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To:	Wilson, Aimee
Cc:	Robinson, Jeffrey; Kovacs, Jeffrey K
Subject:	PSD-TX-102982_GHG_Clarifying Information
Date:	Friday, September 06, 2013 9:47:30 AM
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Aimee,

We are providing clarifying information (attached) with regard to certain items, information, assertions, etc. in the Sierra Club comment letter on draft permit PSD-TX-102982-GHG for the Baytown Olefins Plant. If you have any questions, please contact me at (281) 834-6110.

Thank you,

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We are providing clarifying information with regard to certain items, information, assertions, etc. in the Sierra Club comment letter (SC Letter)[1]. The bullets below are not a complete analysis or response to the SC Letter and therefore may be supplemented by ExxonMobil in the future. Failure to address any items, information, assertions, etc. in the SC Letter is not to be considered tactic endorsement or agreement. We would be glad to discuss or answer any questions that EPA may have in future communications.

The following bullets reiterate the application basis for the proposed Baytown Olefins Plant (BOP) (draft permit PSD-TX-102982-GHG ("Draft BOP Permit")) and correct calculations made in the SC Letter:

- In "*A. The Permit Should Include an Emission Rate Based on the Production of Ethylene at the Facility*" on page 2 of the SC Letter, Sierra Club did not use the correct draft permit information to calculate the "production efficiency" cited in their comments. The SC Letter states, "*The production efficiency of the Baytown Plant is therefore 1,479,665 tons CO_2e emitted annually per 1,650,000 tons of ethylene produced. This equates to 0.90 tons of CO_2e per ton of ethylene, which is less efficient than the 0.85 rate at the INEOS plant.*" The draft permit correctly states in the Process Description, "*The new ethylene unit will increase the production capacity of the plant by approximately 2 million metric tons per year of polymer grade ethylene. Other products produced by the Baytown Olefins Plant include fuel gas, mixed C3 and C4 hydrocarbon streams, and other lower hydrocarbon streams.*" Using only the ethylene production capacity of 2 MT/y (which converts to 2,204,623 tons / year), the calculated value of the "production efficiency" is approximately 0.67 tons of CO_2e per ton of ethylene. Please note that this value does not account for the "*Other products produced by the Baytown Olefins Plant include fuel gas, mixed C3 and C4 hydrocarbon streams, and other lower hydrocarbon streams*" noted in the draft permit which would result in an even lower value on a per ton of total output basis.

  Although the corrected tons of CO_2e per ton of ethylene for the proposed project is less than that cited for Ineos, please note that:

  (1) This response is not an indication of support for a "production efficiency" in tons of CO_2e per ton of ethylene. On the contrary, achieving a high thermal efficiency by establishing and monitoring energy efficiency surrogates such stack exhaust gas exit temperatures and excess oxygen present in the exhaust gas already exist in the Draft BOP Permit.

[1] Letter correspondence, RE: ExxonMobil Baytown Olefins Plant –Permit No. PSD-TX-102982-GHG, from Mr. Travis Ritchie, Sierra Club, to Ms. Aimee Wilson, US EPA Region 6, on July 8, 2013.

(2) A comparison of the proposed BOP project to the Ineos project is inappropriate because:

(a) the difference in project scope – the proposed BOP project is a grass root facility, including furnaces, flares, engines, etc., and the Ineos project is a one furnace expansion of an existing furnace block. A single furnace being placed into operation with several existing furnaces that do not operate under imposed efficiency targets may be able to commit to and operate reliably and economy at lower stack exhaust gas temperatures because of the operational flexibility provided by the unconstrained furnaces.

(c) the difference in furnace feed – the proposed BOP project includes ethane feed, and the Ineos project includes ethane, naphtha, raffinate, and debutanizer natural gasoline feed.

- In "*B. The Draft Permit Does not Require the Most Efficient Processes*" on pages 3 through 5 of the SC Letter, Sierra Club states, "*Vendor literature for cracking furnaces indicates that innovations over the last twenty years have reduced CO_2 emissions by 30 percent using furnaces that achieve greater than 95 percent thermal efficiency.*" The cited vendor literature is marketing/sales brochure not sufficient as vendor guarantee, technical design document, or industry benchmark. On page 16 of the document, Technip states, "*This document… is not intended to be a binding contractual document. Any information contained herein shall not result in any binding obligation on the part of Technip, any of its affiliates, and is provided for informational purposes only.*"[2]

- In "*B. The Draft Permit Does not Require the Most Efficient Processes*" on page 4 of the SC Letter, Sierra Club states, "*A common measure of energy consumption for ethane cracking is the specific energy consumption (SEC) per ton of ethylene produced. Modern plant values for SEC are 14 GJ/tonne of ethylene for ethane cracking (13 MMBtu/ton, HHV). The SEC for the Baytown Plant is not reported in the record for this case. However, the data provided allow for an estimate by backing into the calculation. The draft permit allows eight cracking furnaces, each with a maximum design heat input of 515 MMBtu/hr and duct burners with a combined maximum design heat input of 773 MMBtu/hr (HHV). (Draft Permit at p. 2) Thus, the total annual heat input to produce 1.65 million tons of ethylene from ethane is 42,862,680 MMBtu/yr. The corresponding SEC rate is therefore 26 MMBtu/ton. This rate is much higher than the 13 MMBtu/ton SEC that modern plants can achieve.*"

  The Sierra Club inappropriately uses environmental air permit application data to estimate a highly complex measure of actual energy consumption. That fact notwithstanding, the Sierra

[2] *Ethylene Production*, Technip – Group Communications – October 2012.

Club used incorrect air permit application data in their calculations. The Draft BOP Permit correctly states in the Process Description, "*The new ethylene unit will increase the production capacity of the plant by approximately 2 million metric tons per year of polymer grade ethylene. Other products produced by the Baytown Olefins Plant include fuel gas, mixed C3 and C4 hydrocarbon streams, and other lower hydrocarbon streams.*"[3] In addition, the annual heat input from the steam cracking furnaces and the Train 5 duct burner used to estimate the emissions of CO_2e is 37,887,000 MMBtu/yr.[4] Using only the ethylene production capacity of 2 MT/y (which converts to 2,204,623 tons / year) and the correct annual heat input value, the corrected SEC (based on environmental air permit application data) is 17.19 MMBtu/ton, which is much lower than the value calculated by Sierra Club.

In addition, the document cited by Sierra Club states, "*In order to be able to compare different processes and feedstocks (with different yields for the various products) another allocation has to be used. In order to exclude effects from changing product yields, energy consumption should be allocated over all products formed in a particular process (on a mass basis).*"[5] As pointed out in the Draft BOP Permit Process Description, "*Other products produced by the Baytown Olefins Plant include fuel gas, mixed C3 and C4 hydrocarbon streams, and other lower hydrocarbon streams.*"[6] The 17.19 MMBtu/ton calculated above does not account for the other products that will be produced in the proposed BOP plant.

Furthermore, the value of 13 MMBtu/ton cited by Sierra Club is a "best estimate"[7] of the SEC for North American steam crackers based on an average product mix. In summary, it does not represent an actual SEC of an operating plant for which the configuration, feedstock input, product mix, etc. can be compared to the proposed project to ensure an appropriate comparison.

Because of the detailed design and/or operational data necessary to (1) calculate a SEC and then (2) compare facilities/projects on an SEC basis, the SEC cannot be accurately calculated from air permit application data and is not an appropriate energy efficiency parameter for benchmarking GHG BACT.

- In "*B. The Draft Permit Does not Require the Most Efficient Processes*" on pages 3 through 5 of the SC Letter, Sierra Club states, "*The revised BACT analysis should also fully explore other widely recommended efficiency measures disclosed elsewhere that are not even mentioned*

[3] http://www.epa.gov/earth1r6/6pd/air/pd-r/ghg/exxonmobil-baytown-olefins-draftpermit.pdf
[4] http://www.epa.gov/earth1r6/6pd/air/pd-r/ghg/exxonmobil-olefins-response.pdf
[5] http://www.energystar.gov/ia/business/industry/industrial_LBNL-44314.pdf
[6] http://www.epa.gov/earth1r6/6pd/air/pd-r/ghg/exxonmobil-baytown-olefins-draftpermit.pdf
[7] http://www.energystar.gov/ia/business/industry/industrial_LBNL-44314.pdf

in the record for this case."[8] The SC Letter specifically references the "Energy Efficiency Improvement and Cost Saving Opportunities for the Petrochemical Industry".[9] The relevant efficient measures in the referenced document are incorporated into the project as cited in the application record below.

- ***Heat generation*** *– specifically control of air-to-fuel ratios using oxygen analyzers on the exhaust gas streams and use of Low NOx burner technology.*
  The draft permit requires oxygen analyzers to maintain appropriate air-to-fuel ratios. Also, as discussed in an October 2012 application supplement submitted to EPA ("October 2012 Letter"), the ExxonMobil proprietary burner technology uses air staging and integral flue gas recirculation to minimize NOx emissions without compromising the burner stability and performance. Typical staged fuel low-NOx burners use small diameter fuel gas injection holes that are prone to plugging. The staged air burners are intrinsically safer and more robust than typical staged fuel low-NOx burners.

- ***Heat transfer and heat containment in heaters*** *– burning off carbon and reducing heat loss through opening and casings.*
  The draft permit requires decoking of the furnace tubes. Also, as discussed in the October 2012 Letter, the design specification will include details such as the use of seal bags at each furnace penetration to limit air ingress over the life of the furnace. It will also specify the insulation to minimize casing heat losses.

- ***Flue gas heat recovery*** *– recovery flue gas heat for air preheat, steam generation, incineration, etc.*
  As discussed in the May 2012 Application and October 2012 Letter, the design specifications will include use of economizers, steam generation from process waste heat, and/or feed preheat.

- ***Other – controls, maintenance and electric heaters***
  As discussed in the May 2012 Application and October 2012 Letter, the proposed BOP plant will include robust process controls. Elimination of electric heaters does not apply to the proposed steam cracking furnaces.

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[8] See, e.g., Maarten Neelis, Ernst Worrell, and Eric Masanet, Energy Efficiency Improvement and Cost Saving Opportunities for the Petrochemical Industry, June 2008, Lawrence Berkeley National Lab Report LBNL-964E. Available at: http://www.energystar.gov/ia/business/industry/Petrochemical_Industry.pdf?28f1-c5cb

[9] Maarten Neelis, Ernst Worrell, and Eric Masanet, Energy Efficiency Improvement and Cost Saving Opportunities for the Petrochemical Industry, June 2008, Lawrence Berkeley National Lab Report LBNL-964E. Available at: http://www.energystar.gov/ia/business/industry/Petrochemical_Industry.pdf?28f1-c5cb

- In "*C. The Cost Analysis for Carbon Capture and Sequestration is Invalid, 3. ExxonMobil's Cost Analysis Is Faulty, d) Averaging the Cost Estimates of Separate CO_2 Streams is Misleading*" on pages 12 through 13 of the SC Letter, Sierra Club states, "*…the utility plant would most likely be simple cycle or combined cycle natural gas fired turbine. This stream would have a lower concentration of CO2 (4 vol%) than the cracking furnaces (8 - 12 vol%). From both a cost and design perspective, ExxonMobil should not combine these two streams and instead should analyze each process separately*." However, we believe that the economies of scale indicate that separate CCS systems would not be more cost effective. Furthermore, the cost analysis for CCS for the proposed project assumed the furnaces and boilers would both fire blended fuel gas (i.e., a blend of natural gas and tail gas). Therefore, the cost analysis was based on the same CO_2 concentration (approximately 4.7%) in the exhaust stream of the furnaces and the utility boiler. The use of the same CO_2 concentration in the exhaust stream of furnaces and the utility boiler is indicated on page 22 of the October 2012 Letter[10] on a mass basis.

  As such, the cost analysis for CCS did not overstate the operating cost of CCS by lumping together cost of CCS for the cracking furnace with the cost of CCS from the additional utility plant.

- In "*G. Operating Conditions, 2. Stack Temperatures*" on page 18 of the SC Letter, Sierra Club states, "*Responses 6.A and 6.B (pages 16-17) and 11 (pages 28-29) assert that the Baytown Plant will operate with an exhaust stack temperature at or below 325 F during on-line operation to assure efficient operation. They also quote a range of 309 to 340 F for other similar projects. The draft permit Conditions II 7 and III.A.1.j limit the furnace gas exhaust temperature to <340 F, for the same reasons asserted by ExxonMobil. However, 340 F is the upper end of the range for other furnaces, which does not satisfy BACT. The permit should at a minimum adopt ExxonMobil's assertion that the Baytown Plant will maintain efficiency based on 325 F. Further, EPA should consider whether a lower temperature, as low at 309 F, would result in greater efficiency and thereby constitute BACT.*"

  The type of feedstock into a steam cracking furnace has an effect on stack exhaust gas temperature. Liquid feed (e.g, naphtha) cracking furnaces are able to achieve lower exhaust gas temperatures since liquid enters the furnace at close to ambient temperatures, whereas, gas (e.g., ethane) is conditioned (e.g., heated to 30 – 40 ºF above saturation) before it enters a steam cracking furnace. Therefore, it is inappropriate to compare the stack exhaust gas temperature for gas crackers (such as those proposed by the ExxonMobil and Chevron Phillips GHG applications) to gas/liquid crackers proposed by the other Region 6 applicants.

  The maximum exhaust gas temperature of 340 ºF ensures energy efficient operation of the proposed steam cracking furnaces. The difference in thermal efficiency between a gas

[10] http://www.epa.gov/earth1r6/6pd/air/pd-r/ghg/exxonmobil-olefins-response.pdf

exhaust temperature of 325 ºF and 340 ºF is about 0.5% absolute, which is less than the calculation uncertainty and typical assumptions on heat loss through the furnace casing (assume ~2% of the firing rate). ExxonMobil increased the proposed maximum allowable exhaust gas temperature from 325 ºF to 340 ºF to allow for a longer operating time between shutdowns over the life of the project.

As stated in the Draft BOP Permit Statement of Basis, the thermal efficiency of the furnaces is 92% based on a 2% casing heat loss and the 340 maximum stack temperature. Increased shutdowns (as much as double) over the life of the equipment to achieve an arbitrarily low temperature target will reduce the overall efficiency of the furnaces over the life of the unit which will directionally increase CO_2 as well as other criteria pollutants. Increased shutdowns may result in the following process operation requirements that will drive down long-term energy efficiency and increase overall emissions:

- Inefficient modes of operation – Start-ups after a shutdown are energy intensive with minimal or no output of ethylene, tail gas, steam, etc. making them very inefficient modes of operation.
- Reduced efficiency of the furnaces – Steam cracking furnaces are designed for efficient operation with minimal shutdowns. Each time a convection section is washed it does not allow for the recovery of 100% of the heat losses, due to fouling and tube fin oxidation/corrosion. In addition, each convection section washing introduces opportunity for damaging the refectory, thus increasing casing loss and directionally increasing GHG emissions.
- Increased NOx emissions – Each time a furnace is cycled through shutdown and start-up there are discrete periods when the NO_x control technology (i.e., SCR) cannot operate properly because of low stack gas temperatures. During these periods, NOx emissions may be as high as 6 times normal operating emissions on a pound per million British thermal unit basis.
- Increased Decoking emissions – After each time a furnace is cycled through shutdown and start-up, coking rates trend higher for a period of time due deterioration/damage of the chromium oxide layer in the radiant tubes. It can take up to 6 months for the chromium oxide layer to fully reform. During this period, more frequent decoking is required to maintain efficient operation releasing additional emissions of PM, PM_{10}, $PM_{2.5}$, CO, and CO_2e.

The maximum exhaust gas temperature of 340 ºF is 10 ºF lower than the maximum exhaust gas temperature of 350ºF established in Chevron Phillips' GHG permit.

- In "*G. Operating Conditions, 4. Work Practice Standards and Operating Limits*" on pages 18 of the SC Letter, Sierra Club states, "*ExxonMobil's October 16, 2012 responses include as Attachment 4, Table 3-2 a list of proposed "Work Practice Standards and Operating Limits." The Region should verify that, at a minimum, all of the proposed work practice standards and operational limits are included in the draft permit.*" The following table provides a summary of how the Table 3-2 items have been addressed.

Emission Point		**Emission Unit Work Practice Standard, Operational Requirement, or Monitoring**	**Reference**
EPN	**Name**		
XXAF01-ST through XXHF01-ST	XXA through XXHF Furnace Combustion Vent	Consume pipeline quality natural gas, or a fuel with a lower carbon content, as fuel to the furnace section	S.C. III(A)(1)(a)
		Maintain the furnace exhaust stack temperature ≤ 325 °F during online operation (furnace producing ethylene) on a 365-day rolling average basis	Table 1 and S.C. III(A)(1)(j), 340 deg. F on a 12-month rolling basis
		Maintain furnace exhaust stack CO ≤ 50 ppmv @ 3% O_2 during online operation on a 12-month rolling average basis	-- [1]
		Monitor fuel gas composition with a fuel gas analyzer daily with an analyzer that meets the requirements of 40 CFR 98.244(b)(4)	S.C. III(A)(1)(c)(iii)
		Calibrate and perform preventative maintenance checks of the continuous oxygen and carbon monoxide stack monitors per 40 CFR 60 Appendix B4 every quarter	S.C. III(A)(1)(d) and S.C. III(A)(1)(g) for O_2 monitors [1]
		Calibrate and perform preventative maintenance checks of the fuel gas flow meter per the requirements of 40 CFR 98.33(i) and quality assurance requirements of 40 CFR 98.33(i)(2) & (3)	S.C. III(A)(1)(c), annual
		Perform and maintain records of online burner inspections when indicated by CO levels >100 ppmv @ 3% oxygen for a one-hour average and during planned shutdowns	-- [1]
XXAB-DEC through XXGH-DEC	XXA/B through XXG/H Furnace Decoke Vent	Maintain furnace exhaust stack CO ≤ 50 ppmv @ 3% O_2 during online operation (furnace producing ethylene) on a 12-month rolling average basis	-- [1]
FLAREXX1 and FLAREXX2	Staged Flare System	Maintain a minimum heating value and maximum exit velocity that meets 40 CFR § 60.18 requirements for the routine streams routed to the elevated flare including the assist gas flow	S.C. III(A)(3)(a)
		Continuously monitor and maintain a minimum heating value of 1,000 Btu/scf of the waste gas (adjusted for hydrogen) routed to the multi-point ground flare system to ensure the intermittent stream is combustible; however, if a lower heating value limit can be demonstrated to achieve the same level of combustion efficiency, then this lower limit will be implemented	S.C. III(A)(3)(f), 800 btu/scf
		Continuously monitor the flow rate to the multi-point ground flare to demonstrate that flow routed to the multi-point ground flare system exceeds 4 psig; however, if a lower pressure can be demonstrated to achieve the same level of combustion efficiency, then this lower limit will be implemented	S.C. III(A)(3)(j)

		Continuously monitor the composition of the waste gas contained in the flare system header and record the heating value of the flare system header through an online analyzer located on the common flare header, sufficiently upstream of the diverting headers to the elevated flare and the multi-point flare, calibrated and maintained at least annually	S.C. III(A)(3)(i)
		Continuously monitor and record the flow to the elevated flare through a flow monitoring system	S.C. III(A)(3)(j)
		Continuously monitor the steam flow to the elevated flare through a flow monitoring system and record the steam to hydrocarbon ratio	S.C. III(A)(3)(j)
		Continuously monitor FLAREXX1 for flame presence	S.C. III(A)(3)(k)
		Continuously monitor the staged flare system pilots for presence of flame	S.C. III(A)(3)(k)
BOPXXFUG	Fugitives	Conduct daily as-observed AVO inspection for piping components in non-VOC natural gas service	S.C. III(A)(5)(b)
		Maintain 28 VHP with CNTQ LDAR program for piping components in VOC service	S.C. III(A)(5)(a) , 28VHP only
HRSG05	HRSG05 Duct Burners	Consume pipeline quality natural gas, or a fuel with a lower carbon content, as fuel to the duct burners	S.C. III(A)(2)(b)
		Maintain a minimum thermal efficiency ≥ 70% on a 12-month rolling average	S.C. III(A)(2)(a)
		Maintain exhaust stack CO concentration ≤ 7.4 ppmvd @ 15% O2 on a 12-month rolling average	-- [2]
		Perform and maintain records of online burner inspections when indicated by CO levels >100 ppmv @ 15% oxygen for a one-hour average and during planned shutdowns	-- [2]
		Monitor fuel gas composition with a fuel gas analyzer daily with an analyzer that meets the requirements of 40 CFR 98.244(b)(4)	S.C. III(A)(2)(i) [3]
		Calibrate and perform preventative maintenance checks of the continuous carbon monoxide stack monitors per 40 CFR 60 Appendix B4 every quarter.	-- [2]
		Calibrate and perform preventative maintenance checks of the fuel gas flow meter per the requirements of 40 CFR 98.33(i) and quality assurance requirements of 40 CFR 98.33(i)(2) & (3)	S.C. III(A)(2)(c), annually
		Calculate and record the thermal efficiency of HRSG05 monthly	S.C. III(A)(2)(g) , 12-month rolling basis
DIESELXX01 – 05	Backup Generator Engines	Maintain intermittent and infrequent use or less than 120 hours of operation for testing and maintenance annually	S.C. III(A)(4)(d)
DIESELXXFW1 and DIESELFW2	Firewater Booster Pump Engines	Maintain intermittent and infrequent use of less than 120 hours of operation for testing and maintenance annually	S.C. III(A)(4)(d)

[1] Draft TCEQ Permit No. 102982 includes Special Condition No. 7c(3), limiting the furnaces to "50 parts per million by volume, dry (ppmvd) carbon monoxide (CO) corrected to 3 percent oxygen on a 12-month rolling average," for normal operations.
[2] Thermal efficiency limit directly incorporated in permit. CO limit deemed duplicative.
[3] Permit condition reference appropriate monitoring requirements.