SECTION 230500

HVAC TESTING, ADJUSTING, AND BALANCING

PART 1 – GENERAL

1.01   SCOPE OF WORK

    A.   Test, adjust and air balance HV B-3, HV B-4, HV B-5 and HV G-1.

    B.   The air balance will be to ensure that all rooftop units are suppling the correct amount of air based on the Mechanical Schedule.

1.02   SUBMITTALS

    A.   Draft Reports: Submit for review prior to final acceptance of Project.

    B.   Assemble a PDF letter size with table of contents page and tabs, and cover identification. Include reduced scale drawings with air outlets and equipment identified to correspond with data sheets, and indicating sensor/thermostat locations.

1.03   TESTING, ADJUSTING AND BALACING

    A.   This section covers testing and balancing of environmental systems including air distribution systems, and the equipment and apparatus connected thereto. The testing and balancing of all environmental systems shall be the responsibility of one Testing, Balancing and Adjusting (TBA) firm. The minimal standards to be met are those set forth in Chapter 40 in the latest edition of the ASHRAE Systems Handbook.

    B.   The balancing, testing and adjustments of the complete mechanical systems shall be the direct responsibility of the Contractor and he shall engage the services of an independent firm specializing in this work. The definition of independent shall mean the firm is not associated with any contracting or manufacturing firm and derives its income solely from testing, adjusting and balancing mechanical systems. Acceptable testing, adjusting and balancing firms are those which are AABC certified. NEBB firms must also be AABC certified.

    C.   The balancing work shall be performed by the same firm having total professional responsibility for the final testing, adjusting, and balancing of the entire system.

    D.   Testing and balancing work shall be directly supervised and the results confirmed by a Registered Professional Mechanical Engineer who shall represent the TBA firm in progress meetings as requested, and shall be available for interpreting all material found in the balance report.

    E.   The balancing firm shall provide all tools, equipment and instruments required and shall take all readings, and make all necessary adjustments.

    F.   After all adjustments are made, prepare a detailed written report and submit for review. Report shall bear the Registered Professional Mechanical Engineer's Stamp of the person supervising the work. Final acceptance of this project will not be made until a satisfactory report is received.

    G.   Verify the following conditions before proceeding with work:

          1.   Conduct site observations during construction to determine the location of required balancing devices and confirm that they are properly located and installed. Submit a written report of these observations to the Architect.

2. Installation of the designated system is complete and in full operation.

3. Outside temperature conditions, occupant loads, lighting loads, special equipment requiring extra sensible or ventilation requirements, and solar conditions are within a reasonable range relative to design conditions or provide for acceptable simulation of loads and conditions that will result in a properly balanced system.

H. All thermal overload protection shall be observed and noted on the data sheets. If the starter equipment is furnished and installed by the Contractor and thermal overload protection is incorrect, such information shall be tabulated, including required size thermal overloads, and included in the report. If thermal overload protection is incorrect, it shall be the responsibility of the Contractor to see that proper overload protection is installed.

I. Measure and set any special conditions such as minimum outside air quantities; check and adjust outside and return air intakes so that the system will deliver substantially the same volume on either; make tests and record data as required in the "Balancing Report" section. All balancing devices such as dampers and valves shall be clearly marked as to the final balanced position. Plug all test holes, replace access doors and belt guards.

J. Upon request of the Mechanical Engineer a representative of the balancing firm performing the work shall demonstrate fluid flow quantities shown in the report by re-measuring outlets or terminals selected at random by the Mechanical Engineer to verify accuracy of settings.

K. Requirements for balancing air systems are as follows:

1. Before any adjustments are made; the major items of equipment shall have been checked to assure all bearings have proper lubrication; all belt drives shall have been adjusted for proper alignment and tension; and the systems shall have been checked for such items as dirty filters, duct leakage, filter leakage, damper leakage, equipment vibrations, correct damper operations, etc.

2. Adjust fan systems, major duct sections, registers, diffusers, etc., to deliver design air quantities within plus or minus 5%. If Individual air outlets serve more than one space, they may have a tolerance of 10% from the average. Pressure drop across filters during balancing shall be simulated to that condition. After balancing is completed, verify that motor is not overloaded with the filters clean.

3. Check and adjust CFM settings on diffusers, grilles and rooftop units.

4. Exchange and pay for sheaves and/or belts as required to adjust the rpm of fans to handle specified air quantity.

L. Provide a PDF of the "Balancing Report" to the Mechanical Engineer. The Mechanical Engineer shall review this report. This report shall contain a general information sheet listing instruments used, method of balancing, altitude correction calculations, manufacturer's grille, register, and diffuser data. Report shall contain the following additional data.

1. Equipment data sheets listing make, size, serial number, rating, operating data, etc., of all mechanical equipment including fans, motors, starters, and drives. Operating data shall include rotational speed, inlet and outlet pressures, pressure drop across filters, coils and other system components, and measured motor current and voltage.

2. Balancing data sheets listing the required and actual CFM of all supply, return, and exhaust outlets or inlets, and totals summarized by systems.

3. A reduced set of contract drawings with outlets marked thereon for easy identification of the designation used in the data sheets.

4. Listing of any abnormal or notable conditions not covered in the above.

M. Even though it is the responsibility of the balancing firm to check the physical operation of each operating piece of equipment, the control contractor must assure the balancing firm that all controls are accurately calibrated and must cooperate with him during the balancing work period.

N. The agency performing the system balance and performance test, shall personally verify that all system control functions and interlocking do in fact provide the desired results as stated. The agency shall provide a written statement within the air balance report verifying this fact.

PART 2 – PRODUCTS - (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Before starting work, verify systems are complete and operable.

B. Report defects, deficiencies, or abnormal conditions in mechanical systems preventing system balance.

C. Beginning of work means acceptance of existing conditions.

3.02 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to deliver design supply and return air quantities.

B. Make air quantity measurements in ducts by traverse of entire cross sectional area of duct.

C. Measure air quantities at rooftop units.

D. Use volume control devices to regulate air quantities only to extent those adjustments do not create objectionable air motion or sound levels. Change volume using dampers mounted in ducts.

E. Vary total system air quantities by adjustment of fan speeds. Provide drive changes to accomplish system air flow. Vary branch air quantities by damper regulation.

F. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Allow for pressure drop equivalent to 50 percent loading of filters.

G. Adjust automatic outside air, return air, and exhaust air dampers for design conditions.

H. Measure temperature conditions across outside air, return air, and exhaust air dampers to check leakage.

I. At modulating damper locations, take measurements and balance at extreme conditions.

3.03 FIELD QUALITY CONTROL

A. Verify recorded data represents actually measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices. Set and lock memory stops.

END OF SECTION

SECTION 230900

ENERGY MANAGEMENT SYSTEM CONTROLS

PART 1 GENERAL

1.1   SCOPE OF WORK

    A. Furnish all labor, materials, equipment, and service necessary for a complete and operating temperature control system, utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.

    B. All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.

    C. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s).

1.2   SYSTEM DESCRIPTION

    A. The temperature control system shall be comprised of a network of interoperable, stand-alone digital controllers communicating via LonMark/LonTalk communication protocols to a Network Area Controller (NAC).   Temperature Control System products shall be manufactured by Honeywell. Equivalent LonWorks products must be approved in writing by the consulting Engineer and be submitted for approval ten (10) days prior to the date of the bid submittal.

    B. The Temperature Control System as provided in this Division shall be based on the Honeywell WEBs System incorporating the Niagara Framework™. Equivalent products must be approved in writing by the consulting Engineer and be submitted for approval ten (10) days prior to the date of the bid submittal. Systems not developed on the Niagara Framework platform are unacceptable.

1.3   SUBMITTAL

    A. Two hard copies of shop drawings of the components and devices for the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions for all controllers, valves, dampers, sensors, routers, etc. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence of Operation shall also be included with the submittal package.

    B. Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media and protocol.

    C. Submittal shall also include a complete point list of all points to be connected to the temperature control system. Controls Contractor shall provide necessary point lists, protocol documentation, and factory support information for systems provided.

    D. Submittal shall also include a copy of each of the graphics developed for the Graphic User Interface including a flowchart (site map) indicating how the graphics are to be linked to one another for system navigation. The graphics are intended to be 80% - 90% complete at this stage with the only remaining changes to be based on review comments from the A/E design team and/or Owner.

E.   Include the following display graphics for the site:

1.   Site plan view of entire campus identifying Building 600 – include the display of outside air temperature & humidity.
2.   Boiler and hot water pumps showing all related points.
3.   Page showing all other miscellaneous points.

F.   Upon completion of the work, provide a complete set of 'as-built' drawings and application software on compact disk. Drawings shall be provided as AutoCAD™ or Visio™ compatible files. Eight copies of the 'as-built' drawings shall be provided in addition to the documents on compact disk. Controls Contractor shall provide as-builts for their portions of work.

1.4   SPECIFICATION NOMENCLATURE

A.   Acronyms used in this specification are as follows:

NAC	Network Area Controller
IDC	Interoperable Digital Controller
IBC	Interoperable BACnet Controller
GUI	Graphical User Interface
WBI	Web Browser Interface
POT	Portable Operator's Terminal
PMI	Power Measurement Interface
DDC	Direct Digital Controls
LAN	Local Area Network
WAN	Wide Area Network
OOT	Object Oriented Technology
PICS	Product Interoperability Compliance Statement

1.5   AGENCY AND CODE APPROVALS

A.   All products of the temperature control system shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable.

1.   UL-916; Energy Management Systems

2.   C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 "signal Equipment"

3.   CE

4.   FCC, Part 15, Subpart J, Class A Computing Devices

1.6   SOFTWARE LICENSE AGREEMENT

A.   The Owner shall agree to the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

B.   The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the Server(s), and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the owner. The owner shall

determine which organizations to be named in the SI organization ID ("orgid") of all software licenses. Owner shall be free to direct the modification of the "orgid" in any software license, regardless of supplier.

1.7   DELIVERY, STORAGE AND HANDLING

   A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.8   JOB CONDITIONS

   A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

PART 2 MATERIALS

2.01   ACCEPTABLE CONTROL MANUFACTURER/CONTRACTOR

   A. Honeywell "Authorized Controls Integrator" **–**   R & R Controls Inc.
                                                          4564 B Alvarado Canyon Road
                                                          San Diego, CA 92120
                                                          ph. 619-516-1880

2.02   GENERAL

   A. The temperature control system shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein. All systems and software within temperature control system shall be shall be supported by compliance documentation from the manufacturer.

   B. The installed system shall provide secure password access to all features, functions and data contained in the overall temperature control system.

2.03   OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

   A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet, LonWorks technology, MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system.

   B. The computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-2001, BACnet and LonMark to assure interoperability between all system components is required. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file and a resource file for the device. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP,) and/or RS-485 (BACnet MSTP) as specified.

   C. All components and controllers supplied under this Division shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

D. The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.

E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.

1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.04   NETWORKS

A. The Local Area Network (LAN) shall be a 100 Megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

B. Local area network minimum physical and media access requirements:

1. Ethernet; IEEE standard 802.3

2. Cable; 100 Base-T, UTP-8 wire, category 5

3. Minimum throughput; 100 Mbps.

2.05   NETWORK ACCESS

A. Remote Access.

1. For Local Area Network installations, provide access to the LAN from a remote location, via the Internet. The Owner shall provide a connection to the Internet to enable this access via high-speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

2.06   NETWORK AREA CONTROLLER (NAC)

A. The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:

1. Calendar functions

2. Scheduling

3. Trending

4. Alarm monitoring and routing

5. Time synchronization

6. Integration of LonWorks controller data and BACnet controller data

7. Network Management functions for all LonWorks based devices

B. The Network Area Controller must provide the following hardware features as a minimum:

1. One Ethernet Port – 10/100 Mbps

2. One RS-232 port

3. One LonWorks Interface Port – 78KB FTT-10A

4. One RS-485 ports

5. Battery Backup

6. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)

7. The NAC must be capable of operation over a temperature range of 32 to 122°F

8. The NAC must be capable of withstanding storage temperatures of between 0 and 158°F

9. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

C. The NAC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

D. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 32 simultaneous users.

E. Event Alarm Notification and actions

1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.

2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.

3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:

   a. To alarm

   b. Return to normal

   c. To fault

   d. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.

4. Provide timed (schedule) routing of alarms by class, object, group, or node.

5. Provide alarm generation from binary object "runtime" and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

F. Control equipment and network failures shall be treated as alarms and annunciated.

G. Alarms shall be annunciated in any of the following manners as defined by the user:

1. Screen message text

2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:

   a. Day of week

   b. Time of day

   c. Recipient

  3. Pagers via paging services that initiate a page on receipt of email message

  4. Graphic with flashing alarm object(s)

  5. Printed message, routed directly to a dedicated alarm printer

 H. The following shall be recorded by the NAC for each alarm (at a minimum):

  1. Time and date

  2. Location (building, floor, zone, office number, etc.)

  3. Equipment (air handler #, access way, etc.)

  4. Acknowledge time, date, and user who issued acknowledgement.

  5. Number of occurrences since last acknowledgement.

 I. Alarm actions may be initiated by user defined programmable objects created for that purpose.

 J. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

 K. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.

 L. Provide a "query" feature to allow review of specific alarms by user-defined parameters.

 M. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

 N. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

2.07 Data Collection and Storage

 A. The NAC shall have the ability to collect data for any property of any object and store this data for future use.

 B. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:

  1. Designating the log as interval or deviation.

  2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.

  3. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.

  4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.

  5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

 C. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.

 D. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

E. All log data shall be available to the user in the following data formats:

   1. HTML

   2. XML

   3. Plain Text

   4. Comma or tab separated values

F. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.

G. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:

   1. Archive on time of day

   2. Archive on user-defined number of data stores in the log (buffer size)

   3. Archive when log has reached it's user-defined capacity of data stores

   4. Provide ability to clear logs once archived

2.08   AUDIT LOG

A. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:

   1. Time and date

   2. User ID

   3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

2.09   DATABASE BACKUP AND STORAGE

B. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.

C. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.

D. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.10   INTEROPERABLE DIGITAL CONTROLLER (IDC)

E. Controls shall be Honeywell Excel 10 microprocessor based Interoperable LonWorks Controllers (IDC) or approved equal. Where possible, all Interoperable Digital Controllers shall bear the applicable LonMark™ interoperability logo on each product delivered.

F. HVAC control shall be accomplished using LonMark™ based devices where the application has a LonMark profile defined. Where LonMark devices are not available for a particular application, devices based on LonWorks shall be acceptable. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file for the device. Publicly available specifications for the Applications Programming Interface (API) must be provided for each LonWorks / LonMark controller defining the programming or setup of each device. The Controls Contractor shall provide all programming, documentation and programming tools necessary to set up and configure the supplied devices per the specified sequences of operation.

G. The Controls Contractor shall run the LonWorks network trunk to the nearest Network Area Controller (NAC). Coordinate locations of the NAC to ensure that maximum network wiring distances, as specified

by the LonWorks wiring guidelines, are not exceeded. A maximum of 126 devices may occupy any one LonWorks trunk and must be installed using the appropriate trunk termination device. All LonWorks and LonMark devices must be supplied using FTT-10A LonWorks communications transceivers.

H. The Network Area Controller (NAC) will provide all scheduling, alarming, trending, and network management for the LonMark / LonWorks based devices.

I. The IDCs shall communicate with the NAC at a baud rate of not less than 78.8K baud. The IDC shall provide LED indication of communication and controller performance to the technician, without cover removal.

J. All IDCs shall be fully application programmable and shall at all times maintain their LONMARK certification, if so certified. Controllers offering application selection only (non-programmable), require a 10% spare point capacity to be provided for all applications. All control sequences within or programmed into the IDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.

K. The Controls Contractor supplying the IDC's shall provide documentation for each device, with the following information at a minimum:

1. Network Variable Inputs (nvi's); name and type

2. Network Variable Outputs (nvo's); name and type

3. Network configuration parameters (nci, nco); name and type

L. It is the responsibility of the Division 23 contractor to ensure that the proper Network Variable Inputs and Outputs (nvi and nvo) are provided in each IDC, as required by the point charts.

M. The supplier of any programmable IDC shall provide one copy of the manufacturer's programming tool, with documentation, to the owner.

2.11   SYSTEM PROGRAMMING

A. The Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.

B. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.

C. Programming Methods

1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.

2. Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.

3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.

4. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.

5. The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

PART 3   EXECUTION

3.01   INSTALLATION

A. All work described in this section shall be performed by a Honeywell **"Authorized Controls Integrator"** that has a successful history in the design and installation of integrated control systems using Niagara Framework™. The installing contractor shall have a local office located within **20 miles** from **San Marcos Unified School District** and a minimum of <u>ten</u> years of integration experience installing Honeywell DDC control systems and shall provide documentation in the submittal package verifying the company's experience.

B. The Controls Contractor shall have employees at the local branch that are fully trained and certified for the Honeywell WEBs Systems incorporating Niagara Framework™. Copies of the employees Niagara Training Certificates shall be included in the submittals.

C. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.

D. Drawings of the temperature control system network are diagrammatic only and any apparatus not shown, but required to make the system operative to the complete satisfaction of the Owner shall be furnished and installed without additional cost.

E. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by this contractor in accordance with these specifications.

F. Controls Contractors shall have a **C-10 License** in good standing in the state of California

3.02   WIRING

A. All electrical control wiring and power wiring to the control panels, NAC, computers and network components shall be installed in conduit and be the responsibility of the Controls Contractor.

B. All wiring shall be in accordance with the National Electrical Code and any applicable local codes. All temperature control system wiring shall be installed in the conduit types allowed by the National Electrical Code or applicable local codes. Where plenum rated cable wiring is allowed it shall be run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike manner.

C. Echelon Compliant Direct Burial Cable shall be used for all underground communication bus wiring between buildings to prevent damage from moisture. The existing underground conduit systems are not watertight.

3.03   WARRANTY

    A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of **one year** from the time of system acceptance.

    B. Within this period, upon notice by the Owner, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within <u>48 hours</u> after receipt of notice) repaired or replaced by this contractor at no expense to the Owner.

3.04   WARRANTY ACCESS

    A. The Owner shall grant to this contractor, reasonable access to the temperature control system during the warranty period.

    B. The owner shall allow the contractor to access the temperature control system from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

3.05   SOFTWARE LICENSE

    A. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s).   The owner, or his appointed agent, shall determine which organizations to be named in the "orgid" of all Niagara Framework software licenses.

    B. The owner, or his appointed agent, shall be free to direct the modification of the "orgid" in any Niagara Framework software license, regardless of supplier.

    C. The owner, or his appointed agent, shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and /or configured for use within Niagara Framework (Niagara) based controllers and/or servers and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required Ids and passwords for access to any component or software program shall be provided to the owner.

3.06   ACCEPTANCE TESTING

    A. Upon completion of the installation, this contractor shall load all system software and start-up the system. This contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

    B. This contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.

    C. Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

    D. System Acceptance: Satisfactory completion is when this contractor have performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.07   OPERATOR INSTRUCTION, TRAINING

A. During system commissioning and at such time acceptable performance of the temperature control system hardware and software has been established this contractor shall provide both off-site and on-site operator instruction to the owner's operating personnel.   Operator instruction shall be done during normal working hours and shall be performed by factory-trained personal that are familiar with the system hardware, software and accessories.

B. This contractor shall provide **2 hours** of instruction to the owner's designated personnel on the operation of the temperature control system and describe its intended use with respect to the programmed functions specified.   Operator orientation of the systems shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation.

END OF SECTION

HEATING AND VENTILATING (HV) SYSTEMS

PART 1- GENERAL

1.01   SCOPE OF WORK

    A.   Work under this section provides materials and equipment related to Heating and Ventilating systems.

    B.   Provide complete Mechanical Submittals and Shop drawings.

    C.   Replace HV B-3, HV B-4, HV B-5 and HV G-1.

    D.   Mechanical Contractor shall dispose of the exiting units.

    E.   Demolish the exiting electrical disconnects and conduit. The existing electrical wiring shall remain and be reused. Provide new electrical disconnects and electrical conduit.

    F.   Provide MERV 13 filters for new rooftop units. The existing curbs and seismic attachments shall be reused.

    G.   Disconnect gas piping for removal and reconnect gas piping when new H rooftop unit is installed.

    H.   Clean, disinfect and coat existing supply air plenums for the rooftop HV units which are being replaced.

1.02   EQUIPMENT AND COMPONENTS REVIEW

    A.   Only Reznor rooftop equipment and components from those manufacturers indicated in this specification is acceptable.

1.03   SUBMITTALS

    A.   Require Submittals

         1.   Reznor HV units.
         2.   R & R Controls.
         3.   Electrical system materials
         4.   Gas piping and fitting material.

PART 2 - PRODUCTS

2.01   ROOFTOP PACKAGED HEATING AND VENTILATING (HV) UNITS AND ACCESSORIES

    A.   Acceptable manufacturer of rooftop package units is Reznor.

    B.   Refer to Reznor Quote and Reznor Submittal for information on HV Rooftop Units.

2.02   NATURAL GAS PIPING AND FITTINGS

    A.   Piping: Galvanized Schedule 40 steel pipe and fittings.

B. Shut Off Valves: Nibco. Class 300 Flanged Ball Valve or equal. Body, stem and ball shall be Stainless Steel A743 GR. CF8M. Ball Valve shall be rated 300 PSI working pressure. Pack gland and stop plate shall be stainless steel. Provide stainless steel handle and nut.

C. Roof piping supports shall be DURA-BLOCK DB620 with 20" overall length.

2.03   IDENTIFICATION OF EQUIPMENT

A. Each item of equipment shall be permanently labeled with a plastic nameplate of sufficient size to clearly indicate the identification designation appearing on the construction drawings. Letters shall be a minimum of 2 inches high.

2.04   ELECTRICAL OUTDOOR FUSED DISCONNECTS AND STARTERS

A. Fusible Switch Assemblies: NEMA Type Heavy Duty; with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: designed to accommodate Class R, Class J or Class CC (motors) cartridge type fuses. Outdoors: NEMA 3R code gauge zinc coated steel with baked enamel finish. Provide manufacturer's equipment ground kit in all disconnect switches. Fuses 600 Amperes and Less: Dual element, time delay, UL Class. Provide three (3) spares of each size and type fuse.

B. Starters Assemblies: NEMA Type Heavy Duty; with externally operable switches. Provide On/Off/Auto switches. Outdoor NEMA 3R code gauge zinc coated steel with baked enamel finish. Provide manufacturer's equipment ground kit. Provide electrical line and control voltage attachments.

PART 3 – EXECUTION

3.01   ROOFTOP HV UNITS

A. Install equipment in accordance with manufacturer's recommendations, good industry standards and SMACNA Installation Standards for Heating, Air Conditioning and Solar systems.

B. Provide high pressure air seal around ducts and units.

C. Coordinate with other work, including ductwork, roof construction, and electrical work as necessary to interface installation of rooftop equipment.

D. Ensure equipment is wired properly, with rotation in direction indicated and intended for proper performance. If there is no rotation arrow supplied by the manufacturer, install a correct rotation arrow.

3.02   ELECTRICAL OUTDOOR FUSED DISCONNECTS AND OUTDOOR STARTERS

A. Remove and dispose of existing electrical disconnects and starters.

B. Keep electrical wiring for future connection.

C. Provide new fused disconnects and starters located in the same location as the existing if wall mounted.

D. If the disconnects are equipment mounted provide them similar locations as the existing so the wiring does not have to change.

3.03   NATURAL GAS PIPING INSTALLATION

A.   Piping shall be grouped wherever practical and shall be installed uniformly in straight parallel lines in either vertical or horizontal positions and at right angles with building lines.

B.   Pipe shall be installed to eliminate sagging.

C.   All pipe, fittings and valves shall bear manufacturer's name and trademark, and valves shall have service and pressure rating cast in bodies.

D.   Roof piping supports shall be DURA-BLOCK DB620 with maximum of 6 foot spacing. Provide supports shall be located near or at changes in piping direction and concentrated loads.

E.   All piping system shall be tested and proven tight prior to concealment.

F.   Ensure that the test pressure which might damage equipment does not reach such units by valving them off or otherwise isolating them during the test.

G.   All air tests shall be held for a minimum of four hours without loss of pressure.

3.04   RECORD DRAWINGS

A.   Maintain at the site, a set of record drawings, upon which shall be clearly indicated (by shading, coloring, or some other acceptable method) the day by day extent of the work installed. Indicate all changes to the original design at the end of each day.

A.   At the completion of the construction phase, furnish to the Owner's Representative all necessary drawings showing work which was not installed as shown in the contract drawings.

3.05   GUARANTEES AND WARRANTIES

A.   All work shall be guaranteed to be free from defects in material and workmanship for a period of one year from the date of final acceptance of the work, or a longer period if stipulated under specific headings. Replace at no additional cost any material, fixtures or equipment developing defects and also pay for any damage caused by such defects, or the correction of defects.

B.   Use warrantee terms for specific items of equipment, relative to the work guarantee requirements of this specification.

END OF SECTION