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Hospital & Healthcare Initiative 2013 Energy Savings Validation

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M e m o r a n d u m

FROM: SBW Consulting

TO: Rita Siong, Northwest Energy Efficiency Alliance

DATE: February 24, 2014

RE: Hospital & Healthcare Initiative 2013 Energy Savings Validation

CC: John Boroski, Evergreen Economics

SUMMARY

This memorandum describes SBW Consulting's (SBW's) validation of the electrical energy savings from the Northwest Energy Efficiency Alliance's (NEEA's) Hospital and Healthcare (H&H) Initiative for the year 2013. Table 1 summarizes the validated savings for the nine facilities included.

SBW's validation consisted of inspection and review of the documentation provided by NEEA, the utilities, and the facilities. Where a utility has incentivized a measure, SBW verified that the savings amount claimed by NEEA matched the amount reported by the utility. Where more detailed information was available, SBW verified that the means used to arrive at the savings claimed were reasonable, and that the results were within the range of expected savings for the measures.

To protect the anonymity of Initiative participants, SBW used site identifiers throughout the report to refer to each site in this report.

Table 1: H&H Initiative Validated Electrical Energy Savings for 2013

Hospital Group / Facility Identifer	2013 Validated kWh (aMW)
2013-1	165,929 (0.019)
2013-2	192,173 (0.022)
2013-3	626,265 (0.072)
2013-4[1]	609,587 (0.070)
2013-5	520,000 (0.059)
2013-6	140,150 (0.016)
2013-7	1,109,481 (0.127)
2013-8	234,916 (0.027)
2013-9	106,864 (0.012)
Total	**3,705,365** **(0.422)**

[1]A savings adjustment of -6,358 kWh was made based on evaluation findings.

1. 2013-1

1.1. Methodology

The serving utility verified the savings for 2013-1 as part of their energy efficiency incentive program. SBW examined forms provided by the utility and verified that the savings were as reported.

1.2. Findings

Claimed savings derived from one HVAC measure and one lighting measure. The facility replaced block heaters serving the emergency generation system with more efficient heaters. The facility also completed various lighting upgrades across the campus. No detail was available for individual lighting upgrades. Table 2 shows savings for the two measures.

Table 2: 2013-1 Facility Lighting Projects

Project Title	Original Savings (kWh/year)	Validated Savings (kWh/year)
More efficient block heaters for emergency generator	43,362	43,362
Lighting projects	122,567	122,567
Total	**165,929**	**165,929**

2. 2013-2

2.1. Methodology

The serving utility verified the savings for this facility as part of their energy efficiency incentive program. SBW examined ventilation night setback and block heater forms provided by the utility and verified that the savings were as reported.

2.2. Findings

Claimed savings derived from two HVAC measures:

1. The facility replaced block heaters serving the emergency generation system with more efficient heaters.
2. The facility programmed the HVAC system to reduce ventilation quantities during nighttime hours.

Table 3 shows the validated savings for each measure.

Table 3: 2013-2 Facility HVAC Projects

Project Title	Original Savings (kWh/year)	Validated Savings (kWh/year)
Efficient block heaters	7,884	7,884
Ventilation nighttime setback	184,289	184,289
Total	**192,173**	**192,173**

3. 2013-3

Savings at 2013-3 fell into two categories:

1. NEEA reported Energy Expert savings, which are cumulative for the year based on reductions tracked on the main utility meter due to various actions related to operations and maintenance. These savings were not incentivized by the utility.
2. The serving utility approved a lighting upgrade on a different meter.

3.1. Main Meter Energy Expert Savings

Energy Expert is a utility billing meter monitoring package offered by Northwrite, Inc. The software captures and records pulses from the meter on 15-minute intervals. The program allows monitoring and comparison of energy usage.

3.1.1. Methodology

SBW reviewed the method used by Energy Expert to calculate savings, and compared the Energy Expert estimate with an itemized list of installed measures provided by the facility. These measures were not incentivized by the utility.

NEEA's Energy Expert consultant estimated savings with 2012 as the baseline year. Energy Expert compared meter use in 2013 with 2012 usage on a weather-normalized basis. Energy Expert normalizes for weather by associating each meter reading with the outside air temperature. The software also "bins" the meter readings into 5-degree temperature bins. The usage in these bins is compared from one year to the next, based on the assumption that energy usage is closely tied to outside air temperature. This process means that an improvement in late 2012 will have a small effect on the 2012 bins, and that some of these 2012 savings will actually accrue in 2013. Likewise, the 2013 reporting will not account for a project implemented in late 2013 in its entirety.

The Energy Expert consultant provided monthly and quarterly progress reports written by 2013-3 staff. Table 4 shows the list of 2012 and 2013 energy conservation measures (ECMs) implemented at 2013-3 as of December 2013. The list describes the conservation measures implemented, and gives an estimate of projected energy savings. These estimates were for planning purposes, and the consultant does not intend these to represent monitoring and verification (M&V) estimates.

Table 4: Energy Savings Measures Implemented at 2013-3

Project	Month Finished	Estimated Annual Savings (kWh)
Bad mixed air dampers on fan	Jul-12	92,653
LED upgrade	Jan-12	1,109
AHU hi/lo speed operation w/ VFD	Feb-12	336,200

Project	Month Finished	Estimated Annual Savings (kWh)
Space lights	Mar-12	23,354
Parking lot pole light upgrade - 1000 W to 575 W	Sep-12	218,557
MR-16 LED upgrade	Sep-12	1,226
AHU DAT reset 54 to 58°F	Oct-12	138,361
AHU DAT reset 54 to 58°F	Oct-12	25,612
Chiller shutdown earlier in the night	Oct-12	300 (kWh/hr)[1]
AHU airflow night setback	Oct-12	62,903
AHU reset schedule	Oct-12	52,961
Cooling Tower sequencing	Oct-12	9,708
T-12 to T-8 upgrade	Oct-12	1,457
MR-16 LED upgrade	Oct-12	4,253
LED upgrade	Oct-12	1,533
Data center cooling	Nov-12	751,008
Parking garage LED lighting	Dec-12	50,449
MR-16 LED	Feb-13	5,599
Total[2]		**1,776,943**

Notes: Based on "ECM project list December 2013.xls," 2013-3, December 2013.

[1] The facility reported savings in kWh per hour of setback. The number of setback hours was not specified.

[2] Excludes savings reported in kWh per hour of setback for chiller shutdown measure.

3.1.2. Findings

As noted above, 2012 measures will have part of their impact in 2012 and part of their impact in 2013, and some of the 2013 savings will be deferred until 2014 Energy Expert accounting. For this reason, the facility estimate of 2013 energy savings shown above does not include any savings for measures implemented in the second half of 2013. This is a conservative methodology.

Additionally, according to the consultant, various operations and maintenance actions are taken on a regular basis that are not formally reported. While the impact of these actions cannot be quantified, they are captured in the Energy Expert accounting.

In conclusion, Energy Expert's estimate appears to be a reasonable estimate of savings for the list of measures reported. Table 5 shows the validated savings.

Table5: 2013-3 Energy Expert Energy Savings

Project	Original Savings (kWh/year)	Validated Savings (kWh/year)
Multiple commissioning and capital	450,051	450,051

Project	Original Savings (kWh/year)	Validated Savings (kWh/year)
measures		

3.2. Lighting Upgrade

This project upgraded T12 lighting to T8 in three areas (referred to here as Areas A, B, C). Additionally, outdoor lighting in another building (referred to here as Building B) parking area was upgraded, and MR-16 exterior lighting at Building B was upgraded.

3.2.1. Methodology

SBW examined the documentation provided by the serving utility, consisting of an email from the project manager, forms from the utility, and measure descriptions.

3.2.2. Findings

Table 6 shows the validated savings for the lighting system upgrade.

Table 6: 2013-3 Lighting Upgrade Energy Savings

Project	Original Savings (kWh/year)	Validated Savings (kWh/year)
Area A T-12 to T-8 Upgrade	47,118	47,118
Area B T-12 to T-8 Upgrade	36,996	36,996
Area C T-12 to T-8 Upgrade	62,084	62,084
Building B Parking & Exterior Lighting Upgrades	30,016	30,016
Total	**176,214**	**176,214**

4. 2013-4

Savings for this facility fell into two categories.

1. The serving utility verified the savings for three measures as part of their energy efficiency incentive program.
2. Savings for three additional measures not incentivized by the utility were estimated using engineering calculations.

SBW verified that the savings were as reported and that the engineering calculations were reasonable.

4.1. Utility Incentivized Measures

The serving utility incentivized three measures:

1. Operating room HVAC hours were reduced
2. Lighting was upgraded to T-8 and LED
3. Parking lot lighting was upgraded from metal halide to LED

4.1.1. Methodology

SBW examined the documentation provided by the serving utility, consisting of an email from the utility and measure descriptions.

4.1.2. Findings

Savings claimed by the utility were limited to one HVAC measure and two lighting measures for 2013. SBW checked that the amount claimed by NEEA matched the savings claimed by the utility. The value for the HVAC measure was valid, but values for the two lighting measures differed, with the utility claiming savings lower than what NEEA had reported for one measure, and claiming savings higher than reported by NEEA for the other. The net effect was to reduce savings by 6,358 kWh, or 1.6% of the total utility incentivized savings. Table 7 shows the utility incentivized savings for 2013-4.

Table 7: 2013-4 Utility Incentivized Projects

Project Title	Original Savings (kWh/year)	Validated Savings (kWh/year)
Reduce HVAC hours for operating rooms	349,660	349,660
Lighting upgrades to T-8 and LED	17,198	6,741
Parking lot lighting upgrade - metal halide to LED	35,636	39,735

Project Title	Original Savings (kWh/year)	Validated Savings (kWh/year)
Total	**402,494**	**396,136**

4.2. Non-Utility Measures

The facility implemented three measures for which they did not receive utility incentives:

1. Air handling unit economizer operation
2. VFD for boiler combustion air fan
3. Rebuilt air handler in another building (referred to here as Building B)

4.2.1. Methodology

SBW performed a review of the provided engineering calculations, which consisted of a spreadsheet weather bin model for each ECM.

ECM-5: Air Handler Unit Economizer Operation

This measure repaired the outside air economizer in the air handling unit serving Area A, resulting in cooling energy savings. The consultant calculated savings using a weather bin-based spreadsheet analysis. The analysis used spot measurements of AHU component volts and amperage to calculate kW's for the compressors, evaporator blower, condenser fans, and power exhaust (all components affected by the measure). The baseline assumed no economizer operation (The spreadsheet calculated mechanical cooling energy for all bin hours with a cooling load). The installed case assumed outside air economizer operation, resulting in no mechanical cooling energy during hours in which free cooling was available. In addition, the analysis calculated a penalty due to power exhaust operation, which occurs when outside air exceeded 50% of supply air.

ECM-6: VFD for Boiler Combustion Air Fan

This measure added a variable frequency drive (VFD) to the boiler room combustion air fan. In the baseline, the fan ran at full capacity and a damper bypassed unneeded airflow to the boiler. The VFD allowed for fan speed modulation, eliminating the need for a bypass damper and resulting in fan energy savings. Savings were calculated using readings taken from a kWh consumption counter at the VFD panel during the baseline and post-installation periods. The analysis calculated an average kWh per day for each case (110.4 kWh/day baseline, 62.0 kWh/day post-installation). The analysis assumed that the boiler operates an average of 354.6 days per year. The savings was calculated as (110.4 kWh/day - 62.0 kWh/day) x 354.6 days/yr = 17,166 kWh/yr.

ECM-21: Building B AHU Upgrade

Compressor efficiency was increased by rebuilding the existing compressors on the air handling unit. In addition, the measure repaired the outside air economizer and replaced unit controls. These actions resulted in cooling energy savings. The analysis calculated savings using a weather bin-based spreadsheet analysis. The analysis used spot measurements of AHU

component volts and amperage to calculate kW's for the compressors, condenser fans, supply fans, and return fans (all components affected by the measure). The baseline assumed no economizer operation. The installed case assumed economizer operation and an assumed 25% reduction in kW for the rebuilt compressors.

4.2.2. Findings

SBW reviewed each calculation in depth and found them to be a reasonable estimate of savings. The evaluation did not uncover any errors. The model used actual measurements/readings taken on site, which further bolstered the credibility of the estimates. Table 8 shows savings for each of the non-incentivized measures.

Table 8: 2013-4 Non-Incentivized Projects

Project Title	Original Savings (kWh/year)	Validated Savings (kWh/year)
Area A air handler unit economizer operation	20,314	20,314
VFD for boiler combustion air fan	17,166	17,166
Building B AHU upgrade	175,971	175,971
Total	**213,451**	**213,451**

5. 2013-5

5.1. Methodology

The serving utility verified the savings for this facility as part of their energy efficiency incentive program. SBW verified that the savings were as reported.

5.2. Findings

Claimed savings were due to one HVAC measure. SBW verified that the amount claimed by NEEA matched the savings claimed by the utility. Table 9 shows the savings for 2013-5.

Table 9: 2013-5 Facility HVAC Project

Project Title	Original Savings (kWh/year)	Validated Savings (kWh/year)
Constant Volume AHUs Converted to Variable Volume	520,000	520,000

6. 2013-6

6.1. Methodology

Savings for one measure not incentivized by the utility were estimated using engineering calculations. SBW reviewed the savings calculation and verified that the savings were as reported.

Claimed savings were due to one HVAC measure. The analysis calculated savings using a weather bin-based spreadsheet analysis. The analysis used spot measurements of the building chiller compressor and chilled water pump volts and amperage to calculate a spot kW reading. A part load efficiency curve from eQUEST was used to calculate an adjustment factor for each outside air temperature bin, to be applied to the spot kW. For outside air temperatures below 44°F outside air temperature (the chilled water supply temperature setpoint), the compressor kW was set to its minimum value. The chilled water system kWh was calculated for each temperature bin as (adjusted compressor kW + pump kW) x operating hours. In the baseline, the chilled water system operated 24/7 year round (8,760 hours). After the installation, observations revealed that the chiller operated only between 53°F and 62°F outside air temperature, which equates to 2,362 annual operating hours. Below 53°F, cooling loads are satisfied by airside economizers at the air handling unit. Above 62°F, central plant chillers handle the entire cooling load and the building chiller is deactivated.

6.2. Findings

SBW reviewed the provided calculations in depth and found them to be a reasonable estimate of savings. The evaluation did not uncover any errors. The model used actual measurements/readings taken on site, which further bolstered the credibility of the estimate. Table 10 shows the savings claimed for 2013-6, which matches the savings value from the engineering calculation.

Table 10: 2013-6 Facility HVAC Project

Project Title	Original Savings (kWh/year)	Validated Savings (kWh/year)
Reduce Building Chiller Runtime	140,150	140,150

7. 2013-7

7.1. Methodology

The serving utility verified the savings as part of their strategic energy management (SEM) incentive program for multiple facilities within the 2013-7 health system. SBW verified that the savings were as reported.

7.2. Findings

SBW verified that the amount claimed by NEEA matched the savings claimed by the utility. No information was available on specific measure savings, or savings at specific facilities within the system. Table 11 shows the total savings for all facilities within the system.

Table 11: 2013-7 SEM Savings

Project Title	Original Savings (kWh/year)	Validated Savings (kWh/year)
SEM Year 2 Continuation	1,109,481	1,109,481

8. 2013-8

8.1. Methodology

The serving utility verified the savings as part of their strategic energy management (SEM) incentive program for multiple facilities within the 2013-8 health system. SBW verified that the savings were as reported.

8.2. Findings

SBW verified that the amount claimed by NEEA matched the savings claimed by the utility. No information was available on specific measure savings, or savings at specific facilities within the system. Table 12 shows the total savings for all facilities within the system.

Table 12: 2013-8 SEM Savings

Project Title	Original Savings (kWh/year)	Validated Savings (kWh/year)
SEM Year 2 Standard	234,916	234,916

9. 2013-9

9.1. Methodology

The serving utility verified the savings for a lighting measure at one facility. SBW verified that the savings were as reported.

9.2. Findings

SBW verified that the amount claimed by NEEA matched the savings claimed by the utility. Table 13 shows the total savings at the facility.

Table 13: 2013-8 SEM Savings

Project Title	Original Savings (kWh/year)	Validated Savings (kWh/year)
LED Lighting Upgrade	106,864	106,864