

Trump Towers Emissions Testing – August 25, 2011

As part of the NYSERDA REAP Multifamily Performance Program (MPP), combined heat and power (CHP) systems must meet exhaust emission requirements for nitric oxide (NOx) and carbon monoxide (CO). The systems are tested at the end of each performance year, and passing the emissions level is a requirement for receiving the performance portion of the NYSERDA incentive.

Each CHP unit at Trump Towers was tested using a recently calibrated Testo T350 XL portable flue gas analyzer. The analyzer was provided by and calibrated by Clear Air Engineering¹.

The environmental testing occurred over a period of 30 minutes, between 8:30 AM EDT and 9:30 AM EDT. Each engine was operating continuously during the test period, and power output and engine RPM was not observed to fluctuate substantially during the test period. CHP Unit #1 displayed an average power of 60.8 kW @ 1,818 RPM, and CHP Unit #2 displayed an average power of 60.5 kW @ 1,818 RPM.

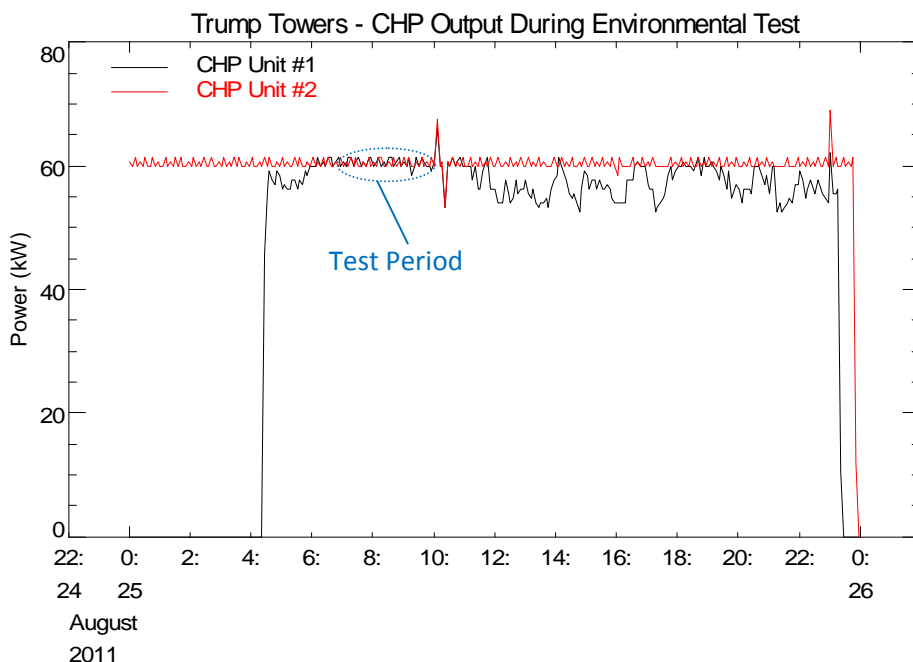


Figure 1. CHP Unit Power Output – August 25, 2011

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Palatine, IL 60067, USA
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<http://express.cleanair.com/PortableGasAnalyzers/testo.html>

The NYSEERDA emissions limits, the resulting calculated exhaust concentrations, and the test results for each CHP unit are shown in Table 1. Test data, including an ambient air reading taken on site and the test probe calibration runs performed by Clean Air Engineering are found at the end of this report.

Table 1. Results of Emissions Testing

| Emission | NYSEERDA Program Limit (lb/MWh) | Calculated Exhaust Concentration (PPM) | CHP Unit #1 Test Results [Failed due to CO] (PPM) | CHP Unit #2 Test Results [Failed due to NOx, CO] (PPM) |
|----------|---------------------------------|--|---|--|
| NOx | 1.6 lb/MWh | 93 | 49 | 119 |
| CO | 6.33 lb/MWh | 605 | >3,000 (off scale) | >3,000 (off scale) |

Both CHP units did not meet the NYSEERDA program emissions limits on CO, and CHP unit #2 did not meet the limit of NOx. A retest will be scheduled after the site has developed and implemented a corrective action plan.

Test Notes:

There is no readily apparent test port on the exhaust breaching in the mechanical room (Figure 2). The emissions test was performed by inserting the probe into the end of the exhaust breaching located on the upper mechanical penthouse roof (Figure 3).



Figure 2. Exhaust Breaching at Engine (CHP #1 as typ) – no test port found



Figure 3. Exhaust Breaching at Roof – probe inserted into breaching approximately 2-feet.

Nominal Emissions Rate Calculation - lb/MWh to PPM

Equipment rating 75 kw/hr red input value
 convert to MW Hr 0.075 Mw/hr blue Calculated value
 Exhaust flowrate 180 scf/min

NYSERDA Nox limit 1.6 lb/MW hr
 NYSERDA CO limit 6.33 lb/MW hr

Equivalent hourly Nox limit for unit 0.12 lb/hr
 Equivalent hourly CO limit for unit 0.47475 lb/hr

Convert lbs per hour to ppm conversion - estimate

$$\text{emission rate } \frac{\text{lb}}{\text{hour}} = \text{measured conc.} \times \frac{1 \text{ ppm}}{1 \times E6} \times \text{exhaust flow } \frac{\text{scf}}{\text{min}} \times 60 \frac{\text{min}}{\text{hour}} \times \frac{1 \text{ lb mol}}{385.5 \text{ scf}} \times \text{Molecular weight } \frac{\text{lbs}}{\text{lb mol}}$$

Constants

| | |
|-----------|-----------------|
| molar vol | 385.5 scf/lbmol |
| Nox MW | 46 lb/lbmol |
| CO MW | 28 lb/lbmol |

| Pollutant | equiv limit | MW | molar vol | | flowrate | | convert | Approx Max concentration (PPM) to meet the limit |
|-----------|-------------|----|-----------|----------|----------|----------|---------|--|
| | lb/hr | | LB/LBMOL | scf/mole | min/hr | dscf/min | to ppm | |
| Nox | 0.12 | 46 | 385.5 | 60 | 180.00 | 1.00E+06 | 93 | |
| CO | 0.47475 | 28 | 385.5 | 60 | 180.00 | 1.00E+06 | 605 | |

Trump #2

Asset #207618

Testo t350 XL

SN: 01948945 /USA

Test 1

08/25/11 08:11:44

Fuel: Test Gas

| | |
|-------|--------------|
| -0.51 | % Oxygen |
| 243 | ppm CO |
| 118 | ppm SO2 |
| 118 | ppm NO |
| 0.0 | ppm NO2 |
| 118 | ppm NOx |
| 0.00 | % CO2 |
| 27.8 | °C Ta |
| 78.3 | °C Tf |
| 8.4 | V Batt. |
| 1.23 | l/m Pump |
| 100.0 | % Efficiency |
| | % Excess air |

Heat transf. °F: --- °F

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Asset #207618

Testo t350 XL

SN: 01948945 /USA

Test 1

08/25/11 08:13:36

Fuel: Test Gas

| | |
|-------|--------------|
| -0.64 | % Oxygen |
| 190 | ppm CO |
| 120 | ppm SO2 |
| 120 | ppm NO |
| 0.0 | ppm NO2 |
| 120 | ppm NOx |
| 0.00 | % CO2 |
| 28.0 | °C Ta |
| 80.0 | °C Tf |
| 8.4 | V Batt. |
| 1.22 | l/m Pump |
| 100.0 | % Efficiency |
| | % Excess air |

Heat transf. °F: --- °F

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Trump #1

Asset #207618

Testo t350 XL

SN: 01948945 /USA

Test 1

08/25/11 07:55:39

Fuel: Test Gas

| | |
|-------|--------------|
| -0.53 | % Oxygen |
| 392 | ppm CO |
| 50 | ppm SO2 |
| 0.0 | ppm NO |
| 50 | ppm NO2 |
| 50 | ppm NOx |
| 0.00 | % CO2 |
| 26.8 | °C Ta |
| 85.9 | °C Tf |
| 8.5 | V Batt. |
| 1.23 | l/m Pump |
| 100.0 | % Efficiency |
| | % Excess air |

Heat transf. °F: --- °F

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Asset #207618

Testo t350 XL

SN: 01948945 /USA

Test 1

08/25/11 07:58:15

Fuel: Test Gas

| | |
|-------|--------------|
| -0.36 | % Oxygen |
| 262 | ppm CO |
| 48 | ppm SO2 |
| 0.0 | ppm NO |
| 48 | ppm NO2 |
| 48 | ppm NOx |
| 0.00 | % CO2 |
| 26.3 | °C Ta |
| 82.6 | °C Tf |
| 8.4 | V Batt. |
| 1.23 | l/m Pump |
| 100.0 | % Efficiency |
| | % Excess air |

Heat transf. °F: --- °F

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Fresh Air

Asset #207618

Testo t350 XL

SN: 01948945 /USA

Test 1

08/25/11 07:59:32

Fuel: Test Gas

| | |
|-------|--------------|
| 20.60 | % Oxygen |
| 0 | ppm CO |
| 0 | ppm SO2 |
| 0 | ppm NO |
| 0.0 | ppm NO2 |
| 0 | ppm NOx |
| --- | % CO2 |
| 26.6 | °C Ta |
| 32.0 | °C Tf |
| 8.5 | V Batt. |
| 1.24 | l/m Pump |
| --- | % Efficiency |
| --- | % Excess air |

Heat transf. °F: --- °F

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Asset #207618

Testo t350 XL

SN: 01948945 /USA

Test 1

08/15/11 14:40:48

Ambient Air
Fuel: Test Gas

| | |
|-------|--------------|
| 20.94 | % Oxygen |
| 0 | ppm CO |
| 0 | ppm SO2 |
| 0 | ppm NO |
| 0.0 | ppm NO2 |
| 0 | ppm NOx |
| 0.00 | % CO2 |
| 27.9 | °C Ta |
| 25.8 | °C Tf |
| 9.1 | V Batt. |
| 1.26 | 1/m Pump |
| --- | % Efficiency |
| --- | % Excess air |

Heat transf.°F: --- °F

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Asset #207618

Testo t350 XL

SN: 01948945 /USA

Test 1

08/15/11 15:00:58

Leak Check
Fuel: Test Gas

| | |
|------|--------------|
| 0.04 | % Oxygen |
| 0 | ppm CO |
| 0 | ppm SO2 |
| 0 | ppm NO |
| 0.0 | ppm NO2 |
| 0 | ppm NOx |
| 0.00 | % CO2 |
| 29.1 | °C Ta |
| 26.5 | °C Tf |
| 9.1 | V Batt. |
| 1.15 | 1/m Pump |
| --- | % Efficiency |
| 0.2 | % Excess air |

Heat transf.°F: --- °F

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Asset #207618

Testo t350 XL

SN: 01948945 /USA

Test 1

08/15/11 15:35:20

2.89002
Fuel: Test Gas

| | |
|------|--------------|
| 2.80 | % Oxygen |
| 0 | ppm CO |
| 4 | ppm SO2 |
| 0 | ppm NO |
| 0.0 | ppm NO2 |
| 0 | ppm NOx |
| 0.00 | % CO2 |
| 27.6 | °C Ta |
| 26.7 | °C Tf |
| 9.0 | V Batt. |
| 1.24 | 1/m Pump |
| --- | % Efficiency |
| 12.0 | % Excess air |

Heat transf.°F: --- °F

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Asset #207618

Testo t350 XL

SN: 01948945 /USA

Test 1

08/15/11 15:04:27

250ppm CO
Fuel: Test Gas

| | |
|-------|--------------|
| -0.05 | % Oxygen |
| 250 | ppm CO |
| 0 | ppm SO2 |
| 0 | ppm NO |
| 0.0 | ppm NO2 |
| 0 | ppm NOx |
| 0.00 | % CO2 |
| 27.7 | °C Ta |
| 26.6 | °C Tf |
| 9.1 | V Batt. |
| 1.20 | 1/m Pump |
| --- | % Efficiency |
| -0.2 | % Excess air |

Heat transf.°F: --- °F

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Asset #207618

Testo t350 XL

SN: 01948945 /USA

08/15/11

15:36:25

Sensor information

O2 :
Sensor ser. # 06851729
Cal gas val. 2.80 %
sensor val. 2.79 %
Calibr. date: 08/15/11

CO :
Sensor ser. # 06546137
Cal gas val. 250 ppm
sensor val. 250 ppm
Calibr. date: 08/15/11

NO :
Sensor ser. # 16545833
Cal gas val. 251 ppm
sensor val. 252 ppm
Calibr. date: 08/15/11

NO2 :
Sensor ser. # 06881474
Cal gas val. 51.0 ppm
sensor val. 51.5 ppm
Calibr. date: 08/15/11

SO2 :
Sensor ser. # 06837525
Cal gas val. 230 ppm
sensor val. 230 ppm
Calibr. date: 08/15/11

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Asset #207618

Testo t350 XL

SN: 01948945 /USA

Test 1

08/15/11 15:10:09

251ppm NO
Fuel: Test Gas

| | |
|-------|--------------|
| -0.05 | % Oxygen |
| 2 | ppm CO |
| 0 | ppm SO2 |
| 251 | ppm NO |
| 0.0 | ppm NO2 |
| 251 | ppm NOx |
| 0.00 | % CO2 |
| 29.3 | °C Ta |
| 26.7 | °C Tf |
| 9.0 | V Batt. |
| 1.22 | 1/m Pump |
| --- | % Efficiency |
| -0.2 | % Excess air |

Heat transf.°F: --- °F

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Asset #207618

Testo t350 XL

SN: 01948945 /USA

Test 1

08/15/11 15:24:19

19.002
51ppm NO2
Fuel: Test Gas

| | |
|------|--------------|
| 0.94 | % Oxygen |
| 0 | ppm CO |
| 7 | ppm SO2 |
| 0 | ppm NO |
| 51.0 | ppm NO2 |
| 51 | ppm NOx |
| 0.00 | % CO2 |
| 29.1 | °C Ta |
| 27.0 | °C Tf |
| 9.0 | V Batt. |
| 1.23 | 1/m Pump |
| --- | % Efficiency |
| 3.6 | % Excess air |

Heat transf.°F: --- °F

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Asset #207618

Testo t350 XL

SN: 01948945 /USA

Test 1

08/15/11 15:32:46

230ppm SO2
Fuel: Test Gas

| | |
|-------|--------------|
| -0.07 | % Oxygen |
| 0 | ppm CO |
| 230 | ppm SO2 |
| 1 | ppm NO |
| 0.0 | ppm NO2 |
| 1 | ppm NOx |
| 0.00 | % CO2 |
| 28.1 | °C Ta |
| 26.8 | °C Tf |
| 9.0 | V Batt. |
| 1.23 | 1/m Pump |
| --- | % Efficiency |
| -0.3 | % Excess air |

Heat transf.°F: --- °F

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Standard

O2, CO, NO, NO2, SO2

Analyzer box # 207618

C.U. # 207619

Probe # 207575

8/15/11

Dennis Benham