Miller, Felicia@Energy

To: Miller, Felicia@Energy
Subject: FW: HBEP emission rates and modeling results

From: Stephen O'Kane [mailto:stephen.okane@AES.com]
Sent: Thursday, October 25, 2012 4:40 PM
To: Chris Perri
Cc: Robert.Mason@CH2M.com; 'Jerry.Salamy@CH2M.com'; McKinsey, John A.; Foster, Melissa A.; Miller, Felicia@Energy
Subject: RE: HBEP emission rates and modeling results

Chris,

Here's the data I can provide. If you really need the additional performance data at the other temperatures I will have to get our consultants to run some additional heat balance models. Please let me know as this is an extra expenditure and additional time to execute.

With these two temperature cases you can see the performance of the CCGT in both 1-on-1 and 2-on-1 modes. Additional data would merely show the same relative difference compared to the 3-on-1 case for different operating temperatures and humidities. Note the highlighted numbers. Our CCGT design actually provides the best performance on a heat rate basis (and consequently CO2e per MW) in the 2-on-1 case. Which is a big part of the design objective. Instead of the normal heat rate curve of a CCGT that deteriorates as output or load is decreased, this design will maintain a very constant heat rate across a wide range of output, and be able to ramp up and down output very quickly. Thus we achieve approximately 800-1,000 BTU/kwh better heat rate than a simple cycle LMS 100 and still provide the fast ramp and quick start support.

	32 F – 87% RH (Evaporative Cooling Off, Case 2)	ISO 59 F- 60% RH (Evaporative Cooling Off)	66 F – 58% RH (Evaporative Cooling On, Case 7)	85 F - 45.75% RH (Evaporative Cooling On)	110 F-8% RH (Evaporative Cooling On, Case 12)
Gas Turbine Heat Input, mmbtu/h HHV[1]	1,498	1,388	1,403	1,354	1,350
Total Heat Input, mmbtu/h HHV (w/duct fire)[2]	2,005	1,895	1,910	1,861	1,857
Gas Turbine Gross Output, kW[3]	132,256	121,435	121,840	115,962	115,264
Steam Turbine Gross Output, kW[3]	49,579	51,865	50,192	48,523	43,632
Total Gross Power Output, kW[3]	181,835	173,300	172,032	164,485	158,896
Total Net Power Output, Kw[3]	175,925	167,583	166,328	158,901	153,352
Net Plant Heat Rate, btu/kWh, LHV	7,558	7,354	7,487	7,508	7,814
Net Plant Heat Rate, btu/kWh, HHV	8,516	8,285	8,435	8,459	8,803
Steam Turbine Gross Output, kW (2-on-1)			102,640	99,501	
Total Gross Power Output, kW (2-on-1)			346,320	331,425	
Total Net Power Output, Kw (2-on-1)			334,035	319,363	
Net Plant Heat Rate, btu/kWh, LHV (2-on-1)			7,337	7,408	
Net Plant Heat Rate, btu/kWh, HHV (2-on-1)			8,400	8,483	
Steam Turbine Gross Output, kW (1-on-1)			49,382	47,192	
Total Gross Power Output, kW (1-on-1)			171,222	163,154	
Total Net Power Output, Kw (1-on-1)			163,611	155,661	
Net Plant Heat Rate, btu/kWh, LHV (1-on-1)			7,489	7,600	

Net Plant Heat Rate, btu/kWh, HHV (1-on-1)			8,575	8,702	

Notes:
1. Cases 110F, 32F and 66F heat input taken directly from M501DA Gas Turbine Expected Performance and Emissions Provided by MPSA a included in Table 5.1B.2 of *HBEP_Appendix 5.1B_Ops Emissions Calcs.pdf*. ISO 59F Case Heat input taken from GT PRO model.

2. Total Heat Input per gas turbine with duct firing can only be achieved while operating in a 1-on-1 or 2-on-1 mode. The steam cycle is sized the maximum heat input into the steam cycle is reached in a 3-on-1 mode without duct firing.

3. All output is provided on a per turbine basis assuming a 3-on-1 operating mode. To calculate total output for the entire power block these va must be multiplied by 3

Stephen

From: Chris Perri [mailto:CPerri@aqmd.gov]
Sent: Thursday, October 25, 2012 2:57 PM
To: Stephen O'Kane
Cc: Robert.Mason@CH2M.com; 'Jerry.Salamy@CH2M.com'; McKinsey, John A.; Foster, Melissa A.; Miller, Felicia@Energy
Subject: RE: HBEP emission rates and modeling results

Steve-

The data for the summer max and annual average are probably the most appropriate, but if you could also provide the max and min temperature cases as well for the sake of completing the table for all cases, I'd appreciate it.

Thanks

Chris Perri
Air Quality Engineer
South Coast Air Quality Management District
(909) 396-2696

From: Stephen O'Kane [mailto:stephen.okane@AES.com]
Sent: Thursday, October 25, 2012 12:10 PM
To: Chris Perri
Cc: Robert.Mason@CH2M.com; 'Jerry.Salamy@CH2M.com'; McKinsey, John A.; Foster, Melissa A.; Miller, Felicia@Energy
Subject: RE: HBEP emission rates and modeling results

Chris,

I spoke too fast. I do not have the off base performance for all of the temperature cases where we provided the 3-on-1 data.

- The low temp 32o 3-on-1 case was provided only for the1304 MW-MW comparison as the maximum gross output and for screening the worst case emissions scenarios, and therefore there was no need to run the full heat balances for the 1-on-1 and 2-on-1 case.
- The high temp 110o 3-on-1 case was calculated only for maximum emissions impact and therefore there was no need to run the heat balances for the off base performance case
- The ISO temp 59o case was a special one off we provided for you at the last request and has no use for evaluating performance or environmental impact

What I can give you is the data for the off base conditions at the site summer maximum average (85o and 46% RH) and the site annual average (66o and 57% RH). These are the cases required to evaluate actual operating performance at off base conditions and for GHG BACT analysis. The data for the 2-on-1 and 1-on-1 performance cases from these conditions would provide you the data for evaluating off base performance conditions.

Please let me know if this data would meet your needs.

If you need the off base performance conditions for the other temperature cases I will need more time to run the heat balance model. Also you might enlighten me as to why other cases would be required as all of the requisite emissions, modeling and BACT analysis would be captured by the data already provided.

Thanks

Stephen

From: Chris Perri [mailto:CPerri@aqmd.gov]
Sent: Thursday, October 25, 2012 10:53 AM
To: Stephen O'Kane
Cc: Robert.Mason@CH2M.com; 'Jerry.Salamy@CH2M.com'; McKinsey, John A.; Foster, Melissa A.; Miller, Felicia@Energy
Subject: RE: HBEP emission rates and modeling results

Thanks, Stephen. As a follow up to the issue about plant heat rate, could you also provide the data for output during 1-on-1 and 2-on-1 operation. Specifically, for each temp/humidity condition, the following:

Steam turbine gross output
Total gross power output
Net power output

Also, out of the 5,900 hrs/yr operation that the plant will operate without duct firing, how much of that is it anticipated would be without steam turbine output?

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