Sacramento Cogeneration Authority
P.O. Box 15830, Sacramento, CA 95852-1830 · 916/732-5218
Procter & Gamble Cogeneration Project

SCA 94-030

March 18, 1994

Mr. B.B. Blevins
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814
Attn: Docket Unit

RESPONSE TO COST EFFECTIVENESS QUESTION FROM SMAQMD REGARDING THE AUXILIARY BOILER AT THE PROPOSED PROCTER AND GAMBLE COGENERATION PROJECT(Docket No. 93-AFC-02).

Dear Mr. Blevins:

Please find enclosed twelve copies of the analysis presented to the Sacramento Metropolitan Air Quality Management District with regard to the cost effectiveness of the auxiliary boiler at the Procter and Gamble Cogeneration Project. Please telephone (916-732-6540) if you have any questions.

With Regards,

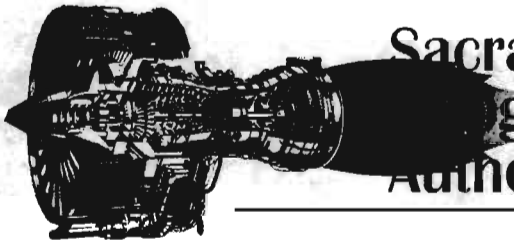
Diana Parker

Diana Parker
Environmental Specialist

Enclosure

cc: Ron Simms, Walsh Construction
Rich Chapman, Black & Veatch

6201 "S" Street, Sacramento, CA 95817-1899



Sacramento
Cogeneration
Authority P.O. Box 15830, Sacramento, CA 95852-1830 · 916/732-5218
Procter & Gamble Cogeneration Project

SCA 94-027

March 14, 1994

Mr. Brian Krebs
Sacramento Metropolitan Air Quality
Management District
8411 Jackson Road
Sacramento, CA 95826

PROCTER AND GAMBLE PROJECT - BACKUP BOILER BACT ANALYSIS

Dear Mr. Krebs:

Enclosed please find a BACT analysis prepared for the backup boiler on the Procter & Gamble project. Based on the analysis, we conclude that the boiler equipped with low NO_x burners and flue gas recirculation to a level of 25 ppmvd NO_x, 3% O_2 complies with BACT requirements. Selective catalytic reduction (SCR) is not cost-effective for this boiler application at a 10% annual capacity factor.

We believe that this resolves the boiler BACT issue. Please contact me at (916) 732-6703 or Stuart Husband at (916) 732-6246 with any remaining questions or comments regarding this issue.

Sincerely,

John E. Larsen
Manager, Projects Development and Construction

Enclosure

cc: Ron Simms, Walsh
Rich Chapman, B&V

bcc: S. Husband
D. Parker
S. Strachan
C. Taylor
D. Thorpe
Chron File
Corp File

sierra research

1801 J Street
Sacramento, CA 95814
(916) 444-6666
Fax: (916) 444-8373

March 14, 1994

Memo To: Stuart Husband
SMUD

From: Gary Rubenstein

Subject: Cost/Effectiveness of NOx Controls for Backup Steam Boiler at Proctor & Gamble Site

After discussions with you and with the staff of the Sacramento Metropolitan Air Quality Management District (SMAQMD), we have prepared the following estimates of the cost/effectiveness of various NOx emission control technologies for the backup steam boiler at the Proctor & Gamble site. In preparing these calculations we have followed EPA's "top down" approach for control technology assessments, which is the approach most often used in California.

Based on these cost estimates, we believe that SCR is not cost/effective for the backup boiler if it is operated at less than 10% of capacity, as computed on an annual basis.

This conclusion is based on the following assumptions:

- The maximum annual operations of the backup steam boiler will be limited to 10% of its rated capacity.
- The incremental cost of low NOx burners for the boiler is $200/MMBtu. Since this would be a new installation which would otherwise require standard burners, this value is based on the assumption that the incremental capital cost of a low NOx burner would be 50% of its total cost, and that no additional installation costs would be incurred.
- The incremental cost of flue gas recirculation for the boiler would be $1070/MMBtu, which includes the full cost of the additional hardware, but only 50% of the installation cost otherwise associated with a retrofit installation.
- The incremental cost of an SCR system would be $4574/MMBtu, based on the quote provided by Peerless for the SEPCO project.

Based on discussions with the SMAQMD staff, we have also assumed that the uncontrolled NOx emission level from the boiler is 100 lbs/MMscf,

which is equivalent to 76 ppm @ 3% O_2. This is based on an AP-42 emission factor for small industrial and commercial boilers. Since this level is roughly equivalent to the NOx levels which can be achieved using some elements of low NOx burner technology (which are fairly standard in boiler installations today), we have assumed that the $200/MMBtu cost estimate described above for low NOx burners is included in the basic boiler cost, and thus does not affect the cost/effectiveness calculation.

The enclosed analyses present three cases. Case 1 assumes that the boiler must incorporate low NOx burners, flue gas recirculation and selective catalytic reduction to achieve the 9 ppm NOx level which represents "presumptive" BACT/LAER for industrial and commercial boilers in most air districts in California. A combination of simple low NOx burner technology and some FGR is assumed to reduce NOx levels to approximately 45 ppm, and an 80% efficient SCR system further reduces NOx levels to 9 ppm. Based on a 10% annual capacity factor, the total cost/effectiveness of these controls is $31,749/ton. This exceeds the SMAQMD cost/effectiveness threshold of $24,500/ton; thus, this combination of NOx controls is not considered best available control technology.

Case 2 assumes that in addition to low NOx burners, SCR is used to reduce NOx emissions by 80%, to a level of approximately 15 ppm. Again, based on a 10% annual capacity factor, the total cost/effectiveness of this alternative is $28,147/ton; thus, the combination of low NOx burners and SCR is not cost/effective, and does not represent best available control technology.

Case 3 assumes the use of low NOx burners and flue gas recirculation to achieve a NOx level of 25 ppm. Based on a 10% annual capacity factor for the boiler, the cost/effectiveness of this alternative is $8,430/ton. This is below the SMAQMD threshold, and thus represents best available control technology.

If you have any questions, please don't hesitate to call.

encl

cc w/encl:
Andrea Dozier, RMI

Sierra Research

Cost-Effectiveness of NOx Control Strategies 12-Mar-94
Case 1: Low NOx Burners, Flue Gas Recirculation, SCR

Annual Capacity Factor: 10.0% 876 hours/year
Fuel Heat Content: 1050 btu/scf

	NOx ppm @ 3% O2	NOx lbs/MMscf	NOx lbs/MMbtu	Fuel Cons MMBtu/hr	NOx lbs/hr	NOx tons/yr
100% Load						
Uncontrolled	76	100	0.095	97.50	9.26	4.06
With LNB, FGR, SCR	9	12	0.011	97.50	1.10	0.48
Decrease	88%		0.084		8.17	3.58

Capital Costs (installed)			
Low NOx Burners	$0	$200 /MMbtu	Sierra estimate; incremental cost
Flue Gas Recirculation	$104,325	$1,070 /MMbtu	Sierra estimate; incremental cost
Selective Catalytic Reduction	$445,939	$4,574 /MMbtu	Peerless quote for SEPCO
Total Capital Costs	$550,264		
Annual Capital Recovery	$89,553	Annualized levelized fixed charge rate, 10 year capital recovery period, 10.0% capital recovery rate	
Catalyst Life	20 years		
Catalyst cost/change	$39,315	$403 /MMbtu	SEPCO estimate
Catalyst cost/yr	$2,359	Includes 20% labor cost	
Aqueous Ammonia cost/ton	$425		
NOx Reduction Due to SCR	80%		
NOx Reduced by SCR	4.39 lbs/hr		
NH3:NO mole ratio	1.05		
Anhydrous NH3 (tons/yr)	0.75	17.03 lb/lb-mole NH3	
Aqueous NH3 (tons/year)	2.58	29% solution	
Total NH3 Cost/yr	$1,095		
Annual O&M Costs			
FGR electric power cost	$2,843	55 kw @	$0.059 /kwh
SCR backpressure fuel cost	$1,039	0.315% fuel penalty @	$3.86 /MMbtu
SCR electric power cost	$155	3 kw @	$0.059 /kwh
Equipment O&M costs	$16,508	3.0% of capital costs	
Total Annual O&M Costs	$20,544		
Total Cost/yr	$113,551		
NOx Reduction, tons/yr	3.58		
Cost-Effectiveness, $/ton	$31,749		

Sierra Research

Cost-Effectiveness of NOx Control Strategies 12-Mar-94
Case 2: Low NOx Burners, SCR

Annual Capacity Factor: 10.0% 876 hours/year
Fuel Heat Content: 1050 btu/scf

	NOx ppm @ 3% O2	NOx lbs/MMscf	NOx lbs/MMbtu	Fuel Cons MMBtu/hr	NOx lbs/hr	NOx tons/yr
100% Load						
Uncontrolled	76	100	0.095	97.50	9.26	4.06
With LNB, SCR	15.2	20	0.019	97.50	1.85	0.81
Decrease	80%		0.076		7.41	3.25

Capital Costs			
Low NOx Burners	$0	$200 /MMbtu	- Sierra estimate for utility boilers
Flue Gas Recirculation	$0	$1,070 /MMbtu	- Sierra estimate for utility boilers
Selective Catalytic Reduction	$445,939	$4,574 /MMbtu	- Peerless quote for SEPCO, shipped & i
Total Capital Costs	$445,939		
Annual Capital Recovery	$72,575	Annualized levelized fixed charge rate, 10 year capital recovery period 10.0% capital recovery rate	
Catalyst Life	20 years		
Catalyst cost/change	$39,315	$403 /MMbtu	- SEPCO estimate
Catalyst cost/yr	$2,359	Includes 20% labor cost	
Aqueous Ammonia cost/ton	$425		
NOx Reduction Due to SCR	80%		
NOx Reduced by SCR	7.41 lbs/hr		
NH3:NO mole ratio	1.05		
Anhydrous NH3 (tons/yr)	1.26	17.03 lb/lb-mole NH3	
Aqueous NH3 (tons/year)	4.35	29% solution	
Total NH3 Cost/yr	$1,849		
Annual O&M Costs			
FGR electric power cost	$0		
SCR backpressure fuel cost	$1,039	0.315% fuel penalty @	$3.86 /MMbtu
SCR electric power cost	$155	3 kw @	$0.059 /kwh
Equipment O&M costs	$13,378	3.0% of capital costs	
Total Annual O&M Costs	$14,572		
Total Cost/yr	$91,354		
NOx Reduction, tons/yr	3.25		
Cost-Effectiveness, $/ton	$28,147		

Sierra Research

Cost-Effectiveness of NOx Control Strategies
Case 3: Low NOx Burners and Flue Gas Recirculation

12-Mar-94

Annual Capacity Factor: 10.0% 876 hours/year
Fuel Heat Content: 1050 btu/scf

	NOx ppm @ 3% O2	NOx lbs/MMscf	NOx lbs/MMbtu	Fuel Cons MMBtu/hr	NOx lbs/hr	NOx tons/yr
100% Load						
Uncontrolled	76	100	0.095	97.50	9.26	4.06
With LNB, FGR	25	33	0.031	97.50	3.05	1.33
Decrease	67%		0.064		6.22	2.72

Capital Costs			
Low NOx Burners	$0	$200 /MMbtu	- Sierra estimate for utility boilers
Flue Gas Recirculation	$104,325	$1,070 /MMbtu	- Sierra estimate for utility boilers
Selective Catalytic Reduction	$0	$4,574 /MMbtu	- Peerless quote for SEPCO, shipped & i
Total Capital Costs	$104,325		
Annual Capital Recovery	$16,978	Annualized levelized fixed charge rate, 10 year capital recovery period, 10.0% capital recovery rate	
Catalyst Life	20 years		
Catalyst cost/change	$0	$403 /MMbtu	- SEPCO estimate
Catalyst cost/yr	$0	Includes 20% labor cost	
Aqueous Ammonia cost/ton	$425		
NOx Reduction Due to SCR	0%		
NOx Reduced by SCR	0.00 lbs/hr		
NH3:NO mole ratio	1.05		
Anhydrous NH3 (tons/yr)	0.00	17.03 lb/lb-mole NH3	
Aqueous NH3 (tons/year)	0.00	29% solution	
Total NH3 Cost/yr	$0		
Annual O&M Costs			
FGR electric power cost	$2,843	55 kw @	$0.059 /kwh
SCR backpressure fuel cost	$0	0.000% fuel penalty @	$3.86 /MMbtu
SCR electric power cost	$0	0 kw @	$0.059 /kwh
Equipment O&M costs	$3,130	3.0% of capital costs	
Total Annual O&M Costs	$5,972		
Total Cost/yr	$22,951		
NOx Reduction, tons/yr	2.72		
Cost-Effectiveness, $/ton	$8,430		

STATE OF CALIFORNIA

State Resources Conservation
and Development Commission

In the matter of:	)	Docket No. 93-AFC-2
	)	
Application for Certification	)	PROOF OF SERVICE
of the Sacramento Cogeneration	)	(rev. 12/3/93)
Authority's Procter & Gamble	)	
Cogeneration Project	)	
	)	

PROOF OF SERVICE

I, Evangeline Parchamento, declare that on March 18, 1994, I deposited copies of the attached response to Cost Effectiveness question from SMAQMD regarding the Auxiliary Boiler at the proposed Procter and Gamble cogeneration project (Docket No. 93-AFC-02) in the United States mail at Sacramento, California, with first class postage thereon fully prepaid and addressed to the following:

APPLICANT

Ms. Susan Strachan, Manager
Projects Permitting & Licensing
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Sacramento, CA 95852-1830

Steve Cohn
Senior Attorney
SMUD
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INTERESTED AGENCIES

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Ray Menebroker, Chief Project
Assessment Branch
Stationary Source Division
California Air Resources Board
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Sacramento, CA 95814

Ed Schnabel
Sacramento Metropolitan Water District
5331 Walnut Avenue
Sacramento, CA 95841

CALIFORNIA ENERGY COMMISSION
(Docket Unit - 12 copies required)

Docket Unit, MS-4
1516 Ninth Street
Sacramento, CA 95814

I declare under penalty of perjury that the foregoing is true and correct.

Evangeline B. Parchamento
Signature

Attachment