
Measurement & Verification - Final Report

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Equipment Provider:	The Ozone Company
Program:	Commercial
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Measure Description:	Installation of an Ozone Laundry system on two existing washers
Installation Date:	August 2010
Inspector:	Rana/Nelson/ McLeer
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Report Date:	October 2010

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Executive Summary

The site inspection at the Fairfield Inn & Suites located in Middleton, Wisconsin, conducted by the Measurement & Verification team of the Focus on Energy Business Programs Quality Group, was completed in August, 2010. The hotel is located near the University of Wisconsin-Madison and near several other places of interest and business.

The project completed by the Fairfield Inn & Suites, with the assistance of a financial incentive from the Business Programs Commercial Sector of the Focus on Energy program, was for the upgrade of their laundry system. The new system reduces energy and water use by reducing the demand for hot water and shortening cycle times. The system upgrade was provided and manufactured by The Ozone Company. The proposed project cost was \$11,183. It was projected that this upgrade would result in annual electricity savings for washers and dryers of 310 kWh, total water savings of 112,840 gallons and natural gas savings for heating the water of 2,821 therms.

A summary of the energy and water savings provided by the implementation of this project follows. The M&V team did not attempt to confirm the natural gas use reduction for the tumbler dryers, projected labor and chemical savings. The Ozone Company projected additional savings of \$996.84 for the gas dryers, \$164 in chemical and \$4,005 in labor.

* .7 power factor assumed, \$.1/kWh blended electric rate, \$.78/therms gas rate, \$.007/gallons water rate

Methodology

The method used to track the energy and cost avoidance for Fairfield Inn & Suites utilizes measurement and verification procedures that are compatible with the Department of Energy's (DOE) September 2000 *Measurement and Verification Guidelines for Federal Energy Management Projects* (commonly called FEMP). The above listed DOE guidelines list four options for determining energy savings from energy conservation projects: *Options A, B, C, and D*. For a description of these options, please turn to Appendix A.

The following table lists the M&V Plan protocol that was used for this ECM:

Energy Conservation Measure (ECM)	M&V Plan Protocol
Install the EcoWash™ Ozone Laundry system on two (2) washers.	Option B

Engineering Review

Existing Equipment

The Fairfield Inn has an in house laundry that consists of the following equipment:

- 2 Unimac UW50 PVQU20001 washers
- 1 American dryer
- 1 Huebsch HT075NRMF6G10002 dryer
- 1 dedicated A.O. Smith BTR 200100 hot water heater

Existing equipment remained in place and was only reprogrammed and modified to accommodate the installation of the new ozone system.

Installed Equipment

The project involved the installation of EcoWash™ Ozone Laundry system on two (2) washers. Traditionally laundry processes use hot water to provide thermal disinfection and aid in chemical activation. EcoWash™ ozone laundry equipment achieves these objectives using less hot water and goes beyond the traditional laundry process by eliminating and shortening the programmed washer cycles for a typical load. The following table lists the equipment that was installed:

Quantity	Model #	Description
1	EQ150-2	Ecowash™ - Dual Washer System 7g/h, 120 VAC 60 Hz
1	O2Con	Single oxygen concentrators 8L/m, 120 VAC 60 Hz
1	AOSM	Ambient ozone safety monitors

M&V Review Findings and Conclusions

Measurements were taken by the M&V Team prior to and following the installation of the EcoWash™ System. The two washers and two dryers were compared as one system through four values:

- 1 - Program Baseline - provided by the manufacturer
- 2 - Program Energy Use - provided by the manufacturer
- 3 - Measured Pre-retrofit System – running a typical 50 lb load (sheets & towels).
- 4 - Measured Post-retrofit w / EcoWash™ System – ran the same load repeating the data collection protocol.

Data collected for these individual loads were extrapolated to arrive at annual pre and post retrofit kWh, therms and water use values and calculated energy savings. Energy consumption and savings per 100 lbs of per load of laundry washed and dried is also reported.

The M&V teams' HOBOR external amperage recording data loggers (models HO8 from the OnSet Corporation) utilizing 0 to 50amp CTs were located on the power input feeds to each of the washers and dryers. A separate data logger recorded the 0.165 kWh per load energy use of the ozone generation/ supply system. Using thermocouples, the HOBOR loggers also measured the hot and cold water temperatures continuously for the same duration, thermocouples attached to the hot and cold water lines, downloading data to HOBOS. Gas use was calculated by measuring the volume and temperature of the hot water then determining the therms required to heat the water (delta T) based on the efficiency of the water heater. The amount of laundry washed and dried during a recorded one-month period, weight and number of loads, was used for the annual projections.

The data was downloaded and used to create the tables below. As the measured data indicates, considerable water and natural gas savings has been achieved by the installation of the new EcoWash™ system. The results show that the reduction in total cycle time reduced electricity usage, but the savings was offset by energy use of the ozone system (see graphs in Appendix C). The hot water and therefore natural gas usage in washers was reduced significantly.

The savings were calculated as follows:

1. Program Projected Savings = (Program Baseline – Program Projected Use)
2. Estimated Verified Savings = (Measured Pre-retrofit – Measured Post-retrofit Use)

The estimated annual savings shown in the tables below are based on the laundry system operating 365 days per year, processing 15.5 loads per day of 50 lbs each.

Pre and post-retrofit comparison – projections vs. measurements

The following tables show the pre and post- retrofit comparisons of the laundry system within each of the previously mentioned periods.

Consumption Per Load				
	Baseline	Projected	Pre-Retrofit	Estimated Verified
kWh	1.45	1.39	1.33	1.24
Water	70.00	50.00	72.20	54.20
Therms	0.55	0.00	0.44	0.00

Cost per Load				
	Baseline	Projected	Pre-Retrofit	Estimated Verified
kWh	\$0.145	\$0.139	\$0.133	\$0.124
Water	\$0.490	\$0.350	\$0.505	\$0.379
Therms	\$0.429	\$0.000	\$0.342	\$0.000
Total	\$1.064	\$0.489	\$0.981	\$0.503

Consumption per 100lb of Laundry				
	Baseline	Projected	Pre-Retrofit	Estimated Verified
kWh	2.90	2.79	2.67	2.48
Water	140.00	100.00	144.40	108.40
Therms	1.1	0.00	0.88	0.00

Cost per 100lb of Laundry				
	Baseline	Projected	Pre-Retrofit	Estimated Verified
kWh	\$0.290	\$0.279	\$0.267	\$0.248
Water	\$0.980	\$0.700	\$1.011	\$0.759
Therms	\$0.858	\$0.000	\$0.684	\$0.000
Total	\$2.128	\$0.979	\$1.961	\$1.007

Annual Consumption				
	Baseline	Projected	Pre-Retrofit	Estimated Verified
kWh	8,175	7,865	7,519	6,993
Water	394,940	282,100	407,352	305,796
Therms	3,103	0	2,474	0

Annual Cost				
	Baseline	Projected	Pre-Retrofit	Estimated Verified
kWh	\$818	\$786	\$752	\$699
Water	\$2,765	\$1,975	\$2,851	\$2,141
Therms	\$2,420	\$0	\$1,930	\$0
Total	\$6,002	\$2,761	\$5,533	\$2,840

Annual Reduction		
	Projected	Estimated Verified
kWh	4%	7%
Water	29%	25%
Therms	100%	100%

Appendix A – Measurement & Verification Options

The DOE guidelines list four options for determining energy savings from energy conservation projects: *Options A, B, C, and D*.

The options differ in their methodology to the level and length of the retrofit M&V. Options A and B focus at the system level, while Option C focuses at the entire building/facility level. Option A uses short term measurements, while Option B and C use regular interval measurements or continuous measurements during the term of the contract. Option D can focus at either the specific equipment/ systems level or the whole-building level and can involve a combination of Option A stipulations and Options B or C, end-use or whole-building data analyses. It is important to note that all four Options are methods of estimating Energy Savings.

The following is a quick overview of the four DOE protocol options:

- *Option A*. Verifies that the measure has the potential to perform and to generate savings. The verification of performance (savings) is stipulated. The performance verification techniques are engineering calculations, possibly including spot measurements (pre and post retrofit measurements), with stipulated values.
- *Option B*. Verifies that the measure has the potential to perform and verifying actual performance by end use. The verification of performance (savings) is measured. The performance verification techniques are engineering calculations with metering and monitoring throughout the term of the contract.
- *Option C*. Verifies that the measure has the potential to perform and verifying actual performance (whole building analysis). The verification of performance (savings) is measured. The performance verification techniques are utility meter billing analysis, possibly with computer simulation.
- *Option D*. Verifies that the measure has the potential to (perform and verifying actual performance (the potential to generate savings and analysis of actual energy use compared to (the baseline model for savings calculations). The verification of performance (savings) is through the use of a calibrated simulation of baseline energy use and calibrated simulations of post-installation energy consumption. The performance verification building simulation model may involve intensive computer modeling programs such as Market Manager, DOE-2, Trane TRACE™, spreadsheets, vendor estimating programs, etc. Calibration is accomplished by linking simulation inputs to actual operating conditions and comparing simulation results with end-use or whole-building data.

Appendix B – Measurement & Verification Calculations

Pre- Retrofit Water Meter Reading			
Cold Water	Initial Reading (gallons)	Final Reading (gallons)	Water Usage (gallons)
1-C	21,563.90	21,578.20	14.30
2-C	13,016.10	13,024.50	8.40
Hot Water			
1-H	7,191.50	7,226.90	35.40
2-H	4,547.70	4,561.80	14.10

Post- Retrofit Water Meter Reading			
Cold Water	Initial Reading (gallons)	Final Reading (gallons)	Water Usage (gallons)
1-C	21,578.20	21,610.20	32.00
2-C	13,024.50	13,046.70	22.20
Hot Water			
1-H	7,226.90	7,226.90	-
2-H	4,561.80	4,561.80	-

Pre-Retrofit Summary	
Cold Water used per load (gallons)	22.70
Hot Water used per load (gallons)	49.50
Hot Water Temperature (°F)	140.00
Total Laundry Load (pounds)	50
kWh per Load	1.33
Natural Gas used per Load (therms)	0.44
Gallons of water used per Load	72.20

Post-Retrofit Summary	
Cold Water used per load (gallons)	54.20
Hot Water used per load (gallons)	-
Hot Water Temperature (°F)	140.00
Total Laundry Load (pounds)	50
kWh used per Load	1.24
Natural Gas used per Load (therms)	0.00
Gallons of water used per Load	54.20

Pre-Retrofit Natural Gas Calculation	
Volume	49.50 gallons
Mass	412.68 pounds
Δt	85.00 °F
Efficiency	0.8
Gas Heat Content	100,000 Btu/therm
Natural Gas Used	0.44 therms

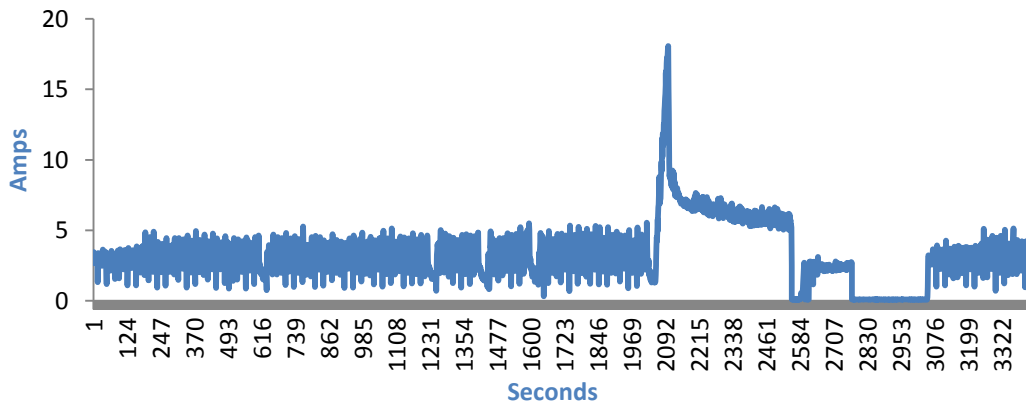
Post-Retrofit Natural Gas Calculation	
Volume	- gallons
Mass	0 pounds
Δt	85.00 °F
Efficiency	0.8
Gas Heat Content	100,000 Btu/therm
Natural Gas Used	0 therms

Appendix C – Single Load Measurements

The following data shows current draw over a single load by washers.

Washer Pre-Retrofit Load Summary	
Category	Value
Average amps	3.47546
Average Watts	535.221
Wh per load	508.46
kWh energy per 100 pounds	1.01692

Washer Pre-Retrofit Amp Profile



Washer Post-Retrofit Load Summary	
Category	Value
Average amps	6.52
Average Watts	909.45
Wh per load	454.72
kWh energy per 100 pounds	0.91

Washer Post-Retrofit Amp Profile

