PART 2 - PRODUCTS REQUIREMENTS CONTINUED

2.01 MSTP CABLING

A. BLN:

1. Cable utilized on an MS/TP BLN shall be a 24 gauge stranded, twisted pair low capacity [CM] cable in an orange jacket.

   i. 24 AWG STR TSP LOCAP CM ORANGE JACKET

B. FLN:

1. Cable utilized on an MS/TP BLN shall be a 24 gauge stranded, twisted pair low capacity [CM] cable in an **orange and blue** jacket.

   i. 24 AWG STR TSP LOCAP CM ORANGE JACKET W/ BLUE STRIP

2.02 FIELD DEVICES

A. All sensors will be engineered to accuracy and tolerance levels specific to their application by the Mechanical Engineering firm designing the project. They will be commissioned by the commissioning firm for accuracy and performance related to actual use. The submittal of the sensors used during a project will be reviewed by the Mechanical Engineering firm prior to submittal to WSU FS.

Sensor ranges will be selected to avoid a sensor failure or out of range, even when HVAC equipment failure or mechanical failure has occurred.

B. Temperature Sensors:

1. All temperature sensors will be scaled to a temperature range to avoid a sensor failure or out of range, even when HVAC equipment failure has occurred.

2. Sensor signal ranges.can be 0-10 VDC, 4-20Ma and Siemens provides a direct resistance circuit on curves for RTD’s that have been approved for use at WSU.

3. Liquid immersion temperature sensors will be installed in dry wells. Conductive thermal paste will be applied to the sensor and dry well to insure conductivity.

4. Duct (single point) temperature sensors will be used in locations where coil or mixed air stratification are certain to not be issues. Such locations include after a fan or blower.

5. Duct Average temperature calculations will be applied to locations where mixed air or coil stratification are an issue. Because of issues measuring mixed air in

particular, more than one sensor may be required, accurate measurement of this plenum is important.. A calculation based on air quantity and velocity on 2 or more sensors may be applied.

6. Outside air sensors will be installed in a manner that will prohibit them from being influenced by sources other than the outdoor ambient temperature.

   Outside air sensors will be installed on the north side of facilities. They will include a reflective shield to cover the sensor when implemented.

   Unless otherwise approved, one of these sensors will be installed in any controller that uses them to control equipment. They will not pass information across network to control. No sensor will do this unless approved.

7. Other temperature sensors will be submitted for review and approval by both the WSU Control Shop and Facilities Services Engineering.

C. Liquid Static Pressure Transmitters:

1. Will be engineered to range, accuracy and tolerance levels appropriate to the specific application by the Mechanical Engineering firm designing the project. They will be commissioned by the commissioning firm for accuracy and performance related to actual use.

2. The sensor output will be 4 – 20 mA DC unless the sensor is close enough to the measuring device that voltage drop is not an issue, then 0-10 VDC may be the signal output.

3. Zero and Span calibration adjustments and procedures will be made available on and with these units.

4. These devices will be engineered to be capable of functioning, without failure, under the total static pressure of the system they are employed upon.

5. Liquid Differential Pressure:

6. Will be engineered to range, accuracy and tolerance levels appropriate to the specific application by the Mechanical Engineering firm designing the project. They will be commissioned by the commissioning firm for accuracy and performance related to actual use.

7. Liquid Differential Pressure sensors for use on close tolerance devices such as a flow venturi require a Rosemount 3015 Coplanar Pressure Transmitter or approved equal.

8. The sensor output will be 4 – 20 mA DC unless the sensor is close enough to the measuring device that voltage drop is not an issue, then 0-10 VDC may be the signal output.

9. Zero and Span calibration adjustments and procedures will be made available on and with these units.

10. Differential Pressure Sensors: 3-valve isolation manifolds (supply, return, and equalizing) are required.

11. These devices will be engineered to be capable of functioning, without failure, under the total static pressure of the system they are employed upon.

12. Static inlet pressures $\leq$ 150 psig: Remote wired pressure sensors with plug in cables.

13. Static inlet pressures > 150 psig: Single element sensors are required.

D. Static air pressure and air differential pressure sensors:

1. Will be engineered to range, accuracy and tolerance levels appropriate to the specific application by the Mechanical Engineering firm designing the project. They will be commissioned by the commissioning firm for accuracy and performance related to actual use.

2. The sensor output will be 4 – 20 mA DC unless the sensor is close enough to the measuring device that voltage drop is not an issue, then 0-10 VDC may be the signal output.

3. Zero and Span calibration adjustments and procedures will be made available on and with these units.

E. Humidity and Moisture Sensors:

1. Will be engineered to range, accuracy and tolerance levels to be applicable to the application by the Mechanical Engineering firm designing the project. They will be commissioned by the commissioning firm for accuracy and performance related to actual use.

2. The Mechanical Engineering firm designing the project will be responsible for establishing the control set points and limits to assure the control of humidification and moisture do not exceed saturation levels and maintain the required air moisture levels required by the project whether using RH, moisture quantity in the air or other means.

3. The sensor output will be 4 – 20 mA DC unless the sensor is close enough to the measuring device that voltage drop is not an issue, then 0-10 VDC may be the signal output.

4. Zero and Span calibration adjustments and procedures will be made available on and with these units.

F. Flow Meters- Insertion, Magnetic and Ultrasonic

1. Will be engineered to range, accuracy and tolerance levels to be applicable to the application by the Mechanical Engineering firm designing the project. They will be commissioned by the commissioning firm for accuracy and performance related to actual use.

2. The Mechanical Engineering firm designing the project will be responsible for establishing the control set points and limits to assure the control of flow rates do not exceed the meter range and piping velocity standards.

3. The sensor output will be 4 – 20 mA DC unless the sensor is close enough to the measuring device that voltage drop is not an issue, then 0-10 VDC may be the signal output.

4. Zero and Span calibration adjustments and procedures will be made available on and with these units.

G. Control Valves:

1. Globe / Characterized Ball Valves: 2” - 6”:

i. Range: 40:1(minimum)

ii. Flow characteristics: Modified, Equal Percentage, (Linear Control Valves are to be used on steam applications.

iii. Control action: Normal Open or Closed, as selected

1) Normal Open valves on Heating Water
2) Normal Closed valves on Chilled Water unless the chilled water valve is inline with a process cooling application. The control valve will be then fail open.
3) Steam Valves will be engineered as linear valves and the actuator will be protected against heat by insulation means and as possible by setting the actuator in a position not directly above the steam valve and piping.

iv. Medium: Steam, water, glycol

v. Body type: Screwed ends 2” and smaller, flanged Valves 2½” and larger

vi.	Body material:	Bronze
vii.	Body trim:	Bronze
viii.	Stem:	Stainless Steel
ix.	Actuator:	0-10 VDC, 4-20 MA or 2 position Voltage 24VAC/120 VAC If a clean dry control air source is available and the control process variable will require an excessive number of starts on an electric actuator, a Pneumatic Valve and actuator may be implemented.
x.	Stem:	Stainless Steel

2.03 MISCELLANEOUS DEVICES

A. Current Sensing Relay – Other equipment proof indication:

1. Provide solid-state, adjustable, current operated relay. Provide a Hawkeye Split Core Series current relay, which changes switch contact state in response to an adjustable set point value of current in the monitored A/C circuit. The relays should be set in such a manner to indicate that when a motor is unloaded such as when a belt is off or a coupler has failed, to indicate the loss of load on main or high priority level equipment. When this is not possible other means of equipment proof will be required. Proof indication methods will be reviewed by the Facilities Services, PM, CM, Control Shop and Engineering group.

   - Minimum Amperage range 0.5 A on smaller systems
   - Minimum Amperage range 2.5 A on larger systems

2. Provide for status device for all fans and pumps.

3. Output shall be contact closure.

B. Other means of proof indication.

1. Differential pressure switches may be used to indicate that a pump or fan is operating. The range of the switches will be engineered for the application and the switch will be set in such a manner to indicate that when a motor is unloaded

such as when a belt is off or a coupler has failed, to indicate the loss of load on main or high priority equipment. . Proof indication methods will be reviewed by the Facilities Services, PM, CM, Control Shop and Engineering group.

2. Sail switches may be used to indicate that a pump or fan is operating. The range of the switches will be engineered for the application and the switch will be set in such a manner to indicate that when a motor is unloaded such as when a belt is off or a coupler has failed, to indicate the loss of load on main or high priority equipment. . Proof indication methods will be reviewed by the Facilities Services, PM, CM, Control Shop and Engineering group.

C. CO_2 sensors

1. Range: Range 0-2000 ppm
2. Response Time: 60 seconds for 90% step change
3. Accuracy: + 30 ppm (+ 2% of measured value)
4. CO2 – Demand – Controlled Ventilation control as applied to air handling units with mixed air will assume a maximum background level of 400 PPM. The control will not need to monitor outdoor CO-2 levels.
5. CO2 – Demand – Controlled Ventilation control as applied to individual rooms with air handling units with mixed air will assume a maximum background level of 400 PPM. The control will not need to monitor outdoor CO-2 levels will only be applied to spaces that are used at a high occupancy levels and that have in turn large variations in occupancy .
6. Control Dampers
7. Standard applications < 3000 FPM and 5” W.C. close off:
   i. Ruskin CD-46 or Honeywell D2 Ultra Low Class II Leakage Dampers
8. Applications < 4000 FPM and 8” W.C. close off:
   i. Ruskin CD-60 or Honeywell D1 Airfoil Extremely Low Leakage Class 1 Dampers

2.04 LABORATORY SUPPLY AND EXHAUST

A. Approval from WSU Integrated Engineering and Infrastructure Group (IEIG) is required for all Venturi valve applications other than fume hoods.

B. Siemens Building Technologies laboratory supply and exhaust:

1. Laboratory terminal units and/or Venturi air valves shall provide turndown ratios of 5 to 1 for fume hood exhaust terminals and adequate turndown for room supply and general exhaust terminals. Adequate turndown to assure that the airflows specified can be maintained. All terminals shall be controlled to be pressure independent and include actual airflow measurement feedback as an integral part of their control process. Minimum airflow measurement accuracy shall be +/- 5% of actual reading over the entire rated airflow range of each device. Minimum to maximum terminal airflow (or vice versa) shall be attained in less than 1 second.

2. Exhaust airflow measurement shall be provided by airflow sensing techniques that are not likely to obstruct the exhaust duct or become inoperative due to the accumulation of chemical deposits.

3. All supply air terminals shall be constructed of minimum 20 gauge-galvanized steel. Damper shafts shall be solid stainless steel with Teflon or Teflon infused aluminum bearings. Supply terminals must be capable of 100% shut-off to accommodate smoke control requirements. Supply terminal air leakage shall not exceed 2% of design airflow at 4 inches w.g. positive static pressure.

4. All general exhaust terminals shall be constructed of 316L stainless steel or coated with corrosion resistant Teflon (can also be 20 gage galvanized steel if required). Damper shafts shall be solid stainless steel with Teflon bearings.

5. All FHET (Fume Hood Exhaust Terminals) shall be constructed of 316L stainless steel or coated with corrosion resistant Teflon. Damper shafts shall be solid stainless steel with Teflon bearings.

6. All terminals shall have a pressure drop of 0.3 inch or less at the maximum rated airflow.

7. A loss, increase and/or decrease of airflow shall be transmitted to the fume hood or room controller as appropriate.

C. Alerton / Phoenix Lab Controls laboratory supply and exhaust:

1. For applications > 100 CFM, the airflow control device shall be a Venturi valve. Venturi valves shall not be used for applications $\leq$ 100 CFM.

2. The airflow control device shall be pressure independent over its specified differential static pressure operating range. An integral pressure independent assembly shall respond and maintain specific airflow within one second of a change in duct static pressure irrespective of the magnitude of pressure and/or flow change or quantity of airflow controllers on a manifold system.

3. No minimum entrance or exit duct diameters shall be required to ensure accuracy and/or pressure independence.

4. No rotational/axial orientation requirements shall be required to ensure accuracy and/or pressure independence.

5. The airflow control device shall maintain pressure independence regardless of loss of power.

6. The airflow control device shall be constructed of one of the following four types:

   i. Class A: The airflow control device for non-corrosive airstreams, such as supply and general exhaust, shall be constructed of 16-gauge aluminum. The device's shaft and internal “S” link shall be made of 316 stainless steel. The shaft support brackets shall be made of galvaneal (non-shutoff valves) or 316 stainless steel (shutoff valves). The pivot arm shall be made of aluminum (for non-shutoff valves) and 303/304 stainless (for shut off valves). The pressure independent springs shall be a spring-grade stainless steel. All shaft bearing surfaces shall be made of a PP (polypropylene) or PPS (polyphenylene sulfide) composite. Sound attenuating devices used in conjunction with general exhaust or supply airflow control devices shall be constructed using 24 gauge galvanized steel or other suitable material used in standard duct construction. No sound absorptive materials of any kind shall be used.

   ii. Class B: The airflow control device for corrosive airstreams, such as fume hoods and biosafety cabinets, shall have a baked-on, corrosion-resistant phenolic coating. The device's shaft shall be made of 316 stainless steel with a Teflon coating. The shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal “S” link shall be made of 316 or 303 stainless steel. The pressure independent springs shall be a spring-grade stainless steel. The internal nuts, bolts and rivets shall be stainless steel. All shaft bearing surfaces shall be made of PP (polypropylene) or PPS (polyphenylene sulfide) composite.

   iii. Class C: The airflow control device for highly corrosive airstreams shall be constructed as defined as Class B. In addition, these devices shall have no exposed aluminum or stainless steel components. Shaft support brackets, pivot arm, and pressure independent springs shall have a baked-on, corrosion-resistant phenolic coating in addition to the materials defined in 2.2.B.6.B. The internal “S” link, nuts, bolts, and rivets shall be epoxy phenolic coated stainless steel. Only devices clearly defined as “high corrosion resistant” on project drawings will require this construction.

   iv. Class D: The airflow control device for extremely corrosive airstreams, such as acid digestion fume hoods, shall have a PVDF (polyvinylidene fluoride fluoropolymer) coating. The device's shaft shall be made of 316 stainless steel with a Teflon coating. The shaft support brackets shall be made of 316 stainless steel with PVDF coating. The pivot arm and internal mounting link shall be made of 316 or 303 stainless steel with PVDF coating. The pressure independent springs shall be a spring-grade stainless steel with PVDF coating. The internal nuts, bolts and rivets shall be stainless steel with PVDF coating. All shaft bearing surfaces shall be made of Teflon or PPS (polyphenylene sulfide) composite. Only devices clearly defined as “extremely corrosion resistant” on project drawings will require this construction.

7. Actuation

i. For electrically actuated VAV operation, a CE certified electronic actuator shall be factory mounted to the valve. Loss of main power shall cause the valve to position itself in an appropriate failsafe state. Options for these failsafe states include: normally open-maximum position, normally closed-minimum position and last position. This position shall be maintained constantly without external influence, regardless of external conditions on the valve (within product specifications).

ii. For pneumatically-actuated two-position or VAV operation, a pneumatic actuator shall be factory mounted to the valve. Loss of pneumatic main air or control power shall cause normally open valves to fail to maximum position and normally closed valves to fail to minimum position.

iii. Constant volume valves do not require actuators.

8. The controller for the airflow control devices shall be microprocessor based and operate using peer-to-peer control architecture. The room-level airflow control devices shall function as a standalone network.

9. There shall be no reliance on external or building-level control devices to perform room-level control functions. Each laboratory control system shall have the capability of performing fume hood control, pressurization control, temperature control, humidity control, and implement occupancy and emergency mode control schemes.

10. The LACS shall have the option of digital integration with the BMS.

11. NVLAP Accreditation (Lab Code 200992-0)

i. Each airflow control device shall be factory characterized on air stations NVLAP Accredited (a program administered by NIST) to ISO/IEC 17025:2005 standards.

ii. Each airflow control device shall be factory characterized to the job specific airflows as detailed on the plans and specifications using NVLAP Accredited air stations and instrumentation having a combined accuracy of no more than ±1% of signal (5,000 to 250cfm), ±2% of signal (249 to 100cfm) and ±3% of signal (199 to 35cfm). Electronic airflow control devices shall be further characterized and their accuracy verified to ±5% of signal at a minimum of 48 different airflows across the full operating range of the device.

iii. Each airflow control device shall be marked with device-specific factory characterization data. At a minimum, it should include the room number, tag number, serial number, model number, eight-point characterization information (for electronic devices), date of manufacture and quality control inspection numbers. All information shall be stored by the manufacturer for use with as-built documentation. Characterization data shall be stored indefinitely by the manufacturer and backed up off site for catastrophic event recovery.

2.05 LABORATORY ROOM CONTROLLER

A. Siemens Building Technologies laboratory room controllers:

1. Room airflow tracking shall be accomplished via actual measurement of terminal unit airflow. Controllers, which track within a range of airflow's versus actual airflow setpoints shall not be acceptable.

2. Each laboratory room controller shall be specifically designed for control of laboratory temperature, (humidity and differential pressure monitoring where applicable) and room ventilation. Each controller shall be a microprocessor-based, multi-tasking, real-time digital control processor. Control sequences shall be included as part of the factory supplied software. These sequences shall be field customized by adjusting parameters such as control loop algorithm gains, temperature setpoint, alarm limits, airflow differential setpoint, and pressurization mode. Closed loop Proportional Integral Derivative (PID) control algorithms shall be used to maintain temperature and airflow offset set points.

3. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM memory, or a minimum of 72-hour battery backup shall be provided. All controllers shall return to full normal operation without any need for manual intervention after a power failure of unlimited duration.

B. Alerton / Phoenix Lab Controls provided laboratory room controllers:

1. Only for use in air flow applications > 100 CFM.

2. The airflow control device shall be a microprocessor-based design and shall use closed loop control to linearly regulate airflow based on a digital control signal. The device shall generate a digital feedback signal that represents its airflow.

3. The airflow control device shall store its control algorithms in non-volatile, re-writeable memory. The device shall be able to stand-alone or to be networked with other room-level digital airflow control devices using an industry standard protocol.

4. Room-level control functions shall be embedded in and carried out by the airflow device controller using distributed control architecture. Critical control functions shall be implemented locally; no room-level controller shall be required.

5. The airflow control device shall use industry standard 24 VAC power.

6. The airflow control device shall have provisions to connect a notebook PC commissioning tool and every node on the network shall be accessible from any point in the system.

7. The airflow control device shall have built-in integral input/output connections that address fume hood control, temperature control, humidity control occupancy control, emergency control, and non-network sensors switches and control devices. At a minimum, the airflow controller shall have:

i. Three universal inputs capable of accepting 0 to 10 VAC, 4 to 20 mA, 0 to 65 K ohms, or Type 2 or Type 3 10 K ohm @ 25 degree C thermistor temperature sensors.

ii. One digital input capable of accepting a dry contact or logic level signal input.

iii. Two analog outputs capable of developing either a 0 to 10 VAC or 4 to 20 mA linear control signal.

iv. One Form C (SPDT) relay output capable of driving up to 1 A @ 24 VAC/VAC.

8. The airflow control device shall meet FCC Part 15 Subpart J Class A, CE, and CSA Listed per file #228219.

2.06 VARIABLE AIR VOLUME FUME HOOD CONTROLLER

A. Siemens Building Technologies variable air volume fume hood controller:

1. Provide a UL 916 listed individual VAV fume hood controller for each fume hood, which shall maintain the face velocity setpoint (adjustable) in response to sash position.

B. Alerton / Phoenix Lab Controls provided variable air volume fume hood controller:

1. A fume hood monitor shall be provided to receive the sash sensor output, and presence and/or motion signal. This same monitor shall generate an exhaust airflow control signal for the appropriate airflow control device in order to provide a constant average face velocity. Audible and separate visual alarms shall be provided for flow alarm and emergency exhaust conditions. The fume hood monitor shall incorporate the following capabilities:

i. (Optional) LED display with the ability to display one of the following measurements:

1) Cubic feet per minute (CFM)
2) Meters cubed per hour (m3/h)
3) Liters per second (l/s)
4) Feet per minute (fpm)
5) Meters per second (m/s)

ii. Alarm Muting option, which silences the audible alarm for an adjustable time period when the mute button is pushed. If another alarm is generated during the mute period, the new alarm will override the mute delay and the alarm will sound again.

iii. Auto Alarm Muting option, which sets the alarm to mute automatically after 20 seconds.

iv. Emergency Exhaust button with LED, which activates an emergency exhaust mode. In this mode, the exhaust air is at its maximum flow. When activated, the alarm will sound and the LED will flash. To activate emergency exhaust mode, push the button. Push the button again to cancel emergency exhaust mode.

v. Flow Alarm LED, which illuminates to indicate an unsafe airflow condition. The audible alarm will also activate and may be muted.

vi. Broken retracting cable alarm, an audible alarm with a flashing LED that indicates whether a vertical sash sensor cable is detached, thereby ensuring the fume hood users' safety.

vii. (Optional) Diversity Alarm LED that can be activated locally or from the BMS system. No audible alarm will be generated at the fume hood monitor.

viii. (Optional) Energy waste alarm option, which generates a local visual and audible alarm to notify when the fume hood sash is open beyond its minimum flow position and the lights in the room are off. When activated, the LED display will show "ENRG" and the audible alarm will sound until the sash is closed. The light levels at which the alarm is both initiated and cancelled shall be configurable.

ix. (Optional) Fume hood decommissioning option, which commands the exhaust flow through the fume hood to the minimum allowed by the exhaust valve when the sash is fully closed and no chemicals are present in the hood. The mode shall be initiated by either a pushbutton sequence on the fume hood monitor, external momentary switch input to the fume hood monitor, or a network command. When activated, the LED display will show "OFF," and the exhaust valve will move to its minimum position or shutoff position. Safety shall be built into the decommission option, whereby opening the fume hood sash will automatically return the fume hood exhaust to an in-use operating volume as determined by the sash sensor. Fume hood decommissioning shall be a point that can be integrated to the BMS system.

2.07 FUME HOOD OPERATOR DISPLAY

A. Siemens Building Technologies Fume Hood Operator Display:

1. An operator display panel shall be provided for each fume hood to comply with laboratory safety standards. The operator display panel shall provide the following functionality:

i. Indicator lights that verify normal operation (green), marginal operation (yellow), and alarm condition (red). An alarm condition shall automatically be initiated for both high and low face velocity conditions.

ii. An audible alarm device shall also be initiated in response to an alarm condition. The audible alarm device shall be capable of being silenced by a user silence button; however, the alarm device shall automatically resound upon another alarm occurrence.

iii. A user initiated emergency purge functions shall initiate visual and audible alarm and increase the fume hood exhaust to maximum airflow. When the emergency purge button is depressed, a second time, the emergency sequence shall be terminated and fume hood control shall return to normal operation.

B. Alerton / Phoenix Lab Controls Fume Hood Operator Display:

1. Refer to Variable Air Volume Fume Hood Controller paragraph.

2.08 SASH SENSOR

A. Provide sash position sensors for each fume hood to indicate the actual position of each sash. The sash sensor shall be a precision linear device with repeatable location accuracy within 1/2 inch.

B. Sash sensor material shall be corrosion resistant.

C. Sash sensors shall allow complete and easy removal of the sashes for cleaning and maintenance.

D. Operational life of each sash sensor shall be a minimum of 1,000,000 full cycles.

E. Sash sensor failure shall be indicated as an alarm at the fume hood operator display panel.

2.09 SPECIALTY DEVICES

A. Any specialty devices must be approved through the owner and WSU FS Control Shop before installation.

1. This would be any sensor or control that has not been previously introduced into the system. For instance a wireless vibration meter.

END OF SECTION