UNIVERSITY OF TORONTO

FACILITIES AND SERVICES

COVID-19 HVAC Assessment

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Completed by: Facilities and Services & Environmental Health and Safety

Background

In light of the current COVID-19 pandemic, the University of Toronto is preparing buildings for the resumption of increased activity for Fall 2021. As understanding of the SARS-CoV-2 virus and guidance from Public Health authorities evolve, there have been inquiries around the role of engineering controls for building ventilation systems as one measure to prevent the spread of the SARS-CoV-2 virus, as well as ventilation operation best practices in response to a confirmed COVID-19 case in a building.

This document summarizes a joint review by University Utilities and Operation (U&O) and Environmental Health and Safety (EHS) of available guidelines to provide best practices and recommendations associated with well-designed HVAC systems and control measures specific to pandemic response.

The scope of this review focused on non-health care administrative offices, classrooms, laboratories, etc. (Note: spaces such as dental and student health clinics are excluded from this assessment, as those spaces operate under different HVAV requirements).

Summary of Recommended and Implemented Control Measures

a) Enhanced Air Filtration

i. Utilization of MERV 13 air filters as final air handler filtration prior to point of use.
ii. Most units were equipped with MERV 13 air filters in 2020. Ongoing review continues to ensure performance is as expected (e.g., that the filters have not resulted in negative impacts to the air change rate). Any outstanding air handling systems without MERV 13 final filters are currently being refitted with MERV 13 filters, where possible.

b) Outbreak Occurrence

i. A COVID-19 outbreak, as declared by the Public Health authorities, requires the impacted HVAC system be flushed for two days, or as directed by the Public Health authorities. Flushing requires provision of maximum outside air volume without compromising space temperature or relative humidity.

c) Operational Maintenance

i. Building operating engineers are licensed and trained to identify, and subsequently arrange and oversee repair of all HVAC issues.

ii. Building operating engineers are assigned daily to specific buildings to manage the mechanical systems. This includes observance of visual, noise, smell, and thermal inspections of all mechanical rooms and equipment to identify deficiencies that should be repaired.

Possible observations include:

- Equipment noise changes – (possible bearing wear)
- Equipment heat generation – (electric motors or leaking valves)
- Apparent system leakage – (pumps or pipe couplings)
- Drive belt tension and wear – (air handler fans)
- Filter movement (requires adjustments)
- Increasing electrical usage – (electrical motors or seized drives)
- Volume, temperature, humidity, differential pressure variance from normal

iii. Continuous monitoring at one-minute intervals, maximum five-minute intervals on all HVAC systems, providing insight into instantaneous and trend data. Additionally, control limits provide alarms investigated by the Operating Engineers.

iv. The air handling unit filters are monitored and changed based on loading in the filter, or after a specific operating period. The filters are also physically monitored by the building engineers for damage or leak due to possible shifting in the holding frames.

v. Starting the system in 'occupied mode' 2 hours before opening the building and continuing to operate it for 2 hours after occupancy.

d) Classroom specific – additional control measures

For classrooms, due to the transient nature of the population and greater number of people indoors compared to the other spaces, further measures are considered:

1. Performing a classroom HVAC assessment process, including conducting an air survey, to determine if the classroom is recommended for use, with modified capacity and/or with the addition of local air filtration. Target ventilation for classrooms is 6 air-changes-per-hour equivalent (ACH eq).
2. Disabling demand control ventilation where it exists (typically in place to support energy conservation efforts), to avoid reductions in air flow.
3. Starting the HVAC system 2 hours before the first class and continuing to operate the system for 2 hours after the last class has ended, which exceeds 3 air changes.

Details of the Assessment

There are various documents, reference standards, and resources circulating regarding maintenance of healthy building operations during COVID-19 pandemic conditions. Some recommendations do not provide clear guidelines, having minimal research evidence. Some are consistently updated such as U.S. Centers for Disease Control and Prevention (CDC) guidelines and ASHRAE building readiness guidelines.

Basis of Investigation and Actions

The University is guided by the American Society of Heating, Refrigerating, Air-Conditioning Engineers (ASHRAE). This organization is the globally recognized leader and provides peer-reviewed guidelines and standards for HVAC Systems. The document used to prepare this communication "ASHRAE Position Document on Infection Aerosols, April 14th, 2020," provides guidance to designers and facility managers to control the dissemination of infectious aerosols. This position document emphasizes the need to perform risk assessments of immediate environments to understand the corrective measure at the University of Toronto.

Specific challenges exist.

1. Many buildings do not have mechanical ventilation
2. Due to legacy design, the system capability or capacity to increase/decrease ventilation changing outside air content is highly restricted.

Assessment

This approach is required because as stated prior, the ability to design engineered solutions in this environment is greatly restricted by timeline and physical capability.

STEP 1: Objective:

Review the operations of the HVAC system during the COVID-19 pandemic, excluding specialized labs such as CL3, and health-care, clinical locations.

STEP 2: Assessment

Route of transmission

COVID-19 is most commonly spread from an infected person through:

- Respiratory droplets shared when you cough or sneeze. These droplets can spread up to 2 metres, or 6 feet.
- Close, prolonged personal contact (defined as being within 2 metres for 15 minutes or more), or having physical contact, such as hugging someone.
- Touching something with the virus on it, then touching your mouth, nose, or eyes before washing your hands.

While COVID-19 can spread from aerosols generated during medical procedures and certain dental procedures, airborne transmission is not a common way the virus is spread. COVID-19 is not known to be spread through airborne transmission in community settings, ventilation systems or through water.

Transmission from aerosols may be possible when there are a higher number of people indoors, for a longer period of time, in enclosed spaces with poor airflow or ventilation. With proper airflow or ventilation, smaller virus particles will become diluted and disperse faster, similar to what occurs when you open windows to air out a smoky room. While aerosols may contribute to the

spread of COVID-19, infections are still linked to person-to-person transmission through close direct contact with someone who was contagious.

There is no evidence at this time that the virus is able to transmit over long distances through the air, for example, from room to room through air ducts. It is still unclear how easily the virus spreads through contact with surfaces or objects.

Reference:

1) Toronto Public Health (TPH): https://www.toronto.ca/home/covid-19/covid-19-protect-yourself-others/covid-19-reduce-virus-spread/
2) Public Health Agency of Canada (PHAC): https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/health-professionals/main-modes-transmission.html
3) World Health Organization: https://www.who.int/news-room/q-a-detail/coronavirus-disease-covid-19-how-is-it-transmitted

STEP 3: Reducing the risk of transmission

Primary controls to reduce the risk of transmission

The most important elements in reducing the risk of COVID-19 are:

- Screening of symptoms and other risk factors and staying home when ill or have screened positive for one of the COVID-19 risk factors (see https://www.utoronto.ca/utogether/ucheck for more), by completing self-screening such as UCheck: https://ucheck.utoronto.ca/
- Physical distancing, de-densification through working at home policies and moving the majority of learning to online, setting maximum occupancy limits where applicable and avoiding crowded spaces, close interactions
- Non-medical mask usage
- Personal hygiene
- Enhanced disinfection
- Contact tracing and follow up by the U of T occupational health nurse (provides advice on self-isolation, testing, etc. where appropriate); proactive disinfection of both symptomatic and confirmed cases

Note: The best hazard prevention is eliminating hazard at the source. For COVID-19, elimination means reducing the number of people in the workplace and screening to prevent those with symptoms/risk factors from entering the workplace.

Accordingly, the University has implemented the above measures and developed guidelines and procedures during the pandemic. For more information, please refer to the UTogether2020 page, the Human Resources & Equity page on COVID-19 and the EHS COVID-19 webpage.

The type of activity can also impact the risk of transmission. Activities such as singing or heavy breathing (like aerobic exercise) can increase the risk of transmission. Additional controls such as medical grade masks, eye protection or impermeable barriers may be required based on the activity and the level of risk per the unit's re-entry plans.

Ventilation

Improving indoor air quality through increased ventilation is an additional step, but ventilation alone cannot protect people from exposure to the virus, particularly during close, unprotected contact or in the absence of other measures. General dilution ventilation and pressure differentials do not significantly influence short-range transmission.

Recommendations for ventilation during the COVID-19 pandemic include:

- Regular maintenance of HVAC systems
- Opening windows where possible or feasible (thermal comfort)
- Installing high-efficiency air filters (MERV 13 or highest efficiency compatible with the HVAC infrastructure)
- Increasing ventilation rates and drawing as much fresh air as possible
- Classrooms: Disabling demand-controlled ventilation to increase the amount of fresh air
- Classrooms: Due to the transient nature and high density of people, classrooms with less than 6 equivalent air changes per hour will be equipped with portable air filtration. Where not possible, classrooms will not be used.
- In the event of an outbreak, flush for two days (48 hours) with as much outside air as possible without affecting thermal comfort or the infrastructure of the building. EHS will notify Facilities of an outbreak.

Reference:

1) ASHRAE Position Document on Infectious Aerosols, April 14, 2020

2) PHAC: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/guidance-documents/guide-indoor-ventilation-covid-19-pandemic.html
3) TPH: https://www.toronto.ca/home/covid-19/covid-19-protect-yourself-others/covid-19-reduce-virus-spread/
4) US Occupational Safety and Health Agency (OSHA): https://www.osha.gov/Publications/OSHA3990.pdf
5) Centers for Disease Control and Prevention USA (CDC) "Implementation of mitigation Strategies for Communities with Local COVID -19 transmission " April 2020 (May 2020)
6) Public Health Ontario (PHO April 22 2020 "Review of "COVID -19 Outbreak associated with air conditioning in restaurant, Guangzhou, Chine, 2020)"
7) ASHRAE "Building readiness guidelines", February 2, 2021

Conclusion:

Based on the information and review above, the University has implemented a rigorous approach to reducing the risk of COVID-19 transmission on all three campuses in accordance with leading public health and industry guidance. This multi-layered approach includes several types of hazard mitigation (including changes to HVAC systems), is in keeping with public health guidance and industry practices and demonstrates the University's due diligence in addressing health and safety concerns arising from the global COVID-19 pandemic.

Classroom HVAC assessment process