ENERVEST



July 11, 2014

Department of Environmental Quality
Air Quality Division
120 W. Chapin
Attn. Caryn Owens
Cadillac, MI 49601

RE: Bear Lake 28 CPF - SRN N8032 Violation Letter

Dear Caryn,

The purpose of this correspondence is to respond to your referenced Violation Letter dated June 23, 2014. Ward Lake Energy completes monthly monitoring reports (attached) as required in associated permit #113-08A. Subject monthly reports were reviewed for accuracy utilizing Caterpillar associated emission factors (attached specification sheets) and confirmed that the emission levels tabulated in your violation letter were correct.

The emission levels also shown that the relative fuel usage for subject engines appeared elevated and suggested that the fuel meter may need recalibration. The fuel meter was recalibrated and revealed that a deviation had occurred. Once calibrated the meter was reconnected to each engine and determined that the emissions from both engines have now come into compliance.

Of note, the recalibrated emission tests were completed over a short period of time (hours) and 12-month associate rolling averages were not possible to obtain at that juncture. It is our intention to revisit this issue in several months to better ascertain that subject emissions remain in compliance.

Please call (989) 732-8499 or (231) 946-8200 should you have any questions or should you require additional information.

Sincerely,

Jeffrey A. Riling

Jeff Riling

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## FUEL CONSUMPTION, $NO_x$ AND CO RECORD KEEPING

**Bear Lake 28 CPF**
**SRN N 8032**
**Ward Lake Energy**
**Project #: 080228-2700**
**Compressor Engine Type:** CAT 3516, 1085 HP, 88% Total Fuel Less Dehydrator Fuel (91 mcf/mo.)
**$NO_x$ Permit Limit:** 21.5 tons/year
**CO Permit Limit:** 20 tons/year
***Input Parameters:*** Emission Factors corrected to reflect BTU value of fuel gas.

Conversion Factor = 1,000 mcf to scf
Vendor $EF_{NOx}$ = 0.00055 lb/scf
Vendor $EFC_O$ = 0.0005 lb/scf
Conversiton Factor = 2,000 lb to ton
BTU/scf: 986 Dry

| Month | Year | Fuel Consumption (mcf) | Fuel 12 - Month Rolling (mcf) | Monthly $NO_x$ Emission (tons) | $NO_x$ 12 - Month Rolling (tons) | Monthly CO Emission (tons) | CO 12 - Month Rolling (tons) |
|---|---|---|---|---|---|---|---|
| January | 2012 | 3,374 | 3,374 | 0.928 | 0.928 | 0.844 | 0.844 |
| February | | 3,174 | 6,548 | 0.873 | 1.801 | 0.794 | 1.637 |
| March | | 3,489 | 10,037 | 0.959 | 2.760 | 0.872 | 2.509 |
| April | | 3,329 | 13,366 | 0.915 | 3.676 | 0.832 | 3.342 |
| May | | 3,437 | 16,803 | 0.945 | 4.621 | 0.859 | 4.201 |
| June | | 3,406 | 20,209 | 0.937 | 5.557 | 0.852 | 5.052 |
| July | | 3,568 | 23,777 | 0.981 | 6.539 | 0.892 | 5.944 |
| August | | 3,650 | 27,427 | 1.004 | 7.542 | 0.913 | 6.857 |
| September | | 3,518 | 30,945 | 0.967 | 8.510 | 0.880 | 7.736 |
| October | | 3,627 | 34,572 | 0.997 | 9.507 | 0.907 | 8.643 |
| November | | 3,420 | 37,992 | 0.941 | 10.448 | 0.855 | 9.498 |
| December | | 4,333 | 42,325 | 1.192 | 11.639 | 1.083 | 10.581 |
| **2012 Total** | | **42,325** | - | **11.639** | - | **10.581** | - |
| January | 2013 | 6,787 | 45,738 | 1.866 | 12.633 | 1.697 | 11.435 |
| February | | 5,999 | 48,563 | 1.650 | 13.323 | 1.500 | 12.141 |
| March | | 6,693 | 51,767 | 1.841 | 14.248 | 1.673 | 12.942 |
| April | | 6,520 | 54,958 | 1.793 | 15.096 | 1.630 | 13.740 |
| May | | 6,297 | 57,818 | 1.732 | 15.891 | 1.574 | 14.455 |
| June | | 5,221 | 59,633 | 1.436 | 16.346 | 1.305 | 14.908 |
| July | | 6,720 | 62,785 | 1.848 | 17.190 | 1.680 | 15.696 |
| August | | 6,756 | 65,891 | 1.858 | 18.080 | 1.689 | 16.473 |
| September | | 6,609 | 68,982 | 1.817 | 18.900 | 1.652 | 17.246 |
| October | | 6,973 | 72,328 | 1.918 | 19.878 | 1.743 | 18.082 |
| November | | 6,922 | 75,830 | 1.904 | 20.590 | 1.731 | 18.958 |
| December | | 6,996 | 78,493 | 1.924 | 21.322 | 1.749 | 19.623 |
| **2013 Total** | | **78,493** | - | **21.586** | - | **19.623** | - |
| January | 2014 | 7,137 | 78,843 | 1.963 | 21.635 | 1.784 | 19.711 |
| February | | 6,362 | 79,206 | 1.750 | 21.544 | 1.591 | 19.802 |
| March | | 6,758 | 79,271 | 1.858 | 21.609 | 1.690 | 19.818 |
| April | | 5,985 | 78,736 | 1.646 | 21.523 | 1.496 | 19.684 |
| May | | 6,434 | 78,873 | 1.769 | 21.857 | 1.609 | 19.718 |
| June | | | | | | | |
| July | | | | | | | |
| August | | | | | | | |
| September | | | | | | | |
| October | | | | | | | |
| November | | | | | | | |
| December | | | | | | | |
| **2014 Total** | | | | | | | |
| January | 2015 | | | | | | |
| February | | | | | | | |
| March | | | | | | | |
| April | | | | | | | |
| May | | | | | | | |
| June | | | | | | | |
| July | | | | | | | |
| August | | | | | | | |
| September | | | | | | | |
| October | | | | | | | |
| November | | | | | | | |
| December | | | | | | | |
| **2015 Total** | | | | | | | |

## FUEL CONSUMPTION, $NO_x$ AND CO RECORD KEEPING

**Bear Lake 28 CPF**
**SRN N8032**
**Ward Lake Energy**
**Project #: 080228-2700**
**Compressor Engine Type:** CAT 3306, 145 HP, 12% Total Fuel
**$NO_x$ Permit Limit:** 28.4 tons/yr
**CO Permit Limit:** 5 tons/year
***Input Parameters:***
Conversion Factor = 1,000 mcf to scf
$EF_{NOx}$ = 0.0055 lb/scf
$EFC_O$ = 0.0004 lb/scf
Conversiton Factor = 2,000 lb to ton
BTU/scf: 986 Dry

| Month | Year | Fuel Consumption (mcf) | Fuel 12 - Month Rolling (mcf) | Monthly $NO_x$ Emission (tons) | $NO_x$ 12 - Month Rolling (tons) | Monthly CO Emission (tons) | CO 12 - Month Rolling (tons) |
|---|---|---|---|---|---|---|---|
| January | 2012 | 456 | 456 | 1.245 | 1.245 | 0.093 | 0.093 |
| February | | 429 | 885 | 1.171 | 2.416 | 0.088 | 0.181 |
| March | | 472 | 1,357 | 1.289 | 3.705 | 0.097 | 0.278 |
| April | | 450 | 1,807 | 1.229 | 4.933 | 0.092 | 0.370 |
| May | | 465 | 2,272 | 1.269 | 6.203 | 0.095 | 0.466 |
| June | | 461 | 2,733 | 1.259 | 7.461 | 0.095 | 0.560 |
| July | | 483 | 3,216 | 1.319 | 8.780 | 0.099 | 0.659 |
| August | | 494 | 3,710 | 1.349 | 10.128 | 0.101 | 0.761 |
| September | | 476 | 4,186 | 1.299 | 11.428 | 0.098 | 0.858 |
| October | | 491 | 4,677 | 1.340 | 12.768 | 0.101 | 0.959 |
| November | | 463 | 5,140 | 1.264 | 14.032 | 0.095 | 1.054 |
| December | | 589 | 5,729 | 1.608 | 15.640 | 0.121 | 1.174 |
| **2012 Total** | | **5,729** | - | **15.640** | - | **1.174** | - |
| January | 2013 | 925 | 6,198 | 2.525 | 16.921 | 0.190 | 1.271 |
| February | | 818 | 6,587 | 2.233 | 17.983 | 0.168 | 1.350 |
| March | | 913 | 7,028 | 2.492 | 19.186 | 0.187 | 1.441 |
| April | | 889 | 7,467 | 2.427 | 20.385 | 0.182 | 1.531 |
| May | | 859 | 7,861 | 2.345 | 21.461 | 0.176 | 1.612 |
| June | | 712 | 8,112 | 1.944 | 22.146 | 0.146 | 1.663 |
| July | | 916 | 8,545 | 2.501 | 23.328 | 0.188 | 1.752 |
| August | | 921 | 8,972 | 2.514 | 24.494 | 0.189 | 1.839 |
| September | | 901 | 9,397 | 2.460 | 25.654 | 0.185 | 1.926 |
| October | | 951 | 9,857 | 2.596 | 26.910 | 0.195 | 2.021 |
| November | | 944 | 10,338 | 2.577 | 28.223 | 0.194 | 2.119 |
| December | | 954 | 10,703 | 2.604 | 29.219 | 0.196 | 2.194 |
| **2013 Total** | | **10,703** | - | **29.219** | - | **2.194** | - |
| January | 2014 | 974 | 10,752 | 2.659 | 29.353 | 0.200 | 2.204 |
| February | | 867 | 10,801 | 2.367 | 29.487 | 0.178 | 2.214 |
| March | | 921 | 10,809 | 2.514 | 29.509 | 0.189 | 2.216 |
| April | | 816 | 10,736 | 2.228 | 29.309 | 0.167 | 2.201 |
| May | | 877 | 10,754 | 2.394 | 29.358 | 0.180 | 2.205 |
| June | | | | | | | |
| July | | | | | | | |
| August | | | | | | | |
| September | | | | | | | |
| October | | | | | | | |
| November | | | | | | | |
| December | | | | | | | |
| **2014 Total** | | | | | | | |
| January | 2015 | | | | | | |
| February | | | | | | | |
| March | | | | | | | |
| April | | | | | | | |
| May | | | | | | | |
| June | | | | | | | |
| July | | | | | | | |
| August | | | | | | | |
| September | | | | | | | |
| October | | | | | | | |
| November | | | | | | | |
| December | | | | | | | |
| **2015 Total** | | | | | | | |

G3516

| | | | |
|---|---|---|---|
| Engine Speed (rpm) | 1200 | Fuel | NAT GAS |
| Compression Ratio | 8:1 | LHV of Fuel (Btu/SCF) | 920 |
| Aftercooler Inlet Temperature (°F) | 130 | Fuel System | HPG IMPCO |
| Jacket Water Outlet Temperature (°F) | 210 | | |
| Ignition System | EIS | Minimum Fuel Pressure (psig) | 35 |
| Exhaust Manifold | WATER COOLED | Methane Number at Conditions Shown | 80 |
| Combustion System Type | LOW EMISSION | Rated Altitude (ft) at 77°F Design Temperature | 5000 |

| **Engine Rating Data** | **% Load** | **100%** | **75%** | **50%** |
|---|---|---|---|---|
| Engine Power (w/o fan) | bhp | 1085 | 814 | 542 |
| **Engine Data** | | | | |
| Specific Fuel Consumption (BSFC) (1) | Btu/bhp-hr | 7450 | 7540 | 8104 |
| Air Flow (Wet, @ 77°F, 28.8 in Hg) | SCFM | 2264 | 1680 | 991 |
| Air Mass Flow (Wet) | lb/hr | 10040 | 7450 | 4392 |
| Compressor Out Pressure | in. HG (abs) | 69.2 | 64 | 45.9 |
| Compressor Out Temperature | °F | 287 | 264 | 179 |
| Inlet Manifold Pressure | in. HG (abs) | 62.4 | 47.9 | 30.2 |
| Inlet Manifold Temperature (10) | °F | 139 | 138 | 138 |
| Timing (11) | °BTDC | 33 | 33 | 33 |
| Exhaust Stack Temperature | °F | 842 | 820 | 862 |
| Exhaust Gas Flow (Wet, @ stack temperature, 29.7 in Hg) | CFM | 5977 | 4368 | 2681 |
| Exhaust Gas Mass Flow (Wet) | lb/hr | 10437 | 7756 | 4611 |
| **Engine Emissions Data** | | | | |
| Nitrous Oxides (NOx as NO2) (9) | g/bhp-hr | 2.0 | 2.6 | 4.2 |
| (Corr. 15% 02) | ppm | 129 | 185 | 230 |
| Carbon Monoxide (CO) (9) | g/bhp-hr | 1.8 | 2.0 | 1.8 |
| (Corr. 15% 02) | ppm | 215 | 230 | 236 |
| Total Hydrocarbons (THC) (9) | g/bhp-hr | 3.2 | 3.1 | 2.3 |
| (Corr. 15% 02) | ppm | 677 | 636 | 517 |
| Non-Methane Hydrocarbons (NMHC) (9) | g/bhp-hr | 0.48 | 0.47 | 0.35 |
| (Corr. 15% 02) | ppm | 47 | 43 | 33 |
| Exhaust Oxygen (9) | % | 8.0 | 7.5 | 6.9 |
| Lambda | | 1.56 | 1.50 | 1.24 |
| **Engine Heat Balance Data** | | | | |
| Input Energy LHV (1) | Btu/min | 134707 | 102239 | 73261 |
| Work Output | Btu/min | 46029 | 34522 | 23014 |
| Heat Rejection to Jacket (2) (6) | Btu/min | 40639 | 32950 | 29325 |
| Heat Rejection to Atmosphere (Radiated) (4) | Btu/min | 4554 | 3795 | 3037 |
| Heat Rejection to Lube Oil (5) | Btu/min | 0 | 0 | 0 |
| Total Heat Rejection to Exhaust (to 77°F) (2) | Btu/min | 37337 | 26992 | 17002 |
| Heat Rejection to Exhaust (LHV to 350°F) (2) | Btu/min | 23004 | 16362 | 10751 |
| Heat Rejection to Aftercooler (3) (7) (8) | Btu/min | 6148 | 3980 | 883 |

| | | | |
|---|---|---|---|
| Engine Speed (rpm) | 1800 | Fuel | NAT GAS |
| Compression Ratio | 10.5:1 | LHV of Fuel (Btu/SCF) | 920 |
| Aftercooler Inlet Temperature (°F) | N/A | Fuel System | LPG IMPCO |
| Jacket Water Outlet Temperature (°F) | 210 | | |
| Ignition System | MAG | Minimum Fuel Pressure (psig) | 1.5 |
| Exhaust Manifold | WATER COOLED | Methane Number at Conditions Shown | 80 |
| Combustion System Type | STANDARD | Rated Altitude (ft) at 77°F Design Temperature | 500 |



| **Engine Rating Data** | **% Load** | **100%** | **75%** | **50%** |
|---|---|---|---|---|
| Engine Power (w/o fan) | bhp | 145 | 109 | 73 |
| **Engine Data** | | | | |
| Specific Fuel Consumption (BSFC) (1) | Btu/bhp-hr | 7543 | 8064 | 9134 |
| Air Flow (Wet, @77°F, 28.8 in Hg) | lb/hr | 990 | 799 | 607 |
| Air Mass Flow (Wet) | scfm | 216 | 174 | 132 |
| Compressor Out Pressure | N/A | N/A | N/A | N/A |
| Compressor Out Temperature | N/A | N/A | N/A | N/A |
| Inlet Manifold Pressure | in. Hg (abs) | 26.8 | 21.9 | 17.4 |
| Inlet Manifold Temperature (10) | °F | 102 | 103 | 105 |
| Timing (11) | °BTDC | 30 | 30 | 30 |
| Exhaust Stack Temperature | °F | 1035 | 999 | 957 |
| Exhaust Gas Flow (Wet, @ stack temperature, 29.7 in Hg) | CFM | 711 | 559 | 409 |
| Exhaust Gas Mass Flow (Wet) | lb/hr | 1044 | 842 | 640 |
| **Engine Emissions Data** | | | | |
| Nitrous Oxides (NOx as NO2) (9) | g/bhp-hr | 20.3 | 20.2 | 22.1 |
| (Corr. 15% O2) | ppm | 1461 | 1351 | 1303 |
| Carbon Monoxide (CO) (9) | g/bhp-hr | 1.5 | 1.5 | 1.5 |
| (Corr. 15% O2) | ppm | 171 | 167 | 144 |
| Total Hydrocarbons (THC) (9) | g/bhp-hr | 1.6 | 1.4 | 1.5 |
| (Corr. 15% O2) | ppm | 332 | 279 | 256 |
| Non-Methane Hydrocarbons (NMHC) (9) | g/bhp-hr | 0.24 | 0.21 | 0.22 |
| (Corr. 15% O2) | ppm | 50 | 42 | 38 |
| Exhaust Oxygen (9) | % | 2.0 | 2.0 | 2.1 |
| Lambda | | 1.21 | 1.22 | 1.21 |
| **Engine Heat Balance Data** | | | | |
| Input Energy LHV (1) | Btu/min | 18229 | 14616 | 11037 |
| Work Output | Btu/min | 6149 | 4612 | 3075 |
| Heat Rejection to Jacket (2) (6) | Btu/min | 6971 | 6024 | 5039 |
| Heat Rejection to Atmosphere (Radiated) (4) | Btu/min | 729 | 585 | 441 |
| Heat Rejection to Lube Oil (5) | Btu/min | 0 | 0 | 0 |
| Total Heat Rejection to Exhaust (to 77°F) (2) | Btu/min | 4557 | 3527 | 2554 |
| Heat Rejection to Exhaust (LHV to 350°F) (2) | Btu/min | 3299 | 2514 | 1784 |
| Heat Rejection to Aftercooler (3) (7) (8) | N/A | N/A | N/A | N/A |