

INSTRUCTIONS TO DESIGNER

PART 1 – GENERAL

- 1.01 UAF uses Siemens Industry, Inc., Building Technologies Division under a sole source, brand name only Direct Digital Controls (DDC) contract. All building systems shall be fully compatible with the Siemens APOGEE system.
- 1.02 As part of the contract with UAF, Siemens will support the Consultant and/or UAF during the design development. UAF fully expects the Consultant to engage Siemens' local Fairbanks office during all major design stages, from 35% through 100%. Siemens will provide design review comments alongside UAF DD&C and FS and will participate in comment review sessions as appropriate. Siemens' goal during design development is to help provide UAF with the best value system with respect to the project goals and UAF standards, and to minimize DDC related changes post-bid.
- 1.03 The Consultant will use the attached 23 09 23 specification, and will provide selective editing as described, below.
- 1.04 Sequences of operations are to be provided under 23 09 93. See design standards for 23 09 93 for default sequence of operations preferences and standards.
- 1.05 Consider metering and building dashboards when developing the specifications for Direct Digital Controls.

PART 2 – EDITS OF TEMPLATE 23 09 23 SPECIFICATION

- 2.01 The consultant shall review and be familiarized with the attached specification.
- 2.02 The consultant shall only edit select portions of the specification that are project specific, unique requirements. Any section that is not applicable will be formatted with ~~strickthrough~~ font, and "N/A" appended to the section.
- 2.03 The following sections will be addressed by the consultant as project specific, and edits provided in the format described.

PART 3 – PROJECT SPECIFIC CONTENT TO BE EDITED

- 3.01 **23 09 23 1.02.E.** In this section, list specific additional scope of work items beyond DDC controls that will be covered under this section. For example, installation of 3rd party specialty control systems such as Greenhouse Controls or a Gas Detection System, or network integration to lighting, chillers, etc. **Consultant shall be mindful of scope expected to be addressed under the controls section (Siemens). While most times it is entirely up to the contracting tier during the bid process to cover all scope in the documents, and not important to the**

consultant to delineate responsibility amongst trades, it is important for UAF since the controls scope is directly contracted between UAF and Siemens.

- 3.02 **23 09 23 1.03.A.2 Manufacturer installed VAV box controls.** This is the default standard, but is impractical on very small (~20 VAV boxes or less) or quick turn projects. Designer to confer with Siemens if manufacturer installed controls is practical for the project. If not, provide strikethrough font and add N/A. Same for second sentence of 23 09 23 1.03.B.1. Important- also be sure to correlate this requirement in the VAV box spec.
- 3.03 **23 09 23 1.03.B.4 Airflow Measuring Stations (AFMS.)** Designer to identify type of AFMS. If packaged with AHU or if it is a duct-section type necessarily installed by the sheet metal contractor, this spec paragraph is valid- leave as is. If however the AFMS is a duct-probe type, strikethrough 1.03.B.4 , add N/A, and specify AFMS type under 2.15 PROJECT SPECIFIC PRODUCTS. Basis of design will be Ebtron Gold series.
- 3.04 **23 09 23 1.03.D.2 Fire Alarm interface.** This section is valid if a new building, new DDC system, or new F/A system. Otherwise, the monitoring point described in this paragraph may already be existing. Confirm w/ Siemens. If existing, add sentence in **bold** font: “Existing monitoring to remain. No work required.”
- 3.05 **23 09 23 1.03.D Integration.** Review need for network level integration between DDC and specialty systems such as lighting, chillers, etc. w/ Siemens. If network level integration is required, add paragraph for each such system under 1.03.D.3,4,5, etc. Integration protocol desired in order of preference and lowest cost of integration:
- Siemens APOGEE FLN, P1 protocol
 - BACnet over IP, **BTL Listed**
 - BACnet over MS/TP, **BTL Listed**
 - BACnet over IP
 - Modbus

Template for Network Integration, with fill in the blank items to be updated specific to the system underlined:

“1.03.D.3 Chiller System CH-1. Chiller provider to include all devices, programming, setup, and testing to allow Siemens APOGEE BAS network integration using BACnet over IP communication protocol. Chiller provider to submit points list w/ addresses, point names, descriptions, ranges/units, I/O types, commandability, and other applicable notes for use by BAS system integration programming. Chiller provider shall provide factory trained technician with ability to setup and commission integration interface to coordinate and work directly with Siemens BAS technician to complete the integration work. Integration network wiring provided by Siemens.”

Please also include the above paragraph in the spec section of whichever system is to be integrated.

- 3.06 **23 09 23 2.03 Workstation.** Typically only provided if large/new or complicated facility or if there is a special end-user function. Review with Siemens and UAF PM/Facilities Services. If not applicable, strikethrough and add N/A.
- 3.07 **23 09 23 2.15 Project Specific Products.** Under this section, list any specialty control devices or other products to be provided that are not covered elsewhere in the template spec. Do not add for example special temperature sensors for a specific project need under *2.07 Sensors*, add them under 2.15 Project Specific Products. Examples might include gas detection equipment, specialty control valves, airflow measurement stations, etc.
- 3.08 **23 09 23 3.09 Training.** Consultant to edit. Standard of 4hrs bldg-specific training for small projects, 8 hrs for medium sized, 16hrs or more for large and/or complex projects. Confer with Siemens and UAF PM, then update Qty. in **bold** font, this section.
- 3.09 **23 09 23 3.10 Special Conditions.** In this section, include any project specific conditions, such as LEED, additional commissioning requirements, metering and dashboard requirements, additional seasonal testing, etc.

PART 4 – ADDITIONAL NOTES FOR DESIGNER

- 4.01 Prefer control valves to be installed on SUPPLY side of coils or terminal units. Coordinate with your details on dwgs.
- 4.02 For Siemens 3-way mixing valves, the bottom port w.r.t. the actuator is N.O. Coordinate with your details on dwgs.
- 4.03 Steam Valves. Instruct on dwgs. that steam valves should be installed so that the actuator is rotated out of the vertical plane by 45 deg. Also, insulate the valve body.
- 4.04 Control Valve Sizing. For modulating Hydronic valves, Siemens' nominal Cv ratings are: 0.4, 0.63, 1, 1.6, 2.5, 4, 6.3, 10, 16, 25, 40, 63, 100, 160, 250, 400. Design w/ nominal 3 psi or less pressure drop for terminal units of small coils, and 5 psi or larger if appropriate for proper control authority for large coils. Steam valves should be Linear.
- 4.05 Siemens Fairbanks Office Contact info:

Ben LaRue
907-479-7034 x1102
ben.larue@siemens.com

SECTION 23 09 23 MASTER UAF SPEC
INSTRUMENTATION AND CONTROLS FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Section 07 84 00, Firestopping
- B. Section 08 00 00, Access Doors
- C. Section 23 05 00, Common Work Results for HVAC
- D. Section 26 29 23, Variable Frequency Drives
- E. Division 26 00 00 Electrical

1.02 DESCRIPTION OF WORK

- A. This section specifies the requirements for the Building Automation System (BAS) to be installed in conjunction with this project. Refer to Division 01 11 00, Summary of Work.
- B. Pricing of this BAS system shall be determined using the UAF DDC Term Agreement between the University and Siemens Industry Inc. (SII). The BAS contract will be direct to the Owner or assigned to the General Contractor. See Bid Form and Special Conditions for clarification.
- C. SII shall furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems as defined in Project Documents.
- D. SII shall be responsible for all BAS and Temperature Control wiring for a complete and operable system. All wiring shall be done in accordance with Division 26 of the specification and all local and national codes.
- E. The specific additional items of work included in this section are:
 - 1. (List specific items)

1.03 WORK BY OTHERS

- A. Products provided by SII for installation by the Mechanical contractor:
 - 1. Control valves.

2. VAV box controllers. SII shall furnish VAV box controls to the VAV box manufacturer for factory installation at the expense of the box manufacturer.
3. Wells for hydronic temperature sensors.
4. Static and differential pressure sensors for piping systems.

B. Products provided and installed by Mechanical contractor:

1. VAV boxes. SII shall furnish VAV box controls to the VAV box manufacturer for factory installation at the expense of the box manufacturer.
2. VAV box controller enclosures will be provided by box manufacturer.
3. Gauges, thermometers and thread-o-lets for SII furnished control sensor wells.
4. Airflow measuring stations.
5. Control and balancing dampers.
6. Smoke and smoke/fire dampers with actuators.

C. Electrical contractor provides:

1. Wiring of all power feeds through disconnects, starters, TT switches, and VFDs to electrical motors.
2. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished by SII.
3. Duct smoke detectors including installation and wiring.
4. Power wiring of all smoke/fire dampers.
5. Stand-alone packaged controls and wiring of stand-alone packaged controls to their remote sensors and devices.
6. Ethernet drop at or near designated BAS control panel.

D. Products to receive integration under this section:

1. Variable Frequency Drives. (VFDs) The BAS shall use hardwired points for start/stop, proof, and speed control. The VFD shall also be connected to the BAS FLN. VFDs shall be factory-furnished with the appropriate communication hardware and software to allow communication over the SII FLN. Control wiring connections to VFD will be provided under this Section.

2. Fire Alarm/Life Safety System. The DDC system shall monitor general alarm status of the fire alarm/life safety system via an alarmable point in the form of a dry contact. An addressable relay of the fire alarm system will be provided and terminated by Division 26, located next to the appropriate DDC panel. This Section will provide wiring from the relay to the DDC panel.

1.04 SUBMITTALS / O&M MANUALS

- A. All submittals will be bound in white D-ring binders with sufficient ring capacity available for future additions.
- B. Prior to beginning on-site installation, SII will submit four (4) complete sets of documentation containing the following:
 1. Sequence of Operations (Designer to provide electronic text version to SII)
 2. Riser Diagrams
 3. Control Diagrams
 4. Panel layouts
 5. Valve schedule
 6. Point Summary Report
 7. If applicable, a survey of existing building control components noting those devices proposed to be reused.
 8. Product Data
- C. The O&M Manuals will consist of the following:
 1. Sequence of Operations
 2. Riser Diagrams
 3. Control Diagrams
 4. Panel layouts
 5. Valve schedule
 6. Point Summary Report
 7. Enhanced Alarm Report
 8. Commented PPCL (Program Code)

9. Product Data including items reused from existing control system as noted.

10. Electronic Plans Room file

1.05 INSTALLATION SCHEDULING AND COORDINATION

- A. This is an existing facility and will require interface with an existing control system and the existing host computer system.
- B. Remove all controls related pneumatic tubing and electrical conduit that is not reused as part of the new direct digital control and monitoring system.
- C. Patch holes in existing ductwork, at removed sensors that are not reused, with sheet metal patches of equal gauge or heavier. Seal airtight with adhesive and then screwed or pop riveted to the ductwork.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Management Level Network (MLN). Acceptable manufacturers and product are limited to the following:
 - 1. Siemens Industry Inc., Siemens APOGEE Insight, APOGEE Ethernet protocol.
 - 2. No Alternate Brand Request; no Substitution Request.
- B. Automation Level Network (ALN). Acceptable manufacturers and product are limited to the following:
 - 1. Siemens Industry Inc., Siemens APOGEE, P2 protocol.
 - 2. No Alternate Brand Request; no Substitution Request.
- C. Floor Level Network (FLN). Acceptable manufacturers and product are limited to the following:
 - 1. Siemens Industry Inc., Siemens APOGEE, P1 protocol.
 - 2. No Alternate Brand Request; no Substitution Request.

2.02 NETWORKING COMMUNICATIONS

- A. The design of the BAS shall network an operator workstation(s) and stand-alone DDC Controllers. The network architecture shall consist of three levels; a campus-wide Management Level Network (MLN) Ethernet network based on TCP/IP and Siemens APOGEE protocol, a high performance peer-to-peer automation level network (ALN) and DDC Controller floor level local area networks (FLN). Access to the system shall be totally transparent to the user when accessing data or developing control programs.
- B. The design of the BAS shall allow the co-existence of new DDC Controllers with existing DDC Controllers on the same network without the use of gateways, protocol converters, or third-party interface devices.
- C. The control system installed under this project shall report to the University's Apogee Insight Host System through the campus Ethernet system. This installation includes all work required on the host such as construction of the Master Point Database, Synonym Database, complete system graphics, etc.
- D. Management Level Network
 - 1. All PCs shall simultaneously direct connect to the Ethernet and Management Level Network without the use of an interposing device.
 - 2. The Management Level Network shall not impose a maximum constraint on the number of operator workstations.
 - 3. Simultaneous user access to network limited to number of sight licenses issued to user.
 - 4. When appropriate, any DDC controller residing on the peer-to-peer level network shall connect to Ethernet network without the use of a PC.
 - 5. Any PC on the Ethernet Management Level Network shall have transparent communication with controllers on the automation level networks connected via Ethernet as well as directly connected automation level networks. Any PC shall be able to interrogate any controller on the automation level network in addition to being able to download program changes to individual controllers.
 - 6. The Management Level Network shall reside on industry standard Ethernet utilizing standard TCP/IP, IEEE 802.3. The Ethernet system will be provided and maintained by UAF.
 - 7. Access to the system database shall be available from any client workstation on the Management Level Network.
- E. Peer-to-Peer Automation Level Network (ALN)

1. The system shall have the ability to support integration of third party systems (fire alarm, security, lighting, Variable Frequency Drives, PLCs, chillers, boilers) via a panel mounted open protocol processor. This processor shall exchange data between the two systems for inter-process control. All exchange points shall have full system functionality as specified herein.
2. Data transfer via RS485.

F. Floor Level Network (FLN)

1. This level communication shall support a family of application specific controllers and shall communicate with the peer-to-peer network through DDC Controllers for transmission of global data.

2.03 PERSONAL COMPUTER OPERATOR WORKSTATION (*SELECTABLE BY UAF*)

- A. A standard PC workstation shall be provided in the selected mechanical space for Remote Desktop or Terminal Services access to the UAF Siemens APOGEE Insight Server.
- B. Workstation center will be equipped with appropriately sized uninterruptible power supply (UPS).

2.04 CONTROL PANELS

- A. All Terminal Equipment Controllers will be mounted in enclosed control panels with screwed, removable covers.
- B. All control devices located in exposed areas subject to outside weather conditions shall be mounted inside weatherproof enclosures. Location of each panel shall be convenient for adjustment service.
- C. Nameplates shall be provided beneath each panel face mounted control device describing the function of each device. Nameplates shall have white letters engraved on blue Lamicoid, or approved equal.
- D. All control panels shall bear a UL label compatible with the application.
- E. Control panels will not be installed in public areas unless otherwise noted. Control panels will not be recessed installed on an outside wall where condensation can accumulate in panel.
- F. All electrical devices within the panel shall pre-wired to terminal strips with all inter-device wiring within the panel completed prior to installation of the system.
- G. All ALN level controllers will be provided with standby power to provide power quality and minimum 15 minutes operation. UPS manufacturer: Powerware or equal.

2.05 ELECTRIC DAMPER AND VALVE ACTUATORS

- A. The operators shall have ample power to overcome friction of damper linkage, air pressure acting on the damper blades and differential fluid pressures, as applicable.
- B. Actuators up to 2 in. diameter: Electric-gear driven or electric-hydraulic drives.
- C. Actuators 2 in. diameter and above: Electric-hydraulic assist drives.
- D. Air damper operator mounting arrangement shall be outside the air stream wherever possible. The operators shall have external adjustable stops to limit the stroke.
- E. The operator arrangement shall be such as to permit normally open or normally closed positions of dampers and valves as indicated on Drawings. Terminal unit control valves for DDC application specific controllers may fail in place for baseboard, reheat coils, radiant ceiling panels, and similar applications.

2.06 AUTOMATIC CONTROL VALVES

- A. All modulating automatic control valves shall be fully proportioning with modulating plugs for equal percentage or linear flow characteristics. The valves shall be sized by SII and be provided with actuators of sufficient power for the duty intended. Valve body and actuator selection shall be sufficient to handle system pressure and shall close against the differential pressures expected to be encountered on the project. Butterfly valves are not acceptable unless otherwise noted.
- B. Valves - 1/2 in. through 2 in. diameter: Siemens Powermite or Flowrite series as appropriate for valve size, close-off pressure, and signal type.
- C. Valves - 2-1/2 in. diameter and above: Siemens Flowrite series with flanged connections. ANSI 125 class unless otherwise noted.
- D. Rural campus sites: For non-DDC zone valves, use standard Honeywell zone valve V8043 series.
- E. Valves shall be selected for default maximum 3.0-PSI pressure drop through valve at design flow. Large flow coils may require a 5 psi or larger pressure drop for proper control authority. Submit requested pressure drop as part of valve schedule.
- F. Unless otherwise noted, heating valves shall fail normally open, cooling valves normally closed, and steam valves normally closed, with fail-in-place for terminal unit applications described under 2.05.

2.07 SENSORS

- A. Temperature

1. Liquid Immersion, Duct Temperature Sensors: Siemens 1000 Ohm RTD 544-XXX series basis of design. For TECs or other I/O with special requirements, use Siemens standard 10k or 100k thermistors or other as appropriate and compatible with I/O.
2. Outside Air Temperature Sensors: Siemens 536-768, range -58 deg F to 122 deg F.
3. Where the sensor is used for sensing of mixed air temperature or air handler coil discharge temperatures, and/or the duct area cross-section is in excess of 14 square feet, the instrument shall incorporate an averaging element. Outside air sensing shall be accomplished using a sensing element and transmitter shielded from the effects of sunlight.
4. Sensors shall be furnished in scale ranges compatible with system operating range.
5. Where sensors are used for sensing liquid temperatures, they shall be furnished with separable wells or appropriate material.
6. Monitor VAV or terminal unit discharge air temperatures for applications with a duct mounted coil. Cooling only VAV box applications do not require discharge air temperature sensing unless otherwise noted.

B. Humidity.

1. Standard accuracy: Siemens Q-Series, 2% with replaceable tip.
2. High accuracy, regular calibrations expected: Vaisala HMW92, HMD60 or equal.

C. Liquid Differential Pressure, Setra 231 Series with 3-Valve Minifold, or equal.

D. CO2 Sensors: Siemens QPA Series (wall mount), QPM Series (duct mount).

2.08 THERMOSTATS AND ROOM TEMPERATURE SENSORS

- A. Electronic Room Temperature Sensors: Shall be thermistor type with 55 degree F to 95 degree F range. Optional features include: LED display, slider bar and night setback button. Covers shall be robust, of institutional quality, suitably finished. Covers will be sensing only unless otherwise noted to include optional features. Siemens Series 1000, white.
- B. Line-voltage Thermostats: Shall have bi-metal switches with a rating of at least 1.2 times the load they are handling. Covers will be sensing only.
- C. Rural campus sites: For non-DDC zone control, use standard Honeywell thermostat T8775C.
- D. Provide locking covers or gym guards only as indicated on the dwgs.

2.09 PRESSURE GAUGES AND THERMOMETERS

- A. Shall be provided and installed by mechanical contractor.

2.10 RELAYS AND SIGNAL TRANSMITTERS

- A. All necessary relays and signal boosters shall be furnished to make the system a full and operable system as required by the Sequence of Operations.

2.11 AIR FLOW HIGH AND LOW LIMIT THERMOSTATS

- A. Low limit thermostats shall employ an element of sufficient length to cover a complete vertical cross-section of the duct. Install multiple units if necessary. If any one-foot section of the element is subjected to temperatures below 35 degrees F (adjustable), the respective electric or pneumatic circuit shall open causing action to fans and dampers as required under the sequence of operation.
- B. High limit thermostats shall employ rod and tube type elements that extend approximately ten inches into the duct. If instrument is subjected to temperatures above 135 degrees F, action required by sequence of operations shall occur. Where high limit is required for fire protection, such thermostats shall be UL listed for fire protection.
- C. Shall be automatic reset with time delay and virtual lockout functions provided by DDC system programming.

2.12 AIR AND WATER FLOW PROOF DEVICES

- A. Provide current operated relays as standard proof devices. Pressure differential switches may be used as directed. Paddle type flow switches are not acceptable.
 - 1. Provide solid-state, adjustable, current operated relay. Provide a relay that changes switch contact state in response to an adjustable set point value of current in the monitored A/C circuit.
- B. Provide status device for fans, motors and pumps.
- C. RIBX series, basis of design.

2.13 ACCESS PANELS

- A. Access panels provided by Section 08 30 00.
- B. Coordinate access panel location with Owner and Division 08 30 00. Provide access to concealed control devices.

2.14 PNEUMATIC TUBING

- A. Provide color coded, flame retarded, crack resistant, polyethylene tubing for installation in concealed areas, in control cabinets and inside conduit raceways. Dekoron FR or equal.
 - 1. Plenum Rated.
 - 2. Environmental stress crack resistance: ASTM D 1693, 0 percent failure in 48 hours.
 - 3. Acceptable manufactures include, but are not limited to the following:
 - a. Dekoron FR.
 - b. Alternate Brand Request or Substitution Request not required.
- B. Concealed:
 - 1. Polyethylene connected with serrated brass fittings.
 - 2. Copper: Type “M” hard-drawn with solder joints or brass compression fittings.
- C. Exposed:
 - 1. Copper: Type “M” hard-drawn with solder joints or brass compression fittings.
- D. In Return Air Plenums:
 - 1. Polyethylene connected with serrated brass fittings.
 - 2. Copper: Type “M” hard-drawn with solder joints or brass compression fittings.

2.15 PROJECT SPECIFIC PRODUCTS

- A. (List specific items)

PART 3 - EXECUTION

3.01 RELATED DOCUMENTS

- A. Refer to Section 23 01 00, General Conditions and Section 23 05 00, Basic Materials and Methods and Division 26.

3.02 GENERAL

- A. Do not install control devices in locations where they are subject to damage or malfunction due to normally encountered ambient temperatures.

- B. Mount damper operators and other control devices secured to insulated ductwork on brackets such that the device is external of the insulation.

3.03 IDENTIFICATION

- A. Major Equipment: All major equipment such as fans, pumps, control valves, dampers, heat exchangers, etc. will have the associated DDC point name included on the PMI (“Green”) tag provided by UAF. Siemens will coordinate with UAF facilities engineering for the associated DDC point names to be included.
- B. Control Panels: All DDC panels, point expansion panels, and auxiliary component panels will be tagged with engraved phenolic labels, such as “PXCM-1” (DDC Panel, PXCM type, Node #1), or PNL-1 (auxiliary component panel #1).
- C. Terminal Equipment Controllers (TECs): TEC enclosures above ceilings or elsewhere will be labeled with the controller’s DDC name, such as 981.110.TEC (Bldg 981, serving Rm 110). The label will be applied to both the outside and inside of the enclosure. Label will be printed from a portable label maker, peel-and-stick type.
- D. Wiring
 1. All DDC panel input and output point wiring will be labeled with a computerized labeler with the point address at the device and control panel ends.
 2. TEC Room Temperature Sensors: RTS cable at sensor end will be labeled with the TEC name (described above.)
 3. TEC Reheat Coil and Baseboard Valves: At TEC end, label “RHV” or “BBV” or similar. At valve end, label with TEC name (described above.)
 4. TEC controlled VAV box damper actuator wiring will not be labeled if under same enclosure as TEC.
 5. FLN wiring will be labeled at both ends of a segment with the FLN # (“FLN-2” for example) and To/From the controller name of the TEC or control panel at the other end of the segment.
 6. ALN wiring will be labeled at both ends of a segment with “ALN” and To/From the controller name of the DDC panel or device at the other end of the segment.
 7. 24VAC power trunk wiring will be labeled at all 24VAC consuming devices with the corresponding transformer number (“XFMR 1-5” for example.)
- E. Devices associated with DDC points (other than above) such as sensors, relays, CTs, switches, valve actuators, damper actuators will be labeled with the DDC point name. Label will be printed from a portable label maker, peel-and-stick type.

- F. Room sensors will not be labeled for aesthetic reasons (but the associated wiring will be labeled per above.)
- G. Misc. switches or other special function devices in public areas that have occupant interaction will be labeled with engraved phenolic labels or as directed elsewhere.
- H. UAF will provide system of equipment naming.
- I. Properly define BACNET or other integrated devices or controllers to match their equipment name.

3.04 SENSORS AND SWITCHES

- A. Pump flow or fan flow, etc, shall be sensed using current switch unless indicated otherwise. Calibrate current switch to distinguish between loaded or unloaded motor condition due to belt or coupler breakage.
- B. Protect averaging or capillary tubes where they penetrate duct with rubber grommet and seal with clear silicon. Support with capillary clips and maintain minimum 1 inch tubing bending radius.

3.05 WIRING

- B. Install, connect and wire the items included under this Section. This work includes providing required conduit, wire, fittings, and related wiring accessories. All wiring in exposed or inaccessible areas shall be installed in EMT conduit. Plenum-rated cable may be used in concealed, accessible areas only.
- C. Provide wiring between thermostats and unit heater motors, and all control and alarm wiring.
- D. Provide conduit and wiring between the BAS panels and the temperature, humidity, or pressure sensing elements, including low voltage control wiring in conduit or plenum-rated cable.
- E. Provide conduit and control wiring for devices specified in this Section.
- F. Provide conduit and signal wiring between motor starters in motor control centers and high and/or low temperature relay contacts and remote relays in BAS panels located in the vicinity of motor control centers.
- G. Provide conduit and wiring between the PC workstation, electrical panels, metering instrumentation, indicating devices, miscellaneous alarm points, remotely operated contactors, and BAS panels, as shown on the drawings or as specified.
- H. All wiring to be compliant with the Division 26 requirements and the NEC. Minimum trade size for control system conduit is ½”.

- I. Provide electrical wall box and conduit sleeve for all wall-mounted devices. Mount thermostats at 48 inches AFF unless otherwise noted.
- J. Use Scotchlok UY2 connectors for all splices. All splices and loops shall be contained in a gutter or junction box, not in the control panel.

3.06 WARRANTY

- A. Upon completion of the project, as defined in the Contract Conditions, a warranty period of one (1) year shall commence. The warranty shall consist of a commitment by SII to provide, at no cost to the Owner, parts and labor as required to repair or replace such parts of the control system that prove inoperative due to defective materials or installation practices. The warranty expressly excludes routine service such as instrument calibration.

3.07 TREND LOGS

- A. SII shall prepare trend logs for all points required to show system calibration and stability.
- B. These logs shall document building operation after the installation, balancing and calibration is completed and after the control system is fully operational
- C. Terminate commissioning trend collections. Setup ongoing trends required by UAF.

3.08 SUBSTANTIAL COMPLETION

- A. SII shall demonstrate complete and proper operation of all systems per the Sequence of Operations.
- B. Refer to Sect. 01 78 00 - CLOSE-OUT SUBMITTALS.
- C. The demonstration shall include, but not necessarily be limited to, the following:
 - 1. Review of the Trend Logs.
 - 2. Complete and proper operation of control systems including setpoints, valve positions, etc. shall be adjusted to artificially induce the sequences to occur.
 - 3. Access to all devices for required maintenance.
 - 4. Review of associated graphics on Host.
 - 5. Identify and configure alarms.

3.09 TRAINING

- A. xx (X) hours of on-site instruction will be provided by SII to familiarize operating personnel with the control system. instructions will include:

1. A brief description of the controls' sequence of operation.
2. A discussion and explanation of all alarms, switches and gauges.
3. A summary and explanation of steps to be taken in response to specific alarms or control malfunctions.
4. Building walk-through to physically locate and examine all control devices and demonstrate control setpoint adjustment procedures.
5. Instructions regarding adjustment procedures shall emphasize methods for continual building "fine-tuning"

3.10 SPECIAL CONDITIONS

A. (List specific items)

3.11 SEQUENCE OF OPERATION – SEE 23 09 93

END OF SECTION