200606055035 Received FERC OSEC 06/05/2006 02:16:00 PM Docket# CP06-54-000, ET AL.

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June 5, 2006

BY ELECTRONIC FILING

Magalie Roman Salas, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Re: Broadwater Energy LLC, Docket No. CP06-54-000
Broadwater Pipeline LLC, Docket Nos. CP06-55-000 & CP06-56-000

Dear Ms. Salas:

Enclosed for filing in the referenced proceedings is a copy of correspondence from Broadwater Energy LLC and Broadwater Pipeline LLC to the Environmental Protection Agency.

Please do not hesitate to contact me with any questions regarding this submission.

Respectfully submitted,

/s/ Brett A. Snyder

Brett A. Snyder

Counsel to Broadwater Energy LLC and Broadwater Pipeline LLC

Enclosure

cc: James Martin, FERC
Coordinating Agencies
ENTRIX, Inc.
Roger Stebbing and Associates

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June 5, 2006

BY ELECTRONIC AND FIRST CLASS MAIL

Mr. Frank Jon
Permitting Section
Air Programs Branch
U.S. Environmental Protection Agency, Region 2
290 Broadway
New York, NY 10007-1866

Re: Broadwater Energy Project – Response to EPA's Follow up Questions Regarding Broadwater Energy's May 3, 2006 Response

Dear Mr. Jon:

Attached hereto is the response of Broadwater Energy LLC and Broadwater Pipelines LLC ("Broadwater Energy") to the U.S. Environmental Protection Agency's request for additional information concerning the power pump estimates for the LNG carriers offloading cargo to the Broadwater Energy Project. We also have attached updated versions of Tables 13a and 14 which have been revised in accordance with your discussions with Bruce Wattle of Ecology and Environment, Inc. Please note that footnote 4 to Table 13a has been revised to address your question regarding the maximum pound per hour SO_2 emission rate for the 125,000 m^3 LNG carriers.

Please do not hesitate to contact me or Sandra Barnett at 403-920-7776 if you have any questions concerning the attached response and revised tables.

Respectfully submitted,

FOR

James A. Thompson, Jr.
Counsel for Broadwater Energy

Attachments

cc: Kristine Delkus (Broadwater Energy)
Sandra Barnett (Broadwater Energy)
Robert J. Alessi (LLGM)
Steven C. Riva (EPA)

BROADWATER

Evaluation of LNG Pumping Power Requirements and Associated Emissions

Step 1: Evaluate representative LNG pumping power requirements on existing and new LNG vessels

LNG cargo pumping power requirement data was collected from a representative pump curve of cargo pumps used on LNG ships in service as well as pump specifications described in shipbuilder's technical specifications for new LNG ships. The data summarized below is data representative of actual LNG vessels. The pump motor kW shown is based on all pumps discharging simultaneously.

- Vessel type: steam turbine vessel of 138,000 m^3 cargo capacity;
- Number of pumps: 8;
- Flow rate per pump: 0.47 m^3 per second;
- Vessel total pumping rate: 3.78 m^3 per second;
- Head (meters): 155
- Cargo density (kg/m^3): 500
- Total Cargo pumping power requirement from pump curve (kW): 2,872
- Efficiency (accounts for how close pump operates to its duty point): 0.85
- Total motor power rating determined by dividing cargo pumping power by efficiency: 3,379 kW (8 pumps).

The efficiency value is based on various factors that effect how close the pump operates to its duty point (the duty point is a pump curve feature that indicates optimum pump operating capability for a given set of pumping conditions). For the Broadwater Project, the discharge head will be lower than the representative vessel data provided above, so the pump will operate further away from the duty point. Therefore, the efficiency will be less for Broadwater. An estimate of the pump efficiency for Broadwater is 0.75 and is taken from the representative pump curve at the corresponding flow rate. Therefore, the total motor (8) power rating at an efficiency of 0.75 would be 3,830 kW.

Step 2: Relate results from Step 1 to Broadwater specifications

Power requirements for LNG vessels delivering to the Broadwater Project are based on a loading rate of 10,000m^3/hr (2.78 m^3/s). This rate is lower than the representative data shown above and, therefore, to determine the pump motor kW requirements for the Broadwater Project, a ratio was developed between the Broadwater loading rate and the vessel total pumping rate. This factor was then multiplied by the representative vessel motor kW at an efficiency rating of 0.75.

Example Calculation:

(Broadwater loading rate/Representative vessel discharging rate) * Motor kW = Broadwater motor kW

(2.78/3.78) * 3,830 (8 pumps on a steam vessel 138,000 m^3 cargo capacity at efficiency of 0.75) = 2,816 kW

Step 3: Use LNG pump power requirements to estimate LNG vessel emissions due to pumping

The cargo pumping power requirement determined in Step 2 (which is specific to Broadwater) (2,816 kW for a 10,000 m3/hr transfer rate) was then multiplied by vessel boiler emission rates (in units of grams/kW-hr) to determine emissions. Hours of operation for LNG pumping were also used in the estimate.

20060605035 Received FERC OSEC 06/05/2006 02:16:00 PM Docket# CP06-54-000, ET AL.

Table 13a
SUMMARY OF EMISSION RATES FOR LNG CARRIERS OF VARIOUS CARGO CAPACITY AND LOADING RATE WHILE AT THE FSRU

Daily Natural Gas Delivery	1	bcf/day	Estimated average daily natural gas delivery rate.
	21,095	Mg/day	Calculated from ideal gas law using standard temperature and pressure.
Annual LNG Delivery Rate by Mass	7,700,000	metric tons/yr	Maximum annual LNG delivery to FSRU
	7,700,051	Mg/yr	
LNG Density	470	kg/m^3	Design data from RR13
LNG Annual Delivery Rate by Volume	16,383,086	m^3/yr	Calculated from Annual LNG Delivery Rate by Mass and LNG Density

Pump Power requirements 2,816 ST vessel 138K m3
3,212 SSD reliq vessel, 260K m3

Vessel Type	Vessel Size (m^3)	LNG Loading Rate (m^3/hr)	Annual Vessel Dockings (#/yr)	Vessel Duration at FSRU: LNG Loading (hr)	Vessel Duration at FSRU: No Loading (hr)	Power Supplied by Engines[1]: LNG Pumps (kW)	Power Supplied by Engines[1]: Other Equip. (kW)	Fuel Use by Vessel at FSRU[2,3] (tons)	Maximum Hourly Emissions[4] (lb/hr): NO_x	VOC	CO	CO_2	SO_2	PM_{10} ($PM_{2.5}$)	Maximum Hourly Emissions with No Loading[5] (lb/hr): SO_2	PM_{10} ($PM_{2.5}$)	Average Hourly Emission Over 24-Hour Period[6] (lb/hr): SO_2	PM_{10} ($PM_{2.5}$)	Annual Emissions - LNG Loading (tpy) - Pumping and Ship Hoteling Subtotal: NO_x	VOC	CO	CO_2	SO_2	PM_{10} ($PM_{2.5}$)
Existing Vessel Population																								
Conventional LNGC	125,000	10,000	132	12.5	8	2,816	1,900	25	22	0.3	1.2	9,939	285	8	68	3.1	171	5	18.01	0.3	1.03	8,200	140	6
Heavy Fuel Oil (2.7%S)		13,000	132	9.6	8	3,661	1,900	23	26	0.4	1.5	11,720	337	9	68	3.1	158	5	16.34	0.2	0.93	7,438	127	6
Steam turbine propulsion		15,000	132	8.3	8	4,224	1,900	22	28	0.4	1.6	12,907	371	10	68	3.1	151	5	15.59	0.2	0.89	7,099	121	6
Conventional LNGC	140,000	10,000	118	14.0	8	2,816	1,900	27	22	0.3	1.2	9,939	285	8	68	3.1	189	6	18.03	0.3	1.03	8,210	140	6
Heavy Fuel Oil (2.7%S)		13,000	118	10.8	8	3,661	1,900	25	26	0.4	1.5	11,720	337	9	68	3.1	174	5	16.36	0.2	0.93	7,447	127	6
Steam turbine propulsion		15,000	118	9.3	8	4,224	1,900	24	28	0.4	1.6	12,907	371	10	68	3.1	167	5	15.61	0.2	0.89	7,107	121	6
Conventional LNGC	160,000	10,000	103	16.0	8	2,816	1,900	30	22	0.3	1.2	9,939	285	8	68	3.1	213	6	17.99	0.3	1.03	8,190	140	6
Heavy Fuel Oil (2.7%S)		13,000	103	12.3	8	3,661	1,900	28	26	0.4	1.5	11,720	337	9	68	3.1	195	6	16.32	0.2	0.93	7,429	127	6
Steam turbine propulsion		15,000	103	10.7	8	4,224	1,900	27	28	0.4	1.6	12,907	371	10	68	3.1	187	6	15.57	0.2	0.89	7,090	121	6
Vessel Design On-Order (Expected in-service 2008)																								
New Design LNGC	160,000	10,000	1	16.0	8	2,816	2,700	24	239	7.3	19.3	8,293	79	20	69	9.8	76	17	2	0.1	0.2	66	1	0
Heavy Fuel Oil (1.5%S)		13,000	1	12.3	8	3,661	2,700	21	276	8.4	22.3	9,564	92	23	69	9.8	70	15	2	0.1	0.1	59	1	0
Slow Speed Diesel		15,000	1	10.7	8	4,224	2,700	21	300	9.2	24.3	10,410	100	25	69	9.8	67	14	2	0.0	0.1	56	1	0
New Large LNGC	215,000	10,000	1	21.5	8	2,816	3,000	32	252	7.7	20.4	8,745	84	21	77	10.8	83	20	3	0.1	0.2	94	2	0
Heavy Fuel Oil (1.5%S)		13,000	1	16.5	8	3,661	3,000	29	289	8.8	23.3	10,015	96	24	77	10.8	90	20	2	0.1	0.2	83	1	0
Slow Speed Diesel		15,000	1	14.3	8	4,224	3,000	27	313	9.6	25.3	10,861	104	26	77	10.8	88	19	2	0.1	0.2	78	1	0
Concept Vessels In Serivce (beyond 2010)																								
New Very Large LNGC	250,000	10,000	1	25.0	8	3,212	3,200	40	278	8.5	22.5	9,641	92	23	82	11.6	92	23	3	0.1	0.3	121	2	0
Heavy Fuel Oil (1.5%S)		13,000	1	19.2	8	4,176	3,200	36	320	9.8	25.9	11,089	106	27	82	11.6	101	24	3	0.1	0.2	107	2	0
Slow Speed Diesel[7]		15,000	1	16.7	8	4,818	3,200	34	348	10.6	28.1	12,055	115	29	82	11.6	105	24	3	0.1	0.2	100	2	0
New Very Large LNGC	250,000	10,000	1	25.0	8	3,212	2,300	n/a	16	0.10	4.1	5,457	0.03	0.33	0.01	0.14	0.03	0.33	0	0.00	0	68	0.00	0.00
LNG fuel only		13,000	1	19.2	8	4,176	2,300	n/a	19	0.12	4.8	6,411	0.04	0.38	0.01	0.14	0.03	0.34	0	0.00	0	62	0.00	0.00
Gas Turbine Propulsion[8,9]		15,000	1	16.7	8	4,818	2,300	n/a	20	0.13	5.3	7,047	0.04	0.42	0.01	0.14	0.03	0.34	0	0.00	0	59	0.00	0.00

Notes:
1. Based on data supplied in Ref 15. LNG Pumps operate only during "LNG Loading". Other Equip. operates during "LNG Loading" and "No Loading"
2. Steam Turbine fuel use based on engine flow rate of 305 g/kW-hr (Ref. 11, Table 2.8). Steady operation while unloading is consistent with "at sea" operations.
3. Slow speed diesel fuel use based on fuel flow rate of 195 g/kW-hr (Ref. 11, Table 2.8). Steady operation while unloading is consistent with "at sea" operations.
4. Maximum hourly emission rate based on operation of vessel auxiliary engines needed to power LNG Pumps and Other Equipment. SO2 max lb/hr based on use of 4.5%S fuel since for short term this is possible.
5. Maximum hourly emission rate based on operation of vessel auxiliary engines needed to power only Other Equipment.
6. Weighted values based on emissions during Loading and No Loading periods.
7. New Very Large LNGC vessel assumed to use slow speed diesel on HFO only. Vessel will have a LNG reliquefaction plant on-board, no boil off gas available for propulsion.
8. New Very Large LNGC vessel assumed to use gas turbine capable of 22MW generation. No vessels of this type under design yet; specifications speculative only. No reliquefaction plant used.
9. Fuel rate of gas turbines estimated at 9,000 Btu/kW-hr.

BV006526

20060055035 Received FERC OSEC 06/05/2006 02:16:00 PM Docket# CP06-54-000, ET AL.

Annual Emissions (tpy) - No Loading period - Ship Hoteling 8 hours						Annual Emissions - Total (tpy)						Annual Emissions - LNG Pumping Only (tpy)						Annual Emissions - Hoteling During LNG Pumping (tpy)					
NO_x	VOC	CO	CO_2	SO_2	PM_{10} ($PM_{2.5}$)	NO_x	VOC	CO	CO_2	SO_2	PM_{10} ($PM_{2.5}$)	NO_x	VOC	CO	CO_2	SO_2	PM_{10} ($PM_{2.5}$)	NO_x	VOC	CO	CO_2	SO_2	PM_{10} ($PM_{2.5}$)
5	0.1	0.27	2,114	36	1.7	23	0.3	1.3	10,314	176	8	10.76	0.2	0.615	4,896	83	4	7.26	0.1	0.415	3,304	56	3
5	0.1	0.27	2,114	36	1.7	21	0.3	1.2	9,552	163	7	10.76	0.2	0.615	4,896	83	4	5.58	0.1	0.319	2,541	43	2
5	0.1	0.27	2,114	36	1.7	20	0.3	1.2	9,213	157	7	10.76	0.2	0.615	4,896	83	4	4.84	0.1	0.276	2,202	38	2
4	0.1	0.24	1,890	32	1.5	22	0.3	1.3	10,100	172	8	10.77	0.2	0.615	4,902	84	4	7.27	0.1	0.415	3,308	56	3
4	0.1	0.24	1,890	32	1.5	21	0.3	1.2	9,337	159	7	10.77	0.2	0.615	4,902	84	4	5.59	0.1	0.319	2,544	43	2
4	0.1	0.24	1,890	32	1.5	20	0.3	1.1	8,997	153	7	10.77	0.2	0.615	4,902	84	4	4.84	0.1	0.277	2,205	38	2
4	0.1	0.21	1,650	28	1.3	22	0.3	1.2	9,840	168	8	10.74	0.2	0.614	4,890	83	4	7.25	0.1	0.414	3,300	56	3
4	0.1	0.21	1,650	28	1.3	20	0.3	1.1	9,078	155	7	10.74	0.2	0.614	4,890	83	4	5.58	0.1	0.319	2,538	43	2
4	0.1	0.21	1,650	28	1.3	19	0.3	1.1	8,740	149	7	10.74	0.2	0.614	4,890	83	4	4.83	0.1	0.276	2,200	37	2
0	0.0	0.0	16	0	0.0	2	0.1	0.2	83	1	0	0.98	0.0	0.1	34	0.32	0.08	1	0.0	0.1	32	0	0
0	0.0	0.0	16	0	0.0	2	0.1	0.2	75	1	0	0.98	0.0	0.1	34	0.32	0.08	1	0.0	0.1	25	0	0
0	0.0	0.0	16	0	0.0	2	0.1	0.2	72	1	0	0.98	0.0	0.1	34	0.32	0.08	1	0.0	0.1	22	0	0
1	0.0	0.0	18	0	0.0	3	0.1	0.3	112	2	0	1.31	0.0	0.1	46	0.44	0.11	1	0.0	0.1	48	0	0
1	0.0	0.0	18	0	0.0	3	0.1	0.2	101	2	0	1.31	0.0	0.1	46	0.44	0.11	1	0.0	0.1	37	0	0
1	0.0	0.0	18	0	0.0	3	0.1	0.2	96	2	0	1.31	0.0	0.1	46	0.44	0.11	1	0.0	0.1	32	0	0
1	0.0	0.0	19	0	0.0	4	0.1	0.3	140	2	0	2	0.1	0.1	60	1	0	2	0.1	0.1	60	1	0
1	0.0	0.0	19	0	0.0	4	0.1	0.3	126	2	0	2	0.1	0.1	60	1	0	1	0.0	0.1	46	0	0
1	0.0	0.0	19	0	0.0	3	0.1	0.3	120	2	0	2	0.1	0.1	60	1	0	1	0.0	0.1	40	0	0
0.0	0.00	0.0	9	0.000	0.001	0	0.00	0.1	77	0.00	0.00	2	0.1	0.1	60	1	0	1	0.0	0.1	43	0	0
0.0	0.00	0.0	9	0.000	0.001	0	0.00	0.1	71	0.00	0.00	2	0.1	0.1	60	1	0	1	0.0	0.1	33	0	0
0.0	0.00	0.0	9	0.000	0.001	0	0.00	0.1	68	0.00	0.00	2	0.1	0.1	60	1	0	1	0.0	0.1	29	0	0

BV006527

20060605035 Received FERC OSEC 06/05/2006 02:16:00 PM Docket# CP06-54-000, ET AL.

Table 14
REFERENCES

No.	Description
1	Spreadsheet: *Emission Sources Parameters 22Jul05.xls* (29-Jul-05 E-Mail from David Carpenter to Sandra Barnett).
2	Spreadsheet: *Diesel Engine NOX_CO Calc.xls* (29-Jul-05 E-Mail from David Carpenter to Sandra Barnett).
3	*Broadwater, RR13 Phase - Flare Height Study, 312383-SAI-CAL-601* (Saipem America, Inc., 02-Aug-05).
4	*13-Jul-05 E-Mail from David Carpenter to Paul Van Kerkhove* (Subject: Broadwater - LNG Transfer from Carriers to FSRU)
5	*Caterpillar 3608.pdf: "Gen Set Performance Data"* (RR13 Part B, 3-Aug-05).
6	16-Aug-05 Telephone Contact Report with OPFI (Contact Report_08_16_2005 OPFI.doc)
7	WFRU Calculations.doc (Internal E & E document)
8	*GE LM2500+ Graphs: NOx and CO Emissions During Start-up and Shutdown* (provided to GE to E & E in six pdf files on 15-Aug-2005)
9	*Broadwater, RR13 Phase - Topsides Section View Fore Area, 312383-SAI-DWG-403.03 Rev. 0* (Saipem America, Inc., 02-Aug-05).
10	LNG Carrier Aux Equip Calculations.doc (Internal E & E document)
11	*Quantification of Emissions from Ships Associated with Ship Movements Between Ports in the European Community* (Entec, 2002)
12	*AP-42: Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources* (USEPA)
13	*The New York, Northern New Jersey, Long Island Nonattainment Area Commercial Marine Vessel Emissions Inventory* (Starcrest, 2003)
14	GE Estimated Average Engine Performance, run 06/01/05, time 3:49:01 pm, version 3.3.2, LM2500 standard DLE
15	*27-April-06 E-Mail from Willie Gray to Sandra Barnett* (Subject: EBARA LNG Pump Curve)

BV006528

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document upon each person designated on the service list compiled by the Secretary in this proceeding in accordance with the requirements of Rule 2010 of the Commission's Rules of Practice and Procedure.

Dated at Washington, D.C. this 5th day of June 2006.

/s/ Brett A. Snyder
Brett A. Snyder

Submission Contents

bw060506.pdf····· 1-7