Consumers Energy
Existing Building Commissioning
Phase 1 Study

Delta College

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University Center, MI 48710

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February 11, 2010

Larry Ramseyer
Delta College
1961 Delta Road
University Center, MI 48710

RE: Existing Building Commissioning

Dear Larry Ramseyer,

The Consumers Energy Business Solutions team would like to thank you for your participation in the Existing Building Commissioning Program. Commissioning has been identified as the most cost effective means of reducing energy costs, increasing equipment life, and improving occupant comfort for large commercial facilities. This study is the first step towards controlling those costs.

The Existing Building Commissioning Program is one of many programs offered by Consumers Energy as part of our Consumers Energy Business Solutions program designed to help our customers implement energy efficiency measures in their facilities. Additional measures include incentives for energy efficient lighting retrofits, HVAC upgrades, and other equipment. This could include changes to processes and facilities that result in a net energy efficiency increase.

Please feel free to contact your account manager, or one of the energy advisors on the Consumers Energy Business Solutions team for more information on these opportunities.

We appreciate your interest in the Business Solutions Program and the energy efficiency efforts you are undertaking. If you have questions, please call the Business Solutions Team at 1-877-607-0737, or e-mail us at ConsumersEnergyBusinessSolutions@kema.com.

Sincerely,

The Consumers Energy Business Solutions Team
P.O. Box 1040
Okemos, MI 48805

PHASE I REPORT – OPERATIONS AND MAINTENANCE SURVEY

Consumers Energy Existing Building Commissioning Program

Delta College
University Center, Michigan

Site Survey Date: November 23 - 24, 2009

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INTRODUCTION

This pilot program will be used to determine the feasibility and cost effectiveness of a larger scale EBCx effort in the Consumers Energy territory.

The program is being broken down into three major phases:

1. Phase I – Operations and Maintenance Review: This phase establishes the current facilities requirements (CFR), evaluating schedules and set points, and identifying potential low and no cost facility improvement measures (FIMs). FIMs are focused on energy savings and improved facility performance.

2. Phase II – Systems Commissioning: This phase will include traditional commissioning activities including testing and diagnostics of the existing systems ability to meet the CFR and to further develop/quantify savings associated with energy savings facility improvement measures.

3. Phase III – Systems Optimization: This phase will focus on implementation of FIMs through capital improvements and introduction of new control strategies in order to bring existing systems to peak efficiency.

This report summarizes the findings for Phase I. The results of Phase I, will determine if the building participant should be recommended for Phase II of Consumers Energy Existing Building Commissioning Program.

"This report (in whole or in part) is the property of Consumers Energy and was funded through the Consumers Energy Existing Building Commissioning Pilot Program."

I. EXECUTIVE SUMMARY

A. Building Description/Energy Data

The campus of Delta College located in University Center, Michigan (Saginaw area) includes multiple inter-connected building wings and the Consumers Energy Phase I Existing Building-Commissioning project focus was on the entire campus. The campus began construction in 1960 and multiple expansions have occurred through 2003. The campus is 932,812 gross square feet in size and contains education and lab occupancies. The tallest building of the campus is two stories.

All building wings are heated and/or air conditioned by air handling units. The heating for the campus is provided by three steam boilers (2 – 500BHP & 1 – 25 BHP) that are located in the powerhouse building. Steam is supplied to air handling heating coils for ventilation air heating. Steam is also supplied to hot water heat exchangers in most campus building wings to produce heating hot water. The heating hot water pumping systems for the building wings include either stand-alone or lead/standby hot water pumps, half of which are equipped with variable frequency drives. The heating hot water is distributed to perimeter radiation, reheat coils, and air handling heating coils. Air handling unit chilled water coil, hot water heating coil and steam heating coil control valves are two way. There are two water cooled centrifugal chillers (800 tons each) that serve the campus air handling unit cooling coils as well as build ice during off-peak electrical rate hours for chilled water cooling during peak electrical rate hours. One absorption chiller is used sparingly only during high cooling load conditions. Chiller cooling towers are also utilized for free cooling when the outdoor air conditions are suitable and the towers have variable speed fans.

The utility data presented in Table 1 below is for the entire campus that was included in the retro-commissioning process.

Table 1: Building Energy Data

2008-2009 Fiscal Year	Electric	Natural Gas	Totals
Usage	14,080,000 kWh	85,246 MCF	-
Cost ($)	931,190	682,230	1,613,420
MMBtu	48,055	85,246	133,301
Btu/ft^2 – yr*	51,516	91,386	142,902
$/ft^2 – yr*	1.00	0.73	1.73

* Based on campus building area of 932,812 GSF

The current facility requirements (CFR) for the building were provided by Larry Ramseyer, Director of Facilities Management of Delta College. The CFR can be found in Exhibit 2 of this report.

B. Facility Improvement Measures

As indicated in the Introduction the objective of this Phase I Existing Building-Commissioning effort was to identify current facilities requirements (CFR) for the building and identify energy and energy cost savings facility improvement measures. The following Table 2 provides a listing of facility improvement measures (FIMs) identified as a result of the EBCx Phase I process. Note that implementation costs of FIMs do not include design related costs, if applicable, and do not include Delta College project management/personnel fees that may be applicable to listed FIMs. Also note that these values are cursory in nature and would be further developed if this campus moves to Phase 2 of the EBCx program.

Table 2: Summary of Facility Improvement Measures

FIM	Description	Energy Savings ($)	Estimated Capital Cost ($)	Simple Payback (years)
1	Close Outside Air Dampers During Unoccupied AHU Start-up and during Morning Warm-up	$7,500-12,500	Negligible	<1
2	Provide Morning Warm-up Optimal Start	$5,000-10,000	$1,000-5,000	<1
3	Control AHU Preheat Coil Valves to Unoccupied Mixed Air Temperature Setpoints	$50-200	Negligible	<1
4	Close Variable Air Volume Box Reheat Coil Valves when AHU is Off	$100-1,000	Negligible	<1
5	Close Outside Air Dampers on Gymnasium AHU-1 & 2 when AHU's are Off	$100-1,000	Negligible	<1
6	Lockout AHU Cooling Coil Control Valves during Morning Warm-up	$100-1,000	Negligible	<1
7	Reset AHU Mixed Air and Discharge Air Setpoints	$6,000-8,000	Negligible	<1
8	Reset all Variable Air Volume AHU Supply Air Static Pressure Setpoints	$1,500-1,750	Negligible	<1
9	Reduce Pool Filter Pump Operation A: Reduce Filter Pump Hours of Operation B: Reduce Filter Pump Speed During Unoccupied Hours	 $2,000-3,000 $4,000-7,000	 $1,000-2,000 $20,000-25,000	 <1 3-7
10	Swimming Pool Cover	$7,500-15,000	$10,000-20,000	1-3
1-10	All measures shown above	$33,850-60,450	$32,000-52,000	.5-1.5
11	Trim Pump Impellers A: Chiller-1 – CP-3 B: Chiller-2 – CP-5 & CP-6 C: East Courtyard Hot Water Radiation –CP-1 & CP-2 D: Pool Current and Slide Pump	 $4,000-6,000 $1,000-2,500 $500-1,500 $100-250	 $1,000-2,000 $2,000-4,000 $2,000-4,000 $2,000-4,000	 <1 1-4 2-8 8-40
12	Add Occupancy Sensors in Large Classrooms for Variable Air	Varies	Varies	Varies

FIM	Description	Energy Savings ($)	Estimated Capital Cost ($)	Simple Payback (years)
	Volume Box Minimum Position Override Control			
13	Greenhouse AHU-37 – Reconfigure AHU System to Include Return Air	$8,000-12,000	NI	NI
14	Provide Control Valves for All Hot Water Unit Heaters	$75-150	$1,000-1,500	6-20
15	High Efficiency Equipment Replacement	Varies	Varies	Varies
16	Submetering	Varies	Varies	Varies

NI = Needs investigation and will be further investigated if this building moves to Phase II of the Consumers Energy Existing Building-Commissioning Program.
NA = Not available
Note that Consumers Energy does not guarantee that proposals, bids or actual construction costs and stated energy savings will not vary from costs and savings contained herein.

From Table 2 it can be seen that potential energy savings of $26,000 - $44,500 can be realized from measures #1 thru #9 and #11A with a simple payback period of less than one year. Additionally, if measures #10 and #11B are included in implementation another $8,500 - $17,500 in savings can be realized with a simple payback of less than four years. The Delta College engineering/operations personnel team is very engaged in the Existing Building-Commissioning process and Consumers Energy believes that through functional testing of systems, more savings can be realized with low or no capital investment.

II. FACILITY IMPROVEMENT MEASURES

This section of the report contains facility improvement measures (FIMs) that were identified through the existing building commissioning process. There is a brief narrative for each measure, energy savings projections, energy cost savings and probable capital costs to implement the short payback measures. The simple payback period is presented and is the capital cost divided by the energy savings. For each FIM, certain basic data was utilized and assumptions made to arrive at the projected savings. The basic data came primarily from field surveys, interviews with operations staff, record drawings, and nameplate data. Note that the cost/savings values are cursory in nature and would be further developed in the event that this building goes forward as part of Phase II of the Consumers Energy Existing Building-Commissioning Program. Also note that it is believed the payback periods are conservative, based on similar measures from previous projects, and would most likely be shortened in further analysis.

Delta College has maintenance personnel capable of making both setpoint and programming modifications in the building automation system (BAS) and therefore the capital costs associated with any measure which strictly involves setpoint or easy to moderately complex programming modifications is listed as negligible because it is assumed this work will be performed by the College's on-site staff.

FIM 1: Close Outside Air Dampers During Unoccupied AHU Start-up and during Morning Warm-up: All AHU's controlled by the American Auto-Matrix control system have their outdoor air dampers open during unoccupied AHU setback and/or setup operation and during early startup for morning warm-up. These AHU's also do not have true morning warm-up sequence as they are all started at an operator selected time prior to occupancy. This applies to a total of 25 AHU's. It is suggested that these AHU's be reprogrammed to keep the outside air dampers closed during unoccupied setback/setup startup and be reprogrammed with a true morning warm-up cycle.

Annual Energy Savings	(kWh/yr)	25,000-35,000
	(MCF/yr)	6,00-8,00
	($)	$7,500-12,500
Capital Cost	($)	Negligible
Simple Payback	(yrs)	<1

FIM 2: Provide Morning Warm-up Optimal Start: The units controlled by the Trane control system have a morning warm-up cycle of a preset length regardless of how far the space is from setpoint. It is suggested that an optimal start sequence be provided which determines the duration of morning warm-up based on how far the spaces are from occupied temperature setpoints and adjusts these durations based on historical trends. The addition of a true

morning warm-up cycle for the AHUs controlled by the Auto-Matrix control system is suggested as a separate measure and the new morning warm-up sequence for these units should also be provided with an optimal start.

Annual Energy Savings	(kWh/yr)	50,000-100,000
	($)	$5,000-10,000
Capital Cost	($)	$1,000-5,000
Simple Payback	(yrs)	<1

FIM 3: Control AHU Preheat Coil Valves to Unoccupied Mixed Air Temperature Setpoints: All AHU's controlled by the American Auto-Matrix BAS have their preheat coil control valves controlling to occupied discharge air temperature setpoints even when the AHU is off. This applies to a total of 26 AHU's. It is suggested that these AHU's be reprogrammed to control the preheat coil valves to a reduced mixed air temperature setpoint when the unit is off to minimize energy usage while still preventing freezing.

Annual Energy Savings	($)	$50-200
Capital Cost	($)	Negligible
Simple Payback	(yrs)	<1

FIM 4: Close Variable Air Volume Box Reheat Coil Valves when AHU is Off: All AHU's controlled by the American Auto-Matrix building automatic system have their variable air volume (VAV) box reheat coil control valves under control from occupied room air temperature setpoints even when the AHU is off. This applies to a total of 15 AHU's and 190 VAV boxes. It is suggested that these VAV box controllers be reprogrammed to close the reheat coil valves when the associated AHU is off.

Annual Energy Savings	($)	$100-1,000
Capital Cost	($)	Negligible
Simple Payback	(yrs)	<1

FIM 5: Close Outside Air Dampers on Gymnasium AHU-1 & 2 when AHU's are Off: When AHU-1 & 2 are off, their outdoor air dampers remain open resulting in infiltration and forcing the heating coils to control to occupied discharge air temperature setpoints. It is suggested that these AHU's be reprogrammed to close their outdoor air dampers when their fans are off.

Annual Energy Savings	($)	$100-1,000
Capital Cost	($)	Negligible
Simple Payback	(yrs)	<1

FIM 6: Lockout AHU Cooling Coil Control Valves during Morning Warm-up: Upon initial AHU startup for all AHU's controlled by the American Auto-Matrix control system, the outdoor dampers are held closed while the preheat coil valve

is opened to warm the AHU plenum. During this time, the chilled water coil valve is under control to cool down the discharge air temperature resulting in energy waste. This applies to a total of 25 AHU's. It is suggested that these AHU's be reprogrammed to lock out the cooling coil valve control during morning warm-up.

Annual Energy Savings	($)	$100-1,000
Capital Cost	($)	Negligible
Simple Payback	(yrs)	<1

FIM 7: Reset AHU Mixed Air and Discharge Air Setpoints: Many AHU's do not have their mixed air damper, preheat coil valve, cooling coil valve and reheat coil valve control loop setpoints being reset by room air temperature. This applies to a total of 76 control loops. Some of the air handling units only have some of the setpoints reset and therefore the unit may sometimes be heating or cooling unnecessarily to make up the difference between the setpoints. It is suggested that all of these control loop setpoints be reprogrammed to be reset by room air temperature.

Annual Energy Savings	(MCF/yr)	6,00-8,00
	($)	$6,000-8,000
Capital Cost	($)	Negligible
Simple Payback	(yrs)	<1

FIM 8: Reset all Variable Air Volume AHU Supply Air Static Pressure Setpoints: Only some of the AHU's have their supply air static pressure control loop setpoints being reset by cumulative variable air volume (VAV) box airflow. A total of 10 AHU's do not have reset control. It is suggested that these static setpoints be reprogrammed to be reset by cumulative VAV box airflow similar to the other units.

Annual Energy Savings	(kWh/yr)	15,000-17,500
	($)	$1,500-1,750
Capital Cost	($)	Negligible
Simple Payback	(yrs)	<1

FIM 9: Reduce Pool Filter Pump Operation: The pool filter pump operates continuously and it may be possible to reduce the hours of operation or the flow while still maintaining proper water quality.

A: Reduce Filter Pump Hours of Operation: The pool filter pump should be able to be shut off for some of the unoccupied hours if timeclock control was added. The below savings are representative of a 3 hour reduction per day but the actual shutdown duration should be determined by increasing and decreasing the shutdown duration while monitoring water quality to determine the maximum allowable shutdown.

Annual Energy Savings	(kWh/yr)	20,000-30,000
	($)	$2,000-3,000
Capital Cost	($)	$1,000-2,000
Simple Payback	(yrs)	<1

B: Reduce Filter Pump Speed During Unoccupied Hours: A more sophisticated method of saving pool filter pump energy would be to install a variable frequency drive on the filter pump and to reduce the pump speed during all unoccupied hours which would reduce pumping energy while still providing continuous circulation and water filtration. The actual unoccupied pump speed should be determined by increasing and decreasing the speed while monitoring water quality to determine the minimum allowable speed.

Annual Energy Savings	(kWh/yr)	40,000-70,000
	($)	$4,000-7,000
Capital Cost	($)	$20,000-25,000
Simple Payback	(yrs)	3-7

FIM 10: Swimming Pool Cover: The swimming pool does not have a cover. It is suggested that the feasibility of using a swimming pool cover be evaluated and that the cover be used to cover the swimming pool during unoccupied periods.

Annual Energy Savings	($)	$7,500-15,000
Capital Cost	($)	$10,000-20,000
Simple Payback	(yrs)	1-3

FIM 11: Trim Pump Impellers: Multiple pumps were found with their balance valves partially closed. It is suggested that the impellers for these pumps be trimmed to provide the required water flow at a lower pressure head and that the balance valves be opened.

A: Chiller-1 – CP-3: Chilled water pump CP-3 was found with its balance valve 10% open.

Annual Energy Savings	(kWh/yr)	40,000-60,000
	($)	$4,000-6,000
Capital Cost	($)	$1,000-2,000
Simple Payback	(yrs)	<1

B: Chiller-2 – CP-5 & CP-6: Chilled water pump CP-5 and condenser water pump CP-6 were found with their balance valves 20% open and 50% open, respectively.

Annual Energy Savings	(kWh/yr)	10,000-25,000

	($)	$1,000-2,500
Capital Cost	($)	$2,000-4,000
Simple Payback	(yrs)	1-4

C: East Courtyard Hot Water Radiation –CP-1 & CP-2: Hot water pumps CP-1 and CP-2 were found with their balance valves 30% open.

Annual Energy Savings	(kWh/yr)	5,000-15,000
	($)	$500-1,500
Capital Cost	($)	$2,000-4,000
Simple Payback	(yrs)	2-8

D: Pool Current and Slide Pump: Pool current and slide pumps were found with their balance valves 50% open and 40% open, respectively.

Annual Energy Savings	(kWh/yr)	1,000-2,500
	($)	$100-250
Capital Cost	($)	$2,000-4,000
Simple Payback	(yrs)	8-40

FIM 12: Add Occupancy Sensors in Large Classrooms for Variable Air Volume Box Minimum Position Override Control: The variable air volume (VAV) boxes serving the rooms use a timeclock to determine occupancy but there are likely many times throughout the day when the spaces are actually unoccupied but the VAV box continues to provide the occupied minimum airflow. The addition of occupancy sensors to detect the actual occupancy of the room and reducing the VAV box minimum damper position when the space is unoccupied will save both fan and reheat energy. The savings and payback for this FIM will be best for large classrooms/conference rooms which are frequently unoccupied.

Annual Energy Savings	($)	Varies
Capital Cost	($)	Varies
Simple Payback	(yrs)	Varies

FIM 13: Greenhouse AHU-37 – Reconfigure AHU System to Include Return Air: The existing greenhouse AHU is designed as 100% outside air but it does not appear that this is required. It is suggested that the unit be modified to include some return air. Savings are based on 100% outside air unit; currently an access door on the unit is being left open which is allowing some return air to be provided to the unit and therefore actual savings may be less.

Annual Energy Savings	(kWh/yr)	3,000-5,000
	(MCF/yr)	8,000-12,000
	($)	$8,000-12,000
Capital Cost	($)	NI
Simple Payback	(yrs)	NI

FIM 14: Provide Control Valves for All Hot Water Unit Heaters: Currently all hot water unit heaters in mechanical rooms do not have control valves. Room temperature is controlled by cycling the unit heater fan on/off. When the room temperature is satisfied hot water still flows through the unit heater coil, potentially overheating the room. It is suggested that two way control valves be installed for each unit heater and controlled from the room.

Annual Energy Savings	($)	$75-150 (each)
Capital Cost	($)	$1,000-1,500 (each)
Simple Payback	(yrs)	6-20

FIM 15: High Efficiency Equipment Replacement: Some of the existing equipment is old and may be approaching the end of its useful life. When the equipment needs to be replaced it is suggested that higher efficiency equipment be installed. The incremental cost for higher efficiency equipment may have a very attractive payback for some of the systems.

FIM 16: Submetering: Submetering allows for additional monitoring of individual loads or groups of loads (i.e. HVAC equipment or office equipment). There is no direct payback for additional metering but the greater monitoring capability should result in a number of benefits if the energy usage is properly monitored and evaluated. Metering allows operating personnel to more easily determine when a system has a problem that is wasting energy and also makes it much easier to determine the effectiveness of any other energy conservation measures that have been performed.

III. OPERATION AND MAINTENANCE RECOMMENDATIONS

1. **A Wing - Replace missing HWS gauge for one of the HX2 HW pumps.**

2. **F Wing - Repair leaking HE3 HW pump.**

3. **L Wing - Repair heat exchanger gaskets to eliminate water leaks.**

4. **L Wing - Replace non-functioning heat exchanger pump discharge pressure gauge.**

5. **S Wing – HWS thermometer reads 225F while HWR thermometer reads 165F - replace HWS thermometer.**

6. **AHU-3 - Replace supply fan motor with a larger HP motor to prevent motor overload condition.**

7. **AHU-11 & 12 - Need new software to look at control program, parameters & setpoints.**

8. **AHU-22 - Clean dirty cooling coil.**

9. **AHU-26 - Replace non-functioning mixed air temperature sensor.**

10. **AHU-29 - Clean dirty heating coil.**

11. **AHU-29 - Add missing supply fan inlet vane control to the BAS graphic.**

12. **AHU-43 - Replace missing outdoor air damper blade seals.**

13. **AHU-50 - Reconnect outdoor air damper actuator control.**

14. **AHU-50 - Add missing outdoor air and relief air damper control to the building automatic system graphic.**

15. **CT-2 & 3 - Repair water leak in basin at seam.**

16. **CT-3 - Repair water leak in basin at low water probe.**

17. **Greenhouse AHU-37 – Adjust Heating Coil Integral Face And Bypass Damper to Close Off Tight:** With the AHU heating coil face and bypass damper commanded to 100% bypass, the dampers leak enough to raise the discharge air temperature several degrees and overheat the space. The College currently keeps an AHU access door to the mixing box open to introduce cooler mechanical room air into the AHU to help prevent overheating of the discharge air temperature. It is suggested that the face and bypass damper

be adjusted, repaired or replaced to eliminate overheating the discharge air temperature to the space.

18. **Auto Labs AHU-38, 40 & Welding Lab AHU-42 – Provide Steam Preheat Coil with Face and Bypass Dampers to Prevent Freezing of Coil:** These 100% outdoor air AHU's have been shutting down on freezestat alarms. The College currently keeps an AHU access door to the mixing box open to introduce warmer mechanical room air into the AHU to help prevent cold air from tripping the freezestats. It is suggested that face and bypass dampers be installed on the steam preheat coils with a control sequence to protect the coils from freezing and to eliminate the freezestat AHU shutdown alarms.

19. **L Wing – Move Hot Water Supply and Return Temperature Sensors Closer to Heat Exchanger:** Currently, hot water supply and return temperature sensors are located near one of the three hot water branch loops that serve the L Wing and not near the heat exchanger. Due to the sensor locations, there is an excessive time lag in the control loop for controlling the heat exchanger steam control valve. The hot water supply temperature leaving the heat exchanger will over shoot the control setpoint by the time the hot water reaches the hot water supply temperature sensor. The hot water return temperature sensor is also located in one of the branch loops and does not sense a common hot water return temperature to the heat exchanger. It is suggested that the hot water supply and return temperature sensors be relocated close to the heat exchanger and the steam control valve control loop retuned for more accurate control of the hot water supply and to provide accurate sensing of the hot water return.

20. **L Wing – Add Hot Water Branch Loop Bypass Valves to Maintain Circulation:** There are three hot water branch loops serving the L-Wing. Each branch loop has heating coils with two way control valves. When all zone control valves close off, flow is stopped in the hot water branch piping and the hot water supply eventually cools down before a zone requires hot water again. It is suggested that two way bypass valves be installed at the end of the three loops to maintain water flow through each hot water branch loop even during no zone demand periods. The bypass valves should be controlled from hot water loop differential pressure.

EXHIBIT 1

EXISTING BUILDING COMMISSIONING (EBCx) TEAM DIRECTORY

EBCx Team Directory

EXHIBIT 1
Delta College
University Center, Michigan

Existing Building Commissioning (EBCx) Team Directory

The EBCx Team consists of individuals who through coordinated actions are responsible for implementing the EBCx Process.

ENTITY	FIRM/ADDRESS	CONTACT(S)	PHONE/CELLULAR/FAX/EMAIL
Delta College	Delta College 1961 Delta Road University Center, MI 48710	Larry Ramseyer Director of Facilities Management	P 989-686-9234 C F 989-667-0620 E larryramsyeyer@delta.edu
Consumers Energy		Cheryl Sabias, Corporate Account Manager	P 989-791-5683 C 989-791-1156 F E
Consumers Energy Business Solutions	P.O. Box 1040 Okemos, MI 48805	John Nametz Senior Engineer	P 877-607-0737 C 248-255-6170 F 877-607-0738 E jnametz@franklinenergy.com

EXHIBIT 2

CURRENT FACILITY REQUIREMENTS

1.0 PROJECT DESCRIPTION

A. Location: Delta College, University Center, Michigan
B. Year of Construction: 1960-1980, 1997, 2003
C. Size: 932,812 (net) sq ft
D. Type occupancy/use: Education with Labs
E. Number of Floors: 2

2.0 TEMPERATURE AND HUMIDITY CRITERIA

Functional Space	Criteria	Occupied		Unoccupied	
		Summer	Winter	Summer	Winter
Classrooms & Offices	Temperature (F)	75 official 74 average	68 official 72 average	80 or none	60
	Humidity (%RH)	None	None	None	None
Print Shop	Temperature (F)	75	68	80	60
	Humidity (%RH)	None	35-40	None	None
Data Center	Temperature (F)	72	68	NA	NA
	Humidity (%RH)	None	None	NA	NA
Swimming Pool	Temperature (F)	86	86	NA	NA
	Humidity (%RH)	50-55	50-55	NA	NA
Greenhouse	Temperature (F)	Varies depending upon requirements	Varies depending upon requirements	Varies depending upon requirements	Varies depending upon requirements
	Humidity (%RH)	None	Humidifier not used	None	None

3.0 VENTILATION AND FILTRATION CRITERIA

Functional Space	Outside Air CFM/person	Supply Air A/C Rate	Filtration Requirement
Automotive Labs	100% OA		

4.0 OCCUPANCY REQUIREMENTS

Functional Space/Area – Education - Summer

Day of Week	Morning Warm-Up	Occupied	Unoccupied
Weekday		6:30am-9:30pm	9:30pm-6:30am
Saturday		Varies based events	
Sunday		Varies based events	
Holiday		Varies based events	

Functional Space/Area – Education - Winter

Day of Week	Morning Warm-Up	Occupied	Unoccupied
Weekday		5:00am to 7:30am- 5:30pm to 10:30pm (Varies by space)	5:30pm to 10:30pm - 5:00am to 7:30am (Varies by space)
Saturday		Varies based events	
Sunday		Varies based events	
Holiday		Varies based events	

5.0 SYSTEM SETPOINTS

A. Chilled Water Supply Setpoint = 45F

B. Condenser Water Supply Setpoint

a. Freecool Setpoint = 39F
b. Ice Build Setpoint = 71F
c. Mech. Cooling Setpoint = 85F

C. Hot Water Supply Setpoints

System Tag	Supply Temperature Setpoint/Reset Range	Outdoor Air Temperature Reset Range	Reset (Yes/No)
HES-1 - Reheat Coils	130F-180F	70F-10F	Yes
HES-2 - Radiation	70F-180F	70F-10F	Yes
HX-1 - Science Wing - Reheat Coils	-210F		Yes
HX-2 - Library - Reheat Coils	-210F		Yes
HE - B Wing - Reheat Coils	110F-185F	60F-0F	Yes
HE-1 - F Wing - West Booster Coils	120F-200F	70F-25F	Yes
HE-2 - F Wing - East Booster Coils	120F-195F	65F-0F	Yes
HE-3 - F Wing - Radiation	100F-175F	60F-0F	Yes
HE-1 - G Wing - AH-21 & Radiation	100F-190F		Yes
HE - H Wing	155F-195F	60F-10F	Yes
HE - J Wing	150F-190F	60F-10F	Yes
HE - K Wing	120F-200F	60F-10F	Yes
HE - L Wing	150F-190F	60F-30F	Yes
HE-1 - M Wing - Reheat Coils	131F-191F	60F-0F	Yes
HE-2 - M Wing - 2nd Flr Reheat Coils	160F	NA	No
HE - N Wing	150F-190F	60F-30F	Yes
HE - P Wing - AH's, Pool, Spa	180F	NA	No
HE-1 - S Wing - West Unit Ventilators	140F-190F	65F-15F	Yes
HE-2 - S Wing - East Booster Coils & Radiation	130F-180F	65F-15F	Yes

D. Water Loop System Static Setpoints

System Tag	Static Pressure Setpoint	Reset (Yes/No)
Secondary Chilled Water Pumps CP-		No

1,2		
Htg HW Pumps CP-1,2 – Reheat Coils	7.0 psig	No
Htg HW Pumps CP-1,2 – H Wing	10.0 psig	No
Htg HW Pumps CP-1,2 – J Wing	12.1 psig	No
Htg HW Pumps CP-1,2 – K Wing	7.5 psig	No
Htg HW Pumps CP-1,2 – L Wing	7.0 psig	No
Htg HW Pumps CP-1,2 – M Wing 2nd Flr	9.0 psig	No
Htg HW Pumps CP-1,2 – N Wing	7.0psig	No
Htg HW Pumps CP-1,2 – P Wing	5.0psig	No

E. Air Distribution System Static Setpoints

System Tag	Static Pressure Setpoint	Reset (Yes/No)
AH-3 - N Wing Commons & Lockers	2.0"w.c.	No
AH-4 - N Wing Classrooms	2.0"w.c.	No
AH-5 - A Wing 2nd Flr Classrooms	0.5-1.0"w.c.	Yes
AH-7 - N Wing Printshop	2.0"w.c.	No
AH-8 - N Wing Bookstore	1.0-2.0"w.c.	Yes
AH-9 - A Wing LL East Concourse No.	1.5-2.5"w.c.	Yes
AH-10 - H Wing LL East Concourse So.	1.5-2.5"w.c.	Yes
AH-11 - LL West Courtyard	1.0-2.0"w.c.	Yes
AH-12 - LL West Courtyard	1.0-2.0"w.c.	Yes
AH-14 - B Wing Admin. Offices	1.0-2.0"w.c.	Yes
AH-17 - J Wing Classrooms	1.6-2.6"w.c.	Yes
AH-20 - D Wing	2.0-3.0"w.c.	Yes
AH-25 - P Wing 2nd Flr RQTB Courts	1.0"w.c.	No
AH-28 - P Wing LL Mech. Offices	1.5-2.5"w.c.	Yes
AH-29 - M Wing	1.5"w.c.	No
AH-31 - A Wing Library	0.5-1.0"w.c.	Yes
AH-32 - A Wing West	1.0-2.0"w.c.	Yes
AH-33 - D Wing	1.0-2.0"w.c.	Yes
AH-34 - E Wing	1.5-2.5"w.c.	Yes
AH-35 - C Wing	1.5-2.5"w.c.	Yes
AH-36 - E Wing Science	2.0"w.c.	No
AH-37 - E Wing Greenhouse	RMT 72.5F	No
AH-41 - L Wing	0.9-1.9"w.c.	Yes
AH-42 - M Wing Welding Lab	2.0"w.c.	No
AH-43 - M Wing Construction Lab	0.2"w.c.	No
AH-44 - M Wing Classrooms	2.0"w.c.	No
AH-45 - Kitchen	1.2"w.c.	No
Cooling Tower CT-1 Fans	CDWS 82F	No
Cooling Tower CT-2 Fans	CDWS Freecool 39F Ice Build 71F Mech Cooling 85F	No
Cooling Tower CT-3 Fans	CDWS Freecool 39F Ice Build 71F Mech Cooling 85F	No