NY City Family Court Service Curran Biotech Spray on Filters

Measurement and Verification Report

PRIMARY CONTACT

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Dated: 12/3/2020

Table of Contents

EDISON energy

1.0 - Executive Summary:

Department of Citywide Administrative Services retained the services of ENERActive Solutions, L.L.C. to provide Measurement & Verification consulting services for demonstration of a new technology. The new technology consists of a hydrophobic material sprayed on to the filters of air handling units (AHUs) to stop the COVID-19 virus from passing through the filters. This spray/technology was developed by Curran Biotech. The purpose of this application is to eliminate the COVID 19 virus within the airstream / ventilation system without incurring an increase in AHU fan energy due to increased filter differential pressure.

DCAS has selected the New York City Family Court Service building located at 60 Lafayette street, New York, NY 10013 for demonstration of this new technology. The M&V consulting services provided consist of a thorough analysis and verification of the energy impact at the facility.

For this site, ENERActive was tasked with the following:

- Conduct Initial M&V Site Visits to investigate and review existing conditions.
- Develop an M&V Plan that includes measures to accurately determine both pre and post AHU-11 energy consumption. This plan will include the measurement and verification of pressure drop, humidity and associated AHU fan energy before and after implementation of the Hydrophobic Spray.
- Develop and submit an M&V report that details the energy consumption of the AHU-11 supply fan for pre and post ECM implementation to determine the energy saving benefits of this technology.

The results and findings from the M&V site visits and equipment tests, show a slight increase in energy consumption of the supply fan motor. The electric energy consumption after the application of the hydrophobic spray on the AHU filters results in an increase of 1,674 kWh/yr. The energy cost penalty for the increase in electric consumption is $71 per year. However, there is little to no impact on the pressure drop pre and post spray application on the filters.

2.0 - Review of New Technology:

DCAS-Energy Management Division contracted ENERActive to conduct measurement and verification procedures during the demonstration of the Hydrophobic Spray AHU filter application developed by Curran Biotech. The M&V process evaluated the energy impact of this new technology developed to stop the COVID 19 virus without incurring an increase in AHU fan energy consumption due to increased pressure drop across the AHU's filter bank. This evaluation was conducted at the New York City Family Court Service to screen various new technologies being developed in response to the COVID 19 pandemic.

The scope of work for this project was to conduct measurement and verification procedures for the proposed technology which will determine its overall energy impact. This technology involves the application of a hydrophobic spray onto the AHU filters. Upon drying, the hydrophobic coating works to repel water that is traveling with the virus particles. Once the water is separated, the remaining dry virus particles adhere to the hydrophobic coating. As the hydrophobic spray coats tightly to the filter's fibers, the spaces between the fibers are left open, allowing for unprohibited airflow. As a result, Curran Biotech claims that there will be no increase in static pressure across the filters and associated energy increase post application.

ENERActive calculated the energy impact of the new technology on AHU-11 supply fan energy and measure and verified the impact on static pressure and humidity levels across the filter.

3.0 – Kick-Off on Site Meeting

In order to prepare the M&V plan for the project an on-site kick off meeting was coordinated on the 14th of October 2020. Gavin Lall from ENERActive and Qahtan Al-Jamali & Daniel Donovan from DCAS were present at 60 Lafayette Street, New York, NY 10013. The air handling unit was identified for the demonstration of the new technology. The AHU-11 identified for the M&V consists of the following features:

1. The AHU-11 has humidity sensors for the supply air and mixed air.
2. The AHU-11 is a constant volume flow air handling unit.
3. The AHU-11 has acceptable for the functional testing and key parameter testing.

4.0 - Measurement & Verification Strategy:

4.1 - Selection of IPMVP Option A:

The M&V Plan was developed using IPMVP's Option A (Retrofit Isolation with Key Parameter Measurement) for savings determination.

Option A is an approach designed for measures in which the potential to generate savings must be verified, but the actual savings can be determined from short-term, periodic or continuous measurements, estimates, and engineering calculations. This approach is intended for retrofits where key performance factors (e.g., end-use capacity, demand, power) or operational factors (e.g., lighting operational hours, cooling ton-hours) can be measured short-term, periodically, or continuously during the baseline period and periodically during the post-installation period.

With Option A, savings are determined by measuring key parameters, such as demand capacity, efficiency, or operation of a system, before the spray is applied to the AHU-11 filters and periodically during the performance period and multiplying the difference by an estimated factor. This level of savings determination may suffice for certain types of projects where a single factor represents a significant portion of the savings uncertainty – such as impact to a fan motor's energy consumption. A key consideration in implementing Option A is identifying the parameters that will be measured and those that will be estimated. For example, motor power measured in kilowatts is often a key performance parameter.

The level of accuracy depends on what measurements are made to verify equipment ratings, capacity, operating hours, and/or efficiencies; the quality of assumptions made; and the accuracy of the equipment inventory including nameplate data and quantity of installed equipment.

For this project, the boundary of this measure will be drawn to only include the AHU-11 supply fan motor demand kW. A decrease in electricity used by the air conditioner may also be considered. Any changes in energy consumption will be determined from a trend review which begins prior to implementation of the application through post implementation.

The project consists of applying a spray on to the AHU-11 filters to prevent the transmission of COVID 19. The manufacturer claims that there is no impact on the porosity of the filters and hence no pressure-drop across the filters. ENERActive will be measuring the humidity across the filters and logging the fan motor power (kW).

- A power meter will be used to verify the supply fan motor kW draw for the pre and post spray application on the AHU-11's filters, and current draw of the fans will be logged. Estimated accuracy of the power measurement assumptions is +/-1.5%. The AHU-11 operates on a fixed schedule it was decided not to log for the current draw to verify the operating hours.
- Base year and post applications hours of operation for the AHU-11 fan motor will be logged for two weeks with a current transformer (CT) and humidity data loggers and extrapolated for the year. No logging of current draw or humidity sensors was performed only spot reading were taken.
- The energy impact for the new spray technology will be calculated by subtracting the pre and post spray application of AHU-11 filters supply fan kWh usage.

4.2 - M&V Process Development:

4.2.1 - SITE VISIT & STAFF INTERVIEWS

A site visit was coordinated and conducted with DCAS Facilities Management. Daniel Donovan was the point contact, who is knowledgeable of the buildings operating parameters. He escorted the ENERActive team to AHU-11 were the spray technology was applied on the filters. The following information was reviewed and provided to ENERActive:

- EC3 Utility information for a period of 1 year

- Typical building occupancy and spaces served by AHU-11
- Existing BMS capability.
- Location of AHU-11

4.2.2 - ESTABLISH BASELINE

The existing AHU-11 that was tested for measurement and verification. The following testing was performed for the key parameters:

1. Measure instantaneous demand (kW) of supply fan motor at full fan speed. The readings were measured for pre & post application of the spray application on the AHU-11 filters.
2. Initially it was planned to measure "Current draw for the supply fan motor will be logged by a data logger and current transformer (CT, two-week period". The current draw for the supply fan was not logged for two weeks as the AHU-11 is a constant volume unit with no load variation on the fan. It has a fixed schedule of operation of 60 hours per week.
3. Supply CFM was measured for the AHU-11 at full speed pre and post.
4. Initially the "BMS will trend humidity before and after the filters for pre & post application of the spray on the AHU-11 filters". The humidity sensor wase out of calibration and humidity values were measure for pre and post conditions, before and after the filters for AHU-11.
5. The static pressure drop across AHU-11 filters pre & post application of spray on the AHU-11 filters was measured.
6. Initially is was planned to "Trend outdoor air (OA) humidity pre & post application of spray on the AHU-11 filters". No trending was performed for the testing.

The key parameters were measured for pre-application of spray product on the AHU-11 filters and post -application. Based on the pre-installation site visit and functioning testing of the AHU-11, it was found that the humidity sensors were out of calibration and the DCAS staff suggested to just take spot measurements with the ENERActive calibrated equipment. No trending through the BMS was performed.

4.2.3 - MEASUREMENTS REQUIRED POST MEASURE IMPLEMENTATION

A power meter was used to measure the kW draw for the post application supply fan motor demand. Pressure drop across the filter was measured by ENERActive pre and post application of spray on the AHU-11 filters. These measurements were taken for the key parameters for the pre and post spray application and calculations were setup to determine the impact on energy consumption.

4.3 - Calculation Methodology

4.3.1 - BASE YEAR ENERGY USE

The base year AHU-11 energy use was calculated based on the operating hours of 60 hrs per week of operation for pre-application spray period. The following equation will be used to calculate the annual AHU-11 fan motor electricity usage:

Annual AHU-11 Energy Consumption kWh = Fan Motor demand(kW) (hrs) Hours of operation*

4.3.2 - POST-RETROFIT ENERGY USE

After the spray application was been applied to the AHU-11 filters, the same equations will be utilized except for the post conditions (AHU-1)1 fan motor demand (kW) and operation hours.

Annual AHU-11 Energy Consumption kWh = Fan Motor demand(kW) (hrs) Hours of operation*

Subtracting the baseline annual AHU-11 fan kWh from the post installation annual AHU-11 fan kWh yields the kWh saved from the spray application to stop COVID 19 virus passing through the filters.

kWh DIfference = Annual Baseline AHU-11 fan motor kWh – Annual Post- spray application-AHU-11 fan motor kWh

Subtracting the baseline AHU-11 fan motor demand kW from the post installation AHU-11 fan motor demand kW yields the kW saved from the spray application to stop COVID 19 virus passing through the filters.

kW Difference = Total Baseline AHU-11 fan motor Demand kW – Total Post- spray application-AHU-11 fan motor Demand kW

4.3.4 - ASSUMPTIONS

All estimates will be based on reliable, documentable sources and should be known with a high degree of confidence.

5.0 – Pre-Installation Site Visit

The field work for establishing the pre-installation parameters was performed on 11/03/2020. Alex Sanchez from ENERActive performed the pre-installation M&V. Qahtan Al-Jamali and Danial Donovan from DCAS were present at the facility. The following functional tests were performed for the AHU-11:

	PRE-INSTALL SENSOR CALIBRATION				
Item No.	Sensor	Actual	BMS	Difference	PASS (Y/N)
1	Outside Air Temp	54.6	59.7	-5.1	Yes
2	Humidity	33%	30.4%	2.4%	Yes
3	Mixed Humidity	35%	49.5%	-14.1%	No
4	Mixed Air Temp	55.1	56	-0.9	Yes
5	After Filter Humdity	48%	38.1%	9.5%	No
6	After Filter Temp	57.4	53.6	3.8	Yes
7	Pre Heat Temp	61.8	57.6	4.2	Yes
8	Pre Heat Humidity	29%	47.6%	-18.4%	No
9	Supply Air Temp	61	63	-2	Yes
10	Supply Humidity	45.0%	27.0%	18.0%	No

The above pre-installation functional testing of AHU-11 showed that the mixed, pre-heat and after filter humidity sensors for the AHU were out of calibration. In the M&V plan it was proposed that these parameters will be trended for a period of two weeks. However, as these sensors were out of calibration, the DCAS team suggested that only spot measurements for these values should be measured by ENERActive and recorded. The outdoor air humidity sensor was with in calibration limits. All temperature sensors are within calibration.

In addition to the above functional testing of the AHU-11, the supply fan air flow was measured using the duct traverse method. The total supply air flow of the air handling unit (AHU-11) was measured to be 36,325 CFM.

The static pressure measurements were also measured across the air handling unit filter bank to benchmark the pressure drop across the filter before the hydrophobic spray was applied to the filters. The total static pressure was calculated by measuring the suction pressure and the discharge pressure before the application of the hydrophobic spray, which is 4.80 in. H20.

Pre-Install Test Data	Design	Actual
Total CFM	N.A	36325
Total SP	N.A	4.80
Discharge SP	N.A	3.45
Suction SP	N.A	-1.35

The power draw of the fan motor was measured using a power meter pre application of hydrophobic spray on the AHU-11's filters. The current draw from the fans were not logged as it was decided that operating hours of the supply fans are constant volume. Estimated accuracy of the power measurement assumptions is +/-1.5%. The average power measure of the three legs is 30.1 kW.

Pre-Install Test Data	Design	Actual		
Hertz	60	60.0		
Motor Volts: P-G	-	275	275	273
Motor Volts: P-P	460	475	475	479
Motor Amps $T_1/T_2/T_3$	69	44.5	45.7	42.5
Kilowatts (KW)	-	29.40	31.70	29.30
Power Factor (PF)	0.85	0.80	0.84	0.83

6.0 – Post- Installation Site Visit

The field work for establishing the post installation parameters was performed on 11/05/2020. Alex Sanchez from ENERActive performed the post installation M&V. Qahtan Al-Jamali and Danial Donovan from DCAS were present at the facility. The following functional tests were performed for the AHU-11:

POST SENSOR CALIBRATION					
Item No.	**Sensor**	**Actual**	**BMS**	**Difference**	**PASS (Y/N)**
1	Outside Air Temp	54.6	53.4	1.2	Yes
2	Humidity	85%	86.7%	-2.0%	Yes
3	Mixed Humidity	84%	74.2%	9.3%	No
4	Mixed Air Temp	55.4	61.3	-5.9	Yes
5	After Filter Humdity	83%	69.1%	14.2%	No
6	After Filter Temp	55.4	64.7	-9.3	No
7	Pre Heat Temp	57.6	64.8	-7.2	No
8	Pre Heat Humidity	77%	68.2%	8.8%	No
9	Supply Air Temp	64.8	68	-3.2	Yes
10	Supply Humidity	61.6%	63.7%	-2.1%	Yes

The above pre-installation functional testing of AHU-11 showed that the mixed air, pre-heat and after filter humidity sensors for the AHU were out of calibration. In the M&V plan it was proposed that these parameters will be trended for a period of two weeks. However, as these sensors were out of calibration and the DCAS team suggested that only spot measurements for these values be measured by ENERActive and recorded. The outdoor air humidity sensor was with in calibration limits. Most of the temperature sensors are within calibration, however, the after filter temp sensor and pre heat temperature sensors were out of calibration.

In addition to the above functional testing of the AHU-11, the post installation supply fan air flow was measured using the duct traverse method. The total supply air flow of the air handling unit (AHU-11) was measured to be 35,504 CFM.

The static pressure measurements were also measured across the air handling unit filter bank to measure the changes in pressure drop across the filter post application of the hydrophobic spray. The total static pressure was calculated by measuring the suction pressure and the discharge pressure post application of the hydrophobic spray, which is 4.85 in. H20.

Post Test Data	Design	Actual
Total CFM	N.A	35504
Total SP	N.A	4.85
Discharge SP	N.A	3.52
Suction SP	N.A	-1.33

The power draw of the fan motor was measured using a power meter post application of hydrophobic spray on the AHU-11's filters. The current draw from the fans were not logged as it was decided that operating hours of the supply fans are constant volume. Estimated accuracy of the power measurement assumptions is +/-1.5%. The average power measure of the three legs is 30.7 kW for the post conditions.

Post Test Data	Design	Actual		
Hertz	60	60.0		
Motor Volts: P-G	-	267	267	265
Motor Volts: P-P	460	460	460	463
Motor Amps $T_1/T_2/T_3$	69	45.7	47.4	43.9
Kilowatts (KW)	-	29.60	32.21	30.20
Power Factor (PF)	0.85	0.81	0.85	0.85

7.0 – Fan Energy Calculations

7.1 – Fan Energy Calculations:

The energy calculations were performed for the AHU-11 supply fan motor. These were based on the measured power draw on the fan motor (kW) and the operational hours of the AHU-11 fan motor. The AHU-11 is a constant volume fan and is turned ON in the morning at 7:00am and is shut off at 6:00pm.

The measurement of power draw was performed pre-installation of the hydrophobic spray application on the AHU-11 filters and the average power draw was 30.1kW. The power draw of the AHU-11 fan was measured after the application of hydrophobic spray on the AHU filters and the post installation power draw was 30.7 kW.

The AHU-11 has 60 hours of operations per week and a total of 3,120 hours per year. The fan energy consumption for pre-installation was calculated to be 94,016 kWh/yr and the fan energy consumption of 95,690 kWh/yr. There is a slight increase in energy consumption of the fans. The following table shows the electric fan energy calculated for the pre-installation and post-installation of hydrophobic spray on the filters.

	Measured kW	Operation hrs/yr	Annual Energy
Pre-Installation	30.1	3,120	94,016
Post Installation	30.7	3,120	95,690

8.0 – M&V Results and Findings

After analysis of the key parameters pre and post application of the hydrophobic spray. The AHU-11 supply fan air flow measurements were taken pre and post application of the hydrophobic spray. There was a slight decrease in supply fan air flow of 2.3%, this is within the measurement error of duct traverse method and does not represent a significant decrease in air flow. The measurement results for the air flows are listed in the table below:

Key Parameters	Pre-Install	Post Installation	Diff.	% Diff.
Total CFM	36,325	35,504	-821	-2.3%

The impact of the spray on the post static pressure drop across the filters is 2.0% higher than the pre spray static pressure across the filters. The 2% increase in the static pressure which is close to the error of measurement. The results of the M&V field testing are aligned with the claim by Curran Biotech that the hydrophobic spray adheres to the fibers of the filters and do not block the spaces between the fibers. Hence having none to minimum impact on the energy consumption of the fan.

Key Parameters	Pre-Install	Post Installation	Diff.	% Diff.
Discharge SP	3.45	3.52	0.07	2.0%
Suction SP	-1.35	-1.33	0.02	-1.5%
Total SP	4.8	4.85	0.05	1.0%

The impact of the hydrophobic spray on the filters on the post power draw of the fan motor results in an increase of 1.8%. The 1.8% increase in the post fan power draw is close to error of measurement. The results of the M&V field testing show that there is a small increase in post fan power draw, and this may increase the fan electric energy slightly.

	Measured Demand kW
Pre-Installation	30.1
Post Installation	30.7
Difference	-0.54
Percentage Diff.	*-1.8%*

The electric energy consumption for the supply fan motor was calculated for the pre and post spray application on the filters. There is an increase of electric consumption for the post conditions. The increase of 1.78% post supply energy results in a cost penalty of $71 (based on DCAS electric utility rate of $0.0425 per kWh). Table below shows the pre and post energy consumption and the percentage difference in electric energy.

	Annual Energy kWh/yr
Pre-Installation	94,016
Post Installation	95,690
Difference	(1,674)
Percentage Diff.	-1.78%

The cost of energy increase for the installation/application of hydrophobic spray on AHU-11 filters is minimum and can be offset by reduced cost of replacement of filters. Currently the filters are being replacement every month for the AHUs. The developer of the hydrophobic spray claims that the filters can be replaced every three months once the spray is applied to the filters. Curran Biotech also claim that the COVID -19 virus also dies by adhering to the hydrophobic solutions and there is no need of special protection for the person replacing the filters.

9.0 – Appendices

9.1 – Field Work -Testing

Functional Check - AHU - Full & LL87

PROJECT:	Family Court	**Manufact:**	
SYSTEM:	AHU-11	**Mod #:**	
LOCATION:	60 Lafayette Street. 11th Floor Mech Rm	**Ser #:**	
Reporting Engineer:	Alexander Sanchez		
Date of Test:	11/03/20		

1. BMS			**Description**
AHU Type (Recirc, Economizer, 100% OA, HV, DX)	Recirc		
Describe CHW Valves (Type)	2 Way		
Describe HW Valves (Type)	2 Way		Hot water
Does the BMS graphic properly represent the actual unit?	Yes		

2. SENSOR CALIBRATION

Sensor	Actual	BMS	Difference	PASS (Y/N)	Description
Outside Air Temp	**54.6**	**59.7**	**-5.1**	Yes	
Humidity	**32.8%**	**30.4%**	**2.4%**	Yes	
Mixed Humidity	**35.4%**	**49.5%**	**-14.1%**	No	Sensor out of calibration
Mixed Air Temp	**55.1**	**56**	**-0.9**	Yes	
After Filter Humdity	**47.6%**	**38.1%**	**9.5%**	No	Sensor out of calibration
After Filter Temp	**57.4**	**53.6**	**3.8**	Yes	
Pre Heat Temp	**61.8**	**57.6**	**4.2**	Yes	
Pre Heat Humidity	**29%**	**47.6%**	**-18.4%**	No	Sensor out of calibration
Supply Air Temp	**61**	**63**	**-2**	Yes	
Supply Humidity	**45.0%**	**27.0%**	**18.0%**	No	Sensor out of calibration

3. CONTROL VERIFICATION (Current Operating Condition)

		Actual	BMS	Difference	PASS (Y/N)	Description
Valves	CHWV	Close	Close		Yes	
	HWV or Steam	Close	Close		Yes	
	Humidifier Valve	n/a	n/a		na	No in used
	Valve position accurate for mode of operation?				Yes	
	With valves closed any leakby?				No	
	Any simultaneous H/C?				Yes	
Dampers	Damper Operating Mode (Econ/Recirc)				Econ	
	OA Damper	Open	Open		Yes	
	RA Damper	Close	Close		Yes	
	Exhuast Air	Open	Open		Yes	
	Damper postion accurate for mode of operation?				Yes	

4. CONDITION and CLEANLINESS

	Y/N	PASS (Y/N)	Description
Are exterior and interior of unit clean?		Yes	
Are exterior and interior of unit in good condition?		Yes	
Are filters clean and in good condition?		Yes	
If unit does not have filters. Measure duct area in suitable location an note.		na	

5. NEBB Readings

	PASS (Y/N)	Description
Place the unit in 100% OA or typical airflow mode if unit is a minimum OA unit.	Yes	system testes as is
Complete attached NEBB form	Yes	

6. MOTOR / FAN OPERATIONAL CHECKS

						Description
Nameplate Amps	1ϕ	2ϕ	3ϕ	Average		
69.0	44.5	45.7	42.5	44.2		
KW	1ϕ	2ϕ	3ϕ	Average		
	29.40	31.70	29.30	30.13		
RPM - Fan		RPM - Motor				
Design	Actual	Design	Actual			
-	1276	1780	1792			
VFD Hertz		Nameplate (V)				
0		460				
	1ϕ	2ϕ	3ϕ	Average		
Phase / Ground Volts	275	275	273	274		
Phase / Phase Volts	475	475	479	476		
Power Factor	0.80	0.84	0.83	0.82		

	Y/N	PASS (Y/N)	Description
Is fan rotation correct?	Yes	Yes	
Is average measured amperage less than nameplate amperage (FLA)?		yes	
Is largest deviation from the average current within the range of +/- 10%		yes	
Is Motor measured RPM within +/- 10% of design RPM?		yes	
Is Fan measured RPM within +/- 10% of design RPM?		na	not RPM designed provided

7. CONTROLS & VALVE OPERATIONAL CHECKS (via BMS)

		PASS (Y/N)	Description
Cooling Mode	Adjust the Supply Air Temperature Set point 5 degrees Lower than the current set point:	Yes	
	Does the Preheat Valve FULLY CLOSE?	Yes	
	Does the Cooling Valve OPEN?	Yes	
	Can the AHU maintain the new set point? (I.E. no system hunting or temp. extremes, etc.)	Yes	
Heating Mode	Adjust the Supply Air Temperature Set point 5 degrees Higher than the current set point:	-	
	Does the Preheat Valve OPEN?	Yes	
	Does the Cooling Valve FULLY CLOSE?	Yes	
	Can the AHU maintain the new set point? (I.E. no system hunting or temp. extremes, etc.)	Yes	
Leakby Test (If Necessary)	Stroke the valve to FULL OPEN. Does it indicate FULL OPEN?	Yes	
	Stroke the valve to FULL CLOSED. Does it indicate FULL CLOSED?	na	
	LEAK-BY TEST: Keeping the control valve closed, close off the PHC Isolation valve and test air temp.		
	Using the TSI, does air temperature after the coil lower? No = Leak By Issue	na	
	Describe valve failure – NO / NC / As is	na	

Project:	**Manhattan Family Court**	**Test Date:**	**11/3/20**
System Unit:	**AHU-11**	**Test Equipment:**	**Digital Nanometer**
Location:	**11th floor Mech Room**	**Eqpt Serial #:**	**9565P1941039**
Engineer:	**Alexander Sanchez**	**Calibration Date:**	**Oct-20**

Unit Data			
Make / Model No.			
Serial Number			
Type / Size			
Arr. / Class			
Discharge			
No. Belts / make / size			
No. Filters / type / size	9	bag	20x24x29
	6	bag	24x24x29
	4	bag	12x24x29
	16	merv-8	24x24x2
	4	merv-8	24x12x2

Motor Data			
Make / Frame	US Motors	364T	
HP (W) / Rpm	60	1780	
Volts / Phase / Hertz	460	3	60
FL Amps / S.F.	69.0	1.15	
Efficiency (%) / Power Factor	94.5	0.85	

Test Data	**Design**	**Actual**		
Total CFM		36325		
Total SP		4.80		
Fan RPM	-	1276		
Motor RPM	1780	1792		
Hertz	60	60.0		
Motor Volts: P-G	-	275	275	273
Motor Volts: P-P	460	475	475	479
Motor Amps $T_1/T_2/T_3$	69	44.5	45.7	42.5
Kilowatts (KW)	-	29.40	31.70	29.30
Power Factor (PF)	0.85	0.80	0.84	0.83
Outside Air CFM		36325		
Return Air CFM				

Test Data	**Design**	**Actual**
Discharge SP		3.45
Suction SP		-1.35
Clng Coil 1 - diff SP		0.61
Preheat Coil - diff SP		0.12
Filter - diff SP		0.49
Ret Air Damper Position		Close
Out Air Damper Position		Open

Project:	**Wyckoff Hospital**	**Test Date:**	**1/23/20**
System Unit:	**AC 5-1**	**Test Equipment:**	**Digital Nanometer**
Location:	**5th Floor mech Rm**	**Eqpt Serial #:**	**9565P1941039**
Engineer:	**Alexander Sanchez**	**Calibration Date:**	**Oct-20**

Duct				**Design**		**Actual**	
Static Pressure (in wc)							
Air Temp (F)				FPM	-	FPM	538
Size (in)	108	x	90	CFM		CFM	36325
Area (sq ft)	67.500						

Distance from Bottom	Position	1	2	3	4	5	6	7	8	9	10	11	12
0	1	523	546	504	544	539	547	582	483	471			
	2	522	506	487	510	490	487	546	497	601			
	3	522	593	585	503	544	553	513	565	559			
	4	466	626	492	505	487	500	500	531	580			
	5	512	568	639	538	527	530	547	633	647			
	6	509	498	654	517	605	584	449	470	624			
	7												
	8												
	9												
	10												
	11												
	12												
Distance from Duct Edge													
Velocity Sub-Totals		3054	3337	3361	3117	3192	3201	3137	3179	3482	0	0	

Functional Check - AHU - Full & LL87

PROJECT:	Family Court	**Manufact:**	
SYSTEM:	AHU-11	**Mod #:**	
LOCATION:	60 Lafayette Street. 11th Floor Mech Rm	**Ser #:**	
Reporting Engineer:	Alexander Sanchez		
Date of Test:	11/05/20		

1. BMS			**Description**
AHU Type (Recirc, Economizer, 100% OA, HV, DX)	Recirc		
Describe CHW Valves (Type)	2 Way		
Describe HW Valves (Type)	2 Way		Hot water
Does the BMS graphic properly represent the actual unit?	Yes		

2. SENSOR CALIBRATION

Sensor	**Actual**	**BMS**	**Difference**	**PASS (Y/N)**	**Description**
Outside Air Temp	**54.6**	**53.4**	**1.2**	Yes	
Humidity	**84.7%**	**86.7%**	**-2.0%**	Yes	
Mixed Humidity	**83.5%**	**74.2%**	**9.3%**	No	Sensor out of calibration
Mixed Air Temp	**55.4**	**61.3**	**-5.9**	Yes	
After Filter Humdity	**83.3%**	**69.1%**	**14.2%**	No	Sensor out of calibration
After Filter Temp	**55.4**	**64.7**	**-9.3**	No	Sensor out of calibration
Pre Heat Temp	**57.6**	**64.8**	**-7.2**	No	Sensor out of calibration
Pre Heat Humidity	**77%**	**68.2%**	**8.8%**	No	Sensor out of calibration
Supply Air Temp	**64.8**	**68**	**-3.2**	Yes	
Supply Humidity	**61.6%**	**63.7%**	**-2.1%**	Yes	

3. CONTROL VERIFICATION (Current Operating Condition)

		Actual	**BMS**	**Difference**	**PASS (Y/N)**	**Description**
Valves	CHWV	Close	Close		Yes	
	HWV or Steam	Close	Close		Yes	
	Humidifier Valve	n/a	n/a		na	No in used
	Valve position accurate for mode of operation?				Yes	
	With valves closed any leakby?				No	
	Any simultaneous H/C?				Yes	
Dampers	Damper Operating Mode (Econ/Recirc)				Econ	
	OA Damper	Open	Open		Yes	
	RA Damper	Close	Close		Yes	
	Exhuast Air	Open	Open		Yes	
	Damper postion accurate for mode of operation?				Yes	

4. CONDITION and CLEANLINESS	**Y/N**	**PASS (Y/N)**	**Description**
Are exterior and interior of unit clean?		Yes	
Are exterior and interior of unit in good condition?		Yes	
Are filters clean and in good condition?		Yes	
If unit does not have filters. Measure duct area in suitable location an note.		na	

5. NEBB Readings	**PASS (Y/N)**	**Description**
Place the unit in 100% OA or typical airflow mode if unit is a minimum OA unit.	Yes	system testes as is
Complete attached NEBB form	Yes	

6. MOTOR / FAN OPERATIONAL CHECKS

						Description
Nameplate Amps	1ϕ	2ϕ	3ϕ	Average		
69.0	45.7	47.4	43.9	45.7		
KW	1ϕ	2ϕ	3ϕ	Average		
	29.60	32.21	30.20	30.67		
RPM - Fan		RPM - Motor				
Design	Actual	Design	Actual			
-	1276	1780	1791			
VFD Hertz		Nameplate (V)				
0		460				
	1ϕ	2ϕ	3ϕ	Average		
Phase / Ground Volts	267	267	265	266		
Phase / Phase Volts	460	460	463	461		
Power Factor	0.81	0.85	0.85	0.84		
				Y/N	**PASS (Y/N)**	
Is fan rotation correct?				Yes	Yes	
Is average measured amperage less than nameplate amperage (FLA)?					yes	
Is largest deviation from the average current within the range of +/- 10%					yes	
Is Motor measured RPM within +/- 10% of design RPM?					yes	
Is Fan measured RPM within +/- 10% of design RPM?					na	not RPM designed provided

7. CONTROLS & VALVE OPERATIONAL CHECKS (via BMS)

		PASS (Y/N)	**Description**
Cooling Mode	Adjust the Supply Air Temperature Set point 5 degrees Lower than the current set point:	Yes	
	Does the Preheat Valve FULLY CLOSE?	Yes	
	Does the Cooling Valve OPEN?	Yes	
	Can the AHU maintain the new set point? (I.E. no system hunting or temp. extremes, etc.)	Yes	
Heating Mode	Adjust the Supply Air Temperature Set point 5 degrees Higher than the current set point:	-	
	Does the Preheat Valve OPEN?	Yes	
	Does the Cooling Valve FULLY CLOSE?	Yes	
	Can the AHU maintain the new set point? (I.E. no system hunting or temp. extremes, etc.)	Yes	
Leakby Test (If Necessary)	Stroke the valve to FULL OPEN. Does it indicate FULL OPEN?	Yes	
	Stroke the valve to FULL CLOSED. Does it indicate FULL CLOSED?	na	
	LEAK-BY TEST: Keeping the control valve closed, close off the PHC Isolation valve and test air temp.		
	Using the TSI, does air temperature after the coil lower? No = Leak By Issue	na	
	Describe valve failure – NO / NC / As is	na	

Project:	**Manhattan Family Court**	**Test Date:**	**11/3/20**
System Unit:	**AHU-11**	**Test Equipment:**	**Digital Nanometer**
Location:	**11th floor Mech Room**	**Eqpt Serial #:**	**9565P1941039**
Engineer:	**Alexander Sanchez**	**Calibration Date:**	**Oct-20**

Unit Data			
Make / Model No.			
Serial Number			
Type / Size			
Arr. / Class			
Discharge			
No. Belts / make / size			
No. Filters / type / size	9	bag	20x24x29
	6	bag	24x24x29
	4	bag	12x24x29
	16	merv-8	24x24x2
	4	merv-8	24x12x2

Motor Data			
Make / Frame	US Motors	364T	
HP (W) / Rpm	60	1780	
Volts / Phase / Hertz	460	3	60
FL Amps / S.F.	69.0	1.15	
Efficiency (%) / Power Factor	94.5	0.85	

Test Data	Design	Actual		
Total CFM		35504		
Total SP		4.85		
Fan RPM	-	1276		
Motor RPM	1780	1791		
Hertz	60	60.0		
Motor Volts: P-G	-	267	267	265
Motor Volts: P-P	460	460	460	463
Motor Amps $T_1/T_2/T_3$	69	45.7	47.4	43.9
Kilowatts (KW)	-	29.60	32.21	30.20
Power Factor (PF)	0.85	0.81	0.85	0.85
Outside Air CFM		35504		
Return Air CFM				

Test Data	Design	Actual
Discharge SP		3.52
Suction SP		-1.33
Clng Coil 1 - diff SP		0.65
Preheat Coil - diff SP		0.14
Filter - diff SP		0.40
Ret Air Damper Position		Close
Out Air Damper Position		Open

Project:	**Wyckoff Hospital**	**Test Date:**	**1/23/20**
System Unit:	**AC 5-1**	**Test Equipment:**	**Digital Nanometer**
Location:	**5th Floor mech Rm**	**Eqpt Serial #:**	**9565P1941039**
Engineer:	**Alexander Sanchez**	**Calibration Date:**	**Oct-20**

Duct				**Design**		**Actual**	
Static Pressure (in wc)							
Air Temp (F)				FPM	-	FPM	526
Size (in)	108	x	90	CFM		CFM	35504
Area (sq ft)	67.500						

Distance from Bottom	Position	1	2	3	4	5	6	7	8	9	10	11	12
0	1	544	544	502	511	551	509	515	486	479			
	2	498	489	540	465	486	517	507	580	529			
	3	481	484	507	498	509	531	511	585	477			
	4	612	597	504	568	567	483	493	489	453			
	5	522	522	482	510	497	609	529	635	603			
	6	557	555	581	519	554	592	478	449	608			
	7												
	8												
	9												
	10												
	11												
	12												
Distance from Duct Edge													
Velocity Sub-Totals		3214	3191	3116	3071	3164	3241	3033	3224	3149	0	0	

9.2- Calculations

ECM-1
AHU-11 Fan Energy Consumption
Facility:
Agency DCAS
Consultant: Eneractive Solutions LLC
Date: 12/04/2020

Report Table

ECM-1 AHU-11 Fan Energy Consumption								
Savings								
		Electric kWh	Demand kW	No. 2 Oil (gal)	No. 4 Oil (gal)	Gas (Therms)	Steam (MLbs)	Total Savings
Energy	Unit	-1,674	0	0	0	0	0	--
	Cost ($)	$ (71)	$ -	$ -	$ -	$ -	$ -	$ (71)

Economic Performance				
Savings			Total Install Cost	Simple Payback
Energy $	Maintenance $	Total Savings $		
$ (71)		$ (71)	$ 570	(8.01)

Utility Costs:

Electric	$ 0.0425	per kWh	Electric Demand	$ 32	per kW

Tag #: **ECM-1**
Title: AHU-11 Fan Energy Consumption

Description: Calculating the AHU-11 supply fan motor energy consumption for baseline and post installation of hydrophobic spray.

Assumptions: The operation of the AHU-11 is five days a week from 7am to 6pm.

Baseline Fan Power Readings

AHU -11 Fan 60 hp	29.4	*From testing*
AHU -11 Fan 60 hp	31.7	*From testing*
AHU -11 Fan 60 hp	29.3	*From testing*
Average Power (kW)	**30.1**	*Average*

Baseline

Hours 'On'	60	hrs./wk.
Baseline Electric (kWh/Year)	94,016	kWh

Post Fan Power Readings

AHU -11 Fan 60 hp	29.6	*From testing*
AHU -11 Fan 60 hp	32.21	*From testing*
AHU -11 Fan 60 hp	30.2	*From testing*
Average Power (kW)	**30.7**	*Average*

Post Installation

Hours 'On'	60	hrs./wk.
Baseline Electric (kWh/Year)	95,690	kWh

Energy Impact

Electrical Savings (kWh/Year)	-1,674	kWh/year
Electrical Savings ($/year)	$ (71)	

Investment Calcs:

Install Cost									
Category	Quantity	Unit	Unit Cost ($) Material	Labor Rate	Hours	Labor	Category Cost ($) Material	Labor	Total $
Hydrophobic Spray	39	1 Ea.	$ 3	$ 120	2	$ 240.00	$ 117.00	$ 240	$ 357
							$ -	$ -	$ -
							$ -	$ -	$ -
							$ -	$ -	$ -
							$ -	$ -	$ -
							$ -	$ -	$ -
Subtotal	--	-- --	--			--	$ 117	$ 240	$ 357
Contractor Overhead	10%	-- --	--			--	$ 11.70	$ 24	$ 36
Contractor Profit	10%	-- --	--			--	$ 13	$ 26	$ 39
Engineering & Construction	20%	-- --	--			--	$ 28	$ 58	$ 86
Contingency	10%	-- --	--			--	$ 17	$ 35	$ 52
Total							$ 187	$ 383	$ 570