214
18:55	21.1	32.67	5822	34.25	15836.68768	16348.068	1.032290863
18:56	20.8	32.49	5818	34.21	15825.8071	16257.996	1.027309122
18:57	21	32.6	5822	34.24	15836.68768	16313.04	1.030079037
18:58	20.8	32.55	5813	34.24	15812.20637	16288.02	1.030091539
18:59	21.1	32.55	5809	34.26	15801.32579	16288.02	1.030800846
19:00	20.9	32.65	5825	34.29	15844.84812	16338.06	1.031127586
19:01	20.9	32.24	5813	34.3	15812.20637	16132.896	1.020281144
19:02	50.9	32.53	5812	34.29	15809.48623	16278.012	1.029635737
19:03	20.8	32.63	5814	34.34	15814.92652	16328.052	1.032445644
19:04	20.9	32.06	5829	34.37	15855.7287	16042.824	1.011799855
19:05	21.5	32.49	5825	34.33	15844.84812	16257.996	1.026074588
19:06	21.1	32.27	5825	34.26	15844.84812	16147.908	1.019126714
19:07	21.2	32.6	5816	34.31	15820.36681	16313.04	1.031141705
19:08	20.9	32.16	5829	34.31	15855.7287	16092.864	1.014955812
19:09	21.3	32.46	5831	34.29	15861.16899	16242.984	1.024072312
19:10	21.2	32.76	5830	34.32	15858.44885	16393.104	1.033714215
19:11	21	32.27	5843	34.43	15893.81074	16147.908	1.015987183

19:12	22.1	32.93	5861	34.46	15942.77336	16478.172	1.033582528
19:13	21.5	32.93	5859	34.48	15937.33307	16478.172	1.033935347
19:14	21.8	32.67	5865	34.49	15953.65394	16348.068	1.02472249
19:15	21.9	33.11	5862	34.49	15945.49351	16568.244	1.039054953
19:16	21.5	32.66	5861	34.47	15942.77336	16343.064	1.025107968
19:17	21.3	32.93	5844	34.37	15896.53089	16478.172	1.036589185
19:18	21.1	32.19	5847	34.42	15904.69132	16107.876	1.012775141
19:19	21.9	32.92	5852	34.46	15918.29205	16473.168	1.034857757
19:20	21	32.74	5859	34.54	15937.33307	16383.096	1.027969732
19:21	21.2	32.94	5874	34.57	15978.13525	16483.176	1.031608241
19:22	21.1	32.63	5861	34.49	15942.77336	16328.052	1.02416635
19:23	21.2	33.06	5860	34.47	15940.05322	16543.224	1.037839948
19:24	20.9	32.47	5852	34.4	15918.29205	16247.988	1.020711767
19:25	21.5	32.94	5857	34.4	15931.89278	16483.176	1.034602494
19:26	20.9	32.42	5855	34.38	15926.45249	16222.968	1.0186178
19:27	21.4	32.76	5852	34.41	15918.29205	16393.104	1.029828071
19:28	21.1	32.71	5849	34.45	15910.13161	16368.084	1.028783696
19:29	21.1	32.73	5850	34.4	15912.85176	16378.092	1.029236761
19:30	21.1	32.94	5845	34.42	15899.25103	16483.176	1.036726571
19:31	21	32.72	5850	34.51	15912.85176	16373.088	1.028922298
19:32	1.7	32.49	5863	34.56	15948.21365	16257.996	1.019424266
19:33	21.2	32.53	5878	34.66	15989.01584	16278.012	1.018074669
19:34	21.4	32.84	5873	34.6	15975.41511	16433.136	1.02865158
19:35	21.1	32.73	5868	34.52	15961.81438	16378.092	1.026079593

	NOx ppm			Load (MW)	Gas Usage (lb/h)	Water Usage (lb/h)	Water-to-Fuel
1	21.43	32.15	5753.08	33.77	15649.22	16086.89	1.03

Note

1 Including all data

ATTACHMENT C

GE Industrial AeroDerivative
Gas Turbines

GE Power Systems
One Neumann Way, S158
Cincinnati, OH 45215-1988
Phone: (513) 552-5925
Fax: (513) 552-5059

October 19, 1999

KUA

Attn: Larry Mattern

The purpose of this letter is to

- Respond to your inquiry regarding high water injection rates
- Provide response on the use of spray intercooling on the KUA units

High Water Injection Rates

GE currently offers LM6000PC with water injection for NOx abatement to levels of 25 ppm NOx. At ISO conditions, the expected water : fuel ratio for a typical natural gas fuel is 1.18. With engine-to-engine variation, the water : fuel requirements can be as high as 1.42 to achieve this NOx level.

GE recommends that water should not be injected beyond that required to achieve 25 ppm NOx, and, in no case, beyond 1.42 water to fuel ratio (without consulting GE). Attempts to oversuppress to levels significantly below 25 ppm will have the following consequences and added risks:

- Reduced combustor venturi life and need for more frequent inspections. Expected venturi life is 25000 hours on natural gas with water suppression to 42 ppm. Expected life of the same combustor is 16000 hours at 25 ppm. Erosion life is believed to be very non linear, therefore suppressing to <<25 will result in significantly lower erosion life and increased maintenance costs and reduced availability.
- Oversuppressing *will add risk* in terms of combustor stability and could cause high combustor dynamic pressures which will result in distress of combustion system components.

High Water Injection Rates

GE currently offers spray intercooling, also known as SPRINT™, exclusively on the LM6000PC. While there have been several inquiries relative to use of SPRINT™ with LM6000PA, GE does not currently plan to offer this as a product.

GE recently proposed to the FL-DEP that SPRINT™ could be used in conjunction with other new features on two LM6000 PB engines in Bartow FL in order to achieve the permit level of 15 ppm. This will require a development program and engine testing to ensure no adverse consequences result from the water injection levels envisioned for the LM6000PB machines. If the FL-DEP is supportive of this approach we will be conducting tests before end of June 2000 and will have a better idea of the exact benefits on a PB engine.

The intent of the above program is to achieve 15 ppm on the existing LM6000PB engines at the Bartow site. Since the LM6000PB is no longer in production, this system is not intended to be a general product offering at this time.

Best regards,

RB Hook
LM6000 Technical Program Mgr.
GE Industrial Aeroderivative Gas Turbines

Cc: Z Biernacki, D Harmon, C Stump, P Tinne

ATTACHMENT D

GIVEN

Reference 1 - Quote from Engelhard for high temperature SCR to reduce emissions from an LM 6000. Emissions reduction from 22 ppm to 2 ppm.
Reference 4 - Quote from Cormetech for conventional catalyst. Used as a basis for adjusting costs to Cane Island Unit 1 emissions requirements.

CALCULATING AN ADJUSTMENT FACTOR TO BE USED TO ADJUST ENGELHARD QUOTE

Cormatech Data	inlet	outlet	Price	% Removed	(Reference 4)
RATIO 1 (Case 2) for 25 to 4.5 ppm	25	4.5	$504,000	82%	
RATIO 2 (Case 4) for 9 to 2 ppm	25	2	$737,000	92%	

Therefore, to go from 25 TO 4.5 PPM, requires 68 % of the catalyst for reduction from 25 TO 2.0 PPM
68 % = $504000 / $737000 * 100

ADJUSTING ENGELHARD QUOTE

Engelhard Data	inlet	outlet	Price	(Reference 1)
	22	2.5	$1,558,000	

Therefore, 68 % of $1558000 is the catalyst cost = $1,065,444

Plus, need to correct for the difference in inlet NOx.
A unit achieving 92 % (25 to 2) requires 104 % more catalyst than a unit achieving 89 % (22 to 2.5).
104 % = 92 % / 89 % * 100
Therefore, $1065444 * 104 % is the catalyst cost = $1,105,876

Reference 4

p-622-bv-9/16/98

CORMETECH, INC.

ENVIRONMENTAL TECHNOLOGIES
5000 International Drive Durham, NC 27712

TEL 919-620-3000 FAX 919-620-3001
If not received properly, call 919-620-3000

Number of pages including cover: 7 Reference Number: 96 1267

TO: Rick Lausman
BLACK & VEATCH
Overland Park, KS
TEL 913-458-7528
FAX 913-458-2934

7528
P461

CC: Nancy Stephenson

FROM: Elizabeth Mancini

DATE: 9/16/98

SUBJECT: SCR Catalyst Budgetary Quotation
General Information

REFERENCE:
1. Cormetech Reference Number CM622
2. Fax from Rick Lausman/BV to Elizabeth Mancini/Cormetech 9/10/98

We are pleased to submit our budgetary quotation to supply SCR catalyst for the above subject project. Budgetary indicates ± 10%. If you have any questions or require additional information, please contact me at 919-620-3022.

Best regards,

EM

Proposals/bv/bvgeninfo.doc:CM622

Fax to Rick Lausman/BV from Elizabeth Mancini/Cormetech
RE: SCR Catalyst Budgetary Quotation: General Information

Scope of Supply:

- Catalyst Design, Supply, and Assembly
- Patent and License Indemnification
- Module Engineering and Supply
- Initial Pilot Test
- Sample Module for Easy Catalyst Sample Retrieval

Catalyst:

	Case 1
Catalyst	CM-27™
Pitch, mm	2.7
Gas Flow Orientation	Horizontal

Modules:

	Case 1	Case 2	Case 3	Case 4
Number/Unit	24	24	24	24
Number of Layers	1	1	1	1
Arrangement/Layer	$3_w \times 8_h$	$3_w \times 8_h$	$3_w \times 8_h$	$3_w \times 8_h$
Dimensions, in each	$127.375_w \times 66.375_h \times 16_d$	$103.125_w \times 66.375_h \times 14_d$	$127.375_w \times 66.375_h \times 16_d$	$127.375_w \times 66.375_h \times 20_d$
Weight, lbs each	2400	1800	2400	2900
Material	Carbon Steel	Carbon Steel	Carbon Steel	Carbon Steel

Price:

	Case 1	Case 2	Case 3	Case 4
Price, 1 Unit(s)	$304,000	$200,000	$313,000	$433,000
FOB				Durham
Delivery				6 - 9 mo ARO
Validity from date of this proposal				90 days
Payment Terms				Net 30 days
Invoice Schedule				30% upon Order; 70% upon Delivery

[illegible] % 67.5 53.1 68.8 % 79.2 %

NO_x [illegible]

Fax to Rick Lausman/BV from Elizabeth Mancini/Cormetech
RE: SCR Catalyst Budgetary Quotation: General Information

Guarantee Performance*:

	Case 1	Case 2	Case 3	Case 4
NOx Outlet, ppmvd @ 15% O_2	≤ 9	≤ 4.5	≤ 3.0	≤ 2.0
NH_3 Slip, ppmvd @ 16% O_2	≤ 10	≤ 10	≤ 10	≤ 10
Δp Across Catalyst, in wg	≤ 1.8	≤ 2.0	≤ 1.8	≤ 2.5
Design Life	The earlier of 36 months from first gas-in or 39 months from contracted delivery			

*Guarantee performance is based on the attached Cormetech, Inc. Catalyst Technical Terms and Conditions and the following:

1. Maldistribution criteria:
   Flow ± 15% RMS; Temperature ± 20°F; NH_3:NOx Molar Ratio ± 5% RMS.

Design Flue Gas Conditions:

	Case 1	Case 2	Case 3	Case 4
Fuel	Gas	Gas	Gas	Gas
Flue Gas Flow Rate, lb/hr	3,474,000	3,474,000	3,474,000	3,474,000
Design Temperature, °F	650	650	650	650
Flue Gas Composition				
N_2, vol %	73.7	73.7	73.7	73.7
O_2, vol %	9.43	9.43	9.43	9.43
CO_2, vol %	5.2	5.2	5.2	5.2
H_2O, vol %	10.75	10.75	10.75	10.75
Ar, vol %	0.92	0.92	0.92	0.92
O_2, vol % dry	10.57	10.57	10.57	10.57
Inlet NOx, ppmvd @ 15% O_2	27.7	9.6	9.6	9.6
NOx lb/hr	243	84.7	84.7	84.7

General Terms and Conditions:
Cormetech, Inc. General Terms and Conditions of Sale, attached.

CORMETECH, INC.
Catalyst Technical Terms and Conditions

Warranty Conditions

1. Unit operating conditions shall be within the limits of design cases specified in SCR Catalyst Quotation.

2. The catalysts must be handled, operated, and maintained according to Cormetech instruction.

3. Cormetech maintains warranty protection as long as normal furnace start-up and shut-down procedures are followed and no moisture other than from flue gas or ambient air is present. The allowed start-up and shut-down temperature gradient for the catalyst is 10°C/min below and 60°C/min above the flue gas dew point.

4. Catalyst has been designed to accommodate profile maldistributions, based on a Normal Distribution, per SCR Catalyst Quotation.

5. Cormetech is not responsible for catalyst deterioration caused by aqueous ammonia drainage or water contact to the catalyst.

6. Suitable means must be employed, if needed, to clean catalyst masked or plugged by firing of particulate producing fuel. Customer will inspect visually at shutdowns and clean, as needed.

7. Access must be provided to Cormetech for visual inspection and catalyst sampling. Cormetech reserves the right to review the Unit's operating data at any time during the warranty period.

8. Customer must provide catalyst samples to Cormetech no less than annually during the warranty period, in order to maintain warranties.

9. Customer will provide a copy of all procedures and methods of analysis to be employed in catalyst evaluation for Acceptance and anytime throughout the warranty period.

Warranty Fulfillment

1. Cormetech's warranties are fulfilled at the end of the period stated in SCR Catalyst Quotation if the results of on-site tests indicates that the performance values, shown in SCR Catalyst Quotation, are met.

2. If the results of on-site tests during the warranty period indicates that the warranted values are not being met, Customer will conduct an on-site investigation to determine the cause of non-performance. If the catalyst is suspect, Cormetech will conduct laboratory tests, according to the conditions specified in SCR Catalyst Quotation, to verify the catalyst performance.

3. If the results of the laboratory tests indicate that the warranted values are being met, Cormetech's warranties will be deemed in fulfillment at this time and Customer will continue their investigation to determine the cause of non-fulfillment. Customer will compensate Cormetech for the cost of laboratory evaluation.

4. If the results of the laboratory tests indicate that the warranty values are not being met, Cormetech will, at its option, repair, replace, or add catalyst at its cost to meet the required performance values. Cormetech will absorb cost of laboratory evaluation.

CORMETECH, INC.
General Terms and Conditions of Sale

1. DEFINITIONS:
"Buyer" means the firm or company which places the order and purchases the Goods from Seller.
"Seller" means Cormetech, Inc.
"Goods" means the SCR Catalyst to be purchased by the Buyer.
"Order" means the purchasing order placed by the Buyer for the supply of the Goods.
"Specifications" means Seller's written technical description of the Goods purchased pursuant to the Order therefor and Seller's acceptance thereof.
"Owner" means the person, firm or company to whom the Buyer furnishes the plant including the Goods supplied by the Seller.

2. CONTRACT:
The contract for the purchase and sale of Goods shall be deemed to have been entered into by and between the Buyer and the Seller when, upon receipt of the Buyer's Order for such Goods, the Seller sends an acceptance in writing, within the time limit for such acceptance specified in such Order, executed by the duly authorized representative of Seller. Neither the Buyer nor the Seller shall be bound by any variation, waiver of, or addition to these general terms and conditions unless otherwise agreed by both parties in a writing executed by their duly authorized representatives. Except as otherwise provided in an express written agreement, these general terms and conditions shall govern in the event of any conflict with any terms or conditions proposed by the Seller or Buyer whether or not contained in any order or acceptance, or applicable in previous transactions, practice or course of dealings.

3. LIAISON PERSONNEL:
The Seller, immediately upon receiving Buyer's Order for Goods, may appoint an appropriate person for the performance of Seller's obligation to Buyer with respect to the Goods, to whom all communication thereon shall be directed.

4. DELIVERY:
The method of packing of the Goods shall be in accordance with the agreement of the Buyer and Seller and if no agreement has been reached, the Seller shall take all reasonable steps to prevent damage to or deterioration of the Goods in transit to their destination as specified in the accepted order.
The purchase price for Goods sold pursuant to an accepted purchase order shall include the cost of packing as mentioned above.

5. WARRANTY, QUALITY AND DESCRIPTION:
Seller hereby warrants to Buyer that at the time of delivery, the Goods sold to Buyer will conform to the written specifications set forth in Catalyst Technical Terms and Conditions to acceptable quality levels normally supplied by Seller in connection with the sales of said Goods. Seller will, solely at its option, repair or replace Goods which fail to meet the Terms and Conditions of this limited warranty.
In addition, Seller warrants that the performance of the Goods will, under the conditions specified in Catalyst Technical Terms and Conditions for the period set forth therein meet the performance criteria under the conditions specified therein. Verification of such performance guarantee will be accomplished as specified in Catalyst Technical Terms and Conditions, through the use of laboratory tests.
In the absence of specific alternate language, warranty period is on a calendar basis and begins at first gas-in and no later than three (3) months after scheduled delivery. Specific warranty period and terms are as set forth in the Catalyst Technical Terms and Conditions.
In the event Goods are stored and handled between the time of delivery and installation, Buyer shall provide adequate and appropriate facilities for storage of the Goods. Goods shall be handled according to Seller's Catalyst Handling Manual.
THE FOREGOING WARRANTY AND THE WARRANTY SET FORTH IN SECTION (15) ARE IN LIEU OF ALL OF THE WARRANTIES EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

6. SPECIFICATIONS:
The Goods sold hereunder shall comply with the written specifications set forth in Catalyst Technical Terms and Conditions. The performance of such Goods will vary in accordance with individual specifications, operation, and maintenance of the systems in which they are installed. Buyer has the sole responsibility for the completeness and accuracy of information. Seller will rely exclusively on such information to make recommendations on the type and volume of Goods to be used in Owner's facility.

7. MODIFICATION IN SPECIFICATIONS:
The specifications may be modified and/or changed at any time provided that both the parties agree in writing. Such agreement may include reasonable adjustments of the price, time of delivery of the Goods and other terms before such modifications and/or changes are carried out.

8. DRAWINGS:
Drawings, such as, drawings for approval, drawings for installation, drawings showing the finished conditions of the Goods, instruction manuals, etc., shall be supplied by the Seller to the Buyer strictly in accordance with and by the time instructed in the Specification or in the accepted order.

9. INSPECTION AND TEST AT SELLER'S WORKS
Upon reasonable notice and at reasonable times, the Buyer shall have access to the office of the Seller or, subject to written consent of such supplier, the office and manufacturing operations of Seller's supplier for expedition of manufacturing or inspection of the Goods in the course of a normal working day during the period from the date of the Order to the date of shipment of the Goods. If such inspection shall be done at the factory of Seller's supplier, the Seller shall also inform the Buyer of the details of such visit in advance. Buyer shall inspect all Goods within thirty (30) days of delivery of such Goods and immediately report to Seller in writing any claims for breach of warranty set forth in Section (5) above. All Goods which remain uninspected after such thirty (30) days shall be deemed accepted by Buyer.
In the event that the Goods are rightfully rejected at the time of inspection for failure to conform to the provisions of Section (5) above, the Seller shall, solely at the Seller's option, repair or replace such Goods.

10. PRODUCTION SCHEDULE:
When requested, the Seller will provide the Buyer with the production schedule setting forth the estimated dates for the issuance schedule of drawings, order of material, fabrication schedule, inspection schedule, if any, for the Goods purchased pursuant to the acceptance order, and during the contractual period, keep the Buyer informed monthly of actual progress in providing the Goods.
In case there is some unexpected factor or occurrence which prevents normal progress of production or manufacturing, the Seller shall inform the Buyer promptly.

11. SHIPPING INSTRUCTION:
The Goods subject to Buyer's Order shall be sold FOB Jobsite, unless otherwise indicated, and the Buyer or Seller on Buyer's behalf pursuant to Buyer's instructions will book and arrange appropriate transportation from such site. The Seller shall provide the following information regarding such Goods.
a. Net weight, gross weight, freight tons
b. Measurement of each packing or parcel
c. Number of packages
d. Name of loading port
e. Date of cargo readiness

12. LIMITATION OF LIABILITY:
If, owing to force majeure as defined in Section (14) hereof, the Seller is unable to deliver the Goods within ninety (90) days of the delivery time specified in the accepted order for such Goods, then provided that the Seller shall have given Buyer written notice of such force majeure, the Buyer shall grant the Seller extension of time, as may be reasonable, to complete performance.
The liability of the Seller, its supplier, their agents, employees, subcontractors and sub-suppliers with respect to any and all claims arising out of the performance or non-performance of obligations in connection with the design, manufacture, sale, delivery, storage, erection or use of the Goods or the rendition of other services in connection therewith, whether based on contract, warranty, tort (including negligence), strict liability or otherwise, shall not exceed in the aggregate the purchase price for the Goods and shall in no event include: damages for loss of profits or revenue or the loss of use of either; loss by reason of plant shutdown or inability to operate at rated capacity; increased expense of operation of plant or equipment; increased costs of purchasing or providing Goods, equipment, materials, supplies or services; costs of replacement power or capital; claims of Owner's customers; inventory or use charges; or any other incidental or consequential damages of any nature.
This limitation of liability shall prevail over any conflicting or inconsistent provisions contained in any of the documents comprising the contract for the Goods, except to the extent such conflicting or inconsistent provisions further restrict the Seller's liability.

13. PRICE AND PAYMENT:
All payments shall be made within thirty (30) days after the presentation of the invoice therefor, unless otherwise indicated.
Seller will meet delivery schedule required by contract. In the event Buyer delays requested delivery, terms of payment shall commence per original schedule. Seller shall notify Buyer of all resultant fees and requirements due to delay, including but not limited to, handling, storage, and truck cancellation fees. Buyer shall be invoiced for said fees upon shipment.
Payments received after date specified on invoice will be assessed a monthly finance charge (12% per annum).

14. FORCE MAJEURE:
Force majeure shall mean unavoidable causes beyond the control of the Seller, including but not limited to, acts of God, war (declared or undeclared), acts of governmental authorities, riot, revolution, civil commotion, fires, strikes (and other labor disputes, sabotage), or epidemic, and other similar matters beyond the reasonable control of a party.
Should the causes of force majeure prevent the total or partial performance required concerning the purchase of Goods, the party claiming force majeure shall promptly advise the other party at the beginning and end of such force majeure and furnish the other party a written notice identifying the nature of the circumstances of force majeure promptly.
In cases of force majeure described above, there shall be consultation between the parties to discuss the effect on the contractual obligations of both parties. For delays and/or non-performance of the obligations due to force majeure, the affected party shall be entitled to an extension of time equal to that of the delay plus such additional time as is reasonably necessary to resume performance of its obligations.

15. PATENTS:
The Seller warrants freedom from patent infringement on those Goods sold under an accepted order when such Goods are used for the purposes normally intended.
Purchase of this product from Cormetech, Inc. includes a license to use this product in the practice of the method claimed in U.S. Patent 4,358,428.

16. ASSIGNMENT:
Neither the contract nor any part of it shall be assigned or transferred to any third party without the other parties' prior written consent where such consent shall not be unreasonably withheld.

17. TAXES:
Any applicable sales, use, excise or other tax shall not be included in Seller's quoted price for Goods.

18. BACKCHARGE:
Seller is not liable, whether by backcharge or otherwise, for the cost of work performed or material or equipment furnished by the Buyer or any third parties unless such work and the costs thereof have been approved in writing by an authorized representative of Seller.

19. NON-DISCLOSURE:
Data, drawings, specifications, or other technical information furnished directly or indirectly, in writing or otherwise, to Seller by Purchaser or to Purchaser from Seller pursuant to this order shall in no event become the property of the receiving party and shall be used only in fulfilling the obligations imposed by this order and shall not be duplicated or disclosed to others or used in whole or in part for any other purpose. Such furnishing of data, drawings, specification, or other technical information shall not be construed as granting any rights whatsoever, express or implied, under patents or privileges of the disclosing party.

20. TERMINATION:
Upon notice, Seller will take all reasonable measures to cease production in-process and to minimize the cost of goods and services procured for fulfillment against this contract. It is recognized that the Goods and Services contracted herein are of custom design and manufacture, the value of which is not reasonably expected to be recoverable by the Seller in the event of termination.
Therefore, upon termination, Seller will submit to Buyer an accounting of all Goods and Services directly allocated to fulfillment of this contract including but not limited to finished Goods, Goods-in-process, non-cancelable subcontracts, and custom dies. Forced disruption of manufacturing in process may result in additional expense which is the sole responsibility of Buyer. It is expected that raw materials may be purchased and production proceed against the requirements of any or all of the defined scope of contract at any time following contract award by Buyer. Seller will keep Buyer informed of progress against contract.

Reference 1

BLACK & VEATCH

8400 Ward Parkway
P.O. Box 8405
Kansas City, Missouri 64114

Tel: (913) 458-2000

Black & Veatch Corporation

FAX NUMBER: 913-458-2934 913-458-2936 913-458-2939

FACSIMILE TRANSMISSION

TO: Mr. Fred Booth
COMPANY: Engelhard
FAX NUMBER: (410) 569-1841
TELEPHONE NUMBER: (410) 569-0297
FROM: Don Wolf
EXTENSION: 2845 LOCATION: P4G1

B&V PROJECT: 063045
B&V PHASE: 0042
B&V FILE:

PAGE: 1 of 2
DATE: June 14, 1999

NOTE TO RECEIVING OPERATOR
In the event of incomplete transmission, please call (913) 458-7218.

TRANSMITTAL DATE/TIME: _____ OPERATOR'S INITIALS: _____

SUBJECT: High Temperature SCR Catalyst for Simple Cycle Combustion Turbines

MESSAGE: As we discussed on the phone this morning Black & Veatch is assessing the experience, feasibility, potential NO_x reductions, and costs for high temperature SCR catalyst located at the outlet of 3 different simple cycle combustion turbines (SCCT).

Please provide the following information:

1. An experience list of Engelhard SCR catalyst applications on SCCT including the inlet and outlet NO_x emissions.
2. A review of the information provided below for the 3 SCCT machines to determine the maximum practical NO_x reduction that can be achieved with high temperature catalyst.
3. Provide cost or catalyst volume (if possible with the limited data and response time).

The 3 SCCTs being evaluated have the general design criteria listed in the table below. Please note that no specific data is available at this time since this is a very cursory review. Therefore, please assume the data below is full load data only.

	GE 7241 (7FA)	GE 7121 (7EA)	GE LM6000 PC Sprint
Exhaust Flow, lb/hr	3,427,200	2,314,800	1,008,000
Exhaust Temperature, F	1,116	998	842
NO_x, ppmvd @ 15% O_2	9	9	22

Please provide the requested information by noon (CST) Tuesday June 15, 1999. If you have any questions please do not hesitate to call me at (913) 458-2845. I appreciate your attention to this matter. Thank you.

P4CJ
2845

ENGELHARD

101 WOOD AVENUE
ISELIN, NJ 08830

ENGELHARD CORPORATION
2205 CHEQUERS COURT
BEL AIR, MD 21015
PHONE 410-569-0297
FAX 410-569-1841
E-Mail Fred_Booth@ENGELHARD.COM

DATE:	**June 15, 1999**	**NO. PAGES**	**4 (INCLUDING COVER)**
TO:	**BLACK & VEATCH** **ATTN: Don Wolf**	**FAX 913-458-2934**	
	ENGELHARD **ATTN: Nancy Ellison**		
FROM:	**Fred Booth**	**Ph 410-569-0297 // FAX 410-569-1841**	

RE: **Simple Cycle Turbines**
High Temperature SCR Catalyst System Components
Engelhard Budgetary Proposal EPB99465

We provide Engelhard Budgetary Proposal EPB99465 for Engelhard **NOxCAT ZNX™** High Temperature SCR Catalyst system components per your FAXed request of June 14, 1999.

Our Budgetary Proposal is based on:

- Gas Turbine operating in simple cycle mode;
- SCR Catalysts for NOx reductions from noted inlet levels to 2.5 ppmvd @ 15% O_2 with ammonia slip of 5 ppmvd @ 15% O_2;
- Nominal 5.0" Delta P across SCR;
- Scope as noted. Please note that we have assumed horizontal gas flow through the SCR reactor and the use of 28% aqueous ammonia.
- Please note that turbine exhaust flow for the GE7FA is cooled with an ambient air injection system to reduce the gas temperature at the SCR to 1,025F. The cost of the components for this turbine is included. The ductwork to hold the catalysts and the transitions and any flow straighteners are not included in scope detailed herein.
- We have indicated cross section area required to meet the conversions and pressure drop. Inside liner width and height can be varied while maintaining same cross sectional area.
- Three (3) Year Performance Guarantee (expected life five to seven years).

We request the opportunity to work with you on this project.

Sincerely yours,

ENGELHARD CORPORATION

Frederick A. Booth
Senior Sales Engineer

cc: Nancy Ellison - Proposal Administrator

ENGELHARD

Black & Veatch 063045
Simple Cycle Turbines
ZNX™ SCR Catalyst Systems
Engelhard Budgetary Proposal EPB99465
June 15, 1999

ENGELHARD CORPORATION
NOxCAT ZNX™ HIGH TEMPERATURE SCR NOx ABATEMENT CATALYST SYSTEMS

Engelhard Corporation ("Engelhard") offers to supply to Buyer the **NOxCAT ZNX™** ceramic substrate SCR system components summarized herein.

NOxCAT ZNX™ High Temperature SCR Catalyst System: Scope of Supply: The equipment supplied is installed by others in accordance with the Engelhard design and installation instructions.

- Engelhard **NOxCAT ZNX™** SCR catalyst in modules;
- Internal support structures for catalyst modules (frame);
- Ambient Air injection cooling system components (GE 7FA);
- Ammonia Injection Grid (AIG);
- AIG manifold with flow control valves ;
- NH_3/Air dilution skid: 28% Aqueous Ammonia
  - Pre-piped & wired (including all valves and fittings) Two (2) dilution air fans, one for back-up purposes
  - Panel mounted system controls for:
    - Blowers (on/off/flow indicators)
    - System pressure indicators
    - Air/ammonia flow indicator and controller
    - Main power disconnect switch

Excluded from Scope of Supply:
Ammonia storage and pumping
Any internally insulated reactor ductwork to house catalysts
Any transitions to and from reactor
Structural support
Any monorails and hoists for handling modules
Any interconnecting field piping or wiring
Electrical grounding equipment
Utilities
Foundations
All Monitors
All other items not specifically listed in Scope of Supply

BUDGET PRICES: **See Performance Data**

WARRANTY AND GUARANTEE:

Mechanical Warranty:	One year of operation* or 1.5 years after catalyst delivery, whichever occurs first.
Performance Guarantee:	9,000 hours of operation* or 3.5 years after catalyst delivery, whichever occurs first. Catalyst warranty is prorated over the guaranteed life

**Operation is considered to start when exhaust gas is first passed through the catalyst.*

DOCUMENT / MATERIAL DELIVERY SCHEDULE

Drawings / Documentation	10 weeks after notice to proceed and Engelhard receipt of all engineering specifications and details
Operating manuals	
Material Delivery	20 - 24 weeks after approval and release for fabrication

SYSTEM DESIGN BASIS:

Gas Flow from:	Combustion Turbines
Gas Flow:	Assumed Horizontal
Fuel:	Natural Gas
Gas Flow Rate (At catalyst face):	See Performance data
Temperature (At catalyst face):	See Performance data
NOx Concentration (At catalyst face):	See Performance data
NOx Reduction:	To 2.5 ppmvd @ 15% O_2
NH3 Slip:	5 ppmvd@15%O_2
Pressure Drop through SCR	Nom. 5"WG

ENGELHARD

Black & Veatch 063045
Simple Cycle Turbines
ZNX™ SCR Catalyst Systems
Engelhard Budgetary Proposal EPB99465
June 15, 1999

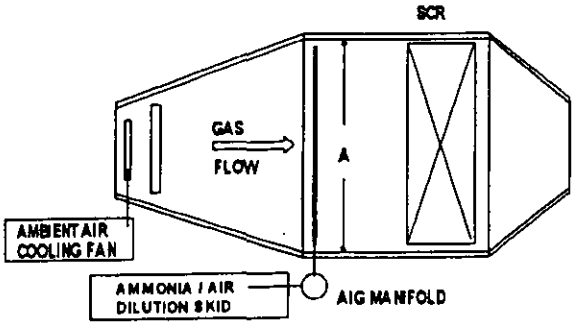
Performance Data

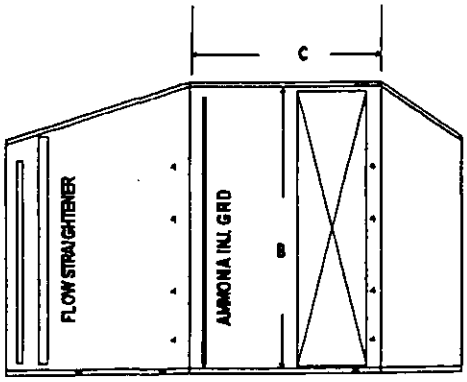
	TURBINE	GE 7FA	GE 7EA	GE LM6000
	ASSUMED AMBIENT	95	95	95
	GIVEN TURBINE EXHAUST TEMPERATURE, F	1,116	998	842
	GIVEN TURBINE EXHAUST FLOW, lb/hr	3,427,200	2,314,800	1,008,000
ASSUMED TURBINE EXHAUST GAS ANALYSIS, % VOL.	N2	74.06	73.24	73.24
	O2	12.50	13.42	13.42
	CO2	3.90	3.80	3.80
	H2O	8.65	8.65	8.65
	Ar	0.89	0.89	0.89
	AMBIENT COOLING AIR FLOW, lb/hr	368,745	0	0
	TOTAL FLOW – TURBINE EXHAUST + AMBIENT - lb/hr	3,795,945	2,314,800	1,008,000
AMBIENT + EXHAUST GAS ANALYSIS, % VOL.	N2	74.75	73.24	73.24
	O2	13.10	13.42	13.42
	CO2	3.53	3.80	3.80
	H2O	7.82	8.65	8.65
	Ar	0.80	0.89	0.89
	CALCULATED AIR + GAS MOL. WT.	28.42	28.40	28.40
	GIVEN: TURBINE NOx, ppmvd @ 15% O_2	9.0	9.0	22.0
	CALC.: TURBINE NOx, lb/hr	55.9	32.4	34.5
	CALC.: NOx, ppmvd @ 15% O2 - AT CATALYST FACE	8.7	9.0	22.0
	GAS TEMP. @ SCR CATALYST, F	1,025	998	842
DESIGN REQ. SCR CATALYST	NOx OUT, ppmvd @ 15% O2	2.5	2.5	2.5
	NH3 SLIP, ppmvd @ 15% O2	5	5	5
	SCR PRESSURE DROP, 5"WG – Nom..			
	GUARANTEED PERFORMANCE DATA			
SCR CATALYST	NOx CONVERSION, % - Min.	72.2%	72.2%	88.6%
	NOx OUT, lb/hr - Max.	15.5	9.0	3.9
	NOx OUT, ppmvd @ 15% O2 - Max.	2.4	2.5	2.5
	EXPECTED AQUEOUS NH3 (28% SOL.) FLOW, lb/hr	96	55	51
	NH3 SLIP, ppmvd @ 15% O2 - Max.	5	5	5
	SCR PRESSURE DROP, "WG - Max.	4.5	4.0	4.5
	REACTOR INSIDE LINER AREA - A x B, sq ft	**2100**	**1350**	**640**
	SCR SYSTEM	**$4,015,000**	**$2,711,000**	**$1,558,000**
	REPLACEMENT SCR CATALYST MODULES	**$2,496,000**	**$2,057,000**	**$1,111,000**

ENGELHARD

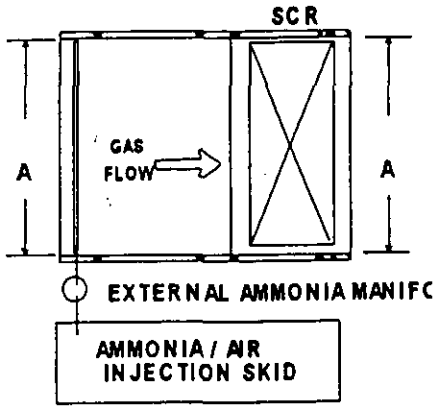
Black & Veatch 063045
Simple Cycle Turbines
ZNX™ SCR Catalyst Systems
Engelhard Budgetary Proposal EPB99465
June 15, 1999

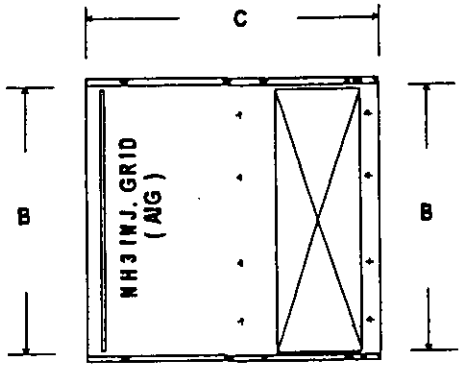
Dimensions / Sketch: GE 7FA
Required Cross Sectional Area
Inside Liner Width x Inside Liner Height
(A x B) sq. ft.
Reactor Depth (C) 12'-0"





Dimensions / Sketch:
Required Cross Sectional Area
Inside Liner Width x Inside Liner Height
(A x B) sq. ft.
Reactor Depth (C) 12'-0"





ENGELHARD

101 WOOD AVENUE
ISELIN, NJ 08830
732-205-5000

POWER GENERATION SALES:
ENGELHARD CORPORATION
2205 CHEQUERS COURT
BEL AIR, MD 21015
PHONE 410-569-0297
FAX 410-569-1841
E-Mail Fred_Booth@ENGELHARD.COM

DATE:	June 15, 1999	NO. PAGES	2 (INCLUDING COVER)
TO:	BLACK & VEATCH ATTN: Don Wolf 2401/2845	FAX 913-458-2934	
FROM:	Fred Booth	Ph 410-569-0297 // FAX 410-569-1841	

High Temp SCR Experience attached.

Engelhard SCR System Experience List

Application	Flow Catalyst	(lb/sec)	Fuel	Start-Up
(1) BBC (50 MW)	VNX	650	NG	11/90
(1) Kawasaki 1 MW	ZNX	23	NG	2/91
(1) Allison 3.5 MW	VNX	38	NG	9/91
(1) Rolls Royce 25 MW	VNX	259	NG	8/92
(2) Westinghouse 251	VNX	422	NG	10/92
(1) GE Frame 7	VNX	669	NG	1Q/93
(1) LM-2500	VNX	157	NG	5/93
(2) LM-6000	VNX	283	NG	4Q/93
(1) LM 5000	VNX	248	NG	1993
(1) LM 5000	VNX	342	NG	1994
(1) GE Frame 6	ZNX	305	NG	1/95
(1) Solar T4500	ZNX	41	NG	1/95
(2) GE Frame 5	ZNX	212	NG	1/95
(1) GE Frame 7	VNX	638	NG	2Q/95
(1) GE Frame 6	VNX	330	NG	1996
(3) ABB GT11N	ZNX	728	#2 Oil	6/96
(1) 2000 Hp	VNX	97	NG	1985
(2) 4000 Hp	VNX	23	NG/DF	1986
(3) 1500 Hp	ZNX	9	DF	5/91
(1) 800 Hp	VNX	8	NG	1993
(1) Refinery Heater	VNX	84	NG	10/90
(1) Refinery Heater	VNX/ZNX	46	NG	10/90
(1) Boiler 1 MW	VNX	26	NG	10/90
(1) Annealing Furnace	VNX	29	NG	1991
(5) Refinery Heater	VNX	16-31	NG	3/91
(1) Refinery Heater	VNX	39	NG	6/91
(1) Refinery Heater	VNX	120.6	#6/NG	1/94
(1) Refinery Heater	VNX	137.8	#6/NG	5/94
(1) Refinery Heater	VNX	110.6	#6/NG	5/94
(1) Utility Boiler (250 MW)	PNX	404	Coal	9/96
(1) Process Off-Gas	ZNX	4	CP	8/90
(1) Nitric Acid Plant	VNX	99	NG	3/91
(1) Process Off-Gas	ZNX	4	CP	1/94
(1) Utility Boiler - LD	VNX		Coal	1985
(8) Gas Turbines	VNX/ZNX		NG	1987
(2) Utility Boiler - LD	VNX/ZNX		Coal	1987
(1) Utility Boiler - HDW	VNX/ZNX		Coal	1989
(1) Utility Boiler - HDD	VNX/ZNX		Coal	1989
(1) Utility Boiler - LD	VNX		Coal	1991
(1) Utility Boiler - HD	VNX		#6 Oil	1991
(2) Turbines	VNX/ZNX		#2 Oil	1994
(1) Utility Air Preheater	PNX		NG/#2 Oil	1994/95
(1) Utility Boiler - HDW	PNX		Coal/NG	2Q/95
(1) Utility Boiler - HDD	PNX		Coal	3Q/95
(1) Utility Boiler - HDD	PNX		Coal	4Q/95

ATTACHMENT E

Table 1

NO_x Control Alternative Capital Cost (Revised)

	SCR	Low NO_x Burners	Remarks
Direct Capital Cost			
Catalysts and Ammonia Injection	1,106,000	NA	Scaled from previous projects.
Ductwork and Catalyst Reactor	710,000	NA	Based on conceptual ductwork arrangement
Control/Instrumentation	100,000	NA	Estimated; includes controls and monitoring equipment.
Ammonia Storage	167,000	NA	Scaled from previous projects
Balance of Plant	833,000	NA	For SCR: 8% Foundation & Supports, 10% Erection, 4% Electrical Installation, 1% Painting, 1% Insulation, 10% Engineering, 6 % Retrofit Factor.
Total Direct Capital Cost	2,916,000	Base	
Indirect Capital Costs			
Contingency	729,000	NA	25% of Direct Capital Cost
Engineering and Supervision	208,000	NA	10% of Purchased Equipment Cost
Construction & Field Expense	104,000	NA	5% of Purchased Equipment Cost
Construction Fee	208,000	NA	10% of Purchased Equipment Cost
Start-up Assistance	42,000	NA	2% of Purchased Equipment Cost
Performance Test	35,000	NA	Estimated Cost
Total Indirect Capital Costs	1,326,000	Base	
Total Installed Cost	**4,242,000**	Base	

Table 2

NO_x Control Alternative Annual Cost (Revised)

	SCR	Low NO_x Burners	Remarks
Direct Annual Cost			
Catalyst Replacement	121,000	NA	Catalyst life of 3 yr. of equivalent operating hours (5.3 equivalent years)
Operation and Maintenance	16,000	NA	
Reagent Feed	18,000	NA	Assumes 1.4 stoichiometric ratio
Power Consumption	5,000	NA	
Lost Power Generation	150,000	NA	Back pressure on combustion turbine
Annual Distribution Check	15,000	NA	Required for SCR
Total Direct Annual Cost	325,000	NA	
Indirect Annual Costs			
Overhead	7,000	NA	60% of O&M Labor
Administrative Charges	85,000	NA	2% of Total Installed Cost
Property Taxes	42,000	NA	1% of Total Installed Cost
Insurance	42,000	NA	1% of Total Installed Cost
Capital Recovery	355,000	NA	Capital Recovery Factor * Total Installed Cost
Total Indirect Annual Costs	531,000	NA	
Total Annual Cost	**856,000**	NA	
Annual Emissions, tpy	18	90	Emissions from BACT for 5,000 hrs of natural gas firing
Emissions Reduction, tpy	72	NA	Emissions calculated from BACT
Total Cost Effectiveness, $/ton	**11,889**	NA	Total Annual Cost/Emissions Reduction

ATTACHMENT F

Table 3

NO_x Control Alternative Cost

With and Without Contingency

	SCR W/ Contingency	SCR W/out Contingency
Direct Capital Cost		
Catalysts and Ammonia Injection	1,106,000	1,106,000
Ductwork and Catalyst Reactor	710,000	710,000
Control/Instrumentation	100,000	100,000
Ammonia Storage	167,000	167,000
Balance of Plant	833,000	833,000
Total Direct Capital Cost	2,916,000	2,916,000
Indirect Capital Costs		
Contingency	729,000	0
Engineering and Supervision	208,000	208,000
Construction & Field Expense	104,000	104,000
Construction Fee	208,000	208,000
Start-up Assistance	42,000	42,000
Performance Test	35,000	35,000
Total Indirect Capital Costs	1,326,000	597,000
Total Capital Cost	4,242,000	3,513,000
Direct Annual Cost		
Total Direct Annual Cost	325,000	325,000
Indirect Annual Costs		
Overhead	7,000	7,000
Administrative Charges	85,000	70,000
Property Taxes	42,000	35,000
Insurance	42,000	35,000
Capital Recovery	355,000	294,000
Total Indirect Annual Costs	531,000	441,000
Total Annual Cost	**856,000**	**766,000**
Annual Emissions, tpy	18	18
Emissions Reduction, tpy	72	72
Total Cost Effectiveness, $/ton	**11,889**	**10,639**

ATTACHMENT G

BLACK & VEATCH

TELEPHONE MEMORANDUM

B&V Project 63812.0030
7/21/99
11:30 am

Puerto Rico-Simple Cycle Firing No. 2 Fuel Oil
NOx Emission Problems

From: Mr. Harish Patel
Company: EPA, Region 2, New York
Phone No.: (212) 637-4046

Recorded by: Greg Holscher

The following is a telephone conversation regarding the Cambalache Plant in Puerto Rico. The plant has a simple cycle combustor capable of firing No. 2 fuel oil. The main concern was whether the facility was meeting their permit requirements for NOx output.

Mr. Patel informed me of the following:

1) The Puerto Rico plant was permitted for NOx at 10 ppm and ammonia slip at 10 ppm.
2) They are using water injection followed by an SCR.
3) They are having problems meeting their permit with the SCR.
4) Using a simple cycle turbine, which has a high temperature outlet. They are trying to use a zeolite catalyst for the SCR. The zeolite catalyst does not seem to be working in the SCR like it did in the laboratory.
5) To keep the NOx level low, they are increasing the amount of ammonia injected into the system (decrease NOx results in increasing ammonia slip).
6) The ammonia delivery system is finite, meaning they can only inject so much ammonia into their system.
7) After a few weeks/months the NOx level is slightly increasing. The level of NOx is about 20 to 25 ppm.
8) The ammonia slip is also increasing to about 30 to 40 ppm.
9) When the water injection-SCR system first went into operation, the NOx levels were at about 10 ppm, but are estimated to steadily increase to 42 ppm (42 ppm is the limit using only water injection).
10) Another contact is in Puerto Rico: Mr. Francisco Claudio at (787) 729-6951 Ext. 258

BLACK & VEATCH

8400 Ward Parkway
P.O. Box 8405
Kansas City, Missouri 64114

Tel: (913) 458-2000

Black & Veatch Corporation

Kissimmee Utility Authority
Cane Island – Unit 1 PSD Permit Amendment Request

B&V Project 24489.018
B&V File 14.1000
October 28, 1999

Florida Department of Environmental Protection
Division of Air Resource Management
Bureau of Air Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Subject: Response to Request for Additional Information

0970043-007-AC
PSD-FL-182(a)

Attention: Al Linero
Administrator, New Source Review Section

Gentlemen:

On behalf of Kissimmee Utility Authority (KUA, the Applicant), Black & Veatch (B&V) is herewith submitting the additional information requested in Florida Department of Environmental Protection's (FDEP) September 24, 1999 response to the Applicant's Unit 1 permit amendment application of August 31, 1999. As FDEP is aware, General Electric (GE) has not been able to develop the technology for a dual fuel LM6000PA unit to meet a 15 ppmvd natural gas NOx emission rate, and cannot guarantee when, if ever, such technology may be available. Thus, KUA is requesting an amendment to Construction Permit No. AC49-205703 (PSD-FL-182) and the Initial Title V Air Operating Permit, Permit No. 0970043-002-AV, to modify Unit 1's NOx emission limit during natural gas firing from 15 to 25 ppmvd, based on the revised BACT analysis and an operating limit of 5,000 hours per year. As a result of the requested permit amendment, annual potential emissions from Unit 1 will be less than those currently allowed. FDEP's specific information requests, along with the Applicant's responses, are provided below.

Request Item 1:

What are the lowest levels of NO_x that can possibly be consistently achieved with water injection with the LM6000PA engine, based on the experience of KUA and the engine manufacturer? Are lower emissions achievable with higher water injection rates?

Response:

Historical Unit 1 emission test data and relative accuracy test audit (RATA) data (Attachment A) from 1995 through 1998 indicate that natural gas fired NOx emission levels have ranged from approximately 20 ppmvd @ 15% O_2 to just under 25 ppmvd @ 15% O_2 with water injection. The lowest levels consistently achieved are best represented by recent continuous emissions monitoring (CEM) data from October 12, 1999. These data, included as Attachment B, reveal an

average NOx emission level for Unit 1 of 21.4 ppmvd @ 15% O_2 for a 3-hour period on October 12, 1999. The average water-to-fuel injection ratio during this period was 1.03:1. It should be noted that compliance with Unit 1's NOx emission limit is determined with a CEM system based on a 1-hour averaging period (i.e., any 60 minute period). Based on the October 12, 1999 CEMs data, Unit 1 consistently achieves a NOx emission level of approximately 22 ppm @ 15% O_2 based on a 1-hour averaging period.

The water injection control systems for Unit 1 were configured by GE to achieve the delicate balance of minimizing NOx emissions while optimizing turbine performance and limiting CO formation. GE's recommended water-to-fuel ratio for LM6000PC combustion turbines firing natural gas is typically 1.18:1 to achieve NOx levels of 25 ppm, while KUA's experience firing natural gas in the LM6000PA combustion turbine demonstrates that approximately a 1:1 water-to-fuel ratio is necessary to achieve NOx emission levels less than 25 ppm. While higher water-to-fuel ratios may result in limited additional NOx reduction (certainly not down to the 15 ppm level), such ratios are not recommended by GE, and may result in reduced combustor life and increased combustor inspections, increased equipment erosion and maintenance costs, unstable combustor flames and potential flame extinction, and high combustor dynamic pressures. GE does not recommend any higher water injection rates than are necessary to achieve NOx emission levels of 25 ppm. Please refer to GE's letter of October 19, 1999 to KUA regarding this issue (included as Attachment C).

Request Item 2:

Please evaluate the applicability of spray intercooling to reducing NO_x emissions from this engine.

Response:

GE currently offers LM6000PC combustion turbines with spray intercooling technology, also known as SPRINT. There have been several inquiries to GE relative to use of SPRINT technology on LM6000PA combustion turbines, but these have been with an emphasis on providing hot day power augmentation (increasing turbine output on high end days), rather than as a method for enhanced NOx control. To date, SPRINT technology has not been used for emission reductions from a LM6000PA combustion turbine, nor has a decision been made whether GE will consider adapting SPRINT technology for modification of LM6000PA field machines. Please refer to GE's letter of October 19, 1999 included as Attachment C.

Request Item 3:

The analysis provided proposed reducing allowable hours of operation firing gas from the current 8760 hours per year to 5000 hours per year. The application information for potential NO_x emissions shows that KUA proposes no reduction in hours of operation for fuel oil firing, allowing for a total of 6000 hours of operation per year (5000 hours for gas firing plus 1000 hours for oil firing). Based on information provided in annual operation reports, Unit 1 has operated 1096 hours in 1996 and 774 hours in 1997, for an average of 935 hours (firing primarily gas). Comparing past actual operation with proposed future operation shows that NO_x emissions will increase by approximately 105 tons per year. Please address this issue.

Response:

It is the Applicant's position that a hot-side SCR for Unit 1 became cost ineffective in the best available control technology (BACT) analysis when the annual hours of natural gas firing were limited to 5,000 h/yr. Furthermore, it is also cost ineffective at 8,760 h/yr. Results of the revised BACT analysis submitted with the application were intended to substantiate the requested modification of Unit 1's natural gas NOx emission limit from 15 ppmvd @ 15% O_2 to 25 ppmvd @ 15% O_2 on January 1, 2000. A reduction in fuel oil firing hours is neither relevant to the natural gas NOx limit for Unit 1, as it plays no role in achieving lower gas fired NOx emission limits, nor practical for KUA, who's natural gas fuel contracts and partnership with Florida Municipal Power Agency (FMPA) depend on the level of dual-fuel capability currently allowed. Test data while firing distillate fuel oil (Included in Attachment A) clearly indicate Unit 1's ability to achieve compliance with the 42 ppmvd @ 15% O_2 NOx emission limit. For these reasons, KUA is not proposing a reduction in the distillate fuel oil firing capability of Unit 1.

A comparison of past actual emissions to future potential emissions is typically performed to determine whether or not a modification (physical change or change in the method of operation of an emission unit) results in a significant emission increase with respect to Prevention of Significant Deterioration (PSD) applicability. It must however be made very clear that KUA is neither proposing a physical modification nor change in the method of operation of Unit 1, but merely a relaxation of the 15 ppm NOx emission limit for natural gas firing scheduled to take effect January 1, 2000. The 15 ppm was based on the specific representations from GE, that GE had emerging technology designed to lower LM6000PA emissions to 15 ppm during natural gas firing. A more accurate and representative comparison of NOx emissions, with regard to the proposed request, is to compare the current permit "Potential Emissions" and future proposed permit "Potential Emissions". The following comparison of "Potentials" to "Potentials" illustrates a 49.7 tpy reduction in NOx emissions from Unit 1 based on an emission limit of 25 ppm and 5,000 h/yr of natural gas operation.

Permitted Emission Levels

(36 lb/h (25ppm) * 7,760 h/yr) + (63 lb/h (42 ppm) * 1,000 h/yr) = 171.2 tpy

Proposed Emission Levels

(36 lb/h (25ppm) * 5,000 h/yr) + (63 lb/h (42 ppm) * 1,000 h/yr) = 121.5 tpy

Additional Emissions Reduction

(171.8 tpy (Permitted Emission Level) – 121.5 tpy (Proposed Emission Level)) = 49.7 tpy

Request Item 4:

The application proposes no reduction in hours for oil firing even though annual operation reports show that the greatest amount of oil firing was in 1998 with approximately 13 full load hours on oil. It appears that KUA could propose a dramatic reduction in allowable hours for oil firing without compromising the ability to operate the unit. Please comment and provide historical data showing the actual hours of operation firing gas and oil as well as the fuel consumption by fuel type for calendar years 1998 through 1994. We wish to confirm the information available in our records from annual operation reports.

B. The indirect capital costs were generally calculated as a percentage of the total direct capital cost, although more typically the direct installation costs (in the analysis shown as "balance of plant") are not used to estimate the indirect capital costs.

C. The rate for administrative charges, taxes and insurance at 5.75% is higher than a more typical 4% rate.

D. The nominal interest rate used for the capital recovery factor was 10% (the "real interest rate" shown of 5.5% plus apparently an anticipated annual rate of inflation of 4.5%) although 7% is more typical.

E. The charge for lost power generation from backpressure seems excessive, as does the stated increase in back pressure of 6 inches of water.

F. Catalyst life seems low at 3 years, particularly for a unit that fires primarily gas. The Department is aware of at least one vendor that will guarantee a catalyst life of 3 years inclusive of 1000 hours of annual oil firing, yet no NO_x reductions due to oil firing were included in the analysis.

G. The analysis did not consider the control effectiveness for the allowable use of fuel oil, and did not consider any reduction in annual Title V fees associated with the overall decrease in NO_x emissions from both gas and oil firing.

H. There is no description of what constitutes the "annual distribution check", or justification for this cost.

I. The economic analysis was based on only 5000 hours of operation on gas, although with installation of SCR there would be no reason to limit operation to less than 8760 hours per year.

J. The "starting point" for determining the NO_x reductions appears to presume the continuance of water injection. In the event that an SCR is installed, water injection (for gas as well as oil firing) should be able to be eliminated (or at least reduced). A higher "starting point" should therefore be assumed.

Accounting for these comments would serve to improve the cost effectiveness of SCR. Please provide the basis for costs used in the analysis where they differ from the recommendations in the above comments.

Response:

A quote was not obtained directly for this project. However, B&V had a current quote for a similar project that had been obtained only a month before the cost analysis was being developed for Unit 1. This quote is included as Attachment D along with the calculation performed to adjust this quote to the conditions associated with Unit 1. As illustrated by the costs in the quote, high temperature SCR catalysts are extremely expensive in comparison to conventional SCR catalyst. Changes have been made to the revised BACT cost tables based on FDEP comments. These changes are shown in the enclosed Tables 1 and 2 of Attachment E. It should be noted, however, that these changes do not change the conclusions of the revised BACT analysis which show that installing a high temperature SCR on the Cane Island Unit 1 combustion turbine is not cost effective.

5a. The contingency of 25 percent is typical for studies of this level of detail and is the right level of contingency for this estimate. The contingency accounts for the fact that this is a preliminary design. The following items, which are not resolved at this stage in the project, can significantly impact the cost:

- An exact layout of the new SCR ductwork is not complete
- Location of ammonia storage is not established
- Catalyst prices are in state of fluctuation due to the NOx SIP call being proposed by the EPA for coal fired units
- Structural steel costs are currently volatile
- Labor costs are volatile

Table 3, included in Attachment F shows a comparison of the costs with and without the contingency included. It reasoned from Table 3, that removing the contingency does not result in the high temperature SCR being cost effective.

The six percent retrofit factor is required due to the additional costs associated with retrofit work. The following costs are included in the six percent value:

- Costs associated with lost power generation during the outage to tie in the new equipment.
- Costs associated with additional construction labor required to work around existing equipment at the plant.

5.b. Changes have been made to the costs in accordance with FDEP's comment. Revised costs are reflected in Tables 1 and 2 in Attachment E. Specifically, the Purchase Equipment Cost consists of catalyst and ammonia, ductwork and catalyst reactor, control/instrumentation, and ammonia storage.

5.c. Changes have been made to the costs in accordance with FDEP's comment. Revised costs are reflected in Tables 1 and 2 in Attachment E.

5.d. The capital recovery factor for this project was calculated incorrectly. It should have been based on an interest rate of 5.5 percent. Revisions to the costs using the correct capital recovery factor are shown in Tables 1 and 2 in Attachment E. Please note that this interest rate is less than the seven percent referenced in FDEP's Request for additional information.

5.e. The charge for lost power is based on taking the backpressure on the combustion turbine and converting it to lost kilowatts (kW's). This calculation is based on a graph provided to B&V by Westinghouse on another project. This is the standard calculation used by B&V for calculating lost generation. Once kW's are calculated, the kW's are multiplied by the hours of operation per year and the energy costs (in $/kWh) listed in Table 1 of the revised BACT included in the "Application". The back pressure of 6 inches w.g. was developed by taking the 4.5 in w.g. from the catalyst quote plus an additional 1.5 in w.g. due to the additional ductwork that will be required in Unit 1's retrofit. The extra 1.5 in w.g. would not be required for a new unit.

5.f. The catalyst in the quote has been guaranteed for 3 years worth of operating hours. Therefore, for Unit 1 (with only 5,000 hours of operation), the actual catalyst life is equivalent to 5.3 years. The catalyst costs listed in the revised BACT are for 5.3 years not 3 years. Manufacturers are guaranteeing a catalyst life of three years worth of operating hours. However, there are concerns about how well high temperature SCR's will last on a unit which has the potential to fire fuel oil. Included as Attachment G is a telephone memorandum discussing three oil fired units in Puerto Rico which have rapidly degrading, high temperature SCR catalysts. It

should be noted that due to impurities in the oil, fuel oil firing degrades the catalyst even when ammonia is not being injected.

5.g. As previously discussed, no reduction in fuel oil fired emissions are required in this request for modification of the natural gas NOx emission limit and no evaluation of fuel oil NOx reduction is required or relevant to this process. Title V fee savings are not included in the BACT cost analysis, but neither are the training and development costs associated with the Title III - Risk Management Program which are required when ammonia is stored onsite. It is expected that the savings and incurred costs of these two items would nearly offset each other, and therefore were not included in the BACT cost analysis.

5.h. An annual distribution check is required to ensure the ammonia slip is minimized in the SCR system and to track catalyst life. The activities associated with this include NOx testing of the SCR catalyst inlet and outlet. Ammonia testing of the catalyst outlet is included and catalyst activity tests are also included. The costs are based on testing quotes from other projects.

5.i. A revised BACT analysis was performed based on the operating scenario of the Cane Island Power Park. If KUA proposed that Unit 1 would be operated 8,760 hours per year, then the revised BACT analysis would have been performed for 8,760 hours per year. However, we are proposing an operating limitation of 5,000 hours per year. Therefore, this is the operating scenario that should be used to perform the BACT analysis and is the information contained in the revised BACT submitted to FDEP as Attachment D of the "Request Letter".

5.j. As stated in the revised BACT, the analysis follows a "Top Down" approach as USEPA guidance authorizes, and the most stringent NOx control should be compared to the next most stringent NOx control technology analysis. Therefore, an SCR is compared to the next most stringent NOx control (water injection). If the revised BACT had compared SCR to conventional combustors without water injection, it would have skipped an important step in the NOx control alternatives. In addition, the revised BACT analysis would not have followed regulatory guidelines, which require a "Top Down analysis in which the most stringent technology is compared to the next most stringent technology. It seems inconsistent to suggest comparing SCR to conventional combustors when FDEP has a documented history of promoting in-combustion controls over post-combustion controls.

Request Item 6:

Please indicate whether any other (additional) means are available to obtain real offsetting reductions in NO_x emissions from the facility as a whole.

Response:

Short of installing SCR systems, which are clearly contrary to FDEP's documented history of promoting in-combustion controls over post combustion controls, limited annual operation of Unit 1 is the only practical option available to obtain real offsetting NOx reductions. In a meeting held in FDEP's offices on October 20, 1999, with parties from FDEP, KUA, and B&V attending, FDEP suggested a NOx emission cap for Units 1 and 2 as a method for obtaining real offsetting reductions in NOx emissions from the facility as a whole.

Specifically, Mike Halpin suggested an annual ton per year NOx emission cap for Units 1 & 2 based on the following formula:

- Unit 2's annual NOx ton per year permitted potential to emit; plus, Unit 1's annual NOx ton per year potential to emit based on 5,000 h/yr gas firing at 15 ppm and 1,000 h/yr of fuel oil firing at 42 ppm.

Based on the aforementioned formula, the NOx emission cap for Units 1 & 2 will equal 377.1 tpy. All calculations and assumptions relevant to the NOx emission cap are included in Attachment H. This is more than a 30 tpy offsetting reduction in NOx emissions from the facility as a whole, compared to permitted levels. As such, with the understanding that Units 1 & 2 will retain their current fuel oil firing capability (i.e., 1,000 h/yr when natural gas is unavailable and 800 h/hr when natural gas is available, per unit), the Applicant is willing to limit the total NOx emissions from Units 1 & 2 to the suggested cap of 377.1 tpy.

If you have any questions regarding this submittal, please do not hesitate to call me at 913-458-7928.

Very truly yours,

BLACK & VEATCH

Timothy M. Hillman
Air Permit Coordinator

kjl
Enclosure[s]

cc: Ben Sharma (KUA)
Jeff Ling (KUA)
Tasha Buford

CC: EPA
NPS
CD
M. Halpin, BAR

Owner/Authorized Representative or Responsible Official

1. Name and Title of Owner/Authorized Representative or Responsible Official :

Name : A. K. Sharma
Title : Director of Power Supply

2. Owner or Authorized Representative or Responsible Official Mailing Address :

Organization/Firm : Kissimmee Utility Authority
Street Address : 1701 West Carroll Street
City : Kissimmee
State : FL Zip Code : 34741-6804

3. Owner/Authorized Representative or Responsible Official Telephone Numbers :

Telephone : (407)933-7777 Fax : (407)847-0787

4. Owner/Authorized Representative or Responsible Official Statement :

I, the undersigned, am the owner or authorized representative of the non-Title V source addressed in this Application for Air Permit or the responsible official, as defined in Rule 62-210.200, F.A.C., of the Title V source addressed in this application, whichever is applicable. I hereby certify, based on information and belief formed after reasonable inquiry, that the statements made in this application are true, accurate and complete and that, to the best of my knowledge, any estimates of emissions reported in this application are based upon reasonable techniques for calculating emissions. The air pollutant emissions units and air pollution control equipment described in this application will be operated and maintained so as to comply with all applicable standards for control of air pollutant emissions found in the statutes of the State of Florida and rules of the Department of Environmental Protection and revisions thereof. I understand that a permit, if granted by the Department, cannot be transferred without authorization from the Department, and I will promptly notify the Department upon sale or legal transfer of any permitted emissions units.*

A K Sharma
Signature

10/26/99
Date

* Attach letter of authorization if not currently on file.

Professional Engineer Certification

1. Professional Engineer Name : D. D. Schultz Registration Number : 30304
2. Professional Engineer Mailing Address : Organization/Firm : Black & Veatch Street Address : 8400 Ward Parkway City : Kansas City State : MO Zip Code : 64114-2031
3. Professional Engineer Telephone Numbers : Telephone : (913)458-2028 Fax : (913)458-2934

4. Professional Engineer Statement :

I, the undersigned, hereby certify, except as particularly noted herein, that :*

(1) To the best of my knowledge, there is reasonable assurance that the air pollutant emissions unit(s) and the air pollutant control equipment described in this Application for Air Permit, when properly operated and maintained, will comply with all applicable standards for control of air pollutant emissions found in the Florida Statutes and rules of the Department of Environmental Protection; and

(2) To the best of my knowledge, any emission estimates reported or relied on in this application are true, accurate, and complete and are either based upon reasonable techniques available for calculating emissions or, for emission estimates of hazardous air pollutants not regulated for an emissions unit addressed in this application, based solely upon the materials, information and calculations submitted with this application.

If the purpose of this application is to obtain a Title V source air operation permit (check here [ ] if so), I further certify that each emissions unit described in this Application for Air Permit, when properly operated and maintained, will comply with the applicable requirements identified in this application to which the unit is subject, except those emissions units for which a compliance schedule is submitted with this application.

If the purpose of this application is to obtain an air construction permit for one or more proposed new or modified emissions units (check here [X] if so), I further certify that the engineering features of each such emissions unit described in this application have been designed or examined by me or individuals under my direct supervision and found to be in conformity with sound engineering principles applicable to the control of emissions of the air pollutants characterized in this application.

If the purpose of this application is to obtain an initial air operation permit or operation permit revision for one or more newly constructed or modified emissions units (check here [ ] if so), I further certify that, with the exception of any changes detailed as part of this application, each such emissions has been constructed or modified in substantial accordance with the information given in the corresponding application for air construction permit and with all provisions contained in such permit.

D O Schultz
Signature
(seal)

10/26/99
Date

ATTACHMENT A

NOx EMISSION SUMMARY for RELATIVE ACCURACY TEST AUDITS
COMBUSTION TURBINE 1
CANE ISLAND PLANT
KISSIMMEE UTILITIES AUTHORITY
INTERCESSION CITY, FLORIDA
NOVEMBER 15, 1995

FIGURE 1 - RELATIVE ACCURACY DETERMINATION(NOx)

RUN NO.	TIME	NOx PPM @ 15% O2			CT LOAD	NOx LB/MMBTU		
		RM	M	DIFF	MW	RM	M	DIFF
1	0750-0814	22.19	22.39	-0.2	40.0	0.082	0.082	0
2	0837-0901	23.7	22.89	0.81	40.0	0.087	0.084	0.003
3	0909-0933	23.58	23.65	-0.07	40.0	0.087	0.087	0
4	0945-1009	24.32	23.95	0.37	40.0	0.09	0.088	0.002
5	1016-1040	23.94	23.41	0.53	40.0	0.088	0.086	0.002
6	1047-1111	22.99	22.97	0.02	40.0	0.084	0.085	-0.001
7	1121-1145	23.89	23.12	0.77	39.8	0.088	0.085	0.003
8	1152-1216	23.6	23.08	0.52	39.9	0.087	0.085	0.002
9	1224-1248	23.54	23.08	0.46	39.7	0.086	0.085	0.001
TOTAL DATA POINTS:				9				9
AVERAGE :		23.53	23.17	0.357		0.0866	0.0852	0.0013
Sd:				0.362				0.0014
CC:				0.278				0.0011
RA:				**2.70**				**2.80**
BAF(BIAS ADJUSTMENT):				1.015				1.016

Table 1 Emission Summary
Units 1 and 2
Cane Island Facility
Kissimmee Utility Authority
Intercession City, Florida
October 8-9, 1996

Unit 1 - Number 2 Diesel Firing - October 9, 1996

Run No.	Time	Actual Heat Input GPM	MMBTUH HHV	O2%	NOx Emissions ppmvd	15% O2 ppmvd	ISO ppmvd	lbs/MMBTU	
1	0952-1059	38.1	315.61	14.92	38.12	37.59	44.47	0.147	4
2	1122-1231	38.7	320.6	14.65	38.71	36.55	44.19	0.142	4
3	1245-1352	44.1	365.3	14.92	37.99	37.49	46.00	0.146	5
Average		40.3	333.8	14.83	38.27	37.21	44.89	0.145	4

Unit 1 - Natural Gas Firing - October 9, 1996

Run No.	Time	Actual Heat Input KSCFH	MMBTUH HHV	O2%	NOx Emissions ppmvd	15% O2 ppmvd	ISO ppmvd	lbs/MMBTU	
1	1458-1648	339.85	354.3	15.41	22.82	24.5	29.97	0.090	3
2	1701-1845	339.85	354.3	15.33	23.02	24.39	29.18	0.090	3
3	1857-2024	359.04	374.3	15.39	23.06	24.68	30.46	0.091	3
Average		346.25	361.0	15.38	22.97	24.52	29.87	0.090	3

Unit 2 - Natural Gas Firing - October 8, 1996

Run No.	Time	Actual Heat Input KSCFH	MMBTUH HHV	O2%	NOx Emissions ppmvd	15% O2 ppmvd	ISO ppmvd	lbs/MMBTU	
1	1405-1512	800	834	15.08	7.89	7.99	10.02	0.030	24
2	1532-1639	810	844	15.01	7.91	7.93	10.04	0.029	24
3	1653-1800	815	850	15.12	8.06	8.23	9.90	0.030	25
Average		808	843	15.07	7.95	8.05	9.99	0.030	24

NOTES: ISO = emissions at 59°F, 40% RH, 29.92" Hg
HHV Oil = 138064 BTU/Gal
HHV Gas = 1042.5 BTU/SCF
lbs/MMBTU = ppm $(2.595 \times 10\text{-}9)(M)(Fd)\left(\frac{20.9}{20.9 - \%O2}\right)$
lbs/Hr = lbs/MMBTU x MMBTUH

TABLE 1 - NOx RATA RESULTS
COMBUSTION TURBINE CT-1
KISSIMMEE UTILITIES AUTHORITY
CANE ISLAND PLANT
10/16/97
NATURAL GAS FIRING

RELATIVE ACCURACY DETERMINATION(NOx/DILUENT)

RUN NO.	TIME	REFERENCE METHOD			NOx COMBINED SYSTEM(LB/MMbtu)		
		NOx PPM	O2 %	LB/MMbtu	RM	M	DIFF
1	1007-1037	22.61	15.27	0.087	0.087	0.077	0.010
2	1047-1117	21.15	15.24	0.081	0.081	0.074	0.007
3	1132-1202	20.99	15.23	0.080	0.080	0.074	0.006
4	1210-1240	21.19	15.22	0.081	0.081	0.075	0.006
5	1253-1323	21.50	15.24	0.083	0.083	0.077	0.006
6	1331-1401	22.36	15.23	0.086	0.086	0.076	0.010
7	1410-1434	22.87	15.32	0.089	0.089	0.077	0.012
8	1441-1505	21.82	15.25	0.084	0.084	0.078	0.006
9	1514-1538	21.58	15.17	0.082	0.082	0.077	0.005
TOTAL DATA POINTS:				9			9
AVERAGE DIFF. :		21.78	15.24	0.084	0.084	0.076	0.008
Sd:							0.002
CC:							0.002
RA:							**11.29**
BAF(BIAS ADJUSTMENT):							1.099

TABLE 1 - NOx RATA RESULTS
COMBUSTION TURBINE CT-1
KISSIMMEE UTILITIES AUTHORITY-CANE ISLAND
INTERCESSION CITY, FLORIDA
10/6/98
NATURAL GAS FIRING

RELATIVE ACCURACY DETERMINATION(NOx/DILUENT)

RUN NO.	TIME	REFERENCE METHOD			NOx COMBINED SYSTEM(LB/MMbtu)		
		NOx PPM	O2 %	LB/MMbtu	RM	M	DIFF
1	1025-1045	21.53	14.64	0.075	0.075	0.079	-0.004
2	1059-1119	20.33	14.75	0.072	0.072	0.081	-0.009
3	1130-1150	19.90	14.69	0.070	0.070	0.082	-0.012
4	1205-1225	22.02	14.71	0.077	0.077	0.083	-0.006
5	1235-1255	20.82	14.72	0.073	0.073	0.083	-0.010
6	1309-1329	20.30	14.77	0.072	0.072	0.083	-0.011
7	1346-1406	21.71	14.76	0.077	0.077	0.083	-0.006
8	1418-1438	21.65	14.70	0.076	0.076	0.083	-0.007
9	1448-1508	22.20	14.71	0.078	0.078	0.083	-0.005
TOTAL DATA POINTS:				9			9
AVERAGE DIFF. :		21.16	14.72	0.074	0.074	0.082	-0.008
Sd:							0.003
CC:			PASSED WITH AVERAGE DIFFERENCE < 0.01				0.002
RA:							13.36
BAF(BIAS ADJUSTMENT):							1.000

ATTACHMENT B

October 12,1999
Unit 1

	NOx_cor_1	H2O_INJ_1	GAS_FL_1	LOAD_1	Gas pph	H2o pph	water to gas ratio
16:30	21.7	27.44	5228	30	14220.9212	13730.976	0.965547577
16:31	21.5	27.39	5219	30.01	14196.43989	13705.956	0.965450219
16:32	24.3	27.55	5218	30.01	14193.71974	13786.02	0.971276047
16:33	20.9	27.63	5224	30.06	14210.04061	13826.052	0.972977655
16:34	21.2	27.83	5223	30.02	14207.32047	13926.132	0.980208198
16:35	21	27.79	5227	30.01	14218.20105	13906.116	0.978050314
16:36	20.9	27.45	5225	30.01	14212.76076	13735.98	0.966454036
16:37	21.4	28.04	5220	30.03	14199.16003	14031.216	0.988172256
16:38	20.9	27.54	5216	30.04	14188.27945	13781.016	0.971295783
16:39	21.2	27.68	5230	30.01	14226.36149	13851.072	0.973620136
16:40	21.1	28.11	5222	30.06	14204.60032	14066.244	0.990259752
16:41	20.8	27.71	5224	30.01	14210.04061	13866.084	0.975794818
16:42	21.2	27.91	5223	30	14207.32047	13966.164	0.983025901
16:43	20.7	30.36	5610	33.09	15260.01682	15192.144	0.995552245
16:44	22.9	32.81	5781	33.94	15725.16171	16418.124	1.044067101
16:45	20.9	31.94	5785	33.89	15736.0423	15982.776	1.015679527
16:46	21.9	32.35	5778	33.81	15717.00128	16187.94	1.02996365
16:47	21.1	32.24	5775	33.84	15708.84084	16132.896	1.026994682
16:48	21.5	32	5778	33.84	15717.00128	16012.8	1.018820303
16:49	21.6	32.45	5782	33.85	15727.88186	16237.98	1.03243273
16:50	21.1	32.1	5774	33.88	15706.12069	16062.84	1.02271212
16:51	21.5	32.64	5779	34.02	15719.72142	16333.056	1.039016886
16:52	21.2	32.21	5785	34.05	15736.0423	16117.884	1.024265422
16:53	21.5	32.77	5777	33.99	15714.28113	16398.108	1.043516268
16:54	21.1	31.82	5762	33.86	15673.47895	15922.728	1.015902599
16:55	21.9	32.6	5766	33.8	15684.35953	16313.04	1.040083273
16:56	21	32.04	5764	33.81	15678.91924	16032.816	1.022571502
16:57	21.4	32.13	5779	33.86	15719.72142	16077.852	1.022782247
16:58	21.5	32.31	5768	33.81	15689.79982	16167.924	1.030473568
16:59	21.4	32.32	5777	33.89	15714.28113	16172.928	1.029186627
17:00	21.4	32.49	5778	33.94	15717.00128	16257.996	1.034420989
17:01	21.4	32.41	5775	33.89	15708.84084	16217.964	1.032409976
17:02	51.8	32.95	5773	33.92	15703.40055	16488.18	1.049975128
17:03	20.2	33	5774	33.88	15706.12069	16513.2	1.051386292
17:04	20.5	32.16	5775	33.89	15708.84084	16092.864	1.024446308
17:05	21.3	32.69	5773	33.93	15703.40055	16358.076	1.041690043
17:06	20.9	32.58	5770	33.94	15695.24011	16303.032	1.0387246
17:07	21.3	32.38	5775	33.85	15708.84084	16202.952	1.031454336
17:08	21.1	32.33	5744	33.75	15624.51633	16177.932	1.0354197
17:09	21.1	32.23	5767	33.84	15687.07968	16127.892	1.028100343
17:10	21.3	32.41	5770	33.78	15695.24011	16217.964	1.033304612
17:11	21.1	32.04	5734	33.76	15597.31487	16032.816	1.027921545
17:12	21.4	32.68	5741	33.77	15616.35589	16353.072	1.04717593
17:13	20.7	32.31	5746	33.72	15629.95662	16167.924	1.034418994
17:14	21	32.3	5740	33.71	15613.63574	16162.92	1.035179779
17:15	21	31.95	5736	33.7	15602.75516	15987.78	1.024676721
17:16	21.2	32.41	5725	33.7	15572.83356	16217.964	1.041426657
17:17	20.8	32.55	5747	33.77	15632.67676	16288.02	1.041921371
17:18	20.8	32.15	5754	33.91	15651.71778	16087.86	1.027865454
17:19	21.5	32.91	5758	33.92	15662.59836	16468.164	1.051432439

17:20	20.6	32.68	5773	33.92	15703.40055	16353.072	1.041371386
17:21	20.8	32.51	5757	33.84	15659.87822	16268.004	1.038833366
17:22	21	32.34	5758	33.76	15662.59836	16182.936	1.033221668
17:23	21.1	32.06	5721	33.66	15561.95298	16042.824	1.030900429
17:24	21	32.09	5714	33.58	15542.91196	16057.836	1.033129187
17:25	21.1	31.94	5714	33.55	15542.91196	15982.776	1.028299976
17:26	21	32.12	5713	33.52	15540.19181	16072.848	1.034276037
17:27	20.9	32.12	5721	33.61	15561.95298	16072.848	1.03282975
17:28	21	32.45	5740	33.77	15613.63574	16237.98	1.039987116
17:29	20.8	32.4	5756	33.76	15657.15807	16212.96	1.035498264
17:30	20.9	32.52	5751	33.77	15643.55735	16273.008	1.040237054
17:31	21	32.16	5759	33.77	15665.31851	16092.864	1.027292486
17:32	33.1	31.74	5735	33.74	15600.03502	15882.696	1.018119253
17:33	21.4	31.77	5749	33.7	15638.11705	15897.708	1.016599885
17:34	21.4	32.23	5753	33.79	15648.99764	16127.892	1.030602239
17:35	20.9	32.1	5761	33.92	15670.7588	16062.84	1.025019924
17:36	21.7	32.48	5773	33.95	15703.40055	16252.992	1.034998244
17:37	21.1	32.41	5778	33.97	15717.00128	16217.964	1.031873938
17:38	21.3	32.11	5775	33.91	15708.84084	16067.844	1.022853574
17:39	21.5	32.4	5776	33.93	15711.56099	16212.96	1.031912743
17:40	21.3	32.56	5782	33.97	15727.88186	16293.024	1.035932502
17:41	21.1	32.22	5784	33.96	15733.32215	16122.888	1.024760559
17:42	21.6	31.92	5775	33.83	15708.84084	15972.768	1.016801186
17:43	21.4	32.06	5757	33.78	15659.87822	16042.824	1.024453944
17:44	21.4	32.18	5774	33 81	15706.12069	16102.872	1.025260936
17:45	21.2	32.19	5766	33.8	15684.35953	16107.876	1.027002471
17:46	21.3	32.17	5757	33.77	15659.87822	16097.868	1.027968914
17:47	21.2	32.21	5770	33.87	15695.24011	16117.884	1.026928157
17:48	21.4	32.42	5784	33.92	15733.32215	16222.968	1.03112158
17:49	21.3	32.67	5790	33.89	15749.64302	16348.068	1.037996098
17:50	20.9	32.02	5753	33.9	15648.99764	16022.808	1.023887176
17:51	21.2	32.47	5761	33.83	15670.7588	16247.988	1.036834796
17:52	21	32.23	5757	33.9	15659.87822	16127.892	1.02988617
17:53	21.2	32.62	5793	33.95	15757.80346	16323.048	1.03587077
17:54	20.9	32.3	5778	33.97	15717.00128	16162.92	1.028371743
17:55	21.3	32.56	5801	33.99	15779.56463	16293.024	1.032539515
17:56	21.1	32.77	5796	33.99	15765.9639	16398.108	1.040095493
17:57	20.8	32.08	5787	33.93	15741.48259	16052.832	1.019778913
17:58	21.3	32.68	5786	33.88	15738.76244	16353.072	1.03903163
17.59	20 7	31.76	5759	33.79	15665.31851	15892.704	1.014515216
18:00	21.3	32.51	5760	33.8	15668.03866	16268.004	1.038292307
18:01	20.7	32.22	5776	33.82	15711.56099	16122.888	1.026179895
18:02	45.4	32.08	5759	33.81	15665.31851	16052.832	1.024737032
18:03	20.5	31.92	5754	33.75	15651.71778	15972.768	1.020512139
18:04	20.6	32.56	5758	33.76	15662.59836	16293.024	1.040250386
18:05	20.3	32.74	5764	33.91	15678.91924	16383.096	1.044912328
18:06	20.5	32.52	5766	33.85	15684.35953	16273.008	1.037530922
18:07	20.4	32.55	5764	33.79	15678.91924	16288.02	1.03884839
18:08	20.5	32.79	5772	33.79	15700.6804	16408.116	1.045057639
18:09	20.4	32.61	5772	33.94	15700.6804	16318.044	1.039320818
18:10	20.5	32.82	5776	33.96	15711.56099	16423.128	1.04528939
18:11	20.6	32.52	5776	33.87	15711.56099	16273.008	1.035734642
18:12	20.9	32.62	5783	33.95	15730.602	16323.048	1.037662004
18:13	20.6	32.65	5791	33.97	15752.36317	16338.06	1.037181522
18:14	20.7	32.43	5792	34.06	15755.08332	16227.972	1.030014991
18:15	20.9	32.8	5797	34.04	15768.68404	16413.12	1.040868087

18:16	20.7	32.53	5764	33.95	15678.91924	16278.012	1.03821008
18:17	20.6	32.68	5765	33.87	15681.63938	16353.072	1.042816481
18:18	20.5	32.06	5776	33.97	15711.56099	16042.824	1.021084029
18:19	21	32.6	5783	34 03	15730.602	16313.04	1.037025792
18:20	20.6	32.5	5787	34.08	15741.48259	16263	1.033130133
18:21	20.8	32.71	5819	34.17	15828.52725	16368.084	1.034087616
18:22	20.9	32.5	5810	34.17	15804.04594	16263	1.029040289
18:23	21	32.65	5800	34.17	15776.84448	16338.06	1.035572102
18:24	21	32.74	5811	34.13	15806.76608	16383.096	1.036460963
18:25	21	32.41	5796	34.07	15765.9639	16217.964	1.02866936
18:26	21	32.44	5795	34.01	15763.24375	16232.976	1.029799212
18:27	21.1	32.47	5787	33.97	15741.48259	16247.988	1.032176474
18:28	21	32.76	5795	34.06	15763.24375	16393.104	1.039957528
18:29	20.7	32.55	5794	34 06	15760.52361	16288.02	1.033469471
18:30	20.8	32.8	5798	34.15	15771.40419	16413.12	1.040688565
18:31	20.9	32.87	5814	34.19	15814.92652	16448.148	1.040039483
18:32	4.7	33.01	5807	34.21	15795.8855	16518.204	1.045728269
18:33	17.5	33.17	5809	34.2	15801.32579	16598.268	1.050435148
18:34	20.2	32.28	5821	34.26	15833.96754	16152.912	1.020143054
18:35	21.3	32.66	5822	34.27	15836.68768	16343.064	1.031974888
18:36	20.9	32.71	5822	34.24	15836.68768	16368.084	1.033554764
18:37	21	32.48	5807	34.24	15795.8855	16252.992	1.028938327
18:38	21.3	32.89	5840	34.26	15885.6503	16458.156	1.036039173
18:39	20.8	32.87	5817	34.26	15823.08696	16448.148	1.039503104
18:40	21.1	32.63	5810	34.21	15804.04594	16328.052	1.03315645
18:41	21.2	32.71	5813	34.32	15812.20637	16368.084	1.035154969
18:42	21.4	32.99	5839	34.3	15882.93016	16508.196	1.039367159
18:43	21.1	32.76	5835	34.33	15872.04958	16393.104	1.032828427
18:44	21.2	33.03	5815	34.25	15817.64666	16528.212	1.044922317
18:45	21	33.13	5816	34.24	15820.36681	16578.252	1.047905665
18:46	20.9	32.67	5818	34.23	15825.8071	16348 068	1.033000585
18:47	21.3	32.5	5820	34 27	15831.24739	16263	1.027272179
18:48	21.4	32.78	5823	34.28	15839.40783	16403.112	1.035588715
18:49	21.4	32.68	5826	34.23	15847.56827	16353.072	1.031897874
18:50	21.4	32.6	5825	34.28	15844.84812	16313.04	1.029548524
18:51	21.4	32.77	5821	34.27	15833.96754	16398.108	1.035628497
18:52	21 3	32.8	5834	34.26	15869.32943	16413.12	1.034266764
18:53	21.4	32.68	5820	34.27	15831.24739	16353.072	1.032961686
18:54	20.8	32.35	5825	34.21	15844.84812	16187.94	1.021653214
18:55	21.1	32.67	5822	34.25	15836.68768	16348.068	1.032290863
18:56	20.8	32.49	5818	34 21	15825.8071	16257.996	1.027309122
18:57	21	32.6	5822	34.24	15836.68768	16313.04	1.030079037
18:58	20.8	32.55	5813	34.24	15812.20637	16288.02	1.030091539
18:59	21.1	32.55	5809	34.26	15801.32579	16288.02	1.030800846
19:00	20.9	32.65	5825	34.29	15844.84812	16338.06	1.031127586
19:01	20.9	32.24	5813	34.3	15812.20637	16132.896	1.020281144
19:02	50.9	32.53	5812	34.29	15809.48623	16278.012	1.029635737
19:03	20.8	32.63	5814	34.34	15814.92652	16328.052	1.032445644
19:04	20.9	32.06	5829	34 37	15855.7287	16042.824	1.011799855
19:05	21.5	32.49	5825	34 33	15844.84812	16257.996	1.026074588
19:06	21.1	32.27	5825	34.26	15844.84812	16147.908	1.019126714
19:07	21.2	32.6	5816	34.31	15820.36681	16313.04	1.031141705
19:08	20.9	32.16	5829	34.31	15855.7287	16092.864	1.014955812
19:09	21.3	32.46	5831	34.29	15861.16899	16242.984	1.024072312
19:10	21.2	32.76	5830	34.32	15858.44885	16393.104	1.033714215
19:11	21	32.27	5843	34.43	15893.81074	16147.908	1.015987183

19:12	22.1	32.93	5861	34.46	15942.77336	16478.172	1.033582528
19:13	21.5	32.93	5859	34.48	15937.33307	16478.172	1.033935347
19:14	21.8	32.67	5865	34.49	15953.65394	16348.068	1.02472249
19:15	21.9	33.11	5862	34.49	15945.49351	16568.244	1.039054953
19:16	21.5	32.66	5861	34.47	15942.77336	16343.064	1.025107968
19:17	21.3	32.93	5844	34.37	15896.53089	16478.172	1.036589185
19:18	21.1	32.19	5847	34.42	15904.69132	16107.876	1.012775141
19:19	21.9	32.92	5852	34.46	15918.29205	16473.168	1.034857757
19:20	21	32.74	5859	34.54	15937.33307	16383.096	1.027969732
19:21	21.2	32.94	5874	34.57	15978.13525	16483.176	1.031608241
19:22	21.1	32.63	5861	34.49	15942.77336	16328.052	1.02416635
19:23	21.2	33.06	5860	34.47	15940.05322	16543.224	1.037839948
19:24	20.9	32.47	5852	34.4	15918.29205	16247.988	1.020711767
19:25	21.5	32.94	5857	34.4	15931.89278	16483.176	1.034602494
19:26	20.9	32.42	5855	34.38	15926.45249	16222.968	1.0186178
19:27	21.4	32.76	5852	34.41	15918.29205	16393.104	1.029828071
19:28	21.1	32.71	5849	34.45	15910.13161	16368.084	1.028783696
19:29	21.1	32.73	5850	34.4	15912.85176	16378.092	1.029236761
19:30	21.1	32.94	5845	34.42	15899.25103	16483.176	1.036726571
19:31	21	32.72	5850	34.51	15912.85176	16373.088	1.028922298
19:32	1.7	32.49	5863	34.56	15948.21365	16257.996	1.019424266
19:33	21.2	32.53	5878	34.66	15989.01584	16278.012	1.018074669
19:34	21.4	32.84	5873	34.6	15975.41511	16433.136	1.02865158
19:35	21.1	32.73	5868	34.52	15961.81438	16378.092	1.026079593

	NOx ppm			Load (MW)	Gas Usage (lb/h)	Water Usage (lb/h)	Water-to-Fuel
1	21.43	32.15	5753.08	33.77	15649.22	16086.89	1.03
2	21.91						

Note

1 Including all data

2 Rolling 1-hour average

ATTACHMENT C

GE Industrial AeroDerivative
Gas Turbines

GE Power Systems
One Neumann Way, S158
Cincinnati, OH 45215-1988
Phone: (513) 552-5925
Fax: (513) 552-5059

October 19, 1999

KUA

Attn: Larry Mattern

The purpose of this letter is to

- Respond to your inquiry regarding high water injection rates
- Provide response on the use of spray intercooling on the KUA units

High Water Injection Rates

GE currently offers LM6000PC with water injection for NOx abatement to levels of 25 ppm NOx. At ISO conditions, the expected water : fuel ratio for a typical natural gas fuel is 1.18. With engine-to-engine variation, the water : fuel requirements can be as high as 1.42 to achieve this NOx level.

GE recommends that water should not be injected beyond that required to achieve 25 ppm NOx, and, in no case, beyond 1.42 water to fuel ratio (without consulting GE). Attempts to oversuppress to levels significantly below 25 ppm will have the following consequences and added risks:

- Reduced combustor venturi life and need for more frequent inspections. Expected venturi life is 25000 hours on natural gas with water suppression to 42 ppm. Expected life of the same combustor is 16000 hours at 25 ppm. Erosion life is believed to be very non linear, therefore suppressing to <<25 will result in significantly lower erosion life and increased maintenance costs and reduced availability.
- Oversuppressing *will add risk* in terms of combustor stability and could cause high combustor dynamic pressures which will result in distress of combustion system components.

High Water Injection Rates

GE currently offers spray intercooling, also known as SPRINT™, exclusively on the LM6000PC. While there have been several inquiries relative to use of SPRINT™ with LM6000PA, GE does not currently plan to offer this as a product.

GE recently proposed to the FL-DEP that SPRINT™ could be used in conjunction with other new features on two LM6000 PB engines in Bartow FL in order to achieve the permit level of 15 ppm. This will require a development program and engine testing to ensure no adverse consequences result from the water injection levels envisioned for the LM6000PB machines. If the FL-DEP is supportive of this approach we will be conducting tests before end of June 2000 and will have a better idea of the exact benefits on a PB engine.

The intent of the above program is to achieve 15 ppm on the existing LM6000PB engines at the Bartow site. Since the LM6000PB is no longer in production, this system is not intended to be a general product offering at this time.

Best regards,

RB Hook
LM6000 Technical Program Mgr.
GE Industrial Aeroderivative Gas Turbines

Cc: Z Biernacki, D Harmon, C Stump, P Tinne

ATTACHMENT D

GIVEN

Reference 1 - Quote from Engelhard for high temperature SCR to reduce emissions from an LM 6000. Emissions reduction from 22 ppm to 2 ppm.
Reference 4 - Quote from Cormetech for conventional catalyst. Used as a basis for adjusting costs to Cane Island Unit 1 emissions requirements.

CALCULATING AN ADJUSTMENT FACTOR TO BE USED TO ADJUST ENGELHARD QUOTE

Cormatech Data	inlet	outlet	Price	% Removed	(Reference 4)
RATIO 1 (Case 2) for 25 to 4.5 ppm	25	4.5	$504,000	82%	
RATIO 2 (Case 4) for 9 to 2 ppm	25	2	$737,000	92%	

Therefore, to go from 25 TO 4.5 PPM, requires 68 % of the catalyst for reduction from 25 TO 2.0 PPM
68 % = $504000 / $737000 * 100

ADJUSTING ENGELHARD QUOTE

Engelhard Data	inlet	outlet	Price	(Reference 1)
	22	2.5	$1,558,000	

Therefore, 68 % of $1558000 is the catalyst cost = $1,065,444

Plus, need to correct for the difference in inlet NOx.
A unit achieving 92 % (25 to 2) requires 104 % more catalyst than a unit achieving 89 % (22 to 2.5).
104 % = 92 % / 89 % * 100
Therefore, $1065444 * 104 % is the catalyst cost = $1,105,876

Reference 4

p-622-bv-9/16/98

CORMETECH, INC.

ENVIRONMENTAL TECHNOLOGIES
5000 International Drive Durham, NC 27712

TEL 919-620-3000 FAX 919-620-3001
If not received properly, call 919-620-3000

Number of pages including cover: 7 **Reference Number:** 96 1267

TO: Rick Lausman
BLACK & VEATCH
Overland Park, KS 7528 P461
TEL 913-458-7528
FAX 913-458-2934

CC: Nancy Stephenson

FROM: Elizabeth Mancini

DATE: 9/16/98

SUBJECT: SCR Catalyst Budgetary Quotation
General Information

REFERENCE:
1. Cormetech Reference Number CM622
2. Fax from Rick Lausman/BV to Elizabeth Mancini/Cormetech 9/10/98

We are pleased to submit our budgetary quotation to supply SCR catalyst for the above subject project. Budgetary indicates ± 10%. If you have any questions or require additional information, please contact me at 919-620-3022.

Best regards,

EM

Fax to Rick Lausman/BV from Elizabeth Mancini/Cormetech
RE: SCR Catalyst Budgetary Quotation: General Information

Scope of Supply:

- Catalyst Design, Supply, and Assembly
- Patent and License Indemnification
- Module Engineering and Supply
- Initial Pilot Test
- Sample Module for Easy Catalyst Sample Retrieval

Catalyst:

	Case 1
Catalyst	CM-27^{tm}
Pitch, mm	2.7
Gas Flow Orientation	Horizontal

Modules:

	Case 1	Case 2	Case 3	Case 4
Number/Unit	24	24	24	24
Number of Layers	1	1	1	1
Arrangement/Layer	$3_w \times 8_h$	$3_w \times 8_h$	$3_w \times 8_h$	$3_w \times 8_h$
Dimensions, in each	$127.375_w \times 66.375_h \times 16_d$	$103.125_w \times 66.375_h \times 14_d$	$127.375_w \times 66.375_h \times 16_d$	$127.375_w \times 66.375_h \times 20_d$
Weight, lbs each	2400	1800	2400	2900
Material	Carbon Steel	Carbon Steel	Carbon Steel	Carbon Steel

Price:

	Case 1	Case 2	Case 3	Case 4
Price, 1 Unit(s)	$304,000	$200,000	$313,000	$433,000
FOB	Durham			
Delivery	6 - 9 mo ARO			
Validity from date of this proposal	90 days			
Payment Terms	Net 30 days			
Invoice Schedule	30% upon Order; 70% upon Delivery			

67.5 53.1 68.8% 79.2%

NO_x removal

Fax to Rick Lausman/BV from Elizabeth Mancini/Cormetech
RE: SCR Catalyst Budgetary Quotation: General Information

Guarantee Performance*:

	Case 1	Case 2	Case 3	Case 4
NOx Outlet, ppmvd @ 15% O_2	≤ 9	≤ 4.5	≤ 3.0	≤ 2.0
NH_3 Slip, ppmvd @ 15% O_2	≤ 10	≤ 10	≤ 10	≤ 10
Δp Across Catalyst, in wg	≤ 1.8	≤ 2.0	≤ 1.8	≤ 2.5
Design Life	The earlier of 36 months from first gas-in or 39 months from contracted delivery			

*Guarantee performance is based on the attached Cormetech, Inc. Catalyst Technical Terms and Conditions and the following:

1. Maldistribution criteria:
   Flow ± 15% RMS; Temperature ± 20°F; NH_3:NOx Molar Ratio ± 5% RMS.

Design Flue Gas Conditions:

	Case 1	Case 2	Case 3	Case 4
Fuel	Gas	Gas	Gas	Gas
Flue Gas Flow Rate, lb/hr	3,474,000	3,474,000	3,474,000	3,474,000
Design Temperature, °F	650	650	650	650
Flue Gas Composition				
N_2, vol %	73.7	73.7	73.7	73.7
O_2, vol %	9.43	9.43	9.43	9.43
CO_2, vol %	5.2	5.2	5.2	5.2
H_2O, vol %	10.75	10.75	10.75	10.75
Ar, vol %	0.92	0.92	0.92	0.92
O_2, vol % dry	10.57	10.57	10.57	10.57
Inlet NOx, ppmvd @ 15% O_2	27.7	9.6	9.6	9.6
NOx lb/hr	243	84.7	84.7	84.7

General Terms and Conditions:
Cormetech, Inc. General Terms and Conditions of Sale, attached.

CORMETECH, INC.
Catalyst Technical Terms and Conditions

Warranty Conditions

1. Unit operating conditions shall be within the limits of design cases specified in SCR Catalyst Quotation.

2. The catalysts must be handled, operated, and maintained according to Cormetech instruction.

3. Cormetech maintains warranty protection as long as normal furnace start-up and shut-down procedures are followed and no moisture other than from flue gas or ambient air is present. The allowed start-up and shut-down temperature gradient for the catalyst is 10°C/min below and 60°C/min above the flue gas dew point.

4. Catalyst has been designed to accommodate profile maldistributions, based on a Normal Distribution, per SCR Catalyst Quotation.

5. Cormetech is not responsible for catalyst deterioration caused by aqueous ammonia drainage or water contact to the catalyst.

6. Suitable means must be employed, if needed, to clean catalyst masked or plugged by firing of particulate producing fuel. Customer will inspect visually at shutdowns and clean, as needed.

7. Access must be provided to Cormetech for visual inspection and catalyst sampling. Cormetech reserves the right to review the Unit's operating data at any time during the warranty period.

8. Customer must provide catalyst samples to Cormetech no less than annually during the warranty period, in order to maintain warranties.

9. Customer will provide a copy of all procedures and methods of analysis to be employed in catalyst evaluation for Acceptance and anytime throughout the warranty period.

Warranty Fulfillment

1. Cormetech's warranties are fulfilled at the end of the period stated in SCR Catalyst Quotation if the results of on-site tests indicates that the performance values, shown in SCR Catalyst Quotation, are met.

2. If the results of on-site tests during the warranty period indicates that the warranted values are not being met, Customer will conduct an on-site investigation to determine the cause of non-performance. If the catalyst is suspect, Cormetech will conduct laboratory tests, according to the conditions specified in SCR Catalyst Quotation, to verify the catalyst performance.

3. If the results of the laboratory tests indicate that the warranted values are being met, Cormetech's warranties will be deemed in fulfillment at this time and Customer will continue their investigation to determine the cause of non-fulfillment. Customer will compensate Cormetech for the cost of laboratory evaluation.

4. If the results of the laboratory tests indicate that the warranty values are not being met, Cormetech will, at its option, repair, replace, or add catalyst at its cost to meet the required performance values. Cormetech will absorb cost of laboratory evaluation.

CORMETECH, INC.

General Terms and Conditions of Sale

1. DEFINITIONS:

"Buyer" means the firm or company which places the order and purchases the Goods from Seller.
"Seller" means Cormetech, Inc.
"Goods" means the SCR Catalyst to be purchased by the Buyer.
"Order" means the purchasing order placed by the Buyer for the supply of the Goods.
"Specifications" means Seller's written technical description of the Goods purchased pursuant to the Order therefor and Seller's acceptance thereof.
"Owner" means the person, firm or company to whom the Buyer furnishes the plant including the Goods supplied by the Seller.

2. CONTRACT:

The contract for the purchase and sale of Goods shall be deemed to have been entered into by and between the Buyer and the Seller when, upon receipt of the Buyer's Order for such Goods, the Seller sends an acceptance in writing, within the time limit for such acceptance specified in such Order, executed by the duly authorized representative of Seller. Neither the Buyer nor the Seller shall be bound by any variation, waiver of, or addition to these general terms and conditions unless otherwise agreed by both parties in a writing executed by their duly authorized representatives. Except as otherwise provided in an express written agreement, these general terms and conditions shall govern in the event of any conflict with any terms or conditions proposed by the Seller or Buyer whether or not contained in any order or acceptance, or applicable in previous transactions, practice or course of dealings.

3. LIAISON PERSONNEL:

The Seller, immediately upon receiving Buyer's Order for Goods, may appoint an appropriate person for the performance of Seller's obligation to Buyer with respect to the Goods, to whom all communication thereon shall be directed.

4. DELIVERY:

The method of packing of the Goods shall be in accordance with the agreement of the Buyer and Seller and if no agreement has been reached, the Seller shall take all reasonable steps to prevent damage to or deterioration of the Goods in transit to their destination as specified in the accepted order.
The purchase price for Goods sold pursuant to an accepted purchase order shall include the cost of packing as mentioned above.

5. WARRANTY, QUALITY AND DESCRIPTION:

Seller hereby warrants to Buyer that at the time of delivery, the Goods sold to Buyer will conform to the written specifications set forth in Catalyst Technical Terms and Conditions to acceptable quality levels normally supplied by Seller in connection with the sales of said Goods. Seller will, solely at its option, repair or replace Goods which fail to meet the Terms and Conditions of this limited warranty.
In addition, Seller warrants that the performance of the Goods will, under the conditions specified in Catalyst Technical Terms and Conditions for the period set forth therein meet the performance criteria under the conditions specified therein. Verification of such performance guarantee will be accomplished as specified in Catalyst Technical Terms and Conditions, through the use of laboratory tests.
In the absence of specific alternate language, warranty period is on a calendar basis and begins at first gas-in and no later than three (3) months after scheduled delivery. Specific warranty period and terms are as set forth in the Catalyst Technical Terms and Conditions.
In the event Goods are stored and handled between the time of delivery and installation, Buyer shall provide adequate and appropriate facilities for storage of the Goods. Goods shall be handled according to Seller's Catalyst Handling Manual.
THE FOREGOING WARRANTY AND THE WARRANTY SET FORTH IN SECTION (15) ARE IN LIEU OF ALL OF THE WARRANTIES EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

6. SPECIFICATIONS:

The Goods sold hereunder shall comply with the written specifications set forth in Catalyst Technical Terms and Conditions. The performance of such Goods will vary in accordance with individual specifications, operation, and maintenance of the systems in which they are installed. Buyer has the sole responsibility for the completeness and accuracy of information. Seller will rely exclusively on such information to make recommendations on the type and volume of Goods to be used in Owner's facility.

7. MODIFICATION IN SPECIFICATIONS:
The specifications may be modified and/or changed at any time provided that both the parties agree in writing. Such agreement may include reasonable adjustments of the price, time of delivery of the Goods and other terms before such modifications and/or changes are carried out.

8. DRAWINGS:
Drawings, such as, drawings for approval, drawings for installation, drawings showing the finished conditions of the Goods, instruction manuals, etc., shall be supplied by the Seller to the Buyer strictly in accordance with and by the time instructed in the Specification or in the accepted order.

9. INSPECTION AND TEST AT SELLER'S WORKS
Upon reasonable notice and at reasonable times, the Buyer shall have access to the office of the Seller or, subject to written consent of such supplier, the office and manufacturing operations of Seller's supplier for expedition of manufacturing or inspection of the Goods in the course of a normal working day during the period from the date of the Order to the date of shipment of the Goods. If such inspection shall be done at the factory of Seller's supplier, the Seller shall also inform the Buyer of the details of such visit in advance. Buyer shall inspect all Goods within thirty (30) days of delivery of such Goods and immediately report to Seller in writing any claims for breach of warranty set forth in Section (5) above. All Goods which remain uninspected after such thirty (30) days shall be deemed accepted by Buyer.
In the event that the Goods are rightfully rejected at the time of inspection for failure to conform to the provisions of Section (5) above, the Seller shall, solely at the Seller's option, repair or replace such Goods.

10. PRODUCTION SCHEDULE:
When requested, the Seller will provide the Buyer with the production schedule setting forth the estimated dates for the issuance schedule of drawings, order of material, fabrication schedule, inspection schedule, if any, for the Goods purchased pursuant to the acceptance order, and during the contractual period, keep the Buyer informed monthly of actual progress in providing the Goods.
In case there is some unexpected factor or occurrence which prevents normal progress of production or manufacturing, the Seller shall inform the Buyer promptly.

11. SHIPPING INSTRUCTION:
The Goods subject to Buyer's Order shall be sold FOB Jobsite, unless otherwise indicated, and the Buyer or Seller on Buyer's behalf pursuant to Buyer's instructions will book and arrange appropriate transportation from such site. The Seller shall provide the following information regarding such Goods.

a. Net weight, gross weight, freight tons
b. Measurement of each packing or parcel
c. Number of packages
d. Name of loading port
e. Date of cargo readiness

12. LIMITATION OF LIABILITY:
If, owing to force majeure as defined in Section (14) hereof, the Seller is unable to deliver the Goods within ninety (90) days of the delivery time specified in the accepted order for such Goods, then provided that the Seller shall have given Buyer written notice of such force majeure, the Buyer shall grant the Seller extension of time, as may be reasonable, to complete performance.
The liability of the Seller, its supplier, their agents, employees, subcontractors and sub-suppliers with respect to any and all claims arising out of the performance or non-performance of obligations in connection with the design, manufacture, sale, delivery, storage, erection or use of the Goods or the rendition of other services in connection therewith, whether based on contract, warranty, tort (including negligence), strict liability or otherwise, shall not exceed in the aggregate the purchase price for the Goods and shall in no event include: damages for loss of profits or revenue or the loss of use of either; loss by reason of plant shutdown or inability to operate at rated capacity; increased expense of operation of plant or equipment; increased costs of purchasing or providing Goods, equipment, materials, supplies or services; costs of replacement power or capital; claims of Owner's customers; inventory or use charges; or any other incidental or consequential damages of any nature.
This limitation of liability shall prevail over any conflicting or inconsistent provisions contained in any of the documents comprising the contract for the Goods, except to the extent such conflicting or inconsistent provisions further restrict the Seller's liability.

13. PRICE AND PAYMENT:
All payments shall be made within thirty (30) days after the presentation of the invoice therefor, unless otherwise indicated.
Seller will meet delivery schedule required by contract. In the event Buyer delays requested delivery, terms of payment shall commence per original schedule. Seller shall notify Buyer of all resultant fees and requirements due to delay, including but not limited to, handling, storage, and truck cancellation fees. Buyer shall be invoiced for said fees upon shipment.
Payments received after date specified on invoice will be assessed a monthly finance charge (12% per annum).

14. FORCE MAJEURE:
Force majeure shall mean unavoidable causes beyond the control of the Seller, including but not limited to, acts of God, war (declared or undeclared), acts of governmental authorities, riot, revolution, civil commotion, fires, strikes (and other labor disputes, sabotage), or epidemic, and other similar matters beyond the reasonable control of a party.
Should the causes of force majeure prevent the total or partial performance required concerning the purchase of Goods, the party claiming force majeure shall promptly advise the other party at the beginning and end of such force majeure and furnish the other party a written notice identifying the nature of the circumstances of force majeure promptly.
In cases of force majeure described above, there shall be consultation between the parties to discuss the effect on the contractual obligations of both parties. For delays and/or non-performance of the obligations due to force majeure, the affected party shall be entitled to an extension of time equal to that of the delay plus such additional time as is reasonably necessary to resume performance of its obligations.

15. PATENTS:
The Seller warrants freedom from patent infringement on those Goods sold under an accepted order when such Goods are used for the purposes normally intended.
Purchase of this product from Cormetech, Inc. includes a license to use this product in the practice of the method claimed in U.S. Patent 4,358,428.

16. ASSIGNMENT:
Neither the contract nor any part of it shall be assigned or transferred to any third party without the other parties' prior written consent where such consent shall not be unreasonably withheld.

17. TAXES:
Any applicable sales, use, excise or other tax shall not be included in Seller's quoted price for Goods.

18. BACKCHARGE:
Seller is not liable, whether by backcharge or otherwise, for the cost of work performed or material or equipment furnished by the Buyer or any third parties unless such work and the costs thereof have been approved in writing by an authorized representative of Seller.

19. NON-DISCLOSURE:
Data, drawings, specifications, or other technical information furnished directly or indirectly, in writing or otherwise, to Seller by Purchaser or to Purchaser from Seller pursuant to this order shall in no event become the property of the receiving party and shall be used only in fulfilling the obligations imposed by this order and shall not be duplicated or disclosed to others or used in whole or in part for any other purpose. Such furnishing of data, drawings, specification, or other technical information shall not be construed as granting any rights whatsoever, express or implied, under patents or privileges of the disclosing party.

20. TERMINATION:
Upon notice, Seller will take all reasonable measures to cease production in-process and to minimize the cost of goods and services procured for fulfillment against this contract. It is recognized that the Goods and Services contracted herein are of custom design and manufacture, the value of which is not reasonably expected to be recoverable by the Seller in the event of termination.
Therefore, upon termination, Seller will submit to Buyer an accounting of all Goods and Services directly allocated to fulfillment of this contract including but not limited to finished Goods, Goods-in-process, non-cancelable subcontracts, and custom dies. Forced disruption of manufacturing in process may result in additional expense which is the sole responsibility of Buyer. It is expected that raw materials may be purchased and production proceed against the requirements of any or all of the defined scope of contract at any time following contract award by Buyer. Seller will keep Buyer informed of progress against contract.

Reference 1

BLACK & VEATCH

8400 Ward Parkway
P.O. Box 8405
Kansas City, Missouri 64114

Tel: (913) 458-2000

Black & Veatch Corporation

FAX NUMBER: 913-458-2934 913-458-2936 913-458-2939

FACSIMILE TRANSMISSION

TO: Mr. Fred Booth
COMPANY: Engelhard
FAX NUMBER: (410) 569-1841
TELEPHONE NUMBER: (410) 569-0297
FROM: Don Wolf
EXTENSION: 2845 LOCATION: P4G1

B&V PROJECT: 063045
B&V PHASE: 0042
B&V FILE:

PAGE: 1 of 2
DATE: June 14, 1999

NOTE TO RECEIVING OPERATOR
In the event of incomplete transmission, please call (913) 458-7218.

TRANSMITTAL DATE/TIME: OPERATOR'S INITIALS:

SUBJECT: High Temperature SCR Catalyst for Simple Cycle Combustion Turbines

MESSAGE: As we discussed on the phone this morning Black & Veatch is assessing the experience, feasibility, potential NO_x reductions, and costs for high temperature SCR catalyst located at the outlet of 3 different simple cycle combustion turbines (SCCT).

Please provide the following information:

1. An experience list of Engelhard SCR catalyst applications on SCCT including the inlet and outlet NO_x emissions.
2. A review of the information provided below for the 3 SCCT machines to determine the maximum practical NO_x reduction that can be achieved with high temperature catalyst.
3. Provide cost or catalyst volume (if possible with the limited data and response time).

The 3 SCCTs being evaluated have the general design criteria listed in the table below. Please note that no specific data is available at this time since this is a very cursory review. Therefore, please assume the data below is full load data only.

	GE 7241 (7FA)	GE 7121 (7EA)	GE LM6000 PC Sprint
Exhaust Flow, lb/hr	3,427,200	2,314,800	1,008,000
Exhaust Temperature, F	1,116	998	842
NO_x, ppmvd @ 15% O_2	9	9	22

Please provide the requested information by noon (CST) Tuesday June 15, 1999. If you have any questions please do not hesitate to call me at (913) 458-2845. I appreciate your attention to this matter. Thank you.

P4CT 2845

ENGELHARD

101 WOOD AVENUE
ISELIN, NJ 08830

ENGELHARD CORPORATION
2205 CHEQUERS COURT
BEL AIR, MD 21015
PHONE 410-569-0297
FAX 410-569-1841
E-Mail Fred_Booth@ENGELHARD.COM

DATE:	**June 15, 1999**	**NO. PAGES**	**4**	**(INCLUDING COVER)**
TO:	**BLACK & VEATCH** **ATTN: Don Wolf**	**FAX 913-458-2934**		
	ENGELHARD **ATTN: Nancy Ellison**			
FROM:	**Fred Booth**	**Ph 410-569-0297 // FAX 410-569-1841**		

RE: **Simple Cycle Turbines**
High Temperature SCR Catalyst System Components
Engelhard Budgetary Proposal EPB99465

We provide Engelhard Budgetary Proposal EPB99465 for Engelhard **NOxCAT ZNX™** High Temperature SCR Catalyst system components per your FAXed request of June 14, 1999.

Our Budgetary Proposal is based on:

- Gas Turbine operating in simple cycle mode;
- SCR Catalysts for NOx reductions from noted inlet levels to 2.5 ppmvd @ 15% O_2 with ammonia slip of 5 ppmvd @ 15% O_2;
- Nominal 5.0" Delta P across SCR;
- Scope as noted. Please note that we have assumed horizontal gas flow through the SCR reactor and the use of 28% aqueous ammonia.
- Please note that turbine exhaust flow for the GE7FA is cooled with an ambient air injection system to reduce the gas temperature at the SCR to 1,025F. The cost of the components for this turbine is included. The ductwork to hold the catalysts and the transitions and any flow straighteners are not included in scope detailed herein.
- We have indicated cross section area required to meet the conversions and pressure drop. Inside liner width and height can be varied while maintaining same cross sectional area.
- Three (3) Year Performance Guarantee (expected life five to seven years).

We request the opportunity to work with you on this project.

Sincerely yours,

ENGELHARD CORPORATION

Frederick A. Booth
Senior Sales Engineer

cc: Nancy Ellison - Proposal Administrator

ENGELHARD

Black & Veatch 063045
Simple Cycle Turbines
ZNX™ SCR Catalyst Systems
Engelhard Budgetary Proposal EPB99465
June 15, 1999

ENGELHARD CORPORATION
NOxCAT ZNX™ HIGH TEMPERATURE SCR NOx ABATEMENT CATALYST SYSTEMS

Engelhard Corporation ("Engelhard") offers to supply to Buyer the **NOxCAT ZNX™** ceramic substrate SCR system components summarized herein.

NOxCAT ZNX™ High Temperature SCR Catalyst System: Scope of Supply: The equipment supplied is installed by others in accordance with the Engelhard design and installation instructions.

- Engelhard **NOxCAT ZNX™** SCR catalyst in modules;
- Internal support structures for catalyst modules (frame);
- Ambient Air injection cooling system components (GE 7FA);
- Ammonia Injection Grid (AIG);
- AIG manifold with flow control valves ;
- NH_3/Air dilution skid: 28% Aqueous Ammonia
  Pre-piped & wired (including all valves and fittings) Two (2) dilution air fans, one for back-up purposes
  Panel mounted system controls for:
  Blowers (on/off/flow indicators) Air/ammonia flow indicator and controller
  System pressure indicators Main power disconnect switch

Excluded from Scope of Supply:
Ammonia storage and pumping
Any internally insulated reactor ductwork to house catalysts
Any transitions to and from reactor
Structural support
Any monorails and hoists for handling modules
Any interconnecting field piping or wiring
Electrical grounding equipment
Utilities
Foundations
All Monitors
All other items not specifically listed in Scope of Supply

BUDGET PRICES: **See Performance Data**

WARRANTY AND GUARANTEE:

Mechanical Warranty:	One year of operation* or 1.5 years after catalyst delivery, whichever occurs first.
Performance Guarantee:	9,000 hours of operation* or 3.5 years after catalyst delivery, whichever occurs first. Catalyst warranty is prorated over the guaranteed life

**Operation is considered to start when exhaust gas is first passed through the catalyst.*

DOCUMENT / MATERIAL DELIVERY SCHEDULE
Drawings / Documentation - 10 weeks after notice to proceed and Engelhard receipt of all engineering specifications and details

Operating manuals
Material Delivery 20 - 24 weeks after approval and release for fabrication

SYSTEM DESIGN BASIS:

Gas Flow from:	Combustion Turbines
Gas Flow:	Assumed Horizontal
Fuel:	Natural Gas
Gas Flow Rate (At catalyst face):	See Performance data
Temperature (At catalyst face):	See Performance data
NOx Concentration (At catalyst face):	See Performance data
NOx Reduction:	To 2.5 ppmvd @ 15% O_2
NH3 Slip:	5 ppmvd@15%O_2
Pressure Drop through SCR	Nom. 5"WG

ENGELHARD

Black & Veatch 063045
Simple Cycle Turbines
ZNX™ SCR Catalyst Systems
Engelhard Budgetary Proposal EPB99465
June 15, 1999

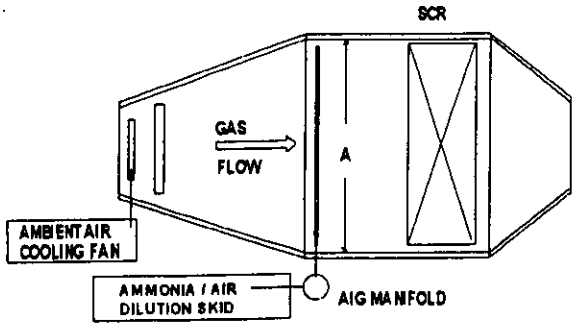
Performance Data

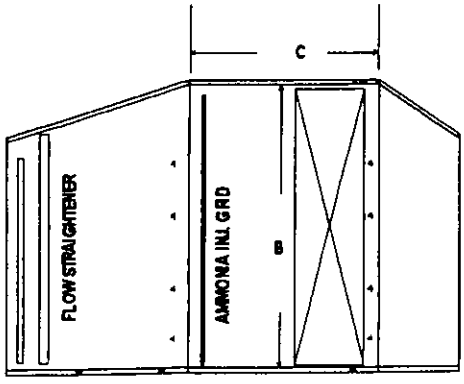
	TURBINE	GE 7FA	GE 7EA	GE LM6000
	ASSUMED AMBIENT	95	95	95
	GIVEN TURBINE EXHAUST TEMPERATURE, F	1,116	998	842
	GIVEN TURBINE EXHAUST FLOW, lb/hr	3,427,200	2,314,800	1,008,000
ASSUMED TURBINE EXHAUST GAS ANALYSIS, % VOL.	N2	74.06	73.24	73.24
	O2	12.50	13.42	13.42
	CO2	3.90	3.80	3.80
	H2O	8.65	8.65	8.65
	Ar	0.89	0.89	0.89
	AMBIENT COOLING AIR FLOW, lb/hr	368,745	0	0
	TOTAL FLOW – TURBINE EXHAUST + AMBIENT - lb/hr	3,795,945	2,314,800	1,008,000
AMBIENT + EXHAUST GAS ANALYSIS, % VOL.	N2	74.75	73.24	73.24
	O2	13.10	13.42	13.42
	CO2	3.53	3.80	3.80
	H2O	7.82	8.65	8.65
	Ar	0.80	0.89	0.89
	CALCULATED AIR + GAS MOL. WT.	28.42	28.40	28.40
	GIVEN: TURBINE NOx, ppmvd @ 15% O_2	9.0	9.0	22.0
	CALC.: TURBINE NOx, lb/hr	55.9	32.4	34.5
CALC.:	NOx, ppmvd @ 15% O2 - AT CATALYST FACE	8.7	9.0	22.0
	GAS TEMP. @ SCR CATALYST, F	1,025	998	842
DESIGN REQ. SCR CATALYST	NOx OUT, ppmvd @ 15% O2	2.5	2.5	2.5
	NH3 SLIP, ppmvd @ 15% O2	5	5	5
	SCR PRESSURE DROP, 5"WG – Nom..			
	GUARANTEED PERFORMANCE DATA			
SCR CATALYST	NOx CONVERSION, % - Min.	72.2%	72.2%	88.6%
	NOx OUT, lb/hr - Max.	15.5	9.0	3.9
	NOx OUT, ppmvd @ 15% O2 - Max.	2.4	2.5	2.5
	EXPECTED AQUEOUS NH3 (28% SOL.) FLOW, lb/hr	96	55	51
	NH3 SLIP, ppmvd @ 15% O2 - Max.	5	5	5
	SCR PRESSURE DROP, "WG - Max.	4.5	4.0	4.5
	REACTOR INSIDE LINER AREA - A x B, sq ft	**2100**	**1350**	**640**
	SCR SYSTEM	**$4,015,000**	**$2,711,000**	**$1,558,000**
	REPLACEMENT SCR CATALYST MODULES	**$2,496,000**	**$2,057,000**	**$1,111,000**

ENGELHARD

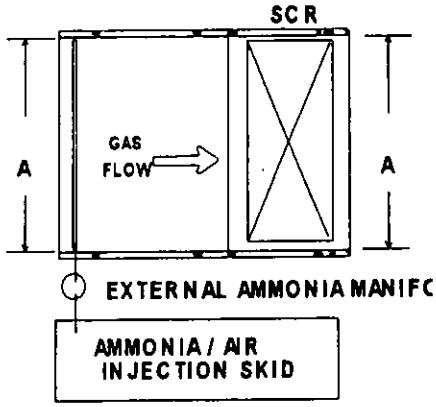
Black & Veatch 063045
Simple Cycle Turbines
ZNX™ SCR Catalyst Systems
Engelhard Budgetary Proposal EPB99465
June 15, 1999

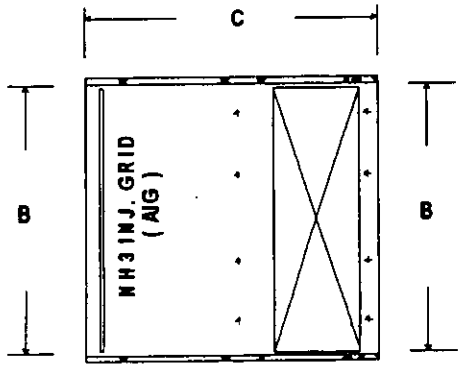
Dimensions / Sketch: GE 7FA
Required Cross Sectional Area
Inside Liner Width x Inside Liner Height
(A x B) sq. ft.
Reactor Depth (C) 12'-0"





Dimensions / Sketch:
Required Cross Sectional Area
Inside Liner Width x Inside Liner Height
(A x B) sq. ft.
Reactor Depth (C) 12'-0"





ENGELHARD

101 WOOD AVENUE
ISELIN, NJ 08830
732-205-5000

POWER GENERATION SALES:
ENGELHARD CORPORATION
2205 CHEQUERS COURT
BEL AIR, MD 21015
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E-Mail Fred_Booth@ENGELHARD.COM

DATE:	June 15, 1999	NO. PAGES	2	(INCLUDING COVER)
TO:	BLACK & VEATCH ATTN: Don Wolf 2491/2845	FAX 913-458-2934		
FROM:	Fred Booth	Ph 410-569-0297 // FAX 410-569-1841		

High Temp SCR Experience attached.

Engelhard SCR System Experience List

Application	Flow Catalyst	(lb/sec)	Fuel	Start-Up
(1) BBC (50 MW)	VNX	650	NG	11/90
(1) Kawasaki 1 MW	ZNX	23	NG	2/91
(1) Allison 3.5 MW	VNX	38	NG	9/91
(1) Rolls Royce 25 MW	VNX	259	NG	8/92
(2) Westinghouse 251	VNX	422	NG	10/92
(1) GE Frame 7	VNX	669	NG	1Q/93
(1) LM-2500	VNX	157	NG	5/93
(2) LM-6000	VNX	283	NG	4Q/93
(1) LM 5000	VNX	248	NG	1993
(1) LM 5000	VNX	342	NG	1994
(1) GE Frame 6	ZNX	305	NG	1/95
(1) Solar T4500	ZNX	41	NG	1/95
(2) GE Frame 5	ZNX	212	NG	1/95
(1) GE Frame 7	VNX	638	NG	2Q/95
(1) GE Frame 6	VNX	330	NG	1996
(3) ABB GT11N	ZNX	728	#2 Oil	6/96
(1) 2000 Hp	VNX	97	NG	1985
(2) 4000 Hp	VNX	23	NG/DF	1986
(3) 1500 Hp	ZNX	9	DF	5/91
(1) 800 Hp	VNX	8	NG	1993
(1) Refinery Heater	VNX	84	NG	10/90
(1) Refinery Heater	VNX/ZNX	46	NG	10/90
(1) Boiler 1 MW	VNX	26	NG	10/90
(1) Annealing Furnace	VNX	29	NG	1991
(5) Refinery Heater	VNX	16-31	NG	3/91
(1) Refinery Heater	VNX	39	NG	6/91
(1) Refinery Heater	VNX	120.6	#6/NG	1/94
(1) Refinery Heater	VNX	137.8	#6/NG	5/94
(1) Refinery Heater	VNX	110.6	#6/NG	5/94
(1) Utility Boiler (250 MW)	PNX	404	Coal	9/96
(1) Process Off-Gas	ZNX	4	CP	8/90
(1) Nitric Acid Plant	VNX	99	NG	3/91
(1) Process Off-Gas	ZNX	4	CP	1/94
(1) Utility Boiler - LD	VNX		Coal	1985
(8) Gas Turbines	VNX/ZNX		NG	1987
(2) Utility Boiler - LD	VNX/ZNX		Coal	1987
(1) Utility Boiler - HDW	VNX/ZNX		Coal	1989
(1) Utility Boiler - HDD	VNX/ZNX		Coal	1989
(1) Utility Boiler - LD	VNX		Coal	1991
(1) Utility Boiler - HD	VNX		#6 Oil	1991
(2) Turbines	VNX/ZNX		#2 Oil	1994
(1) Utility Air Preheater	PNX		NG/#2 Oil	1994/95
(1) Utility Boiler - HDW	PNX		Coal/NG	2Q/95
(1) Utility Boiler - HDD	PNX		Coal	3Q/95
(1) Utility Boiler - HDD	PNX		Coal	4Q/95

ATTACHMENT E

Table 1

NO_x Control Alternative Capital Cost (Revised)

	SCR	Low NO_x Burners	Remarks
Direct Capital Cost			
Catalysts and Ammonia Injection	1,106,000	NA	Scaled from previous projects.
Ductwork and Catalyst Reactor	710,000	NA	Based on conceptual ductwork arrangement
Control/Instrumentation	100,000	NA	Estimated; includes controls and monitoring equipment.
Ammonia Storage	167,000	NA	Scaled from previous projects
Balance of Plant	833,000	NA	For SCR: 8% Foundation & Supports, 10% Erection, 4% Electrical Installation, 1% Painting, 1% Insulation, 10% Engineering, 6 % Retrofit Factor.
Total Direct Capital Cost	2,916,000	Base	
Indirect Capital Costs			
Contingency	729,000	NA	25% of Direct Capital Cost
Engineering and Supervision	208,000	NA	10% of Purchased Equipment Cost
Construction & Field Expense	104,000	NA	5% of Purchased Equipment Cost
Construction Fee	208,000	NA	10% of Purchased Equipment Cost
Start-up Assistance	42,000	NA	2% of Purchased Equipment Cost
Performance Test	35,000	NA	Estimated Cost
Total Indirect Capital Costs	1,326,000	Base	
Total Installed Cost	**4,242,000**	Base	

Table 2

NO_x Control Alternative Annual Cost (Revised)

	SCR	Low NO_x Burners	Remarks
Direct Annual Cost			
Catalyst Replacement	121,000	NA	Catalyst life of 3 yr. of equivalent operating hours (5.3 equivalent years)
Operation and Maintenance	16,000	NA	
Reagent Feed	18,000	NA	Assumes 1.4 stoichiometric ratio
Power Consumption	5,000	NA	
Lost Power Generation	150,000	NA	Back pressure on combustion turbine
Annual Distribution Check	15,000	NA	Required for SCR
Total Direct Annual Cost	325,000	NA	
Indirect Annual Costs			
Overhead	7,000	NA	60% of O&M Labor
Administrative Charges	85,000	NA	2% of Total Installed Cost
Property Taxes	42,000	NA	1% of Total Installed Cost
Insurance	42,000	NA	1% of Total Installed Cost
Capital Recovery	355,000	NA	Capital Recovery Factor * Total Installed Cost
Total Indirect Annual Costs	531,000	NA	
Total Annual Cost	**856,000**	NA	
Annual Emissions, tpy	18	90	Emissions from BACT for 5,000 hrs of natural gas firing
Emissions Reduction, tpy	72	NA	Emissions calculated from BACT
Total Cost Effectiveness, $/ton	**11,889**	NA	Total Annual Cost/Emissions Reduction

ATTACHMENT F

Table 3
NO_x Control Alternative Cost
With and Without Contingency

	SCR W/ Contingency	SCR W/out Contingency
Direct Capital Cost		
Catalysts and Ammonia Injection	1,106,000	1,106,000
Ductwork and Catalyst Reactor	710,000	710,000
Control/Instrumentation	100,000	100,000
Ammonia Storage	167,000	167,000
Balance of Plant	833,000	833,000
Total Direct Capital Cost	2,916,000	2,916,000
Indirect Capital Costs		
Contingency	729,000	0
Engineering and Supervision	208,000	208,000
Construction & Field Expense	104,000	104,000
Construction Fee	208,000	208,000
Start-up Assistance	42,000	42,000
Performance Test	35,000	35,000
Total Indirect Capital Costs	1,326,000	597,000
Total Capital Cost	4,242,000	3,513,000
Direct Annual Cost		
Total Direct Annual Cost	325,000	325,000
Indirect Annual Costs		
Overhead	7,000	7,000
Administrative Charges	85,000	70,000
Property Taxes	42,000	35,000
Insurance	42,000	35,000
Capital Recovery	355,000	294,000
Total Indirect Annual Costs	531,000	441,000
Total Annual Cost	**856,000**	**766,000**
Annual Emissions, tpy	18	18
Emissions Reduction, tpy	72	72
Total Cost Effectiveness, $/ton	**11,889**	**10,639**

ATTACHMENT G

BLACK & VEATCH

TELEPHONE MEMORANDUM

B&V Project 63812.0030
7/21/99
11:30 am

Puerto Rico-Simple Cycle Firing No. 2 Fuel Oil
NOx Emission Problems

From: Mr. Harish Patel
Company: EPA, Region 2, New York
Phone No.: (212) 637-4046

Recorded by: Greg Holscher

The following is a telephone conversation regarding the Cambalache Plant in Puerto Rico. The plant has a simple cycle combustor capable of firing No. 2 fuel oil. The main concern was whether the facility was meeting their permit requirements for NOx output.

Mr. Patel informed me of the following:

1) The Puerto Rico plant was permitted for NOx at 10 ppm and ammonia slip at 10 ppm.
2) They are using water injection followed by an SCR.
3) They are having problems meeting their permit with the SCR.
4) Using a simple cycle turbine, which has a high temperature outlet. They are trying to use a zeolite catalyst for the SCR. The zeolite catalyst does not seem to be working in the SCR like it did in the laboratory.
5) To keep the NOx level low, they are increasing the amount of ammonia injected into the system (decrease NOx results in increasing ammonia slip).
6) The ammonia delivery system is finite, meaning they can only inject so much ammonia into their system.
7) After a few weeks/months the NOx level is slightly increasing. The level of NOx is about 20 to 25 ppm.
8) The ammonia slip is also increasing to about 30 to 40 ppm.
9) When the water injection-SCR system first went into operation, the NOx levels were at about 10 ppm, but are estimated to steadily increase to 42 ppm (42 ppm is the limit using only water injection).
10) Another contact is in Puerto Rico: Mr. Francisco Claudio at (787) 729-6951 Ext. 258

ATTACHMENT H

Kissimmee Utility Authority (KUA)
Cane Island Units 1 & 2
Emission Cap Calculations

Current NOx Permitted Levels (Title V Operating Permit: 0970043-002-AV)

Unit 1 NOx PTE based on:	116.9 tpy
1000 h/yr oil firing	
7760 h/yr gas firing @ 15 ppm NOx	
Unit 2 NOx PTE based on:	290.6 tpy
1000 h/yr oil firing	
7760 h/yr gas firing @ 15 ppm NOx	
Permit Total	**407.5 tpy**

Proposed NOx Cap for Units 1 & 2 (Meeting of 10/20/99)

Unit 1 NOx emissions based on:	86.5 tpy
1000 h/yr oil firing	
5000 h/yr gas firing @ 15 ppm NOx	
Unit 2 NOx emissions based on:	290.6 tpy
1000 h/yr oil firing	
7760 h/yr gas firing @ 15 ppm NOx	
Cap Total	**377.1 tpy**
Resulting Unit 1 & 2 NOx Cap Emission Reduction	30.4 tpy

Unit NOx Emission Information

Unit 1		
	22 lb/h	NOx gas emission rate - 15 ppm@15%O2
	36 lb/h	NOx gas emission rate - 25 ppm@15%O2
	63 lb/h	NOx oil emission rate - 42 ppm@15%O2
Unit 2		
	53 lb/h	NOx gas emission rate - 15 ppm@15%O2
	170 lb/h	NOx oil emission rate - 42 ppm@15%O2

Department of Environmental Protection

Jeb Bush
Governor

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

David B. Struhs
Secretary

September 24, 1999

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. A. K. Sharma
Director of Power Supply
Kissimmee Utility Authority
1701 West Carroll Street
Kissimmee, Florida 34741-6804

Re: Request for Additional Information
DEP File No. 0970043-007-AC (PSD-FL-182A)
Modification of NO_X Emission Limitation for Cane Island Power Park Unit 1

Dear Mr. Sharma:

On September 1, 1999 the Department received your application and complete fee for a modification to the air construction permit for Cane Island Unit 1 to change the NO_X limit from 15 ppmvd (at 15% O_2) to 25 ppmvd (at 15% O_2). The application is incomplete. In order to continue processing your application, the Department will need the additional information requested below. Should your response to any of the below items require new calculations, please submit the new calculations, assumptions, reference material and appropriate revised pages of the application form.

1. What are the lowest levels of NO_X that can possibly be consistently achieved with water injection with the LM6000-PA engine, based on the experience of KUA and the engine manufacturer? It appears that tested emissions have averaged about 21 ppm. Are lower emissions are achievable with higher water injection rates?

2. Please evaluate the applicability of spray intercooling to reducing NO_X emissions from this engine.

3. The analysis provided proposed reducing allowable hours of operation firing gas from the current 8760 hours per year to 5000 hours per year. The application information for potential NO_X emissions shows that KUA proposes no reduction in hours of operation for fuel oil firing, allowing for a total of 6000 hours of operation per year (5000 hours for gas firing plus 1000 hours for oil firing). Based on information provided in annual operation reports, Unit 1 has operated 1096 hours in 1996 and 774 hours in 1997, for an average of 935 hours (firing primarily gas). Comparing past actual operation with proposed future operation shows that NO_X emissions will increase by approximately 105 tons per year. Please address this issue.

4. The application proposes no reduction in hours for oil firing even though annual operation reports show that the greatest amount of oil firing was in 1998 with approximately 13 full load hours on oil. It appears that KUA could propose a dramatic reduction in allowable hours for oil firing without compromising the ability to operate the unit. Please comment and provide historical data showing the actual hours of operation firing gas and oil as well as the fuel consumption by fuel type for calendar years 1998 through 1994. We wish to confirm the information available in our records from annual operation reports.

5. Overall, the control cost effectiveness seems high. The analysis does not appear to have been based upon a vendor's quote for a hot SCR system for this installation; an actual quote should be obtained for this analysis. Below are specific points which appear questionable:

A. The contingency of 25% (particularly on top of a 6% retrofit factor) seems very high given that this is commercially available technology.

B. The indirect capital costs were generally calculated as a percentage of the total direct capital cost, although more typically the direct installation costs (in the analysis shown as "balance of plant") are not used to estimate the indirect capital costs.

C. The rate for administrative charges, taxes and insurance at 5.75% is higher than a more typical 4% rate.

D. The nominal interest rate used for the capital recovery factor was 10% (the "real interest rate" shown of 5.5% plus apparently an anticipated annual rate of inflation of 4.5%) although 7% is more typical.

E. The charge for lost power generation from back pressure seems excessive, as does the stated increase in back pressure of 6 inches of water.

F. Catalyst life seems low at 3 years, particularly for a unit that fires primarily gas. The Department is aware of at least one vendor that will guarantee a catalyst life of 3 years inclusive of 1000 hours of annual oil firing, yet no NO_X reductions due to oil firing were included in the analysis.

G. The analysis did not consider the control effectiveness for the allowable use of fuel oil, and did not consider any reduction in annual Title V fees associated with the overall decrease in NO_X emissions from both gas and oil firing.

H. There is no description of what constitutes the "annual distribution check", or justification for this cost.

I. The economic analysis was based on only 5000 hours of operation on gas, although with installation of SCR there would be no reason to limit operation to less than 8760 hours per year.

J. The "starting point" for determining the NO_X reductions appears to presume the continuance of water injection. In the event that an SCR is installed, water injection (for gas as well as oil firing) should be able to be eliminated (or at least reduced). A higher "starting point" should therefore be assumed.

Accounting for these comments would serve to improve the cost effectiveness of SCR. Please provide the basis for costs used in the analysis where they differ from the recommendations in the above comments.

6. Please indicate whether any other (additional) means are available to obtain real offsetting reductions in NO_X emissions from the facility as a whole.

The Department will resume processing your application after receipt of the requested information. Rule 62-4.050(3), F.A.C. requires that all applications for a Department permit must be certified by a professional engineer registered in the State of Florida. This requirement also applies to responses to Department requests for additional information of an engineering nature. Material changes to the application should also be accompanied by a new certification statement by the authorized representative or responsible official. Permit applicants are advised that Rule 62-4.055(1), F.A.C. now requires applicants to respond to requests for information within 90 days. If there are any questions, please call Mike Halpin at 850/921-9530.

Sincerely,

9/24

A. A. Linero, P.E. Administrator
New Source Review Section

AAL/jk

cc: Gregg Worley, EPA
John Bunyak, NPS
Len Kozlov, DEP CD
D. D. Schultz, Black & Veatch

Department of Environmental Protection

Jeb Bush
Governor

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

David B. Struhs
Secretary

September 2, 1999

Mr. Gregg Worley, Chief
Air, Radiation Technology Branch
Preconstruction/HAP Section
U.S. EPA – Region IV
61 Forsyth Street
Atlanta, Georgia 30303

Re: KUA Cane Island Unit 1 Permit Amendment Request

Dear Mr. Worley:

Enclosed for your review and comment is an application for the above-mentioned project. It essentially consists of a request to modify the permitted NOx limit from 15 ppm (which begins on 1/1/00) to 25 ppm (the current limit). The applicant indicates that they are willing to accept a reduction in hours of operation in order to ensure that the annual NOx tonnage (potential to emit) does not increase.

Your comments can be forwarded to my attention at the letterhead address or faxed to me at (850) 922-6979. If you have any questions, please contact Mike Halpin at (850) 921-9530.

Sincerely,

MPHalpin for AAL

A. A. Linero, P.E. Administrator
New Source Review Section

AAL/mph/kt

Enclosures

cc: Mike Halpin, BAR

Department of Environmental Protection

Jeb Bush
Governor

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

David B. Struhs
Secretary

September 2, 1999

Mr. John Bunyak, Chief
Policy, Planning & Permit Review Branch
NPS-Air Quality Division
Post Office Box 25287
Denver, CO 80225

Re: KUA Cane Island Unit 1

Dear Mr. Bunyak:

Enclosed for your review and comment is an application for the above-mentioned project. It essentially consists of a request to modify the permitted NOx limit from 15 ppm (which begins on 1/1/00) to 25 ppm (the current limit). The applicant indicates that they are willing to accept a reduction in hours of operation in order to ensure that the annual NOx tonnage (potential to emit) does not increase.

Your comments can be forwarded to my attention at the letterhead address or faxed to me at (850) 922-6979. If you have any questions, please contact Mike Halpin at (850) 921-9530.

Sincerely,

MHalpin for AAL

A. A. Linero, P.E.
Administrator
New Source Review Section

AAL/mph/kt

Enclosures

cc: Mike Halpin, BAR