

SECTION 23 09 05

LABORATORY AIRFLOW CONTROL SYSTEM

PART 1 - GENERAL

- A. Division 23 00 00 Heating, Ventilating and Air Conditioning (HVAC)
 - 1. Section 23 - Testing, Adjusting, and Balancing for HVAC
 - 2. Section 23 - Commissioning of HVAC
 - 3. Section 23 - DDC System for HVAC

1.1 SCOPE

- 1. Where required: IV Prep Suite. See drawings for location, airflow, valve schedules, and pressurization requirements.
 - 2. Furnish and install a Laboratory Airflow Control System (LACS) in conjunction with the central Building Automation System (BAS) to maintain laboratory room supply and exhaust airflows, room ventilation rates, room static pressurization, room ambient temperatures and humidity's and the laboratory exhaust system functionality as specified herein and Section 23 0923.
 - 3. The LACS shall ensure that all CAV fume hood exhaust airflows are maintained as required and as indicated in the project plan schedules.
 - 4. The LACS shall ensure that all biological safety cabinets, glove boxes and/or other required exhaust airflows listed in the project plan schedules are maintained.
 - 5. The LACS shall provide the laboratory emergency control modes as detailed in this specification.
 - 6. The LACS shall comply with the functional requirements of U.S. OSHA 29 CFR, NFPA 45, AIHA Z9.5, and VA Design Guide.
 - 4. Comply with ASHRAE 135-2010 BACNet: A Data Communication Protocol for Building Automation and Control Networks.
- B. The LACS shall include all isolation or critical room supply and exhaust airflow terminals, reheat coils, reheat coil valves, air terminal actuators, sensors, associated instrumentation and the control units and associated interconnecting wiring and pneumatic tubing. Any and all associated components required to implement a

fully functioning and integrated system as specified herein shall also be provided. System verification and other documentation as specified under the commissioning plan section shall also be included.

- C. All LACS data shall be capable of being accessed by authorized persons via the facility BAS network as well as via the Intranet using standard web browsers to obtain LACS data in graphical form as well as in specific user defined and configured LACS summary and status reports.

1.2 QUALITY ASSURANCE REQUIREMENTS

- A. LACS components shall be the standard catalogued products of the LACS supplier and shall be the most recent product design that complies with the specified requirements.
- B. The manufacturer of the LACS shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing) and ISO-140001 (The application of well-accepted business management principles to the environment). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.
- C. The LACS supplier shall have a fully staffed support facility within 150 miles of the project site with fully qualified, factory trained technical support personnel, spare parts and all necessary test, diagnostic and service equipment.
- D. The complete installation of the LACS shall be the responsibility of the LACS supplier and the checkout, startup and verification of specified performance of the LACS shall be by factory trained employees of the LACS supplier.
- E. Provide UL 864 - UUKL Smoke Control, where controllers and networks are used for that purpose.
- F. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.
- G. Preinstallation Meetings:

1. The LACS representative shall review the proper installation of the system with the sheet metal contractor and the BAS contractor.

H. Project Installation Phase:

1. The LACS representative shall make periodic visits to the project jobsite to assure that the system is being installed properly to assure optimal performance and that the location and orientation of the control valves is consistent for proper operation and future owner maintenance. Any discrepancies shall first be brought to the attention of the appropriate subcontractor. If no action is taken by said contractor, the representative shall bring these issues to the project manager, engineer or owner's representative for resolution.

1.3 SUBMITTAL REQUIREMENTS

A. Refer to Division 01- Submittal Procedures.

B. The submittal documentation shall include.

1. Manufacturer's product data sheets including technical specifications of all LACS components including air terminals, sensors, actuators, reheat valves, control units, local monitors, etc. Where applicable the specifications shall include minimum and maximum flow rates, sound ratings, measurement device accuracies, operational ranges, etc.
2. A tabulation of all air terminals including types, sizes, air capacities, sound ratings, reheat coil ratings, etc.
3. A comprehensive list of all LACS input/output functions including all alarm and monitoring points.
4. Detailed descriptions of all LACS operational sequences.
5. Shop drawings showing LACS control unit configuration and wiring connection diagrams covering all LACS input/output interconnections and termination details.
6. Electrical characteristics indicating any field wiring which is to be performed by others, type of signal wiring, and installation methods including raceway type and grounding method.

7. Control drawings with graphic representation of system components. Identify controlled devices as referenced on plans with unique valve and damper tag numbers.
 8. Supply and exhaust air terminal certified sound data for both casing discharge and radiated sound levels from 125 through 8000 Hz as tested in accordance with ASHRAE/ANSI Standard 130, S12.12 or ARI Standard 880.
- C. Organize submittal with table of contents and tabs for each section arranged by logical groups of devices.
- D. Provide submittals for fast track items that need to be approved and released to meet the schedule of the project separately.

1.4 O&M MANUALS

- A. Refer to Division 01 - General Requirements.
- B. Operating and maintenance manuals shall provide descriptions of maintenance on all system components including sensors and controlled devices. These shall include Control Contractor's completion check list, inspection requirements, periodic preventative maintenance, cleaning methods and materials, troubleshooting guide, calibration instructions and tolerances, repair parts lists, and manufacturer representative's name, address, and phone number.
- C. O&M Manuals shall also include interconnection wiring diagrams with identified and numbered system components and devices.

1.5 RECORD DRAWINGS

- A. Refer to Division 01 - General Requirements.
- B. Submit revised shop drawings indicating all changes made during project including any changes to operating sequences or setpoints.
- C. Update control diagrams to include all tuning parameters and setpoints applicable to systems as depicted as of date of system completion. This information shall be incorporated with sequence of operation of each system.
- D. Record actual locations of control components including control units, temperature/humidity sensors, air terminals and any controlled devices on As-Built ductwork/piping plans provided by Mechanical Contractor

1.6 WARRANTY

- A. The Contractor shall warranty the BMS to be free from defects in workmanship and material for a period of one (1) year from the date of acceptance by the Owner. During the warranty period, the Contractor shall furnish all labor to repair or replace all items or components that fail due to defects in workmanship or material. This contractor shall also provide all system software upgrades during the warranty period.
- B. The Contractor shall provide an on-line troubleshooting service during the warranty period. The on-line system shall allow the contractor or owner's agent the ability to interrogate, troubleshoot and correct warranty defects remotely. This system shall be operational 24 hours a day, 365 days a year. If the local manufacturer's staff cannot resolve the problem, the corporate home office staff shall remotely connect to the system and troubleshoot the warranty defect.
- C. The Contractor shall submit a written report within 3 days of all warranty defects, the action taken, and corrections made for each warranty call.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials shall be new, unused and free from defects and imperfections.
- B. Laboratory temperature and airflow control system shall be stand-alone for each individual laboratory or laboratory support space. System shall not use or rely on information from controllers in other laboratory areas or from outside laboratory space to control functions within its laboratory.
- C. Electrically actuated terminal units shall be pressure stet with airflow accuracy of +/-5% over airflow range of terminal. Air terminal units shall be balanced to conform to requirements of Section 23 - Testing, Balancing, and Adjusting and as scheduled on the drawings.

- D. Unless indicated elsewhere herein, the lab airflow control system shall use volumetric offset to maintain room pressurization. Offset airflow is indicated for each lab on Air Terminal Device schedule.
- E. Control wiring shall meet requirements of specification 23 - Building Automation System.
- F. Control panels shall be located near entry to each lab. Coordinate location of control panel with all trades to provide access to panel for maintenance. Provide communications jack as part of or adjacent to space temperature sensor to allow communication between laptop computer and control panel. Provide one control panel for each lab.

2.2 AIR TERMINAL DEVICES - AIR MEASURING

A. SINGLE BLADE DAMPER

- 1. Terminal/flow package will require AMCA610 Certification
- 2. Terminals shall have a single blade damper for airflow adjustment and shall provide the individual airflow capacities indicated in the project airflow schedules. Terminal airflow shall be pressure independently controlled using actual independent airflow measurement feedback as an integral part of a closed loop control process. Units not conforming to all construction and performance criteria listed herein will be rejected
- 3. Terminal units shall be factory tested as a complete system (terminal units, actuation, flow sensor/transmitter, controls).
- 4. Minimum airflow sensor measurement accuracy shall be +/- 5% of actual airflow over the entire design airflow range of each air terminal. Airflow measurement accuracy substantiation by a qualified independent test agency shall be available upon request.
- 5. Airflow transmitter shall be factory mounted on the terminal and shall include the necessary signal conditioning/transmitter instrumentation to provide an output proportional to the velocity

pressure. Transmitter shall have an accuracy of at least $\pm 0.5\%$ of the transmitter range and a drift no greater than 0.5% full scale/year. Transmitters shall have an appropriate range and resolution for effectively measuring the required flows. High and low limits shall be fully adjustable.

6. All airflow measurement signals shall be made available to the BAS.
7. Autozero modules (AZM) shall be provided for all supply and general exhaust terminals. The AZMs shall consist of an auto-zero solenoid that connects to the air velocity pressure transducer's inlet ports for enabling automatic periodic re-calibration to ensure drift-free airflow measurement. Automatic re-calibration shall occur at a minimum every 24 hours without airflow disruption to the space. Manufacturer's not providing autozero modules responsible for automatic self calibration, without disruption of airflow to the space, shall be responsible provide on-site recalibration service.
8. All single blade damper air terminals shall have a wide open pressure drop less than $0.25''\text{wc}$ at airflow equivalent to 2000 fpm inlet duct velocity.
9. Discharge and radiated sound power level data shall be provided for each different size and type of air terminal as part of the submittal documentation. Sound power data shall be obtained in accordance with ANSI/ASHRAE 130-1995 Standard Methods of Testing for Rating Ducted Air Terminal Units. All sound data shall be obtained by a qualified, accredited and ARI approved testing laboratory.
10. Room supply air terminals :
 - a. Shall be constructed of 22 gauge galvanized steel with mechanically locked and gasketed seams and shall meet the mechanical standards of and be in compliance with UL 181 and UL 723, NFPA 90A, ESTM E84 and bacteria standard ASTM C665.

- b. Air terminal casings shall have 3/4" thick fiber-free closed cell foam insulation. Damper shafts shall be solid 1/2" diameter zinc-plated steel with self-lubricating polyethylene bushings and with external indication of the damper position.
- c. Terminal lining shall be fiber-free foam meeting NFPA 90A and UL181 requirements. Lining shall consist of closed cell structure foam allowing for disinfecting and hand washing with detergents and water.
- d. Damper blades shall be 22 gauge steel with a polyurethane foam gasket to enable tight shutoff where required for smoke control applications.
- e. Provide minimum four quadrant averaging Pitot tube array type of airflow sensor located upstream from all other air terminal components. Flow sensor shall have accuracy within 2% of flow at one duct diameter upstream straight duct run.
- f. Supply terminal units shall be capable of single gang airflow control of up to 7000 cfm per unit, with a single factory mounted reheat coil.

Terminal casing and damper leakage must not exceed the following when tested in accordance with ASHRAE 130-1996, "Methods of Testing for Rating Ducted Air Terminal Units" (Data must be included in submittal). Leakage rates are exclusive of reheat coils :

Unit Size	Casing Leakage			Damper Leakage		
	1.0" wc	3.0" wc	6.0" wc	1.5" wc	3.0" wc	6.0" wc
4	1	2	3	4	5	6
6	1	2	3	4	6	11
8	1	2	3	5	7	10
10	1	2	3	6	7	10
12	1	2	4	8	12	19
14	2	3	5	6	10	16
16	2	4	7	13	21	38
18	3	6	12	98	154	305

11. Exhaust air terminals:

- a. General exhaust terminal casing, sensor and blade shall be constructed of 22 gauge galvanized steel. Damper shafts shall be ½" diameter stainless steel with self-lubricating Teflon bushings and with external indication of the damper position.
- b. General exhaust air terminals shall be provided with an orifice ring type of airflow sensor located upstream of the damper. Flow sensor shall have accuracy within 2% of flow at one duct diameter upstream straight duct run.
- c. All fume hood, glove box, and specialty exhaust terminals shall be constructed of 20 gauge, 316L stainless steel. Damper shafts shall be ½" diameter stainless steel with self-lubricating Teflon bushings and with external indication of the damper position.
- d. Fume hood, glove box, and specialty exhaust terminals shall be provided with an orifice ring type of airflow sensor located upstream of the damper. Flow sensor shall have accuracy within 2% of flow at one duct diameter upstream straight duct run.
- e. Airflow sensing techniques that may become inoperative due to accumulation of particulate or chemical deposits or which can catch debris and obstruct exhaust airflow may be inappropriate for fume hood exhaust applications. Such sensors include pitot tubes, vortex shedders, thermal anemometers and other devices that protrude into the center of the exhaust air stream. Terminals using this type of flow sensing technologies must be pre-approved prior to bid.
- f. Terminal casing and damper leakage must not exceed the following when tested in accordance with ASHRAE 130-1996, "Methods of Testing for Rating Ducted Air Terminal Units" (Data must be included in submittal) :

Exhaust Terminal Casing Leakage (CFM)							
Unit Size	1" WC	3.0"WC	6.0"WC	Unit Size	1.0" WC	3.0" WC	6.0"WC
4	0	1	3	10	1	3	4
6	0	1	3	11 / 12	1	2	3
7	1	2	4	14	1	3	5
8	1	2	4	16	1	3	5
9	1	2	4	18	1	3	5
Closed Blade Leakage, No Seals (Per ASHRAE 130-1996)							
Imperial Units (CFM, Inches Water)							
Unit Size	1.0" WC	3.0"WC	6.0"WC	Unit Size	1.0" WC	3.0" WC	6.0"WC
4	13	20	25	10	67	110	135
6	31	50	63	11/12	72	144	168
7	39	58	77	14	98	195	228
8	42	73	94	16	133	266	310
9	56	94	111	18	112	280	335
Blade Seal Leakage (Per ASHRAE 130-1996)							
Imperial Units (CFM, Inches Water)							
Unit Size	1" WC	3.0"WC	6.0"WC	Unit Size	1.0" WC	3.0" WC	6.0"WC
4	0	1	3	10	1	3	4
6	0	1	3	11/12	1	2	4
7	1	2	3	14	1	3	5
8	1	2	3	16	1	3	5
9	1	2	4	18	1	3	5

2.3 ROOM LEVEL CONTROLLERS

A. VAV/CAV GENERAL LAB ROOM CONTROLLERS (IV Prep Suite)

1. Laboratory room controllers shall provide closed loop pressure independent control of all laboratory room ventilation and ambient requirements. The laboratory room controller shall continuously monitor all the supply and auxiliary exhaust airflow devices including VAV fume hoods and specialty exhaust in the room.
2. Pressure control algorithm shall control supply and exhaust airflow devices in order to maintain a volumetric offset (either positive or negative). Offset shall be maintained regardless of any change in flow or static pressure. The offset shall be field adjustable and represents the volume of air which will enter (or exit) the room from the corridor or adjacent spaces.
3. Unless specifically indicated within Part 3, Sequence of Operation, volumetric offset shall be the only acceptable means of controlling room pressurization. Systems that rely on differential pressure as a means of control shall provide documentation that space pressurization can be maintained if fume hood sashes are changed at the same time a door to the space is opened.
4. Room ambient control (temperature, humidity etc.) and any other room control functions (lighting, IAQ etc.) shall be maintained by the controller as indicated in Part 3 Sequence of Operation
5. All laboratory room controllers shall include all inputs and control outputs necessary to perform the specified control sequences. Each laboratory room controller shall operate as a stand alone unit, performing its specified control responsibilities independently. All input point and control output point databases as well as the control programs shall be stored in non-volatile EEPROM, EPROM and PROM memory, or a minimum of 100-hour battery backup shall be provided.

6. Laboratory and Pressurized Room Controllers shall have available a SECURE MODE of operation, in which changes to any control parameter can only be made from designated terminals on BAS by authorized personnel, and not through the man-machine interface port.
7. Momentary or extended losses of power shall not change or affect any laboratory room controller setpoints or stored data. Upon resumption of power the controller shall resume full normal operation exactly as before without any need for manual intervention. Upon a power failure or operational failure within the controller, the air terminal shall automatically be positioned to the predetermined fully open or fully closed (failsafe) position as indicated on the air terminal schedules in the project plans.
8. All laboratory room controllers shall include the ability to accept a minimum of two dry contact closure inputs from an auxiliary source into the room control sequence for such purposes as occupied/unoccupied ventilation changeover, emergency mode sequences, etc.
9. All laboratory room controllers shall provide a general alarm output that may be used for auxiliary signaling or notification.

2.4 SPECIALTY EXHAUST CONTROLLERS

A. BIOSAFETY CABINET (DUCTED) EXHAUST FLOW CONTROLLER

1. Where required: IV Prep Glove Boxes.
2. Provide a UL 916 listed controller where shown on drawings for ducted Biosafety Cabinets (BSC). Exhaust air shall be controlled as indicated in Part 3, Sequence of Controls. The exhaust control process shall maintain exhaust at its respective setpoint in response to actual exhaust airflow measurement to ensure full pressure independent closed loop control using a proportional, integral and derivative (PID) control algorithm.
3. Controller shall be capable of receiving any status override functions as defined in Part 3, Sequence of Controls

4. The controller shall provide a continuous hardwired flow signal to the Lab Room Controller indicating exhaust airflow to ensure stand-alone flow tracking. If the control function is directly connected to the Biosafety Lab Room Controller, a dedicated controller is not required. Stand-alone controllers relying on the LAN or "assumed flows" for input to the Lab Room Controller are not acceptable.

2.5 TEMPERATURE SENSORS

1. Sensors shall be 10K ohm thermister type. Sensor shall include communicatin jack to allow remote programming of room controller via laptop computer. Temperature sensor shall include LED digital display and setpoint adjustment. Space temperature sensor shall allow for room temperature and room temperature setpoint input to BAS.

2.6 ROOM PRESSURE MONITORING SYSTEMS

- A. *Systems to be equal to TSI, Inc. Model 8630-SM PRESSURA Room Pressure Monitoring System. The system shall continuously measure, display and output (to the DDC system) the room pressure to meet the recommendations set forth in USP 800 Hazardous Drugs - Handling in Healthcare Settings and VA Design Guidelines for and Construction of Health Care Facilities and applicable VA design guidelines. System to consist of: through-wall pressure sensor (constant temperature thermal anemometer type); connector cable between sensor and monitor; wall-mounted room pressure monitor panel (with indicator lights, alphanumeric digital display indicating room pressure in inches of water, audible alarm, analog pressure output and alarm output to DDC system); Transformer. The controller shall be labeled for infectious isolation (negative pressure and no isolation (neutral)).*
- B. *Where a wall is not shared between an hazardous room or other room requiring differential pressure control and a corridor, provide extension tube with through-wall pressure sensor or provide two sensors at each wall and totalize the difference in pressure.*

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The LACS supplier shall install all control system equipment including controllers, sensors, damper actuators, fume hood sash sensors and fume hood operator display panels. This contractor shall install and terminate all low voltage control system wiring including wiring between each controller and between each controller and all control and sensing devices. This contractor shall also provide 24 VAC power where required by the control system and associated control devices.
- B. The electrical contractor shall provide 120 volt power in the laboratory ceiling spaces for connection to the laboratory control system equipment.
- C. The mechanical contractor shall install all supply air terminals, reheat coils, exhaust air terminals, air valves and interconnecting ductwork associated with the laboratory ventilation system
- D. Air Terminal and Control Valves
 - 1. LACS contractor shall furnish to Mechanical Contractor for installation air terminals, sound attenuators, reheat coils and access doors as shown on drawings and according to manufacturer's instructions.
 - 2. Mount actuators on same side of air terminal device as coil connections to ensure service access.
 - 3. Connect air terminals to ductwork with removable type joints as detailed.
 - 1. Provide access doors for supply air terminals with reheat coils. Mount access door at inlet side of coil. Refer to Section 23 - Ductwork Specialties for access door requirements.
- C. Control and Power Wiring:
 - 1. LACS manufacturer shall provide control wiring from laboratory control panel to and between other laboratory control system components as required for complete and proper functioning, including but not limited to air terminals, control valves, sensors, transducers, controllers, panels, and interface modules.
 - 2. Electrical Contractor will provide one spare 20-amp circuit at each emergency power electrical panel, serving laboratory. LACS supplier shall provide required conduit, wire, junction boxes, disconnect switches and circuit breakers as specified in Division

26 as required to wire electrical panel to each laboratory control panel.

D. Laboratory Control Panels and Power Supplies:

1. Mount laboratory control panels and power supplies in accessible location within laboratory room as shown on plans.
2. Coordinate location of electrical power panels with Division 26 Contractor.

3.2 CHECKOUT AND TESTING

A. Coordinate timing of start-up with Mechanical Contractor to confirm HVAC Systems are operating as specified.

B. System startup shall be provided by factory authorized representative of system manufacturer. All testing listed in this article shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner's representative is notified of the system demonstration. Start up shall include the following tasks:

1. Determine when the HVAC equipment and each room are ready for ventilation system operational testing.
2. Furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
3. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
4. Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules.
5. Alarms and Interlocks:
 - a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
 - b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

- c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.
- 6. Set up all room, and any required specialty exhaust, controllers and verify that all controlled parameters are being maintained at the required setpoint and that all associated operational aspects including measurement accuracies, alarm criteria, high-low limits, time delays, etc. are functioning in accord with the specified performance. The Testing Adjusting and Balancing (TAB) agent shall verify that all airflows are within the specified requirements and any departure from the specified performance shall be corrected and verified by the LACS to ensure all aspects of the control system are in full conformance with these specifications. The setup and verification process shall cover as a minimum:
 - a. Room supply and exhaust airflows and the room ventilation rate control.
 - b. Room emergency control sequences.
 - c. Laboratory facility centralized exhaust system static pressure, exhaust stack velocity and associated exhaust system functionality.
- C. All operational aspects of the LACS performance shall be formally recorded when verified and a copy of the recorded data shall be provided to the owner as part of the as-built documentation

3.3 SYSTEM DEMONSTRATION

- A. Demonstration
 - 1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.
 - 2. The tests described in this section are to be performed in addition to the tests that the contractor performs as a necessary part of the installation, start-up, and debugging process and as

specified in the "Checkout and Testing" article in Part 3 of this specification. The engineer will be present to observe and review these tests. The engineer shall be notified at least 10 days in advance of the start of the testing procedures.

3. The demonstration process shall follow that approved in Part 1, "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.
4. The LACS supplier shall provide a functional demonstration on the LACS operation to owner designated representatives as well as other interested participants which may include the architect, engineer, as well as the general and mechanical contractors. This demonstration shall include any LACS control sequences selected by the owners representatives and may cover several laboratory rooms.
5. LACS manufacturer shall demonstrate that, with specified room offset, system maintains proper room directional air flows under both static and dynamic operating conditions, and can recover to proper flow direction upon change in room/system conditions such as raising and lowering of any hood sashes or room occupancy conditions. Verification shall be provided by temporary visual indication, using smoke wand. If performance requirements can not be demonstrated, unless due to circumstances beyond the control of the contractor, then laboratory control system manufacturer shall be responsible for any costs and labor necessary to meet minimum performance requirements. Coordinate with and work in conjunction with TAB Contractor.
6. Demonstration shall also include (but not limited to) exhaust system functionality, emergency functions and associated local monitoring provisions as well as required BAS monitoring and alarm reporting.
7. The day for this demonstration shall be established by the owner's representatives in conjunction with the other participants

B. Acceptance

1. All tests described in this specification shall have been performed to the satisfaction of both the engineer and owner prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if stated as such in writing by the engineer. Such tests shall then be performed as part of the warranty.
2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1, "Submittals."

3.4 TRAINING

- A. The laboratory ventilation control system contractor shall provide on-site instruction for up to six (6) owner designated personnel covering all aspects of the operation and use of the LACS including operator interface, control parameter setpoint adjustment, alarm limit and time delay adjustments, point trending, automatic startup, shutdown and changeover scheduling as well as the manipulation and utilization of all associated LACS monitoring and control functions. The training shall be augmented an operational manual for each attendee and shall also include the recommended procedures to verify the proper functioning of the LACS. Instructors shall be highly qualified factory trained personnel who reside at the local branch office of the LACS supplier and who are thoroughly familiar with all aspects of the overall subject matter and this specific facility's LACS. All training shall be provided on weekdays during the normal daytime working hours of the facility operations personnel.
- B. Training shall consist of not less than 24 hours for designated personnel and shall include:
 1. A thorough walk-through of the facility to identify LACS controls and controlled equipment.
 2. Explanations of the LACS system, its operation and user interaction.

3. Explanation of the control sequences for room, fume hood, biosafety cabinets, and any other specialty exhaust systems part of this project.
 4. Explanation of adjustment, inspection and test procedures.
- C. Additional specialized operational training courses shall be made available to facility personnel covering the LACS and its components.

3.5 BUILDING AUTOMATION SYSTEM INTERFACE

- A. A. Where applicable the following laboratory ventilation and environmental information shall be provided to the BAS:
1. Laboratory room supply airflow (cfm) or (l/s) and high / low alarm.
 2. Laboratory room general exhaust airflow (cfm) or (l/s) and high / low alarm.
 3. Laboratory room differential airflow (cfm) or (l/s).
- B. Information may be communicated by means of protocol translators or by seamless LAN connections. As an option the LACS supplier may provide the information by individual direct connections (hard wired inputs). If the direct connection approach is used the LACS supplier shall be responsible for all interconnecting wiring and any additional BAS and LACS system control panels that may be required to accept these inputs. If the communications approach is used the LACS supplier shall be responsible for all network wiring and any protocol translators required by the BAS and LACS.
- C. The LACS system shall accept the following control inputs from the BAS:
1. Laboratory room airflow tracking offset setpoint adjustment.
 2. Laboratory room ambient temperature / humidity setpoint adjustment.
 3. Occupied/Unoccupied state of the laboratory room for room control mode changeover

3.6 CONTROL SEQUENCES OF OPERATION

E. Ducted STET (IV Prep Glove Boxes)

1. This control sequence applies to Biosafety Cabinets (BSC) ducted to a central exhaust system
2. Each STET has an individual exhaust terminal connected to a central fan to maintain an "on" or "off" flow setpoint through inputs described below.
3. The STET control as defined herein can either be performed directly as inputs to the lab room controller or as a stand-alone controller. If a stand-alone controller is used, a hardwired signal indicating BSC exhaust flow shall be provided to the room controller. Due to the criticality of the room pressure relationship, BSC controllers sending flow information across a local area network (LAN) to the room controller will not be accepted.
4. Steady State Operation
 - a. BSC exhaust airflow shall be controlled to "on" or "off" setpoints based on hardwired inputs from the BSC.
5. Fail-safe Operation
 - a. Momentary or extended losses of power shall not change or affect any BSC controller setpoints or stored data. Upon resumption of power the BSC controller shall resume full normal operation exactly as before without any need for manual intervention. Upon a power failure or operational failure within the BSC controller, the BSC exhaust air terminal shall be automatically positioned to the fully open (failsafe) position.

F. CAV General Laboratory - Airflow Tracking

1. This control sequence applies to general laboratory spaces and support spaces with supply and exhaust laboratory airflow terminal devices for providing flow tracking pressurization control with constant or two position flow setpoint.
2. Each room consists of a single supply and exhaust laboratory air terminal or multiple combinations.
3. Steady State Operation - Normal
 - a. Steady state operation mode is set to airflows scheduled on drawings for supply, return, and exhaust valves.

4. The room can be manually started or shutdown, via the BAS, as required for operational and maintenance needs.
5. Degrade Operation - Air flow control
 - a. If the central exhaust system is loaded to the extent that the general exhaust or fume hood exhaust flows fall short of the setpoint, the controller shall continue to maintain the scheduled offset between total supply and total exhaust flow.
6. Power Interruption Mode
 - a. When there is a power interruption to the supply or exhaust air distribution system for the suite then the room will go into a shutdown mode. Startup will follow the planned startup operation for the suite.

G. ALARMS AND LIMITS

- H. Refer to points list for alarm points. Alarm points and appropriate message to be segregated and classified to complement facility protocols and procedures.

3.7 Points List

System: CAV Laboratory - Airflow tracking with BSC Exhaust												
Point Identification		Inputs		Outputs		Failsafe/ De-energized	Alarm	Trend	Archive	Secure Mode	Remarks	Notes
Description	Point Label	Digital	Analog	Digital	Analog							
General exhaust air flow	GXF		X				X	X				1
Gen exhaust air flow control	GXFC				X	NO						

System: CAV Laboratory - Airflow tracking with BSC Exhaust													
Point Identification		Inputs		Outputs		Failsafe/ De-energized	Alarm	Trend	Archive	Secure Mode	Remarks	Notes	
Description	Point Label	Digital	Analog	Digital	Analog								
Gen exhaust airflow setpoint												2	
Min exh airflow setpoint												2	
Max exh airflow setpoint												2	
Supply air flow	SAF		X				X	X				1	
Supply air flow control	SAFC				X	NC							
Supply air flow setpoint												2	
Min supply air flow setpoint												2	
Max supply airflow setpoint												2	
Room differential airflow	OFFSET											2	
Room diiff airflow setpoint	OFFSPT											2	
Misc room exhaust air	unique		X								Label each accordingly	3	

System: CAV Laboratory - Airflow tracking with BSC Exhaust												
Point Identification		Inputs		Outputs		Failsafe/ De-energized	Alarm	Trend	Archive	Secure Mode	Remarks	Notes
Description	Point Label	Digital	Analog	Digital	Analog							
flow												
BSC exhaust airflow	BEX		X				X					1
BSC exhaust airflow control	BEXC				X	NO					Verify best failsafe mode	
Min BSC exh airflow setpoint	BEXLO											2
Max BSC exh airflow setpoint	BEXHI											2
BSC Setback Mode	FHMODE	X						X				
BSC Setback Mode LO	LO											4
BSC Setback Mode HI	HI											4
Component Failure							X	X				
General Alarm	GALM			X			X	X			FHC general alarm	

Notes: All points listed shall be available to/from the BAS. All points labeled shall be available for graphical representation within the BAS. All points alarm points shall have alarm limits available to the BAS

1. Systems that do not measure actual airflow shall provide the following three physical points in lieu of the airflow point - actuator position - AI, High airflow pressure switch - DI, Low airflow pressure switch - DI. Both pressure switches shall provide an alarm
2. Calculated value or software point.

3. Address miscellaneous exhaust airflows as required. For devices where fixed values in lieu of actual airflow measurement is allowed, simply indicate as a software point (note 2).
4. BSC Monitor displays LO, HI, or CFM.

- - - END - - -

Harry S. Truman Memorial Veterans' Hospital
Expand Ambulatory Care Addition
VA Project No. 589-333

Construction Documents
Bid Set

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