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1.0 EXECUTIVE SUMMARY

This document intends to identify and describe the various ventilation systems to be utilised within the proposed MCFC North Stand Expansion.

The project consists of three major elements:

1. North Stand
2. Hotel Building
3. Commercial Building

2.0 MECHANICAL VENTILATION SERVICES

Mechanical ventilation (supply and / or extract) will be included to the following areas:

- City Hall
- Offices and production suites
- Store rooms & ancillary areas
- Hospitality areas
- Stair cores
- Kitchens
- Concessions
- Suites
- Retail
- Museum
- Interactive Visitor Experience
- Commercial workspace

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- Back of house operation areas
- Hotel rooms
- Gym
- Staff changing areas

3.0 HVAC MAIN PLANT

The heating and cooling demand throughout the building will predominantly be met by the provision of Air Source Heat Pump (ASHP) technologies.

For City Hall, this technology shall take the form of Air Handling Units (AHUs) with an integral reversible ASHP that utilises the Hall exhaust air as a heat source or heat sink, as required.

The ASHP AHUs serve to provide heating and cooling to temper the air from external conditions to meet the internal comfort criteria within City Hall.

Variable Refrigerant Flow / Volume (VRF / V) ASHPs provide the heating and cooling to the remainder of the areas within each of the buildings, with the ventilation requirements to each space met by local MVHR units.

The majority of air-side plant within the North Stand shall discharge within the Level 03 plant area. The plant area shall be bounded by an open mesh façade to facilitate air exchange between the ventilation systems and atmosphere.

Air-side plant within the Commercial and Hotel buildings shall discharge locally through the building façade.

4.0 VENTILATION STRATEGY

4.1 City Hall (Black Box)

The City Hall shall have two primary operating modes; match day and non-match day. On match days, the space shall be opened up to City Square, allowing for free movement between the internal and external space. On non-match days, the space shall be enclosed and operate as an internal space only.

The ventilation strategy for this area is based on the operating modes as described above. On match days, the space shall be naturally ventilated via louvres located on the North façade at high level. The prevailing wind and louvres encourage air movement through City Square and into the City Hall. During non-match day events, the louvres at high level are closed off through a series of motorised dampers to create a thermally enclosed space. A mechanical ventilation system shall be energised to provide fully-conditioned outside air.

Ventilation to City Hall is to be provided by 2no AHUs each equipped with heat pump technology, located within the Level 03 plant area.

Each AHU is to be sized to deliver 8m³/s of supply air, allowing for comfort conditions and internal air quality to be maintained for all event types within City Hall.

Intake air is drawn from atmosphere via the mesh façade. The inlet air attenuator is sized to ensure the noise breakout from the AHU complies with the site acoustic criteria.

The inlet air is then filtered before being passed through a thermal wheel and DX cooling coils for conditioning. A high efficiency array of plug fans with EC motors will deliver the air into City Hall via a supply side attenuator. The supply side attenuator will be sized and positioned to maintain the integrity of the acoustic properties of the building envelope.

From within City Hall, the conditioned and filtered supply air will be distributed via a range of jet nozzles.

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Air temperature sensors and air quality sensors shall be positioned within The Hall to ensure that comfort conditions and a good level of indoor air quality is maintained within the space and dictate the control of the AHUs.

The return air will be extracted directly from The Hall via bellmouth extract terminals located at high level. The return air will route back to the AHU via a duct mounted silencer. The air will pass through a series of heat exchangers and refrigerant coils prior to being exhausted to atmosphere. There will be an air side attenuator to control the noise breakout from the AHUs in compliance with the site acoustic criteria. The Exhaust air will discharge at the Level 03 plant area.

4.2 **North Stand GA Concourses**

GA Concourses shall be untreated, naturally ventilated spaces. Ventilation will be achieved via cross flow of air through open vomitories to the bowl, and openings in the external façade. This is to be provided through permanent openings in the façade system.

GA Toilets and Concessions with cooking facilities shall be provided with mechanical extract ventilation with air makeup via the adjacent naturally ventilated Concourse. Air shall be extracted local to the space via distribution ductwork and associated extract fans located within the Level 03 plant area. The vitiated air shall then be discharged at the Level 03 plant area.

Concessions and kitchens which are within the thermal boundary, shall be provided with dedicated supply and extract ventilation systems via air handling plant sited within the Level 03 plant enclosure. The current methodology is that induced capture type canopies shall be incorporated above cooking appliances for collection of cooking odours and radiant/convective heat.

Air handling sections providing air intake shall incorporate primary filtration and a heating coil to temper the supply air to maintain a minimum 16°C within the Concession. Odour filtration shall be incorporated on exhaust air streams to neutralize cooking smells prior to atmospheric air discharge through the external façade.

F&B Concessions serving hot food shall be maintained at a negative pressure avoid odour from the cooking process migrating to the adjacent Concourse.

4.3 **Front of House**

All Front of House areas which are within the thermal boundary shall be served by a decentralised ventilation strategy, allowing full flexibility of operation to areas within the building, allowing zones, sections and areas to be run independent of any others.

This approach will utilise local MVHR units, each provided with duct-mounted attenuation sized to maintain the noise criteria of both the MVHR's local area and the areas served by distribution ductwork. The MVHR units will draw intake air from the façade of the building via weatherproof louvres.

The intake air is passed through G4 and F7 filtration and a cross-flow heat exchanger to temper the air. The supply air will be distributed via low pressure ductwork and introduced into the occupied space via supply air diffusers or FCUs.

Extract air shall be drawn directly from the space to the MVHR generally via bellmouth extract terminals. The extract air shall be passed through a G4 filter and then a cross-flow heat exchanger to provide free heating / cooling to the intake air.

The exhaust air shall be ducted from the MVHRs to the external wall of the building and rejected via louvres that are both local to the connected MVHR and allow for 10m separation from any intake louvres, as required by BREEAM.

This decentralised ventilation strategy reduces the need for vertical ventilation risers internal to the building, and allows less GIA to be absorbed by services risers.

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All air intakes shall be positioned a minimum of 10m from exhausts, and 20m away from sources of pollution to achieve the available credit within section Hea 02 of BREEAM.

All MVHRs shall be provided with inverter driven fans and controlled via a network of temperature and air quality sensors as well as the central BMS system. This shall allow a variable volume system to be provided, thus allowing for maximum energy efficiency from these systems.

4.4 **Hospitality Areas**

Localised outdoor air ventilation shall be provided to the following areas via low profile MVHR air handling plant located within ceiling void adjacent to or within the area served. Systems shall be stand-alone, allowing independent operation to suit the extended operation profile for use out of hours and non-match day:

Player's Club (Level 02)

Hospitality (Level 03)

Sky Bar (Level 04)

Air intake and air exhaust shall be via weather louvre integrated within the adjacent façade, with maximised air separation to limited cross contamination between incoming and outgoing airstreams.

MVHR units shall include filtered outdoor air make up with counterflow plate heat exchanger or thermal wheel for energy recovery from the extract airstream. A VRF / VRV or electric heating coil shall be included to temper supply air and provide boost condition upon plant start up. The tempered air shall be routed to the conditioned space with air supply via ceiling mounted diffusers.

Vitiated air shall be extracted via high level ceiling grilles within the conditioned space. Extract ductwork shall be routed back to the MVHR units providing energy recovery to the incoming air stream via the counterflow plate heat exchanger or thermal wheel.

MVHR units shall include variable speed supply and extract fans for commissioning set up and factory installed pre-packaged controls including interface for connection to remote BMS.

4.5 **General Store & Plantroom Ventilation (Natural)**

Store Rooms shall generally be untreated spaces with natural means of ventilation. Mechanical ventilation shall only be considered necessary where temperature and/ or humidity control is required to prevent degradation to items being stored.

The Level 03 plant area shall be untreated and naturally ventilated.

4.6 **Support Kitchens**

Kitchen extract air is to be drawn from induction canopies located above the catering equipment. Each canopy shall include in-line grease baffles and UV-C filtration. From here, the kitchen extract air shall be ducted via low pressure ductwork to an ecology AHU located within the Level 03 plant area.

The ecology AHU shall be provided with a G4 filter, an F7 filter and an activated carbon filter. The filtered kitchen exhaust air shall then be discharged at the Level 03 plant area.

Filtered, tempered outside air shall be provided in part to the kitchen directly, via the induction canopies and supply air terminals co-ordinated with the kitchen layout, and additionally to adjacent areas to ensure the cooking areas are maintained at a slight negative pressure.

Make-up air drawn from adjacent areas shall be provided via dedicated air paths via transfer ducts equipped with cross-talk attenuation.

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Ductwork shall be installed in accordance with HVAC TR17 in terms of access for cleaning and insulated where required to prevent condensation of cooking vapours.

4.7 **Commercial Building**

The shop, museum & workspaces within the commercial building shall be provided with decentralised MVHR units with associated coils providing the Fresh Air demands of the room uses.

MVHR ceiling void mounted packaged air handling units with reverse cycle heat pumps connected to external condensers shall provide filtered outdoor air with heating and cooling to the occupied spaces via supply air ductwork distribution; directed to chassis type VRF fan coil units, with induction swirl diffusers located at high level within each space.

Carbon dioxide sensors shall be provided to measure and monitor CO₂ concentration within each space. The quantity of supply air shall be scheduled via fan speed inverter control to meet outdoor air requirements within the control zone having the highest CO₂ concentration.

Wall mounted sensors shall monitor temperature conditions provide re-set adjustment of the supply air temperature based upon highest cooling demand value.

Vitiated air shall be extracted via high level grilles within the space. Extract air ductwork shall be routed back to the air handling plant providing energy recovery to the incoming air stream via a plate heat exchanger or thermal wheel.

The air handling units shall include factory installed pre-packaged controls and operator panels including interface for connection to remote BMS.

Ceiling void mounted chassis VRF fan coil units shall be provided to supplement the outdoor air ventilation system cooling capacity, prior to and during performance intervals. During these periods of high occupancy and heat gain fan coils boost available cooling capacity.

Supply air from the VRF fan coils shall be distributed via secondary ductwork with induction swirl diffusers located at high level within the space. Return air to the VRF fan coils shall be via ceiling grilles utilising the ceiling plenum as a return path.

Fan coils shall be controlled via return air sensors providing heating/ cooling to maintain space temperature conditions, during periods of peak occupation.

Fan coils shall include factory installed pre-packaged controls including interface for connection to remote BMS.

4.8 **Hotel Rooms**

Each room shall be served by an independent MVHR, located over the bathroom lower ceiling. A VRF / VRV Fan Coil Unit shall serve the bedroom. Each room shall be given an independent controller.

It is anticipated lowered ceilings & bulkheads shall accommodate the Fan Coil Unit and ductwork to the facade.

Condensers for the hotel VRV / VRF systems will be located within the North Stand L03 plant enclosure where appropriate. In the instance of piping lengths exceeding limitations, condensers will be located on the Hotel roof.

5.0 **SMOKE EXHAUST SYSTEMS**

5.1 **Fire Fighting Stair Cores**

Each firefighting stair core shall be provided with a mechanical smoke extract system to the lobbies and an Automatically Opened Vent (AOV) at the head of the stair core which shall be opened under fire condition.

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The smoke extract system will consist of a duty and standby variable speed extract fans with inverter drives, linked to pressure sensors within the lobby at each level via a control panel. A motorised damper will be provided between the extract shaft and lobby at each level. A 1m² ventilator is needed in the stairwell for air inlet.

The pressure sensors maintain acceptable pressure difference between the lobby and stairs, typically 25Pa. This ensures that excess pressures do not draw extra smoke past door seals or cause excessive door opening forces.