SECTION 15904

DIRECT DIGITAL CONTROL SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Related documents which govern the work specified in this section.

1. The Conditions of the Contract.
2. Other applicable sections of the specifications.

1.02 SECTION INCLUDES

A. Direct Digital Control System (DDC). The DDC system will consist of a combination of Building Controllers and Custom Application Controllers linked together on a main Local Area Network (LAN) and subLAN, measuring and controlling input and output devices and being accessed and programmed from one or more Operator Workstations (OWS).

1.03 RELATED SECTIONS

A. General Conditions, special conditions, and sections 15000 and 16000 shall apply to this section.

1.04 SCOPE

A. Provide all labor, materials, programming and supervision necessary to install a Direct Digital control system (DDC).

B. The scope of work shall include but not be limited to the following:

1. The Direct Digital Control System (DDC) shall be 100% compatible with all Tarrant County facilities utilizing server based control and server based graphical user interface software manufactured by Reliable Controls Corporation.
2. The database utilized by the server based graphical user interface shall be 100% compatible with the P.C. based graphical user interface. Any icon links to additional control system applications are not acceptable.
3. The Control Contractor shall furnish all electrical control and interlock wiring connected to the controls and instrumentation systems. 120 VAC or greater voltage power wiring to main control panels (i.e. AHU's) as shown on the mechanical plans and/or specifications, shall be provided by Division 16 Contractor (Electrical), and coordinated by this Contractor. Failure of

this Contractor to coordinate requirements with other Divisions shall result in this Contractor to be responsible for any non-coordinated items.

4. All conduits in connection with the controls and instrumentation system shall be furnished and installed by this Contractor.

5. The Control Contractor shall complete all sensing and control installations including electrical and electronic components, not the Mechanical Contractor, unless otherwise required.

6. Provide a comprehensive operator and technician-training program as described herein.

7. Provide as-built documentation, software, and all DDC control logic and all associated support documentation on approved media, which accurately represents the final installed system.

8. Provide all necessary hardware and software to allow the direct digital control system to reside on the owners existing Ethernet TCP/IP infrastructure.

1.05 COORDINATION

A. The direct digital portions and automatic temperature control system shall be provided and installed by the Control Contractor.

B. Coordination of all controls items with other trades shall be the responsibility of the Controls Contractor. Coordination of wall space for panels shall be the responsibility of the Controls Contractor.

C. The Control Contractor shall be fully responsible for coordination of all sensor locations with furniture cabinets.

1.06 TEST

A. The Control Contractor shall test the entire system and document the point-by-point operation of all controls and perform all required continuity testing of conductors prior to final connection to control equipment.

B. Substantial Completion inspections will not be scheduled or performed until a detailed statement has been received from the Control Contractor certifying that the point-to-point checks have been completed. Also, a list of any non-completed or improperly operating devices shall be a part of this certified statement. This list must be submitted a minimum of five (5) days prior to Substantial Completion inspection.

C. Provide an all points print report log (site specific) with the substantial completion inspection report as required in paragraph 1.05 B.

D. CALIBRATION AND ADJUSTMENT

E. After completion of the installation, perform calibration and adjustments of the Automatic Temperature Control system provided under this contract, and supply services incidental to the proper performance of the temperature control system under the warranty below.

F. Provide a detailed calibration and checkout log detailing the calibration and adjustment activities performed.

1.07 SYSTEM WARRANTY AND SERVICE CONTRACT

A. System Warranty:

1. All control Global Controllers and Unitary Controllers (as defined in this section) devices provided by this Contractor shall be warranted – by the Manufacturer, not the local installation contractor -- to be free of defects in workmanship and material for a period of two (2) year from the first date of beneficial use. Any Global Controllers and Unitary Controllers found to be defective during this period shall be repaired or replaced without equipment expense to the Owner.

2. All other components of the control system are to be warranted to be free of defects in workmanship and material for a period of one (1) year from the first date of beneficial use.

3. The Contractor shall respond to warranty items within one working day from when they are reported. Provide a report to the Owners Maintenance Department identifying the problem, the devices affected and the nature of the repair or replacement.

4. Throughout the first year of warranty period, the warranty shall cover all costs for parts, labor, associated travel, any software sequence modifications, and expenses throughout the warranty period.

1.08 SUBMITTAL SHOP DRAWINGS REQUIREMENT

A. After award of the Construction Contract, and prior to delivering submittal data to the Engineer, the Control Contractor with the Engineer shall schedule a pre-submittal conference. The purpose of the pre-submittal conference is to review the proposed system concept and to discuss the sequence of construction activities.

B. The following data/information shall be submitted for approval (prior to ordering any hardware or software items):

1. Provide twelve (12) copies of all submittal data.

2. An overall system interconnecting diagram showing all remote panels (PCs, Field Panels, and LAN devices), and power/surge protection locations and Uninterrupted Power Supply (UPS).

3. Distributed panel locations (site and/or building plan, as appropriate to identify physical locations).

4. Data sheets for all hardware and software control components.

5. Thermostat/sensor locations.

6. A description of the methodology used to keep graphics files on various PC terminals updated and consistent with one another. (Remote computer graphics vs. site computer)

7. A detailed point-to-point diagram of circuitry of all DDC panels. Submit on a per distributed panel basis. Typical are accepted, provided all applicable units are listed and the units are identified.

8. A list of connected data points, including connected control unit and input or output devices.

9. A detailed Sequence of Operations.

10. Detailed documentation on the specific field equipment to be supplied by the Controls Contractor shall be submitted and approved prior to installations; including, but not limited to, actuators, valves, temperature sensors, surge protection, and damper operators.

11. All schemes and methods proposed to provide lightning protection for the DDC system, entering and leaving each building shall be submitted for review and approval.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with terms and conditions each authorized installation contractor agrees to provide the following from DDC manufacturers and suppliers;

1. Reliable Controls Corporation or approved equal

B. The controls contractor shall have been in business a minimum of ten years installing and servicing direct digital control systems.

C. The installation of the direct digital control systems shall be installed and programmed by full-time employees of the controls contractor. No installation subcontractors will be allowed.

D. The controls contractor shall have completed a minimum of thirty projects within the last five years that are equal in the scope to this project.

2.02 COMMUNICATIONS NETWORK, PC, AND MODEM SUPPORT

A. The Communications network between all buildings systems must be achieved by utilizing the existing Ethernet TCP/IP infrastructure

B. Each facility will have a global controller with communication network.

C. Server Hardware: Provide a server as defined in Internet/Intranet Connectivity utilizing a Web Browser section following

D. Local PC Software: The operator interface panel software shall be compatible with Windows 95, 98, ME, NT 4.0, 2000, and XP operating systems. All operating system software, control software, and graphics generation software shall be provided, along with required usage licenses. All software shall be provided for the Owner to make any changes to the system without Control Contractor support. (i.e. if the Owner needs to change a graphic, provide the graphic software that generated the original)

E. Remote authorized personal computers shall have access to the automation system, and shall be able to communicate with and control the remote site even if the on-site PC is turned off or not functioning.

F. Upon failure of the LAN to communicate information, each controller will retain the last legitimate value of its imported network points, and continue to control the systems based on those values. Failure of any controller, or any part of a controller on the LAN shall nor affect the ability of the LAN to communicate among the remaining controllers.

2.03 GLOBAL CONTROLLER PANELS

A. Provide an independent, stand alone, microprocessor based control panel (Global Controller) for each facility. These panels shall communicate with the operator via the Main Communications Trunk – EIA-232C and/or EIA-485 and/or Ethernet (IEEE.802.2) with TCP/IP, using PC/Graphics Interface Software.

B. The controller shall reside on and communicate on the main LAN using either Ethernet (IEEE.802.3) with TCP/IP

C. In addition to main LAN communications, the controller shall support EIA-485 subLANs, PC, modem communications.

D. The controller shall have at least two ports (other than the PC port) which can be configured to BACnet conformance class 3 using TCP/IP or EIA-232 point-to-point communications for interface to other BACnet products

E. The Global Controller panel (GC) shall contain the necessary hardware and firmware to interface the building Unitary Controller Devices with the PC over the Main Communications Trunk, modem interface, existing Ethernet and the Internet (WWW) infrastructure utilizing IEEE.802.3 specifications with TCP/IP for off-site access to data and programming functions. Simply put, the GC controller plugs into the existing 10BaseT Capable Ethernet backbone. Configure the GC with customer provided masking, TCP/IP routers and addresses for each GC; the system works.

F. Each Global Controller panel shall be stand alone in a standard NEMA 1 enclosure. The electrical requirements shall be identified and coordinated by this Contractor. Any 110 VAC requirements are to be coordinated with Division 16 Contractor. The division 16 Contractor shall provide 110 VAC power circuits to each panel. Use panduits in each control panel to conceal all wiring. Fuse all transformers. Control panels shall be clearly identified by labels (1" lettering). Provide and install as-built wiring diagrams to indicate the control points on all equipment.

G. Each GC panel shall have a clock with battery back-up. Where there are multiple GC panels, the respective clocks shall be synchronized by the PC or a designated GC.

H. As many GC panels, as required, shall be furnished to provide the monitoring and control functions and capabilities specified. The panel shall be strategically located in areas of the building that are easily accessible for maintenance and repair.

I. The main communications trunk using a peer-to-peer communications protocol or IEEE.802.3 with TCP/IP shall directly interface the GC panels. The GC panel shall communicate without requiring a PC or remote modem device.

J. The GC panel shall have at lest two digital inputs.

K. The trend log, schedules and alarms shall be located in the GC not the PC. The GC should have the capability to log all the information.

L. The GC shall have automatic protection from any power failure of at least twenty-four (24) hours duration.

M. During a power outage situation, the real-time clock continues to operate and the GC automatically restarts upon restoration of power.

N. Any Input, Variable, Schedule point shall have a user-definable, unique, system-wide logical point mnemonic.

2.04 UNITARY CONTROLLER PANELS

A. The manufacturer shall have multiple unitary controllers (UC) specifically designed for HVAC applications. The devices shall be stand-alone. The UC devices shall be able to interface with an operator and interface/room and/or zone sensor devices. The operator interface device shall allow the operator to adjust set points, initiate push-button actions, and receive feedback of temperature and/or status.

1. INPUT/OUTPUT (I/O) INTERFACE

a. To gather sensor data and interface with controlled equipment, the UC devices shall use I/O types consistent with the application for which it is designed. This design shall allow different types of points using any of the following input/output options:

(1) Input Options (universal; analog or digital) - monitor the open/closed status of dry contacts, monitor analog values of voltages, current and resistance from temperature, pressure, relative humidity, CO2 sensors, etc.

(2) Digital Outputs Options - control on/off, start/stop relays.

(3) Analog Output Options - supply voltage or current outputs to controlled devices.

b. All I/O points must be universal (i.e. user definable as digital or analog). Dedicated analog/digital points will not be accepted.

c. Any Input, Variable, Schedule point shall have a user-definable, unique, system-wide logical point mnemonic

2. UNIVERSAL INPUTS (UI)

a. The Unitary Controller devices shall accept isolated contact closures (either normally open or normally closed contacts).

b. The Unitary Controller devices shall accept analog inputs (DC voltage, DC current, resistance).

c. Analog inputs can be linear or non-linear. Points shall include an A/D converter and an analog power supply. All points shall be wired to the UC device using #18 AWG twisted, shielded pair cables (Belden 8760 or equivalent) or larger or as recommended by the Control Manufacturer.

3. DIGITAL OUTPUTS (DO)

a. The digital outputs shall control on/off, start/stop relays which have low voltage coils. Dry contact, two position pilot voltage (0/12vDC), or triac outputs are acceptable. Common ground outputs are acceptable.

4. ANALOG OUTPUTS (AO)

a. The analog output supplies voltage or current to the control devices(i.e. damper actuator). All output points to valves and dampers shall read as a percent open. Signal types shall include 4-20 mA (into 1,000 Ohm load), resistance (up to 1,000 Ohms), and voltage (0-10 VDC).

5. GC AND UC OPERATOR CONTROL LANGUAGE

a. The Operator Control Language (OCL) will support the concept of output-oriented code allowing many small individual programs to be written and connected to graphic screens. Each output and/or calculation will have its own dedicated program and not be part of one larger program.

(1) The DDC system shall have the capacity for timed start/stop on daily schedules, as well as the capability for the owner to develop and run user written application programs. For this, the DDC system shall have a proven OCL, which shall be capable of reading the value and/or status of all system points, and initiating both analogue and digital control actions from any user defined combination of calculations and logical expressions, which shall at a minimum include:

(a) Addition, subtraction, multiplication and division.

(b) Square roots, summations, absolute differences.

(c) IF THEN ELSE statements.

(d) Logical "not", "and", "or", "less than", "greater than", and "equal to" or their equivalents.

(e) Time delays in seconds, minutes or hours.

(f) Ability to imbed comments in system generated documentation.

(g) Ability to use time-of-day and day-of year in algebraic calculations.

(h) Ability to filter continuous small changes in input signals to prevent equally small increment in output signals from occurring.

(2) All of the above functions must be accomplished via software. FIRMWARE BASED FUNCTIONS WILL NOT BE ACCEPTED.

b. From within the OCL programming editor

(1) Provide full screen editor to enable editing of the OCL programs source code down to character-by-character changes.

(2) Provide the capability in the editor of accepting programs from ASCII files that have been created on other text editors and word processors.

(3) If a point name is changed, all occurrences of that will point will automatically be changed, regardless of where the occurrence exists.

(4) Provide cutting and pasting functions within editor, such that sections of OCL code from one program can be easily cut and pasted into a different OCL code on residing in another controller.

(5) Provide debug utility that will indicate line of OCL containing structural or syntax error.

(6) If OCL contains line number, provide automatic renumbering feature to sequentially renumber lines.

(7) Provide the capability to automatically view value and/or status of points used within OCL code without exiting editor.

(8) Provide at least TEN (10) unique local variables that can be declared for each individual OCL code.

6. PACKAGING AND ENVIRONMENT

a. Distributed unitary controller enclosures shall be locking type, metal cabinet, with common keying. The panels shall have a metal print pocket suitable for storing wiring, service and log information. Indoor panels shall be NEMA 1 enclosures with gaskets. The panel, when required, must functionally operate over a temperature range of 0 degrees F to 120 degrees F, and a humidity range of 0 - 95% non-condensing.

b. The electrical requirements shall be identified and coordinated by the Controls Contractor. Any 110 VAC requirements are to be coordinated with Division 16 Contractor. The division 16 Contractor shall provide 110 VAC power circuits to each panel. Use panduits in each control panel to conceal all wiring. Fuse all transformers.

c. Control panels shall be clearly identified by labels (1" lettering).

d. Provide and install as-built wiring diagrams to indicate the control points on all equipment.

2.05 SOFTWARE

A. The graphic software shall be based on Microsoft Windows 95, 98, ME, 2000, NT 4.0, and XP.

1. Basic Interface Description

a. The software manufacturer shall furnish written conformation that they will provide all upgrades free to the owner for as long as Tarrant County utilizes the system.

b. Operator workstation interface software shall minimize operator use and through the use of English language prompting. English language point identification and industry standard PC application software. The software shall provide, as a minimum, the following functionality:

(1) Real-time graphical viewing and control of environment

(2) Scheduling and override of building operations

(3) Collection and analysis of historical data and dynamic data (trend plot)

(4) Definition and construction of dynamic color graphic displays

(5) Editing, programming, storage and downloading of global controller databases

(6) The software shall have a "simulator" mode that allows controllers to be fully programmed off-line without the need of any controller hardware.

(7) Alarm reporting, routing, messaging, and acknowledgment

c. Provide a graphical user interface that shall minimize the use of keyboard through the use of a mouse or similar pointing device and "point and click" approach to menu selection.

d. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. The DDC software shall run on Microsoft Windows 95, 98, ME, 2000, NT 4.0, or XP. Other Windows applications shall run simultaneously with the DDC software. The mouse or Keyboard shall be used to quickly select and switch between multiple applications. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciation on-line DDC alarms and monitoring information.

(1) Provide functionality such that any of the following may be performed simultaneously on-line, and in any combination, via user-sized windows:

(a) Dynamic color graphics and graphic control

(b) Alarm management, routing to designated locations, and customized messages

(c) Week at a Glance Time-of-Day scheduling

(d) Trend data definition and presentation

(e) Historical Data Archiving to the local computer hard drive

(f) Graphic definition and construction

(g) Program and point database editing on-line

(h) Each system graphic group will accommodate up to 160 points.

(2) Report and alarm printing shall be accomplished via Windows program manager, allowing use of network printers.

e. Provide a security system that prevents unauthorized use unless the operator is logged on. Access shall be limited to the operator's terminal functions unless the user is logged on.

(1) Each operator Terminal shall provide security for 124 users (minimum). Each user shall have an individual password. Each user shall be individually assigned which control functions and menu items the user has access to. All passwords, user names and access assignments shall be adjustable on-line, at the operators terminal. Each user shall also have a set security level that defines access to displays and also defines what individual points the user can control.

f. Operator Activity Tracking - An audit trail report to track system changes, accounting for individual user logons shall be printable and archived for future use. The operator activity tracking shall be in a tamper-proof buffer file.

g. Reports shall be generated on demand and directed to Computer workstation displays, printers or disk. As a minimum, the system shall allow the user to easily obtain the following types of reports:

(1) A general listing of all or selected points in the network

(2) List of all points currently in alarm

(3) List of all points currently in override status

(4) List of all disabled points

(5) List of all points currently locked out

(6) List of user accounts and access levels

(7) List all weekly schedules

(8) List of limits and dead-bands

(9) Excel reports

(10) System diagnostic reports including, list of DDC panels on line and communicating, status of all DDC terminal unit device points

(11) List of programs

h. Scheduling and override

(1) Provide a graphical spreadsheet-type format for simplification of time-of-day scheduling and overrides of building operations. Schedules reside in DDC Global Controller to ensure time equipment scheduling when PC is off-line, PC is not required to execute time scheduling. Provide override access through menu selection or function key. Provide the following spreadsheet graphic types as a minimum:

(a) Display of Weekly schedules shall show all information in easy to read 7-day (week) format for each schedule. This includes all on/off times for each day along with all optimum start information.

(b) Holiday schedules shall show all dates that are to be holidays. Holidays shall be shown on the terminal in

a graphical calendar format showing all scheduled days for a given month. User shall be able to easily scroll through the months for each year. Each day assigned as a holiday shall display as "All Off" or show "Scheduled" for that day.

(c) Event schedules shall be shown in the same graphical calendar format and manner as Holiday schedules. Event schedules allow for scheduling of special events. After an event has elapsed, control returns to normal schedule.

(d) Operator shall be able to change all information for a given Weekly, Holiday or Event schedule if logged on with the appropriate security access. This includes all information that has to do with optimum start including assignments such as sensors to use and heating/cooling factors.

i. Collection and Analysis of Historical Data

(1) Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or change of value, both of which shall be user-definable. Trend data may be stored on hard disk for future diagnostics and reporting. Additionally, trend data may be archived to network drives or removable disk media for future retrieval.

(2) Trend data reports shall be provided to allow the user to view all trended point data. Reports may be customized to include individual point or predefined groups of at least six points. Provide additional functionality to allow predefined groups of up to 250 trended points to be easily transferred on-line to Microsoft Excel. DDC contractor shall provide custom designed spreadsheet reports for use by the owner to track energy usage and cost, equipment run times equipment efficiency, and/or building environmental conditions. DDC contractor shall provide setup of custom reports including creation of data format templates for monthly or weekly reports.

(3) A minimum of six points may be graphed, regardless of whether they have been predefined for trending. The dynamic graphs shall continuously update point values. At

any time the user may redefine sampling times or range scales for any point. In addition, the user may pause the graph and take "snapshots" of screens to be stored on the workstation disk for future recall and analysis. Exact point values may be viewed and the graphs may be printed.

(4) System software shall be capable of graphing the trend log point data. Software shall be capable of creating x-y graphs that display up to 6 points at the same time in different colors. Graphs shall show point value relative to time.

(5) Operator shall be able to change trend log setup information as well. This includes information to be trend logged as well as interval at which information is to be logged. All points in the system may be logged. All operations shall be password protected. Setup and viewing may be accessed directly from any and all graphics point is displayed on.

j. Application Software

(1) The application software is the auxiliary software, which shall be integrated in this system:

(2) Energy Management software

(a) Daily use
(b) Monthly use
(c) Daily Hi and Low
(d) Monthly Hi and Low
(e) Demand Limiting and Load Shedding Program

(3) Maintenance Software

(a) Schedule Maintenance
(b) Run time accumulation for any specified equipment

(4) Occupancy Software

(a) After hour use log

k. Alarm Indication

(1) System Terminal shall provide audible, visual and printed means of alarm indication. The Alarm Dialog box shall always become the Top Dialog box regardless of the application(s) being run at the time (such as a word

processor). Printout of alarms shall be sent to the assigned terminal and port.

(2) Provide log of alarm messages. Alarm log shall be archived to the hard disk of the system terminal. Each entry shall include point descriptor and address, time and date of alarm occurrence, point value at time of alarm, time and date of point return to normal condition, time and date of alarm acknowledge.

(3) Alarm messages shall be in plain English (or specified language) and shall be user definable on site or via remote communication. System shall provide a minimum of 20 user definable messages for each zone controlled.

l. Energy Log Information

(1) System shall periodically gather energy log data stored in the field equipment and archive the information on the operator terminal's hard disk. Archive files shall be appended with the new data, allowing data to be accumulated over several years. Systems that write over archived data shall not be allowed. System shall automatically open archive files as needed to display archived data when operator scrolls through the data. Display all Energy log information in standard engineering units.

(2) System software shall be capable of graphing the Energy log data. Software shall be capable of creating graphs in x-y format that show recorded data relative to time.

(3) Operator shall be able to change the Energy log setup information as well. This includes which meters to be logged, meter pulse value and what type of energy units are being logged. All meters monitored by the system may be logged. All operations shall be password protected.

(4) Provide means for operator to export to a comma delimited file format all trend log data for use by other spread sheet programs. Operation of system shall not be affected by this operation. In other words, it shall stay completely on-line.

m. Controller Status

(1) Provide means for operator to view communication status of all controllers connected to the system. Display shall include

controller, status and error count. Status will show if controller is communicating or not.

n. Configuration/Setup

(1) Provide means for operator to display and change system configuration. This shall include but not be limited to system time, day of the week, date of day light savings set forward/ setback, printer type and port addresses, modem port and speed, etc. Items shall be modified utilizing easy to understand terminology using simple mouse/cursor key movements.

o. Dynamic Color Graphic Displays

(1) Create Site Layout Color graphic including building penetration Icons, building floor plan displays with room temperatures and other building sensors values dynamically displayed. Icon links on the floor plans will allow penetration to the building Mechanical equipment. Provide System graphics for each piece of mechanical equipment, including air handling units, chilled and hot water systems as applicable, with dispersed dynamic data as indicated in the system point I/O summary of this specification. Points required by the sequence of operations shall also be displayed even if they are not defined by the I/O schedule to optimize system performance analysis and speed alarm recognition. Provide as a minimum the following graphics.

(a) Site layout

(b) Building Floor plans

(c) Individual AHU graphics

(d) Zone information shall be shown on the floor plans, clicking on the device will display all data associated with the device.

(e) All graphics will provide in addition to the system points the following. They are:

1) Outside air temperature
2) Outside air humidity
3) Weekly scheduling

(2) The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands. Graphics software shall permit the importing of *.BMP or *.TIF drawings for use in the system.

(3) Dynamic temperature values, humidity values, flow values and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention and without pre-defined screen refresh rates.

(a) Analog values displayed in 3 color conventions shall be available for monitor and control of analog values; high and low alarm limit settings shall be displayed on the analog scale or available and displayed separately. The user shall be able to "click and drag" the pointer to change the set point.

(b) Provide the user the ability to display blocks of point data by defined point groups; alarm conditions shall be displayed by flashing point blocks.

(c) Equipment state can be changed by clicking on the point block or graphic symbol and selecting the new state (on /off) or set point.

(d) Colors shall be used to indicate status and change as the status of the equipment changes. The state colors shall be user definable. (Example: Red-Alarm, Green-OK).

(e) The windowing environment of the PC operator workstation shall allow the users to simultaneously view several applications at a time to analyze total building operation or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.

B. Internet/Intranet Connectivity utilizing a Web Browser

a. Shall be a "Server" based product that provides browser access to Ethernet enabled automation controllers. Access is accomplished by utilizing Microsoft Internet Explorer 5.0 or later. NO other "client" side software shall be necessary to view and utilize the system. The "Server" hosting the Web Application can be located anywhere on the Internet. The software functions by taking real-time data from

the automation systems and combining that information with the appropriate graphic file in an HTML format to be viewed by the web browser. The number of simultaneous users connected to the web application is only limited by the capability of the server hosting the application. The application can service multiple sites.

b. The graphics utilized for this system shall not require external applications to convert the images for use between the web server based application and the traditional graphical user interface. Graphics shall be interchangeable between applications.

c. Web Browser Server The server-based software must support Microsoft's .NET standards for the exchange and interoperability of information and data.

d. The software manufacturer shall furnish Server-based software upgrades free to the owner for as long as Tarrant County utilizes the system.

2.

a. Server Requirements for IIS based application:
   (1) Intel Pentium III 1.2 GHZ Processor
   (2) Gigabyte Dual Socket 370 Server Motherboard
   (3) 2x Maxtor 40 GB, 7200 RPM ATA/133 Hard Drive
   (4) 1.44 MB Floppy Drive, LG 52X CDROM Drive
   (5) 512MB SDRAM
   (6) Windows 2000 Service License, IIS Service
   (7) Monitor, Keyboard, Mouse
   (8) Case to house above components
      (a) Rack mountable Optional per site requirements

3. Web Browser Interface
   a. User Configuration
      (1) Usernames and Passwords can be setup via the Web Browser Interface. Physical access to the server is not required but will be password protected.
         (a) Individual user names/passwords are to be utilized
         (b) Usernames/passwords can be specifically unique to allow the user to be automatically redirected to a specific site, and or graphic display when logging into the system.
      (2) Passwords can be configured to allow the user to modify setpoints or not.
      (3) All user configuration functions shall be provided through and intuitive graphical user interface.
      (4) Web Browser Interface shall not require any external applications, "Client Side" software or "Plug-Ins" to connect, view, control any aspect of the building automation system.
      (5) Access to the installed automation system shall be performed through Microsoft Internet Explorer
   b. Site Graphics

(1) Graphics displayed through the Web Browser Interface must be the same graphic images provided through the Graphical User Interface described above. No external applications are to be required to interchange graphic images between the web server application and the graphical user interface.

(2) Trend data must be able to be displayed graphically and in "spread sheet "format without the addition of any additional" client side software, plug-Ins, or additional applications.

(3) Digital Start/Stop Logging shall be able to be displayed and printed from the browser interface without the addition of any additional "client side" software, plug-Ins, or additional applications.

(4) The display and printing of alarm data shall be performed without the addition of any "client side" software, plug-Ins, or additional applications.

(5) Points that are manually overridden shall be displayed on the graphic screen by an icon adjacent to the overridden point to provide a quick visual indication of any point on the screen that are overridden.

(6) The viewing and modification of weekly schedules shall be performed in a graphically intuitive manner that is consistent with the non Web Enabled application. This shall be performed without the addition of any "client side" software, plug-Ins, or additional applications.

(7) The viewing and modification of annual holiday schedules shall be performed in a graphically intuitive manner that is consistent with the non Web Enabled application. This shall be performed without the addition of any "client side" software, plug-Ins, or additional applications.

(8) "Right clicking" on the point and modifying the value shall perform the editing of point values.

(9) Points can be placed in "manual" or "automatic" mode from the Web Browser, providing password restrictions for the user allow such functionality.

2.06 AUXLLIARY CONTROL DEVICES

A. AUTOMATIC CONTROL DAMPERS AND OPERATORS

1. Automatic control dampers shall be provided with the multizone units.

2. Damper actuators shall be supplied and installed by the controls contractor. The motors shall be of the proper size required to operate the damper with uniform and gradual movement and shall return the damper to the same position for a given signal during an opening or closing movement of the

damper. Damper operators shall be of the proportional type capable of accepting 0-10 volts control signal and 2-10 VDC feedback signal.

3. Damper operators shall be spring return on all outdoor and return air dampers.

4. All modulating dampers shall be sized for an effective linear air flow control characteristic within the angle of rotation and maximum pressure drop specified.

5. Damper actuators shall be Belimo or Siemens with 5-year warranty.

B. CURRENT SWITCHES

1. Provide a solid state switch which when the current level sensed by the internal current transformer exceeds the adjustable trip point. Internal circuits are to be totally powered by induction from the line being monitored.

C. DIFFERENTIAL PRESSURE SWITCHES

1. Differential pressure switches shall be furnished as indicated by the sequence for status purposes for either air or water applications. Provide single pole double throw switch with fully adjustable differential pressure settings. The switch shall have a snap-acting Form C contact rated for the application. The switch contact shall be rated for 5 amps at 120 volts as a minimum. Units shall be selected for ranges consistent with the application and shall be submitted for the Engineer's approval.

   a. Dwyer and Cleveland products are acceptable manufacturers.

D. ELECTRONIC SPACE TEMPERATURE SENSORS

1. Electronic space temperature sensors shall be transducer based and shall be calibrated to less than or equal to a ¼ degree F resolution for the specific application.

2. Electronic space temperature sensors shall have a minimum of six programmable buttons and two dedicated buttons for set-point adjustment.

3. Electronic space temperature sensors shall have a built-on RJ11 connector that will allow access via laptop computer to the host network.

4. Electronic space temperature sensors shall have an external dry contact available to work as a auxiliary input

5. Electronic space temperature sensors shall have the ability to have up to 16 sensors connected to any global controller with all buttons on sensors fully programmable.

6. The electronic space temperature sensors shall be Reliable Controls Corporation SS100 or equal.

E. ELECTRONIC DUCT TEMPERATURE SENSORS

1. Temperature sensors shall be thermistors or transducer based and shall be calibrated to less than or equal to a 1/4 degree F resolution for the specific application. The Engineer must approve substitutions. All sensors to be field verified as correct.

2. Provide twisted pair lead wires and shield for input circuit or as otherwise required by the manufacturer.

3. Use insertion elements in ducts not affected by temperature stratification or smaller than one square meter. Use averaging elements where larger or prone to stratification. Sensor length 2.5 m or 5 m as required.

4. Insertion elements for liquids shall be brass separable sockets (thermo wells) with minimum insertion length of 2-1/2 inches (60 mm).

5. Provide outside air sensors with watertight inlet fittings, shielded from direct rays of the sun. Mount on the North side of the facility.

6. The temperature sensors shall be field verified by the Installing Contractor. Engineer will spot check and verify these calibrations during walk through inspection.

7. Wall mounted sensor shall be mounted at 5'-6" above finished floor in an area which free air current is not constricted or blocked, final location shall be approved by the Owner and Engineer prior to installation

8. Sensor elements shall be applicable for the medium being sensed; i.e., room elements, well-mounted elements, duct mounted elements and outdoor mounted elements. Range shall be from 0 to 150 degrees F.

9. Strap on sensors shall not be used unless specifically required.

F. ELECTRONIC STATIC PRESSURE SENSORS

1. Static pressure sensors shall be differential pressure sensors, with the "high" output sensing the duct pressure and the "low" input sensing atmospheric pressure.

2. The range for the static pressure sensor shall be matched to the static pressure of the system being sensed, 0 to .5 inches, 0 to 2 inches, 0 to 5 inches, or 0 to 10 inches.

3. Accuracy shall be plus or minus 2% of the full range being sensed.

G. FIRESTATS

1. Provide UL-listed fire protection thermostats where indicated in main return air ducts of air handling units which are rated less than 2,000 cfm. Connect thermostats that are capable of stopping fans in event of excessive temperatures in fan control circuits. Provide thermostats with fixed or adjustable settings to operate at not less than 75 F above normal maximum temperature at their location in the air handling system. Comply with requirements of NFPA 90A. Provide thermostats with the following operating features:

   a. Provide manual reset type thermostat.

H. TEMPERATURE THERMOSTATS (Stand/alone applications, as required)

1. Two position (On/Off) room thermostat with bimetallic sensing element, set point dial or thumb wheel dial, room temperature indicator, surface mounting base, and hard plastic cover plate, UL listed.

I. HUMIDITY SENSOR/TRANSMITTER

1. Provide relative humidity sensor/transmitter where shown on the control drawings. Sensor and transmitter shall have:

System Accuracy:	±2% RH @ 25°C from 20-95% RH
Output Signal:	Two wire 4-20 ma linear, proportional to 5-95% RH

2. The transmitter power shall be compatible with and powered by, the low voltage power supplied by this Contractor.

J. LOW TEMPERATURE LIMIT SENSORS

1. Provide low temperature protection thermostats of manual-reset type, with sensing elements 8'-0" or 20' in length. Provide thermostat designed to operate in response to coldest 1'-0" length of sensing element, regardless of temperature at other parts of element. Support element properly to cover entire duct width. Provide separate thermostats for each 25 sq. ft. of coil face area or fraction thereof.

K. CONTROL WIRING

1. All conductors shall be of stranded copper wire.

2. All PVC/EMT/rigid steel conduit and outlet boxes shall conform to the requirements specified under Division 16, Electrical.

3. All cable runs exposed in return air plenums shall be smoke rated for the application and secured to the building structure. Do not run wire in drywall without conduit.

4. All wiring cables shall have 300-volt insulation.

5. Cables shall be properly identified/tagged with matching wire markers on both ends as to the control point.

6. All cables from ceilings to wall temperature sensors shall be installed in conduit (EMT). EMT Conduit fittings shall be steel compression type. Set Screw fittings are not acceptable.

7. Non-conduit wires (exposed wires above ceiling) will be decided by the detail spec (project scope).

PART 3 – EXECUTION

3.01 CONTROL WIRING

A. Provide outlet boxes.

B. Line voltage and exposed low voltage control wiring shall be run in conduit in mechanical equipment rooms. Low voltage wires will be decided by the detail spec (project scope).

C. No splices will be allowed except at junction boxes and control centers.

D. No two wires of the same color shall be run in one conduit unless wires of the same color are properly tagged at both ends and any splice points. Do not change colors at splice points.

E. EMT Conduit fittings shall be steel compression type or Set Screw type fittings

F. All electrical components shall be UL listed.

3.02 INSTALLATI0N

A. The control sequences indicated in the specifications herein show the intended sequence of operation of the various control systems.

B. Each control system shall be complete with all necessary thermostats, relays, switches, accessories, etc., and all interconnections, and so arranged that they will provide the proper automatic sequence of operation between the various control devices as required to maintain the desired temperature, conditions and sequence, to provide a complete operating system.

C. All control equipment shall be fully modulating unless otherwise noted, and relays or accessories not specifically mentioned but required for proper operation shall be included.

D. Competent personnel, who are well trained and regularly employed by the Control Contractor, shall install the system. Installation by the others is not acceptable.

E. Control and instrument wiring and capillaries are to be secured to the building structure, not to ductwork, conduits, or water piping.

F. The exact location of instruments, panel boards, accessories, etc., shall be approved by the project Engineer, reviewed and discussed with the owner during the pre-submittal conference.

G. All automatic controls and accessories shall be located in accessible locations.

H. All non-panel, as well as panel mounted instruments, shall be clearly labeled as to use and system served by means of engraved laminated nameplates.

I. Where control instruments or accessories are to be installed on covered casings, ductwork etc., they shall be mounted on the finished surface of the covering. Care shall be taken that there are no leaks around the stems where they pass through the metal work

J. All modulating control valves, dampers, etc., shall operate in a slow, gradual manner without any jerking or slamming. Valve actuators shall be vertical. Horizontal shall not be acceptable.

K. All controls shall operate satisfactorily without any cycling or hunting.

L. Automatic Control Contractor shall provide power to all electric actuators requiring an external power source. If equal to or greater than 110 VAC, coordinate with Division 16 Contractor.

M. All labor to mount controllers in the multi-zone units shall be responsibility of Automatic Controls Contractor.

N. The Automatic Control Contractor shall furnish and install all motorized damper actuators.

3.03 CONTROL MANUFACTURER'S FIELD SERVICES AND INSTRUCTIONAL REQUIREMENTS

A. Start-up and commissioning system: Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation. On-site training shall not begin until the system has been accepted by the Engineer and field verifications have been completed.

B. On-site Training: Provide (40) hours of training. This training shall be completed in groups of no more than 6 persons per group at one time in one 4-hour session for each group. Also include four (2) hours of training for the Test and Balance Representative. The training shall focus on the specific installation and shall address both hardware and software. Specific as-built documentation for this project shall be used for reference as a part of this training.

C. For all levels of training, a sign-in sheet shall be submitted to the Engineer certifying that each individual has completed such training to the satisfaction of the instructor. Hours of instruction received shall be a part of the sign-in sheet.

D. It shall be the Owner's responsibility to provide adequate time for attendance at all training sessions.

3.04 DEMONSTRATION

A. General: Provide field-testing and adjustment of the complete DDC and an on-site operational acceptance test of the complete operational DDC. Notify the Owner in advance of all testing activities. The Owner may witness all tests.

B. Field Test: Contractor shall submit to the Engineer the Format/Form that shall be used for field-testing for approval, with submittal package. When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed on line. The Automatic Control Contractor shall complete all testing, calibration, adjusting, and final field tests. Provide a cross

check of each control point within the DDC by making a comparison between the control demand at the Master and field controlled device. Verify that all systems are operable from local controls in the specified failure mode upon DDC failure or loss of power. Verify that all systems return to DDC control automatically upon resumption of DDC operation or return of power. Submit the results of functional, cross and diagnostic tests, along with a request for the Engineer to complete controls verification.

C. The punch list items shall be corrected to the satisfaction of the Engineer within a four (4) week period directly following the verification period and shall be demonstrated to the Engineer (re-verification) in order to complete the verification process. This process shall continue until all items have been successfully demonstrated and acknowledged to the Engineer in writing.

3.05 SUBSTANTIAL COMPLETION, ACCEPTANCE AND WARRANTY

A. After the Engineer's verification, an acceptance test of the completed system in the presence of the Owner's representative and the Engineer shall be performed. When the system performance is deemed satisfactory by these observers and all record (as-built) drawings have been received by the Owner, that part of the system shall be considered complete.

B. All control hardware, software, and firmware installed by the Automatic Control Contractor shall be warranted for a period of one (2) year form date of owner's acceptance. Defects arising during this warranty period shall be corrected without cost to the Owner. This warranty is for material only and labor is not included beyond the standard project warranty.

3.06 SEQUENCE OF OPERATION

Sequence of operation goes here.

3.07 I/O SUMMARY

A. Attached.