From: Hurst, Benjamin M
To: Robinson, Jeffrey
Cc: Wilson, Aimee; Bigon, Judy M; Kovacs, Jeffrey K
Subject: RE: MBPP Vent Gas Recovery Follow-up
Date: Thursday, May 23, 2013 10:36:34 AM
Attachments: image001.png
image004.png

Jeff,

The power costs are included in the estimate of annual O&M expenses. When you consider the amount of indirect GHG emissions generated to achieve approximately 780 hp of compression capability needed to utilize the vent gas recovery system off-gas as a supplemental fuel for the boilers, the total cost per ton of CO_2e avoided increases to $287/ton. A revised table with a row including compression associated emissions is included below.

If you have any additional questions on this analysis, please feel free to contact me (281) 834-6110 or benjamin.m.hurst@exxonmobil.com.

Thank you,

Benjamin M. Hurst
Baytown Olefins Plant
Ph: (281) 834-6110
Email: benjamin.m.hurst@exxonmobil.com

Economic Analysis for Supplemental Fuel System

Item	Units[A]	Value	Comments
Vent Gas Recovery System Cost			
Capital Cost of Equipment	$ (millions)	7.0	Site-specific design.
Amortized Capital Cost	$ (millions)	1.4	See Footnote B.
Operating and Maintenance Expenses	$ (millions)	0.38	Site-specific design. See Footnote C.
Total Annual VGR Cost	**$ (millions) / yr**	**1.7**	Amortized Capital Cost + O&M Expenses
Vent Gas Recovered			
Total Vent Gas Recovered	MMscf/yr	308.0	See Footnote C.
	MMBtu/yr	196,812	Higher heating value of 661 Btu/scf.
Economics of Avoided CO_2e			
Vent Recovery System Off-Gas Emissions Avoided at FTO	tons CO_2e / yr	12,883	Oxidation emissions from control of vent recovery system off-gas.
Vent Recovery System Off-gas Emissions Generated at Boilers	tons CO_2e / yr	12,883	Emissions from firing vent recovery system off-gas as fuel in the boilers.
Emissions from Natural Gas Avoided at Boilers	tons CO_2e / yr	9,161	Avoided emissions generated by firing natural gas at the boilers if the supplemental fuel system is employed.
Emissions Associated with Compression	tons CO_2e / yr	3,146	Indirect emissions from energy required for vent gas recovery system off-gas compression. See Footnote E.
Tons of CO_2e Avoided	**tons CO_2e / yr**	**6,079**	See Footnote D.
Cost per ton of CO_2e Avoided	**$ / ton CO_2e**	**287**	Total Annual VGR Cost / Tons of CO_2e Avoided

[A] All monetary estimations have been calculated in 2016 dollars.
[B] Capital charge rate = 19%.
Equipment life = 20 years.
[C] Accounts for credit from reduced natural gas consumption.
Accounts for complexity of variable composition, variable flow stream.
Recovery compressor service factor = 98%;
Boiler availability= 90%;
Steam Loss = 10%.
[D] Tons of CO_2e avoided = Vent Recovery System Off-Gas Emissions Avoided at FTO + Emissions from Natural Gas Avoided at Boilers - Vent Recovery System Off-Gas Emissions Generated at Boilers - Emissions Associated with Compression
= 12,883 tpy + 9,161 tpy - 12,883 tpy - 3,146 tpy = 6,079 tpy
[E] 720 hp * 0.7457 kW/hp * 6954 hr/yr * 0.00070555 tonnes CO2/kWh * 1.10231 tonnes/ton = 3,146 tons/yr
Per http://www.epa.gov/cleanenergy/energy-resources/refs.html

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From: Robinson, Jeffrey [mailto:Robinson.Jeffrey@epa.gov]
Sent: Wednesday, May 22, 2013 8:09 AM
To: Kovacs, Jeffrey K
Cc: Wilson, Aimee; Hurst, Benjamin M; Bigon, Judy M
Subject: RE: MBPP Vent Gas Recovery Follow-up

Do you have additional details handy on the power costs for the gas compression system that gets the potential cost up to $287/ton of CO2 avoided. I would like to be able to reflect this a little clearer in the analysis and I want to be able to talk this through with EPA HQ. I'm anticipating they may ask about the power cost details.

From: Kovacs, Jeffrey K [mailto:jeffrey.k.kovacs@exxonmobil.com]
Sent: Tuesday, May 21, 2013 5:59 PM
To: Robinson, Jeffrey
Cc: Wilson, Aimee; Hurst, Benjamin M; Bigon, Judy M
Subject: MBPP Vent Gas Recovery Follow-up

Jeff,

My team made me aware that vent gas recovery for the Mont Belvieu Plastics Plant draft permit has been identified by EPA HQ for more review. I realized there is value in clarifying that vent gas recovery technology is indeed a key component of the proposed expansion project.

Our previous technical write-ups may not have highlighted the recovery aspects of the proposed project. As such, the I instructed the project technical team to develop the supplemental technical write up below. It provides a better description how the proposed project will use improved technologies to collect and re-use most unreacted gases. The vent gas recovery system collects approximately 90 percent of the potential GHGs. The expanded technical discussion below also shows that control of the remaining GHG to be beyond BACT.

We look forward to working with your team to develop a draft permit and move forward with public notice for the Mont Belvieu Plastics Plant expansion.

Best Regards,

Jeff Kovacs, P.E., CSP
SSHE Manager, North American Growth Venture
ExxonMobil Chemical Company
office 281.834.6207, cell 281.409.6118

Vent Gas Recovery System

The proposed project incorporates state-of-the-art technology to recover unreacted gases from the polyethylene reactor system and minimize air emissions. The vent gas recovery system is inherent in the design and operation of the proposed polyethylene plant, and includes capital intensive investments such as recovery compressors, refrigeration systems, heat exchangers, pumps and vessels, to return unreacted hydrocarbon liquids back to the process. Specifically, vent gases are filtered by a compressor intake filter, cooled in a pre-cooler, compressed in the multi-stage recovery compressor with an inter-stage cooler, and then condensed using ethylene refrigeration in order to recover and return unreacted hydrocarbon liquids back to the process. In typical conventional polyethylene units, the unrecovered vent gases from the above system are then sent to a control device system for destruction. However, the proposed polyethylene unit includes additional recovery technologies such as a reactor vent column and two-staged membrane unit to achieve incremental increases in gas recovery. The reactor vent column is used to control nitrogen concentration of reactor content, with a small vent to the flare. The vent column scrubs vent gases through a packed column using recovered liquids to 'wash' and extract hydrocarbon present in the vent stream to the flare for routing back into the process. The two-stage membrane unit is a separation system to further enhance recovery of lighter molecules by separating a low pressure hydrocarbon rich stream from a high pressure nitrogen rich stream in the 1st membrane module. The hydrocarbon stream is recycled back into the process. The high pressure nitrogen rich stream goes to 2nd stage membrane module to purify the nitrogen for use in the process. Finally, after cycling through the vent gas recovery system, and two-staged membrane system, unrecovered vapor, as the low pressure permeate from the 2nd membrane module is sent to the control device system. In all, the technology that will be employed by the proposed project which collects and recycles hydrocarbon vapor and liquids will avoid the generation of approximately 810,000 tons CO_2e/yr.

For the proposed polyethylene unit, the molecules unable to be collected by the vent gas recovery system, vent column, and two-staged membrane system are routed to a vent collection system for destruction in a flameless thermal oxidizer (FTO) system, an elevated flare, and/or a multi-point ground flare (MPGF). As an alternative to sending unrecovered residual hydrocarbon lean gases from the vent gas recovery system to the control system, a system to deliver the vent gas recovery system off-gas to the boilers as supplement fuel was explored. Such a system would require an additional compression technology with a total capacity to process up to 1,800 pounds per hour of gas, which is equivalent to approximately 1,000 pounds per hour of natural gas. Although there are concerns with introducing any variable composition, variable flow streams into the boilers as fuel, this flow rate is assumed to be the amount of vent recovery system off-gas the boilers could reliably fire in place of natural gas. Since it is assumed that a supplemental fuel system is technically feasible, an economic analysis was performed to evaluate the feasibility of this disposition for the vent recovery system off-gas. The table below summarizes the economic analysis for a boiler supplemental fuel system, which is estimated to avoid approximately 6 to 9 ktons of CO2e per year. As shown in the table, vent gas recovery is estimated at a cost a minimum of $191 ton of CO2e avoided even when considering cost savings from a reduction in natural gas firing. Please note that compressor availability, boiler availability, and steam impacts from unsteady vent recovery system off-gas flow were accounted for in this cost analysis. In addition, if additional GHG emissions and/or costs associated with increases in gas compression power requirements are considered, then the cost could be as high as $287/ton of CO_2e avoided. The estimated cost is an excessive cost to mitigate GHG emissions and renders supplemental fuel system an economically infeasible control technology.

Economic Analysis for Supplemental Fuel System

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Emissions from Natural Gas Avoided at Boilers	tons CO_2e / yr	9,161	Avoided emissions generated by firing natural gas at the boilers if the supplemental fuel system is employed.
Tons of CO_2e Avoided	**tons CO2e / yr**	**9,161**	See Footnote D.
Cost per ton of CO_2e Avoided	**$ / ton CO_2e**	**191**	Total Annual VGR Cos / Tons of CO_2e Avoided

[A] All monetary estimations have been calculated in 2016 dollars.

[B] Capital charge rate = 19%.
Equipment life = 20 years.

[C] Accounts for credit from reduced natural gas consumption.
Accounts for complexity of variable composition, variable flow stream.
Recovery compressor service factor = 98%;
Boiler availability = 90%;
Steam Loss = 10%.

[D] Tons of CO_2e avoided = Vent Recovery System Off-Gas Emissions Avoided at FTO + Emissions from Natural Gas Avoided at Boilers - Vent Recovery System Off-Gas Emissions Generated at Boilers = 12,883 tpy + 9,161 tpy - 12,883 tpy = 9,161 tpy