Brian Lusher

From: Jeff Valmus [jvalmus@emerachem.com]
Sent: Monday, September 08, 2008 1:36 PM
To: Weyman Lee
Cc: Bob Nishimura; Brian Lusher; jcole@hydrogen.la
Subject: RE: Request for EMx cost information


App_8 Mx-SCR_BACT_Analy


BACT economic analysis (final)...


SF BACT LM6000 Emissions Calcu...


GE 7FA Emissions.pdf

Weyman,

Please find our attached BACT analysis for both the LM-6000 and 7FA (180MW combined cycle) plants. Sorry for the delay but as you can expect it was a great undertaking. All of the economics have been updated to current day pricing (these numbers are actual quotes we have provided customers recently). I have attached some of the supporting detail. Please let me know what else you need.

Sincerely,

Jeff Valmus
Vice President of Business Development
EmeraChem Power
O: 949-496-5802
C: 949-355-0320
F: 949-496-2696

-----Original Message-----
From: Weyman Lee [mailto:Weyman@baaqmd.gov]
Sent: Friday, August 29, 2008 12:47 PM
To: Jeff Valmus
Cc: Bob Nishimura; Brian Lusher
Subject: RE: Request for EMx cost information

Thanks

-----Original Message-----
From: Jeff Valmus [mailto:jvalmus@emerachem.com]
Sent: Fri 8/29/2008 6:53 AM
To: Weyman Lee
Cc: jcole@hydrogen.la
Subject: RE: Request for EMx cost information

I am working on these and would expect to be able to get something to you next week.

Sincerely,

Jeff Valmus
Vice President of Business Development
EmeraChem Power
O: 949-496-5802
C: 949-355-0320
F: 949-496-2696

-----Original Message-----
From: Weyman Lee [mailto:Weyman@baaqmd.gov]
Sent: Monday, August 25, 2008 11:03 AM
To: jcole@hydrogen.la; Jeff Valmus
Subject: FW: Request for EMx cost information

Correction - pleae do analysis for 170 MW turbine, not 200 MW.

> -----Original Message-----
> From: Weyman Lee
> Sent: Monday, August 25, 2008 10:33 AM
> To: '
> Cc: Bob Nishimura; Brian Lusher
> Subject: Request for EMx cost information
>
> Jerald-
>
> I understand that you are completing a top-down BACT analysis with cost effectiveness calculations to compare EMx and SCR systems for a LM6000 turbine. This is timely because the District is in the process of updating the BACT analysis for combustion gas turbines. I would like to request the BACT analysis for the LM6000 and also request that the analysis be scaled up for a 200 MW combined cycle turbine. I will be faxing you a copy of a 1999 SCR cost analysis to show the cost information the District is interested in. I would like to have the analyses (for both the LM6000 and 200 MW turbine) by end of this week on 8/29. If this is not possible, please let me know the earliest date you can provide the requested information. Thank you.
>
> Weyman Lee
> (415) 749-4796
>
>

SCR Analysis

		50 MW Class		Flow		180MW		Flow
Turbine Model		GE LM6000		1,100,000		GE 7FA Combined Cycle		3,400,000
Turbine Output		47.5 MW				120MW		
							Scaling Factor	3.090909
Direct Capital Costs (DC)								
Purchased Equip. Cost (PE)			**Source**		**Cost**		**Scaled Up Cost**	
Basic Equipment (A)	SCR System		EC Power-Canyon Quote		$ 1,753,336		$ 5,419,402	
	Ammonia injection skid		Included					
	NH3 Tank and Unloading Station		Vector Systems-Canyon		$ 607,332		$ 1,877,208	
	Instrumentation		Included					
	Taxes and freight	0.08 A x B	OAQPS		$ 188,853		$ 583,729	
PE Total					$ 2,549,521		$ 7,880,339	
Direct Installation Costs (DI)								
	Foundation & supports	0.08 x PE	OAQPS		$ 203,962		$ 630,427	
	Handling and erection	0.14 x PE	OAQPS		$ 356,933		$ 1,103,247	
	Electrical	0.04 x PE	OAQPS		$ 101,981		$ 315,214	
	Piping	0.02 x PE	OAQPS		$ 50,990		$ 157,607	
	Insulation	0.01 x PE	OAQPS		$ 25,495		$ 78,803	
	Painting	0.01 x PE	OAQPS		$ 25,495		$ 78,803	
		DI Total			764,856		$ 2,364,102	
DC Total					$ 3,314,378		$ 10,244,441	
Indirect Costs (IC)								
	Engineering:	0.10*PE	OAQPS		$ 254,952		$ 788,034	
	Construction and field expenses	0.05*PE	OAQPS		$ 127,476		$ 394,017	
	Contrctor fees	0.10*PE	OAQPS		$ 254,952		$ 788,034	
	Start-up	0.02*PE	OAQPS		$ 50,990		$ 157,607	
	Performance testing	0.01*PE	OAQPS		$ 25,495		$ 78,803	
	Contingencies	0.03*PE	OAQPS		$ 76,486		$ 236,410	
	IC Total				$ 790,352		$ 2,442,905	
Total Capital Investment (TCI = DC + IC)					$ 4,104,730		$ 12,687,346	
Direct Annual Costs (DAC)								
Operating Costs (O)	24 hrs/day, 7 days/wk, 50 wks/yr							
	Operator	0.5 hrs/shift $25/hr	OAQPS		$ 13,125		$ 13,125	
	Supervisor	15% of Operator	OAQPS		$ 1,969		$ 1,969	
Maintenance Costs (M)								
	Labor	0.5 hrs/shift $25/hr	OAQPS		$ 13,125		$ 13,125	
	Material	100% of labor cost	OAQPS		$ 13,125		$ 13,125	
Utility Costs								
	Perf Loss	0.50%						
	Electricity cost	0.10 ($/kwh) performance penalty variable			$ 607,781		$ 1,878,596	
	Water and Air		Carter Burgess		$ 80,114		$ 247,624	
	Catalyst replacement	5 year life	EC Power quote		$ 70,000		$ 216,364	
	Catalyst disposal	1 time every 5 years	EC Power quote		$ 16,000		$ 49,455	
	Ammonia		Carter Burgess		$ 91,341		$ 282,328	
	NH3 injection skid		Carter Burgess		$ 34,000		$ 105,091	
Total DAC					$ 940,580		$ 2,779,458	
Indirect Annual Costs (IAC)								
	Overhead	60% of O&M			$ 24,806		$ 24,806	
	Administrative	0.02 x TCI			$ 82,095		$ 253,747	
	Insurance	0.01 x TCI			$ 41,047		$ 126,873	
	Property tax	0.01 x TCI			$ 41,047		$ 126,873	
	Capital recovery 10% interest rate, 15 yr period	0.13 x TCI			$ 533,615		$ 1,649,355	
Total IAC					$ 722,610		$ 2,181,655	
Total Annual Cost (DAC + IAC)					$ 1,663,190		$ 4,961,113	
Steady State NOx Emission Rate (tons/year)	25 ppm		88.2			9ppm		197.9
Start-up and Shutdown Emissions (tons/yr)	250 per year		10			100 per year		2
Total NOx Emissions			98.2					199.9
NOx Removed (TPY) at 2.5 ppm	90 percent removal at SS. Zero control during S/U		79.4	kWh	47,000	180,000		178.1
Cost Effectiveness	$/ton	$	20,952	Annual hrs	4,000	7884	$	27,854
Utility Cost Impact	¢/kWh		0.500	kWh /yr	188,000,000	1,419,120,000		0.20

Carter Burgess Utility Cost Analysis UCSD Titan

Exhaust Flow	395,180	
Power, Steam, dP losses		#######
Water		$ 15,000
Air		$ 14,811
Urea Use		$ 33,989
Total		#######

Scale up to LM6000PC Sprint

Exhaust Flow	1,062,000	
Power, Steam, dP losses		$ 607,781
Water		$ 40,311
Air		$ 39,803
Urea Use		$ 91,341
Total		$ 779,236

Figure 8.1E-2

EMx Cost Effectiveness Calculation

2008 EC Power Analysis

	50 MW Class					180 MW Class			Flow
Turbine						GE FA	Combine Cycle		3,400,000
Model	GE LM6000	Flow				120MW			
Turbine Output	47.5 MW	1,100,000	**Source**	**Cost**					
Direct Capital Costs (DC)									
Purchased Equip. Cost (PE)									
	EMx Reactor Housing and components	A	EC Power quote	$2,940,000	PB Power Anaheim Quote			$6,500,000	
	Regeneration Gas System	B	EC Power quote	$874,073	PB Power Anaheim Quote	included		$0	
	EMx Non Precious Metal Catalyst	C	EC Power quote	$1,942,028	PB Power Anaheim Quote			$3,938,775	
	Precious Metals	D	EC Power quote	$2,578,917	PB Power Anaheim Quote			$6,883,193	
	Taxes and freight	0.08 (A+ B+C+D)	OAQPS	$666,801				$1,385,757	
		PE Total		$9,001,819				$18,707,725	
NPMPE		Non PM PE Total (A+B+C)		$5,756,101	No Tax & Freight			$10,438,775	
Direct Installation Costs (DI)									
	Foundation & supports	Same Costs as SCR	OAQPS	$ 203,962				$630,427	
	Handling and erection	Same Costs as SCR	OAQPS	$ 356,933				$1,103,247	
	Electrical	Same Costs as SCR	OAQPS	$ 101,981				$315,214	
	Piping	Same Costs as SCR	OAQPS	$ 50,990				$157,607	
	Insulation	Same Costs as SCR	OAQPS	$ 25,495				$78,803	
	Painting	Same Costs as SCR	OAQPS	$ 25,495				$78,803	
DI Total				$ 764,856				$2,364,102	
DC Total				$6,520,957				$12,802,877	
Indirect Costs (IC)									
	Engineering:	Same Costs as SCR	OAQPS	$200,000				$ 788,034	
	Construction and field expenses	Same Costs as SCR	OAQPS	$ 127,476				$ 394,017	
	Contrctor fees	Same Costs as SCR	OAQPS	$ 254,952				$ 788,034	
	Start-up	Same Costs as SCR	OAQPS	$ 50,990				$ 157,607	
	Performance testing	Same Costs as SCR	OAQPS	$ 25,495				$ 78,803	
	Contingencies	0.05*NPMPE	OAQPS	$ 76,486				$ 521,939	
	IC Total			$735,400				$ 2,728,434	
Total Capital Investment (TCI = DC + IC)				$7,256,357				$15,531,310	
Direct Annual Costs (DAC)									
Operating Costs (O) 24/7/50									
	Operator 0.5 hrs/shift 25/hr	Same Costs as SCR	OAQPS	$13,125				$13,125	
	Supervisor 15% of Operator	Same Costs as SCR	OAQPS	$1,969				$1,969	
Maintenance Costs (M)									
	Labor 0.5 hrs/shift 25/hr	Same Costs as SCR	OAQPS	$13,125				$13,125	
	Material 100% of labor cost	Same Costs as SCR	OAQPS	$13,125				$13,125	
Utility Costs									
	Perf Loss	0.50%				Steam		$2,224,760	
	Electricity cost 0.10 /kwh		EC Power	$ 15,968		Natural Gas		$193,027	
	Water and Air		Carter Burgess	$ 464		Water and Air		$6,365	
	Catalyst replacement	15%PM+NPM every 10 years	EC Power	$ 232,887		Electricity		$10,582	
	Catalyst disposal	PM recovery: 85 percent reclaim/10 years	EC Power	$ (219,208)		15%PM+NPM every 10 years		$ 709,106	
	Catalyst Cleaning	Once per year	EC Power	$ 15,000		PM recovery: 85 percent reclaim/10 years		$ (585,071)	
						Catalyst Cleaning		$20,000	
Total DAC				$ 86,454				$ 2,600,112	
Indirect Annual Costs (IAC)									
	Overhead	60% of O&M		$24,806				$ 24,806	
	Administrative	Same as SCR		$82,095				$ 310,626	
	Insurance	0.01 x TCI		$72,564				$ 155,313	
	Property tax	0.01 x TCI		$72,564				$ 155,313	
	Capital recovery 10% interest rate, 15 yr period	0.13 x TCI		$943,326				$ 2,019,070	
Total IAC				$1,195,354				$ 2,665,129	
Total Annual Cost (DAC + IAC)				$1,281,809				$ 5,265,241	
Steady State NOx Emission Rate (tons/year)	25 ppm		88.2					197.9	
Start-up and Shutdown Emissions (tons/yr)	250 per year		10					2	
Total NOx Emissions			98.2	47,000		180,000		199.9	
NOx Removed (TPY) at 1.0 ppm	96 percent removal at SS. 50% during S/U and S/D		89.7	4,000		7,884		191.0	
Cost Effectiveness	$/ton	$	14,294	188,000,000		1,419,120,000	$	27,569	
Electricity Cost Impact	¢/kWh		0.008					0.18	

EC Power Utility Cost Analysis UCSD (same H2 gas requirement of 3 Titan 130)

	HGM3000		Carrier Steam		TOTAL	
Power, Steam, dP losses	$	130,656	$	669,987	$	15,968
Water	$	918	$	2,215	$	-
Air	$	625	$	-	$	464
Urea Use	$	-	$	-	$	-
					$	-
Total	$	132,199	$	672,202	$	16,432

EMx Utility Requirements

1 Units operating at 100% load

H2 Reformer

Natural Gas Usage	scfh	2512
Power Usage	kw	0
RO/DI Water	gpm	0
Air	scfh	0

NG (HHV) 1026 BTU/cf NG
Operating hours 7884

Commodity Costs		
Power	$/kWh	$ 0.12
Fuel	$/MMBTU	$ 10.00
Fuel	$/1000scf	9.75
Compressed Air	$/1000 SCF	$ 0.35
RO/DI Water	$/1000gallons	$ 3.00

Annual Usage

Natural Gas Usage	scf	19,804,608
Power Usage	kw	-
RO/DI Water	gal	-
Air	scf	-

Annual Costs

Natural Gas Usage	$	193,027
Power Usage	$	-
RO/DI Water	$	-
Air	$	-
Total	**$**	**193,027**

CARRIER STEAM

Superheated Steam@850F	lbs/hr	20925
Condensate Return	lbs/hr	18833
Makeup Required	lbs/hr	2093

Condensate Return 90% percent
Enthalpy superheated @ 850F 1457.59 BTU/lb
Enthalpy of water @ 180ºF 147.99 BTU/lb
Enthalpy of water @ 60ºF 28.08 BTU/lb

Annual Usage

Superheated Steam@850F	lbs/yr	164,972,700
Condensate Return	lbs/yr	148,475,430
Makeup Required	lbs/yr	16,497,270

Heat Input required to make carrier steam

Condensate Return	BTU/yr	194,443,423,128	194,443.42	MMBTU/yr
Makeup Required	BTU/yr	23,583,012,438	23,583.01	MMBTU/yr
Total Requirement	BTU/yr	218,026,435,566	218,026.44	MMBTU/yr

Cost to make carrier steam

Thermal Effieciency of tubes 98% percent
HRSG per CMI

Natural Gas Costs	**$**	**2,224,760**
Makeup Water Costs	**$**	**5,934**

Valve and Blower Costs

# of times operated	per yr		283,824
Time operated	min/yr		94,608
Air usage	scf		1,229,904
Costs per Year	$/yr	**$**	**430**

Air valves operate for 20 seconds every 5 minutes
Rate when valves operating 13 scfm

Blower power requirement	bhp		15
Blowers	#		1
Total power rate	bhp-hr		15
Total power rate	kwh		11
Annual Power usage	kw		88,186
Annual costs	$	**$**	**10,582**

Conversion 1 BHP 745.7 watts

CLEANINGS

Catalyst Cleaning	**$**	**20,000**

Total Operating Costs	**$**	**2,454,734**