AUTOARCH
ARCHITECTS

HCC Culinary Arts Shell Interior Buildout

HCC Project No. IFB 21-26
Culinary Arts Interior Shell Build Out

ADDENDUM 1

02/8/2021

Revisions included in this Addendum:
Please refer to drawings and specifications for more information. These specifications and drawings supersede any previously issued versions of the same spec or drawings. Please replace and refer to the most current drawings in your set. Please refer to specifications for more information.

Questions and Answers

- Engineers' Addendum Project No. IFB 20-22 Culinary Arts Interior Shell Build Out – Question and Answers No.1

Specifications

Added Specifications to Project Manual:

- 25 10 00 Control System

Drawings

Remove existing drawing sheets and replace with Drawings Sheets below attached within this Addendum:

Mechanical

M2.04 ROOF PLAN

END OF ADDENDUM 1

Architect's ADDENDUM 1

PROJECT NO. IFB 21-26
CULINARY ARTS INTERIOR SHELL BUILD OUT

QUESTIONS AND ANSWERS No. 1

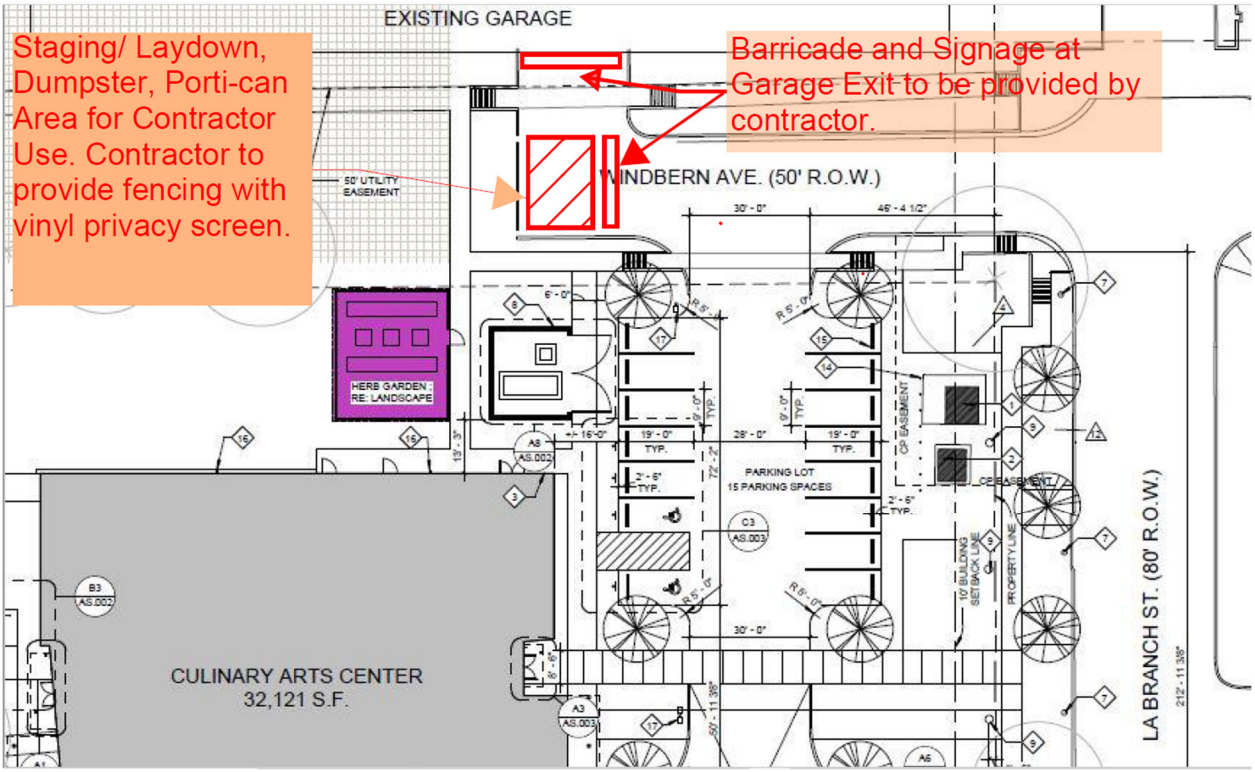
Date: February 2, 2021

To: Prospective Bidders

From: Procurement Operations Department, Houston Community College

Subject: Questions and Answers Responses

Laydown/ Staging/ Barricade/ and Porti-Can locations (Contractor's Shall Provide within their bid pricing for below)



Existing Subcontractors from Previous project (For General Information)

Company		Address	City	State	Zip	Business Phone	Fax Number
Airline Louvers	Louvers	1020 Prince Frederick Blvd. Suite 305	Prince Frederick	Maryland	20678	(570) 420-7079	(570) 420-7078
BD Electric	Electrical Work	30340 Dobbin Huffsmith	Magnolia	Texas	77354	(281) 356-2925	(281) 259-6886
Camarata Masonry Systems	Masonry	16465 W. Hardy Road	Houston	Texas	77060	(281) 876-1111	(281) 876-1120
Cook Mechanical	HVAC	20200 Hempstead Rd. #34	Houston	Texas	77065	(832) 688-8628	(832) 779-8331
ECO Services	SWPPP	13810 Hollister Drive Suite 100	Houston	Texas	77086	(832) 456-1000	(832) 456-1010
Fire Proof Contractors	Water Proofing, Insulation	8100 Blakenship Dr.	Houston	Texas	77255	(713) 690-7600	(713) 690-7635
FireTron Life Safety Solutions	Fire Alarm	10101A Stafford Centre Drive	Staffprd	Texas	77477	(281) 499-1500	(281) 499-3711
Flexible Lifeline Systems	Fall Protection System	2437 Peyton Rd	Houston	Texas	77032	(832) 448-2900	
Har-Con Mechanical Contractors	Plumbing	9009 West Little York	Houston	Texas	77040	(832) 300-1060	(832) 300-1061
Kauffman Company	Sprinkler System	13225 FM 529 Suite A	Houston	Texas	77041	(713) 937-4144	(713) 937-4149
Mares Glass	Aluminum Storefront, Doors, Glass	11948 C Hempstead	Houston	Texas	77092	(713) 789-7119	(713) 789-2055
McIntosh Wood & Metal Works	Wall Metal Panels	2757 Ludelle Street	Fort Worth	Texas	76105	(817) 591-1393	(817) 413-7228
Meyer Hammer Excavation	Demolition and Earthwork	1795 N Fry Rd. Suite 308	Katy	Texas	77449	(832) 771-3287	(832) 201-8884
MSD Building Corporation	Structural Steel Fabrication and Erection	120 N. Main St.	Pasadena	Texas	77506	(713) 477-8335	(713) 477-1090
NCS	Telecommunication/Security	12626 Fuqua St	Houston	Texas	77034	(281) 484 1777	(281) 484 1776
Otis Elevator Company	Elevator	9001 Jameel Rd. Suite 100	Houston	Texas	77040	(281) 906-8142	(860) 353-0438
Peña's Concrete & Demolition	Concrete Work	P.O. Box 270184	Houston	Texas	77277	(713) 401-9581	(713) 552-9939
Reliable Commercial Roofing Services	Roofing System	PO Box 1246	Brookshire	Texas	77423	(281) 934-1495	(281) 934-1380
Texas Underground Utilities	Underground Site Utilities	8515 Cambridge Street	Houston	Texas	77054	(832) 487-9039	(713) 583-0115
Vivas Contractors	CFMF, Drywall, Fireproofing	5205 Spindle Dr.	Houston	Texas	77086	(281) 445-9554 x205	(281) 445-9584
Von Younger Landscaping	Landscaping/Irrigation	313 W. Donovan St.	Houston	Texas	44091	(713) 695-6918	

1. D03/AD1.01 states to demo and relocate an existing floor drain for future kettle equipment. FS1.02 shows the pour path of the equipment but no layout/location dimensions. FS1.10 shows a funnel drain for the kettle and references Note #3 on this sheet that states that this accessory is provided with the food service equipment and field installed by the plumber. Please provide the location for the relocated floor drain based on existing conditions. Please state whether the existing floor drain will be used or if the owner will supply a new drain/grate specific to this kettle to be installed and poured in. Please provide a cut sheet of the new drain if it is to be supplied to contractor, the Groen DH-40 spec sheet does not show it. **Response: 809 Kettle is in the contract (not future). The location and dimensions for the Trench Grate are shown on our drawings and should be field verified by KEC and shown on Rough-Ins. Additional information clarified and provided in the submittals.**
2. A9.01 shows UF-1 as alternate #1. The bid form does not have an alternate section. Please state whether contractor is to price an alternate for the owner to switch from quarry tile to urethane flooring. If alternate is desired, please provide a section In the bid form to breakout cost. **Response: Contractor's to provide pricing for this Alternate in their bid for review by the owner.**
3. Elevations on A9.02 shows the base to be 6" high quarry tile. Quarry tile base is not shown on the finish legend. Please add quarry tile base to the finish legend and specify the quarry tile trim to be used from the DAL-TILE fact sheet. **Response: Contractor shall provide 6" Quarry tile base in project.**
4. 002/AD2.01 states to prep existing sprinkler lines for new condition. Please provide an as-built of existing conditions. Please provide a sprinkler system specification. Please state whether or not calculations will be required for the final system. Please provide the contact information for the contractor who installed the existing system. **Response: The sprinkler sub-contractor is in the charts for the existing subs from the previous project.**

5. E3.01 shows switches for the pastry lab and culinary lab. The switch type is not shown. Please provide the switch type for these two areas. **Response: Refer to the symbols legend and specifications.**
6. A9.01 shows ceiling VC1 as 24"x24"x1 1/2". The Armstrong data sheet shows this as 5/8" thick. Please confirm. **Response: 24"x24"x5/8" shall be used.**
7. 06&26/A2.01 does not have dimensional details. Please provide dimensions for this bulkhead and the exhaust hood detail. **Response: Coordinate with MEP Drawings.**
8. The water, gas, and existing vent lines will be exposed coming from the ceiling where there are no full height walls. Additionally, these lines will need to penetrate the SS cap and wall coverings as it is currently designed. Please confirm this is desired or provide a new coordinated design with full height walls to hide these building elements. **Response: Contractor to coordinate and provide water and Gas lines within walls as shown. The Partial Height walls are required in the project. Refer to FS1.10 and FS2.06.**
9. The drawings call for contractor to create new openings in roof. Please provide the final moisture testing reports for the existing roof system. Please provide the warranty for the existing system. Please state who the manufacturer is for the existing system. Please provide the contact information for the contractor who installed the existing system. **Response: See Chart of Existing Subcontractors. The roofing contractor is on this chart.**
10. FS1.01 & FS2.01 Equipment schedules are not completed. Please Provide contractor scope of work for all food service equipment and accessories. **Response: All equipment not labeled as OF/CI or OF/OI in the schedule is to be Contractor Furnished and Installed.**
11. The return air duct from the new AHU to the roof is in conflict with existing piping and joists. Please coordinate the design with existing conditions. Please also keep in mind the angle reinforcement to be installed for the new roof opening. **Response: Dimension of outside air duct has been designed to fit in between the existing joists. An offset has been provided in the portion of duct going up to roof to dodge the existing piping. In case of conflict, recommend to adjust the offset as required. Coordinate with structural for new roof opening.**
12. M2.04 shows 96x24 duct through the roof to the AHU. M2.03 shows 98x24 duct to roof from the AHU. Please state which size duct is required at this location. **Response: The 98x24 is the correct size.**
13. A1.01 does not show the wall in the southwest corner of the kitchen with its associated partition tag. Please provide a partition type for these walls. **Response: Could not find what was requested.**
14. There is a wall drawn in at GL G/2-4 which has no partition tag. There is also a wall at GL 1/E-F that does not have a partition tag. Please provide a wall types at these locations. **Response: Could not find what was requested.**
15. There are no elevations for the C6 walls. Please confirm they are 54" high per FS1.02 and provide finish details/requirements. **Response: These walls are the end walls and are full height.**
16. FS1.02 show sections of the E1 partitions to be full height. A9.02 elevations do not show this. Please confirm these segments of the E1 partitions are to be full height as shown on FS1.02. Please state the finish details/requirements for the full height wall if required. **Response: Section of walls @ hand sinks to be full height refer to A9.01 and A9.02 for finish information.**

17. Please provide the CAD file for this project. **Response: Cad files shall be provided to contractor awarded the contract.**
18. Please provide the thickness for the SS panels and corner guards. **Refer to specifications from food service and corner guards.**
19. Please confirm the C3 partition is painted all around and receives no ceramic tiling. **Response: Contractor to review A9.01 and A9.02 for finishes.**
20. Please provide a specification for division 25. **Response: Section 25 10 00 Control System has been added.**
21. Elevation detail 27/A9.02 shows the B2 wall to be partial height and looks to have a tiled wall cap. Please provide the height of the B2 wall at this location or state how far below the window sill that the top of the tile wall cap should be. Please also state whether this configuration is desired at all other B2 partition locations. **Response: partial height wall is located on details 21 and 16/ A9.02 wall height is 4'-6". This location is the Exterior wall to be tiled full height.**
22. Elevation detail 17/A9.02 shows the X2 wall as partial height. Please provide the height of this wall at this location. Please state if a tile wall cap is required at this location. Please provide the dimension from bottom of window sill to top of tile. **Response: partial height wall is located on details 21 and 16/ A9.02 wall height is 4'-6". This location is the Exterior wall to be tiled full height.**
23. General note 8 on A9.02 states that room names and numbers on signs are to be provided by architect. Please provide room names and numbers. Please state the size of the room signs. **Response: The Room signs are to match existing. Room number and names shall be determined by the owner in the submittal process.**
24. General note /A9.02 states to paint all exposed columns white. The elevations show to paint the columns grey. Please clarify. **Response: Columns shall be painted white for cleanability.**
25. Note 13/M2.02 states to coordinate touch screen location with architect. Please confirm this is supplied by owner. Please state mounting location. **Response: This equipment is supplied by the contractor unless otherwise noted.**
26. Please confirm 6/FS1.17 does not apply to the project. If it does, please state location and provide dimensional details. **Response: Detail does not apply.**
    General note 6/A2.01 states that the architect will select a paint color for exposed ceilings. Please provide paint color and type in these areas. **Response: Paint shall be To Be Determined by Architect. Contractor shall be accordingly.**
27. The following finishes are not identified in the drawings:
    a. FRP1 – Fiberglass Panel
    b. RB1 – Rubber Base
    c. CG – Corner Guard
    d. TEP – Tile Edge Protection
    Response: Refer to A9.01 and A9.02 for the requested information.
29. Who is the existing roofing contractor? **Response: See Chart of Existing Subcontractors.**
28. What is the existing roofing manufacture? **Response: See Chart of Existing Subcontractors.**
29. Is the current roof still under warrantee? **Response: See Chart of Existing Roofing Subcontractor. Work for the existing roof and the previous project has been on going while this project is bidding. The Existing roof is under warranty and shall be by this project's end.**

30. Who is the existing controls contractor? **Response: See Chart of Existing Subcontractors.**
31. Who is the existing Fire Alarm contractor? **Response: See Chart of Existing Subcontractors.**
32. Who is the existing Security contractor? **Response: See Chart of Existing Subcontractors.**
33. Please provide specs for fire protection there is no division 21 00 00. **Refer to FP1.01. A specification is not required. Existing sprinkler lines and head are in the shell spaces. They are to be redirected accordingly by the Sprinkler Subcontractor for the new condition.**

SECTION 251000 - CONTROL SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Division 23 for mechanical equipment

C. Electrical, Lighting, and Fire Alarm Equipment

D. Division 28 for the security system which shall integrate into the Building Control System. The security/access control system shall reside on the BAS Network and utilize the same Network Control Panels.

E. The HCC Mechanical-Electrical Design Guidelines

1.02 SUMMARY

A. Provide a complete Control System (CS) turnkey installation as detailed in this section of these specifications. The CS shall be an Andover Continuum based system that is stand alone in all aspects except that it shall be remotely monitored and controlled from the HCC Central Monitoring and Control System (CMCS) located at 3100 Main. The CS shall integrate seamlessly with the Security Systems.

B. The CS shall comprise the following components:
1. Communication Control Panels (CCP).
2. Distributed Control Panels (DCP)
3. Unitary Controllers (UC)
4. CS Automation Level Network
5. Field instrumentation.
6. Automatic dampers and valves.
7. Actuators for automatic valves and dampers.
8. Communication, sequences of operation and optimization software.
9. All power supplies, interlocking and control relays, equipment enclosures, conduit, junction and mounting boxes, cabling and other components, materials and services required for a completed and fully operational turnkey CS installation meeting these specifications.

C. Provide the following support for the CS facilities:
1. Warranty and service during the warranty period.
2. Submittals, samples, CAD files, and record documentation.
3. Comprehensive commissioning and testing of the CS.
4. Training services for the Owner and Operators.
5. Coordination with other site contractors.
6. Reporting to the General Contractor, the Architect and Engineer for the coordinated and timely execution of the Work.

D. The CS shall be remotely monitored by the HCC Facility wide CMCS.

E. Furnish the following devices for installation by Division 23:
1. Temperature sensing thermo wells.
2. Automatic dampers.
3. Pipe tap for insertion flowmeters.
4. Motorized control valves.
5. Water pressuring sensors and switches with isolation valves.

6. Companion flanges for inline pipe mounted equipment.
7. Furnish UC for terminal units and fan coil units to the unit manufacturer for factory mounting.

F. The Mechanical Contractor shall provide access doors where required for all control system components to proper maintenance access.

G. 120 V ac power shall be provided by the Electrical Subcontractor at locations indicated on the Electrical drawings. Review and verify that these locations are adequate for the proposed CS. Extend power from these locations to all devices as necessary. Power required for Smoke Control Systems, Fire, and Lighting are to be provided by the Electrician.

1.03 ABBREVIATIONS

AD	Automatic Damper
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BIBB	BACnet Interoperability Building Block
CS	Remote facilities/building Control System
CCP	Communications Control Panel
CMCS	Central Monitoring and Control System
CPU	Central Processing Unit
DCP	Distributed Control Panel
DDC	Direct Digital Control
FAS	Fire Alarm System
FCU	Fan Coil Unit
FPTU	Fan Powered Terminal Unit
FSD	Fire / Smoke Damper
HMI	Human Machine Interface
HVAC	Heating, Ventilating and Air Conditioning
ICT	Information Communication Technology
IEEE	Institute of Electrical and Electronics Engineers
I/O	Input/Output
IP	Internet Protocol
ISA	Instrumentation Society of America
ISO	International Standards Organization
I/O	Input/Output
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
OIW	Operator Interface Workstation
PC	Personal Computer
PICS	Protocol Implementation Conformance Statement
PIM	Process Interface Module
POT	Portable Operator Terminal
RAM	Random Access Memory
ROM	Read Only Memory
RFI	Radio Frequency Interference
RH	Relative Humidity
SD	Smoke Damper
SVGA	Super Video Graphics Adapter
UC	Unitary Controller
UL	Underwriters Laboratory
VAV	Variable Air Volume
VDU	Video Display Unit
WAN	Wide Area Network

1.04 OVERALL FACILITY-WIDE CONTROL SYSTEM PHILOSOPHY

A. The following is a description of the overall CMCS philosophy that shall be applicable to the CMCS and all facilities CS. It is provided for the purpose of placing the work of the facilities CS contracts.

B. For the purpose of describing the CMCS system architecture it shall be divided into three layers:
   1. Management Level:
      a. A Wide Area Network (the HCC WAN), shall provide a means of interoperable communication between the CMCS and the facilities CS using the existing HCC Network. This WAN is hereafter referred to as the Management Level Network. The Management Level Network shall provide a means by which the building systems throughout the HCC facilities can exchange data.
      b. The contractor is responsible for providing System Graphics on the existing BAS Network.
   2. Automation Level:
      a. The Communication Control Panels (CCP) shall be part of the CS. CCP shall be software programmable routers/gateways that shall be Andover Continuum on the Management Level Network as well as Andover on the Automation Level Network.
      b. The Automation Level shall, primarily, include the DDC controllers that interface with the field sensors and final control elements. It is anticipated that there will be two types of DDC controller within the CMCS architecture:
         1) Distributed Control panels (DCP).
         2) Unitary Controllers (UC).
      c. DCP controllers shall be freely programmable peer-to-peer controllers and shall have an I/O capability to handle major items of equipment such as air handling units, roof top units, chiller plants, heating plants, etc. The DCP shall be an Andover controllers interfaced with the Management Level Network via the CCP.
      d. UC shall be application specific or freely programmable controllers and shall be suitable for the monitoring and control of specific items of smaller equipment such as VAV terminal units and Fan Coil Units. UC shall be Andover controllers at the Automation Level. These UC shall operate on the same network as the Andover DCP.
      e. All controllers shall be Andover Continuum.
      f. Where interface to a third party controller is not BACnet compatible, the interface shall be via Modbus RTU. Provide Modbus RTU converters as necessary to integrate the third party controller into the Automation Level Network. If Modbus RTU controllers cannot be integrated into the Automation Level, they may be integrated directly to the CCP.

C. Field Level: The Field Level shall include the instrumentation interfaced to the Automation Level DDC controllers such as the temperature, humidity, level, pressure sensors and switches. It shall also include the final control elements such as the valve and damper actuators and the control relays.

1.05 SUBMITTALS

A. The following information shall be included on the cover page for each shop drawing and equipment documentation submittal:
   1. Project name.
   2. Date.
   3. Submittal number and re-submittal number, as appropriate.
   4. Name and address of Consultant.
   5. Name and address of General Contractor.
   6. Name and address of CS Contractor.
   7. Name and address of supplier or vendor, as appropriate.
   8. Name of manufacturer.
   9. Reference to the applicable Specification Section by name and number.

B. Shop drawings shall be CAD generated, minimum plot size of 11 x 17 inches. Drawings shall include diagrams, mounting instructions, installation procedures, equipment details and software descriptions for all aspects of the system to be installed. At minimum, the shop drawings shall include:
   1. CS topology schematic.

2. CCP, DCP, UC and other panel layouts, including floor plan location and interconnection drawings.
3. Field instrumentation locations on floor plan drawings.
4. Schematic of systems indicating instrumentation locations.
5. Installation details.
6. Schedule of cabling including details of proposed cable types.

C. Equipment submittals shall include design, performance and installation details for all aspects of the system to be installed. At minimum, the equipment documentation submittals shall include:
1. Equipment technical data sheets with mounting and installation details.
2. The documentation shall include comprehensive and complete details of the BIBB and Automation Level documentation including address, associated controller type, etc. as required and for the interface to the CMCS.
3. Details of networks/communications equipment, cabling and protocols proposed.
4. Software specifications and descriptions including operating sequences.
5. Field sensor and instrumentation specification sheets.
6. Damper and actuator specification sheets.
7. Valves and actuator specification sheets.
8. Details of piping and/or tubing proposed.

D. Record Documentation
1. Provide Operators' Manuals with, at minimum, the following information:
   a. Details of all features and functions available to the Operators.
   b. Details of all alarm, diagnostic, error and other messages. Detail the Operator action to be taken for each instance.
   c. Detail special programs provided and provide a complete programming instruction manual. Detail operation of all software applications.
   d. Detailed list of the database for all installed devices.
   e. Details of all data base management functions and features.
2. All details and descriptions shall be in a step by step format such that an Operator/ Manager would be able to undertake the respective actions solely on the basis of information provided in the manuals and drawings.
3. Provide hardware manuals which shall include, at minimum, the following:
   a. Specifications, maintenance requirements and installation requirements for all hardware components.
   b. Record drawings and schedules of the completed installation including location of devices, mounting details, cabling details.
   c. Operating sequences and interlocks.
   d. Names and addresses of spare parts suppliers.
4. Record drawings shall be CAD generated and shall include, at minimum, the following:
   a. Details required by the shop drawings.
   b. Final locations and point ID for each monitored and controlled device.
   c. Copy of actual CAD Files for Owner Record.

1.06 QUALITY ASSURANCE

A. Contractor Qualifications: The CS Contractor shall:
1. Have a local staff in the Houston, Texas area of trained personnel capable of giving instructions and providing routine and emergency maintenance on the CS, all components and software/firmware and all other elements of the CS.
2. Have a proven record of experience in the supply and installation of equivalent systems over a minimum period of five years. Provide documentation of at least three and no more than six projects of equal or greater size and complexity, if so requested by the General Contractor.
3. Be certified by the manufacturer for design, installation, and maintenance of the proposed systems.
4. Have comprehensive local service and support facilities for the total CS as provided.
5. Maintain supplies of essential expendable parts for service and construction.

1.07 ELECTRICAL POWER PROVISIONS

A. 120V ac power shall be provided under a separate contract by the Electrical Contractor. Power shall be fed from either normal power circuits or emergency power circuits, as indicated in the Drawings.

B. Normal power shall be provided to the UC serving fan powered terminal units via the control transformer provided with the unit.

C. Provide the necessary low voltage power to the UC provided that will serve VAV terminal units from the power sources indicated on the Drawings. Provide step down transformers within panel enclosures. Provide all necessary fuses and circuit protection devices.

D. Power shall be provided to the dampers interlocked to fans via the control transformer provided with the motor starter.

E. All components of the CS shall be powered from the sources above. Provide final terminations from the locations indicated on the Electrical Drawings.

F. The CS Contractor shall provide any additional power that is required as part of this contract. This shall include all conduit, cabling, circuit breakers, interfaces, etc

1.08 WARRANTY

A. Provide the manufacturer's warranty for all equipment installed at no additional charge for a period of not less than one year. The warranty shall ensure that the installed equipment shall conform to its description and any applicable specifications, and shall be of good quality for the known purpose for which it is intended. The warranty shall allow for replacement or repair at the discretion of the Contractor and shall include all upgrades for firmware and/or operating systems.

PART 2 - PRODUCTS

1.09 MANAGEMENT LEVEL NETWORK

A. Extension of the Management Level Network shall meet, at minimum, the following requirements:
   1. Ethernet TCP/IP network.
   2. Cabling shall be Category 6 or higher quality and shall be tested and certified for 1,000 Mbps data transfer rate.

B. The failure of any node on the secondary LAN shall in no way affect the operation of the CS except to inhibit monitoring and control functions at the OIW for that node or any devices served by the failed node.

C. The failure of any node shall not inhibit the communication between remaining nodes.

1.10 CS AUTOMATION LEVEL NETWORK

A. CS Automation Level LAN shall meet, at minimum, the following requirements:
   1. MSTP.
   2. Data transfer rate and data throughput as required to meet the alarm annunciation requirements.

B. The failure of any node on the secondary LAN shall in no way affect the operation of the CS except to inhibit monitoring and control functions at the OIW for that node or any devices served by the failed node.

C. The failure of any node shall not inhibit the communication between remaining nodes.

1.11 COMMUNICATION CONTROL PANELS (CCP)

A. CCP shall be software programmable controllers on the primary Management Level Network and shall be a router between the Management Level Network and the Automation Level Network.

B. Provide, at minimum, one CCP.

C. The CCP shall incorporate software as necessary to provide communications on the Management Level Network.

D. The failure of any CCP shall be annunciated as an alarm at the CMCS.

E. Provide a real-time hardware clock at each CCP. The hardware real-time clock shall be used to synchronize all other hardware and software clocks in the CS.

1.12 DISTRIBUTED CONTROL PANELS (DCP)

A. DCP shall be software programmable controllers on the CS Automation Level Network and shall provide an interface via Point Interface Modules (PIM) to the field instrumentation and final control elements.

B. DCP may be used for any equipment monitored and controlled by the CS. DCP shall be used to monitor and control the following equipment (as applicable):

1. Chilled water system.
2. Heating water system.
3. Air handling units.

C. The DCP shall control its own communications so that the failure of any one node, including the PC, shall not inhibit communications on the network between the remaining nodes. Provide integral network communication connections.

D. All applications programs and associated operating sequences shall reside at the DCP.

E. Provide each DCP with a battery back-up for the protection of volatile memory for a minimum of 72 hours.

F. Provide a real-time software or hardware at each DCP. The software clock shall have a battery back-up of at least 72 hours.

G. Interfaces to field instrumentation and final control elements shall have Point Interface Modules (PIM) that will:
1. Enable the DCP to receive signals from the digital and analog instrumentation.
2. Enable the DCP to output control signals to the final control elements.

H. Analog I/O PIM shall have a minimum 12 bit analog-to-digital conversion and shall interface to all signal types listed in the Point Schedules.

I. Control shall be based on either three term algorithms, i.e. proportional plus integral plus derivative, or two term algorithms, i.e. proportional plus integral, unless specified otherwise.

1.13 UNITARY CONTROLLERS

A. Unitary Controllers (UC) shall be fully programmable or applications specific controllers with pre-packaged operating sequences maintained in EEPROM or flash ROM.

B. The UC shall be a node on one of the Automation LANs and shall control its own communications so that the failure of any one node, shall not inhibit communications on the network between the remaining nodes.

C. UC shall be totally independent of other LAN nodes for their monitoring and control functions.

D. Provide each UC with a battery back-up for the protection of volatile memory for a minimum of 72 hours. Batteries shall be rated for a seven year life.

E. All associated applications programs shall reside at the UC. UC shall not require communication to any other panel for normal operating sequences other that time scheduled base commands.

F. Control shall be based on either three term algorithms, i.e. proportional plus integral plus derivative, or two term algorithms, i.e. proportional plus integral, unless specified otherwise.

1.14 UNITARY CONTROLLER – TERMINAL UNITS

A. Each terminal unit shall have a UC. The number and location of terminal units and air flow rates shall be as indicated on the Mechanical Drawings.

B. The terminal unit manufacturer shall provide the following components for each fan powered terminal unit for interface and mounting of the UC:
   1. Primary air dampers to be controlled by the UC.
   2. Enclosure to house the UC and associated components or suitable mounting brackets within the terminal unit enclosure.
   3. Multi-point averaging type flow sensor at the primary air inlet to the terminal unit.
   4. 24 VAC control transformer.
   5. 24 VAC fan control relay interface.
   6. 24 VAC heater control relay interface (up to two stages).

C. The terminal unit manufacturer shall provide the following components for each cooling only VAV terminal unit for interface and mounting of the UC:
   1. Primary air dampers to be controlled by the UC.
   2. Enclosure to house the UC and associated components or suitable mounting brackets within the terminal unit enclosure.
   3. Multi-point averaging type flow sensor at the primary air inlet to the terminal unit.

D. The CS Contractor shall furnish the terminal unit manufacturer the following components for factory installation for each terminal unit:
   1. UC.
   2. Damper actuator.

E. The CS Contractor shall field install the following components for each terminal unit:
   1. Room temperature sensor.
   2. Hot water heating control valve (if using hot water heating).

F. Provide integral differential pressure transducers for the monitoring of the terminal unit primary air flow rate.

G. Furnish primary damper actuators, for factory mounting, meeting the following requirements:
   1. Direct shaft mounting.
   2. Adequate torque, to properly operate the damper from fully open to fully closed without binding.
   3. Locking “V” groove or similar means to prevent slippage between actuator and shaft.

H. The UC shall monitor and control the following parameters for fan powered terminal units:
   1. Space temperature.
   2. Primary air flow rate.
   3. Damper modulation.
   4. Heating coil stage control or heating valve control (as applicable).
   5. Fan on/off control.

I. The UC shall monitor and control the following parameters for VAV terminal units:
   1. Space temperature.
   2. Primary air flow rate.
   3. Damper modulation.

J. PID algorithms shall maintain the system operation within + or - 1.0 Deg. F. of the space temperature set points.

K. Following the installation of the terminal unit in the ceiling space the CS Contractor shall undertake the following tasks:
   1. Physically connect the UC into the CS Automation Level Network.
   2. Install all data into the UC as necessary for the correct operation of the terminal unit.
   3. Calibrate the instrumentation associated with the following monitored parameters:
      c. a. Space temperature.
      d. b. Primary air flow rate sensor.
   1. Verify that the UC modulates the primary air duct dampers from fully open to fully closed and vice versa within the specified time and verify either visually or by feel that the damper closes fully under UC control.
   2. Verify that each of the heating stages or valve cycles on and off (as applicable).
   3. Verify that the terminal unit-UC is satisfactorily integrated into the Automation Level Network.

4. Verify that the operating sequences are correct and that there is stable modulation of the primary air damper and staging of the heat.
5. Assist the Air Balancing Contractor as required for the complete commissioning, calibration and operational verification of the HVAC and terminal unit systems.

1.15 INTERFACE SOFTWARE

A. Alarms shall be generated by the CS upon the occurrence of one of the following events:
1. Failure of a CCP, DCP, UC, or any other CS hardware components.
2. Failure of communications of devices on the Automation Level Network.
3. A monitored status indicates a discrepancy between the actual and the required value.
4. A monitored value does not meet criteria established by the operator.
5. The deviation of a variable from set point exceeds operator established criteria.
6. The output to a final control element is outside operator established criteria.
7. A digital input is in the state defined by the operator as indicating an alarm condition.
8. Software failures and errors shall be diagnosed and annunciated by the CS.
9. Failure of WAN or LAN.
10. Power failure.

B. Provide configuration of alarming for all monitored and controlled points. Coordinate all alarm limits and definitions with HCC.

1.16 ENERGY MANAGEMENT SOFTWARE

A. An operator with CS configuration software shall be able to define a minimum time delay between successive starts of equipment so that disturbances created on the building electrical system are minimized in frequency and amplitude.

B. An operator with CS configuration software shall be able to define the minimum time delay between the stopping of a piece of equipment and its subsequent restart. This time delay shall be in effect for motors in the CS software control mode and for motors in the CS manual control mode.

C. The CS shall not override any hardwired interlocks such as those provided at motor starters for overload protection, damper interlock, pressure interlock, etc. and those provided to facilitate control by the Fire Alarm System regardless of the CS output control mode.

D. Unless stated otherwise elsewhere in these Specifications, the modulation of final control elements by the CS in the CS software control mode shall be based on a Proportional-Integral-Derivative (PID) control algorithm. The control constants for the PID algorithm shall be definable by the operator. If self-tuning algorithms are provided, it shall still be possible for the operator to manually tune the control loops. The software shall incorporate facilities to enable the bump less transfer of a modulating output from CS manual control to CS software control and vice versa and the prevention of integral wind-up. PID algorithms shall maintain the system operation within the desired tolerance around the set point.

E. Provide dynamic graphical trending software that emulates, at minimum, a three point strip chart recorder. This program shall concurrently display three or more plots of variables in a graphical format. The graphs shall be plotted as the values are sampled in a similar fashion to a chart recorder and when the plot reaches the right hand side of the X-axis, the X-axis shall scroll to the left so as to accommodate newly sampled data.

F. Provide an energy monitoring software facility to monitor and report electrical energy usage and instantaneous energy demand. This feature shall also store data for recall via the historical data trend package.

G. Provide run time totalizing software that will accumulate the operating times for motors and unitary equipment as selected by the operator using an interactive procedure. Any piece of equipment that has its status monitored by the CS shall be selectable for inclusion in this feature. It shall be possible to concurrently monitor the accumulated operating time for every item of equipment monitored and/or controlled by the CS.

H. Provide demand limiting and duty cycle programs that will duty cycle equipment usage in a manner that conserves energy. The cycling of equipment shall be initiated by one of the following means:
   1. Operator defined schedule.
   2. Peak electric demand control software program.
   3. Operator manual command.

I. The proportion of ON time to OFF time in a single cycle shall either be assigned by the operator using an interactive procedure or the operator may elect to have a variable ON/OFF ratio based on other criteria.

J. Provide a scheduling program that will enable the CS to automatically schedule an item of equipment on and off. The operator shall be able to assign a minimum of four start and four stop times to each piece of equipment for each day of the week and for holidays. These schedules shall only be in effect for a piece of equipment when it is in the CS software control mode. The scheduling feature shall conform to the CMCS scheduling interface.

K. Provide equipment fail restart software that will restart equipment shut down as the result of a fire alarm system following the return to normal conditions or a power fail condition.

L. Provide a night setback software program that shall:
   1. Start HVAC equipment after normal hours of scheduled operation to maintain building after hour set points, while reducing energy consumption.
   2. Night setback temperatures for heating shall be initially set at 55 Deg. F. to activate the heating equipment and 60 Deg. F. to stop the heating equipment. Once activated, the units involved shall operate as specified in the respective sequence of operation. Coordinate the operation of this program with the requirements for terminal unit controls.
   3. Night setup temperatures for cooling shall be initially set at 90 Deg. F. to activate the cooling equipment and 85 Deg. F. to stop the cooling equipment. Once activated, the units involved shall operate as specified in the respective sequence of operation. Coordinate the operation of this program with the requirements for terminal unit controls.
   4. This feature shall be provided for all HVAC equipment under control of the CS. The operator shall be able to enable/disable this function on a unit by unit basis

1.17 SEQUENCES OF OPERATION SOFTWARE

A. Air Cooled Chiller System (Two Chillers With Dedicated Pumps)
   1. System Off - When the system is off:
      a. The chilled water pumps shall be off.
      b. The chillers shall be disabled.
      c. The bypass valve shall be open.
      d. The Chiller motorized isolation valves shall be closed.
   2. Initiation of System Start-Up - The system shall be started:
      a. By an operator manually entered command at the CMCS.
      b. Automatically by the CS based on time schedule or demand by the AHU.
   3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:
      a. The lead chilled water pump shall start, after confirmation of motorized chiller isolation valves have been opened.
      b. Once flow has been proven through the chiller then the chiller shall start under control of its unit mounted controller.
      c. After an operator defined time delay, the chilled water bypass valve shall be modulated to maintain the chilled water differential pressure set point to ensure adequate flow through the operating chillers.
      d. If the bypass control valve is fully closed and the building chilled water supply temperature cannot be maintained by the lead chiller for an operator defined period, then the lag pump and chiller shall be started as described above.
      e. If the building chilled water supply temperature is at or below the set point and the chilled water bypass flow rate is greater than the lag chilled water pump, then the lag chiller and associated pump shall stop.

4. Set points - The set points for the system shall be determined as follows:
   a. The chilled water supply temperature set point shall be set initially at 44 deg. F (adjustable).
   b. The differential set point at the plant shall be initially set at 7 psi.
   c. The operator defined period for chiller and pump staging shall be initially set at 15 minutes during occupied times and 30 minutes during initial staging.
   d. The period for chilled water bypass control shall be initially set at 5 minutes.
5. Initiation of System Shutdown - System shutdown shall be initiated:
   a. By operator entered manual command.
   b. Automatically by the CS based on a time schedule basis.
6. Alarm set points - The CS shall generate an alarm:
   a. If the chilled water supply temperature is outside the operator established high alarm limits, which shall be initially set at + 4 Deg. F. around the set point.
   b. If the differential pressure is outside operator established low and high alarm limits, initially set at + or - 3 psi about the set point.
   c. If a pump or chiller fails to start or fails in service.
   d. If a chiller is operating and there is no flow as indicated by its associated flow switch.
   e. An equipment alarm signal is initiated by unit controller.
7. Freeze Protection: When the outdoor temperature fall below 35 F (adjustable), the chilled water pumps shall energize and circulate chilled water with chillers off and control valves open to the coils.
8. Failure positions - When a CS component or power failure occurs:
   a. Pumps shall remain at the last commanded state.
   b. Chillers shall remain at the last commanded state.
   c. Valves shall remain at the last commanded position.

B. Hot Water System (Boiler With Dedicated Pump)
1. System Off - When the system is off:
   a. The hot water pumps shall be off.
   b. The boiler units shall be disabled.
2. Initiation of System Start-Up - The system shall be started:
   a. By an operator manually entered command at the CMCS.
   b. Automatically when there is a requirement for the hot water at the any of the AHU or terminal units after an operator defined time delay.
3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:
   a. The boiler and associated pump shall be enabled and the boiler unit shall start under control of the unit mounted control panel.
   b. The differential pressure bypass valve shall be modulated to maintain the hot water differential pressure set point.

Hot water supply temperature set point	50 Deg. F. OAT	70 Deg. F. OAT

   c. The hot water mixing valve shall be modulated to maintain the hot water supply temperature set point. The hot water supply temperature set point shall be reset on a linear reset schedule based on outside air temperature in accordance with the following:
4. Set points - The set points for the system shall be determined as follows:
   a. The hot water differential pressure set point shall be set initially at 8 psig.
   b. The hot water supply temperature set point shall be initially set to 180 Deg. F.
5. Initiation of System Shutdown - System shutdown shall be initiated:
   a. By operator entered manual command.
   b. Automatically by the CS based on a time schedule basis.
6. Freeze Protection: When the outdoor temperature fall below 35 F (adjustable), the hot water pumps shall energize and circulate hot water through the coils.
7. Alarms - The CS shall generate an alarm:
   a. If a boiler is operating without an associate pump operating and vice versa.
   b. If the hot water differential pressure is outside the operator established low and high alarm

limits, which shall be initially set at + of - 3 psig around the current set point.

8. Failure positions - When a CS component failure occurs:
   a. Pumps shall remain at the last commanded state.
   b. Boilers shall remain at the last commanded state.
   c. If any operating pump or boiler fails.

C. VAV Air Handling Units
1. System Off - When the system is off:
   a. The unit outside air damper shall be closed.
   b. The supply air fan shall be off.
   c. The cooling coil valve shall be closed.
2. Initiation of System Start-Up - System start-up shall be initiated:
   a. By an operator manually entered command at the CMCS.
   b. Automatically by the CS based on night setup, time schedule.
3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:
   a. The variable speed supply air fan shall start and the speed shall be modulated to maintain the duct static pressure set point.
   b. Once the unit is operating during normal occupied time periods, the outside air damper shall be modulate open to the maximum position as coordinated with the balancing contractor.
   c. The chilled water control valve shall be modulated to maintain the supply air temperature set point.
   d. If the AHU has been operating for over 60 minutes and the return air CO_2 is below the operator defined high limit, then the outside damper shall be positioned to the 75% of full open position. If after another 30 minutes the return air CO_2 is below the operator defined high limit, then the outside damper shall be positioned to the 50% of full open position. If after another 30 minutes the return air CO_2 is below the operator defined high limit, then the outside damper shall be positioned to the 25% of full open position. If the return air CO_2 reached the operator defined high limit, the outside air damper shall open to the full open position. The outside air damper shall remain in the full open position and the return air CO_2 below the high limit for a minimum of 60 minutes before the outside air reset sequences is enabled.
4. Set points - The set points for the system shall be determined as follows:
   a. The supply air temperature set point shall be set manually by the operator and shall be set initially at 55 Deg. F.
   b. The duct static pressure set point shall be set by the operator and shall be set initially at 1.25 inches w.g.
   c. The set point for high static shutdown shall be set initially at 2.5 inches w.g.
   d. The return air CO2 reset limit shall be initially set at 800 ppm.
5. Initiation of System Shutdown - System shutdown shall be initiated:
   a. By operator entered manual command.
   b. Automatically by the CS when there are no terminal units requiring primary air.
   c. High static pressure shut down.
6. Alarms - The CS shall generate an alarm:
   a. If the duct static pressure is outside the operator established low and high alarm limits, initially set at 0.5 and 1.5 inches w.g.
   b. If the supply air temperature is outside the operator established low and high limits, which shall be set at + or - 4 Deg. F. around the current set point.
   c. All alarms shall be inhibited when the supply fan is not operating except the space temperature alarms. The alarms, except the fan failure to start and failure in service alarms and the space temperature alarms, shall remain inhibited following start up of the unit for an operator determined period of time initially set at 2 minutes.
   d. If the space humidity is above 75 % RH.
   e. If the return air CO_2 is above the operator established limit, initially set at 1100 ppm.
7. Failure positions - When a CS component or power failure occurs:
   a. Supply fan shall remain in the last commanded state.
   b. The cooling coil valve shall remain in the last commanded position.

c. The outside air damper shall remain in the last commanded position.

D. VAV Outside Air Handling Units
1. System Off - When the system is off:
   a. The outside air intake damper shall be closed.
   b. The supply air fan shall be off.
   c. The cooling coil valve shall be closed.
2. Initiation of System Start-Up - System start-up shall be initiated:
   a. By an operator manually entered command at the CMCS.
   b. Automatically by the CS based on night setup, time schedule.
3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:
   a. The hardwired interlock damper shall open.
   b. Once the damper is fully open, the variable speed supply air fan shall start and the speed shall be modulated to maintain the duct static pressure set point.
   c. The heating coil valve or electric heater shall be controlled to maintain the heating supply air temperature set point.
   d. The chilled water control valve shall be modulated to maintain the cooling supply air temperature set point.
4. Set points - The set points for the system shall be determined as follows:
   a. The heating and cooling supply air temperature set point shall be set manually by the operator and shall be set initially at 40 Deg. F. and 55 Deg. F., respectively.
   b. The duct static pressure set point shall be set by the operator and shall be set initially at .75 inches w.g.
   c. The set point for high static shutdown shall be set initially at 2.5 inches w.g.
   d. Freeze stat set point shall be set at the device for 35 Deg. F.
5. Initiation of System Shutdown - System shutdown shall be initiated:
   a. By operator entered manual command.
   b. Automatically by the CS when there are no terminal units requiring primary air.
   c. High static pressure shut down.
6. Alarms - The CS shall generate an alarm:
   a. If the duct static pressure is outside the operator established low and high alarm limits, initially set at 0.2 and 1.25 inches w.g.
   b. If the supply air temperature is outside the operator established low and high limits, which shall be set at + or - 4 Deg. F. around the current set point.
   c. All alarms shall be inhibited when the supply fan is not operating except the space temperature alarms. The alarms, except the fan failure to start and failure in service alarms and the space temperature alarms, shall remain inhibited following start up of the unit for an operator determined period of time initially set at 2 minutes.
7. Failure positions - When a CS component or power failure occurs:
   a. a. Supply fan shall remain in the last commanded state.
   b. b. The cooling coil valve shall remain in the last commanded position.
   c. c. The outside air damper shall remain in the last commanded position.

E. Constant Volume Air Handling Unit (Heating/Cooling)
1. System Off - When the system is off:
   a. The supply fan shall be off.
   b. The heating coil shall be de-energized or the heating coil valve shall be closed.
   c. The cooling coil valve shall be closed.
   d. The outside air damper shall be closed.
2. Initiation of System Start-Up - System start-up shall be initiated:
   a. By an operator manually entered command at the CMCS.
   b. Automatically by the CS based on night setup, time schedule.
3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:
   a. The supply air fan shall start.

b. The electric heating coils shall be controlled to maintain the heating space temperature set point or the heating hot water valve shall be modulated to maintain the spaced temperature heating set point.
c. The cooling coil valve shall be modulated to maintain the cooling space temperature set point.
d. If the AHU has been operating for over 60 minutes and the return air CO_2 is below the operator defined high limit, then the outside damper shall be positioned to the 75% of full open position. If after another 30 minutes the return air CO_2 is below the operator defined high limit, then the outside damper shall be positioned to the 50% of full open position. If after another 30 minutes the return air CO_2 is below the operator defined high limit, then the outside damper shall be positioned to the 25% of full open position. If the return air CO_2 reached the operator defined high limit, the outside air damper shall open to the full open position. The outside air damper shall remain in the full open position and the return air CO_2 below the high limit for a minimum of 60 minutes before the outside air reset sequences is enabled.

4. Set points - The system shall have the following set points:
   a. Space temperature set point shall be 71 Deg. F. for heating and 74 Deg. F. for cooling.
   b. The return air CO_2 reset limit shall be initially set at 800 ppm.
5. Initiation of System Shutdown - System shutdown shall be initiated:
   a. By operator entered manual command.
   b. Automatically by the CS base on time schedule.
6. Alarms - The CS shall generate an alarm:
   a. If the space temperature is outside the operator established low and high limits, which shall be set initially at + or - 2 Deg. F. around the set point.
   b. All alarms shall be inhibited when the supply fan is not operating. The alarms, except the fan failure to start and failure in service alarms, shall remain inhibited following start up of the unit for an operator determined period of time initially set at 2 minutes.
   c. If the return air CO_2 is above the operator established limit, initially set at 1100 ppm.
7. Failure positions - When a CS component failure occurs:
   a. Supply fan shall remain in the last commanded state.
   b. Heating coil shall be de-energized or the heating valve shall remain in the last commanded position.
   c. The outside air damper shall close.
   d. The cooling coil valve shall remain in the last commanded position.

F. Fan Coil Unit (Heating/Cooling) - If the unit has an outside air damper, it shall be controlled as described above.
1. System Off - When the system is off:
   a. The supply fan shall be off.
   b. The heating coil shall be de-energized or the heating coil valve shall be closed.
   c. The cooling coil valve shall be closed.
2. Initiation of System Start-Up - System start-up shall be initiated:
   a. By an operator manually entered command at the CMCS.
   b. Automatically by the CS based on night setup, time schedule.
3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:
   a. The supply air fan shall start.
   b. The electric heating coils shall be controlled to maintain the heating space temperature set point or the heating hot water valve shall be modulated to maintain the spaced temperature heating set point.
   c. The cooling coil valve shall be modulated to maintain the cooling space temperature set point.
4. Set points - The system shall have the following set points:
   a. Space temperature set point shall be 71 Deg. F. for heating and 74 Deg. F. for cooling.
5. Initiation of System Shutdown - System shutdown shall be initiated:
   a. By operator entered manual command.
   b. Automatically by the CS base on time schedule.
6. Alarms - The CS shall generate an alarm:
   a. If the space temperature is outside the operator established low and high limits, which shall be

set initially at + or - 2 Deg. F. around the set point.
b. All alarms shall be inhibited when the supply fan is not operating. The alarms, except the fan failure to start and failure in service alarms, shall remain inhibited following start up of the unit for an operator determined period of time initially set at 2 minutes.

7. Failure positions - When a CS component failure occurs:
   a. Supply fan shall remain in the last commanded state.
   b. Heating coil shall be de-energized or the heating valve shall remain in the last commanded position.
   c. The cooling coil valve shall remain in the last commanded position.

G. Ventilation Fans
1. System Off - When the system is off, the fan shall be off.
2. Initiation of System Start-Up - System start-up shall be initiated:
   a. Manually by a CMCS operator entered command.
   b. Automatically by the CS base on time schedule.
3. System Operation – When system start-up has been initiated, the following sequences shall be implemented: The fan shall be started.
4. Initiation of System Shutdown - System shutdown shall be initiated:
   a. Manually by an operator entered command.
   b. Automatically by the CS.
5. Alarms - The CS shall generate an alarm if the fan fails to start or fails in service.
6. Failure positions - When a CS component failure occurs, the fan shall remain in the last commanded state.

H. Powered VAV Terminal Units (Series Fan)
1. System Off - When the system is off:
   a. The fan shall be off.
   b. The primary air damper shall be closed.
   c. The FPTU heating coil shall be off or the heating valve shall be closed.
2. System start-up shall be initiated:
   a. Manually by an operator entered command at the CMCS.
   b. Automatically when the CS based on time schedule or night setback.
3. When an FPTU start-up has been initiated for the FPTU to operate in the normal occupied mode of operation, the following operating sequences shall be implemented:
   a. The fan shall operate.
   b. The primary air damper, and the heating coil or heating valve shall be sequenced to maintain the space temperature within + or - 0.5 Deg. F. of set point.
   c. The primary damper shall be modulated between maximum and minimum values as scheduled in the Mechanical Documents.
4. The set points for the FPTU control shall be set initially as follows:
   a. The occupied space temperature heating set point shall be set initially at 72 Deg. F.
   b. The occupied space temperature cooling set point shall be set initially at 75 Deg. F.
   c. The unoccupied space temperature heating set point shall be set initially at 10 Deg. F. below the occupied space temperature heating set point.
   d. The unoccupied space temperature cooling set point shall be set initially at 10 Deg. F. above the occupied space temperature cooling set point.
   e. The maximum and minimum primary air flow rates shall set initially at the values given in the Mechanical Drawings.
   f. The unoccupied high and low limits shall be set initially at 15 Deg. F. above the cooling temperature set point and 15 Deg. F. below the heating temperature set point respectively.
5. The CS shall generate an alarm as follows: If the space temperature in the occupied mode is outside the operator established high and low alarm limits which shall be set initially at 5 Deg. F. above the cooling temperature set point and 5 Deg F. below the heating temperature set point, respectively.

I. VAV Terminal Units (Cooling Only)
1. System Off - When the system is off, the primary air damper shall be closed.

2. System start-up shall be initiated:
   a. Manually by an operator entered command at the CMCS.
   b. Automatically when the optimized scheduling program calls for the start-up of a terminal unit.
3. When the terminal unit is in the occupied mode of operation:
   a. The primary air damper shall be sequenced to maintain the space temperature within + or – 0.5 Deg. F. of set point.
   b. The primary air shall be modulated between the minimum and maximum primary air flow rates, as scheduled in the Mechanical Documents.
4. When the terminal unit is off, the primary air damper shall be closed.
5. The set points for the terminal unit control shall be initially as follows:
   a. The occupied space temperature cooling set point shall be set initially at 75 Deg. F.
   b. The unoccupied space temperature cooling set point shall be set initially at 10 Deg. F. above the occupied space temperature cooling set point.
   c. The unoccupied high and low limits shall be set initially at 15 Deg. F. above the cooling temperature set point.
6. The CS shall generate an alarm: If the space temperature in the occupied mode is outside the operator established high and low alarm limits which shall be set initially at 5 Deg. F. above the cooling temperature set point .

PART 2 - PRODUCTS

2.1. AUTOMATIC DAMPERS

A. Furnish automatic dampers (AD), smoke dampers (SD), and combination fire/smoke dampers (FSD) as indicated on the Division 23 Mechanical Drawings and Specifications and in the Point Sheets for installation by the Division 23 Mechanical Contractor. Refer to Division 23 Drawings and Specifications. Furnish smoke dampers complete with factory mounted actuators.

B. Provide actuators for all automatic dampers furnished as part of the CS contract. Provide all required actuator mountings, installation, drive arms, linkages and damper end switches.

C. Dampers and actuators shall be configured for normal and failure positions as indicated in the operating sequences and as indicated in the Division 23 Mechanical Drawings.

D. The maximum leakage rate for AD shall not exceed 10 cfm per square foot at 4 inches W.C.

E. SD shall be as specified above with the following additional requirements:
   1. Maximum leakage rate shall not exceed U.L. 555S Class 1 low leakage.
   2. Actuator shall be factory mounted.
   3. Compliant with NFPA 90A, NFPA 92A, NFPA 92B, U.L. 555 and U.L. 555S.

F. FSD shall be as specified above with the following additional requirements:
   1. Maximum leakage rate shall not exceed U.L. 555S Class 1 low leakage and shall be qualified under UL 555S to an elevated temperature of 250 Deg. F.
   2. Dampers shall be classified for use for fire resistance ratings of less than 3 hours in accordance with UL555
   3. Dampers shall be equipped with a UL classified and tested Fire stat that will permit re-openable operation following a fire induced closure. Fire stat shall be factory installed
   4. Actuator shall be factory mounted.
   5. Compliant with NFPA 90A, NFPA 92A, NFPA 92B, U.L. 555 and U.L. 555S.

G. Provide electric damper actuators for all AD, SD, and SFD. Electric actuators shall meet, at minimum, the following requirements:
   1. Actuators shall be directly coupled to damper drive blades with no intermediate linkages or shall be rotary type actuators directly coupled to the damper drive shaft.
   2. 120 V ac + or - 10% 60 Hz or 24 V ac power supply.
   3. Actuators shall be motorized / driven in both the open and closed directions. Where required by the sequences of operation, actuators shall have a spring return to the de-energized position upon loss of power. Damper normal and failure positions shall be as identified within the sequences of

operation.

2.2. CONTROL VALVES

A. Furnish all valves controlled by the CS as detailed in the Mechanical Documents and as indicated in the Point Sheets. Furnish all shut-off valves for instrumentation. Valves shall be installed by the Mechanical Contractor. All other valves such as check valves, relief valves, pressure reducing valves, self regulating valves, manually operated valves, etc. shall be furnished and installed by the Mechanical.

B. Refer to the Division 23 plans and drawings for the design conditions on which to base sizing and ratings of the valves and their actuators.

C. All chilled water, condenser water, and hot water valves shall meet, at minimum, the following ANSI Class 150 ratings.

D. Valves 0.5 inch to 2 inches shall have NPT female screwed ends. Valves 2.5 inches and larger shall have flanged ends.

E. Verify and certify that the materials of construction of the pipe, weld, flange, bolts and valve will not cause any galvanic corrosion.

F. Where necessary to achieve the required performance and pressure drop a control valve may be sized up to two nominal sizes below line size. Two position valves shall be full line size.

G. Provide two way globe control valves or characterized ball valves at the following locations:
   1. Chilled water coils.
   2. Hot water coils.

H. Two way globe control valves shall meet, at minimum, the following requirements:
   1. Pressure drop shall not exceed 5 psig.
   2. Leakage rate shall not exceed 0.01% of the rated valve capacity (ANSI Class 4) at pump shut-off head.
   3. Valve trim shall be stainless steel.

I. Provide butterfly valves at the following locations:
   1. Cooling tower bypass.
   2. Chilled water bypass.

J. Butterfly valves shall meet, at minimum, the following requirements:
   1. Full lugged type. Semi-lug and wafer valves are not acceptable.
   2. Valves shall be full line size.
   3. Stem shall be stainless steel.

K. Provide electric actuators for all control valves that are furnished as part of the CS contract. Two way and three way control valve actuators shall meet, at minimum, the following requirements:
   1. Motor driven type.
   2. Gear assembly shall be made of hardened steel. No plastic components shall be acceptable.
   3. Actuator shall have an input voltage of 24 VAC.
   4. Exterior housings shall be NEMA-4 rated.
   5. Sized to meet the shut-off requirements when operating at the maximum system differential pressure and with the installed system pump operating at shut-off head. Actuators shall control against system maximum working pressures.
   6. Normal and failure positions shall be as indicated in the Operating Sequences.
   7. Visual mechanical position indication, showing valve position.
   8. Equipped with an integral position potentiometer to indicate the stem position of the valve if required by the sequence of operation.
   9. Manual declutch lever to enable manual operation of the valve. It shall be possible for an operator to manually modulate valves located in mechanical rooms in the event of loss of power.

2.3. FIELD INSTRUMENTATION

A. Outside air temperature sensor: Provide outside air temperature sensors as indicated within the Point Schedules. Temperature sensors shall meet, at minimum, the following requirements:
   1. 1. Ventilated white PVC sun shield.
   2. 2. Wall mounted weather proof enclosure with conduit fitting.
   3. 3. RTD or thermistor.
   4. 4. CS shall report the monitored temperature with an accuracy of ± 0.5 Deg. F.

B. Duct mounted temperature sensor: Provide duct mounted, single point temperature sensors as indicated within the Point Schedules. Temperature sensors shall meet, at minimum, the following requirements:
   1. Probe length of 8 inches minimum.
   2. Stainless steel.
   3. RTD or thermistor.
   4. CS shall report the monitored temperature with an accuracy of ± 0.5 Deg. F.

C. Wall mounted space temperature sensor: Provide wall mounted temperature sensors for spaces as indicated within the Point Schedules. Temperature sensors shall meet, at minimum, the following requirements:
   1. Location as shown on the Mechanical Drawings. No sensor shall be mounted until specific location instructions are given.
   2. RTD or thermistor.
   3. CS shall report the monitored temperature with an accuracy of ± 0.5 Deg. F.

D. Thermo well temperature sensor: Provide thermo well mounted temperature sensors as indicated within the Point Schedules. Temperature sensors shall meet, at minimum, the following requirements:
   1. Rigid stainless steel probe of length which is, at minimum, 20% of the pipe width.
   2. RTD or thermistor.
   3. CS shall report the monitored temperature with an accuracy of ± 0.25 Deg. F. accuracy.
   4. Moisture/waterproof housing with conduit fitting.
   5. Stainless steel thermo well.
   6. Provided with thermal conductivity grease to aid temperature sensing.

E. Freeze stat: Provide freeze stats for all air handling systems that receive untreated outside air. Freeze stats shall meet, at minimum, the following requirements:
   1. Minimum 20 feet vapor tension element, which shall serpentine the inlet face on all coils. Provide additional sensors, wired in series, to provide one linear foot per square foot of coil surface area.
   2. Interlock to the associated fan so that fan will shut down when HOA switch is in Hand or Auto position. Provide time delay relays with a 0-10 minute time delay relay duration to minimize nuisance freezes tat trips. Time delay relay shall be adjustable at the associated control panel.
   3. Automatic reset.

F. High temperature limit switches: Provide high temperature limit switches for all air systems that do not have duct type smoke detectors. High limit sensors and switches shall meet, at minimum, the following requirements:
   1. Single point type sensor.
   2. Interlock to the associated fan so that fan will shut down when HOA switch is in Hand or Auto position.
   3. Manual reset.
   4. Set point shall be adjustable. Switches shall be selected to shutdown the air system upon sensing a temperature of 75 Deg. F. above the normal system temperature.

G. Outside air relative humidity sensor: Provide outside air relative humidity sensors as indicated within the Point Schedules. Humidity sensors shall meet, at minimum, the following requirements:
   1. Wall-mount weather proof enclosure with conduit fitting.
   2. Two wire, 4-20 mA output proportional to relative humidity range of 0% to 100%.
   3. ± 2% accuracy (5 - 95% RH).
   4. Humidity sensor shall be replaceable.

H. Interior air relative humidity sensor: Provide wall mounted relative humidity sensors as indicated within the Point Schedules. Humidity sensors shall meet, at minimum, the following requirements:

1. Wall-mount enclosure with white cover.
2. Two wire, 4-20 mA output proportional to relative humidity range of 0% to 100%.
3. Humidity sensor shall be replaceable.
4. ± 2% accuracy (5 - 95% RH).

I. Duct mounted relative humidity sensor: Provide duct mounted relative humidity sensors as indicated within the Point Schedules. Humidity sensors shall meet, at minimum, the following requirements:
1. Duct mounted moisture resistant enclosure with conduit fitting.
2. Two wire, 4-20 mA output proportional to relative humidity range of 0% to 100%.
3. Humidity sensor shall be replaceable.
4. ± 2% accuracy (5 - 95% RH).
5. 8 inch probe length.

J. Latching control relays: Provide latching control relays as indicated within the Point Schedules and sequences of operation. Relays shall meet, at minimum, the following requirements:
1. Pickup rating, time and hold rating as required for individual applications.
2. Rated for a minimum of ten (10) million mechanical operations and a minimum of 500,000 electrical operations.
3. Provide complete isolation between the control circuit and the digital output.
4. Located in the DCP, UC or other local enclosures.
5. Malfunction of a CS component shall cause the controlled output to fail to the positions identified in the failure procedure within the operating sequences.
6. 10 amp contact rating.
7. Pin type terminals.

K. Momentary control relays: Provide momentary control relays as indicated within the Point Schedules and sequences of operation. Relays shall meet, at minimum, the following requirements:
1. Coil ratings of 120 VAC, 50 mA or 10-30 VAC/VDC, 40 mA as suitable for the application.
2. Provide complete isolation between the control circuit and the digital output.
3. Located in the DCP, UC or other local enclosures.
4. 10 amp contact rating.
5. LED status indication.
6. Pin type terminals.

L. Duct static pressure sensor: Provide duct mounted static pressure sensors as indicated within the Point Schedules. Static pressure sensors shall meet, at minimum, the following requirements:
1. Input range shall be 0 to 2.0 inches w.g.
2. 4-20 mA output proportional to pressure input range.
3. ± 5% accuracy.

M. Current sensing relay: Provide current sensing relays as indicated in the Point Schedules. Current metering transformers and relays shall meet, at minimum, the following specifications:
1. Rated for the applicable load.
2. The output relay shall have an accessible trip adjustment over its complete operating range. Provide LED indication of relay status.
3. Split core or solid core shall be sized for the application.

N. Water differential pressure sensor: Provide water differential pressure sensors as indicated in the Point Schedules. Water differential pressure sensors shall meet, at minimum, the following requirements:
1. Cast aluminum NEMA 1 enclosure.
2. Output of 4-20 mA or 0-10 vdc proportional to the pressure sensed.
3. Operating range of 0 to 30 psig.
4. Accuracy of ± 2% of full scale reading.
5. Valved tappings shall be installed by the Mechanical Contractor. Furnish the valves to the Mechanical Contractor.

O. Air differential pressure switch for fan shutdown: Provide air differential pressure switches as indicated in the Point Schedules to shut down the associated fan in the event of sensing high differential pressure. Air differential pressure switches shall meet, at minimum, the following requirements:

1. Adjustable set point with a set point range of 0 to 10 inches w.g.
2. 1/4 inch compression fittings suitable for copper sensing tubing.
3. Manual reset.

P. Photocell: Provide ambient light level sensors as indicated within the Point Schedules. Light level sensor shall meet, at minimum, the following requirements:
1. Non-corroding and weatherproof housing with sensor shield suitable for exterior installations.
2. 4-20 mA output proportional to the ambient light level.
3. Mounted on the exterior of a North wall on the roof.
4. Sensor reading from 0 to 750 foot candles.

Q. Refrigerant leak detection monitoring: Provide refrigerant leak monitoring as identified within the point schedules. Refrigerant leak detection monitors shall meet, at minimum, the following requirements:
1. Power consumption: AC - 325 mA, DC - 250 mA.
2. Operating temperature range of 0 Deg. C. to 70 Deg. C. (32 Deg. F. to 158 Deg. F.).
3. Operating humidity range: 10% to 95% non-condensing.
4. Measuring range of 0-1000 ppm proportional to 4 to 20mA output range for each sampling point.
5. Volt free contacts to indicate an alarm condition.
6. Refrigerant gas system detection supplier/contractor shall be familiar with standard practices of safety and installation for refrigerant gas detection systems.
7. Submit details of refrigerant monitors, breathing apparatus, control panel and diagrams as part of the submittal process.
8. System shall detect the presence of the of the following types of refrigerants regardless of refrigerant type using sequential sampling and multi-point monitoring method:
   a. HCFC
   b. HFC
9. System shall annunciate to the CS and locally alarm (audible and visual) upon detection of alarm conditions. Provide silencing alarm button at control panel. Provide approved appropriate signage at all entry points to the chiller room. Initial alarm shall comply with recommended Allowable Exposure Level (AEL). Adjustable 3 level alarm for each point shall be supplied with common alarm output contacts. Provide local digital indication of ppm level for a minimum of 1 sample point per chiller. A sample point shall be located close to each chiller and the refrigerant pump out unit location. Location to be approved by the Engineer. Sample point if in alarm shall flash the associated LED. Provide local alarm horns and visual (stroboscopic) beacons at the following locations to activate upon alarm to an approved detail:
   a. Outside of entrance doors to chiller machine room.
   b. Inside rooms without an escape route other than through the chiller room.
   c. At each chiller location.
   d. At any other location in the chiller room as necessary to ensure that a person at any location in the chiller room and room that can be entered from the chiller room can see the visual alarm and hear the audible alarm and at any other location required to meet the applicable codes.
10. System shall shut down all electrical equipment (chiller systems and associated pumps, AHU, FCU, etc.) and sequence emergency extract equipment as required to meet regulations. Where combustion equipment is employed, refrigerant vapor monitoring system shall automatically shut down the combustion process in event of refrigerant leakage if other alternative acceptable conditions are not applied. Ventilation system, chiller and associated pumps and other equipment shut down as a result of the refrigerant leak alarm shall return to normal operation when the refrigerant monitoring system is no longer detecting refrigerant levels above set points and alarms have been silenced.
11. System shall have self-diagnostics and supply common malfunction output. Loss of sample flow at either sample or ZERO line and electrical malfunction shall annunciate to the BMS.
12. Provide two (2) additional particulate filters and zero gas filter cartridges.
13. Provide self-contained breathing apparatus that is OSHA approved and certified meeting the following requirements:
   a. Certified for 20 minutes of use.

b. Furnish in clearly marked wall mount metal enclosures to be located inside each room that does not have an escape route apart from through the chiller room, outside one exterior door serving the chiller machine room, within the chiller room at locations such that no point in the chiller room is more than 50 feet from an escape door or a SCBA and at all other locations required by the code. Locations of SCBA to be approved by the Engineer.

14. Provide an emergency shut-off control button outside each chiller plant room entrance/exit door. Button shall be mounted at 1200mm above finished floor adjacent to refrigerant leak detection alarm light. Activation of any one of the buttons shall de-energize all chillers and other electrical equipment within the chiller plant room. Button shall be manually reset.

2.4. PANELS

A. Provide panels and enclosures for all components of the CS, which are susceptible to physical or environmental damage.

B. Interior panels and enclosures shall meet be NEMA 1 rated painted steel panels with locking door.

C. Exterior mounted panels and enclosures shall be NEMA 4 painted steel panels with locking door.

2.5. LABELING

A. Provide labeling for all DCP, UC, panels and enclosures.

B. Provide labeling of all cables.

2.6. WARNING NOTICES

A. Provide warning notices at all equipment controlled by the CS and at all associated motor starters.

2.7. TUBING AND PIPING

A. Provide tubing and piping as required for the field instrumentation.

B. Tubing within equipment rooms, vertical risers, and penetrations to ductwork shall be either copper pipe or shall be plastic tubing within conduit. Identify the type of tubing proposed in the shop drawing submittal.

C. Provide suitable bulk head fittings for duct and panel penetrations.

D. Tubing in plenum rated areas shall be plastic tubing. Plastic tubing shall meet, at minimum, the following requirements:
1. Flame retardant.
2. Crack resistant.
3. Polyethylene tubing.
4. 300 psi burst pressure.

2.8. CONDUIT AND FITTINGS

A. Provide all conduits, raceways and fittings for the CS monitoring, communication and control cabling. All work shall meet all applicable codes.

B. Conduit, where required, shall meet, the requirements specified within Electrical Sections.

C. Conduit shall be provided whenever one of the following conditions exists:
1. Conduit is required by code.
2. Conduit is indicated on the drawings or specifically required by the specifications.
3. Cabling runs through inaccessible areas such as within partitions/walls, above closed in ceilings, under floor, within trenches on the exterior of the building, when encased in concrete or other material that makes the cable inaccessible or when located such that access to the cable is not readily obtained.
4. Cable within mechanical, telecommunications and electrical equipment rooms and control rooms shall be enclosed within conduit.
5. Cable run on the exterior of the building shall be in conduit.
6. Cable run on an exposed surface shall be in conduit.
7. Conduit shall be provided for all primary communication LAN (Ethernet TCP/IP or equivalent) cable.

D. CS monitoring and control cable shall not share conduit with cable carrying voltages in excess of 48 volts.

2.9. CABLING

A. Provide all cables for the CS. Cable shall meet, at minimum, the following requirements:
   1. Minimum 98% conductivity stranded copper.
   2. Proper impedance for the application as recommended by the CS component manufacturer.
   3. Monitoring and control cable shall be #18 AWG or larger, dependent on the application. Analog input and output cabling shall be shielded.
   4. Management Level Network cable shall be CAT 5, 24 gauge unshielded.
   5. Automation Level Network cable shall be #24 AWG shielded.
   6. Shield shall be grounded at the CCP, DCP, UC, or control panel. Ground at one end only to avoid ground loops.
   7. Identification of each end at the termination point. Identification should be indicated on and correspond to the record drawings.

B. 120 VAC power wiring shall be of #12 AWG solid conductor or larger as required.

C. All cable within the building shall be plenum rated cable where required by code. All cable that is not enclosed in conduit shall be plenum rated cable. Plenum rated cable not in conduit shall be routed parallel and perpendicular with the building column lines. Cable may follow ductwork routing and may be fixed to the top or side of the ductwork. If cabling does not follow the ductwork routing, it shall be fixed tight to the structure above. Provide cable rings and supports, at minimum, 15 ft. to support the cabling.

PART 3 - EXECUTION

3.1. TRAINING

A. Training shall be provided by the CS Contractor on site using the completed installations. Coordinate use of the equipment for training with the Owner. Where specific training requires the use of the Owner's meeting room space, co-ordinate these requirements with the Owner. Training shall consist of, at minimum, one 4-hour session.

3.2. INSPECTION DURING INSTALLATION

A. Prior to acceptance testing, the CS shall be available for use by the Owner. Use by the Owner shall not imply acceptance of any component of the CS or the commencement of the warranty period.

B. Provide staff to assist the Owner/Engineer with inspections made during the installation period that are required to review the progress and quality of ongoing work. The Owner/Engineer will generate Field Observation Reports on the findings of the inspection. The Owner/Engineer shall advise the CS Contractor during the inspection of any concerns noted with respect to the installation and shall repeat the concerns in writing as soon as possible after the inspection is completed. The CS Contractor shall take corrective action to meet the requirements of the specifications

3.3. ACCEPTANCE TESTING

A. Prior to the scheduling of the acceptance testing with the Owner/Engineer, the CS Contractor shall perform a complete and detailed operational check of each CS component. Test results shall be documented using test sheets. The test sheets shall be prepared in an appropriate format for the various categories of component to be tested.

B. Installation, engineering, software and system personnel shall be available on-site during the acceptance test. These personnel shall be familiar with the installation and shall undertake all tests as requested by the Owner and Consultant in order to verify that the CS components individually and in total meet the specifications.

3.4. HANGING AND SUPPORTING

A. Install all equipment, devices, materials and components in compliance with the manufacturers' recommendations. Supports shall be suitable for the environment within which the component is to be installed. Coordinate all hanging and supporting of components with all trades.

B. Provide sleeves for all cable and conduit passing through walls, partitions, structural components, floors and roofs.

3.5. HARDWIRED INTERLOCKS

A. Provide all required hardwired interlocks between fans, intake and discharge dampers, emergency generators, etc. and any motor actuated damper as identified within this specification or the Mechanical Drawings, whether or not furnished under this Section unless the fan is furnished with interlock by fan manufacturer.

3.6. CS POINT SCHEDULES

A. The following schedules define the minimum monitoring and control functions to be undertaken by the CS.

B. The column headed POINT provides an English language description of the point to be monitored or controlled.

C. The column headed DI indicates digital input monitoring.

D. The columns headed DO indicate digital output control.

E. The column headed AI indicates analog input monitoring.

F. The column headed AO indicates analog output control.

G. The column headed HI indicates hardwired interface.

H. The column headed CI indicates digital communications interface to a third party monitoring or controlling device.

POINT SCHEDULE: AIR COOLED CHILLER SYSTEM WITH DEDICATE PUMPS AND PRESSURE DIFFERENT BYPASS							
POINT	DI	DO	AI	AO	HI	CI	NOTES
CHILLER CONTROL		X					PER CHILLER
CHILLER STATUS	X						PER CHILLER
CHILLER ARLARM	X						PER CHILLER
CURRENT LIMIT							PER CHILLER
CHILLED WATER RETURN TEMPERATURE			X				PER CHILLER
CHILLED WATER SUPPLY TEMPERATURE RESET				X			PER CHILLER
CHILLER AMPERAGE			X				PER CHILLER
CHILLER PHASE VOLTAGE			X				PER CHILLER PER PHASE
CHILLER LOSS OF PHASE	X						PER CHILLER
CHILLED WATER SUPPLY TEMPERATURE			X				PER CHILLER
CHW PUMP CONTROL		X					PER PUMP
CHILLED WATER PUMP STATUS	X						PER PUMP
CHILLED WATER BYPASS FLOW RATE			X				
BYPASS VALVE CONTROL				X			
BUILDING CHILLED WATER RETURN TEMPERATURE			X				
BUILDIGN WATER SUPPLY TEMPERATURE			X				
CHILLED WATER SUPPLY FLOW			X				
CHILLED WATER RISER DIFFERENTIAL PRESSURE			X				

POINT SCHEDULE: HEATING HOT WATER SYSTEM WITH PRESSURE DIFFERENTIAL BYPASS							
POINT	DI	DO	AI	AO	HI	CI	NOTES
BOILER ENABLE/ DISABLE CONTROL		X					PER BOILER
BILER BURNER STATUS	X						PER BOILER
BOILER LOW WATER ALARM	X						PER BOILER
BOILER TEMPERATURE			X				PER BOILER
HEATING HOT WATE RSUPPLY TEMPERATURE			X				PER BOILER
HEATING HOT WATER RETURN TEMPERATURE			X				PER BOILER
HEATING HOT WATER PUMP CONTROL		X					PER BOILER
HEATING HOT WATER PUMP STATUS	X						PER PUMP
HOT WATER MIXING VALVE CONTROL				X			
HOT WATER SUPPLY TEMPERATURE LEAVING			X				DOWNSTREAM FO THE MIXING VALVE
HOT WATER BYPASS VALVE CONTROL				X			
HEATING HOT WATER BYPASS FLOW RATE			X				
HEATING HOT WATER DIFFERENTIAL RESSSURE			X				

POINT SCHEDULE: VAV AIR HANDLING UNIT							
POINT	DI	DO	AI	AO	HI	CI	NOTES
OUTSIDE AIR DAMPER CONTROL				X			
RETURN AIR CO^2			X				
SUPPLY FAN VSD START AND STOP		X					
SUPPLY FAN VSD SPEED CONTROL SIGNAL				X			
SUPPLY FAN VSD MOTOR OPERATING STATUS	X					X	
HIGH STATIC SHUTDOWN					X		
COOLING COIL VALVE CONTROL				X			
SUPPLY AIR TEMPERATURE			X				
SUPPLY STATIC PRESSURE			X				
SPACE HUMIDITY			X				ONE PER UNIT

POINT SCHEDULE: VAV OUTSIDE AIR HANDLING UNIT							
POINT	DI	DO	AI	AO	HI	CI	NOTES
OUTSIDE AIR DAMPER CONTROL		X					
HEATING VALVE CONTROL			X				
FREEZES AT	X				X		
SUPPLY FAN VSD START AND STOP		X					
SUPPLY FAN VSD SPEED CONTROL SIGNAL				X			
SUPPLY FAN VSD MOTOR OPERATING STATUS	X					X	
HIGH STATIC SHUTDOWN					X		
COOLING COIL VALVE CONTROL				X			
SUPPLY AIR TEMPERATURE			X				
SUPPLY STATIC PRESSURE			X				

POINT SCHEDULE: CONSTANT VOLUME AIR HANDLING UNIT AND UNIT VENTILATOR (HEATING / COOLING)							
POINT	DI	DO	AI	AO	HI	CI	NOTES
OUTSIDE AIR DAMPER CONTROL		X					
HEATING VALVE CONTROL			X				
FREEZE STAT	X				X		
SUPPLY FAN VSD START AND STOP				X			
SUPPLY FAN VSD MOTOR OPERATING STATUS	X					X	
HIGH STATIC SHUTDOWN					X		
COOLING COIL VALVE CONTROL				X			
SUPPLY AIR TEMPERATURE			X				
SUPPLY STATIC PRESSURE			X				

POINT SCHEDULE: FAN COIL (COOLING)							
POINT	DI	DO	AI	AO	HI	CI	NOTES
COOLING COIL VALVE CONTROL				X			
SUPPLY FAN CONTROL		X					
SUPPLY FAN STATUS	X						
SPACE TEMPERATURE			X				
CONDENSATE ALARM	X						
SPACE HUMIDITY			X				ONE PER UNIT

POINT SCHEDULE: FAN POWERED TERMINAL UNITS

POINT	DI	DO	AI	AO	HI	CI	NOTES
PRIMARY AIR FLOWRATE			X				
PRIMARY AIR DAMPER CONTROL				X			
FAN CONTROL START/ STOP		X					
ELECTRIC VALVE CONTROL				X			
SPACE TEMPERATURE			X				

POINT SCHEDULE: VAV TERMINAL UNITS (COOLING ONLY)							
POINT	DI	DO	AI	AO	HI	CI	NOTES
PRIMARY AIR FLOWRATE			X				
PRIMARY AIR DAMPER CONTROL				X			
SPACE TEMPERATURE			X				

POINT SCHEDULE: VENTILATION/ EXHAUST FANS							
POINT	DI	DO	AI	AO	HI	CI	NOTES
FAN CONTROL START/ STOP		X					
FAN STATUS	X						

POINT SCHEDULE: ELECTRICAL MAIN SWITCHBOARD MONITORING							
POINT	BI	DO	AI	AO	HI	CI	NOTES
KW DEMAND	X		X			X	
KW HOUR			X			X	

POINT SCHEDULE: MISCELLANEOUS							
POINT	BI	DO	AI	AO	HI	CI	NOTES
OUTSIDE AIR TEMPERATURE			X				
OUTSIDE AIR RELATIVE HUMIDITY			X				
OUTSIDE AIR CO_2			X				
EMERGENCY OUTSIDE AIR SUPPLY SHUTDOWN BUTTON	X						

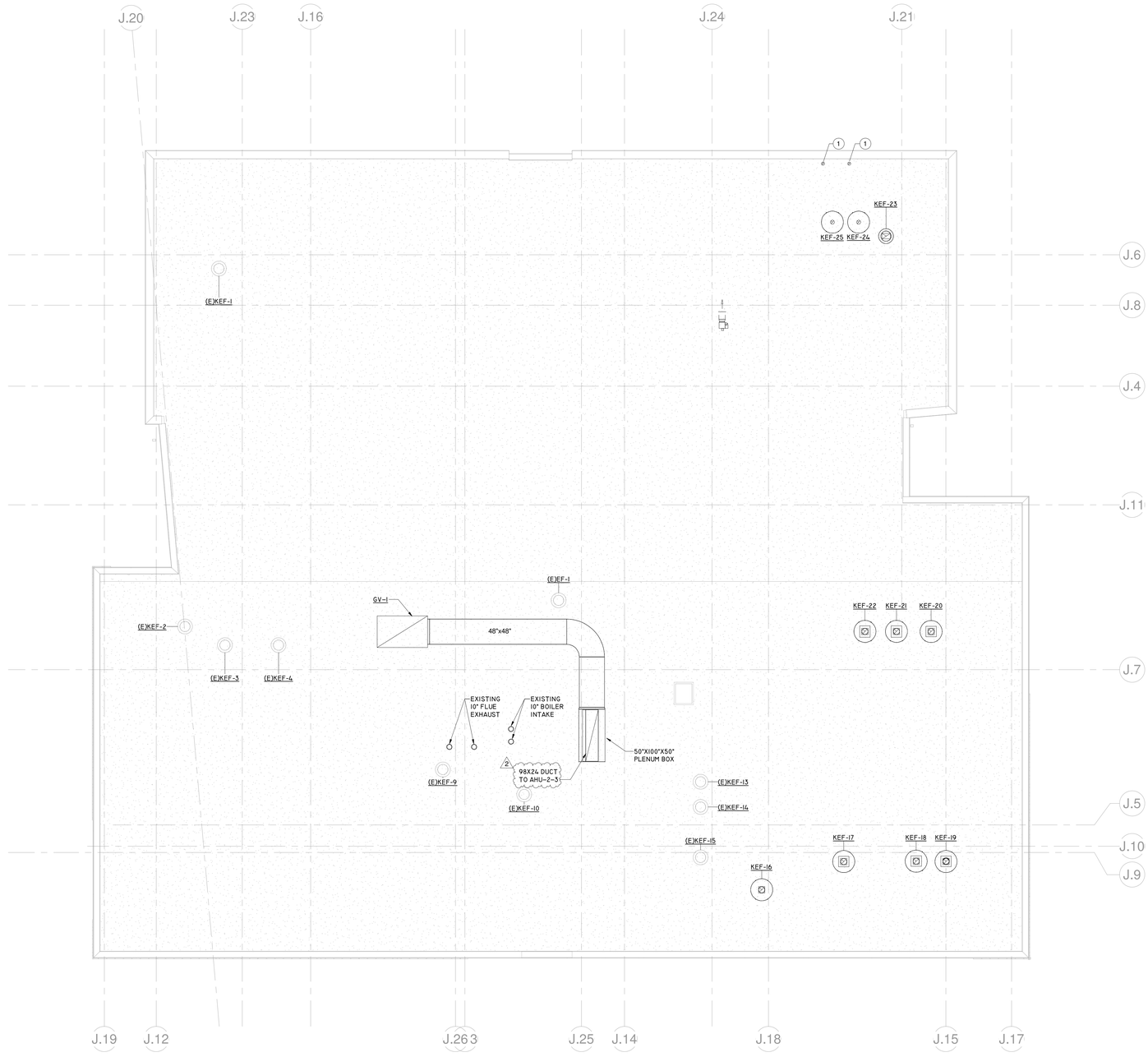
END OF SECTION

GENERAL NOTE

1. ALL DUCTWORK ON ROOF SHALL BE CONSTRUCTED OF 16 GAUGE STAINLESS STEEL.

KEYNOTE LEGEND

1	6" FLUE EXHAUST DUCT FROM 2ND LEVEL. TERMINATE 3 FT ABOVE FINISHED ROOF WITH STACK CAP. AMPCO MODEL P-SK OR APPROVED EQUAL.



1 ROOF PLAN - HVAC

Scale: 1/8" = 1'-0"

HOUSTON COMMUNITY COLLEGE
CENTRAL CAMPUS

AUTOARCH Architects, LLC.
6200 Savoy, Suite 100
Houston, TX 77036
t (713) 952-3366
f (713) 952-5002
www.autoarch.net

CONSULTANTS:

MEP ENGINEERS
Infrastructure Associates
(713) 622-0120

STRUCTURAL ENGINEERS
Dally + Associates
(713) 337-8881

FOOD SERVICE
Foodservice Design Professionals
(281) 350-2323

PROFESSIONAL SEAL:

STATE OF TEXAS
ANWAR HASSAN
64671
LICENSED
PROFESSIONAL ENGINEER

2021-02-05

A PROJECT FOR:

CULINARY ARTS SHELL INTERIOR BUILDOUT

#	Date	ISSUED FOR
	2020/04/15	PERMIT
1	2020/12/08	BID
2	2021/02/05	ADDENDUM #1

Infrastructure Associates
INFRASTRUCTURE ASSOCIATES, INC.
6117 RICHMOND AVENUE, SUITE 200
HOUSTON, TEXAS 77057
TBPE REGISTRATION NO. F-4506
(713) 622-0120 PH (713) 622-0557 FAX
WWW.IAHOUSTON.COM

KEY PLAN

TRUE NORTH PLAN NORTH

Project Number	17024
Drawn By	Author
Checked By	Checker
Approved By	Approver
Drawing Title	ROOF PLAN - HVAC
Drawing Number	M2.04

2/5/2021 7:59:41 PM