

SECTION 23 09 23**DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Control equipment.
- B. Software.

1.02 SYSTEM DESCRIPTION

- A. The existing Pritchett Controls system, including Network Controllers, local controllers and operator workstation software/hardware, may be reused in lieu of furnishing new controllers and server software/hardware as specified. All reused components shall be subject to the same warranty obligations as specified herein and the final system as a whole must provide all specified functionality.
- B. Final system to provide functionality as specified:
 - 1. Automatic temperature control field monitoring and control system using field programmable micro-processor based units with communications to a Building Automation System.
 - 2. 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.
 - 3. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
 - 4. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units.
 - 5. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
 - 6. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

1.03 SUBMITTALS

- A. Product Data: Provide data for each system component and software module.
- B. Shop Drawings:
 - 1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
 - 2. List connected data points, including connected control unit and input device.
 - 3. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
 - 4. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 - 5. Indicate description and sequence of operation of operating, user, and application software.
- C. Operation and Maintenance Data:
 - 1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
 - 2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
 - 3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

- D. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Tri-County Council's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years experience approved by manufacturer.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.05 WARRANTY

- A. Correct defective Work within a five year period after Substantial Completion.
- B. Provide five year manufacturer's warranty for field programmable micro-processor based units.

1.06 MAINTENANCE SERVICE

- A. Provide service and maintenance of energy management and control systems for one year from Date of Substantial Completion.
- B. Provide two complete inspections per year, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.

1.07 PROTECTION OF SOFTWARE RIGHTS

- A. Prior to delivery of software, the Tri-County Council and the party providing the software will enter into a software license agreement with provisions for the following:
 - 1. Limiting use of software to equipment provided under these specifications.
 - 2. Limiting copying.
 - 3. Preserving confidentiality.
 - 4. Prohibiting transfer to a third party.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Honeywell: www.honeywell.com.
- B. Johnson Controls, Inc: www.johnsoncontrols.com.
- C. Siemens Building Technologies, Inc: www.sbt.siemens.com.
- D. Pritchett Controls, Inc.: www.pritchettcontrols.com.
- E. Trane, Inc. : www.trane.com.
- F. Substitutions: See Division 01.

2.02 OPERATOR STATION

- A. Work Station:
 - 1. Configuration: Windows-compatible Intel based microcomputer system or better.
 - 2. Display: 17-inch non-interlaced LCD color monitor.
 - 3. Keyboard: Low profile, detachable, having Qwerty layout plus a 10 key numeric keypad, dedicated function keys.
 - 4. Hard disk drive: 80 Gb.

5. Mouse: Software supported mouse with support software including self building menus and displays of system operations and functions.
6. Operating System: Windows Vista or higher.

2.03 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 48 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 that occur among associated points. Continue to perform associated control functions regardless of status of network.
 7. Perform in stand-alone mode:
 - a. Start/stop.
 - b. Automatic Temperature Control.
 - c. Full direct digital control.
 - d. Trend logging.
 - e. Maintenance scheduling.
- D. Global Communications:
 1. Transmit any or all input/output points onto network for use by other control units and utilize data from other control units.
- E. Input/Output Capability:
 1. Discrete/digital input (contact status).
 2. Discrete/digital output.
- F. Monitor, control, or address data points. Mix shall include analog inputs, analog outputs, pulse inputs, pulse outputs and discrete inputs/outputs, as required. Install control unit's with minimum 30 percent spare capacity.
- G. 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 wirelessly.
- H. 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.
- I. Local display and adjustment panel: Portable control unit, containing digital display, and numerical keyboard. Display and adjust:
 1. Input/output point information and status.
 2. Controller set points.
 3. High and low limit values.
 4. Control outputs connected to the network.
 5. Automatic control outputs.

2.04 LOCAL AREA NETWORK (LAN)

- A. Provide communication between control units over local area network (LAN).
- B. LAN Capacity: Not less than 120 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 telephone lines utilizing modems.
- 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, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

2.05 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 engineering 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. Provide capability to sort and extract data from archived files and to generate custom reports.
 - 12. Support two printer operations.
 - a. Alarm printer: Print alarms, operator acknowledgements, action messages, system alarms, operator sign-on and sign-off.
 - b. Data printer: Print reports, page prints, and data base prints.
- 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: Changes shall utilize standard procedures. Control unit shall automatically check work station data base files upon connection and verify data base match. Minimum capability shall include:
 - 1. Add and delete points.
 - 2. Modify any point parameter.
 - 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, etc.
 - 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 any applications program.
 - 10. Add, delete, develop, or modify dynamic color graphic displays.
- D. 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. Provide data archiving of assigned points and support overlay graphing of this data utilizing up to four (4) variables.
- E. Alarm Processing:
1. Off normal condition: Cause alarm and appropriate message, including time, system, point descriptor, and alarm condition. Select alarm state/value and which alarms shall cause 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 if alarm requires acknowledgement.
 8. Continue to indicate unacknowledged alarms after return to normal.
- F. 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.
- G. Automatic Restart: Automatically restart field equipment on restoration of power. Provide time delay between individual equipment restart and time of day start/stop.
- H. Messages:
1. Automatically display or print user-defined message subsequent to occurrence of selected events.
 2. Compose, change, or delete any message.
 3. Display or log any message at any time.
 4. Assign any message to any event.
- I. Reports:
1. Manually requested with time and date.
 2. Long term data archiving to hard disk.
 3. Automatic directives to download to transportable media such as floppy diskettes for storage.
 4. Data selection methods to include data base search and manipulation.
 5. Data extraction with mathematical manipulation.
 6. Data reports shall 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 work station direction.
 8. Reports may either manually displayed or printed, or may be printed automatically on daily, weekly, monthly, yearly or scheduled basis.
 9. Include capability for statistical data manipulation and extraction.
 10. Provide capability to generate four types of reports: Statistical detail reports, summary reports, trend graphic plots, x-y graphic plots.

- J. Parameter Save/Restore: Store most current operating system, parameter changes, and modifications on disk or diskette.
- K. 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.
- L. 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 per 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.
- M. Maintenance Management:
 - 1. Run time monitoring, per point.
 - 2. Maintenance scheduling targets with automatic annunciation, scheduling and shutdown.
 - 3. Equipment safety targets.
- N. Advisories:
 - 1. Report of power failure detection, time and date.
 - 2. Report of communication failure with operator device, field interface unit, point, programmable control unit.

2.06 HVAC CONTROL PROGRAMS

- A. General:
 - 1. Support Inch-pounds and SI (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. Add/delete outside air temperature point.
 - 7. Control Summary:
 - a. HVAC Control system begin/end status.
 - b. Optimal run time lock/unlock control status.
 - c. Heating/cooling mode status.
 - d. Start/Stop times.
 - 8. HVAC point summary:
 - a. Control system identifier and status.

- b. Outside air temperature point ID and status.
 - c. Calculated optimal start and stop times.
- C. Supply Air Reset:
- 1. Monitor heating and cooling loads in building spaces, terminal reheat systems, both hot deck and cold deck temperatures on dual duct and multizone systems, single zone unit discharge temperatures.
 - 2. Operator commands:
 - a. Lock/unlock program.
 - b. Request HVAC point summary.
 - 3. Control summary:
 - a. HVAC control system status (begin/end).
 - b. Supply air reset system status.
- D. 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. Control summary:
 - a. HVAC control system begin/end status.
 - b. Enthalpy switchover optimal system status.
 - c. Status of damper mode switch.

2.07 PROGRAMMING APPLICATION FEATURES

- A. Trend Point:
- 1. 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. Assign alarm messages to system messages including point's alarm condition, point's off-normal condition, totalized point's warning limit, hardware elements advisories.
 - 2. Output assigned alarm with "message requiring acknowledgement".
 - 3. 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 preselected time schedule for points specified.
 - 2. Provide program times for each day of week, per point, with one minute resolution.
 - 3. Automatically generate alarm output for points not responding to command.
 - 4. Provide for holidays, minimum of 366 consecutive holidays.
 - 5. 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 shall be capable of being utilized as master. Same master may monitor or command 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.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.

3.02 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 work station. Implement all features of programs to specified requirements and appropriate to sequence of operation.
- C. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Provide service engineer to instruct Tri-County Council 's representative in operation of systems plant and equipment for 3 day period.
- B. Provide basic operator training for 4 persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 40 hours dedicated instructor time. Provide training on site.

3.04 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate complete and operating system to Tri-County Council .

END OF SECTION