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Reoccupation of Unoccupied Buildings HVAC & Hydraulics Systems

Introduction

The purpose this paper is to highlight items to be considered by building managers, maintenance contractors and tenants when re-starting heating, ventilation and air conditioning (HVAC) and hydraulic systems following a period where a building has been temporarily or partially shut down, for example a period of 2 – 12 weeks.

It is recommended that Heating, ventilation and air conditioning systems are re-started and made fully functional prior to reoccupation of a building after a shutdown period. The ventilation and filtration aspects of systems will help pre-purge the buildings of potentially elevated levels of VOC's (Volatile Organic Compounds) prior to occupation and can assist in reducing the risk of transmitting airborne infectious diseases following reoccupation of the building.

Reoccupation of buildings without running these essential systems is likely to result in elevated levels of carbon dioxide, VOC's, disagreeable odours and uncomfortable thermal conditions. Prolonged exposure to such conditions will reduce levels of concentration and staff productivity, increase the rate of work errors and negatively affect cognition. It can also lower resistance to infection.

In order to avoid unnecessary risks to maintenance staff, building occupants or potential damage to plant, proper restart procedures must be followed for all HVAC and hydraulic systems, including such items as cleaning and dosing of cooling towers and ensuring domestic hot water systems are flushed and sanitised, due to the potential risk of legionella disease.

This article is limited to HVAC and Hydraulics systems commonly found in commercial office buildings and does not cover start-up procedures for the systems listed below. Advice from subject experts and specialist service staff should be sought for these systems to understand the process of start-up and to ensure the building is in a safe and fit state for people to resume normal occupation and operations prior to reoccupying the building.

- Fire alarm systems
- Fire Protection Systems
- Electrical Systems and Lighting
- Communication systems
- Security / Access Control system
- Back-up / standby Generators
- Lifts / Vertical Transport Systems
- Buildings that have been formally shut down for longer than 3 months
- Buildings that have not yet been first commissioned into service

As all buildings are different, this article is aimed at providing general guidance and recommendations only. For specific advice regarding re-starting of your building, we recommend seeking professional advice from a specialist engineer or mechanical maintenance contractor.

Parties involved in building start-up planning

All stakeholders in a building, including the tenants should be involved with planning the re-start procedure so that the requirements around timing and access to the building can be understood by all.

This will be driven by potential health and safety risks and may highlight potential comfort issues if some plant cannot be started immediately. E.g. cooling towers may require draining, cleaning and dosing prior to putting back into service. Potential risks to building occupants should be identified and highlighted if the start-up plan is not followed or earlier reoccupation is being contemplated.

We recommend the following parties should be consulted when planning the building re-start process:

- Landlord or Building Manager.
- Facilities Manager.
- Tenant Representatives.
- Mechanical Maintenance Contractor.
- Plumbing Maintenance Contractor.
- Electrical maintenance contractor.
- Mechanical HVAC or Hydraulics Services Engineer.

Timing of building re-start

Ideally, the building re-start procedure should be completed in its entirety prior to the building being re-occupied, so that occupant safety and comfort levels can be ensured.

However, due to the nature of some businesses earlier re-occupation may be required. If this is the case, it is important to highlight to tenants that not all HVAC systems may be operational at the start of occupation, and some discomfort / loss of productivity can be expected until all systems have been successfully restored.

As a minimum, systems associated with HVAC and hydraulic compliance requirements must be met to ensure they are fully operational, compliant and safe before the building is reoccupied. These systems include:

- Outdoor air systems.
- Some exhaust air ventilation systems.
- Cooling towers if chillers are required to operate from the beginning of occupancy.
- Domestic water supplies (both hot and cold water).

These systems must be fully operational and safe before the building occupants are allowed to return and resume normal building usage. The time required for this process must therefore be factored into the preoccupation timeline.

While planning can occur early, under restrictions on personnel movement and business operations applied during a pandemic situation, clarity should be sought before undertaking physical works on the HVAC and hydraulics systems prior to restrictions being officially lifted. This may result in delaying physical re-entry into the building for up to several days depending on the level of work required.

Where a building has been unoccupied for several weeks in cooler weather, a preheating period may be required to warm the building structure. Tenants should be made aware that the first few days of occupation may feel cooler than normal or may fluctuate more than normal because the building's fabric will be colder than normal until it stabilises.

Key plant items to be considered

The headings below address critical plant items to be considered to ensure the building is safe and can be legally re-occupied. Failure to ensure these systems are fully operational prior to re-occupation may expose occupants to unnecessary serious Health and Safety risks.

Ventilation systems

Where a building relies solely on mechanical outdoor air supply and/or extract systems for ventilation, these must be operational prior to reoccupation, as per the requirements of the NZ Building Act / NZ Building Code Clause G4. Where a building has both natural and mechanical ventilation systems or natural ventilation only, specialist advice should be sought from a mechanical/HVAC engineer as to what areas can be safely occupied.

Cooling towers

Where a cooling tower has been idle for a period of weeks, specific maintenance will be required to recommission the tower, so it is fit to resume normal operation.

The level of maintenance required will to an extent depend on whether the tower was simply switched off for the duration of the shutdown, whether it was operated periodically to maintain chemical dosing levels or whether it was shut down and drained for the duration of the unoccupied time of the building.

Cleaning and/or decontamination of the cooling tower, including draining and chemical dosing is recommended to ensure the risk of legionella is minimised.

Non-maintained cooling towers are a known source of legionella bacteria, which is spread by aerosol droplets produced by cooling towers in operation, posing a significant Health & Safety risk to the building occupants and people in the immediate vicinity.

If a cooling tower has been switched off during the lockdown period, we recommend the following maintenance tasks be undertaken, along with the usual cooling tower maintenance items. The maintenance contractor must wear all appropriate PPE.

- Drain all water from the cooling tower and its connected condenser water system. This water poses a biological hazard so should be removed via the dedicated cooling tower drain and not be allowed to discharge to the stormwater system.
- Clean the cooling tower as required.
- Refill the cooling tower with clean potable water.
- Undertake an approved chemical biocide 'shock' dose to the cooling tower to kill any bacteria in the water/system.
- Start the condenser water system pumps to circulate the water through the cooling tower and condenser water system.
- Note that the cooling tower fan must not operate during this procedure, and that none of the connected HVAC systems can operate until this process is complete.
- Resume normal dosing and testing procedures, including the addition of corrosion inhibitors etc. once complete.

In cooler weather, ensure crankcase heaters for chillers have been operational prior to restarting the chillers.

Domestic hot and cold water systems

Domestic hot water (DHW) systems which have been switched off for a period of time have an elevated risk of Legionella bacteria being present in the system, especially at shower heads and basin/sink taps etc. This poses a risk to occupants when taps or showers are used, due to contaminated aerosol droplets being produced which can then be inhaled.

The re-start process for these systems depends on the type of system installed. If you are unsure, please seek advice from a services engineer.

- For systems which use either electric or gas fired storage cylinders, these should be switched on and allowed to reach operating temperature for a period of 48 hours prior to any water being drawn from the system. The DHW system should then be flushed by operating all hot water taps, mixers and showers (mixer set to full hot) to purge the water in the pipes.
- For circulating loop hot water systems, the circulation pumps and hot water plant should be switched on and allowed to circulate for 48 hours at the normal operating temperature. No water must be used / consumed from the system during this time. The DHW system should then be flushed by operating all hot water taps, mixers and showers (mixer set to full hot) to purge the water in the system dead legs from the circulating main to the fixtures.

Domestic cold-water (DCW) systems also have a risk of Legionella growth after being idle for a period of time, although less so than the DHW systems due to the lower water temperatures. We recommended a similar flushing process for the DCW system, by operating all taps, mixers and showers, is undertaken before any water is drawn off or used.

Note that the maintenance contractor is at risk from potentially contaminated aerosol droplets during the above procedures, so must wear all appropriate PPE.

Considerations for different building types & sizes

General recommendations applicable to all building types

The following items are applicable to all building types or sizes:

- The contractor and/or the personnel who were responsible for shutting the building down should be re-engaged to put the building back into operation. This will provide an increased level of efficiency and continuity to help reduce the risk of damage or malfunction of any systems due to valves or dampers inadvertently being overlooked during the process of re-starting the building systems.
- If the building control system / Building Management System (BMS) contains a self-learning optimum start / stop system, these should be checked and reset as part of the start-up procedure. Self-learning optimisation systems rely on the systems being fully operational so that they understand how well the systems perform, then self-correct for optimal performance. If parts of the plant were switched off manually, this may upset the self-learning function.
- We recommend considering bringing the annual service of the HVAC plant forward to occur immediately upon re-starting the systems. All filters should be checked, cleaned and replaced as necessary. This will ensure all items of plant are physically checked for their operation and condition after the building has been re-started, providing early intervention of any potential problems.
- Pre-purging of the building by operating the ventilation systems prior to occupancy is recommended.

Small to medium buildings

These buildings will typically be served by either single split system heat pump units or small VRF/VRV systems, with local outdoor air and exhaust systems. Due to the low complexity of these systems, the restart procedure for the HVAC plant will be simple and quickly accomplished.

In cold weather, if the units have been isolated, power to the outdoor units should be reconnected 24 hours prior to start-up to ensure all refrigerant is removed from the crankcase oil. Otherwise these systems have no special requirements before start-up, as internal control systems handle the start-up of the fans and compressors in each machine.

However, consideration towards staging the start-up of the systems should be given so the electrical system is not over-loaded, and so no protection devices trip. Allow sufficient time for systems to go through their start-up procedure and reach stable operation before starting subsequent systems.

If the building has a BMS installed, it may already have a staged start up programme in place. Check with your controls or maintenance contractor prior to restarting these systems.

Medium to large buildings with air cooled chillers

These buildings will typically be served by larger VRF/VRV systems or chilled water systems with air cooled chillers, with electric or reverse cycle heating. Ventilation systems typically consist of individual fans or central air handling systems for outdoor air and exhaust systems.

The relatively higher complexity of these systems means that the restart procedure is more involved and will take longer than for a simpler building.

HVAC plant start-up for this building type would include the following recommendations:

- Operate chilled water and heating circulation pumps for 10 minutes to allow water to move through the system, and any sediment and air to be re-entrained into the water or captured at strainers, air vents etc.
- Start central plant in a staged manner allowing each plant item to stabilise its operation before starting successive plant items.
- Once the central plant is operating, the terminal units (FCU's, AHU's etc) can be started in a staged manner. If FCU's operate with electric heating elements, start-up in a cold building will cause a high initial electrical demand, so start-up should be managed/staged to avoid overloading the building electrical systems.
- AHU's should also be started in a staged manner as the electrical demand of these units from fans and/or high capacity electric heating elements can also be significant.
- Ventilation fans, including outdoor air fans, general exhaust fans and kitchen exhaust fans can generally be started at will.
- Where the restart is during or approaching cooler weather, we recommend considering bringing the annual inspection and maintenance forward for any boilers to coincide with the re-start.

Medium to large buildings with water cooled chillers

The requirements for buildings with water cooled plant are similar to those for air-cooled plant, with additional considerations for a condenser water system and cooling tower.

Due to the high complexity of these systems, the restart procedure for the HVAC systems will take longer than for a building with air cooled plant.

The primary difference with water-cooled plant is that the condenser water circuit and cooling tower must be fully operational and have undergone cleaning and maintenance prior to starting any chillers. Maintenance includes chemical dosing (regular or shock) as determined by the cooling tower maintenance contractor. Refer to the recommendations under Cooling towers above.

Depending on the BMS or controls setup, it may be necessary to manually operate the condenser water system and cooling towers to allow them to run without the chiller/s being operated during the cooling tower cleaning and maintenance procedures.

Further Information

Please follow the links below for more information.

<https://www.health.govt.nz/system/files/documents/publications/prevention-of-legionellosis-in-new-zealand-jul19.pdf>

<https://worksafe.govt.nz/topic-and-industry/legionnaires-disease/legionnaires-disease-cooling-towers-and-evaporative-condensers/>

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