Energy Efficient Indoor Air Quality (IAQ) Analysis

LaBella Associates
Preliminary Findings Report #3
September 28, 2020

A) Summary of Progress to Date

As of September 28th, work plans for all (8) sites have been submitted and approved. The table below outlines a summary of approved sites as well as the progress with site investigations and coordination with vendors.

Work Plan #	Client Name	Facility Name	City	Sector	Work Plan Approved	Kickoff Meeting	Utility Analysis	Review Industry Guidance	Review Site Drawings & Controls Sequences	Site Visits Underway	Identify Potential Measures	Energy Calculations	Economic Analysis	Draft Report Submitted to Customer for Review	Estimated Report Completion Date
WP-01	NFTA	Buffalo Niagara International Airport	Buffalo	Airport	✓	✓	✓	✓	✓	✓	✓	✓			Oct. 16
WP-02	City of Rochester	Blue Cross Arena	Rochester	Arena	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Oct. 9
WP-03	The Rosenblum Companies	100 Great Oaks	Albany	Office/ Medical	✓	✓	✓	✓	✓	✓	✓				Nov. 15
WP-04	NFTA	Metro Transportation Center	Buffalo	Offices/ Bus Station	✓	✓	✓	✓	✓	✓	✓	✓			Oct. 16
WP-05	City of Rochester	Rundel Library	Rochester	Library	✓	✓	✓	✓	✓	✓	✓				Dec. 1
WP-06	Webster CSD	Dewitt Road E.S.	Rochester	Primary School	✓		✓	✓							Dec. 1
WP-07	OGS	299 Old Niskayuna	Albany	Office	✓	✓	✓	✓	✓	✓	✓				Nov. 15
WP-08	North Tonawanda CSD	NT Middle School	Buffalo	Middle School	✓	✓	✓	✓	✓	✓					Dec. 1

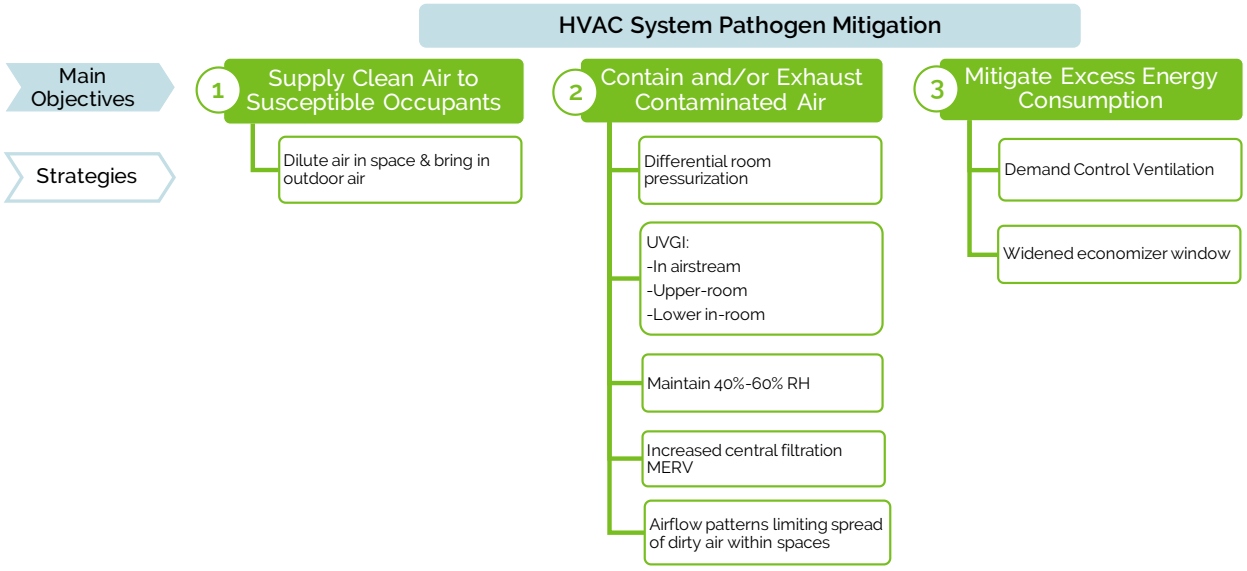
Note: cumulative report is anticipated to be submitted for review at the same time as the latest individual site report.
Boxes highlighted in green indicate progress made in past month since previous progress report.

As indicated on the graph below, 7 of the 8 approved sites have commenced with kickoff meetings, data collection, and utility analyses. Site visits have commenced with these sites with coordination with AHU vendors on available technologies and equipment selection information. Pathogen mitigation measures and energy conservation measures have been identified for 5 of the 8 sites and are in the process of collecting final selections from vendors and developing energy and cost analyses.

The estimated report completion dates are listed above and are expected to be submitted to NYSERDA in early December at the latest in order to allow for enough time for NYSERDA to make comments and LaBella to address them before the end of the calendar year.

B) Study Findings to Date

A thorough review of ASHRAE safe-operation measures has been conducted. The chart below indicates the main objectives of the HVAC system within its role in mitigating the spread of pathogens, as well as strategies that can be used to achieve these goals.



Based on a variety of site conditions, the strategies outlined above are narrowed down to specific recommendations that will enable the safest operation conditions. In addition to mitigating the spread of pathogens, additional energy conservation strategies are being evaluated, where feasible.

The following table outlines a summary of the recommended measures on a site-by-site basis. Factors limiting the implementation of certain ASHRAE-recommended measures are stated as well as alternate approaches to help mitigate the spread of pathogens. In general, the most common recommended measures are to maximize filtration as much as possible, bring in as much outdoor air as possible in order to increase air changes in the spaces, put UVGI on the cooling coils of air handling units as space allows, and modify controls in order to maintain humidity levels between 40% RH and 60%RH.

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Measures / Sites	Increased OA Ventilation	UVGI	Increased Filtration	Humidification Control	Energy Conservation Opportunities	Current Ventilation	Current Filtration	Current UVGI	# AHUs
BNIA Terminal	It is recommended that during pandemic mode occupied hours, the percent OA intake is increased from 17% to 40% to increase the number of outdoor air changes per hour.	1) Recommended UVGI inside large Mammoth AHUs. Smaller units do not have sufficient space for UVGI. Typical UVGI layouts in these units are spaced 18" from the cooling coil with 5 rows of 2 lamps.	All units currently have MERV-15 filters. No additional filtration is recommended based on current industry guidance.	In retrofitted unit option, Humidifiers are being recommended in order to maintain 40%-60% RH. Final selection of proposed equipment is expected to be completed by 9/28.	1) Replacement of DX cooling coils to centralized chilled water system will allow for reduced maintenance, energy cost savings, and the capacity to allow for additional OA ventilation and space for UVGI. Final vendor selection of retrofit options and air-cooled rooftop chillers is expected to be complete by 9/28. 2) Re-introduction of demand control ventilation/ reduced ventilation during unoccupied hours. Feasibility of this measure is currently being evaluated. 3) The supply fan in the unit is nearing the end of its useful life. Replacing the supply fan with a fan wall will present increased energy efficiency as well as increased resiliency.	The facility currently operates bringing in 17% outdoor air.	MERV-15 throughout	None	32
NFTA MTC	1) Increased OA ventilation is recommended. Amount of OA intake will be limited by either cooling coil capacity or ability to meet indoor air setpoints. This has yet to be determined. 2) Each air handling unit has been analyzed to calculate individual unit limitations for treatment of outside air. Outside air temperature ranges to operate with 100% outside air have been defined for each unit. Total impacts on both the chilled water system and hot water system have also been calculated. The limiting factor for most AHUs is the water-side pressure drop through either the cooling or heating coils.	Cooling coil mounted UVGI has been selected for all (7) AHUs. Economic impacts of purchasing, installing, and operating the UVGI equipment are currently being calculated.	The supply air fans for all (7) air-handling units have been analyzed on their capacity and ability to handle the additional pressure drop of installing MERV-13 filters. AHU-1 and AHU-2 have the ability to accept a 4" M13 filter, with spare BHP to accomodate the additional pressure drop. AHU-3, 4, 5, 6, and 7 are configured to accept a 2" M13 filter; these units also have available BHP to accomodate the additional pressure drop.	1) AHU-1 and AHU-2 were originally constructed with DriSteem electric humidifiers to provide space humidification for the tower offices and spaces. The dispersion piping has since been disconnected to both of these units. A measure is currently being analyzed to re-install humidification equipment and dispersion piping to treat these areas. The intent is to provide increased humidification capabilities in the office spaces. Preliminary sizing for each humidifier has been completed, showing a separate 75-100 lb/hr humidifier required for AHU-1 and AHU-2. 2) The remaining (5) AHUs have been assessed for the feasibility of adding humidification. Due to both the nature of these spaces (high traffic, high infiltration, and materials of construction) achieving the desired humidity levels during occupied hours is not feasible.	1) Replacing the existing air-cooled chiller, which is nearing the end of its useful life, will present an opportunity for increased cooling capacity- which will increase the potential for increased OA ventilation. The total increase in tonnage required for operating all (7) AHUs with maximum outside air has been calculated. It is anticipated to increase the required chilled water tonnage by 48 tons. Installing a more efficient air-cooled chiller with higher part-load efficiencies will present an opportunity for energy savings. 2) Destratification fans in the bus station terminal may present an opportunity for improved HVAC performance, which will allow more opportunity for OA ventilation. Selection of fans, layouts, and pricing is currently being evaluated. 3) Sealing ductwork in the catwalk above the bus terminals will result in increased HVAC system efficiency- which will result in energy savings as well as reduced limitations on OA intake. Aeroseal duct sealing is being assessed for economic feasibility.	Code-minimum	MERV-8, upgrading to MERV-11	None	7
Blue Cross Arena	1) Additional OA intake is recommended for AHU-12. Using CO_2 sensors throughout will help increase OA intake as the building occupancy increases beyond the original design for 4,500 occupants. 2) Repairing low-temperature cutoff alarms in AHU-14 and AHU-20 will reduce the amount of return air brought into the space and allow for more OA intake. 3) Repairing operating sequences of the suite fan coil units and AHUs supplying fresh air to them will allow the units to supply fresh air instead of the current 100% recirculated air	Recommended UVGI inside AHUs in cooling coil sections - all units that are not using 100% outside air.	1) Facility is currently using MERV-8 Filters and is capable of upgrading to MERV 13 Filters.	Blue Cross Arena does not incorperate humdification controls at this time. Due to both the nature of these spaces (high traffic, high infiltration, and materials of construction) achieving the desired humidity levels during occupied hours is not feasible.	1) Resolving low-temperature cutoff alarms in AHU-14 and AHU-20 will reduce the amount of return air brought into the space and allow for more OA intake. 2) Using variable speed drives to adjust return & exhaust fan speeds, will create safer airflow pathways in the arena while reducing overall energy consumption	Code-minimum. Economizer is used when OA is between 40 and 65 deg F.	MERV-8	None	26
Webster CSD - Dewitt Road Elementary	More information required before site-specific recommendations are made.	More information required before site-specific recommendations are made.	More information required before site-specific recommendations are made.	More information required before site-specific recommendations are made.	More information required before site-specific recommendations are made.	More information required.	More information required.	More information required.	More information required.

Blue text indicated additions in past month since previous progress report.

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Measures / Sites	Increased OA Ventilation	UVGI	Increased Filtration	Humidification Control	Energy Conservation Opportunities	Current Ventilation	Current Filtration	Current UVGI	# AHUs
299 Niskayuna	Current OA intake is being overridden in order to satisfy the humidity control issue in the building. Upgraded controls sequencing and CO2 sensors in spaces is being investigated in order to increase OA ventilation as well as maintain humidity in space below required threshhold. Further investigation into RTU control functionality revealed issues with control system as a whole: current humidity issues are likely due to over-ventilating during the past summer with minimal occupancy. Going forward a full controls review will likely be necessary from the installing contractor to incorporate appropriate occupancy modes.	1) Coil-mounted UVGI is not possible due to limited space and accessibility to units for maintenance. Duct mounted UV being considered for office areas which are served by longer duct mains. 2) In-duct UVGI and upper-room UVGI for the warehouse space is currently being evaluated for feasibility and effectiveness. Warehouse storage area will likely not need upper room UV due to low occupancy and large space volume.	Owner is currently in process of upgrading to MERV-13 filters. Higher rated filters are not recommended due to pressure drop issues in the units.	Upgrades in controls are being investigated in order to satisfy the building's humidity requirements. Strict humidity requirements were already in-place in this facility to accommodate paper storage requirements.	Incorporating an economizer function into the air handling units will allow for significant savings as well as increased outdoor air ventilation. Full control review for RTUs could result in savings. Currently units are bringing in more OA than expected and are not calibrated properly.	Units are controlled by combination of CO2 sensors and standard economizer controls. Some units do not currently bring in OA into the space.	MERV-8, upgrading to MERV-13	None	28
100 Great Oaks	The existing units ventilate outdoor air based on CO2 levels in the building. Thew unit's ability to incorporate additional ventilation has yet to be determined and will depend on either the cooling coil capacity or unit's ability to meet space setpoints.	There is very limited space in AHUs for UVGI. Installing UVGI in return ducts is a possible solution that will be investigated further in upcoming site visits.	There is currently a 2" filter rack in the AHUs. The feasibility of upgrading to higher-rated MERV filters has yet to be determined based on the fan's ability to overcome the pressure drop.	More information required before site-specific recommendations are made.	More information is required in upcoming site visits before site-specific recommendations are made.	Unit ventilation is controlled by CO2 sensors within space.	MERV-8	None	10
NT Intermediate School	More information required before site-specific recommendations are made.	More information required before site-specific recommendations are made.	More information required before site-specific recommendations are made.	More information required before site-specific recommendations are made.	More information required before site-specific recommendations are made.	More information required.	More information required.	More information required.	More information required.
COR Library	1) Outside air to the public spaces is primarily supplied by the main penthouse air handler (AHU-1). Office and storage areas (closed to the public) are supported through natural ventilation and various zone air handlers. Potential improvements are still being evaluated.	1) UVGI is currently being evaluated for the main penthouse air handler's cooling coil section as this provides the majority of fresh air to the building. Other units are being reviewed for potential installations.	1) Most air handlers are being considered for upgrades to MERV-13 and will likely be capable of the increased static pressure. Fan Coils that provide localized cooling likely don't have capacity to support a MERV-13 filter.	More information required before site-specific recommendations are made.	More information required before site-specific recommendations are made.	The building has been designed for a combination of natural and mechaical ventilation. This is currently being compared to 2020 code to evaluate potential improvements.	Air Handlers currently use MERV-8 filters. Fan Coils used for local cooling support MERV 4 (estimated)	None	10

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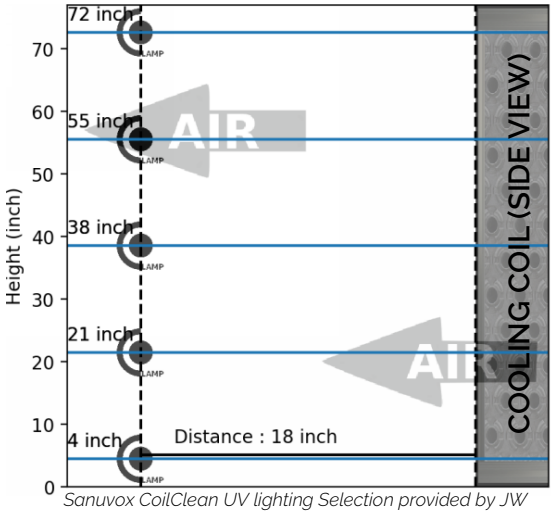
C) Lessons Learned/ Barriers Encountered

A common barrier that has been encountered is that some air handling units either have limited space for UVGI on the cooling coil or components inside the unit that are vulnerable to UV degradation. For units with limited space, 2 options are being evaluated: (1) place an increased number of UV lamps closer to the cooling coil in order to maintain the minimum intensity required to kill microorganisms, and (2) place upper-room UVGI lamps in the spaces where the air handling units serve.

Another obstacle associated with the upper-room UVGI is that in some instances such as a warehouse space, though there is ample room for upper room UVGI to be implemented and effective, there are also a number of components in the ceiling that are subject to UV degradation such as wires and rope. The vendor is still in the process of evaluating the feasibility of placing the UV lights in the upper room given these constraints. Possible solutions may include putting conduits over wires or protective coatings over vulnerable materials.

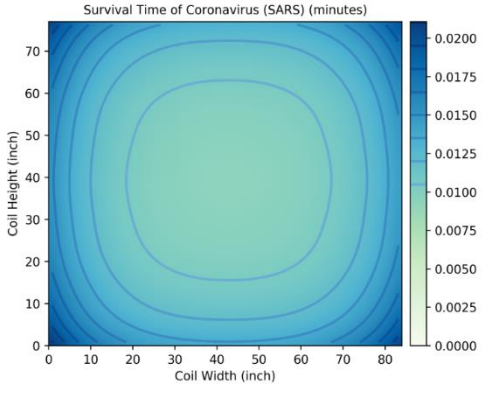
The figures to the right and below shows a sample UVGI selection for an air handling unit at the Buffalo Niagara International Airport. The figure to the right shows the side view of the lamps inside the unit and their location relative to the cooling coil.



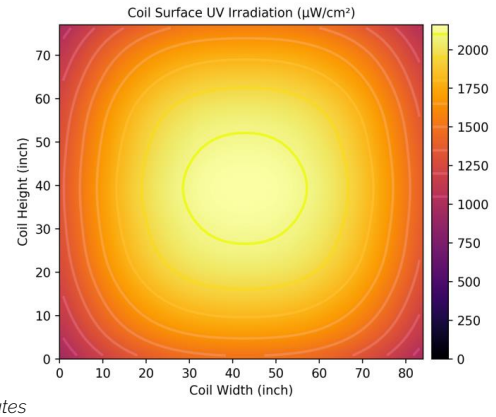
Sanuvox CoilClean UV lighting Selection provided by JW Swanson & Associates

The graphs below shows the surface irradiation intensity across the coil's cross section for a 5-row, 10-lamp configuration located 18 inches away from the cooling coil. The average irradiation intensity for this configuration is 1,741 μW/cm², which is enough to sufficiently kill all microorganisms on the surface of the cooling coil. In addition, the second graph shows the estimated survival time of the COVID-19 virus on the cooling coil, with an average of 0.01 minutes (0.6 seconds).

Coronavirus (SARS)		
Min	Average	Max
0.01 min	0.01 min	0.02 min



Irradiation Intensity		
Min dose	Average dose	Max dose
966.0 μW/cm²	1741.0 μW/cm²	2161.0 μW/cm²



Sanuvox CoilClean UV lighting Selection provided by JW Swanson & Associates

Additional considerations when implementing UVGI inside the units include interlocking doors so the lamps are shut off if the access door is opened, window film, and wiring protection inside the cooling coil section.

D) Proposed Work Plan Adjustments

N/A

E) Next Steps

- Finish gathering information from remaining sites
- Complete remainder of site visits
- Finalize measures to be evaluated at each facility with vendor input and pricing
- Perform energy calculations & feasibility analyses
- Submit draft reports for review