PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

Investigation Report for
Anoka Ramsey Community College, Coon Rapids

Minnesota
STATE COLLEGES
& UNIVERSITIES

ANOKA-RAMSEY
COMMUNITY COLLEGE
CAMBRIDGE · COON RAPIDS

5/21/2012

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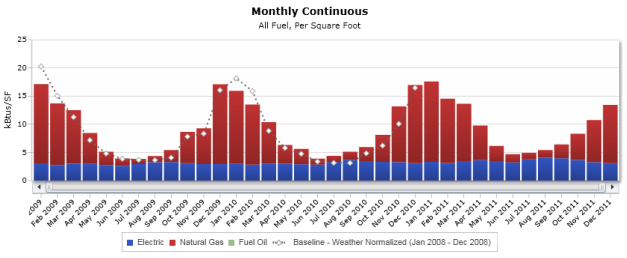
Screening Report

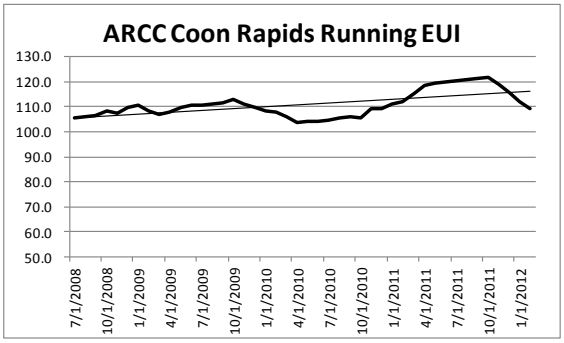
PBEEEP State Government

Investigation Overview

The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. A limited investigation of Anoka Ramsey Community College, Coon Rapids was performed by AMEC Earth and Environmental, Inc. This report is the result of that information.

Payback Information and Energy Savings				
Total Project costs (Without Co-funding)			**Project costs with Co-funding**	
Total costs to date including study	$31,998		Total Project Cost	$35,633
Future costs including Implementation , Measurement & Verification	$3,635		Study and Administrative Cost Paid with ARRA Funds	($31,998)
Total Project Cost	$35,633		Utility Rebates	($0)
			Total costs after co-funding	$3,635
Estimated Annual Total Savings ($)	$665		Estimated Annual Total Savings ($)	$665
Total Project Payback	51		Total Project Payback with co-funding	5.5
Electric Energy Savings	**0 %**	**and**	**Gas Energy Savings**	**0.3 %**





Year	Days	SF	Total kBtu	Normalized Baseline kBtu	Change from Baseline kBtu	% Change	Total Energy Cost $	Average Cost Rate $ /kBtu
2009	365	380,646	41,666,185	40,323,463	1,342,722	3%	$525,053.48	$0.01
2010	365	380,646	41,593,211	38,297,782	3,295,429	9%	$546,023.18	$0.01
2011	365	380,646	43,962,759	37,032,819	6,929,940	19%	$586,595.64	$0.01

The energy use at Anoka Ramsey Community College, Coon Rapids increased approximately 4% over the period of the investigation.

Summary Tables

Facility Name	Anoka Ramsey Community College, Coon Rapids
Location	11200 Mississippi Blvd Coon Rapids, MN 55433
Facility Managers	Roger Freeman Jim Nieswaag
Number of Buildings Investigated	26
Interior Square Footage Investigated	380,446
PBEEEP Provider	AMEC Earth and Environmental, Inc.
Study Period	October 2011 through April 2012
Annual Energy Cost	$586,595 (2011)
Utility Company	Xcel Energy-Electric CenterPoint Energy - Gas
Site Energy Use Index (EUI)	105 kBtu/ft^2 (start of study) 109 kBtu/ft^2 (end of study
Benchmark EUI (from B3)	153 kBtu/ft^2

Building Data as listed in B3

Building Name	State ID	Area (Square Feet)	Year Built	Recommended for Investigation
Training & Develop Center	E26152C0162	9,800	1962	Y
College Services	E26152C0266	32,882	1966	Y
Library	E26152C0366	34,029	1966	Y
Library/Gym Addition	E26152C2105	17,000	1987	Y
Technology	E26152C0466	21,711	1966	Y
Humanities	E26152C0566	24,869	1966	Y
Gym	E26152C0668	34,042	1968	Y
Fine Arts	E26152C0771	17,171	1971	Y
Student Center	E26152C0871	19,064	1971	Y
Business/Nursing	E26152C0971	31,119	1971	Y
Business/Nursing Addition	E26152C0987	10,203	1987	Y
Performing Arts Center	E26152C1075	21,205	1975	Y
Performing Arts Center East Vestibule	E26152C1005	165	2005	Y

Fine Arts North/South Penthouse	E26152C1271	896	1971	Y
Link-Hum/Student Center	E26152C1371	418	1971	Y
Business/Nursing Ext Penthouse	E26152C1487	931	1987	Y
Library Add Penthouse	E26152C1587	931	1987	Y
Fine Arts North Vestibule	E26152C1697	130	1997	Y
College Services Addition	E26152C1797	31,650	1997	Y
Student Center Addition 1	E26152C1897	8,235	1997	Y
Link-Hum/Student Center	E26152C1997	418	1997	Y
Science Building	E26152C2098	36,466	1998	Y
Student Center Addition II		22,905	2009	Y
Performing Arts Lobby Addition		606	2001	Y
Garage	E26152C1176	1,800	1976	N
Garage Addition		1,800	2005	N

Mechanical Equipment Included in Investigation: Summary Table	
Total	**Equipment Description**
1	Andover Continuum Building Automation System
36	Air Handlers
25	Fan Coil Units (Estimate)
155	VAV Boxes
2	Chillers
1	Cooling Tower
5	Boilers (2 small boilers in TDC building)
5	Secondary Hot Water Pumps (2 are small and in TDC building)
2	Chilled Water Pumps

Implementation Information			
Estimated Annual Total Savings ($)	5.1% Savings		$665
Total Estimated Implementation Cost ($)			$1,635
GHG Avoided in U.S Tons (CO2e)			6
Electric Energy Savings (kWh) (2011 Usage 4,682,168 kWh)	0.02 % Savings		1,323
Gas Energy Savings (Therms) (2011 Usage was 279,871 Therms)	0.3 % Savings		810
Statistics			
Number of Measures identified			3
Number of Measures with payback < 3 years			2
Screening Start Date	07/8/2010	Screening End Date	08/5/2010
Investigation Start Date	10/19/2011	Investigation End Date	3/23/2012
Final Report	5/20/2012		

Anoka Ramsey Community College, Coon Rapids Owatonna Cost Information			
Phase		**To date**	**Estimated Future Cost**
Screening		$6,130	
Investigation [Provider]*		$24,990	
Investigation [CEE]		$878	$1,000
Implementation			$1,635
Implementation [CEE]			$500
Measurement & Verification			$500
Total		$31,998	$3,635

Co-funding Summary	
Study and Administrative Cost	$31,998
Utility Co-Funding - Estimated Total ($)	$0
Total Co-funding ($)	$31,998

*This was a study of limited scope.

Anoka Ramsey Community College, Coon Rapids Overview

The energy investigation identified 0.2% of total energy savings at Anoka Ramsey Community College, Coon Rapids with measures that payback in less than 15 years and do not adversely affect occupant comfort. This is an intensively managed facility with few opportunities for energy savings that have not already been identified and addressed by the staff. The energy savings opportunities identified at Anoka Ramsey Community College, Coon Rapids include optimizing damper adjusting equipment schedules to match actual occupancy period in one building, repairing or replacing another damper and a implementing a control sequence that prevents simultaneous heating and cooling. The total cost of implementing all the measures is $1,635.

Implementing all these measures can save the facility approximately $665 a year. During the period of the PBEEEP investigation energy use at Anoka Ramsey Community College, Coon Rapids increased approximately 4% compared to the year prior to the study, probably due to increased loads due to increased student enrollment. It is now 29% below the benchmark value according to the Minnesota Benchmarking and Beyond database (B3).

ARCC includes 26 buildings totaling 380,446 ft^2. Twenty of the buildings are part of the main campus and are all connected together. These buildings compromise a total of 345,070 ft^2. The detached buildings are the Training and Development Center (TDC, 9,800 ft^2), Performing Arts Center (PAC 21,976 ft^2) and Garage (3,600 ft^2).

Controls and Trending
The campus contains a Schneider Electric-IA ® automation system by UHL. The system controls all the mechanical equipment in the buildings except for one MAU in the Fine Arts building and the mechanical equipment in the Garage. The system is capable of trending a large number of points which were set up as part of the facility screening by CEE.

General HVAC Overview
There are three boilers in the main campus building. Two are for winter use and one is for summer and shoulder seasons. They utilize a hot water reset and were installed in 2007. These three boilers supply heat to all buildings on the campus except for the Training and Development Center and the garage. The Training and Development Center contains two smaller boilers for heat during the winter. The garage is heated by forced air ceiling units and infrared radiation.

For cooling there are two 500 ton centrifugal chillers which run on a lead/lag schedule with a cooling tower. They supply chilled water to all the AHUs on campus except for the Training and Development Center which is cooled by DX cooling with a condensing unit.

The facility has a wide range of AHUs ranging from multi-zone units from 1970 to new Variable Air Volume (VAV) AHUs from 2009. The building contains 36 AHUs. Eleven are multi-zone, 8 are constant volume, 3 are VAV with variable inlet guide vanes for volume control, and 14 are VAV with VFDs for volume control. Anoka-Ramsey has been systematically upgrading the original multi-zone constant volume AHU's to VAV systems for several years. Approximately half of them are upgraded.

Lighting
Most of the interior lighting consists of T8 28 watt lights. Additional savings can be realized by replacing the 28 W bulbs with 25 W bulbs as they burn out. These lights are mainly controlled by switches. There are very few occupancy sensors or timers controlling interior lights. Outside lighting runs on timers and photocells and is controllable by the building automation system.

EUI B3 Benchmark Overview
The actual energy user index (EUI), as computed from utility bills and square footage, is currently at 109 kBtu/ft^2, which is less than the B3 benchmark score of 153 kBtu/ft^2. The benchmark value may be too high (for example if spaces are improperly classified as laboratories or summer cooling hours are too high the benchmark value will be too high). The average state building has an EUI 23% lower than the corresponding B3 Benchmarks.

Other Important Issues
Anoka-Ramsey Community College was chosen by MnSCU as the site of a side by side comparison of PBEEEP and a Guaranteed Energy Savings Contract (GESC) offered by Energy Services Group (ESG). It is likely that this facility would not have otherwise been recommended for an investigation due to the low potential for savings.

Metering
There are a total of four gas meters and three electrical meters on the campus. Fuel oil #2 is also used in the boilers on the main campus when natural gas is curtailed by the utility company.

Findings Glossary: Findings Examples

a.1 (1)	**Time of Day enabling is excessive**
	• HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	**Equipment is enabled regardless of need, or such enabling is excessive**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	**Lighting is on more hours than necessary**
	• Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	**OTHER Equipment Scheduling and Enabling**
	• Please contact PBEEEP Project Engineer for approval
b.1 (5)	**Economizer Operation – Inadequate Free Cooling**
	• Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	**Over-Ventilation**
	• Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	**OTHER Economizer/Outside Air Loads**
	• Please contact PBEEEP Project Engineer for approval
c.1 (8)	**Simultaneous Heating and Cooling is present and excessive**
	• For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	**Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement**
	• OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	**Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints**
	• CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	**OTHER Controls**
	• Please contact PBEEEP Project Engineer for approval
d.1 (12)	**Daylighting controls or occupancy sensors need optimization**
	• Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	**Zone setpoint setup / setback are not implemented or are sub-optimal**
	• The cooling setpoint is 74 ºF 24 hours per day
d.3 (14)	**Fan Speed Doesn't Vary Sufficiently**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	**Pump Speed Doesn't Vary Sufficiently**
	• Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	**VAV Box Minimum Flow Setpoint is higher than necessary**
	• Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	**Other Controls (Setpoint Changes)**
	• Please contact PBEEEP Project Engineer for approval
e.1 (18)	**HW Supply Temperature Reset is not implemented or is sub-optimal**
	• HW supply temperature is a constant 180 ºF. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	**CHW Supply Temperature Reset is not implemented or is sub-optimal**
	• CHW supply temperature is a constant 42 ºF. It could be reset, based on demand or ambient temperature.
e.3 (20)	**Supply Air Temperature Reset is not implemented or is sub-optimal**
	• The SAT is constant at 55 ºF. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ( )	**Supply Duct Static Pressure Reset is not implemented or is suboptimal**
	• The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	**Condenser Water Temperature Reset is not implemented or is sub-optimal**
	• CW temperature is constant leaving the tower at 85 ºF. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	**Other Controls (Reset Schedules)**
	• Please contact PBEEEP Project Engineer for approval
f.1 (23)	**Lighting system needs optimization - Spaces are overlit**
	• Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	**Pump Discharge Throttled**
	• The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	**Over-Pumping**
	• Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	**Equipment is oversized for load**
	• The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	**OTHER Equipment Efficiency/Load Reduction**
	• Please contact PBEEEP Project Engineer for approval
g.1 (28)	**VFD Retrofit Fans**
	• Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	**VFD Retrofit - Pumps**
	• 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	**VFD Retrofit - Motors (process)**
	• Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	**OTHER VFD**
	• Please contact PBEEEP Project Engineer for approval
h.1 (32)	**Retrofit - Motors**
	• Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	**Retrofit - Chillers**
	• Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	**Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)**
	• Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	**Retrofit - Boilers**
	• Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	**Retrofit - Packaged Gas-fired heating**
	• Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	**Retrofit - Heat Pumps**
	• Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	**Retrofit - Equipment (custom)**
	• Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	**Retrofit - Pumping distribution method**
	• Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	**Retrofit - Energy / Heat Recovery**
	• Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	**Retrofit - System (custom)**
	• Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	**Retrofit - Efficient lighting**
	• Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	**Retrofit - Building Envelope**
	• Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	**Retrofit - Alternative Energy**
	• Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	**OTHER Retrofit**
	• Please contact PBEEEP Project Engineer for approval
i.1 (46)	**Differed Maintenance from Recommended/Standard**
	• Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	**Impurity/Contamination**
	• Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ( )	**Leaky/Stuck Damper**
	• The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ( )	**Leaky/Stuck Valve**
	• The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	**OTHER Maintenance**
	• Please contact PBEEEP Project Engineer for approval
j.1 (49)	**OTHER**
	• Please contact PBEEEP Project Engineer for approval

Findings Summary

Site: ARCC- Coon Rapids Campus

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	Fine Arts	Operation of OA dampers of FS-1 are not optimum based on building occupancy	$460	$344	1.34	$0	1.34	3
1	Training and Development Ctr	AHU-1 calls for HW and DX cooling	$365	$252	1.45	$0	1.45	2
2	Training and Development Ctr	The outside air damper of AHU-1 leaks	$810	$69	11.72	$0	11.72	1
		Total for Findings with Payback 3 years or less:	**$825**	**$596**	**1.38**	**$0**	**1.38**	**5**
		Total for all Findings:	**$1,635**	**$665**	**2.46**	**$0**	**2.46**	**6**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Summary

Building: Fine Arts

Site: ARCC- Coon Rapids Campus

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	Operation of OA dampers of FS-1 are not optimum based on building occupancy	$460	$344	1.34	$0	1.34	3
	Total for Findings with Payback 3 years or less:	**$460**	**$344**	**1.34**	**$0**	**1.34**	**3**
	Total for all Findings:	**$460**	**$344**	**1.34**	**$0**	**1.34**	**3**

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Findings Details

PBEEEP State Government

Building: Fine Arts

FWB Number:	13131	Eco Number:	1
Site:	ARCC- Coon Rapids Campus	Date/Time Created:	5/3/2012

Investigation Finding:	Operation of OA dampers of FS-1 are not optimum based on building occupancy	Date Identified:	8/29/2012
Description of Finding:	AHU FS-1 is introducing OA during warm-up when the building is unoccupied before 7:00 M-F. AHU FS-1 is 8,215 CFM.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Other Economizer/OA Loads		

Implementer:	Controls contractor	Benefits:	Natural gas savings
Baseline Documentation Method:	Trend data shows OA damper not closed during unoccupied warm-up hours in heating mode starting at 0500.		
Measure:	Keep the OA damper closed when the building is unoccupied during warm-up cycle in heating mode.		
Recommendation for Implementation:	Re-program OA damper position of FS-1 to 0 before 7:00 am M-F when the building requires warming up.		
Evidence of Implementation Method:	Trend the SF status and OA damper position at 15 minute intervals for 2 weeks when the OAT is less than 40F. Analyze data and ensure that the OA damper is commanded closed during morning warm-up.		

Annual Natural Gas Savings (therms):	486	Contractor Cost ($):	$210
Estimated Annual Natural Gas Savings ($):	$344	PBEEEP Provider Cost for Implementation Assistance ($):	$250
		Total Estimated Implementation Cost ($):	$460

Estimated Annual Total Savings ($):	$344	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.34	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.34	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	3	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	13.3%	Percent of Implementation Costs:	15.1%

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Findings Summary

Building: Training and Development Ctr

Site: ARCC- Coon Rapids Campus

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	AHU-1 calls for HW and DX cooling	$365	$252	1.45	$0	1.45	2
2	The outside air damper of AHU-1 leaks	$810	$69	11.72	$0	11.72	1
	Total for Findings with Payback 3 years or less:	**$365**	**$252**	**1.45**	**$0**	**1.45**	**2**
	Total for all Findings:	**$1,175**	**$321**	**3.66**	**$0**	**3.66**	**3**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Training and Development Ctr

FWB Number:	13143	Eco Number:	1
Site:	ARCC- Coon Rapids Campus	Date/Time Created:	5/7/2012

Investigation Finding:	AHU-1 calls for HW and DX cooling	Date Identified:	8/8/2011
Description of Finding:	There is a significant amount of time throughout the year when the DX cooling is on, the heating valve is open, and hot water is available. This simultaneous heating and cooling is unnecessary because the AHU can achieve the discharge air temperature setpoint by economizing.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls Problems
Finding Type:	Simultaneous Heating and Cooling is present and excessive		

Implementer:	Controls contractor	Benefits:	Natural gas and electrical savings when the conditioned air is simultaneously cooling, then heating the air stream
Baseline Documentation Method:	Trends of the DX cooling, heating valve position, and fan inlet vane position show that AHU-1 simultaneously heats and cools throughout the year. This happens most often during outside temperatures that are ideal for economizing, indicating that neither the heating or cooling is necessary.		
Measure:	Ensure the mixed air temperature setpoint and discharge air temperature setpoint are appropriate and add a lockout so that whenever the heating valve is open, the outside air dampers are at minimum position and the DX cooling is off.		
Recommendation for Implementation:	Adjust the control sequences to have the DX cooling, heating coil, and outside air damper modulate in sequence to meet the discharge air temperature setpoint. For simplicity, the mixed air temperature setpoint can be set to the DAT minus 2F. The minimum outside damper position of 10% shall remain in place to ensure adequate ventilation. A lockout shall also be put in place so that when the heating valve is open, the outside damper cannot economize and the cooling valve cannot open in order to eliminate simultaneous heating and cooling.		
Evidence of Implementation Method:	Trend the supply fan inlet vane position, DAT, DAT setpoint, MAT, HW valve position, DX cooling stage 1 status, and OA damper at 15 minute intervals for at least 2 weeks when 30<70F. Analyze the trend data to ensure that AHU-1 economizes to meet the DAT setpoint when outside conditions are appropriate and that the OA damper goes to minimum position and the DX cooling is off when the heating valve is open. Also ensure that the DAT setpoint is being achieved at all times.		

Annual Electric Savings (kWh):	1,323	Annual Natural Gas Savings (therms):	226
Estimated Annual kWh Savings ($):	$92	Estimated Annual Natural Gas Savings ($):	$160
Contractor Cost ($):	$115		
PBEEEP Provider Cost for Implementation Assistance ($):	$250		
Total Estimated Implementation Cost ($):	$365		

Estimated Annual Total Savings ($):	$252	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.45	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.45	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	2	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	9.7%	Percent of Implementation Costs:	12.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Training and Development Ctr

FWB Number:	13143	Eco Number:	2
Site:	ARCC- Coon Rapids Campus	Date/Time Created:	5/7/2012

Investigation Finding:	The outside air damper of AHU-1 leaks	Date Identified:	3/14/2012
Description of Finding:	MAT does not equal RAT when the AHU is using 100% recirculated air		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Maintenance Related Problems
Finding Type:	Leaky/Stuck Damper		

Implementer:	HVAC Installer	Benefits:	Increased OA control and energy savings due to better control of outside air intake.
Baseline Documentation Method:	MAT was too low during heating mode and unoccupied hours of operation when OA damper was zero		
Measure:	Install a new OA damper		
Recommendation for Implementation:	Replace outside air damper of AHU-1.		
Evidence of Implementation Method:	Trend the supply fan inlet vane position, DAT, DAT setpoint, MAT, RAT, and OA damper at 15 minute intervals for at least 2 weeks when OAT<70F. Analyze the trend data to ensure that when the OA damper is shut, the MAT is equal to the RAT.		

Annual Natural Gas Savings (therms):	98	Contractor Cost ($):	$560
Estimated Annual Natural Gas Savings ($):	$69	PBEEEP Provider Cost for Implementation Assistance ($):	$250
		Total Estimated Implementation Cost ($):	$810

Estimated Annual Total Savings ($):	$69	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	11.72	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	11.72	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	1	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	2.7%	Percent of Implementation Costs:	26.6%

Investigation Checklist

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13131 - ARCC/Fine Arts

NOTE: this worksheet was filled out by CEE

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive			Not cost-effective to investigate	May be able to reduce run-time of AHUs FS-1, FS-2, and FS-3.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive			Not cost-effective to investigate	CHW pumps that serve FCUs appear to run when the FCUs are off.
	a.3 (3)	Lighting is on more hours than necessary.			Investigation looked for, but did not find this issue.	Lighting opportunities were ruled out during screening.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Investigation looked for, but did not find this issue.	
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.			Investigation looked for, but did not find this issue.	
	b.3 (7)	OTHER_Economizer/OA Loads	Measure 1	FS-1		OA damper for FS-1 is open during morning warm-up.
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Investigation looked for, but did not find this issue.	
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Not Relevant	
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Investigation looked for, but did not find this issue.	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Not Relevant	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not Relevant	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Not Relevant	
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Not Relevant	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not Relevant	
	f.2 (24)	Pump Discharge Throttled			Not Relevant	
	f.3 (25)	Over-Pumping			Not Relevant	
	f.4 (26)	Equipment is oversized for load.			Investigation looked for, but did not find this issue.	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				
	g.1 (28)	VFD Retrofit - Fans			Not Relevant	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13131 - ARCC/Fine Arts

NOTE: this worksheet was filled out by CEE

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps			Not Relevant	
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors			Not Relevant	
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not Relevant	
	h.4 (35)	Retrofit - Boilers			Not Relevant	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not Relevant	
	h.7 (38)	Retrofit - Equipment (custom)			Not Relevant	
	h.8 (39)	Retrofit - Pumping distribution method			Not Relevant	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting			Not Relevant	
	h.12 (43)	Retrofit - Building Envelope			Not Relevant	
	h.13 (44)	Retrofit - Alternative Energy			Not Relevant	
	h.14 (45)	OTHER_Retrofit				
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not Relevant	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Not Relevant	
	i.4 ( )	Leaky/Stuck Valve			Not Relevant	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

Investigation Checklist

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13143 - ARCC/Training and Development Center

NOTE: this worksheet was filled out by CEE

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive			Investigation looked for, but did not find this issue.	
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive			Investigation looked for, but did not find this issue.	
	a.3 (3)	Lighting is on more hours than necessary.			Investigation looked for, but did not find this issue.	
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Investigation looked for, but did not find this issue.	
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.				
	b.3 (7)	OTHER_Economizer/OA Loads				
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	Measure 1			
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Not Relevant	
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Investigation looked for, but did not find this issue.	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Investigation looked for, but did not find this issue.	
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	HWST ranges between 140 and 160.
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not Relevant	
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Investigation looked for, but did not find this issue.	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				
	g.1 (28)	VFD Retrofit - Fans				

PBEEEP State Government

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13143 - ARCC/Training and Development Center

NOTE: this worksheet was filled out by CEE

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps				
	g.3 (30)	VFD Retrofit - Motors (process)				
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				
	h.2 (33)	Retrofit - Chillers				
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)				
	h.4 (35)	Retrofit - Boilers				
	h.5 (36)	Retrofit - Packaged Gas fired heating				
	h.6 (37)	Retrofit - Heat Pumps				
	h.7 (38)	Retrofit - Equipment (custom)				
	h.8 (39)	Retrofit - Pumping distribution method				
	h.9 (40)	Retrofit - Energy/Heat Recovery				
	h.10 (41)	Retrofit - System (custom)				
	h.11 (42)	Retrofit - Efficient Lighting				
	h.12 (43)	Retrofit - Building Envelope				
	h.13 (44)	Retrofit - Alternative Energy				
	h.14 (45)	OTHER_Retrofit				
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Investigation looked for, but did not find this issue.	
	i.2 (47)	Impurity/Contamination			Investigation looked for, but did not find this issue.	
	i.3 ( )	Leaky/Stuck Damper	Measure 2			
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

Investigation Checklist

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13135 - ARCC/Library

NOTE: this worksheet was filled out by CEE

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive			Investigation looked for, but did not find this issue.	
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive			Investigation looked for, but did not find this issue.	
	a.3 (3)	Lighting is on more hours than necessary.			Investigation looked for, but did not find this issue.	This opportunity was eliminated during screening.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Investigation looked for, but did not find this issue.	
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.			Investigation looked for, but did not find this issue.	
	b.3 (7)	OTHER_Economizer/OA Loads				There may be an opportunity to close the OA dampers when AHUs LS-2 and LS-4 operate at night.
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Not Relevant	All multizone or cooling-only AHUs
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement				Return air temperature sensor appears to be placed too close to the OA dampers. Uncertain if it will result in energy savings.
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints				The mixed air temperature of AHUs LS-1 through LS-4 vary widely during the winter, indicating that the PID loop for the OA dampers needs to be tuned. This will not result in energy savings, however, because the MAT averages the MAT setpoint.
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Investigation looked for, but did not find this issue.	
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Investigation looked for, but did not find this issue.	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not Relevant	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Investigation looked for, but did not find this issue.	
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Investigation looked for, but did not find this issue.	
	f.2 (24)	Pump Discharge Throttled			Not Relevant	
	f.3 (25)	Over-Pumping			Not Relevant	
	f.4 (26)	Equipment is oversized for load.			Investigation looked for, but did not find this issue.	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13135 - ARCC/Library

NOTE: this worksheet was filled out by CEE

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.1 (28)	VFD Retrofit - Fans				
	g.2 (29)	VFD Retrofit - Pumps				
	g.3 (30)	VFD Retrofit - Motors (process)				
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				
	h.2 (33)	Retrofit - Chillers				
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)				
	h.4 (35)	Retrofit - Boilers				
	h.5 (36)	Retrofit - Packaged Gas fired heating				
	h.6 (37)	Retrofit - Heat Pumps				
	h.7 (38)	Retrofit - Equipment (custom)				
	h.8 (39)	Retrofit - Pumping distribution method				
	h.9 (40)	Retrofit - Energy/Heat Recovery				
	h.10 (41)	Retrofit - System (custom)				
	h.11 (42)	Retrofit - Efficient Lighting				
	h.12 (43)	Retrofit - Building Envelope				
	h.13 (44)	Retrofit - Alternative Energy				
	h.14 (45)	OTHER_Retrofit				
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Investigation looked for, but did not find this issue.	
	i.2 (47)	Impurity/Contamination			Investigation looked for, but did not find this issue.	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

Investigation Checklist

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13136 - ARCC/Humanities

This checklist was filled out by PBEEEP.

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive			Investigation looked for, but did not find this issue.	
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive			Investigation looked for, but did not find this issue.	
	a.3 (3)	Lighting is on more hours than necessary.			Investigation looked for, but did not find this issue.	
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Investigation looked for, but did not find this issue.	
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.			Investigation looked for, but did not find this issue.	
	b.3 (7)	OTHER_Economizer/OA Loads				
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Investigation looked for, but did not find this issue.	It was thought that there was an issue with heating while economizing, but upon further review of the trend data, it was found that simultaneous heating and cooling was not occurring. See Measures 1 and 2 for details (both measures were deleted).
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Investigation looked for, but did not find this issue.	
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Investigation looked for, but did not find this issue.	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not Relevant	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Investigation looked for, but did not find this issue.	
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not Relevant	
	f.2 (24)	Pump Discharge Throttled			Not Relevant	
	f.3 (25)	Over-Pumping			Not Relevant	
	f.4 (26)	Equipment is oversized for load.				
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13136 - ARCC/Humanities

This checklist was filled out by PBEEEP.

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.1 (28)	VFD Retrofit - Fans				
	g.2 (29)	VFD Retrofit - Pumps				
	g.3 (30)	VFD Retrofit - Motors (process)				
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				
	h.2 (33)	Retrofit - Chillers				
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)				
	h.4 (35)	Retrofit - Boilers				
	h.5 (36)	Retrofit - Packaged Gas fired heating				
	h.6 (37)	Retrofit - Heat Pumps				
	h.7 (38)	Retrofit - Equipment (custom)				
	h.8 (39)	Retrofit - Pumping distribution method				
	h.9 (40)	Retrofit - Energy/Heat Recovery				
	h.10 (41)	Retrofit - System (custom)				
	h.11 (42)	Retrofit - Efficient Lighting				
	h.12 (43)	Retrofit - Building Envelope				
	h.13 (44)	Retrofit - Alternative Energy				
	h.14 (45)	OTHER_Retrofit				
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Investigation looked for, but did not find this issue.	
	i.2 (47)	Impurity/Contamination			Investigation looked for, but did not find this issue.	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

Investigation Checklist

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13139 - ARCC/Theatre Performing Arts Center

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive			Investigation looked for, but did not find this issue.	
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive			Investigation looked for, but did not find this issue.	
	a.3 (3)	Lighting is on more hours than necessary.			Investigation looked for, but did not find this issue.	
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Investigation looked for, but did not find this issue.	
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.			Investigation looked for, but did not find this issue.	
	b.3 (7)	OTHER_Economizer/OA Loads				
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive				The heating valves for PA-1 and PA-3 are open while the unit is economizing.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Not Relevant	
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Investigation looked for, but did not find this issue.	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Not Relevant	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not Relevant	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Not Relevant	
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Not Relevant	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not Relevant	
	f.2 (24)	Pump Discharge Throttled			Not Relevant	
	f.3 (25)	Over-Pumping			Not Relevant	
	f.4 (26)	Equipment is oversized for load.			Investigation looked for, but did not find this issue.	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				
	g.1 (28)	VFD Retrofit - Fans				

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13139 - ARCC/Theatre Performing Arts Center

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps				
	g.3 (30)	VFD Retrofit - Motors (process)				
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				
	h.2 (33)	Retrofit - Chillers				
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)				
	h.4 (35)	Retrofit - Boilers				
	h.5 (36)	Retrofit - Packaged Gas fired heating				
	h.6 (37)	Retrofit - Heat Pumps				
	h.7 (38)	Retrofit - Equipment (custom)				
	h.8 (39)	Retrofit - Pumping distribution method				
	h.9 (40)	Retrofit - Energy/Heat Recovery				
	h.10 (41)	Retrofit - System (custom)				
	h.11 (42)	Retrofit - Efficient Lighting				
	h.12 (43)	Retrofit - Building Envelope				
	h.13 (44)	Retrofit - Alternative Energy				
	h.14 (45)	OTHER_Retrofit				
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Investigation looked for, but did not find this issue.	
	i.2 (47)	Impurity/Contamination			Investigation looked for, but did not find this issue.	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

Deleted Findings Summary

Building: Library

Site: ARCC- Coon Rapids Campus

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	OA damper is not controlled properly for LS-1 AHU: no savings	$0	$0	0.00	$0	0.00	0
2	OA damper is not controlled properly for LS-2 AHU: no savings	$0	$0	0.00	$0	0.00	0
3	OA damper is not controlled properly for LS-3 AHU	$0	$0	0.00	$0	0.00	0
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

PBEEEP State Government

Building: Library

FWB Number:	13135	Eco Number:	1
Site:	ARCC- Coon Rapids Campus	Date/Time Created:	5/20/2012

Investigation Finding:	OA damper is not controlled properly for LS-1 AHU: no savings	Date Identified:	8/29/2011
Description of Finding:	The outdoor air dampers cycle uncontrollably causing the MAT to vary widely in cold weather for LS-1, 6,480 CFM. AMEC estimated that resolving this issue would save 435 Therms annually and cost $115. However, during the review process, it was found that the cycling of the dampers would not lead to any energy savings, but is recommended to prevent wear on the dampers and actuators. As a result, this measure was deleted.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Controls contractor	Benefits:	Reduce heat loss from HW loop and reduce boiler Nat Gas consumption to create HW for heating air
Baseline Documentation Method:	Calculate proposed MAT_1 from using only 10% OA MAT_1 = (RAT-OAT) x 90% + OAT		
Measure:	Maintain 10% outdoor air for the 3 AHUs by controlling OAD when building is occupied. Determine Btu saved by finding new MATs with minimal OA. Btu saved is the difference he status quo MAT and MATs when OAD is controlled properly. CFM x 1.08 x (DHH_0-DHH_1)/EFF_Boiler		
Recommendation for Implementation:	Change sequence of operation and control the LS-1 AHU properly Monitor new MATs with the reduction of OA		
Evidence of Implementation Method:	New MAT		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

PBEEEP State Government

Building: Library

FWB Number:	13135	Eco Number:	2
Site:	ARCC- Coon Rapids Campus	Date/Time Created:	5/20/2012

Investigation Finding:	OA damper is not controlled properly for LS-2 AHU: no savings	Date Identified:	8/29/2011
Description of Finding:	The outdoor air dampers cycle uncontrollably causing the MAT to vary widely in cold weather for LS-2, 8,320 CFM. AMEC estimated that resolving this issue would save 516 Therms annually and cost $115. See Finding 1 for more details on why the measure was deleted.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Controls contractor	Benefits:	Reduce heat loss from HW loop and reduce boiler Nat Gas consumption to create HW for heating air
Baseline Documentation Method:	Calculate proposed MAT_1 from using only 10% OA MAT_1 = (RAT-OAT) x 90% + OAT		
Measure:	Maintain 10% outdoor air for the 3 AHUs by controlling OAD when building is occupied. Determine Btu saved by finding new MATs with minimal OA. Btu saved is the difference he status quo MAT and MATs when OAD is controlled properly. CFM x 1.08 x (DHH_0-DHH_1)/EFF_Boiler		
Recommendation for Implementation:	Change sequence of operation and control the LS-2 AHU properly Monitor new MATs with the reduction of OA		
Evidence of Implementation Method:	New MAT		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

PBEEEP State Government

Building: Library

FWB Number:	13135	Eco Number:	3
Site:	ARCC- Coon Rapids Campus	Date/Time Created:	5/20/2012

Investigation Finding:	OA damper is not controlled properly for LS-3 AHU	Date Identified:	8/29/2011
Description of Finding:	The outdoor air dampers cycle uncontrollably causing the MAT to vary widely in cold weather for LS-3, 13,345 CFM. AMEC estimated that resolving this issue would save 1,580 Therms annually and cost $115. See Finding 1 for more details on why the measure was deleted.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Controls contractor	Benefits:	Reduce heat loss from HW loop and reduce boiler Nat Gas consumption to create HW for heating air
Baseline Documentation Method:	Calculate proposed MAT_1 from using only 10% OA MAT_1 = (RAT-OAT) x 90% + OAT		
Measure:	Maintain 10% outdoor air for the 3 AHUs by controlling OAD when building is occupied. Determine Btu saved by finding new MATs with minimal OA. Btu saved is the difference he status quo MAT and MATs when OAD is controlled properly. CFM x 1.08 x (DHH_0-DHH_1)/EFF_Boiler		
Recommendation for Implementation:	Change sequence of operation and control the LS-3 AHU properly Monitor new MATs with the reduction of OA		
Evidence of Implementation Method:	New MAT		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Summary

Building: Humanities

Site: ARCC- Coon Rapids Campus

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	HS-1: Simultaneous heating and cooling: not found in QA	$0	$0	0.00	$0	0.00	0
2	HS-2: Simultaneous heating and cooling: not found in QA	$0	$0	0.00	$0	0.00	0
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Humanities

FWB Number:	13136	Eco Number:	1
Site:	ARCC- Coon Rapids Campus	Date/Time Created:	5/20/2012

Investigation Finding:	HS-1: Simultaneous heating and cooling: not found in QA	Date Identified:	8/29/2011
Description of Finding:	The 12,000 CFM VAV AHU with 10 HP supply fan and 5 HP return fan is heating during economizer mode. The 0.75 HP HW pump is rated at 25 GPM and the HW supply and return temps are recorded. AMEC estimated that resolving this issue would save 1,011 kWh and 305 Therms annually and cost $253 to implement. However, during the review process it was found that the simultaneous heating and cooling was not occurring and this measure was deleted.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Controls contractor	Benefits:	Natural gas savings from the reduced heating during economizer mode
Baseline Documentation Method:	Trends of the discharge and mixed air temperatures, outside air damper, and supply fan VFD speed were recorded. The data shows that the AHU is heating while economizing (i.e. the outside air damper is open more than minimum position).		
Measure:	Adjust the controls sequences so that the AHU cannot economize while the heating valve is open.		
Recommendation for Implementation:	Adjust the control sequences to have the cooling coil, heating coil, and outside air damper modulate in sequence to meet the discharge air temperature setpoint. The minimum outside damper position of 10% shall remain in place to ensure adequate ventilation. A lockout shall also be put in place so that when the heating valve is open, the outside damper cannot economize and the cooling valve cannot open in order to eliminate simultaneous heating and cooling.		
Evidence of Implementation Method:	Trend the following points at 15 minute intervals for two weeks during the winter or shoulder season (OAT < 40F): SF VFD speed, OA damper position, MAT, DAT, DAT setpoint, HW valve, and CHW valve. Check trend data to ensure that the HW valve, CHW valve, and OA damper are meeting the DAT setpoint and that the OA damper and CHW valve are closed or at minimum position when the HW valve is open. Also ensure that when the HW valve is closed, the MAT is equal to the DAT, to ensure the valve is not leaking.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Humanities

FWB Number:	13136	Eco Number:	2
Site:	ARCC- Coon Rapids Campus	Date/Time Created:	5/20/2012

Investigation Finding:	HS-2: Simultaneous heating and cooling: not found in QA	Date Identified:	8/29/2011
Description of Finding:	The 12,000 CFM VAV AHU with 10 HP supply fan and 5 HP return fan is heating during economizer mode. The 0.75 HP HW pump is rated at 25 GPM and the HW supply and return temps are recorded. AMEC estimated that resolving this issue would save 49 kWh and 371 Therms annually and cost $253 to implement. However, during the review process it was found that the simultaneous heating and cooling was not occurring and this measure was deleted.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Controls contractor	Benefits:	Natural gas savings from the reduced heating during economizer mode
Baseline Documentation Method:	Trends of the discharge and mixed air temperatures, outside air damper, and supply fan VFD speed were recorded. The data shows that the AHU is heating while economizing (i.e. the outside air damper is open more than minimum position).		
Measure:	Adjust the controls sequences so that the AHU cannot economize while the heating valve is open.		
Recommendation for Implementation:	Adjust the control sequences to have the cooling coil, heating coil, and outside air damper modulate in sequence to meet the discharge air temperature setpoint. The minimum outside damper position of 10% shall remain in place to ensure adequate ventilation. A lockout shall also be put in place so that when the heating valve is open, the outside damper cannot economize and the cooling valve cannot open in order to eliminate simultaneous heating and cooling.		
Evidence of Implementation Method:	Trend the following points at 15 minute intervals for two weeks during the winter or shoulder season (OAT < 40F): SF VFD speed, OA damper position, MAT, DAT, DAT setpoint, HW valve, and CHW valve. Check trend data to ensure that the HW valve, CHW valve, and OA damper are meeting the DAT setpoint and that the OA damper and CHW valve are closed or at minimum position when the HW valve is open.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Summary

Building: Performing Arts Ctr
Site: ARCC- Coon Rapids Campus

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	AHU PA-3: OA Damper is not optimally controlled: payback > 15 years	$0	$0	0.00	$0	0.00	0
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Performing Arts Ctr

FWB Number:	13139	Eco Number:	1
Site:	ARCC- Coon Rapids Campus	Date/Time Created:	5/20/2012

Investigation Finding:	AHU PA-3: OA Damper is not optimally controlled: payback > 15 years	Date Identified:	8/29/2011
Description of Finding:	During warm-up period in heating mode the OA damper is not zero during unoccupied hours before 0900. AMEC estimated that this measure would save 315 Therms annually and cost $305 to implement. However, during the review process, corrections to the calculations caused the savings to decrease significantly so that the payback is greater than 15 years.		
Equipment or System(s):	AHU with heating only	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Controls contractor	Benefits:	Natural gas savings
Baseline Documentation Method:	Trended data shows the OA damper is not closed when OAT is below 55 F and the building is unoccupied before 0900 M-F, but requires warm-up from unoccupied temperature setpoint to occupied temperature setpoint. Determine hours from data this occurs and extrapolate to TMY bin data to determine typical savings per year. Calculate new MAT for savings.		
Measure:	When OAT is below 55 and the building requires warm-up, close OA damper before 0900 M-F		
Recommendation for Implementation:	Close OA damper position when OAT is below 55 and the building requires warming up to occupied temperature setpoint		
Evidence of Implementation Method:	Trend data for 1 week in heating mode to determine warm-up period before 0900 M-F and determine %OA. Confirm OA is 0 from RAT and MAT and OA damper position		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Public Buildings Enhanced Energy Efficiency Program

ATTACHMENT 4: SCREENING RESULTS FOR ANOKA-RAMSEY COMMUNITY COLLEGE, COON RAPIDS PBEEEP # P13100

Date: 8/05/2010

Summary Table

Facility Name	**Anoka Ramsey Community College**
Location	11200 Mississippi Blvd Coon Rapids, MN 55433
Facility Manager	Roger Freeman
Number of Buildings	26
Interior Square Footage	380,446
PBEEEP Provider	CEE (Neal Ray)
State's Project Manager	Mike Seymour
Date Visited	July 8, 2010
Annual Energy Cost	$534,279 (From 2009 B3 Data)
Utility Company	Xcel Energy-Electric CenterPoint Energy - Gas
Site Energy Use Index (EUI)	111.5 kBtu/ft^2
Benchmark EUI (form B3)	161.8 kBtu/ft^2

Recommendation for Investigation

Anoka Ramsey Community College (ARCC) consists of 26 buildings (refer to the *Campus Map* at the end of report). Twenty three of the buildings are recommended for investigation. The new AHU currently being installed in the (Admin) College Services building will be excluded from investigation. The garage and garage addition will not be investigated. There is also a Visual Arts Building which is currently being constructed that will not be investigated.

Table 1: Building Data as listed in B3

Building Name	State ID	Area (Square Feet)	Year Built	Recommended for Investigation
Training & Develop Center	E26152C0162	9,800	1962	Y
College Services	E26152C0266	32,882	1966	Y
Library	E26152C0366	34,029	1966	Y
Library/Gym Addition	E26152C2105	17,000	1987	Y
Technology	E26152C0466	21,711	1966	Y
Humanities	E26152C0566	24,869	1966	Y
Gym	E26152C0668	34,042	1968	Y
Fine Arts	E26152C0771	17,171	1971	Y
Student Center	E26152C0871	19,064	1971	Y
Business/Nursing	E26152C0971	31,119	1971	Y
Business/Nursing Addition	E26152C0987	10,203	1987	Y
Performing Arts Center	E26152C1075	21,205	1975	Y
Performing Arts Center East Vestibule	E26152C1005	165	2005	Y
Fine Arts North/South Penthouse	E26152C1271	896	1971	Y
Link-Hum/Student Center	E26152C1371	418	1971	Y
Business/Nursing Ext Penthouse	E26152C1487	931	1987	Y
Library Add Penthouse	E26152C1587	931	1987	Y
Fine Arts North Vestibule	E26152C1697	130	1997	Y
College Services Addition	E26152C1797	31,650	1997	Y
Student Center Addition 1	E26152C1897	8,235	1997	Y
Link-Hum/Student Center	E26152C1997	418	1997	Y
Science Building	E26152C2098	36,466	1998	Y
Student Center Addition II		22,905	2009	Y
Performing Arts Lobby Addition		606	2001	Y
Garage	E26152C1176	1,800	1976	N
Garage Addition		1,800	2005	N

Anoka Ramsey Community College Screening Overview
The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy savings opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. The screening of ARCC was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. This report is the result of that information.

ARCC includes 26 buildings totaling 380,446 ft^2. Twenty of the buildings are part of the main campus and are all connected together. These buildings compromise a total of 345,070 ft^2. The detached buildings are the Training and Development Center (TDC, 9,800 ft^2), Performing Arts Center (PAC 21,976 ft^2) and Garage (3,600 ft^2).

Controls and Trending
The campus contains a Schneider Electric-IA ® automation system by UHL. The system controls all the mechanical equipment in the buildings except for one MAU in the Fine Arts building and the mechanical equipment in the Garage. The system is capable of trending a large number of points which were set up as part of the facility screening by CEE. Trend data is available from August 1, 2010 for the majority of the points listed below lists the points within each building the system controls.

General HVAC Overview
There are three boilers in the main campus building. Two are for winter use and one is for summer and shoulder seasons. They utilize a hot water reset and were installed in 2007. These three boilers supply heat to all buildings on the campus except for the Training and Development Center and the garage. The Training and Development Center contains two smaller boilers for heat during the winter. The garage is heated by forced air ceiling units and infrared radiation.

For cooling there are two 500 ton centrifugal chillers which run on a lead/lag schedule with a cooling tower. They supply chilled water to all the AHUs on campus except for the Training and Development Center which is cooled by DX cooling with a condensing unit.

The facility has a wide range of AHUs ranging from multi-zone units from 1970 to new Variable Air Volume (VAV) AHUs from 2009. The building contains 36 AHUs. Eleven are multi-zone, 8 are constant volume, 3 are VAV with variable inlet guide vanes for volume control, and 14 are VAV with VFDs for volume control. Anoka-Ramsey has been systematically upgrading the original multi-zone constant volume AHU's to VAV systems for several years. Approximately half of them are upgraded.

Lighting
Most of the interior lighting consists of T8 28 watt lights. These lights are mainly controlled by switches. There are very few occupancy sensors or timers controlling interior lights. Outside lighting runs on timers and photocells and is controllable by the building automation system.

EUI B3 Benchmark Overview

The actual energy user index (EUI), as computed from utility bills and square footage, is currently at 111.5 kBtu/ft^2, which is less than the B3 benchmark score of 161.8 kBtu/ft^2. The benchmark value may be too high (for example if spaces are improperly classified as laboratories or summer cooling hours are too high the benchmark value will be too high). The average state building has an EUI 23% lower than the corresponding B3 Benchmarks. Since the individual buildings are not sub-metered, it is not possible to isolate the performance of each individual building. Our cursory inspection of the equipment during screening leads us to believe that there may be potential savings in individual equipment.

Other Important Issues

Anoka-Ramsey Community College is being used by MnSCU as the site of a side by side comparison of PBEEEP and a Guaranteed Energy Savings Contract(GESC) offered by Energy Services Group (ESG). It is expected that the results of this Investigation will be studied closely by the MnSCU Administration and Facility staff at other campuses. There may be concurrent activities of the two programs.

CEE performed the screening of the facility and as a result of the cursory inspection of the equipment believes that there may be potential savings in individual equipment.

Metering

There are a total of four gas meters and three electrical meters on the campus. Fuel oil #2 is also used in the boilers on the main campus when natural gas is curtailed by the utility company.

Documentation

There is a significant amount of mechanical documentation, including equipment schedules, renovation prints, balance reports for a few buildings, and control sequences. All of this data is readily available and very easy to find.

Building Naming

There are 26 building ID numbers on the campus each of which corresponds to a project which added square footage to the site. This project will use groups of these "buildings" that conform to the mechanical system design. The naming convention of this report lists the building (group) name at the top of the table as it is listed on the campus map and then lists all the buildings within that group.

Mechanical Equipment Summary Table	
1	Building Automation System
380,446	Square Feet
36	Air Handlers
25	Fan Coil Units (Estimate)
155	VAV Boxes
2	Chillers
1	Cooling Tower
5	Boilers (2 small boilers in TDC building)
5	Secondary Hot Water Pumps (2 are small and in TDC building)
2	Chilled Water Pumps

PBEEEP Screening Report for Anoka Ramsey Community College Coon Rapids
PBEEEP # P13100

This screening report is based on the PBEEEP Guidelines. It is based on two site visits, review of the facility documentation, building automation system, a limited inspection of the facility and interviews with the staff. The purpose of the screening report is to evaluate the potential of the facility for the implementation of cost-effective energy efficiency savings through recommissioning. To the best of our knowledge the information here is accurate. It provides a high level view of many of the important parameters of the mechanical equipment in the facility. Because it is the result of a limited audit survey of the facility, it may not be completely accurate or inclusive.

Good Candidates for Investigation

Thirteen building groups (24 buildings) listed below are good candidates for investigation. They have a large square footage, at least one central air handling unit, are tied into the automation system; and only one building has been commissioned.

Potential Energy Savings Opportunities:

- Assure AHUs can meet duct static setpoint
- Non-school mode operation
- Improved operation of chilled water pumps
- Fume hood controls for Science Area
- DAT reset within multi-zone units
- Potential to reduce simultaneous heating and cooling
- Proper calibration of sensors
- Assure economizing is being used properly

FINE ARTS

Fine Arts State ID# E26152C0771
Fine Arts North Vestibule State ID# E26152C1697
Fine Arts North/South Pent State ID# E26152C1271

Area (sqft)	18,197	Year Built	1971, 1997	Occupancy (hrs/yr)	5,500

HVAC Equipment

Description	Type	Size	Notes
FS-1	Multi-Zone	8,215 CFM 3 HP SF 1 HP RF	Contains a HWP for its coil rated at 36 gpm and ½ HP. Between 8 to 10 zones.
FS-2	Multi-Zone	9,325 CFM 5 HP SF 1.5 HP RF	Contains a HWP for its coil rated at 28 gpm and ½ HP. Between 8 to 10 zones.
FS-3	Constant Volume	2,525 CFM 1 HP SF	Contains HWP for its coil rated at 30 gpm and ½ HP
EF-1	Constant Volume	780 CFM 1/4 HP	Exhaust from 2 rooms
EF-2	Constant Volume	480 CFM 1/6 HP	Exhaust from 3 rooms
EF-3	Constant Volume	330 CFM 1/6 HP	Exhaust from 2 rooms
EF-4	Constant Volume	4100 CFM 1.5 HP	Exhaust from welding room and one other room
EF-5	Constant Volume	700 CFM ¼ HP	Exhaust from 4 rooms
EF-6	Constant Volume	175 CFM 1/6 HP	Exhaust from Elevator Equipment and one other room
EF-7	Constant Volume	310 CFM 1/6 HP	Exhaust from one room
HWP-6	Constant Volume	36 gpm ¾ HP	For FTR in building

Points on BAS

Description	Points
FS-1 FS-2	OAT, OA RH, OA enthalpy, MAT, Fan command, CHW valve %, HW Valve %, CD temperature, HD temperature, pump command, EF status, RAT, RF command, OA dampers, Return dampers, HD setpoint, heat enable, minimum OA damper position, CD setpoint, morning warm up setpoint, econ enable setpoint, night setback setpoint, MAT low limit, HWP enable setpoint
Radiation	HWP enable setpoint, Radiation HW temp
FCU	Status, FCU chilled water temp, FCU hot water temp, FCU HWP enable setpoint, FCU CHWP command

Additional Comments

- Only Units FS-1 and FS-2 are automated.
- AHUs are original from 1970.
- Unit FS-3 is not automated it runs 24/7 as long as school is in secession. Supplies 100% OA for foundry glass blowing.

COLLEGE CENTER

Student Center	State ID# E26152C0871
Student Center Addition I	State ID# E26152C1897
Link-Humanities/Student Center	State ID# E26152C1371
Link-Humanities/Student Center	State ID# E26152C1997

Area (sqft)	27,717	Year Built	1971, 1997	Occupancy (hrs/yr)	4,368

HVAC Equipment

Description	Type	Size	Notes
CS-1	Multi-Zone	7,155 CFM 5 HP SF 1 HP RF	Contains a HWP for its coil rated at 20 gpm and 1/3 HP
CS-2	Multi-Zone	11,220 CFM 7.5 HP SF 0.75 HP RF	Contains a HWP for its coil rated at 55 gpm and 3/4 HP
CS-3	Variable air volume	4,640 CFM 5 HP SF	Contains HWP for its coil rated at 17 gpm and 1/4 HP. Contains VIGV with 3 VAV boxes
AHU-4	Variable air volume	13,000 CFM 15 HP SF	VFD with 10 VAVs

Points on BAS

Description	Points
CS-1 CS-2	OAT, OA RH, OA enthalpy, MAT, Fan command, CHW valve %, HW Valve %, CD temperature, HD temperature, pump command, RAT, RF command, OA dampers, RA dampers, HD setpoint, heat enable, minimum OA damper position, CD setpoint, morning warm up setpoint, econ enable setpoint, night setback setpoint, MAT low limit, HWP enable setpoint
CS-3	OAT, OA humidity, Econ enable, CW coil enable, HW coil enable, MAT, HW valve %, HWP command, HWP status, CHW valve %, SF command, Supply Vane %, DAT, Calculated DAT, Return Vane %, RF command, RAT, Exhaust Air damper %, RA damper %, Min OA Damper setpoint, HWP lockout SP, Duct Static Setpoint, Bldg Space Pressure, DAT setpoint, MAT low limit, Night Setback
AHU-4	OAT, OA humidity, OA enthalpy, Econ Damper, MAT, Cooling valve %, Heating valve %, SF command, SF speed, DAT, Bldg pressure, RAT, RF speed, Duct static pressure, Morning warm up setpoint, DAT setpoint, Duct static pressure setpoint, Minimum econ damper setpoint, Night setback setpoint, Circ Pump Disable SP
Multi-Zone Damper	Space Temperature, Space Temperature setpoint, Zone Damper%
VAV	Supply from main AHU, Box flow, Box flow setpoint, Damper %, heat valve %, Box DAT, Space temperature, Space temperature setpoint, Radiation control
HWP	HWP enable setpoint, HWP command

Additional Comments (College Center)

- AHUs CS-1 and CS-2 are original from 1970
- AHU CS-3 is from 1985
- AHU-4 is from 1997

COURTYARD ADDITION					
Student Center Addition II				State ID#	
Area (sqft)	22,905	Year Built	2009	Occupancy (hrs/yr)	3,900

HVAC Equipment

Description	Type	Size	Notes
AHU-5	Variable air Volume	15,350 CFM 25 HP SF 10 HP EF	VFD with 18 VAVs and heat recovery wheel for exhaust air. Contains a HWP rated at 30 gpm and 2/5 HP
AHU-6	Variable air Volume	11,530 CFM 15 HP SF 7.5 HP EF	VFD with 6 VAVs and heat recovery wheel for exhaust air. Contains a HWP for the heat coil rated at 21 gpm and 1/6 HP
UH-1 UH-2	Horizontal Unit Heater	20 kBtu/hr 2.0 gpm,	

Points on BAS

Description	Points
AHU-5 AHU-6	OAT, Econ damper %, Heat wheel VFD, Heat wheel temp, MAT, heat valve %, HW coil pump command, HW coil pump status, cool valve %, SF status, SF speed, DAT, DAT setpoint, Duct static pressure, RARH, RA CO2, RAT, Heat wheel exhaust temp, EF command, EF speed, Exhaust damper %, Return damper %, CO_2setpoint, Minimum OA setpoint, Heat wheel defrost setpoint, Space pressure setpoint, Night setback setpoint, Econ enable setpoint, Humidity setpoint, Heat/Cool Lockout Temp, Duct static setpoint, Bypass damper lockout, DAT setpoint
Elevator Fan	Fan command, Room temperature, Room temperature setpoint
Unit Heater	HW valve %, Room temperature, Room temperature setpoint
VAV	Supply from main AHU, Damper %, reheat valve %, Box DAT, Box flow, Box flow setpoint, Space temperature, Space temperature setpoint

Additional Comments

- Addition was built in 2007. All mechanical equipment is from 2007 and commissioned

ADMIN/COLLEGE SERVICES AND WEST ADDITION					
College Services **College Services Addition**			State ID# E26152C0266 State ID# E26152C1797		
Area (sqft)	64,532	Year Built	1966, 1997	Occupancy (hrs/yr)	4,368

HVAC Equipment

Description	Type	Size	Notes
AS-1	Variable air volume	13,000 CFM 3 HP SF 1.5 HP EF	SF and RF both have VFDs with 12 VAVs. Is currently being installed. Has a HWP for the heat coil rated at 20gpm and ¼ HP
AS-5	Variable air volume	31,500 CFM 30 HP SF 10 HP RF	Both fans have VFDs. There are 32 VAV boxes associated with this unit
7 EFs		700 to 9000 CFM	Large fan serves chiller room rated at 5 HP
AC-1	Split Ductless A/C Unit	15,000 Btu/hr	Serves A126 Server room
2 Chilled water pumps	Secondary Loop Pump	75 HP	
2 Chiller Injector Pumps	Injector Pumps	20 HP	
2 Condenser Pumps	For water cooled chillers	40 HP	
2 Snow Melt Pumps		7.5 HP	
2 Sump Pumps		0.5 HP	
1 Domestic HW pump		1.5 HP	
2 Chillers	Centrifugal Chiller	500 tons	Generally only run one at a time. Scheduled with occupancy, try to utilize economizing when possible.
1 Cooling Tower		3000 gpm 2 fans rated at 25 HP each	There are no VFDs on the cooling tower fans
2 Winter Boilers	Unilux Model 2F1000W-FE2	10,330 kBtu/hr input and 8,780 kBtu/hr output	Used only for winter season.
1 Summer boiler	Viessmann Vitocrossal 300	3,361 kBtu/hr input and 3,203 kBtu/hr output	Used for summer reheats and swing seasons
4 Primary Boiler Pumps	Bell & Gossett	Rated at 2, 3, and 5 HP	
3 Secondary Pumps	Bell & Gossett	40 HP 1000 gpm	

Points on BAS (ADMIN/COLLEGE SERVICES AND WEST ADDITION)

Description	Points
AS-5	OAT, OA humidity, OA enthalpy, Econ damper, MAT, chilled water valve %, SF command, SF speed, DAT, DAT setpoint, Duct static pressure, Duct static pressure setpoint, Morning warm up setpoint, Night setback setpoint, Econ minimum position, Bldg pressure, RAT, RF speed,
VAV	Supply air temp from AHU, Box flow, Box flow setpoint, heat valve %, supply air temperature, space temperature, space temperature setpoint
Boilers	HWS, Pump command, Pump speed, Differential pressure setpoint, Differential pressure, Boiler command, Boiler status, Primary pump status, Boiler %, HWR
Chiller	Chilled water system status, Pump speed, CHWST, CHWRT, Differential pressure, Differential pressure setpoint, Economizer CW mode changeover setpoint
Cooling Tower	Cooling tower level, Cooling Tower level setpoint, Cooling tower fill valve command,

Additional Comments

- AHU AS-1 is not automated yet. This project is currently being implemented but not commissioned. Will not be investigated with the rest of the building.

LIBRARY

Library	State ID# E26152C0366
Library/Gym Addition	State ID# E26152C2105
Library Addition Penthouse	State ID# E26152C1587

Area (sqft)	51,960	Year Built	1966, 1987	Occupancy (hrs/yr)	4,368

HVAC Equipment

Description	Type	Size	Notes
LS-1	Multi-Zone	6480 CFM 7.5 HP SF 1.5 HP RF	Contain HWP for heat coil rated at 14.7 gpm and 1/3 HP. Contains 4 zones.
LS-2	Multi-Zone	8320 CFM 5 HP SF 1.5 HP RF	Contain HWP for heat coil rated at 24.5 gpm and 1/3 HP. Contains 8 zones.
LS-3	Multi-Zone	13,345 CFM 10 HP SF 3 HP RF	Contain HWP for heat coil rated at 42 gpm and ½ HP. Contains 4 zones.
LS-4	Multi-Zone	7,200 CFM 10 HP SF 3 HP RF	Contain HWP for heat coil rated at 25.4 gpm and ½ HP. Contains 4 zones.
LS-5	Variable air Volume	14,665 CFM 15 HP SF	VIGV with 10 VAV boxes
8 FCUs	Constant volume	Rated between 215 to 640 CFM	Serve offices along the perimeter of the library. Work with the schedules of one of the AHUs
L-PS-1	Constant Volume	1 HP 72.5 gpm	Supplies chilled water for FCUs
L-PS-2	Constant Volume	1 HP 72.5 gpm	Supplies hot water for FCUs

Points on BAS

Description	Points
LS-1 LS-2 LS-3 LS-4	OAT, OA RH, OA enthalpy, MAT, Fan command, CHW valve %, HW Valve %, CD temperature, HD temperature, pump command, RAT, RF command, OA dampers, RA dampers, HD setpoint, heat enable, Minimum OA damper position, CD setpoint, Morning warm up setpoint, Econ enable setpoint, Night setback setpoint, MAT low limit, HWP enable setpoint
LS-5	OAT, OA humidity, Econ enable, CW coil enable, MAT, CHW valve %, SF command, Supply Vane %, DAT, Calculated DAT, Return Vane %, RF command, RAT, RA damper %, Min OA Damper setpoint, Duct Static Setpoint, Bldg Space Pressure, DAT setpoint, MAT low limit, Night Setback
VAV	Supply from main AHU, Damper %, Reheat valve %, Box DAT, Box flow, Box flow setpoint, Space temperature, Space temperature setpoint
FCU	HWP enable setpoint, HWP command, CHWP command, CHWST, HWST

Additional Comments (LIBRARY)

- LS-1 through LS-4 were installed in 1966
- LS-5 was installed in 1985
- Pumps for FCUs do not contain 3 way valves

HUMANITIES					
Humanities			State ID# E26152C0566		
Area (sqft)	24,869	Year Built	1966	Occupancy (hrs/yr)	4,680

HVAC Equipment

Description	Type	Size	Notes
H-1S	Variable air volume	12,000 CFM 10 HP SF 5 HP RF	Contain HWP for heat coil rated at 25 gpm and 3/4 HP. Each fan has a VFD. Unit contains 15 VAV boxes
H-2S	Variable air volume	12,000 CFM 10 HP SF 5 HP RF	Contain HWP for heat coil rated at 25 gpm and 3/4 HP. Each fan has a VFD. Unit contains 16 VAV boxes
1 EF		1,500 CFM ½ HP	
HWP-3		33 gpm 1 HP	VFD for VAV box reheat loop
HWP-4		96 gpm 1.5 HP	For existing fan coil units
2 Unit Heaters			

Points on BAS

Description	Points
HS-1 HS-2	OAT, OA humidity, OA enthalpy, Econ damper %, MAT, heat valve %, HW coil pump command, HW coil pump status, HW coil temperature, cool valve %, CHWs temp, CHWR temp, CHW coil temp, SF command, SF status, SF speed, DAT, DAT setpoint, Duct static pressure, RARH, RA CO2, RAT, RF command, RF status, RF speed, Exhaust damper %, Return damper %, CO_2setpoint, Minimum OA setpoint, Space pressure setpoint, Night setback setpoint, Econ enable setpoint, Humidity setpoint, Heat/Cool Lockout Temp, Duct static setpoint, DAT setpoint
Heating Loop	Isolation valve %, HWRT, Loop HWST Pump command, Pump status, Pump speed, Loop Differential pressure, VAV loop valve %, Perimeter valve %, HWST setpoint, Differential pressure setpoint, ISO valve OA enable
VAV	Supply from main AHU, Damper %, Reheat valve %, Box DAT, Box flow, Box flow setpoint, Space temperature, Space temperature setpoint
Unit Heaters	HW valve command, Room temperature, Room temperature setpoint
EF	EF command, EF status

Additional Comments

- All equipment was installed in 2008

SCIENCE ADDITION					
Science Building			State ID# E26152C2098		
Area (sqft)	36,466	Year Built	1997	Occupancy (hrs/yr)	4,368

HVAC Equipment

Description	Type	Size	Notes
AHU-1	Variable air volume	7,900 CFM 7.5 HP SF 3 HP RF	
AHU-2	Variable air volume	24,500 CFM 25 HP SF 3 HP RF	Contains heat recovery coils. Have pumps for the heat recovery and the heating coils. Energy recovery pumps are rated at 7.5 HP. Heat coil pump rated at 3 HP
AHU-3	Variable air volume	10,300 CFM 10 HP SF 2 HP RF	
EF-1	For all exhaust from energy recovery	25,000 CFM 15 HP	VFD for Energy Recovery system
17 EF	For Science Areas	250 to 6000 CFM	EF-2 through EF-18

Points on BAS

Description	Points
AHU-1	OAT, OA humidity, OA enthalpy, Econ damper %, MAT, cool valve %, CHW differential pressure, SF command, SF speed, DAT, DAT setpoint, Duct static pressure, RAT, RF speed, Relief damper %, Minimum OA setpoint, Night setback setpoint, Econ enable setpoint, Duct static setpoint, Bldg pressure
AHU-2	OAT, OA humidity, OA enthalpy, Isolation damper command, Reclaim valve%, Reclaim coil DAT, Heat reclaim pump enable setpoint, Heat valve %, Heat coil pump enable setpoint, Cool valve %, SF command, SF speed, Humidifier status, Humidifier enable setpoint, DAT, DAT setpoint, Duct static pressure, Exhaust air temperature, Exhaust air humidity, Exhaust air duct static, EF speed, Night setback setpoint, Econ enable setpoint, Duct static setpoint, DAT setpoint, Bldg pressure
AHU-3	OAT, OA humidity, OA enthalpy, Econ damper %, MAT, Cool valve %, Heat valve %, Heat coil pump enable setpoint, SF command, SF speed, DAT, DAT setpoint, Duct static pressure, RAT, RF speed, Minimum OA setpoint, Night setback setpoint, Morning warm up setpoint, Econ enable setpoint, Duct static setpoint
VAV	Supply from main AHU, Damper %, Reheat valve %, Box DAT, Box flow, Box flow setpoint, Space temperature, Space temperature setpoint

Additional Comments (Science)

- All equipment was installed in 1997
- AHU-2 utilizes a heat reclaim system due to being 100% OA

BUSINESS & NURSING					
Business/Nursing **Business/Nursing Addition** **Business/Nursing Ext Penthouse**			State ID# E26152C0971 State ID# E26152C0987 State ID# E26152C1487		
Area (sqft)	42,253	Year Built	1971, 1987	Occupancy (hrs/yr)	5,000

HVAC Equipment

Description	Type	Size	Notes
BS-1	Multi-Zone	15,170 CFM 7.5 HP SF 3 HP RF	Contains a HWP for its coil rated at 46 gpm and 3/4 HP
BS-2	Multi-Zone	12,000 CFM 7.5 HP SF 3 HP RF	Contains a HWP for its coil rated at 36 gpm and ½ HP
BS-3	Multi-Zone	14,900 CFM 7.5 HP SF 3 HP RF	Contains HWP for its coil rated at 45 gpm and3/4 HP
EF-1	Constant Volume	260 CFM 1/6 HP	
EF-2	Constant Volume	360 CFM 1/6 HP	
EF-3	Constant Volume	285 CFM 1/6 HP	
EF-4	Constant Volume	1,320 CFM 1/4 HP	
EF-5	Constant Volume	500 CFM 1/6 HP	
HWP-4	Constant Volume	55 gpm 1 HP	For FTR in building

Points on BAS

Description	Points
BS-1 BS-2 BS-3	OAT, OA RH, OA enthalpy, MAT, Fan command, CHW valve %, HW valve %, CD temperature, HD temperature, Heat coil pump command, RAT, RF command, OA dampers, Return dampers, HD setpoint, Heat enable setpoint, Minimum OA damper position, CD setpoint, Morning warm up setpoint, Econ enable setpoint, Night setback setpoint, MAT low limit, HWP enable setpoint

Additional Comments

- AHUs are original from 1970.

THEATRE PERFORMING ARTS CENTER

Performing Arts Center State ID# E26152C1075
Performing Arts Center East Vestibule State ID# E26152C1005
Performing Arts Lobby Addition State ID#

Area (sqft)	21,976	Year Built	1975, 2001, 2005	Occupancy (hrs/yr)	4,368

HVAC Equipment

Description	Type	Size	Notes
PA-1	Constant Volume	14,500 CFM 7.5 HP SF 3 HP RF	
PA-2/AHU-2	Constant Volume	3,200 CFM 3 HP SF	
PA-3	Constant Volume	2,200 CFM 1 HP SF	
PA-4	Constant Volume	2,500 CFM 1 HP	
4 UHs	Constant Volume	360 CFM 1/6 HP	

Points on BAS

Description	Points
PA-1 PA-3	OAT, OA RH, OA enthalpy, MAT, Fan command, HW valve %, CHW valve %, DAT, RAT, Econ damper %, Space temperature setpoint, Heat enable setpoint, Minimum OA setpoint, MAT setpoint, Morning warm-up setpoint, Econ enable setpoint, Night setback setpoint, MAT low limit setpoint
PA-2/AHU-2	OAT, OA RH, OA enthalpy, Econ damper %, MAT, Cooling valve %, Fan command, Heat valve %, DAT, Space Temperature, RAT, RARH, Morning warm-up setpoint, Space temperature setpoint, DAT setpoint, Minimum damper position, Night setback setpoint, CHW available
PA-4	OAT, OA RH, OA enthalpy, Econ damper %, MAT, SF command, MAT setpoint, Space temperature setpoint, Minimum OA setpoint, Morning warm-up setpoint, Econ enable setpoint, Night setback setpoint

Additional Comments

- Units PA-1, PA-3, and PA-4 are original and installed in 1975
- PA-2/AHU-2 was upgraded in 2001.

ACTIVITIES					
Activities/Gym			State ID# E26152C0668		
Area (sqft)	34,042	Year Built	1968	Occupancy (hrs/yr)	5,300

HVAC Equipment

Description	Type	Size	Notes
GS-1	Constant Volume	14,000 CFM 5 HP SF	
GS-2	Constant Volume	14,000 CFM 5 HP SF	
GS-3	Constant Volume	1,265 CFM 3/4 HP SF	Only unit which contains a cooling coil
EF-1	Constant Volume	4,355 CFM 3/4 HP	Not on the BAS
EF-2	Constant Volume	10,000 CFM 1.5 HP	Not on the BAS
HWP-1 HWP-2	Constant Volume	76 gpm ½ HP	Not on the BAS associated with units GS-1 and GS-2
HWP-3	Constant Volume	7 gpm 1/12 HP	Not on BAS associated with unit S-3

Points on BAS

Description	Points
GS-1 GS-2	OAT, OA RH, OA enthalpy, MAT, Fan command, HW Valve %, DAT, RAT, Econ damper %, RA damper %, DAT setpoint, Heat enable setpoint, Minimum OA setpoint, MAT low limit setpoint, Morning warm-up setpoint, Econ enable setpoint, Night setback setpoint
GS-3	OAT, OA RH, OA enthalpy, Econ damper %, MAT, Fan command, cooling valve %, heating valve %, DAT, GS3-R200 zone temperature, GS3-R207 zone temperature, Heat coil pump status, RAT, Return damper %, Space temperature setpoint, Heat enable setpoint, Minimum OA setpoint, MAT low limit setpoint, Morning warm-up setpoint, Econ enable setpoint, Night setback setpoint, Heating coil HWP enable setpoint

Additional Comments

- All equipment original from 1968.
- Not air conditioned, minimally used in summer.

COMPUTER TECHNOLOGY					
Computer Technology			State ID# E26152C0466		
Area (sqft)	21,711	Year Built	1966	Occupancy (hrs/yr)	4,368

HVAC Equipment

Description	Type	Size	Notes
TS-1	Variable air volume	17,000 CFM 15 HP SF 7.5 HP RF	Contains 11 VAV boxes
TS-2	Variable air volume	17,000 CFM 15 HP SF 7.5 HP RF	Contains 11 VAV boxes
EF-1	Constant Volume	1,350 CFM 1/2 HP	Not on the BAS
22 VAV boxes	Reheats	225 to 4,000 CFM	

Points on BAS

Description	Points
TS-1 TS-2	OAT, Econ damper %, MAT, Blender damper command, Heat valve %, HWS to heat coil, HWR to heat coil, Heat coil DAT, cool valve %, CHWST to CHW coil, CHWRT from CHW coil, SF command, SF speed, DAT, Duct static pressure, Building static pressure, RAT, RARH, RA $CO_{2,}$, RF command, RF speed, RA static pressure, Relief damper %, RA damper %, Space static setpoint, Heating/cooling switchover, Minimum OA setpoint, Duct static pressure setpoint, MA low limit setpoint, Calculated DAT setpoint, Blender setpoint, Night setback setpoint, CO_2 setpoint, Relief damper pressure setpoint, Low space temperature, High space temperature
VAV	Supply air from AHU, Damper %, reheat coil %, VAV box DAT, Box flow, Box flow setpoint, Space temperature, Space temperature setpoint

Additional Comments

- All equipment was upgraded in 2006.

CLASSROOMS					
Business/Nursing Addition			State ID# E26152C0987		
Area (sqft)	10,203	Year Built	1987	Occupancy (hrs/yr)	5,000

HVAC Equipment

Description	Type	Size	Notes
AHU-S2	Variable air volume	12,720 CFM 10 HP SF VFD Unknown RF	This is the design documentation for the original AHU. There may have been an upgrade. Contains 5 VAV boxes.

Points on BAS

Description	Points
AHU-S2	OAT, OA RH, Econ dampers, MAT setpoint, MAT, Heat valve %, HW coil pump status, cool valve %, SF command, SF speed, DAT, DAT setpoint, Duct static pressure, space pressure, RF command, RF speed, RAT, Return damper %, Exhaust damper %, Maximum OA damper setpoint, Minimum OA damper setpoint, OAT lockout setpoint, Night setback setpoint, Duct static setpoint, Duct static high limit setpoint, HWP lockout setpoint, Return Fan setpoint
VAV	AHU supply temperature, damper %, heat valve %, VAV DAT, Box flow, Box flow setpoint, Space temperature, space temperature setpoint, radiation valve, radiation enable

Additional Comments

- This building was built in 1987. AHU is original with the building from 1987, there was a control uggrade recently where the volume control of the supply fan was changed from axial vane to VFD,

TRAINING & DEVELOPMENT CENTER					
Training & Develop Center			State ID# E26152C0162		
Area (sqft)	9,800	Year Built	1962	Occupancy (hrs/yr)	4,368

HVAC Equipment

Description	Type	Size	Notes
AHU-1	Variable air volume	9,000 CFM 10 HP SF	Contains VIGV with 6 VAV boxes
Boiler 1	Modular	480 kBtu/hr output	
Boiler 2	Modular	480 kBtu/hr output	
2 HWPs	Inline	1 HP 30 gpm	
Condensing Unit-1	McQuay	25.6 kW	

Points on BAS

Description	Points
AHU-1	OAT, OA RH, OA enthalpy, MAT, DX stage 1, DX stage 2, heat valve %, SF command, Inlet vane damper %, DAT, Duct static pressure, RT, RARH, Econ damper %, Return damper %, Morning warm-up setpoint, DAT setpoint, Duct static pressure setpoint, Minimum econ damper position, Night setback setpoint, Average space temperature
Boiler	Boiler 1 status, Boiler 2 status, pump command, HWST, Domestic HWP command,
VAV	Supply from AHU, Box flow, Box flow setpoint, damper %, heat valve %, VAV DAT, space temperature, space temperature setpoint

Additional Comments

- Building was built in 1962, a renovation was done in 1994 for all mechanical equipment.

Poor Candidates for Investigation

The garage and the garage addition are poor candidates for investigation. The building is small, detached from the campus, contains limited mechanical equipment, and is not automated. The Visual Arts Building is still under construction, will be commissioned and therefore will not be investigated.

It is unlikely to be cost effective to tie the garage and garage addition into the automation system due to the lack of mechanical equipment.

GARAGE					
Garage **Garage Addition**			State ID# E26152C1176 State ID#		
Area (sqft)	3,600	Year Built	1976, 2005	Occupancy	2,340
HVAC Equipment					
1 Gas forced air ceiling unit New addition contains an IR heating system.					
Points on BAS					
Not automated, controlled by t-stats					
Additional Comments					
• Building was built in 1962, a renovation was done in 1994 for all mechanical equipment.					

VISUAL ARTS					
Building under construction, not yet in B3					
Area (sqft)		Year Built		Occupancy (hrs/yr)	

HVAC Equipment

Description	Type	Size	Notes
AHU-1	Variable air volume	22,000 CFM; 40 HP SF 25 HP RF	
HX-1	Water	245 gpm; 3617 kBtu/hr	
HX-2	30% glycol	40 gpm; 746 kBtu/hr	
EF-1		1000 CFM; ¼ HP	
EF-2		1400 CFM; ½ HP	
EF-3		1530 CFM; ¾	
EF-4		700 CFM; 1 HP	
EF-5		1400/2500 CFM; ¾ HP	
EF-6		5450 CFM; 2 HP	VFD
EF-7		4050 CFM; 3 HP	
EF-8		1000 CFM; ½ HP	
EF-9		3,500 CFM; 3 HP	VFD
EF-10		3,500 CFM; 3 HP	VFD
SF-1		5,450 CFM; 3 HP	VFD
SF-2		4,750 CFM; 3 HP	VFD
SF-3		3,500 CFM; 2 HP	VFD
SF-4		3,500 CFM; 2 HP	VFD
UH-1		24.25 kBtu/hr	
UH-2		52.57 kBtu/hr	

Points on BAS (Visual Arts)

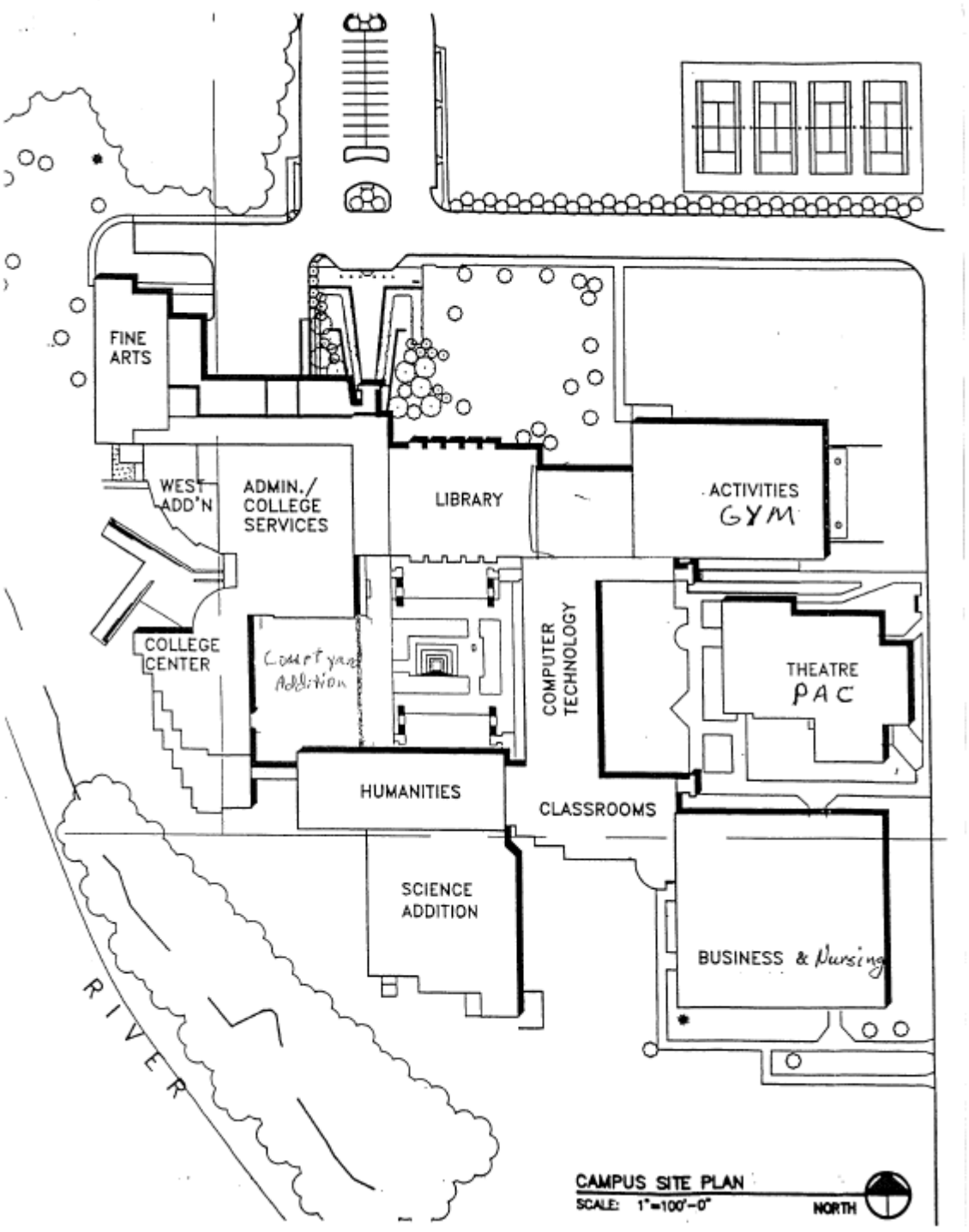
Description	Points
AHU VA-1	OAT, OA damper, MA damper, MAT, Heat valve %, Cool valve %, SF command, SF status, SF speed, DAT, Duct static setpoint, space pressure, RARH, RAT, RF command, RF status, RF speed, EA dampers, CO_2setpoint, Minimum OA setpoint, Return humidity setpoint, Space pressure setpoint, Night setback setpoint, Econ lockout setpoint, Heat/cool lockout temp, DAT reset setpoint
HX	Pump command, Pump status, Pump speed, HWST, Loop differential pressure, HWRT
SF	SF command, SF status, SF speed, heat valve %, DAT, Space temperature, Space pressure
EF	EF command, EF status,
UH	Room temperature, Room temperature setpoint

Additional Comments

- There are 2 HWPs associated with HX-1 with unknown design conditions
- There is one HWP associated with HX-2 with unknown design conditions
- There are going to be a total of 4 supply fans bringing fresh air to various labs. This make up air is exhausted out by the exhaust fans (EF-4, EF-6, EF-7, EF-9, and EF-10)

Campus Map

(The Garage and Training and Development Center (TDC) are off the map to the east; The Visual Arts Building will be at the Northwest corner of the map, where trees are currently shown.)



PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	HP	Horsepower
BAS	Building Automation System	HRU	Heat Recovery Unit
CD	Cold Deck	HW	Hot Water
CDW	Condenser Water	HWDP	Hot Water Differential Pressure
CDWRT	Condenser Water Return Temperature	HWRT	Hot Water Return Temperature
CDWST	Condenser Water Supply Temperature	HWST	Hot Water Supply Temperature
CFM	Cubic Feet per Minute	kW	Kilowatt
CHW	Chilled Water	kWh	Kilowatt-hour
CHWRT	Chilled Water Return Temperature	MA	Mixed Air
CHWDP	Chilled Water Differential Pressure	MA Enth	Mixed Air Enthalpy
CHWST	Chilled Water Supply Temperature	MARH	Mixed Air Relative Humidity
CRAC	Computer Room Air Conditioner	MAT	Mixed Air Temperature
CV	Constant Volume	MAU	Make-up Air Unit
DA	Discharge Air	OA	Outside Air
DA Enth	Discharge Air Enthalpy	OA Enth	Outside Air Enthalpy
DARH	Discharge Air Relative Humidity	OARH	Outside Air Relative Humidity
DAT	Discharge Air Temperature	OAT	Outside Air Temperature
DDC	Direct Digital Control	Occ	Occupied
DP	Differential Pressure	PTAC	Packaged Terminal Air Conditioner
DSP	Duct Static Pressure	RA	Return Air
DX	Direct Expansion	RA Enth	Return Air Enthalpy
EA	Exhaust Air	RARH	Return Air Relative Humidity
EAT	Exhaust Air Temperature	RAT	Return Air Temperature
Econ	Economizer	RF	Return Fan
EF	Exhaust Fan	RH	Relative Humidity
Enth	Enthalpy	RTU	Rooftop Unit
ERU	Energy Recovery Unit	SF	Supply Fan
FCU	Fan Coil Unit	Unocc	Unoccupied
FPVAV	Fan Powered VAV	VAV	Variable Air Volume
FTR	Fin Tube Radiation	VFD	Variable Frequency Drive
GPM	Gallons per Minute	VIGV	Variable Inlet Guide Vanes
HD	Hot Deck		

Conversions:
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH