1.01 OWNER-FURNISHED PRODUCTS
   A. New Products: Johnson Controls.

1.02 SYSTEM DESCRIPTION
   A. Automatic temperature control field monitoring and control system using field
      programmable micro-processor 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. Include computer software and hardware, operator input/output devices, control
      units, local area networks (LAN), sensors, control devices, actuators.
   D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan
      coils, and the like when directly connected to the control units. Individual terminal
      unit control is specified in Section 23 09 13.
   E. 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.
   F. Include installation and calibration, supervision, adjustments, and fine tuning
      necessary for complete and fully operational system.

1.03 OPERATOR INTERFACE
   A. PC Based Work Station:
   B. Workstation, controllers, and control backbone to communicate using BACnet
      protocol and addressing.
   C. Hardware:
      1. Desktop:
         a. Computer(s) and display(s) to be provided by DDC controls manufacturer.
         b. Quantity: As indicated on the Drawings.
         c. Minimum RAM: 16 G.
         d. Minimum Processing Speed: 3 GHz.
         e. Minimum Hard Drive Memory: 1 T.
f. Drives: [_______].
g. Ports: [_______].
h. Monitor: [_______].
i. Location(s): As indicated on the Drawings.
j. Network Connection:
   1) Ethernet interface card.
   2) Minimum Speed: [_______].
k. System Printer:
   1) Printer(s) to be provided by DDC controls manufacturer.
   2) Quantity: As indicated on the drawings.
   3) Type: [_______].
   4) Resolution: [_______].
   5) Minimum Print Speed: [_______].
   6) Locations(s): As indicated on the Drawings.

2. Laptop:
   a. Laptop(s) to be provided by DDC controls manufacturer.
   b. Quantity: As indicated on the Drawings.
   c. Minimum RAM: 16 G.
   d. Minimum Processing Speed: 3.1 GHZ.
   e. Minimum Hard Drive Memory: 1 T.
   f. Drives: [_______].
   g. Ports: [_______].
   h. Display: [_______].
   i. Network Connection:
      1) Ethernet interface card.
      2) Minimum Speed: [_______].

1.04 CONTROLLERS
A. BUILDING CONTROLLERS
   1. General:
a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.

b. Provide sufficient memory to support controller’s operating system, database, and programming requirements.

c. Share data between networked controllers.

d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.

e. Utilize real-time clock for scheduling.

f. Continuously check processor status and memory circuits for abnormal operation.

g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.

h. Communication with other network devices to be based on assigned protocol.

2. Communication:
   a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
   b. Perform routing when connected to a network of custom application and application specific controllers.
   c. Provide service communication port for connection to a portable operator’s terminal or hand held device with compatible protocol.

3. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.

B. INPUT/OUTPUT INTERFACE

   1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.

   2. All Input/Output Points:
      a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
      b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.

1.05 POWER SUPPLIES AND LINE FILTERING
A. Power Supplies:
   1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
   2. Limit connected loads to 80 percent of rated capacity.
   3. Match DC power supply to current output and voltage requirements.
   4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
   5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
   6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
   7. Operational Ambient Conditions: 32 to 120 degrees F (0 to 50 degrees C).
   8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD 810 for shock and vibration.
   9. Line voltage units UL recognized and CSA approved.

B. Power Line Filtering:
   1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
   2. Minimum surge protection attributes:
      a. Dielectric strength of 1000 volts minimum.
      b. Response time of 10 nanoseconds or less.
      c. Transverse mode noise attenuation of 65 dB or greater.
      d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

1.06 LOCAL AREA NETWORK (LAN)
   A. Provide 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. LAN Data Speed: Minimum 19.2 Kb.
   E. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.
F. Transmission Median: Fiber optic or single pair of solid 24 gage twisted, shielded copper cable.

G. 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.

1.07 SYSTEM SOFTWARE

A. Operating System:
   1. Concurrent, multi-tasking capability.
      b. Acceptable Operating Systems: [_______].
   2. System Graphics:
      a. Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
      b. Animation displayed by shifting image files based on object status.
      c. Provide method for operator with password to perform the following:
         1) Move between, change size, and change location of graphic displays.
         2) Modify on-line.
         3) Add, delete, or change dynamic objects consisting of:
            (a) Analog and binary values.
            (b) Dynamic text.
            (c) Static text.
            (d) Animation files.
   3. Custom Graphics Generation Package:
      a. Create, modify, and save graphic files and visio format graphics in PCX formats.
      b. HTML graphics to support web browser compatible formats.
      c. Capture or convert graphics from AutoCAD.
   4. Standard HVAC Graphics Library:
      a. HVAC Equipment:
      b. Ancillary Equipment:

B. Workstation System Applications:
1. Automatic System Database Save and Restore Functions:
   a. Current database copy of each Building Controller is automatically stored on hard disk.
   b. Automatic update occurs upon change in any system panel.
   c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.

2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
   a. Save database from any system panel.
   b. Clear a panel database.
   c. Initiate a download of a specified database to any system panel.

3. Software provided allows system configuration and future changes or additions by operators under proper password protection.

4. On-line Help:
   a. Context-sensitive system assists operator in operation and editing.
   b. Available for all applications.
   c. Relevant screen data provided for particular screen display.
   d. Additional help available via hypertext.

5. Security:
   a. Operator log-on requires user name and password to view, edit, add, or delete data.
   b. System security selectable for each operator.
   c. System supervisor sets passwords and security levels for all other operators.
   d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
   e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
   f. All system security data stored in encrypted format.

6. System Diagnostics:
   a. Operations Automatically Monitored:
      1) Workstations.
2) Printers.
3) Modems.
4) Network connections.
5) Building management panels.
6) Controllers.
b. Device failure is annunciated to the operator.

7. Alarm Processing:
   a. All system objects are configurable to "alarm in" and "alarm out" of normal state.
   b. Configurable Objects:
      1) Alarm limits.
      2) Alarm limit differentials.
      3) States.
      4) Reactions for each object.

8. Alarm Messages:
   b. Recognizable Features:
      1) Source.
      2) Location.
      3) Nature.

9. Configurable Alarm Reactions by Workstation and Time of Day:
   a. Logging.
   b. Printing.
   c. Starting programs.
   d. Displaying messages.
   e. Dialing out to remote locations.
   f. Paging.
   g. Providing audible annunciation.
   h. Displaying specific system graphics.

10. Custom Trend Logs:
a. Definable for any data object in the system including interval, start time, and stop time.
b. Trend Data:
   1) Sampled and stored on the building controller panel.
   2) Archivable on hard disk.
   3) Retrievable for use in reports, spreadsheets and standard database programs.
   4) Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.
   5) Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.

11. Alarm and Event Log:
   a. View all system alarms and change of states from any system location.
   b. Events listed chronologically.
   c. Operator with proper security acknowledges and clears alarms.
   d. Alarms not cleared by operator are archived to the workstation hard disk.

12. Object, Property Status and Control:
   a. Provide a method to view, edit if applicable, the status of any object and property in the system.
   b. Status Available by the Following Methods:
      1) Menu.
      2) Graphics.
      3) Custom Programs.

13. Reports and Logs:
   a. Reporting Package:
      1) Allows operator to select, modify, or create reports.
      2) Definable as to data content, format, interval, and date.
      3) Archivable to hard disk.
   b. Real-time logs available by type or status such as alarm, lockout, normal, etc.
   c. Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
d. Set to be printed on operator command or specific time(s).

14. Reports:
   a. Standard:
      1) Objects with current values.
      2) Current alarms not locked out.
      3) Disabled and overridden objects, points and SNVTs.
      4) Objects in manual or automatic alarm lockout.
      5) Objects in alarm lockout currently in alarm.
      6) Logs:
         (a) Alarm History.
         (b) System messages.
         (c) System events.
         (d) Trends.
   b. Custom:
      1) Daily.
      2) Weekly.
      3) Monthly.
      4) Annual.
      5) Time and date stamped.
      6) Title.
      7) Facility name.
   c. Tenant Override:
      1) Monthly report showing total, requested, after-hours HVAC and
         lighting services on a daily basis for each tenant.
      2) Annual report showing override usage on a monthly basis.
   d. Electrical, Fuel, and Weather:
      1) Electrical Meter(s):
         (a) Monthly showing daily electrical consumption and peak electrical
             demand with time and date stamp for each meter.
         (b) Annual summary showing monthly electrical consumption and
             peak demand with time and date stamp for each meter.
2) Fuel Meter(s):
   (a) Monthly showing daily natural gas consumption for each meter.
   (b) Annual summary showing monthly consumption for each meter.

3) Weather:
   (a) Monthly showing minimum, maximum, average outdoor air
       temperature and heating/cooling degree-days for the month.

C. Workstation Applications Editors:
   1. Provide editing software for each system application at PC workstation.
   2. Downloaded application is executed at controller panel.
   3. Full screen editor for each application allows operator to view and change:
      a. Configuration.
      b. Name.
      c. Control parameters.
      d. Set-points.

4. Scheduling:
   a. Monthly calendar indicates schedules, holidays, and exceptions.
   b. Allows several related objects to be scheduled and copied to other objects
      or dates.
   c. Start and stop times adjustable from master schedule.

5. Custom Application Programming:
   a. Create, modify, debug, edit, compile, and download custom application
      programming during operation and without disruption of all other system
      applications.
   b. Programming Features:
      1) English oriented language, based on BASIC, FORTRAN, C, or PASCAL
         syntax allowing for free form programming.
      2) Alternative language graphically based using appropriate function
         blocks suitable for all required functions and amenable to
         customizing or compounding.
      3) Insert, add, modify, and delete custom programming code that
         incorporates word processing features such as cut/paste and
         find/replace.
4) Allows the development of independently, executing, program modules designed to enable and disable other modules.

5) Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.

6) Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.

7) Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.

8) Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values can be used in IF/THEN comparisons, calculations, programming statement logic, etc.

9) Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

1.08 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.

1.09 CHILLER CONTROL PROGRAMS

A. Control function of condenser water reset, chilled water reset, and chiller sequencing. Support inch-pounds and SI (metric) units of measurement.

PART 3 EXECUTION

2.01 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. Refer to Section 23 09 93.

C. Provide conduit and electrical wiring in accordance with Section 26 05 83. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

END OF SECTION 23 09 23