Project Name:	Harry Walker Parkway Warehouse Upgrade	Date Issued:	November 18, 2024
Quasar Project #:	CM-22-149		
Client Project #:	RFTC-709-23-22021		

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Addendum #:	M04
Revision #:	0

This Addendum forms part of the Contract Specifications and Drawings, and modifies the Bidding Documents, with Amendments and Additions noted below. This Addendum shall be added to the front of the specifications as issued. Bidders shall acknowledge receipt of this Addendum in the space provided in the Bid Form and include in bid amount.

This addendum includes modifications to the drawings as summarized below. Unless otherwise noted, all drawings listed below are attached herewith.

Changes to Specifications:

1. **Update Specification Section 23 34 00.00 HVAC Fans- attached**

    a. Added paragraph 2.04 Ceiling mounted Destratification Fans.

    b. Added paragraph 3.04 Installation of Ceiling Destratification Fans.

2. **Update Specification Section 25 05 02.00- Building Automation System- Attached**

    a. Added item .4 to .37 under paragraph 1.04 Description of the Building Automation System .

    b. Updated paragraph 2.03 Dedicated Web Based User Interface.

Changes to Drawings:

1. **Drawing M301 - HVAC New Layout - Attached**

    a. Updated General Demo Notes "Ten (10) existing ceiling fans to be removed along with all associated control wiring".

2. **Drawing M500 – Control Sequence - Attached**

    a. Welding workshop HVAC system shall be supplied with a BACnet/MSTP controller capable of interfacing with existing building automation system.

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1   General

1.01   Submittals

.1   Submit shop drawings/product data sheets for fans and accessories. Include following:

.1   certified fan performance curves at specified operating point with flow, static pressure and HP clearly plotted;

.2   certified sound power data that conforms to specified levels;

.3   product data sheets for all accessories;

.4   product data sheets for fan motors.

1.02   Closeout Submittals

.1   Submit with delivery of each unit a copy of the factory inspection report, and include a copy of each report with O&M Manual project closeout data.

.2   Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this section.

.3   Supply reviewed copies of fan/curb assembly shop drawings or product data to trade who will cut roof openings for fans, and ensure openings are properly located.

.4   Supply reviewed copies of fan assembly shop drawings or product data to trade who will form/prepare Include following paragraph for ceiling mounted fans.

.5   Submit a signed copy of ceiling mounted fan manufacturer's extended 3 year warranty.

.6   Training attendance records.

1.03   Quality Assurance

.1   Fan manufacturers, as applicable, are to be current members of the Air Movement and Control Association International Inc. (AMCA), and fans are to be rated (capacity and sound performance) and certified in accordance with requirements of following standards:

.1   ANSI/AMCA Standard 210, Laboratory Method of Testing Fans for Certified Aerodynamic Performance Rating;

.2   AMCA Standard 211, Product Rating Manual for Fan Air Performance;

.3   ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans;

.4   AMCA Standard 311, Product Rating Manual for Fan Sound Performance;

.5   AMCA Standard 99-2408, Operating Limits for Centrifugal Fans.

2   Products

2.01   Centrifugal Fans

.1   Centrifugal fans in accordance with drawing schedule, each capable of operating over the complete pressure class limits as specified in AMCA Standard 99-16.

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.2 Continuously welded heavy-gauge steel housing, braced and reinforced as required to prevent vibration or pulsation, equipped with a discharge flange, spun, aerodynamically designed inlet cones or venturies with wire grid guards, drain plug, and epoxy enamel coated both inside and outside to a 3 mm dry film thickness.

.3 Continuously welded, stable, non-overloading wheel with die-formed steel blades and, unless otherwise required, a cast iron hub, statically and dynamically balanced prior to assembly, then balanced as an assembly and braced and secured to base prior to shipment.

.4 AISI C1040 or C1050 hot rolled steel fan shaft, accurately turned, ground, polished, and ring gauged for accuracy, and sized for a first critical speed of at least 1.25 times the maximum rated speed for fan, and heavy-duty, grease lubricated, ball or roller, self-aligning pillow block type bearings selected for an AFBMA L-10 minimum average bearing life in excess of 200,000 hours, and equipped with extended copper lubrication lines terminated in lubrication fittings immediately inside fan section access door.

.5 NEMA Premium TEFC motor, adjustable V-belt drive selected for 40% service factor based on motor nameplate data, and OHSA guard, all in accordance with requirements of Section 20 05 00 – Common Work Results for Mechanical.

.6 Fan and motor support base is to be rigid, welded structural steel, vibration isolated base with steel cross members, factory cleaned, deburred, and finished with epoxy enamel, and complete with a slide type motor base and stable, colour coded spring mounts with sound pads selected to suit static deflection and maximum equipment load and to operate at not greater than 2/3 solid load, and shipping restraints.

.7 Unless otherwise specified, finish is to consist of rust inhibiting primer applied to cleaned and deburred metal surfaces prior to assembly, then a second coat of primer after assembly and an air dried epoxy enamel finished coat both inside and outside to a 3 mm dry film thickness.

.8 Manufacturers:

    .1 Twin City Fan and Blower;

    .2 Loren Cook Co.;

    .3 Greenheck Fan Corp.;

    .4 CML Northern Blower;

    .5 PennBarry.

2.02 Roof Mounted Exhaust Fans

.1 Centrifugal, ULC listed, factory run tested roof mounted exhaust fans in accordance with drawing schedule.

.2 Spun aluminium housing with deep venturi inlet, aluminium curb cap with continuously welded corners, pre-punched mounting holes, galvanized steel or aluminium bird screen, and EMT conduit chase to the motor compartment.

.3 Centrifugal, non-overloading aluminum wheel with backward inclined blades matched to inlet venturi, statically and dynamically balanced as an assembly.

.4 For belt-drive fans only, hot rolled steel shaft, accurately turned, ground, and polished, and sized for a first critical speed of at least 1.25 times maximum rated speed for fan, and one-piece grease lubricated pillow block type bearings selected for an AFBMA L-50 minimum average life in excess of 500,000 hours at maximum catalogue operating speed and equipped with a lubrication fitting, and a heavy-gauge galvanized steel adjustable V-belt drive with guard conforming to requirements of Section 20 05 00 – Common Work Results for Mechanical.

.5 Motors are to conform to requirements specified in Section 20 05 00 – Common Work Results for Mechanical, mounted on vibration isolation in a compartment outside of the airstream, and factory pre-wired to a NEMA 4 disconnect switch.

.6 Prefabricated, minimum 300 mm (12") high heavy-duty aluminum roof mounting curb with factory installed wood nailer, 40 mm (1-½") thick insulation, continuously welded seams, and damper tray.

.7 For fans as scheduled, factory supplied accessories as follows:

.1 gravity backdraft damper with #20 gauge galvanized steel frame and #26 gauge aluminum blades with felt edge blade seals;

.2 non-corrosive motorized damper with linkage, end switch, and motor with voltage to match fan motor;

.3 continuous non-corrosive piano type curb hinge to permit access to fan, damper and connecting duct, complete with retaining chain and a security hasp to prevent removal of unit from curb cap and prevent building entry through connecting ductwork;

.4 2-speed switch and 2-speed double winding 1-phase motor in accordance with Section 20 05 00 – Common Work Results for Mechanical;

.5 factory secured seismic restraint connection hardware.

.8 Manufacturers:

.1 Twin City Fan and Blower;

.2 Loren Cook Co.;

.3 Greenheck Fan Corp.;

.4 JencoFan;

.5 Carnes Company Inc.

2.03 Ceiling Mounted Fans

.1 ULC listed and labelled ceiling mounted centrifugal, AMCA rated and certified (capacity and sound to AMCA Standards 211 and 311), exhaust fans in accordance with drawing schedule, complete with:

.1 minimum #20 gauge galvanized steel housing equipped with duct connection collar(s), integral spring loaded aluminum backdraft damper, 12 mm (½") thick acoustic insulation meeting 25/50 flame spread/smoke developed ratings when tested in accordance with CAN/ULC S102, multi-position mounting brackets, and

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an integral CSA certified electrical receptacle in an outlet box for plug-in connection of fan motor;

.2 low RPM, resiliently mounted, direct connected fan wheel and motor assembly with a forward curved, statically and dynamically balanced galvanized steel or calcium carbonate filled polypropylene centrifugal wheel direct connected to a 1-phase motor conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical, and equipped with a length of power cord and plug;

.3 for fans as indicated and/or scheduled, a white calcium carbonate exhaust grille;

.4 factory supplied accessories in accordance with drawing schedule, as follows:

.1 rectangular to round duct transitions;

.2 roof cap with backdraft damper and birdscreen;

.3 wall cap with backdraft damper and birdscreen.

.2 Manufacturers:

.1 Twin City Fan and Blower;

.2 Loren Cook Co.;

.3 Greenheck Fan Corp.;

.4 CML Northern Blower;

.5 PennBarry.

2.04 Ceiling Mounted Destratification Fans

.1 Northwest Envirofan "Gold Line" white, down-blowing, extra heavy-duty industrial grade, CSA certified direct drive ceiling mount destratification fans in accordance with drawing schedule, each complete with:

.1 curved aluminum fan blades secured to a steel hub;

.2 permanent magnet, brushless, non-ventilated, heat sink design motor rated for continuous operation at maximum speed in a 55°C (130°F) ambient temperature and capable of modulating fan speed from 0 to 100% without the use of a gearbox or other mechanical means of control, and a factory programmed controller housed in an enclosure independent of motor to minimize starting and braking torques, with a simple diagnostic program and a LED to identify and relay faults in system;

.3 250 mm (10") long down rod, a 330 mm (13") long galvanized steel safety chain, and all other required mounting and securing hardware;

.4 400 mm (16") long power cord with 3-prong plug, factory pre-wired to motor;

.5 "Protecto-Guard" welded wire fan guard sized to suit fan blade size;

.6 120 volt variable speed (Off-High-Low) solid-state infinite speed fan controller with stainless steel faceplate designed to mount to a 100 mm (4") outlet box and to control fan groupings as indicated on drawings;

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.2   Manufacturers:

      .1   Northwest Envirofan;

      .2   Big Ass Fan Co.;

      .3   Envira-North System Ltd.;

      .4   Marley Engineered Products "Leading Edge".

3   Execution

3.01   Installation of Centrifugal Fans

.1   Provide centrifugal fans.

.2   Secure each base mounted fan in place, level and plumb, on vibration isolation on a concrete housekeeping pad.

.3   Secure suspended units in place from structure, level, and plumb, by means of vibration isolation spring hangers, properly sized galvanized steel hanger rods and galvanized structural steel angle or channel trapeze supports.

.4   For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.5   For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.6   Include for a 1/2 day on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.02   Installation of Roof Mounted Exhaust Fans

.1   Provide roof mounted exhaust fans.

.2   Supply a roof mounting curb with each fan and hand curbs to roofing trade on roof for mounting and flashing into roof construction as part of roofing work. Secure fans in place on curbs.

.3   Install dampers in curb damper tray and secure in place.

.4   For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.5   For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.6   Include for a 4 hour on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.03   Installation of Ceiling Fans

.1   Provide ceiling exhaust fans.

.2 Secure each ceiling mounted fan housing in place in ceiling space, flush with suspended ceiling.

.3 Secure suspended units in place from structure, level, and plumb, by means of vibration isolation spring hangers and galvanized steel hanger rods.

.4 Plug fan motors into housing receptacles.

.5 Supply exterior wall/roof discharge caps as indicated.

.6 Hand roof caps to roof trade for installation and flashing into roof construction as part of roofing work.

.7 Install wall caps and secure in place. Caulk perimeter of each wall cap in accordance with caulking requirements specified in Division 07.

.8 Connect fan housings and discharges with ductwork.

.9 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

3.04 Installation of Ceiling Destratification Fans

.1 Provide ceiling destratification fans.

.2 Secure each fan in place at the ceiling from structure in accordance with manufacturer's instructions and drawing details. Confirm exact locations prior to roughing-in. Install safety chains and fan blade guards.

.3 Plug each fan motor into an adjacent receptacle.

.4 Supply a fan speed controller for fans as indicated and hand to electrical trade at site for wall mounting and connection to fan motor controllers. Confirm exact speed controller locations prior to installation, and include for identification of each speed controller.

.5 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.6 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.7 Include for a 1/2 day on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

3.05 Closeout Activities

.1 Include for a 4 hour on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration.

End of Section

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Building Automation System
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1   General

1.01   Abbreviations and Definitions

   .1   Abbreviations used in this Specification are as follows:

          .1   BAS   building automation system;

          .2   DDC   direct digital controls;

          .3   LAN   local area network;

          .4   PC   personal computer.

1.02   Submittals

   .1   Submit shop drawings/product data sheets for BAS components. As a minimum, submit
            the following:

          .1   BAS network architecture, including modes and interconnections;

          .2   systems schematics, sequences, and flow diagrams;

          .3   points schedule for each point in BAS, including point type, object name,
                   expanded ID, display units, controller type, and address;

          .4   samples of graphic display screen types and associated menus;

          .5   detailed Bill of Materials for each system or application, identifying quantities,
                   part numbers, descriptions, and optional features;

          .6   control damper schedule including a separate line for each damper and a column
                   for each of damper attributes including code number, fail position, damper type,
                   damper operator, duct size, damper size, mounting and actuator type;

          .7   control valve schedules including a separate line for each valve and a column for
                   valves as for control dampers;

          .8   room schedule including a separate line for each HVAC terminal unit indicating
                   type, location and address;

          .9   details of BAS interfaces and connections to other systems;

          .10   product data sheets or marked catalogue pages including part number,
                   photograph and description for BAS hardware and software.

1.03   Closeout Submittals

   .1   Submit a site inspection and start-up report from manufacturer's representative as
            specified in Part 3 of this Section.

   .2   Record "as-built" drawings are to include:

          .1   schematic outline of BAS for quick reference of overall system scope;

          .2   adequate record of work as installed, including locations and routing of system
                   wiring.

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.3 O&M Manual is to include:

.1 hardware specification manual which gives a functional description of hardware components;

.2 operator's manual which outlines concise instructions for operation of system and an explanation and recovery route for system alarms;

.3 engineering manual which outlines and defines system set-up, definition and application;

.4 data manual which indicates applications data programmed into system;

.5 system software documentation.

1.04 Description of the Building Automation System

.1 Building automation system is to consist of a modular, BACnet protocol, open architecture system incorporating direct digital control and monitoring of equipment and systems and consisting of all hardware and software required for complete, functional DDC control system. BAS is to be accessible through standard personal computers within building through a wireless application protocol device, or remotely through Internet by means of a standard web browser.

.2 BAS is to be field expandable, with a distributed architectural design to eliminate dependence upon any single device for alarm reporting and control execution. Failure of any single component or network connection is not to interrupt execution of control strategies at other operational devices. BAS is to maintain all settings and overrides through a system re-boot, and is to incorporate, as a minimum, following integrated features, functions, and services:

.1 graphic user interface for accessing and viewing BAS information, commanding points, changing setpoints, responding to alarms, programming time-of-day schedules;

.2 operator information, alarm management, and control features;

.3 enterprise-level information and control access;

.4 information management including monitoring, transmission, archiving, retrieval, and reporting functions;

.5 diagnostic monitoring and reporting of BAS functions;

.6 off-site monitoring and management access;

.7 energy management;

.8 standard applications for terminal HVAC systems.

.3 BAS is to include, but not be limited to, following:

.1 personal computer based server for networking and integrating all hardware components into a single BAS;

.2 personal computer based operator work station with colour monitor for colour graphic displays, and a colour printer;

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.3   portable operator's terminal;

.4   network of standalone network automation engine(s);

.5   network of field equipment controllers;

.6   input/output modules;

.7   local display devices;

.8   distributed user interfaces;

.9   network processing, data storage and communication equipment;

.10   all other components required for a complete and operating BAS.

.4   The entire BAS shall be peer-to-peer networked, stand-alone, distributed control in accordance with American National Standards Institute/American Society of Heating, Refrigerating and Air Conditioning Engineers (ANSI/ASHRAE) Minimum Standard 135-2015, BACnet – A Data Communication Protocol for Building Automation and Control Networks.

.5   All labour, material, equipment and software not specifically referred to herein or on the plans, but is required to meet the functional intent, shall be provided without additional cost to the Owner.

.6   The automation vendor must have least 2 dealers in Ontario that can provide parts and services to upon request.

.7   The BAS shall be compatible with future control Products for 10 years or more.

.8   The system shall be installed by trade certified electricians regularly employed by the controls contractor. The system shall be tested and calibrated by factory certified technicians qualified for this type of work and in the regular employment of the BAS manufacturer or its exclusive factory authorized installing contracting field office representative. The installing office shall have a minimum of five years of installation experience with the manufacturer. Supervision, calibration and commissioning of the system shall be by the employees of the factory authorized BAS branch or representative.

.9   Submit wiring diagrams including complete power system, interlocks, control and data communications.

.10   Submit Hard copy graphical depiction of the application control programs.

.11   All points shall be available to BACnet.

.12   Points shall be field reconfigurable. No set points shall be hard coded in the programs.

.13   All controllers shall be loaded to a maximum of 80%. 20% of each of the inputs, outputs and variables shall remain unused to allow for future growth and expandability

.14   The HVAC equipment shall be supplied as "Thermostat-Ready". The building automation system shall have direct control of dampers, heating and cooling stages without the requirement of BACnet, Lonworks or any other type of communication interface. Factory installed interlocks, safeties and anti-cycle timers shall be provided as required.

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.15   Provide trend logs for every hardware input and output.

.16   Provide trending capabilities at 5 minute intervals that allow the user to easily monitor and preserve records of system activity over a one year period.

.17   The primary input sensor for all control loops must connect to the same panel containing the control loop output.

.18   The BAS shall be configured to 3 categories: notifications, urgent alarms and critical alarms with different priorities.

.19   Valve actuators shall accept a 0-10VDC control voltage for all proportional applications.

.20   Heating valves shall spring-return fail open and cooling valves shall spring-return fail closed. Non-spring-return control valves may be used for terminal reheat coils and large HVAC control valves requiring a higher close off pressure.

.21   Actuators shall be direct coupled for either modulating or two position control.

.22   Outdoor and/or return air mixing dampers and face and bypass (F&BP) dampers shall be parallel blade, arranged to direct airstreams toward each other.

.23   Other modulating dampers shall be the opposed blade type.

.24   Two-position shutoff dampers may be parallel or opposed blade type with blade and side seals.

.25   Do not mount room sensor/thermostat on outside walls without permission of consultant.

.26   Two outdoor air temperature sensors shall be installed and shall be programmed to check each other for accuracy.

.27   Well - Technical Performance - 10k ohm thermistor sensor encapsulated in a 6mm OD, 50mm long probe, with screw fitting for insertion into a standard thermowell.

.28   All BAS programs shall follow the equipment manufacturer's sequence recommendations.

.29   All BAS programs should include comments embedded in the program to describe the function and steps of the coding.

.30   All wiring line and low voltage shall be installed in EMT conduit unless specifically specified otherwise.

.31   No wire smaller than 18 gauge is to be used on the project except for: wiring between terminal computer devices

.32   All field wiring including sensor wiring and wiring from panels to devices shall be continuous. The use of wire connectors, wire nuts or splicing is not allowed.

.33   Power for control system shall not be obtained by tapping into miscellaneous circuits that could be inadvertently be switched off.

.34   All 120 VAC power for any controls equipment shall be from dedicated circuits. Provide a breaker lock for each breaker used to supply the control system. Update the panel circuit directory.

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.35 All other BAS controllers, and interface devices that require regular inspection or that serve multiple HVAC systems shall be located in mechanical rooms, or in pre-approved storage rooms, or janitor closets.

.36 No BAS panel shall be located inside the rooftop fan enclosure under any circumstances. All BAS panels shall be located within the building envelope, and shall be enclosed in a metal locking enclosure, as specified in 16.4.

.37 Warranty all components supplied under this contract for a period of two years from substantial completion. Replace all controls equipment that fails during this period without cost to the owner.

1.05 Quality Assurance

.1 BAS hardware and software is to be installed by experienced personnel employed and trained by manufacturer/supplier of field equipment controllers. System wiring is to be installed by journeyman electricians or under direct on-site supervision of journeyman electricians.

2 Products

2.01 General Re: Building Automation System

.1 Control system components (field devices) other than those specified in this Section are generally specified in Section 25 05 01 – Automatic Control Systems. Components factory installed with equipment or supplied with equipment are specified in mechanical work Sections with equipment.

.2 BAS specified in this Section is an expandable DDC building automation system in accordance with drawing control diagrams and sequences, and points lists.

.3 Manufacturers:

    .1 Reliable Controls.;

2.02 BAS Architecture

.1 BAS is to be based industry standard Ethernet TCP/IP communications protocol. Where used, LAN controller cards are to be standard "off-the-shelf" products available through normal PC vendor channels. BAS is to be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication. BAS is to be compatible with other enterprise-wide networks, and where indicated, BAS is to be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

.2 Network automation engines are to provide supervisory control over control network and are to support BACnet Standard MS/TP bus communication protocol (ASHRAE SSPC-135, Clause 9). Control networks are to provide either a "peer-to-peer", master-slave, or supervised token passing communications and are to operate at a minimum communication speed of 9600 baud. DDC controllers are to reside on control network.

.3 BAS is to include appropriate hardware and software to allow BACnet bi-directional data communications between BAS and building equipment/system control panels. BAS is to receive, react to, and return information from connected equipment and systems. Data

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required by application is to be mapped into automation engine's data base and is to be transparent to operator. Point inputs and outputs from building equipment/system control panels is to have real-time interoperability with BAS software features such as control software, energy management, custom process programming, alarm management, historical data and trend analysis, totalization, and local area network communications.

2.03   Dedicated Web Based User Interface

.1   User interface is to be web based and is to operate on a personal computer for command entry, information management, network alarm management, and database management functions. Real-time control functions including scheduling, history collection, and alarming are to be resident in appropriate components of BAS network to facilitate greater fault tolerance, availability, and reliability.

.2   Architecture of personal computer is to be implemented to conform to industry standards such that it can accommodate applications provided with BAS and mechanical systems and equipment, including but not limited to Microsoft Office Applications. Specifically, it must conform to following interface standards:

.1   Microsoft Edge (or other standard browser) for user interface functions;

.2   Microsoft Office Professional for creations, modification and maintenance of reports, and sequencing other necessary building management functions;

.3   Microsoft Outlook or other email program for supplemental alarm functionality and communication of system events, and reports;

.4   required network operating system for exchange of data and network functions such as printing of reports, trends, and specific system summaries.

.3   Personal computer server or operator workstation is existing and contractor to tie new equipment's controls to the exiting operator workstation:

2.04   Distributed Web Based User Interface

.1   Features and functions of dedicated web-based user interface described above are to be available on any computer connected directly or via a wide area or virtual private network to BAS network, which conforms to the following specifications:

.1   software is to run on Microsoft Edge (or other standard browser);

.2   minimum hardware requirements are:

.1   2 GB RAM;

.2   2.0 GHz clock speed Pentium 4 microprocessor;

.3   120 GB hard drive;

.4   keyboard with 83 keys minimum;

.5   SVGA 1024 x 768 resolution display with 64 k colours and 16 bit colour depth;

.6   mouse or other pointing feature.

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2.05   Remote Access Via Smart Phone and/or Tablet Devices

.1   Available with an operator interface designed for use on various modern smart phone devices with network connectivity with the follow features:

.1   Mobile user interface operating over standard TCP network connection, performing well down to standard mobile 3G speeds, and optimized to ensure very high performance across different network topologies.

.2   Solution written with HTML5 web standards and browser agnostic, not deploying or using ActiveX controls, nor requiring installation of Java Runtime engine.

.3   Mobile solution incorporating full scope of responsibilities of BAS operators for remote mobile users, allowing them to view or control points within their assigned facility locations.

.4   Without alternation, mobile user interface operable within any standard internet browser from a normal personal computer.

.2   Along with optimized smart phone user interface, a dedicated tablet access user interface, optionally providing full operator workstation functionality, on a tablet style device. Tablet interface is to support standard operator workstation features including full operator scope of responsibility, and operable using commercial off-the-shelf technology.

2.06   User Interface Application Components

.1   Integrated browser based client application is to be used as user operator interface program. System is to employ an event-driven rather than a device polling methodology to dynamically capture and present new data to user. Additional features are as follows:

.1   inputs, outputs, set-points, and other parameters as defined in Part 3 of this Section, shown on drawings, or required as part of system software are to be displayed for operator viewing and modification from operator interface software;

.2   user interface software is to provide help menus and instructions for each operation and/or application;

.3   system is to support customization of user interface configuration and a home page for each operator;

.4   system is to support user preferences in alarm, trend, display, and applications screen presentations;

.5   controller software operating parameters are to be displayed for operator to view/modify from user interface, and these parameters are to include set-points, alarm limits, time delays, PID tuning constants, run times, point statistics, schedules, etc.;

.6   operator interface is to incorporate comprehensive support for functions including but not limited to following:

.1   user access for selective information retrieval and control command execution;

.2   monitoring and reporting;

.3   alarm, non-normal, and return to normal condition annunciation;

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.4   selective operator override and other control actions;

.5   information archiving, manipulation, formatting, display and reporting;

.6   BAS internal performance supervision and diagnostics;

.7   on-line access to help menus;

.8   on-line access to current BAS as-built records and documentation;

.9   means for controlling, re-programming, and re-configuration of the BAS operation and for the manipulation of the BAS database information in compliance with applicable Codes and Regulations for individual BAS applications.

.7   system is to support a list of application programs configured by users that are called up by the Tools Menu, hyperlinks within graphic displays, and key sequences;

.8   operation of control system is to be independent of user interface, which is to be used for operator communication only.

.2   System is to have a minimum of 5 levels of nesting, and the capability of displaying multiple navigation trees to aid operator in navigating throughout all systems and points connected, adding custom trees, defining any logical grouping of points, and arranging them on a tree in any order, and nesting groups within other groups. Navigation trees are to be "dockable" to other displays such as graphics, meaning trees will appear as part of display but can be detached and then minimized to Windows task bar or closed altogether, however, a simple keystroke will reattach navigation to primary display of user interface.

.3   Alarms are to be routed directly from network automation engines to PC's and servers, and it is to be possible for specific alarms from specific points to be routed to specific PC's and servers. BAS is to annunciate diagnostic alarms indicating system failures and non-normal operating conditions, annunciate application alarms as required by points lists and sequences, and as a minimum, permit 4 categories of alarm sounds customizable through user defined wav files. Alarm management segment of user interface is to provide, as a minimum, following alarm functions:

.1   log, date, and time of alarm occurrence;

.2   generate a "pop-up" window or populate a dedicate section of screen with audible alarm to inform a user that an alarm has been received;

.3   permit a user with the appropriate security level to acknowledge, temporarily silence, or discard an alarm;

.4   provide an audit trail on PC hard drive for alarms by recording user acknowledgement, deletion or disabling of an alarm, name of the user, alarm, action taken, and time/date of alarm;

.5   facilitate ability to direct alarms to an email address or alphanumeric pager, in addition to pop-up window described above;

.6   any attribute of any object in system may be designated to report an alarm.

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.4 Reports and summaries are to be generated and directed to user interface displays with subsequent assignment to printers or discs. Summaries and reports are to be accessible via standard user interface functions, and selection of a single menu item, tool bar item, or tool bar button is to print any displayed report or summary. System is to permit creation of custom reports and queries via a standard web services XML (Extensible Mark-up Language) interface and commercial of-the-shelf software such as Microsoft Access, Microsoft Excel, or Crystal Reports. As a minimum, BAS is to provide following reports and summaries:

.1 all points in BAS;

.2 all points in each BAS application;

.3 all points in a specific controller;

.4 all points in a user-defined group of points;

.5 all points currently in alarm;

.6 all points locked out;

.7 all BAS schedules;

.8 all user defined and adjustable variables, schedules, interlocks, etc.

.5 Graphical display for time-of-day scheduling and override scheduling of building operations is to be provided, with weekly schedules for each group of equipment with a specific time use schedule, and it is to be possible to define one or more exception schedules for each schedule including reference to calendars, with monthly calendars provided to permit simplified scheduling of holidays and special days for a minimum of 5 years in advance, user selected with the pointing device or keyboard. Changes to schedules made from user interface are to directly modify network automation engine schedule database. Selection of a single menu item or tool bar button is to print any displayed schedule. As a minimum, following functions are to be provided:

.1 weekly schedules;

.2 exception schedules;

.3 monthly calendars;

.4 global schedules.

.6 BAS Is to be complete with multiple-level password access protection to permit user/manager to user interface control and display, database manipulation capabilities deemed appropriate for each user, based on an assigned password. Password access protection features are to include:

.1 each user is to have a user name (24 characters minimum), a password (12 characters minimum), and access levels;

.2 each user may change his or her password at any time;

.3 when editing or entering passwords, system is not to echo actual characters for display on monitor;

.4 minimum of 500 unique password is to be supported;

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.5   operators are to be able to perform only those commands available for their respective passwords, and display of menu selections is to be limited to only those items defined for access level assigned to password of each user;

.6   BAS is to automatically generate a report of log-on/log-off and system activity for each user, and any action that results in a change in operation or configuration of control system is to be recorded, including acknowledgement and deletion of alarms;

.7   minimum of 5 levels of access is to be supported individually or in any combination of following:

    .1   Level 1 – view data;

    .2   Level 2 – command;

    .3   Level 3 – operator overrides;

    .4   Level 4 – database modification;

    .5   Level 5 – database configuration;

    .6   Level 6 – all privileges including password add/modify.

.7   User interface is to be equipped with screen management capabilities that allows user to activate, close, and simultaneously manipulate a minimum of 4 active display windows plus a network of user defined navigation trees.

.8   Graphics application program is to be an integral part of user interface and is to include a create/edit function and a runtime function, and system architecture is to support a number of graphic documents (graphic definition files) limited only by memory and computing resources to be generated and executed. Graphics are to be capable of displaying and providing animation based on real-time data that is acquired, derived, or entered. Additional features include following:

    .1   maximum of 16 graphic applications are to be able to be executed at any one time on a user interface or workstation with 4 visible to user, and each graphic application is to capable of following functions:

        .1   all graphics are to be fully scalable;

        .2   graphics are to support a maintained aspect ratio;

        .3   multiple fonts are to be supported;

        .4   unique background is to be assigned on a per graphic basis;

        .5   colour of animations and values on displays is to indicate status of object attribute.

    .2   it is to be possible to change values (set-points) and states in system controlled equipment by using drop-down windows accessible via pointing device;

    .3   graphic editing tool is to be provided to permit creation and editing of graphic files, and graphic editor is to be capable of performing/defining animations, defining runtime binding, and:

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.1   in general, facilitate creation and positioning of point objects by dragging from tool bars or drop-downs and positioning where required;

.2   be capable of adding additional content to any graphic by importing backgrounds in the SVG, BMP, or JPG file formats.

.4   many graphic displays representing part of building and various building components are exact duplicates, with exception that various variables are bound to different field values, consequently, it is to be possible to bind value of a graphic display to aliases, as opposed to physical field tags.

.9   Trend and change of value data is to be stored within the automation engines or server and uploaded to a dedicated trend database or exported in a selectable data format via a data export utility. Uploads to a dedicated database are to occur based on one of user-defined interval, manual command, or when trend buffers are full. Exports are to be as requested by user or on a time scheduled basis. System is to be equipped with a configurable data storage sub-system for collection of historical data which can be stored in either Microsoft Access or SQL database format. Each automation engine is to store, trend, and point history data for analog and digital inputs and outputs as follows:

.1   any point, physical or calculated, may be designated for trending, and methods of collection are to be defined time interval or a change of value;

.2   each automation engine or server is to capable of storing multiple samples for each physical point and software variable based on available memory, including an individual sample time/date stamp, and points may be assigned to multiple history trends with different collection parameters.

.10   Trend viewing utility with access to data points and capability of defining trend study displays to include multiple trends is to be provided, and is to include:

.1   capability of retrieving any historical database point for use in displays and reports by specifying point name and associated trend name;

.2   displays which are able to be single or stacked graphs with on-line selectable display characteristics such as ranging, colour, and plot style;

.3   display magnitude (zoom capability) and units selectable by operator at any time without reconfiguration of processing or collection of data;

.4   display magnitude is to be automatically scaled to show full graphic resolution of data being displayed;

.5   trend studies are to be capable of calculating and displaying calculated variables including highest value, lowest value, and time based;

.6   display is to support user's ability to change colours, sample sizes, and types of markers.

.11   BAS is to be equipped with a database manager that separates database monitoring and management functions by supporting 2 separate windows. Database secure access is to be accomplished using standard SQL authentication including ability to access data for use outside of BAS application. Additional features are as follows:

.1   database management function is to include summarized information on trend, alarm, event, and audit for backup, purge, and restore database management functions;

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.2 database manager is to support 4 tabs as follows:

.1 statistics, which is to display database server information and trend, alarm (event), and audit information on BAS database;

.2 maintenance, which is to be an easy method of purging records from BAS server trend, alarm (event), and audit databases by supporting separate screens for creating a backup prior to purging, selecting database, and allowing for retention of a selected number of day's data;

.3 backup, which is to provide means to create a database backup file and select a storage location;

.4 restore, which is to provide a restricted means of restoring a database by requiring user to log into an Expert Mode in order to view Restore screen.

.3 status bar is to appear at bottom of BAS database manager tabs and is to indicate information on current display activity with icons as follows:

.1 Ready;

.2 Purging Record From Database;

.3 Action Failed;

.4 Refreshing Statistics;

.5 Restoring Database;

.6 Shrinking A Database;

.7 Backing-Up A Database;

.8 Resetting Internet Information Services;

.9 Shutting Down BAS Deice Manager;

.10 Action Successful.

.4 database manager monitoring functions are to be accessed through Monitoring Settings window and are to continuously read database information once user has logged in;

.5 system is to advise user via task bar icons and email messages when a database value has exceeded a warning or alarm limit;

.6 Monitoring Settings window is to have following sections:

.1 General: allow user to set and review scan intervals and start times;

.2 Email: allow user to create and review email and telephone text messages to be delivered when a warning or alarm is generated;

.3 Warning: allow user to define warning limit parameters, set reminder frequency, and link email message;

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.4 Alarm: allow user to define alarm limit parameters, set reminder frequency, and link email message;

.5 Database Login: protect system from unauthorized database manipulation by creating a read access and write access for each trend, alarm (event), and audit databases as well as an Expert Mode required to restore a database.

.7 Monitoring Settings taskbars to display following informational icons:

  .1 Normal: indicates by colour and size that databases are within their limits;

  .2 Warning: indicates by colour and size that one or more databases have exceeded their warning limit;

  .3 Alarm: which indicates by colour and size that one or more databases have exceeded their alarm limit.

.8 BAS is to indicate via taskbar icons and email messages when a database value has exceeded a warning or alarm limit;

.12 BAS is to be equipped with a demand limiting and load rolling program for purpose of limiting peak energy usage and reducing overall energy consumption. Program is to support both Sliding Window and Fixed Window methods of predicting demand. Additional features are as follows:

  .1 system is to support 3 levels of sensitivity in Sliding Window demand calculations for fine tuning the system, as follows:

    .1 Low Setting: sheds loads later and over shortest period of time and maximizes period of time equipment is on;

    .2 Medium Setting: sheds loads earlier over a period of time greater than Low Setting, and increases time equipment is on and decreases probability of exceeding "Tariff Target";

    .3 High Setting: sheds loads earlier and over a longer period of time than Medium Setting to minimize probability of exceeding "Tariff Target".

  .2 system is to have both a Shed Mode and a Monitor Only Mode of operation, as follows:

    .1 when Shed Mode is engaged, system is to actively control demand;

    .2 when Monitor Mode is engaged, system is to simulate shedding action but will not take any action.

  .3 Demand Limiting Program is to monitor energy consumption rate and compare it to a user defined "Tariff Target", and maintain consumption below target by selectively shedding loads based on a user defined strategy;

  .4 Demand Limiting Program is to be capable of supporting a minimum of 10 separate load priorities, with each load user assigned, and a minimum of 12 separate "Tariff Targets" defining maximum allowed average power usage during current interval;

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.5 system is to support a maximum shed time for each load as determined by user, and system is to restore load before maximum shed time has expired;

.6 system is to support a minimum shed time for each load as determined by user, and system is not to restore load before minimum shed time has expired;

.7 system is to support a minimum release time for each load as determined by user, and system is not to shed load until it has been off for minimum release time;

.8 system is to support three user defined options if meter does not function properly, as follows:

.1 shedding – currently shed loads will be released as their maximum shed time expires;

.2 maintain current shed rate – system will use demand limiting shed rate that was present when meter began to function improperly;

.3 use unreliable meter shed rate – system is to control to a user defined unreliable shed rate target.

.9 Load Rolling Program is to sum the loads currently shed and compare sum to a user defined load rolling target, and system is to maintain consumption below target by selectively shedding loads based on a user defined load priority;

.10 Load Rolling Program is to be capable of supporting a minimum of 10 separate load priorities with each load user defined to a load priority;

.11 Load Rolling Program is to be capable of supporting a minimum of 12 separate "Tariff Targets" defining amount of energy by which demand must be reduced;

.12 system is to equip user with a Load Tab that displays all demand limiting and load rolling parameters for any selected load;

.13 system is to be complete with a Load Summary that displays all loads associated with demand limiting and load rolling program, and status icons for each load are to indicate:

.1 Load Is Offline;

.2 Load Is Disabled;

.3 Load Is Shed;

.4 Load Is Locked;

.5 Load Is In Comfort Override.

.14 Load Summary is to include a load summary runtime view listing following load conditions:

.1 Load Priority;

.2 Shed Strategy;

.3 Load Rating;

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.4   Present Value;

.5   Ineligible Status;

.6   Active Timer;

.7   Time Remaining;

.8   Last Shed time.

2.07   Network Automation Engines

.1   Network automation engines are to be ULC listed and labelled, BACnet Testing Labs (BTL) certified and labelled, fully user programmable supervisory controllers to monitor a network of a minimum of 100 distributed application-specific controllers for a global strategy and direction and to communicate on a peer-to-peer basis with other network automation engines.

.2   Each network automation engine is to have ability to deliver a web based user interface as specified above, and computers connected physically or virtually to automation network are to have access to web-based user interface. Additional characteristics/requirements are as follows:

.1   web-based user interface software is to be imbedded in each network automation engine;

.2   each network automation engine is to support a minimum of 4 concurrent users;

.3   user is to be capable of accessing all system data through one network automation engine;

.4   remote users connected to network through an internet service provider or by telephone dial-up are also to have total system access through one network automation engine;

.5   each network automation engine is to be capable of generating web-based user interface graphics, and this capability is to be imbedded in network automation engine;

.6   user interface is to support following functions using a standard version of Microsoft Edge:

.1   configuration;

.2   commissioning;

.3   data archiving;

.4   monitoring;

.5   commanding;

.6   system diagnostics.

.7   each network automation engine is to permit temporary use of portable devices without interrupting normal operation of permanently connected modems.

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.3 Each network automation engine is to be a multi-tasking, multi-user, microprocessor-based real time digital control processor sized to meet requirements of system with a minimum word size of 32 bits, and standard operating systems.

.4 Each network automation engine is to have sufficient memory to support its own operating system, databases, and control programs to provide supervisory control for control level devices.

.5 Each network automation engine is to include an integrated, hardware based real time clock.

.6 Each network automation engine is to be equipped with LED indicators to identify following conditions:

   .1 Power, On/Off;

   .2 Ethernet Traffic, Ethernet Traffic/No Ethernet Traffic;

   .3 Ethernet Connection Speed, 10 Mbps/100 Mbps;

   .4 FC Bus A, Normal Communications/No Field Communications;

   .5 FC Bus B, Normal Communications/No Field Communications;

   .6 Peer Communication, Data Traffic Between Network Automation Engines;

   .7 Run, NAE Running/NAE in Start-up/NAE Shutting Down/Software Not Running;

   .8 Battery Fault, Battery Defective/Data Protection Battery Not Installed;

   .9 24 VAC, 24 VAC Present/Loss of 24 VAC;

   .10 Fault, General Fault;

   .11 Modem RX, NAE Modem Receiving Data;

   .12 Modem TX, NAE Modem Transmitting Data.

.7 Each network automation engine is to be equipped with ports for operation of operator input/output devices such as industry standard computers, modems, and portable operator's terminals. Ports are to be as follows:

   .1 2 USB ports;

   .2 2 RS-232 serial data communication ports;

   .3 2 RS-485 ports;

   .4 one Ethernet port.

.8 Each network automation engine is to continually perform self-diagnostics, communications diagnostics, and diagnostics of all pane components, and transmit both local and remote annunciation of any detected component failure, low battery condition, and repeated failures to establish communication.

.9 In event of loss of normal power each network automation engine is to continue to operate for a user adjustable period of up to 10 minutes after which there is to be an

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orderly shut-down of all programs to prevent loss of database or operating system software, and:

    .1   during a loss of normal power, control sequences are to go to normal system shutdown conditions, and critical configuration data is to be saved into Flash memory;

    .2   upon restoration of normal power and after a minimum off-time delay, controller is to automatically resume full operation through a normal soft-start sequence without manual intervention.

2.08 Field Equipment Controllers

.1   Each field equipment controller is to be a fully user programmable BACnet Testing Labs (BTL) certified and labelled digital controller that communicates via BACnet MS/TP protocol. Each controller is to be housed in a plenum rated plastic housing with removable base to permit pre-wiring of analog and binary input/output field points without controller in place.

.2   Each controller is to employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences, and is to be factory programmed with a continuous adaptive tuning algorithm that sense changes in physical environment and continually adjusts loop tuning parameters appropriately.

.3   Each field equipment controller is to:

    .1   include troubleshooting LED's to identify following conditions:

        .1   Power On;

        .2   Power Off;

        .3   Download or Start-Up In Progress-Not Ready For Normal Operation;

        .4   No Faults;

        .5   Device Fault;

        .6   Field Controller Bus-Normal Data Transmission;

        .7   Field Controller Bus-No Data Transmission;

        .8   Field Controller Bus-No Communication;

        .9   Sensor Actuator Bus-Normal Data Transmission;

        .10   Sensor Actuator Bus-No Data Transmission;

        .11   Sensor Actuator Bus-No Communication.

    .2   support universal inputs, configured to monitor any of following:

        .1   analog input, voltage mode;

        .2   analog output, current mode;

        .3   analog input, resistive mode;

　　　.4　　binary input, dry contact maintained mode;

　　　.5　　binary input, pulse counter mode.

　.3　support binary inputs configured to monitor either of following:

　　　.1　　dry contact maintained mode;

　　　.2　　pulse counter mode.

　.4　support analog outputs configured to output either of following:

　　　.1　　analog output, voltage mode;

　　　.2　　analog output, current mode.

　.5　support binary outputs, 24 VAC Triac;

　.6　support configurable outputs capable of following:

　　　.1　　analog output, voltage mode;

　　　.2　　binary output mode.

　.7　have ability to reside on a master-slave/token-passing field controller bus supporting BACnet standard protocol as follows:

　　　.1　　support communications, including input/output communications between field controllers and network automation engines;

　　　.2　　support a minimum of one hundred input/output modules and field equipment controllers in any combination;

　　　.3　　operate at a maximum distance of 4560 m (15,000 ft) between field controller and furthest connected device.

　.8　have ability to monitor and control a network of sensors and actuators over a master-slave/token-passing sensor-actuator bus supporting BACnet standard protocol as follows:

　　　.1　　bus is to support a minimum of ten devices per trunk;

　　　.2　　bus is to operate at a maximum distance of 365 m (1200 ft) between field controller and furthest connected device.

　.9　capability of executing complex control sequences involving direct wired input/output points as well as input and output devices communicating over field controller bus or sensor-actuator bus;

　.10　support, but not limited to, following:

　　　.1　　hot water, chilled water/central plant applications;

　　　.2　　custom air handling units for special applications;

　　　.3　　terminal units;

　　　.4　　special programs as required for systems control.

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.11 support a password protected local controller LCD back-lit display with 6 key keypad as an integral part of field controller or as a remote device communicating over sensor-actuator bus to permit user to view monitored points without logging into system, and to view and change set-points, modes of operation, and parameters.

2.09 Input/Output Modules

.1 Input/output modules to facilitate additional inputs and outputs for use in field equipment controllers are to be similar to field equipment controllers but less display and with a minimum of 4 and a maximum of 17 points.

2.10 System Configuration Tools

.1 System configuration tool is a software package supplied with BAS to enable a computer platform to be used as a stand-alone engineering configuration tool for a network automation engine and to permit programming of field equipment controllers. Configuration tool is to provide an archive database for configuration and application data and is to have same look and feel at user interface regardless of whether configuration is being done online or offline. Additional features and characteristics are as follows:

    .1 tool is to include:

        .1 basic system navigation tree for connected networks;

        .2 integration of system enabled devices;

        .3 customized user navigation tress;

        .4 point naming operator parameter setting;

        .5 graphic diagram configuration;

        .6 alarm and event message routing;

        .7 graphical logic connector tool for custom programming;

        .8 downloading, uploading, and archiving databases.

    .2 tool is to have capability to automatically discover field devices on connected buses and networks;

    .3 tool is to be capable of configuring from a library of standard applications, simulating to verify applications, and commissioning field equipment controllers and field devices;

    .4 tool is to be complete with a Bluetooth Wireless Technology wireless access point to enable a wireless enabled portable computer to make a temporary Ethernet connection to automation network.

.2 Bluetooth Wireless Technology converter is to provide temporary wireless connection between sensor-actuator bus or field-controller bus and a wireless enabled portable computer. Converter is to be powered through a connection to either sensor-actuator bus or the field-controller bus and is to support downloading and troubleshooting field equipment controllers and field devices from portable computer over wireless connection. Converter is to be complete with LED indicators for following conditions:

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.1   Power: On/Off;

.2   Fault: Fault/No Fault;

.3   SA/FC Bus: Bus Activity/No Bus Activity;

.4   Bluetooth: Bluetooth Communication Established/Bluetooth Communication Not Established.

2.11 Wiring Materials

.1   System wiring, conduit, boxes, and similar materials are to be in accordance with requirements specified in Division 26 – Electrical.

3 Execution

3.01 General Re: Installation of the BAS

.1   Provide a complete building automation system in accordance with requirements of this Section of the Specification, Section 25 05 01 – Automatic Control Systems, drawings, and the input/output points list(s).

.2   Unless otherwise specified, perform BAS work in accordance with system manufacturer's instructions.

3.02 Installation of Direct Digital Control System Components

.1   Provide required direct digital control hardware, software, accessories, and wiring for a complete BAS. Refer to drawing control diagrams and sequences, points list(s), and Section 25 05 01 – Automatic Control Systems.

.2   Provide operator workstation, including required power and data connections, in a location as directed by the Owner or as indicated on drawings.

.3   DDC work is to be performed by skilled technicians, properly trained and are qualified for this work.

.4   Materials and equipment used are to be standard components, regularly manufactured for this and/or other systems, and not custom designed especially for this project. Systems and components are to have been thoroughly tested and proven in actual use.

.5   System is to be modular, permitting expansion by adding hardware and software without changes in communication or processing equipment.

.6   Provide new communications bus as required complete with required ancillaries. Connect and extend existing communications bus.

.7   Provide 1 supervisory controller (SC) per cabinet fan (air handler). Provide necessary field equipment controllers (FEC).

.8   Provide necessary quantity of SC to accomplish requirements of this specification, and to minimize number of mechanical systems that would be inoperative in event of a FEC failure. A maximum of 2 major mechanical systems are to be controlled by 1 FEC.

.9   Surface wall mount SC and FEC control units in Mechanical Rooms ensuring they are not mounted on vibrating surfaces, and connect to 15 A/1-pole circuit breakers dedicated for control system applications, in branch panel circuit boards in adjacent spaces. Power

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wiring from control units to circuit breakers is to be the responsibility of the controls contractor. Wiring is to be in conduit and conduit and wiring are to be in accordance with standards and requirements of Division 26 – Electrical. Refer to electrical drawings for locations of branch circuit panelboards with dedicated circuits for controls system applications.

.10 Indicate via number, and systems controlled by SC and FEC. Indicate via a lamacoid label mounted inside panel the identification number of electrical panel supplying power to SC and FEC.

.11 Submit schedule(s) of input/output points to the Consultant for review. Directly connect each SC and FEC to point devices in accordance with control diagrams and schedule of miscellaneous control points as shown on drawings. Sensor wires for each analogue input are to be 18 AWG twisted-shielded cable. Other types of wire required are to be as recommended by system supplier.

.12 Provide required sensors, remote devices, etc., and required interface accessories. Mount duct and/or plenum sensors half-way across duct or plenum.

.13 Differential pressure sensor used to provide space pressurization control through regulation of return air quantities must be mounted with snubbers on indoor pressure leg to prevent sudden fluctuations caused by door openings, etc. Mount outdoor air ports in locations that minimize effects of abnormal surface flow conditions and wind gusts.

.14 Supply and turn over to the Consultant prior to application for a Certificate of Substantial Performance of the Work, reports to be used in assisting Owner in defining and debugging DDC programs. These reports are to consist, as a minimum, of following:

.1 process control language (PCL) logs;

.2 control loop logs;

.3 PCL master point.

.15 Submit Point Data Input forms to Consultant that Owner will fill out with DDC system supplier's assistance. Input this point data into the system.

.16 Contacts will be supplied as part of mechanical work or electrical work for alarm and status points for systems and equipment other than building environmental systems and equipment. Connect to DDC system in accordance with point schedule.

3.03 Implementation of Energy Management Programs

.1 Implement energy management programs indicated for building equipment and systems.

.2 Ensure energy management program adjustable parameters are accessible to and adjustable by building operations personnel at operator's workstation.

.3 Configure energy management programs so they may be enabled/disabled on an individual basis for each system to which they apply.

3.04 Control Wiring

.1 Perform required control wiring work for control systems except:

.1 power wiring connections to equipment and panels, except as noted below;

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.2   control wiring associated with mechanical plant equipment and systems whose control is not part of work specified in this Section;

.3   starter interlock wiring.

.2   Except as specified below, install wiring in conduit. Unless otherwise specified, final 600 mm (2 ft) connections to sensors and transmitters, and wherever conduit extends across flexible duct connections is to be liquid-tight flexible conduit.

.3   Control wiring in ceiling spaces and wall cavities may be plenum rated cable installed without conduit but neatly harnessed, secured, and identified.

.4   Wiring work is to be in accordance with BAS manufacturer's certified wiring schematics and instructions, and wiring standards specified in electrical work Division of this Specification.

3.05   Identification and Labelling of Equipment and Circuits

.1   Refer to Section 20 05 00 – Common Work Results for Mechanical.

.2   Identify BAS equipment as follows:

.1   enclosures: engraved laminated nameplates with lettering such as BAS Panel CP2, or BAS Relays, or BAS E/P Transformers, with all wording listed and approved prior to manufacture of nameplates;

.2   panel points: a weather-proof input/output layout sheet for each controller with the name of each point connected to controller, and associated wire labelling information;

.3   wiring: numbered sleeves or plastic rings at both ends of conductor, with numbering corresponding to conductor identification on shop drawings and "as-built" record drawings;

.4   interface components: a weather-proof layout sheet clearly illustrating/identifying purpose of each component within enclosure such that an operator or service technician can quickly identify exact use of each relay, transducer, contactor, etc., with each sheet fastened securely to back of enclosure door.

3.06   System Startup

.1   For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

.2   For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

3.07   Closeout Activities

.1   Include for demonstration and training sessions for each of 2 groups of Owner's operating and maintenance personnel as follows:

.1   3 full, 8 hour day orientation sessions at system manufacturer's office to educate personnel on BAS architecture, hardware, and software, with an overview of BAS operation and capabilities including but not limited to operational programmes, equipment functions (both individually and as part of a total integrated system),

BAS commands, advisories, alarms, and appropriate operator intervention required in responding to BAS operation;

.2　　2 full, 8 hour day sessions at site using BAS for a "hands-on" demonstration of BAS functions and features with instruction regarding chronological flow of information from field devices, contacts and sensors to operator's workstation, an overview of communications network describing interplay between initiating devices, field hardware panels, systems communications, and their importance within operating BAS, and alarm indications and appropriate responses;

.3　　2 full, 8 hour day seasonal (summer-winter) site sessions to perform additional instruction regarding seasonal changes and how they affect BAS.

.2　　Include for 2 follow-up site training and troubleshooting visits, one 6 months after Substantial Completion and other at end of warranty period, both when arranged by Owner and for a full day to provide additional system training as required.

End of Section

GENERAL SHEET NOTES

1. ALL EXISTING MECHANICAL SERVICES TO REMAIN UNLESS NOTED OTHERWISE.
2. ALL DUCTWORK IN WASHBAY TO BE ALUMINIUM CONSTRUCTION OR STAINLESS STEEL
3. PROVIDE NEW MECHANICAL SERVICES AS SHOWN IN THE DRAWING.
4. ALL NEW HVAC WORK TO COMPLY WITH O.B.C PART 6 AND OTHER PARTS AS APPLICABLE.

SHEET KEYNOTES

1. WELDING EXHAUST HOOD. SEE DETAIL THIS DRAWING
2. HIDDEN LINE INDICATE EXHAUST FAN ON ROOF. STRAIGHT DUCT FROM THE LAST 90 TO INLET OF THE FAN TO BE 1000MM (3 TIMES DIA OF THE FAN).
3. 350x350 EXHAUST DUCT UP THROUGH ROOF TO EXHAUST FAN EF-5.
4. NEDERMAN EXTRACTION DUAL ARM 10560532 NEX HD 5M (16 FT) LENGTH, C/W WALL BRACKET FOR NEX SERIES, AND CONNECT TO EXHAUST DUCT WITH BALANCING DAMPER. (TYP.)
5. GAS DETECTION CONTROL PANEL TO OPERATE THE WELDED HOOD EXHAUST FAN AND MAKEUP AIR UNIT.
6. 450x450 EXHAUST DUCT UP TO EF-2 ON ROOF C/W INSECT SCREEN AT OUTLET AND TERMINATE THE DUCT 600 MM BELOW U/S OF DECK.. INSTALL MOTORIZED DAMPER HORIZONTALLY TO THE DUCT.
7. 200x200 TRANSFER AIR DUCT C/W ACOUSTIC LINING AND GRILLES AT BOTH END EH PRICE MODEL 80 (TYP.).
8. 400x400 EXHAUST DUCT UP TO EF-3 ON ROOF C/W INSECT SCREEN AT OUTLET AND TERMINATE THE DUCT 600 MM BELOW U/S OF DECK.INSTALL MOTORIZED DAMPER HORIZONTALLY TO THE DUCT.
9. 500x500 EXHAUST DUCT UP TO EF-4 ON ROOF C/W INSECT SCREEN AT OUTLET AND TERMINATE THE DUCT 600 MM BELOW U/S OF DECK.INSTALL MOTORIZED DAMPER HORIZONTALLY TO THE DUCT.
10. OPEN ENDED DUCT(OED) WITH INSECT SCREEN
11. NEW LOCATION OF UNIT HEATER. PROVIDE A NEW 150MM VENT UP THROUGH ROOF. CONNECT TO THE EXISTING GAS LINE. CONTRACTOR TO ALLOW ADDITIONAL PIPE FITTINGS, SUPPORTS FOR RELOCATION.
12. PROVIDE SPLIT UNIT A/C AS SHOWN. REFER TO SCHEDULES FOR DETAILS AND SIZES. CONDENSING UNIT LOCATED ON LOWER ROOF (INSIDE THE WAREHOUSE).
13. HIDDEN LINE INDICATE MAKEUP AIR UNIT ON ROOF.
14. NATURAL GAS PIPE SHOWN IS RUNNING ON ROOF
15. 100Ø DRYER VENT UP THROUGH ROOF. TERMINATE AT 900MM ABOVE ROOF C/W RAIN CAP.
16. 150Ø EXHAUST UP THROUGH ROOF. TERMINATE AT 900MM ABOVE ROOF C/W RAIN CAP
17. ALL DUCTWORK TO BE MOUNTED AT A HIGH LEVEL SUCH THAT THERE IS A MINIMUM 5FT OF CLEARANCE ABOVE TOP OF RACKING FRAME.
18. DUCT TO BE RAISED AND MAINTAIN THE DISTANCE BETWEEN CEILING AND DUCT ACROSS THE ROOF HEIGHT CHANGE.
19. DUCT TO BE MOUNTED TIGHT TO UNDERSIDE OF THE ABOVE ROOF DECK
20. 100Ø RIGID METAL DOWN AND CONNECT TO DRYER. VERTICALLY INSTALL THE BOOSTER FAN AND LINT TRAP FOR DRYER DBF-1. REFER TO DETAIL ON DRAWING M504.

350x350 EXHAUST DUCT TO ROOF

200Ø EXTRACTOR CONNECTION
WITH BALANCING DAMPER TO
BALANCE 800 CFM
(TYP OF BOTH ARMS)

FLOOR

DUAL WELDING EXTRACTION ARM SECTION DETAIL

Main plan annotations

NATURAL GAS PIPING RUNNING AT HIGH LEVEL (TYP.)

500x500 DUCT FROM MUA-3

A-300x200-177 TYP.OF.8

INTAKE AIR LOUVER AND ASSOCIATED DUCTWORK AT HIGH LEVEL (TYP.)

WALL MOUNTED SMART CONTROLLER FOR CEILING FAN (TYP.)

EXISTING EXHAUST FAN (EF-2) AT HIGH LEVEL AND ASSOCIATED CONTROLLER AT LOW LEVEL (TYP.)

A-400x150-165 TYP.OF.5

500x400 DUCT FROM MUA-1

D-150x150-24. TYP.OF.2

D-600x600-94 TYP.OF.3

A-250x150-47

A-250x150-47

A-200x200-90

A-250x150-94 TYP.OF.7

400x400 DUCT FROM MUA-2

450x400 DUCT FROM MUA-4

TOILET EXHAUST

PRV VENT TO BE TERMINATED OUTSIDE THROUGH ROOF.
PRV INLET PRESSURE: 5 PSIG
OUTLET PRESSURE: 7" W.C
CAPACITY: 230 MBH

EXISTING THERMOSTAT (TYP.)

PROVIDE 100Ø THERMALLY INSULATED COMBUSTION AIR INLET PIPE(RIGID) FOR NEW INFRARED TUBE HEATER C/W WALL CAP.

EXISTING ROOF EXHAUST TO REMAIN

PROVIDE 100Ø VENT PIPE FOR NEW INFRARED TUBE HEATER UP THROUGH ROOF

PROVIDE 100Ø VENT PIPE FOR NEW INFRARED TUBE HEATER UP THROUGH ROOF

OUTLINE OF AIR INTAKE HOOD ON ROOF "AH"

PROVIDE 100Ø THERMALLY INSULATED COMBUSTION AIR INLET PIPE(RIGID) FOR NEW INFRARED TUBE HEATER C/W WALL CAP.

500x500 DUCT (ALUMINIUM) UP TO INTAKE HOOD AH-1 C/W INSECT SCREEN AT OUTLET AND TERMINATE THE DUCT 600 MM BELOW U/S OF DECK. INSTALL MOTORIZED DAMPER HORIZONTALLY TO THE DUCT.

EXISTING HONEYWELL GAS DETECTION SENSOR (TYP.)

GENERAL DEMO NOTES

1. TEN (10) EXISTING CEILING FANS TO BE REMOVED ALONG WITH ALL ASSOCIATED CONTROL WIRING.

EXISTING SPLIT AIRCONDITIONING UNITS AND ASSOCIATED CONDENSERS TO BE DEMOLISHED

2 DEMO FLOOR PLAN - PALLET RACKING
SCALE: 1:100

EXISTING ERV TO BE REMOVED. WASHROOM EXHAUST TO REMAIN.

3 HVAC DEMOLITION CMS OFFICE
SCALE: 1:100

1 HVAC NEW LAYOUT - GROUND FLOOR
SCALE: 1:250

Revisions

No.	DATE	DESCRIPTION	CH'D
13	2024-11-18	ISSUED FOR ADDENDUM M04	
12	2024-11-01	ISSUED FOR ADDENDUM M02	
11	2024-10-28	ISSUED FOR ADDENDUM M01	
10	2024-09-30	RE-ISSUED FOR TENDER	
9	2024-08-29	ISSUED FOR TENDER	
8	2024-07-18	ISSUED FOR PERMIT	
7	2024-06-11	ISSUED FOR 100% CD	
6	2024-05-15	ISSUED FOR 50% CD	
5	2024-04-01	RE-ISSUED FOR 100% DD	
4	2024-02-27	RE-ISSUED FOR 50% DD	
3	2023-10-30	ISSUED FOR 100% DD	
2	2023-10-11	ISSUED FOR COORDINATION	
1	2023-08-01	ISSUED FOR 60% DD COSTING	

REVISIONS

THE SPECIFICATIONS ARE TO BE CONSIDERED AS AN INTEGRAL PART OF THESE DRAWINGS AND NEITHER THE DRAWINGS NOR THE SPECIFICATIONS SHALL BE USED ALONE. REFER TO ARCHITECTURAL DRAWINGS FOR DIMENSIONS. DO NOT SCALE.

PROJECT NORTH

QUASAR CONSULTING GROUP

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FOR QUESTIONS REGARDING THIS PROJECT, PLEASE EMAIL:
CM-22-149@QUASARCG.COM

PROJECT
HWP WAREHOSE UPGRADE
145 HARRY WALKER PARKWAY
NEWMARKET
ON L3Y 7B3

TITLE
HVAC NEW LAYOUT

CHECKED		PROJECT No.
	ZH	CM-22-149
SCALE		DRAWING No.
	AS SHOWN	M301

1 — WELDING WORKSHOP HVAC SYSTEM - MAU-4/EF-5 AND MAU-6/EF-9
NOT TO SCALE

MAKE-UP AIR UNIT CONTROL SEQUENCE:

OPERATING MODE:
1. THE SYSTEM SHALL BE ENABLED ACCORDING TO THE FOLLOWING MODE:
   - UNOCCUPIED/OCCUPIED SET THROUGH THE MANUFACTURER'S SPACE TEMPERATURE CONTROLLER
   - SPACE TEMPERATURE CONTROL MODE

INITIAL SET UP:
1. THE SYSTEM SHALL BE A 100% OUTDOOR AIR MAKE-UP AIR UNIT DOWNSTREAM DAMPERS SHALL BE BALANCED AND THEIR MINIMUM POSITIONS RECORDED TO A FIELD DETERMINED AIRFLOW AS AS PER THE VALUE
2. THE SYSTEM SHALL BE SUPPLIED WITH A BACNET/MSTP CONTROLLER CAPABLE OF INTERFACING WITH EXISTING BUILDING AUTOMATION SYSTEM.
   - MECHANICAL VENTILATION VIA SUPPLY FAN
   - MECHANICAL HEATING VIA GAS FIRED HEATING COIL AND BURNER.
4. THE ROOF TOP UNIT SHALL BE PROVIDED WITH A MANUFACTURER SUPPLIED SPACE TEMPERATURE SENSOR (T1) CAPABLE OF MAINTAINING THE SPACE TEMPERATURE SET POINT AND CONTROLLING THE UNIT.
5. OUTDOOR AIR DAMPER SHALL BE NORMALLY CLOSED.
6. FAN SHALL BE BALANCED TO A FIELD DETERMINED AIRFLOW AS PER THE VALUES INDICATED ON THE DRAWINGS DURING SYSTEM BALANCING AND COMMISSIONING.
7. SYSTEM SHALL BE ENABLED BASED ON SCHEDULED RUN TIME (MONDAY-SUNDAY - 9am-5PM) AND ON SPACE TEMPERATURE CONTROL 20°C IN HEATING.

FAN CONTROL:
1. ON COMMAND TO START OUTDOOR AIR DAMPER SHALL OPEN. UPON PROOF OF MOTORIZED DAMPER POSITION FAN SHALL BE ENABLED.

HEAT WHEEL CONTROL:
2. N/A

FROST PREVENTION CONTROL SEQUENCE:
11. N/A

TEMPERATURE CONTROL:
   HEATING REQUIRED.
   - T1 SHALL BE SET TO 20°C DRY BULB.
   - GAS FIRED HEATING COIL SHALL BE DISABLED.

HUMIDITY CONTROL:
2. N/A

FIRE ALARM MODE:
1. FAN SHALL BE DISABLED DURING FIRE ALARM.

SMOKE VENTING MODE:
1. N/A

100% RE-CIRCULATION MODE:
1. N/A

EXHAUST FAN CONTROL SEQUENCE:

OPERATING MODE:
1. THE SYSTEM SHALL BE ENABLED ACCORDING TO THE FOLLOWING MODE:
   - MANUAL RUN TIME MODE.

INITIAL SET UP:
1. FAN SHALL BE NORMALLY DISABLED.
2. SWITCH SHALL BE A LINE VOLTAGE MOTOR SWITCH CONTROLLER.
3. FAN SHALL BE ENABLED/DISABLED LOCALLY AT THE SWITCH.

FAN CONTROL:
1. ON COMMAND TO START MD1 SHALL OPEN. UPON PROOF OF MOTORIZED DAMPER POSITION FAN SHALL BE ENABLED. MD1 SHALL BE HARD WIRED INTERLOCKED WITH EF TO ENSURE CONTROLS OPERATION WHEN FAN IS OPERATING IN "HAND" OR "AUTO" MODE.
2. FAN SHALL OPERATE AT CONSTANT SPEED.

COMBINED SEQUENCE OF OPERATION:

OPERATING MODE:
1. THE SYSTEM SHALL BE ENABLED ACCORDING TO THE FOLLOWING MODE:
   - UNOCCUPIED-OCCUPIED; SET THROUGH MANUFACTURER'S SPACE TEMPERATURE CONTROLLER
   - OCCUPIED MODE - WELDING EXTRACTION IN USE
   - SPACE TEMPERATURE CONTROL MODE

OCCUPIED MODE SEQUENCE OF OPERATION:
1. EXHAUST FAN SHALL RUN AT CONSTANT SPEED.
2. MUA SUPPLY FAN SHALL RUN AT CONSTANT SPEED.

HEATING MODE:
1. T1 SHALL BE SET TO 20°C DRY BULB.

UNOCCUPIED MODE SEQUENCE OF OPERATION
1. MUA SUPPLY FAN AND EXHAUST FAN SHALL BE DISABLED

SYSTEM ALARMS & PRIORITY AT BAS:
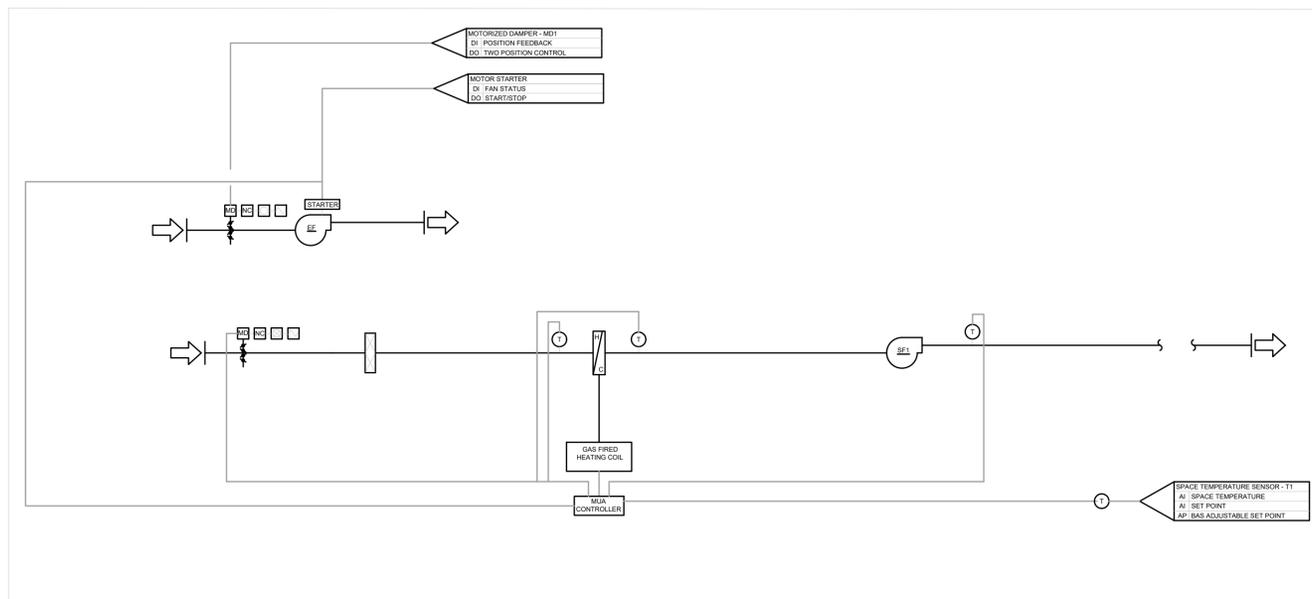   - FAN FAILURE : COMMANDED ON/STATUS OFF
   - FAN IN HAND: HOA SWITCH IN HAND
   - DAMPER FAILURE: COMMANDED OPEN/CLOSED FEEDBACK
   - DAMPER IN HAND: COMMANDED CLOSED/OPEN FEEDBACK
   - HIGH SUPPLY AIR TEMPERATURE: T1 IS GREATER THAN 28°C FOR MORE THAN 30 MINUTES
   - LOW SUPPLY AIR TEMPERATURE: T1 IS LOWER THAN 10°C FOR MORE THAN 30 MINUTES
   - FREEZE STAT: T2 IS EQUAL TO OR LOWER THAN 4°C

SYSTEM TRENDS AT BAS:
   - FAN STATUS
   - EQUIPMENT OPERATING HOURS
   - POSITION FEEDBACK

NOTE:
   - ALL NEW BAS CONNECTIONS TO BE COMPATIBLE WITH BASE BUILDING RELIABLE CONTROLS.

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2 — WARE HOUSE HVAC SYSTEM-MUA-1/EF-1, MUA-2/EF-3, MAU-3/EF-4 AND MAU-5/EF-8
NOT TO SCALE

MAKE-UP AIR UNIT CONTROL SEQUENCE:

OPERATING MODE:
1. THE SYSTEM SHALL BE ENABLED ACCORDING TO THE FOLLOWING MODE:
   - UNOCCUPIED/OCCUPIED SET THROUGH THE MANUFACTURER'S SPACE TEMPERATURE CONTROLLER
   - SPACE TEMPERATURE CONTROL MODE

INITIAL SET UP:
1. THE SYSTEM SHALL BE A 100% OUTDOOR AIR MAKE-UP AIR UNIT DOWNSTREAM DAMPERS SHALL BE BALANCED AND THEIR MINIMUM POSITIONS RECORDED TO A FIELD DETERMINED AIRFLOW AS AS PER THE VALUE INDICATED IN THE DRAWINGS DURING SYSTEM BALANCING AND COMMISSIONING.
2. THE SYSTEM SHALL BE SUPPLIED WITH A BACNET/MSTP CONTROLLER CAPABLE OF INTERFACING WITH EXISTING BUILDING AUTOMATION SYSTEM.
3. THE UNIT SHALL BE CAPABLE OF PROVIDING THE FOLLOWING FUNCTIONS:
   - MECHANICAL VENTILATION VIA SUPPLY FAN.
   - MECHANICAL HEATING VIA GAS FIRED HEATING COIL AND BURNER.
4. THE ROOF TOP UNIT SHALL BE PROVIDED WITH A MANUFACTURER SUPPLIED SPACE TEMPERATURE SENSOR (T1) CAPABLE OF MAINTAINING THE SPACE TEMPERATURE SET POINT AND CONTROLLING THE UNIT.
5. OUTDOOR AIR DAMPER SHALL BE NORMALLY CLOSED.
6. FAN SHALL BE BALANCED TO A FIELD DETERMINED AIRFLOW AS PER THE VALUES INDICATED ON THE DRAWINGS DURING SYSTEM BALANCING AND COMMISSIONING.
7. SYSTEM SHALL BE ENABLED BASED ON SCHEDULED RUN TIME (MONDAY-SUNDAY - 9am-5PM) AND ON SPACE TEMPERATURE CONTROL 20°C IN HEATING.

FAN CONTROL:
1. ON COMMAND TO START OUTDOOR AIR DAMPER SHALL OPEN. UPON PROOF OF MOTORIZED DAMPER POSITION FAN SHALL BE ENABLED.

HEAT WHEEL CONTROL:
2. N/A

FROST PREVENTION CONTROL SEQUENCE:
3. N/A

TEMPERATURE CONTROL:
   HEATING REQUIRED.
   - T1 SHALL BE SET TO 20°C DRY BULB.
   - GAS FIRED HEATING COIL SHALL BE DISABLED.

HUMIDITY CONTROL:
2. N/A

FIRE ALARM MODE:
1. FAN SHALL BE DISABLED DURING FIRE ALARM.

SMOKE VENTING MODE:
1. N/A

100% RE-CIRCULATION MODE:
1. N/A

EXHAUST FAN CONTROL SEQUENCE:

OPERATING MODE:
1. THE SYSTEM SHALL BE ENABLED ACCORDING TO THE FOLLOWING MODE:
   - MANUAL RUN TIME MODE

INITIAL SET UP:
1. MD-1 SHALL BE NORMALLY CLOSED.
2. FAN SHALL BE NORMALLY DISABLED.
3. SWITCH SHALL BE A LINE VOLTAGE MOTOR SWITCH CONTROLLER.
4. FAN SHALL BE ENABLED/DISABLED LOCALLY AT THE SWITCH.

FAN CONTROL:
1. ON COMMAND TO START DAMPER MS1 SHALL OPEN. UPON PROOF OF MOTORIZED DAMPER POSITION FAN SHALL BE ENABLED.
2. ON COMMAND TO START FAN SHALL BE ENABLED.
3. FAN SHALL OPERATE AT CONSTANT SPEED.

COMBINED SEQUENCE OF OPERATION:

OPERATING MODE:
1. THE SYSTEM SHALL BE ENABLED ACCORDING TO THE FOLLOWING MODE:
   - UNOCCUPIED-OCCUPIED; SET THROUGH MANUFACTURER'S SPACE TEMPERATURE CONTROLLER
   - SPACE TEMPERATURE CONTROL MODE

OCCUPIED MODE SEQUENCE OF OPERATION:
1. EXHAUST FAN SHALL RUN AT CONSTANT SPEED.
2. MUA SUPPLY FAN SHALL RUN AT CONSTANT SPEED.

HEATING MODE:
1. T1 SHALL BE SET TO 20°C DRY BULB.

UNOCCUPIED MODE SEQUENCE OF OPERATION
1. MUA SUPPLY FAN AND EXHAUST FAN SHALL BE DISABLED

SYSTEM ALARMS & PRIORITY AT BAS:
   - FAN FAILURE : COMMANDED ON/STATUS OFF
   - FAN IN HAND: HOA SWITCH IN HAND
   - DAMPER FAILURE: COMMANDED OPEN/CLOSED FEEDBACK
   - DAMPER IN HAND: COMMANDED CLOSED/OPEN FEEDBACK
   - HIGH SUPPLY AIR TEMPERATURE: T1 IS GREATER THAN 28°C FOR MORE THAN 30 MINUTES
   - LOW SUPPLY AIR TEMPERATURE: T1 IS LOWER THAN 10°C FOR MORE THAN 30 MINUTES
   - FREEZE STAT: T2 IS EQUAL TO OR LOWER THAN 4°C

SYSTEM TRENDS AT BAS:
   - FAN STATUS
   - EQUIPMENT OPERATING HOURS
   - POSITION FEEDBACK

NOTE:
   - ALL NEW BAS CONNECTIONS TO BE COMPATIBLE WITH BASE BUILDING RELIABLE CONTROLS.

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3 — WASHBAY HVAC SYSTEM
NOT TO SCALE

OPERATING MODE:
1. THE SYSTEM SHALL BE ENABLED ACCORDING TO THE FOLLOWING MODE:
   - SPACE TEMPERATURE CONTROL MODE MODE
   - EMERGENCY EXHAUST MODE

INITIAL SET UP:
1. INTAKE AND EXHAUST AIR MD SHALL BE NORMALLY CLOSED.
2. FAN SHALL BE BALANCED TO A FIELD DETERMINED AIRFLOW & STATIC PRESSURE AS PER THE VALUES INDICATED ON THE DRAWINGS DURING SYSTEM BALANCING AND COMMISSIONING.
3. SYSTEM SHALL MAINTAIN THE SPACE HUMIDITY/TEMPERATURE SET POINT AND SHALL BE ENABLED DURING EMERGENCY EXHAUST OF CO AND NO2.
4. FAN SHALL BE ENABLED/DISABLED LOCALLY AT THE STARTER OR REMOTELY THROUGH THE BAS.

FAN CONTROL:
1. ON COMMAND TO START MD SHALL OPEN. UPON PROOF OF MOTORIZED DAMPER POSITION FAN SHALL BE ENABLED. MD SHALL BE INTERLOCKED WITH EF TO ENSURE CONTROLS OPERATION WHEN FAN IS OPERATING IN "HAND" OR "AUTO" MODE. CONTROLS SIGNAL SHALL BE DUPLICATED AT THE BAS.
2. FAN SHALL OPERATE AT CONSTANT SPEED.

TEMPERATURE CONTROL:
   SPACE TEMPERATURE IS GREATER THAN 20°C DRY BULB.
   - THERMOSTAT 'T' SHALL BE SET TO 20°C DRY BULB.
   - INTAKE AND EXHAUST AIR MD SHALL BE OPEN.
   - MD'S SHALL MODULATE TO MAINTAIN THE T SET POINT.
   - EXHAUST FAN(EF) SHALL BE ENABLED EVERY 4 HOURS TO CIRCULATE AIRFLOW IN THE SPACE

2. SPACE TEMPERATURE IS LESS THAN 16°C DB.
   - BOD SHALL BE SET TO 20°C DB.
   - MD'S SHALL BE CLOSED.
   - FAN SHALL BE DISABLED.
   - INFRA RED HEATER SHALL BE ENABLED.

EMERGENCY EXHAUST:
1. CO UPPER CONCENTRATION LIMIT SHALL BE SET TO 100 P.P.M.
2. NO2 UPPER CONCENTRATION LIMIT SHALL BE SET TO 3 P.P.M.
3. INTAKE AND EXHAUST AIR MD SHALL BE OPEN.
4. EF SHALL BE ENABLED.

FIRE ALARM MODE:
1. FAN SHALL REMAIN OPERATIONAL DURING FIRE ALARM.

FAN FAILURE:
1. UPON FAN FAILURE INTAKE AND EXHAUST AIR MD SHALL BE CLOSED.
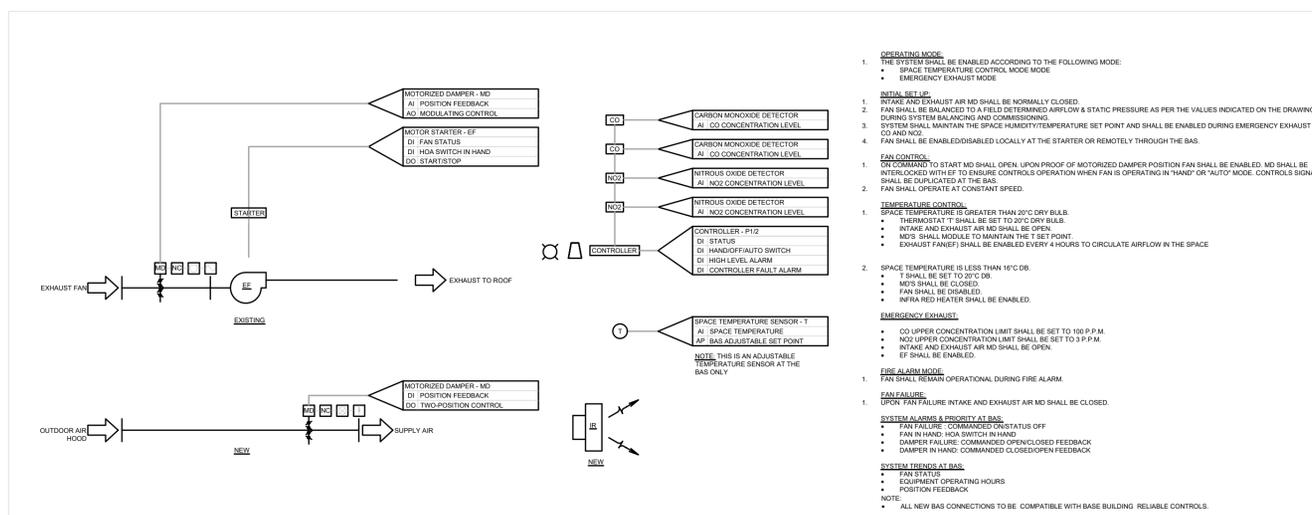
SYSTEM ALARMS & PRIORITY AT BAS:
   - FAN FAILURE : COMMANDED ON/STATUS OFF
   - FAN IN HAND: HOA SWITCH IN HAND
   - DAMPER FAILURE: COMMANDED OPEN/CLOSED FEEDBACK
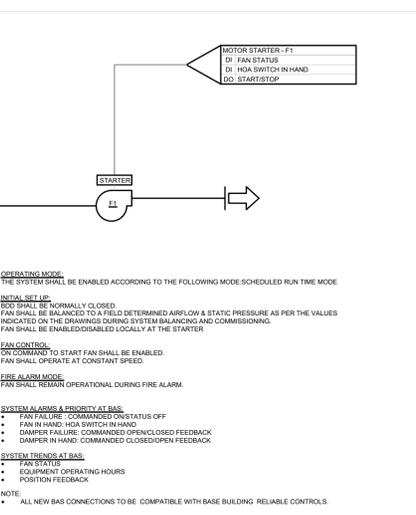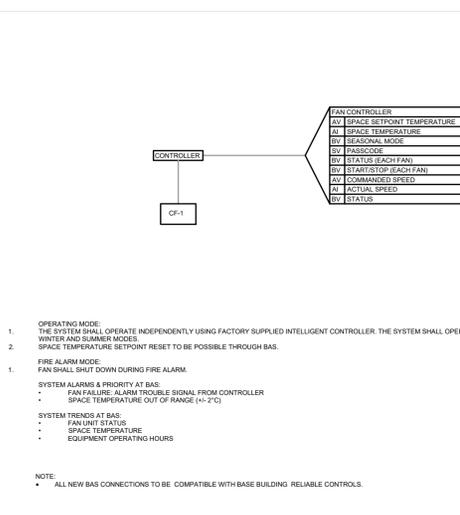   - DAMPER IN HAND: COMMANDED CLOSED/OPEN FEEDBACK

SYSTEM TRENDS AT BAS:
   - FAN STATUS
   - EQUIPMENT OPERATING HOURS
   - POSITION FEEDBACK
NOTE:
   - ALL NEW BAS CONNECTIONS TO BE COMPATIBLE WITH BASE BUILDING RELIABLE CONTROLS.

NOTE: THIS IS AN ADJUSTABLE TEMPERATURE SENSOR AT THE BAS ONLY

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4 — CONSTANT SPEED EXHAUST CONTROL SEQUENCES-EF-6 AND EF-10
NOT TO SCALE

OPERATING MODE:
1. THE SYSTEM SHALL BE ENABLED ACCORDING TO THE FOLLOWING MODE SCHEDULED RUN TIME MODE

INITIAL SET UP:
1. FAN SHALL BE NORMALLY CLOSED.
2. FAN SHALL BE BALANCED TO A FIELD DETERMINED AIRFLOW & STATIC PRESSURE AS PER THE VALUES INDICATED ON THE DRAWINGS DURING SYSTEM BALANCING AND COMMISSIONING.
3. FAN SHALL BE ENABLED/DISABLED LOCALLY AT THE STARTER

FAN CONTROL:
1. ON COMMAND TO START FAN SHALL BE ENABLED.
2. FAN SHALL OPERATE AT CONSTANT SPEED.

FIRE ALARM MODE:
1. FAN SHALL REMAIN OPERATIONAL DURING FIRE ALARM.

SYSTEM ALARMS & PRIORITY AT BAS:
   - FAN FAILURE : COMMANDED ON/STATUS OFF
   - FAN IN HAND: HOA SWITCH IN HAND
   - DAMPER FAILURE: COMMANDED OPEN/CLOSED FEEDBACK
   - DAMPER IN HAND: COMMANDED CLOSED/OPEN FEEDBACK

SYSTEM TRENDS AT BAS:
   - FAN STATUS
   - EQUIPMENT OPERATING HOURS
   - POSITION FEEDBACK
NOTE:
   - ALL NEW BAS CONNECTIONS TO BE COMPATIBLE WITH BASE BUILDING RELIABLE CONTROLS.

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5 — HVAC - FANS - CEILING MOUNTED DESTRATIFICATION FAN
NOT TO SCALE

OPERATING MODE:
1. THE SYSTEM SHALL OPERATE INDEPENDENTLY USING FACTORY SUPPLIED INTELLIGENT CONTROLLER. THE SYSTEM SHALL OPERATE IN WINTER AND SUMMER MODES.
2. SPACE TEMPERATURE SETPOINT RESET TO BE POSSIBLE THROUGH BAS.

FIRE ALARM MODE:
1. FAN SHALL SHUT DOWN DURING FIRE ALARM.

SYSTEM ALARMS & PRIORITY AT BAS:
   - FAN FAILURE: ALARM TROUBLE SIGNAL FROM CONTROLLER
   - SPACE TEMPERATURE OUT OF RANGE (+/- 2°C)

SYSTEM TRENDS AT BAS:
   - FAN UNIT STATUS
   - SPACE TEMPERATURE
   - EQUIPMENT OPERATING HOURS

NOTE:
   - ALL NEW BAS CONNECTIONS TO BE COMPATIBLE WITH BASE BUILDING RELIABLE CONTROLS.