DATE: November 11, 2020

Hurst-Rosche, Inc.
200 N. Market
Marion, Illinois 62959

TO: PROSPECTIVE BIDDERS

SUBJECT: ADDENDUM NO. 3 TO THE BIDDING DOCUMENTS FOR

Murphysboro CUSD #186
Murphysboro Middle School HVAC – Phase 3
Murphysboro, Jackson County, Illinois
HR: 365-3198

This addendum forms a part of the bidding and contract documents and modifies the bidding documents dated October 27, 2020. Acknowledge receipt of this addendum in space provided on Bid Form. FAILURE TO DO SO MAY SUBJECT BIDDER TO DISQUALIFICATION.

CLARIFICATIONS

1. Contractors bidding the project as "general" are REQUIRED to submit their Capital Development Board prequalification statement with their bidding documents.
2. Floor to deck height (based on drawings from the 1925 set)
    a. 1st floor – 11'
    b. 2nd floor – 13'
    c. 3rd floor – 12'
3. Batt insulation to be installed above ceiling attached to structure is strictly for sound mitigation. Insulation can be installed with facing against the above structure.
4. The current Fire Alarm system at the school is Simplex.

SPECIFICATIONS

1. REPLACE Specification Section 238000 – Variable Refrigerant Flow System as attached.

2. ADD Specification Section 230923 – Direct-Digital Control System for HVAC as attached.

DRAWINGS

1. ASB – 101 ADD General Note 15 – Asbestos contractor to remove an additional 250 sf. of ACM floor tile located in the rooms that radiators are being removed. General contractor to install new VCT to replace ACM tile removed in these locations.
2. A106 – Keynote #1 – DELETE "With R-19 Batt insulation above new ACT ceiling system mounted directly to the underside of the floor deck above".
3. A601 – ADD to Window Schedule – Storage 113 – 31"x31" Match existing window
4. Sheet MD101 – First Floor HVAC Demo Plan - REVISE Keyed Note 5 to state: "Existing Kiln 48" x 48" kiln exhaust hood, ductwork and through wall exhaust fan shall be removed and relocated to Classroom 228. Kiln location is as shown on Sheet A102 in Classroom 228. Install exhaust fan in existing window opening. Coordinate exact mounting location prior to installation.

5. Sheet M502 – HVAC Schedules - REPLACE keyed note #1 in the "Schedule of VRF Indoor Heat Pumps" to read as follows: "Provide wired wall mounted thermostat: LG model PREMTC00U."

6. Sheet ED101
    a. First Floor Electrical Demolition Plans - CLARIFY the existing electrical panel in Weight Room 514 to be replaced is surface mounted, 120/208V, 3 phase, 200 amp with main circuit breaker. There are (26) existing branch circuit breakers, (1) is 30A/1P and (25) are 20A/1P. Contractor shall supply a new (30) circuit panelboard with (1) 30A/1P circuit breaker and (29) 20A/1P circuit breakers. The existing tub is 60" tall by 22" wide.

    b. CLARIFY the existing electrical panel in Storage 504B to be replaced is surface mounted, 120/208V, 3 phase, 200 amp with main circuit breaker. There are (26) existing 20A/1P branch circuit breakers. Contractor shall supply a new (30) circuit panelboard with (30) 20A/1P circuit breakers. The existing tub is 60" tall by 22" wide.

    c. CLARIFY the existing electrical panel (west) in Boiler Room 111A is surface mounted, 120/208V, 3 phase, 200 amp, main lug only. There are (20) existing 20A/1P branch circuit breakers. Contractor shall supply a new (20) circuit panelboard with (20) 20A/1P circuit breakers. The existing tub is 52" tall by 22" wide.

    d. CLARIFY the existing electrical panel (middle) in Boiler Room 111A is surface mounted, 120/208V, 3 phase, 400 amp, main lug only. There are (4) existing 200A/3P branch circuit breakers, and (2) existing 100A/3P branch circuit breakers. Contractor shall supply a new panelboard with (4) 200A/3P branch circuit breakers, and (2) 100A/3P branch circuit breakers. The existing tub is 66" tall by 22" wide.

    e. CLARIFY the existing electrical panel (east) in Boiler Room 111A is surface mounted, 120/208V, 3 phase, 600 amp with main circuit breaker. There are (2) existing 400A/3P branch circuit breakers, (1) existing 225 amp branch circuit breaker, (1) existing 50A/3P branch circuit breaker, (2) existing 30A/3P circuit breakers, (4) existing 20A/3P branch circuit breakers, (1) existing 20A/2P branch circuit breaker, and (3) existing 20A/1P branch circuit breakers. Contractor shall supply a new panelboard with (2) 400A/3P branch circuit breakers, (1) 225 amp branch circuit breaker, (1) 50A/3P branch circuit breaker, (2) 30A/3P circuit breakers, (4) 20A/3P branch circuit breakers, (1) 20A/2P branch circuit breaker, and (3) 20A/1P branch circuit breakers. The existing tub is 73" tall by 38" wide.

7. Sheet E102 – Second and Third Floor Electrical Plans - ADD a 60A/2P disconnect switch and electrical connections for the relocated Kiln. Kiln is as shown on Sheet A102 in Classroom 228. Route 3-#6 AWG & #8 AWG GND in a ¾" EMT conduit to the existing electrical panel located on the north wall of Band 403. Install a new 60A/2P circuit breaker in existing blank panel spaces.

8. Sheet E201/E202 – Partial First Floor Lighting Plans - REVISE the lights in Corridors 107 and 115 from Type A/AE light fixtures to Type B/BE light fixtures. There are a quantity of 21 Type A light fixtures that get revised to Type B light fixtures and 8 Type AE light fixtures that get revised to Type BE light fixtures.

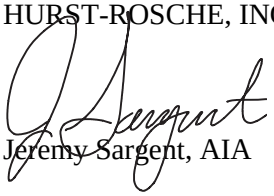
9. Sheet S-100 – Add in its entirety.

This addendum **DOES NOT** alter the previously published bid date of **November 17, 2020** at 593 Ava Road, Murphysboro, IL 62966.

UPON RECEIPT OF THIS ADDENDUM, PLEASE SIGN BELOW AND E-MAIL TO HURST-ROSCHE ENGINEERS, INC., AT jsiefert@hurst-rosche.com WITHIN 24 HOURS OF RECEIPT.

Respectfully submitted,

HURST-ROSCHE, INC.



Jeremy Sargent, AIA

cc: All plan holders

RECEIVED BY:

_____

Authorized Representative

_____ _____

Company Name Date

SECTION 23 09 23

DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. Section includes control equipment and software.

1.2 SCOPE OF WORK STATEMENT

A. The DDC system shall include provisions for Phase 1 work (equipment is already installed) to include the following as a minimum:
   1. Aaon Gym RTU-1/RTU-2
   2. LG VRF System
   3. Aaon DOAS RTU-3

B. The DDC system shall include provisions for Phase 2 work (equipment is already installed) to include the following as a minimum:
   1. Cafeteria RTU's (2 each)
   2. Band RTU

C. The DDC system shall include provisions for Phase 3 work (current bid package) to include all work as shown on these bid documents, and as noted below, but not limited to:
   1. LG VRF Systems (5 each)
   2. Aaon DOAS RTU's (3 each)
   3. Aaon RTU's (4 each)

D. The DDC system shall include provisions for FUTURE work to include items as listed below, but not limited to:
   1. Boilers
   2. Pumps
   3. Access & Door Control

E. The DDC system shall include the ability/capacity to include everything within the specifications and scope statement above without the need for future expansion of the main DDC system.

1.3 REFERENCES

A. American National Standards Institute:
   1. ANSI MC85.1 - Terminology for Automatic Control.

1.4 SYSTEM DESCRIPTION

A. Automatic temperature controls field monitoring and control system using field programmable microprocessor based units.

B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.

C. Provide computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.

D. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories to operate mechanical systems, and to perform functions specified.

E. Provide installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

1.5 SUBMITTALS

A. Shop Drawings: Indicate the following:
   1. Trunk cable schematic showing programmable control-unit locations and trunk data conductors.
   2. Connected data points, including connected control unit and input device.
   3. System graphics showing monitored systems, data (connected and calculated) point addresses, and operator notations.
   4. System configuration with peripheral devices, batteries, power supplies, diagrams, modems, routers, and interconnections.
   5. Description and sequence of operation for operating, user, and application software.
   6. Use terminology in submittals conforming to ASME MC85.1.
   7. Coordinate submittals with information requested in Section 23 09 93.

B. Product Data: Submit data for each system component and software module.

C. Manufacturer's Installation Instructions: Submit installation instruction for each control system component.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
   1. Revise shop drawings to reflect actual installation and operating sequences.
   2. Submit data specified in "Submittals" in final "Record Documents" form.

B. Operation and Maintenance Data:
   1. Submit interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
   2. Submit keyboard illustrations and step-by-step procedures indexed for each operator function.
   3. Submit inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 MAINTENANCE SERVICE

A. Furnish service and maintenance of control systems for one year from Date of Substantial Completion.

B. Furnish complete service of controls systems, including callbacks. Make minimum of 4 complete normal inspections of approximately 4 hours duration in addition to normal service calls to inspect, calibrate, and adjust controls. Submit written report after each inspection.

C. Furnish four complete inspections per year, one in each season, to inspect, calibrate, and adjust controls. Submit written report after each inspection.

D. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.

E. Perform work without removing units from service during building normal occupied hours.

F. Provide emergency call back service during working hours for this maintenance period.

G. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.

H. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.

PART 2 PRODUCTS

2.1 DIRECT DIGITAL CONTROLS

A. Manufacturers:
   1. Johnson Controls.
   2. Dynamic Controls Inc.
   3. Substitutions: No Substitutions.

2.2 OPERATOR WORKSTATION

A. Furnish each operator workstation consisting of the following:

B. Personal Lap Top Computer: IBM PC compatible with sufficient memory and hard drive storage to support graphics, reports, and communication requirements. Furnish with the following minimum configuration requirements:
   1. Processor: AMD or Intel, 3.6 GHz.

2. Hard Drive: 2 Terabyte Gigabyte.
3. Memory: 16 GB DDR SDRAM.
4. Drive 1: 48x CD Burner, DVD combination.
5. Ports: Required serial, parallel, network communications, USB, and cables for proper system operation.
6. LAN Card: EtherNet (100 base-T minimum)/integrated wireless card.
7. Mouse: two-button optical type wireless.
8. Keyboard: 104 key, QWERTY wireless.

C. Monitor: Minimum of 21 inch CRT, flat panel display.

D. Operating System: Windows 10, 64 bit.

E. System Support: Minimum ten (10) work stations connected to multi-user, multi-tasking environment with concurrent capability to:
1. Access DDC network.
2. Access or control same control unit.
3. Access or modify same control unit database.
4. Archive data, alarms, and network actions to hard disk regardless of what application programs are being currently executed.
5. Develop and edit database.
6. Implement and tune DDC control.
7. Develop graphics.
8. Control facility.

2.3 CONTROL UNITS

A. Units: Modular in design and consisting of processor board with programmable RAM memory, local operator access and display panel, and integral interface equipment.

B. Battery Backup: For minimum of 100 hours for complete system including RAM without interruption, with automatic battery charger.

C. Control Units Functions:
1. Monitor or control each input/output point.
2. Completely independent with hardware clock/calendar and software to maintain control independently.
3. Acquire, process, and transfer information to operator station or other control units on network.
4. Accept, process, and execute commands from other control unit's or devices or operator stations.
5. Access both data base and control functions simultaneously.
6. Record, evaluate, and report changes of state or value occurring among associated points. Continue to perform associated control functions regardless of status of network.
7. Perform in stand-alone mode:
   a. Start/stop.
   b. Duty cycling.
   c. Automatic Temperature Control.
   d. Demand control via a sliding window, predictive algorithm.

e. Event initiated control.
f. Calculated point.
g. Scanning and alarm processing.
h. Full direct digital control.
i. Trend logging.
j. Global communications.
k. Maintenance scheduling.

D. Global Communications:
1. Broadcast point data onto network, making information available to other system controls units.
2. Transmit input/output points onto network for use by other control units and use data from other control units.

E. Input/output Capability:
1. Discrete/digital input (contact status).
2. Discrete/digital output.
3. Analog input.
4. Analog output.
5. Pulse input (5 pulses/second minimum).
6. Pulse output (0-655 seconds in duration with 0.01-second resolution minimum).

F. Monitor, control, or address data points. Include analog inputs, analog outputs, pulse inputs, pulse outputs and discrete inputs/outputs. Furnish control units with minimum 30 percent spare capacity.

G. Point Scanning: Set scan or execution speed of each point to operator selected time from 1 to 250 seconds.

H. Upload/Download Capability: Download from or upload to operator station. Upload/Download time for entire control unit database maximum 10 seconds on hard-wired LAN or 60 seconds over voice grade phone lines.

I. Test Mode Operation: Place input/output points in test mode to allow testing and developing of control algorithms on line without disrupting field hardware and controlled environment. In test mode:
1. Inhibit scanning and calculation of input points. Issue manual control to input points (set analog or digital input point to operator determined test value) from workstation.
2. Control output points but change only database state or value; leave external field hardware unchanged.
3. Enable control-actions on output points but change only data base state or value.

J. Local display and adjustment panel: Integral to control-unit containing digital display, and numerical keyboard. Display and adjust:
1. Input/output point information and status.
2. Controller set points.
3. Controller tuning constants.
4. Program execution times.
5. High and low limit values.

6. Limit differential.
7. Set/display date and time.
8. Control outputs connected to the network.
9. Automatic control outputs.
10. Perform control unit diagnostic testing.

K. Points in "Test" mode.

2.4 LOCAL AREA NETWORKS (LAN):

A. Furnish communication between control units over local area network (LAN).

B. LAN Capacity: Not less than 60 stations or nodes.

C. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.

D. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over high speed internet access utilizing modems and routers.

E. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.

F. Network Support: Time for global point to be received by any station, less than 3 seconds. Furnish automatic reconfiguration when station is added or lost. In event transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

2.5 OPERATING SYSTEM SOFTWARE

A. Input/output Capability From Operator Station:
1. Request display of current values or status in tabular or graphic format.
2. Command selected equipment to specified state.
3. Initiate logs and reports.
4. Change analog limits.
5. Add, delete, or change points within each control unit or application routine.
6. Change point input/output descriptors, status, alarm descriptors, and unit descriptors.
7. Add new control units to system.
8. Modify and set up maintenance scheduling parameters.
9. Develop, modify, delete or display full range of color graphic displays.
10. Automatically archive select data even when running third party software.
11. Capability to sort and extract data from archived files and to generate custom reports.
12. Support two printer operations.
13. Alarm printer: Print alarms, operator acknowledgments, action messages, system alarms, operator sign-on and sign-off.
14. Data printer: Print reports, page prints, and data base prints.
15. Select daily, weekly or monthly as scheduled frequency to synchronize time and date in digital control units. Accommodate daylight savings time adjustments.
16. Print selected control unit database.

B. Operator System Access: Via software password with minimum 30 access levels at work station and minimum 3 access levels at each control unit.

C. Data Base Creation and Support: Use standard procedures for changes. Control unit automatically checks workstation data base files upon connection and verify data base match. Include the following minimum capabilities:
   1. Add and delete points.
   2. Modify point parameters.
   3. Change, add, or delete English language descriptors.
   4. Add, modify, or delete alarm limits.
   5. Add, modify, or delete points in start/stop programs, trend logs, and other items.
   6. Create custom relationship between points.
   7. Create or modify DDC loops and parameters.
   8. Create or modify override parameters.
   9. Add, modify, and delete applications programs.
   10. Add, delete, develop, or modify dynamic color graphic displays.

D. Dynamic Color Graphic Displays:
   1. Utilizes custom symbols or system supported library of symbols.
   2. Sixteen (16) colors.
   3. Sixty (60) outputs of real-time live dynamic data for each graphic.
   4. Dynamic graphic data.
   5. 1,000 separate graphic pages.
   6. Modify graphic screen refresh rate between 1 and 60 seconds.

E. Operator Station:
   1. Accept data from LAN as needed without scanning entire network for updated point data.
   2. Interrogate LAN for updated point data when requested.
   3. Allow operator command of devices.
   4. Allow operator to place specific control units in or out of service.
   5. Allow parameter editing of control units.
   6. Store duplicate data base for every control unit and allow down loading while system is on line.
   7. Control or modify specific programs.
   8. Develop, store and modify dynamic color graphics.
   9. Data archiving of assigned points and support overlay graphing of this data using up to four (4) variables.

F. Alarm Processing:
   1. Off normal condition: Cause alarm and appropriate message, including time, system, point descriptor, and alarm condition. Select alarm state or value and alarms causing automatic dial-out.
   2. Critical alarm or change-of-state: Display message, stored on disk for review and sort, or print.
   3. Print on line changeable message, up to 60 characters in length, for each alarm point specified.
   4. Display alarm reports on video. Display multiple alarms in order of occurrence.
   5. Define time delay for equipment start-up or shutdown.
   6. Allow unique routing of specific alarms.

7. Operator specifies when alarm requires acknowledgment.
8. Continue to indicate unacknowledged alarms after return to normal.
9. Alarm notification:
10. Print automatically.
11. Display indicating alarm condition.
12. Selectable audible alarm indication.

G. Event Processing: Automatically initiate commands, user defined messages, take specific control actions or change control strategy and application programs resulting from event condition. Event condition may be value crossing operator defined limit, change of state, specified state, or alarm occurrence or return to normal.

H. Automatic Restart: Automatically start field equipment on restoration of power. Furnish time delay between individual equipment restart and time of day start/stop.

I. Messages:
1. Automatically display or print user-defined message subsequent to occurrence of selected events.
2. Compose, change, or delete message.
3. Display or log message at any time.
4. Assign any message to event.

J. Reports:
1. Manually requested with time and date.
2. Long term data archiving to hard disk.
3. Automatic directives to download to transportable media including floppy diskettes for storage.
4. Data selection methods to include data base search and manipulation.
5. Data extraction with mathematical manipulation.
6. Data reports to allow development of XY curve plotting, tabular reports (both statistical and summary), and multi-point timed based plots with not less than four (4) variables displayed.
7. Generating reports either normally at operator direction, or automatically under workstation direction.
8. Either manually display or print reports. Automatically print reports on daily, weekly, monthly, yearly or scheduled basis.
9. Include capability for statistical data manipulation and extraction.
10. Capability to generate four types of reports: Statistical detail reports, summary reports, trend graphic plots, x-y graphic plots.

K. Parameter Save/Restore: Store most current operating system, parameter changes, and modifications on disk or diskette.

L. Data Collection:
1. Automatically collect and store in disk files.
2. Daily electrical energy consumption, peak demand, and time of peak demand for up to electrical meters over 2-year period.
3. Daily consumption for up to 30 meters over a 2 year period.
4. Daily billable electrical energy consumption and time for up to 1024 zones over a 10 year period.

5. Archiving of stored data for use with system supplied custom reports.

M. Graphic Display: Support graphic development on work station with software features:
1. Page linking.
2. Generate, store, and retrieve library symbols.
3. Single or double height characters.
4. Sixty (60) dynamic points of data for each graphic page.
5. Pixel level resolution.
6. Animated graphics for discrete points.
7. Analog bar graphs.
8. Display real time value of each input or output line diagram fashion.

N. Maintenance Management:
1. Run time monitoring, for each point.
2. Maintenance scheduling targets with automatic annunciation, scheduling and shutdown.
3. Equipment safety targets.
4. Display of maintenance material and estimated labor.
5. Target point reset, for each point.

O. Advisories:
1. Summary containing status of points in locked out condition.
2. Continuous operational or not operational report of interrogation of system hardware and programmable control units for failure.
3. Report of power failure detection, time and date.
4. Report of communication failure with operator device, field interface unit, point and programmable control unit.

2.6 LOAD CONTROL PROGRAMS

A. General: Support inch-pounds and S.I. metric units of measurement.

B. Demand Limiting:
1. Monitor total power consumption for each power meter and shed associated loads automatically to reduce power consumption to an operator set maximum demand level.
2. Input: Pulse count from incoming power meter connected to pulse accumulator in control unit.
3. Forecast demand (kW): Predicted by sliding window method.
4. Automatically shed loads throughout the demand interval selecting loads with independently adjustable on and off time of between one and 255 minutes.
5. Demand Target: Minimum of 3 for each demand meter; change targets based upon (1) time, (2) status of pre-selected points, or (3) temperature.
6. Load: Assign load shed priority, minimum "ON" time and maximum "OFF" time.
7. Limits: Include control band (upper and lower limits).
8. Output advisory when loads are not available to satisfy required shed quantity, advise shed requirements and requiring operator acknowledgment.

C. Duty Cycling:
1. Periodically stop and start loads, based on space temperature, and according to various On/Off patterns.

2. Modify off portion of cycle based on operator specified comfort parameters. Maintain total cycle time by increasing on portion of cycle by equal quantity off portion is reduced.
3. Set and modify following parameters for each individual load.
    a. Minimum and maximum off time.
    b. On/Off time in one-minute increments.
    c. Time period from beginning of interval until cycling of load.
    d. Manually override the DDC program and place a load in an On or Off state.
    e. Cooling Target Temperature and Differential.
    f. Heating Target Temperature and Differential.
    g. Cycle off adjustment.

D. Automatic Time Scheduling:
1. Self-contained programs for automatic start/stop/scheduling of building loads.
2. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two (2) temporary day schedules.
3. Special day's schedule supporting up to 30 unique date/duration combinations.
4. Number of loads assigned to time program; with each load having individual time program.
5. Each load assigned at least 16 control actions for each day with 1 minute resolution.
6. Furnish the following time schedule operations:
    a. Start.
    b. Optimized Start.
    c. Stop.
    d. Optimized Stop.
    e. Cycle.
    f. Optimized Cycle.
7. Capable of specifying minimum of 30 holiday periods up to 100 days in length for the year.
8. Create temporary schedules.
9. Broadcast temporary "special day" date and duration.

E. Start/Stop Time Optimization:
1. Perform optimized start/stop as function of outside conditions, inside conditions, or both.
2. Adaptive and self-tuning, adjusting to changing conditions unattended.
3. For each point under control, establish and modify:
    a. Occupancy period.
    b. Desired temperature at beginning of occupancy period.
    c. Desired temperature at end of occupancy period.

F. Night Setback/Setup Program: Reduce heating space temperature set point or raise cooling space temperature set-point during unoccupied hours; in conjunction with scheduled start/stop and optimum start/stop programs.

G. Calculated Points: Define calculations and totals computed from monitored points (analog/digital points), constants, or other calculated points.
1. Employ arithmetic, algebraic, Boolean, and special function operations.
2. Treat calculated values like any other analog value; use for any function where a "hard wired point" might be used.

H. Event Initiated Programming: Any data point capable of initiating event, causing series of controls in a sequence.

1. Define time interval between each control action between 0 to 3600 seconds.
2. Output may be analog value.
3. Provide for "skip" logic.
4. Verify completion of one action before proceeding to next action. When not verified, program capable of skipping to next action.

I. Direct Digital Control: Furnish with each control unit Direct Digital Control software so operator is capable of customizing control strategies and sequences of operation by defining appropriate control loop algorithms and choosing optimum loop parameters.
1. Control loops: Defined using "modules" are analogous to standard control devices.
2. Output: Paired or individual digital outputs for pulse width modulation, and analog outputs.
3. Firmware:
    a. PID with analog or pulse-width modulation output.
    b. Floating control with pulse-width modulated outputs.
    c. Two-position control.
    d. Primary and secondary reset schedule selector.
    e. Hi/Low signal selector.
    f. Single pole double-throw relay.
    g. Single pole double throw time delay relay with delay before break, delay before make and interval time capabilities.
4. Direct Digital Control loop: Downloaded upon creation or on operator request. On sensor failure, program executes user defined failsafe output.
5. Display: Value or state of each of lines interconnecting DDC modules.

J. Fine Tuning Direct Digital Control PID or floating loops:
1. Display information:
    a. Control loop being tuned.
    b. Input (process) variable.
    c. Output (control) variable.
    d. Set-point of loop.
    e. Proportional band.
    f. Integral (reset) Interval.
    g. Derivative (rate) Interval.
2. Display format: Graphic, with automatic scaling; with input and output variable superimposed on graph of "time" versus "variable".

K. Trend logging:
1. Each control unit capable of storing samples of control unit's data points.
2. Update file continuously at operator assigned intervals.
3. Automatically initiate upload requests and then stores data on hard disk.
4. Time synchronize sampling at operator specified times and intervals with sample resolution of one minute.
5. Co-ordinate sampling with specified on/off point- state.
6. Display trend samples on workstation in graphic format. Automatically scale trend graph with minimum 60 samples of data in plot of time versus data.

2.7 HVAC CONTROL PROGRAMS

A. General:

1. Support Inch-pounds and S.I. metric units of measurement.
2. Identify each HVAC Control system.

B. Optimal Run Time:
   1. Control start-up and shutdown times of HVAC equipment for both heating and cooling.
   2. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
   3. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
   4. Use outside air temperature to determine early shut down with ventilation override.
   5. Analyze multiple building mass sensors to determine seasonal mode and worse case condition for each day.
   6. Operator commands:
      a. Define term schedule.
      b. Add/delete fan status point.
      c. Add/delete outside air temperature point.
      d. Add/delete mass temperature point.
      e. Define heating/cooling parameters.
      f. Define mass sensor heating/cooling parameters.
      g. Lock/unlock program.
      h. Request optimal run-time control summary.
      i. Request optimal run-time mass temperature summary.
      j. Request HVAC point summary.
      k. Request HVAC saving profile summary.
   7. Control Summary:
      a. HVAC Control system begin/end status.
      b. Optimal run time lock/unlock control status.
      c. Heating/cooling mode status.
      d. Optimal run time schedule.
      e. Start/Stop times.
      f. Selected mass temperature point ID.
      g. Optimal run-time system normal start-times.
      h. Occupancy and vacancy times.
      i. Optimal run time system heating/cooling mode parameters.
   8. Mass temperature summary:
      a. Mass temperature point type and ID.
      b. Desired and current mass temperature values.
      c. Calculated warm-up/cool-down time for each mass temperature.
      d. Heating/cooling season limits.
      e. Break point temperature for cooling mode analysis.
   9. HVAC point summary:
      a. Control system identifier and status.
      b. Point ID and status.
      c. Outside air temperature point ID and status.
      d. Mass temperature point ID and status.
      e. Calculated optimal start and stop times.
      f. Period start.

C. Enthalpy Switchover:
   1. Calculate outside and return air enthalpy using measured temperature and relative humidity; determine energy expended and control outside and return air dampers.
   2. Operator commands:
      a. Add/delete fan status point.
      b. Add/delete outside air temperature point.
      c. Add/delete discharge controller point.
      d. Define discharge controller parameters.
      e. Add/delete return air temperature point.
      f. Add/delete outside air dewpoint/humidity point.
      g. Add/delete return air dewpoint/humidity point.
      h. Add/delete damper switch.
      i. Add/delete minimum outside air.
      j. Add/delete atmospheric pressure.
      k. Add/delete heating override switch.
      l. Add/delete evaporative cooling switch.
      m. Add/delete air flow rate.
      n. Define enthalpy deadband.
      o. Lock/unlock program.
      p. Request control summary.
      q. Request HVAC point summary.
   3. Control summary:
      a. HVAC control system begin/end status.
      b. Enthalpy switchover optimal system status.
      c. Optimal return time system status.
      d. Current outside air enthalpy.
      e. Calculated mixed air enthalpy.
      f. Calculated cooling cool enthalpy using outside air.
      g. Calculated cooling cool enthalpy using mixed air.
      h. Calculated enthalpy difference.
      i. Enthalpy switchover deadband.
      j. Status of damper mode switch.

2.8 PROGRAMMING APPLICATION FEATURES

A. Trend Point:
   1. Sample points, real or computed, with each point capable of collecting multiple samples at intervals specified in minutes, hours, days, or month.
   2. Output trend logs as line-graphs or bar graphs. Output graphic on terminal, with each point for line and bar graphs designated with a unique color, vertical scale either actual values or percent of range, and horizontal scale time base. Print trend logs up to 12 columns of one point/column.

B. Alarm Messages:
   1. Allow messages.
   2. Assign alarm messages to system messages including point's alarm condition, point's off-normal condition, totaled point's warning limit, hardware elements advisories.
   3. Output assigned alarm with "message requiring acknowledgment".

4. Operator commands include define, modify, or delete; output summary listing current alarms and assignments; output summary defining assigned points.

C. Weekly Scheduling:
   1. Automatically initiate equipment or system commands, based on selected time schedule for points specified.
   2. Program times for each day of week, for each point, with one minute resolution.
   3. Automatically generate alarm output for points not responding to command.
   4. Allow for holidays, minimum of 366 consecutive holidays.
   5. Operator commands:
      a. System logs and summaries.
      b. Start of stop point.
      c. Lock or unlock control or alarm input.
      d. Add, delete, or modify analog limits and differentials.
      e. Adjust point operation position.
      f. Change point operational mode.
      g. Open or close point.
      h. Enable/disable, lock/unlock, or execute interlock sequence or computation profile.
      i. Begin or end point totals.
      j. Modify total values and limits.
      k. Access or secure point.
      l. Begin or end HVAC or load control system.
      m. Modify load parameter.
      n. Modify demand limiting and duty cycle targets.
   6. Output summary: Listing of programmed function points, associated program times, and respective day of week programmed points by software groups or time of day.

D. Interlocking:
   1. Permit events to occur, based on changing condition of one or more associated master points.
   2. Binary contact, high/low limit of analog point or computed point capable of being used as master. Master capable of monitoring or commanding multiple slaves.
   3. Operator commands:
      a. Define single master/multiple master interlock process.
      b. Define logic interlock process.
      c. Lock/unlock program.
      d. Enable/disable interlock process.
      e. Execute terminate interlock process.
      f. Request interlock type summary.

2.9 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Disconnect Switch: Factory-mount in control panel.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify conditioned power supply is available to control units and to operator workstation.

B. Verify field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.2 INSTALLATION

A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.

B. Install software in control units and in operator workstation. Implement features of programs to specified requirements and appropriate to sequence of operation.

C. Install with 120 volts alternating current, 15 amp dedicated emergency power circuit to each programmable control unit.

D. Install conduit and electrical wiring.

E. Install electrical material and installation in accordance with appropriate requirements of Division 26.

3.3 MANUFACTURER'S FIELD SERVICES

A. Start and commission systems. Allow adequate time for start-up and commissioning prior to placing control systems in permanent operation.

B. Furnish service technician employed by system installer to instruct Owner's representative in operation of systems plant and equipment for 8 hour period.

3.4 DEMONSTRATION AND TRAINING

A. Furnish basic operator training for Owner personnel on data display, alarm and status descriptors, requesting data, execution commands and log requests. Include a minimum of 8 hours instructor time. Furnish training on site.

B. Demonstrate complete and operating system to Owner.

END OF SECTION

SECTION 23 80 00

VARIABLE REFRIGERANT FLOW SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Indoor ceiling cassette units.
   2. Indoor wall cassette units.
   3. Outdoor heat recovery units.

B. Related Sections:
   1. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.
   2. Section 23 33 00 - Air Duct Accessories: Product requirements for flexible connections for placement by this section.

1.2 SYSTEM DESCRIPTION

A. The heat recovery system shall consist of a outdoor unit (s), Branch Circuit Controller(s), multiple indoor units, and Direct Digital Controls. Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units or groups. System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. Each indoor unit or group of indoor units shall be independently controlled. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of outdoor rated capacity.

1.3 REFERENCES

A. Air-Conditioning and Refrigeration Institute:
   1. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
   2. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
   3. ARI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.

B. Air Movement and Control Association International, Inc.:
   1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
   1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. Underwriters Laboratories, Inc.:
   1. UL 1995 - Heating and Cooling Equipment.

1.4 DEFINITIONS

A. Coefficient of Performance (COP), heat pump, heating - Ratio of rate of heat delivered to rate of energy input, in consistent units, for complete heat pump system, including compressor and, if applicable, auxiliary heat, under designated operating conditions.

B. Energy Efficiency Ratio (EER) - Ratio of net cooling capacity in Btu/h to total rate of electric input in watts under designated operating conditions.

C. Heating Seasonal Performance Factor (HSPF) - Total heating output of heat pump during its normal annual usage period for heating (in Btu) divided by total electric energy input during the same period.

D. Seasonal Energy Efficiency Ratio (SEER) - Total cooling output of an air conditioner during its normal annual usage period for cooling (in Btu) divided by total electric energy input during the same period (in Wh).

1.5 SUBMITTALS

A. Shop Drawings: Indicate dimensions, rough-in connections, and duct connections of manufactured products and assemblies. Indicate electrical service with connection requirements.

B. Product Data: Submit drawings indicating capacity, weights, electrical characteristics and connection requirements. Indicate electrical characteristics.

C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of controls separate from units.

B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.7 QUALITY ASSURANCE

A. Air Cooled Equipment:
   1. Cooling Performance Requirements: Conform to minimum SEER/EER prescribed by ASHRAE 90.1 when tested in accordance with ARI 210/240/ARI 340/360.
   2. Heating Performance Requirements: Conform to minimum HSPF/COP prescribed by ASHRAE 90.1 when tested in accordance with ARI 210/240/ARI 340/360.

B. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

C. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

D. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

E. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.

1.8 QUALIFICATIONS

A. The VRF system shall be installed by a contractor with extensive VRF system installation and service training. The mandatory contractor service and install training should be performed by the manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept heat pump units on site in factory packaging. Inspect for damage.

B. Protect heat pump units from damage by providing temporary covers until construction is complete in adjacent space. Protect rooftop heat pump units from damage by storing off roof until roof mounting curbs are in place.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

A. The units shall be covered by the manufacturer's limited warranty for a period of one (1) year from date of installation.

B. In addition the compressor shall have a manufacturer's limited warranty for a period of seven (7) years from date of installation.

C. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer.

D. This warranty shall not include labor.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURER

A. LG, to match existing system/brand installed.

B. Substitutions: Not permitted.

2.2 4-WAY CEILING-RECESSED CASSETTE WITH GRILLE INDOOR UNIT (33")

A. General: Units shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function, a test run switch, and the ability to adjust airflow patterns for different ceiling heights. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. Unit Cabinet:
   1. The cabinet shall be space-saving ceiling-recessed cassette.
   2. The cabinet panel shall have provisions for a field installed filtered outside air intake.
   3. Branch ducting shall be allowed from cabinet.
   4. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.
   5. The grille vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space

C. Fan:
   1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
   2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
   3. The indoor fan shall consist of five (5) speed settings, Low, Mid1, Mid2, High and Auto.
   4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
   5. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
   6. The indoor unit shall have switches that can be set to provide optimum airflow based on ceiling height and number of outlets used.
   7. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
   8. The vanes shall have an Auto-Wave selectable option in the heating mode that shall randomly cycle the vanes up and down to evenly heat the space.
   9. If specified, the grille shall have an optional i-see sensor that will measure room temperature variations and adjust the airflow accordingly to evenly condition the space.

D. Filter: Return air shall be filtered by means of a long-life washable filter

E. Coil:
   1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
   2. The tubing shall have inner grooves for high efficiency heat exchange.
   3. All tube joints shall be brazed with phos-copper or silver alloy.
   4. The coils shall be pressure tested at the factory.
   5. A condensate pan and drain shall be provided under the coil.
   6. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 33 inches above the condensate pan.
   7. Both refrigerant lines to the PLFY indoor units shall be insulated.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

G. Controls: This unit shall use controls provided by supplier to perform functions necessary to operate the system.

2.3 4-WAY CEILING-RECESSED CASSETTE WITH GRILLE INDOOR UNIT (24")

A. General: Unit shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. Unit Cabinet:
1. The cabinet shall be a compact 22-7/16" wide x 22-7/16" deep so it will fit within a standard 24" square suspended ceiling grid.
2. The cabinet panel shall have provisions for a field installed filtered outside air intake.
3. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.

C. Fan:
1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall consist of three (3) speeds, Low, Mid, and High.
4. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
5. The auto air swing vanes shall be capable of automatically swinging up and down for uniform air distribution.

D. Filter: Return air shall be filtered by means of a long-life washable filter.

E. Coil:
1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 19-3/4" inches above the condensate pan.
7. Both refrigerant lines to the indoor units shall be insulated.

F. Electrical:
1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

G. Controls: This unit shall use controls provided by supplier to perform functions necessary to operate the system.

2.4 WALL CASSETTE

A. Configuration: Wall hung cassette.

B. Cabinet:
   1. Panels: Constructed of ABS plastic, white finish. Unit shall contain removable mounting brackets.
   2. Insulation: Factory applied to each surface to insulate entire cabinet. 1/2 inch thick neoprene coated glass fiber with edges protected from erosion.

C. Evaporator Fan: Forward curved centrifugal type, resiliently mounted with adjustable DC direct drive and motor. Motor permanently lubricated with built-in thermal overload protection. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and sensed space temperature.

D. Evaporator Coil: Constructed of copper tubes expanded onto aluminum fins. Pressure tested. A condensate pan with drain connections shall be provided under the coil. The unit shall also include a built-in, automatic condensate lift mechanism that will be able to raise drain water 33 inches above the condensate pan. The lift mechanism shall be equipped with a positive active liquid level sensor to shut down the indoor unit if liquid level in the drain pan reached maximum level.

E. Refrigeration System: Single refrigeration circuits controlled by factory installed electronic linear expansion valve.

F. Air Filters: Integral, easily removable, washable filter.

2.5 OUTDOOR UNIT

A. General: The heat recovery outdoor unit shall be used specifically with VRF components. The outdoor units shall be equipped with multiple circuit boards that interface to the DDC controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.

   1. The model nomenclature and unit requirements are shown below. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor.
   2. Outdoor unit shall have a sound rating no higher than 60 dB(A) individually or 63 dB(A) twinned. Units shall have a sound rating no higher than 50 dB(A) individually or 53 dB(A) twinned while in night mode operation. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.
   3. Both refrigerant lines from the outdoor unit to the Branch Circuit Controller shall be insulated.
   4. There shall be no more than 3 branch circuit controllers connected to any one outdoor unit.

5. Outdoor unit shall be able to connect to up to 50 indoor units depending upon model.
6. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
7. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
8. The outdoor unit shall have the ability to operate with a maximum height difference of 164 feet and have total refrigerant tubing length of 1804-2625 feet. The greatest length is not to exceed 541 feet between outdoor unit and the indoor units without the need for line size changes or traps.
9. The outdoor unit shall be capable of operating in heating mode down to -4°F ambient temperature or cooling mode down to 23°F ambient temperature, without additional low ambient controls. If an alternate manufacturer is selected, any additional material, cost, and labor to meet low ambient operating condition and performance shall be incurred by the contractor.
10. The outdoor unit shall not cease operation in any mode based solely on outdoor ambient temperature.
11. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
12. Unit must defrost all circuits simultaneously in order to resume full heating more quickly. Partial defrost which may extend "no or reduced heating" periods shall not be allowed.

B. Unit Cabinet: The casing(s) shall be fabricated of galvanized steel, bonderized and finished.

C. Fan:
1. Each outdoor unit module shall be furnished with one direct drive, variable speed propeller type fan. The fan shall be factory set for operation under 0 in. WG external static pressure, but capable of normal operation under a maximum of 0.24 in. WG external static pressure via dipswitch.
2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
3. All fan motors shall be mounted for quiet operation.
4. All fans shall be provided with a raised guard to prevent contact with moving parts.
5. The outdoor unit shall have vertical discharge airflow.

D. Refrigerant
1. R410A refrigerant shall be required for outdoor unit systems.

E. Coil:
1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
3. The coil shall be protected with an integral metal guard.
4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
5. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.

F. Compressor:
1. Each outdoor unit module shall be equipped with one inverter driven scroll hermetic compressor. Non inverter-driven compressors shall not be allowed.

2. A crankcase heater(s) shall be factory mounted on the compressor(s).
3. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable with a turndown of 19%-8% of rated capacity, depending upon unit size.
4. The compressor will be equipped with an internal thermal overload.
5. The compressor shall be mounted to avoid the transmission of vibration.
6. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.

G. Electrical:
1. The outdoor unit electrical power shall be 208/230 or 460 volts, 3-phase, 60 hertz.
2. The outdoor unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz), 207-253V (230V/60Hz) or 414-506V (460V/60Hz).
3. The outdoor unit shall be controlled by integral microprocessors.
4. The control circuit between the indoor units, Branch Circuit Controllers and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.6 Controls Overview

A. General: The Controls Network shall be capable of supporting remote controllers, schedule timers, system controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to Building Management Systems via BACnet® and LonWorks®.

B. Electrical Characteristics
1. General: The Controls Network shall operate at 24VDC. Controller power and communications shall be via a common non-polar communications bus.

C. Wiring: Control wiring shall be installed in a system daisy chain configuration from indoor unit to remote controller to indoor unit, to the BC controller and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.

1. Control wiring for schedule timers, system controllers, and centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to system controllers, to the power supply.
2. Control wiring for the remote controllers shall be from the remote controller to the first associated indoor unit then to the remaining associated indoor units in a daisy chain configuration...
3. The system controller shall be capable of being networked with other system controllers for web based control.

D. Wiring type: Wiring shall be 2-conductor (16 AWG), twisted shielded pair, stranded wire. Network wiring shall be minimum CAT-6 with RJ-45 connection.

2.7 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics: As scheduled.

B. Disconnect Switch: Factory mount on equipment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify piping rough-in is at correct location.

B. Verify electrical rough-in is at correct location.

3.2 INSTALLATION

A. Install unit on concrete housekeeping pad, minimum 3-1/2 inches high and 6 inches larger than unit on each side.

B. Connect indoor units to supply and return ductwork with flexible connections. Refer to Section 23 33 00.

C. Install refrigerant piping from indoor to outdoor unit. Install refrigerant specialties furnished with unit.

D. Install condensate piping from drain pan to condensate drainage system.

E. Install accessories furnished loose for field mounting.

F. Install electrical devices furnished loose for field mounting.

G. Install control wiring between unit control panel and field mounted control devices.

3.3 MANUFACTURER'S FIELD SERVICES

A. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

3.4 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units.

B. Vacuum clean coils and inside of cabinets.

C. Touch up marred or scratched surfaces of factory finished cabinets, using finish materials furnished by manufacturer.

D. Install new throwaway filters in units after Substantial Completion.

3.5 DEMONSTRATION

A. Demonstrate unit operation and maintenance.

B. Furnish services of manufacturer's technical representative for one 8 hour day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days notice to Architect/Engineer of training date.

3.6 PROTECTION OF FINISHED WORK

A. Protect finished surfaces of cabinets with protective covers during remainder of construction.

END OF SECTION

1. DESIGN CRITERIA.

A. CODES AND STANDARDS:
ALL DESIGN AND CONSTRUCTION WORK FOR THIS PROJECT SHALL CONFORM TO THE 2015 INTERNATIONAL BUILDING CODE.

B. LIVE LOAD DATA:
ALL LIVE LOADS NON-REDUCIBLE
ROOF.....20 PSF

C. SNOW LOAD DATA:
GROUND SNOW LOAD.....15 PSF
FLAT ROOF SNOW LOAD.....17 PSF
SNOW EXPOSURE FACTOR.....1.0
SNOW LOAD IMPORTANCE FACTOR.....1.10
THERMAL EXPOSURE FACTOR.....1.0
DESIGN SNOW LOAD.....17 PSF

D. IN CASE OF CONFLICT BY GOVERNING CODES, THE MOST STRINGENT REQUIREMENT SHALL GOVERN.

2. EXISTING CONDITIONS.

A. BECOME FAMILIAR WITH EXISTING CONDITIONS PRIOR TO BIDDING. PROVIDE NECESSARY DETAILS AND METHODS TO ACCOMPLISH THE SPECIFIED WORK.
MEANS AND METHODS TO ACCOMPLISH THE SPECIFIED WORK.
B. FIELD VERIFY CONDITIONS, SIZES, SPACING, AND DIMENSIONS OF EXISTING STRUCTURE TO FABRICATIONS AND NEW CONSTRUCTION. CONTACT THE STRUCTURAL ENGINEER IF EXISTING CONDITIONS, ETC. VARY FROM THOSE SHOWN ON THESE DRAWINGS.
C. CONTRACTOR IS RESPONSIBLE FOR TEMPORARY REMOVAL AND REPLACEMENT/RELOCATION OF ANY NON-STRUCTURAL ELEMENTS NECESSARY TO COMPLETE THE STRUCTURAL WORK. FOLLOW ALL APPLICABLE CODES AND REQUIREMENTS OF AFFECTED TRADES. PROVIDE FOR THIS REQUIREMENT IN THE BID.

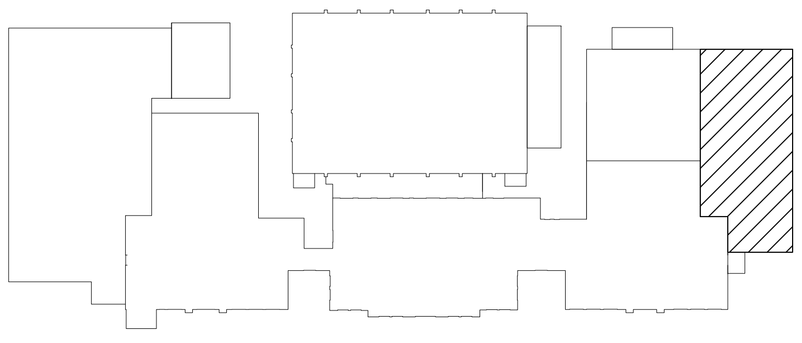
3. STRUCTURAL STEEL:

A. ALL STRUCTURAL STEEL SHALL BE DETAILED, FABRICATED, AND ERECTED IN ACCORDANCE WITH THE AISC CODE OF STANDARD PRACTICE, EXCEPT AS MODIFIED IN THESE NOTES AND THE PROJECT SPECIFICATIONS.
B. ALL STRUCTURAL STEEL EXPOSED TO VIEW ON INTERIOR OR EXTERIOR OF ARCHITECTURAL ELEMENTS OF THE BUILDING SHALL CONFORM TO THE REQUIREMENTS OF SECTION 10.
C. BOLTED CONNECTIONS:
1. ALL EXTERIOR EXPOSED BOLTS, NUTS, AND WASHERS SHALL BE TYPE 3 U.N.O.
2. SHOP DRAWINGS SHALL INDICATE THE TYPE OF BOLT USED IN EACH CONNECTION AND THE DESIGN VALUES USED FOR THE VARIOUS BOLT TYPES.
D. ALL WELDS EXPOSED TO VIEW SHALL BE GROUND SMOOTH. PROHIBITED WITHOUT WRITTEN APPROVAL OF THE ARCHITECT/ENGINEER.
E. SPLICING OF STEEL MEMBERS, UNLESS SHOWN ON THE DRAWING, IS F. NO CHANGE IN SIZE OR POSITION OF STRUCTURAL ELEMENTS SHALL BE MADE AND HOLES, SLOTS, CUTS, ETC. ARE NOT PERMITTED THROUGH ANY MEMBER UNLESS THEY ARE APPROVED BY THE ARCHITECT/ENGINEER.
G. FABRICATE ALL BEAMS WITH THE MILL CAMBER UP
H. ALL CONNECTIONS TO BE SHOP WELDED AND FIELD BOLTED WHERE PRACTICALLY POSSIBLE EXCEPT AS INDICATED ON DRAWINGS.
I. ALL STRUCTURAL STEEL SHALL HAVE ONE SHOP COAT OF RUST INHIBITING PRIMER PAINT.
J. ALL ADDITIONAL STEEL OR OTHER MATERIALS REQUIRED BY THE CONTRACTOR FOR ERECTION PURPOSES AND SITE ACCESS OF STOCKPILED ADDITIONAL MATERIALS SHALL BE REMOVED BY THE CONTRACTOR UNLESS APPROVED BY THE OWNER IN WRITING.
K. ANGLES SHALL BE GRADE ASTM A992. PLATES SHALL BE GRADE ASTM A572.

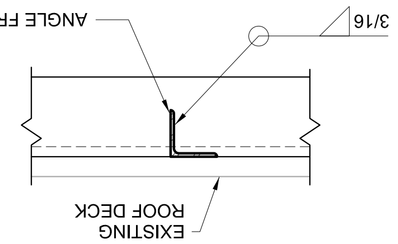
4. MISCELLANEOUS.

A. STRUCTURAL DRAWINGS ARE INTENDED TO BE USED WITH ARCHITECTURAL AND MECHANICAL DRAWINGS. CONTRACTOR IS RESPONSIBLE FOR COORDINATING SUCH REQUIREMENTS. SHOP DRAWINGS, AND WORK.
B. NO OPENING SHALL BE MADE IN ANY STRUCTURAL MEMBER WITHOUT THE WRITTEN APPROVAL OF THE ARCHITECT/ENGINEER.
C. NO CHANGE IN SIZE OR DIMENSION OF STRUCTURAL MEMBERS SHALL BE MADE WITHOUT THE WRITTEN APPROVAL OF THE ARCHITECT/ENGINEER.
D. THE CONTRACTOR IS RESPONSIBLE FOR LIMITING THE AMOUNT OF CONSTRUCTION LOAD IMPOSED UPON STRUCTURAL FRAMING. CONSTRUCTION LOADS SHALL NOT EXCEED THE DESIGN CAPACITY OF THE FRAMING AT THE TIME LOADS ARE IMPOSED.
E. THE STRUCTURE IS DESIGNED TO FUNCTION AS A UNIT UPON COMPLETION. THE CONTRACTOR IS RESPONSIBLE FOR FURNISHING ALL TEMPORARY BRACING AND/OR SUPPORT THAT MAY BE REQUIRED AS THE RESULT OF THE CONTRACTOR'S CONSTRUCTION METHODS AND/OR SEQUENCES.
F. DO NOT SCALE THESE DRAWINGS, USE DIMENSIONS.
G. THE CONTRACTOR SHALL INFORM THE ARCHITECT IN WRITING OF ANY DEVIATION FROM THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL NOT BE RELIEVED OF THE RESPONSIBILITY FOR SUCH DEVIATION BY THE ARCHITECT'S APPROVAL OF SHOP DRAWINGS, PRODUCT DATA, ETC., UNLESS HE/SHE HAS SPECIFICALLY INFORMED THE ARCHITECT OF SUCH DEVIATION AT THE TIME OF SUBMISSION, AND THE ARCHITECT HAS GIVEN WRITTEN APPROVAL TO THE SPECIFIC DEVIATION.
H. ALL THINGS WHICH, IN THE OPINION OF THE CONTRACTOR, APPEAR TO BE DEFICIENCIES, OMISSIONS, CONTRADICTIONS, OR AMBIGUITIES, IN THE PLANS AND SPECIFICATIONS SHALL BE BROUGHT TO THE ATTENTION OF THE ARCHITECT. PLANS AND/OR SPECIFICATIONS WILL BE CORRECTED, OR WRITTEN INTERPRETATION OF THE ALLEGED DEFICIENCY, OMISSION, CONTRADICTION OR AMBIGUITY WILL BE MADE BY THE ARCHITECT/ENGINEER BEFORE THE AFFECTED WORK PROCEEDS.
I. FURNISH ALL LABOR, MATERIALS, AND EQUIPMENT NECESSARY TO COMPLETE THE WORK SHOWN OR INFERRED BY THESE DRAWINGS.
J. DETAILS LABELED "TYPICAL DETAILS" ON THE DRAWINGS SHALL APPLY TO ALL SITUATIONS OCCURRING ON THE PROJECT THAT ARE THE SAME OR SIMILAR TO THOSE SPECIFICALLY DETAILED. THE APPLICABILITY OF THE DETAIL TO ITS LOCATION ON THE PLANS CAN BE DETERMINED BY THE TITLE OF THE DETAIL. SUCH DETAILS SHALL APPLY WHETHER OR NOT THEY ARE KEYED IN AT EACH LOCATION. DECISIONS REGARDING APPLICABILITY OF TYPICAL DETAILS SHALL BE DETERMINED BY THE ARCHITECT/ENGINEER.
K. REVIEW OF THE SHOP DRAWINGS SHALL NOT BE CONSTRUED AS AN AUTHORIZATION TO DEVIATE FROM CONTRACT DOCUMENTS.

KEY PLAN

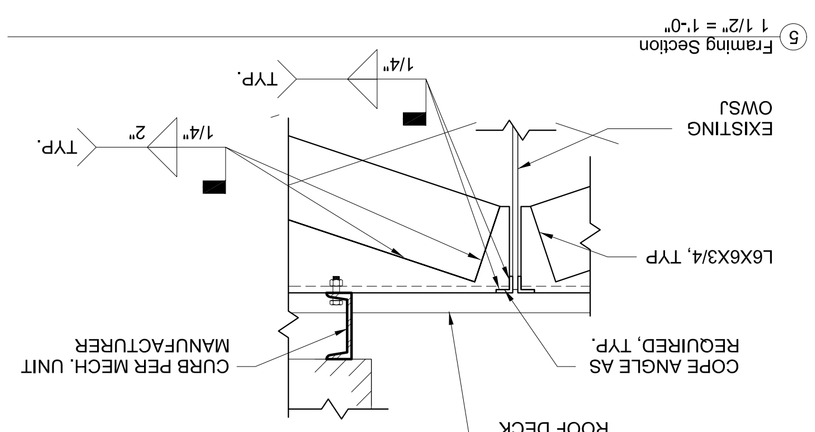


GENERAL NOTES:
1. CENTER RTU BETWEEN OWSJ TO DISTRIBUTE THE LOAD EVENLY.
2. STRUCTURAL DESIGN BASED ON THE FOLLOWING RTU WEIGHTS. EOR SHALL BE NOTIFIED IF ACTUAL WEIGHTS DIFFER.
A. RTU-BAND: 1265 LBS (+/- 5%)
B. RTU-CAFETERIA: 1817 LBS (+/- 5%)
3. EXISTING OWSJ ARE SHOWN FOR ILLUSTRATIVE PURPOSES ONLY. ACTUAL LOCATIONS OF THE OWSJ SHALL BE VERIFIED IN THE FIELD.

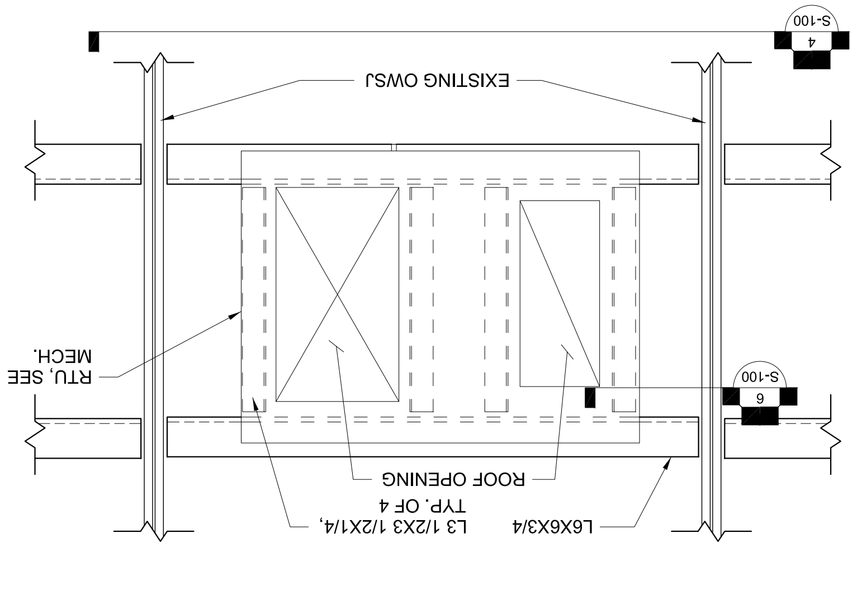


6 Framing Section 1 1/2" = 1'-0"

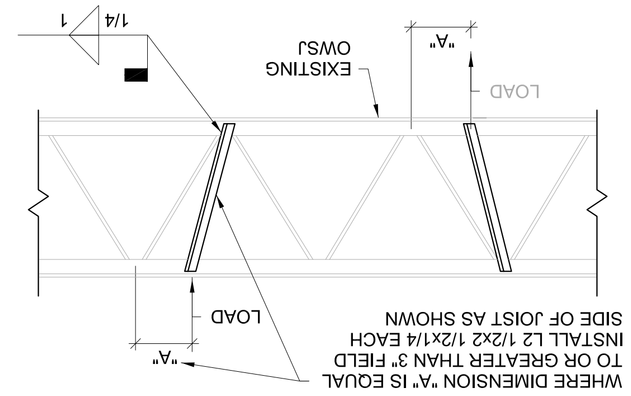
4 Framing Section 3/4" = 1'-0"



5 Framing Section 1 1/2" = 1'-0"



2 Typical Roof Opening for RTU 3/4" = 1'-0"



PROVIDE AT ALL MECHANICAL UNITS AT CURBS WHERE CURBS CROSS JOISTS.

NOTE: THE ANGLE STRUT SHOWN TO TRANSFER THE LOAD TO A PANEL POINT ON THE OPPOSITE CHORD SHALL NOT BE REQUIRED, PROVIDED THE SUM OF THE CONCENTRATED LOADS WITHIN A CHORD PANEL DOES NOT EXCEED 100 POUNDS AND THE ATTACHMENTS ARE CONCENTRIC TO THE CHORD.

3 Typ. Joist Load Strut Detail 3/4" = 1'-0"

Hurst-Rosche, Inc.
PROFESSIONAL DESIGN NUMBER: 184-000298
200 NORTH MARKET ST.
MARION, IL 62959
PH: 618.998.0075
www.hurst-rosche.com
HILLSBORO, IL
EAST ST. LOUIS, IL
ARNOLD, MO
NEOSHO, MO
NASHVILLE, TN

JEREMY D SAUGENT 001022086 LICENSED ARCHITECT STATE OF ILLINOIS

SIGNATURE 08-30-2020
DATE 11-30-2020
LICENSE EXPIRES

MURPHYSBORO CUSD #186 - MURPHYSBORO MIDDLE SCHOOL

BUILDING RENOVATIONS - PHASE 3
2125 SPRUCE STREET
MURPHYSBORO, JACKSON COUNTY, IL 62966

MARK	DATE	DESCRIPTION

DATE: 11/10/2020
PROJECT NO: 365-3198

DESIGN:	DRAWN:	CHECK:
JDS	CDT	JDS

STRUCTURAL MODIFICATIONS

S100

© 2020 HURST-ROSCHE, INC.