March 10, 2014

Mr. Thomas H. Diggs
Associate Director
Air Programs Branch
U.S. EPA Region 6, 6PD
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

RE: EPA Application Completeness Determination and Request for Information
Greenhouse Gas PSD Permit Application
M&G Resins USA, LLC
Polyethylene Terephthalate and Terephathalic Acid Units
Corpus Christi, Nueces County, Texas

Dear Mr. Diggs:

This letter is in response to your letter dated February 5, 2014, requesting supplemental information related to M&G Resin USA, LLC's Greenhouse Gas (GHG) Prevention of Significant Deterioration (PSD) permit application for the Polyethylene Terephthalate (PET) and Terephathalic Acid (PTA) Units, together considered the PET Plant. The attachment to this letter provides the majority of the supplemental information you have requested. Please note that responses for two of the questions will be provided at a later date. M&G Resins is still gathering information for those responses. Notably, the complete process flow diagrams (PFD) will be provided in hardcopy submittal as Confidential Business Information (CBI) in response to the numerous requests for additional PFD detail. The updated discussion and BACT analysis of Carbon Capture and Storage (CCS) for the project will also follow under separate cover.

The responses to your information request (enclosed) have been separated in a table of questions extracted from your letter and addressed individually (Attachment A). It should be noted that a number of questions were related to process design and operation of systems that have no direct GHG emissions. In response to these questions we have confirmed that they are not GHG sources subject to the controls under this GHG PSD permit.

Also, M&G Resins submitted the Biological Assessment and Cultural Resources Reports in June 2013 and is actively working with EPA staff to finalize the submittals.

Should you have any questions regarding this application, please contact me at tsullivan@zephyrenv.com, or 512-879-6632, or Ms. Allana Whitney of Chemtex International, Inc. at Allana.Whitney@chemtex.com or 910-509-4451.

Regards,

Thomas I. Sullivan, P.E.

Attachment A: Matrix of Questions
Attachment B: Facility Benchmark Data and Presentation
Attachment C: Updated CTX Calculations

cc: Ms. Allana Whitney, Chemtex International, Inc.
Mr. Mauro Fenoglio, M&G Resins USA, LLC
Ms. Martha Martinez, M&G Resins USA, LLC

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ATTACHMENT A

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Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
1	2.B	Hot vapor exiting the water removal column is superheated in the offgas preheater and then routed to the expander for energy recovery. Following the expander, the decompressed vapor is partially condensed in a WRC condenser. The discharge from the WRC condenser passes to the WRC reflux tank. The separated, uncondensed offgas stream is routed to the RTO preheater. What media is being used in the preheaters to preheat these streams?	The RTO preheater uses steam as the heating media.
2	2.B	What media is being used in the scrubber to convert the residual bromine containing species	The bromine scrubber utilizes water with caustic and bisulfite as the scrubbing media and has no contribution to or reduction in the GHG emissions of the RTOs
3	2.B	Show the inlet and outlet streams to the waste scrubber with labeling. What is the material converted to?	The bromine scrubber utilizes water with caustic as the scrubbing media and has no contribution or reduction to the GHG emissions of the RTOs. Bromine is converted to bromine salts and bromates in caustic solution.
4	2.B	The application states that during normal operation the heat release of the offgas is sufficient for the RTO to operate auto-thermally, i.e. supplementary heat input is not required. Should the heat release from the offgas decrease, natural gas will be supplied to the RTOs to sustain proper firebox temperature. During what times of plant operation would M&G Resin (M&G) expect that natural gas will need to be supplied to the RTOs?	Natural gas would be required during startup and as needed to maintain a temperature set point during low production periods. Actual production thresholds for autothermal operation will change based on variability in the process emissions.
5	2.B	Is natural gas added to the RTOs automatically or manually?	Natural gas is added automatically to maintain a temperature set point.
6	2.B	What is the proposed compliance strategy for the operation of the RTOs?	Good production practices involve utilizing the minimum amount of natural gas in order to operate the RTO in compliance with its regulated role as a control device. For GHG emission compliance, the RTO will not exceed the natural gas combustion rates represented in the application.
7	2.B	For the operation of the RTOs, what will be monitored and recorded?	Temperature in the oxidation chamber, natural gas fuel usage, exhaust gas flow and oxygen level will be measured and recorded.
8	2.C	Is fuel or steam added to the acetic acid vaporizer?	Steam is used in the acetic acid vaporizer.
9	2.C	It is stated that the high pressure vaporized mixture of acetic acid and water fed to the WRC is used to increase the enthalpy input to the WRC, thereby increasing acetic acid/water fractionating capacity. Does this method of operation conserve energy usage or demand (fuel, steam, etc.) of the WRC that would otherwise be needed to accomplish the same result?	Acetic acid is used to increase slurry temperature inside the digester to complete oxidation from para-xylene to terephtalic acid. This is not an energy recovery system.

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
10	2.C	Excess underflow is cooled in a train of heat exchangers and steam generators for energy recovery. Is this a design strategy that is common to PET and PTA production or is it unique to M&G Resin?	This design is unique to the PTA process licensed for use by M&G.
11	2.C	Excess underflow is cooled in a train of heat exchangers and steam generators for energy recovery. Can this reduction of energy demand be quantified?	At full capacity production, the electricity demand of the PTA plant is expected to be met by the heat recovery steam generator production. This energy recovery is an integral part of the plant design and is reflected in the annual GHG emission calculations. This is accounted for in the natural gas combustion represented in the permit application.
12	2.D	The process flow diagram indicates at the beginning of the process a "catalyst and feed preparation" unit. Please update the process description to include a summary of this unit	The catalyst and feed preparation unit consists of a simple process vessel for mixing of the materials. There are no GHG emissions associated with this operation.
13	2.E.v	After crystallization, product slurry is flash-cooled and sent to the PTA filters which separate the PTA from the acetic acid/catalyst liquid. Where is this liquid-mix directed? Does it go to the wastewater treatment plant (WWTP)?	The liquid mixture is routed to filtrate tanks and recycled back into the process. This is not a potential GHG source.
14	2.E.vi	The wet PTA cake is sent to the respective PTA dryers, which are heated by steam. Is this steam produced from the energy recovery mentioned on page 17 when the underflow from the WRC is cooled?	The facility steam system includes multiple steam headers that operate at different pressures. The steam headers receive steam generated both by the utility plant boilers and process heat recovery operations. There are no direct GHG emissions from the steam system.
15	2.E.ix	The off-spec silo located in the PTA unit process area is used to store off-spec material for further re-processing. Where is off-spec material re-introduced in the process?	The off-specification PTA silo is located in the PET area; off-specification material is reintroduced to vacuum flash tank V-0600. There are no GHG emissions associated with this operation.
16	2.E.x	All the pneumatic transport systems of the PTA unit are operated using nitrogen in a closed loop. Please confirm if product conveyance is enclosed. Are the vents from this enclosed system directed to the flare, RTOs or scrubber system?	The closed loop system description refers to the use of nitrogen return lines that allow for the recycling of the nitrogen. The nitrogen has a cost and is not vented directly to atmosphere, except during maintenance. There are no GHG emissions associated with this operation.
17	2.E.x	Are the vents from this enclosed system directed to the flare, RTOs or scrubber system?	See answer number 16 above

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
18	2.E.x	If the product conveyance is not enclosed, is this a potential GHG emission source? Typically CO2 emissions are associated with combustion pollutants and CH4 is associated with VOC pollutants, therefore if M&G believes that such emission sources do not have the potential to experience a change in the amount of GHG pollutants emitted as a result of this project, please provide an explanation.	See answer number 16 above
19	2.F.iii	M&G proposes a numerical energy efficiency based BACT limit for maximum exhaust gas temperature of 320°F. The proposed BACT does not appear to include the thermal efficiency of the heaters. Please provide supplemental technical data that includes the thermal efficiency of the process gas heaters.	The preliminary vendor specified efficiency of the HTF heater is greater than 80%. The efficiency value is referred to the design air temperature and according to ASME Test Code PTC 4.1 Ed 88 (Abbreviated) and based on fuel lower heating value (LHV).
20	2.F.v	From the prepolymerization system onward, all equipment is maintained under vacuum conditions to promote reactions and to remove the reaction side products. The vacuum is maintained in each CP line through a system of glycol vapor ejectors with three inter-condensers and a liquid ring vacuum pump. Vapor streams from the liquid ring vacuum pump bubble into the esterifier seal pot. Please provide supplemental information that explains how make-up liquid is provided back into the vacuum liquid ring pump seal pots to ensure proper operation of the pump. What will be implemented to alert on-site personnel to problems?	This is an integral part of the PET process that M&G operates at several plants around the world. The plant will be operated to maximize online time. There are no GHG emissions associated with this operation.
21	2.F.v	Is there continuous monitoring of the system?	This is an integral part of the PET process that M&G operates at several plants around the world. The plant will be operated to maximize online time. There are no GHG emissions associated with this operation.
22	2.F.v	Are there low/high level alarms?	This is an integral part of the PET process that M&G operates at several plants around the world. The plant will be operated to maximize online time. There are no GHG emissions associated with this operation.
23	2.F.v	Is the ethylene glycol system a potential GHG source?	There are no GHG emissions associated with the ethylene glycol system operation.
24	2.F.v	Does the ethylene glycol system impact the potential GHG emissions from other equipment?	The ethylene glycol system does not impact the GHG emissions associated with other equipment.
25	2.F.v	Besides monitoring the liquid level of the ethylene glycol system, will there be continuous monitoring of other operating parameters (e.g., pressure) of the process equipment?	This is an integral part of the PET process that M&G operates at several plants around the world. The plant will be operated to maximize online time. There are no GHG emissions associated with this operation.

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
26	2.F.v	What is the proposed compliance strategy for ensuring that the vacuum system is properly functioning?	This is an integral part of the PET process that M&G operates at several plants around the world. The plant will be operated to maximize online time. This is not a GHG source and does not require a GHG compliance plan.
27	2.F.v	What operating parameters will be monitored to ensure the maintaining of a vacuum around the CP system and no venting to the atmosphere?	This is an integral part of the PET process that M&G operates at several plants around the world. The plant will be operated to maximize online time. There are no GHG emissions associated with this operation.
28	2.F.v	Will there be concerns for solid carry-over or plugging around the vapor ejectors or other vacuum equipment?	This is an integral part of the PET process that M&G operates at several plants around the world. The plant will be operated to maximize online time. There are no GHG emissions associated with this operation. Solids are separated before entering into the vapor ejectors. Vapor ejectors as operated by M&G are not normally affected by fouling by solids.
29	2.F.v	Please confirm the design type for the inter-condensers. (i.e., direct-contact, shell and tube, etc)	The inter-condensors are direct contact. This is an integral part of the PET process that M&G operates at several plants around the world. The plant will be operated to maximize online time. There are no GHG emissions associated with this operation.
30	2.F.viii	It is stated that during instances when off-spec material is produced, silos are used to store off-spec material. Also, the amorphous PET chips produced as feedstock for the SSP unit are stored in silos. Is this a potential GHG source? Please provide an explanation.	Off-specification PET will not emit CO2, CH4 or other GHGs. This is not a potential source of GHG emissions.
31	2.F.ix	The CP unit is designed to recover scraps coming from the PET production plant (both from CP and SSP) and further recycling in the process. Is this recycling process enclosed?	Off-specification PET will not emit CO2, CH4 or other GHGs. This is closed process and is not a potential source of GHG emissions.
32	2.F.ix	If not, are fugitive or dust suppressants necessary and is it utilized?	Off-specification PET will not emit CO2, CH4 or other GHGs. This is closed process and is not a potential source of GHG emissions.

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
33	2.F.x	Provide supplemental technical data that includes the design efficiency of the heat transfer fluid system.	The HTF fluid system is an integral part of the PET process that M&G operates at several plants around the world. The HTF heaters are designed to match the performance specifications for the HTF fluid system. The compliance of the HTF fluid systems is demonstrated by the performance of the HTF , as represented in the permit application. The plant will be operated to maximize online time. There are no separate GHG emissions associated with the HTF fluid systems.
34	2.F.x	What parameters will be monitored and recorded to ensure this system is operating as designed?	The HTF heaters performance demonstrates the operating performance of the HTF fluid systems. There are no separate GHG emissions associated with the HTF fluid systems.
35	2.F.x	What is the proposed compliance strategy for the heat recovery system?	See response to number 34.
36	2.F.x	The process gas for the crystallization system uses nitrogen. The fluidizing nitrogen leaving the fluid bed heater(s) passes through multi-cyclones and a filter. Then, the nitrogen is heated and sent back to the crystallizer in closed loop. How is heat transferred to the nitrogen?	Heat Transfer Fluid (HTF) is used as the source of heat.
37	2.F.x	What is used to heat the nitrogen?	HTF is used to heat the nitrogen, in a non-contact tube/fin heat exchanger.
38	2.F.xi	In the GTU, the gas is heated and sent to a catalytic bed reactor, where the oxidation of volatile organic compounds coming from the crystallization and SSP reaction units takes place. Where are the vents from the catalytic bed directed?	There is no vent stream. The gas continues to be recycled in the process. The catalytic bed reactor is used to convert organics in the recycled gas stream and eliminate potential build up of VOCs within the system. Any CO2 emissions are accounted for in the fugitive calculations.
39	2.F.xi	Is heat recovery from this vent stream possible?	The heat stays within the process as the gas steam is continuously recycled.

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
40	2.F.xi	Is the heat from this vent stream recouped by preheating the gas before it is fed to the catalytic bed reactor?	The heat stays within the process as the gas stream is continuously recycled.
41	2.F.xi	What is used to preheat the inert gas used in the molecular sieve drier?	The gas passed through the molecular sieve is not heated, on the contrary it is cooled down before being fed to the molecular sieve bed.
42	2.F.xi	After removal of by-products, the "clean gas" leaving the GTU is then heated up, and sent to the SSP unit. What is used to heat the "clean gas"?	The process stream passing through the GTU is used to preheat the gas, before it is fed to the GTU through a shell and tube heat exchanger. After heat recovery, the stream leaving the GTU unit is recycled.
43	2.F.xii	The SSP reaction section comprises a horizontal inclined rotating cylinder (SSP reactor) in which inert gas is flowing counter current with respect to the chips flow direction. How is this accomplished?	The chips flow through the inclined rotary cylinder by gravity and through rotation of the reactor. The SSP reactor system is very much like a cement kiln.
44	2.F.xii	Does the inert gas suspend the chips?	No, see answer to number 43 above.
45	2.F.xii	Are the chips on some type of conveyor system?	No, see answer to number 43 above.
46	2.F.xiii	After the SSP reactor, chips are cooled in a fluidized bed that is operated with air. Is it possible to recover heat from the air used to cool the chips?	No, the chips are at approximately 440 deg F at that point in the process and the process air temperature is approximately 220 degF, which is too low to efficiently recover usable heat.
47	2.G	The proposed project will include the installation of a cooling tower that will be comprised of 10 modules which will supply cooling water to both the PET plant and the utility plant. Is it possible for GHG emissions to be present in the process water cooling towers due to process equipment leaks into the system or CO_2 entrainment? Please provide an explanation.	There are no GHG emissions associated with the cooling towers.
48	2.G	If there is a possibility for GHG emissions, please supplement the BACT analysis with an evaluation of leak repair and monitoring technologies and a proposal of what M&G would propose as BACT.	There are no GHG emissions associated with the cooling towers.
49	2.G	What is the proposed compliance strategy for the cooling tower?	There are no GHG emissions associated with the cooling towers.
50	2.G	Does the process include direct-contact coolers/condensers?	There are no GHG emissions associated with the cooling towers.

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
51	2.H	PET chips are conveyed within the plant units and to/from the rail yard. Ambient air is filtered and then pressurized at the desired value using oil-free, water cooled centrifugal compressors. What drives these compressors (i.e., electric, steam)?	The compressors are driven by electric motors.
52	2.I	The liquid stream from the tank farm scrubber is sent to the WWTP. Is the tank scrubber a potential GHG source?	There are no GHG emissions associated with tank scrubber operation.
53	2.I	If so, a BACT analysis should be developed for the tanks to be installed for the project.	Not Applicable
54	2.J	Dock, rail yard and truck loading and unloading of product and raw materials is included. Are any of these potential GHG sources?	There are no GHG emissions associated with the stationary equipment. Barge, truck and rail car unloading racks GHG emissions would only be from the mobile vehicles, not the tanks or loading operations.
55	2.J	If so, a BACT analysis should be developed for the identified method of loading and/or unloading of product and/or raw materials. Please include the pollution controls that were evaluated.	Not Applicable
56	2.J	Will there be operating or work practice standards implemented to minimize GHG emissions generated during the truck loading operation? Please provide supplemental information that details these procedures.	Not Applicable
57	2.K	Please provide design efficiency data for the emergency generator and fire pump engines.	The final engine models have not been selected. They will be new Caterpillar diesel engines that will meet the requirements of 40 CFR 60 Subpart IIII, for Compression Ignition Internal Combustion Engines. A review of typical engines in the design range provides an approximate efficiency of 33-35%.
58	3	M&G is proposing to select a PET process that eliminates the second esterification step found in traditional CP units at PET plants and reduces the total energy required during the esterification unit operation by the number of heated vessels. If possible, please provide the number of heated vessels that will be reduced using the chosen technology instead of traditional technology.	One large esterification reactor, and its associated energy demand, is eliminated.
59	3	For single step esterification in the CP unit, if possible quantify the reduction in fuel and/or GHG emission production.	A comparison of technologies and their energy consumption is provided in Attachment B.
60	3	M&G is proposing to construct a SSP unit that eliminates the precrystallization and crystallization steps found in traditional SSP units. This is contradicted elsewhere. Please clarify statements made on page 28 that asserts its elimination.	The technology operated by M&G will eliminate the traditional precrystallization and crystallization steps and will require only one crystallization step before entering into the rotating reactor.

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
61	3	Provide supplemental information that compares the efficiency gains in heat and electricity consumption or reduction in GHG emissions for chosen technology versus traditional PET technology.	A comparison of technologies and their energy consumption is provided in Attachment B.
62	3	Provide a copy of any technical resources used to evaluate the design decisions for the M&G facility and any benchmark comparison data of similar sources existing nationally or internationally, that may have been utilized in the design selection strategy.	A comparison of technologies and their energy consumption is provided in Attachment B.
63	3	Please provide technical resources, literature and calculations to substantiate the claimed efficiencies.	A comparison of technologies and their energy consumption is provided in Attachment B.
64	4	Please provide supplemental information that quantifies the amount of potential GHG emissions that will be minimized and reduces the amount of imported natural gas by using the biogas generated from the WWTP as fuel to the process heaters.	A comparison of technologies and their energy consumption is provided in Attachment B.
65	4	If possible please provide an estimate on how long the biogas will be flared.	The biogas may be flared for up to 8760 hours a year. The goal is to recover the heat content of the biogas in the HTF heaters for use in the process. The biogas will either be combusted in the flare or in the HTF heaters resulting in the same level of GHG emissions.
66	4	Please confirm if the biogas is the only vent stream directed to the flare.	Biogas is the only vent stream routed to the flare.
67	5	Please provide manufacturers data for the process heaters, RTOs, flare, emergency generator engine and fire pump engine.	The manufacturers final specifications have not been finalized at this date. The process parameters required for GHG emission calculation have been determined as part of the preliminary design package. Final specifications will not be available for approximately a year or more as the facility goes through detailed design.
68	5	If possible, please provide supplemental data comparing the energy efficiency and production of GHG emissions of the chosen equipment to similar or existing sources.	A separate discussion of overall process benchmarking is attached.
69	5	Please provide the technical assessment conducted to compare the performance of the equipment considered for this project.	A separate discussion of overall process benchmarking is attached.
70	6	Provide the production capacity for PET and PTA the proposed facility.	The PTA annual production rate is 1,440,000 metric tons (1,587,328 short tons). The PTE annual production rate is 1,200,000 metric tons (1,322,774 short tons).

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
71	7	Please supplement the application by indicating whether your proposed BACT includes MSS emissions for the overall process, or provide supplemental information that details why a different BACT limit is needed during MSS along with a proposed BACT analysis for such startup/shutdown emissions.	The GHG emissions from this facility are due to combustion with a very minor contribution from the waste water treatment plant generated biogas and natural gas fugitives. The MSS emissions from all sources are expected to the same or less than normal operational emissions. A separate MSS limit is not required.
72	8	Please provide the site-specific parameters that were used to evaluate and eliminate CCS from consideration. Please include cost of construction, operation and maintenance, cost per ton of C02 removed by the technologies evaluated and include the feasibility and cost analysis for storage or transportation for these options.	An updated CCS review will be provided at a later date under separate cover.
73	8	Please discuss in detail any site specific safety or environmental impacts associated with a CCS removal system.	An updated CCS review will be provided at a later date under separate cover.
74	9	M&G will utilize an energy efficient design for the heaters. Please provide supplemental information for the process heaters.	The manufacturers final specifications have not been finalized at this date. The process parameters required for GHG emission calculation have been determined as part of the preliminary design package. Final specifications will not be available for approximately a year or more as the facility goes through detailed design. Preliminary specifications are as provided in the response to number 19.
75	9	If possible, please provide benchmark data that compares similar industries with existing or similar heaters that utilize the same technology.	The HTF heaters are an integrated part of the PET plant design that has been operated successfully at installations in Brazil and Mexico in the two largest PET plants in the world. Alternative heater designs are not considered a reasonable technical option for this facility.
76	10	Provide updated emission tables using the new GWPs so that EPA can cross-check its own calculations.	Revised GHG calculations are attached.

ATTACHMENT B

Attachment B

Response to following questions from the EPA completeness letter and associated data request letter dated February 5, 2014.

5. Please provide manufacturers data for the process heaters, RTOs, flare, emergency generator engine and fire pump engines. If possible, please provide supplemental data comparing the energy efficiency and production of GHG emissions of the chosen equipment to similar or existing sources. Please provide the technical assessment conducted to compare the performance of the equipment considered for this project.

Responses to the request for manufacturers data on individual equipment are provided in Attachment A.

This response focuses on the overall benefits and efficiency of the PTE plant as a whole. The information provided is based on engineering analysis of competitive technologies and should not be considered an operational guarantee or limitation.

The PET production technology in the M&G facility is owned by Chemtex International, Inc., the engineering subsidiary of the Mossi Ghisolfi Group, which also owns M&G Resins the owner and operator of this project. The technology has been proven in several applications and has performance advantages over competing technologies as described below and in the following slides.

The overall energy efficiency comparison between the primary competitive technology (a Melt-to-Resin or MTR process) and the Chemtex Continuous Polymerization (CP) and Solid State Polymerization (EASYUP® SSP) technology is shown in the following slides. The information shows that while electrical consumption is higher for the Chemtex process, the majority of energy usage comes from heat transfer fluid and steam which is why the total facility energy consumption is lower by approximately 5% for equivalent production rates.

Integration & Technology

PTA and PET – single line provides additional cost efficiency.

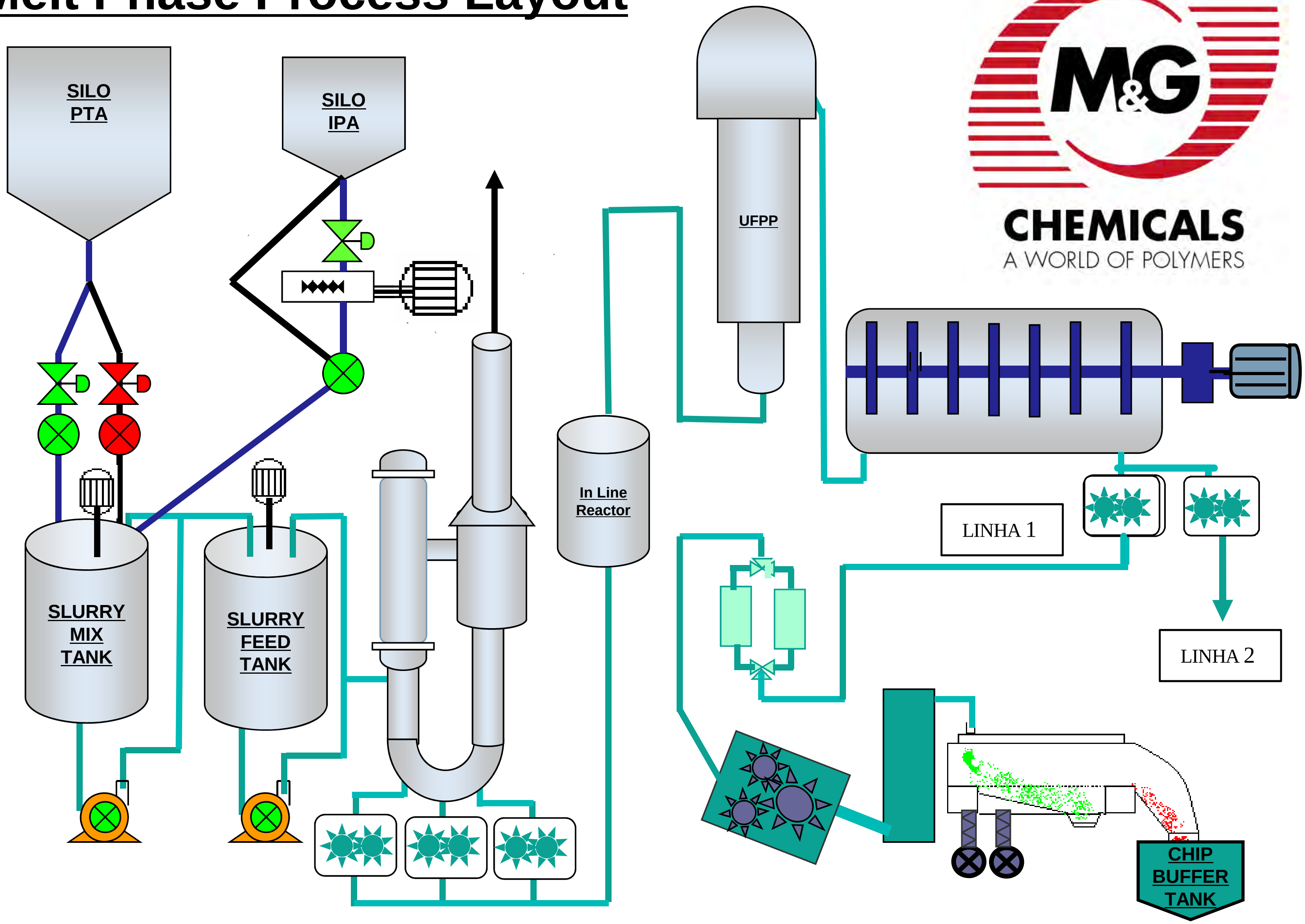
- PET volumes are achievable on a single line through the implementation of the M&G EasyUp™ proprietary technology, which eliminates the size constraints faced by competitors

- EasyUp™ technology consists in the application of an horizontal solid state polymerization phase (SSP), instead of the traditional vertical tower provided by existing competitive technologies.

Melt Phase (CP) Technology

- Highly attractive CAPEX & OPEX
- Lowest residence time < 4 hrs. – quick product transitions
- Highly consistent product quality
- Minimal rotating parts – minimal maintenance
- >10 years operation without shutdown for quality reasons
- Chemical cleaning done using MEG, Mechanical cleaning not required
- Highly effective downstream productivity (in preform & bottle making)
- Low end product AA, VEG and CEG
- Product suitable for Mineral water, CSD, large containers, A PET, C PET & other general applications.
- Preferred product for high value brands such as Avian / Dannone.

Melt Phase Process Layout



CHEMICALS
A WORLD OF POLYMERS

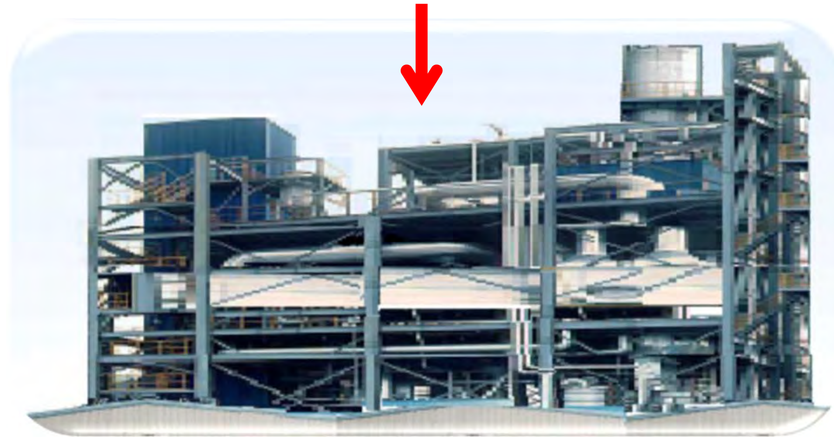
EasyUp^{TM} – An Innovative Approach

Traditional: Vertical Reactor (700 MT/day max)

100 m

30 m

M&G Technology: Horizontal (1,500+ MT/day)

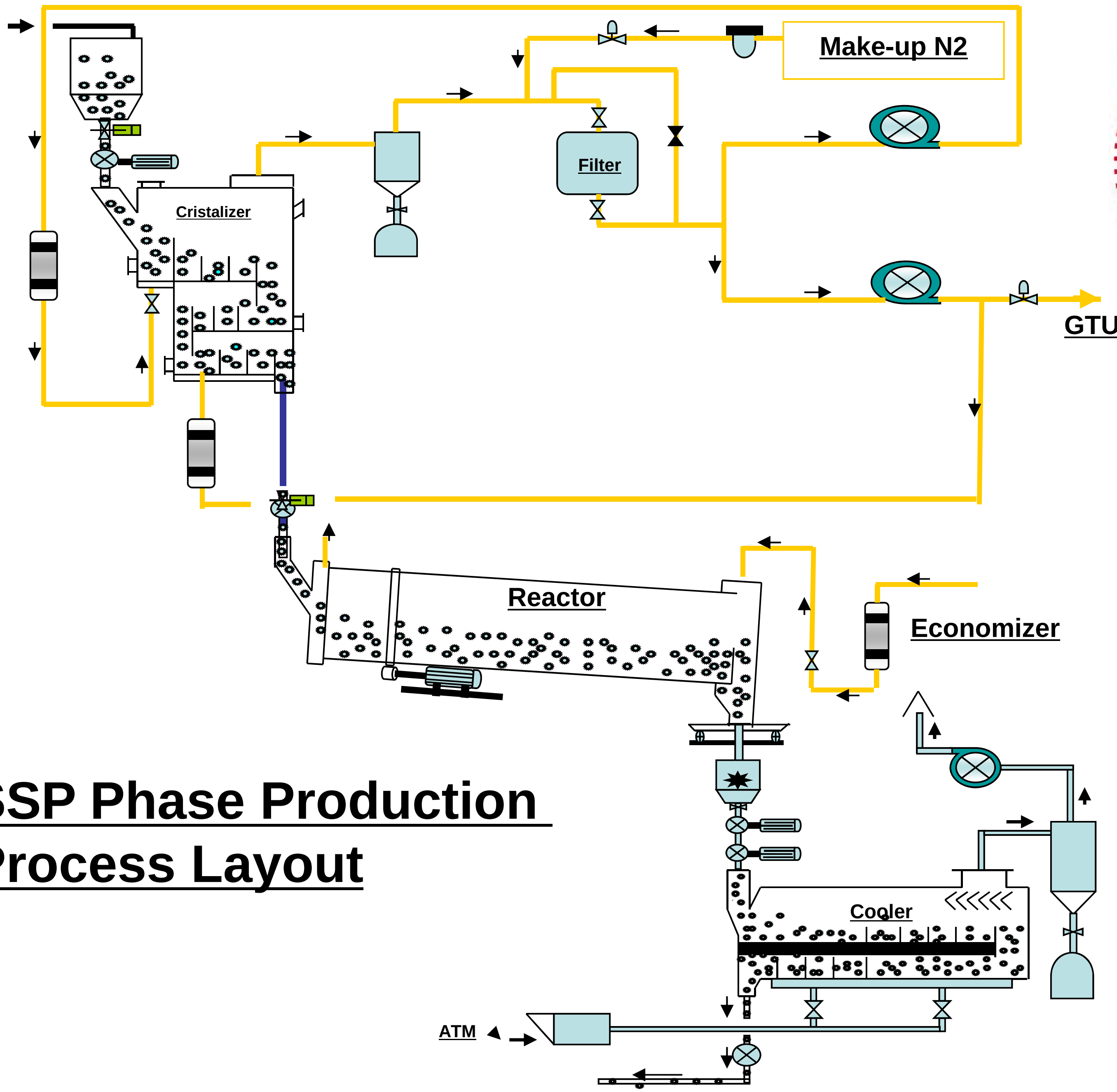


50 m

100 m

- The streamlined process for M&G EasyUp^{TM} requires less equipment than utilized in traditional technology
- M&G EasyUp^{TM} technology avoids the impact of a vertical tower and has no capacity limitation for a single line

M&G CHEMICALS
A WORLD OF POLYMERS

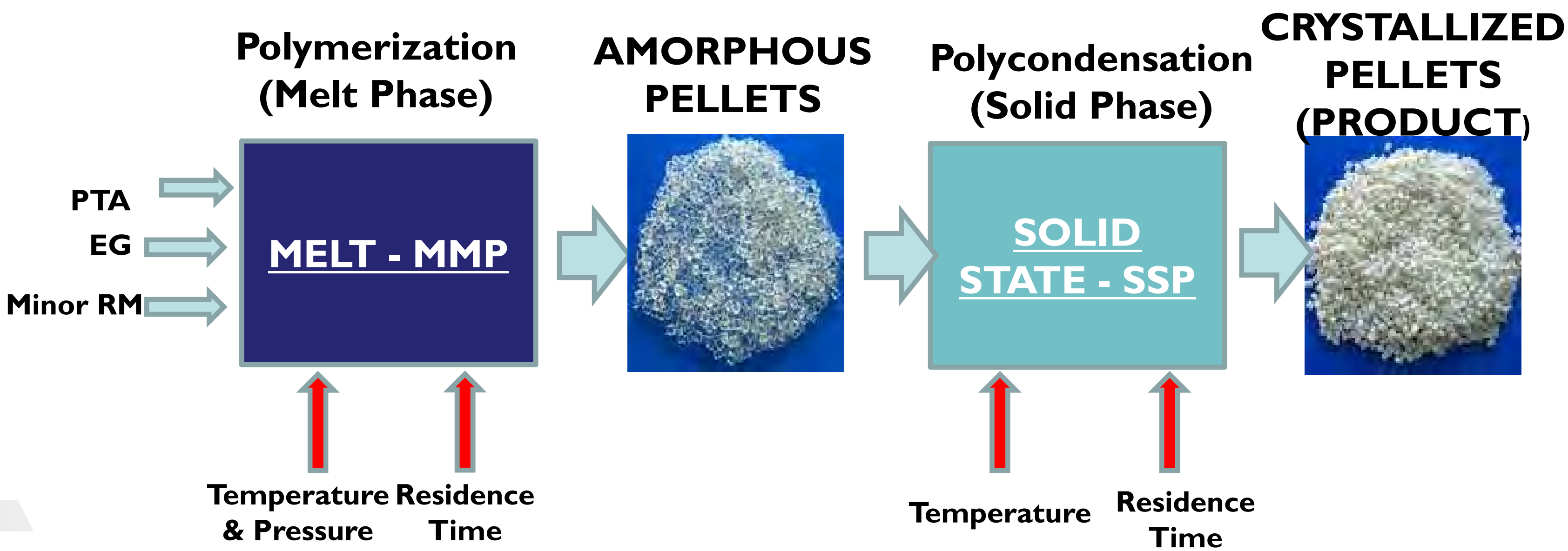


SSP Phase Production Process Layout

CP – SSP Integration

- Optimize designs of CP, Chip making, & SSP to maximize:
  - Operational flexibility
  - Best product performance
  - Attractive CAPEX for the whole plant
  - Compact layout
  - Ease of operation
- Flexible commercial options

M&G CHEMICALS
A WORLD OF POLYMERS



Competitive Analysis

Parameter	Chemtex	Other
Residence time	< 4 Hours	> 8-10 Hours
Quick transitions	Positive	Negative
Transition product	<25 tons	>150 Tons
Energy & Raw Material	Lower	Higher
Flexibility	High	Low
On-line performance	>10 years	3-4 years
Product quality	High	?
Single line capacity	>1500 tpd	<700 tpd

Energy Analysis

Description	Chemtex Performance versus three Melt to Resin (MTR) Plants (Percentage difference of energy consumption per ton product)			
MTR Plant Location	USA	Turkey	UK	Average of three MTR Plants
Electrical Energy Usage	142%	121%	128%	130%
Heat Transfer Fluid/ Steam Energy Usage	90%	91%	90%	90%
Total Energy Usage	95%	94%	94%	95%

ATTACHMENT C

zephyr

Table A-1
Plantwide GHG Emission Summary
M&G Resins USA, LLC
PET Plant
March 2014

Name	EPN	Fuel	GHG Mass Emissions ton/yr	CO_2e ton/yr
HTF (Heat Transfer Fluid) Heater 1	E7-A	Natural Gas	72,624	72,697
HTF (Heat Transfer Fluid) Heater 2	E7-B	Natural Gas	72,624	72,697
HTF (Heat Transfer Fluid) Heater 3	E7-C	Natural Gas	72,624	72,697
HTF (Heat Transfer Fluid) Heater 4	E7-D	Natural Gas	72,624	72,697
HTF Heaters 1 through 4	E7-A through E7-D	Bio Gas [1]	9,032	9,037
		OSC Stream [1]	548	555
		EC Stream [1]	0.61	0.62
Biogas Flare	FLARE	Natural Gas	31.2	31.3
		Bio Gas [2]	8,956	9,308
RTO1	E1	Natural Gas	9,104	9,113
RTO1	E1	Waste Gas [3]	54,578	56,727
RTO2	E2	Natural Gas	9,104	9,113
RTO2	E2	Waste Gas [3]	54,578	56,727
Emergency Diesel Generator 1	E85-A	Diesel	2,577	2,585
Emergency Diesel Generator 2	E85-B	Diesel	2,577	2,585
Fire Water Pump Diesel Engine 1	E87-A	Diesel	248	249
Fire Water Pump Diesel Engine 2	E87-B	Diesel	248	249
Combined Plant Fugitives	FUGPTA and FUGPET	NA	21	508
		total =	***433,141***	***438,268***

Notes:
[1] The following fuel gas streams may be routed to any of the four process heaters: biogas, OSC stream, EC stream.
[2] Biogas is used as fuel gas in the heaters but may be flared during heater downtime. *Emissions from biogas are included from HTF Heater combustion only to avoid double counting.* The total (sum) GHG emissions only includes GHG emissions from biogas combustion in the heaters. The natural gas emissions shown are for the flare pilot.
[3] Waste gas from the PTA unit may be routed to either or both RTOs for combustion.

Table A-2
GHG Emission Calculations - Natural Gas Combustion
M&G Resins USA, LLC
PET Plant
March 2014

GHG Emissions Contribution From Natural Gas Fired Combustion Sources (EPNs E7-A to D, E1 and E2 and Flare):

Source Type	Average Heat Input/Unit HHV (MMBtu/hr)	Annual Operation (hrs/yr)	Annual Avg Heat Input, Each Unit HHV (MMBtu/yr)	Pollutant	Emission Factor (kg/MMBtu)[1]	Emissions per Unit: GHG Mass Emissions[2] (metric ton/yr)	GHG Mass Emissions (ton/yr)	Global Warming Potential[3]	CO_2e (metric ton/yr)	CO_2e (tpy)
HTF Heaters 1 through 4 (each)	142	8,760	1,242,369	CO_2	53.02	65,870	72,622	1	65,870	72,622
				CH_4	1.0E-03	1.24	1.37	25	31.06	34.24
				N_2O	1.0E-04	0.12	0.14	298	37.02	40.82
					Totals	**65,872**	**72,624**		**65,938**	**72,697**
RTO1 or RTO2 (each)	18	8,760	155,733	CO_2	53.02	8,257	9,103	1	8,257	9,103
				CH_4	1.0E-03	0.16	0.17	25	3.89	4.29
				N_2O	1.0E-04	0.02	0.02	298	4.64	5.12
					Totals	**8,257**	**9,104**		**8,266**	**9,113**
Biogas Flare	0.06	8,760	534	CO_2	53.02	28	31	1	28	31
				CH_4	1.0E-03	5.34E-04	5.89E-04	25	0.013	0.015
				N_2O	1.0E-04	5.34E-05	5.89E-05	298	0.016	0.018
					Totals	**28.3**	**31.2**		**28.4**	**31.3**

Notes:

1. CO2 GHG factor from Table C-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting (GHG MRR).
CH4 and N2O GHG factors based on Table C-2 of GHG MRR.
2. CO_2 emissions based on 40 CFR Part 98, Subpart C, Equation C-1.
CH_4 and N_2O emissions based on 40 CFR Part 98, Subpart C, Equation C-8.
3. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

Sample Calculation: Pyrolysis Furnaces - CO_2:

GHG Mass Emissions (metric ton/yr) = 0.001 x 1242368.55291577 (MMBtu/yr) x 53.02 kg/MMBtu = 65870
CO2e (metric ton/yr) = 65870 (metric ton/yr) x 1 = 65870.4

Table A-3
GHG Emission Calculations - Fuel Gas Combustion in Heaters (EPNs E7-A through E7-D)
M&G Resins USA, LLC
PET Plant
March 2014

Fuel Gas Stream Data:

Variable	Value, by Stream: Bio Gas	Organic Stripping Column (OSC) Stream	Esterification Column (EC) Stream	Units	Reference
HHV	667	153	0.27	Btu/scf	design specification
Carbon Content (Annual Avg)	0.650	8.00E-03	9.50E-06	kg C/kg	design specification
Molecular Weight (Annual Avg)	24.59	20.58	32.0	kg/kg-mol	design specification

GHG Emissions Contribution From Fuel Gas Fired Combustion in Heaters (EPNs E7-A through E7-D):

Fuel Gas Type	Average Heat Input/Unit (MMBtu/hr)	Annual Average BioGas Usage/Unit[1] (MMscf/hr)	Annual Operation (hrs/yr)	Annual Average Fuel Use, Each Unit (scf/yr)	Annual Average Heat Input, Each Unit (MMBtu/yr)	Pollutant	Emission Factor (kg/MMBtu)[2]	Emissions per Fuel Gas Stream: GHG Mass Emissions[3] (metric ton/yr)	GHG Mass Emissions (ton/yr)	Global Warming Potential[4]	CO_2e (metric ton/yr)	CO_2e (tpy)
Bio Gas	9.04	0.014	8,760	1.19E+08	7.92E+04	CO_2		8192.6	9032.4	1	8192.6	9032.4
						CH_4	1.0E-03	0.079	0.087	25	1.98	2.18
						N_2O	1.0E-04	0.008	0.009	298	2.36	2.60
							Totals	**8192.7**	**9032.5**		**8197.0**	**9037.1**
OSC Stream	12.22	0.080	8,760	7.00E+08	1.07E+05	CO_2		497.1	548.1	1	497.1	548.1
						CH_4	1.0E-03	0.107	0.118	25	2.68	2.95
						N_2O	1.0E-04	0.011	0.012	298	3.19	3.52
							Totals	**497.2**	**548.2**		**503.0**	**554.5**
EC Stream	0.013	0.048	8,760	4.22E+08	1.14E+02	CO_2		0.55	0.61	1	0.55	0.61
						CH_4	1.0E-03	0.00011	0.00013	25	0.0028	0.0031
						N_2O	1.0E-04	0.00001	0.00001	298	0.0034	0.0037
							Totals	**0.55**	**0.61**		**0.56**	**0.62**
Total, All Fuel Gas Combustion								***8,690.5***	***9,581.3***		***8,700.5***	***9592.3***

Notes:

1. Fuel use calculated as: MMscf/hr = Firing rate (MMBtu/hr) / HHV (Btu/scf)
2. CH_4 and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.
CH_4 and N_2O emissions based on 40 CFR Part 98, Subpart C, Equation C-8.
*CH_4 / N_2O = 1E-03 * Fuel * HHV * EF*

3. CO_2 emissions based on 40 CFR Part 98, Subpart C, Equation C-5.
*CO_2 = 44/12 * Fuel * CC* MW / MVC *0.001*
CO_2 = CO_2 emitted from fuel combustion, metric tons/yr
Fuel = volume of fuel, scf/yr
CC = Annual average carbon content of fuel (kg C per kg)
MW = annual average molecular weight of fuel (kg/kg-mole)
MVC = molar volume conversion factor = 849.5 scf/kg-mole @ std cond.
0.001 = conversion factor from kg to metric tons

4. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

Sample Calculation: Heaters - CO_2:

GHG Mass Emissions (metric ton/yr) = (44/12) x 1.19E+08 (scf/yr) x 0.65 kg C/kg x 24.59 kg/kg-mol / 849.5 scf/kg-mole @ std cond. x 0.001 = 8.19E+03
CO2e (metric ton/yr) = 8.19E+03 (metric ton/yr) x 1 = 8.19E+03

Table A-4
GHG Emission Calculations - RTO Waste Gas Combustion
M&G Resins USA, LLC
PET Plant
March 2014

RTO Waste Gas Data:

Variable	Value	Units	Reference
Carbon content (annual avg)	0.0061	kg C/kg	design data for RTO inlet stream
Molecular Weight (annual avg)	26.8	kg/kmol	

GHG Emissions from Waste Gas Combustion from RTOs (EPNs E1 and E2):

Source Type	Annual Avg Waste gas flow rate (scf/yr)	Pollutant	GHG Mass Emissions[2] (metric ton/yr)	GHG Mass Emissions[2] (ton/yr)	Global Warming Potential[3]	CO_2e (metric ton/yr)	CO_2e (tpy)
RTO1 or RTO2 (each)	7.04E+10	CO_2	49,428	54,495	1	49,428	54,495
		CH_4	75	83	25	1,877	2,070
		N_2O	0.49	0.54	298	147	162
		Totals	**49,504**	**54,578**		**51,453**	**56,727**

Notes:

1. CH_4 and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

2. CO_2 emissions based on 40 CFR Part 98, Subpart Y Equation Y-1a

*CO_2 = 0.99 * 0.001 * 44/12 * RTOGas * CC* MW / MVC*

where:

CO_2 = CO_2 emitted from RTO waste gas combustion, metric tons/yr

RTOGas = volume of RTO waste gas combusted, scf/yr

CC = Annual average carbon content of waste gas (kg C per kg)

MW = annual average molecular weight of waste gas (kg/kg-mole)

MVC = molar volume conversion factor = 849.5 scf/kg-mole @ std cond.

0.001 = conversion factor from kg to metric tons

0.99 = RTO VOC destruction efficiency

Table A-4

GHG Emission Calculations - RTO Waste Gas Combustion

M&G Resins USA, LLC

PET Plant

CH_4 emissions based on 40 CFR Part 98, Subpart Y Equation Y-4

$CH_4 = (CO_2 * EF_{CH4}/EF) + CO_2 * (0.01/0.99) * (16/44) * f_{CH4}$

where:

CH_4 = CH_4 emitted from RTO waste gas combustion, metric tons/yr

EF_{CH4} = CH_4 emission factor for "Petroleum Products", Table C–2 of Subpart C = 3.0E-03 *kg CH_4/MMBtu*

EF = Default CO_2 emission factor for waste gas of *60* *kg CO_2/MMBtu (HHV basis).*

CO_2 = Emission rate of CO_2 from waste gas (metric tons/yr)

0.01/0.99 = Correction factor for RTO VOC destruction efficiency.

16/44 = Correction factor ratio of the molecular weight of CH_4 to CO_2.

f_{CH4} = Weight frac. of carbon in the waste gas that is contributed by methane (kg CH_4/kg C); default is *0.4*

N_2O emissions based on 40 CFR Part 98, Subpart Y Equation Y-5

$N_2O = (CO_2 * EF_{N2O}/EF)$

where:

N_2O = N_2O emitted from RTO waste gas combustion, metric tons/yr

EF_{N2O} = N_2O emission factor for "Petroleum Products", Table C–2 of Subpart C = 6.0E-04 *kg N_2O/MMBtu*

EF = Default CO_2 emission factor for waste gas of *60* *kg CO_2/MMBtu (HHV basis).*

CO_2 = Emission rate of CO_2 from RTO waste gas (metric tons/yr)

3. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

Sample Calculations, CO_2:

GHG Mass Emissions = 44/12 x 7.04E+10 (scf/yr) x 0.00614 (kg C/kg) x (26.8 (kg/mol) /
849.5 scf/kg-mole @ std cond.) x 0.001 x 0.98
= 4.94E+04 (metric ton/yr)

CO2e Emissions (from CO2) = 4.94E+04 (metric ton/yr) x 1 = 4.94E+04 (metric ton/yr)

Table A-5
GHG Emission Calculations - Bio Gas Combustion in Flare
M&G Resins USA, LLC
PET Plant
March 2014

Bio Gas Data:

Variable	Value	Units	Reference
Carbon content (annual avg)	0.6500	kg C/kg	design data
Molecular Weight (annual avg)	24.6	kg/kmol	design data

GHG Emissions from Bio Gas Combustion in Flare (EPN Flare):

Source Type	Annual Avg Waste gas flow rate (scf/yr)	Pollutant	GHG Mass Emissions[2] (metric ton/yr)	GHG Mass Emissions (ton/yr)	Global Warming Potential[3]	CO_2e (metric ton/yr)	CO_2e (tpy)
Biogas Flare	1.19E+08	CO_2	8111	8942	1	8111	8942
		CH_4	12.3	13.6	25	308.1	339.6
		N_2O	0.081	0.089	298	24.170	26.647
		Totals	**8123**	**8956**		**8443**	**9308**

Notes:

1. CH_4 and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

2. CO_2 emissions based on 40 CFR Part 98, Subpart Y Equation Y-1a

CH_4 emissions based on 40 CFR Part 98, Subpart Y Equation Y-4

$CH_4 = (CO_2 * EF_{CH4}/EF) + CO_2 * (0.01/0.99) * (16/44) * f_{CH4}$

where:

CH_4 = CH_4 emitted from RTO waste gas combustion, metric tons/yr

EF_{CH4} = CH_4 emission factor for "Petroleum Products", Table C–2 of Subpart C = 3.0E-03 *kg CH_4/MMBtu*

EF = Default CO_2 emission factor for waste gas of 60 *kg CO_2/MMBtu (HHV basis).*

CO_2 = Emission rate of CO_2 from waste gas (metric tons/yr)

0.01/0.99 = Correction factor for RTO VOC destruction efficiency.

Table A-5

GHG Emission Calculations - Bio Gas Combustion in Flare

M&G Resins USA, LLC

PET Plant

16/44 = Correction factor ratio of the molecular weight of CH_4 to CO_2.

f_{CH4} = Weight frac. of carbon in the waste gas that is contributed by methane (kg CH_4/kg C); default is *0.4*

N_2O emissions based on 40 CFR Part 98, Subpart Y Equation Y-5

$N_2O = (CO_2 * EF_{N2O}/EF)$

where:

N_2O = N_2O emitted from RTO waste gas combustion, metric tons/yr

EF_{N2O} = N_2O emission factor for "Petroleum Products", Table C–2 of Subpart C = 6.0E-04 *kg N_2O/MMBtu*

EF = Default CO_2 emission factor for waste gas of *60* *kg CO_2/MMBtu (HHV basis)*

CO_2 = Emission rate of CO_2 from RTO waste gas (metric tons/yr)

3. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

Sample Calculations, CO_2:

GHG Mass Emissions = 44/12 x 1.19E+08 (scf/yr) x 0.65 (kg C/kg) x (24.6 (kg/mol) /
(849.5 scf/kg-mole @ std cond.) x 0.001 x 0.98
= 8.11E+03 (metric ton/yr)

CO2e Emissions (from CO2) = 8.11E+03 (metric ton/yr) x 1 = 8.11E+03 (metric ton/yr)

Table A-6
GHG Emission Calculations - Emergency Engines
M&G Resins USA, LLC
PET Plant
March 2014

Diesel Emergency Engine Specifications:

Variable	Value, by Engine: Engine 1	Engine 2	Engine 3	Engine 4	Units	Reference
Annual Operating Schedule	100	100	100	100	hours/year	NSPS IIII Limitation
Power Rating	5,361	5,361	420	420	hp	Design Specs
Brake Specific Fuel Consumption	5,894	5,894	7,254	7,254	Btu/hp-hr	Design Specs

GHG Emissions Contribution From Diesel Combustion in Engines (EPN E85-A and B and 87-A and B):

Source	Heat Input (MMBtu/hr)	Pollutant	Emission Factor (kg/MMBtu)[1]	GHG Mass Emissions[3] (metric ton/yr)	GHG Mass Emissions (ton/yr)	Global Warming Potential[2]	CO_2e (metric ton/yr)	CO_2e (tpy)
Emergency Diesel Generator 1	316.0	CO_2	73.96	2,337	2,577	1	2,337	2,577
		CH_4	3.0E-03	0.095	0.10	25	2.37	2.61
		N_2O	6.0E-04	0.019	0.02	298	5.65	6.23
Emergency Diesel Generator 2	316.0	CO_2	73.96	2,337	2,577	1	2,337	2,577
		CH_4	3.0E-03	0.095	0.10	25	2.37	2.61
		N_2O	6.0E-04	0.019	0.02	298	5.65	6.23
Fire Water Pump Diesel Engine 1	30.5	CO_2	73.96	225	248	1	225	248
		CH_4	3.0E-03	0.0091	0.010	25	0.23	0.25
		N_2O	6.0E-04	0.0018	0.0020	298	0.54	0.60
Fire Water Pump Diesel Engine 2	30.5	CO_2	73.96	225	248	1	225	248
		CH_4	3.0E-03	0.009	0.010	25	0.23	0.25
		N_2O	6.0E-04	0.0018	0.0020	298	0.54	0.60
Total, Emergency Engines			**Totals**	***5,125***	***5,650***		***5,142***	***5,669***

Notes:

1. *GHG factors based on Tables C-1 and C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*
2. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*
3. *Annual Emission Rate = Heat Input x Emission Factor x 0.001 metric ton/kg x hours/year*

Sample Calculation: Diesel Combustion - CO_2:

GHG Mass Emissions (metric ton/yr) = 316 (MMBtu/hr) x 73.96 kg/MMBtu x 0.001 x 100 hours/year = 2337
CO2e (metric ton/yr) = 2337 (metric ton/yr) x 1 = 2337

Table A-7
GHG Emission Calculations - Process Fugitives
M&G Resins USA, LLC
PET Plant
March 2014

GHG emissions from process piping and components for fugitives (EPNs PTAFUG and PETFUG).
Components in service with streams with vp ≥ 0.147 psia

Component Type	Material type	# Components [1]	SOCMI without Ethylene Emission Factor (lb/hr/component)	Control Method [2]	28VHP Control Efficiency (%)	CO2 Emissions	
						CO_2 Mass Fraction	(tpy)
Valves	Gas/Vapor	730	0.0089	-	97	5.44E-03	4.65E-03
	Light Liquid	899	0.0035	-	97	5.20E-06	2.15E-06
	Heavy Liquid	2629	0.0007	-	0	0.00E+00	0.00E+00
Flanges	Gas/Vapor	613	0.0029	A	97	2.27E-03	5.30E-04
	Light Liquid	987	0.0005	A	97	3.65E-06	2.37E-07
	Heavy Liquid	4739	0.00007	A	97	0.00E+00	0.00E+00
Pumps	Light Liquid	86	0.0386	-	85	1.70E-04	3.71E-04
	Heavy Liquid	73	0.0161	-	0	0.00E+00	0.00E+00
Compressors	Gas/Vapor	0	0.5027	-	85	0.00E+00	0.00E+00
Relief Valves	All	130	0.2293	-	97	5.79E-04	2.27E-03
Open Ended Lines	All	0	0.004	B	100	0.00E+00	0.00E+00
Sampling Connections	All	0	0.033	-	97	0.00E+00	0.00E+00
TOTAL							**7.82E-03**
GHG Mass-Based Emissions							7.82E-03
Global Warming Potential							1
CO_2e Emissions							7.82E-03

Components in service with streams with 0.0147 psia ≤ vp < 0.147 psia

Component Type	Material type	# Components [1]	SOCMI Non-Leaker	Control Method [2]	Control Efficiency (%)	CO2 Emissions	
						CO_2 Mass Fraction	(tpy)
Valves	Gas/Vapor	330	0.00029	-	0	1.91E-03	7.99E-04
	Light Liquid	0	0.00036	-	0	0.00E+00	0.00E+00
	Heavy Liquid	46	0.0005	-	0	0.00E+00	0.00E+00
Flanges	Gas/Vapor	1016	0.00018	-	0	1.82E-03	1.46E-03
	Light Liquid	0	0.00018	-	0	0.00E+00	0.00E+00
	Heavy Liquid	140	0.00018	-	0	0.00E+00	0.00E+00
Pumps	Light Liquid	0	0.0041	-	0	0.00E+00	0.00E+00
	Heavy Liquid	18	0.0046	-	0	1.44E-03	5.24E-04
Compressors	Gas/Vapor	0	0.1971	-	0	0.00E+00	0.00E+00
Relief Valves	All	27	0.0986	-	0	2.31E-03	2.69E-02
Open Ended Lines	All	0	0.0033	B	100	0.00E+00	0.00E+00
Sampling Connections	All	0	0.033	-	0	0.00E+00	0.00E+00
TOTAL							**2.97E-02**
GHG Mass-Based Emissions							2.97E-02
Global Warming Potential							1
CO_2e Emissions							2.97E-02

Components in service with streams with vp < 0.0147 psia

Component Type	Material type	# Components [1]	SOCMI without Ethylene Emission Factor (lb/hr/component)	Control Method [2]	AVO Control Efficiency (%)	CO2 Emissions	
						CO_2 Mass Fraction	(tpy)
Valves	Gas/Vapor	132	0.0089	-	97	6.06E-03	9.36E-04
	Light Liquid	0	0.0035	-	97	0.00E+00	0.00E+00
	Heavy Liquid	1244	0.0007	-	97	3.47E-07	3.97E-08
Flanges	Gas/Vapor	257	0.0029	-	97	6.06E-03	5.93E-04
	Light Liquid	0	0.0005	-	97	0.00E+00	0.00E+00
	Heavy Liquid	1735	0.00007	-	97	8.91E-08	1.42E-09
Pumps	Light Liquid	0	0.0386	-	93	0.00E+00	0.00E+00
	Heavy Liquid	85	0.0161	-	93	1.25E-03	5.25E-04
Compressors	Gas/Vapor	2	0.5027	-	95	5.85E-03	1.29E-03
Relief Valves	All	51	0.2293	-	97	2.97E-03	4.56E-03
Open Ended Lines	All	0	0.004	B	100	0.00E+00	0.00E+00
Sampling Connections	All	0	0.033	-	97	0.00E+00	0.00E+00
TOTAL							**7.90E-03**
GHG Mass-Based Emissions							7.90E-03
Global Warming Potential							1
CO_2e Emissions							7.90E-03

Notes:
[1] Estimated quantity of fugitive components based on preliminary design information and used for emission calculation purposes only.
[2] Control methods are either the 28 VHP leak detection and repair program.

Table A-8
GHG Emissions Calculations - Natural Gas Piping Fugitives
M&G Resins USA, LLC
PET Plant
March 2014

GHG emissions from natural gas piping and components for fugitives (EPNs PTAFUG and PETFUG).

EPNs	Source Type	Fluid State	Count	Emission Factor[1] scf/hr/comp	CO_2[2] (tpy)	Methane[3] (tpy)	Total (tpy)
FUGPTA and FUGPET	Valves	Gas/Vapor	600	0.121	0.45	12.74	
	Flanges	Gas/Vapor	2400	0.017	0.26	7.16	
	Relief Valves	Gas/Vapor	5	0.193	0.006	0.17	
	Sampling Connections	Gas/Vapor	10	0.031	0.0019	0.054	
	Compressors	Gas/Vapor	3	0.30	0.005631	0.1579	
GHG Mass-Based Emissions					0.72	20.27	***21.0***
Global Warming Potential[4]					1	25	
CO_2e Emissions					0.72	506.9	***507.6***

Notes

1. Emission factors from Table W-1A of 40 CFR 98 Mandatory Greenhouse Gas Reporting included in the August 3, 2012 Technical Corrections
2. CO_2 emissions based on vol% of CO_2 in natural gas 1.25%
3. CH_4 emissions based on vol% of CH_4 in natural gas 96.13%
4. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

Example Calculation

600 valves	0.123 scf gas	0.0125 scf CO2	lbmole	44 lb CO_2	8760 hr	ton
	hr * valve	scf gas	385 scf	lbmole	yr	2000 lb

= 0.45 ton/yr

TCEQ

TABLE 1F
AIR QUALITY APPLICATION SUPPLEMENT

Permit No.:	TBD	Application Submittal Date:	02/28/2013
Company	M&G Resins USA, LLC		
RN:	TBD	Facility Location:	
City	Corpus Christi	County:	Nueces
Permit Unit I.D.:	TBD ☑ New Major Source ☐ Modification	Permit Name:	TBD
Permit Activity:			
Project or Process Description:	PET Plant		

Complete for all pollutants with a project emission increase.	POLLUTANTS						
	Ozone		CO	SO_2	PM	GHG	CO_2e
	NOx	VOC					
Nonattainment? (yes or no)						No	No
Existing site PTE (tpy)	This form for GHG only					>100,000	>100,000
Proposed project increases (tpy from 2F)						433,141	438,268
Is the existing site a major source? If not, is the project a major source by itself? (yes or no)	Yes						
If site is major, is project increase significant? (yes or no)						Yes	Yes
If netting required, estimated start of construction:		3/1/14					
5 years prior to start of construction:		NA	Contemporaneous				
estimated start of operation:		NA	Period				
Net contemporaneous change, including proposed project, from Table 3F (tpy)						433,141	438,268
FNSR applicable? (yes or no)						Yes	Yes

2. Nonattainment major source is defined in Table 1 in 30 TAC 116.12(11) by pollutant and county. PSD thresholds are found in 40 CFR §51.166(b)(1).
3. Sum of proposed emissions minus baseline emissions, increases only.
4. Since there are no contemporaneous decreases which would potentially affect PSD applicability and an impacts analysis is not required for GHG emissions, contemporaneous emission changes are not included on this table.

The presentations made above and on the accompanying tables are true and correct to the best of my knowledge.

Signature	Title	Date

TABLE 2F
PROJECT EMISSION INCREASE

Pollutant[1]:	GHG Mass Emissions				**Permit:**	TBD			
Baseline Period:			N/A	**to**	N/A				
				A	B				
Affected or Modified Facilities[2]		**Permit No.**	**Actual Emissions[3]**	**Baseline Emissions[4]**	**Proposed Emissions[5]**	**Projected Actual Emissions**	**Difference (B - A) [6]**	**Correction[7]**	**Project Increase[8]**
FIN	**EPN**								
1	E7-A through E7-D		0.00	0.00	300,076		300,076		300,076
2	Flare - Normal		0.00	0.00	31.2		31.2		31.2
3	Flare - Biogas		0.00	0.00	8,955.7		8,955.7		8,955.7
4	E1		0.00	0.00	63,682		63,682		63,682
5	E2		0.00	0.00	63,682		63,682		63,682
6	E85-A		0.00	0.00	2,577		2,577		2,577
7	E85-B		0.00	0.00	2,577		2,577		2,577
8	E87-A		0.00	0.00	248		248		248
9	E87-B		0.00	0.00	248		248		248
10	FUGPTA and FUGPET		0.00	0.00	21.01		21.01		21.01

Note: **Total [1] =** **433,141**

[1] Line 3 is not included in the total emission summation. These are potential emissions for biogas combustion in the flare, as backup to natural gas combustion in the heaters. The summation includes GHG emissions from biogas combustion in the heaters (as a fuel gas).

TABLE 2F
PROJECT EMISSION INCREASE

Pollutant[(1)]:	CO2e					**Permit:**	TBD			
Baseline Period:				N/A	**to**	N/A				
					A	**B**				
Affected or Modified Facilities[(2)]	**FIN**	**EPN**	**Permit No.**	**Actual Emissions[(3)]**	**Baseline Emissions[(4)]**	**Proposed Emissions[(5)]**	**Projected Actual Emissions**	**Difference (B - A) [(6)]**	**Correction[(7)]**	**Project Increase[(8)]**
1		E7-A through E7-D		0.00	0.00	300,381		300,381		300,381
2		Flare - Normal		0.00	0.00	31.3		31.3		31.3
3		Flare - Biogas		0.00	0.00	9,308.3		9,308.3		9,308.3
4		E1		0.00	0.00	65,840		65,840		65,840
5		E2		0.00	0.00	65,840		65,840		65,840
6		E85-A		0.00	0.00	2,585		2,585		2,585
7		E85-B		0.00	0.00	2,585		2,585		2,585
8		E87-A		0.00	0.00	249		249		249
9		E87-B		0.00	0.00	249		249		249
10		FUGPTA and FUGPET		0.00	0.00	507.58		507.58		507.58
	Summary of Contemporaneous Changes						**Total [1] =**			**438,268**

Note:

[1] Line 3 is not included in the total emission summation. These are potential emissions for biogas combustion in the flare, as backup to natural gas combustion in the heaters. The summation includes GHG emissions from biogas combustion in the heaters (as a fuel gas).

March 14, 2014

Mr. Thomas H. Diggs
Associate Director
Air Programs Branch
U.S. EPA Region 6, 6PD
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

RE: EPA Application Completeness Determination and Request for Information
Greenhouse Gas PSD Permit Application
M&G Resins USA, LLC
Polyethylene Terephthalate and Terephathalic Acid Units
Corpus Christi, Nueces County, Texas

Dear Mr. Diggs:

This letter is a supplement to the March 10, 2014 response to your letter dated February 5, 2014, requesting supplemental information related to M&G Resin USA, LLC's Greenhouse Gas (GHG) Prevention of Significant Deterioration (PSD) permit application for the PET Plant. This supplement provides a site-specific cost per ton for a Carbon Capture and Storage (CCS) system, as requested in item 72 of the attached Matrix of Questions. It also responds to item 73 about site-specific safety and environmental impacts of a CCS system.

This letter does not address the questions in the February 5 letter related to process design. This information is being mailed, in hardcopy to your attention, today under an assertion of Confidential Business Information (CBI).

Should you have any questions regarding this application, please contact me at tsullivan@zephyrenv.com, or 512-879-6632, or Ms. Allana Whitney of Chemtex International, Inc. at Allana.Whitney@chemtex.com or 910-509-4451.

Regards,

Thomas I. Sullivan, P.E.

Attachment A: Matrix of Questions
Attachment B: Site Specific CCS Cost Estimate
Attachment B.1 Updated Capital Cost Estimate

cc: Ms. Allana Whitney, Chemtex International, Inc.
Mr. Mauro Fenoglio, M&G Resins USA, LLC
Ms. Martha Martinez, M&G Resins USA, LLC

ATTACHMENT A

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
1	2.B	Hot vapor exiting the water removal column is superheated in the offgas preheater and then routed to the expander for energy recovery. Following the expander, the decompressed vapor is partially condensed in a WRC condenser. The discharge from the WRC condenser passes to the WRC reflux tank. The separated, uncondensed offgas stream is routed to the RTO preheater. What media is being used in the preheaters to preheat these streams?	The RTO preheater uses steam as the heating media.
2	2.B	What media is being used in the scrubber to convert the residual bromine containing species	The bromine scrubber utilizes water with caustic and bisulfite as the scrubbing media and has no contribution to or reduction in the GHG emissions of the RTOs
3	2.B	Show the inlet and outlet streams to the waste scrubber with labeling. What is the material converted to?	The bromine scrubber utilizes water with caustic as the scrubbing media and has no contribution or reduction to the GHG emissions of the RTOs. Bromine is converted to bromine salts and bromates in caustic solution.
4	2.B	The application states that during normal operation the heat release of the offgas is sufficient for the RTO to operate auto-thermally, i.e. supplementary heat input is not required. Should the heat release from the offgas decrease, natural gas will be supplied to the RTOs to sustain proper firebox temperature. During what times of plant operation would M&G Resin (M&G) expect that natural gas will need to be supplied to the RTOs?	Natural gas would be required during startup and as needed to maintain a temperature set point during low production periods. Actual production thresholds for autothermal operation will change based on variability in the process emissions.
5	2.B	Is natural gas added to the RTOs automatically or manually?	Natural gas is added automatically to maintain a temperature set point.
6	2.B	What is the proposed compliance strategy for the operation of the RTOs?	Good production practices involve utilizing the minimum amount of natural gas in order to operate the RTO in compliance with its regulated role as a control device. For GHG emission compliance, the RTO will not exceed the natural gas combustion rates represented in the application.
7	2.B	For the operation of the RTOs, what will be monitored and recorded?	Temperature in the oxidation chamber, natural gas fuel usage, exhaust gas flow and oxygen level will be measured and recorded.
8	2.C	Is fuel or steam added to the acetic acid vaporizer?	Steam is used in the acetic acid vaporizer.
9	2.C	It is stated that the high pressure vaporized mixture of acetic acid and water fed to the WRC is used to increase the enthalpy input to the WRC, thereby increasing acetic acid/water fractionating capacity. Does this method of operation conserve energy usage or demand (fuel, steam, etc.) of the WRC that would otherwise be needed to accomplish the same result?	Acetic acid is used to increase slurry temperature inside the digester to complete oxidation from para-xylene to terephtalic acid. This is not an energy recovery system.

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
10	2.C	Excess underflow is cooled in a train of heat exchangers and steam generators for energy recovery. Is this a design strategy that is common to PET and PTA production or is it unique to M&G Resin?	This design is unique to the PTA process licensed for use by M&G.
11	2.C	Excess underflow is cooled in a train of heat exchangers and steam generators for energy recovery. Can this reduction of energy demand be quantified?	At full capacity production, the electricity demand of the PTA plant is expected to be met by the heat recovery steam generator production. This energy recovery is an integral part of the plant design and is reflected in the annual GHG emission calculations. This is accounted for in the natural gas combustion represented in the permit application.
12	2.D	The process flow diagram indicates at the beginning of the process a "catalyst and feed preparation" unit. Please update the process description to include a summary of this unit	The catalyst and feed preparation unit consists of a simple process vessel for mixing of the materials. There are no GHG emissions associated with this operation.
13	2.E.v	After crystallization, product slurry is flash-cooled and sent to the PTA filters which separate the PTA from the acetic acid/catalyst liquid. Where is this liquid-mix directed? Does it go to the wastewater treatment plant (WWTP)?	The liquid mixture is routed to filtrate tanks and recycled back into the process. This is not a potential GHG source.
14	2.E.vi	The wet PTA cake is sent to the respective PTA dryers, which are heated by steam. Is this steam produced from the energy recovery mentioned on page 17 when the underflow from the WRC is cooled?	The facility steam system includes multiple steam headers that operate at different pressures. The steam headers receive steam generated both by the utility plant boilers and process heat recovery operations. There are no direct GHG emissions from the steam system.
15	2.E.ix	The off-spec silo located in the PTA unit process area is used to store off-spec material for further re-processing. Where is off-spec material re-introduced in the process?	The off-specification PTA silo is located in the PET area; off-specification material is reintroduced to vacuum flash tank V-0600. There are no GHG emissions associated with this operation.
16	2.E.x	All the pneumatic transport systems of the PTA unit are operated using nitrogen in a closed loop. Please confirm if product conveyance is enclosed. Are the vents from this enclosed system directed to the flare, RTOs or scrubber system?	The closed loop system description refers to the use of nitrogen return lines that allow for the recycling of the nitrogen. The nitrogen has a cost and is not vented directly to atmosphere, except during maintenance. There are no GHG emissions associated with this operation.
17	2.E.x	Are the vents from this enclosed system directed to the flare, RTOs or scrubber system?	See answer number 16 above

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
18	2.E.x	If the product conveyance is not enclosed, is this a potential GHG emission source? Typically CO2 emissions are associated with combustion pollutants and CH4 is associated with VOC pollutants, therefore if M&G believes that such emission sources do not have the potential to experience a change in the amount of GHG pollutants emitted as a result of this project, please provide an explanation.	See answer number 16 above
19	2.F.iii	M&G proposes a numerical energy efficiency based BACT limit for maximum exhaust gas temperature of 320°F. The proposed BACT does not appear to include the thermal efficiency of the heaters. Please provide supplemental technical data that includes the thermal efficiency of the process gas heaters.	The preliminary vendor specified efficiency of the HTF heater is greater than 80%. The efficiency value is referred to the design air temperature and according to ASME Test Code PTC 4.1 Ed 88 (Abbreviated) and based on fuel lower heating value (LHV).
20	2.F.v	From the prepolymerization system onward, all equipment is maintained under vacuum conditions to promote reactions and to remove the reaction side products. The vacuum is maintained in each CP line through a system of glycol vapor ejectors with three inter-condensers and a liquid ring vacuum pump. Vapor streams from the liquid ring vacuum pump bubble into the esterifier seal pot. Please provide supplemental information that explains how make-up liquid is provided back into the vacuum liquid ring pump seal pots to ensure proper operation of the pump. What will be implemented to alert on-site personnel to problems?	This is an integral part of the PET process that M&G operates at several plants around the world. The plant will be operated to maximize online time. There are no GHG emissions associated with this operation.
21	2.F.v	Is there continuous monitoring of the system?	This is an integral part of the PET process that M&G operates at several plants around the world. The plant will be operated to maximize online time. There are no GHG emissions associated with this operation.
22	2.F.v	Are there low/high level alarms?	This is an integral part of the PET process that M&G operates at several plants around the world. The plant will be operated to maximize online time. There are no GHG emissions associated with this operation.
23	2.F.v	Is the ethylene glycol system a potential GHG source?	There are no GHG emissions associated with the ethylene glycol system operation.
24	2.F.v	Does the ethylene glycol system impact the potential GHG emissions from other equipment?	The ethylene glycol system does not impact the GHG emissions associated with other equipment.
25	2.F.v	Besides monitoring the liquid level of the ethylene glycol system, will there be continuous monitoring of other operating parameters (e.g., pressure) of the process equipment?	This is an integral part of the PET process that M&G operates at several plants around the world. The plant will be operated to maximize online time. There are no GHG emissions associated with this operation.

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
26	2.F.v	What is the proposed compliance strategy for ensuring that the vacuum system is properly functioning?	This is an integral part of the PET process that M&G operates at several plants around the world. The plant will be operated to maximize online time. This is not a GHG source and does not require a GHG compliance plan.
27	2.F.v	What operating parameters will be monitored to ensure the maintaining of a vacuum around the CP system and no venting to the atmosphere?	This is an integral part of the PET process that M&G operates at several plants around the world. The plant will be operated to maximize online time. There are no GHG emissions associated with this operation.
28	2.F.v	Will there be concerns for solid carry-over or plugging around the vapor ejectors or other vacuum equipment?	This is an integral part of the PET process that M&G operates at several plants around the world. The plant will be operated to maximize online time. There are no GHG emissions associated with this operation. Solids are separated before entering into the vapor ejectors. Vapor ejectors as operated by M&G are not normally affected by fouling by solids.
29	2.F.v	Please confirm the design type for the inter-condensers. (i.e., direct-contact, shell and tube, etc)	The inter-condensors are direct contact. This is an integral part of the PET process that M&G operates at several plants around the world. The plant will be operated to maximize online time. There are no GHG emissions associated with this operation.
30	2.F.viii	It is stated that during instances when off-spec material is produced, silos are used to store off-spec material. Also, the amorphous PET chips produced as feedstock for the SSP unit are stored in silos. Is this a potential GHG source? Please provide an explanation.	Off-specification PET will not emit CO2, CH4 or other GHGs. This is not a potential source of GHG emissions.
31	2.F.ix	The CP unit is designed to recover scraps coming from the PET production plant (both from CP and SSP) and further recycling in the process. Is this recycling process enclosed?	Off-specification PET will not emit CO2, CH4 or other GHGs. This is closed process and is not a potential source of GHG emissions.
32	2.F.ix	If not, are fugitive or dust suppressants necessary and is it utilized?	Off-specification PET will not emit CO2, CH4 or other GHGs. This is closed process and is not a potential source of GHG emissions.

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
33	2.F.x	Provide supplemental technical data that includes the design efficiency of the heat transfer fluid system.	The HTF fluid system is an integral part of the PET process that M&G operates at several plants around the world. The HTF heaters are designed to match the performance specifications for the HTF fluid system. The compliance of the HTF fluid systems is demonstrated by the performance of the HTF , as represented in the permit application. The plant will be operated to maximize online time. There are no separate GHG emissions associated with the HTF fluid systems.
34	2.F.x	What parameters will be monitored and recorded to ensure this system is operating as designed?	The HTF heaters performance demonstrates the operating performance of the HTF fluid systems. There are no separate GHG emissions associated with the HTF fluid systems.
35	2.F.x	What is the proposed compliance strategy for the heat recovery system?	See response to number 34.
36	2.F.x	The process gas for the crystallization system uses nitrogen. The fluidizing nitrogen leaving the fluid bed heater(s) passes through multi-cyclones and a filter. Then, the nitrogen is heated and sent back to the crystallizer in closed loop. How is heat transferred to the nitrogen?	Heat Transfer Fluid (HTF) is used as the source of heat.
37	2.F.x	What is used to heat the nitrogen?	HTF is used to heat the nitrogen, in a non-contact tube/fin heat exchanger.
38	2.F.xi	In the GTU, the gas is heated and sent to a catalytic bed reactor, where the oxidation of volatile organic compounds coming from the crystallization and SSP reaction units takes place. Where are the vents from the catalytic bed directed?	There is no vent stream. The gas continues to be recycled in the process. The catalytic bed reactor is used to convert organics in the recycled gas stream and eliminate potential build up of VOCs within the system. Any CO2 emissions are accounted for in the fugitive calculations.
39	2.F.xi	Is heat recovery from this vent stream possible?	The heat stays within the process as the gas steam is continuously recycled.

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
40	2.F.xi	Is the heat from this vent stream recouped by preheating the gas before it is fed to the catalytic bed reactor?	The heat stays within the process as the gas stream is continuously recycled.
41	2.F.xi	What is used to preheat the inert gas used in the molecular sieve drier?	The gas passed through the molecular sieve is not heated, on the contrary it is cooled down before being fed to the molecular sieve bed.
42	2.F.xi	After removal of by-products, the "clean gas" leaving the GTU is then heated up, and sent to the SSP unit. What is used to heat the "clean gas"?	The process stream passing through the GTU is used to preheat the gas, before it is fed to the GTU through a shell and tube heat exchanger. After heat recovery, the stream leaving the GTU unit is recycled.
43	2.F.xii	The SSP reaction section comprises a horizontal inclined rotating cylinder (SSP reactor) in which inert gas is flowing counter current with respect to the chips flow direction. How is this accomplished?	The chips flow through the inclined rotary cylinder by gravity and through rotation of the reactor. The SSP reactor system is very much like a cement kiln.
44	2.F.xii	Does the inert gas suspend the chips?	No, see answer to number 43 above.
45	2.F.xii	Are the chips on some type of conveyor system?	No, see answer to number 43 above.
46	2.F.xiii	After the SSP reactor, chips are cooled in a fluidized bed that is operated with air. Is it possible to recover heat from the air used to cool the chips?	No, the chips are at approximately 440 deg F at that point in the process and the process air temperature is approximately 220 degF, which is too low to efficiently recover usable heat.
47	2.G	The proposed project will include the installation of a cooling tower that will be comprised of 10 modules which will supply cooling water to both the PET plant and the utility plant. Is it possible for GHG emissions to be present in the process water cooling towers due to process equipment leaks into the system or CO_2 entrainment? Please provide an explanation.	There are no GHG emissions associated with the cooling towers.
48	2.G	If there is a possibility for GHG emissions, please supplement the BACT analysis with an evaluation of leak repair and monitoring technologies and a proposal of what M&G would propose as BACT.	There are no GHG emissions associated with the cooling towers.
49	2.G	What is the proposed compliance strategy for the cooling tower?	There are no GHG emissions associated with the cooling towers.
50	2.G	Does the process include direct-contact coolers/condensers?	There are no GHG emissions associated with the cooling towers.

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
51	2.H	PET chips are conveyed within the plant units and to/from the rail yard. Ambient air is filtered and then pressurized at the desired value using oil-free, water cooled centrifugal compressors. What drives these compressors (i.e., electric, steam)?	The compressors are driven by electric motors.
52	2.I	The liquid stream from the tank farm scrubber is sent to the WWTP. Is the tank scrubber a potential GHG source?	There are no GHG emissions associated with tank scrubber operation.
53	2.I	If so, a BACT analysis should be developed for the tanks to be installed for the project.	Not Applicable
54	2.J	Dock, rail yard and truck loading and unloading of product and raw materials is included. Are any of these potential GHG sources?	There are no GHG emissions associated with the stationary equipment. Barge, truck and rail car unloading racks GHG emissions would only be from the mobile vehicles, not the tanks or loading operations.
55	2.J	If so, a BACT analysis should be developed for the identified method of loading and/or unloading of product and/or raw materials. Please include the pollution controls that were evaluated.	Not Applicable
56	2.J	Will there be operating or work practice standards implemented to minimize GHG emissions generated during the truck loading operation? Please provide supplemental information that details these procedures.	Not Applicable
57	2.K	Please provide design efficiency data for the emergency generator and fire pump engines.	The final engine models have not been selected. They will be new Caterpillar diesel engines that will meet the requirements of 40 CFR 60 Subpart IIII, for Compression Ignition Internal Combustion Engines. A review of typical engines in the design range provides an approximate efficiency of 33-35%.
58	3	M&G is proposing to select a PET process that eliminates the second esterification step found in traditional CP units at PET plants and reduces the total energy required during the esterification unit operation by the number of heated vessels. If possible, please provide the number of heated vessels that will be reduced using the chosen technology instead of traditional technology.	One large esterification reactor, and its associated energy demand, is eliminated.
59	3	For single step esterification in the CP unit, if possible quantify the reduction in fuel and/or GHG emission production.	A comparison of technologies and their energy consumption is provided in Attachment B.
60	3	M&G is proposing to construct a SSP unit that eliminates the precrystallization and crystallization steps found in traditional SSP units. This is contradicted elsewhere. Please clarify statements made on page 28 that asserts its elimination.	The technology operated by M&G will eliminate the traditional precrystallization and crystallization steps and will require only one crystallization step before entering into the rotating reactor.

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
61	3	Provide supplemental information that compares the efficiency gains in heat and electricity consumption or reduction in GHG emissions for chosen technology versus traditional PET technology.	A comparison of technologies and their energy consumption is provided in Attachment B.
62	3	Provide a copy of any technical resources used to evaluate the design decisions for the M&G facility and any benchmark comparison data of similar sources existing nationally or internationally, that may have been utilized in the design selection strategy.	A comparison of technologies and their energy consumption is provided in Attachment B.
63	3	Please provide technical resources, literature and calculations to substantiate the claimed efficiencies.	A comparison of technologies and their energy consumption is provided in Attachment B.
64	4	Please provide supplemental information that quantifies the amount of potential GHG emissions that will be minimized and reduces the amount of imported natural gas by using the biogas generated from the WWTP as fuel to the process heaters.	A comparison of technologies and their energy consumption is provided in Attachment B.
65	4	If possible please provide an estimate on how long the biogas will be flared.	The biogas may be flared for up to 8760 hours a year. The goal is to recover the heat content of the biogas in the HTF heaters for use in the process. The biogas will either be combusted in the flare or in the HTF heaters resulting in the same level of GHG emissions.
66	4	Please confirm if the biogas is the only vent stream directed to the flare.	Biogas is the only vent stream routed to the flare.
67	5	Please provide manufacturers data for the process heaters, RTOs, flare, emergency generator engine and fire pump engine.	The manufacturers final specifications have not been finalized at this date. The process parameters required for GHG emission calculation have been determined as part of the preliminary design package. Final specifications will not be available for approximately a year or more as the facility goes through detailed design.
68	5	If possible, please provide supplemental data comparing the energy efficiency and production of GHG emissions of the chosen equipment to similar or existing sources.	A separate discussion of overall process benchmarking is attached.
69	5	Please provide the technical assessment conducted to compare the performance of the equipment considered for this project.	A separate discussion of overall process benchmarking is attached.
70	6	Provide the production capacity for PET and PTA the proposed facility.	The PTA annual production rate is 1,440,000 metric tons (1,587,328 short tons). The PTE annual production rate is 1,200,000 metric tons (1,322,774 short tons).

Responses to Process Description, BACT Updates, and Supplemental Information Requests in February 5, 2014 EPA letter:

ZEC Counter	I-Letter No.	Instruction	Response
71	7	Please supplement the application by indicating whether your proposed BACT includes MSS emissions for the overall process, or provide supplemental information that details why a different BACT limit is needed during MSS along with a proposed BACT analysis for such startup/shutdown emissions.	The GHG emissions from this facility are due to combustion with a very minor contribution from the waste water treatment plant generated biogas and natural gas fugitives. The MSS emissions from all sources are expected to the same or less than normal operational emissions. A separate MSS limit is not required.
72	8	Please provide the site-specific parameters that were used to evaluate and eliminate CCS from consideration. Please include cost of construction, operation and maintenance, cost per ton of C02 removed by the technologies evaluated and include the feasibility and cost analysis for storage or transportation for these options.	See Attachment B of the March 14, 2014 supplemental response.
73	8	Please discuss in detail any site specific safety or environmental impacts associated with a CCS removal system.	No new safety considerations are expected from the carbon capture, separation and compression operations expected with a CCS system. The power demand of the CCS system will require new electricity generation, which will be generated using fossil fules increasing pollution from both conventional pollutants, such as CO, NOx and PM, and greenhouse gases. The amine system reboiler will require increased natural gas consumption, which also will increase pollution from conventional and nonconventional combustion byproducts.
74	9	M&G will utilize an energy efficient design for the heaters. Please provide supplemental information for the process heaters.	The manufacturers final specifications have not been finalized at this date. The process parameters required for GHG emission calculation have been determined as part of the preliminary design package. Final specifications will not be available for approximately a year or more as the facility goes through detailed design. Preliminary specifications are as provided in the response to number 19.
75	9	If possible, please provide benchmark data that compares similar industries with existing or similar heaters that utilize the same technology.	The HTF heaters are an integrated part of the PET plant design that has been operated successfully at installations in Brazil and Mexico in the two largest PET plants in the world. Alternative heater designs are not considered a reasonable technical option for this facility.
76	10	Provide updated emission tables using the new GWPs so that EPA can cross-check its own calculations.	Revised GHG calculations are attached.

ATTACHMENT B

zephyr

ATTACHMENT B
M&G Resins GHG PSD Permit Application

Response to CCS question #8 in EPA letter dated February 5, 2014.

> *8. Please provide the site-specific parameters that were used to evaluate and eliminate CCS from consideration. Please include cost of construction, operation and maintenance, cost per ton of CO2 removed by the technologies evaluated and include the feasibility and cost analysis for storage or transportation for these options. Please discuss in detail any site specific safety or environmental impacts associated with a CCS removal system.*

For the economic analysis of CCS, M&G Resins assumed that an amine based scrubbing system and associated compressors would be used. While not fully proven on gas-fired turbine flue gas or process heater exhaust, amine based scrubbing systems are the most mature technology potentially available for CCS. To calculate the cost of CCS, M&G Resins used cost information from a DOE-NETL study from 2010 to determine the capital cost of the amine scrubbing system and associated compressors. Costs were revised assuming a 12-inch diameter, 440-mile long pipe to deliver the compressed CO2 to the SACROC CO2 pipeline manifold in Scurry County, TX. CO2 injection in enhanced oil recovery (EOR) projects is cannot be considered as sequestration due to the inherent differences in the goals of EOR. However, there is a market for CO2 for EOR project and the pipelines originating in Scurry County supply the majority of exiting EOR projects in the Permian Basin. This destination is the most likely to be able to receive and distribute additional CO2. Note that EOR revenues cannot be guaranteed nor can available capacities in current EOR pipelines. EOR projects are driven by the recovery of oil and will end when the cost of oil recovery no longer makes financial sense, therefore the long term viability of EOR as a CO2 destination is not assured.

A 12-inch pipe is conservatively small and underestimates the costs for constructing the pipeline as a similar length pipeline project in Texas has an estimated $1 Billion cost (BridgeTex Pipeline 450 miles from Permian Basin to Houston).
http://articles.chicagotribune.com/2013-05-31/news/sns-rt-usa-pipelineoil-factboxl2n0ec1r6-20130531_1_eagle-ford-shale-oil-pipeline-enbridge-inc-origin-destination/3

Note also that the liability and property issues related to underground CO2 storage have not been fully resolved. CCS cost estimates provided by DOE-NETL did not include an escalation factor to account for increasing costs as available sinks begin to fill up or the ongoing monitoring costs associated with a sequestration project.

An updated capital cost estimate is included as Attachment B.1 to this submittal.

ATTACHMENT B.1

Scaling Factor Calculations
Utilizing DOE-NETL Combined-Cycle Gas Turbine Cost Example

Years of Operation for Levelization: 30

Cost Type	Units	Cost (millions $)	Reference
Carbon Capture Systems - Capital Expense Estimation			
CO2 Removal System	$ (million)	215.943	[1]
CO2 Compression System		24.39	[1]
Cooling Water System		8.483	[1]
Accessory Electric Plant		11.151	[1]
Instrumentation and Control		1.828	[1]
Total Costs		**261.80**	
Owner's Costs		6.76	[1]
Inventory Capital		1.458	[1]
Initial Cost for Chemicals		0.823	[1]
Other Owner's Costs		38.45	[1]
Financing Costs		6.921	[1]
Total Overnight Costs		**316.21**	
Carbon Capture Systems-Operational Expense Estimation			
Annual Electrical Power Requirements	MWh/yr	714,028	[1]
Electrical Power Unit Cost	$/MWh	58.00	[1]
Annual Electrical Power Costs	$ (million/yr)	41.41	[1]
Annual Fixed Operating Costs		7.14538	[1]
Annual Variable Operating Costs		3.582561	[1]
Subtotal		**52.14**	
Total Capture Expense Estimation			
Annual Tons of CO2 Sequestered	Short Tons/yr	1,495,489	[1]
Total CO2 Tons Sequestered Throughout Lifespan	Short Tons	44,864,670	[1]
Capital Recovery Factor		0.093	
Indirect Annual Cost (CRF * TCI)	$ (million)/yr	29.42	[1]
Annual Operating Expense	$ (million)/yr	52.14	[1]
Per CO2 Ton Capital Expense	$/Ton CO2 Avoided	19.67	[1]
Per CO2 Ton Operating Expense	$/Ton CO2 Avoided	34.87	[1]
	$/Ton CO2 Captured and Compressed	**54.54**	

Reference [1]: DOE-NETL Report: Cost and Performance Baseline for Fossil Energy Plants
Volume 1: Bituminous Coal and Natural Gas to Electricity
Revision 2a, September 2013
Natural Gas Combined Cycle Plants

M&G Annual CO2 Tons Sequestered	Short Tons/Yr.	1,028,342	<90% of Carbon Dioxide Captured
CCGT Annual CO2 Tons Sequestered	Short Tons/Yr.	1,495,489	<90% of Carbon Dioxide Captured
Adjustment Factor	**M&G/NRG Tons/CCGT Tons**	**0.69**	**< Will be utilized to scale the CAPEX and OPEX expenditures for M&G**

M&G PET PLANT
CARBON CAPTURE AND STORAGE SYSTEM
COST ESTIMATE
Carbon Capture and Compression

Adjusted Cost Factors For M&G Facility

Years of Operation: 30

Cost Type	Units	Value	
Carbon Capture Systems - Capital Expense Estimation			
CO2 Removal System	$ (million)	148.49	
Collection System Duct Work		100.00	
CO2 Compression System		16.77	
Cooling Water System		5.83	
Accessory Electric Plant		7.67	
Instrumentation and Control		1.83	<Non-scaled value
Total Costs		**280.59**	
Owner's Costs		4.65	
Inventory Capital		1.00	
Initial Cost for Chemicals		0.57	
Other Owner's Costs		26.44	
Financing Costs		4.76	
Total Overnight Costs		**318.00**	
Carbon Capture Systems-Operational Expense Estimation			
Annual Power Requirements	MWh/yr	490,986	
Cost of Power	$/MWh	58.00	
Annual Power Costs	$ (million/yr)	28.48	
Annual Fixed Operating Costs		4.91	
Annual Variable Operating Costs		2.46	
Subtotal		**35.85**	
Capture/Compression Expense Estimation			
Annual Tons of CO2 Sequestered	Short Tons/yr	1,028,342	
Total CO2 Tons Sequestered Throughout Lifespan	Short Tons	30,850,258	
Capital Recovery Factor		0.093	
Indirect Annual Cost (CRF * TOC)	$ (million)/yr	29.59	
Annual Operating Expense	$ (million)/yr	35.85	
Per CO2 Ton Capital Expense	$/Ton CO2 Avoided	28.77	
Per CO2 Ton Operating Expense	$/Ton CO2 Avoided	34.87	
$/Ton CO2 Captured and Compressed		**63.64**	

M&G PET PLANT
CARBON CAPTURE AND STORAGE SYSTEM
COST ESTIMATE
Carbon Transport Calcs

Transport Costs for Compressed CO_2 From M&G Facility in Corpus Christi to Scurry County TX

Scurry County Transport Costs			
Pipeline Distance	miles	440.94	
CO2 Daily Flow Rate	short tons/day	2,817	90% of daily CO2 Production
Pipeline Diameter	inches	12	
Pipeline Capital Cost	Million $	354	
CO2 Surge Tank		1.15	
Pipeline Control System		0.11	
Total Pipeline Capital Cost		**355.63**	
Capital Recovery Factor		**0.093**	
Annual Capital Cost	Million $/yr	**33.09**	
Annual O&M Costs		**3.81**	
Annual Cost for Transport		**36.90**	
Total $/ton of CO2 Transported	**$/Ton CO2 Transported**	**35.88**	

Reference: [2] DOE-NETL Report 2010/1447
Estimating Carbon Dioxide Transport and Storage Costs
March 2010

Scurry County TX Pipeline Distances and Capital Costs, Reference: Kinder Morgan Pipeline Cost Metrics			
Terrain	**Capital Cost ($/inch-Diameter/mile)**	**No. Miles of Each Terrain**	**Adjusted Capital Costs**
Flat, dry	$50,000	256.00	$153,600,000
Mountainous	$85,000	141.00	$143,820,000
Marsh, Wetland	$100,000	5.18	$6,216,000
River	$300,000	1.76	$6,338,182
High Population	$100,000	37.00	$44,400,000
Offshore (150'-200' depth)	$700,000	0.00	$0
	Totals:	**440.94**	**$354,374,182**

M&G PET PLANT
CARBON CAPTURE AND STORAGE SYSTEM
COST ESTIMATE
Storage Calcs

Geologic Storage Capital Costs		
	Capital Costs	
Site Screening and Evaluation	$	$4,738,488
No. of Injection Wells (approx 1 per 10K daily CO2 t	No. of Wells	1
Injection Well Cost	$	$647,041
Injection Equipment	$	$483,032
Liability Bond	$	$5,000,000
Total:	**Million $**	**$10.87**
Capital Recovery Factor		**0.124**
Annual Capital Cost of Storage	**Million $/yr**	**$1.35**
Annual Capital Cost of Storage/ton CO2 stored	**$/Ton CO2 Stored**	**$1.31**

	Declining Capital Funds	
Pore Space Acquisition	**$/ton CO2**	**$0.334**
Annual Cost of Pore Space Acquisition	**$/yr**	**$343,466**
Total Cost of Pore Space Acquisition	**Million $**	**$10.30**

Storage O&M		
Normal Annual Expenses (Fixed O&M)	Million $/yr	$4.22
Annual Consumables (Variable O&M)	Million $/yr	$8.44
Annual Surface Maintenance (Fixed O&M)	Million $/yr	$0.12
Annual Subsurface Maintenance (Fixed O&M)	Million $/yr	$3.19
Annual Storage O&M:	**Million $/yr**	**$15.97**
Annual Storage O&M/ton CO2 stored:	**$/ton CO2**	**$15.53**
$/ton of CO2 stored:	**$/Ton CO2 Stored**	**$17.18**

M&G PET PLANT
CARBON CAPTURE AND STORAGE SYSTEM
COST ESTIMATE
Daily CO2 Rate Calcs

GHG Annual Emissions per Unit **Natural Gas Combustion**

Unit	Annual Emissions per Unit (short tons)	No. of Units	Total Emissions (CO2) Combined	
HTF Heaters (natural gas)	72,622	4	290,488	
HTF Heaters (all) (other fuel streams)	7,310	1	7,310	
RTO1	52,932	1	52,932	
RTO2	52,932	1	52,932	
GE LM-6000 Natural Gas Turbine and Duct Burner	363,659	1	363,659	
Auxiliary Boiler A	247,286	1	247,286	
Auxiliary Boiler B	127,995	1	127,995	
Total	**924,736**		**1,142,602**	**TPY**
			3,130	**TPD**

Pipe Diameter Based on TPD Value: 12 inches

NOTE: Small sources and flare emissions are not included in the totals for CCS computations.

NOTE: RTOs may get excluded due to their ultra-low CO2 concentrations.

M&G PET PLANT
CARBON CAPTURE AND STORAGE SYSTEM
COST ESTIMATE
Summary

Summary Costs for CO_2 Capture, Compression, Transport and Storage	Scurry County, TX
CO_2 Capture Costs	
Estimated Capitol Cost of Carbon Capture and Compression Construction ($ million)	$318.0
Annualized Cost of CO_2 Capture Equipment Construction ($ million/yr)	$29.6
Annual Operating Costs of CO_2 Capture Equipment ($ million/yr)	$35.9
Carbon Capture and Compression ($/ton CO_2 avoided)	$63.6
CO_2 Transport Costs	
Estimated Capitol Cost of CO_2 Transport Construction ($ million)	$354.4
Annualized Cost of CO_2 Transport Construction ($ million/yr)	$33.1
Annual Operating and Maintenance Costs for CO_2 Transport ($ million/yr)	$3.8
Transport ($/ton CO_2 avoided)	$35.9
CO_2 Storage Costs	
Estimated Capitol Cost of CO_2 Storage Construction ($ million)	$10.9
Annualized Cost of CO_2 Storage Construction ($ million/yr)	$1.3
Annual Operating and Maintenance Costs for CO_2 Storage ($ million/yr)	$16.0
Storage ($/ton CO_2 avoided)	$17.2
Summary	
Annual CO_2 Emissions from M&G/NRG Plants (tons CO_2/yr)	1,142,602
Total CCS Cost ($/ton CO_2 Avoided @ 90% recovery)	$116.7
Total CCS Capitol Cost ($ million)	$683.2
Total CCS Capitol Cost (Percentage Increase in Project Capitol Cost, base project approx. $1 Billion)	68%