New York State

DEC

Division of Mineral Resources

Appendix 16

Applicability of NOx RACT Requirements for Natural Gas Production Facilities

Draft Supplemental Generic Environmental Impact Statement

Applicability of NOx RACT Requirements for Natural Gas Production Facilities

New York State's air regulation Part 227-2, Reasonably Available Control Technology (RACT) for Oxides of Nitrogen (NOx), applies to boilers (furnaces) and internal combustion engines at major sources.

The requirements of Part 227-2 include emission limits, stack testing, and annual tune-ups, among others. Many facilities whose potential to emit (PTE) air pollutants would make them susceptible to NOx RACT requirements can limit, or "cap", their emissions using the limits within the New York State Department of Environmental Conservation's (DEC) Air Emissions Permits applicability thresholds to avoid this regulation.

New York State has two different major source thresholds for NOx RACT and permitting. Downstate (in New York City and Nassau, Suffolk, Westchester, Rockland, and Lower Orange Counties) the major source permitting and NOx RACT requirements apply to facilities with a PTE of 25 tons/yr or more of NOx. For the rest of the state (where the majority of natural gas production facilities are anticipated to be located), the threshold is a PTE of 100 tons/yr or more of NOx.

If the stationary engines at a natural gas production facility exceed the applicability levels or if the PTE at the facility would classify it as a Major NOx source, the following compliance options are available:

1. Develop a NOx RACT compliance plan and apply for a Title V permit.
2. Limit the facility's emissions to remain under the NOx RACT applicability levels by applying for one of two New York State Air Emissions permits, depending on how low emissions can be limited.

The permitting options for facilities that wish to limit, or "cap", their emissions by establishing appropriate permit conditions are described below.

New York State's air regulation Part 201, Permits and Registrations, includes a provision that allows a facility to register if its actual emissions are less than 50% of the applicability thresholds (less than 12.5 tons/yr downstate and less than 50 tons/yr upstate). This permit option is known as "cap by rule" registration.

Part 201 also includes a provision that allows a facility to limit its emissions by obtaining a State Facility Permit, if its actual emissions are above the 50% level but below the applicability level (between 12.5 and 25 tons/yr downstate and between 50 and 100 tons/yr upstate).

If the facility NOx emissions cannot be capped below the applicablity levels, then the facility should immediately develop a NOx RACT compliance plan. This plan should contain the necessary steps (purchase of equipment and controls, installation of equipment, source testing, submittal of permit application, etc.) and projected completion dates required to bring the facility into compliance. This plan is to be submitted to the appropriate DEC Regional Office as soon as possible. In this case the facility would also be subject to Title V, and a Title V air permit application must be prepared and submitted.

New York State

DEC

Division of Mineral Resources

Appendix 17

Applicability of Proposed Revision of 40 CFG Part 63 Subpart ZZZZ (Engine MACT) for Natural Gas Production Facilities

Draft Supplemental Generic Environmental Impact Statement

Applicability of Proposed Revision of 40 CFR Part 63 Subpart ZZZZ (Engine MACT) for Natural Gas Production Facilities

This action proposes to revise 40 CFR Part 63, Subpart ZZZZ, in order to address hazardous air pollutants (HAP) emissions from existing stationary reciprocating internal combustion engines (RICE) located at area sources. A major source of HAP emissions is a stationary source that emits or has the potential to emit any single HAP at a rate of 10 tons or more per year or any combination of HAP at a rate of 25 tons or more per year. An area source of HAP emissions is a source that is not a major source.

Available emissions data show that several HAP, which are formed during the combustion process or which are contained within the fuel burned, are emitted from stationary engines. The HAP which have been measured in emission tests conducted on natural gas fired and diesel fired RICE include: 1,1,2,2-tetrachloroethane, 1,3-butadiene, 2,2,4-trimethylpentane, acetaldehyde, acrolein, benzene, chlorobenzene, chloroethane, ethylbenzene, formaldehyde, methanol, methylene chloride, n-hexane, naphthalene, polycyclic aromatic hydrocarbons, polycyclic organic matter, styrene, tetrachloroethane, toluene, and xylene. Metallic HAP from diesel fired stationary RICE that have been measured are: cadmium, chromium, lead, manganese, mercury, nickel, and selenium. Although numerous HAP may be emitted from RICE, only a few account for essentially all of the mass of HAP emissions from stationary RICE. These HAP are: formaldehyde, acrolein, methanol, and acetaldehyde. EPA is proposing to limit emissions of HAP through emissions standards for formaldehyde for non-emergency four stroke-cycle rich burn (4SRB) engines, and engines less than 50 HP, and through emission standards for carbon monoxide (CO) for all other engines.

The applicable emission standards (at 15% oxygen) or management practices for existing RICE located at area sources are as follows:

Subcategory	Emission standards at 15 percent O2, as applicable, or management practice	
	Except during periods of startup, or malfunction	During periods of startup, or malfunction
Non-Emergency 4SLB* ≥250HP	9 ppmvd CO or 90% CO reduction	95 ppmvd CO.
Non-Emergency 4SLB 50-250HP	Change oil and filter every 500 hours; replace spark plugs every 1000 hours; and inspect all hoses and belts every 500 hours and re-place as necessary.	Change oil and filter every 500 hours; replace spark plugs every 1000 hours; and inspect all hoses and belts every 500 hours and re-place as necessary.
Non-Emergency 4SRB ≥50HP**	200 ppbvd formaldehyde or 90% formaldehyde reduction.	2 ppmvd formaldehyde.
Non-Emergency CI >300HP	4 ppmvd CO or 90% CO reduction	40 ppmvd CO.

Non-Emergency CI* 50-300HP**	Change oil and filter every 500 hours; inspect air cleaner every 1000 hours; and inspect all hoses and belts every 500 hours and re-place as necessary.	Change oil and filter every 500 hours; replace spark plugs every 1000 hours; and inspect all hoses and belts every 500 hours and re-place as necessary.
Non-Emergency CI <50HP	Change oil and filter every 200 hours; replace spark plugs every 500 hours; and inspect all hoses and belts every 500 hours and re-place as necessary.	Change oil and filter every 200 hours; replace spark plugs every 500 hours; and inspect all hoses and belts every 500 hours and re-place as necessary.

*4SLB - four stroke-cycle lean burn
**4SRB – four stroke-cycle rich burn
***CI – compression ignition

Fuel Requirements

In addition to emission standards and management practices, certain stationary CI RICE located at existing area sources are subject to fuel requirements. stationary non-emergency diesel-fueled CI engines greater than 300 HP with a displacement of less than 30 liters per cylinder located at existing area sources must only use diesel fuel meeting the requirements of 40 CFR 80.510(b), which requires that diesel fuel have a maximum sulfur content of 15 ppm and either a minimum cetane index of 40 or a maximum aromatic content of 35 volume percent.

New York State

DEC

Division of Mineral Resources

Appendix 18

Clean Air Act Unique Regulatory Definition of Facility for the Oil and Gas Industry

Draft Supplemental Generic Environmental Impact Statement

Clean Air Act Unique Regulatory Definition of "Facility" for the Oil and Gas Industry

The definition of facility is important for understanding how this rule applies to the oil and gas industry and how emissions are aggregated for major source determination. In many places of the 1990 Clean Air Act Amendments (CAAA), facilities were defined as sites that were contiguous and under common control by a company. However, for the oil and gas industry, this definition could potentially lead to the aggregation of emissions from dehydrators that are a substantial distance apart, since one company often controls large geographic areas. To avoid this unintended consequence, the Environmental Protection Agency developed a unique definition of facility for the oil and gas industry. Key excerpts from the definition are as follows:

"***Facility*** means any grouping of equipment where hydrocarbon liquids are processed, upgraded (i.e., remove impurities or other constituents to meet contact specifications), or stored prior to the point of custody transfer; or where natural gas is processed, upgraded, or stored prior to entering the natural gas transmission and storage source category. For the purpose of major source determination, facility (including a building, structure, or installation) means oil and natural gas production equipment that is located within the boundaries of an individual surface site as defined in this section. Equipment….will typically be located within close proximity to other equipment… Pieces of production equipment located on different…leases, tracts, or sites…shall not be considered part of the same facility. Examples of facilities…include…well sites, satellite tank batteries, central tank batteries, a compressor that transports natural gas to a natural gas processing plant, and natural gas processing plants."

"***Surface-site*** means any combination of one or more graded pad sites, gravel pad sites, foundations, platforms, or the immediate physical location upon which the equipment is physically affixed."

New York State

DEC

Division of Mineral Resources

Appendix 19

Greenhouse Gas (GHG) Emissions

Draft Supplemental Generic Environmental Impact Statement

Part A

GHG Tables

GHG Tables

Table GHG-1 – Emission Rates for Well Pad[1]

Emission Source/ Equipment Type	CH_4 EF	CO_2 EF	Units	EF Reference[2]
Fugitive Emissions				
Gas Wells				
Gas Wells	0.014	0.00015	lbs/hr per well	Vol 8, page no. 34, table 4-5
Field Separation Equipment				
Heaters	0.027	0.001	lbs/hr per heater	Vol 8, page no. 34, table 4-5
Separators	0.002	0.00006	lbs/hr per separator	Vol 8, page no. 34, table 4-5
Dehydrators	0.042	0.001	lbs/hr per dehydrator	Vol 8, page no. 34, table 4-5
Meters/Piping	0.017	0.001	lbs/hr per meter	Vol 8, page no. 34, table 4-5
Gathering Compressors				
Large Reciprocating Compressor	29.252	1.037	lbs/hr per compressor	GRI - 96 - Methane Emissions from the Natural Gas Industry, Final Report
Vented and Combusted Emissions				
Normal Operations				
1,775 hp Reciprocating Compressor	not determined	1,404.716	lbs/hr per compressor	6,760 Btu/hp-hr, 2004 API, page no. 4-8
Pneumatic Device Vents	0.664	0.024	lbs/hr per device	Vol 12, page no. 48, table 4-6
Dehydrator Vents	12.725	0.451	lbs/MMscf throughput	Vol 14, page no. 27
Dehydrator Pumps	45.804	1.623	lbs/MMscf throughput	GRI June Final Report
Blowdowns				
Vessel BD	0.00041	0.00001	lbs/hr per vessel	Vol 6, page no. 18, table 4-2
Compressor BD	0.020	0.00071	lbs/hr per compressor	Vol 6, page no. 18, table 4-2
Compressor Starts	0.045	0.00158	lbs/hr per compressor	Vol 6, page no. 18, table 4-2
Upsets				
Pressure Relief Valves	0.00018	0.00001	lbs/hr per valve	Vol 6, page no. 18, table 4-2

[1] Adapted from Exhibit 2.6.1, ICF Incorporated, LLC. *Technical Assistance for the Draft Supplemental Generic EIS: Oil, Gas and Solution Mining Regulatory Program. Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low Permeability Gas Reservoirs*, Agreement No. 9679, August 2009., pp 34-35.

[2] Unless otherwise noted, all emission factors are from the Gas Research Institute, *Methane Emissions from the Natural Gas Industry*, 1996. Available at: epa.gov/gasstar/tools/related.html.

Table GHG-2 – Drilling Rig Mobilization, Site Preparation and Demobilization – GHG Emissions

	One-Well Project or Ten-Well Pad						
Emissions Source	Vehicle Miles Traveled (VMT) In-State Sourcing/Out-of-State Sourcing		Total Operating Hours	Vented Emissions (tons CH_4)	Combustion Emissions In-State Sourcing/Out-of-State Sourcing (tons CO_2)		Fugitive Emissions (tons CH_4)
Transportation [3]	1,800 – 3,500	36,000 – 70,000	NA	NA	3 – 6	58 – 112	NA
Drill Pad and Road Construction [4]	NA		48 hours	NA	11		NA
Total Emissions	NA		NA	NA	14 – 17	69 – 123	NA

Table GHG-3 – Completion Rig Mobilization and Demobilization – GHG Emissions

	One-Well Project or Ten-Well Pad					
Emissions Source	Vehicle Miles Traveled (VMT) In-State Sourcing/Out-of-State Sourcing		Vented Emissions (tons CH_4)	Combustion Emissions In-State Sourcing/Out-of-State Sourcing (tons CO_2)		Fugitive Emissions (tons CH_4)
Completion Rig 15 Truckloads[5]	300	6,000	NA	1	10	NA
Total Emissions	NA	NA	NA	1	10	NA

[3] Transportation includes Drill Pad and Road Construction Equipment 10 – 45 Truckloads, Drilling Rig 30 Truckloads, Drilling Fluid and Materials 25 – 50 Truckloads, Drilling Equipment (casing, drill pipe, etc.) 25 – 50 Truckloads. Transportation estimates taken from NTC Consultants, 2009. *Impacts on Community Character of Horizontal Drilling and High Volume Hydraulic Fracturing in the Marcellus Shale and Other Low-Permeability Gas Reservoirs*, p. 13.

[4] Assumed 20 gallons of diesel fuel used per hour with 100% oxidation of fuel carbon to CO_2.

[5] NTC Consultants, August 2009. *Impacts on Community Character of Horizontal Drilling and High Volume Hydraulic Fracturing in the Marcellus Shale and Other Low-Permeability Gas Reservoirs*, p. 13

Table GHG-4 – Well Drilling – GHG Emissions

	One-Well Project					Ten-Well Pad				
Emissions Source	Total Operating Hours	Activity Factor	Vented Emissions (tons CH_4)	Combustion Emissions (tons CO_2)	Fugitive Emissions (tons CH_4)	Total Operating Hours	Activity Factor	Vented Emissions (tons CH_4)	Combustion Emissions (tons CO_2)	Fugitive Emissions (tons CH_4)
Power Engines[6]	168 hours	1	NA	94	NA	1680 hours	1	NA	940	NA
Circulating System[7]	168 hours	1	negligible	NA	negligible	1680 hours	1	negligible	NA	negligible
Well Control System[8]	As needed	1	negligible	negligible	negligible	As needed	1	negligible	negligible	negligible
Total Emissions	NA	NA	negligible	94	negligible	NA	NA	negligible	940	negligible

6 Power Engines include rig engines, air compressor engines, mud pump engines and electrical generator engines. Assumed 50 gallons of diesel fuel used per hour with 100% oxidation of fuel carbon to CO_2.

7 Circulating system includes mud system piping and valves, mud-gas separator, mud pits or tanks and blooie line for air drilling.

8 Well Control System includes well control piping and valves, BOP, choke manifold and flare line.

Table GHG-5 – Well Completion – One-Well Project GHG Emissions

Emissions Source	One-Well Project: Vehicle Miles Traveled (VMT) In-State Sourcing/Out-of-State Sourcing		Total Operating Hours or Fuel Use	Activity Factor	Vented Emissions (tons CH_4)	Combustion Emissions In-State Sourcing/Out-of-State Sourcing (tons CO_2)		Fugitive Emissions (tons CH_4)
Transportation[9]	15,740 – 23,040	314,800 – 460,800[10]	NA	1	NA	25 – 37	504 – 737	NA
Hydraulic Fracturing Pump Engines	NA		29,000 gallons[11]	1	NA	325		NA
Line Heater	NA		72 hours	1	NA	negligible		NA
Flowback Pits/Tanks	NA		72 hours	1	NA	NA		negligible
Flare Stack	NA		72 hours	1	4[12]	576[13]		NA
Rig Engines[14]	NA		24 hours	1	NA	7		NA
Site Reclamation[15]	NA		24 hours	NA	NA	6		NA
Total Emissions	NA		NA	NA	4	939 – 951	1,418 – 1,651	negligible

[9] Transportation includes Completion Fluid and Materials 10 – 20 Truckloads, Completion Equipment (pipe, wellhead) 5 Truckloads, Hydraulic Fracture Equipment (pump trucks, tanks) 150 – 200 Truckloads, Hydraulic Fracture Water 400 – 600 Tanker Trucks, Hydraulic Fracture Sand 20 – 25 Trucks, Flow Back Water Removal 200 – 300 Truckloads, Site Reclamation Equipment 2 Truckloads. Transportation estimates taken from NTC Consultants, 2009. *Impacts on Community Character of Horizontal Drilling and High Volume Hydraulic Fracturing in the Marcellus Shale and Other Low-Permeability Gas Reservoirs*, p. 13.

[10] For illustration purposes, VMT includes out-of state sourcing for all materials including water necessary for hydraulic fracturing. Water required for fracturing more likely to be sourced as close to well pad as possible. Analysis assumes no reuse of flowback fluid.

[11] ALL Consulting, 2009. *Horizontally Drilled/High-Volume Hydraulically Fractured Wells Air Emissions Data*, Table 11, p. 10.

[12] ICF Incorporated, LLC. Technical Assistance for the Draft Supplemental Generic EIS: Oil, Gas and Solution Mining Regulatory Program. Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low Permeability Gas Reservoirs, August 2009, NYSERDA Agreement No. 9679. p. 28.

[13] ICF Incorporated, LLC. Technical Assistance for the Draft Supplemental Generic EIS: Oil, Gas and Solution Mining Regulatory Program. Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low Permeability Gas Reservoirs, August 2009, NYSERDA Agreement No. 9679. p. 28.

[14] Assumed 25 gallons of diesel fuel used per hour with 100% oxidation of fuel carbon to CO_2.

[15] Assumed 20 gallons of diesel fuel used per hour with 100% oxidation of fuel carbon to CO_2.

Table GHG-6 – Well Completion – Ten-Well Pad GHG Emissions

<table>
<tr><th></th><th colspan="8">Ten-Well Pad</th></tr>
<tr><th>Emissions Source</th><th colspan="2">Vehicle Miles Traveled (VMT) In-state Sourcing/Out-of-state Sourcing</th><th>Total Operating Hours or Fuel Use</th><th>Activity Factor</th><th>Vented Emissions (tons CH_4)</th><th colspan="2">Combustion Emissions In-State Sourcing/Out-of-State Sourcing (tons CO_2)</th><th>Fugitive Emissions (tons CH_4)</th></tr>
<tr><td>Transportation[16]</td><td>130,040 – 194,040</td><td>2,600,800 – 3,880,800[17]</td><td>NA</td><td>NA</td><td>NA</td><td>208 – 310</td><td>4,161 – 6,209</td><td>NA</td></tr>
<tr><td>Hydraulic Fracturing Pump Engines</td><td colspan="2">NA</td><td>290,000 gallons</td><td>NA</td><td>NA</td><td colspan="2">3,250</td><td>NA</td></tr>
<tr><td>Line Heater</td><td colspan="2">NA</td><td>72 hours</td><td>1</td><td>NA</td><td colspan="2">negligible</td><td>NA</td></tr>
<tr><td>Flowback Pits/Tanks</td><td colspan="2">NA</td><td>72 hours</td><td>1</td><td>NA</td><td colspan="2">NA</td><td>negligible</td></tr>
<tr><td>Flare Stack</td><td colspan="2">NA</td><td>720 hours</td><td>1</td><td>40</td><td colspan="2">5,760</td><td>NA</td></tr>
<tr><td>Rig Engines[18]</td><td colspan="2">NA</td><td>240 hours</td><td>1</td><td>NA</td><td colspan="2">70</td><td>NA</td></tr>
<tr><td>Site Reclamation[19]</td><td colspan="2">NA</td><td>24 hours</td><td>NA</td><td>NA</td><td colspan="2">6</td><td>NA</td></tr>
<tr><td>Total Emissions</td><td colspan="2">NA</td><td>NA</td><td>NA</td><td>40</td><td>9,294 – 9,396</td><td>13,247 – 15,295</td><td>negligible</td></tr>
</table>

---

[16] Transportation includes Completion Fluid and Materials 10 – 20 Truckloads, Completion Equipment (pipe, wellhead) 5 Truckloads, Hydraulic Fracture Equipment (pump trucks, tanks) 150 – 200 Truckloads, Hydraulic Fracture Water 400 – 600 Tanker Trucks, Hydraulic Fracture Sand 20 – 25 Trucks, Flow Back Water Removal 200 – 300 Truckloads,
Site Reclamation Equipment 2 Truckloads. Transportation estimates taken from NTC Consultants, 2009. *Impacts on Community Character of Horizontal Drilling and High Volume Hydraulic Fracturing in the Marcellus Shale and Other Low-Permeability Gas Reservoirs*, p. 13.

[17] For illustration purposes, VMT includes out-of state sourcing for all materials including water necessary for hydraulic fracturing. Water required for fracturing more likely to be sourced as close to well pad as possible. Analysis assumes no reuse of flowback fluid.

[18] Assumed 25 gallons of diesel fuel used per hour with 100% oxidation of fuel carbon to CO_2.

[19] Assumed 20 gallons of diesel fuel used per hour with 100% oxidation of fuel carbon to CO_2.

Table GHG-7 – First-Year Well Production – One-Well Project GHG Emissions[20]

	One-Well Project							
Emissions Source	Vehicle Miles Traveled (VMT) In-state Sourcing/Out-of-state Sourcing		Total Operating Hours	Activity Factor	Vented Emissions (tons CH_4)	Combustion Emissions In-State Sourcing/Out-of-State Sourcing (tons CO_2)		Fugitive Emissions (tons CH_4)
Production Equipment 5 – 10 Truckloads	100 - 200	2,000 – 4,000	NA	NA	NA	1	3 – 6	NA
Wellhead	NA		7,896 hours[21]	1	NA	NA		negligible
Compressor	NA		7,896 hours	1	not determined	5,546[22] (&4[23])		117[24]
Line Heater	NA		7,896 hours	1	negligible	negligible		negligible
Separator	NA		7,896 hours		NA	negligible		negligible
Glycol Dehydrator	NA		7,896 hours	1	negligible	negligible		negligible
Dehydrator Vents	NA		7,896 hours	1	21[25]	3[26]		negligible
Dehydrator Pumps	NA		7,896 hours	1	76[27]	NA		negligible
Pneumatic Device Vents	NA		7,896 hours	3	8[28]	NA		negligible
Meters/Piping	NA		7,896 hours	1	NA	NA		negligible
Vessel BD	NA		4 hours	4	negligible	NA		negligible
Compressor BD	NA		4 hours	4	negligible	NA		negligible
Compressor Starts	NA		4 hours	4	negligible	NA		negligible
Pressure Relief Valves	NA		4 hours	5	negligible	NA		negligible
Production Brine Tanks	NA		7,896 hours	1	negligible	NA		negligible
Production Brine Removal 44Truckloads	880	17,600	NA	NA	NA	2	28	NA
Total Emissions	NA		NA	NA	105	5,556	5,584 – 5,587	117

[20] First-Year production is the production period in the first year after drilling and completion activities have been concluded. Assumed production 10 mmcfd per well.
[21] Calculated by subtracting total time required to drill and complete one well (36 days) from 365 days.
[22] Combustion emission, Emissions Factor (EF) of 1,404.716 lbs per hour.
[23] Fugitive emission, Emissions Factor (EF) of 1.037 lbs per hour.
[24] One compressor at Emissions Factor (EF) of 29.252 lbs per hour.
[25] Emissions Factor (EF) of 12.725 lbs. per mmcf throughput.
[26] Vented emission, Emissions Factor (EF) of 1.623 lbs per mmcf throughput.
[27] Emissions Factor (EF) of 45.804 lbs. per mmcf throughput.
[28] Emissions Factor (EF) of 0.664 lbs per hour.

Table GHG-8 – Post-First Year Annual Well Production – One-Well Project GHG Emissions[29]

	One-Well Project							
Emissions Source	Vehicle Miles Traveled (VMT) In-state Sourcing/Out-of-state Sourcing		Total Operating Hours	Activity Factor	Vented Emissions (tons CH_4)	Combustion Emissions In-State Sourcing/Out-of-State Sourcing (tons CO_2)		Fugitive Emissions (tons CH_4)
Wellhead	NA		8,760 hours	1	NA	NA		negligible
Compressor	NA		8,760 hours	1	not determined	6,153[30] (&5[31])		128[32]
Line Heater	NA		8,760 hours	1	negligible	negligible		negligible
Separator	NA		8,760 hours		NA	negligible		negligible
Glycol Dehydrator	NA		8,760 hours	1	negligible	negligible		negligible
Dehydrator Vents	NA		8,760 hours	1	23[33]	3[34]		negligible
Pneumatic Device Vents	NA		8,760 hours	3	9[35]	NA		negligible
Dehydrator Pumps	NA		8,760 hours	1	84[36]	NA		negligible
Meters/Piping	NA		8,760 hours	1	NA	NA		negligible
Vessel BD	NA		4 hours	4	negligible	NA		negligible
Compressor BD	NA		4 hours	4	negligible	NA		negligible
Compressor Starts	NA		4 hours	4	negligible	NA		negligible
Pressure Relief Valves	NA		4 hours	5	negligible	NA		negligible
Production Brine Tanks	NA		8,760 hours	1	negligible	NA		negligible
Production Brine Removal 48 Truckloads	960	19,200	NA	NA	NA	2	31	NA
Total Emissions	NA		NA	NA	116	6,163	6,202	128

---

29 Assumed production 10 mmcfd per well.
30 Combustion emission, Emissions Factor (EF) of 1,404.716 lbs per hour.
31 Fugitive emission, Emissions Factor (EF) of 1.037 lbs per hour.
32 Emissions Factor (EF) of 29.252 lbs per hour.
33 Emissions Factor (EF) of 12.725 lbs. per mmcf throughput.
34 Vented emission, Emissions Factor (EF) of 1.623 lbs per mmcf throughput.
35 Emissions Factor (EF) of 0.664 lbs per hour.
36 Emissions Factor (EF) of 45.804 lbs. per mmcf throughput.

Table GHG-9 – First-Year Well Production – Ten-Well Pad GHG Emissions[37]

	Ten-Well Pad							
Emissions Source	Vehicle Miles Traveled (VMT) In-state Sourcing/Out-of-state Sourcing		Total Operating Hours	Activity Factor	Vented Emissions (tons CH_4)	Combustion Emissions In-State Sourcing/Out-of-State Sourcing (tons CO_2)		Fugitive Emissions (tons CH_4)
Production Equipment 5 – 10 Truckloads	100 – 200	2,000 – 4,000	NA	NA	NA	1	3 – 6	NA
Wellhead	NA		120 hours[38]	10	NA	NA		
Compressor	NA		120 hours	3	not determined	253[39] (&1[40])		6[41]
Line Heater	NA		120 hours	3	negligible	negligible		negligible
Separator	NA		120 hours	3	NA	negligible		negligible
Glycol Dehydrator	NA		120 hours	2	negligible	negligible		negligible
Dehydrator Vents	NA		120 hours	1[42]	4[43]	1[44]		negligible
Dehydrator Pumps	NA		120 hours	1[45]	9[46]	NA		negligible
Pneumatic Device Vents	NA		120 hours	6	1[47]	NA		negligible
Meters/Piping	NA		120 hours	1	NA	NA		negligible
Vessel BD	NA		2 hours	9	negligible	NA		negligible
Compressor BD	NA		2 hours	4	negligible	NA		negligible
Compressor Starts	NA		2 hours	4	negligible	NA		negligible
Pressure Relief Valves	NA		2 hours	19	negligible	NA		negligible
Production Brine Tanks	NA		120 hours	2	negligible	NA		negligible
Production Brine Removal 40 Truckloads	NA		NA	NA	NA	NA		NA
Total Emissions	NA		NA	NA	14	256	258 – 261	6

[37] First-Year production is the production period in the first year after drilling and completion activities have been concluded. Assumed production 10 mmcfd per well.
[38] Calculated by subtracting total time required to drill and complete ten wells (360 days) from 365 days.
[39] Combustion emission, Emissions Factor (EF) of 1,404.716 lbs per hour.
[40] Fugitive emission, Emissions Factor (EF) of 1.037 lbs per hour.
[41] Emissions Factor (EF) of 29.252 lbs per hour.
[42] Emissions Factor (EF) based on throughput, not number of units.
[43] Emissions Factor (EF) of 12.725 lbs. per mmcf throughput.
[44] Vented emission, Emissions Factor (EF) of 1.623 lbs per mmcf throughput.
[45] Emissions Factor (EF) based on throughput, not number of units.
[46] Emissions Factor (EF) of 45.804 lbs. per mmcf throughput.
[47] Emissions Factor (EF) of 0.664 lbs per hour.

Table GHG-10 – Post-First Year Annual Well Production – Ten-Well Pad GHG Emissions[48]

Emissions Source	Ten-Well Pad: Vehicle Miles Traveled (VMT) In-state Sourcing/Out-of-state Sourcing		Total Operating Hours	Activity Factor	Vented Emissions (tons CH_4)	Combustion Emissions In-State Sourcing/Out-of-State Sourcing (tons CO_2)		Fugitive Emissions (tons CH_4)
Wellhead	NA		8,760 hours	10	NA	NA		negligible
Compressor	NA		8,760 hours	3	not determined	18,458[49] (&14[50])		384[51]
Line Heater	NA		8,760 hours	3	negligible	negligible		negligible
Separator	NA		8,760 hours	3	NA	negligible		negligible
Glycol Dehydrator	NA		8,760 hours	2	negligible	negligible		negligible
Dehydrator Vents	NA		8,760 hours	1[52]	232[53]	negligible		negligible
Pneumatic Device Vents	NA		8,760 hours	6	18[54]	NA		negligible
Dehydrator Pumps	NA		8,760 hours	1[55]	836[56]	297[57]		negligible
Meters/Piping	NA		8,760 hours	1	NA	NA		negligible
Vessel BD	NA		4 hours	9	negligible	NA		negligible
Compressor BD	NA		4 hours	4	negligible	NA		negligible
Compressor Starts	NA		4 hours	4	negligible	NA		negligible
Pressure Relief Valves	NA		4 hours	19	negligible	NA		negligible
Production Brine Tanks	NA		8,760 hours	2	negligible	NA		negligible
Production Brine Removal 480 Truckloads	9,600	192,000	NA	NA	NA	15	307	NA
Total Emissions	NA		NA	NA	1,086	18,784	19,076	384

[48] Assumed production 10 mmcfd per well.
[49] Combustion emission, Emissions Factor (EF) of 1,404.716 lbs per hour.
[50] Fugitive emission, Emissions Factor (EF) of 1.037 lbs per hour.
[51] Emissions Factor (EF) of 29.252 lbs per hour.
[52] Emissions Factor (EF) based on throughput, not number of units.
[53] Emissions Factor (EF) of 12.725 lbs. per mmcf throughput.
[54] Emissions Factor (EF) of 0.664 lbs per hour.
[55] Emissions Factor (EF) based on throughput, not number of units.
[56] Emissions Factor (EF) of 45.804 lbs. per mmcf throughput.
[57] Vented emission, Emissions Factor (EF) of 1.623 lbs per mmcf throughput.

Table GHG-11 – Estimated First-Year Green House Gas Emissions from One-Well Project

	In-state Sourcing vs. Out-of-state Sourcing					
	CO_2 (tons)		CH_4 (tons)	CH_4 Expressed as CO_2e (tons)[58]	Total Emissions from Proposed Activity CO_2e (tons)	
Drilling Rig Mobilization, Site Preparation and Demobilization	14 –17	69 - 123	NA	NA	14 – 17	69 – 123
Completion Rig Mobilization and Demobilization	1	10	NA	NA	1	10
Well Drilling	94		negligible	negligible	94	
Well Completion including Hydraulic Fracturing and Flowback	939 – 951	1,418 – 1,651	4	100	1,039 – 1,051	1,518 – 1,751
Well Production	5,556	5,584 – 5,587	222	3,650	9,206	9,234 – 9,237
Total	6,604 – 6,619	7,175 – 7,465	226	5,650	12,254 – 12,269	12,825 – 13,115

Table GHG-12 – Estimated Post First-Year Annual Green House Gas Emissions from One-Well Project

	In-state Sourcing vs. Out-of-state Sourcing					
	CO_2 (tons)		CH_4 (tons)	CH_4 Expressed as CO_2e (tons)[59]	Total Emissions from Proposed Activity CO_2e (tons)	
Well Production Total	6,163	6,202	244	6,100	12,263	12,302

[58] Equals CH_4 (tons) multiplied by 25 (100-Year GWP).
[59] Equals CH_4 (tons) multiplied by 25 (100-Year GWP).

Table GHG-13 – Estimated First-Year Green House Gas Emissions from Ten-Well Pad

	In-state Sourcing vs. Out-of-state Sourcing					
	CO_2 (tons)		CH_4 (tons)	CH_4 Expressed as CO_2e (tons)[60]	Total Emissions from Proposed Activity CO_2e (tons)	
Drilling Rig Mobilization, Site Preparation and Demobilization	14 – 17	69 – 123	NA	NA	14 – 17	69 – 123
Completion Rig Mobilization and Demobilization	1	10	NA	NA	1	10
Well Drilling	940		negligible	negligible	940	
Well Completion including Hydraulic Fracturing and Flowback	9,294 – 9,396	13,247 – 15,295	40	1,000	10,294 – 10,396	14,247 – 16,295
Well Production	256	258 – 261	20	500	756	758 – 761
Total	10,505 – 10,610	14,524 – 16,629	60	1,500	12,005 – 12,110	16,024 – 18,129

Table GHG-14 – Estimated Post First-Year Annual Green House Gas Emissions from Ten-Well Pad

	In-state Sourcing vs. Out-of-state Sourcing					
	CO_2 (tons)		CH_4 (tons)	CH_4 Expressed as CO_2e (tons)[61]	Total Emissions from Proposed Activity CO_2e (tons)	
Well Production Total	18,784	19,076	1,470	36,750	55,534	55,826

[60] Equals CH_4 (tons) multiplied by 25 (100-Year GWP).
[61] Equals CH_4 (tons) multiplied by 25 (100-Year GWP).

Part B

Sample Calculations for Combustion Emissions from Mobile Sources

Sample Calculation for Combustion Emissions (CO_2) from Mobile Sources[1]

INPUT DATA: A fleet of heavy-duty (HD) diesel trucks travels 70,000 miles during the year. The trucks are equipped with advance control systems.

CALCULATION METHODOLOGY:

The fuel usage of the fleet is unknown, so the first step in the calculation is to convert from miles traveled to a volume of diesel fuel consumed basis. This calculation is performed using the default fuel economy factor of 7 miles/gallon for diesel heavy trucks provided API's Table 4-10.

$$70{,}000 \frac{miles}{project} \times \frac{gallon\ diesel}{7\ miles} = 10{,}000 \frac{gallons\ diesel\ consumed}{project\ move}$$

Carbon dioxide emissions are estimated using a fuel-based factor provided in API's Table 4-1. This factor is provided on a heat basis, so the fuel consumption must be converted to an energy input basis. This conversion is carried out using a recommended diesel heating value of 5.75×10^6 Btu/bbl (HHV), given in Table 3-5 of this document. Thus, the fuel heat rate is:

$$10{,}000 \frac{gallons}{project\ move} \times \frac{bbl}{42\ gallons} \times \frac{5.75\ x\ 10^6\ Btu}{bbl} = 1{,}369{,}047{,}619 \frac{Btu}{project\ move} (HHV)$$

According to API's Table 4-1, the fuel basis CO_2 emission factor for diesel fuel (diesel oil) is 0.0742 tonne $CO_2/10^6$ Btu (HHV basis).

Therefore, CO_2 emissions are calculated as follows, assuming 100% oxidation of fuel carbon to CO_2:

$$1{,}369{,}047{,}619 \frac{Btu}{project\ move} \times 0.0742 \frac{tonne\ CO2}{10^6} Btu = 101.78 \frac{tonnes\ CO2}{project\ move}$$

To convert tonnes to US short tons:

$$101.78\ tonnes \times 2204.62 \frac{lbs}{tonne} \div 2000 \frac{lbs}{short\ ton} = 112.19\ tons \frac{CO2}{project\ move}$$

[1] American Petroleum Institute (API). *Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Gas Industry*, Washington DC, 2004; amended 2005. pp. 4-39, 4-40.

New York State

DEC

Division of Mineral Resources

Appendix 20

PROPOSED Pre-Frac Checklist and Certification

Draft Supplemental Generic Environmental Impact Statement

PROPOSED PRE-FRAC CHECKLIST AND CERTIFICATION

Well Name and Number:
(as shown on NYSDEC-issued well permit)

API Number:

Well Owner:

Planned Frac Commencement Date:

Yes	No	
☐	☐	Well drilled, cased and cemented in accordance with well permit, or in accordance with revisions approved by the Regional Mineral Resources Manager on the dates listed below and revised wellbore schematic filed in regional Mineral Resources office. <u>Approval Date & Brief Description of Approved Revision(s)</u> *(attach additional sheets if necessary)*
☐	☐	All depths where fresh water, brine, oil or gas were encountered or circulation was lost during drilling operations are recorded on the attached sheet. Additional sheets are attached which describe how any lost circulation zones were addressed.
☐	☐	Enclosed cement bond log verifies top of cement and effective cement bond at least 500 feet above the top of the formation to be fractured or at least 300 feet into the previous casing string. If intermediate casing was used and not cemented to surface, or if intermediate casing was not used and production casing was not cemented to surface, then provide the date of approval by the Department and a brief description of justification. <u>Approval Date & Brief Description of Justification</u> *(attach additional sheets if necessary)*
☐	☐	If fracturing operations will be performed down casing, then the pre-fracturing pressure test required by permit conditions will be conducted and fracturing operations will only commence if test is successful. Any unsuccessful test will be reported to the Department and remedial measures will be proposed by the operator and must be approved by the Department prior to further operations.
☐	☐	All other information collected while drilling, listed below, verifies that all observed gas zones are isolated by casing and cement and that the well is properly constructed and suitable for high-volume hydraulic fracturing. <u>Date and Brief Description of Information Collected</u> *(attach additional sheets if necessary)*
☐	☐	Fracturing products used will be the same products identified in the well permit application materials or otherwise identified and approved by the Department.

I hereby affirm under penalty of perjury that information provided on this form is true to the best of my knowledge and belief. False statements made herein are punishable as a Class A misdemeanor pursuant to Section 210.45 of the Penal Law.

Printed or Typed Name and Title of Authorized Representative
Signature, Date

INSTRUCTIONS FOR PRE-FRAC CHECKLIST AND CERTIFICATION

The completed and signed form must be received by the appropriate Regional office at least 48 hours prior to the commencement of fracturing operations. The operator may conduct fracturing operations provided 1) all items on the checklist are affirmed by a response of "Yes," 2) the *Pre-Frac Checklist And Certification* is received by the Department at least 48 hours in advance and 3) all other pre-frac notification requirements are met as specified in permit conditions. **The well owner is prohibited from conducting fracturing operations on the well without additional Department review and approval if a response of "No" is provided to any of the items in the pre-frac checklist.**

SIGNATURE SECTION

Signature Section - The person signing the *Pre-Frac Checklist and Certification* must be authorized to do so by the Organizational Report on file with the Division.

New York State

DEC

Division of Mineral Resources

Appendix 21

Publically Owned Treatment Works (POTWs) With Approved Pretreatment Programs

Draft Supplemental Generic Environmental Impact Statement

Pretreatment Facilities and Associated WWTPs

Region	Pretreatment Program	Facility	SPDES Number
1	Nassau County DPW - this facility is tracked under Cedar Creek in PCS.	Inwood STP Bay Park STP ***Cedar Creek WPCP	NY0026441 NY0026450 NY0026859
	Glen Cove (C)	Glen Cove STP	NY0026620
	Suffolk DPW	Suffolk Co. SD #3 - Southwest	NY0104809
2	New York City DEP	Wards Island WPCP Owls Head WPCP Newtown Creek WPCP Jamaica WPCP North River WPCP 26th Ward WPCP Coney Island WPCP Red Hook WPCP Tallman Island WPCP Bowery Bay WPCP Rockaway WPCP Oakwood Beach WPCP Port Richmond WPCP Hunts Point WPCP	NY0026131 NY0026166 NY0026204 NY0026115 NY0026247 NY0026212 NY0026182 NY0027073 NY0026239 NY0026158 NY0026221 NY0026174 NY0026107 NY0026191
3	Suffern (V)	Suffern	NY0022748
	Orangetown SD #2		NY0026051
	Orange County SD #1	Harriman STP	NY0027901
	Newburgh (C)	Newburgh WPCF	NY0026310
	Westchester County	Blind Brook Mamaroneck New Rochelle Ossining Port Chester Peekskill Yonkers Joint	NY0026719 NY0026701 NY0026697 NY0108324 NY0026786 NY0100803 NY0026689
	Rockland County SD #1		NY0031895
	Poughkeepsie (C)	Poughkeepsie STP	NY0026255
	New Windsor (T)	New Windsor STP	NY0022446
	Beacon (C)	Beacon STP	NY0025976
	Haverstraw Joint Regional Sewer Board	Haverstraw Joint Regional Stp	NY0028533
	Kingston (C)	Kingston (C) WWTF	NY0029351
4	Amsterdam (C)	Amsterdam STP	NY0020290
	Albany County	North WWTF South WWTF	NY0026875 NY0026867
	Schenectady (C)	Schenectady WPCP	NY0020516
	Rennselaer County SD #1	Rennselaer County SD #1	NY0087971
5	Plattsburgh (C)	City of Plattsburgh WPCP	NY0026018
	Glens Falls (C)	Glens Fall (C)	NY0029050
	Gloversville-Johnstown Joint Board		NY0026042
	Saratoga County SD #1		NY0028240

Region	Pretreatment Program	Facility	SPDES Number
6	Little Falls (C)	Little Falls WWTP	NY0022403
	Herkimer County	Herkimer County SD	NY0036528
	Rome (C)	Rome WPCF	NY0030864
	Ogdensburg (C)	City of Ogdensburg WWTP	NY0029831
	Oneida County		NY0025780
	Watertown		NY0025984
7	Auburn (C)	Auburn STP	NY0021903
	Fulton (C)		NY0026301
	Oswego (C)	Westside Wastewater Facility Eastside Wastewater Facility	NY0029106 NY0029114
	Cortland (C)	LeRoy R. Summerson WTF	NY0027561
	Endicott (V)	Endicott WWTF	NY0027669
	Ithaca (C)		NY0026638
	Binghamton-Johnson City		NY0024414
	Onondaga County	Metropolitan Syracuse Baldwinsville/Seneca Knolls Meadowbrook/Limestone Oak Orchard Wetzel Road	NY0027081 NY0030571 NY0027723 NY0030317 NY0027618
8	Canandaigua (C)	Canandaigua STP	NY0025968
	Webster (T)	Walter W. Bradley WPCP	NY0021610
	Monroe County	Frank E VanLare STP Northwest Quadrant STP	NY0028339 NY0028231
	Batavia (C)		NY0026514
	Geneva (C)	Marsh Creek STP	NY0027049
	Newark (V)		NY0029475
	Chemung County	Chemung County SD #1 Chemung County - Elmira Chemung County - Baker Road	NY0036986 NY0035742 NY0246948
9	Middleport (V)	Middleport (V) STP	NY0022331
	North Tonawanda (C)		NY0026280
	Newfane STP (T)		NY0027774
	Erie County Southtowns	Erie County Southtowns Erie County SD #2 - Big Sister	NY0095401 NY0022543
	Niagara County	Niagara County SD #1	NY0027979
	Blasdell (V)	Blasdell	NY0020681
	Buffalo Sewer Authority	Buffalo (C)	NY0028410
	Amherst SD (T)		NY0025950
	Niagara Falls (C)		NY0026336
	Tonawanda (T)	Tonawanda (T) SD #2 WWTP	NY0026395
	Lockport (C)		NY0027057
	Olean STP (C)		NY0027162
	Jamestown STP (C)		NY0027570
	Dunkirk STP (C)		NY0027961

Mini-Pretreatment Facilities

Region	Facility	SPDES Number
3	Arlington WWTP	NY0026271
3	Port Jervis STP	NY0026522
3	Wallkill (T) STP	NY0024422
4	Canajoharie (V) WWTP	NY0023485
4	Colonie (T) Mohawk View WPCP	NY0027758
4	East Greenbush (T) WWTP	NY0026034
4	Hoosick Falls (V) WWTP	NY0024821
4	Hudson (C) STP	NY0022039
4	Montgomery co SD#1 STP	NY0107565
4	Park Guilderland N.E. IND STP	NY0022217
4	Rotterdam (T) SD2 STP	NY0020141
4	Delhi (V) WWTP	NY0020265
4	Hobart (V) WWTP	NY0029254
4	Walton (V) WWTP	NY0027154
7	Canastota (V) WPCP	NY0029807
7	Cayuga Heights (V) WWTP	NY0020958
7	Moravia (V) WWTP	NY0022756
7	Norwich (C) WWTP	NY0021423
7	Oak Orchard STP	NY0030317
7	Oneida (C) STP	NY0026956
7	Owego (T) SD#1	NY0022730
7	Owego WPCP #2	NY0025798
7	Sherburne (V) WWTP	NY0021466
7	Waverly (V) WWTP	NY0031089
7	Wetzel Road WWTP	NY0027618
8	Avon (V) STP	NY0024449
8	Bath (V) WWTP	NY0021431
8	Bloomfield (V) WWTP	NY0024007
8	Clifton Springs (V) WWTP	NY0020311
8	Clyde (V) WWTP	NY0023965
8	Corning (C) WWTP	NY0025721
8	Dundee STP	NY0025445
8	Erwin (T) WWTP	NY0023906
8	Holley (V) WPCP	NY0023256
8	Honeoye Falls (V) WWTP	NY0025259
8	Hornell (C) WPCP	NY0023647
8	Marion STP	NY0031569
8	Ontario (T) STP	NY0027171
8	Seneca Falls (V) WWTP	NY0033308
8	Walworth SD #1	NY0025704
9	Akron (V) WWTP	NY0031003
9	Arcade (V) WWTP	NY0026948
9	Attica (V) WWTP	NY0021849
9	East Aurora (V) STP	NY0028436
9	Gowanda (V)	NY0032093

New York State

DEC

Division of Mineral Resources

Appendix 22

NYSDEC - Division of Water Hydrofracturing Chemical (HFC) Evaluation Requirements for POTWs

Draft Supplemental Generic Environmental Impact Statement

Form HFC (01/09)

NYSDEC - Division of Water

Hydrofracturing Chemical (HFC) Evaluation Requirements for POTWs

Instructions Page

Note: All requested information must be supplied. Incomplete submissions will not be reviewed.

Applicability

The discharge of wastewater from hydrofracturing gas well operations via a POTW requires prior DEC review and authorization. The POTW must notify the DEC in writing of its intent to accept return or production wastewater from hydrofracturing operations, including the submittal of a headworks analysis. As part of this analysis, the quantity and quality of the wastewater must be evaluated. The attached form is designed for use by the permittee and the well driller or operator to provide the information necessary for the Department to evaluate the HFCs to be used and the quality of the return water to be treated. The DEC will review this submittal as part of its review of the headworks analysis and determine whether a formal SPDES permit modification is necessary.

Notification Requirements and Instructions

HFCs: For **each** proposed HFC, the well drilling concern should complete items 1- 10 on the attached *Hydrofracturing Chemical (HFC) Evaluation Data Sheet.* The well drilling concern may alternately have the hydrofracturing chemical manufacturer complete these sections. This alternative method may be necessary because the HFC manufacturer may be reluctant to reveal trade secret product formulations to the driller.[1]

Return and Production Water: For the return and production water, the well drilling concern should complete items 11 – 17 on the attached form, and sign the certification in Item 18.

Certification: The POTW plant operator must sign and date the certification in Item 19 and submit it to the Department as part of its headworks analysis for the proposed discharge. **Fax or Mail the completed form to** the Bureau of Water Permits, 625 Broadway, Albany, NY 12233-3505**.**

Completing Items 10 and 16 (Toxicity Information) - All reported test data must represent tests conducted in accordance with current EPA toxicity testing manuals and that the results are for the appropriate receiving water (i.e. fresh water or salt water).[2] In general, submissions which do not include any toxicity information will not be authorized. Submissions containing incomplete toxicity information will be reviewed using conservative safety factors that may prevent authorization or result in the permit being modified to include routine whole effluent toxicity testing or other monitoring.

Completing Item 17 (Return Water Analysis) – The return and production water shall be sampled for the parameters listed on Table 17, as well as the following pollutant scans: GC/MS Volatile, GC/MS Base/Neutral, GC/MS Acid, and Metals using GFAA. The pollutant scan sampling results should be included as an attachment. Alternately, all sampling results may be submitted in electronic spreadsheet format. All reported test data must represent tests conducted using Department or EPA approved laboratory methods, and analyzed at an ELAP certified laboratory. For Mercury, Method 1631 shall be used. For proposed discharges, testing results from similar wells drilled in the same formation using the same HFCs are acceptable for purposes of analysis. All radioactive isotopes must be identified as part of this analysis, including measurements of radioactivity in picoCuries/liter.

Phosphorus - The permittee must demonstrate that the use and discharge of any HFCs containing phosphorus, tributary to the Great Lakes Basin or other ponded waters, is necessary and that no acceptable alternatives exist. Please note that in some cases your permit may require modification to regulate phosphorus.

(1) If requested, the Department will restrict access to trade secret information to the extent authorized by law.

(2) **Submission of both acute (48 or 96 hour LC50 or EC50) and chronic (NOEC) test results for at least one vertebrate and one invertebrate species are required**. Refer to the following three manuals: EPA/600/4-90/027F (1993); EPA/600/4-91/002 (1994); EPA/600/4-91/003 (1994); or their replacements.

NYSDEC - Division of Water

Hydrofracturing Chemical (HFC) Evaluation Data Sheet

TO BE COMPLETED BY DRILLING CONCERN OR HFC CHEMICAL SUPPLIER

Note: All requested information must be supplied. Incomplete submissions will not be reviewed.

1.a. Facility Name:	1.b. Facility Location:
2.a. Date Signed by Facility:	2.b. Date Signed by HFC Mfr:
3.a. HFC Name:	
3.b. HFC Manufacturer:	
4. HFC Function:	
5. Method of onsite storage:	
6.a. HFC Daily Dosage to well: average lbs/day = , maximum lbs/day =	
7.a. HFC BOD: (lb/lb) - (mg/l) -	
7.b. HFC COD: (lb/lb) - (mg/l) -	
8.a. Is HFC a NYS registered biocide?	8.b. Registration Number -

9.a. HFC Composition - Ingredients/Impurities (note: ingredients/impurities must total to 100%)	9.b. %	9.c. CAS#	9.d. Injection Concentration
			mg/l
			mg/l
			mg/l
			mg/l
			mg/l
			mg/l
			mg/l
			mg/l
			mg/l

10. HFC Toxicity Info (most sensitive species) - Attach description of endpoint for each EC50 and LOEC.

10.a. Vertebrate Species	LC50	EC50	Chronic NOEC	Chronic LOEC	Other -
	mg/l	mg/l	mg/l	mg/l	
10.b. Invertebrate Species	LC50	EC50	Chronic NOEC	Chronic LOEC	Other -
	mg/l	mg/l	mg/l	mg/l	

NYSDEC - Division of Water

Hydrofracturing Chemical (HFC) Evaluation Data Sheet

11.a. WWTP Name:			11.b. WWTP Location:		
12. SPDES No.:			13. Return Water Source:		
14.a. Date Signed by WWTP:			14.b. Date Signed by Drilling Co.:		
15.a. Return water flow rate: average GPM = , maximum GPM =					
15.b. Proposed HFC return water loading to WWTP:					
average GPM = , maximum GPM=					
16. Return Water Toxicity (most sensitive species) - Attach description of endpoint for each EC50 and LOEC.					
16.a. Vertebrate Species	LC50	EC50	Chronic NOEC	Chronic LOEC	Other -
	mg/l	mg/l	mg/l	mg/l	
16.b. Invertebrate Species	LC50	EC50	Chronic NOEC	Chronic LOEC	Other -
	mg/l	mg/l	mg/l	mg/l	
17. Return Water Analysis: Complete attached table for all detected analytes.					

18. HFC Manufacturer Certification - I certify under penalty of law that this notification and all attachments are, to the best of my knowledge and belief, true, accurate and complete.

Name:	Signature:
Title and Company:	
Telephone:	Fax:

19. Permittee Certification - I certify under penalty of law that this notification and all attachments are, to the best of my knowledge and belief, true, accurate and complete.

Permittee Name:	2.b. SPDES No.:
Contact Name:	
Signature:	Date:
Telephone:	Fax:

20. NYSDEC Approval:

Name:	Signature:
Title:	Date:
Address:	
Telephone:	Fax:

17. Return Water Analysis: Complete the attached table for all analytes detected, and attach the results from the pollutant scans as listed in the instructions. Alternately, this information may be provided on an Excel spreadsheet listing the information in the table below.

WWTP Name:		HFC Source:				Proposed Start Date:			
SPDES No.: NY		WWTP Loading Rates, in lb/day				Percent Removal		Projected Effluent Quality	
Parameter	Return Water Concentration mg/l	Return Water Loading	Present WWTP Loading	Total WWTP Loading	Permitted WWTP Loading	Present WWTP % Removal	Anticipated WWTP % Removal	Maximum Effluent Loading, lb/day	Maximum Effluent Concentration mg/l
pH, range, SU									
Oil and Grease									
Solids, Total Suspended									
Solids, Total Dissolved									
Chloride									
Sulfate									
Alkalinity, Total (CaCO3)									
BOD, 5 day									
Chemical Oxygen Demand (COD)									
Total Kjeldahl Nitrogen (TKN)									
Ammonia, as N									
Total Organic Carbon									
Phenols, Total									
Radium (sum of all isotopes), pCi/l									
Thorium, pCi/l									
Uranium (sum of all isotopes)									
Gross Alpha Radiation, pCi/l									
Gross Beta Radiation, pCi/l									

Please note that a log listing the date, volume, and source of all wastewater accepted from hydrofracturing activites shall be kept and submitted on a monthly basis as an attachment to the facility’s Discharge Monitoring Report.

New York State

DEC

Division of Mineral Resources

Appendix 23

USEPA Natural Gas STAR Program

Draft Supplemental Generic Environmental Impact Statement

TO: Peter Briggs, New York State Department of Environmental Conservation, Mineral Resources

FROM: Jerome Blackman, Natural Gas STAR International

DATE: September 1, 2009

RE: Natural Gas Star

This memo lists methane emission mitigation options applicable in exploration and production; in reference to your inquiry. Natural Gas STAR Partners have reported a number of voluntary activities to reduce exploration and production methane emissions, and major project types are listed and summarized below and may help focus your research as you review the resources available on the Natural Gas STAR website.

In addition to these practices and technologies is an article that lists the same and several more cost effective options for producers to reduce methane emissions. Please refer to the link below.

Cost-Effective Methane Emissions Reductions for Small and Midsize Natural Gas Producers
www.epa.gov/gasstar/documents/CaseStudy.pdf

Reduced Emission Completions
Traditionally, "cleaning up" drilled wells, before connecting them to a production sales line, involves producing the well to open pits or tankage where sand, cuttings, and reservoir fluids are collected for disposal and the produced natural gas is vented to the atmosphere. Partners reported using a "green completion" method in which tanks, separators, dehydrators are brought on site to clean up the gas sufficiently for delivery to sales. The result is reducing completion emissions, creating an immediate revenue stream, and less solid waste.

Partner Recommended Opportunity from the Natural Gas STAR website:
www.epa.gov/gasstar/documents/greencompletions.pdf

BP Experience Presentation with Reduced Emission Completions
www.epa.gov/gasstar/documents/workshops/2008-annual-conf/smith.pdf

Green Completion Presentation from a Tech-Transfer Workshop in 2005 at Houston, TX
www.epa.gov/gasstar/documents/workshops/houston-2005/green_c.pdf

Optimize Glycol Circulation and Install of Flash Tank Separators in Dehydrator
In dehydrators, as triethylene glycol (TEG) absorbs water, it also absorbs methane, other volatile organic compounds (VOCs), and hazardous air pollutants (HAPs). When the TEG is regenerated through heating, absorbed methane, VOCs, and HAPs are vented to the atmosphere with the water, wasting gas and money. Many wells produce gas below the initial design capacity yet

TEG circulation rates remain two or three times higher than necessary, resulting in little improvement in gas moisture quality but much higher methane emissions and fuel use. Optimizing circulation rates reduces methane emissions at negligible cost. Installing flash tank separators on glycol dehydrators further reduces methane, VOC, and HAP emissions and saves even more money. Flash tanks can recycle typically vented gas to the compressor suction and/or used as a fuel for the TEG reboiler and compressor engine.

Lessons Learned Document from the Natural Gas STAR website:
www.epa.gov/gasstar/documents/ll_flashtanks3.pdf

Dehydrator Presentation from a 2008 Tech-Transfer Workshop in Charleston, WV:
www.epa.gov/gasstar/documents/workshops/2008-tech-transfer/charleston_dehydration.pdf

Replacing Glycol Dehydrators with Desiccant Dehydrators

Natural Gas STAR Partners have found that replacing glycol dehydrators with desiccant dehydrators reduces methane, VOC, and HAP emissions by 99 percent and also reduces operating and maintenance costs. In a desiccant dehydrator, wet gas passes through a drying bed of desiccant tablets. The tablets pull moisture from the gas and gradually dissolve in the process. Replacing a glycol dehydrator processing 1 million cubic feet per day (MMcfd) of gas with a desiccant dehydrator can save up to $9,232 per year in fuel gas, vented gas, operation and maintenance (O&M) costs, and reduce methane emissions by 444 thousand cubic feet (Mcf) per year.

Lessons Learned Document from the Natural Gas STAR website:
www.epa.gov/gasstar/documents/ll_desde.pdf

Directed Inspection and Maintenance

A directed inspection and maintenance (DI&M) program is a proven, cost-effective way to detect, measure, prioritize, and repair equipment leaks to reduce methane emissions. A DI&M program begins with a baseline survey to identify and quantify leaks. Repairs that are cost-effective to fix are then made to the leaking components. Subsequent surveys are based on data from previous surveys, allowing operators to concentrate on the components that are most likely to leak and are profitable to repair.

Lessons Learned Documents from the Natural Gas STAR website:
www.epa.gov/gasstar/documents/ll_dimgasproc.pdf
www.epa.gov/gasstar/documents/ll_dimcompstat.pdf

Partner Recommended Opportunity from the Natural Gas STAR website:
www.epa.gov/gasstar/documents/conductdimatremotefacilities.pdf

DI&M Presentation from a Tech-Transfer Workshop in 2008 at Midland, TX
www.epa.gov/gasstar/documents/workshops/2008-tech-transfer/midland4.ppt

New York State

DEC

Division of Mineral Resources

Appendix 24

Key Features of USEPA Natural Gas STAR Program

Draft Supplemental Generic Environmental Impact Statement

Key Features of USEPA Natural Gas STAR Program[1]

Complete information on the Natural Gas STAR Program is given in USEPA's web site (http://epa.gov/gasstar/index.html)

- Participation in the program is voluntary.

- Program outreach is provided through the web site, annual national two-day implementation workshop, and sector– or activity – specific technology transfer workshops or webcasts, often with a regional focus (approximately six to nine per year).

- Companies agreeing to join ("Partners") commit to evaluating Best Management Practices (BMP) and implementing them when they are cost-effective for the company. In addition, "…partners are encouraged to identify, implement, and report on other technologies and practices to reduce methane emissions (referred to as Partner Reported Opportunities or PROs)."

- Best Management Practices are a limited set of reduction measures identified at the initiation of the program as widely applicable. PROs subsequently reported by partners have increased the number of reduction measures.

- The program provides calculation tools for estimating emissions reductions for BMPs and PROs, based on the relevant features of the equipment and application.

- Projected emissions reductions for some measures can be estimated accurately and simply; for example, reductions from replacing high-bleed pneumatic devices with low-bleed devices are a simple function of the known bleed rates of the respective devices, and the methane content of the gas. For others, such as those involving inspection and maintenance to detect and repair leaks, emissions reductions are difficult to anticipate because the number and magnitude of leaks is initially unknown or poorly estimated.

- Tools are also provided for estimating the economics of emission reduction measures, as a function of factors such as gas value, capital costs, and operation and maintenance costs.

- Technical feasibility is variable between measures and is often site- or application- specific. For example, in the Gas STAR Lessons Learned for replacing high-bleed with low-bleed pneumatic devices, it is estimated that "nearly all" high-bleed devices can feasibly be replaced with low-bleed devices. Some specific exceptions are listed, including very large valves requiring fast and/or precise response, commonly on large compressor discharge and bypass controllers.

- Partners report emissions reductions annually, but the individual partner reports are confidential. Publicly reported data are aggregated nationally, but include total reductions by sector and by emissions reduction measure.

---

[1] New Mexico Environment Department, *Oil and Gas Greenhouse Gas Emissions Reductions.* December 2007, pp. 19-20.

New York State

DEC

Division of Mineral Resources

Appendix 25

Reduced Emissions Completion (REC) Executive Summary

Draft Supplemental Generic Environmental Impact Statement

Reduced Emissions Completions – Executive Summary[1]

High prices and high demand for natural gas, have seen the natural gas production industry move into development of the more technologically challenging unconventional gas reserves such as tight sands, shale and coalbed methane. Completion of new wells and re-working (workover) of existing wells in these tight formations typically involve hydraulic fracturing of the reservoir to increase well productivity. Removing the water and excess proppant (generally sand) during completion and well clean-up may result in significant releases of natural gas and methane emissions to the atmosphere (The 40 BCF value is an extension of BP's venting for well-bore deliquification scaled up for the entire basin. It is not due to well clean-up post fracture stimulation).

Conventional completion of wells (a process that cleans the well bore of drill cuttings and fluid and fracture stimulation fluids and solids so that the gas has a free path from the reservoir) resulted in gas being either vented or flared. Vented gas resulted in large amounts of methane, volatile organic compounds (VOCs), and hazardous air pollutants (HAPs) emissions being released to the atmosphere, while flared gas resulted in carbon dioxide emissions.

Reduced emissions completions (RECs) – also known as reduced flaring completions or green completions – is a term used to describe an alternate practice that captures gas produced during well completions and well workovers following hydraulic fracturing. Portable equipment is brought on site to separate the gas from the solids and liquids produced during the completion and process this gas suitably for injection into the sales pipeline. Reduced emissions completions help to mitigate methane, VOC, and HAP emissions during well cleanup and can eliminate or significantly reduce the need for flaring.

RECs have become a popular practice among Natural Gas STAR production partners. A total of eight different partners have reported performing reduced emissions completions in their operations. RECs have become a major source of methane emission reductions since 2000. Between 2000 and 2005 emissions reductions from RECs have increased from 200 MMcf to over 7,000 MMcf. This represents additional revenue from natural gas sales of over $65 million in 2005 (assuming $7/Mcf gas prices).

Method for Reducing Gas Loss	Volume of Natural Gas Savings (Mcf/yr)[1]	Value of Natural Gas Savings ($/yr)[2]	Additional Savings ($/yr)[3]	Set-up Costs ($/yr)	Equipment Rental and Labor Costs ($)	Other Costs ($/yr)[4]	Payback (Months)[5]
Reduced Emissions Completion	270,000	1,890,000	197,500	15,000	212,500	129,500	3

1. Based on an annual REC program of 25 completions per year
2. Assuming $7/Mcf gas
3. Savings from recovering condensate and gas compressed to lift fluids
4. Cost of gas used to fuel compressor and lift fluids
5. Time required to recover the entire annual cost of the program

---

[1] ICF Incorporated, LLC. Technical Assistance for the Draft Supplemental Generic EIS: Oil, Gas and Solution Mining Regulatory Program. Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low Permeability Gas Reservoirs, *Task 2 – Technical Analysis of Potential Impacts to Air*, Agreement No. 9679, August 2009. Appendix 2.1.

New York State

DEC

Division of Mineral Resources

Appendix 26

Instructions for Using The On-Line Searchable Database To Locate Drilling Applications

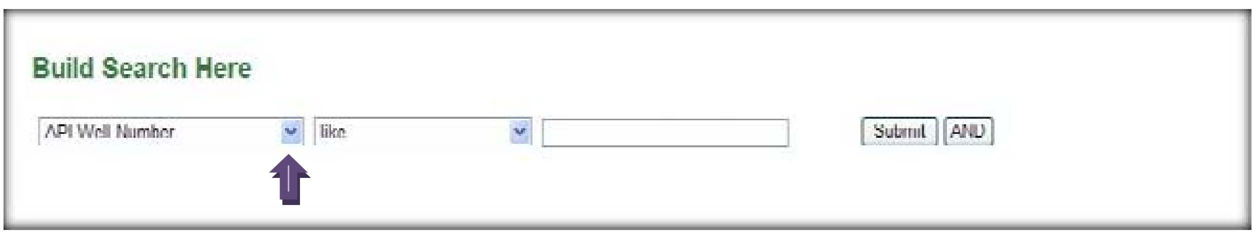
Draft Supplemental Generic Environmental Impact Statement

How to search for a newly applied for permit in the online searchable database

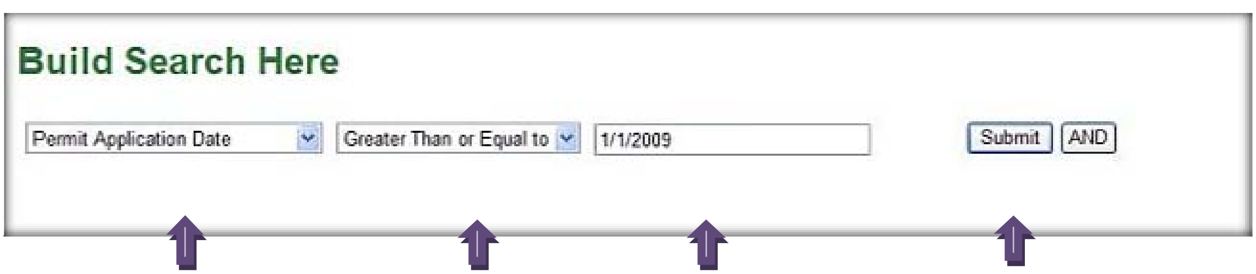
The online searchable database can be found at http://www.dec.ny.gov/cfmx/extapps/GasOil/. It is a very user friendly program and can be used to conduct both simple and complex searches.

1. Select Wells Data to begin your search.

2. Select your search criteria. Use the pull down arrow next to API Number to select your search criteria.



3. To find a new permit application, enter Permit Application Date is Greater Than or Equal to, and the date that you would like to search from. Enter permit application date is Greater Than or Equal to 1/1/year to find all permit applications filed during a specific year. Click the submit button.

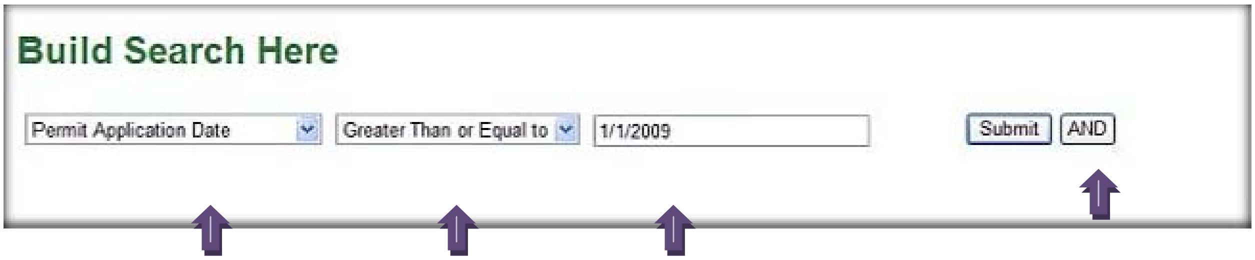


4. View results. By selecting the View Map hyperlink a new window will open to Google Maps showing the well location along with latitude and longitude. The results from your query can be saved to your computer as either an Excel spreadsheet (xls) or as a comma separated value file (csv) by clicking the appropriate Export button at the bottom of the results screen. Clicking a hyperlink in the Company Name column will provide contact information for the company.

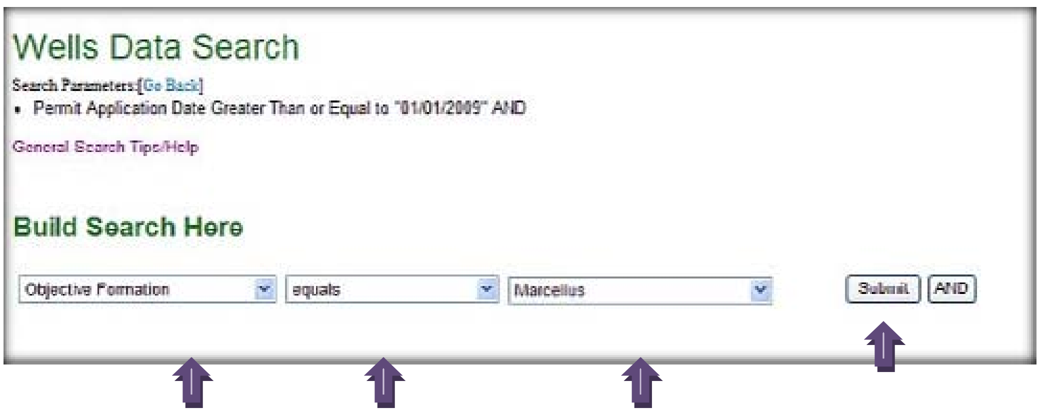
How to search for more specific information utilize the AND button

1. Select Wells Data to begin your search.

2. Select your search criteria. To find all Permits filed in 2009 that target a specific geologic formation, select Permit Application Date is greater than or equal to 1/1/2009. Click the AND button.



3. Select your next set of search criteria. To find all permits applied for in 2009 for the Marcellus formation, select Objective Formation equals Marcellus. Hit the Submit button.



4. View Results.

Wells Data Search

Search Parameters:[Go Back]

- Permit Application Date Greater Than or Equal to "01/01/2009" AND
- Objective Formation equals "Marcellus"

Export XLS | Export CSV

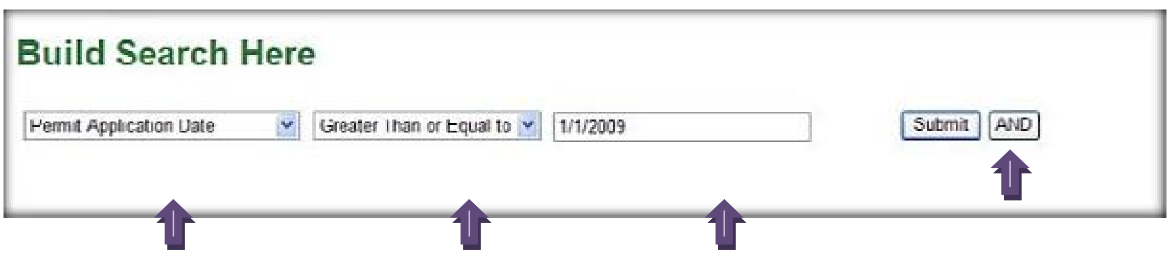
Record Count: 39 Rows: 1 to 39

API Well Number	Production Information	Formation Tops	Casing and Cementing	Hole Number	Well Name	Company Name	Well Type	Well Status	Objective Formation	Producing Formation	County	Town	Map Quadrangle	Quad Section Code	Field	Status Date	Permit Application Date
31007263900000 View Map	N/A	View	N/A	26390	Kark 1H	Chesapeake Appalachia, L.L.C.	NL	AR	Marcellus	Not Applicable	Broome	Fenton	Chenango Forks	F	New Field Wildcat	6/29/2009	6/29/2009
31007263910000 View Map	N/A	View	N/A	26391	Kark 2H	Chesapeake Appalachia, L.L.C.	NL	AR	Marcellus	Not Applicable	Broome	Fenton	Chenango Forks	F	New Field Wildcat	6/29/2009	6/29/2009
31007263920000 View Map	N/A	View	N/A	26392	Kark 3H	Chesapeake Appalachia, L.L.C.	NL	AR	Marcellus	Not Applicable	Broome	Fenton	Chenango Forks	F	New Field Wildcat	6/29/2009	6/29/2009

How to search by submitted Applications and a specific County

1. Select Wells Data to begin your search.

2. Select your search criteria. To find all Permits filed in 2009 in a specific county, select Permit Application Date is greater than or equal to 1/1/2009. Click the AND button.



3. Select your next set of search criteria. To find all permits applied for in 2009 in Allegany County, select County equals Allegany. Click the Submit button.