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Appendix for ECM 11: Variable Flow Pumping, Union Colony Civic Center

I. Energy Savings Calculations

ECM 11 Variable Flow Pumping Union Colony Civic Center Savings Calculation

Savings Estimate

Date:	28-Aug-12
Project:	City of Greeley Colorado
Location:	UCCC
Measure:	ECM 14 Variable Flow Pumping

ECM 14 Variable Flow Pumping	
Estimated Savings (kWh/Yr):	11,910
Estimated Savings (kW):	1.2

Savings Estimate
Date: 28-Aug-12
Project: City of Greeley Colorado
Location: UCCC
Measure: ECM 14 Variable Flow Pumping

Pump 1 HP	5
Pump 2 HP	5
Motor Load Factor	0.90
Total Pump kW	3.36

Average BIN Temp	Existing BIN Hours	Existing Pump kW	Existing Pump kWh	Flow Fraction	VFD Load Fraction	Proposed Pump kW	Proposed Pump kWh	kW Savings	kWh/Yr Savings
-17.5	5	3.36	17	1.00	1.05	3.5	18	-0.2	(1)
-12.5	26	3.36	87	0.95	0.98	3.3	86	0.1	2
-7.5	26	3.36	87	0.90	0.93	3.1	81	0.2	6
-2.5	48	3.36	161	0.85	0.87	2.9	140	0.4	21
2.5	70	3.36	235	0.80	0.82	2.8	193	0.6	42
7.5	88	3.36	295	0.75	0.76	2.6	225	0.8	71
12.5	104	3.36	349	0.70	0.71	2.4	248	1.0	101
17.5	264	3.36	886	0.65	0.66	2.2	585	1.1	301
22.5	422	3.36	1,417	0.60	0.61	2.0	864	1.3	552
27.5	630	3.36	2,115	0.55	0.56	1.9	1,184	1.5	931
32.5	636	3.36	2,135	0.50	0.51	1.7	1,089	1.6	1,046
37.5	745	3.36	2,501	0.45	0.46	1.5	1,150	1.8	1,351
42.5	801	3.36	2,689	0.40	0.41	1.4	1,102	2.0	1,586
47.5	788	3.36	2,645	0.40	0.41	1.4	1,085	2.0	1,561
52.5	699	3.36	2,347	0.40	0.41	1.4	962	2.0	1,384
57.5	737	3.36	2,474	0.40	0.41	1.4	1,014	2.0	1,460
62.5	755	3.36	2,535	0.40	0.41	1.4	1,039	2.0	1,495
Total		3.36	22,975			2.2	11,065	1.2	11,910

Note: 1. Pumps are redundant and operate in lead/standby mode.

Franktown Colorado

Latitude : 39° 23' 32" N
Longitude : 104° 45' 03" W
Elevation : 6158 ft.
Report Generated on: Aug. 3, 2012

Start Date : Jan. 1, 2011
End Date : Dec. 31, 2011
# of Days : 365 of 365
obs : poss : 8755 of 8760

Sub Interval Windows

	Start	End
Date	Jan. 01	Dec. 31
Hour	0	23

Average Air Temperature

Total number of Observations
Greater than or equal to initial interval value and Less than ending interval value.

Range Deg F		1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm	12 am	All Hrs
		Hour of day (L.S.T.)																								
-20 to -15	-17.5		1	2	1	1																				5
-15 to -10	-12.5	2	1	2	2	2	3	3	2	1	1									1	1	1	1	2	1	26
-10 to -5	-7.5	3	2				1			1		1				1	1	1	1	2	2	3	2	2	3	26
-5 to 0	-2.5	2	4	2	3	3	1	3	4		1	1	1	1	1			1	4	2	2	2	3	3	4	48
0 to 5	2.5	5	5	6	6	4	5	4	3	2	1	1	2	1	1	1	1	4	2	2	3	2	4	2	3	70
5 to 10	7.5	6	6	4	5	7	7	6	1	4	1	1	1	2	2	2	3	1	3	3	3	2	3	7	8	88
10 to 15	12.5	4	1	9	8	10	7	8	7	3	4	2	1				1	4	2	8	6	8	5	4	2	104
15 to 20	17.5	15	20	19	20	17	20	19	10	5	3	3	2	4	4	7	9	5	9	6	10	12	14	16	15	264
20 to 25	22.5	26	21	21	29	30	31	25	21	13	10	7	10	8	8	7	3	9	16	16	20	22	23	22	24	422
25 to 30	27.5	43	43	54	44	45	41	28	23	19	9	9	7	4	4	4	9	19	26	35	29	30	32	35	38	630
30 to 35	32.5	34	38	31	29	40	41	40	31	19	16	7	8	9	8	10	19	30	20	20	34	37	34	39	42	636
35 to 40	37.5	35	37	32	38	34	34	25	30	30	29	25	18	19	20	21	24	20	36	42	45	39	42	38	32	745
40 to 45	42.5	36	33	38	36	34	27	35	29	34	34	32	31	31	25	31	29	33	34	39	31	38	36	33	42	801
45 to 50	47.5	30	40	40	47	43	35	25	27	31	30	35	37	33	37	31	31	33	31	24	30	33	31	30	24	788
50 to 55	52.5	35	33	31	22	24	26	19	26	28	29	27	28	35	35	40	37	26	28	28	24	21	27	32	38	699
55 to 60	57.5	39	36	38	40	39	31	32	24	29	29	31	31	19	30	26	25	27	22	24	31	32	37	34	31	737
60 to 65	62.5	36	34	29	32	29	36	18	24	22	30	27	27	35	31	30	30	24	34	35	33	42	39	40	38	755
65 to 70	67.5	14	10	7	2	2	17	32	25	24	21	30	28	30	32	33	30	29	23	26	38	24	20	22	19	538
70 to 75	72.5				1		2	31	31	27	24	24	26	25	25	24	22	25	20	31	19	16	12	4	1	390
75 to 80	77.5							11	25	26	28	20	20	21	21	24	34	30	34	18	4					316
80 to 85	82.5								19	28	23	30	26	28	30	29	25	27	15	3						283
85 to 90	87.5								2	18	34	28	28	32	30	30	23	14	5							244
90 to 95	92.5									1	7	23	29	25	20	13	9	2								129
95 to 100	97.5										1	1	4	3	1	1										11
Total # obs.		365	365	365	365	364	365	364	364	365	365	365	365	365	365	365	365	364	365	365	365	364	365	365	365	8755
Average Deg F		40.9	40.2	39.5	39.1	38.6	39.8	44.1	49.6	54.4	58.1	60.8	62	62.3	61.6	60.6	58.5	54.6	50.9	47.7	45.4	44	43.1	42.2	41.3	49.1

Copyright: Western Regional Climate Center - Desert Research Institute - Reno, Nevada.

Data are subject to further review and editing. Please refer any questions to the Western Regional Climate Center.

Building: Union Colony Civic Center

CBECS Data

Electricity

Electric Intensity:	15.8 kWh/sqft		
	End-use %	End-use Intensity (kWh/sqft)	% Difference from CBECS data
Lighting	31%	5	13.6%
Cooling	19%	3	1.0%
Ventilation	17%	3	3.2%
Office Equip.	12%	2	-11.8%
Other	9%	1	0.0%
Heating	6%	1	-1.1%
Water Heating	2%	0	-1.9%
Cooking	2%	0	-1.6%
Refrigeration	1%	0	-1.4%
	100.0%	16	

Natural Gas

Natural Gas Intensity:	38.7 kBtu/sqft		
Heating	72%	27.7	0.0%
Water Heating	20%	7.6	15.2%
Cooling	5%	1.9	-9.7%
Other	3%	1.2	-5.0%
Cooking	1%	0.2	0.0%
	100%	38.7	

Estimated Building End Use

Electricity

Basline Consumption:	460,597 kWh/yr	
	End-use %	End-use (kWh)
Lighting	45%	207,269
Cooling	20%	93,501
Ventilation	21%	94,422
Office Equip.	1%	2,303
Other	9%	39,611
Heating (pumping)	5%	23,490
Water Heating	0%	0
Cooking	0%	0
Refrigeration	0%	0
Total	100.0%	460,597

Natural Gas

Electricity	14,488 Therms	
Heating	87%	12,575
Water Heating	10%	1,449
Cooling	0%	-
Other	3%	464
Cooking	0%	-
Total	100.0%	14,488