LOCAL VENTILATION UPGRADE FOR THE WELDING SHOP OXYGEN/ACETYLENE WORKSTATIONS

JACK WHITE BUILDING,
CAMOSUN COLLEGE,
SAANICH, B.C.

MECHANICAL TECHNICAL SPECIFICATION

June 11, 2009

Avalon Mechanical Consultants Ltd.
300-1245 Esquimalt Road
Victoria, BC V9A 3P2
voice: (250) 384-4128
fax: (250) 384-4134

SECTION 15 SPECIFICATIONS – INDEX

DRAWING INDEX

1 GENERAL PROVISIONS

1.1 All Clauses of the contract agreement, general conditions and requirements shall apply to the work in this division.

1.2 Obtain and pay for all permits, and give all notices.

1.3 Ensure that all work and material shall comply with, but not be limited to, the requirements of the latest edition of the following Codes and Standards:

1.3.1 B.C. Building Code 1998 (BCBC).
1.3.2 Local Municipal Codes Bylaws and Standards
1.3.3 British Columbia Fire Code
1.3.4 Provincial Fire Marshal Regulations and the Fire Marshall Act
1.3.5 N.F.P.A. 13 Sprinkler System Installation 1999.
1.3.6 Applicable N.F.P.A. Regulations
1.3.7 Canadian Electrical Code 2002 (CEC) CSA Standard C22.1
1.3.8 B.C. Safety Standards Act and Regulations
1.3.9 M58 Electrical Safety Regulation
1.3.10 M61 Gas Safety Regulation
1.3.11 M63 Safety Standards General Regulation.C. Electrical Safety Branch Bulletins.
1.3.12 WorkSafeBC – Workers' Compensation Board (WCB) Regulations,
1.3.13 ANSI and ASTM Standard III-1988,
1.3.14 SMACNA Standards.
1.3.15 RCABC Roofing Specification Manual.
1.3.16 CSA Standards & ULC Standards
1.3.17 ASHRAE 90.1

1.4 Carry out work in a neat and professional manner to the satisfaction of the Engineer and The Owner (Camosun College).

1.5 The use of a trade name for materials does not preclude the use of approved alternate materials of equal performance and quality. Where materials, equipment and other products are specified by manufacturer's name, other manufacturer's products may be substituted upon obtaining written approval of the Engineer five working days prior to opening of bids. Submit list of proposed equivalent products, with detailed dimensional, material and performance specifications, in duplicate to the Engineer with a stamped, self-addressed envelope. Fax submittals will not be accepted. Alternates are not accepted unless approved by the Engineer in writing. Approved alternates will be announced to all bidders by addendum.

1.6 Additional costs which are required to provide equal performance to the original design intent (including, but not limited to redesign, electrical upgrade, extra controls, relocations, structural, etc.) and which result from the use of approved alternates, shall be borne by the Contractor.

1.7 Cover and protect benches and equipment within occupied areas during work, and clean each area (including removal of debris and redundant materials) at the end of each work shift. Remove garbage from site each day.

1.8 Work in the occupied areas shall be performed during un-occupied hours as stipulated by the Camosun Project Manager. As the installation proceeds insure that all installed components are secured and "made safe" at the end of each work shift.

1.9 Make good any damages to existing equipment and building components caused by work under this contract at no extra cost to the Owner.

1.10 Provide the manufacturers' recommended service procedures for all components during the first year of operation following the date of approved substantial completion.

1.11 The entire installation shall be guaranteed against defects in manufacture and installation for a period of one year following the date of approved substantial completion. Provide on-site repair and/or replacement of failed components in a timely manner.

1.12 All mechanical work for this project shall be carried out in coordination with roofing and electrical trades. Consult with project manager, and sub-trades to ensure to insure the entire project work is carried out in a logical sequence while minimizing any disruptions to building occupants.

2 SCOPE

2.1 Supply all materials and labour necessary to ensure complete and efficient systems in accordance with the intent of the specifications and drawings. Should there be any discrepancies or unclear directions, advise the Engineer before any work is commenced. Contact Avalon Mechanical Consultants Ltd. (tel. 384-4128) on any such items in this Division.

2.2 Work under this Contract includes, but is not limited to, provision of the following fully functional items:

2.3 All materials and labour required to complete one new stand alone fume extraction system serving 11 existing oxy/acetylene workstations in the welding shop. This new fume extraction system shall include 11 new overhead canopy hoods (each with its own occupancy enabled control damper), one new rooftop fan (with a variable speed drive motor), and all the ducting, dampers, and controls required to make the system complete and functional as per the drawings and these specifications.

2.4 All materials and labour required to complete one new stand alone variable volume make-up air handling system. This make-up air unit will modulate its airflow based on the barometric pressure differential between the welding shop and the outdoors. The unit will be equipped with a electric resistance heater. Air will be tempered to 17C via 7 stages of electric heat, plus a variable SCR first stage. Provide all the ducting, dampers, sensors, and controls required to make the system complete and functional as per the drawings and these specifications.

2.5 Complete structural changes as called for in structural drawings. Coordinate with Structural Engineer (Genivar Engineering - gary.liang@genivar.com).

2.6 Sheet Metal Work, including all new ducting, with associated hangers and hardware.

2.7 All required sensors and switches as per drawings and specifications. Coordinate with controls contractor to ensure a complete and functional system as per the drawings and these specifications.

2.8 Air Balancing for new fume extraction system.

2.8.1 Plumbing – Provide and install three new 2-way control valves (one for each of the three existing hydronically heated make-up air units AMU-1, AMU-2, & AMU-8). These valves shall be sized based on the existing hot water piping feeding these units (one size smaller than existing) . These new three way control valves shall be connected to the DDC system. The existing control of these three makeup units is to remain in place and operational until future phase (welding booth ventilation upgrade) is implemented.

2.8.2 (sized based on the existing hot water piping feeding these units (one size smaller than existing piping)). These new three way control valves shall be connected to the DDC system (refer to points list). Note: existing control of these three makeup units is to remain in place and operational until future phase (welding booth ventilation upgrade) is implemented.

2.9 Electrical - Line Voltage: All Power wiring to be carried out be a licensed electrician and be done in accordance with the design/build requirements contained in this specification. Coordinate with Electrical Contractor to insure that all components (e.g., starters, H/O/A switches, etc.) are provided.

2.10 Electrical – Low Voltage: Low voltage control wiring (<25Volts) may be carried out by controls contractor.

2.11 The TAB agency shall compile 3 copies of all maintenance instructions and performance data concerning the new rooftop Exhaust Fan, Canopy Hoods, Controls, etc. Enclose these in labelled 3-ring binders and hand over to the Consultant, together with as-built record drawings. Coordinate with DDC Contractor so that control schematics, wiring diagrams, updated shop drawings and panel printouts are included. (See Section 7).

3 HVAC – FUME EXTRACTION SYSTEM

3.1 Canopy Hoods:

Provide one 2m X 2m overhead canopy hood for each of the eleven existing oxy/acetylene quad workstations as indicated on drawings. Each canopy hood shall be supported by factory supplied legs connected as shown on the drawings. Standard of acceptance: Lincoln Euromate "Modular Extraction Hood" 2X2 m.

3.2 Canopy Hood Task Lights: (Provide shop drawings)

Provide two 4ft. fluorescent light fixtures to the underside of each canopy hood as indicated on drawing. Each fixture to be a single tube 30-watt 4 ft. T-8 strip light with a clear polycarbonate T8 tube-shield cover over each fluorescent lamp. Acceptable manufacturers: GE, Philips, Osram Sylvania (power wiring by Div.16).

3.3 Ductwork and accessories

3.3.1 Solid round ductwork: galvanized sheet metal spiral ductwork to SMACNA class 4" w.c. Fittings to SMACNA. Dimensions indicated on drawing are clear internal dimensions. Refer to "Duct Gauge Table" on drawing.

3.3.2 Balancing dampers (BD) : single blade with a locking quadrant and pivot pins which are anchored on both sides of the duct. Install on each branch duct run-out to each new canopy hood where indicated according to the drawings.

3.3.3 Take-offs: conical type, to SMACNA.

3.3.4 Flexible Duct Connections: DuroDyne heavy neoprene flex material (1/8" thickness) at ducting connection to new rooftop exhaust fan EF-30.

3.4 Control Dampers:

3.4.1 CD-1 (Canopy Hood Control Dampers x 11) Control Dampers to be "Butterfly type" consisting of a single circular blade mounted to a pivoting shaft. Damper leakage shall not exceed 0.15 cfm per inch of blade circumference at a pressure differential of 4" w.c. Dampers shall be rated for a maximum pressure differential of 6" w.c.. Damper frame and blade shall be fabricated from galvanized steel. Install on each branch duct run-out to each new canopy hood where indicated on drawings. Standard of Acceptance: Ruskin CDRS25 round control damper (12" dia). Each CD-1 to be direct coupled with an on-off, spring return failsafe 120V actuator . Standard of Acceptance: Belimo AF120

3.5 Exhaust Fan:

EF-30 (Rooftop Exhaust Fan x 1) Centrifugal high efficiency Backward Inclined flat blade industrial fan with a direct drive motor. Fan to be mounted on vibration isolators secured to rooftop sleepers as indicated on drawings. Exhaust Fan EF-30 will be equipped with a Variable Speed Drive (VSD) (refer to section 3.7 below). Exhaust Fan EF-30 shall be furnished with the following features:

a. Spark Resistant construction (nonferrous wheel)
b. Gravity backdraft damper at fan outlet
c. Bolted access door (for access to fan interior)
d. Spring vibration isolator mounts (rated for the size and weight of the fan assembly)
e. Weather Cover to protect motor, shaft & bearings
f. Weatherproof finish suitable for mounting outdoors
g. For Design Duty: 10,000 CFM @ 3.3" TSP
h. Voltage: 460/3/60
i. Fan c/w access door, drains.
j. Coordinate with Div. 16 to ensure a HOA (on/off motor control) is provided to isolate EF-30
k. Fan starter, motor, disconnects, and controls will be supplied by the manufacturer.
l. Connection of Fan controls by electrical (Div 16).
m. Standard of Acceptance**:** Twin City Fan model: BC-SW 330, SWSI, Arrangement 4 , or approved equal.

3.5.1 Submit shop drawings of the proposed fan EF-30. Include the following:

a. capacity ratings: fan curves.
b. Method of installation with proposed curbs/sleepers, mounting details, sizes and location of spring vibration isolator mounts.
c. size and location of all connections
d. technical details of construction, including fan wheel , direct drive motor, bearings.
e. details of vibration isolation;
f. operating weight;
g. electrical data;
h. details concerning installation of seismic restraint measures.

3.6 Make-up Air Unit MUA 30:

Roof mounted make up air unit MUA 30 shall have the following features:

a. Rated at 9000 cfm at 1.5” w.c.
b. 100 % outdoor air
c. 460 volt 3 phase power
d. Variable speed drive motor (as per section 3.7 below)
e. Screen on air inlet
f. 2” filters Merv 8
g. Electric resistance heat section 142 Kw
h. Electric heat with 8 stages of on-off control plus last stage with SCR control
i. Electric heat controlled by single input 4-20 ma.
j. Install on roof as shown on drawings.
k. Standard of acceptance: Haakon packaged fan-coil makeup air unit.

3.7 Variable Speed Drives:

Variable Speed Drive VSD for EF-30 and MUA-30**:**

3.7.1 Variable frequency drive with integral fusible disconnects; manufacturer-certified as compatible with fan motor, and with bypass to allow full speed operation on drive failure. Provide load side reactor or other filters as required for electrical protection. Ensure compatibility with DDC Controls so that control signal will vary fan speed appropriately without the need for extra components or costs. Meet manufacturer's recommendations.

3.7.2 Variable frequency drive to vary the rpm of the EF-30 fan motor in accordance with the control signal from the DDC system.

3.7.3 Variable frequency drive shall be of the Pulse Width Modulated (PWM), voltage source type, utilizing fixed diode bridge input rectification and Insulated Gate Bipolar Transistor (IGBT) output devices.

3.7.4 VSD shall be UL or CSA / NRTL-C certified.

3.7.5 The VSD shall be dual current rated for constant and variable torque loads. The VSD shall have a constant torque overload rating of 150% for 60 seconds and a variable torque overload rating of 115% for 60 seconds.

3.7.6 The VSD shall be capable of starting and stopping and outputting a variable voltage/frequency waveform with the motor disconnected.

3.7.7 The VSD shall have a minimum displacement power factor of 0.96 or higher at all output frequencies.

3.7.8 Input voltages shall be +/- 10%

3.7.9 Input frequency shall be 50/60 Hz +/- 5%

3.7.10 The VSD is to be supplied in a wall or floor mount NEMA 1 enclosure. Coordinate with Contractor for final selection of wall or floor enclosure.

3.7.11 Warranty of the VSD package shall be for thirty-six months from the date of commissioning completion. The warranty shall include all parts and repair labour.

3.7.12 The keypad shall have the ability to enable or disable reverse & stop button.

3.7.13 An integral PID motor speed controller shall be a programmable feature above 7.5 HP.

3.7.14 Software settings shall be lockable by both software and digital input.

3.7.15 A non volatile memory shall be provided so that programming and fault log memory will not be lost in the event of a power failure.

3.7.16 The VSD shall offer the following protective features and digital displays as a minimum:

a. Instantaneous over current protection.
b. Electronic thermal overload protection.
c. Over voltage protection and Under voltage protection.
d. Ground fault protection.
e. Phase loss protection.
f. Current transformer fault.

g. Instantaneous power failure protection.
h. Unattended start protection.
i. External trip input and display.
j. CPU error, EEPROM error and Option board error.

3.7.17 All systems shall include 5% impedance harmonically compensated line reactors rated to carry 150% total RMS current continuously.

3.7.18 All systems shall include 5% impedance harmonically compensated load reactors rated to carry 150% total RMS current continuously.

3.7.19 The VSD shall operate within the following environmental ratings without de-rating:

a. .Ambient temperature of -10 to 40 degrees Celsius.
b. .Humidity of 20% to 90% non-condensing.
c. .Altitude of 1200 meters.
d. .Vibration of 0.5 G or less.

3.7.20 Acceptable Suppliers:

Hitachi, ABB, Toshiba, Baldor, Benshaw, Cutler Hammer, Danfoss Graham, Trane TR1, Seimens and Mitsubishi or APPROVED equal.

3.7.21 Approvals must be in writing by Engineer. Application for equal must be made at lest 5 working days before tender closing, and must contain a succinct list of all technical features.

3.7.22 VSD's shall be installed by the mechanical contractor, and connected by the Electrical Contractor. The manufacturer's representative and the commissioning agent shall be present and shall supervise VSD start-up.

3.8 2-Way Control Valves

3.8.1 Provide and install three new 2-way control valves (one for each of the three existing hydronically heated make-up air units AMU-1, AMU-2, & AMU-8). These valves shall be sized based on the existing hot water piping feeding these units (one size smaller than existing). Site verify to determine existing piping sizes. Valves to be installed in existing hot water supply branch line feeding each of these three make-up air units. Control valves to be coupled with a low voltage actuator which will be connected to the DDC control system by the controls contractor (section-6). Provide shop drawings for both the valves and the actuators to engineer for approval prior to bid submittal.

4 EXECUTION - SHEET METAL

4.1 Install equipment to manufacturers' instructions.

4.2 Install ductwork on site to avoid interference with structural elements etc. Conserve headroom and space.

4.3 Reduce any vibration of sheet metal which is audible in surrounding occupied areas until it is inaudible.

4.4 Ducts shall be straight and smooth inside with joints neatly finished. Install and support ductwork in accordance with SMACNA. Use full radius elbows (2 x diameter) for changes in direction. Maximum slope of transitions is 1 in 4.

4.5 Make solid ducts airtight with mastic type duct sealer.

4.6 Provide seismic restraints for all new canopy hoods. Use slack cables to limit lateral movement of canopy hoods and attached ducting as per SMACNA.

4.7 Branch take-offs to be 150% the size of the branch duct.

4.8 Coordinate closely with Controls Contractor and Balancing Agent to ensure that sensors, etc. are properly located.

4.9 Any damper actuators which bind or which in any way are not able to operate correctly, shall be repaired or replaced by sheet metal trade.

5 ELECRICAL

Electrical by Division 16

6 CONTROLS - SCOPE

6.1 Scope of Work:

6.1.1 Provide expansions to the DDC control systems on the existing Burke/MutiNet/RCS Local Area Network or provide new Delta Controls Network with all hard and virtual points and programs visible on RCS network via BACNET interface.

6.1.2 System to meet the intent of the drawings and specifications. Install items listed in the Schedule of New & Relocated Input and Output Control Points at a minimum.

6.1.3 Provide all relays, wiring, sensors, actuators, valves, panels, controllers, enclosures, etc., installation supervision and labour, including calibration, adjustments, commissioning and check-outs, and as-builts necessary for complete and fully operational system.

6.1.4 Provide all software and licenses necessary to do programming and to view system information, including database. Provide software programming as required to implement the new sequences of operation. Software shall employ the Graphic Guidelines and Naming Convention as described on the ARES Website. Coordinate with Camosun to ensure that the other HVAC systems in all related buildings operate properly at all times during installation and programming.

6.1.5 Provide 2 copies of the required Commissioning Report, which describes how all features were exercised and their functions verified. Provide 2 copies of an O&M Manual containing guarantee, product warrantees, all maintenance instructions and performance data, certificate of acceptance from Inspection Authority, and product spec sheets.

6.1.6 The Commissioning Agent shall assign one person, experienced and qualified in commissioning control systems through practical experience and a comprehensive knowledge of the interactive nature of HVAC systems and DDC controls, to verify the performance of the control systems by conducting random tests of the control sequences until he is satisfied that the controls are performing according to the intention of the Controls Specification. The Controls Contractor shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Controls Contractor in good working order at the completion of the commissioning process. The Controls Contractor shall cooperate fully with the Commissioning Agent and work together to obtain a fully operating system, providing additional technicians and trades people to assist the designated commissioning person as required.

6.2 Graphic Programming

6.2.1 Provide a dynamic graphics operating system with all equipment shown, within an accurately drawn system schematic, so the operator can "click" on equipment symbols and have a schematic appear with status and values of all points visible, and being dynamically refreshed. The Contractor can obtain ACAD or DXF file of the drawings from Avalon Mechanical Consultants.

6.2.2 The system shall have direct access, via points or icons linked to each on-line graphic, to the following (without loading different software programs):

a. Point reports and Point definitions (to view or directly revise parameters).
b. Trend logs (tables or graphs).
c. Operator Control Language (to view or directly revise programs).
d. Group displays (to add or delete points, or access GCL).
e. Global variables.
f. Set points and schedules (to view or directly revise).
g. PID controllers (to view or directly revise parameters).

6.2.3 The software shall allow the operator to easily utilize colour graphics in generating user defined, dynamic data displays or system groups. The graphic images are created in any third party application (e.g. CorelDraw, VisioTechnical) and exported as a bit mapped image for use within the DDC system.

6.2.4 The operator shall be able to annotate the graphic with any combination of hard points, soft points, and keywords, and have the ability to link any group to any other group from any controller in the system.

6.2.5 The operator will have the ability to display either the description, value or status of a point, using any colour.

6.2.6 Any point shall have the ability to be hidden from view, yet retain functionality if accessed.

6.2.7 The graphics must support mouse and keyboard cursor access.

6.3 Overview of Work:

6.3.1 The upgrade is required to provide each quad workstation with a single canopy hood, of approximately 6 feet square, suspended above it, and centered over it. The resulting 11 new canopy hoods would then be ducted to a common main duct which would elbow up thru the roof to a single variable speed rooftop exhaust fan (EF-30). The intention is for the students to stand outside of the canopy, so that little contaminated air enters their breathing zone.

6.3.2 Each workstation hood would be equipped with a dedicated control damper in the duct branch serving it. These control dampers would be operated by occupancy sensors located at each workstation. Input signals from these sensors would regulate the fan speed according to how many stations were being used at any one time. A duct static pressure sensor would provide a further input to insure that a minimum negative pressure is maintained during operation of EF-30. When operating, each canopy hood would exhaust about 1530 cfm. None of this exhausted air would be recirculated back into the shop.

6.3.3 New variable speed electrically heated make-up air unit MAU-30 is to provide outdoor air to maintain building static pressure and IAQ. The air will be tempered to 17C via 7 stages of electric heat, plus a variable SCR first stage. Airflow of MUA-30 shall be controlled based on the input of a "ultra-low" barometric differential pressure sensor (Transducer) which would provide a modulating signal to the DDC in relation to the barometric pressure differential between the welding shop and the outdoors.

6.3.4 Existing fixed volume hydronically heated make-up air units AMU-1, AMU-2, & AMU-8 are to remain as backup make-up air systems. Each of these three units shall be fitted with a new 2-way control valve . These new three way control valves shall be connected to the DDC system (refer to points list). Note: The existing control of these three makeup units is to remain in place and operational until future phase ("welding booth ventilation upgrade") is implemented.

6.4 "Design/Build" Power Wiring

The Contractor shall be responsible for

a. the design of the new electrical system required for proper operation of the proposed DDC system expansion,
b. the electrical system's compliance with all applicable codes, (including the BC Building Code, and The Canadian Electrical Code) and authorities having jurisdiction, and
c. installation of wiring and electrical devices in accordance with the design, and as per the manufacturer's specifications.
d. Coordinate with Camosun (Mark Terpstra) to determine what provisions exist for CCS power. Inform the Engineer of any shortcomings or concerns prior to tender closing. There is a parallel but separate electrical contract taking place, so coordination with the other Contractor may be required.

6.5 General Conditions:

6.5.1 The CCS shall be remotely accessible via internet thru Camosun's system located in building 5.

6.5.2 The operating system of the entire CCS shall operate with the existing Windows NT and RC Studio software on the existing operator's work station located in Building 5.

6.5.3 The operating system of the CCS shall co-exist with other vendors' systems, presently operating in Windows, to provide a multi vendor work station at the Camosun.

6.5.4 System Architecture: Gain approval of Camosun Project Manager for system architecture.

6.5.5 There will be other work being done concurrently under other Contracts. This work includes the following:

a. Installation of EF and air handler and variable frequency drives,
b. Sheet metal work,
c. Electrical,
d. Commissioning TAB and re-commissioning.
e. Provision of input/output points and programming for some items relating to the above is part of this CCS installation, and coordination with the other Contractors is required.

6.5.6 No communication computers will be provided for this project. Communication will be via the existing operators' workstation. The Contractor shall make the new and existing CCS operating system operational on this computer and demonstrate remote communication to all points in the expanded DDC system, and onto the network.

6.5.7 Install all components in accordance with the manufacturers' recommendations.

6.5.8 Coordinate with sub-trades to ensure that supply of sensors, valves, wells, etc. is accounted for. Inform the Engineer of any shortcomings prior to tender closing.

6.5.9 Contractor shall submit design data (including system architecture, and spare point capacity), shop drawings and software sequences for approval prior to installation.

6.5.10 Coordinate the schedule of work with the Camosun Project Manager. The buildings must be kept in operation. The work of this contract involves working in a museum. All conditions and procedures that are currently in place must be maintained at all times while the work is being carried out. Obtain permission from the Camosun Facilities Department before interrupting any electrical or fire protection services. Ensure that all services are restored prior to the end of the work shift. On no account will the Contractor stand, walk on, or work off the furniture, fittings or exhibits in the buildings. Allow as necessary for ladders, scaffolding, etc. to carry out the work. Dust containment procedures must be employed for any work that creates dust - such as concrete drilling or cutting access holes in drywall.

6.5.11 Remove all debris and surplus material and leave the premises broom clean each morning; vacuum

clean all electrical equipment.

6.6 Power Surge Protection

The DDC system shall be protected form power line surges and voltage transients by means of a powerline filter or UPS.

6.7 Power Failure Protection

6.7.1 The DDC system shall have automatic protection from any power failure of at least forty-eight (48) hours duration.

6.7.2 This protection shall at a minimum include continuous real-time clock operation and automatic system restart upon power return.

6.7.3 Outputs shall have the option of being set to "staggered start" upon power reset.

7 CONTROLS - PRODUCTS

7.1 Field Instrumentation

7.1.1 Input and output devices and accessories to be compatible with the control system, and to be as specified herein. Provide all that is required to make the points listed in the Schedule of DDC Input & Output Points fully functional. Provide shop drawings.

7.1.2 Reliable Controls or Delta Controls DDC outdoor temperature sensor.

7.1.3 Reliable Controls or Delta Controls DDC duct S/A temperature sensor (for MUA-30).

7.1.4 Ultra-low barometric differential pressure sensor (Transducer) (for MUA-30)
Standard of Acceptance: Greystone Ultra-low Pressure Transducer ,ULP series, two port differential with selectable pressure ranges, output 0 to 10Vdc

7.1.5 Venturi type duct mounted sensor with pitot type velocity sensor having 4-20 mA output and sensing range from 0 to 3500 fpm . Mounted in the main exhaust air duct (leading to EF-30) at location approved by consultant.

7.1.6 Occupancy Sensors:
Provide four Occupancy sensors for each overhead canopy hood as indicated on drawings. Each Occupancy sensor shall be installed on the outside edge of the canopy hood directly above each of the four work tables (pointing downward as indicated on drawing).
Occupancy sensors shall have the following features:

a. Automatic temperature compensation
b. EMI and RFI protection

c. Dual element sensor
d. Anti-tamper switch
e. Adjustable lens position (0^o or 10^o) (beam pattern adjustment)
f. Selectable operating voltage 12Vdc or 24 Vdc
g. Adjustable alarm signal duration
h. Standard of acceptance: Paradoor 460 (by Paradox) Vertical View Motion Detector .

7.2 Relays, etc. compatible with the control system, and as specified herein.

7.2.1 Relay, Point Type "RY"

a. Description - Control relay (electro-mechanical relay).
b. Technical Performance - 240 V, 10A to suit application.
c. Standard of Acceptance - IDEC-RH Series Johnson R1020 series.

8 CONTROLS - SCHEULE OF DDC INPUT AND OUTPUT POINTS:

8.1 Points List is a guideline. Provide any additional points, equipment, or components that may be required to meet the design intent.

8.1.1 Device legend (see Points List below)

AO	Analog output
ASD	Adjustable speed drive
BPS	Building pressure sensor
CO2	Duct Carbon Dioxide sensor
CT	Current Transformer
DA	Damper actuator
DC	Dry contact
DI	Digital Input
DO	Digital output
DRH	Duct relative humidity sensor
DSP	Duct static pressure sensor
DTS	Duct temperature sensor
O/C	Open/closed
NML	Normal position
RTS	Room Temp Sensor
RY	Relay

SCHEDULE OF DDC INPUT & OUTPUT CONTROL POINTS										Date:	8-Jun-09
CAMOSUN COLLEGE – INTERURBAN										Page 1	of 1
Logical Point Code				Digital			Analog			Legend: O= open F=full pressure C= closed Z=zero pressure	
Device Type					NML			Fail			
Point Description		system	point	DO	O/C	DI	AO	O/C	AI	Remarks	
NEW DDC SYSTEM											
Jack White Cutting Tables											
EF-30 on/off & status	RY; CT	EF30	EF-30	1					1	on/off; fan status	
EF-30 VFD & Feedback	signal	EF30	EF30 FS				1		1		
Table Occupancy Sensors	OS	EF30	COS*			44				occupancy sensors on canopies	
Table Dampers	DA	EF30	TA*	11						2-position	
MAU-30 on/off & status	RY; CT	EF30	MAU30	1					1	on/off; fan status	
MAU-30 VFD & Feedback	signal	EF30	MAU30FS				1		1		
MAU-30 Electric Heat	signal	EF30	MAU30H				1			4 to 20mA for 7 stages + 1 SCR stage	
MAU-30 Supply Air Temp	DTS	EF30	MAU30SAT						1	duct mount, 6" probe	
Room Temperature	RTS	Weld Shp	RT								
Bldg Pressure	BPS	Weld Shp	WSBP						1	neg 15 Pa to pos 15 Pa	
Space CO2	CO2	Weld Shp	WSCO2						1	0 to 2000 ppm	
Jack White Grinding Rm											
EcoGate 12 system	signal	Grind EA	Gr Alm			1				alarm from separate system	
Existing AMU-1,2&8 Enable	RY	Weld Shp	AMU*	3						3 existing rooftop Make-up fans	
Existing AMU-1,2&8 Heat	AO	Weld Shp	AMU*HCV				3			three 2-way control valves on existing coils	
TOTAL				**16**		**45**	**6**		**7**		

9 CONTROLS - EXECUTION

9.1 General

9.1.1 Install equipment to manufacturers' instructions.

9.1.2 Provide what is necessary for a complete and fully operational system, including the following:

9.1.3 All relays, wiring, sensors, transducers, actuators, power supplies, panels, controllers, enclosures, and other required components.

9.1.4 All software necessary to program and control the system and to view system information.

9.1.5 Installation supervision and labour, including calibration, software, adjustments, and check-outs.

9.1.6 Install wiring on site to avoid interference with structural elements etc. Conserve headroom and space. Install square and parallel to building walls and ceilings. Fire stop penetrations through fire separation walls, floors or ceilings. Provide complete, permanent grounding of entire system.

9.1.7 All wiring in inaccessible spaces or electrical and mechanical rooms to be within conduit. All exposed wiring to be within conduit. Accessible concealed low voltage wiring may be plenum-rated cable.

9.1.8 Carefully calibrate Barometric Pressure Differential Transducer & Monitor (sensor) as per manufacturer’s recommendations.

9.1.9 Piping sensor wells shall block less than 30% of pipe cross sectional area. Hand over to piping trade for installation.

9.1.10 Field mounted components to be properly supported on pipe stands, channel brackets, plywood panels securely attached to walls, or as approved by Engineer.

10 CONTROLS - ENCLOSURES AND WIRING

10.1 Enclosures

10.1.1 All controllers shall be installed neatly in an appropriately sized enclosure as per the manufacturer’s specifications.

10.1.2 Relays, transformers, and I/O devices and peripherals shall be installed in separate enclosures and not in the enclosures containing the controllers.

10.1.3 All wires penetrating the enclosure that are not required to be in conduit must be neatly bundled and strapped in place.

10.1.4 All Building Controllers will be installed in enclosures that are complete with hinged and key-locked doors. The door will be painted and labelled suitably bearing the manufacturer's system name, the controller address, and the installing contractor's contact information. This enclosure will be mounted at a height that provides easy access without the need of a ladder.

10.1.5 Custom Application Controllers may reside above T-bar ceiling spaces in conventional screw lid enclosures.

10.1.6 All enclosures will be CSA rated.

10.1.7 A hard points list shall be affixed on the inside surface of the door/cover of the enclosure.

10.1.8 The inside bottom surface of the enclosure shall be clean of dirt, metal shavings, and debris.

10.1.9 All junction boxes will have covers properly and firmly affixed after installation completion.

10.2 Controls – I/O Wiring

10.2.1 All input/output device wiring will use #18-2 solid core cable with individually jacked conductors and jacketed sheath over the pair.

10.2.2 Use plenum cable where permitted by codes, but run wire in rigid conduit in the following areas:
a. mechanical or electrical rooms,
b. where exposed in finished areas,
c. where subject to physical damage.

10.2.3 All I/O wiring passing near or within the enclosure of a VFD will be shielded, with the shield terminated at the device end.

10.2.4 All I/O wiring will be suitably identified using Panduit adhesive wire-marker or equivalent at the controller end.

10.2.5 All I/O wiring within controller enclosure shall be neat and tidy and suitably bundled and strapped or contained in Panduit wire duct or equivalent.

10.2.6 All I/O wiring that requires a transition to a different conductor to meet electrical code requirement shall be executed using a terminal strip. Screw on (Marret) connections are not acceptable for any connection other than to connect low-voltage pigtails at the device end (e.g., thermistors, 24VAC/VDC transducers, actuators etc.).

10.2.7 Low voltage I/O wiring may be mixed together within a conduit.

10.3 Controls - Power Wiring

10.3.1 Provide power wiring and transformers and grounding to each controller and component as per the

manufacturer's specification.

10.3.2 Each new Building Controller will have its own dedicated power supply. No other controller, I/O device, building power or lighting device will be powered from this supply.

10.3.3 Custom Application Controllers may share a common power supply, but this supply will not be used for any other device (e.g. I/O devices).

10.3.4 Power wiring shall not be mixed with I/O wiring in a conduit.

10.3.5 Use plenum cable where permitted by codes, but run wire in rigid conduit in the following areas:
a. mechanical or electrical rooms,
b. where exposed in finished areas,
c. where subject to physical damage.

11 CONTROLS - STRATEGIES AND SOFTWARE PROGRAMMING

11.1 Define and commission new points, and provide software which results in proper operation of all connected equipment in a timely fashion. Correct any malfunctions immediately.

11.2 Prevent short cycling of equipment, prevent potential freezing, and produce alarms for all unusual conditions which can have adverse effects on equipment or comfort.

11.3 Ensure that existing weekly and annual run schedules remain in effect for all equipment as new software is implemented.

11.4 Ensure that existing set points remain in effect for all equipment as new software is implemented, unless new set points are defined in the Sequences of Operation below.

11.5 Basis of Design: The primary purpose of this project is to provide demand controlled ventilation for the oxy-acetylene work stations.

11.6 The human interfacing with the system will be approved by CAMOSUN. At the least, a high level password should be required for access to set points, changing points from automatic to manual, programming, etc.

11.7 The Contractor is required to develop, simulate/test and implement the strategies below.

11.8 Sequences of Operation :

11.8.1 The sequences described herein are not intended to be complete. Prevent short cycling of equipment, prevent potential freezing, and produce alarms for unusual conditions which can have adverse effects on equipment. All modulating points and set points shall be trended once every 3 minutes. All digital points shall have change of state recorded. Allow for ongoing programming refinements to improve the strategies, based upon discoveries in the first hours, days and weeks of

DDC operation, and to achieve proper operation, as judged by the Engineer. All new output points shall be programmed by the Contractor in accordance with the design intent.

11.8.2 EF-30 on/off & status RY; CT EF30
11.8.2.1 Fan to be enabled when movement is sensed at any table. Minimum on-time 2 minutes.

11.8.3 EF-30 VFD & Feedback EF30 FS
11.8.3.1 Speed drive to be controlled so that each open damper increases airflow at fan by approximately 1530 cfm (note if all hoods open, the total flow will be only 9000 – this allows for a diversity factor)
11.8.3.2 Alarm to report fan failure.

11.8.4 Table Dampers TA
11.8.4.1 Each damper will open whenever any of the 4 occupancy sensors served senses occupancy. Damper to stay open for 2 minutes after last occupancy sensed.

11.8.5 MAU-30 on/off & status RY; CT MAU30
11.8.5.1 Fan to be enabled whenever shop building pressure is less than -12 Pa, or shop temperature is less than 14C. Minimum on-time 2 minutes.

11.8.6 MAU-30 VFD MAU30FS
11.8.6.1 Speed drive to be controlled so that space pressure set point of -8 Pa is maintained.
11.8.6.2 Alarm to report fan failure.

11.8.7 MAU-30 Electric Heat MAU30H
11.8.7.1 If MAU-30 fan is on, and shop space temperature drops below 15C, or if SAT <17C, then enable first stage SCR to maintain SAT = 18C.
11.8.7.2 If SAT< 17.5, then stage 2
11.8.7.3 If SAT< 17, then stage 3
11.8.7.4 If SAT< 16.5, then stage 4
11.8.7.5 If SAT< 16, then stage 5
11.8.7.6 If SAT< 15.5, then stage 6
11.8.7.7 If SAT< 15, then stage 7
11.8.7.8 If SAT< 14.5, then stage 8

11.8.8 Existing AMU-1,2 & 8 Enable Weld Shp AMU*
11.8.8.1 If MUA30 is on, and space pressure drops 5 Pa, 10 Pa, 15 Pa, turn on AMU 1, 2 and 8 respectively.

11.8.9 Existing AMU-1,2&8 Heat Weld ShpAMU*HCV
11.8.9.1 If AMU is on, then maintain space temp set point in accordance with weekly schedule

12 COMMISSIONING

12.1 Scope of Work

12.1.1 Coordinate with separate Commissioning Agent (hired by CAMOSUN), but be responsible for commissioning the proper control of all equipment supplied or wired under this contract. Commissioning is the process of assuring and verifying that the installation is functioning fully in accordance with the contract documents design intent. The following tasks must be performed:

a. Prepare all functional testing criteria (including specific documentation) for all new controls.
b. Submit all testing documentation to the Consultant for review (with Shop Drawings).
c. Attend all commissioning meetings as required by the Consultant.
d. Execute or delegate all commissioning tasks as set out in the final functional testing criteria documents.
e. Participate in troubleshooting those systems that do not meet the functional testing criteria and provide all necessary follow up testing and documentation.
f. Include completed functional test documentation in the final Commissioning Report.

12.2 The Controls Contractor shall provide advance notice to the Commissioning Agent before carrying out end-to-end checks of the control systems so that the Commissioning Agent may be present while the tests are being carried out.

12.3 Check lists shall include end to end check out sheets.

12.4 The required submittals are summarized below:

a. Contractor Submittal Drawings and Equipment Data
b. Pre-start/Start-up Checklists by contractor's commissioning agent
c. Functional Performance Test Checklists by contractor's commissioning agent
d. Commissioning Report
e. As-built line drawings
f. O&M Manuals

12.5 The Controls Contractor shall provide functional test plans and submit a draft for approval with shop drawings. Written, repeatable test procedures to prove proper function shall be described. The Consultant/Engineer shall review and approve the plans subject to incorporation of recommended amendments.

12.6 The start-up and checkouts must be clearly documented according to the respective manufacturer's written instructions and the Contract Documents. Once the start-up is successful, the Contractor shall conduct the functional test. These tests must be documented to clearly describe the following:

a. the individual test procedures,
b. the expected system response or acceptance criteria for each procedure,
c. the actual response or findings,
d. pertinent comments.

12.7 Commissioning Execution

12.7.1 Each control sequence and strategy shall be tested, verified and documented by the Contractor, including:

a. start-up,
b. shut down,
c. auto and manual modes,
d. modulation up and down over unit's range of capacity,
e. component staging,
f. power failure and backup/restart,
g. interlocks,
h. alarms,
i. sensor calibration.

12.7.2 Verify that temperature sensors are situated out of sun, direct supply air, process heat and dead air regions.

12.7.3 Verify that duct and pipe temperature sensors are mounted correctly, and are thermally isolated/insulated to sense the correct average temperature of flow.

12.7.4 Calibrate all sensors/transducers in project area and ensure proper operation.

12.7.5 Set-up weekly and annual run schedules for all equipment as determined in consultation with the Engineer, and as described herein.

12.7.6 Set-up run time totalizers for all digital outputs and digital status points.

12.7.7 Set-up trendlogs for all analog inputs, set points and PID controllers. Submit printed trendlogs and run time totals for all equipment for one week of system operation prior to total completion of work.

12.7.8 Set-up alarms for failure of all controlled devices and significant deviation from set points.

12.7.9 PID or PI Controllers: Tune each controller for accurate operation without oscillation, hunting, dithering or end-stop dithering. Actuator movement should not occur before the effects of the previous movements have had enough time to affect the sensor (e.g., 10 minutes for an RTS or 1 minute for an MAT sensor). Movement of the respective dampers is not required if space temperature is within 0.5 deg C of setpoint, or when MAT is within 1 degree of set point.

12.7.10 Verify correct sensor scale ranges.

12.7.11 Verify that new outputs which are in manual mode are investigated, resolved, and placed in auto.

12.7.12 Verify that areas which are not under 24/7 operation have appropriate schedules and setbacks.

12.7.13 Verify that set points are appropriate. Review any problems with Engineer.

12.7.14 Verify that control strategies are effective and efficient.

12.8 Controls contractor shall commission the entire installation and verify correct operation and full systems' performance according to the design intent. Rectify any defects. Produce a report detailing performance and accuracy of all field devices and submit to the Engineer for approval. Provide panel printout (.pdf) (including programs) and 48 hours of trend logs on all outputs to Engineer at completion of installation. Include a copy of the program in the O+M Manual, together with detailed instructions on how to access the system.

12.9 Training

12.9.1 Demonstrate all sequences of operation and trend graphs to personnel designated by the Engineer. In addition, provide 4 hours of basic Owner training on operation of the system, including

a. DDC system overview,
b. hardware descriptions,
c. manual over-rides,
d. software and graphics, set point reviews,
e. reviewing and trending space temperature and RH,
f. demonstration of stability of temperatures and airflows
g. alarms and reaction procedures;
h. energy features;

13 TAB & COMMISSIONING

Note: Commissioning work may be carried out by a separate Commissioning Agent, or by the Testing & Balancing Contractor.

13.1 Scope of Work

13.1.1 Be responsible for the commissioning of all equipment supplied under this contract including new exhaust fan, speed drive, control dampers, and DDC controls. Commissioning is the process of assuring and verifying that the installation is functioning fully in accordance with the contract documents design intent. The following tasks must be performed:

13.1.2 Prepare all functional testing criteria (including specific documentation) for all new controls, dampers as well as the exhaust fan speed drive.

13.1.3 Execute or delegate all commissioning tasks as set out in the final functional testing criteria documents.

13.1.4 Participate in troubleshooting those systems that do not meet the functional testing criteria and provide all necessary follow up testing and documentation.

13.1.5 Submit completed functional test documentation for inclusion into the final Commissioning Report.The required submittals are summarized below:

a. Contractor Submittal Drawings and Equipment Data
b. Pre-start/Start-up Checklists by contractor's commissioning agent
c. Functional Performance Test Checklists by contractor's commissioning agent
d. Commissioning Report by contractor's commissioning agent
e. Air Balance Report by contractor's commissioning agent
f. As-built drawings
g. O&M Manuals prepared by contractor's balancing agent.

13.1.6 Written, repeatable test procedures to prove proper function shall be described. The start-up and checkouts must be clearly documented according to the respective manufacturer's written instructions and the Contract Documents. Once the start-up is successful, the Contractor shall conduct the functional test. These tests must be documented to clearly describe the following:

a. the individual test procedures,
b. the expected system response or acceptance criteria for each procedure,
c. the actual response or findings,
d. Pertinent comments.

13.2 Commissioning – Execution

13.2.1 The Commissioning Agent shall assign one person, experienced and qualified in commissioning control systems through practical experience and a comprehensive knowledge of the interactive nature of HVAC systems and DDC controls, to verify the performance of the control systems by conducting random tests of the control sequences until he is satisfied that the controls are performing according to the intention of the Controls Specification.

13.2.2 The Controls Contractor shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Controls Contractor in good working order at the completion of the commissioning process. The Controls Contractor shall cooperate fully with the Commissioning Agent and work together to obtain a fully operating system, providing additional technicians and trades people to assist the designated commissioning person as required.

13.2.3 Each control sequence and strategy shall be tested, verified and documented by the Contractor, including:

a. start-up,
b. shut down,
c. auto and manual modes,
d. successful occupancy sensing at each worktable of each workstation
e. modulation up and down over unit's range of capacity,
f. component staging,
g. power failure and backup/restart,
h. interlocks,
i. alarms,
j. sensor/calibration.

13.2.4 Inspect the Test and adjust flows of each hood thru normal operating range of speed drive to meet those indicated. Clearly mark and permanently set all dampers. First measure air flow thru canopy hood at exhaust fans minimum speed with only 2 hoods open, then measure airflows in canopy hoods with 6 hoods open at 100% fan speed , finally measure and record airflows through all hoods with all hoods open at 100% fan speed. Note: the DDC control system is programmed to ensure that at minimum fan speed there will always be at least 2 hoods with open control dampers.

13.2.5 The intention of the system is to maintain a design airflow of 1530 cfm for each hood that is open up to a maximum of 6 hoods (with any combination of 2 to 6 hoods served by the system).

13.2.6 The system has been designed with a 60% diversity factor (6 out of 11 hoods open at any given time). When more than 6 hoods are open the diversity is exceeded and the resulting airflow thru each hood will fall below the design airflow (1530cfm/hood) and should be balanced roughly equally between all the open hoods.

13.2.7 Fill out checklists and submit to the consultant a written deficiencies report on any equipment or installation deficiencies, including, but not limited to, objectionable noise, significant air leakage, poor alignment of components causing unnecessary resistance to air flow, components not functioning as per design intent.

13.2.8 Provide variable sheaves and adjust new motors' performance as required.

13.2.9 Ensure proper operation of exhaust fan EF-30 and it's variable speed drive motor by the control system.

13.2.10 Verify safe and proper operation of the exhaust fan system.

13.3 Report

13.3.1 Include as-built schematics and detailed results of all measurements and settings.

13.3.2 Provide with full O+M manual for all equipment. Submit 3 copies in 3-hole binders with shop drawings, switchgear locations and identification, maintenance procedures and schedules, and warrantees.

13.3.3 Provide the following measurements with the other report requirements:

a. All air flows (hood airflows below and above design diversity)
b. Pressures and differential pressure
c. RPM
d. Voltage and Amperage per phase.

END