Indeck Wharton, LLC

Submission of additional Information to US EPA – Region 6

Based on Communication from Jennifer Huser, US EPA, on Wednesday, January 22, 2014

Document Availbility

1. Please provide an electronic copy of the Cultural Resources Report and Biological Assessment Report to AC as soon as possible.

   Response: Electronic copies have been provided via internet links. You have confirmed that these have been received.

Emission Calculations

2. Please provide the detailed spreadsheets (in Excel format) for all of the calculations on a per turbine bases, including the BACT limit for CO2 in lbs/MWhr, the total potential to emit/emission limit for each chemical and the calculations to arrive at CO_2e. Please note that as of 1/1/14, the Global Warming Potential for methane increased from 21 to 25. When you provide the spreadsheets, please revise the methane CO_2e calculations to reflect the revised GWP. For the BACT limit, please express the value in lbs CO2/MWh rather than tons as in the original application. Also, please provide the BACT limit calculations for both net and gross power supply.

   Response: Updates of the detailed calculation spreadsheets are attached. The GE and Siemens calculations (first two spreadsheets) are now all done on a per turbine basis only. The proposed BACT limits for CO2 are expressed in lb/MWhr, and are provided both on a gross and net output basis. We have updated the calculations to reflect the latest changes to the GWP factors in 40 CFR Part 98, Table A-1. In addition to the change in the GWP for CH_4 from 21 to 25, the GWP for N_2O has decreased from 310 to 298, and the GWP for SF_6 has decreased from 23,900 to 22,800. All three GWP changes are reflected in the updated calculations. We have also added further explanation on how the calculations are done in order to facilitate your review.

3. In the detailed calculation spreadsheet, please include a breakdown of startup emissions per turbine, with a detailed explanation of the timing of turbine startup (ie., cold start, warm start, hot start, ramp up time, time it takes to put power to the grid and at what level, time to full generating capacity, time to reach maximum efficiency).

Response: As reflected in the attached detailed calculation spreadsheets, the startup emissions are based on all the same GHG emission factors as for normal operation, using a vendor supplied total quantity of fuel used over the startup period. The GHG emissions are therefore directly proportional to the fuel flow. For a simple cycle turbine, there are not normally separate designations for "cold", "warm", or "hot" starts since these are related to the warm-up period required for a heat recovery steam generator used in a combined cycle system. A GE 7FA.05 performance curve is attached for a simple cycle startup. GE considers this material to be proprietary and we would appreciate the agency viewing this data as confidential. The key variables for purposes of our response are the fuel flow and load (power output). In the first 15 minutes shown on the graph, the turbine is "rolled" using an electric motor and the fuel flow does not start until minute 15.5. The actual fuel-fired portion of startup (for GE) is 21 minutes in duration (from minute 15.5 to minute 36.5). Fuel flow is very low for the first 7 minutes of firing, and then steadily increases to the normal 100% load value. Power starts to be delivered to the grid approximately 9.5 minutes after fuel firing commences (minute 25 in the chart). Maximum output and efficiency is reached 21 minutes after fuel firing commences. This all assumes a normal start without equipment issues. GE also supplied a total fuel flow value of 265 MMBtu/event for a typical start at 59 deg F. Siemens' startup time (fuel firing portion) has been specified at 22 minutes, with a total amount of fuel consumed at 440.5 MMBtu/event.

4. In the permit application, Indeck states that the total potential to emit includes an 8.5% increase over ISO-corrected conditions. Please provide a detailed breakdown of the added emissions, and an explanation, including any supporting documentation, to justify why a performance degradation of 8.5% is anticipated for the particular equipment proposed in this application.

Response: The 8.5% value includes a number of factors, one of which is degradation. The allowance for equipment degradation over time is 2.5%. As the equipment ages, some degradation (loss of performance) is unavoidable. As noted in our application in Section 5.2.5, EPA

(Region 1) has noted a decrease in efficiency of 2.5% over time is reasonable, even for a well-operated turbine.[1]

The 8.5% factor also includes a 2% allowance for compliance margin, in that the equipment may simply underperform compared to the vendor specified values. Inclusion of a compliance margin of several percent is very common for equipment guarantees or absolute permit limits for the power generation industry. It is very important for financing purposes to have a reasonable expectation of compliance even if the actual project equipment is subject to a small performance variation.

In addition, we have allowed 2.5% for some operation that may occur at varying loads and temperatures other than at 70 deg F/full load as used in the calculation spreadsheets. At 110 degrees and 70% load, the GE turbine heat rate is 14% higher than at 70 deg F and full load. For these same conditions, the Siemens turbine has a 10% higher heat rate. Certainly, these type of operating conditions (110 deg F and 70% load) will not occur all the time, but some allowance for varying ambient conditions and electric demand is reasonable. Therefore, a 2.5% allowance is made for varying ambient and operating conditions.

We have also allowed a 1.5% allowance for inclusion of startup and shutdown emissions. This is based on the annual startup/shutdown emissions shown in the spreadsheet. Note that the GE startup emissions correspond to approximately the 1.5% value, while the Siemens startup emissions are actually slightly higher than this.

Therefore, the total allowance of 8.5% includes 2.5% (output degradation over time), 2% (compliance margin), 2.5% (varying ambient and electrical demand), and 1.5% (startup/shutdown).

We noted in our application in Section 5.2.5, that EPA Region 1 found an 8.5% overall compliance margin between short-term full load and longer-term performance is reasonable. Therefore, we believe the use of 8.5% is also reasonable for the Indeck Wharton project.

[1] "Combined-cycle gas & steam turbine power plants" by Rolf Kehlhofer, Bert Rukes, Frank Hannemann, Franz Stirnimann, page 242.

5. In the regulatory applicability section of the permit application, Indeck notes that the simple cycle combustion turbines are exempt from regulation under the proposed 40 CFR Part 60 Subpart TTTT. Since EPA vacated the reference proposed regulation and proposed a new Subpart TTTT on January 8, 2014, please revise this section of the application to reflect the applicability of this subpart to the equipment proposed in the application.

   Response: We have reviewed the revised Subpart TTTT as proposed on January 8, 2014. Under this proposal, simple cycle turbines would no longer be categorically exempt from Subpart TTTT. However, a new combustion turbine will not be subject to the rule if it is not able to supply one-third or more of its potential electric output to the grid (66.5509(a)(2)). Potential electric output is based on 8760 hours per of operation (60.5580). Since the Indeck Wharton project will be limited to 2500 hours per year of normal operation (non-startup/shutdown), and 2500/8760 is only 28.5%, the Indeck Wharton project will not be capable of supplying one-third or more of its net electric output to the grid. Indeck Wharton will accept a permit restriction that ensures that the facility does not meet the applicability definition of Subpart TTTT as proposed. We note in the preamble to the rule, EPA states that (highlighted added):

   > The EPA also proposes to maintain the definition of EGUs under the NSPS that differentiates between EGUs (sources used primarily for generating electricity for sale to the grid) and non-EGUs (turbines primarily used to generate steam and/or electricity for on-site use). That definition defines EGUs as units that sell more than one-third of their potential electric output to the grid. Under this definition, most simple cycle "peaking" stationary combustion turbines, which typically sell significantly less than one-third of their potential electric output to the grid, would not be affected by today's proposal.`

Manufacturer's Data

6. Please provide any simulation run data that has been provided by the turbine manufacturers that was used to support the emissions and/or BACT level calculations. For your reference, an example is provided below.

   Manufacturer's data is attached. This is also provided in the TCEQ application materials that have been forwarded.

BACT

7. Based on comments EPA has received on the La Paloma permit (see link to all EPA Region 6 permit actions), it will be difficult to support multiple BACT levels (or "options") in a permit. EPA

encourages Indeck to please advise us as soon as a manufacturer has been selected so that we may set only one BACT limit for the site's combustion turbines.

It is Indeck's belief that the BACT selection for the project is identified as "F" class gas turbines firing solely on natural gas. The differences between the proposed GE and Siemens models are minor, and reflect to some degree manufacturer's operating margins. This determination is consistent with that reached in the La Paloma case, where EPA ruled that the BACT determination was consistent across the range of proposed machines, discussed as follows:

> EPA has determined that BACT for this facility is combined cycle technology with efficient turbine design, and does not agree that each gas turbine model is a different control technique that must be compared against other models, with one model necessarily being chosen over the others. Because the project is defined by the permit applicant as having a production capacity range of 637-753 megawatts (MW) of gross electrical power, EPA has established alternative sets of BACT limits for combined cycle technology that will apply based on the capacity of the turbine selected by the applicant from among efficient turbine models that have comparable control efficiencies.

As at La Paloma, Indeck is exploring multiple options and will reach a final determination upon receiving air permit approval and closing of financing. Finally, Indeck does not believe the two turbine option rules out a single BACT limit, if a single BACT limit is necessary. Further discussions could yield such an outcome.

8. As we discussed, please add the following information to your BACT analysis:
   a. Discussion of why combined cycle combustion turbines are not applicable to this site. Based on Sierra Club comments on the El Paso permit (see link), with a peaking power facility of 650 MW of power generation, EPA reasonably anticipates that we will receive comment on the choice of simple cycle turbines vs. combined cycle.

Both submitted TCEQ and EPA permit applications have discussed the issue of combined cycle combustion turbines (CCCT) relative to the Indeck Wharton project. As discussed in both, CCCT technology does offer efficiency advantages, as heat rates are now approaching 7000 btu/KWh, compared to 9000+ for simple cycle, both values in general terms (neither site specific nor cycle specific). This lower heat rate will yield a lower emission rate of CO2 for the same output. However, the Wharton project is a power project specifically targeted for peaking power. It has very limited annual hours. Therefore, a change to CCCT design would potentially increase annual CO2 emissions by a factor of

2.5, as operating hours would increase from a permitted 2500 hours for the simple cycle project to 8760 hours for a CCCT design.

Also, the low capital cost for a simple cycle project can accommodate the intended utilization of limited, flexible, and on-demand operations. The capital cost for a CCCT project is roughly twice the cost of a simple cycle project. Project economics at that level of capital cost cannot withstand the limited operating hours associated with a peaker.

A CCCT design is just not feasible for the Indeck Wharton project. Its utilization would totally re-define the project from its intended peaking scenario into an intermediate or baseload operation, which would result in substantially greater CO2 annual emissions as stated above.

b. Discussion of other available simple cycle turbines that are more efficient in design (from an emissions perspective)

It is assumed that this inquiry is primarily directed toward aeroderivative machines. It is an accepted fact that aeroderivatives have better heat rates than frame machines. For instance, the following comparison is provided using data from the 2013 GTW Handbook (ISO conditions).

GT	Gross Base Load	Heat Rate
LM6000	50.5 MW	8458 btu/kWh
7F 5-series	215.7 MW	8830 btu/KWh

The values above reflect ISO conditions and are not site specific. As seen, the aeroderivative has a heat rate advantage of approximately 4 percent. It is also a greater emitter of criteria pollutants, with higher NOx and CO emissions likely over the frame machines. For the Indeck Wharton project, aeroderivatives were discussed in both the TCEQ and EPA air permit application documents. For the Indeck Wharton project, Indeck ruled out these machines on the basis of size, economics and environmental aspects. The size disadvantage would require 10+ units to supply the same output as three “7FA” class turbines. The higher NOx emissions would likely require add-on control in the form of ammonia injection. This would introduce ammonia transport, storage and use into the rural landscape of the Indeck Wharton project site. Finally, the aeroderivative option would basically re-define the whole project. As such, Indeck ruled out aeroderviatives for the proposed 650 MW peaking proposal.

c. Discussion of how Indeck will meet BACT limits at all times, including during startup and shutdown.

It is our assumption that BACT limits will include a TPY CO2e (tons per year CO2) and a lb CO2/MWh (lbs per hour CO2). We are assuming the annual value will be a 365 day rolling average. We have proposed the lbs/MWh limit to be a 30-day rolling average, though subsequent looks into recent projects have also shown 365-day averages to be a reasonable option. In each case, we will be using a continuous emissions monitoring system (CEMS) to track this data. The TPY value will be based on the assumed 2500 annual operating hour limitation. Indeck will limit its operations of the turbines to stay below that annual limit, which will include startup/shutdown cycles. The lbs/MWh limit will require further discussion after the draft permit condition is written. It is assumed that the limit to be assigned will be achievable given the various operating loads and across the various operating scenarios. The agreed to limitation, for instance a specified lbs CO2/ MWh, will have to take into account the effects of temperature and load. For instance, turbine efficiency increases with load and decreases with temperature. A single specific limitation will have to take these variations into account. The application has proposed such a single limit (see Page 5-10)

Documents

9. Please provide a copy of the application submitted to TCEQ for the NOx and CO NSR permit.

Documents and materials submitted to TCEQ have been supplied via an internet link.

Maintenance

10. Please discuss whether Indeck will have need to conduct maintenance purges of the natural gas pipeline, and if so, include those emissions in the total PTE for the site.

Indeck does foresee maintenance purges of the gas line as a likely procedure. It is not normally performed on a set schedule. In general, our similar facilities have seen this conducted in a once every two to three year timeframe. At one site, purges are done to clear lines and gas filters from debris. Emission estimates have been revised to account for this added source. We calculate an added methane emission of 125 lbs methane per year attributable to this activity.

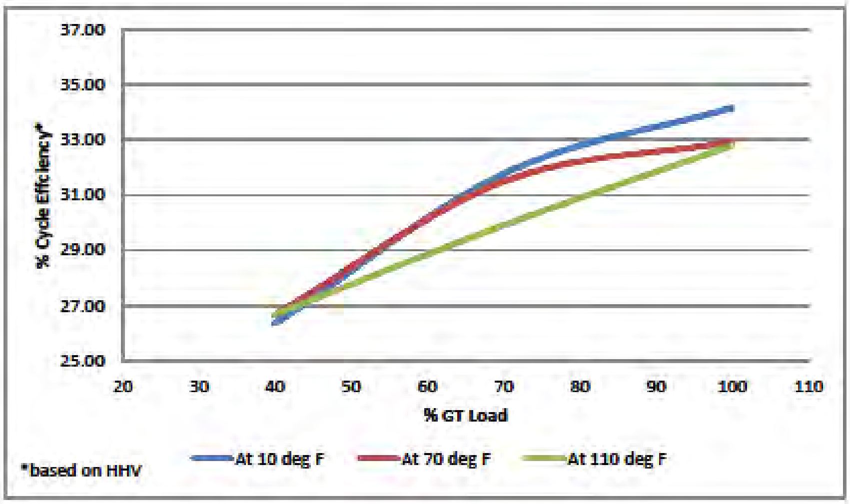
Efficiency Graphs

Indeck has prepared efficiency graphs versus load for both the GE and Siemens units. They are provided as follows:

Siemens SGT6-5000F(5)

Estimated Performance Curves

Cycle Efficiency versus %Load at various temperatures



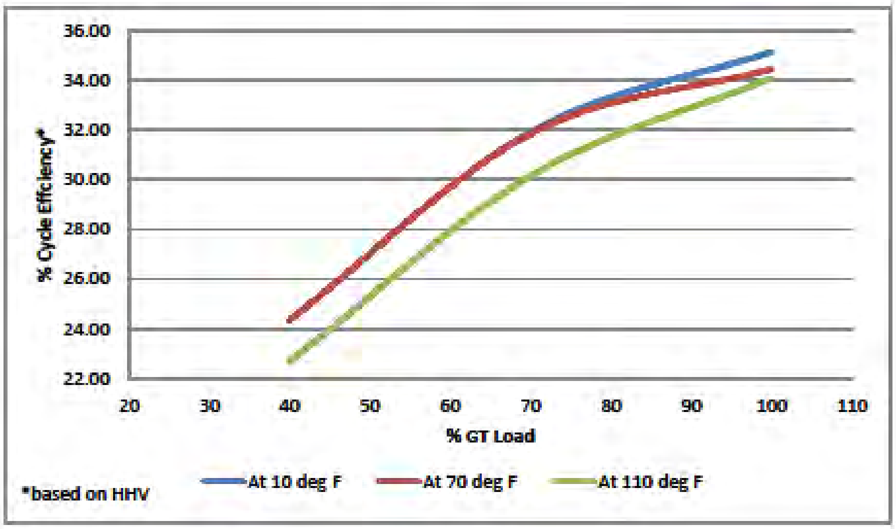
From Siemens datasheets

Temperature	X axis	Y Axis
	Load	Efficiency
10	100	34.16
10	70	31.76
10	40	26.33
70	100	32.93
70	70	31.49
70	40	26.66
110	100	32.79
110	70	29.91
110	40	26.68

GE 7FA

Estimated Performance Curves

Cycle Efficiency versus %Load at various temperatures



From GE datasheets

Temperature	X axis	Y Axis
	Load	Efficiency
10	100	35.14
10	70	31.91
10	40	24.35
70	100	34.44
70	70	31.85
70	40	24.35
110	100	34.09
110	70	30.15
110	40	22.70